



2026

ANNUAL REPORT

For the period of
July 1, 2025 - June 30, 2026



Save
Our
Streams™

Prepared by:
City of Tulsa Public Works Department
Stormwater Maintenance and Operations



MS4 Annual Report



OPDES Stormwater Permit #OKS000201

July 1, 2025 to June 30, 2026

Co-Permittees:

Oklahoma Department of Transportation

Oklahoma Turnpike Authority

Certification Statement

OPDES Permit No. OKS000201

Review of Stormwater Annual Report

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing of violations.



Heath Kirkeby
Division Manager
Stormwater Maintenance and Operations Division

10/15/2026
Date

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Section 1

The Status of Implementing the Stormwater Management Program (SWMP)

The City of Tulsa's most current municipal stormwater discharge permit, #OKS000201, went into effect on February 1, 2024. In accordance with Part II of the permit, the City was required to review its existing Stormwater Management Program (SWMP), revise or update Best Management Practices (BMPs) and measurable goals as needed to meet the new permit requirements, and document all modifications within one year of the effective date of the permit. The permit also requires implementation of the revised SWMP two years after the effective date of the permit; SWMP implementation began July 1, 2025. This report will follow the annual reporting guidelines consistent with Part IV.C. of the permit.

The Stormwater Maintenance and Operations (SMO) division of Public Works, with assistance and guidance from other departments, reviewed its SWMP during the reporting year and evaluated progress toward complying with and meeting measurable goals under the new permit. Required updates and program modifications were incorporated following the procedures specified in Part II.F. of the permit. With the reporting period being the first full year under the new SWMP, there were only minor modifications that were made. The City maintained adequate finances, staff, equipment, and support capabilities to implement the activities under the SWMP and will continue to assess resource needs annually.

Part II of the SWMP consists of eight individual program areas that guide efforts to reduce stormwater pollution and protect local water quality. This section provides an overview of each program and highlights progress made during the reporting year toward meeting permit goals and maintaining compliance.

1. Public Education and Involvement

Status: Compliant and ongoing

a. Educational, Training, and Public Information Activities

The City of Tulsa Stormwater Quality group continues its robust public education efforts through the implementation of strong media campaigns. Stormwater Quality outreach was viewed via digital media, social media, tv ads, public events, utility bill stuffers, and other sources. The Stormwater Quality group continued the collaboration with Byers Creative to develop new radio ads to help deliver stormwater quality public education messages. While radio and digital streaming were used, social media was prioritized via Facebook, X, and Instagram and played an integral role in Tulsa’s outreach efforts this year. City Communications staff posted 89 stormwater-related messages to social media this fiscal year, creating 448,988 impressions and 17,332 engagements, and 3,570 post link clicks. Tulsa’s social media has about 64,000 Facebook followers, 60,500 Twitter followers, and 14,000 followers on Instagram.

Stormwater Quality ran a campaign called “Only Rain in the Drain” from April 23rd to July 1st. The billboard featured a clean storm drain, with “Dump No Waste, Drains to River” embossed on them. The ad was posted on a rotating digital billboard at 15 different locations that displayed our ad about 1,200 times per day. Refer to the table below for impressions based on billboard location.

Billboard Location	Impressions
I-44, S/S, 0.30 mi E/O Yale Ave Facing East	426,509
9510 BA-XWY 300’ W/O S Mingo Rd Facing West	106,620
8515 E I-44 NS 0.5 mi E/O Memorial Dr Facing West	892,068
8515 E I-44 NS 0.5 mi E/O Memorial Drive Facing East	124,663
7601 S HWY 169 .64 mi S/O 71 st St Facing North	1,356,789
2510 E BA-XWY 100’ N/O 15 th St Facing West	448,493
200 E I-244 SS 0.6 mi W/O Hwy 75 Facing West	20,332
10710 S Creek Tpk, SS 200’ W/O Elwood Facing West	295,031
3811 E I-44 0.3 mi E/O Harvard Ave Facing West	126,282
12555 S HWY 75 0.4 mi S/O Hwy 117 Facing South	175,506
16301 E I-44 0.1 mi E/O 165 th St Facing East	586,039
1300 I-44 200’ W/O Peoria Ave Facing East	814,082
2801 E I-244 NS 0.4 mi W/O Harvard Ave Facing West	464,970
2801 E I-244 NS 0.4 mi W/O Harvard Ave Facing East	172,722
Total	6,010,106



Section 1 – Status of Implementing the Stormwater Management Program

Tulsa’s stormwater-related webpages had a total of 43,405 views, with some notable differences from last year. There were 1,345 views for the general stormwater quality webpage and 16,767 for the household pollutant collection facility webpage – a 19% increase from previous year. Nearly 1,700 people accessed the “My Watershed Map” through the Stormwater Quality page. The rain barrel webpage increased its views by 2,975%, which can be attributed to increased advertising effort.

Stormwater Quality Webpage Views		Youtube Views	
10 Solutions to Stormwater Pollution	168	SGT Red Painted Turtle	45
Adopt-A-Spot	274	SGT Red Leaves and Grass	425
Adopt-A-Stream	275	SGT Red Blueprint	135
Brochures	72	SGT Red Garbage Juice	208
Contact Us	599	SGT Red Erosion	898
Erosion and Sediment Control	402	Construction	10,000
Fertilizers	52	Biosampling	176
Household Pollutant Collection Facility	16,767	SWQ Tips Household Chemicals	181
Industry	97	SWQ Tips Lawn care	111
Low Impact Development	134	Journey Through Stormrains	392
Motor Oil	74	SOS Little Things	230
My Watershed Map	1,694	Keeping Our Streams Clean	487
Newsletters and Videos	75	Education and Outreach	643
Outside Washing	96	Pet Waste	74
PACE	75	TOTAL PAGE VIEWS	14,005
Pesticides	48		
Rain Barrels	7,565		
Responsible Pet Ownership	116		
Stormwater Quality Main Page	1,345		
Watershed Story Map	895		
Zink Lake Dashboard	12,592		
TOTAL PAGE VIEWS	43,405		

Other Media Impressions	
K95.5	2,612,500
KRMG	1,375,600
Mix 102.3	567,000
Spotify	573,011
TOTAL IMPRESSIONS	5,128,111

3,801 brochures, such as the Stormwater Quality Brochure, Household Pollutant Collection Facility, Cause and Effect, among others were available to the public at locations such as community centers, parks, and libraries. Brochures are distributed to 22 locations quarterly.

Tulsa and its educational partners continued to educate the public on the prevention of pollution at the source. To get the most from each educational opportunity, many public educational activities targeted multiple sources of non-point source pollution, including vehicle fluids, pesticides, herbicides, fertilizers and erosion control practices. Approximately 1,218,984 people were exposed to stormwater education opportunities at events during the reporting period.

Section 1 – Status of Implementing the Stormwater Management Program

Environmental educational activities were conducted at Summer Camps through Tulsa Parks. These events and others involved approximately 12,494 children, who were educated on the importance of reducing litter, non-point source pollution and recycling through various activities. Other education activities included the use of fish and macroinvertebrate demonstrations, hands on landscape displays (i.e., “Enviroscape”), and live plant education. Distribution of handouts and material containing non-point source pollution information, littering, and pollutant reduction were available where appropriate. More details about giveaways and literature distributed can be found in [Section 11](#), Attachment A – Educational Material Distributed 2025–2026.

The following groups participated in various public education events during this reporting period:

- City of Tulsa
 - Public Works Department
 - Parks Department
 - Communications Department
- Tulsa County Conservation District (Blue Thumb Program)
- Metropolitan Environmental Trust (M.e.t.)
- The Sustainability Alliance
- Green Country Watersheds Coalition
- Tulsa Zoo
- Philbrook Museum
- Tulsa Garden Center at Woodward Park

Educational Activities Included:

- Displays at workshops and conferences
- Public presentations at conferences and seminars
- Presentations/demonstrations at summer camps
- Creation and distribution of educational material (brochures and giveaways) at a number of events
- News press releases and articles informing the public about environmental issues, including non-point source pollution
- Quarterly stormwater newsletter
- Environmental awareness at numerous events
- Utility bill stuffer – stormwater information sent to all citizens that purchase water and sewer as well as pay utility bills to the City of Tulsa



See Attachment B in [Section 11](#) for a full list of Educational Activities.



A Community Involvement Coordinator displays a fish during a fish collection event

Promotional products such as rain gauges, fans, and stress balls were given away at most events alongside brochures. Each product has “Save Our Streams” branding, and some products, such as the fans, have a QR code that eventgoers can scan to learn more information.

The Tulsa County Blue Thumb Program continued its efforts to reduce non-point source pollution. The Tulsa County Conservation District (TCCD) is involved with this Clean Water Act Section 319-funded program, which utilizes citizen volunteers. This year, 50 volunteers monitored 18 sites in City limits. Tulsa County has the most streams monitored statewide. 12 streams are monitored by this group in the City of Tulsa. Blue Thumb volunteers go through 16 hours of training that covers watersheds, common nonpoint source pollutants, educating others, basic stream ecology, and using field test kits for parameters and site observations. Volunteers go through four quality assurance sessions every year. The program’s goal is to make citizens of Tulsa aware of non-point source pollution and to encourage the adoption of practices that protect Tulsa’s streams. This program has contributed greatly to the education of the public through the organization and training of citizen watershed monitoring groups and distribution of the “Blue Thumb Fish Prints” that depict the importance of riparian area and how to keep water clean. The Blue Thumb Program continues to collect data from area streams and uses this data to focus on educational activities within the affected watersheds. This education involves informing local citizens on how to protect their streams against non-point source pollution. The TCCD continues to promote the Blue Thumb Program and encourage participation at public events, such as the Greater Tulsa Home and Garden Show and the Enviro Expo.

The Crow Creek Community formed in 2016 to specifically accomplish work in the Crow Creek Watershed within midtown Tulsa. While much work still centers on this watershed, in late 2024, the Crow Creek Community was renamed the Green Country Watersheds Coalition (GCWC) to better reflect the education

efforts that take place for stream protection throughout Tulsa and beyond. Several local groups make up the GCWC, including: the City of Tulsa, Blue Thumb, the Tulsa County Conservation District, Philbrook Museum, Chandler Park, the Tulsa Zoo, and Tulsa Garden Center.

The City of Tulsa continues to maintain strong public education efforts related to flood concerns. Outreach efforts focus on increasing public understanding of flood risks, promoting flood insurance awareness, and encouraging residents to take proactive measures to protect property and water quality. Education materials and targeted mailings help ensure that property owners understand both their personal risk and their role in reducing flooding and pollution impacts within the community.

All property owners and residents who live in or near the floodplain are notified of their potential to experience flooding and what to do in case of flooding annually. Notifications include the Mayor's Flood Insurance Letter, City of Tulsa Flood Insurance Facts, 2025 City of Tulsa Official Floodplain Notice, City of Tulsa – Flood Risk in West Tulsa, and the 2025 Repetitive Loss Area Notice and Letter. All notifications provide information regarding what to do before and after floods, how you can help Save our Streams, and a contact telephone number and encourages the public to report illegal discharges into the storm sewer. The City of Tulsa mailed approximately 32,000 notifications to Tulsa citizens located near the floodplain in September 2025.

The following are several other flood education materials that were distributed at various events, online, and by mail:

“City of Tulsa Floodplain Map Atlas” is a hardcopy atlas/book that shows the FEMA SFHAs and the City of Tulsa Regulatory Floodplains throughout the City. The atlas also provides flood hazard information as well as provides phone numbers for citizens to report blocked drains or illegal dumping.

“2025 Repetitive Loss Area Notice” is an annual publication that goes to all property owners who are near a repetitive loss property. A repetitive loss property is defined as a property that has filed one or more insurance claims for flood losses in the past 10 years. This publication provides phone numbers for citizens to report blocked drains or illegal dumping.

“Know Your Risk of Flooding” is a brochure that is handed out during public events and/or meeting. It provides tips on what to do before, during, and after a flood event. It also provides facts about flood insurance.

The Stormwater Quality group administers an electronic newsletter that is sent quarterly to over 2,400 email addresses. Through this newsletter, recipients are educated on stormwater issues such as pollution-related concerns that affect households, environmental community efforts performed by the City of Tulsa, new city LID developments, and a “Species Spotlight” article with information about species native to the Tulsa area. The public is also informed of ways they can help improve and maintain stormwater quality, how they can contact the City of Tulsa for more information, request personnel to come speak at an event and how to report illicit discharges. The newsletter is promoted at the Tulsa State Fair and The Tulsa Home and Garden show via surveys. Newsletters were sent in July 2025, October 2025, January 2026, and May 2026.

i. Education and promotion of industrial stormwater BMPs

The City of Tulsa achieves permit compliance by performing industrial stormwater inspections at City of Tulsa facilities. These inspections are performed to control pollutants that may be discharged into the MS4 (Municipal Separate Storm Sewer System) through routine operations and maintenance. These inspections focus on the proper storage of outdoor parts and materials, the condition of tanks and containers that store liquids, and processes that may be conducted outdoors. During each inspection at an industry, commercial operators are educated on implementation and maintenance of best management practices (BMPs) that are necessary to ensure there is no pollutant runoff from the property. Industries with a current OKR05 permit with the Department of Environmental Quality (DEQ)

are also required to perform employee training for maintenance personnel, inspectors, and any staff that performs work where activities or goods are exposed to stormwater.

ii. Public outreach on illicit discharges and improper disposal

Numerous publications that promote the public reporting of illicit discharges and improper disposal were created and distributed by the City of Tulsa. Regular distribution locations included Tulsa Parks, Recreation Centers, and all libraries within city limits. All illicit discharges or improper disposals can be reported to City of Tulsa's Customer Care Center or to Stormwater Quality. During this reporting period, 3,801 pieces of literature were given out at these venues. Material was also distributed at all events attended by Stormwater Quality. The following is a partial list of publications distributed:

"Stormwater Quality Programs" is a general brochure highlighting the current Stormwater Quality programs in the City of Tulsa. Also provided in the brochure are ten solutions to stormwater pollution, including the reporting of illicit discharges, and lists the number for City of Tulsa's Customer Care and material distributed through our Stormwater Quality programs.

"How Long Does It Take for Your Trash to Break Down?" lists common types of litter such as apple cores, styrofoam cups, and plastic bottles along with how long these items take to break down. On the opposite side it provides solutions to litter seen around Tulsa.

"Causes and Effects of Pollution in Our Local Creeks and Streams" is a handout that the effects of oil and grease, fertilizer and pesticide, pet waste, grass and leaves, and litter has on our waterways and how to prevent pollution from these sources. The other side of the handout has an infographic showing how these pollutants can be washed into our streams and creeks and the impact it has on the environment.

"Motor Oil" talks about how motor oil can impact water, how to prevent oil from getting into local waterways, and how to safely dispose of oil.

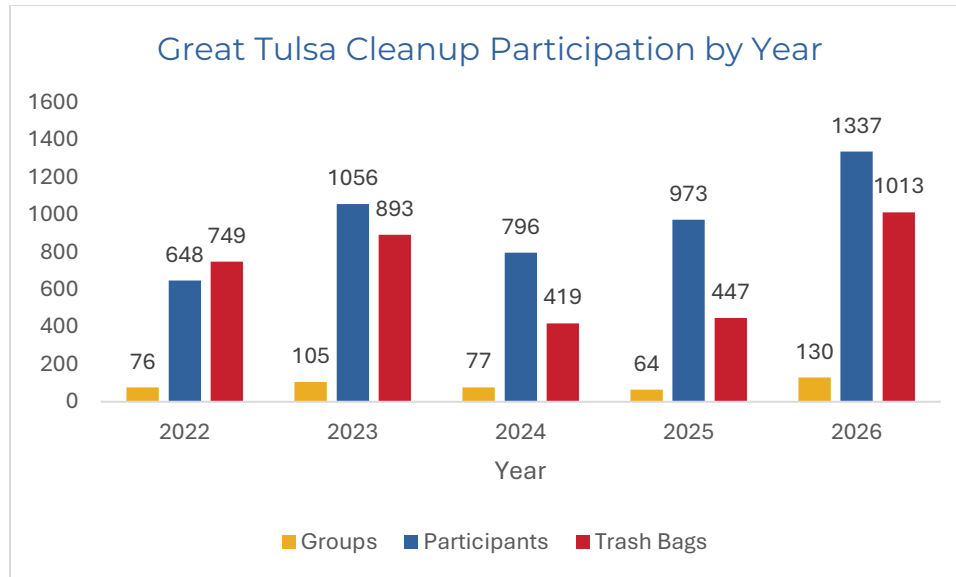
"Stormwater: Where Does It Go and What Can It Impact?" discusses leaves, grass clippings, and tree trimmings and their impact on stormwater quality. It educates the public on how to properly dispose of lawn waste.

During this reporting period, information encouraging the public to report illegal discharges was placed into four monthly utility bill stuffers. These articles gave instructions on the proper procedures for reporting, along with telephone numbers for the 311 Center, which is the primary method for citizens to report any issues. Multiple message topics were conveyed to callers during this timeframe. In previous years, almost 600,000 calls were made to the Customer Care Center. Promotion of the proper disposal of leaves, grass and pet waste was accomplished through the utility bill stuffer. The "Cause and Effect" brochure was prioritized at events to hand out to the public. The brochure includes information and a visual of common issues that contribute to illicit discharges.

Tulsa maintains a website, www.cityoftulsa.org/sos that has several links to tips that promote ways to reduce stormwater runoff pollution, including the public reporting of illegal discharges to the storm sewer. The number of pageviews was 1,345 during this time, close to the previous year. Though the main Stormwater Quality webpage visits were down, the Household Pollutant Collection Facility webpage visits were very strong with 16,767 visits. While conducting inspections, City of Tulsa personnel continued to direct citizens, business owners, or operators to our website for more information about our programs.

The Great Tulsa Cleanup, co-sponsored with the City of Tulsa's Parks Department during the month of April 2026, set a record with 1,337 volunteers, removing 1,013 trash bags from 37 creeks, stormwater facilities, and locations around Tulsa. Not only did this clean-up remove litter from the creeks, but it also helped to bring attention to the importance of reducing litter discharges to urban streams and waterways. A dashboard was created where citizens could go online and sign up for their location, date, and time they wanted to participate. The Save Our Streams social media pages posted ads promoting

the Great Tulsa Cleanup, and staff performed media interviews and handed out flyers at events. This year, nine new locations were added along Route 66 to celebrate Tulsa’s centennial. Staff ensured each location was ranked on accessibility and how much trash was present, which allowed citizens to choose a location that was best for them and to sign up with family members or groups.



As a result of public awareness of the reporting of illicit discharges and improper disposal, 314 investigations were conducted involving the identification and removal of illicit discharges to the storm sewer during this reporting period.

Fliers titled “Cause and Effect” and “Stormwater Quality Programs”, were distributed at events and activities during this reporting period. These flyers educated the reader on the negative aspects of not collecting and disposing of pet waste properly. These programs were also promoted on the City of Tulsa’s Stormwater Quality website.

The City of Tulsa co-sponsored the “Bark in the Park” theme night at the Tulsa Drillers baseball games. “Cause and Effect” flyers, pet waste bags, and other promotional items were passed out to Tulsa area pet owners to educate them on the importance of picking up their pet waste.

iii. Construction site erosion and sediment control education

The brochure “Construction Site Best Management Practices” was available to construction operators at the Permit Center. This brochure lists erosion and sediment controls that can be utilized at construction activities. SMO inspectors keep a stock of this brochure on hand to distribute as necessary. This brochure was also available at other events (see Attachment B in [Section 11](#)). Approximately 35 of these brochures were distributed during this reporting period.

To assist local developers and builders with the use, installation and maintenance of erosion control measures, City of Tulsa representatives attended Builders Council or Developers Council meetings held at the Greater Tulsa Home Builders Association as available.

City inspectors conducting soil erosion control inspections at construction sites, informed construction site operators on aspects of use and maintenance of appropriate structural and nonstructural BMPs. Additionally, City of Tulsa supervisors answered questions regarding construction site OPDES requirements and erosion control requirements. The Development Services department meets with and contacts the Home Builders Association prior to every home build to discuss erosion control placement and gravel access drives to prevent track-out of sediment from construction.

Although formal training was not conducted by Field Engineering, whenever a contractor was out of compliance, Field Engineering took the time to train contractors on the correct installation of erosion control measures. City inspectors conduct soil erosion control inspections at construction sites informing construction site operators on aspects of use and maintenance of appropriate structural and nonstructural BMPs. Additionally, City of Tulsa supervisors answered questions regarding construction site OPDES requirements and erosion control requirements.

iv. Public and developer education on Low Impact Development

The City explains the use of Low Impact Development (LID) as an effective BMP for minimizing water quality impacts to developers and the public. Utilizing predevelopment meetings and the IDP process to open the discussion about implementing LID practices before any development has taken place makes successful implementation of practices more likely to occur. In addition, the City explains stormwater pollution requirements and the benefits of LID when conducting presentations, training, and general education to the public and development and building communities.

LID was promoted at 46 predevelopment meetings and various educational events, particularly those with key personnel, including engineers, planners, and developers/contractors. 1,178 LID educational materials were distributed during the reporting period.

This year, folders with Stormwater Quality education and other information were created to give to new Tulsa residents upon move-in. These folders contained the following brochures: Stormwater Quality Brochure, Cause and Effect, Household Pollutant Collection Facility, Pet Waste, Landscaping, Pool Water Disposal, and Landscaping. This folder is included in welcome packets distributed by Refuse and Recycling.

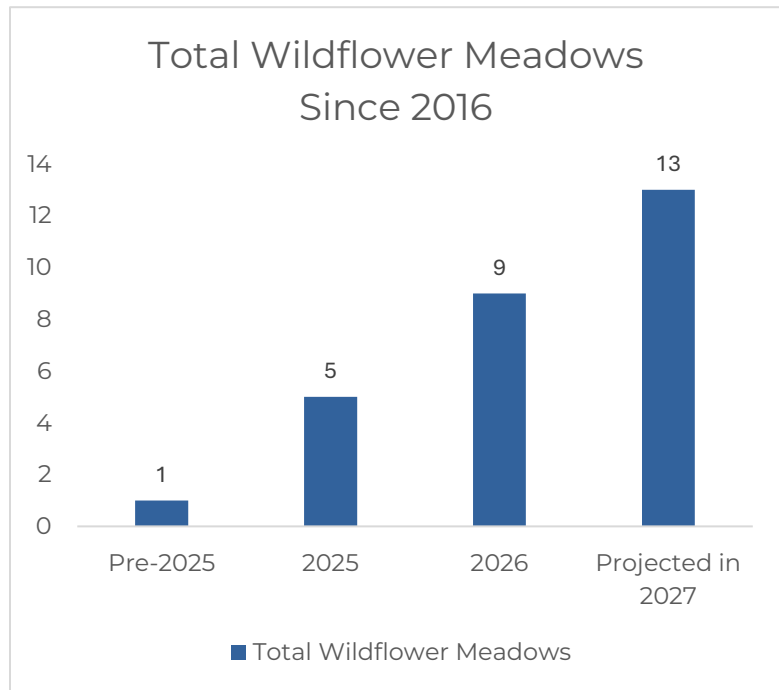
To provide citizens with a low-cost LID implementation, the City of Tulsa hosted a rain barrel sale on May 1-2nd and 8-9th, which resulted in the sale of 478 rain barrels, 2 275-gallon totes, and 8 composters from 342 citizens. These events also resulted in water quality education and promotion of the Tulsa Household Pollutant Collection Facility, which is where the event was hosted.

The Stormwater Quality subdivision of Public Works adopted an existing City Program to recognize Low Impact Development practices in Tulsa. The program, Partners for A Clean Environment (PACE) is a voluntary, non-regulatory recognition program coordinated by the City of Tulsa's Quality Assurance and Stormwater Quality groups. The focus of the program is to provide recognition to businesses, individuals, and groups who go above and beyond environmental regulations to be better stewards of our land and water. Currently there are 17 members of this program, though more LID features have been implemented in Tulsa. The PACE program is currently being modified to promote increased membership and education.

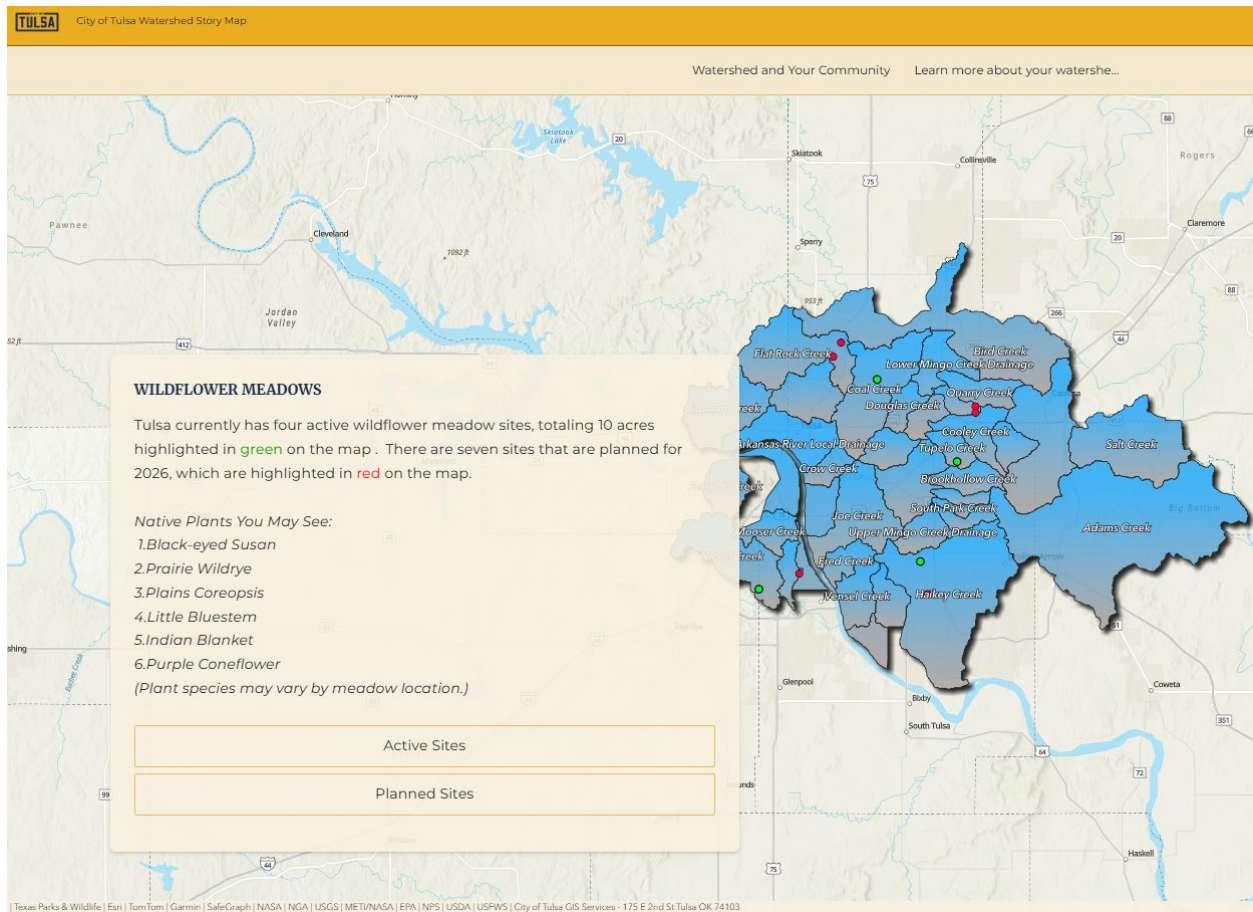


Section 1 – Status of Implementing the Stormwater Management Program

Wildflower meadows were established on stormwater properties as LID projects to improve water quality in nearby waterbodies. These meadows, seeded with native plants, are also used as an educational tool. Citizens visiting the meadows will find signs depicting the benefit these natural areas have on local waterways and the environment. Crow Creek Meadow, a pilot project implemented in 2016, has held numerous education events since its creation. The expansion of meadow locations citywide provides additional LID education opportunities with a regionalized focus.



Section 1 – Status of Implementing the Stormwater Management Program



An ArcGIS story map was completed in March 2026 that shows active and planned wildflower meadow sites.

v. *Public outreach on proper disposal of motor vehicle and household hazardous waste*

Public education in the proper management and disposal of used motor vehicle fluids and other household hazardous waste was accomplished through various methods. These methods include the distribution of the following educational material:

“*Causes and Effects of Pollution in Our Local Creeks and Streams*” highlights the effects of oil and grease, fertilizer and pesticide, pet waste, grass and leaves, and litter have on our waterways and how to prevent pollution from these sources. The other side of the handout has an infographic showing how these pollutants can be washed into our streams and creeks and the impacts they have on the environment.

“*Stormwater Quality Programs*” is a brochure given to the public detailing our Stormwater Quality programs. Included in the brochure is information on the adverse effects of household chemicals on the environment as well as instructions on how to dispose of chemicals properly.

“*Household Pollution Collection Facility*” informs citizens about the City of Tulsa’s Household Pollution Collection Facility where they can dispose of their hazardous waste and pollutants in a safe manner. The handout mentions the importance of proper disposal of chemicals, accepted and non-accepted items, and has contact information.

Section 1 – Status of Implementing the Stormwater Management Program

“Motor Oil”, talks about how motor oil can impact water, how to prevent oil from getting into local waterways, and how to safely dispose of oil.

The City of Tulsa has a Household Pollutant Collection Facility (HPCF), located at 4502 South Galveston Ave, which opened in 2016. The facility is open 2 days a week (Wednesdays and Saturdays) from 8:00 am till 4:30 pm. See [Section 3](#) for a summary of the pollutants collected this year, including motor oil, various vehicle fluids, and most household pollutants. Education material is distributed at this Facility.

The City of Tulsa utilizes utility bill stuffers that are sent out to residents who receive a utility bill. The proper management and disposal of used motor vehicle fluids and household hazardous waste was promoted 3 times in the stuffers. The HPCF was also mentioned in the stuffers and promoted at nearly every education event, with *“Motor Oil”* and *“The Household Pollutant Collection Facility”* brochures distributed. The Utility Bill Stuffer is sent out to 137,000 recipients via mailed Utility Bills, and 16,500 recipients via emailed Utility Bills. Community centers, libraries, and City Hall were stocked with HPCF brochures for the public to take as needed. See Attachment A for brochure/pamphlet distribution for proper management and disposal of used motor vehicle fluids and household hazardous wastes.

Currently, The Metropolitan Environmental Trust (M.e.t.) has nine drop-off recycling depots with collection containers for used motor oil, cooking grease, and batteries. Two of the nine locations have containers for antifreeze collections. The “Recycling Locations” map flier and the “Tulsa Area Recycling Directory” both provide locations of the recycling centers. These handouts are given during speeches, booths and events. The website, www.metrecycle.com, promotes the HPCF and depots (fliers are distributed at booths, speeches, and events throughout the year (see list below).

The following is a list detailing the approximate quantity of materials the M.e.t. distributed:

- Tulsa Area Recycling Directory: 2,900
- Latex Paint and the Environment: >800
- Recycling Locations Map: 2,900
- Backyard Composting: 899
- Where Can I recycle E-Waste: N/A
- Why Should I Recycle Batteries: 225



Section 1 – Status of Implementing the Stormwater Management Program



The revised specifications for new storm sewer inlet hoods include the message “Dump No Waste, Drains to River” embossed on them. These specifications were accepted by the City of Tulsa, and new inlet hoods have been obtained. As a result, all new or repaired catch basins will now have the message permanently cast into the hood, therefore not requiring a placard. This message is embossed to deter the intentional discharge of non-stormwater discharges, with oil being a primary concern.

Public education and outreach in the proper management and disposal of household grease waste was accomplished through the city of Tulsa’s FOG grease abatement program. Through this program, 187 FOG BMP door hangers and 90 apartment packets (can toppers, grease bags, FOG BMP literature) were

handed to residents involved in grease-related sewer blockage/overflow investigations. The FOG program ran television commercials highlighting the importance of proper household grease disposal through the trash rather than through the sanitary sewer. The commercials were aired on the following television networks:

Television Network	Frequency (times aired)	Impressions (views)
KOTV Channel 6	44	207.2
KJRH Channel 2	24	25.6
KTUL Channel 8	28	62.8
KQCW News on 6	8	36
KOKI Channel 23	58	205.8

In addition to television, the FOG program ran streaming television, offering targeted advertising and allowing brands to reach specific audiences based on interests, viewing habits, and demographics. This increases the effectiveness of each ad placement, maximizes return on investment, and ensures messages are delivered to viewers who are most likely to engage.

The FOG program increases residential educational activities during the holiday months to prevent residential grease blockages due to holiday cooking activities. This year, these activities included ‘Trap the Grease’ promotional outreach at Oklahoma State University’s Back to School Bash, where over 2,000 people attended. A fryer oil collection event was held in which 25 citizens collected dropped-off fryer oil. Approximately 200 Union Public Schools cafeteria workers were educated about the proper disposal of fats, oil, and grease. At the Enviro Expo, hosted annually by The Metropolitan Environmental Trust (M.e.t.), over 300 citizens were in attendance and educated about the consequences of pouring grease down the drain when stopping by the booth.

vi. Public outreach on pesticides, herbicides, and fertilizers

Public education on the proper use, application, and disposal of pesticides, herbicides, and fertilizers was accomplished through the distribution of educational material (brochures, videos, ads, etc.), public education events, and utility bill stuffers. The following section lists some of the materials and activities used to comply with this requirement. An extensive list, along with the number of pamphlets distributed, can be found in Appendix A and B in [Section 11](#). This information was also promoted in three utility bill stuffers three times during the reporting period. Like motor vehicle waste, proper pesticide, herbicide, and fertilizer use and disposal were promoted with HPCF educational materials.

“Fertilizers” and “Pesticides” are two brochures which emphasize the proper application and disposal for the use of pesticides and fertilizers. It also lists alternatives to chemicals to control pests and fertilize lawns.

“Stormwater Quality Programs” is a brochure given to the public detailing Stormwater Quality programs. Included in the brochure is information on the adverse effects of pesticides and fertilizers on the environment as well as instructions on how to dispose of them properly.

“Pollution Prevention Plan” is a Best Management Practice (BMP) created to guide citizens and contractors to do their part to keep our storm sewer and creeks clean. It addresses a variety of pollutants including, but not limited to, fertilizers, herbicides, and pesticides.

The Master Gardeners Program, available through the Oklahoma State University (OSU) Cooperative Extension Service, is a free service that offers expert advice to the public on all aspects of gardening, including the proper application of pesticides, herbicides, and fertilizers as well as other gardening and lawn care tips and information. This service is available to the public either by visiting the extension services at 4116 East 15th St, accessing the website www.tulsamastergardeners.org/, or utilizing the telephone hotline at (918) 746-3701. The Tulsa Master Gardeners answer approximately 100,000 gardening questions/contacts a year, and conduct 2,500 soil, water, and forage tests annually to assist homeowners in applying the proper type and amount of nutrients to their properties.

These questions are answered by volunteers trained in various horticultural issues including proper application of pesticides, herbicides, and fertilizers. This program also distributes “Fact Sheets”, which discuss choices of chemicals and application rates for most of the common uses of pesticides and fertilizers in urban areas. Gardening education is further accomplished by various media outlets including TV, radio, print, and online newsletters. This is also accomplished by numerous Home and Garden Shows throughout the year. The Master Gardener Program was also promoted through distribution of the “City Life” newsletter in the months of August 2025 and January 2026. The City of Tulsa further promoted the Master Gardeners Program through the distribution of brochures and on the City of Tulsa’s Stormwater Quality website.

The Tulsa County Conservation District (TCCD) and Oklahoma Conservation Commission (OCC) began a program in 2021 to recognize and promote healthy yards for pollinators, soil, and water quality. This program is called Yard-by-Yard and has 62 members in Tulsa County. Below is a representative’s summary of the program:

“Through our Yard-by-Yard Community Resiliency Project, residents will find not only support to do the right things for their yard and community, but also recognition for their efforts and the chance to encourage others. Whole neighborhoods coming together for the greater good can absolutely add strength, health, and resilience to our city. Wonderful and impactful things will happen. Participants will get to enjoy wildlife neighbors like birds, butterflies, and bees. They will cut down on the amount of waste going into a landfill. They will enjoy the blossoms of native plants and will savor the taste of home-grown fruits and vegetables. Participants will improve the health of the soil and conserve our most precious resource of all: water. We believe individual stewardship efforts contribute to a greater movement reclaiming our connection to the Earth one yard at a time.”

Additionally, The TCCD/Blue Thumb Program continued to stress the importance of the proper application and disposal of pesticides, herbicides, and fertilizers in their presentations to schools, conferences, educational activities and expositions. Speakers from this program conveyed the detrimental impacts to water quality from misuse and improper disposal.

Tulsa continued to maintain a website that is accessible to the public, which contains guidance for pesticide and fertilizer application for both commercial and residential applicators. This website is located at <https://www.cityoftulsa.org/government/departments/public-works/stormwater-quality/pesticides/> and is regularly promoted. This subsection of the main Stormwater Quality website was viewed a total of 48 times by the public; however, similar information is displayed throughout the main website.

vii. Public involvement of the SWMP

On January 24, 2025, the City of Tulsa published a public notice of SWMP implementation in the Tulsa World newspaper, which asked for public review and a 30-day commentary on the SWMP and included instructions on how to do so. The post read:

PUBLIC NOTICE OF IMPLEMENTATION OF DRAFT STORM WATER MANAGEMENT PROGRAM FOR
PERMIT NO. OKS000201

Notice is hereby given that the city of Tulsa has a draft storm water management plan (SWMP) for public review and comment. This SWMP delineates the implementation plan for the city of Tulsa's Municipal Separate Stormwater Sewer System (MS4), Discharge Permit #OKS000201.

A copy of the draft SWMP may be reviewed at the City Hall, 200 Civic Center, Tulsa, 74103, City Clerk's office. A copy of the draft SWMP may also be reviewed on City of Tulsa website at <https://www.deq.ok.gov/permits-for-public-review/>

Pursuant to 27A OS § 2-14-302, persons wishing to make comments concerning the draft SWMP may do so by sending the comments in writing to the Contact Person for the City of Tulsa, at the address listed below, within 30 days after the date of publication or mailing. Comments should include: (1) name and address of the interested person, (2) the application name to which the request relates, (3) the nature and basis of the interest of the person affected, and (4) a statement of the objection or comment, the basis of the objection or comment, and any requested action by the City of Tulsa.

The contact person for the City of Tulsa, to schedule a date and time to review the draft SWMP at the office of DEQ, is:

Scott Van Loo, Operations Manager
Stormwater Operations
Department of Public Works
City of Tulsa
4502 S. Galveston
Tulsa, OK 74107
(918) 591-4325
svanloo@cityoftulsa.org

Revisions to the SWMP are expected before the end of the current permit period. If major changes are made, a public commentary period will be included. The City continues to listen to public feedback during standard operating hours and takes all factors and recommendations into consideration for changes to the SWMP.

Citizens can provide program feedback and suggestions at any time by emailing stormwaterquality@cityoftulsa.org or 311@cityoftulsa.org, calling the SMO front desk at (918) 591-4325, or dialing 311 within City of Tulsa city limits to reach the Customer Care Center.

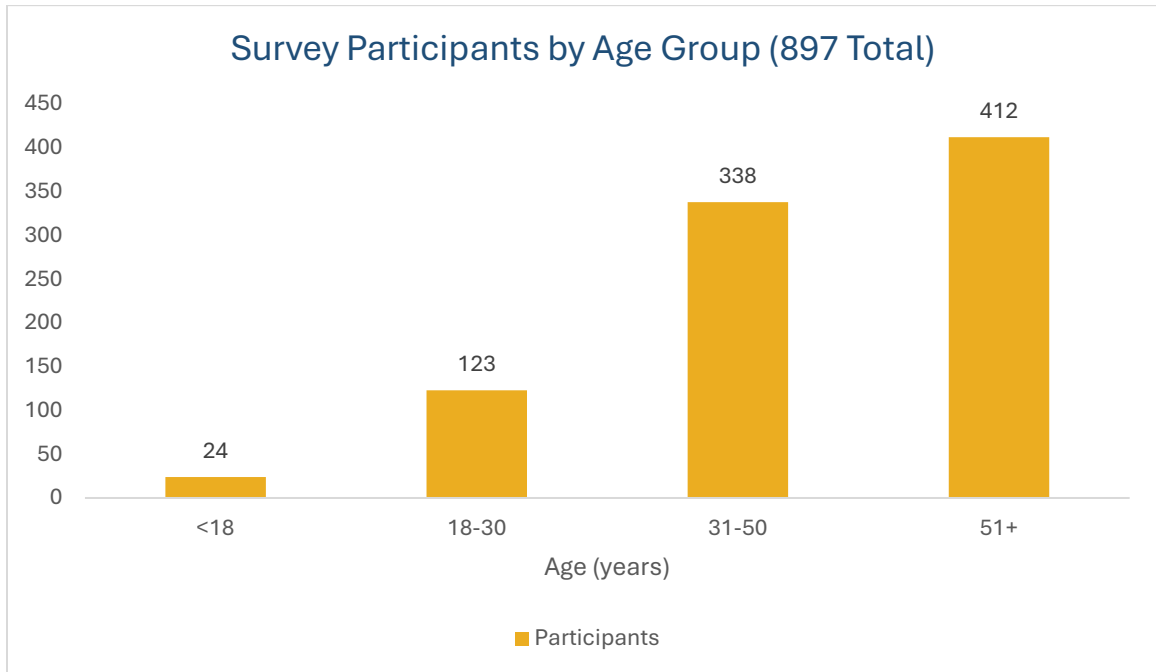
viii. Assessment of program effectiveness

To assess changes in public awareness and behavior, the City of Tulsa gathers data through surveys, the volume of educational material distributed, and other program statistics. This subsection

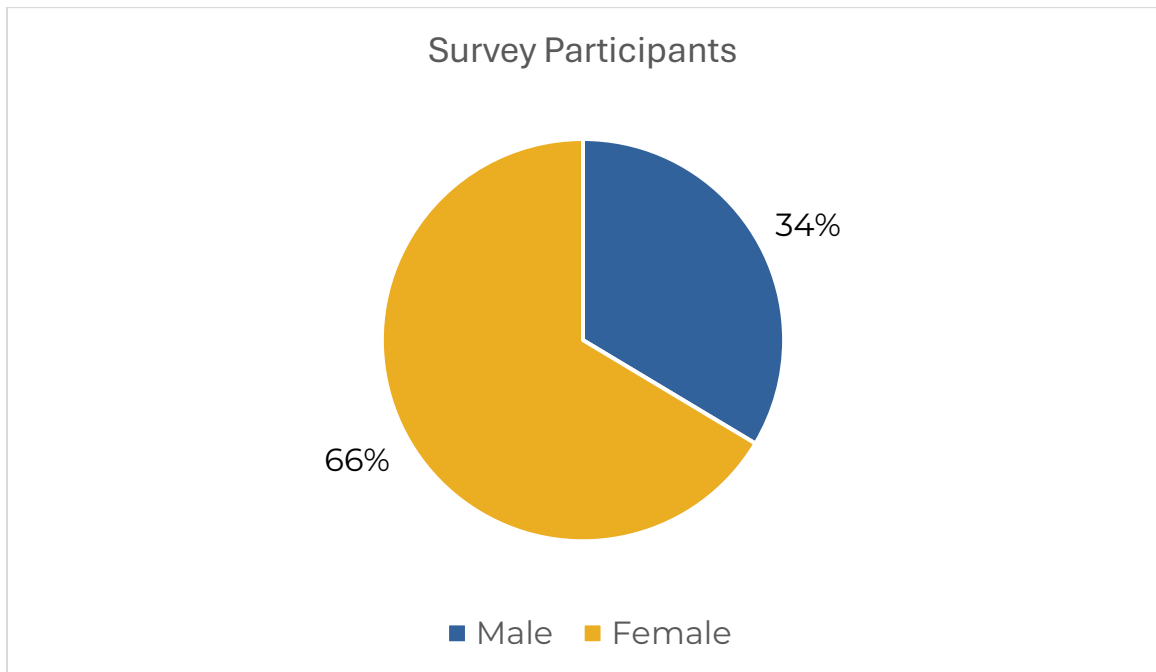
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summarizes survey data used and provides a subsequent assessment for the reporting period. Survey information was acquired at two large public events: the Tulsa State Fair and Home and Garden Show.

Reporting year survey information is summarized in the charts below:

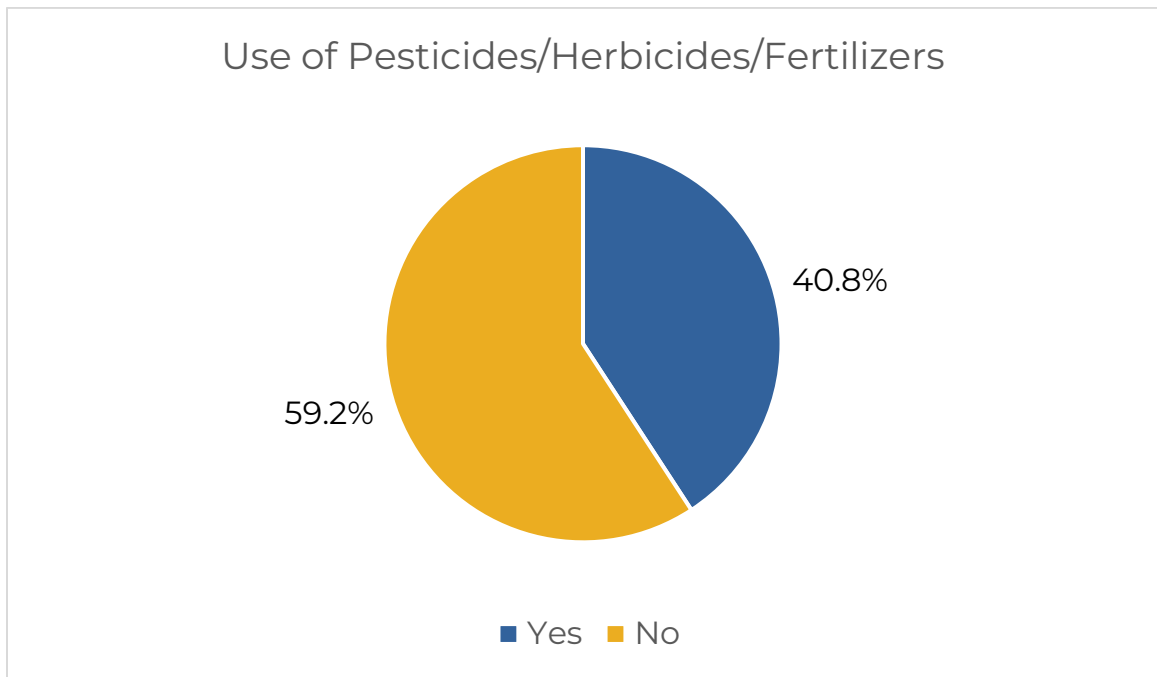


From this survey data, it is evident that the age of most survey participants was greater than 30. Next year, a concerted effort will be made to acquire survey data from the younger audience.

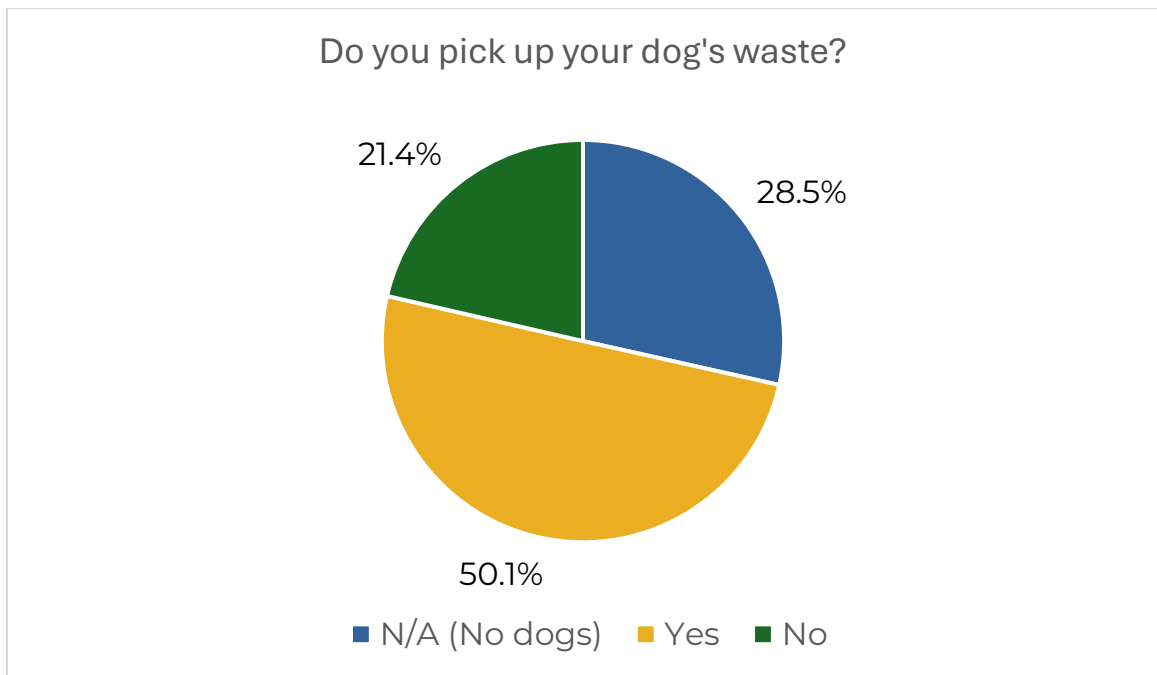


Most survey participants were female.

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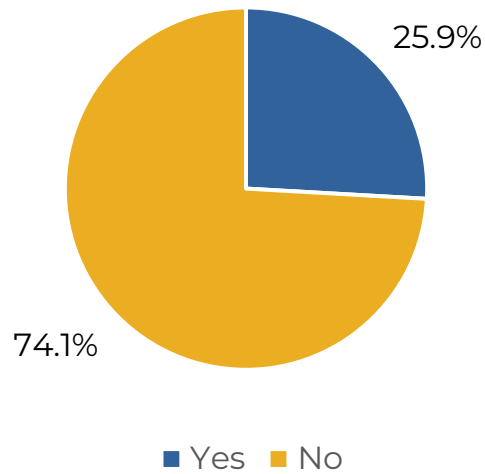


Most survey participants do not use pesticides.



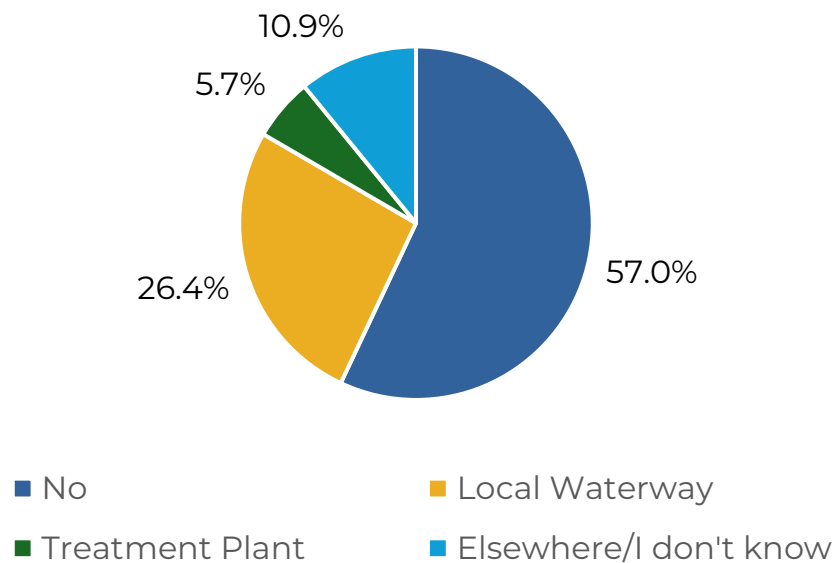
Bacteria from dog waste is a major contributor to creek water quality impairments. This data shows more work could be done to encourage citizens to pick up their pet's waste.

Have you visited the Household Pollutant Collection Facility in the past 3 years?



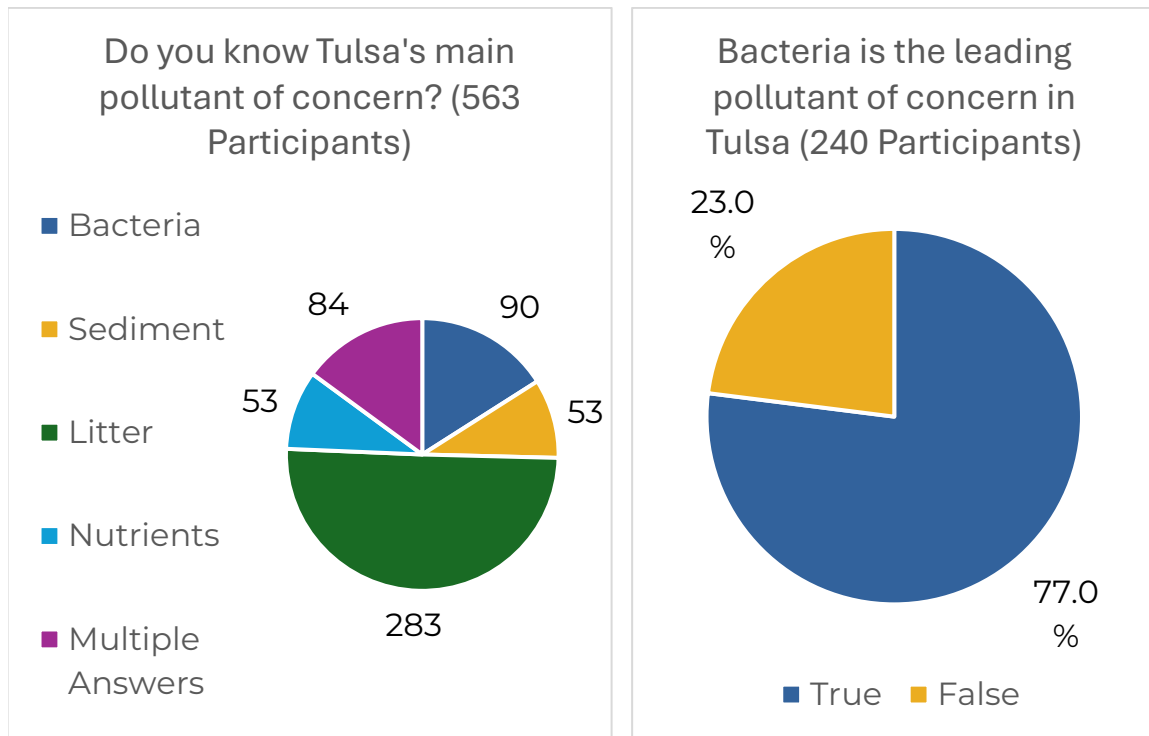
With much of the data coming from events where some participants live outside Tulsa County, survey data would benefit from having a locality question to make a firmer assessment. The program will continue to increase HPCF advertising.

Do you know where stormwater goes?



This data shows that the program should focus on the “Only Rain in the Drain” advertising campaign.

