Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds: A Community Project to Protect Recreational Uses

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Seven Total Maximum Daily Loads for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds[1]

Adopted August 24, 2016.

Approved by EPA October 7, 2016.

One TMDL for Indicator Bacteria in Mound Creek Added by this Addendum I, October 2018[2]

Via the October 2018 Update to the Texas Water Quality Management Plan.

Approved by EPA February 22, 2019.

One TMDL for Indicator Bacteria in White Oak Creek Added by this Addendum II, January 2023

Via the January 2023 Update to the Texas Water Quality Management Plan (SFR-121/2023-02).

Approved by EPA May 26, 2023 (scroll to view or print this addendum).

[1] https://www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82b-ewfsjr-tmdl-adopted.pdf
[2] https://www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82c-ewfsj-bacteria-tmdl-addendum-one.pdf

Appendix VI. Addendum Two to Seven TMDLs for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds

Adding one TMDL for 1004J_01

One TMDL for Indicator Bacteria in White Oak Creek

Introduction

TCEQ adopted *Seven TMDLs for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds* (TCEQ, 2016) on August 24, 2016. EPA approved the TMDL on October 7, 2016. An addendum to the original TMDL was submitted to EPA through the October 2018 WQMP update (TCEQ, 2018a). That addendum added one AU. This document is the second addendum to the original TMDL report.

This second addendum includes information specific to one additional AU for White Oak Creek (AU 1004J_01; also referred to in this addendum as the TMDL watershed). This AU is located within the watershed of the approved original TMDLs for the East and West Forks of the San Jacinto River. The concentration of indicator bacteria in this additional AU exceeds the criterion used to evaluate support of the primary contact recreation 1 use.

This addendum details the development of the added TMDL allocation for this additional AU, which was not specifically addressed in the original TMDL report. For background or other explanatory information, please refer to the *Technical Support Document for One TMDL for Indicator Bacteria in White Oak Creek*[3] (Adams and Millican, 2022). Refer to the original, approved TMDL document for details about the overall project watershed as well as methods and assumptions used in developing the original TMDLs.

Problem Definition

TCEQ first identified the bacteria impairment for White Oak Creek in the *2020 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2020). The impairment was identified again in the subsequent 2022 Texas Integrated Report (TCEQ, 2022a), the latest EPA-approved

[3] www.tceq.texas.gov/downloads/water-quality/tmdl/houston-galveston-recreational-42/82g-as-474-white-oak-bacteria-tsd-2022-sept.pdf

edition. The impaired AU is 1004J_01. The water body includes only one AU. The White Oak Creek watershed also includes the contributing subwatersheds of upstream, non-impaired AUs East Fork White Oak Creek (AU 1004A_01) and West Fork White Oak Creek (AU 1004B_01). Figure VI-1 shows the watershed added in this addendum in relation to the entire watershed of the original TMDLs, which is located within the Lake Houston watershed in the San Jacinto River Basin.