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Survey question changed from the left graphic to the right during the reporting period. Assessment of this data shows that citizens are aware bacteria is a top pollutant. With litter being a visible pollutant and bacteria not, it makes sense that participants typically chose litter on the first survey. Education on bacteria and its impact on stormwater quality will be enhanced in future years.

b. Targeted Education to Entities Significantly Impacting Impaired Waters

The Stormwater Quality program incorporates targeted outreach, inspections, and compliance activities directed toward commercial, industrial, and other sectors with the highest potential to contribute to pollutants of concern in impaired waterbodies. This includes prioritizing facilities whose operations involve materials, processes, or other outdoor activities that may affect the specific impairments for receiving waterbodies.

The City of Tulsa performs the following activities to meet this requirement:

- Targeted education and outreach through direct mailers, in-person interactions and presentations, and social media
- Prioritized inspections of facilities based on risk, history of compliance, and proximity to impaired waterbodies, which includes education with onsite staff during each inspection
- Technical assistance and follow-up enforcement to ensure corrective actions are implemented when deficiencies are identified
- Continuous analysis of areas of “High-Priority Areas” map – see 4(b) for more information

SMO is continuously exploring targeted approaches to educate groups that have a significant impact on impaired waters within the City of Tulsa. One new activity planned for the next reporting period is targeted at education via social media within TMDL areas.

2. Employee Education

Status: Compliant and ongoing

This year, educational events were conducted for personnel from Stormwater Maintenance and Operations (SMO) and Street Maintenance, among others, on their responsibilities at facilities and job sites. Stormwater Quality staff continuously educates individuals and groups from other departments during various interactions and regularly coordinated meetings.

Employees in the Public Works Department are eligible for promotional advancement upon completion of a “Stormwater Operator Certification” program conducted by the SMO group. This two-day, sixteen-hour course covers topics including, but not limited to, stormwater history in Tulsa, maintenance responsibilities, and Low Impact Development. Attendees are required to pass a test for certification. To date 243 employees have been certified. During this FY, 18 employees attended the training.

Employees attended several stormwater-related conferences, including Oklahoma Floodplain Managers Association (OFMA) workshops, Oklahoma Clean Lakes and Watersheds Association (OCLWA) conference, the National Watershed & Stormwater conference hosted by the Center for Watershed Protection (CWP).

City contractors responsible for herbicide, pesticide and fertilizer application, as well as landscape specialists and other lawn care providers, were specifically educated on the proper use of chemicals, disposal thereof and spill prevention procedures. The City of Tulsa requires all City personnel, as well as all City contractors that apply pesticides and herbicides to be licensed and subject to all the regulations under the Oklahoma Combined Pesticide Law and Rules (2 OK Stat § 3-85 [2025]), including re-certification. City personnel that apply pesticides, herbicides, and fertilizers received annual in-house training on specific types of pesticides, herbicides, and fertilizers that are applied. When available, employees attended workshops, conferences, and additional training on proper pesticide, herbicide, and fertilizer application and disposal. The Tulsa Parks Department and SMO Division received training many times throughout the fiscal year including, Oklahoma Vegetation Management Association (OKVMA) in October 2025 and Oklahoma Turfgrass Research Foundation (OTRF) conferences in November of 2025.

Other contractors performing work for the City of Tulsa were made aware of the SWMP, Pollution Ordinance (Title 11A, Chapter 5), and the MS4 Permit requirements through contract language and obligations, preconstruction meetings, and direct communication as necessary to prevent contamination of the waters of the State. As contracts come up for renewal, addendums will continue to be added that require the contractor to review and acknowledge they fully understand the SWMP, MS4 permit, and local, state, and federal regulations.

3. Industrial Stormwater Runoff Control

Status: Compliant and ongoing

a. Permitted industrial facilities

Tulsa continued to use the Industrial & High-Risk Runoff program to identify, monitor and control pollutants from municipal landfills; treatment, storage and disposal facilities for municipal waste; facilities subject to EPCRA Title III, Section 313 reporting requirements; and any other industrial or commercial discharge the City determined had the potential to contribute substantial pollutant loading to the City’s storm sewer system. This program contains procedures for inspecting, monitoring and controlling pollution from the aforementioned sources. A database of industrial storm water sources discharging to the City’s storm sewer continues to be maintained and updated periodically throughout the reporting year. Currently, there are 440 industries inspected within the City of Tulsa.

b. Regulatory mechanisms supporting industrial stormwater management

Tulsa's Pollution Ordinance was adopted in November 1995 and continues to be utilized for the control of industrial runoff. The following ordinance sections specifically allow the City of Tulsa to ensure compliance with Part II(A)(3) Industrial Stormwater Runoff Control:

- Section 502 – Discharge requirements
- Section 503 – Spills
- Section 506 – Record keeping
- Section 509 – Requirements for best management practices
- Section 510 – Inspections and sampling
- Section 511 – Administrative enforcement remedies

The Pollution Ordinance was revised during this reporting period and is awaiting finalization.



c. Site inspection protocols and enforcement actions

Tulsa continued to use the Industrial & High Risk Runoff program to identify, monitor and control pollutants from municipal landfills; treatment, storage and disposal facilities for municipal waste; facilities subject to EPCRA (Emergency Planning and Community Right-to-know Act) Title III, Section 313 reporting requirements; and any other industrial or commercial discharge the City determined had the potential to contribute substantial pollutant loading to the City's storm sewer system. This program contains procedures for inspecting, monitoring, and controlling pollution from the aforementioned sources. A new GIS-based database was implemented in 2025 to better inventory and manage industrial facilities and continues to be maintained. The new database features allow for more fluid and streamlined inspection workflows, as well as integration of spatial data with compliance tracking for more informed decision-making.

During this reporting period, 652 industrial stormwater inspections were conducted. 12 enforcement actions were taken against industries or facilities in order to eliminate illegal or illicit discharges. The total amount of fines and penalties associated with these enforcement actions was \$0.00.

This program has also provided an opportunity to educate owners and operators of industrial or commercial facilities about storm water quality regulations and requirements as per ordinance and

d. Monitoring procedures and control measures

See Section 1, 8(c) for more information.

4. Illicit Discharge Detection and Elimination

Status: Compliant and ongoing

The location and removal of illicit discharges and improper disposal continued to be an important aspect of the City of Tulsa's SWMP. Many departments within the City of Tulsa maintain various programs that involve locating and removing non-stormwater discharges to the storm sewer system and/or educating the public on proper disposal practices.

a. Non-stormwater discharges

Tulsa allows the discharge of exempt non-stormwater discharges, as defined by 40 CFR 122.26(d)(2)(iv)(B)(1), to the storm sewer unless these discharges are determined to be contributing significant amounts of pollutants to the storm sewer. These discharges are identified in the SWMP and correlate with the allowable discharges within the permit itself. When an exempt non-stormwater discharge is found to be contributing significant amounts of pollutants to the storm sewer, enforcement action is taken by utilizing Tulsa's Pollution Ordinance, which contains a list of allowable and prohibited discharges.

One of the most common Dry Weather Field Screening causes of flow and follow-ups is from potable water discharges, commonly caused by water line leaks/breaks or flushing. Chlorinated water is a known stressor or toxin to aquatic life. The City of Tulsa is continuing to explore options for the dechlorination of potable water discharges. The Water and Sewer Department has begun to use dechlorination tablets and diffusers when applicable when flushing dead-end lines. Tulsa's Water and Sewer Department valves down water breaks in an attempt to reduce the amount of chlorinated water discharged to streams after breaks. Water Distribution continues to work with Water Design to reduce dead-end lines in the system. Dead-ends are reduced via waterline extension work included in street rehabilitation projects. The city also reduces or eliminates dead-end lines individually when funding is available, which helps maintain drinking water standards. Stormwater Maintenance and Operations (SMO) receives a daily waterline break report and investigates any signs of harmful effects to aquatic life. Remediation tactics are being explored. During the reporting period, 23 dead-end lines were tied-in and waterlines upgraded in areas to reduce the amount of flushing required for safe drinking water standards. Staff have continued to find lines that can either be removed or tied-in to reduce dead-end lines by 10% each year. Crews clean up sediment from waterline breaks and haul it off after finishing. A private street cleaning contractor was used to assist in removing sediment.

Other categories of allowable non-stormwater discharges to the MS4 are:

- Car Washing without Detergents (non-commercial and charity)
- Swimming Pool / Hot Tub (dechlorinated/non-saltwater)
- Outside Washing without Detergents (pavement washing)

For the above discharges, Tulsa has established BMPs that must be implemented prior to allowing the discharge to the MS4. Failure to implement these measures may result in a violation of the Pollution Ordinance.

Discharges from emergency firefighting activities were monitored during all phases of Tulsa's firefighting activities for potential releases of pollutants. This was accomplished through the continued implementation of Tulsa's Fire Department (TFD) policies. These policies were implemented to ensure public health and safety and reduce the release of pollutants. Stormwater Quality staff responds to emergency spills along roadways or any location where pollutants have the potential to enter the stormwater system.

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Currently, Tulsa's fire training activities do not result in illicit discharges to the MS4. The City of Tulsa completed the construction of a new fire training facility in 2017. The Stormwater Quality group will continue to perform education events with new TFD staff on the impact non-stormwater discharges can have on aquatic life. As mentioned above, the City is continuing to research the feasibility of dechlorination and remediation techniques when potable water sources are discharged to the MS4. Best management practices preventing these discharges from entering the storm sewer system are taken where possible.

The training facility includes two fire training areas that use water. These areas are called the Class A burn area and the drill tower. Permeable concrete was

laid in both areas to capture the water used during training. All discharged domestic water and stormwater produced on or about the new fire training facility will be directed to a retention pond that will include an aerator. The pond will allow the fire department to develop training programs on how to acquire fire suppression water from static sources as well as produce water for selected training evolutions.

Although it rarely occurs, if the burning of an existing structure was approved for training purposes, Tulsa will capture all the runoff and dispose of it in a manner that complies with all federal, state and local water quality regulations. This includes but is not limited to the current edition of NFPA 1403 which requires the consideration of water runoff.

b. IDDE program implementation and documentation

i. High-priority area identification

The Stormwater Quality group, using information obtained from inspections, field screening, investigations, homeless encampment locations, combined with information provided by the Water and Sewer Department, developed a “High-Priority Areas” list of the areas with the greatest risk of illicit discharges and connections. These areas are overlaid on the storm sewer atlas to provide a map of the major storm sewer outfalls with the greatest likelihood of containing illicit discharges and connections. This map is in the SWMP, and locations are reviewed throughout the year and updated as necessary. Currently, there are 40 “High-Priority Area” dry-weather field screening outfalls that are inspected annually.

ii. Field screening activities

Dry-weather field screening and dry weather flow follow-up continue to be used, resulting in the location, identification and removal of illicit discharges and improper disposals that occurred during this reporting period. See additional information Section 1, 4(c) and [Section 9](#).

iii. Investigations of illicit discharge and non-stormwater sources

Based on dry-weather field screening results and information provided by citizen reports, field observations, etc., portions of the MS4 that show a reasonable potential for containing illicit discharges or non-stormwater flows are prioritized for investigation.

Investigations may include follow-up sampling for indicators where such evaluations are documented. Outfalls or storm sewer segments identified during screening as having elevated indicators, recurring flow, or other signs of potential contamination are scheduled for further evaluation in accordance with IDDE investigation protocols. See [Section 9](#), Follow-Up and Response Program for reporting period information.

iv. Illicit discharge tracing procedures

Public reporting of an illicit discharge or illegal disposal by concerned citizens (via the 311 call center or directly to the Stormwater Maintenance and Operations [SMO] Division), other City departments and government agencies (ODEQ or the EPA) are regularly promoted on the city’s website or at educational events (see Attachment B). Multiple channels for reporting illicit discharges are a valuable part of the City’s effort to locate illicit discharges and improper disposals. This year Stormwater Quality staff completed 314 service requests related to the investigation of illicit discharges. 163 of these investigations were from the 311 Customer Care Center. Investigations are performed within 72 hours of the receipt of any complaints via 311, hotline, reports, field screening results, or monitoring information that indicates a potential illicit discharge.

v. Removal of illicit discharges

Once an illicit discharge was identified, the responsible party was required to stop the discharge, redirect the discharge to the sanitary sewer or obtain an OPDES wastewater discharge permit from the Oklahoma Department of Environmental Quality (ODEQ). This was accomplished using the Pollution Ordinance.

vi. Field indicators and screening tools

Field staff routinely inspect outfalls, drainage structures, and receiving waters using established visual indicators to identify potential illicit discharges. Indicators assessed include, color, odor, turbidity, sheen, floatables, algal growth, and any other signs of abnormal aquatic conditions. When visual screening suggests the possibility of contamination, staff use simple field test kits (e.g., chlorine, ammonia, detergents) to further evaluate the discharge.

c. Locate and eliminate illicit discharges and improper disposal

Dry weather field screening (DWFS) was conducted on approximately 87.0 square miles (55,598 acres) of the City of Tulsa's storm sewer system during the period of July 1, 2025 to June 30, 2026. Outfalls were screened in the northeast and southwest quadrants of the city, amounting to 49 % of designated DWFS outfalls. Thus, compliance with this section of the permit was achieved by screening >40 % of Tulsa's MS4,



in addition to all 40 priority area outfalls identified for this fiscal year. The dry weather field screening program was designed to locate illicit discharges and illegal disposals into Tulsa's storm sewer.

A total of 296 outfalls were screened, of which 177 contained flows during dry weather periods. Once conditions met the criteria for dry weather, the source of the flow was identified, the flow was sampled and tested for pH, temperature, appearance, conductivity, detergents, chlorine, copper, ammonia and fluoride. (See Section 4 for specific data collected during dry weather field screening). If contaminants were identified in

concentrations above action levels, then a dry weather flow follow-up investigation was conducted. Dry weather flow follow-up investigations continued until the source of the flow was identified. When the source of the illicit discharge was identified, it was eliminated.

The Stormwater Quality group has been involved in the special event planning process. Information about the City of Tulsa's pollution ordinance and illicit discharges is provided in the Special Permit Event Application. Additionally, special events are regularly inspected by Stormwater Quality staff to ensure no violations occur. This year, the City of Tulsa processed 262 special event permit applications.

The SMO Division continued to conduct random industrial inspections. Inspections were conducted to achieve compliance with Part II(A)(3) Industrial Stormwater Runoff Control. During these inspections, inspectors were checking for illicit discharges to the MS4 or the potential for an illicit discharge. If an illicit discharge was found, action was taken to halt the discharge using the Pollution Ordinance.

Stormwater Quality continued to strengthen its illicit discharge detection capabilities using microbial source tracking (MST) to support more precise identification of bacterial contamination sources. In partnership with Dr. Jason Vogel with the University of Oklahoma's Oklahoma Water Survey, MST methods are being evaluated as a supplemental tool to conventional detection techniques such as ammonia sampling and dye testing. Although sufficient data is not yet available to make firm determinations, preliminary efforts have been focused on developing sampling protocols and determining sampling areas within the MS4. The addition of MST into the program improved the ability to distinguish between human and non-human bacterial sources and effectively decide the appropriate corrective actions necessary. See [Section 9](#) for the full MST Report.

d. Illicit discharge regulatory enforcement

Legal Authority

The City of Tulsa utilizes several Ordinances to ensure compliance with OPDES Permit #OKS000201. The following is a list of the most commonly used Ordinances accompanied by a brief description:

Title 11-A Chapter 3 (Watershed Development Regulations) – This Ordinance allows for the regulation of the methods for handling and disposing of stormwater run-off; the development, excavation, grading, regrading, paving, land filling, berming and diking of land; allows for the regulation of development within

flood plains in order to assure that development is not dangerous to health, safety or property due to stormwater run-off; and allows for the regulation of the connection to and use of the stormwater drainage system. Through this Ordinance, Tulsa permits construction activities that are one acre or greater.

Title 11-A, Chapter 5 (Pollution) – This Ordinance was adopted in November of 1995 in order to give Tulsa the legal authority needed to comply with all of the municipal separate storm sewer system discharge permit requirements that were not covered by existing Ordinances. It prohibits illicit discharges to the storm sewer; allows for the control and monitoring of stormwater runoff; provides Tulsa with the legal means to inspect and investigate potential sources of pollution to the storm sewer; and contains judicial enforcement remedies. This Ordinance was revised during 2006–2007 reporting period to include provision for recovery of cost incurred by Tulsa against violators of this Ordinance. Maximum amount of fines per violation per day is \$1,000.00. Other enforcement measures are also made available within the Ordinance as Administrative orders, such as Consent, Compliance, and Cease and desist orders.

Title 11-C, Chapter 12 (Requirements For Industrial Users To Discharge To The Sanitary Sewer Systems) – This Ordinance provides general sewer use requirements; allows for wastewater discharge permit issuance and inspection of all industries that discharge to the sanitary sewer; prohibit the inflow of stormwater into the sanitary sewer system; and contains judicial enforcement remedies.

Title 24, Chapters 1 and 2 (Nuisances) – These Ordinances provides for abatement of nuisances, including litter, industrial wastes, sewage, etc. from any area lake, basin, public park, alley, highway or street through enforcement actions including total cost recovery to the City of Tulsa from the any person, firm corporation, partnership, or other legal entity who commits or who permits the creation or continuation of a nuisance.

Title 42, Chapter 11 (Planned Unit Development) – This ordinance encourages innovative land development while maintaining appropriate limitation on the character and intensity of use and assuring compatibility with adjoining and proximate properties. It also promotes greater flexibility within the development to best utilize the unique physical features of a particular site. Creative land use design and open space preservation are also promoted in this Ordinance. Further, the final purpose of this Ordinance is to achieve a continuity of function and design within the development.

e. Removal of illicit discharges

Once the source of an illicit discharge was located, the responsible party was required to halt the discharge, redirect the discharge to the sanitary sewer or obtain an OPDES wastewater discharge permit from the ODEQ. 117 illicit discharges were eliminated from Tulsa’s MS4 during this reporting period as a result of enforcement of the Pollution Ordinance.

In a continuing effort to eliminate sanitary sewer overflows during this reporting period, the City of Tulsa initiated 18 sanitary sewer manhole and/or pipeline rehabilitation projects. 9 sanitary sewer evaluation studies were initiated and 9 were completed during this reporting period. 1 un-sewered area projects were completed during this reporting year, which should reduce the risks of failed septic tank effluent entering the MS4. Excess wet weather flow to the sanitary sewer was diverted to 7 flow equalization basins which reduce the amount of non-target rainwater from entering the sanitary sewer system. The Lower Bird Flow Equalization Basin Project began construction in order to reduce dry and wet weather sanitary sewer overflows as well as seepage into the storm sewer system. This project is still under construction.

The Coal Creek Rehab Project is a sanitary sewer improvement project that will ultimately reduce the potential for sanitary sewer overflows into the MS4. A summary of project updates during the reporting period is below (additional information can be found in [Section 7](#)):

- Completed Flow Monitoring to determine amount of Inflow and Infiltration (I/I) in the system in Permanent Meter Basin TL 1415C
- Completed Sanitary Sewer Evaluation Survey (SSES) work in the Permanent Meter Basin TL 1415C

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- In the process of finalizing design and obtaining easements for a Capacity Enhancement project. Approvable plans for this project have been submitted to DEQ as part of active Consent Order Task A. Construction is expected to begin by February 2027
- Began design of a “pure” Rehabilitation and Replacement project (one meant to fix “leaks” and reduce I/I in the system) based upon the Flow Monitoring and SSES work in the TL 1415C basin. Expected to submit Approvable Plans to DEQ for this project in February of 2027 and the potential for construction to begin by February 2028

The City of Tulsa’s Working in Neighborhood’s division utilizes two programs that help eliminate sanitary sewer contamination of waterways. The Emergency Repair Grant consists of a \$7,500 maximum grant to very low-income residents to make emergency repairs to conditions that threaten the health and safety of the occupants. Areas of service include electrical, plumbing, roofs, heating, and sewer lines. The Rehabilitation Loan Program is a \$45,000 maximum rehabilitation loan available for moderate to very low-income residents to assist citizens with home repairs, weatherization, and energy efficiency. Each residence is given a rigorous inspection to include lead-based paint (LBP), electrical/mechanical/plumbing (EMP), structural, and interior repairs. Areas of service include lead-based paint, electrical, plumbing, security (doors and windows), roofs, heating, interior issues, weatherization, and sewer lines. One sewer line was repaired/rehabilitated under these programs during the reporting year.

Sewer cleaning crews targeted specific sewer lines known for grease accumulation problems, cleaning 45.53 miles. This maintenance program reduced the likelihood of sanitary sewer backups and overflows. Emergency cleaning of 24.89 miles of sanitary sewer was also conducted to remove grease and reduce sanitary sewer overflows.

To reduce grease blockages that result in sanitary sewer overflows, Tulsa continued its grease abatement program, better known as FOG (Fats, Oils, Grease) Best Management Practices Program, for the sanitary sewer. This voluntary program encourages restaurant owners to follow best management practices (BMPs) that ensure proper kitchen and grease management practices. Various meetings with business owners also facilitated discussion on the proper care and maintenance for trash receptacles, grease rendering bins, and parking lots.

As a result of the FOG BMP program the following actions took place during this reporting period:

Actions	Results
Businesses Inspected	1,454
FOG Trainings Conducted	3 trainings 700 attendees
Businesses Participating in the FOG Program	563
Samples Obtained	0
Number of Enforcement Actions	0
Fines Issued	\$0

Tulsa continued efforts to reduce sanitary sewer overflows into storm sewers during this reporting period. This was accomplished through the use of TV inspections and smoke testing techniques. Work completed during the reporting period included:

- 164.66 miles of sanitary sewer TV inspected

- 261 sanitary manholes raised to grade
- 234 main line sanitary sewer repairs
- 35,266 feet of main line sanitary sewer replaced or rehabilitated
- 1,863 maintenance activities on 49 sanitary lift/pump stations

A Sewer Nuisance Abatement Program was established to facilitate the remediation of defective private sanitary sewers and to provide a mechanism for owner-occupied properties to connect to new sanitary sewer mains in previously unserved areas. The remediation of the private sewer defects helps prevent seepage in storm drains. Private defects are discovered through field investigations (smoke testing, dye tests, building inspections, service lateral TV) during SSES projects and daily preventative maintenance. When problems are found by smoke testing, the owner is contacted, and education and/or enforcement occur. Additionally, the City has a no-interest repayment program to help low-income residents with repairs to private lines. For fiscal year 2025-2026, staff has abated the following sewer nuisances: 379 defective or missing cleanout caps, 9 cross connections, 7 illegal connections, and 182 defective service lateral lines.

These repairs resulted in the reduction of stormwater inflow and infiltration into the sanitary sewer, which in turn reduced sanitary sewer overflows and illicit discharges to the storm sewer system. Rehabilitation projects supplemented Tulsa's efforts by correcting known structural storm sewer problem areas.

The number of sanitary sewer overflows during the reporting period was 170. This is an 8% decrease from previous year and in-line/out of line with the long-term average goal for the program.

The Water and Sewer Department has several area-wide repair, rehabilitation, and replacement projects underway to reduce both dry weather and wet weather overflows. Risk based prioritization methodologies are used to analyze sanitary sewer overflows and information from SSES studies, flow monitoring, pipe & manhole condition assessment projects to identify and prioritize locations for rehabilitation based on risk to develop specific remediation plans. In addition, Tulsa utilizes a flow monitoring network of 100 permanent flow meters to assist in monitoring flow; updating & calibrating our four (4) hydraulic models; determining where to conduct inflow & infiltration abatement programs; and planning and design of capacity enhancements.

As previously mentioned, investigation/complaint procedures currently in place continue to be very effective in locating illicit discharges and improper disposal practices during this reporting period.

f. Spill Prevention and Response

All agencies and City Departments responding to spills are instructed to follow the City's Pollution Ordinance. This ordinance requires the removal of a pollutant rather than disposing to the storm sewer, unless there is an immediate threat to life and health. The Pollution Ordinance provides the Stormwater Quality group with the authority to require the responsible party to clean up the spill. This Ordinance also gives the authority to recoup all costs incurred from the responsible party. The Stormwater Maintenance and Operations Division has authority to oversee all clean-up work involving spills within the City of Tulsa.

This requirement was achieved as delineated in a Memorandum of Agreement between the Tulsa Fire Department (TFD) Hazardous Materials Unit, the Tulsa City-County Health Department and the Public Works Department. In accordance with Section 300 of the TFD Emergency Operation Procedures, all agencies and City departments responding to spills ensured compliance with the Pollution Ordinance by removing spilled pollutants rather than flushing them into the storm sewer, unless there was an immediate threat to public health and safety.

The TFD HAZMAT Unit responded to incidents involving spills or possible releases of chemicals or pollutants which either had the potential to or were discharged to the City's sanitary or storm sewer. Whenever the TFD responded to a spill that had entered either the sanitary or storm sewer system, the

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Public Works Department was notified to evaluate impact on sewer systems and coordinate remediation activities. This year, Stormwater Quality staff began deploying top-water oil-absorbing booms for any spills where hydrocarbons had the potential to enter a nearby creek. This addition allowed for spills to be contained more quickly upon discovery and investigation.



If the responsible party was identified, they were required to conduct the clean up or hire a remediation company. In cases involving remediation, all work was inspected to ensure a proper and thorough clean up.



A summary of the investigations conducted by the Stormwater Maintenance and Operations Division can be found in [Section 11](#).

Stormwater Quality inspectors conducted 652 industrial stormwater runoff inspections, each involving a discussion regarding spill prevention and management with industrial representatives.

Agreements have been put into place between Tulsa and both the Oklahoma Turnpike Authority (OTA) and the Oklahoma Department of Transportation (ODOT) that address spills that occur on OTA or ODOT MS4s within Tulsa.

g. Collection of used motor vehicle fluids and household hazardous waste

Financial support continued for the M.e.t.'s recycling depots, which accept oil, antifreeze (only 2 of the 9 locations collect antifreeze), cooking grease, batteries, and other recyclable materials. All depots are open 24 hours per day (attended approximately 6–8 hours/day), seven days per week and are located in areas which are easily accessible to the public. The amount of material collected at these depots for the reporting period can be found in the following table. These numbers reflect totals from all the recycling depots and a pilot program that collects from nine restaurants/bars located throughout the greater Tulsa metropolitan area.

Material	Amount
Oil	32,137 gals
Antifreeze	1,313 gals
Plastics	236,968 lbs
Aluminum	64,801 lbs
Steel Cans	56,441 lbs
Scrap Metal	83,600 lbs
Glass	498,680 lbs
Batteries	25,026 lbs (automobile) 39,370 lbs (household)
Newspaper	12,240 lbs
Mixed Paper	349,380 lbs
Cooking Grease	2,176 gals
Cardboard (Corrugated)	2,154,047 lbs
Cardboard (Paperboard)	78,880 lbs
E-Waste	233,705 lbs

Additionally, The M.e.t. conducts special collection events and partnerships for special collection events for hard-to-recycle items like tires and electronics. These collection events are also used to distribute educational material to the public regarding locations of the recycling depots and proper pollutant disposal. During these collection events, educational fliers are distributed to the public. Each car received fliers regarding the following topics: locations of the recycling depots, latex paint disposal, and Tulsa's Household Pollutant Facility.

The following is a list of the collection events held in Tulsa in FY25–26:

- 9-18-2025: Fire Extinguisher & Smoke Alarm Event
- 10-4-2025: Tulsa Zoo Collection Event
- 3-21-2026: Big Spring Clean at Tulsa Fairgrounds
- 4-2-2026: Fire Extinguisher and Smoke Alarm Event
- 4-25-2026: Turley Collection Event
- 4-25-2026: LaFortune Park Collection Event
- 6-3-2026: Fire Extinguisher & Smoke Alarm Event

During the reporting period, The M.e.t. Staff answered calls and emails from citizens who asked what to do with their pollutants. Staff educate people in where to take items and how to handle them responsibly. Staff gave out voucher numbers to citizens who live in outlying communities. This voucher number(s) allows

citizens to use the City of Tulsa's Household Pollutant Collection Facility at no charge (if below 45 pounds). The charge is given to the outlying community through a contract arrangement between The M.e.t. and the City of Tulsa.

The City of Tulsa has had a Household Pollutant Collection Facility at 4502 South Galveston Ave since 2016. The facility is open 2 days a week (Wednesdays and Saturdays) from 8:00 am till 4:30 pm. See Part II(A)(6)(d) for a summary of the pollutants collected this year, including motor oil, various vehicle fluids, and most household pollutants. Education material is distributed at this Facility.

At most of the major events and outreach, the "Motor Oil" and the "The Household Pollutant Collection Facility" were distributed. See attachments for specific information.

Currently, The M.e.t. has nine drop-off recycling depots with collection containers for used motor oil, cooking grease and batteries. Two of the nine locations have containers for antifreeze collections. The "Recycling Locations" map flier and the "Tulsa Area Recycling Directory" both provide locations to the recycling centers. These handouts are given during speeches, news interviews, and at booths and events. The website, www.metrecycle.com promotes the Household Pollutant Collection Facility and depots.

h. Floatables

Reducing floatables (litter) is an important aspect of Tulsa's SWMP. Numerous organizations and COT departments maintain a number of programs to remove and prevent litter from various areas of Tulsa, including the storm sewer.

The City of Tulsa, the "Keep Oklahoma Beautiful" organization, and the Metropolitan Environmental Trust (M.e.t.) sponsor many programs that directly or indirectly target litter control. These programs include but are not limited to:



Great Tulsa Cleanup – As mentioned in the public education section, this event has garnered the attention of many citizens and continues to increase in popularity. The Great Tulsa Cleanup targets both the physical and educational aspects of floatables detection and removal.

Earth Month – This program throughout the month of April consisted of activities targeting the protection of resources including the reduction of litter and nonpoint source pollution.

The City of Tulsa educated citizens on the importance of eliminating litter at many special events during this reporting period. Public education aims to educate on the impact of litter by handing out BMPs such as

our Trash Breakdown Brochure, Animal Waste Bags, and Reusable Litter Bags. A full list of public education activities conducted by the City of Tulsa can be found in [Section 9](#), Attachment B.

Tulsa’s exhibit booth at “The Greater Tulsa Home and Garden Show” highlighted the impacts of floatable pollution through outreach materials, engaging citizens on pollution prevention practices such as proper pollutant disposal, provided brochures for the Household Pollution Collection Facility, and recruited Tulsans for the monthly curbside recycling program.

The Curbside Recycling Program continued offering weekly pickups of plastic, glass, paper, bimetals, aluminum, and other recyclables every week. 115,418 Tulsans participated in the collection of 18,008 tons of recyclables for this reporting period. This program is promoted on the city website.

Tulsa, in conjunction with the Tulsa County Conservation District/Blue Thumb historically had a storm sewer inlet placarding program which included the message “No Dumping Save Our Streams Tulsa” or “Dump No Waste, Drains to River” and has a telephone number to report violators. All new storm sewer inlets have a similar message pre-stamped on the hood. Therefore, any placarded inlets will eventually be replaced with stamped inlets, making the placarding program unnecessary. This year, 561 hoods were installed.

Tulsa’s Stormwater Quality group began a litter monitoring program in September of 2017 with the goal of better understanding the litter problem in Tulsa and doing more targeted education. As more data has become collected, it is apparent that much of the litter in Tulsa is caused by or is associated with homeless populations. Tulsa has created several working groups and taskforce to mitigate homelessness and the negative impact to water quality via litter issues as well as bacteria from these encampments.

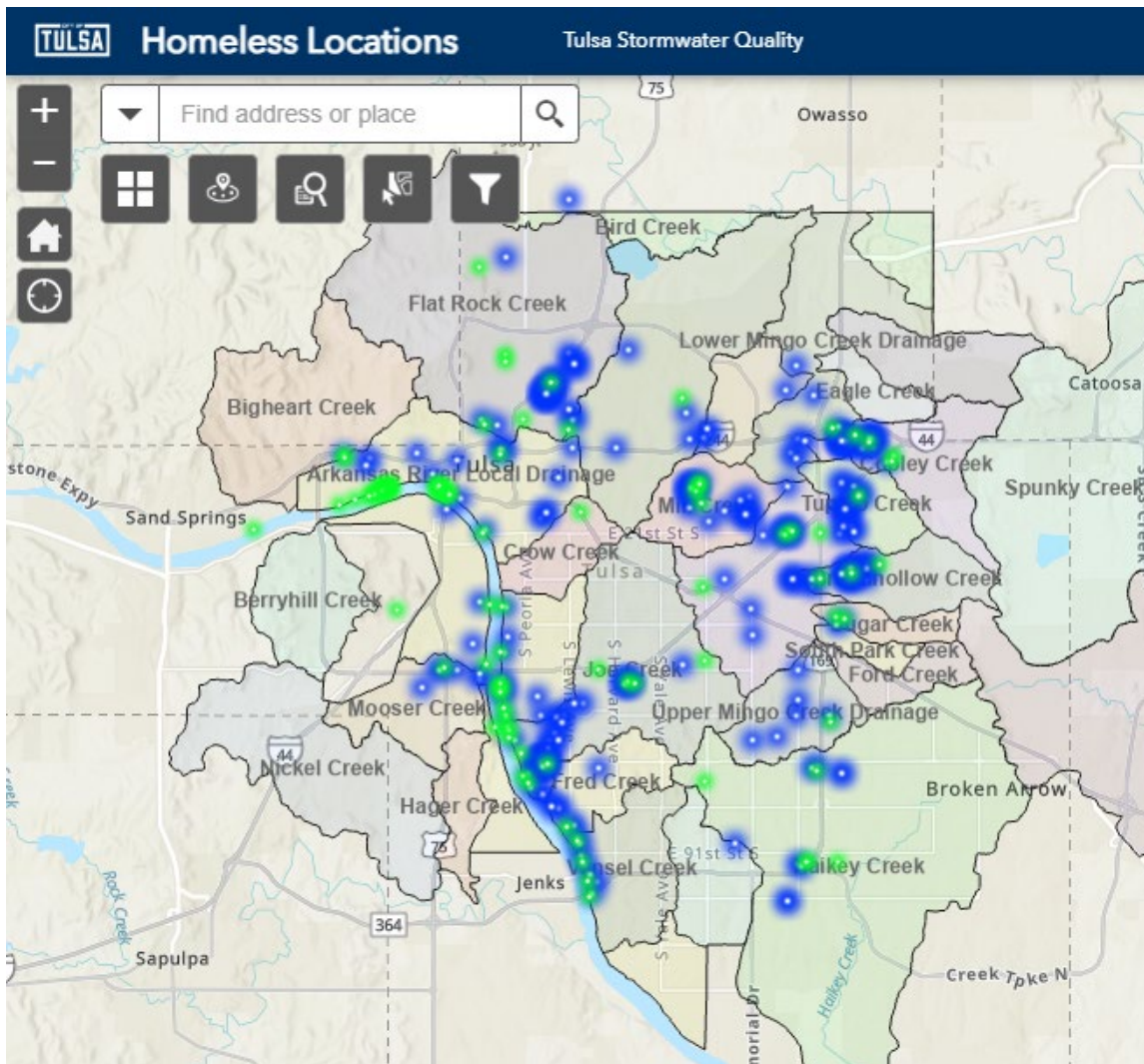
Stormwater Quality has two full-time litter inspectors who coordinate with various departments to ensure floatables are prevented from entering the MS4. The following is a breakdown of litter inspections completed this year. This program will rotate through sections (watersheds) of Tulsa each year with the main goal of the program being to educate property owners on the need to keep litter picked up and prevent it from impacting the MS4. This program now has two litter inspectors. The litter team was able to accomplish the following:

- 1,408 litter inspections
- 262,843 total ft² of litter directed to be cleaned up
- 13 Notice of Violations issued

Litter inspection efforts are partially focused on proximity to stormwater management areas, so these features do not become conductors of litter throughout Tulsa. The intention of this program is to rotate through Tulsa’s watersheds in conjunction with the Watershed Characterization program while also inspecting problematic areas of concern.

A breakdown of the number of hours and amounts of litter associated with homeless camp cleanup, primarily on City of Tulsa Stormwater Maintenance and Operation property is below. Additionally, GIS maps are being utilized to track the locations of these camps. Further analysis will be carried out in future years to determine how resource-intensive the issues with homeless and litter have become and if additional work groups are needed to assist in this area.

FY 25-26	Number	Hours	Total Cubic Yards Cleaned
Homeless Debris Removal	101	4,786	16,248
Homeless Camp Inspections	35	788.5	NA



Two sets of litter BMPs were created and printed, one targeted towards businesses and the other towards citizens. This literature has been passed out due to one-on-one contact with citizens regarding issues, as well as during public events.

The City of Tulsa has anecdotally noticed a continued increase in the amount of litter and illegal dumping issues in Tulsa. Many of these pieces of litter end up in Tulsa's streams as "floatables" potentially causing blockages and creating eyesores for the community's perception of its natural resources. It is these two issues that this litter inspection program aims to abate, though the amount of time and resources currently dedicated to this issue is small compared to the breadth of the problem.

The Metropolitan Environmental Trust (The M.e.t.) continued to operate 8 recycling depots that are conveniently located throughout the metropolitan Tulsa area. Citizens can bring plastics, newspapers, glass, aluminum, batteries, cooking grease and used motor oil for recycling. These depots were also used for the distribution of environmental educational information, including brochures and posters at some locations addressing the reduction of litter. Additionally, the M.e.t. displayed anti-litter posters at the depots and at booths throughout the year. The M.e.t. supplied trash bags and gloves for groups like elementary school environmental clubs, who have picked up litter. In FY 25/26, The M.e.t. staff had about 71 educational booths and gave 66 speeches to school classrooms and scouting groups on trash, recycling, and litter.

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The Parks and Recreation Department emptied approximately 1,000 trash containers (placed at 130 parks 1–2 times per week during March through October and 0–1 times per week during the off-season of November through February). Stormwater detention structures are multiple use facilities, which serve as city parks when not in use for stormwater detention. Additional trash containers were placed in parks to serve special events and scheduled activities. In addition, maintenance crews picked up loose trash from parks a minimum of once per week. Trash containers with hinged lids have replaced opened topped barrels. This has resulted in a reduction of loose trash in the parks where containers were used.

In an effort to control runoff from pet waste, Tulsa parks have a total of 31 pet waste stations. Pet stations provide pet waste disposal bags to properly dispose of pet waste in the trash. The stations are checked and refilled 1–4 times per month depending on usage and weather conditions.

The Stormwater Management Section has crews that removed litter from 10 wet ponds and miles of lined and earthen channels that comprise Tulsa's storm sewer, thus reducing the amount of floatables discharged to waters of the state. During this fiscal year they spent 145.5 hours collecting 22 cubic yards of debris.

Street curb lines within the Inner Dispersal Loop (Downtown Business District) were cleaned on a weekly basis. During this cleaning, crews simultaneously removed debris from the storm sewer intake structures. Pole mounted trashcans were inspected and emptied daily as needed.

The City of Tulsa also has an Adopt a Stream program with 8 adoptees. The creeks that are adopted are: Upper Mill Creek, Fred Creek, Arkansas River, Cherry Creek, Sugar Creek, Coal Creek, Crow Creek, and Vensel Creek. Adoptees must clean at least two times a year to continue to adopt their creek and the groups are recognized through road signage throughout the watershed. These signs also alert citizens which watershed they are in. These signs are aimed at making citizens more aware of Tulsa's streams and the need to keep them clean.

Tulsa's Solid Waste Division accomplished the removal of approximately 1,700 tons of trash through the placement of thirty cubic yard trash dumpsters in neighborhoods in Tulsa, 700 times. Tulsa had 26,022 requests by citizens to pick up bulky waste (appliances, white goods, furniture) of which approximately 494 Freon-bearing items were properly evacuated. In addition, 5,214 lbs of latex paint were picked up with the curbside bulky waste program from 474 requests.

The Solid Waste Program uses the visual observation efforts of various field officers and citizen reports to identify and locate dumpsites throughout the City of Tulsa. The sites are thoroughly searched for evidence to be used for possible enforcement actions. Active sites are monitored using intense visual inspection and when possible, concealed surveillance. After these activities are completed, the sites are cleaned, charted, and monitored for new dump activity. These activities serve to deter the reactivation of dumping in the area and encourage the use of proper disposal methods. As additional enforcement efforts, signage is suggested to be placed in these areas indicating 'No Dumping' and 'Dumpers Will Be Prosecuted'. 31 of the 72 Routine Dump Areas (RDAs) have 60 signs total.

This year, the Solid Waste Division located 1,256 illegal dumpsites and conducted 299 investigations of illegal dumpsites within the city limits. Fourteen citations were issued based on these investigations. 63 signs have been added at routine dump locations in an effort to deter this continued illegal dumping.



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Dumpsite contents were from construction activities, demolitions, green waste, furniture, appliances, tires and other household items. During this fiscal year, they collected 309.3 tons of debris from these dumpsites.



TPD Riverside Division was involved in approximately 212 homeless encampment removal and cleanup efforts. The area the group primarily focuses on is along the Arkansas River from 96th Street to Southwest Blvd. Nationwide populations of unhoused individuals have increased, and Tulsa is seeing a rise in these same populations with various side effects to water quality, including increased amounts of litter and the likely connection to increased fecal material being transported into waterways. A working group has been meeting to address this issue both from a City Mayor administration and Division's working group.

Working in Neighborhoods had 200 homeless encampments reported by Tulsa 311, with 108 confirmed and 34 abated. The total cost of these abatements was \$30,090.

Other programs which clean up litter and trash throughout Tulsa include:

- The Better Way Program picked up 1,054 bags of trash totaling 44.98 tons
- Center of Employment Opportunities program cleaned up 41,010 bags of trash and limb debris from the Right-of-way, as well as removed and trimmed green waste from roadways and sidewalks. This resulted in the removal of 377.85 tons of trash and debris.
- Community service crews removed 106 bags of trash and debris, totaling 22.66 tons

In addition, the City of Tulsa continued to collect and dispose of trash at its five floatable monitoring locations (see [Section 9](#)).

i. Storm sewer system map

The City of Tulsa has a dedicated “Enterprise Asset Viewer” that is routinely updated and includes an extensive catalog of all structural assets, which includes the locations of all outfalls and the names and locations of all receiving watersheds and waterbodies. This viewer is essential in tracking down sources of illicit discharges to the MS4 and is used by many employees every day.

j. OPDES permit holders within the City of Tulsa

Databases are maintained for all OPDES permits for all discharges from construction, industrial activities, and OPDES wastewater discharge permittees within Tulsa. These databases include the name, address, OPDES permit number, contact person, SIC code(s) and other information. During the reporting period, updates were made in the Stormwater Quality database as soon as the information became available. This information is usually obtained through inspections or ODEQ notification.

5. Construction Site Runoff Control

Status: Compliant and ongoing

The City of Tulsa utilizes its Pollution Ordinance (Title 11A, Chapter 5) for the requirement of erosion and sediment controls. Section 505 (Construction Activities) outlines pollution control requirements, BMPs, and mandatory compliance for sites, including the requirement for OKR10 permits for sites greater than or equal to one acre. Section 502 prohibits the disposal of anything other than stormwater into the storm sewer system, including sediment and concrete washout from construction sites. Section 507 requires documentation of the Stormwater Pollution Prevention Plan (SWP3) for sites and any other required documentation related to permits or monitoring.

Through inspections and enforcement actions, Tulsa required construction sites to implement and maintain adequate structural and non-structural BMPs during this reporting period. The use and maintenance of these BMPs to reduce pollutants discharged to the City’s storm sewer from construction sites has been achieved through control measures provided in the Pollution Ordinance, Title 11-A, Chapter 3 (Watershed Development Regulations), Chapter 5 (Pollution Ordinance), Title 35 Infrastructure Development Process (IDP), and building permits.

During this reporting period Tulsa’s Development Services section issued:

- 77 Watershed Development permits, which include Earth Change permits.
- 115 Stormwater Drainage permits
- 885 Stormwater Connection permits
- 80 Floodplain permits
- 11 Floodway permits

These permits require the operator to have adequate erosion control measures in place and maintained prior to, and throughout the duration of the project until final stabilization. Prior to receiving an Earth Change permit, applicants were required to submit an NOI and stormwater pollution prevention plan for all sites disturbing at least one acre. Additionally, 17 Stormwater



Pollution Prevention plans were reviewed to ensure the use and maintenance of structural and nonstructural erosion control BMPs at construction sites.

Inspection and enforcement of control measures to reduce soil erosion at construction sites is shared between several City groups (Stormwater Maintenance and Operations [SMO], Development Services and Engineering Services). SMO conducted a total of 2,677 construction site inspections for compliance with erosion control measures at 693 construction site locations and issued 15 enforcement actions. These actions consisted of issuing a notice of violation that may involve fines and cost recovery. The total amount of fines and penalties collected was \$650.

Development Services conducted 2,225 soil erosion control inspections at various construction sites. Pre-construction erosion control inspections were conducted on all sites, and this resulted in 113 required reinspections. If a site is in violation, the inspector contacts the builder and informs him/her of the actions which must be taken to come into compliance. If voluntary compliance is not achieved, the SMO Division conducts a follow-up inspection to ensure compliance with the Pollution Ordinance. If the site is still non-compliant appropriate enforcement action is taken. Building permits were not issued for construction sites larger than one acre until a stormwater pollution prevention plan was in place.

Engineering Services Division conducted daily inspections on city and privately funded Infrastructure Development Process (IDP) projects. Implementation and continued compliance with the Pollution Ordinance were enforced. Appropriate structural and nonstructural erosion control measures were inspected during these site inspections. If the existing erosion control methods were inadequate, additional structural or nonstructural BMPs were required. Engineering Services has the authority to revoke Watershed Development Permits as a result of failure to implement and maintain adequate erosion control measures. Permits can be revoked if violations continue. Violations were reported to the contractors at weekly progress meetings during the reporting period, resulting in corrective action leading to compliance.



Building permit applicants of all private developments were notified of their responsibility under the OPDES permitting program during the building permit application review process and during any pre-submittal meetings. Through the infrastructure development process (IDP), proposed developments were reviewed, and applicants were notified of the OPDES erosion and sediment control requirements prior to issuing IDP project permits. The City of Tulsa offers pre-development meetings to those considering a new development within the city. These meetings are site-specific and provide guidance on all requirements. Included in the discussion are the requirements for erosion control throughout the construction period and the permanent requirements to prevent stormwater pollution. In addition, the City explains stormwater pollution requirements when conducting presentations or training to the development and building communities.

Developers and design engineers were provided with the "OPDES General Permit for Stormwater Discharges from Construction Activities (OKR10)" information. Anyone obtaining an OPDES General Permit for Stormwater Discharges from Construction Activities (OKR10) submitted

a stormwater pollution prevention plan along with an NOI, for review and approval prior to receiving an Earth Change permit. A stormwater pollution prevention plan checklist was utilized during the review process.

6. Post-Construction Management in New Development and Redevelopment

Status: Compliant and ongoing

Post-construction management requirements were met through the continued implementation of approved City of Tulsa Stormwater Master Drainage Plan, Tulsa Stormwater Management Criteria Manual and ordinances (Title 11-A, Chapter 3, Watershed Development Regulations; Title 11-A, Chapter 5, Pollution; Title 42, Chapter 11, Planned Unit Development) that relate to any new development and significant re-development that occurs in Tulsa. These documents were created in order to reduce flooding due to new developments and significant re-development. A secondary benefit is to reduce the impact on water quality as a result of construction. The City of Tulsa also follows a city-wide Comprehensive Plan (PlaniTulsa). This plan addresses all facets of activities within the city including water quality and was most recently updated in 2016 with guidance from many groups, including Stormwater Quality and the Stormwater Design Section.

The City of Tulsa has developed Master Drainage Plans (MDPs) for 31 watersheds that cover the entire city. The MDPs are used as planning tools to determine/regulate fully developed floodplains that extend beyond the typical FEMA floodplain. The plans are also used as planning tools to develop capital improvement projects that will mitigate flooding and erosion problems in the basins. They identify and provide solutions to storm water drainage, maintenance and management issues. The City of Tulsa adopted new Master Drainage Plans for Cooley Creek, Vensel Creek, Crow Creek, Travis Creek, Swan Creek, and Perryman Ditch during the reporting period. Tulsa is currently updating MDPs for portions of Haikey Creek, Elm Creek, Mooser Creek, South Tulsa, and the Northwest Drainage Basin. Recommended capital improvement projects are added to the project inventory and prioritized based on benefits and costs. Master Drainage Plan updates are prioritized based on age of current study, basin urbanization and development, citizen concerns, repetitive loss areas and flooding events. Master Drainage Plans are updated as funds become available.

Tulsa continued to implement the “Tulsa Stormwater Criteria Manual”. This manual, created and adopted in 1994, is a comprehensive manual designed to assist engineers, designers and construction operators in aspects of storm water runoff control before, during and after construction activities are completed. This includes both water quality and quantity. The Criteria Manual has several purposes including minimizing water quality degradation by preventing siltation and erosion of the City waterways and preserving environmental quality. This manual is utilized by the City of Tulsa staff, as well as site development engineers during the design and review phases of all new developments and significant redevelopment projects that occur within the City of Tulsa. Tulsa completed an update of this document to reflect more current policies and practices in 2019. The 2019 Criteria Manual was reviewed in 2026, and revisions will be adopted in early 2027.

Additionally, the Watershed Development Regulations (Title 11-A, Ordinance # 16959) lists the current practices regarding regulation of new development and significant redevelopment for the control of storm water runoff.

The City of Tulsa developed and adopted the Low Impact Development Design Manual on January 21, 2026. This Manual has replaced the previous chapter in the Stormwater Criteria Manual on Post-Construction Pollution Prevention. Promotion of low impact development was accomplished by implementation of the following:

- LID was promoted at educational functions, particularly those with key personnel, including engineers and planners
- Continued review of Tulsa’s development regulations to determine if they are LID friendly
- Provide LID information to each developer who schedules a Pre-Development meeting for a proposed project
- Incorporated LID into municipal projects when possible

Anyone planning to develop or redevelop areas of Tulsa must follow a process with the Development Services Division of the City of Tulsa. This process requires developers to follow extensive planning, designing, and review. This ensures the area targeted for development meets all City requirements, including reducing the impact of flooding, impacts on city-owned utilities, traffic needs, etc., after construction is completed.

The City of Tulsa has completed work on a major update of its zoning code. Including a separate rewrite of the Landscaping Chapter which was completed between March of 2017 and December 2018. A Stormwater Quality representative was involved in the working group and draft updates to ensure Low Impact Development (LID) impediments are removed and LID is incentivized to the maximum extent practicable.

The Subdivision and Development Regulations has also undergone an update completed in May 2018. This effort was a recommended strategy from the Comprehensive Plan, PlaniTulsa. The guiding principles of this plan include a desire for Tulsa to become a more environmentally and fiscally sustainable city. The City of Tulsa hired a contractor to perform tasks associated with the subdivision regulation update outlined in a Request for Proposals. Stormwater Quality staff have been actively involved in working groups to remove barriers and encourage LID.

The City's Comprehensive Plan had recently undergone a review and was finalized in 2023 with input from Stormwater Quality. This document provides direction and goals for various elements of Tulsa's growth and development. Language was added that promoted the recreational use of waterways, maintaining high water quality, LID, and adding increased enforcement efforts to developments and erosion control.

7. Pollution Prevention/Good Housekeeping for MS4 Operations

Status: Compliant and ongoing

a. General provisions

i. Inventory of MS4 operations

The Stormwater Quality group maintains a inventory of all MS4 operations, which includes, but is not limited to, maintenance and storage yards, fueling depots, waste transfer stations, fleet or maintenance shops, salt/sand storage locations. This inventory is updated at least once annually. Currently, there are 29 municipal facilities that are inspected.

ii. Municipal industrial facilities permitted under OPDES

Along with the MS4 operations inventory, a list of industrial facilities owned or operated by the City of Tulsa that are subject to OKR05 or individual OPDES/NPDES permits is maintained and updated at least once annually. The inventory contains each facilities permit number. Currently, there is 1 OKR05 facility that is inspected. Updates are made when any new facilities become permitted.

iii. Pollution control measures

The City of Tulsa implements and enforces procedures designed to control, reduce, or eliminate pollutant runoff from municipal operations. Staff is required to apply appropriate BMPs during routine maintenance activities, waterline breaks, and emergency repairs. Sediment and erosion control measures are used as needed to prevent sediment from discharging to the MS4. The Stormwater Quality group receives a daily waterline break report and investigates line breaks greater than or equal to 6" in size for sediment discharge. If sediment is not cleaned up and/or stabilized onsite within 7 days, follow up with the responsible group is taken until corrective action is taken.

Measures are also in place to ensure that vehicle wash waters are not discharged offsite from municipal operations. Staff are required to use designated wash facilities or other approved methods that contain and properly manage wash water and do not result in any Pollution Ordinance violations.

b. Structural and non-structural controls and stormwater collection system operation

The City of Tulsa's SWMP provides for the maintenance of both above and below ground structural stormwater controls including detention ponds, inlets, conduits, and channels. The primary purpose of this program is to ensure proper operation of these structural controls for better control of stormwater quantity. Additionally, stormwater quality benefited from the removal of sediment, floatables, and regular inspections of all structures. The following table is an inventory of the work performed on these structures during this reporting period.

Maintenance of Above Ground Stormwater Structural Controls

Above Ground Structure(s)	Inventory (for Reporting Period)	Operations & Maintenance (O&M) activity	O&M Activity (Completed Each Reporting Period)
Channels/ Streams/ Detention Ponds	1,704.7 acres	Mowing	14x/year of mowable property (totaling 22,960 acres/year)
Channels & Streams/ Detention Ponds (Conger Contractor TAC 295)	2,336 acres	Weed control (Herbicide)	All parcels 1x/year for broad leaf weed control (totaling 2,336 acres)
Maintenance Trails (Conger Contractor TAC 295)	27.8 miles	Weed control (Herbicide)	All trails 7x/year for all vegetation control (totaling 166.8 miles)
Channels & Streams (Conger Contractor TAC 100)	408 acres	Weed Control (Herbicide)	All parcels 7x/year for growth control (totaling 3,264 acres)
Channels & Streams (Inhouse)	348 acres	Weed Control (Herbicide)	All parcels 4x/year for growth control (totaling 1,392 acres)
Wet Ponds	67 acres	Algae Control	All ponds 4x/year for growth control (totaling 268 acres)
Channels/ Streams/ Detention Ponds	1,640 acres	Cleaning/ Sediment Removal (Ponds/Streams)	132,662 cubic yards/period
Roadside Ditches	978 miles	Sediment Removal (Roadside Ditching)	11,558 linear feet/period

Maintenance of Below Ground Stormwater Structural Controls

BELOW GROUND STRUCTURE(S)	INVENTORY (FOR REPORTING PERIOD)	OPERATIONS & MAINTENANCE (O&M) ACTIVITY	O&M ACTIVITY (COMPLETED EACH REPORTING PERIOD)
Storm Sewer Pipe (all pipe - driveway pipe, crossover pipe, etc.)	1,273 miles	Inspect Flush/clean Repair or Replace	16 miles/period 11 miles/period 1,005 linear feet units/period
Catch Basin/Inlets	26,360 units	Inspect & Clean Repair	7781 units/period 111 units/period
Pump Station	14 units	Clean interior, Inspect, & Maintain	482 maintenance activities

Additionally, prior to the mowing of all stormwater control structures, all trash was collected and disposed of properly. Detention ponds that are multi-use had trash cans for disposal of litter. These cans were emptied on a regular basis.

Compliance shall be based on completion of the O&M ACTIVITY column found in the charts.

c. Roadways

This requirement was met through the City's street sweeping and mowing activities performed and managed by the Public Works Department.