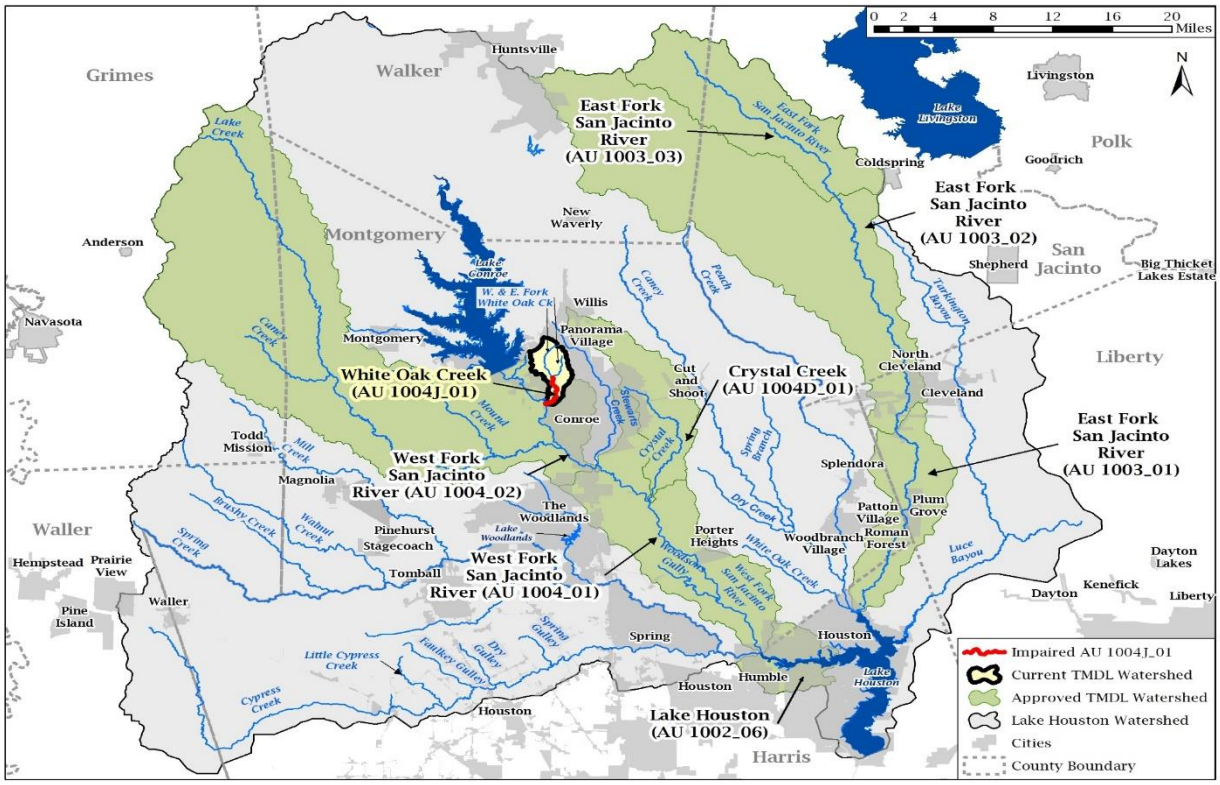

Figure VI-1. Map showing the previously approved TMDL watersheds and the White Oak Creek 1004J_01 watershed added by this addendum

The Texas Surface Water Quality Standards (TCEQ, 2018b) identify uses for surface waters and numeric and narrative criteria to evaluate attainment of those uses. The basis for the water quality target for the TMDL developed in this addendum is the numeric criterion for indicator bacteria from the 2018 Texas Surface Water Quality Standards. *Escherichia coli (E. coli)* is the indicator bacteria for assessing primary contact recreation 1 use in freshwater.

Table VI-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) station on the water body, as reported in the 2022 Texas Integrated Report (TCEQ, 2022a). The data from the assessment indicate nonsupport of the primary contact recreation 1 use for the AU, because the geometric mean concentration for *E. coli* exceeds the freshwater geometric mean criterion of 126 colony

forming units per 100 milliliters (cfu/100 mL) of water. Figure VI-2 shows the location of the TCEQ SWQM station that was used in evaluating water quality in the 2022 Texas Integrated Report for the water body added by this addendum.

Table VI-1. 2022 Texas Integrated Report summary

AU	TCEQ SWQM Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
1004J_01	20731	*E. coli*	28	12/01/2013 – 11/30/2020	3,421.1

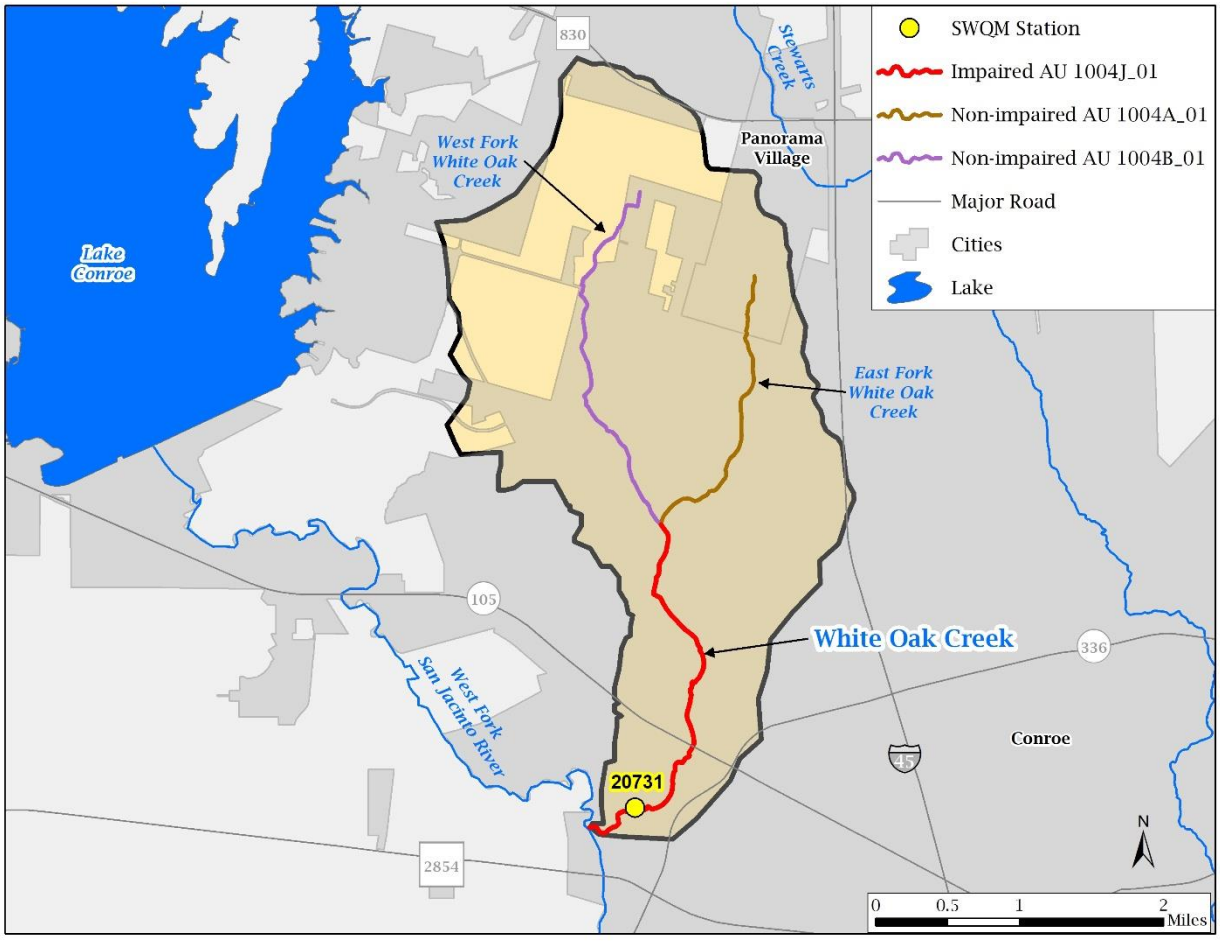

Figure VI-2. Active TCEQ SWQM station

Watershed Overview

White Oak Creek AU 1004J_01 is a tributary to the West Fork San Jacinto River (Segment 1004). The water body is approximately 3.0 miles long, drains 8.7 square miles (5,538 acres), and is located entirely within Montgomery County.

The 2022 Texas Integrated Report (TCEQ, 2022a) provides the following water body and AU description:

- White Oak Creek AU 1004J_01 – Perennial stream from the confluence with West Fork San Jacinto River upstream to the confluence with East Fork White Oak Creek and West Fork White Oak Creek in Conroe.