Through the utilization of private contractors, Public Works Department contractors swept arterial streets 12 times per year. Emphasis was placed on sweeping after deicing material was no longer required as a result of a snow or ice event. Residential streets were swept 4 times. The program's progress is measured in curb miles swept and yds³ of material removed. Arterial and residential mileage per year may vary due to weather variations as well as contractor issues from one year to the next. BMPs that prevent run-off from deicing material are in place at Tulsa's east and west maintenance yards. All of Tulsa's truck washing facilities drain to the sanitary sewer, thus avoiding potential contamination in the storm sewer.

Street sweeping statistics for the reporting period are in the table below:

Type	Sweeping Requirement	Sweeping completed	O & M Activity (for reporting period)	Material Removed
Arterial	~8x annually	12x annually	8,621.4 miles	4,242 yds ³
Residential	~4x annually	4x annually	11,544.8 miles	22,414 yds ³

When possible, deicing materials are stored in covered storage facilities. Records of storage volumes of deicing/sanding materials are updated at least two (2) times per year and after each heavy snow/ice event

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where materials are used. Within 14 days of application, area records are updated for volumes used and locations where applied.

The biannual deicing inventory and applications records are summarized in the tables below:

Deicing Material	Date	Amount/Volume
Brine	11/30/2025	40,000 gallons
Salt Granules	11/30/2025	8,000 tons
Brine	12/2/2025	40,000 gallons
Brine	12/5/2025	40,000 gallons
Brine	1/22/2026	40,000 gallons
Brine	1/30/2026	40,000 gallons
Salt granules	1/30/2026	4292.28 tons

Date(s)	Material	Amount/Volume	Application Area
12/1/2025	Brine	13050 gallons	Arterial streets
12/1/2025	Salt granules	1 ton	Arterial streets
12/4/2025	Brine	6950 gallons	Arterial streets
1/21/2026	Brine	7984.8 gallons	Arterial streets
1/23 to 1/29/2026	Brine	23660 gallons	Arterial streets
1/23 to 1/29/2026	Salt granules	3706.72 tons	Arterial streets



Collected by	Amount Collected	
Inmate work crews	2,518 bags	245 tons

Due to a change in the contractor for the City landfill, it is no longer possible to differentiate the litter collected by different crews used by Security in their various litter programs. The above information

represents all the tons of material disposed of through their programs throughout the year, as opposed to the past, when the metrics reported were more specific to that work group.

The Tulsa Stadium Improvement District (TSID) is responsible for various litter cleaning activities in the Central Business District of the downtown area of Tulsa. This area consists of 1.4 square miles containing 58.37 curb miles. TSID cleaning services, such as sidewalk cleaning and storm sewer intake structure cleaning, resulted in approximately 374,670 pounds of trash and debris collected this year.

Central Business District

Type of Activity	Interval
Sidewalk cleaning	2x/week
Storm sewer intake structure cleaning	2x/week*
134 trash cans (inspect/clean)	6x/week
12 Pet Waste Stations (refilled)	2x/week

Stormwater Quality continued to warn citizens and companies not to sweep or blow grass/leaves/debris into the street or storm sewer as it is a violation of Tulsa's ordinances and could result in a fine. In addition, literature was distributed titled "Landscaping BMP". This literature is given to anyone believed to be disposing of leaves and grass into the MS4 (Municipal Separate Storm Sewer System). It directs the alleged disposer against further disposal of this material into the MS4.

Permit compliance was achieved with the completion of the specified street sweeping and litter removal.

d. Flood control projects

To address this program requirement, the City of Tulsa has continued to implement the following activities:

- Flood Management Project Design Review
- Utilization of the NPDES Permit Evaluation Study – Water Quality Enhancement Assessment of Existing Flood Control Detention Facilities, September 15, 1998.

A discussion of the procedures for each activity is presented below.

Flood Management Project Design Review

To ensure that proposed flood control projects assess the impacts on the water quality of receiving water bodies, the City has and will perform a project design review for all current and future major flood control projects. The project design review utilizes criteria derived from design considerations included in the Stormwater Design Criteria Manual.

By definition, the purpose of a flood control project is to reduce flood damage. Flood control and water quality management strategies differ greatly. Flood control projects are designed to manage stormwater runoff resulting from large, infrequent storm events. Normally, these projects are designed to quickly convey runoff resulting from up to a 100-year storm event. Conversely, water quality management facilities are designed to handle runoff from much smaller, more frequent storm events (1-2 year storm event). In a given year, 70-90 percent of all runoff (and generally the associated pollutants) typically result from storm events producing less than 2 inches of rainfall. Water quality management facilities attempt to slow stormwater runoff, maximizing hydraulic detention periods to facilitate sedimentation and biological uptake. Therefore, this program element does not attempt to provide comprehensive water quality management utilizing "flood control" structures. The goal is to assure that project impacts to receiving waters are assessed and minimized through the use of sound engineering design principles. Where possible, water quality treatment principles will be incorporated into the design of flood control projects.

Sections 700 and 900 of the City of Tulsa Stormwater Design Criteria Manual document minimum design criteria. These criteria address the following design considerations:

- Channel Design
 - Maximum velocity
 - Channel geometry, side slopes
 - Channel material/stabilization
 - Side slope vegetation
- Detention Structure Design
 - Storage volume to maximize residence time
 - Outflow structure design to slowly release detained flows without causing flooding
 - Energy dissipators to slow velocity
- Location
 - Downstream effects
 - Existing receiving water quality
 - Maintainability
 - Proximity in the watershed with respect to impervious area

Existing Flood Control Structure Evaluation – NPDES Permit Evaluation Study

In September 1998, Tulsa evaluated the feasibility of retrofitting 19 existing flood control structures to provide additional pollutant removal. This study recommended using upper watershed Best Management Practices (BMPs) or control of pollutants at the source, rather than retrofitting existing flood control structures. This is currently addressed through the implementation of a number of stormwater management programs. This includes street sweeping, construction site erosion control and public education. These programs will continue to be utilized.

The City of Tulsa has guidelines for development in the upper third of drainage basins to have detention. These detention ponds help slow the rate of stormwater runoff as well as improve the quality of runoff by allowing pollutants to settle out.

Aquatic restoration efforts have been undertaken on Joe Creek in Tulsa. These efforts included bank stabilization, flow diversion, and canopy restoration. The U.S. Army Corps of Engineers partnered with the City of Tulsa to successfully complete this project. Currently, research is being conducted on the feasibility of doing a similar project on another stream. These projects improve water quality by lessening the potential for erosion and improving riparian habitat.

Compliance will be based upon the assessment of the impact(s) to receiving water quality during the design phase of flood control projects. Where possible, water quality treatment principles will be incorporated into the design of these projects.

e. Petroleum products and chemicals

During the reporting period, the City continued to implement and maintain procedures for the proper use, storage, and disposal of petroleum and nonpetroleum products at all municipal offices, police and fire stations, pools, parking garages, and other permittee-owned or operated buildings or utilities. Spill prevention and response is at the forefront of all building maintenance groups. Stormwater Quality staff formally inspects City facilities at least once per year, supplemented by informal observations made throughout the year as staff visits sites in the course of their regular duties.

f. PFAS management

The Tulsa Fire Department (TFD) no longer uses Class B foams, such as aqueous film-forming foam (AFFF), to fight most fires. This change is due to the presence of PFAS, also known as forever chemicals, found in Class B foams and the environmental and health risks associated with these hazardous chemicals. However, for rare circumstances, such as large petroleum-based and polar solvent fires, Class B foams are used. The City of Tulsa HAZMAT Response Team are the only members that carry Class B foam (in small amounts) and a foam eductor. Members of the HAZMAT team are trained to dike, dam, divert & retain any discharges before deploying foam. Other fire apparatuses can use on-board foam educators to deliver finished foam as well (foam concentrate may be delivered on site by HAZMAT, TFD personnel, or TFD Supply). All Class B foam has been retracted from all apparatuses other than eductors. The Tulsa Fire Department is currently in the process of updating their policies and procedures to ensure compliance with the City's MS4 permit requirements regarding Class B foam. This policy will be reviewed and updated as necessary.

The Stormwater Management and Operations Division works closely with TFD, responding to potential releases (with special attention to Class B foam) to the MS4 when necessary. Additionally, if pollutants enter or have the potential to enter the MS4, the Stormwater Management Section will continue to monitor the portion of the MS4 and/or receiving stream to ensure no additional pollutant releases occur.

g. Pesticide, herbicide, and fertilizer application

The City of Tulsa's Street Maintenance, Stormwater Management, and Parks Department applied pesticides, herbicides, and fertilizers during this reporting period. The City of Tulsa requires all personnel, as well as all contract applicators that apply pesticide and herbicides, to be licensed and subject to all the regulations under the Oklahoma Pesticide Applicators Law, including re-certification.

Oklahoma Vegetation Management Association (OKVMA) and Oklahoma Turfgrass Research Foundation (OTRF) conferences were held during this reporting period on proper application and disposal for pesticides, fertilizers, and herbicides for personnel:

- October 1, 2, 2025 – OKVMA
- November 19, 20, 2025 – OTRF

With the issuance of the Oklahoma Department of Agriculture Food and Forestry's Pesticide General Permit in October 2011, which was renewed in 2026, the City of Tulsa was required to formulate a Pesticide Discharge Management Plan (PDMP) as per the "Weed and Algae Control" category. The primary purpose of the PDMP is to protect water quality from abuse and misuse of pesticides. The City of Tulsa is compliant with all requirements of the PDMP and will continue to remain vigilant in their protection of waterways from pesticide misuse.

h. Contractor maintenance

As previously mentioned in employee education, contractors performing work for the City of Tulsa were made aware of the SWMP, Pollution Ordinance (Title 11A, Chapter 5), and the MS4 Permit requirements through contract language and obligations, preconstruction meetings, and direct communication as necessary to prevent contamination of the waters of the State. As contracts come up for renewal, addendums will continue to be added that require the contractor to review and acknowledge they fully understand the SWMP, MS4 permit, and local, state, and federal regulations.

i. BMP inspection and maintenance

Stormwater Quality staff inspected 28 municipal facilities during the reporting period. If staff find site BMP or other pollution ordinance violation issues, the site representative is contacted immediately. A contact list of each site representative is updated annually during the inspection process. Follow-up inspections are performed until the issues are resolved. OKR05 facilities are inspected quarterly to ensure no pollutants

are discharged from the property and into the MS4 and SWP3s documents and other OKR05 requirements are maintained as necessary.

8. Monitoring Programs

Status: Compliant and ongoing

a. Dry weather field screening

The dry weather field screening program continued during this reporting period. 87 square miles (55,598 acres) of the Tulsa's storm sewer system during the period of July 1, 2025 to June 30, 2026. Outfalls were screened in the northeast and southwest quadrants of the city, amounting to 49 % of designated DWFS outfalls. Thus, compliance with this section of the permit was achieved by screening >40 % of Tulsa's MS4, in addition to all 40 priority area outfalls identified for this fiscal year. The dry weather field screening program was designed to locate illicit discharges and illegal disposals into Tulsa's storm sewer.

A total of 296 outfalls were screened, of which 177 contained flows during dry weather periods. Once conditions met the criteria for dry weather, the source of the flow was identified, the flow was sampled and tested for pH, temperature, appearance, conductivity, detergents, chlorine, copper, ammonia and fluoride. (See Section 4 for specific data collected during dry weather field screening). If contaminants were identified in concentrations above action levels, then a dry weather flow follow-up investigation was conducted. Dry weather flow follow-up investigations continued until the source of the flow was identified. When the source of the illicit discharge was identified it was eliminated.



b. Watershed characterization program

See [Section 9](#). This section includes information on the analytical, biological, and habitat measurements taken during this year's sampling, as well as follow-up and response information and program details and data.

c. Industrial stormwater runoff monitoring program

During this reporting period, the SWMP required facilities classified as those having Industrial and High-Risk Runoff to conduct self-monitoring of their stormwater runoff. A summary of the number of industries that conduct monitoring under this program are as follows:

I&HRR Facility Categories	# of Facilities Identified	# Conducting Monitoring
Municipal landfills	1	1
Other treatment, storage and disposal facilities of municipal waste (e.g. transfer stations, incinerators, etc.)	6	5
Hazardous waste treatment, storage, disposal and recovery facilities	1	0
Facilities that are subject to EPCRA Title III, Section 313	47	39
Industrial or commercial discharges the permittee determines are contributing a substantial pollutant loading to the MS4	1	1

The difference between the number of facilities identified above and the number conducting analytical monitoring is attributable to facilities with a valid No Exposure Certification (NEC). For these facilities, an NEC is accepted in lieu of analytical monitoring for the duration of the certification period. Letters informing industries of their responsibility to conduct monitoring were sent out at the end of FY 13-14 and FY 22-23. All monitoring results were required to be submitted to Stormwater Maintenance and Operations within 120 days of receiving the letter.

Section 2

BMP Assessments

The following table includes a list of permit measurable goals and SWMP Best Management Practices that assess the progress of each BMP towards achieving the corresponding measurable goal and the appropriateness of the BMP.

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
1. Public Education and Involvement	a. Continue public education program through other agencies and associations, local developers, local businesses and industries, schools, and the public. Include education and training activities focused on: i. implementation and maintenance of BMPs at industrial facilities; ii. public education on the hazards associated with illicit discharges and improper disposal of waste; iii. implementation and maintenance of erosion and sediment controls at construction sites; iv. developer and public awareness of project designs that minimize water quality impacts, including LID strategies; v. proper management and disposal of used oil and toxic materials, including motor vehicle fluids and household hazardous wastes; and vi. proper use, application, and disposal of pesticides, herbicides, and fertilizers by the public and commercial and private applicators and distributors.	At least six (6) public education activities per year. Each activity listed in items i–vi. Distribute educational materials via brochures, utility bill inserts, media spots, etc., to reach 100% of customers each year.	Fulfilled by the Public Education, Industrial High-Risk Runoff, Construction Site Runoff, and Illicit Discharge Detection and Elimination programs	i. During the permit period, 440 industrial facilities were inspected and provided BMPS when appropriate. ii. 65 public education events occurred where the public was education on the hazards associated with illicit discharges and improper disposal of waste. iii. 3,523 construction sites were inspected where the implementation and maintenance of erosion and sediment controls were examined. iv. 46 groups of developers were made aware of project designs that minimize water quality impacts, including LID strategies where appropriate. v. 55 events occurred where proper management and disposal of used oil and toxic materials, including motor vehicle fluids and household hazardous wastes. vi. 61 events occurred where proper use, application, and disposal of pesticides, herbicides, and fertilizers by the public and commercial and private applicators and distributors was made available.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	b. Promote the public reporting of illicit discharges and improper disposal of pollutants by distributing brochures or utility bill inserts and conducting presentations at public events.	At least two (2) activities per year. These activities may be combined with the public education activities in item a. above. Distribute educational materials via brochures, utility bill inserts, media spots, etc., to reach 100% of customers each year.	Fulfilled by Public Education Program	Utility Bill Stuffers sent during August 2025 and January 2026. 52 activities that promoted public reporting of illicit discharges and improper disposal of pollutants.	Sufficient
	c. Continue to publicize a hotline or have a mechanism in place to be used for reporting illicit connections, improper disposal of waste, and water quality impacts due to MS4 pollutant discharges. Maintain a list of calls and reports with the SWMP.	Provide 24-hour-a-day, 365-day-a-year access for the public to report illicit discharges	Fulfilled by Public Education Program and 311 Hotline	163 out of 314 illicit discharge service requests were from public reporting to 311 or the Customer Care Center.	Sufficient
	d. Promote the proper disposal of leaves, grass clippings, and animal waste through utility bill inserts and youth-related educational events.	At least two (2) activities per year. These activities may be combined with the public education activities in item a. above. Distribute educational materials via brochures, utility bill inserts, media spots, etc., to reach 100% of customers each year.	Fulfilled by the Public Education Program	Utility Bill Stuffers sent during August 2025, October 2025, January 2026, and February 2026 promoted proper disposal of pet waste. Utility Bill Stuffers sent during August 2025 and January 2026 promote proper disposal of leaves and grass clippings. 47 public education events were held that included distributing educational materials to attendees	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	e. Continue participation in public events to target litter reduction using information brochures and displays.	At least two (2) activities per year. These activities may be combined with the public education activities in item a. above.	Fulfilled by the Public Education Program	65 activities public events which targeted litter reduction using brochures and displays.	Sufficient
	f. Promote the proper use, application, and disposal of pesticides, herbicides, and fertilizers through the Master Gardeners Program.	At least two (2) activities per year. These activities may be combined with the public education activities in item a. above.	Fulfilled by the Public Education Program	Utility Bill Stuffers sent during August 2025 and January 2026.	Sufficient
	g. Continue opportunities for public involvement and participation in implementing and updating the SWMP, including compliance with state and local public meeting and notice requirements. Continue to create opportunities for citizens to participate in stormwater-related activities (e.g., stream cleanups, adopt-a-street, storm inlet stenciling/markings).	At least two (2) activities per year. These activities may be combined with the public education activities in item a. above.	Fulfilled by the Public Education Program	The Great Tulsa Cleanup occurs annually during the month of April for public involvement opportunities.	Sufficient
	h. Assess changes in public awareness and behavior resulting from the implementation of surveys, direct evaluations, interviews, or other mechanisms the permittee determines appropriate. Adjust educational materials and delivery of such materials as necessary to address any shortcomings identified as a result of this assessment.	At least one (1) time per year.	Fulfilled by the Public Education Program	Surveys are distributed at the Tulsa Home and Garden Show and The Tulsa State Fair to build an assessment of citizens' knowledge of stormwater.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	i. Continue to create stewardship opportunities and/or partner with existing organizations to encourage residents to participate in activities such as stream teams, storm inlet marking, volunteer monitoring, riparian planting, and other education activities.	At least two (2) public activities per year. These activities shall be in addition to the public education activities in item a. above.	Fulfilled by the Public Education Program	Green Country Watershed Coalition, Sustainability Alliance, Union Public Schools, TSAS, Home Builder's Association	Sufficient
	j. Continue to install embossed storm inlets/hoods with the slogan, "Dump No Waste, Drains to River," as part of operations and maintenance. Tulsa may reduce the number of installations once all storm inlets and hoods are marked.	An average of 200 embossed storm inlets/hoods per year.	Current specifications for cast iron curb inlets have this phrasing embossed.	561 hoods were installed in FY26. At least 12,362 inlets marked total up to FY27.	Sufficient
2. Employee Education	a. Continue mandatory employee stormwater training, including internal policies and procedures for engineers, specialists, inspectors, and contractors.	At least two (2) activities per year.	Fulfilled by Public Education Program	The Stormwater Operator Certification Course is performed a minimum of 1x/year every year. Trainings on campus were performed with the Mayor's Office and Leadership U. Water and Sewer received education on illicit discharges. Pesticide, Herbicide, and Fertilizer Applicators received training on General Permit requirements.	Sufficient
	b. Continue to mail or email educational material to Tulsa's staff and contractor pesticide, herbicide, and fertilizer applicators.	At least one (1) mailing/email per quarter.	Fulfilled by Public Education Program	In progress	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	c. Continue training/education/certification classes for Tulsa's staff and contractor pesticide, herbicide, and fertilizer applicators.	At least two (2) classes per year.	Fulfilled by Stormwater Maintenance and Operations	Applicators attend 3 (three) conferences each year to receive continuing education credits. Pesticide, Herbicide, and Fertilizer Applicators received training on General Permit requirements.	Sufficient
3. Industrial Stormwater Runoff Control	a. Continue the industrial stormwater runoff control program through identifying, inspecting, and controlling pollutants from targeted facilities (see Parts II.A.3. and II.A.8.c.) that IS consistent with the OKROS General Permit for Stormwater Discharges Associated with Industrial Activity within the State of Oklahoma.	Update the list of facilities within 14 days of identifying a new facility.	Fulfilled by Industrial High-Risk Runoff program	When facilities are identified, an account is created for the industry in Stormwater Quality databases within 14 days of identification.	Sufficient
	b. Continue the program to document monitoring, inspection, compliance, and enforcement actions for the targeted facilities.	Inspect at least 20% of facilities per year. Inspect 100% of facilities during the permit term.	Fulfilled by Industrial High-Risk Runoff program	Facilities are inspected at least 20% during the year with the goal being 100% of regulated industries.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
4. Illicit Discharge Detection and Elimination	a. Identify priority areas including, but not limited to, areas with a higher likelihood of illicit connections or discharges and areas with a history of illegal dumping or citizen complaints.	Update the list at least one (1) time per year.	“High-Priority Areas” map	The Stormwater Quality group, using information obtained from inspections, field screening, investigations, homeless encampment locations, combined with information provided by the Water and Sewer Department, developed a “High-Priority Areas” list of the areas with the greatest risk of illicit discharges and connections. These areas are overlaid on the storm sewer atlas to provide a map of the major storm sewer outfalls with the greatest likelihood of containing illicit discharges and connections. The map and locations are reviewed throughout the year and updated as necessary.	Sufficient
	b. Continue investigating reported illicit discharges and eliminating non-authorized non-stormwater discharges.	Investigate 100% of reported illicit discharges within 72 hours of being identified. Eliminate non-authorized non-stormwater discharges within 30 days.	Compliance and Enforcement investigation of reported illicit discharges are performed within 72 hours of being identified. Once sources of non-authorized discharges are identified, they are eliminated within 30 days.	Currently meeting requirements.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	c. Conduct investigations of illegal dump sites to reduce chronic illegal dumping.	Investigate 100% of reported illegal dump sites within 72 hours of being identified. Clean up the sites within 180 days.	Refuse and Recycling program	Currently meeting requirements.	Sufficient
	d. Continue sanitary sewer system inspection, repair, and cleaning program to reduce the likelihood of backups and sanitary sewer overflows.	Inspect at least 20% of the sanitary sewer system per year. Inspect 100% of the sanitary sewer system during the permit term. Initiate repairs or cleaning within 30 days of identifying the need	Sewer Operations and Maintenance program	In progress	Sufficient
	e. Continue to conduct DWFS to identify non-stormwater flows.	Screen all MS4 outfalls in high-priority areas at least one (1) time per year. Screen at least 40% of MS4 outfalls in other areas at least one (1) time per year. Screen all MS4 outfalls at least two (2) times during the permit term.	40 identified “High-Priority Area” outfalls are screen annually	All 40 outfalls were screened during the reporting period.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	f. Spill Prevention and Response. Continue to respond with technical support for the Tulsa Fire Department or other emergency responders on hazardous material spills and incidents that may cause or contribute to stormwater contamination.	Respond with support within 24 hours.	Stormwater Maintenance and Operations has a communication protocol in place with appropriate emergency response personnel to inform Stormwater Quality representatives ASAP. A primary and secondary contractor are both in place for remediation.	During the reporting period, Stormwater Quality personnel responded to spills within 24 hours of notification and utilized an emergency response environmental remediation when necessary.	Sufficient
	g. Develop and maintain a summary of pollution complaints and spill responses.	Update the summary within 7 days of the response.	All pollution complaints and spill responses are logged within databases.	314 service requests related to the investigation of illicit discharges were conducted during the reporting period.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	h. Operate a permanent household pollutant collection facility to properly dispose of used motor vehicle fluids and household hazardous waste that is readily available to the residential sector within the MS4 and to qualifying Tulsa residents or residents from other communities with legal inter-jurisdictional agreements.	Operate the facility at least eight (8) hours per day on at least two (2) weekdays and at least three (3) hours per day on at least one (1) weekend day. Evaluate facility usage and capacity at least one (1) time per year to determine if additional hours/days of operation are warranted; include in annual report.	The facility is currently open 1 weekday and 1 weekend. The facility will be open an extra day by the end of the permit period. Usage and capacity is evaluated on an annual basis.	In progress	Sufficient
	i. Continue support of Tulsa's recycling efforts through curbside recycling and other multi-family recycling collections.	Collect household recyclables from all qualifying residents at least one (1) time every two (2) weeks.	Each City of Tulsa resident has the opportunity to recycle with a 96-gallon blue recycling cart, which has been provided to residents. Recycling pickups occur weekly.	Currently meeting requirements.	Sufficient
	j. Maintain floatable monitoring structures for capture and categorization of floatables at a minimum of five (5) monitoring locations and continue maintenance at a frequency necessary for the removal structures.	Remove floatable materials at least two (2) times per year.	Five floatable monitoring locations are inspected after rainfall events (> 0.1 in.). Floatables are removed if found.	Currently meeting requirements, see Floatable Monitoring Summary in Section 9.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	k. Report all floatable debris removal quantities in cubic yards and include categorization of constituents for the permit year in the annual report.	Update documentation of quantities and categorization within 30 days of removing floatable materials.	Floatable monitoring locations data is logged within a spreadsheet within 30 days.	Currently meeting requirements.	Sufficient
	l. Storm Sewer System Map. Continue updating a storm sewer system map that shows the location of all outfalls and the names of all waters of the state. See also Part III.A.2.b.	Update the map at least one (1) time per year.	“Enterprise Asset Viewer”	The “Enterprise Asset Viewer” is routinely updated and includes an extensive catalog of all structural assets, which includes the locations of all outfalls and the names and locations of all receiving watersheds and waterbodies.	Sufficient
	m. Maintain a list of dischargers with OPDES or NPDES permits/authorizations and occasional incidental non-stormwater discharges to the MS4.	Update the list at least one (1) time per year.	Fulfilled by Industrial High-Risk Runoff program	An industrial database is updated as soon as a permitted facility is identified.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
5. Construction Site Runoff	a. Continue the construction site runoff program through permitting, inspection, and enforcement that is consistent with the OKR10 General Permit for Construction Activities within the State of Oklahoma.	Inspect construction sites that disturb greater than 40 acres, discharge to an ARC, or are within one (1) mile of an impaired/TMDL waterbody, or have been identified as threats to water quality (e.g., sites with recalcitrant or repeat offenders) at least one (1) time per month. Inspect construction sites that disturb greater than or equal to one acre, or are part of a larger common plan of development or sale, at least one (1) time per quarter.	Predevelopment meetings allow for the initial identification of sites. Identified sites that disturb greater than 40 acres are put in Stormwater Quality database and then inspected monthly. A map layer with a one-mile buffer for impaired/TMDL waterbodies has been created. Sites identified to be greater than or equal to one acre or are part of a larger common plant of development or sale are inspected once a quarter.	In progress	Sufficient
	b. Continue the program for site plan review that incorporates consideration of potential water quality impacts, including erosion and sediment control.	Review all site plans within 30 days of submittal.	Development Services department	In progress	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	c. Continue the program to document monitoring, inspections, compliance, and enforcement actions for construction sites.	Complete inspection reports within 14 days of performing inspections. Update an inventory of compliance and enforcement actions at least one (1) time per month.	Fulfilled by Stormwater Quality Construction Runoff program	Inspections are completed during the week of inspection. An inventory of compliance and enforcement actions is updated at least once a month.	Sufficient
6. New Development and Redevelopment	a. Update Stormwater Criteria Manual.	Review at least one (1) time every two (2) years and update as needed.	Stormwater Criteria Manual is reviewed biennially and updated as needed.	Currently meeting requirements.	Sufficient
	b. Review Tulsa's subdivision regulations to identify impediments to Low Impact Development (LID) and propose updates to remove those impediments.	Complete review within 12 months after the effective date of the permit. Complete updates within 18 months after the effective date of the permit.	Low Impact Development Design Manual	The City of Tulsa developed and adopt the Low Impact Development Design Manual on January 21, 2026.	Sufficient
7. Pollution Prevention/ Good Housekeeping for MS4 Operations	a. <i>General Provisions</i>				
	i. Continue to implement, update as necessary, enforce an O&M program with the goal of preventing or reducing pollutant runoff from MS4 operations.	Review O&M program at least one (1) time per year and update SWMP as needed.	O&M are assessed throughout the year with changes made as necessary.	Ongoing	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	ii. Maintain an inventory of all MS4 operations impacted by this program and all industrial facilities owned or operated by the MS4 that discharge to the MS4.	Update the inventory at least one (1) time per year.	A list of all MS4 facilities is updated at least one time per year and all facilities are inspected annually.	Currently meeting requirements	Sufficient
	iii. Implement BMPs, including sediment and erosion controls, during routine maintenance, water line breaks and emergency repairs, and after these activities are completed.	Complete the installation of final stabilization measures within 14 days of project completion. Complete the installation of final stabilization measures within 7 days of project completion for projects that disturb greater than 40 acres, discharge to an ARC or are within one (1) mile of an impaired/TMDL waterbody.	Water and Sewer Stormwater maintenance and Operations work closely together to implement and monitor BMPs to prevent sediment from leaving property. Stormwater Quality responds to daily waterline break reports to investigate for sediment discharge. Follow-up action is taken if sediment is not cleaned within seven days.	Currently meeting requirements.	Sufficient
	b. Structural Controls and Collections System Operations				
	i. Maintain and update a list of active drainage and structural control projects and the status of each project.	Update the project list, including project status, at least one (1) time per year.	Tracking spreadsheet	Currently meeting requirements.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	ii. Continue the maintenance program of both above- and below-ground structural storm water controls, including inspection, repair and clean-up for detention ponds, roadside ditches, storm sewer pipes, catch basins, inlets, culverts, and pump stations.	Update records of maintenance activities at least one (1) time per month.	Database with Work Orders created for all aspects of maintenance program.	Currently meeting requirements.	Sufficient
	<i>c. Roadways</i>				
	i. Continue to evaluate and rate the City's Roadway Sweeping Program, which includes frequency, timing, and efficiency, arterial areas, residential areas, and spot areas as necessary. Street sweeping frequency shall be based on land use, trash, and stormwater pollutant levels generated.	Update street sweeping records, including volume of material removed, at least one (1) time per month. Evaluate and rate the program at least one (1) time per year.	Fulfilled by Public Works Department's Street Maintenance division	Ongoing, currently meeting requirements.	Sufficient
	ii. Continue to use controls for deicing and sanding activities that includes storage facilities, and truck washing facilities.	Update records of storage volumes of deicing/sanding materials at least two (2) times per year and after each heavy snow/ice event where materials are used. Update records of volumes used and locations where applied within 14 days of application.	Fulfilled by Public Works Department's Street Maintenance division	Currently meeting requirements. See Section 1, 7.b. for reporting year information.	Sufficient
	<i>d. Flood Control Projects</i>				

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	i. Review Flood Management Project Designs for compliance with the City's Stormwater Criteria Manual.	Review all project designs compliance with the Manual within 30 days of proposal.	Flood Management Project Design Review NPDES PERMIT EVALUATION STUDY - Water Quality Enhancement Assessment of Existing Flood Control Detention Facilities, September 15, 1998.	Ongoing	Sufficient
	ii. Continue to evaluate the feasibility of retrofitting existing structural flood control devices to provide additional pollutant removal from stormwater.	Conduct an evaluation at least one (1) time per year.	Flood Management Project Design Review NPDES PERMIT EVALUATION STUDY - Water Quality Enhancement Assessment of Existing Flood Control Detention Facilities, September 15, 1998.	Currently meeting requirements – see Section 1, 7.d, for more information.	Sufficient
	<i>e. Petroleum and Non-Petroleum Products</i>				
	i. Continue to implement and revise, as necessary, procedures for proper use, storage, and disposal of both petroleum and non-petroleum products at municipal offices, police and fire stations, pools, parking garages, and other permittee-owned or operated buildings or utilities.	Review and update procedures at least one (1) time per year.	Municipal facilities are inspected by Stormwater Quality staff at least annually.	If any BMP issues are found, corrective actions are taken to resolve the issue.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	ii. Continue to implement and revise, as necessary, Spill Prevention and Response procedures to ensure that appropriate actions will take place when a spill occurs at an MS4 facility. Spill kits shall be maintained and accessible in highly visible locations at appropriate facilities.	Review and update procedures at least one (1) time per year.	Municipal facilities are inspected by Stormwater Quality staff at least annually.	Spill kits are checked annually upon inspection.	Sufficient
	<i>f. PFAS Management</i>				
	i. Implement measures to minimize discharges of PFAS during emergency firefighting activities and post-emergency activities, including clean-up.	Review and update procedures at least one (1) time per year.	Tulsa Fire Department	Procedures are reviewed annually and updated as necessary.	Sufficient
	ii. Establish specific protocols for mm1m1zmg the resuspension, conveyance, and discharge of PFAS, both during normal operations and during all maintenance and remediation activities.	Review and update procedures at least one (1) time per year.	Tulsa Fire Department	Procedures are reviewed annually and updated as necessary.	Sufficient
	<i>g. Pesticides, Herbicides and Fertilizers Application</i>				
	i. Continue to implement and revise, as necessary, a program to reduce discharge of pollutants related to the MS4's storage and application of pesticides, herbicides, and fertilizers.	Review and update procedures at least one (1) time per year.	Education, contract language updates, and enforcement for applicators.	Currently meeting requirements.	Sufficient
	ii. Continue to maintain and update Tulsa's Pesticide General Permit and report this information in the annual report.	Timely (as specified in the permit) apply for permit renewal every five (5) years. Review and summarize permit compliance at least one (1) time per year.	Permit OKG87A015 was renewed during the reporting period.	Permit OKG87A015 was renewed during the reporting period.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	h. <i>Contractor Maintenance</i> i. Contractually require contractors hired to perform maintenance activities on MS4 facilities to comply with all the permittee(s)' stormwater control measures, good housekeeping practices, and facility-specific stormwater management operating procedures.	Review and update contract language at least one (1) time per two (2) years.	Contract language updates.	As contracts come up for renewal, addendums will continue to be added that require the contractor to review and acknowledge they fully understand the SWMP, MS4 permit, and local, state, and federal regulations.	Sufficient
	i. <i>BMP Inspection and Maintenance</i> i. Implement and enforce procedures for inspection and maintenance of structural and non-structural BMPs, including maintenance activities, maintenance schedules, and long-term inspection procedures for controls to reduce floatables and other pollutants discharged to the MS4.	Conduct inspections at least one (1) time per quarter at MS4 facilities subject to OK.ROS or individual OPDES or NPDES permits, or one (1) time per year at other MS4 facilities impacted by the program.	Stormwater Quality Compliance and Enforcement group performs standard industrial inspections at all municipal facilities. OKR05 facility attendants perform quarterly inspections at respective locations.	Currently meeting requirements.	Sufficient
8. Monitoring Programs – Watershed Characterization Program	a. <i>Watershed Characterization</i>				
	i. Submit a monitoring schedule for all sub-basins Program 1. within the system that will result in characterization of all sub-basins within the five-year term of the permit.	Within six months after the effective date of the permit.	The monitoring schedule is in the Watershed Characterization analytical and biological QAPPs.	The monitoring schedules have been reviewed annually for 2 reporting periods.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	ii. Conduct monitoring to characterize storm water discharges in accordance with the above schedule at representative monitoring locations in accordance with approved QAPP.	Review and summarize analytical results at least one (1) time per month.	Thirty monitoring sites have been identified for Watershed Characterization. Monitoring sites meet the criteria identified in OCC's Continuing Planning Process. An EPA compliant analytical QAPP has been developed and submitted to ODEQ. Analytical data is collected once per month on 7-8 watersheds per year for the 5 year permit term.	2 reporting periods of analytical data and associated QA/QC samples have been reviewed monthly.	Sufficient
	iii. Compile analytical data collected from the watershed characterization program during the permit year and summarize results and overall condition of the targeted watersheds. This includes, but is not limited to, stream health, pollutant concentrations, loadings, and potential impacts.	At least one (1) time per year.	Fulfilled by the completion of the Watershed Characterization annual report.	2 reporting periods of Watershed Characterization program have been completed during the reporting period.	Sufficient
	b. Biological Monitoring				
	i. Complete aquatic habitat surveys in accordance with the above schedule at representative locations, including four (4) macroinvertebrate collections and one (1) fish collection for each permit year.	See Part III.A.5. a.	Fulfilled by Watershed Characterization program.	All macroinvertebrate and fish collections and habitat surveys have been completed for the streams in the year 1 and 2 monitoring schedule.	Sufficient

Section 2 – BMP Assessments

Program	BMP Actions	Measurable Goal	BMP(s)	Progress Towards Achieving Measurable Goal	Appropriateness of BMP
	ii. Develop and submit a summary of relevant biological collections and water quality information, if applicable, collected during the permit year.	At least one (1) time per year.	Fulfilled by the completion of section 9.3 Watershed Characterization portion of the City of Tulsa's annual report.	2 reporting periods of the Watershed Characterization program have been completed.	Sufficient
	c. <i>Comprehensive Program Assessment.</i> Based on the results of the watershed characterization program, produce an assessment that includes the findings, impacts identified, responses taken, and any modifications recommended to enhance the usefulness or efficiency of the program.	Complete assessment before the expiration date of the permit. Include in 5 th annual report.	Fulfilled by Watershed Characterization program in the 5 th annual report for the permit.	2 reporting periods of the analytical and biological data collection for the Watershed Characterization program have been completed up to the end of the reporting period.	Sufficient

Section 3

Household Pollutant Collection Facility Usage & Capacity

The City of Tulsa has a Household Pollutant Collection Facility (HPCF) at 4502 South Galveston Ave. The HPCF is open 2 days a week (Wednesdays and Saturdays) from 8:00am till 4:30pm. This facility replaced the biannual collection events and has resulted in an easier and quicker method of pollutant disposal for Tulsans and the surrounding communities. This facility has been well received by the public as evidenced by survey results and social media recognition. Plans to comply with new permit requirements to open the facility additional days are in discussion and ongoing. A third day of operation will be implemented before the end of the permit period.



Summary of Pollutants Collected During FY26	
Total Weight	468,599 lbs
Total Tulsa Customers	4,216
Total M.e.t. Customers	915
Total Customers from outside Tulsa and M.e.t. Communities	52

The following is a breakdown of waste stream collection during the reporting period by category:

Waste Stream	Amount Collected
Toxic Liquids	13,080 lbs
Toxic Solids	8,814 lbs
Aerosols	9,885 lbs
Low-Viscous Flammable Liquids	20,518 lbs
High-Viscous Flammable Liquids	18,307 lbs
Fluorescent Bulbs	3,214 lbs
Bases	7,178 lbs
Acids	4,632 lbs
Oxidizers	1,723 lbs
Flammable Loosepack	14,432 lbs
Oxidizing Pool Chemicals	1,871 lbs

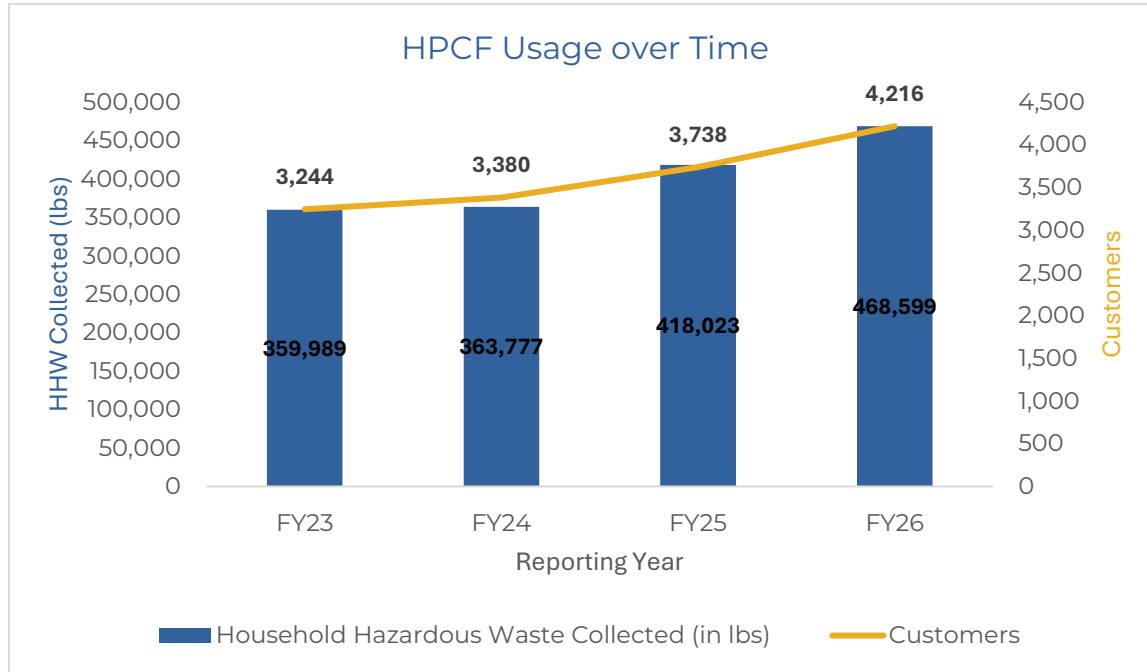
In addition to the above household pollutants, the facility also collected and disposed of:

Items Collected	Amount Collected
Latex Paint	261,247 lbs
Used Oil	3,245 gal
Antifreeze	1,600 gal
Cooking Oil	520 gal
Electronics	10,038 lbs
Batteries	10,425 lbs
Ni-Cad Batteries	573 lbs
Lithium Batteries	716 lbs
Fire Extinguishers	326 lbs
Gas Cylinders	276 lbs
Foaming Aerosols	811 lbs
Mercury Thermostats	24 lbs
Trash-to-Energy	80,909 lbs

The Swap Shop has continued to be popular throughout the year. 2,564 residents visited the Swap Shop during the reporting year, taking 8,965 items totaling 21,917 lbs.

Section 3 – Household Pollutant Collection Facility Usage & Capacity

A working supervisor was added to the facility in late 2024 to provide dedicated oversight to daily operations. 2025 was the first full year for this supervisor role overseeing the facility. The work of the new supervisor has enhanced the facility's efficiency and allowed the previous supervisor responsible for the facility to focus more on their division's specific tasks. The facility set a record with residents served, and the poundage collected was also broken from the previous record. The high poundage collected during the reporting period is a sign that the facility will likely continue to see increased numbers in the future.



Structural improvements were made to the HPCF at the end of FY26 to improve the temperature and safety conditions of the facility. The building was treated with closed-cell spray foam insulation in a manner that allows for an HVAC system to be installed in the future. An implementation timeline of HVAC has yet to be determined. Insulation was observed to reduce summer temperatures by 3-10 degrees Fahrenheit in the facility. Heat-retention observations will be made during the next reporting period. Additionally, a bathroom was installed in the facility so that employees would have a nearby location to wash their hands. The safety shower was updated alongside the bathroom to further improve safety in the facility.

Section 4

Municipal Construction Activity Summary

An engineering status report spreadsheet is kept with information for all municipal construction projects. The following is a summary of FY26 City of Tulsa construction projects.

- There are 92 active City of Tulsa construction projects, with 13 currently covered under an OKR10 General Construction Permit.
- The City of Tulsa started 53 construction projects, including bridge rehab, street reconstruction and rehabilitation, interceptor, sewer rehab, lift station relief line, traffic signal, and other projects.
- There were 15 completed municipal projects, including bridge rehabilitation, street rehab, and waterline replacement projects.
- Of the 15 completed City of Tulsa projects, all achieved final stabilization.
- The Stormwater Quality subdivision of Public Works performed 15 inspections on municipal projects. Other inspections were performed by Field Engineering, however inspections numbers were not able to be acquired.

Section 5

Planned Stormwater Activities

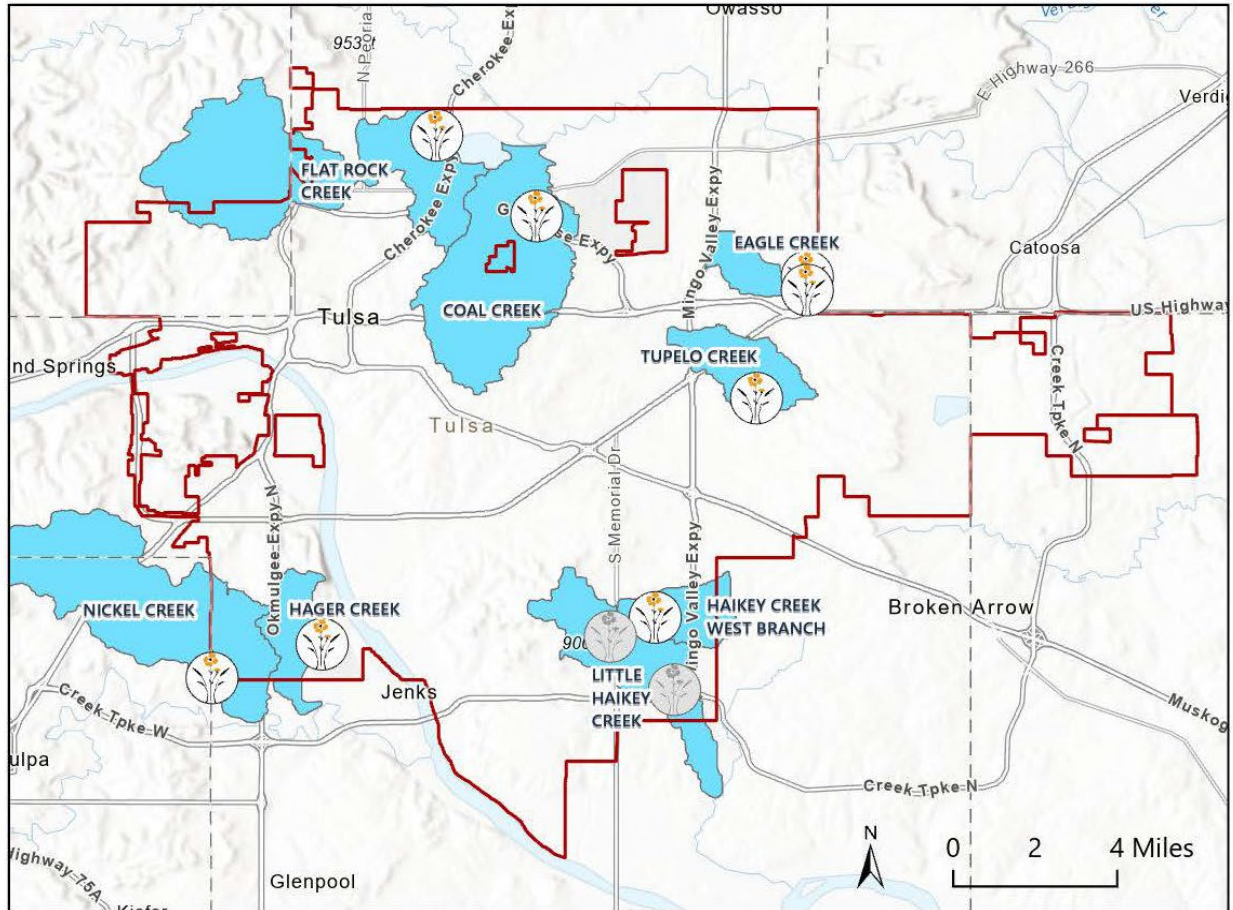
In addition to the City of Tulsa’s ongoing permit-required activities, such as SWMP reviews and updates, field monitoring, construction and industrial inspections, illicit discharge and elimination, and other routine stormwater program activities – the following table represents the current planned stormwater activities and implementation schedule for the next reporting period (July 1, 2026 to June 30, 2027). These activities are subject to change and not an exhaustive list.

Planned Activities	Implementation Schedule
Targeted education efforts in impaired/TMDL watersheds	Ongoing (Q1-Q4)
Tulsa State Fair education booth	October 1 to October 11, 2026
Social media campaigns	Ongoing (Q1-Q4)
University of Tulsa sports games education booth	Q1-Q3
Tulsa Drillers education booth	Q1, Q4
Home and Garden Show education booth	March 4 to March 7, 2027
Great Tulsa Cleanup education event	April 2027
City of Tulsa rain barrel sale	Spring 2027
Watershed Wildflower Meadow implementation (2 in Haikey Creek watershed)	Spring 2027
Various SOP updates	Ongoing (Q1-Q4)
Staff training	Ongoing (Q1-Q4)
Educational material updates and additions	Ongoing (Q1-Q4)
Drone pilot license collections and drone use	Ongoing (Q1-Q4)
QAPP updates	Q2-Q3
Aerial sanitary sewer line inspections for TMDL areas	Q1-Q3
Biological survey poster collaboration with University of Oklahoma	Q2-Q4
Pesticide sampling	Q2-Q4
Wet-weather field screening in response to low biological scores	Ongoing (Q1-Q4)
Drug lab collection training Tulsa Police SID	Q2-Q4

Planned Watershed Wildflower Meadows for FY27



Watershed Wildflower Meadows



Legend

Wildflower Meadow Implementation Status



IMPLEMENTED



PLANNED FY27

Drainage Basins



Tulsa City Limits



Section 6

Proposed Changes to the SWMP

During the previous reporting period, the City of Tulsa conducted a comprehensive review and update of the Stormwater Management Program (SWMP) to ensure continued alignment with requirements of the current MS4 permit (OKS000201). As part of this review, each minimum control measure was examined to determine where refinements or updates were necessary to improve implementation and overall program effectiveness.

Proposed changes were identified in many areas, with the degree of modification varying based on program needs. Some sections required only minor updates, such as clarifying procedures with better verbiage and terminology to match current practices (e.g. the upcoming use of microbial source tracking), or reorganizing content for better readability and correlation to the new permit. Other areas involved more substantive revisions, particularly those that required new solutions to meet permit requirements. All areas were given expanded descriptions of measurable goals.

These updates also strengthen the City's ability to reach permit compliance through interdepartmental coordination by further elaborating on each department's responsibilities regarding stormwater. In turn, this allowed for the identification of opportunities for improved education between City departments and sections. Future modifications will continue to focus on building these connections and integrating new strategies that support ongoing evaluation and improvement for all programs involved.

Collectively, the proposed updates to the SWMP ensure that each program element accurately reflects current operations, supports progress toward water quality measurable goals, and provides a practical framework for maintaining compliance under new and evolving regulations.

As required in Part II(F), the SWMP was evaluated during the current reporting period and the City determined that no major revisions were necessary.

BMPs were also assessed throughout the reporting period (see [Section 2](#)). Current BMPs remain effective in meeting measurable goal requirements, while some are too new to make a definitive assessment.

Section 7

TMDL Implementation Report

The following report provides a description and schedule for implementation of BMPs or monitoring to ensure compliance with applicable Total Maximum Daily Loads (TMDLs), which is defined in the permit as “the sum of the individual wasteload allocations (WLAs) for point sources, margin of safety, reserves, and load allocations for nonpoint sources and natural background. A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet WQS, and an allocation of that amount to the pollutant's sources.”

TMDL Implementation Annual Report 2025-2026

Prepared by: City of Tulsa Public Works

Acronyms

BMP	Best Management Practices
FY	Fiscal Year
GIS	Geographic Information System
LDC	Load Duration Curve
LID	Low Impact Development
IDDE	Illicit Discharge Detection and Elimination
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
ODEQ	Oklahoma Department of Environmental Quality
SOM	Sewer Operations and Maintenance
SSES	Sanitary Sewer Evaluation Study
TMDL	Total Maximum Daily Load

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Introduction

This document fulfills the requirements of annual reporting of progress towards meeting the long-term goals of the City of Tulsa's Total Maximum Daily Load (TMDL) Pollutant Reduction Plan, as required by the City of Tulsa's MS4 permit and the TMDLs approved by the Oklahoma Department of Environmental Quality (ODEQ):

- Arkansas River and Haikey Creek Bacteria TMDLs (2008)
- Lower Bird Creek Watershed Bacteria TMDLs (2011)
- Arkansas River and Verdigris River Area – Bacteria and Turbidity TMDLs (2012)

The purpose is to document actions taken to implement the TMDLs and progress towards improving water quality.

Implementation Activities

1. **Sanitary Sewer Systems.** Tulsa's Sewer Operations and Maintenance endeavors to reduce sanitary sewer overflows into the storm sewer system. Increases were seen in notable areas including a 40% increase in miles of sanitary sewer lines TV inspected, a 31% increase in main line sanitary sewer repairs, and a 7% increase in feet of main line sanitary sewer replaced or rehabilitated. These efforts by SOMs resulted in an 8% decrease in sanitary sewer overflows from FY25 to FY26.

Sanitary sewer system improvements and remediation efforts are underway in the Coal Creek basin to upgrade aging infrastructure and increase system reliability. Activities undertaken in FY26 include:

- Completion of flow monitoring to determine amount of inflow and infiltration.
- Completion of sanitary sewer evaluation study (SSES).
- Finalizing design and obtaining easements for a capacity enhancement project.
- Beginning design of a rehabilitation and replacement project focused on fixing leaks and reducing inflow/infiltration in the system based on the completed flow monitoring and SSES.

2. **On-site Sewage Facilities.** There has been no indication that high bacteria levels have been caused by on-site sewage facilities within Tulsa city limits. Efforts towards bacteria load reduction will be focused elsewhere, but on-site sewage facilities will be revisited in the future if needed.

3. **Illicit Discharge Detection and Elimination.** The IDDE program will continue to detect and eliminate illicit discharges. Priority areas with a higher likelihood of illicit connections or discharges were identified as well as the number of outfalls screened per year increased.

4. **Domestic Animals & Wildlife.** A master list was compiled consisting of facilities such as veterinary clinics, animal hospitals, pet groomers, pet stores, pet adoption centers, doggy daycares, dog parks, dog training businesses, pet boarding businesses, horse stables, etc. that can be used for literature targeted for such facilities or help with investigations.

5. **Public Education.** A new pet waste buck slip was created to target pet owners and pet waste. These buck slips were distributed to Tulsa SPCA and Tulsa Animal Welfare to be given to pet owners when adopting. In addition, a new question regarding pet waste was added to our survey to help assess whether pet owners pick up waste regularly.

Creek cleanups continue to be an important and popular outreach activity. Creek clean ups are an opportunity for the community and residents to get involved helping to clean up physical trash and organic debris that can be sources for bacterial growth.

2026 Creek Cleanups in TMDL Watersheds and Contributing Tributaries	
Arkansas River	30
Coal Creek	5
Haikey Creek	4
Vensel Creek	1
Mooser Creek	6
Joe Creek	16
Mingo Creek	4

Table 1: Number of Creek Clean-ups Completed in TMDL Watersheds and Contributing Tributaries in FY26

6. **Low Impact Development.** Low impact development continues to be promoted as an important strategy for managing bacteria nonpoint sources in urban areas. Pre-development meetings are routinely attended, strongly encouraging use of LID. Furthermore, 478 rain barrels were sold in FY26.

7. **GIS.** Finding ways to implement and integrate GIS in the TMDL program, such as creating an impervious surface map, is being examined to aid in managing urban pollution due to nonpoint sources.

8. **Monitoring.** Monitoring is being used to track water quality data to verify pollutant reduction, allow for data-driven insights to adjust restoration strategies and control measures, as well as track effectiveness of implemented BMPs.

Microbial Source Tracking (MST), performed by The Oklahoma Water Survey at the University of Oklahoma, is a tool to help target the origins of fecal contamination in TMDL waterbodies. The detection frequency is an indication of a persistent problem within the sampling location. All sampling locations contained the presence of avian markers. Coal Creek and Haikey Creek indicated multiple source contamination including human and dog. Bird Creek had elevated human and ruminant contamination while the Arkansas River was primarily elevated for the human marker. The avian marker was not associated with any specific land use category, however, developed land cover and impervious surfaces were strongly associated with human and dog markers, while forested and agricultural lands were linked with the ruminant marker. The Oklahoma Water Survey examined the relationship between rain events and MST markers resulting in a correlation between rain events and an increase in human and ruminant contamination.

Number of <i>E. coli</i> Samples Collected During Recreation Period			
Watersheds	2024	2025	2026 (May – June)
Arkansas River	100	157	24
Bird Creek	34	82	21
Coal Creek	24	28	33
Haikey Creek	11	52	22

Table 2: Number of Recreation Period Bacteria Samples Collected from 2024-2026

MST Marker Detection Frequency				
Marker	Coal Creek	Bird Creek	Arkansas River	Haikey Creek
Avian	100%	100%	100%	100%
Dog	19.0%	25%	19.6%	45.8%
Goose	-	-	50%	-
Human	95.2%	87.5%	87.3%	100%
Ruminant	100%	90%	52.4%	22.2%

Table 3: Microbial Source Tracking Detection Frequency Results in FY26

Watershed Land Use by Site		
Site	Developed	Impervious
Coal Creek 6080	85%	32.4%
Coal Creek 6162	80%	36.9%
Coal Creek PED 039	56%	17.5%
Flat Rock Yahola	62%	24.1%
Fred Creek 9777	99%	41.6%
Haikey Creek 574	96%	41.7%
Haikey Creek 6637	99%	40.0%
Haikey Creek 7035	93%	40.1%
Haikey Creek Co. 146	91%	39.6%
Joe Creek 61 st St	99%	43.1%
Lower Bird Creek	37%	30.4%
Upper Bird Creek	9%	1.7%
Vensel Creek 3355	99%	71.6%
Vensel Creek 5837	94%	28.9%

Table 4: Land Use in TMDL Watersheds

MST Marker Detection Frequency in Wet vs Dry Weather		
Marker	Weather	% Detection
Avian	Dry	100%
	Wet	100%
Dog	Dry	16.2%
	Wet	26.6%
Goose	Dry	80%
	Wet	66.7%
Human	Dry	86.8%
	Wet	88.9%
Ruminant	Dry	53.3%
	Wet	72.2%

Table 5: Microbial Source Tracking Detection Frequency Results in Dry vs Wet Weather in FY26

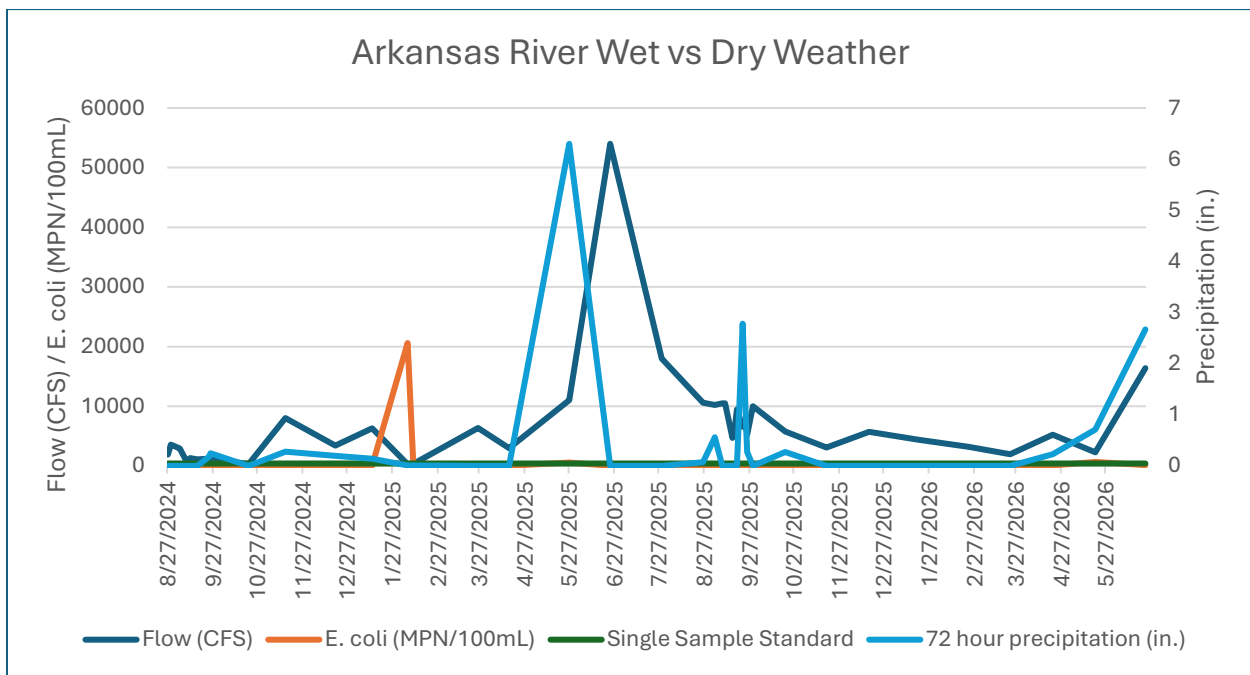


Figure 1: Arkansas River Wet vs Dry Weather Results from 2024-2026

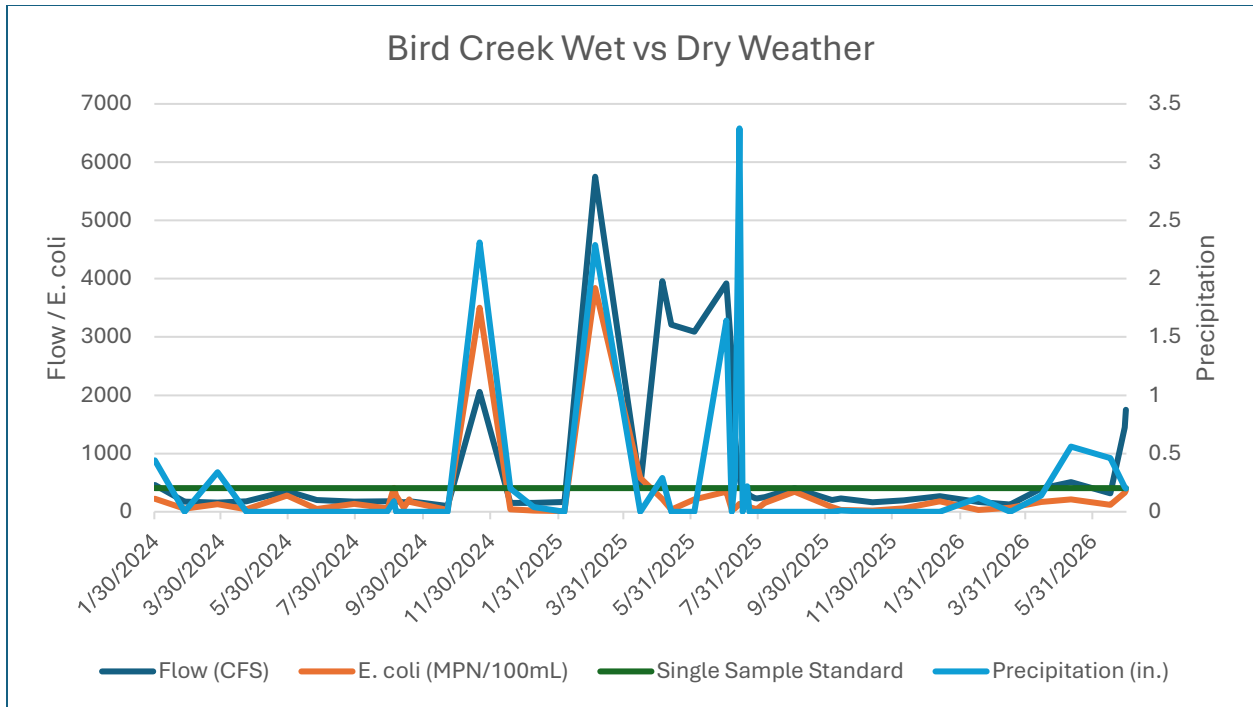


Figure 2: Bird Creek Wet vs Dry Weather Results from 2024-2026

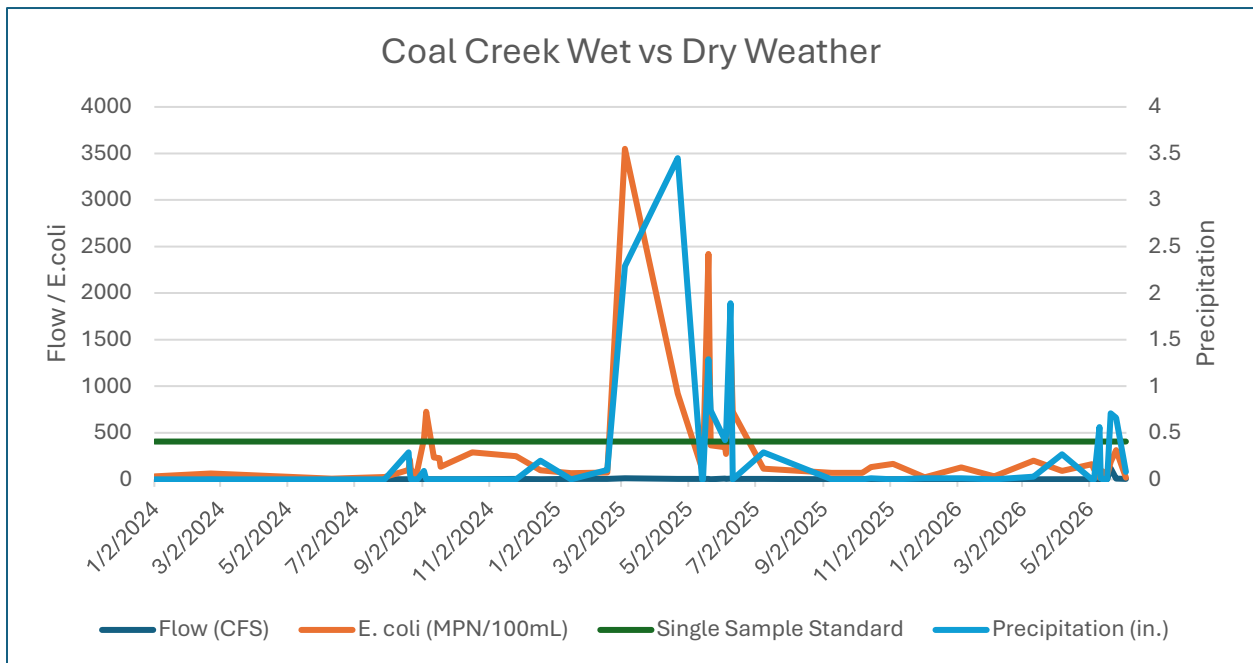


Figure 3: Coal Creek Wet vs Dry Weather Results from 2024-2026

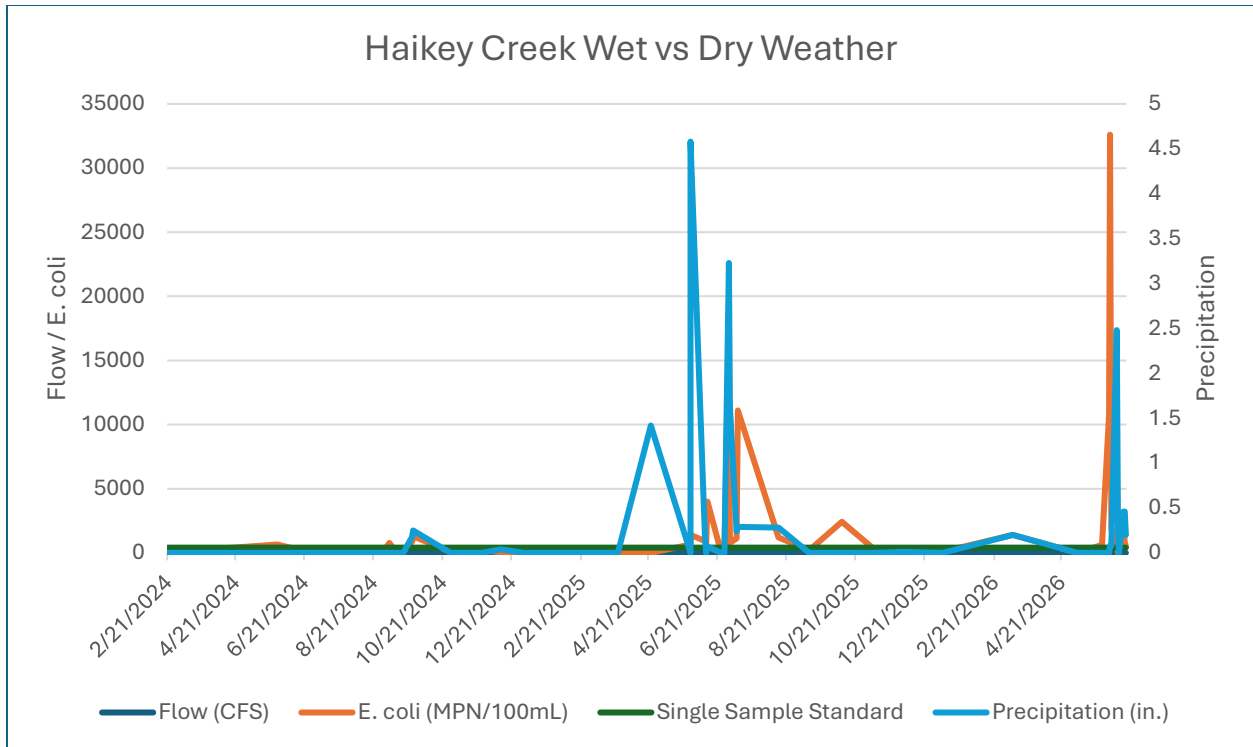


Figure 4: Haikey Creek Wet vs Dry Weather Results from 2024-2026

Load Reduction and Progress Evaluation

Existing load duration curves (LDCs) are used to evaluate existing bacteria loads, water quality standards, and pollutant reductions. Implemented BMPs were evaluated to assess effectiveness.

Stream Segment	Percent Reduction Goal		Average Percent Reduction	
	Instant	Geomean	Instant	Geomean
OK120120010010 (Arkansas River near Bixby)		69.5%		67.1%
OK121300010010 (Lower Bird Creek)	79.1%	44.8%	60.0%	20.0%
OK121300010090 (Coal Creek)	44.8%	58.6%	56.5%	11%
OK120410010210 (Haikey Creek)	84.9%	72.6%	23.6%	2.0%

Table 6: Percent Reduction Goals and Progress Evaluation of TMDL Watersheds

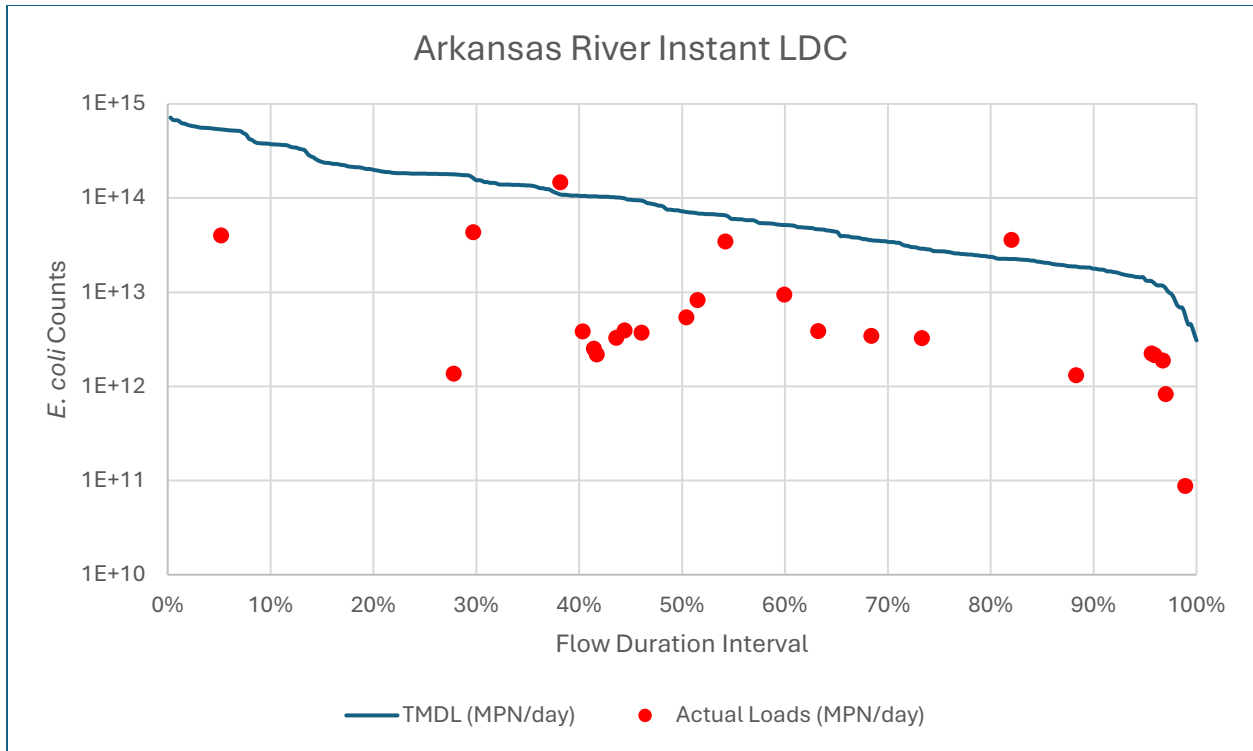


Figure 5: Arkansas River Instant Load Duration Curve

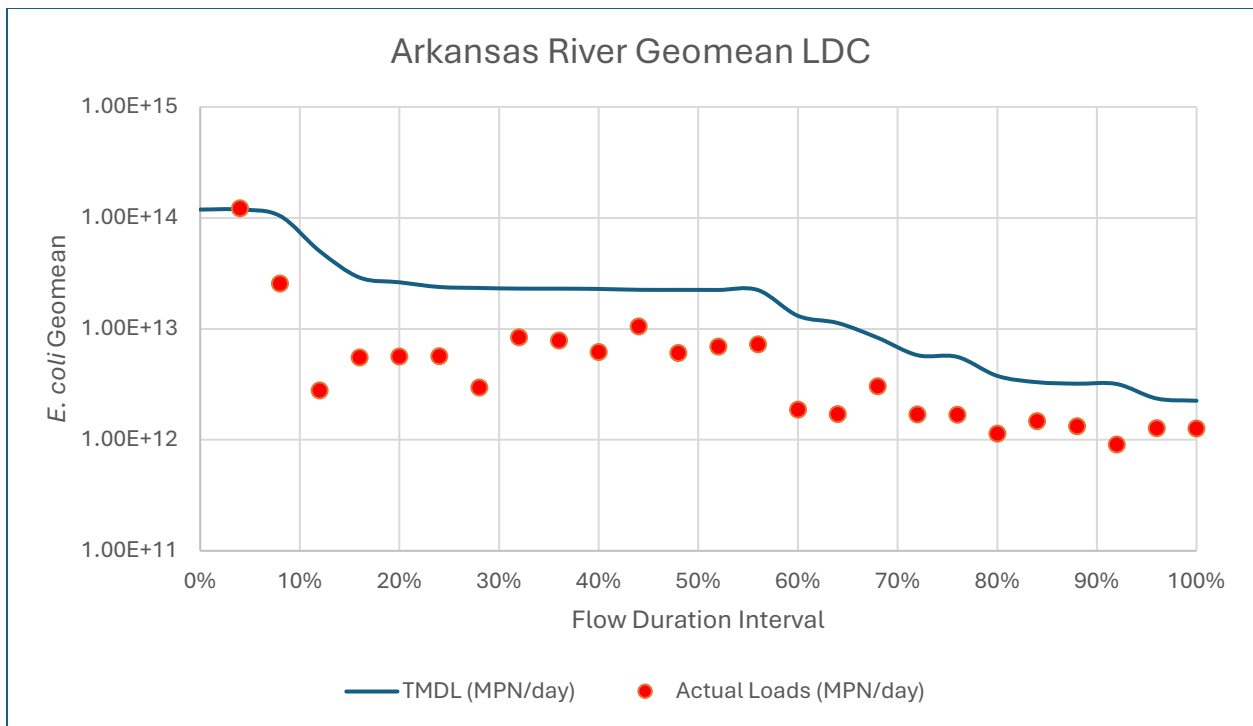


Figure 6: Arkansas River Geomean Load Duration Curve

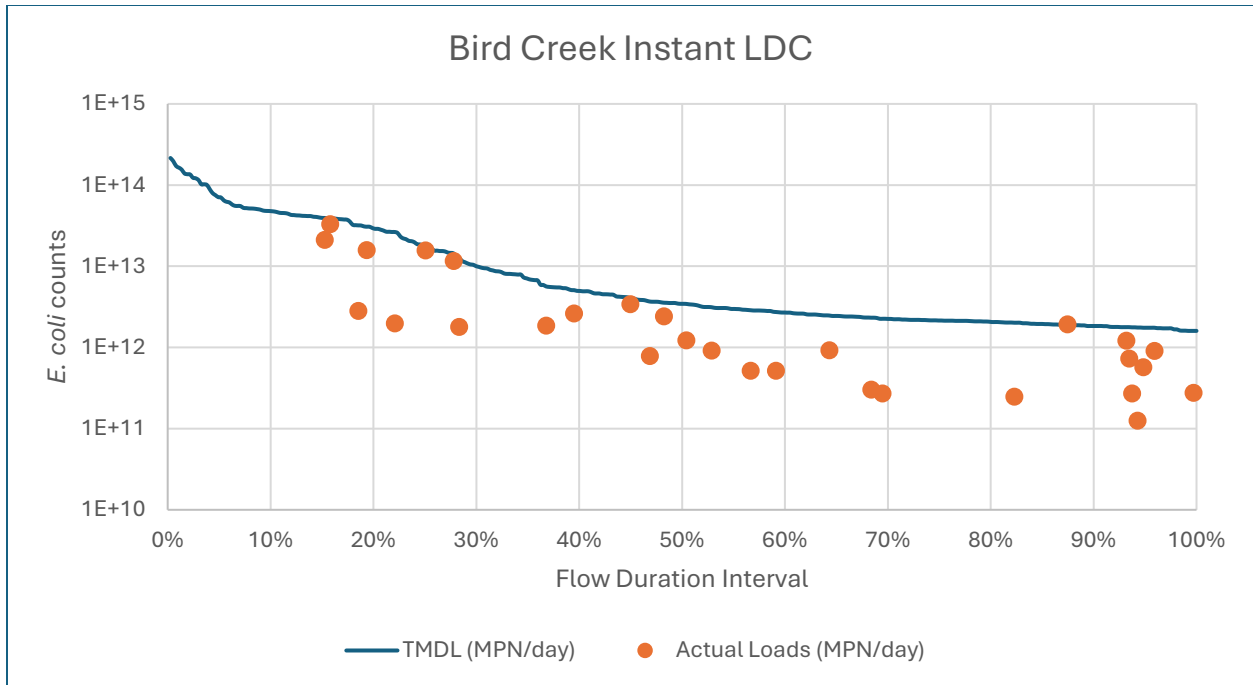


Figure 7: Bird Creek Instant Load Duration Curve

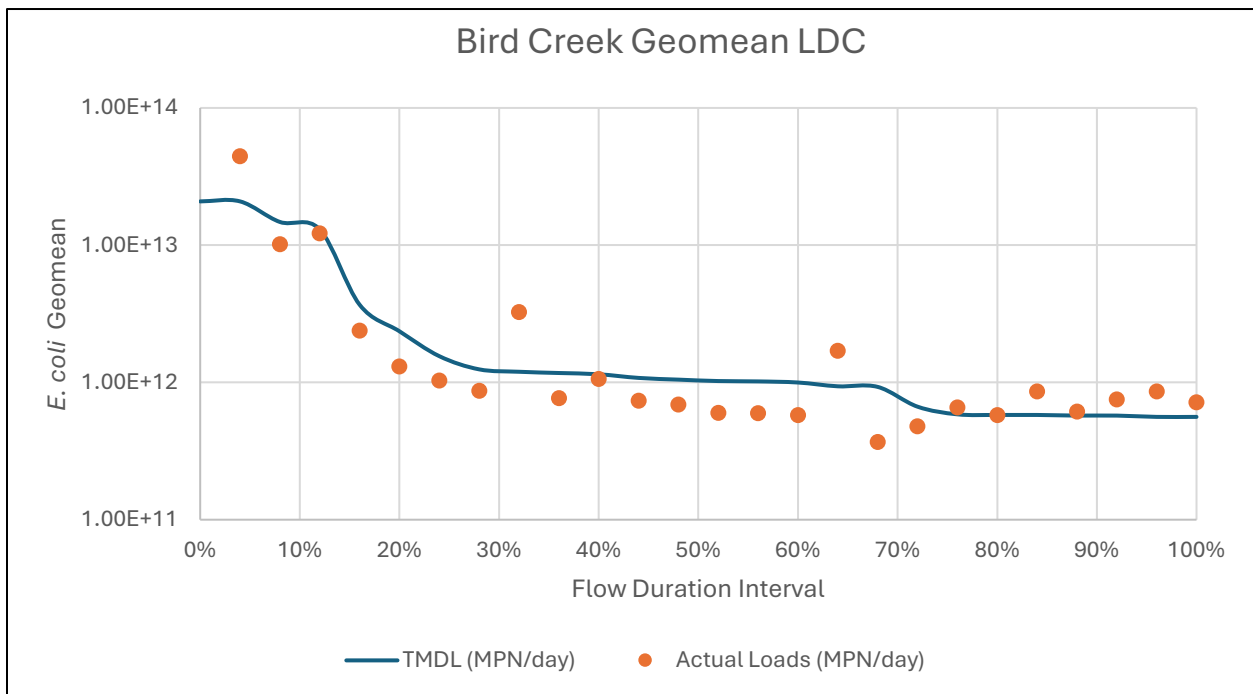


Figure 8: Bird Creek Geomean Load Duration Curve

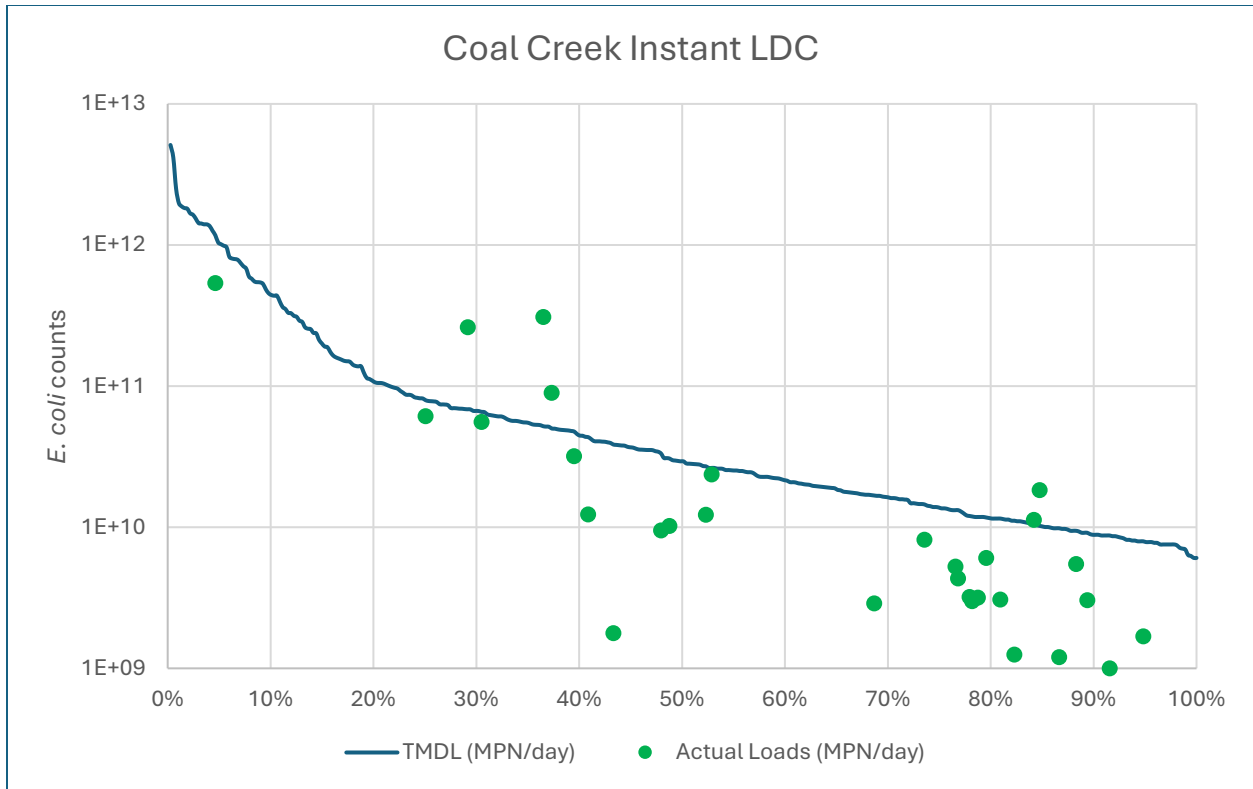


Figure 9: Coal Creek Instant Load Duration Curve

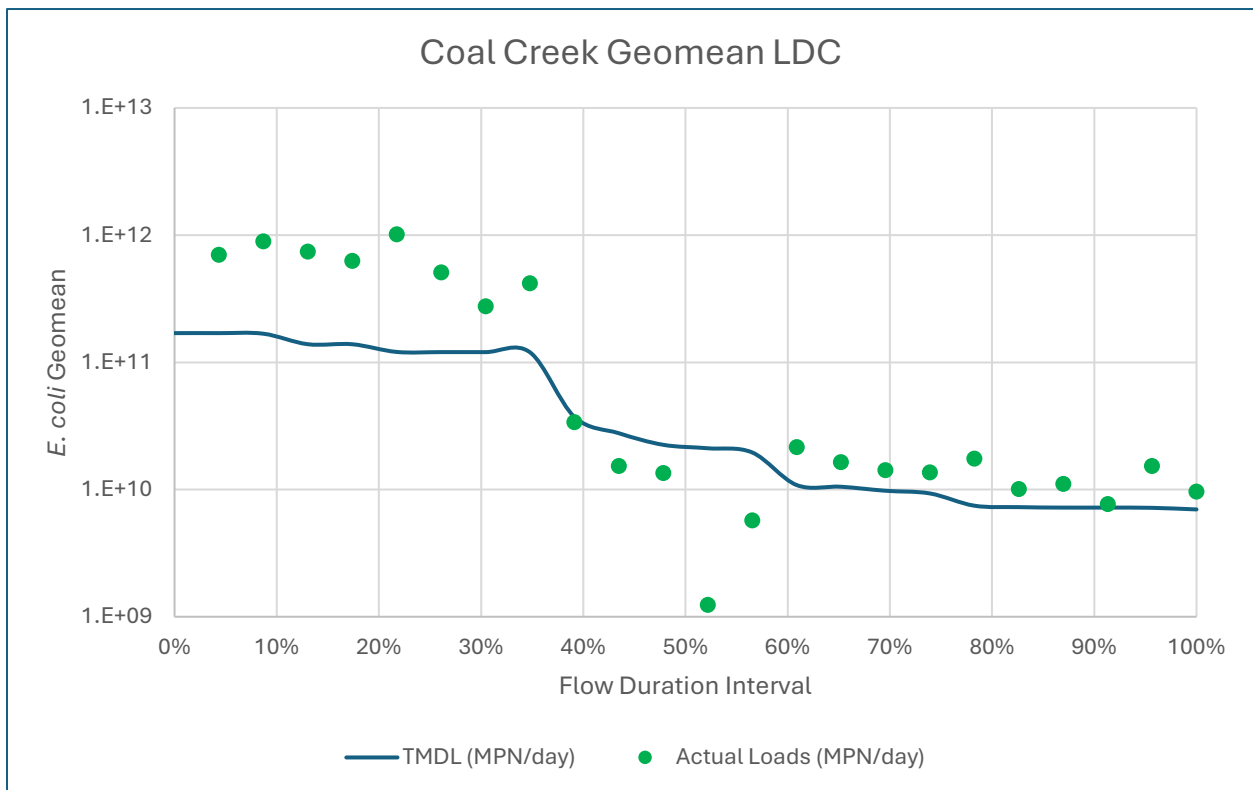


Figure 10: Coal Creek Geomean Load Duration Curve

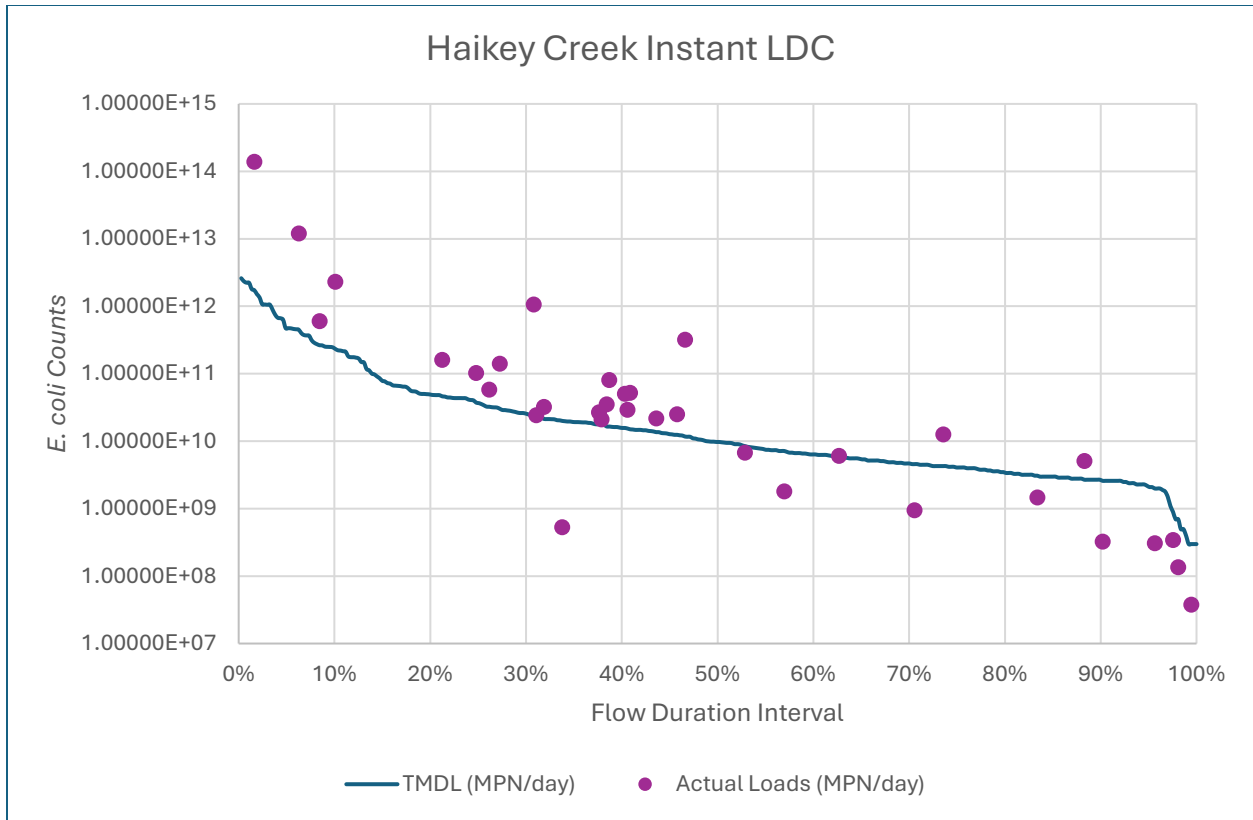


Figure 11: Haikey Creek Instant Load Duration Curve

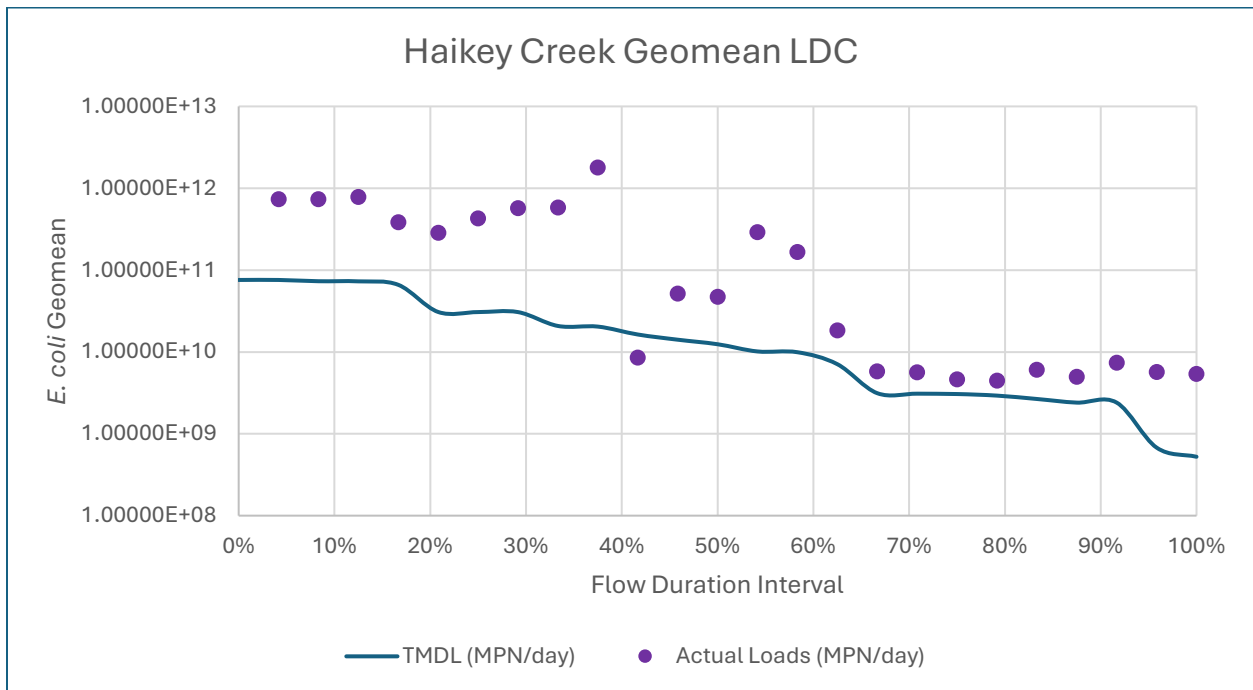


Figure 12: Haikey Creek Geomean Load Duration Curve

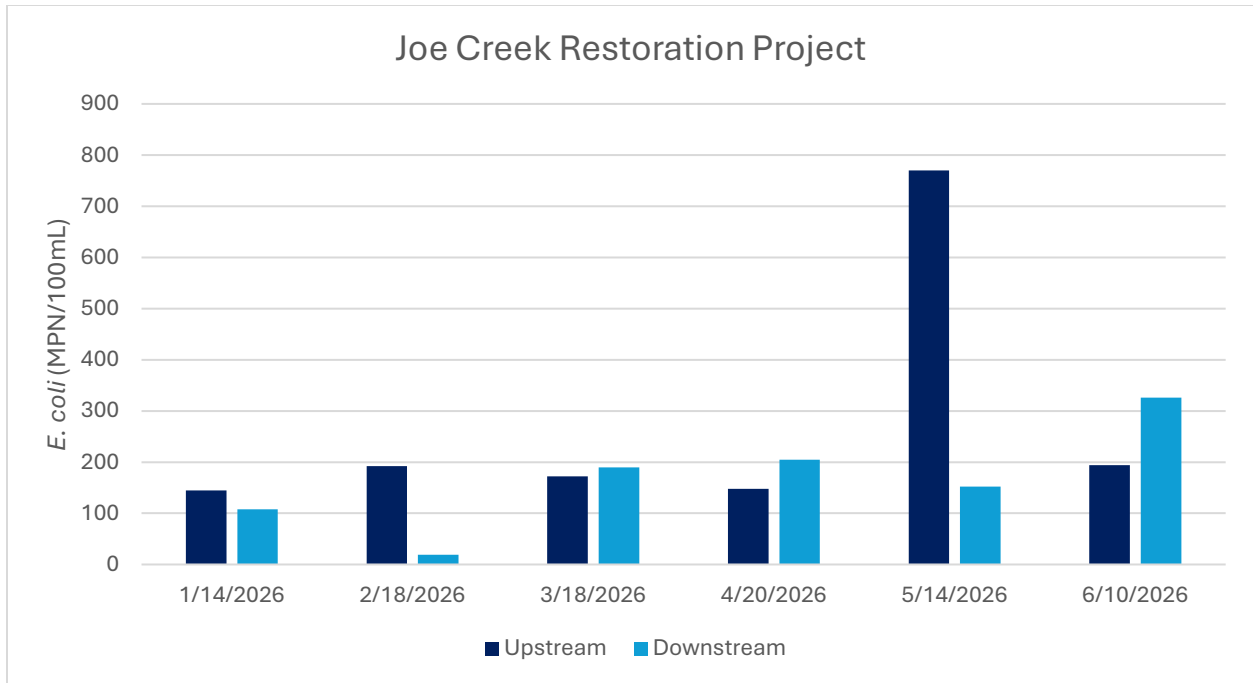


Figure 13: Joe Creek Restoration Project Evaluation

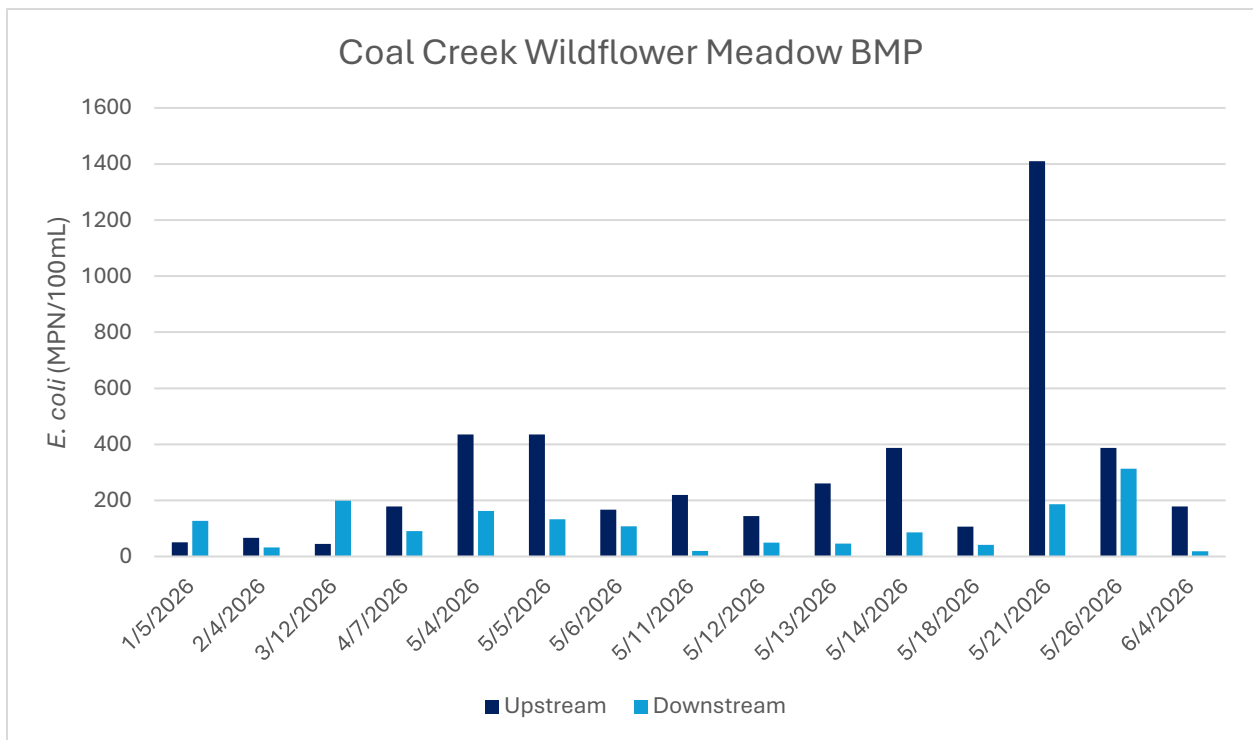


Figure 14: Coal Creek Wildflower Meadow BMP Evaluation

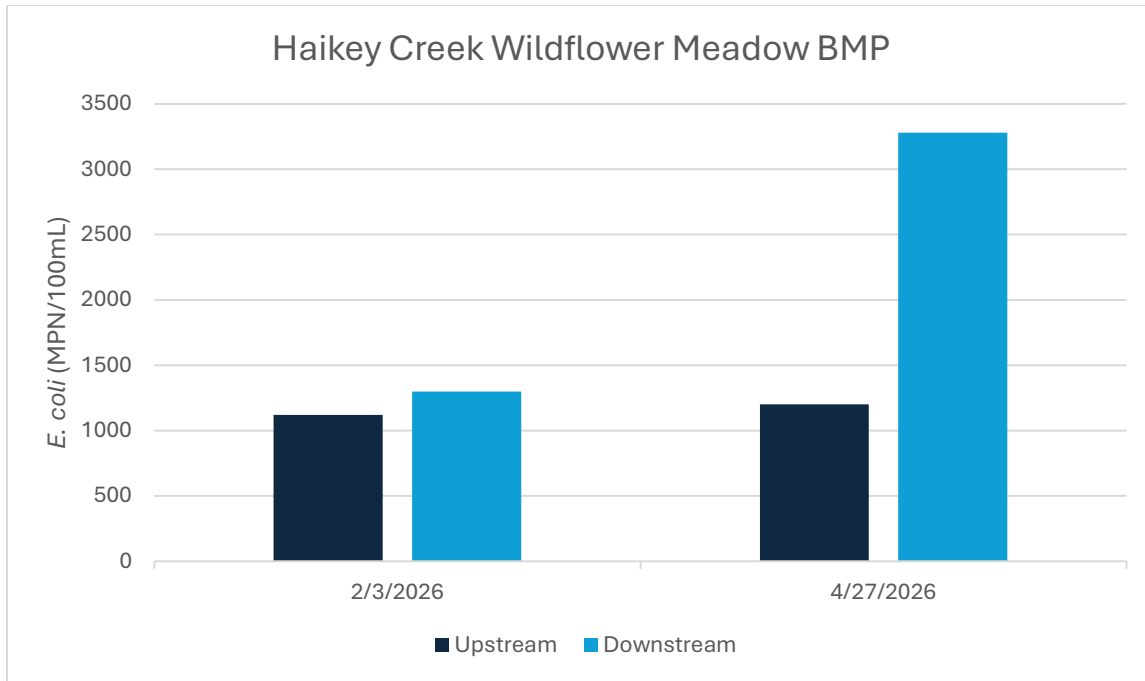


Figure 15: Haikey Creek Wildflower Meadow BMP Evaluation

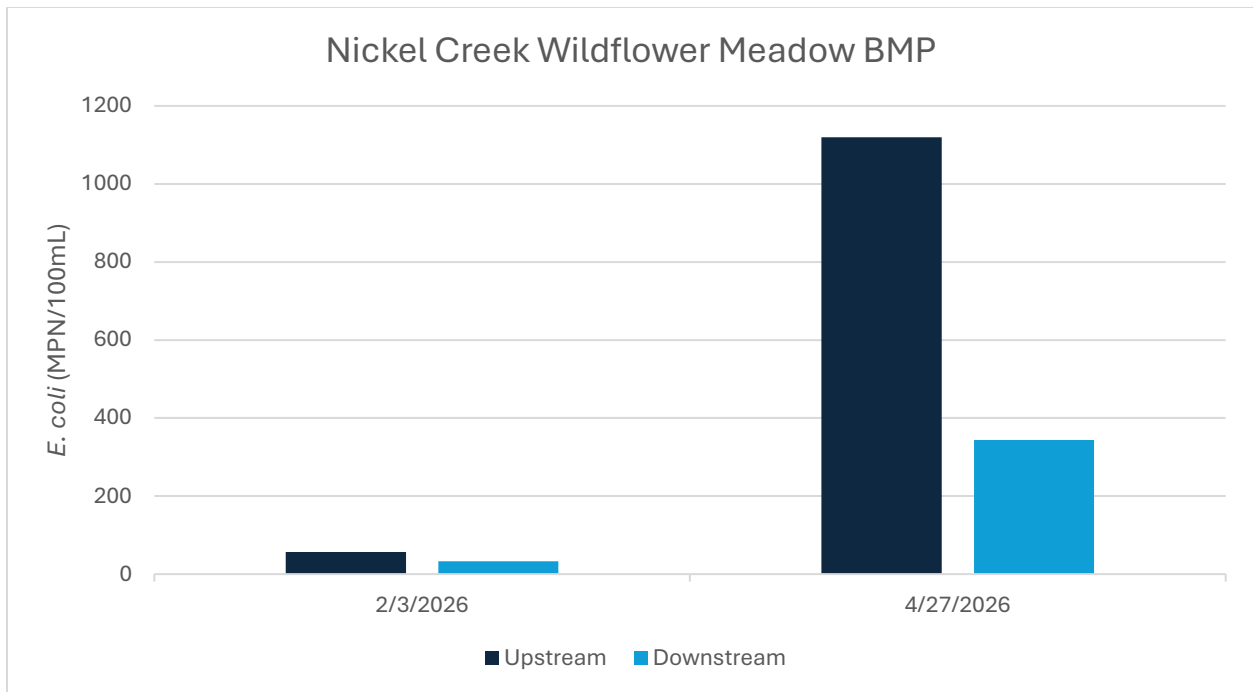


Figure 16: Nickel Creek Wildflower Meadow BMP Evaluation

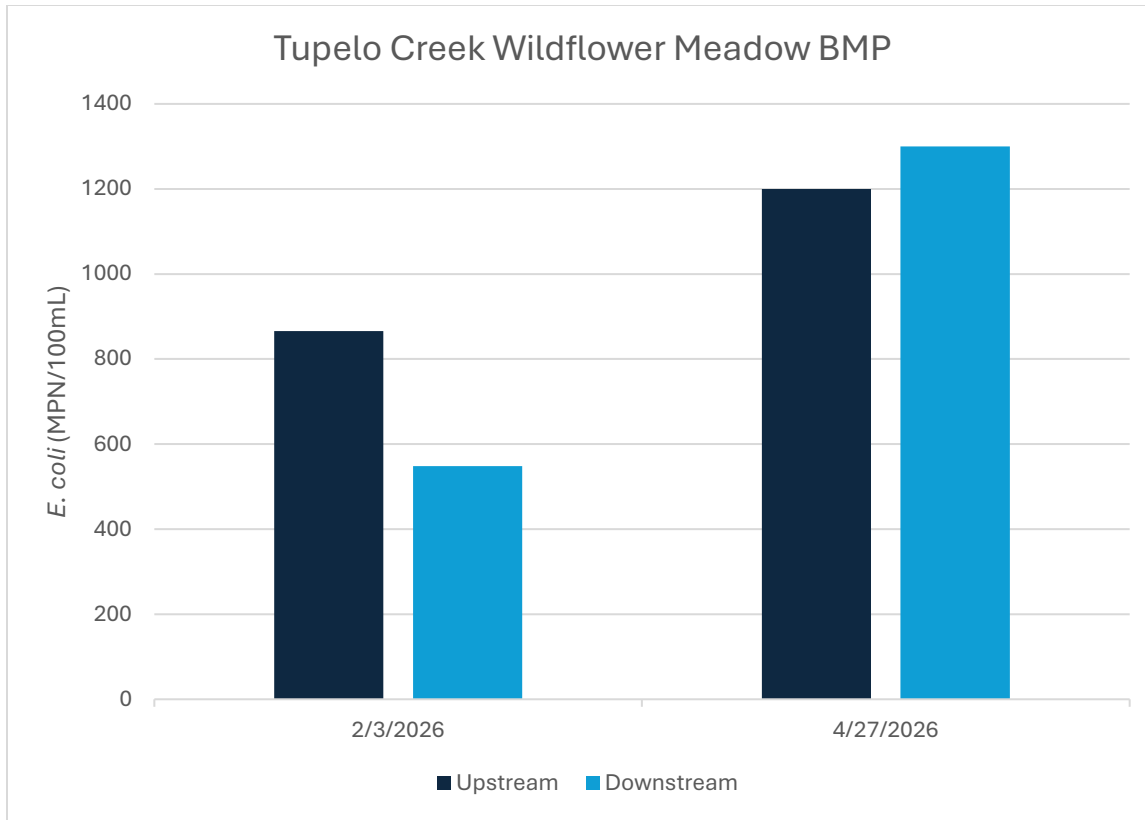


Figure 17: Tupelo Creek Wildflower Meadow BMP Evaluation

Adaptive Management and Next Steps

Data is still being collected to assess BMP effectiveness. Choosing BMPs to manage bacteria in stormwater is difficult due to the fluctuating and unpredictable nature of bacteria. Establishing additional wildflower meadows is being explored if the pilot project proves effective. A targeted campaign to distribute pet waste BMPs in the Haikey Creek watershed is being discussed. Water quality modeling inquiries have been initiated with a contractor to help simulate fate and transport of bacteria and source attribution.

TMDL Implementation Annual Report 25-26

City of Tulsa				
TMDL Implementation Tracking Matrix 2025-2026				
Strategy	Activity	Actions	Progress	TMDL Segment
POLLUTANT: BACTERIA				
Stormwater Management Program	Revise and update SWMP in relation to discharges to 303(d) impaired waters and TMDL reduction goals		By February 1 st , 2025 Complete	All
TMDL Pollutant Reduction Plan	Prepare TMDL Pollutant Reduction Plan for stream segments with existing approved TMDLs		By August 1 st , 2025 Complete	All
TMDL Pollutant Monitoring Plan	Prepare TMDL Pollutant Monitoring Plan for stream segments with existing approved TMDLs		By February 1 st , 2026 Complete	All
Sanitary Sewer Systems	Track and analyze sanitary sewer system data within TMDL watersheds to better understand where to focus efforts to reduce or eliminate SSOs	Analyze data in TMDL watersheds with a focus on: Miles of sanitary sewer CCTV inspected Number of smoke tests performed Main line sanitary sewer repairs Main line sanitary sewer replaced or rehabilitated	Ongoing	All

TMDL Implementation Annual Report 25-26

		Miles of sanitary sewer lines cleaned Sanitary sewer evaluation studies Number of SSOs and causes Lift/pump station maintenance		
On-site Sewage Facilities	Identify and update OSSF inventory to determine if a source of concern	Request information from ODEQ, Tulsa Health Department, and septic system installers Request information on number of residences connected to the public sewer system to determine if OSSF was decommissioned Compile list of resources and assistance for homeowners	Not Started	All
Illicit Discharge Detection and Elimination	Continue to implement and revise IDDE program by placing additional efforts into reducing waste sources of bacteria	Identify priority areas with a higher likelihood of illicit connections or discharges Analyze number of investigations conducted and number of investigations that resulted	Ongoing	All

TMDL Implementation Annual Report 25-26

		in a discovery of a bacteria source		
		Compile number of illicit sanitary connections to MS4		
		Increase number of outfalls screened per year and during the permit term		
		Add personnel to accomplish increased workload	Completed	
Domestic Animals & Wildlife	Identify and target potential animal sources of bacteria	Research geese population control/deterrents	Not Started	All
		Identify and locate horse stables	Initiated	
		Identify and locate livestock sale barns		
		Investigate BMPs at Expo Square where numerous animal events are held		
		Zoo inspections		
Public Education	Continue to implement and revise public education program	Additional pet waste signs/stations	Not Started	All
		Address wildlife food source		
		Target veterinary clinics and pet boarding facilities		

TMDL Implementation Annual Report 25-26

		Add/update billboards	Ongoing	
		Focused creek clean-ups		
		Update surveys		
		Coordinate with FOG program		
		Update website		
		Add personnel to accomplish increased workload	Completed	
Low Impact Development	Continue to promote LID projects	Number and location of LID projects	Ongoing	All
		Number of rain barrels sold	Completed	
		Wildflower meadows pilot project		
Geographic Information Systems	Continue to integrate GIS to aid in assessing bacteria pollutant loading	Water quality modeling	Initiated	All
		SSO map		
		Outfall map		
		Implement GIS based software		
Monitoring	Continue to utilize monitoring programs	Analyze watershed characterization data	Ongoing	All
		Analyze DWFS data		
		Analyze MST data		

Section 8

Revisions to Assessments of Controls and Fiscal Analysis

As part of the City's review of its Stormwater Management Program (SWMP), staff examined how well the City's stormwater controls are working and evaluated the financial resources needed to continue meeting permit requirements. These reviews were completed in January 2025 and are reflected in the updated SWMP that went into effect July 1, 2025. The updates ensure the City's program remains effective, sufficiently funded, and aligned with the goals of the new stormwater permit. Through this review, the City confirmed that the existing best management practices (BMPs) and control measures remain effective for managing stormwater quality throughout the MS4. The modifications made to the SWMP ensured that controls are appropriately structured to meet current regulatory and operational needs.