Climate

Weather data were obtained for the 10-year period from January 2012 through December 2021 from the the National Oceanic and Atmospheric Administration (NOAA) National Centers for Environmental Information for the Conroe North Houston Regional Airport (NOAA, 2022). Data from this 10-year period indicate that the average monthly high temperature typically reaches a maximum of 94.6 °F in August, and the average monthly low temperature reaches a minimum of 38.9 °F in January (Figure VI-3). Annual rainfall averages 51.0 inches. The wettest month is May (6.9 inches) while February (2.9 inches) is the driest month, with rainfall occurring throughout the year.

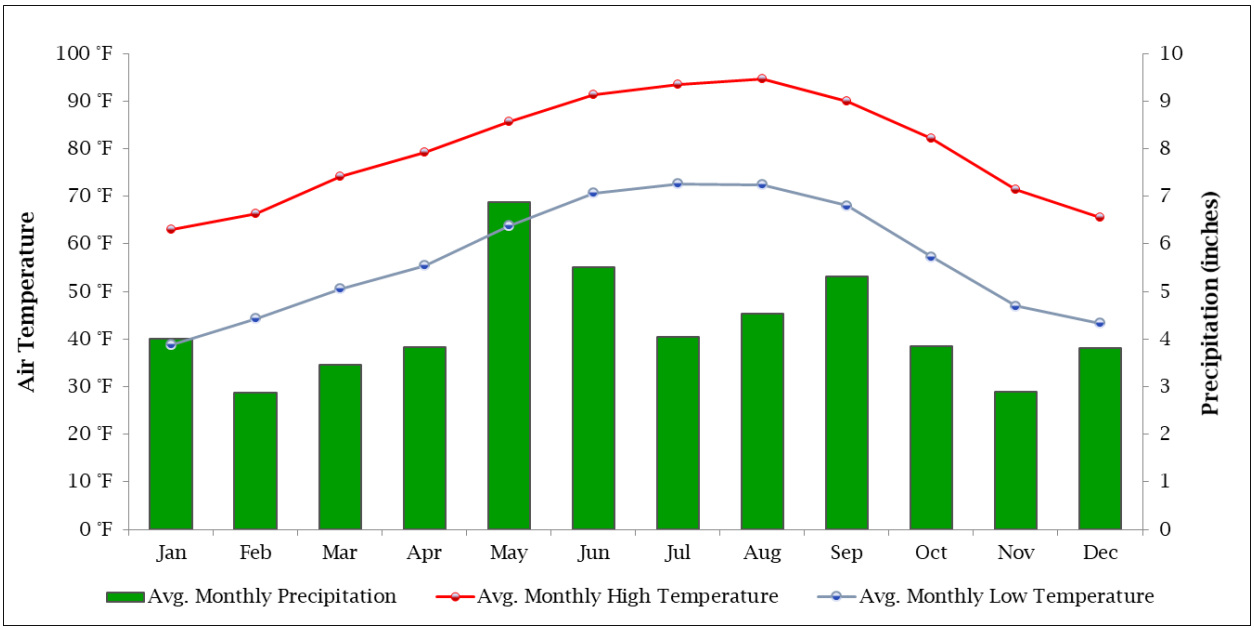

Figure VI-3. Average monthly temperature and precipitation (2012-2021) at the Conroe North Houston Regional Airport

Population and Population Projections

The TMDL watershed is located within Montgomery County. Current predominant population densities for this watershed are zero to two people per acre. According to the 2020 United States Census Bureau (USCB) data (USCB, 2021), the TMDL watershed had an estimated population of 9,645 in 2020.

A population projection through 2045 was developed using data from the H-GAC Regional Growth Forecast data (H-GAC, 2018) to be consistent with the original TMDLs. The forecasts include population projections for transportation analysis zones (TAZ), planning areas used by H-GAC to provide analyses at a local scale. H-GAC updates their regional growth forecast using inputs such as the latest available information on planned and announced developments, population and employment data, and feedback received from forecast users. Table VI-2 provides a summary of the population projection for the TMDL watershed.

Table VI-2. 2020 – 2045 population projection

Area	2020 Estimated Population	2045 Projected Population	Projected Population Increase	Percent Change
White Oak Creek Watershed	9,645	22,341	12,696	132%

The following steps detail the method used to estimate the 2020 and projected 2045 populations in the TMDL watershed.

1. Obtained 2020 USCB data at the block level.
2. Developed the 2020 watershed population using the USCB block level data for the portion of census blocks located within the watershed.
3. For the census blocks that were partially located in the watershed, estimated population by multiplying the block population to the proportion of its area in the watershed.
4. Obtained the 2018 H-GAC Regional Growth Forecast (tabular data) and associated TAZ (spatial data) to be used for population projections (H-GAC, 2018).
5. Joined population data for each TAZ in a geographic information system and located the relevant TAZs within the watershed.
6. For the TAZs that were partially located in the watershed, estimated population projections by multiplying the TAZ population to the proportion of its area in the watershed.
7. Subtracted the 2020 watershed population from the 2045 population projections to determine the projected population increase, then divided the projected population increase by the 2020 watershed population to determine the percentage population increase for the TMDL watershed.

Land Cover

The land cover data for the TMDL watershed were obtained from the United States Geological Survey (USGS) 2019 National Land Cover Database (NLCD; USGS, 2021). The land cover for the TMDL watershed is shown in Figure VI-4. A summary of the land cover data is provided in Table VI-3 and indicates that Evergreen Forest (33.76%) and Developed, Open Space (14.49%) are the dominant land covers in the TMDL watershed.

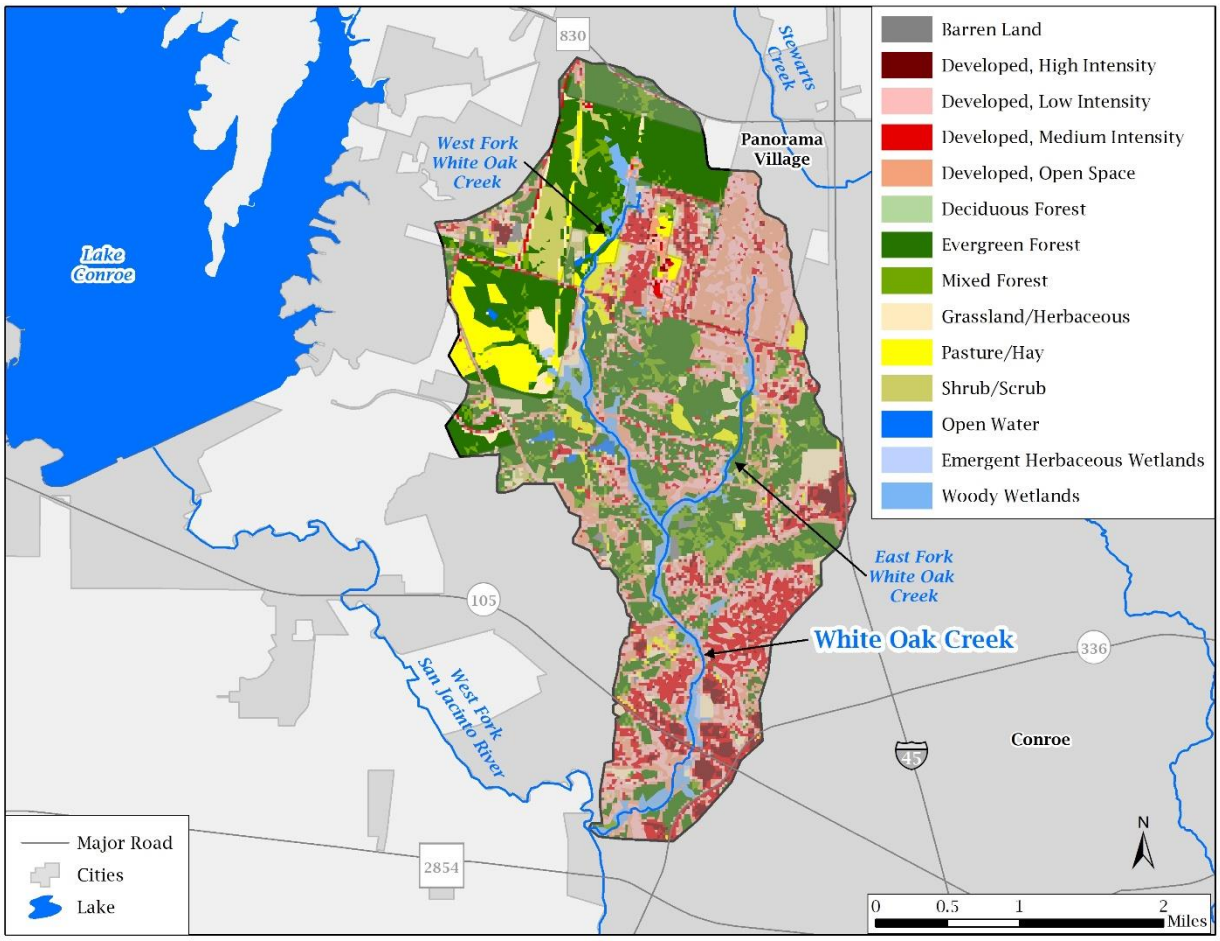

Figure VI-4. Land cover map showing classifications

Table VI-3. Land cover classification by area and percentage

2019 NLCD Classification	Area (Acres)	% of Total
Barren Land	26.04	0.47%
Developed, High Intensity	151.99	2.74%
Developed, Low Intensity	759.94	13.72%
Developed, Medium Intensity	598.24	10.80%
Developed, Open Space	802.59	14.49%
Deciduous Forest	1.25	0.02%
Evergreen Forest	1,869.45	33.76%
Mixed Forest	293.66	5.30%
Grassland/Herbaceous	265.90	4.80%
Pasture/Hay	325.92	5.89%
Shrub/Scrub	153.50	2.77%

2019 NLCD Classification	Area (Acres)	% of Total
Open Water	22.09	0.40%