Based on the SWMP updates and evaluations during the reporting year, the City determined that the management programs and controls to address drainage areas and discharges within the MS4 are sufficient at this time. Future changes to drainage patterns, development practices, or permit requirements will continue to be reviewed to determine whether additional program adjustments are warranted.

Section 9

Summary of Data Used to Assess SWMP Pollution Reduction Effectiveness

To comply with the permit, individual programs were created or adopted and then implemented. Implementation resulted in the creation of databases that track dry weather field screening and floatables monitoring. Data was collected during this reporting period, reviewed for accuracy and completeness and then entered into specific databases. Each program is explained in the following paragraphs along with associated data.

1. Dry Weather Field Screening

Dry weather field screening was continued during this reporting period in an ongoing effort to detect the presence of illicit connections and improper disposal. 296 outfalls were screened, covering approximately 55,598 acres (87.0 square miles). All 40 “High-Priority Area” outfalls were also screened. Of the 296 outfalls screened, 177 contained dry weather flow. Once the source of the dry weather flow was located, the flow was sampled and tested for pH, temperature, appearance, conductivity, detergents, chlorine, copper, ammonia and fluoride. If contaminants were identified in concentrations above action levels, then dry weather flow follow-up activities were implemented. Dry weather flow follow-up procedures continued until the source was identified. When an illicit discharge was identified, it was eliminated.

Specific numbers for this reporting period are as follows:

Table 1: Dry weather field screening findings for FY 25-26.

Total # of Outfalls Screened	296
Total area screened	55,598 acres, 87.0 miles ²
# of “High-Priority Area” outfalls screened	40
# of outfalls with no dry weather flow	119
# of outfalls with dry weather flows not requiring follow-up (flows present but pollutant concentration below action levels)	108
# of outfalls requiring dry weather flow follow-up (flow with concentrations of pollutants above the action levels)	11

2. Floatable Monitoring Summary

Data was obtained from five floatable monitoring locations inspections were performed after rainfall events (> 0.1 in.) during this reporting period. If floatables were present during an inspection, they were collected, and data was gathered regarding the quantity in cubic yards and makeup in percent (organic and inorganic). A summary of the data is as follows:

Floatables Monitoring Summary

Station: 4800 W. 8th St.

Date	Floatables Present	Collection (Cubic Yards)	% Organic	% Inorganic
8/1/2025	no	0	0%	0%
8/11/2025	yes	0.25	70%	30%
8/28/2025	no	0	0%	0%
10/19/2025	yes	1	80%	20%
10/24/2025	yes	2	80%	20%
10/28/2025	no	0	0%	0%
11/24/2025	yes	0.25	0%	100%
3/27/2026	yes	0.5	50%	50%
3/14/2026	yes	1	100%	0%
4/10/2026	yes	0.25	90%	10%
4/11/2026	yes			
5/19/2026	no	0	0%	0%
5/27/2026	yes	0.25	100%	0%
6/13/2026	no	0	0%	0%
6/21/2026	yes	0.25	75%	25%
6/23/2026	yes	0.5	70%	30%
Total Cubic Yards		6.25		
Average Floatable Makeup (%)			72%	28%

Section 9 – Summary of Data Used to Assess SWMP Pollution Reduction Effectiveness

Floatables Monitoring Summary

Station: Osage Detention, 1101 West Pine Street

Date	Floatables Present	Collection (Cubic Yards)	% Organic	% Inorganic
8/1/25	yes	1	80%	20%
8/11/25	yes	0.25	90%	10%
8/28/2025	no	0	0%	0%
10/19/2025	no	0	0%	0%
10/24/2025	yes			
10/28/2025	yes	3.5	70%	30%
11/24/2025	yes			
3/6/2026	no	0	0%	0%
3/14/2026	yes	1.5	90%	10%
4/10/2026	no	0	0%	0%
4/11/2026	yes	26	60%	40%
5/19/2026	no	0	0%	0%
5/27/2026	yes	0.5	80%	20%
6/13/2026	yes			
6/21/2026	yes	0.5	75%	25%
6/23/2026	yes			
Total Cubic Yards		33.25		
Average Floatable Makeup (%)			77%	23%

Section 9 – Summary of Data Used to Assess SWMP Pollution Reduction Effectiveness

Floatables Monitoring Summary

Station: Reed Park 4200 S. Union Ave.

Date	Floatables Present	Collection (Cubic Yards)	% Organic	% Inorganic
8/11/25	no	0	0%	0%
8/28/25	no	0	0%	0%
10/19/2025	no	0	0%	0%
10/24/2025	yes	0.25	100%	0%
10/28/2025	no	0	0%	0%
11/24/2025	yes	0.25	100%	0%
3/6/2026	no	0	0%	0%
3/14/2026	no	0	0%	0%
4/10/2026	yes	0.25	80%	20%
4/11/2026	no	0	0%	0%
5/19/2026	no	0	0%	0%
5/27/2026	no	0	0%	0%
6/13/2026	no	0	0%	0%
6/21/2026	no	0	0%	0%
6/23/2026	yes	0.25	100%	0%
Total Cubic Yards		1		
Average Floatable Makeup (%)			95%	5%

Section 9 – Summary of Data Used to Assess SWMP Pollution Reduction Effectiveness

Floatables Monitoring Summary

Station: Sheridan Park, 10400 South 67th East Avenue

Date	Floatables Present	Collection (Cubic Yards)	% Organic	% Inorganic
8/1/2025	yes	0.5	100%	0%
8/28/2025	yes	0.25	100%	0%
10/24/2025	yes	1.25	90%	10%
10/29/2025	no	0	0%	0%
11/19/2025	no	0	0%	0%
11/25/2025	yes	1.5	100%	0%
2/27/2026	yes	0.5	100%	0%
3/3/2026	yes	0.5	100%	0%
3/7/2026	yes	1	100%	0%
3/10/2026	yes	0.25	80%	20%
4/14/2026	yes	0.5	90%	10%
4/23/2026	yes	0.5	50%	50%
4/24/2026	no	0	0%	0%
6/22/2026	yes	0.5	100%	0%
Total Cubic Yard		7.25		
Average Floatable Makeup (%)			92%	8%

Floatables Monitoring Summary

Station: Vensel Creek 11100 S. Yale Ave.

Date	Floatables Present	Collection (Cubic Yards)	% Organic	% Inorganic
8/1/25	yes	0.5	100%	0%
8/28/2025	yes	0.25	100%	0%
9/23/2025	yes	0.5	100%	0%
10/24/2025	yes	1	100%	0%
10/29/2025	yes	0.25	90%	10%
11/19/2025	yes	1	100%	0%
11/22/2025	yes	1	100%	0%
2/27/2026	yes	0.25	80%	20%
3/3/2026	yes	0.5	90%	10%
3/7/2026	yes	1	100%	0%
3/11/2026	yes	0.25	90%	10%
4/10/2026	yes	1	100%	0%
4/14/2026	yes	1	100%	0%
4/23/2026	yes			
4/24/2026	yes	1	100%	0%
5/19/2026	yes	0.5	90%	10%
5/22/2026	yes			
5/27/2026	no	0	0%	0%
6/2/2026	yes			
6/6/2026	yes	0.25	100%	0%
6/11/2026	no	0	0%	0%
6/22/2026	yes	0.25	100%	0%
Total Cubic Yards		10.5		
Average Floatable Makeup (%)			96%	4%

3. Watershed Characterization - Stream Monitoring Reports

The following is a comprehensive report of biological and analytical assessments for sampled creeks in the Watershed Characterization program during the reporting period.

CITY OF TULSA
WATERSHED CHARACTERIZATION PROGRAM

Comprehensive Watershed Characterization
Assessment Year 2 (2025-2026):

City of Tulsa Public Works
Stormwater Management and Operations Division
4502 South Galveston
Tulsa, OK 74107

Prepared by

Vanessa Cormier
Senior Environmental Monitoring Technician
Watershed Characterization Project

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1.0 INTRODUCTION

1.1 Objective

The purpose of this document is to serve as a comprehensive report of results from the biological, habitat, and analytical assessments of Crow Creek, Dirty Butter Creek, Flat Rock Creek, Hager Creek, Harlow Creek, Mooser Creek and Nickel Creek. These assessments were performed in order to comply with requirements set forth in Part II(A)(13)(12) and (13)(a) and (b) and Part IV(A)(1) and (2) of Oklahoma Pollutant Discharge Elimination System (OPDES) Municipal Separate Storm Sewer System (MS4) Permit No. OKS000201 for the City of Tulsa, Oklahoma (ODEQ, OPDES Permit OKS000201, 2024). Additionally, assessment results are applied to Oklahoma Water Quality Standards to ensure attainment of beneficial use standards. According to 82 O.S., §1085.30, the Oklahoma Department of Environmental Quality is authorized to promulgate rules to be known as "Oklahoma Water Quality Standards." The Oklahoma water quality standards are codified in OAC 252:730 and the implementation of Oklahoma water quality standards are set forth in OAC 252:740 (ODEQ, 2023). While these implementations describe a multitude of surface water quality standards, this document will compare and describe only the standards applicable to the parameters required in the Watershed Characterization Program subsection of the Municipal Separate Storm Sewer System (MS4) permit (ODEQ, OPDES Permit OKS000201, 2024). All additional parameter results without applicable water quality standards are included in this report.

The data presented in this report were collected over a one-year period beginning in July 2025 and completed in June 2026, except for benthic macroinvertebrate data which require a minimum of four sampling events within a two-year period. Field collection and assessment methodology followed project standard operating procedures (SOPs) as provided in the quality assurance project plans (QAPPs) for the biological component (COT, 2016) and the analytical component (COT, 2025) of the City of Tulsa's watershed characterization program. The QAPPs provide quality assurance and quality control procedures for all components of the watershed characterization program. The QAPPs were submitted to and received approval from the Oklahoma Department of Environmental Quality (ODEQ), to ensure compliance with MS4 requirements. All field data sheets were scanned electronically and paper copies archived at the City of Tulsa Stormwater Management Division. All field measurements (in situ measurements, flow measurements, visual observations), biological information (taxonomic identification, species counts, biodiversity analyses), and analytical results were compiled in Microsoft Excel spreadsheets and verified (data entry, formula calculations) per project quality assurance (QA)/quality control (QC) procedures (COT, 2025) (COT, 2016). All raw data, SOPs, and QAPPs are available upon request.

Table 1: FY 25-26 sample sites and watershed size within the City of Tulsa boundaries.

Waterbody	WBID	Latitude	Longitude	Watershed Area (mi ²)	Ecoregion
Crow Creek	OK120420010090_00	36.11651	-95.98178	2.51	Central Irregular Plains
Dirty Butter Creek	OK121300010140_00	36.20616	-95.96829	7.98	Central Irregular Plains
Flat Rock Creek	OK121300010120_00	36.21475	-95.95814	21.25	Central Irregular Plains
Hager Creek	OK120420020020_00	36.04639	-95.98809	2.97	Cross Timbers
Harlow Creek	OK120420010170_00	36.15435	-96.05788	4.17	Cross Timbers
Mooser Creek	OK120420010070_00	36.08539	-95.9991	4.98	Cross Timbers
Nickel Creek	OK120420020040_00	36.0321	-96.02767	11.64	Cross Timbers



2025 - 2026

Drainage Basin Sampling Locations

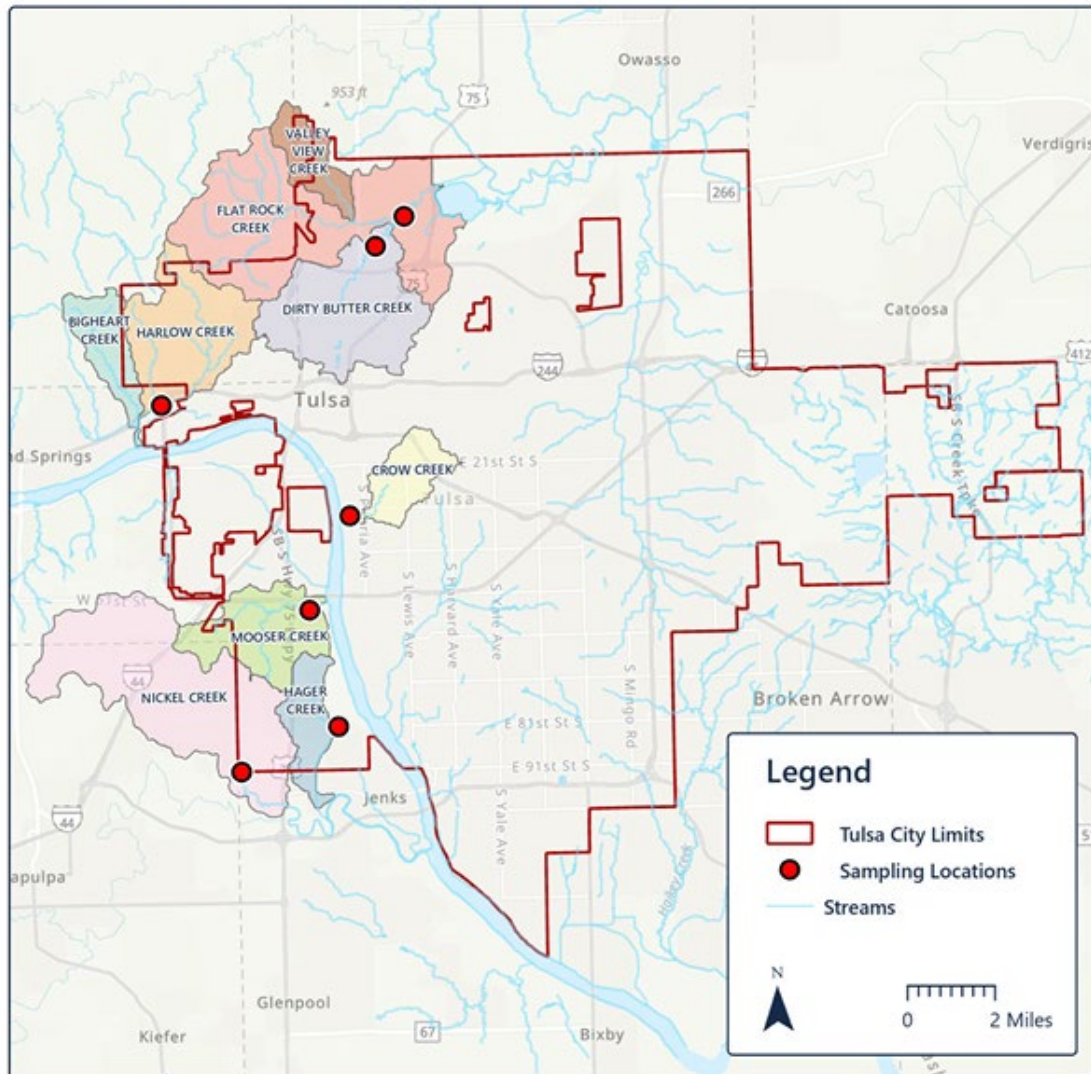


Figure 1: City of Tulsa watershed map for FY 25-26 streams.

2.0 BENEFICIAL USES

2.1 Agriculture

2.1.1 Total Dissolved Solids

Data collected on Total Dissolved Solids (TDS) for the following streams indicate a few impairments of the agricultural beneficial use. Total dissolved solids values from 2025-2026 sampling can be found in Table 2. The beneficial use of surface waters for agriculture is determined by analyzing the mineralization of water. Mineralization is measured by analyzing the concentration of total dissolved solids (TDS) in milligrams per liter.

A minimum of 10 samples is required to determine if the stream meets water quality standards (WQS). The number of samples collected exceeds the number of samples required by water quality standards. If the sample means is less than the yearly mean standard, and not more than 10% of individual samples exceed the sample standard, then the beneficial use is supported (ODEQ, 2023). The sample mean and individual sample water quality standard are dependent on the segment of the receiving water body the stream discharges into. The single sample standard is 470 mg/L for tributaries of Bird Creek segment ID OK121300010010_0 and 1868 mg/L for tributaries of the Arkansas River segment OK120420010010_00. All streams are attaining agricultural beneficial use based on TDS results.

Table 2: Total Dissolved Solid results in FY 25-26 streams.

Waterbody	Sample Mean (mg/L)	Highest Single Sample Result (mg/L)	Water Quality Standard (mg/L)
Dirty Butter Creek	301.0	441	Sample: 470, Yearly: 387
Flat Rock Creek	284.3	406	
Crow Creek	324.0	351	Sample: 1868, Yearly: 1496
Hager Creek	510.6	638	
Harlow Creek	590.8	1520	
Mooser Creek	454.7	678	
Nickel Creek	277.3	319	

2.2 Fish and Wildlife Propagation:

2.2.1 Dissolved oxygen (D.O.)

Dissolved oxygen values for the 2025-2026 sampling year can be found in Table 3. Data collected on Dissolved Oxygen concentrations indicate the beneficial use is not supported for three of the seven streams. Water quality standards require ten samples, the number of samples collected exceeds the number of samples required. The Warm Water Aquatic Community (WWAC) subcategory of the Fish and Wildlife Propagation beneficial use designated for a stream shall be deemed to be fully supported with respect to the D.O. criterion if no more than 10% of the samples from the stream are less than 6.0 mg/L from April 1 through June 15 and less than 5.0 mg/L from June 16 to March 30. The streams marked with an asterisk have limited flow which may contribute to low dissolved oxygen concentrations. Streams are supporting beneficial use if less than 10% of samples are not below the DO threshold (ODEQ, 2023).

Table 3: Dissolved oxygen averages and exceedances in FY 25-26 streams.

Waterbody	Sample Mean (mg/L)	% of samples in exceedance	Water Quality Standard (mg/L)
Dirty Butter Creek	8.31	0%	April 1 – June 15: 6.0 June 16 – March 30: 5.0
Crow Creek	9.52	0%	
Flat Rock Creek	8.15	8%	
Hager Creek *	7.20	25%	
Harlow Creek *	6.69	42%	
Mooser Creek	9.69	0%	
Nickel Creek	7.94	25%	



Figure 2: YSI multi-meter displaying pH, temperature, dissolved oxygen, and conductivity..

2.2.2 Toxicants/Metals

Data collected indicates full support of the beneficial use for Toxicants and Metals for all streams. Five samples are required to make a determination for water quality standards. The number of samples collected exceeds the number of samples required. Water quality standards are met if no more than one sample exceeds the acute standard and no more than 10% of samples exceeds the chronic standard.

Table 4: Toxicants and metals results in FY 25-26 streams.

Waterbody	Parameter	Sample Mean (µg/L)	Highest Single Sample Result (µg/L)	Water Quality Standard (µg/L)
Dirty Butter Creek	Cadmium	0.500	0.500	Cd - Acute: 54.43, Chronic: 1.58 Cu - Acute: 28.65, Chronic: 18.40 Pb - Acute: 140.29, Chronic: 5.46 Zn - Acute: 167.79, Chronic: 151.97
	Copper	1.710	5.62	
	Lead	1.21	8.21	
	Zinc	11.43	27.2	
Flat Rock Creek	Cadmium	0.500	0.500	Cd - Acute: 102.36, Chronic: 2.45 Cu - Acute: 48.56, Chronic: 29.69 Pb - Acute: 286.15, Chronic: 11.15 Zn - Acute: 269.64, Chronic: 244.23
	Copper	1.12	1.76	
	Lead	0.557	1.12	
	Zinc	10.775	19.3	
Crow Creek	Cadmium	0.500	0.500	
	Copper	2.206	5.53	
	Lead	0.534	0.912	
	Zinc	10	10	
Hager Creek	Cadmium	0.500	0.500	
	Copper	1.531	3.28	
	Lead	0.504	0.546	
	Zinc	12.008	34.1	
Harlow Creek	Cadmium	0.500	0.500	
	Copper	0.640	1.05	
	Lead	0.588	1.09	
	Zinc	10	10	
Mooser Creek	Cadmium	0.500	0.500	
	Copper	1.715	2.56	
	Lead	0.669	1.16	
	Zinc	10	10	
Nickel Creek	Cadmium	0.500	0.500	
	Copper	1.359	2.76	
	Lead	0.500	0.500	
	Zinc	12.7	42.4	

2.2.3 pH Hydrogen Ion Activity

Data collected on pH readings indicates full support of the beneficial use for all streams. The pH range for the creeks can be found in table 5 for the creeks to be considered attaining with respect to pH no more than 10% of samples can exceed 6.5-9.0 s.u. (ODEQ, 2023).

Table 5: pH results for FY 25-26 streams.

Waterbody	Sample Range (s.u)	Water Quality Standard Range (s.u)
Crow Creek	7.82- 8.08	6.5 – 9.0
Dirty Butter Creek	7.74-8.12	
Flat Rock Creek	7.70- 8.29	
Hager Creek	7.64- 8.08	
Harlow Creek	6.73- 7.95	
Mooser Creek	7.70- 7.99	
Nickel Creek	7.52- 8.08	

2.2.4 Oil and Grease

Oil and grease are identified in creeks by visual assessment and can be found on the surface or become suspended when the benthos is disturbed. For a creek to be attaining water quality standards, oil and grease cannot be observed on the stream surface for more than 10% of the total observations during the sampling year (ODEQ, 2023).

2.2.5 Suspended and Bedded Sediments

The determination of the suspended and bedded sediments use is accomplished using the monthly turbidity data in conjunction with habitat assessment data. This beneficial use is also conditional on the support based on fish and macroinvertebrate collection results.



Figure 3: Macroinvertebrate on stream bottom in Flat Rock Creek.

2.2.5.1 Turbidity

Data collected from turbidity readings indicate all FY 25-26 streams are supporting the beneficial use. Water quality standards are met when no more than 10% of samples exceed the sample standard. The number of samples collected exceeded the number of samples required (ODEQ, 2023).

Table 6: Turbidity results for FY 25-26 streams.

Waterbody	Sample Mean (NTU)	% of samples in exceedance	Water Quality Standard (NTU)
Crow Creek	2.50	0%	50
Dirty Butter Creek	14.20	8%	
Flat Rock Creek	6.46	0%	
Hager Creek	5.22	0%	
Harlow Creek	7.00	0%	
Mooser Creek	13.11	0%	
Nickel Creek	4.98	0%	

2.2.5.2 Habitat Assessment

The scores found in Table 7 are obtained from habitat assessments conducted by the City of Tulsa's stormwater quality group. These results are compared to the average score of a high-quality reference site provided by the Oklahoma Conservation Commission, from a workbook provided by the Oklahoma Water Resources Board (OWRB, 2001).

The habitat scores are compared to reference sites within the same ecoregion. For the 2025-2026 sampling year Crow Creek, Dirty Butter Creek, and Flat Rock Creek are in the Central Irregular Plains ecoregion. Nickel Creek, Mooser Creek, Harlow Creek, and Hager Creek are in the Cross Timbers ecoregion.

Table 7: Habitat assessment scores by ecoregion for FY 25-26 streams.

Waterbody	Instream Habitat	Pool Bottom Substrate	Pool Variability	Canopy Cover	Presence of Rocky Runs and Riffles	Flow	Channel Alteration	Channel Sinuosity	Bank Stability	Bank Vegetation Stability	Streamside Cover	Total Score	Mean Score
Crow Creek	19.5	10.5	19.4	19.6	14.1	4.9	15.1	-0.1	6.0	1.0	10.0	120.0	86.75
Dirty Butter Creek	14.1	5.7	20.2	11.6	2.2	8.4	16.5	5.0	6.8	1.8	10.0	102.4	
Flat Rock Creek	19.1	11.0	18.3	16.5	10.3	3.0	15.1	2.7	6.6	0.5	9.9	113.2	
Hager Creek	13.5	4.4	7.1	16.5	2.2	0.2	16.5	0.1	2.7	1.8	10.0	75.1	83.99
Harlow Creek	8.6	1.1	0.0	17.1	0.0	0.32	16.5	0.2	9.2	8.2	10.0	71.3	
Mooser Creek	19.0	9.9	4.5	16.5	4.1	1.1	13.7	0.2	6.8	1.9	10.0	87.8	
Nickel Creek	16.6	3.5	16.1	20.0	12.4	5.2	16.5	0.4	4.6	2.0	10.0	107.4	



Figure 4: Sample site at Harlow Creek.

2.2.6 Biological

2.2.6.1 Fish Collections

The data obtained from the fish collections can be found in Table 8. Sampled fish were identified and assessed for deformities, fin erosion, lesions, and tumors in situ and released following collection. The fish data were recorded in the field and input into a workbook to obtain a score to determine if the creek is meeting the biological criteria for fish and wildlife beneficial use.

Table 8: Fish index of biotic integrity scores for FY 25-26 streams.

Waterbody	Sample Composition	Fish Condition	Total Score	Score Key
Crow Creek	18	13	31	30+ Beneficial Use Supported; 23 – 29 Undetermined; <22 Impaired
Dirty Butter Creek	19	15	34	
Flat Rock Creek	22	15	37	
Hager Creek	16	11	27	
Harlow Creek	16	9	25	
Mooser Creek	16	11	27	
Nickel Creek	18	9	27	



Figure 5: Redfin Darter (*Etheostoma whipplei*) caught in Nickel Creek.

2.2.6.2 Macroinvertebrate Collections

The data from the winter and summer index periods and the determination of the macroinvertebrate status can be found below in Table 9 (ODEQ, Continuing Planning Process, 2012).

Table 9: Benthic macroinvertebrate scores for summer and winter index periods.

Waterbody	Summer 2024 Score	Winter 2025 Score	Summer 2025 Score	Winter 2026 Score	Final Macroinvertebrate Assessment
Crow Creek	26	52	45	52	Not attaining
Dirty Butter Creek	58	52	65	44	Undetermined
Flat Rock Creek	71	67	65	67	Undetermined
Hager Creek	52	67	45	67	Undetermined
Harlow Creek	58	44	70	51	Undetermined
Mooser Creek	94	58	70	39	Undetermined
Nickel Creek	81	39	69	58	Undetermined
>80% Attaining : 80 – 50% Undetermined : <50% Not Attaining					



Figure 6: Mayfly larvae.

2.3 Primary Body Contact

The *Escherichia coli* data collected from the 2024-2025 sampling year can be found in Table 10. Water quality standards require a minimum of ten samples to be taken during the one-year sampling period; the number of samples collected exceeded the number of samples required. The monitoring period for primary body contact recreation begins May 1st and continues through Sept 30th. For swimming advisory and permitting purposes, *E. coli* shall not exceed a monthly geometric mean of 126/100 MPN/100mL based upon a minimum of not less than five (5) samples collected over a period of not more than thirty (30) days (ODEQ, 2023). Water quality standards are met when the geometric mean does not exceed the water quality standard 126 MPN/100mL (ODEQ, 2023).

Table 10: *E. coli* results for FY 25-26 streams.

Waterbody	<i>E. coli</i> Recreation Sample Geometric Mean (MPN/100mL)	<i>E. coli</i> Non-recreation Sample Geometric Mean (MPN/100mL)	Highest Single Sample Result (MPN/100mL)	Water Quality Standard (MPN/100mL)
Crow Creek	388	341	816	Recreational Period Geometric Mean: 126; Non-recreational Period Geometric Mean: 630
Dirty Butter Creek	298	163	1050	
Flat Rock Creek	282	189	980	
Hager Creek	386	263	3010	
Harlow Creek	83	37	2420	
Mooser Creek	483	320	2420	
Nickel Creek	292	217	1730	

2.4 Anti-Degradation Policy

2.4.1 Nutrients

Analytical results for Total Phosphorus and Nitrate/Nitrite show no need for further investigation to show support of the beneficial use. Water quality standards require 10 samples. The number of samples collected exceeds the number of required samples. Water quality standards are met if no more than 10% of samples are out of range. While Nitrate/Nitrite concentrations have an action level, it is not a required parameter within the MS4 permit (ODEQ, OPDES Permit OKS000201, 2024).

Table 11: Nutrient results for FY 25-26 streams.

Waterbody	Total Phosphorus Sample Mean (mg/L)	Nitrite - Nitrate Sample Mean (mg/L)	% of samples in exceedance	Water Quality Threshold (mg/L)
Crow Creek	0.04	1.16	0%	Total Phosphorus: 0.24 Nitrate/Nitrite: 4.95
Dirty Butter Creek	0.03	0.54	0%	
Flat Rock Creek	0.03	0.31	0%	
Hager Creek	0.03	0.21	0%	
Harlow Creek	0.07	0.26	8%	
Mooser Creek	0.04	0.27	0%	
Nickel Creek	0.03	0.22	0%	

3.0 SUMMARY

All streams met the criteria for the agricultural beneficial use based on total dissolved solids results. Three out of the seven streams did not meet water quality standards for dissolved oxygen. The three that did not meet these standards are Harlow Creek, Hager Creek and Nickel Creek. Harlow Creek and Hager Creek are both low flow and fragmented. Hager Creek had 10 out of 12 sampling events considered “no flow” and Harlow also had 10 out of 12 sampling days marked as “no flow.” Every year, these two water bodies become fragmented into stagnant pools with low dissolved oxygen. The dissolved oxygen improved as temperatures lowered, flow increased, and there was more rainfall. Nickel Creek has more flow but was still negatively affected by low flow in the summer months. None of the streams exceeded water quality standards for toxicants/metals, oil and grease, pH, and turbidity. Hager Creek and Harlow Creek are the only two that did not receive acceptable habitat assessment scores. They are both streams that have low flow, very small riparian areas that are frequently mowed, little canopy cover and low sediment diversity. Harlow Creek is very narrow and has almost exclusively silt. The lack of substrate diversity in Harlow Creek lowered the macroinvertebrate and habitat scores. All streams apart from Crow Creek received a score of unattaining for macroinvertebrates. The lowest macroinvertebrates scores occurred during the summer index period. Residential activities such as application of insecticides and chlorinated water releases from pools and lawn-watering may have contributed to low macroinvertebrate scores. Crow Creek, Dirty Butter Creek, Flat Rock Creek, Hager Creek, Mooser Creek, and Nickel Creek exceeded the *E.coli* recreation period sample geometric mean. Elevated *E. coli* in urban streams is often related to low flow conditions, pet waste, and sanitary sewer overflows.

On December 11th, 2025, Dirty Butter Creek and Flat Rock Creek experienced a large water line break which caused a fish kill. The discharge from the line break caused elevated turbidity, flow, and chlorine. The total chlorine reading in Dirty Butter Creek was 1.58 mg/L, the action level for chlorine is 0.10 mg/L. At least 51 water line breaks occurred in FY 25-26 watersheds, which can result in chlorine and sediment entering streams. A construction project spanning several acres is believed to be the source of increased sediment in the water column and substrate at Mooser Creek. Other reported problems include concrete washout entering Crow Creek from a nearby construction site and a water line leak in Crow Creek.

4.0 TABLES

Table 12: Complete analytical sampling results for Crow Creek.

ANALYTE	Date Sampled											
	7/28/25	8/18/25	9/17/25	10/1/25	11/12/25	12/10/25	1/13/26	2/10/26	3/27/26	4/7/26	5/13/26	6/10/26
BOD(5) DAY (BDL 3) mg/L	3	3	3	3	3	3	3	3	3	3	3	12.8
Cadmium, Total (BDL 0.5) µg/L	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Conductivity µS	639	595	534	549	384.5	436.5	368.9	458	365.3	498	500	627
Copper, Total (BDL 0.5) µg/L	2.19	5.53	1.64	2.31	1.6	1.85	1.14	2	1.65	2.25	2.44	1.87
Flow CFS	0.182	0.769	1.100	0.104	0.688	1.104	0.667	0.819	0.768	1.409	1.190	2.094
Hardness, Total (BDL 3.6) mg/L	230	200	210	230	210	240	220	210	210	240	220	250
Lead, Total (BDL 0.5) mg/L	0.5	0.5	0.5	0.5	0.912	0.5	0.5	0.501	0.5	0.5	0.5	0.5
Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L	0.593	0.5	0.5	0.5	0.5	0.5	0.5	0.667	0.5	0.5	0.5	0.5
Nitrogen, Nitrate-Nitrite (BDL 0.2) mg/L	1	0.92	0.88	1.1	1.1	1.2	1.2	1.1	0.85	1.2	1.2	2.2
Nitrogen, Total as N (BDL 0.5) mg/L	1.593	1.42	1.38	1.6	1.6	1.7	1.7	1.767	1.35	1.7	1.7	2.7
Oxygen Demand, Chemical (BDL 20) mg/L	20	20	20	20	20	20	20	20	20	20	20	20
Oxygen, Dissolved mg/L	6.25	8.44	6.78	7.84	9.89	12.53	12.88	9.63	11.24	12.82	8.21	7.74
pH (s.u.)	7.82	7.92	7.86	7.89	7.83	8.08	7.92	7.93	7.92	7.91	7.92	7.9
Phosphorus, Total (BDL 0.010) mg/L	0.053	0.046	0.031	0.039	0.053	0.035	0.03	0.04	0.03	0.053	0.037	0.04
Phosphorus, Total Dissolved BDL (0.010) mg/L	0.04	0.043	0.026	0.038	0.034	0.026	0.022	0.025	0.018	0.044	0.025	0.032
Solids, Total Dissolved (BDL 10) mg/L	0.04	0.043	0.026	0.038	0.034	0.026	0.022	0.025	0.018	0.044	0.025	0.032
Solids, Total Suspended (BDL 2.0) mg/L	3.3	2.5	2.5	2.5	5.3	2.5	2.5	3.2	2.5	2.5	2.5	2.5
Temperature, Water °C	26.1	26.8	23.5	20.4	11	9.3	7.9	12.1	6.7	14.9	19.5	24.1
Turbidity	1.2	1.04	0.84	2.16	8.98	1.29	2.88	3.63	3.87	1.63	1.24	1.29
Zinc, Total (BDL 10) µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Results found to be below the detection limit are reported as the detection limit												

Table 13: Complete *E. coli* sampling results for Crow Creek.

ANALYTE	Date Sampled												
	7/28/25	7/29/25	8/18/25	9/17/25	9/29/25	10/1/25	11/1/25	12/1/25	1/13/26	2/10/26	3/17/26	4/7/26	5/4/26
<i>E. coli</i> (BDL 1) MPN/100mL	387	326	345	228	387	192	326	133	192	145	816	308	435
ANALYTE	Date Sampled												
	5/13/26	5/14/26	5/18/26	5/26/26	5/27/26	6/4/26	6/8/26	6/9/26	6/10/26	6/11/26			
<i>E. coli</i> (BDL 1) MPN/100mL	308	261	137	435	326	687	770	649	613	548			

Table 14: Complete analytical sampling results for Dirty Butter Creek.

ANALYTE	Date Sampled											
	7/21/25	8/7/25	9/9/25	10/14/25	11/6/25	12/15/25	1/6/26	2/9/26	3/18/26	4/21/26	5/6/26	6/11/26
BOD (5) Day (BDL 2.0) mg/L	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	1.6	3.0	3.0	3.0
Cadmium, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Conductivity µS	657	450	362	392	392	258	298	362	364	655	523	762
Copper, Total (BDL 0.50) µg/L	1.22	1.59	1.22	1.09	5.62	1.61	0.94	1.30	1.46	1.65	1.12	1.70
Flow CFS	2.153	1.458	1.123	0.351	0.772	1.691	0.838	1.740	1.225	2.915	1.866	4.137
Hardness, Total (BDL 20) mg/L	160	150	140	140	170	180	160	180	180	290	260	280
Lead, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	8.21	1.31	0.50	0.50	0.50	0.50	0.50	0.50
Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L	0.50	0.50	0.50	0.50	0.96	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Nitrogen, Nitrate-Nitrite (BDL 0.20) mg/L	0.42	0.42	0.28	0.24	0.49	0.50	0.41	0.53	0.37	1.00	0.80	0.97
Nitrogen, Total as N (BDL 0.50) mg/L	0.92	0.92	0.78	0.74	1.45	1.00	0.91	1.03	0.87	1.50	1.30	1.47
Oxygen Demand, Chemical (BDL 20) mg/L	20	20	20	20	27	20	20	20	20	20	20	20
Oxygen, Dissolved mg/L	6.57	5.99	6.79	5.67	7.81	12.32	12.03	11.33	8.12	7.29	9.12	6.72
pH (s.u.)	7.86	7.83	7.84	7.74	7.86	8.11	7.96	7.99	8.12	8.01	7.98	7.94
Phosphorus, Total (BDL 0.010) mg/L	0.020	0.028	0.024	0.028	0.124	0.046	0.015	0.015	0.013	0.029	0.034	0.028
Phosphorus, Total Dissolved BDL (0.010) mg/L	0.016	0.022	0.018	0.027	0.020	0.019	0.010	0.100	0.010	0.019	0.018	0.017
Solids, Total Dissolved (BDL 25) mg/L	282	243	222	291	265	253	233	293	284	435	370	441
Solids, Total Suspended (BDL 2.5) mg/L	2.5	4.5	2.5	2.5	84.0	22.0	2.5	2.5	2.5	6.6	5.1	3.4
Temperature, Water °C	27.1	25.7	20.2	21.4	14.4	2.2	8.8	7.3	9.6	16.3	13.7	25.0
Turbidity (NTU)	3.09	5.15	3.18	3.18	114.00	23.90	3.10	2.13	2.51	4.14	2.58	3.43
Zinc, Total (BDL 10) µg/L	10.00	10.00	10.00	10.00	27.20	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Results found to be below the detection limit are reported as the detection limit												

Table 15: Complete E. coli sampling results for Dirty Butter Creek.

ANALYTE	Date Sampled												
	7/21/25	7/29/25	8/7/25	9/6/25	9/29/25	10/1/25	11/6/25	12/1/25	1/6/26	2/9/26	3/18/26	4/21/26	5/4/26
E. coli (BDL 1) MPN/100mL	166	236	345	461	291	214	326	1	6	9	144	186	261
ANALYTE	Date Sampled												
	5/6/26	5/13/26	5/14/26	5/18/26	5/26/26	5/27/26	6/4/26	6/8/26	6/9/26	6/10/26	6/11/26		
E. coli (BDL 1) MPN/100mL	225	130	219	308	345	184	579	1050	397	236	345		

Table 16: Complete analytical sampling results for Flat Rock Creek.

ANALYTE	Date Sampled											
	7/24/25	8/7/25	9/9/25	10/14/25	11/13/25	12/2/25	1/14/26	2/9/26	3/18/26	4/21/26	5/14/26	6/11/26
BOD (5) Day (BDL 2.0) mg/L	3.0	3.0	3.0	3.0	3.0	1.1	3.3	3.0	1.6	3.0	3.0	3.0
Cadmium, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Conductivity µS	474	451	352	394	345	343	318	384	382	623	456	726
Copper, Total (BDL 0.50) µg/L	1.22	1.10	1.05	1.56	0.69	0.63	0.85	0.91	0.78	1.65	1.10	1.76
Flow CFS	3.091	4.029	1.316	1.542	1.608	2.888	2.099	2.107	2.625	4.120	3.052	6.173
Hardness, Total (BDL 20) mg/L	150	140	130	140	160	210	170	170	170	240	180	240
Lead, Total (BDL 0.50) µg/L	0.50	0.50	0.50	1.12	0.50	0.50	0.50	0.50	0.50	0.56	0.50	0.50
Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.51	0.50	0.52	0.50	0.50
Nitrogen, Nitrate-Nitrite (BDL 0.20) mg/L	0.27	0.28	0.20	0.20	0.20	0.40	0.21	0.26	0.20	0.59	0.33	0.54
Nitrogen, Total as N (BDL 0.50) mg/L	0.77	0.78	0.70	0.70	0.70	0.90	0.71	0.77	0.70	1.11	0.83	1.04
Oxygen Demand, Chemical (BDL 20) mg/L	20	20	20	23	20	20	20	20	22	20	20	25
Oxygen, Dissolved mg/L	5.60	5.75	6.95	4.88	10.14	13.07	10.12	10.48	11.54	6.57	6.72	5.94
pH (s.u.)	7.70	7.83	7.90	7.71	7.95	8.29	8.03	7.98	8.21	8.10	7.87	7.94
Phosphorus, Total (BDL 0.010) mg/L	0.038	0.032	0.022	0.055	0.025	0.023	0.020	0.014	0.016	0.041	0.018	0.036
Phosphorus, Total Dissolved BDL (0.010) mg/L	0.014	0.026	0.014	0.030	0.020	0.018	0.010	0.010	0.010	0.026	0.011	0.023
Solids, Total Dissolved (BDL 25) mg/L	248	228	210	244	235	310	250	301	285	406	298	396
Solids, Total Suspended (BDL 2.5) mg/L	7.1	5.8	2.5	12.0	2.8	2.5	2.5	3.8	3.7	14.0	2.5	4.2
Temperature, Water °C	27.2	26.5	19.8	21.7	9.6	3.2	7.7	8.0	10.2	17.3	19.3	26.7
Turbidity (NTU)	9.82	7.03	4.01	23.70	3.38	2.56	2.58	3.15	4.28	8.29	3.58	5.17
Zinc, Total (BDL 10) µg/L	19.30	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Results found to be below the detection limit are reported as the detection limit												

Table 17: Complete *E. coli* sampling results for Flat Rock Creek.

ANALYTE	Date Sampled												
	7/24/25	7/29/25	8/7/25	9/9/25	9/29/25	10/1/25	11/1/25	12/2/25	1/14/26	2/9/26	3/18/26	4/21/26	5/4/26
<i>E. coli</i> (BDL 1) MPN/100mL	166	152	249	206	210	236	54	72	64	17	68	206	228
ANALYTE	Date Sampled												
	5/13/26	5/14/26	5/18/26	5/26/26	5/27/26	6/4/26	6/8/26	6/9/26	6/11/26				
<i>E. coli</i> (BDL 1) MPN/100mL	152	219	435	210	365	980	687	308	387				

Table 18: Complete analytical sampling results for Hager Creek.

ANALYTE	Date Sampled											
	7/23/25	8/11/25	9/3/25	10/8/25	11/5/25	12/9/25	1/7/26	2/5/26	3/10/26	4/8/26	5/7/26	6/10/26
BOD (5) Day (BDL 2.0) mg/L	2.3	3.0	3.0	3.0	3.1	3.0	3.0	3.3	3.0	3.0	3.0	3.0
Cadmium, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Conductivity µS	1037	941	602	742	676	590	648	702	825	815	884	814
Copper, Total (BDL 0.50) µg/L	1.14	3.28	1.60	1.16	1.14	1.00	1.09	1.24	1.53	1.99	1.36	1.84
Flow CFS	0.279	0.000	0.180	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hardness, Total (BDL 20) mg/L	280	240	210	250	270	320	300	310	280	290	330	270
Lead, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.55
Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L	0.50	0.50	0.54	0.50	0.86	0.50	0.50	0.69	0.88	0.72	0.50	0.50
Nitrogen, Nitrate-Nitrite (BDL 0.20) mg/L	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.32
Nitrogen, Total as N (BDL 0.50) mg/L	0.70	0.70	0.74	0.70	1.06	0.70	0.70	0.89	1.08	0.92	0.70	0.82
Oxygen Demand, Chemical (BDL 20) mg/L	23	33	20	21	20	20	20	22	22	20	20	22
Oxygen, Dissolved mg/L	5.85	3.10	3.92	2.87	7.40	11.87	9.69	10.91	7.52	8.92	8.39	6.01
pH (s.u.)	7.89	7.78	7.81	7.64	7.85	8.03	7.98	8.08	7.78	7.85	7.97	7.71
Phosphorus, Total (BDL 0.010) mg/L	0.032	0.033	0.038	0.045	0.043	0.019	0.013	0.011	0.019	0.023	0.022	0.052
Phosphorus, Total Dissolved BDL (0.010) mg/L	0.017	0.026	0.017	0.026	0.031	0.020	0.011	0.010	0.015	0.016	0.020	0.027
Solids, Total Dissolved (BDL 25) mg/L	554	498	359	448	473	526	522	570	479	573	638	487
Solids, Total Suspended (BDL 2.5) mg/L	4.8	5.9	4.9	9.1	2.5	2.5	2.5	2.5	2.8	5.6	3.4	13.0
Temperature, Water °C	28.3	25.9	22.5	20.1	14.4	4.4	7.7	4.6	18.1	15.3	15.3	25.5
Turbidity (NTU)	5.06	6.70	8.97	9.13	2.14	2.21	1.99	2.11	2.96	4.62	4.22	12.50
Zinc, Total (BDL 10) µg/L	10.00	10.00	10.00	10.00	10.00	10.00	34.10	10.00	10.00	10.00	10.00	10.00
Results found to be below the detection limit are reported as the detection limit												

Table 19: Complete *E. coli* sampling results for Hager Creek.

ANALYTE	Date Sampled												
	7/23/25	7/29/25	8/11/25	9/3/25	9/29/25	10/8/25	11/5/25	12/9/25	1/7/26	2/5/26	3/10/26	4/8/26	5/4/26
<i>E. coli</i> (BDL 1) MPN/100mL	238	172	137	291	52	26	75	461	91	69	205	144	308
ANALYTE	Date Sampled												
	5/7/26	5/13/26	5/14/26	5/18/26	5/26/26	5/27/26	6/4/26	6/8/26	6/9/26	6/10/26	6/11/26		
<i>E. coli</i> (BDL 1) MPN/100mL	248	3010	261	172	1550	727	1120	687	579	411	411		

Table 20: Complete analytical sampling results for Harlow Creek.

ANALYTE	Date Sampled											
	7/24/25	8/5/25	9/17/25	10/15/25	11/4/25	12/8/25	1/12/26	2/11/26	3/12/26	4/9/26	5/4/26	6/17/26
BOD (5) Day (BDL 2.0) mg/L	3.0	3.0	3.0	3.0	3.0	3.0	3.0	5.1	6.0	8.0	3.0	3.0
Cadmium, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Conductivity µS	494	365	2166	1508	764	609	616	571	644	984	653	603
Copper, Total (BDL 0.50) µg/L	0.62	0.50	0.50	0.50	0.78	0.52	0.60	0.54	0.59	0.59	0.90	1.05
Flow CFS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.291	0.486
Hardness, Total (BDL 20) mg/L	170	140	440	410	240	260	280	300	230	300	220	180
Lead, Total (BDL 0.50) µg/L	0.50	0.60	1.09	0.50	0.62	0.50	0.50	0.50	0.50	0.75	0.50	0.50
Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L	0.79	0.66	0.58	0.50	0.92	0.60	0.66	0.60	0.60	0.60	0.50	0.50
Nitrogen, Nitrate-Nitrite (BDL 0.20) mg/L	0.33	0.26	0.20	0.20	0.30	0.39	0.20	0.20	0.34	0.20	0.20	0.24
Nitrogen, Total as N (BDL 0.50) mg/L	1.12	0.92	0.78	0.70	1.22	0.99	0.86	0.80	0.94	0.80	0.70	0.74
Oxygen Demand, Chemical (BDL 20) mg/L	20	20	39	33	29	20	24	20	33	30	25	20
Oxygen, Dissolved mg/L	1.25	3.05	3.34	3.14	6.16	12.40	15.97	9.42	7.91	5.51	6.94	5.19
pH (s.u.)	6.73	6.89	7.56	7.30	7.36	7.56	7.95	7.84	7.70	7.55	7.48	7.32
Phosphorus, Total (BDL 0.010) mg/L	0.064	0.072	0.293	0.054	0.064	0.054	0.049	0.030	0.040	0.070	0.030	0.033
Phosphorus, Total Dissolved BDL (0.010) mg/L	0.022	0.036	0.072	0.040	0.026	0.023	0.017	0.017	0.025	0.048	0.023	0.020
Solids, Total Dissolved (BDL 25) mg/L	293	243	1520	1060	516	507	533	575	418	698	407	320
Solids, Total Suspended (BDL 2.5) mg/L	7.1	8.1	3.8	5.3	9.6	8.1	5.4	2.8	2.5	6.2	7.6	4.5
Temperature, Water °C	23.5	22.6	24.7	21.2	13.4	5.6	5.5	8.9	12.0	16.4	18.9	25.5
Turbidity (NTU)	7.77	11.40	2.41	5.02	13.50	7.70	5.19	3.84	6.99	8.97	6.07	5.15
Zinc, Total (BDL 10) µg/L	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Results found to be below the detection limit are reported as the detection limit												

Table 21: Complete *E. coli* sampling results for Harlow Creek.

ANALYTE	Date Sampled												
	7/24/25	7/29/25	8/5/25	9/17/25	9/29/25	10/1/25	11/4/25	12/8/25	1/12/26	2/11/26	3/12/26	4/9/26	5/4/26
<i>E. coli</i> (BDL 1) MPN/100mL	236	131	172	8	47	11	112	13	1	1	8	1	33
ANALYTE	Date Sampled												
	5/13/26	5/14/26	5/18/26	5/26/26	5/27/26	6/4/26	6/8/26	6/9/26	6/10/26	6/11/26	6/17/26		
<i>E. coli</i> (BDL 1) MPN/100mL	21	33	61	50	27	2420	687	214	161	54	35		

Table 22: Complete analytical sampling results for Mooser Creek.

ANALYTE	Date Sampled											
	7/7/25	8/6/25	9/10/25	10/9/25	11/13/25	12/8/25	1/20/26	2/3/26	3/12/26	4/8/26	5/5/26	6/16/26
BOD (5) Day (BDL 2.0) mg/L	3.0	4.2	3.0	3.0	3.0	3.0	4.2	4.0	3.8	3.0	3.0	3.0
Cadmium, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Conductivity µS	830	500	511	572	531	492	441	706	640	633	680	553
Copper, Total (BDL 0.50) µg/L	1.40	1.61	1.60	1.11	0.99	0.85	0.91	1.66	2.21	2.27	3.41	2.56
Flow CFS	0.988	0.096	0.000	0.000	0.000	0.129	0.069	0.000	0.114	0.000	-0.045	0.754
Hardness, Total (BDL 20) mg/L	330	230	240	230	310	310	310	380	260	290	310	230
Lead, Total (BDL 0.50) µg/L	0.56	0.50	0.50	0.50	0.50	0.50	0.50	0.87	0.68	0.67	1.16	1.09
Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L	0.50	0.56	0.61	0.50	0.50	0.50	500.00	1.06	0.58	0.77	0.50	0.50
Nitrogen, Nitrate-Nitrite (BDL 0.20) mg/L	0.22	0.25	0.20	0.20	0.40	0.30	0.20	0.39	0.25	0.32	0.20	0.35
Nitrogen, Total as N (BDL 0.50) mg/L	0.72	0.81	0.81	0.70	0.90	0.80	500.20	1.45	0.83	1.09	0.70	0.85
Oxygen Demand, Chemical (BDL 20) mg/L	20	24	20	20	20	20	20	35	24	20	20	20
Oxygen, Dissolved mg/L	7.45	6.11	6.72	5.68	8.14	13.32	19.14	13.05	8.90	13.98	6.89	6.87
pH (s.u.)	7.86	7.81	7.88	7.71	7.70	7.99	7.97	7.79	7.83	7.77	7.78	7.80
Phosphorus, Total (BDL 0.010) mg/L	0.038	0.033	0.023	0.030	0.043	0.022	0.017	0.051	0.039	0.038	0.042	0.066
Phosphorus, Total Dissolved (BDL 0.010) mg/L	0.013	0.019	0.016	0.026	0.031	0.018	0.010	0.010	0.014	0.014	0.025	0.024
Solids, Total Dissolved (BDL 25) mg/L	496	374	400	349	421	430	448	678	463	502	441	23*
Solids, Total Suspended (BDL 2.5) mg/L	12.0	7.7	4.4	3.5	7.5	2.5	3.4	8.6	15.0	6.2	52.0	7.6
Temperature, Water °C	25.7	24.9	20.1	19.7	9.3	5.0	1.3	1.7	9.7	14.5	19.3	21.7
Turbidity (NTU)	14.80	11.80	5.80	5.38	8.10	3.60	4.02	28.80	18.70	17.60	15.40	23.30
Zinc, Total (BDL 10) µg/L	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Results found to be below the detection limit are reported as the detection limit												

Table 23: Complete E. coli sampling results for Mooser Creek.

ANALYTE	Date Sampled												
	7/7/25	7/29/25	8/6/25	9/10/25	9/29/25	10/9/25	11/13/25	12/8/25	1/20/26	2/3/26	3/12/26	4/8/26	5/4/26
E. coli (BDL 1) MPN/100mL	687	2420	285	195	1410	75	365	48	22	137	22	248	308
ANALYTE	Date Sampled												
	5/5/26	5/13/26	5/14/26	5/18/26	5/26/26	5/27/26	6/4/26	6/5/26	6/9/26	6/10/26	6/11/26	6/11/26	
E. coli (BDL 1) MPN/100mL	285	133	162	308	548	613	1990	1200	365	411	770	791	

Table 24: Complete analytical sampling results for Nickel Creek.

ANALYTE	Date Sampled											
	7/23/25	8/18/25	9/16/25	10/8/25	11/5/25	12/11/25	1/7/26	2/4/26	3/16/26	4/1/26	5/7/26	6/17/26
BOD (5) Day (BDL 2.0) mg/L	3.0	3.0	3.0	3.0	3.0	3.8	3.0	7.0	3.0	3.0	3.0	3.0
Cadmium, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Conductivity µS	571	490	425	380	388	364	366	360	427	515	490	522
Copper, Total (BDL 0.50) µg/L	2.76	0.89	1.34	0.74	1.10	1.07	1.08	1.38	1.61	1.24	1.24	1.86
Flow CFS	1.683	0.028	0.553	0.017	0.718	0.473	1.156	1.635	1.662	0.602	1.348	2.571
Hardness, Total (BDL 20) mg/L	180	150	160	150	180	210	190	210	200	200	210	170
Lead, Total (BDL 0.50) µg/L	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Nitrogen, Kjeldahl, Total (BDL 0.50) mg/L	0.51	0.50	1.65	0.50	0.74	0.79	0.61	0.58	0.50	0.50	0.50	0.50
Nitrogen, Nitrate-Nitrite (BDL 0.20) mg/L	0.20	0.20	0.20	0.20	0.28	0.20	0.20	0.20	0.34	0.20	0.20	0.20
Nitrogen, Total as N (BDL 0.50) mg/L	0.71	0.70	1.85	0.70	1.02	0.99	0.81	0.78	0.84	0.70	0.70	0.70
Oxygen Demand, Chemical (BDL 20) mg/L	20	20	20	20	22	20	20	20	20	27	20	22
Oxygen, Dissolved mg/L	5.22	4.60	3.84	4.57	7.75	11.52	11.28	13.07	11.67	7.61	8.55	5.57
pH (s.u.)	7.57	7.52	7.52	7.59	7.70	7.85	7.81	7.95	8.08	7.60	7.73	7.60
Phosphorus, Total (BDL 0.010) mg/L	0.027	0.024	0.031	0.034	0.042	0.026	0.014	0.012	0.024	0.029	0.024	0.036
Phosphorus, Total Dissolved BDL (0.010) mg/L	0.015	0.023	0.014	0.021	0.023	0.014	0.010	0.010	0.012	0.014	0.015	0.017
Solids, Total Dissolved (BDL 25) mg/L	304	247	247	213	278	303	218	293	319	300	316	290
Solids, Total Suspended (BDL 2.5) mg/L	3.2	2.5	2.5	3.9	2.7	3.7	2.5	4.6	2.5	4.6	4.6	6.1
Temperature, Water °C	27.6	26.8	23.8	20.5	13.4	6.2	7.6	1.9	9.6	20.7	15.1	24.6
Turbidity (NTU)	3.74	2.78	2.76	4.05	5.75	5.92	4.10	4.35	3.09	7.03	7.14	8.99
Zinc, Total (BDL 10) µg/L	10.00	10.00	10.00	10.00	10.00	10.00	42.40	10.00	10.00	10.00	10.00	10.00
Results found to be below the detection limit are reported as the detection limit												

Table 25: Complete E. coli sampling results for Nickel Creek.

ANALYTE	Date Sampled												
	7/23/25	7/29/25	8/18/25	9/16/25	9/29/25	10/8/25	11/5/25	12/11/25	1/7/26	2/4/26	3/16/26	4/1/26	5/4/26
E. coli (BDL 1) MPN/100mL	548	145	37	228	88	96	261	70	65	33	172	166	308
ANALYTE	Date Sampled												
	5/7/26	5/13/26	5/14/26	5/18/26	5/26/26	5/27/26	6/4/26	6/8/26	6/9/26	6/10/26	6/11/26	6/17/26	
E. coli (BDL 1) MPN/100mL	313	158	109	186	548	866	1730	727	517	488	461	186	

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4. Follow-Up and Response Program

Overview

The Follow up and Response program responds to exceedances in water quality standards (WQS) reported by the laboratories as a result of Watershed Characterization monthly sampling. The purpose of the program is to locate and eliminate or rule out any point source pollutant contributing to WQS exceedances. Testing and follow up procedures vary depending on the analyte exceedance including, but not limited to, YSI readings, ammonia, total chlorine, fluoride, detergents, copper test strips, total dissolved solids (TDS), and further laboratory testing as appropriate. Upon identification of the source, if considered to be a possible point source, findings are reported to a number of agencies including SWQ compliance officers, COT Sewer Operations and Maintenance, COT Water Department, ODEQ, and Oklahoma Corporation Commission.

For FY26, there were a total of 69 exceedances to WQS that warranted follow ups. The majority of exceedances were attributed to by E. coli at 78.2% of the total amount of follow-ups. Exceedances for dissolved oxygen (DO) followed behind, making up approximately 17.4% of the total exceedances investigated for FY26. ArcGIS mapping, Sanitary Sewer Overflow (SSO) reports, YSI, ammonia, and total chlorine testing were used to determine possible source for elevated E. coli levels.

Section 9 – Summary of Data Used to Assess SWMP Pollution Reduction Effectiveness

Table 1: Overview of follow-ups from FY 25-26.

Month	Follow up Stream	Parameter	Result	WQS	Source	SSO Occurrence
July 2025	Crow Creek	E. coli	387, 326 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Dirty Butter Creek	E. coli	166, 236 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Flat Rock Creek	E. coli	166, 152 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	1
	Hager Creek	E. coli	238, 172 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Harlow Creek	D.O.	1.25 mg/L	5 mg/L	Segmentation	NA
	Harlow Creek	E. coli	236, 131 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Mooser Creek	E. coli	687, 2420 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Nickel Creek	D.O.	3.74 mg/L	5 mg/L	No	NA
August 2025	Nickel Creek	E. coli	548, 145 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Crow Creek	E. coli	345 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Dirty Butter Creek	E. coli	345 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Flat Rock Creek	E. coli	249 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	1
	Hager Creek	D.O.	3.1 mg/L	5 mg/L	Segmentation	NA
	Hager Creek	E. coli	137 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Harlow Creek	D.O.	3.05 mg/L	5 mg/L	Segmentation	NA
	Harlow Creek	E. coli	172 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
September 2025	Mooser Creek	E. coli	285 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Nickel Creek	D.O.	4.63 mg/L	5 mg/L	No	NA
	Crow Creek	E. coli	228, 287 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	1
	Dirty Butter Creek	E. coli	461, 291 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	1
	Flat Rock Creek	E. coli	206, 210 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	1
	Hager Creek	D.O.	3.92 mg/L	5 mg/L	Segmentation	NA
	Hager Creek	E. coli	291 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Harlow Creek	Tot. Phos.	0.293 mg/L	0.24 mg/L	No	NA
October 2025	Harlow Creek	D.O.	3.34 mg/L	5 mg/L	Segmentation	NA
	Mooser Creek	E. coli	195, 1410 cfu/100mL	126 cfu/100mL	Suspected Abandoned Sanitary Sewer	0
	Nickel Creek	D.O.	3.84 mg/L	5 mg/L	No	NA
	Nickel Creek	E. coli	288 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Crow Creek	E. coli	192 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Dirty Butter Creek	E. coli	214 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	0
	Flat Rock Creek	E. coli	236 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	1
	Flat Rock Creek	D.O.	4.88 mg/L	5 mg/L	No	NA
November 2025	Hager Creek	D.O.	2.87 mg/L	5 mg/L	No	NA
	Harlow Creek	D.O.	3.14 mg/L	5 mg/L	No	NA
	Nickel Creek	D.O.	3.84 mg/L	5 mg/L	No	NA
	Crow Creek	E. coli	326 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Dirty Butter Creek	E. coli	326 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Dirty Butter Creek	Turbidity	114 NTU	50 NTU	Bank stabilization project	NA
	Dirty Butter Creek	Lead	8.21 mcg/L*	Acute 140.29 mcg/L, *Chronic 5.46 mcg/L	Suspected nonpoint runoff	NA
	Mooser Creek	E. coli	365 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
December 2025	Nickel Creek	E. coli	261 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Crow Creek	E. coli	461 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Hager Creek	E. coli	133 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
January 2026	Crow Creek	E. coli	192 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
February 2026	Crow Creek	E. coli	145 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Mooser Creek	E. coli	137 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
March 2026	Crow Creek	E. coli	816 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Dirty Butter Creek	E. coli	144 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Hager Creek	E. coli	205 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Mooser Creek	E. coli	222 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Nickel Creek	E. coli	172 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
April 2026	Crow Creek	E. coli	308 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	2
	Dirty Butter Creek	E. coli	186 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Flat Rock Creek	E. coli	206 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	1
	Hager Creek	E. coli	144 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Mooser Creek	E. coli	248 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
May 2026	Nickel Creek	E. coli	166 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Crow Creek	E. coli	308 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Dirty Butter Creek	E. coli	225 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Flat Rock Creek	E. coli	219 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	5
	Hager Creek	E. coli	248 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
June 2026	Mooser Creek	E. coli	285 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Nickel Creek	E. coli	313 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Crow Creek	E. coli	613 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	2
	Dirty Butter Creek	E. coli	345 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Flat Rock Creek	E. coli	291 cfu/100mL	126 cfu/100mL	Suspected Sanitary Sewer	5
	Hager Creek	E. coli	411 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Mooser Creek	E. coli	291 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0
	Nickel Creek	E. coli	186 cfu/100mL	126 cfu/100mL	Suspected nonpoint source	0

Crow Creek

Crow Creek exceeded WQS for *E. coli* in all twelve months of the year with follow-ups finding no exceedances to total chlorine, ammonia, or dissolved oxygen (DO). There was a total of seven reported SSOs within Crow creek watershed in FY26. The majority of these overflows were found to have occurred in the months of May and June 2026 during heavy rain events. Microbial Source Tracking (MST) was also taken during Watershed Characterization sampling events and found to have less than 1% contribution in months other than those with reported SSOs. No other exceedances of WQS were identified during FY26.

This stream is also noted to be heavily channelized with manmade, stabilized banks and houses with backyards backing up directly to the stabilized bank. This leads to the potential of nonpoint sources contributing to exceedances of *E. coli*, including pet waste contribution.

Studies to narrow down nonpoint source contaminants within this watershed alongside Education and Outreach are planned for FY27. Strategic weekly sampling of *E. coli* is to be extended within this watershed past FY26 alongside Responsible Pet Ownership mailers sent to households in zip codes 74114 and 74105. Sampling will continue after mailers are sent to monitor for any changes to *E. coli* levels within this watershed. Results will likely be reported in SWQ FY27 Annual Report.

Dirty Butter Creek

Dirty Butter Creek had exceedances for *E. coli* 9 out of the 12 months of the year, falling off the exceedances list in the winter months of December 2025 through February 2026. Dirty Butter had three reported SSOs during FY 26 with one reported in August 2025 and two in June 2026. Dirty Butter creek is a mixture of channelized and natural stream. Ammonia, total chlorine, and DO readings on this stream for follow-up response resulted in no exceedances to these analytes. Microbial source tracking samples were taken on this stream indicated a small amount of fecal indicator bacteria contribution by humans. *E. coli* exceedances on this stream are likely a mixture of urban human activity and wildlife dependent upon the stream.

This stream had one exceedance for turbidity, which was found to be caused by an upstream bank stabilization project. This was found to be resolved by time follow-up testing was performed but had also resulted in sedimentation of the watershed characterization sample site.

Lead was resampled at strategically selected sites along this stream after an exceedance of chronic levels during watershed sampling event. Subsequent sampling and strategic sampling found levels of lead to be less than both chronic and acute lead exceedance levels with no further exceedances were observed within this watershed for lead.

In December 2025, a fish kill was discovered and investigated within Dirty Butter creek watershed. The source was identified and resolved. While this occurred more than a month prior to winter benthic macroinvertebrate sampling, this could impact benthic macroinvertebrate scores for that sampling event.

Flat Rock Creek

Flat Rock Creek had exceedances for *E. coli* in 7 out of the 12 months monitored, dropping off in the months of November 2025 through March 2026. Ammonia, total chlorine, and YSI readings used on this stream during follow-up and response found no exceedances to levels when tested. There was a total of 17 SSOs reported within this watershed throughout the fiscal year. This is an urban stream with a mixture of channelized and natural areas. Human urban activities, domesticated animals, and wildlife are likely to contribute to elevated *E. coli* levels within this stream. Flat Rock creek had one WQS exceedance for DO in October 2025 with an unknown cause.

In December 2025, a fish kill was discovered and investigated within Flat Rock creek watershed. The source was identified upstream in Dirty Butter creek watershed and resolved. While this occurred more than a month prior to winter benthic macroinvertebrate sampling, this could impact benthic macroinvertebrate scores for that sampling event.

Hager Creek

Hager Creek had exceedances for *E. coli* in 5 out of the 12 months monitored. Hager creek is a channelized stream with some natural area upstream. There is a wildflower meadow planted by COT on the west bank of this stream. Habitat assessment on this stream revealed upstream beaver dams on this stream segment. Birds, including waterfowl, were regularly observed in and around the water at this segment of stream. There were no reported SSOs in this watershed for FY26 and no exceedances were found with follow-up testing of ammonia, total chlorine, and YSI readings. Elevated *E. coli* levels within this stream are potentially due to nonpoint sources such as wildlife activities.

This stream is low to no flow throughout the year and largely segmented outside of wet weather events (>72 hours after significant rainfall). This is likely the cause of low DO readings measured across the months of August through October. Despite low DO readings, no fish kills were reported, and active fish were found at the sample site during each sampling event.

Harlow Creek

Harlow Creek sample site was moved during FY26. The old sample site was a segmented, stagnant site that was difficult to navigate with unsafe banks. This site was sampled in July and August 2025. In both July and August, this site had exceedances for *E. coli* and DO. Ammonia and total chlorine assessments resulted in no exceedances for WQS. Dissolved oxygen did not improve at this site upon reevaluation. No exceedances to WQS were noted with follow-up testing performed with ammonia, total chlorine, and YSI readings. No SSOs were reported within this watershed for FY26. Low DO and elevated *E. coli* levels are potentially due to wildlife and the stagnant nature of this portion of the stream.

The sample site was moved downstream, closer to the discharge point at the Arkansas River. This site had better and safer access to the stream. DO was found to be in exceedance during the months of September and October. No fish kills were found as a result of low DO. The following 8 months this stream was sampled resulted in no further exceedances in DO. Additionally, *E. coli* was noted to improve as well, resulting in no further exceedances of WQS during watershed characterization sampling events.

There was one exceedance to Total Phosphorus in September 2025. This resolved and did not recur during FY26 sampling events. This was likely due to lawn maintenance activities in the area of the sample site.

Mooser Creek

Mooser Creek is an urban stream with some natural areas. This stream is noted to have sedimentation to the stream bed, likely from upstream construction activities. Despite construction, this stream did not exceed WQS for turbidity in any of the months sampled.

E. coli exceeded WQS in 9 of the 12 months it was sampled. One SSO was reported within this watershed during FY26. One month was noted to have old, abandoned sanitary sewer lines removed during the construction project, likely contributing to elevated *E. coli* levels within that month. Ammonia and YSI readings showed no exceedances in WQS with follow-up testing. Total chlorine did exceed WQS in November 2025, likely as a result of a reported water line break at the construction site upstream. Exceedances to *E. coli* are potentially due to a combination of human urban activity, disturbance of soil during construction activities, and wildlife activity. Mooser creek had no other exceedances to WQS for FY26. There were no other WQS noted to have exceedances during FY26.

Nickel Creek

Nickel Creek is a more natural stream with a wildflower meadow planted by the COT on the west bank of the sample site. Upstream of the sample site at Nickel creek are known pastures with livestock. Nickel Creek was noted to have exceedances to WQS of *E. coli* in 7 of the 12 months sampled. Follow-up testing showed no exceedances to ammonia, total chlorine, and YSI readings. There were no SSOs reported within this watershed for FY26. *E. coli* levels within this stream are likely from domestic livestock and wildlife.

There were exceedances for DO in this stream in 4 out of the 12 months of the year. Reevaluating DO readings by YSI in the afternoons showed an improvement to the DO. This site is noted to have submerged and emergent vegetation at the sample site, likely the cause of the fluctuation in DO readings throughout the day. No dead fish

were found at this location as a result of the DO levels in the earlier hours of the day. There were no other WQS noted to have exceedances for FY26.

303(d) Sampling

The Follow up and Response program has begun extra sampling on targeted streams outside of rotation that are listed on the ODEQ's 2024 303d list. This list includes impairment listings for *E. coli*, DO, and TDS. While certain metals are tested during watershed characterization testing, there are some metals and minerals without water quality standards that can contribute to excessive TDS in surface waters and can be the result of past mining activities. Analytes such as Manganese (Mn), Iron (Fe), Calcium (Ca²⁺), Potassium (K⁺), Magnesium (Mg²⁺), Chloride (Cl⁻), and Sulfate (SO₄²⁻) are being tested on streams listed on the ODEQ 303d list and believed to have headwaters near an abandoned coal or strip mine. Berryhill Creek is used as a control for comparison, as no known mines were located by historical maps near the headwaters for this stream. Further results of this study will be reported in FY27 Annual Report, results from the beginning of 303(d) sampling can be found in the tables and figures below.

Table 3: Minerals results for 303(d) TDS study.

Minerals						
Watershed	Ca (mg/L)	K (mg/L)	Mg (mg/L)	Na (mg/L)	Cl (mg/L)	SO ₄ (mg/L)
Berryhill Creek	55	3.9	10.5	20.8	22	32.6
Coal Creek (W.C.)	81.5	3.6	24.1	36.8	24.1	117
Coal Creek 6080	91	5.9	39.9	50.3	28.2	141
Salt Creek	247.7	6.7	144.3	114.7	7.1	1080
South Park Creek	88	3.2	19.3	82.5	36	103
Upper Mill Creek	97.6	4.1	28.7	35.2	30	158

Table 4: Metals results for 303(d) TDS study.

Metals						
Watershed	Cd (µg/L)	Cu (µg/L)	Pb (µg/L)	Zn (µg/L)	Mn (mg/L)	Fe (mg/L)
Berryhill Creek	0.5	2.5	1.4	10.7	0.1	1.2
Coal Creek (W.C.)	0.5	1.0	0.5	10	0.1	0.2
Coal Creek 6080	0.5	1.7	0.5	10	0.1	0.3
Salt Creek	0.5	0.7	0.5	10	1.0	0.3
South Park Creek	0.5	1.3	0.5	10	0.05	0.2
Upper Mill Creek	0.5	1.3	0.5	10	0.03	0.2

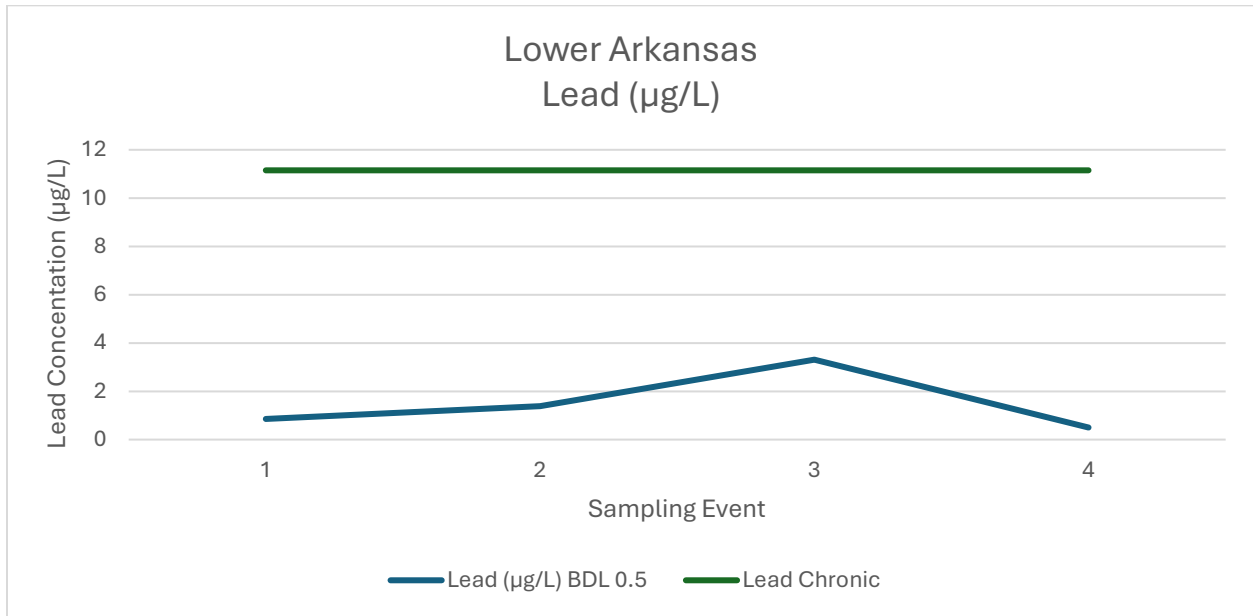


Figure 1: Lower Arkansas lead concentrations.

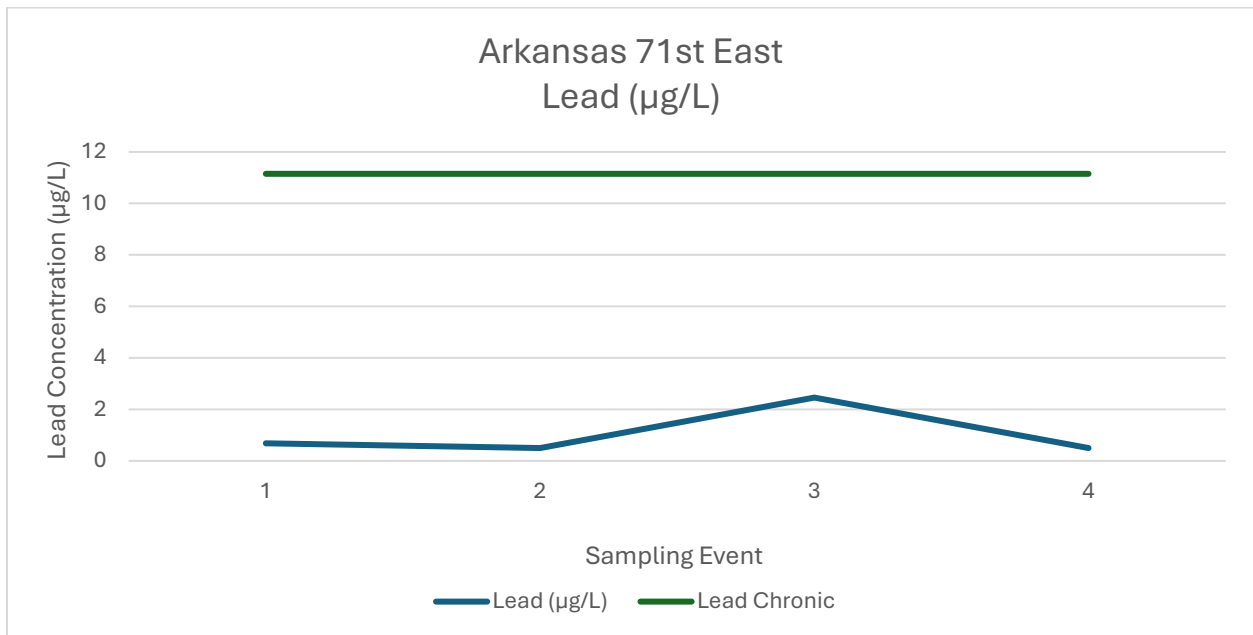


Figure 2: Arkansas 71st East lead concentration.

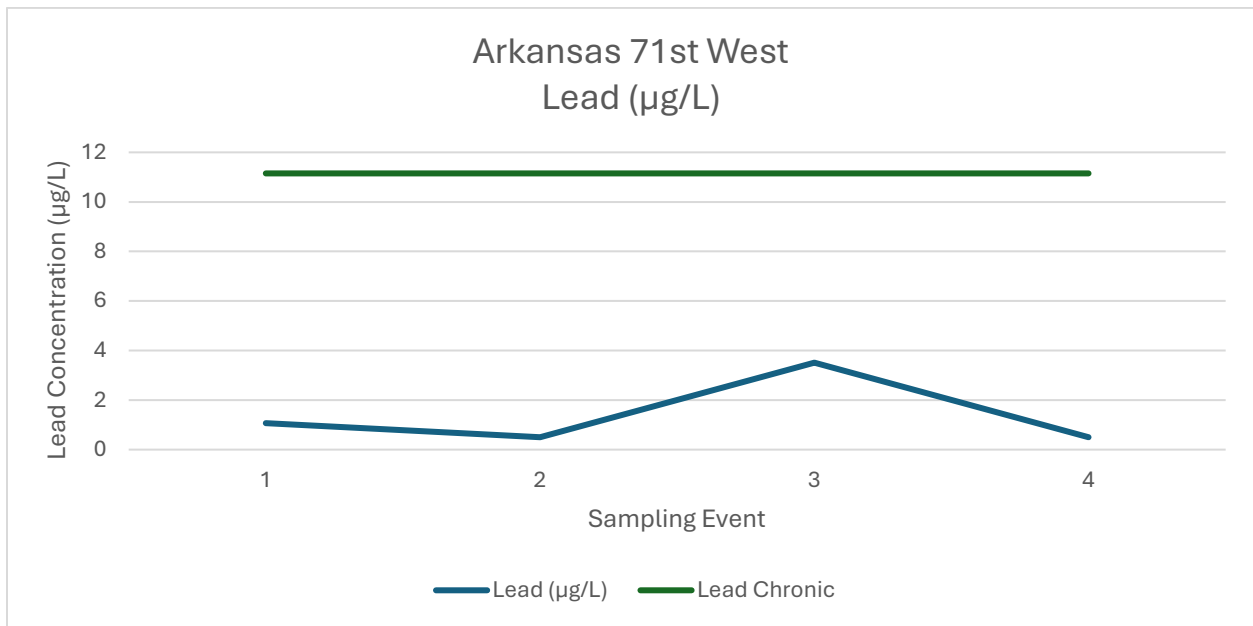


Figure 3: Arkansas 71st West lead concentration.

5. MST Report

Microbial source tracking (MST) sampling was conducted in collaboration with the University of Oklahoma's Oklahoma Water Survey, led by Dr. Jason Vogel. Sampling took place within watershed characterization locations, TMDL waterbodies, Zink Lake sites, and other areas of concern to evaluate potential sources of bacterial contamination. MST analyses focus on detecting specific genetic markers that act as biological indicators to differentiate between different sources of bacteria, such as human, dog, avian, and ruminant host groups. These markers provide valuable insight into the origins of bacteria detected in stormwater and surface waters.

The following is the report created by the University of Oklahoma for the City of Tulsa.

MICROBIAL SOURCE TRACKING REPORT

Project Sponsor: City of Tulsa | CY2025

University of Oklahoma: Jason Vogel, Madelynn Henderson, Jacobey King, Cody
Whatley, and kristen shelton

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SUMMARY

The Oklahoma Water Survey at the University of Oklahoma processed 229 stream water samples between May and November 2025. Samples were tested on three core qPCR assays, and an additional three assays were analyzed for specific sites and dates at the request of the City of Tulsa. Each samples recovery was assessed, with an overall pass rate of 98% for the entire season. This pass rate emphasizes the quality of samples processed for fecal marker analysis. Data was consolidated and reported to the City of Tulsa on a regular basis.

Overall findings from the 2025 recreational season indicate elevated fecal contamination across all site groups, warranting targeted remediation. Zink Lake showed persistent ruminant and goose contamination, while Berryhill and Douglas Creeks were consistently elevated across all markers. Among the TMDL sites, Coal Creek PED039 and Haikey Creek 574 both ranked in the highest quartile for multiple contamination sources including avian, human, and dog markers. Bird Creek TMDLs had elevated human and ruminant contamination. Arkansas River TMDL sites were primarily elevated for dog contamination. These results highlight the need for source-specific interventions across the study area.

The relationship between *E. coli* concentration and MST markers and their concentrations was explored, suggesting there is evidence of a significant relationship between *E. coli* concentration and human, dog, and avian markers. An additional analysis was performed to assess the markers when *E. coli* concentration exceeds the single-sample recreational water safety standard set by the EPA. These results indicated that human and dog marker concentration were significantly associated with fecal contamination in the 90th percentile. This analysis helps inform the relationship between baseline monitoring practices and marker concentration, which can be used as a tool for future monitoring.

The sampling locations encompass a broad gradient of land use conditions from heavily urbanized to forested, agricultural, and rural landscapes. Spearman rank correlations between land use and MST marker concentrations revealed a clear source-landscape relationship. Human and dog markers were most strongly associated with developed land cover and impervious surfaces, while the ruminant marker was significantly correlated with forested, agricultural, and wetland land classes. The avian marker showed no significant association with any land use category. These findings provide a spatially informed foundation for prioritizing best management practices.

An analysis was performed to examine the relationship between rain events and MST markers. There is evidence of a significant relationship between rain events within a 72-hour period and an increase in human and ruminant fecal contamination. The amount of precipitation was also correlated with the markers, with a potentially significant relationship between the amount of precipitation and the human marker. These results suggest that additional sampling should be targeted for rain events to

further investigate the impacts of rain events at MST locations. This will help inform best management practices that mitigate contamination following inclement weather.

The reliability and reproducibility of the field duplicate samples and laboratory triplicates were assessed and were within acceptable bounds for environmental MST monitoring. Observed variability was likely attributable to natural sample heterogeneity and concentration-dependent qPCR dynamics rather than systematic methodological error. These results support the overall reliability of the dataset, though results for low-concentration markers should be interpreted with appropriate consideration of their higher associated uncertainty, and conclusions regarding fecal source contributions are best drawn from multiple lines of evidence including detection frequency, concentration trends, and weather-stratified analyses.

Microbial Source Tracking (MST) provides a powerful and targeted approach to identifying the origins of fecal contamination in recreational waterways, enabling water quality interventions that are mindful of source-specific management strategies. In this report, MST marker data were analyzed across multiple lines of evidence, including associations with *E. coli* concentrations, land use, precipitation events, and data quality assessments. These analyses helped develop a comprehensive characterization of fecal source contributions across the Tulsa area and provide a spatially and temporally informed foundation for prioritizing source-specific best management practices. Continued MST monitoring across all site classifications following BMP implementation is strongly recommended, as continued marker-specific surveillance represents the most direct and reliable means of evaluating whether management interventions are achieving meaningful reductions in fecal contamination and protecting recreational water quality over time.

Recommendation	Markers/Method	Sites	Rationale
Highest Priority: Continued Monitoring			
Continued TMDL site monitoring	All markers	TMDL (all)	Further monitoring will indicate success of interventions, especially at critical sites like Haikey Creek 574 and Coal Creek PED039.
Continued Zink Lake site monitoring	DG3, GFD, CGOF	Zink Lake (all)	Monitor effectiveness of interventions and further characterize fecal contamination along the Arkansas River.
Continued Watershed Characterization site monitoring	All markers	Watershed Characterization (all)	Continued monitoring to distinguish between rural and urban fecal contamination sources
Medium Priority: Targeted Expansion			
Increased avian monitoring	CGOF, other	All sites	Provides higher resolution into fecal contamination by bird populations.
Additional marker(s)	Wildlife marker(s)	Salt Creek, Quarry Creek, Upper Mingo Creek	Persistence of W-Char. sites on 303d list despite low concentration of existing markers.
Targeted storm sampling	All markers	All sites (prioritize TMDLs)	Current rain events analyses limited by small sample size, intentional weather event sampling will expand on 2025 season analysis.
Challenge sampling	All markers	Known fecal samples	QAQC analysis for cross-amplification of known fecal samples within the drainage area.
Lower Priority: Exploratory			
Synoptic shotgun eDNA survey	Shotgun metagenomics	All sites	Survey to detect all fecal sources without prior host assumptions, identifying hosts not captured by targeted assays.

INTRODUCTION

The City of Tulsa lies within the Arkansas River Basin, a hydrologically complex region with diverse land uses spanning residential, agricultural, commercial, and highly urbanized communities (Figure 1). Several streams throughout this watershed have been identified as impaired and listed on the 2024 303(d) list, with a subset of these subjected to Total Maximum Daily Load (TMDL) designations, which carry allocated funding and targeted pollutant reduction requirements.

Accurately identifying the sources of contamination in this region presents a significant challenge. Bacterial indicators alone cannot reliably distinguish between point source and nonpoint source pollution, limiting the effectiveness of broad remediation efforts. Microbial Source Tracking (MST) offers a more precise solution. By detecting host-associated genetic markers in environmental water samples, MST can pinpoint the origin of fecal contamination that enables targeted, cost-effective cleanup strategies.

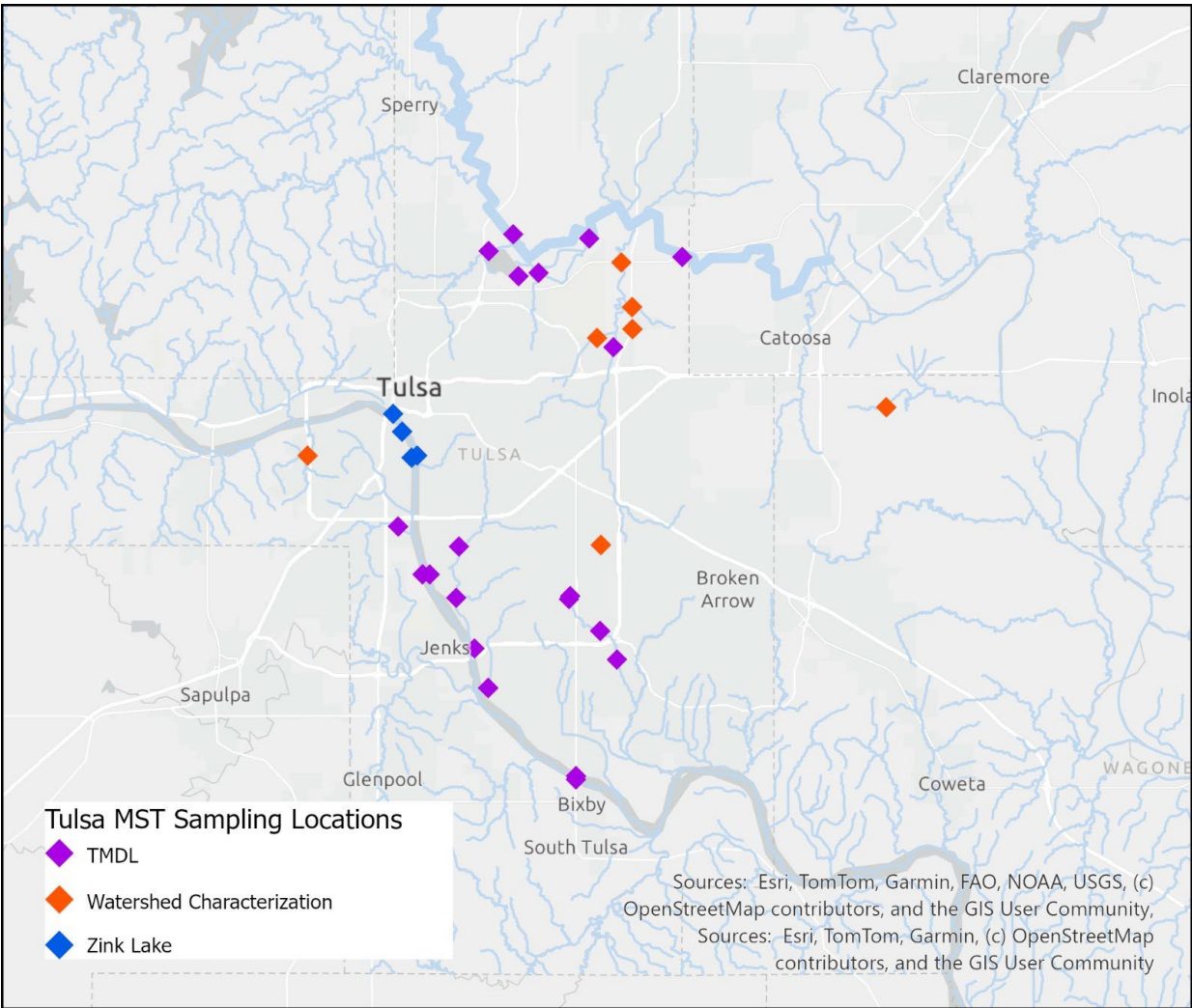


Figure 1 Tulsa microbial source tracking (MST) sampling locations.

Table 1 Microbial Source Tracking sources and markers

Microbial Source	Marker	Marker organism	Reference
Human	HF183	<i>Bacteroidales</i>	Green et al. 2014, USEPA 2019
Dog	DG3	<i>Bacteroidales</i>	Green et al. 2014
General bird	GFD	<i>Helicobacter</i>	Green et al. 2011
Goose	CGOF	<i>Bacteroidales</i>	Fremaux et al. 2010
Ruminant	Rum2Bac	<i>Prevotella</i>	Mieszkin et al. 2010
Horse	HoF	<i>Bacteroidales</i>	Dick et al. 2005

Thirty-one sites were selected for MST analysis for the 2025 recreational season. Each site was evaluated for human, dog, and avian fecal contamination, and a subset of samples were identified for additional analysis for goose, ruminant, and horse contamination (Table 1). Nucleic acid extractions were performed on sample filters and analyzed with quantitative PCR (qPCR). The results were reported weekly throughout the recreational season. This report synthesizes seasonal trends and incorporates several analyses to determine the relationship between the results and determinants of stormwater quality.

METHODS

Sample workflow

Samples were collected by the City of Tulsa team and retrieved by Oklahoma Water Survey sampling team members. All samples were initially processed within a 24–48-hour window from the time of their collection to ensure sample remained representative of original bacterial populations. 100mL of sample was filtered using vacuum filtration onto a 0.47 µm filter. Filters were spiked with 0.2 µg/mL of Salmon sperm DNA (Sketa) to assess sample recovery rate. Nucleic acid extractions were performed on samples using a kit-less extraction method. Samples were prepped for qPCR and immediately archived at -80°C. Molecular analysis included four fixed assays and additional assays by site and stakeholder preferences. All samples were assessed using a Sketa assay to determine sample recovery. Fixed marker assays included human (HF183), dog (DG3), and avian (GFD). Additional assays included Canadian goose (CGOF), ruminant (Rum2Bac), and horse (HOF). Completed assays were evaluated for efficiency and standards before data consolidation and reporting.

Statistical analysis

The primary analytical dataset contains 866 observations drawn from 1,011 raw measurements across 7 markers, 32 tributary sites, and 36 sampling dates (May–November 2025), after excluding 22 failed-recovery samples and reserving 123 field duplicates for QA/QC purposes (Appendix A). Left-censored observations (non-detects and detected-not-quantifiable results) were retained using substitution methods rather than excluded, to avoid upward bias in summary statistics. DG3 and CGOF are restricted to detection frequency reporting due to high censoring rates and insufficient analytical precision for concentration-based comparison.

Statistical analyses employ nonparametric methods appropriate for environmental concentration data. The Mann-Whitney U test and Spearman rank correlation were used to assess relationships between *E. coli* and precipitation, while censored Kendall's tau was applied where non-detects required left-censored treatment. *E. coli* exceedance comparisons evaluated both marker concentrations and detection rates across site-dates.

Watershed delineation was performed for 23 tributary sites using the USGS StreamStats Batch Processor, with land cover classified using NLCD 2021 data into five categories: Developed, Forest, Agriculture, Wetland, and Other. Eight mainstem Arkansas River sites were excluded from watershed-level land use analysis, as their large contributing areas do not reflect local conditions. Antecedent precipitation was obtained from NOAA GHCNd and stratified into five tiers: None, Trace, Light, Moderate, and Heavy.

Results by Site Group

Detection Frequency

The detection frequency is an indicator of a persistent issue within the sample locations, suggesting repeat detections throughout the entire season. To better understand the trends, location, and factors in contamination, the TMDL samples were also broken into their corresponding sample groups: Coal Creek TMDL, Bird Creek TMDL, Arkansas River TMDL, and Haikey Creek TMDL.

Table 2 MST Marker detection frequency

MST Marker Detection Frequency									
n detected / n total (%) Failed recovery samples excluded BacCan excluded									
Marker	Full Name	TMDL Sites					Other Sites		
			Coal Creek	Bird Creek	Arkansas River	Haikey Creek	Watershed	Lake	Lake
Avian									
GFD	Avian: GFD	124/124 (100%)	21 / 21 (100%)	24 / 24 (100%)	55 / 55 (100%)	24 / 24 (100%)	49 / 49 (100%)	26 / 26 (100%)	26 / 26 (100%)
Dog									
DG3	Dog: DG3	32/125 (25.6%)	4 / 21 (19.0%)	6 / 24 (25%)	11 / 56 (19.6%)	11 / 24 (45.8%)	5 / 49 (10.2%)	1 / 26 (3.8%)	1 / 26 (3.8%)
Goose									
CGOF	Goose: CGOF	2/4 (50%)	—	—	2 / 4 (50%)	—	—	18 / 23 (78.3%)	18 / 23 (78.3%)
Horse									
HoF	Horse: HoF	0/1 (0%)	—	—	—	0 / 1 (0%)	—	—	—
Human									
HF183	Human: HF183	113/124 (91.1%)	20 / 21 (95.2%)	21 / 24 (87.5%)	48 / 55 (87.3%)	24 / 24 (100%)	40 / 49 (81.6%)	22 / 26 (84.6%)	22 / 26 (84.6%)
Ruminant									
Rum2Bac	Ruminant: Rum2Bac	31/49 (63.3%)	9 / 9 (100%)	9 / 10 (90%)	11 / 21 (52.4%)	2 / 9 (22.2%)	7 / 14 (50%)	26 / 36 (72.2%)	26 / 36 (72.2%)
Subgroup rows are nested within the overall TMDL summary. Horse marker included. Detection = result_status 'detected_quantified'.									

The avian marker was detected in each sample throughout the recreational season. Human fecal contamination was also frequently detected in the samples, with 91.1% detection in TMDLs and 84.6% detection in Zink Lake samples. Dog fecal contamination was most frequently detected in TMDL sites, where Haikey Creek TMDL locations detection was 45.8%. Ruminant detection was moderately high for the 2025 recreational season, with a detection frequency of 72.2% in Zink Lake sites and 63.3% across all TMDL sites. Coal Creek and Bird Creek TMDL sites had the highest detection frequencies within the TMDL sites (Table 2).

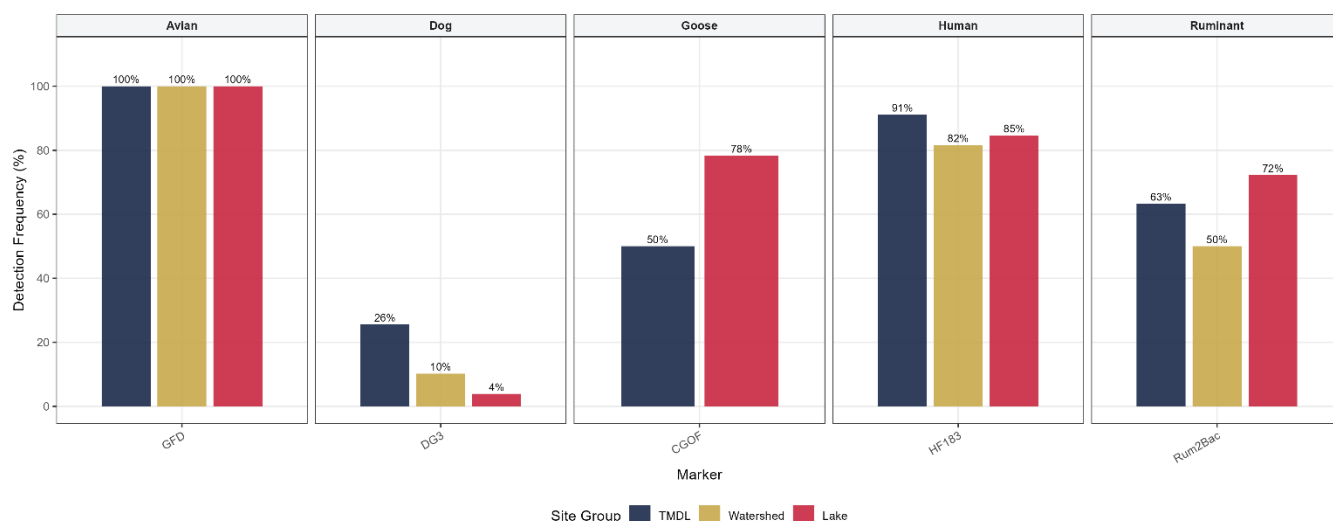


Figure 2 Detection Frequency by Marker and Site Group

Although the detection frequency of the avian marker was 100% for all the sites, the detection frequency and results of the Canadian Goose (CGOF) marker is helpful for interpreting those results. The detection of goose fecal contamination was 78.3% in the Zink Lake samples (Figure 2). Goose marker testing was modest in TMDL locations and not performed on the watershed characterization sites. The mean concentration of avian (GFD) was the highest in the TMDL sites, with an overall concentration of 284,997 copies/100mL (Table 3). Coal Creek TMDL samples had a mean concentration of 797,175 copies/100mL, which disproportionately elevated the overall TMDLs for avian fecal concentration, with other sample groups having mean concentrations between 100,000-400,000 copies/100mL.

Table 3 Avian (GFD) summary statistics

Avian: GFD — Summary Statistics								
Marker: GFD Type: Avian Concentrations in copies/100 mL (back-transformed from log ₁₀)								
Central Tendency								
Site Group	Detection		Percentiles (copies/100 mL)					Mean
	n	% Det.	10th	25th	Median	75th	90th	
TMDL (Overall)	122	100%	67,000	120,497	259,808	762,388	1,936,706	284,997
Coal Creek	21	100%	104,000	380,000	1,000,000	2,400,000	3,500,000	797,175
Bird Creek	22	100%	19,449	45,917	104,881	497,918	696,941	125,034
Arkansas River	55	100%	83,859	125,936	210,000	434,281	967,888	243,141
Haikey Creek	24	100%	91,020	157,701	289,310	772,488	1,816,065	354,847
Watershed	49	100%	20,520	89,000	400,000	1,000,000	2,757,498	269,770
Lake	26	100%	13,000	79,281	280,785	384,901	642,651	170,168

Coal Creek PED039 had the highest concentration between the Coal Creek TMDLs, but there does not appear to be an upstream to downstream trend for the results (Figure 3). The watershed characterization samples had a comparable mean concentration of 269,770 copies/mL for the 2025 recreational season. Berryhill Creek and Douglas Creek had the highest mean concentrations of watershed characterization sites. There is also a slight increase in avian marker downstream from Eagle Creek to Lower Mingo Creek (Figure 3). The Zink Lake sites had the lowest mean concentrations compared to the watershed and TMDL sample groups. The mean avian marker between these sites was relatively consistent (Figure 3).

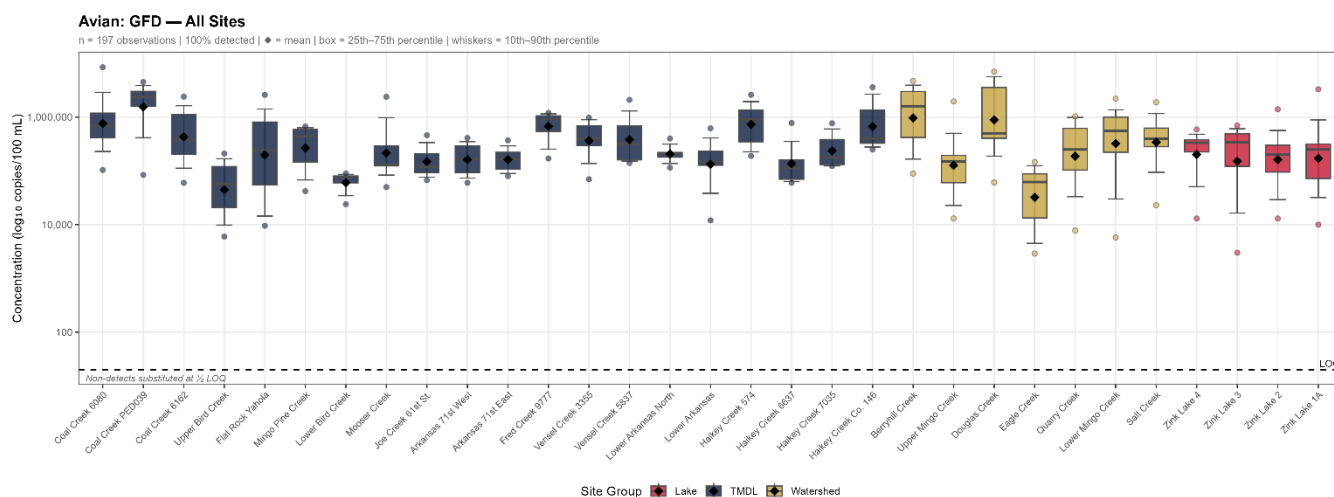


Figure 3 Concentration of avian fecal contamination, organized upstream to downstream

The detection frequency of the human marker was also elevated for the recreational season (Table 2). Detection was highest in the TMDL locations with 91.1% overall and 95.2% detection in Haikey Creek sample locations. The watershed characterization sites and Zink Lake sites also had consistently elevated HF183 detection (Table 2). The TMDL sites also had the highest mean concentration compared to the watershed characterization and Zink Lake locations (Table 4). The Haikey Creek samples had a mean concentration of 14,678 copies/100mL, elevating the overall concentration of 6,524 copies/100mL (Table 4).

Table 4 Human (HF183) summary statistics

Human: HF183 — Summary Statistics								
Marker: HF183 Type: Human Concentrations in copies/100 mL (back-transformed from log ₁₀)								
Central Tendency								
Detection								
Site Group	n	% Det.	10th	25th	Median	75th	90th	Mean
TMDL (Overall)	121	91%	90	830	13,000	62,000	280,000	6,524
Coal Creek	21	95%	90	120	6,000	27,000	114,000	3,107
Bird Creek	22	86%	14	480	11,832	91,141	150,000	5,251
Arkansas River	54	87%	10	1,400	12,490	69,749	293,854	6,633
Haikey Creek	24	100%	291	6,727	16,728	46,201	404,638	14,678
Watershed	49	82%	10	370	2,000	14,000	53,632	1,640
Lake	25	84%	10	200	2,500	46,000	91,807	2,025

Statistics computed on log₁₀-transformed concentrations then back-transformed. Non-detects substituted at ½ LOQ. Failed recovery & BacCan excluded. All values rounded to nearest whole number.

Haikey Creek 574 had the highest mean concentration of the TMDLs, there are slight trends in the TMDL location groups indicating an increase in mean HF183 concentration as samples move downstream, especially in the Arkansas River and Haikey Creek TMDLs (Figure 4). There is also a notable downstream trend in the watershed characterization sites, where the mean concentration (copies/100mL) decreases moving downstream.

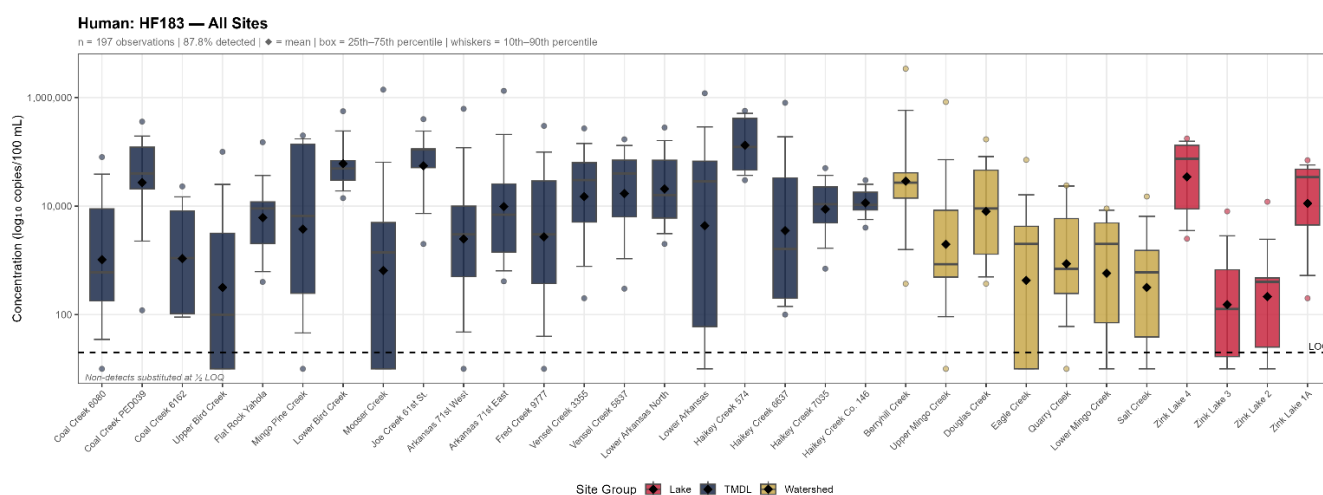


Figure 4 Concentration of human fecal contamination, organized upstream to downstream

Ruminant contamination was predominantly explored in the TMDL and Zink Lake sites. The Zink Lake locations had the highest mean concentration, 1,294 copies/100mL, compared to the other

site groups. However, the Coal Creek TMDLs had a higher mean concentration of 14,245 copies/100mL (Table 5).

Table 5 Ruminant (Rum2Bac) summary statistics

Ruminant: Rum2Bac — Summary Statistics								
Marker: Rum2Bac Type: Ruminant Concentrations in copies/100 mL (back-transformed from log ₁₀)								
Central Tendency								
Site Group	Detection		Percentiles (copies/100 mL)					
	n	% Det.	10th	25th	Median	75th	90th	Mean
TMDL (Overall)	46	61%	10	10	1,949	5,661	21,448	481
Coal Creek	9	100%	2,692	3,000	9,000	20,000	181,308	14,245
Bird Creek	8	88%	169	614	1,789	5,211	9,311	1,319
Arkansas River	20	50%	10	10	126	3,384	8,791	223
Haikey Creek	9	22%	10	10	10	10	3,093	37
Watershed	14	50%	10	10	55	679	935	98
Lake	36	72%	10	10	1,442	28,487	164,317	1,294
Statistics computed on log ₁₀ -transformed concentrations then back-transformed. Non-detects substituted at ½ LOQ. Failed recovery & BacCan excluded. All values rounded to nearest whole number.								

Contamination from dogs was not consistently identified in any of the locations. The detection and concentration of dog fecal contamination was highest in the TMDL samples; Haikey Creek had a mean concentration of 47 copies/100mL. The watershed characterization and Zink Lake samples had modest detection and mean concentration (Appendix B). The goose marker was processed almost exclusively on Zink Lake samples, where the mean concentration was 622 copies/100mL. Four of the Arkansas River TMDL samples were included on the goose assay and resulted in a 50% detection frequency and mean concentration of 344 copies/100mL (Appendix C). Only one Haikey Creek TMDL samples was processed for the horse marker, which resulted in a non-detect (Appendix D).

The overall trends of detection and concentration for the 2025 recreational season suggests actionable steps should be taken towards each of the site groups to address elevated concentrations from the targets. Zink Lake samples consistently had high ruminant and goose contamination (Table 6a). Of the watershed characterization sites, Berryhill Creek and Douglas Creek were consistently elevated for all of the markers. Lower Mingo Creek had a high concentration of avian contamination (Table 6b). Coal Creek TMDLs were also consistently elevated for all of the markers, especially Coal Creek PED039, which fell into the highest quartile for avian, human, and dog contamination (Table 6c). The Haikey Creek TMDLs were generally elevated for human and dog contamination. Haikey Creek 574 fell into the top quartile for avian, human, and dog contamination. Arkansas TMDLs fell into the top quartile for dog contamination. The Bird Creek TMDLs indicated elevated human contamination,

especially in Mingo Pine Creek and Lower Bird Creek. Ruminant contamination was also elevated in Flat Rock Yahola.

Table 6a Quartile Rankings by Site and Marker

Ranked by median concentration (copies/100 mL) | Q1 = top 25% (highest) | Non-detects at ½ LOQ | Failed recovery and BacCan excluded

Site	Group	Avian	Human	Dog	Ruminant	Goose
Zink Lake 1A	Lake	Q2	Q2	Q4	Q1	Q3
Zink Lake 2	Lake	Q3	Q4	Q4	Q2	Q2
Zink Lake 3	Lake	Q2	Q4	Q4	Q1	Q1
Zink Lake 4	Lake	Q2	Q1	Q2	Q2	Q2

■ Q1 Top 25% ■ Q2 Upper middle ■ Q3 Lower middle ■ Q4 Bottom 25%

Table 6b Quartile Rankings by Site and Marker

Ranked by median concentration (copies/100 mL) | Q1 = top 25% (highest) | Non-detects at ½ LOQ | Failed recovery and BacCan excluded

Site	Group	Avian	Human	Dog	Ruminant	Goose
Berryhill Creek	Watershed	Q1	Q2	Q1	Q3	—
Douglas Creek	Watershed	Q1	Q2	Q2	Q1	—
Eagle Creek	Watershed	Q4	Q3	Q2	Q3	—
Lower Mingo Creek	Watershed	Q1	Q3	Q3	Q3	—
Mooser Creek	Watershed	Q4	Q3	Q3	Q4	—
Quarry Creek	Watershed	Q3	Q4	Q4	Q3	—
Salt Creek	Watershed	Q2	Q4	Q3	Q4	—
Upper Mingo Creek	Watershed	Q3	Q4	Q4	Q4	—

■ Q1 Top 25% ■ Q2 Upper middle ■ Q3 Lower middle ■ Q4 Bottom 25%

Table 6c Quartile Rankings by Site and Marker

Ranked by median concentration (copies/100 mL) | Q1 = top 25% (highest) | Non-detects at ½ LOQ | Failed recovery and BacCan excluded

Site	Group	Avian	Human	Dog	Ruminant	Goose
Arkansas 71st East	TMDL	Q3	Q3	Q3	Q1	Q4
Arkansas 71st West	TMDL	Q3	Q3	Q3	Q1	Q4
Coal Creek 6080	TMDL	Q1	Q4	Q3	Q1	—
Coal Creek 6162	TMDL	Q2	Q3	Q2	Q1	—
Coal Creek PED039	TMDL	Q1	Q1	Q1	Q2	—
Flat Rock Yahola	TMDL	Q3	Q2	Q2	Q1	—
Fred Creek 9777	TMDL	Q1	Q3	Q3	Q3	Q1
Haikey Creek 574	TMDL	Q1	Q1	Q1	Q3	—
Haikey Creek 6637	TMDL	Q4	Q3	Q2	Q4	—
Haikey Creek 7035	TMDL	Q3	Q2	Q2	Q4	—
Haikey Creek Co. 146	TMDL	Q2	Q2	Q1	Q2	—
Joe Creek 61st St.	TMDL	Q4	Q1	Q1	Q3	Q3
Lower Arkansas	TMDL	Q4	Q1	Q1	Q2	—
Lower Arkansas North	TMDL	Q3	Q2	Q1	Q2	—
Lower Bird Creek	TMDL	Q4	Q1	Q3	Q2	—
Mingo Pine Creek	TMDL	Q1	Q1	Q2	Q3	—
Upper Bird Creek	TMDL	Q4	Q4	Q4	Q2	—
Vensel Creek 3355	TMDL	Q2	Q2	Q1	Q4	—
Vensel Creek 5837	TMDL	Q2	Q1	Q4	Q4	—

■ Q1 Top 25% ■ Q2 Upper middle ■ Q3 Lower middle ■ Q4 Bottom 25%

E. Coli by Marker

Elevated *E. coli* concentrations in surface waters serve as a primary regulatory indicator of fecal contamination and associated public health risk. However, *E. coli* alone cannot distinguish between diverse animal and human sources that may contribute to fecal contamination in environmental waters. Understanding the relationship between *E. coli* levels and MST markers is essential for identifying pollution sources, prioritizing management interventions, and informing regulatory decision-making. A censored Kendall's tau was employed to assess the correlation between reported *E. coli* concentration (MPN) and the MST markers (Jennings et al., 2018). The results of the censored Kendall's tau suggest that there is a significant relationship between *E. coli* concentration and the concentration of MST markers. This relationship was observed between *E. coli* and human, dog, and avian markers (Table 7). There was no evidence of a significant relationship between *E. coli* concentration and the ruminant marker.

Table 7 Censored Kendall's Tau: *E. coli* MPN vs MST Marker Concentration

Marker	N	N ND	Kendall τ	p-value	Significant
Human: HF183	140	19	0.273	<0.001	Yes
Dog: DG3	134	108	0.525	<0.001	Yes
Avian: GFD	140	0	0.182	0.001	Yes
Ruminant: Rum2Bac	81	21	0.096	0.214	No

Censored Kendall's tau (Helsel, 2012; Boehm et al., 2019). Non-detects treated as left-censored — no value substituted. Only orderable pairs contribute. E. coli (culture-based MPN) is never censored.

The dog marker produced the strongest correlation with *E. coli* ($\tau = 0.525$, $p < 0.001$), despite having the highest rate of non-detects among markers with sufficient sample sizes. The strength of this correlation suggests that when canine fecal contamination is present, it is a meaningful and consistent contributor to elevated *E. coli* concentration. The human and avian marker concentrations were weak to moderate, but still drivers of *E. coli* concentration in the sample locations (Figure 5). Ruminant contributions, where present, do not appear to be a primary driver of *E. coli* variability under the conditions captured in this dataset.

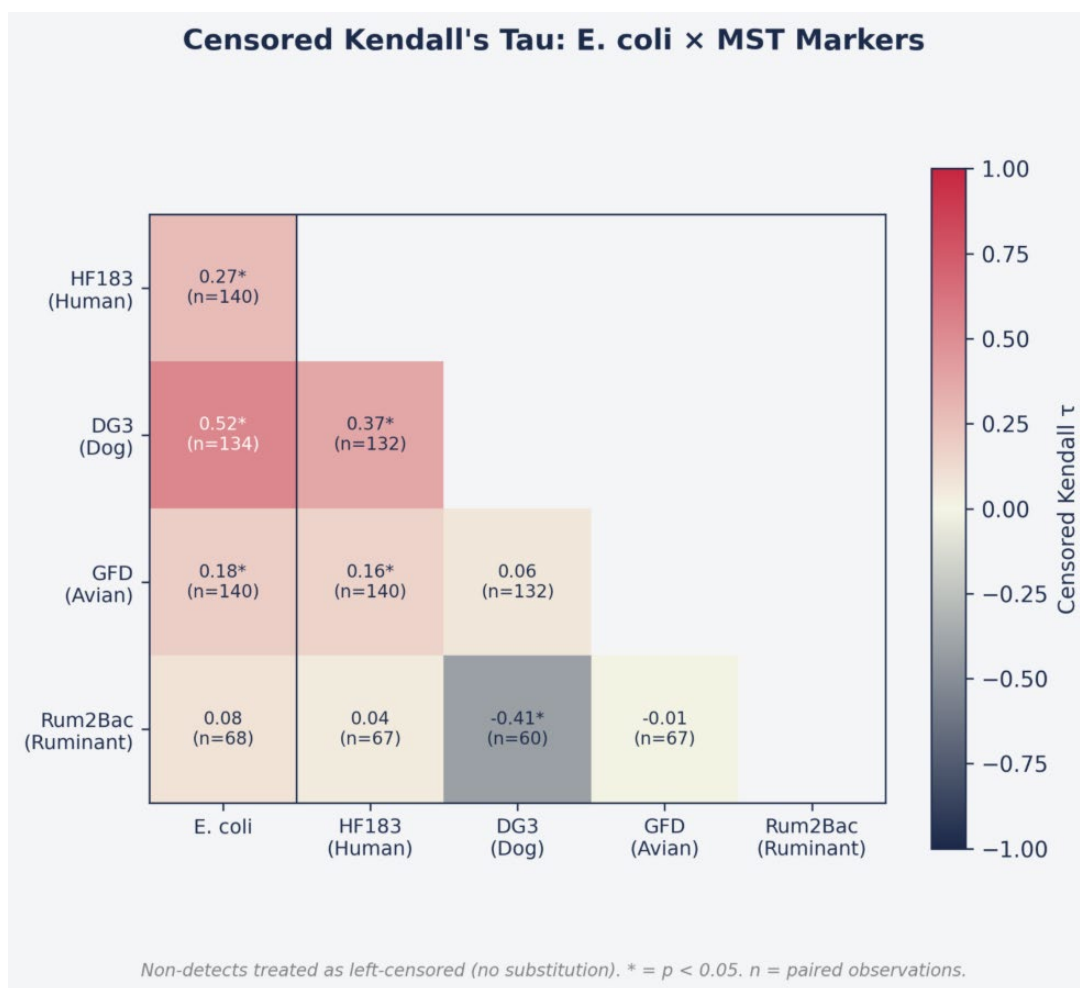


Figure 5 Censored Kendall's Tau Heatmap: *E. coli* × MST Markers

The EPA's guidelines establish the Ten Percent Threshold Value (TPTV) at 406 MPN, a benchmark that generally indicates water is unsafe for recreational use (EPA, 2012). MST marker detection and concentration were then analyzed separately in the context of *E. coli* exceedances: *E. coli* concentration and detection data were paired by site and date, and a Fisher's exact test was conducted to assess whether MST marker detection was more likely to occur when *E. coli* levels exceeded the TPTV.

The human marker was detected frequently regardless of *E. coli* exceedances, with only a modest increase in detection (Table 8). While the odds ratio suggests a positive association, this is not statistically significant ($p=0.091$). Dog contamination was substantially higher during *E. coli* exceedances, where the odds of DG3 detection was 6.3 times more likely when *E. coli* was above 406 MPN ($p<0.001$). This suggests dog contamination is a meaningful contributor to *E. coli* exceedances. There is no evidence of a statistically significant relationship between ruminant contamination and *E. coli* concentration during threshold exceedances (Table 8).

Table 8 MST Marker Detection During *E. coli* Exceedances

Marker	% Det. (>406)	% Det. (≤406)	Odds Ratio	p-value
Human: HF183	93.2	83.3	2.7	0.091
Dog: DG3	40.5	9.8	6.3	<0.001
Ruminant: Rum2Bac	63.9	82.2	0.380	0.983

Detection rate when *E. coli* exceeds vs does not exceed 406 MPN.

The relationship between *E. coli* exceedances and avian detection was not explored due to the 100% detection rate; however, the concentration of the avian marker during these exceedances indicated a potentially significant increase when *E. coli* exceeded the threshold ($p=0.056$) (Table 9). The median concentration of human and dog markers were substantially higher when *E. coli* concentrations exceeded 406 MPN ($p<0.001$). The human marker exhibited a 25.5-fold difference, indicating that human contamination is a strong driver of *E. coli* exceedances (Table 9). Ruminant concentrations were only modestly increased during *E. coli* exceedances, but not statistically significant ($p=0.176$), suggesting there is not a meaningful association between ruminant contamination and elevated *E. coli* concentration.

Table 9 Marker Concentration During *E. coli* Exceedances (copies/100 mL)

Marker	Median (Exceed)	Median (Below)	Fold Difference	p-value
Human: HF183	25,500	1,000	25.5	<0.001
Dog: DG3	40.0	40.0	1.0	<0.001
Avian: GFD	290,000	200,000	1.4	0.056
Ruminant: Rum2Bac	3,450	1,600	2.2	0.176

Median marker concentration when *E. coli* exceeds vs does not exceed 406 MPN. Mann-Whitney U (one-sided): is marker concentration higher during exceedances? All observations (non-detects at LOQ/2).

The results of this analysis revealed that human and dog fecal sources were the most meaningful contributors to the overall fecal indicator burden at these sites. The human marker exhibited a strong association with *E. coli* exceedances in terms of concentration, with a 25.5-fold increase during exceedance events, while dog contamination demonstrated the most significant detection-based association, being over six times more likely to be detected when *E. coli* exceeded the TPTV. In contrast, ruminant and avian markers showed weak or absent associations across both detection and concentration analyses, suggesting these sources contribute to fecal contamination intermittently, at low levels, or in spatial patterns decoupled from the broader *E. coli* signal. These findings highlight human and dog contamination as the primary drivers of *E. coli* exceedances at the study sites, with important implications for targeted source management and remediation efforts.

Impacts of Urbanization by Site

Urbanization and land use patterns are among the most significant drivers of water quality degradation in watersheds. As impervious surfaces replace natural vegetation, stormwater runoff increases in volume and velocity, carrying pollutants directly into nearby streams with little opportunity for natural filtration. In densely developed areas like Tulsa, this process is further complicated by aging sewer infrastructure, illicit discharge connections, and the concentration of human activity near waterways, all of which elevate the risk of fecal contamination (Anh et al., 2023).

The composition of land use within a watershed directly influences the diversity and abundance of MST markers detected in water samples. A total of nine watersheds are represented, ranging considerably in the number of associated sampling sites. The Mooser Creek-Arkansas River watershed contains the greatest number of sites (10), encompassing all Zink Lake sites and many Arkansas TMDL sites (Table 10).

Table 10 *MST Sampling Sites by Watershed*

Watershed	MST Sites
Mingo Creek	Douglas Creek, Eagle Creek, Lower Mingo Creek, Mingo Pine Creek, Quarry Creek, Upper Mingo Creek
Mooser Creek-Arkansas River	Arkansas 71st East, Arkansas 71st West, Fred Creek 9777, Joe Creek 61st St., Mooser Creek, Vensel Creek 3355, Zink Lake 1A, Zink Lake 2, Zink Lake 3, Zink Lake 4
Haikey Creek	Haikey Creek 574, Haikey Creek 6637, Haikey Creek 7035, Haikey Creek Co. 146
Ranch Creek-Bird Creek	Coal Creek 6080, Coal Creek 6162, Coal Creek PED039
Flat Rock Creek-Bird Creek	Flat Rock Yahola, Upper Bird Creek
Harlow Creek-Arkansas River	Berryhill Creek
Posey Creek-Arkansas River	Lower Arkansas, Lower Arkansas North, Vensel Creek 5837
Elm Creek-Bird Creek	Lower Bird Creek
Salt Creek	Salt Creek

GPS (Oklahoma Water Survey) assigned to USGS WBD HUC12 polygons

The identified sites varied substantially in their land use/land cover (Table 11). The majority of sites are characterized by high levels of developed land cover, with many exceeding 90% developed area. Sites such as Fred Creek 9777, Haikey Creek 6637, Joe Creek 61st St., Vensel Creek 3355, and Upper Mingo Creek are nearly entirely urbanized, with developed land comprising 90-100% of their watersheds and correspondingly high impervious surface percentages. A small subset of sites exhibit notably lower development and impervious cover, with land use dominated by forest and agriculture. Upper Bird Creek and Salt Creek represent the most rural end of the spectrum, with developed land comprising only 9% and 4% of their watersheds respectively. Salt Creek is particularly agriculture-dominant at 70%, while Upper Bird Creek and Lower Bird Creek reflect more mixed rural landscapes with substantial forest, agricultural, and other land cover. Mooser Creek is similarly forested at 95%, with an impervious surface percentage of just 0.3%.

Table 11 Watershed Land Use by Site (NLCD 2021)

Site	Group	Area (km ²)	Developed (%)	Forest (%)	Agriculture (%)	Wetland (%)	Other (%)	Imperv. (%)
Coal Creek 6080	TMDL	3.4	85	10	3	0	1	32.4
Coal Creek 6162		44.3	80	7	2	5	5	36.9
Coal Creek PED 039		8.1	56	10	5	8	22	17.5
Flat Rock Yahola		64.9	62	21	11	0	6	24.1
Fred Creek 9777		41.7	99	1	0	0	0	41.6
Haikey Creek 574		2.4	96	4	0	0	0	41.7
Haikey Creek 6637		1.8	99	0	0	0	0	40.0
Haikey Creek 7035		10.7	93	5	1	0	1	40.1
Haikey Creek Co. 146		14.2	91	7	1	0	1	39.6
Joe Creek 61st St		30.2	99	1	0	0	0	43.1
Lower Bird Creek		2911.2	37	25	23	1	14	30.4
Mingo Creek Pine		109.3	87	4	6	0	3	47.1
Upper Bird Creek		2509.7	9	39	30	1	21	1.7
Vensel Creek 3355		0.1	99	1	0	0	0	71.6
Vensel Creek 5837		12.0	94	5	1	1	0	28.9
Berryhill Creek	Watershed	12.7	56	34	6	0	4	14.9
Douglas Creek		8.2	93	2	5	0	0	52.6
Eagle Creek		4.4	53	12	25	0	10	25.0
Lower Mingo Creek		150.3	79	6	9	0	6	43.4
Mooser Creek		0.8	4	95	0	0	1	0.3
Quarry Creek		13.4	46	12	22	0	19	28.2
Salt Creek		8.8	4	18	70	0	8	0.2
Upper Mingo Creek		3.4	100	0	0	0	0	60.8

Watershed land use from NLCD 2021 (30m resolution). Watersheds delineated by USGS StreamStats Batch Processor. Cell color intensity scales with percentage within each land use category. Developed = NLCD classes 21–24. Forest = 41–43. Agriculture = 81–82 (pasture/hay + cultivated crops). Imperv. = mean percent impervious surface (NLCD 2021 Impervious, 30m); grey shading scales with imperviousness. Mainstem Arkansas River and Zink Lake sites excluded.

The association between watershed land use/imperviousness and geomic mean MST marker concentration were explored with a Spearman rank correlation. There were several statistically significant relationships between the marker concentrations and land classifications, all indicated by darker shading (Table 12). The human marker shows a moderate positive association with developed land (+0.41) and impervious surface (+0.27), which aligns with expectations given that human fecal contamination is more likely in urbanized settings with higher population density and infrastructure. The only statistically significant result for this marker is a negative correlation with agricultural land use (−0.42), suggesting human marker concentrations tend to be lower in more rural, agriculturally dominated watersheds.

Table 12 Spearman Rank Correlation: Land Use / Imperviousness vs. MST Marker Concentration

	HF183	DG3	GFD	Rum2Bac
% Developed	+0.41	+0.46*	+0.15	-0.40
% Forest	-0.26	-0.38	-0.10	+0.46*
% Agriculture	-0.42*	-0.44*	-0.19	+0.47*
% Wetland	+0.02	-0.02	+0.01	+0.54*
% Other	-0.37	-0.38	-0.26	+0.58*
% Impervious	+0.27	+0.39	+0.08	-0.27

Bold/shaded with * = $p < 0.05$; italic = $p < 0.10$. NLCD 2021 land cover and impervious surface (30 m).

The dog marker shows a clear urban signal; it is significantly positively correlated with developed land (+0.46) and significantly negatively correlated with agricultural land (-0.44) ($p < 0.05$). The impacts of urban signal of dog and human markers can be visualized in the NLCD land classification of the Arkansas River TMDL sampling locations (Figure 6).

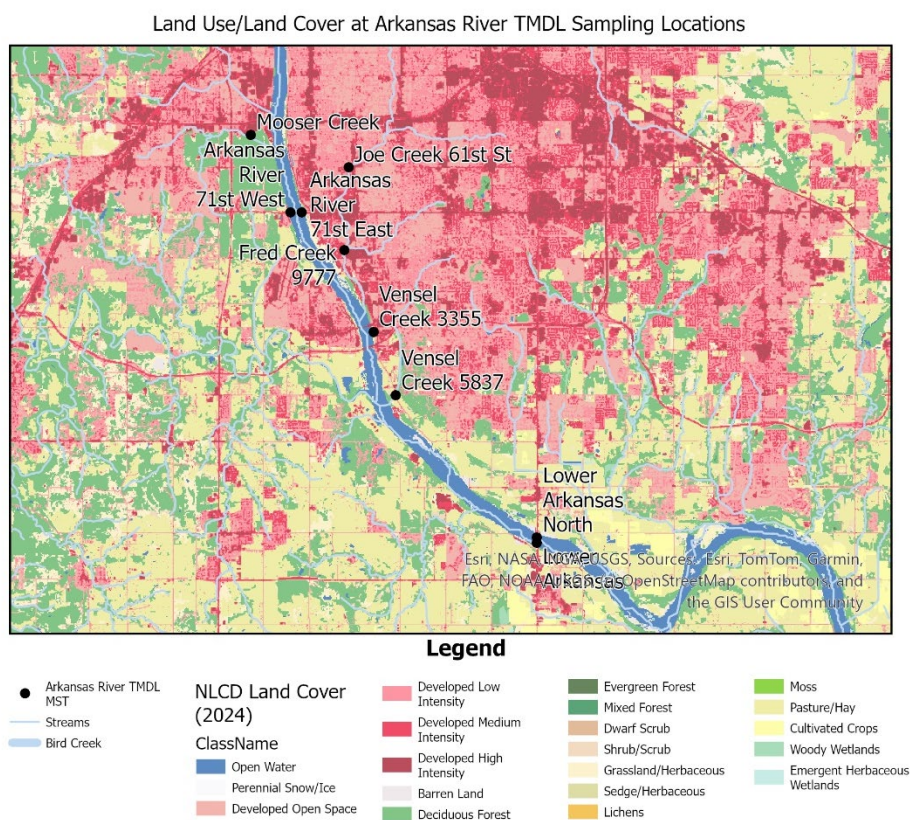


Figure 6 Land Use/Land Cover at Arkansas River TMDL Sampling Locations

There is no evidence of a statistically significant or meaningful correlation between the concentration of the avian marker and land use/imperviousness (Table 12). The ruminant marker is significantly positively correlated with forest (+0.46), agriculture (+0.47), wetland (+0.54), and other land classes (+0.58), while showing negative associations with developed land (-0.40) and impervious surface (-0.27). This strongly suggests that ruminant fecal contamination is concentrated in less

urbanized, more rural watersheds. The Salt Creek location is a clear example of rural and agricultural influence on the MST results (Figure 7).

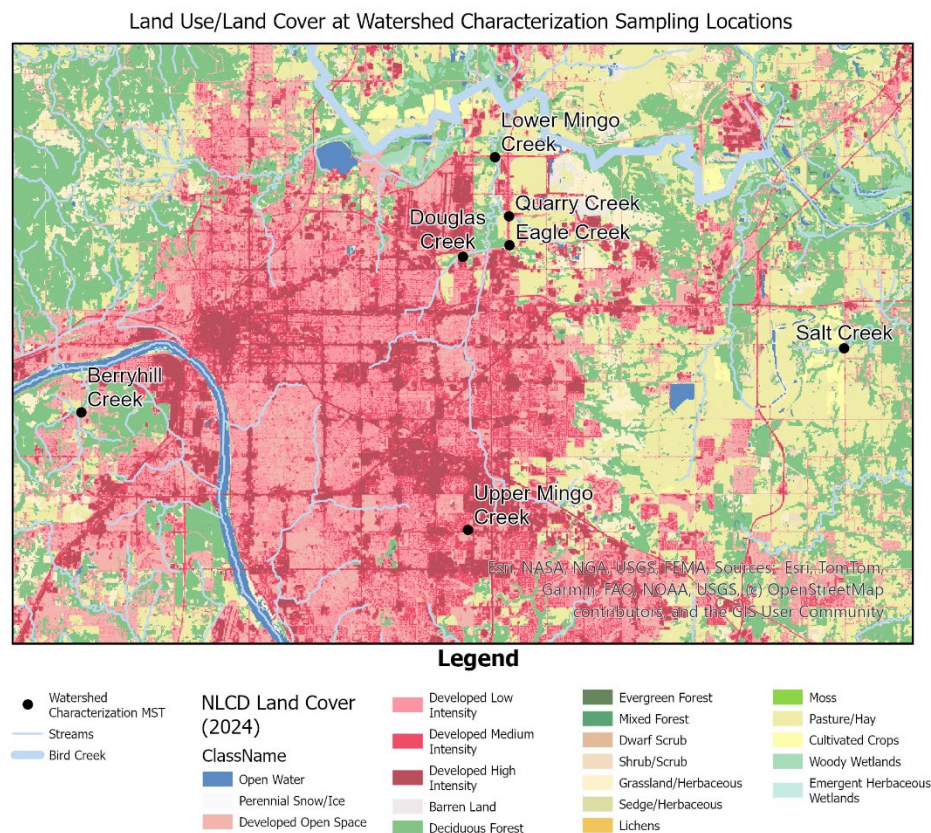


Figure 7 Land Use/Land Cover at Watershed Characterization Sampling Locations

The correlation analysis reveals a clear urban-rural divide in fecal source dynamics. Human and dog contamination are most strongly associated with developed, impervious landscapes, while ruminant contamination is of rural, vegetated, and agricultural watersheds. The avian marker appears largely ubiquitous across all land uses. These patterns are consistent with the ecological expectations for each source and reinforce the importance of land use context when designing targeted fecal source management strategies.

Impacts of Rain Events

Precipitation events represent significant drivers of hydrological and water quality in environmental waters. Rainfall can mobilize contaminants through surface runoff and overwhelm aging sewage infrastructure, leading to elevated levels of fecal indicator bacteria. The conditions of rain events can drastically influence the transport and dilution of microbial contaminants and water quality (Baral et al., 2018). This analysis examines the correlation between short-term precipitation events and results of the 2025 recreational season, aiming to characterize how rainfall influences the detection and abundance of markers. Wet weather conditions were defined as ≥ 0.10 in. cumulative precipitation within 72 hours of sampling.

The summary statistics indicate some discrepancies within the markers for wet/dry conditions; both human and ruminant markers increased substantially during rain events (Table 13). The avian and goose markers decreased in concentration following rain events, indicating potential dilution of the markers. The sample size for some of the groups is notably small, especially for the goose marker (n=21). The dog marker experienced a marginal increase in concentration during precipitation events.

Table13 MST Marker Concentrations in Wet vs Dry Weather (copies/100 mL)

Marker	Weather	N	% Det.	Geo. Mean	Median	P25	P75	Max	Wet:Dry Ratio
Avian: GFD	Dry	136	100.0	255,962	250,000	107,500	827,500	7,000,000	1.0
Avian: GFD	Wet	63	100.0	253,415	270,000	102,000	635,000	8,500,000	1.0
Dog: DG3	Dry	136	16.2	52.0	40.0	40.0	40.0	5,900	1.2
Dog: DG3	Wet	64	26.6	64.0	40.0	40.0	65.0	5,000	1.2
Goose: CGOF	Dry	15	80.0	961.0	1,300	250.0	2,900	200,000	0.700
Goose: CGOF	Wet	12	66.7	665.0	1,600	40.0	4,000	30,000	0.700
Human: HF183	Dry	136	86.8	3,403	4,000	300.0	30,315	1,400,000	2.5
Human: HF183	Wet	63	88.9	8,363	13,200	1,000	69,500	3,400,000	2.5
Ruminant: Rum2Bac	Dry	45	53.3	277.0	100.0	40.0	2,900	46,000	7.0
Ruminant: Rum2Bac	Wet	54	72.2	1,950	1,800	40.0	22,250	540,000	7.0

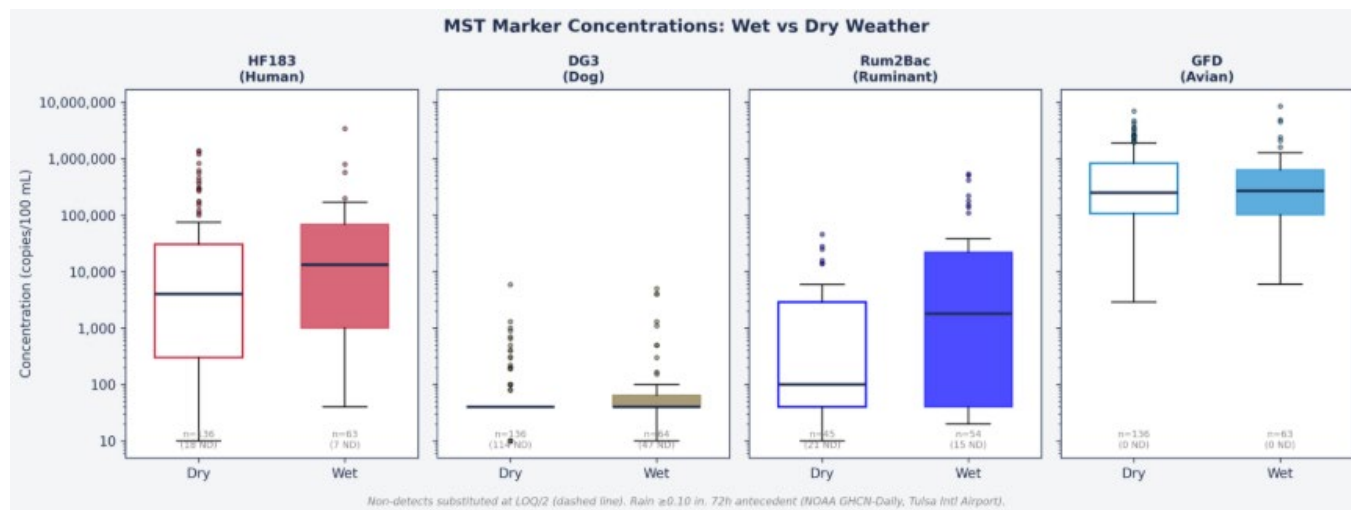
Non-detects substituted at LOQ/2; field duplicates and failed-recovery samples excluded (see Methods). % Det. = detection frequency. Wet:dry ratio computed from geometric means.

The wet:dry ratios indicate considerable variability in the fecal markers during rain events. The ruminant marker exhibited the greatest weather-driven amplification by a substantial margin, with a ratio of 7.0, indicating that ruminant marker concentrations were seven times higher during wet weather than dry. This suggests a strong influence of pasture and agricultural runoff on results. The human and dog markers indicated modest increases in concentration following precipitation, suggesting urban infrastructural influences. The avian marker did not have a meaningful difference between weather

conditions, but the goose marker indicated an inverse relationship, where precipitation events may dilute goose fecal contamination.

Overall, the wet:dry ratios highlight precipitation as a particularly important driver of ruminant and human fecal contamination, with meaningful implications for the timing of sampling efforts and the design of weather-responsive management strategies.

Figure 8 Boxplot comparisons of markers in wet/dry conditions



Box plots showing distribution of marker concentrations (copies/100 mL, log scale) during dry weather (white) and wet weather (filled). Wet weather defined as ≥ 0.10 in, 72-hour antecedent precipitation from NOAA GHCN-Daily.

The significance of the association between rain events and the concentration of the markers was evaluated with a Mann-Whitney test. The analysis reveals a statistically significant relationship ($p = 0.033$) between rain events and human marker concentrations. The negative effect size of -0.227 indicates a small to medium effect, suggesting that human marker concentrations are significantly higher during rain events compared to dry conditions. Similarly, ruminant markers show a statistically significant association with precipitation events ($p = 0.016$) with a medium effect size of -0.342. This negative effect size indicates that ruminant marker concentrations are significantly elevated during rain periods compared to non-rain periods.

Table 14 Mann-Whitney U Test: Wet vs Dry Weather

Marker	N (Wet)	N (Dry)	% Det. (Wet)	% Det. (Dry)	U Statistic	p-value	Effect Size (r)	Significant ($\alpha=0.05$)
Avian: GFD	63	136	100.0	100.0	4,240	0.907	-0.010	No
Dog: DG3	64	136	26.6	16.2	4,648	0.322	0.068	No
Goose: CGOF	12	15	66.7	80.0	89.5	1.0	-0.006	No
Human: HF183	63	136	88.9	86.8	5,089	0.033	0.188	Yes
Ruminant: Rum2Bac	54	45	72.2	53.3	1,635	0.003	0.346	Yes

Two-sided Mann-Whitney U test (rank-based, nonparametric). Non-detects substituted at LOQ/2; field duplicates and failed-recovery samples excluded (see Methods). Effect size is rank-biserial correlation.

The relationship between amount of precipitation and marker concentration was also investigated with a Spearman Correlation (Appendix I). There was one possible significant relationship identified between the amount of precipitation and the human marker ($p=0.050$). More data would be required to investigate a dose-response relationship between precipitation and marker concentration.

These findings demonstrate significant increases in human and ruminant marker concentrations during 72-hour precipitation events, confirming the substantial impact of rainfall on microbial contamination in the selected sampling locations. The observed elevations in human markers during rain events suggest that precipitation mobilizes sewage-related contamination. Similarly, significant increases in ruminant markers indicate that rainfall enhances the transport of livestock-associated contamination via surface runoff from agricultural areas and pastures. The potential dose-response relationship between precipitation amount and human marker concentration indicates rainfall intensity could influence the magnitude of sewage-related contamination events. These results emphasize the importance of considering weather events in water quality monitoring and informing best management practices for urban stormwater and infrastructure.

Quality Assurance Quality Control

Quality assurance and quality control (QAQC) procedures were implemented to evaluate the reliability and reproducibility of results of field and lab analysis. Field duplicate samples were collected to assess variability introduced during sample collection, handling, and transport. Field duplicate performance was evaluated by calculating the relative percent difference (RPD) between the paired samples, indicating grab sample heterogeneity. Laboratory triplicates were assessed for analytical variability of molecular detection methods. The coefficient of variation was assessed by markers to measure the reliability of molecular methods.

The relative percent difference of the markers was analyzed to further understand the variability of field duplicates. The avian marker performed best in terms of the proportion of pairs within target, likely reflecting its consistently high and spatially stable concentrations. The dog and goose markers showed the greatest variability, consistent with their episodic and spatially uneven input patterns. These RPD results should be interpreted as indicators of natural field-level heterogeneity rather than analytical deficiencies, and they emphasize the importance of interpreting MST concentration data with an awareness of the inherent variability associated with grab sampling in aquatic environments.

Table 15 *Field Duplicate Relative Percent Difference*

Marker	N Pairs	RPD Median (%)	RPD Mean (%)	RPD Max (%)	% Within 30%
Avian: GFD	29	30.0	35.9	104.0	51.7
Dog: DG3	3	114.3	87.2	125.0	33.3
Goose: CGOF	1	113.7	113.7	113.7	0.000
Human: HF183	21	40.0	52.8	145.9	33.3
Ruminant: Rum2Bac	12	32.1	38.7	85.7	41.7

RPD = $|Dup - Parent| / ((Dup + Parent)/2) \times 100$. Target: RPD $\leq 30\%$ per EPA guidance. Higher RPD reflects grab sample heterogeneity (field-level variability), not analytical error.

Laboratory analytical precision was strongly influenced by marker concentration (Table 16). High-concentration markers, like avian, performed exceptionally well, and low-concentration markers, like dog, exhibited the greatest variability. This concentration-dependent precision pattern is a characteristic of qPCR and does not indicate methodological deficiencies. Results for dog and goose markers should be interpreted with awareness of their higher analytical uncertainty, while avian and human markers can be considered the most analytically reliable markers in this dataset.

Table 16 *Laboratory triplicate qPCR Coefficient of Variation by Marker*

Marker	N	CV Median (%)	CV Mean (%)	CV P25 (%)	CV P75 (%)	% Good (<25%)	% Accept. (25- 50%)	% Poor (>50%)	GSD Median
Avian: GFD	232	8.9	13.0	5.7	16.2	88.4	9.5	2.2	1.1
Human: HF183	191	19.7	30.9	12.4	40.6	60.2	19.9	19.9	1.2
Ruminant: Rum2Bac	73	24.7	30.5	14.1	39.5	50.7	34.2	15.1	1.3
Goose: CGOF	20	31.3	45.3	25.9	51.4	20.0	55.0	25.0	1.4
Dog: DG3	22	44.1	40.4	19.4	54.3	22.7	31.8	40.9	1.6
Goose: CGOF1-Bac	1	75.4	75.4	75.4	75.4	0.000	0.000	100.0	2.3

CV computed across 3 replicate wells per sample. Good: CV <25%; Acceptable: 25-50%; Poor: >50%. GSD = geometric standard deviation.

Field duplicate and laboratory replicate analyses indicate analytical precision in this project was within acceptable bounds for environmental MST monitoring, with observed variability attributable primarily to natural sample heterogeneity and concentration-dependent qPCR dynamics rather than systematic methodological error. Field duplicate RPD values exceeded the EPA $\leq 30\%$ target across most markers, most notably for the human and dog markers, reflecting the inherently episodic and spatially heterogeneous nature of fecal contamination in grab samples rather than deficiencies in field collection procedures. Laboratory triplicate CVs were generally strong for high-concentration markers, with the avian marker achieving the best precision (median CV 8.9%, 88.4% good) and the dog marker showing the greatest analytical variability (median CV 44.1%, 40.9% poor), consistent with the well-documented relationship between low template concentrations and reduced qPCR reproducibility.

These QAQC results support the overall reliability of the dataset while highlighting that results for low-concentration markers should be interpreted with appropriate consideration of their higher associated uncertainty. The variability observed at both the field and laboratory levels emphasizes the importance of employing multiple lines of evidence, including detection frequency, concentration trends, and weather-stratified analyses, when drawing conclusions about fecal source contributions at these sites.

Future Recommendations

Site specific recommendations

TMDL sites represent the most management-critical locations in this project, as they are subject to existing regulatory load reduction requirements; therefore, continued MST monitoring is essential for demonstrating progress toward those targets. Across TMDL sites, human and dog markers were frequently elevated, particularly at heavily urbanized locations such as the Haikey Creek 574 and Coal Creek PED039. Interventions at these locations could have a substantial impact on their TMDL groups. The strong associations between these markers, *E. coli* exceedances, and wet weather events emphasize the importance for sustained wet-weather sampling programs that inform the precipitation-driven contamination. Recommended BMPs include illicit discharge detection and elimination (IDDE) programs targeting sanitary sewer overflows, proper management and inspection of septic systems for leaks, and expanded pest waste management and associated infrastructure. **Critically, continued monitoring of human and dog markers at TMDL sites is necessary to evaluate the effectiveness of these interventions over time.**

Dog and goose marker concentrations were notably elevated across all Zink Lake sites, suggesting urban recreational activity. Recommended BMPs include targeted goose management through habitat modification. Pet waste management should be reinforced through expanded waste station infrastructure, signage, and public education campaigns directed at recreational users.

Continued monitoring of the dog, avian, and goose markers at the Zink Lake sites is recommended. This would help evaluate the effectiveness of interventions and support a more complete characterization of fecal contamination along the Arkansas River.

Watershed sites reflect a broad gradient of land use conditions, from heavily urbanized sampling locations like Upper Mingo Creek and Douglas Creek to more rural landscapes such as Salt Creek and Mooser Creek. **This diversity of source conditions makes continued monitoring especially valuable at watershed sites, as marker-specific surveillance provides the only reliable means of distinguishing between urban and agricultural fecal contributions when land use is mixed or transitional.** At urbanized watershed sites with elevated human and dog markers, septic system management, continued illicit discharge inspections, stormwater BMP improvements, and pet waste programs are recommended, and ongoing monitoring will be essential for evaluating whether urbanization-driven fecal contamination are effectively reduced. At rural watershed sites where ruminant markers dominated, agricultural BMPs including livestock exclusion fencing and riparian buffer restoration should be implemented and their effectiveness tracked through continued ruminant contamination monitoring across wet and dry weather conditions. However, this is likely outside of the scope of activities of the City of Tulsa and will require partnership with other state and local entities.

Marker-specific Recommendations

Avian fecal contamination was detected at 100% of sampling locations across both wet and dry weather conditions, with concentrations remaining stable regardless of precipitation, which indicates persistent fecal loading rather than a weather-driven input. **While consistent detection limits the diagnostic utility of the avian marker for source-specific management, integrating goose marker surveillance or expanding the waterfowl marker suite could help differentiate between resident and migratory bird contributions and better inform targeted wildlife management strategies.**

The human marker was consistently detected across sites and seasons, with concentrations increasing 2.5-fold during wet weather and showing a significant 25.5-fold concentration increase during *E. coli* exceedance events. These patterns suggest stormwater infrastructure, sanitary sewer overflows, or illicit discharges as potential mobilization pathways during precipitation. **Continued monitoring of the human marker in future recreational seasons is strongly recommended, particularly in conjunction with wet weather sampling, to track the effectiveness of infrastructure improvements.**

The dog marker was the strongest indicator of *E. coli* exceedances from a detection standpoint, being over six times more likely to be detected during exceedance events and showed clear associations with urbanized land cover and impervious surfaces. **Continued dog marker monitoring would provide a sensitive and direct measure of progress toward reducing urban fecal loading at recreational sites.**

The ruminant marker demonstrated the most pronounced wet weather response of all markers, with a sevenfold concentration increase during precipitation events and significant positive correlations with forested, agricultural, and wetland land cover classes. These findings point to surface runoff from upstream agricultural landscapes as the primary transport pathway for ruminant fecal material. **Continued use of this marker in future recreational seasons is recommended to evaluate the effectiveness of rural best management practices.**

The absence of elevated concentrations for existing markers was observed across Quarry Creek, Salt Creek, and Upper Mingo Creek. These watershed characterization sites had little evidence of contamination despite their presence on the 2024 303d list. **We propose including additional markers at these sites that would identify deer or raccoons**, which could both contribute substantially within forested and pasture NLCD land classifications.

Exploratory Recommendations

Traditional marker-based microbial source tracking relies on pre-selected host-specific assays. This methodology is cost effective and efficient but does not capture all fecal contamination sources.

We recommend a one-time synoptic survey employing shotgun environmental DNA (eDNA) analysis that would provide a comprehensive, untargeted profile of fecal contamination sources. Shotgun metagenomics sequences all DNA present in a water or sediment sample, allowing for the detection of microbial communities without prior assumptions about which hosts are contributing.

The rain events analysis revealed significant relationships between the markers and wet/dry conditions. There were also potentially significant correlations between rain events and the human marker; however, these analyses were limited by a small sample size. Implementing a systematic challenge sampling strategy where water samples are collected during discrete storm events, elevated runoff conditions, and varying antecedent moisture conditions would substantially improve the resolution of fecal source dynamics. **Targeted sampling during weather events, paired with real-time hydrological data, would allow fecal source contributions to be interpreted within a hydrological context, enabling the identification of which sources are mobilized under inclement weather conditions.**

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APPENDIX

Appendix A

Statistical Methods

1. Data cleaning

The raw dataset comprises 1,011 observations across 7 markers, 36 sampling dates (May–November 2025), and 32 tributary sites. After excluding 22 failed-recovery samples and reserving 123 field duplicates for QA/QC analysis only, the primary analytical dataset contains 866 observations. For the *E. coli* marker analysis, *E. coli* MPN values from the dated sampling sheets were merged onto the primary qPCR pipeline data by site and date.

Nondetect (ND) and detected-not-quantifiable (DNQ) results are left-censored observations: the true concentration lies between zero and the limit of quantification (LOQ) but cannot be precisely determined. Rather than excluding these observations, which biases summary statistics upward and reduces sample sizes, censored values were substituted for concentration-based analyses.

- ND samples were substituted with LOQ/2
- DNQ samples where replicate values are above the LOQ, the geometric mean of the replicates is used as the concentration estimate. DNQ samples with replicate values at or below the LOQ are treated as censored and assigned LOQ/2.

DG3 and CGOF are **restricted to detection frequency reporting**. Concentration-based analysis is not pursued for these markers due to two analytical limitations: censoring rates exceed thresholds for reliable quantitative analysis and analytical precision is insufficient for quantitative comparison. Detection frequency alone remains informative.

Twenty-two samples flagged with a **failed recovery qualifier** (DNQ-FR or ND-FR) were excluded from analysis entirely. Failed spike recovery indicates matrix interference or PCR inhibition that compromises the result in either direction. The concentration may be artificially elevated or suppressed. Including these samples would introduce unquantifiable error.

Field duplicates (123 observations) were collected as split samples for QA/QC purposes. These are excluded from all primary analyses to avoid pseudoreplication. Field duplicates are used only for the Relative Percent Difference (RPD) analysis in the QA/QC section, which quantifies field-level sampling variability.

2. Statistical Tests

The **Mann-Whitney U test** is a nonparametric rank-based test that makes no assumptions about the distribution of concentrations. The magnitude of these relationships was explored with a rank-biserial correlation (r). Significance is assessed at $\alpha = 0.05$. This test was employed for the *E. coli* and rain events analysis.

The **Spearman rank correlation** is nonparametric statistic, robust to outliers, and detects monotonic (not only linear) relationships. This statistic was utilized to explore the correlations within the *E. coli* and rain events analysis.

Censored Kendall's tau is a nonparametric correlation coefficient that treats qPCR non-detects as left-censored observations without substituting a value. Only pairs where the ordering can be determined despite censoring contribute to the statistic. The standard error uses an effective sample size derived from the number of usable pairs to avoid anti-conservative p-values when censoring is high.

3. *E. coli* × MST Marker Correlation

For each marker, *median concentration* was compared between site-dates where *E. coli* exceeded 406 MPN and site-dates where it did not. Mann-Whitney U (one - sided) tests whether marker concentrations are significantly higher during exceedances. All observations with LOQ/2 substitution.

Detection rates were computed for each marker during *E. coli* exceedances vs non-exceedances. Each site-date is one observation; a marker is 'detected' if not censored. Fisher's exact test (one-sided) assesses whether detection is more likely during exceedances. This analysis includes all five quantitative markers including DG3, which is presence/absence only for concentration statistics, but whose detection status can still be compared against *E. coli* exceedance.

4. Watershed Land Use Characterization

Contributing watersheds for 23 tributary sampling sites were delineated using the USGS StreamStats Batch Processor (v1.6.1; streamstats.usgs.gov). Sampling site coordinates (WGS84) were submitted as a point shapefile. StreamStats snaps each pour point to the nearest cell on a pre-processed 10-meter stream grid and traces upstream to define the contributing drainage area.

Eight mainstem sampling sites (Arkansas River 71st East/West, Lower Arkansas North/South, Zink Lake 1A-4) were excluded from watershed-level land use analysis. These sites sample the Arkansas River directly; their upstream contributing area encompasses the entire upper Arkansas River basin and does not reflect local land use conditions relevant to tributary-level source attribution.

Several sampling sites are located on the same stream at different positions (e.g., four sites along Haikey Creek, three along Coal Creek). StreamStats **delineated nested watershed** polygons for these sites. Each site was assigned to the smallest watershed polygon containing or within 50 m of the sampling point, representing the contributing area upstream of that specific sampling location. Watershed areas range from 0.1 km² (Vensel Creek 3355) to 2,911 km² (Lower Bird Creek-full Bird Creek basin).

Land cover within each delineated watershed was classified using the National Land Cover Database 2021 (NLCD 2021; 30 m resolution; USGS Multi - Resolution Land Characteristics Consortium). Zonal statistics were computed in Python using the rasterstats package, which counts 30 m pixels in each NLCD class within each watershed polygon. NLCD pixel classes were aggregated into five summary categories: Developed (classes 21 - 24: open space through high intensity), Forest (classes 41 - 43: deciduous, evergreen, mixed), Agriculture (classes 81 - 82: pasture/hay and cultivated crops), Wetland (classes 90, 95: woody and emergent herbaceous), and Other (classes 11,

31, 52, 71: water, barren, shrub, grassland). Percentages were computed as pixel count in category divided by total pixels in watershed.

5. Precipitation Classification

Antecedent precipitation was obtained from NOAA GHCNd for Tulsa International Airport (station USW00013968). For each sampling date, 72-hour cumulative precipitation was computed. Data stratification followed two different methods. A **binary wet/dry classification** (wet = ≥ 0.10 in. 72-hour antecedent precipitation) and into **precipitation tiers**. Samples were stratified by antecedent precipitation into five tiers: None (0.00 in.), Trace (>0 - <0.10 in.), Light (0.10 - 0.49 in.), Moderate (0.50 - 1.50 in.), and Heavy (≥ 1.50 in.). These tiers correspond to stormwater activation thresholds and are the primary framework for precipitation analysis.

Appendix B

Dog: DG3 — Summary Statistics								
Marker: DG3 Type: Dog Concentrations in copies/100 mL (back-transformed from $\log_{10}$)								
Central Tendency								
Site Group	Detection		Percentiles (copies/100 mL)					
	n	% Det.	10th	25th	Median	75th	90th	Mean
TMDL (Overall)	120	22%	10	10	10	10	409	23
Coal Creek	20	15%	10	10	10	10	100	17
Bird Creek	23	22%	10	10	10	10	378	24
Arkansas River	53	15%	10	10	10	10	362	18
Haikey Creek	24	46%	10	10	10	200	706	47
Watershed	48	8%	10	10	10	10	10	13
Lake	26	4%	10	10	10	10	10	11

Statistics computed on $\log_{10}$ -transformed concentrations then back-transformed. Non-detects substituted at $\frac{1}{2}$ LOQ. Failed recovery & BacCan excluded. All values rounded to nearest whole number.

Appendix C

Goose: CGOF — Summary Statistics								
Marker: CGOF Type: Goose Concentrations in copies/100 mL (back-transformed from $\log_{10}$)								
Central Tendency								
Site Group	Detection		Percentiles (copies/100 mL)					
	n	% Det.	10th	25th	Median	75th	90th	Mean
TMDL (Overall)	4	50%	10	10	84	2,878	36,665	344
Coal Creek	0	NaN%	NA	NA	NA	NA	NA	NA

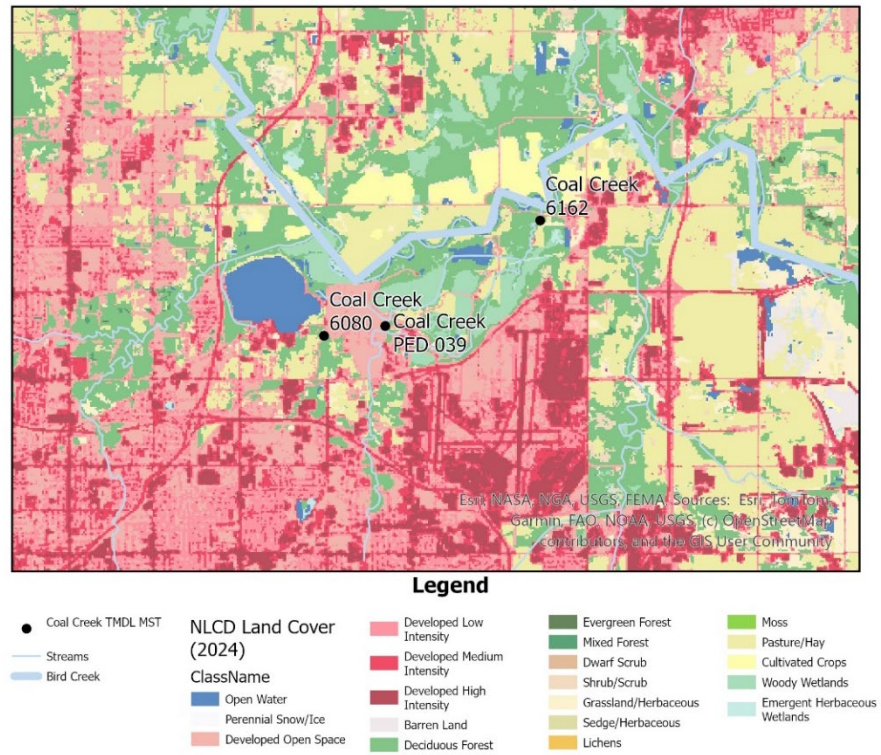
Bird Creek	0	NaN%	NA	NA	NA	NA	NA	NA
Arkansas River	4	50%	10	10	84	2,878	36,665	344
Haikey Creek	0	NaN%	NA	NA	NA	NA	NA	NA
Watershed	0	NaN%	NA	NA	NA	NA	NA	NA
Lake	23	78%	10	126	1,600	4,000	7,282	622
Statistics computed on log ₁₀ -transformed concentrations then back-transformed. Non-detects substituted at ½ LOQ. Failed recovery & BacCan excluded. All values rounded to nearest whole number.								

Appendix D

Horse: HoF — Summary Statistics								
Marker: HoF Type: Horse Concentrations in copies/100 mL (back-transformed from log ₁₀)								
Central Tendency								
Site Group	Detection		Percentiles (copies/100 mL)					
	n	% Det.	10th	25th	Median	75th	90th	Mean
TMDL (Overall)	1	0%	10	10	10	10	10	10
Coal Creek	0	NaN%	NA	NA	NA	NA	NA	NA
Bird Creek	0	NaN%	NA	NA	NA	NA	NA	NA
Arkansas River	0	NaN%	NA	NA	NA	NA	NA	NA
Haikey Creek	1	0%	10	10	10	10	10	10
Watershed	0	NaN%	NA	NA	NA	NA	NA	NA
Lake	0	NaN%	NA	NA	NA	NA	NA	NA
Statistics computed on log ₁₀ -transformed concentrations then back-transformed. Non-detects substituted at ½ LOQ. Failed recovery & BacCan excluded. All values rounded to nearest whole number.								

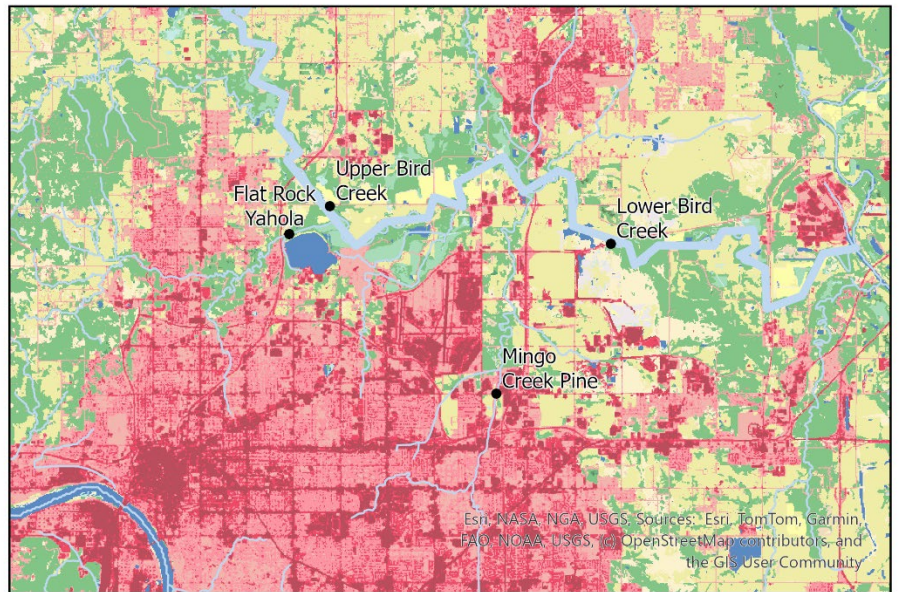
Appendix E

Land Use/Land Cover at Coal Creek TMDL Sampling Locations



Appendix F

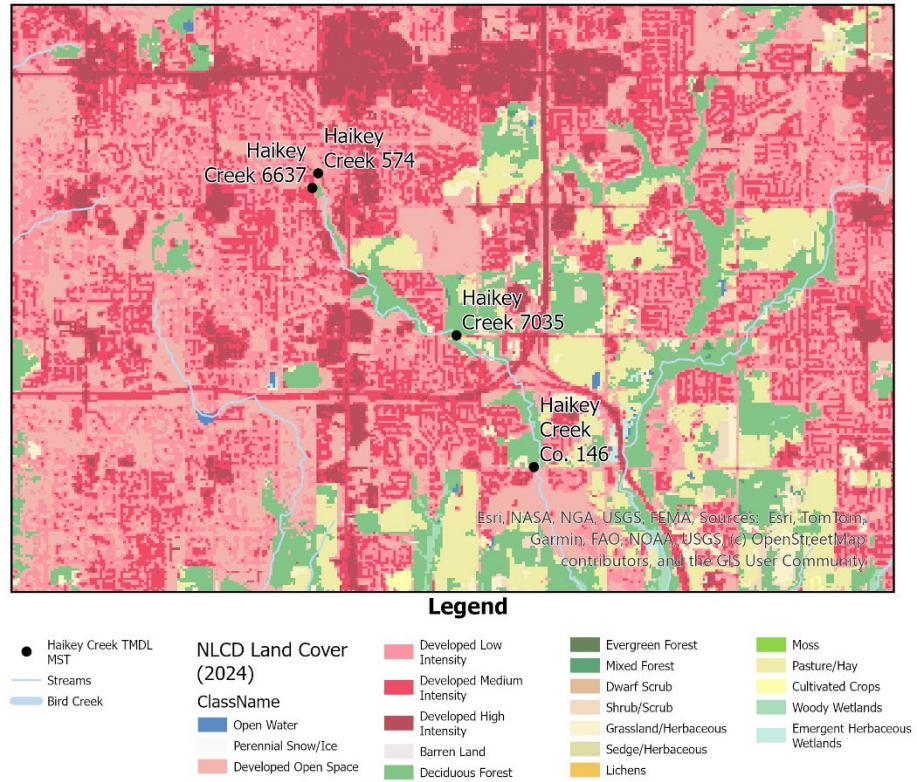
Land Use/Land Cover at Lower Bird TMDL Sampling Locations



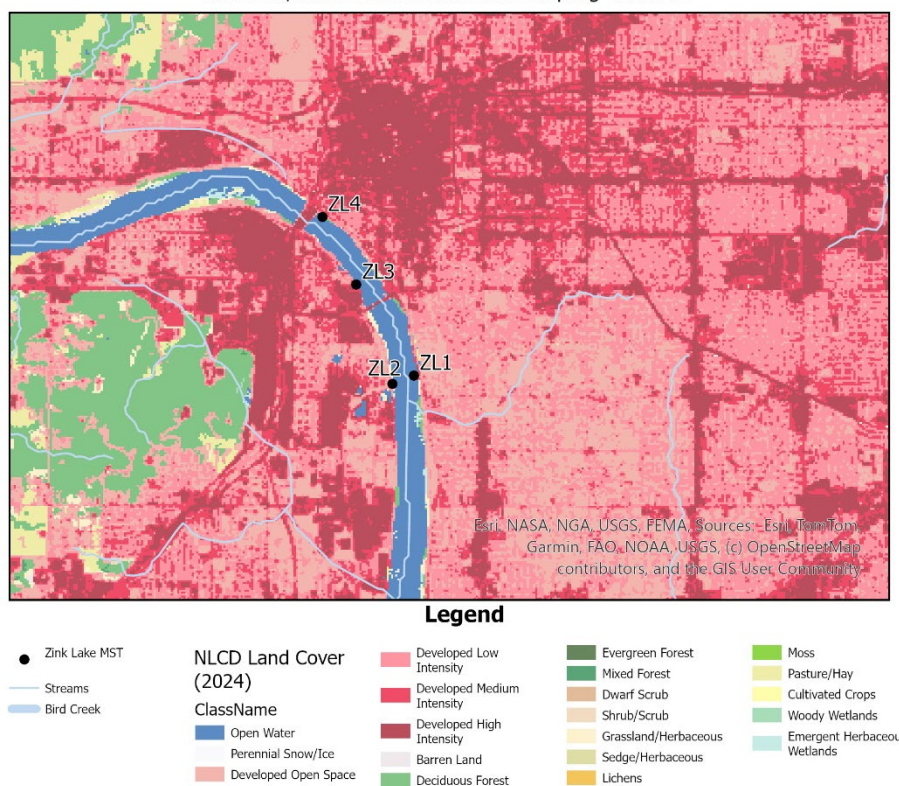
Legend

● Lower Bird TMDL MST	NLCD Land Cover (2024)	Developed Low Intensity	Evergreen Forest	Moss
— Streams	ClassName	Developed Medium Intensity	Mixed Forest	Pasture/Hay
— Bird Creek	Open Water	Developed High Intensity	Dwarf Scrub	Cultivated Crops
	Perennial Snow/Ice	Barren Land	Shrub/Scrub	Woody Wetlands
	Developed Open Space	Deciduous Forest	Grassland/Herbaceous	Emergent Herbaceous Wetlands
			Sedge/Herbaceous	
			Lichens	

Land Use/Land Cover at Haikey Creek TMDL Sampling Locations



Land Use/Land Cover at Zink Lake Sampling Locations



Appendix I

Spearman Correlation: Precipitation vs Concentration

Marker	N	Spearman ρ	p (raw)	p (Bonferroni)	p (BH)	Significant (BH)	Interpretation
Avian: GFD	226	0.007	0.914	1.0	0.914	no	no significant relationship
Dog: DG3	35	-0.148	0.396	1.0	0.475	no	no significant relationship
Goose: CGOF	21	0.205	0.374	1.0	0.475	no	no significant relationship
Human: HF183	195	0.141	0.050	0.299	0.149	no	possible significant relationship
Ruminant: Rum2Bac	70	0.139	0.252	1.0	0.475	no	no significant relationship

Spearman rank correlation between 72-hour antecedent precipitation (inches) and marker concentration (copies/100 mL). Detected values only.

Section 10

Annual Expenditures for the Reporting Period/Budget for Following Year

FISCAL YEAR 2026 REPORT

Totals	61,071,029	52,394,345	66,832,669
Fiscal Year	2026	2027	
SECTION NAME	CY ORIGINAL BUDGET (in \$)	CY ACTUALS (Before Audit, in \$)	BUDGET (in \$)
Fin Dir Internal IT	8,985	7,663	9,777
Warehouse	56,887	47,497	34,473
Utilities Administration	821,217	792,985	988,799
Chief Data Office - Project Management	68,964	-	-
Fin OCDO Admin	68,964	-	-
Fin OCDO Operations	-	-	-
Fin OCDO Innovation	-	-	-
Fin OCDO Governance & Analytic	-	-	-
Customer Care	484,815	431,724	505,143
Security (Direct Charge Fund 560)	63,000	69,997	85,537
Asset Management Admin	2,547	2,978	3,632
Security	344,473	334,432	382,096
Building Operations – Contracts	6,986	7,838	8,169

Building Maintenance	38,109	32,360	38,770
Custodial Services	13,611	16,012	13,611
IT Administration	63,201	69,989	69,655
IT Cio Admin	18,176	18,172	19,384
IT Cio Internal IT	4,569	9,168	4,755
IT Mgt Admin	40,457	42,649	45,515
IT Operations	290,510	278,846	275,411
IT Ops Support Admin	11,414	10,444	12,886
IT Ops Radio Services	50,749	49,705	52,089
IT Ops Network	99,902	104,165	93,593
IT Ops Database Svs	70,818	62,963	72,929
IT Ops Server Svs	57,626	51,569	43,914
IT Client Services	414,343	400,776	418,362
IT Client Deploy Svs	70,833	58,692	50,683
IT Client Services Operations	19,226	19,765	19,954
IT Client Financial	-	-	-
IT Client Project	5,425	4,966	6,374
IT Client Sys Maint	104,805	118,106	110,509
IT Client Architecture Svs	47,602	30,737	50,418
IT Development Svs	77,527	75,857	78,658
IT Client Support Svs	88,924	92,653	101,767
IT Capital Direct Charges	36,000	-	-
IT Cloud Services	154,850	144,618	163,787

IT Ent Cld Sup Svs	115,479	106,107	122,448
IT Utl Sys Etl Sup	107	92	112
IT Utl Bill Sys Sup	39,264	38,419	41,228
Engineering Administration – Stormwater	-	-	-
Hydrology And Hydraulics	-	-	-
Floodplain Management	-	272,743	-
Public Works - Administration	344,883	312,192	467,552
S&SW Dir Admin	336,633	311,476	335,685
S&SW Dir Admin	-	-	123,617
PW Admin D Director	8,250	716	8,250
Pubworksengadmin Stormwater	-	-	-
SS Payroll & Accts Payable	127,265	123,933	133,094
S&SW Dir Stormwater Fund	7,231,298	7,129,321	7,712,158
SS - Legal Representation	54,902	54,902	59,234
S&SW Dir Internal IT	113,694	106,654	150,959
Stormwater & Land Management Admin	1,728,582	1,626,290	1,774,438
S&SW Stm Mgt Admin	1,364,662	169,913	-
S&SW Stm Mgt Admin	363,920	1,456,377	1,774,438
Detention, Ditch, Concrete Channel	2,139,347	2,254,393	2,652,162
Channel Maintenance And Ditching	4,286,165	2,885,094	4,181,894
Storm Sewer Maintenance	4,477,462	2,891,601	4,303,272
Stormwater Quality	2,915,468	2,676,054	3,067,245
Stormwater Vegetation	3,638,430	3,850,136	3,994,362

Land Reclamation Site	111,884	65,672	108,779
Household Pollutant Collection	186,475	187,127	225,265
S&SW Household Pollut Collection	92,500	61,486	97,500
S&SW Household Pollut Collection	93,975	125,641	127,765
Land Reclamation Site	-	-	-
Street Maint & Inspections - Admin	221,052	218,284	231,825
Street Maintenance -- Patching	1,097,047	913,508	987,737
S&SW Str Mt Patching	1,097,047	913,508	987,737
S&SW Str Mt Patching	-	-	-
Paving Cut Administration	43,098	40,188	47,096
S&SW Mowing And SWeeping	3,264,720	2,269,185	3,388,286
S&SW Invest/inspection	912,999	878,937	968,138
S&SW Stormsewer Cleaning	1,062,967	1,021,195	1,152,803
S&SW Stormsewer Repairs	2,396,275	1,965,481	2,257,058
PW Ad Central Svs	92,326	49,598	58,754
PW Design Admin	82,883	55,417	42,940
PW Design Services	115,255	137,068	141,664
PW Field Administration	137,897	76,063	141,568
PW Field Const Inspect	654,700	621,377	691,268
PW Field Surveys	235,453	193,021	191,914
PW Planning Admin	94,745	92,937	101,461
PW Planning Proj Mgt	73,012	75,327	36,489
PW Planning Infrastructure	64,724	164,891	182,487

PW Planning Row Acquisition	296,603	234,529	260,551
Water And Sewer Admin.	23,626	24,347	27,224
Water & Sewer Dept. – Stormwater	3,059,050	1,861,472	3,199,500
W&S Admin Internal IT	30,320	28,275	20,596
W&S Admin Information Systems	-	-	122,894
QualITy Assurance – Administration	20,115	20,079	21,715
QualITy Assurance – Operations Support	3,080	2,033	3,080
Laboratories	294,651	293,099	310,215
Distribution Systems - Administration	20,770	20,196	21,608
Field Cust. Serv. Rep. I (meter Reading)	151,401	147,525	183,068
Field Cust. Serv. Rep. II (meter Turn On/off)	100,333	124,296	118,404
Sewer O & M – Admin	115,475	116,804	119,494
Lift And Pump Stations	358,754	338,038	365,093
Sewer O & M – Support Services / Dispatch	-	-	-
W&S Preventive Maint	-	-	-
W&S Sewer I&I Abatement	-	-	-
Utility Planning & Design Admin	87,578	84,556	89,507
Utility Design	1,054,748	968,256	1,088,010
Utility Asset Planning	328,012	299,969	410,441
GIS Services	671,619	617,939	653,210
Utility GIS	618,152	569,281	580,001
GIS Services	53,467	48,658	73,209
General Site Services Changed To P&R Fac Sys Land & Gen Maint	473,087	487,221	471,660

Horticulture Changed To P&R Uti Svs Horticulture	121,570	118,047	124,101
Park - Fac Svs Forestry - New Split From Horticulture	72,732	72,810	93,176
Debt Service	5,029,000	2,703,551	5,210,000
Transfer To Capital Projects	7,985,000	7,985,000	11,470,000

Section 11

Summary of Enforcement Actions, Inspections, and Public Education

1. Enforcement Actions

It is the philosophy of the City of Tulsa to bring responsible parties into compliance through education prior to initiating any enforcement action. Enforcement actions are taken only when deemed necessary to ensure permit compliance.

During this reporting period 314 investigations were conducted identifying 117 illicit discharges to the storm sewers. Title 11-A Chapter 5 (Pollution Ordinance) was adopted November 1995 and continues to be utilized for the removal of non-storm water discharges. This Ordinance allows the City of Tulsa to recover cleanup costs from the responsible party.

A summary of the investigations conducted by the Stormwater Management Division is as follows:

Number of Investigations	Description of Investigations
17	Construction (relating to potential construction site violations)
9	Hazmat (relating to potential discharges of pollutants from fire department responses involving the hazardous materials unit)
238	Stormwater (relating to potential releases of pollutants to the storm sewer or violations of the pollution ordinance)
2	Drug Labs (relating to the potential release of pollutants from drug lab remediation to the storm sewer or violations of the pollution ordinance)
48	Sanitary Sewer (relating to the potential release of sewage to the storm sewer or violations of the pollution ordinance)
314	Total number of investigations for this reporting year

a. Construction Site – Erosion Control

The Stormwater Management Division conducted 2,677 construction site inspections at 693 construction sites, resulting in 15 enforcement actions. These actions consisted of issuing a notice of violation that may involve fines and cost recovery. The total amount of fines and penalties collected was \$650.

b. Industrial, Commercial and Residential Sites

During this reporting period, 652 industrial stormwater inspections were conducted. 12 enforcement actions were taken against industries or facilities in order to eliminate illegal or illicit discharges. No fines were levied during this fiscal year.

2. Inspections

The following is a summary of inspections that were conducted during this reporting period. These inspections were previously mentioned in other sections of this report.

Sewer Operations Maintenance and Stormwater Maintenance and Operations (SMO) conducted the following:

- Sanitary sewer lines TV inspected – 164.66 miles

SMO conducted the following inspections:

- Storm sewer lines inspected – 16 miles
- Catch basins/inlets inspected – 26,360
- Industrial and commercial storm water runoff inspections – 652
- Litter inspections – 1,408
- Construction site erosion control inspections – 2,677

Development Services conducted the following number of inspections:

- 2,225 construction site inspections were conducted with attention on erosion control measures

Engineering Services conducted inspections at both City and privately funded sites but did not report numbers.

3. Public Education Programs

The public education programs utilized by the City of Tulsa have been described in Section 1 of this report. The City of Tulsa understands that public education plays a major role in reducing non-point source pollution and improving stormwater runoff quality. SMO believes that it is better to prevent non-point source pollution at the source through education than to control it after it is generated. Many educational programs used by the City of Tulsa to meet permit requirements are completed through the cooperative efforts of other groups, such as The M.e.t. and the Tulsa County Conservation District, as well as various City of Tulsa departments. Through activities such as educational events, presentations, school visits, summer day camps, conferences, television/radio commercials, billboards, etc., educational material was viewed many millions of times during this reporting period.

See the following for more information on Tulsa's Public Education Programs.

Attachment A "Education Materials Distributed 2025-2026" lists the educational material distributed during this reporting period by the City of Tulsa.

Attachment B "Education Events 2025-2026" lists the educational activities performed during this period by the City of Tulsa.

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Attachment A: Education Materials Distributed 2025-2026

	Illicit Discharge	Animal Waste	Antifreeze	Motor Oil	Paint	Fertilizer	Pesticides	LID	Compost	Yard Waste	Erosion	Floatables	Master Gardener	HHPCF	Customer Care Line/Website	# Distributed
Adopt a Stream Flyer	x														x	0
Bobbers												x			x	1,265
Car Washing	x		x	x											x	71
Cardboard Binoculars															x	590
Carpet Cleaning BMP	x														x	39
Carwash BMP	X			X											X	71
Cause and Effect	x	x	x	x	x	x	x			x		x			x	1,377
Cleanup Shirts	x											x			x	253
Commercial Litter Buckslip	x											x			x	122
Construction BMP	x														x	394
Door Hanger	x					x									x	80
Educational Display	x	x	x	x	x	x	x	x	x	x	x	x	x		x	2
Fertilizer	x					x							x	x	x	20
General Brochure Spanish	x	x	x	x	x	x	x	x	x	x	x	x		x	x	210
General Brochure	x	x	x	x	x	x	x	x	x	x	x	x		x	x	796
Grass & Leaves	x									x					x	326
HHPCF Brochure Spanish	x		x	x	x	x	x								x	1,014
HHPCF Brochure	x		x	x	x	x	x								x	3,812
HPCF Chip Clip															x	3,678
HPCF Fridge Magnet	x		x	x	x	x	x								x	91
Landscaping BMP	x					x	x			x			x		x	102
LID	x					x	x			x					x	272
Litter Flier	x		x	x			x			x					x	81
	Illicit Discharge	Animal Waste	Antifreeze	Motor Oil	Paint	Fertilizer	Pesticides	LID	Compost	Yard Waste	Erosion	Floatables	Master Gardener	HHPCF	Customer Care Line/Website	# Distributed

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Magnifying Glass												x				85
Motor Oil	x		x	x										x	x	145
Outside Washing	x		x	x											x	11
Pencils	x														x	4,130
Pens	x														x	4,981
Pesticides	x					x	x						x	x	x	150
Pet Waste Bags	x	x													x	4,728
Pet Waste	x	x					x								x	356
Pollution Prevention Plan	x														x	2
Pond Maintenance	x	x													x	23
Pool/Water Disposal	x														x	163
Rain Barrel/Great Tulsa Cleanup Flyer	x											x			x	149
Rain Gauge	x														x	4,165
Reusable Mesh Litter Bags	x	x										x			x	2,492
Seed Packets	x														x	3,512
SOS Fans	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	170
SOS Tote Bags	x					x	x								x	3,462
Stressballs															x	5,401
Sunglasses																5,889
Trash Breakdown	x											x			x	242
Total Materials Distributed																54,922

Attachment B: Education Events 2025-2026

Date	Event Name	Description	Attendance
7.2.2025	Whiteside Summer Camp	Enviroscape/Fish/Plant Demonstration for Summer Camp kids at Whiteside. Ages 6-12	50
7.14.2025	Pre-Development Meeting	This meeting was for the construction of the Parkway Development. The owners have a stormwater detention easement and detention pond built into the plan. They are intending on doing landscaping throughout this area; native plants were mentioned.	14
7.19.2025	Tulsa Driller's Game	Tabled event to distribute SWQ information to attendees	6,168
7.21.2025	Pre-Development Meeting	This meeting was for the remodel of the Berry Park. There is currently no plan for any LID at this location.	14
7.21.2025	Pre-Development Meeting	This meeting was for the remodel of Chamberlain Park. Rain Gardens are already in use at this location and Native Plants will be installed again after construction.	15
7.23.2025	Tulsa Driller's Game	Tabled event to distribute SWQ information to attendees	3,725
7.24.2025	McClure Summer Camp	Enviroscape/Fish/Plant Demonstration for Summer Camp kids at McClure Park Ages 6-12	31
7.28.2025	Pre-Development Meeting	This meeting was for the construction of the Greenhill Phase III Site. There is currently no plan for any LID at this location.	14
7.28.2025	Mayor's Office Campus Tour	SWQ campus tour to Mayor's Office	1
8.2.2025	COHO Back 2 School	Back to School event to hand out school supplies to kids and SWQ to everyone	8,000
8.2.2025	District 2 Back 2 School	Back to School event to hand out school supplies to kids and SWQ to everyone	300
8.4.2025	Pre-Development Meeting	This meeting was for the construction of a Business/Professional Office Space at 86th and Mingo. LID has not been considered for this site yet.	13
8.7.2025	Green Country Watershed Coalition	Tulsa Environmental groups meet to discuss local events	5

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
8.9.2025	Back 2 School	Back to School event to hand out school supplies to kids and SWQ to everyone	824
8.11.2025	Pre-Development Meeting	This meeting was for the development of the H & H Building Complex. There are no concrete plans to implement LID features for this site.	15
8.11.2025	Pre-Development Meeting	This meeting was for the development of the All Star Sports Complex. There are no plans to develop any LID features for this site	17
8.13.2025	Tulsa Driller's Game	Tabled event to distribute SWQ information to attendees	3,237
8.18.2025	Pre-Development Meeting	This meeting was for the development of the Riverline Project (residential and commercial complex). There are no concrete LID plans for this site yet (Phase I).	38
8.18.2025	Pre-Development Meeting	This meeting was for the redevelopment of an existing QT. There are vegetation areas on the site plan and rain gardens were mentioned.	12
8.23.2025	Back 2 School	Back to School event to hand out school supplies to kids and SWQ to everyone	2,079
8.25.2025	Pre-Development Meeting	This meeting was for the development of a Temple near 51st and 136th St. There are plans to include LID features at this site, including an interceptive bioswale, underground stormwater storage, detention ponds, and native plants will be utilized.	17
8.27.2025	Tulsa Driller's Game	Tabled event to distribute SWQ information to attendees	3,237
8.30.2025	Tulsa University Football Game	Tabled event to distribute SWQ information to attendees	17,337
9.3.2025	Crow Creek Meadow	Maintenance event at Crow Creek Meadow	15
9.8.2025	Pre-Development Meeting	This meeting was for the development of a Bank of Oklahoma at 31st and Garnett Road. There are not plans to include LID features at this site yet.	17
9.13.2025	Tulsa Driller's Game	Tabled event to distribute SWQ information to attendees	6,226
9.13.2025	Tulsa University Football Game	Tabled event to distribute SWQ information to attendees	20,103
9.15.2025	Monarchs on the Mountain Meeting	Final meeting before MotM official event.	10

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
9.17.2025	OSU Industrial Class Presentation	Presentation to Industrial Stormwater Management Presentation at OSU	10
9.20.2025	Monarchs on the Mountain	Tabled event to distribute SWQ information to attendees	3,100
9.27.2025	Tulsa University Football Game	Tabled event to distribute SWQ information to attendees	16,311
9.29.2025	Pre-Development Meeting	This meeting was for sewer & water line extensions at Tulsa Riverside Airport. There are no plans to include LID features at this site.	12
9.29.2025	Pre-Development Meeting	This meeting was for the development of Condo Storage Units located at 2006 E. 7th Pl. There are no plans to include LID features at this site.	17
10.4.2025	Trash Bash	Tabled event to distribute SWQ information to attendees	100
9.25-10.5.2025	Tulsa State Fair	State fair at the fairgrounds. We gave out stormwater promo items and discussed the impact of pollution on the environment	1,000,000
10.6.2025	Pre-Development Meeting	This meeting was for the development of family subdivision at 31st and Lynn Lane. There are no plans to include LID features at this site.	11
10.11.2025	Fall Carnival	Tabled event to distribute SWQ information to attendees	1,300
10.13.2025	Pre-Development Meeting	This meeting was for the development of family subdivision at 31st and S Winston Ave. LID has not been considered for this site.	16
10.16.2025	GCWC	Tulsa Environmental groups meet to discuss local events	6
10.18.2025	Trash Bash	Tabled event to distribute SWQ information to attendees	38
10.20.2025	Pre-Development Meeting	This meeting was for the development of multifamily apartment complex at 81st and Mingo. LID has not been considered for this site.	16
10.24.2025	Adopt-a-Creek Clean Up	Spirit Aerosystems performed a creek clean up at Upper Mill Creek	45
10.24.2025	Fall Carnival	Tabled event to distribute SWQ information to attendees	382
10.24.2025	ODEQ Phase II MS4 Conference	BL gave an MS4 presentation to attendees	65
10.25.2025	Tulsa University Football Game	Tabled event to distribute SWQ information to attendees	16,403

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
10.25.2025	Halloween Carnival	Tabled event to distribute SWQ information to attendees	627
10.27.2025	Pre-Development Meeting	This meeting was for the development (definitive plan has not been developed at this moment). LID was brought up as an option to consider.	15
10.29.2025	Build My Future	Tabled event to distribute SWQ information to students	780
11.3.2025	Pre-Development Meeting	This meeting was for the development of Sod Farm at S 105th Ave E. LID will be implemented by means of utilizing certain grass species that have deeper root systems.	12
11.8.2025	Fishing Derby	Tabled event to distribute SWQ information to attendees	65
11.13.2025	Leadership U HPCF Tour	HPCF/Swap Shop Tour provided to the current Leadership U Class	20
11.15.2025	Tulsa University Football Game	Tabled event to distribute SWQ information to attendees	15,034
11.17.2025	Pre-Development Meeting	This meeting was for the development of Amythest Falls Subdivision. LID has not been considered for this site.	15
11.21.2025	Tulsa University Basketball Game	Tabled event to distribute SWQ information to attendees	2,702
11.29.2025	Tulsa University Football Game	Tabled event to distribute SWQ information to attendees	13,026
12.1.2025	Pre-Development Meeting	This meeting was for the development of Queen Street Cottages. LID is being considered for this site with rain barrels and rain gardens.	17
12.02.2025	Sustainability Alliance First Thursday	Tabled event to distribute SWQ information to attendees	17
12.06.2025	Tulsa University Basketball Game	Tabled event to distribute SWQ information to attendees	2,979
12.10.2025	Tulsa University Basketball Game	Tabled event to distribute SWQ information to attendees	2,742
12.15.2025	Pre-Development Meeting	This meeting was for the development of Tulsa Space Testing Center. LID is not being considered for this site.	19
12.15.2025	Pre-Development Meeting	This meeting was for the development of a laundromat. LID is not being considered for this site.	15

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
1.5.2026	Pre-Development Meeting	This meeting was a housing development. LID is not being considered for this site at this time.	13
1.10.2026	Tulsa University Basketball Game	Tabled event to distribute SWQ information to attendees	3,303
1.21.2026	Frenchman's Creek HOA Meeting	Discussed copper sulfate application with HOA board members regarding overuse on neighborhood ponds	2
1.21.2026	Tulsa University Basketball Game	Tabled event to distribute SWQ information to attendees	4,071
1.26.2026	Pre-Development Meeting	This meeting was for the development of a Quick Quack Car Wash. LID is not being considered for this site at this time.	26
1.26.2026	Pre-Development Meeting	This meeting was for the development of a restaurant/shop/business spot called "The Brook". LID is not being considered for this site at this time.	28
1.29.2026	MS4 Permit Coordination Meeting	Meeting with water subdivision to discuss chlorinated discharges and MS4 permit obligations	5
2.2.2026	Pre-Development Meeting	This meeting was for the development of 2 housing development units near I75 S and 61st Street. Mooser Creek portion runs through this proposed project, with the idea that the creek will be left alone and as natural as possible. LID has not been considered as of this point, but it is a possibility.	28
2.5.2026	Sustainability Alliance First Thursday	Tabled event to distribute SWQ information to attendees	60
2.9.2026	Pre-Development Meeting	This meeting was for the development of a housing development units near E 41st Street and 145th E Ave. Development will occur close to Sugar Creek sections. LID is being considered for this site, but no concrete decisions yet.	16
2.11.2026	Tulsa University Basketball Game	Tabled event to distribute SWQ information to attendees	3,361
2.16.2026	Pre-Development Meeting	This meeting was for the development of a Dutch Bros near 67th and Memorial. Development will occur close to the Mingo Creek Mainstream Creek. LID is not being considered for this site.	15

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
2.16.2026	Pre-Development Meeting	This meeting was for the development of a warehouse and parking lot near 66th st n and n yale. Development will occur close to the Bird Creek. LID is TBD for this site and has not yet been discussed.	10
2.17.2026	Bird Creek Seminar	Facilitated discussions between stakeholders and their role in relation to Bird Creek, the history and current state of the creek, and some potential ways to set up systems to manage and sustain the Bird Creek area going forward.	20
2.18.2026	TU Basketball Game	Tabled event to distribute SWQ information to attendees	3,256
2.19.2026	Holland Hall Fish Club	Presentation to Holland Hall's Fish Club regarding SWQ information and what SWQ does as a group	10
2.19.2026	GCWC Meeting	Tulsa Environmental groups meet to discuss local events	7
2.23.2026	Pre-Development Meeting	This meeting was for the development of a 3-story apartment complex and parking lot near 22nd and Utica. Development will occur close to the Arkansas River Local Drainage. LID is not being considered for this site.	10
2.24.2025	Embracing Earth's Designs`	Tabled event to distribute SWQ information to attendees with emphasis on CoT's Wildflower Meadows	36
2.26.2026	SWOCC	Internal Stormwater Operator's Certification Course; discussed MS4 permit, environmental compliance, and HPCF	18
3.2.2026	Pre-Development Meeting	This meeting was for the development of a residential development. LID is not being considered for this site.	15
3.5-3.8.2026	Tulsa Home and Garden Show	Home and Garden Show at the fairgrounds. Distributed SWQ info to attendees	22,472
3.8.2026	Tulsa University Basketball Game	Tabled event to distribute SWQ information to attendees	5,152
3.12.2026	Pesticide Application General Permit Meeting	Permit Training for City of Tulsa SOMS Pesticide Applicators	6

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
3.15.2026	Sugar Creek Cleanup	Blue Thumb requested creek cleanup supplies to perform a cleanup at Sugar Creek	2
3.16.2026	Pre-Development Meeting	This meeting was for the development of Tulsa Hills Multifamily Unit. LID is not being considered for this site.	16
3.16.2026	Pre-Development Meeting	This meeting was for the housing development near 41st St and S 129th E Ave. LID is not being considered for this site.	11
3.23.2026	Pre-Development Meeting	This meeting was for the housing development at E 85th Pl and S Harvard. LID is TBD for this site and has not been discussed yet. The developer asked for LID information.	13
3.25.2026	Union High School Sustainability Fair	Tabled event to distribute SWQ information to students	400
3.27.2026	TSAS Fish Demo	Fish/macrobenthos demo for TSAS students	30
3.30.2026	Pre-Development Meeting	This meeting was for the housing development at N Utica and E Marshall St. LID is being considered for this site; permeable pavement was mentioned specifically. The developer was informed they could reach out in the future if they had any questions.	15
3.31.2026	OKAEE	OK Environmental Group meet up	9
4.7.2026	OFMA Spring Workshop	Watershed Wildflower Presentation	70
4.10-4.11.2026	Spring Fest	Tabled event to distribute SWQ information to attendees	10,000
4.11.2026	Spring Carnival	Tabled event to distribute SWQ information to attendees	150
4.13.2026	Pre-Development Meeting	This meeting was for the development of additional spaces located in Utica Square. Major LID features are not being considered for this site, but a parking lot is being removed to add grassy lawns.	17
4.16.2026	M.e.t. Go Green Driller's Night	Tabled event to distribute SWQ information to attendees	
4.16.2026	Eco Allies Discussion	Discussion for Eco Allies educational group	5
4.20.2026	Pre-Development Meeting	This meeting was for the development of a warehouse addition. LID features are not being considered for this site.	15

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
4.22.2026	Enviro Expo	Tabled event to distribute SWQ information to attendees	300
4.25.2026	Party for the Planet	Tabled event to distribute SWQ information to attendees	3,910
4.27.2026	Pre-Development Meeting	This meeting was for the development of a housing development in Tupelo Creek. LID is not being considered.	15
4.1-4.30.2026	Great Tulsa Cleanup	Community wide event to pick up trash at citizen chosen locations. 5th Annual.	1,337
5.5.2026	Community Conversation	Tabled event to distribute SWQ information to attendees	30
5.11.2026	Pre-Development Meeting	This meeting was for the development of a Maverick gas station near Joe Creek. LID is not being considered.	15
5.11.2026	Community Conversation	Tabled event to distribute SWQ information to attendees	50
5.15.2026	Spring Carnival	Tabled event to distribute SWQ information to attendees	150
5.17.2026	Tulsa Zoo Touch A Truck	Tabled event to distribute SWQ information to attendees	500
5.26.2026	Community Conversation	Tabled event to distribute SWQ information to attendees	106
5.27.2026	Tulsa Driller's Baseball Game	Tabled event to distribute SWQ information to attendees	3,839
6.08.2026	Pre-Development Meeting	This meeting was for the development of a Rosewood Multifamily Development. LID is not being considered.	11
6.08.2026	Pre-Development Meeting	This meeting was for the development of an industrial park at Hwy169 and E46th St N. LID is not being considered.	13
6.9.2026	Community Conversation	Tabled event to distribute SWQ information to attendees	112
6.9.2026	Eco Allies Presentation	Stormwater Quality presentation to the public	8
6.15.2026	Pre-Development Meeting	This meeting was for the development of Brookside Collective. LID is not being considered.	18
6.16.2026	Eco Allies Meeting	City of Tulsa presentations to the public	8
6.16.2026	Meadow Fest	Tabled event to distribute SWQ information to attendees	30
6.22.2026	Pre-Development Meeting	This meeting was for the development of CREOKS Promise Way. LID is not being considered	16

Section 11 – Summary of Enforcement Actions, Inspections, and Public Education Activities

Date	Event Name	Description	Attendance
6.22.2026	Pre-Development Meeting	This meeting was for the development of 7 Brew Coffee. LID is not being considered.	15
6.23.2026	Community Conversation	Tabled event to distribute SWQ information to attendees	29
6.24.2026	Tulsa Driller's Game	Tabled event to distribute SWQ information to attendees	4,114

Section 12

Identification of Water Quality Improvements or Degradation

The Oklahoma Department of Environmental Quality releases a report on Water Quality in Oklahoma biennially, pursuant to section 303(d) and 305(b) of the Clean Water Act. Waterbodies failing to meet state water quality standards or that are not attaining for their beneficial use are placed on the 303(d) impaired waters list. The Tulsa MS4 permit contains conditions that are sufficient to prevent further impairment of 303(d)-listed waterbodies. This section of the annual report is intended to assess compliance and success in preventing further impairment of COT's receiving MS4 streams, based on the addition or removal of streams to the ODEQ's 303(d) impaired waters list.

Since the 2022 Integrated Report (IR) released by ODEQ, 15 of Tulsa's streams have been added to the 303(d) impaired waters list. Not all the streams added to the 303(d) list are monitored by the City of Tulsa's Stormwater Quality group. Most of the 303(d) streams are in the Verdigris River basin. The leading cause of stream impairment in 2022 was macroinvertebrate bio with 8 streams impaired. From 2022 to 2024, more streams and parameters were listed for impairment than delisted. The primary cause of impairment in 2024 is fecal indicator bacteria (enterococcus and E. coli) followed by dissolved oxygen. The City of Tulsa is dedicated to identifying and eliminating sources of fecal indicator bacteria to comply with issued TMDLs. Wet-weather monitoring will be conducted to identify the cause of macroinvertebrate bio impairments. Table 1 and 2 identify impaired waterbodies and associated parameters.

Section 12 –Identification of Water Quality Improvements or Degradation

Table 5: List of impaired streams from 2022 and 2024 integrated reports.

WBID	ODEQ Waterbody Name	Impairments listed in 2022 IR	New impairments in 2024 IR	Parameter Delisted
OK120410010230_00**	Haikey Creek, Unnamed Trib of		Dissolved oxygen, Enterococcus, E. coli	
OK120420010010_00	Arkansas River	Enterococcus, Lead, Turbidity		Turbidity
OK120420010010_10	Arkansas River	Cadmium	E. coli	Cadmium
OK120420010020_00	Twin Hills Creek (Fry Ditch Creek)	Macroinvertebrate Bio	Dissolved oxygen, Enterococcus, E. coli	
OK120420010025_00	Twin Hills Creek, Unnamed Trib of	Fish bioassessments		
OK120420010040_00**	Vensel Creek		Enterococcus, E. coli	
OK120420010050_00	Joe Creek	Macroinvertebrate Bio	Enterococcus	
OK120420010060_00	Fred Creek	Macroinvertebrate Bio, E. coli	Macroinvertebrate Bio - cause category changed, Enterococcus, Fish Bioassessments	E. coli
OK120420010070_00	Mooser Creek	E. coli	Macroinvertebrate Bio, Dissolved Oxygen, Enterococcus	
OK120420010075_00**	Mooser Creek, Unnamed Trib of		Macroinvertebrate Bio	
OK120420010090_00	Crow Creek	Macroinvertebrate Bio, E. coli, Fish bioassessments	Enterococcus	
OK120420010095_00**	Crow Creek, Unnamed Trib of		Enterococcus, E. coli	
OK120420010120_00**	Berryhill Creek		Enterococcus, E. coli	
OK120420010170_00	Harlow Creek	Macroinvertebrate Bio, Enterococcus, Fish bioassessments	E. coli, Dissolved Oxygen	
OK120420010340_00	Little Joe Creek, Unnamed Trib of	Macroinvertebrate Bio, Fish bioassessments		

**Indicates a stream added to the 2024 303(d) list.

Section 12 –Identification of Water Quality Improvements or Degradation

Table 6: List of impaired streams from 2022 and 2024 integrated reports continued.

WBID	ODEQ Waterbody Name	Impairments listed in 2022 IR	New impairments in 2024 IR	Parameter Delisted
OK120420020020_00**	Hager Creek		Dissolved oxygen, Enterococcus, E. coli	
OK120420020040_00	Nickel Creek	Dissolved oxygen, E. coli		Dissolved oxygen
OK121300010010_00	Bird Creek	Enterococcus, Turbidity		
OK121300010030_00**	Mingo Creek		Enterococcus	
OK121300010040_00**	Knudson Creek (Quarry)		Enterococcus	
OK121300010045_00**	Cooley Creek		Dissolved oxygen, Enterococcus, E. coli	
OK121300010045_05**	Tupelo Creek		Enterococcus, E. coli	
OK121300010050_00	Mill Creek	Macroinvertebrate Bio, Fish bioassessments, Total Dissolved Solids		
OK121300010065_00**	Brookhollow Creek		Dissolved oxygen, Enterococcus, E. coli	
OK121300010070_00**	Mingo Creek, Unnamed Trib of		Dissolved oxygen, Enterococcus, E. coli	
OK121300010075_00**	Eagle Creek		Enterococcus	
OK121300010085_00**	Ford Creek		Dissolved oxygen, Enterococcus	
OK121300010090_00	Coal Creek	Macroinvertebrate Bio, E. coli	Total Dissolved Solids	
OK121300010095_00**	South Park Creek		Dissolved oxygen, Enterococcus, E. coli, Total Dissolved Solids	

**Indicates a stream added to the 2024 303(d) list.

Section 13

Co-Permittee Reports

The City of Tulsa attests that, to the best of its knowledge, the unaltered annual reports submitted by the co-permittees contain the required information and were sent within the permit timeframe of 45 days prior to the report due date.



200 N.E. 21st Street
Oklahoma City, OK 73105-3204

August 20, 2026

Heath Kirkeby, Stormwater and Land Management Division Manager
Department of Streets and Stormwater
City of Tulsa
4502 S. Galveston Ave.
Tulsa, OK 74107

Attention: Skyler Robson

Dear Mr. Robson:

Enclosed is the Oklahoma Department of Transportation portion of the Fiscal Year 2026 Annual Report to be submitted to the Oklahoma Department of Environmental Quality in accordance with the Tulsa Municipal Separate Storm Sewer System (MS4) Permit Number OKS000201. This report covers the period from July 1, 2025 through June 30, 2026.

Please provide this office with one copy of the Annual Report as it is submitted. If you have any questions or require further information, please contact Matt Pace, 405-421-2359.

Sincerely,


TJ Dill (Aug 28, 2026 08:20:38 CDT)

TJ Dill, P.E.

Chief Engineer

"The mission of the Oklahoma Department of Transportation is to provide a safe, economical, and effective transportation network for the people, commerce and communities of Oklahoma."



2026

ODOT ANNUAL REPORT

TULSA MS4 PERMIT #OKS000201

CERTIFICATION STATEMENT

NPDES Permit No. OKS000201

Review of Storm Water Annual Report

I certify under penalty that this document and all attachments were prepared under my direction or supervision, in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment for knowing violations.


TJ Dill (Aug 28, 2026 08:20:38 CDT)

TJ Dill, P.E.

Chief Engineer

08/28/2026

Date

FISCAL YEAR
2026
ANNUAL REPORT
BY THE
OKLAHOMA DEPARTMENT OF TRANSPORTATION
ON
TULSA MS4 PERMIT # OKS000201

Status

The Oklahoma Department of Transportation (ODOT) has implemented and is following the Storm Water Management Plan. The subsequent sections demonstrate activities undertaken for this annual reporting period.

Public Education and Involvement

Construction Contractor Compliance Conference (C4)

In April of 2026, the 4th annual C4 conference was held in Stillwater, OK. We had 176 registered for this event, and 135 participants the day-of. With vendors and volunteers, we had an additional 50 people on site. This was our largest event thus far and fully outdoors. Participants were able to partake in the “Install Rodeo” and install sediment and erosion control devices with a group. Additionally, there were demonstrations from our vendors and a presentation from the Natural Resource Conservation Service on soil quality and loss. This event is geared toward contractors, but we have a large representation from ODOT, the Oklahoma Turnpike Authority (OTA), designers, consultants and municipal stormwater staff that attend. This conference has proven to be wildly successful, and the department looks forward to the 5th Annual in the spring of 2027.

Central Oklahoma Stormwater Alliance (COSWA)

ODOT is an active member of COSWA and participates in outreach events. This year, ODOT participated in the Home and Garden Show, the Native Plant Market and the radio ads put together by COSWA. This is a collaborative effort among the alliance which is comprised of central Oklahoma Municipalities and other interested parties.

Great American Cleanup

In partnership with Keep Oklahoma Beautiful (KOB), ODOT supports the Great American Cleanup. In Tulsa County there were 36 events hosted, 217 volunteers and 1,049 bags of trash collected. An additional 11,517,146 pounds of waste was collected in receptacles other than trash bags.

Keep Our Land Grand Art Contest

The Oklahoma Department of Transportation’s Keep our Land Grand Art (KOLG) Contest champions creativity as a powerful tool to promote litter prevention, inspiring Oklahoma’s students and communities to keep roadsides clean and beautiful. The 2026 Keep our Land Grand Art Contest received 2,194 entries from 67 counties. State-level winners were selected and honored at a luncheon in April. The winning artwork will be displayed in the 2027 calendar which is currently in design. This year, state legislatures and county commissioners served as judges. This is the final year for calendar category. In 2028, the poster category will become a postcard category and the entry form category will become a calendar cover category.

The program has undergone a few changes to align with the mission behind it. This year, the mission statement was updated and ways to incorporate recycled materials, natural materials and sustainability. The luncheon dinnerware was all compostable therefore food scraps and dinnerware were collected for composting. Plastic placemats were replaced with bandanas the attendees could keep and reuse; even individual drinks were replaced with aluminum cups that the attendees could also reuse and keep.

Monarch Program

ODOT manages over 16,000 acres of their land system Right of Way (ROW) corridors through conservation mowing, set asides, targeted herbicide applications and brush management for the benefit of the monarch butterfly. To promote monarch habitat resources and conservation practices several ODOT Field Districts participate in supplemental conservation measures. These include allowing land outside the ROW safety zones to sit idle from

management activities during the Spring. This allows milkweed and floral resources to be readily available during the monarch migration and early reproduction season.

ODOT Natural Resources Program (NRP) Staff participating on the steering committee of the Oklahoma Monarch and Pollinator Collaborative, a multi-agency group providing resources to state residents and agencies as part of the statewide Monarch Conservation Plan. With this participation, educational materials were developed and distributed at events state-wide, such as City of Norman's Monarchs in the Park Festival, the Oklahoma Monarch Society Regional State Monarch meetups, Monarch Media Day in Tulsa and the Oklahoma Animal Coalition Outreach Day at the State Capitol. Members of ODOT NRP also contributed to the state Monarch ROW working group and updated statewide Monarch Conservation Plan.

In the summer of 2025, ODOT NRP staff attended the tri-national North American Monarch Summit in Minneapolis, Minnesota. During the Summit, the Agency received multiple awards including the Monarch MVP for reporting the largest number of monarchs and milkweeds on Agency ROW for the Southern and Western Regions. Additionally, ODOT is participating in its 6th year as a partner for the national Monarch Candidate Conservation Agreement with Assurances joining over 100 other transportation and energy sector agencies in providing benefits for the migrating monarch butterfly.

Employee Education

Construction Stormwater

Three new field liaisons were brought on in 2026. All three of these new hires completed the EPA Stormwater Construction Inspection training as well as several weeks of shadowing other liaisons and stormwater personnel before they begin independent inspections within their districts. Two of our liaisons renewed their Oklahoma Water Survey Sediment and Erosion Control Inspector certifications. New staff will complete this course when it is offered again. 8 of our Clean Water staff completed an Oklahoma Local and Technical Assistance Program Course over Sediment and Erosion Control in April, following the C4 conference.

Pesticide Applicator Certifications

ODOT continues to use integrated roadside vegetation management (IRVM). This includes proper vegetation selection, installation and post-installation management. In compliance with the Oklahoma Department of Agriculture, Food and Forestry, ODOT has an Herbicide Program Policy Directive that requires all personnel applying herbicides to be Certified Pesticide Applicator and participate in yearly training pertaining to vegetation management. ODOT partners with Oklahoma State University and the Oklahoma Cooperative Extension Service to offer the Pesticide Applicators test required for a license during our annual workshops.

Herbicide application training was held March 31, 2026-April 1, 2026 for ODOT employees.

Illicit Discharge Detection and Elimination Program

ODOT Maintenance facilities continue to use the guidance document which was developed to assist ODOT personnel in identifying and reporting an Illicit Discharge. As well as the stormwater program having opportunity for IDDE reporting on their webpage. During this year we have had one resolved IDDE complaint.

There were two reported highway spills within the City of Tulsa limits.

The ODOT and the City of Tulsa have worked together to clean up an area where floatable material has been dumped several times in one area throughout the year.

In addition, there are four two-mile increment Adopt-a-Highway locations in the Tulsa metro where litter is picked up twice a year, and five one-mile increment Adopt-a-Highway Corporation locations where litter is picked up once per month.

Collection and Recycling

ODOT recycled 962 gallons of used oil, 1400 gallons of oil and water mixture, 110 gallons of antifreeze, and 250lbs of used oil filters.

Construction Site Runoff

The Department continues to advise toward compliance with OKR10 and municipal construction permits. Contractors are required to conduct weekly inspections on projects with an OKR10 or municipal permit. An ODOT representative reviews contractor's weekly SWPPP reports for accuracy. Additionally, an ODOT Field Liaison conducts inspections based on the priority of the project. During this year, the ODOT District 8 field liaison conducted 253 stormwater inspections within the district, which includes Tulsa city limits.

The stormwater staff reviews plans between 60-90% development for stormwater BMPS and ensures that sites which would require an OKR10 permit have the means to include best management practices. This year, ODOT staff reviewed 328 sets of plans. Additionally, an environmental representative will be present at pre-work meetings for projects to continue to communicate environmental commitments for the project prior to breaking ground.

Pollution Prevention/ Good House Keeping

District 8 Headquarters continues to practice Good House Keeping Pollution Prevention practices in their maintenance facilities and use best management practices. This includes regular inspection of the facility and employee training.

As part of ODOT's Storm Water Management Program, the Tulsa metro area highway system shoulders are swept to remove sediment and debris. \$45,077.20 was spent on litter clean up and 17,885 bags of litter collected. In addition, ODOT right-of-way areas, covering 34,461.56 acres, were mowed in 7 cycles at the expense of \$1,014,203.68.



August 10, 2026

Mr. Skyler Robson
Stormwater Quality Manager
Stormwater Quality, City of Tulsa Public Works
4502 S. Galveston Ave.
Tulsa, Oklahoma 74107

Dear Mr. Robson:

Enclosed is the Oklahoma Turnpike Authority's portion of the Annual Report to be submitted to the Oklahoma Department of Environmental Quality (DEQ) in accordance with the City of Tulsa Municipal Separate Storm Sewer System (MS4) Permit Number OKS000201. This report covers the period from July 1, 2025, through June 30, 2026.

Please provide this office with a copy of the Annual Report as it is submitted to DEQ.

Sincerely,

A handwritten signature in black ink, appearing to read "Zach Paden". The signature is fluid and cursive, with a large, stylized "Z" and "P".

Zach Paden, P.E.
Engineering Project Manager



NPDES Permit No. OKS000201
July 1, 2025, through June 30, 2026
Annual Report for
Oklahoma Turnpike Authority (OTA)

This report summarizes the Oklahoma Turnpike Authority's (OTA) stormwater management activities for turnpike segments located within the City of Tulsa Municipal Separate Storm Sewer System (MS4) area. The segments within the MS4 boundary span several distinct drainage areas. For the Creek Turnpike, a 5.8-mile section in south Tulsa crosses portions of the Vensel Creek, Fry Ditch, and Haikey Creek watersheds, while a 4.0-mile section in east Tulsa crosses parts of the Spunky Creek and Adams Creek watersheds. The Creek Turnpike statistics shown in the remainder of this report refer to the entire Creek Turnpike, not just the portions that are in the Tulsa MS4 area. Approximately 5.0 miles of the Gilcrease Turnpike are within the MS4 area; this includes 0.8 miles in the Mooser Creek-Arkansas River watershed and 4.2 miles in the Harlo Creek-Arkansas River watershed. Additionally, the Creek Turnpike Maintenance yard at Riverside and the 11th Street Salt Barn are within Tulsa's MS4 boundary.

1. Status of the Implementation of the Stormwater Management Program (SWMP).

Requirements outlined in Part 2 of OPDES Permit OKS000201 have been met.

Structural Controls and Stormwater Collection System Operations:

OTA conducts inspections of below-ground stormwater conveyance structures on a biannual schedule as part of its commitment to maintaining an effective stormwater management system. All stormwater structures on the Creek Turnpike within the Tulsa MS4 area were inspected earlier in 2025 and will be inspected again in 2027. The Gilcrease structures are to be inspected in summer/fall of 2026.

Above-ground stormwater controls are monitored daily by the Maintenance staff who are equipped to handle any flow problems that could arise. Examples of such controls include detention areas and roadside ditches. To maintain efficient stormwater flow, OTA completes four (4) mowing cycles each season, with an option for up to three (3) additional cycles. Each mowing cycle covers approximately one thousand six hundred and six (1,606) acres on the Creek Turnpike. OTA completes four (4) mowing cycles, with an option for up to two (2) additional at one hundred seventy-five (175) acres per cycle on the Gilcrease Turnpike.

Roadways:

OTA requires a storm water management plan for all construction projects. The OTA requires contractors to obtain necessary permits for placement of dredge or fill material (from the US Army Corps of Engineers) as well as floodplain and watershed permits (from relevant municipalities).

Approximately seven hundred twenty (720) cubic yards of litter were collected and properly disposed of by Creek Turnpike Maintenance staff. Approximately eighty (80) cubic yards of litter were collected from the Gilcrease Turnpike and properly disposed of by Turner Turnpike Maintenance staff.

OTA Maintenance covers sand piles at Creek Turnpike Maintenance yards with tarps to prevent sand from washing off in the rain or from the wind.

Pesticide, Herbicide, and Fertilizer Application:

OTA requires all turnpike herbicide applicators, as well as all contract applicators, to be licensed and subject to the regulations under the Oklahoma Herbicide Applicators Law, including recertification. Applicators receive yearly training on pesticides, herbicides, and fertilizers from the Oklahoma Vegetation Management Association (OKVMA). OTA has five (5) certified applicators on the Creek Turnpike. Herbicide was applied around sign footings, fences, center medians and at various other locations within the limits of the right of way. Approximately three hundred sixty-two (362) gallons of herbicide were applied on the Creek Turnpike, and seventy (70) gallons of herbicide were applied on the Gilcrease Turnpike.

Illicit Discharge and Improper Disposal:

As part of the inspection of belowground stormwater control structures, no illicit discharges were detected.

OTA's maintenance staff collected and recycled seven hundred eighty-five (785) quarts of oil. The oil is picked up twice a year at the Creek Turnpike Maintenance yard by a private contractor. In addition to the oil, OTA recycled two hundred fifty-two (252) filters. OTA also returned twenty-eight (28) batteries and sixty five (65) tires for recycling to the locations where new ones were purchased. Numbers reported are within the corporate boundary.

Construction Site Runoff:

OTA, following the 2019 ODOT Standard Specifications, establishes requirements designed to "minimize or eliminate air pollution and pollution of rivers, streams, impoundments, and private properties from the discharge of dust and/or stormwater associated with construction activity."

OTA uses Best Management Practices (BMPs) on a site-specific basis to implement an effective erosion and pollutant control program for active construction sites. Where needed, plan sheets are developed to identify project locations and descriptions, the sequence of erosion control activities, limits of disturbance, names of receiving waters, soil stabilization practices, structural controls, offsite vehicle tracking controls, and layout details showing where each soil stabilization and structural practice should be implemented.

During construction, all stormwater activities are monitored and enforced daily by OTA's on-site representative.

Upon project completion, OTA conducts a final inspection and requires that areas impacted by OTA projects be restored to compliance within a specified timeframe after the final inspection, typically within 30 days. OTA Construction Division requires a final assessment to confirm that restoration has been completed.

Public Education:

OTA maintains a Stormwater Management section on its website that provides public education resources on stormwater issues. This section offers materials such as brochures and bookmarks, along with documents related to OTA's Phase I and Phase II MS4 permits that are available for public review.

Employee Education:

OTA maintains an ongoing commitment to regulatory compliance and professional development through structured training programs. To ensure adherence to permit requirements and agency policies, OTA regularly provides targeted educational initiatives to relevant personnel. OTA maintenance employees attend quarterly safety meetings, which may include training and discussion on stormwater-related topics.

Public Participation and Response:

OTA participates in the “Oklahoma: Keep Our Land Grand” anti-litter campaign. As part of this campaign, OTA offers a toll-free number to call to report littering as well as a place to report littering on the website. Individuals who are identified as littering are sent a notice to remind them that littering is a punishable offense and that the goal is to keep Oklahoma land looking grand. For the period from July 1, 2025, to June 30, 2026, OTA received three hundred thirty-two (332) litter reports for the entire statewide turnpike system.

Landscape:

OTA partners with the organization “Up With Trees” to landscape areas in and around the major interchanges in the Tulsa and Broken Arrow communities. OTA also partners with “Color Oklahoma” and maintains one wildflower plot on the right of way adjacent to the Creek Turnpike.

Pollution Prevention/Good Housekeeping:

OTA has developed stormwater pollution prevention plans (SWPPPs) for the Riverside Maintenance facility and the 11th Street Salt Barn. The SWPPPs require annual walk-through inspections at both facilities, quarterly visual monitoring at Riverside, and semi-annual visual monitoring at the 11th Street Salt Barn. There were no findings during the inspections that took place between July 1, 2025, and June 30, 2026.

2. Proposed SWMP Changes.

OTA does not propose any changes to the SWMP.

3. Revision to the Assessment of Controls and the Fiscal Analysis.

OTA proposes no revisions to the assessments of controls. The Fiscal Analysis is included in the City of Tulsa’s Report.

4. Monitoring Data Accumulated Throughout the Reporting Year.

Refer to the Regional Monitoring Report.

5. Annual Expenditures for the Reporting Period with a Breakdown for the Major Elements of the SWMP

Description	Cost
Structural Controls Inspections	\$ 19,000.00
Mowing Creek/Gilcrease Turnpikes	\$ 562,412.00
Sweeping	\$ 40,000.00
Trash Collection and Disposal	\$ 162,758.90
Herbicide Licensing	\$ 3,215.00
Herbicide (Product + Application)	\$ 133,423.00
Total	\$ 920,808.90

6. Enforcement Actions and Inspections Summary

All enforcement actions in OTA's watershed within the City of Tulsa's jurisdiction are issued by the City in concurrence with OTA.

All turnpike roadway areas are inspected regularly as part of ongoing maintenance activities.

Additional inspections of OTA stormwater infrastructure are detailed in the *Structural Controls and Stormwater Collection System Operations* section earlier in this report.

7. Identification of Water Quality Improvements or Degradation.

OTA did not identify any water quality improvements or degradations during this report period.

8. Regional Monitoring Report.

Please see the City of Tulsa's report.

CERTIFICATION

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.



Zach Paden, P.E.
Oklahoma Turnpike Authority

August 10, 2026

Date