Emergent Herbaceous Wetlands	21.72	0.39%
Woody Wetlands	245.91	4.44%
Total	**5,538.20**	**100%**

Endpoint Identification

The endpoint for the TMDL is to maintain the concentration of *E. coli* below the geometric mean criterion of 126 cfu/100 mL, which is protective of the primary contact recreation 1 use in freshwater.

Source Analysis

Pollutants may come from several sources, both regulated and unregulated. Pollutants in regulated discharges, referred to as "point sources," come from a single definable point, such as a pipe, and are regulated by permit under the TPDES program. WWTFs and stormwater discharges from industries, construction activities, and the separate storm sewer systems of cities are considered point sources of pollution.

Unregulated sources are typically nonpoint source in origin, meaning the pollutants originate from multiple locations and rainfall runoff washes them into surface waters. Nonpoint sources are not regulated by permit.

Except for WWTFs, which receive individual wasteload allocations (WLAs; see the Wasteload Allocation section), the regulated and unregulated sources in this section are presented to give a general account of the different sources of bacteria expected in the watershed. These are not meant to be used for allocating bacteria loads or interpreted as precise inventories and loadings.

Regulated Sources

Regulated sources are controlled by permit under the TPDES program. The regulated sources in the TMDL watershed include WWTF outfalls and stormwater discharges from municipal separate storm sewer systems (MS4s) and regulated construction activities.

Domestic and Industrial WWTFs

As of March 25, 2022, there was one domestic WWTF with a TPDES permit within the TMDL watershed (Table VI-4 and Figure VI-5).

Table VI-4. TPDES-permitted WWTF discharging in the TMDL watershed

AU	TPDES Number	NPDES[a] Number	Permittee	Outfall Number	Bacteria Limit (cfu/ 100 mL)	Primary Discharge Type	Daily Average Flow – Permitted Discharge (MGD[b])
1004J_01	WQ0011097001	TX0020206	City of Panorama Village	001	63	Treated domestic wastewater	0.4

[a]NPDES: National Pollutant Discharge Elimination System

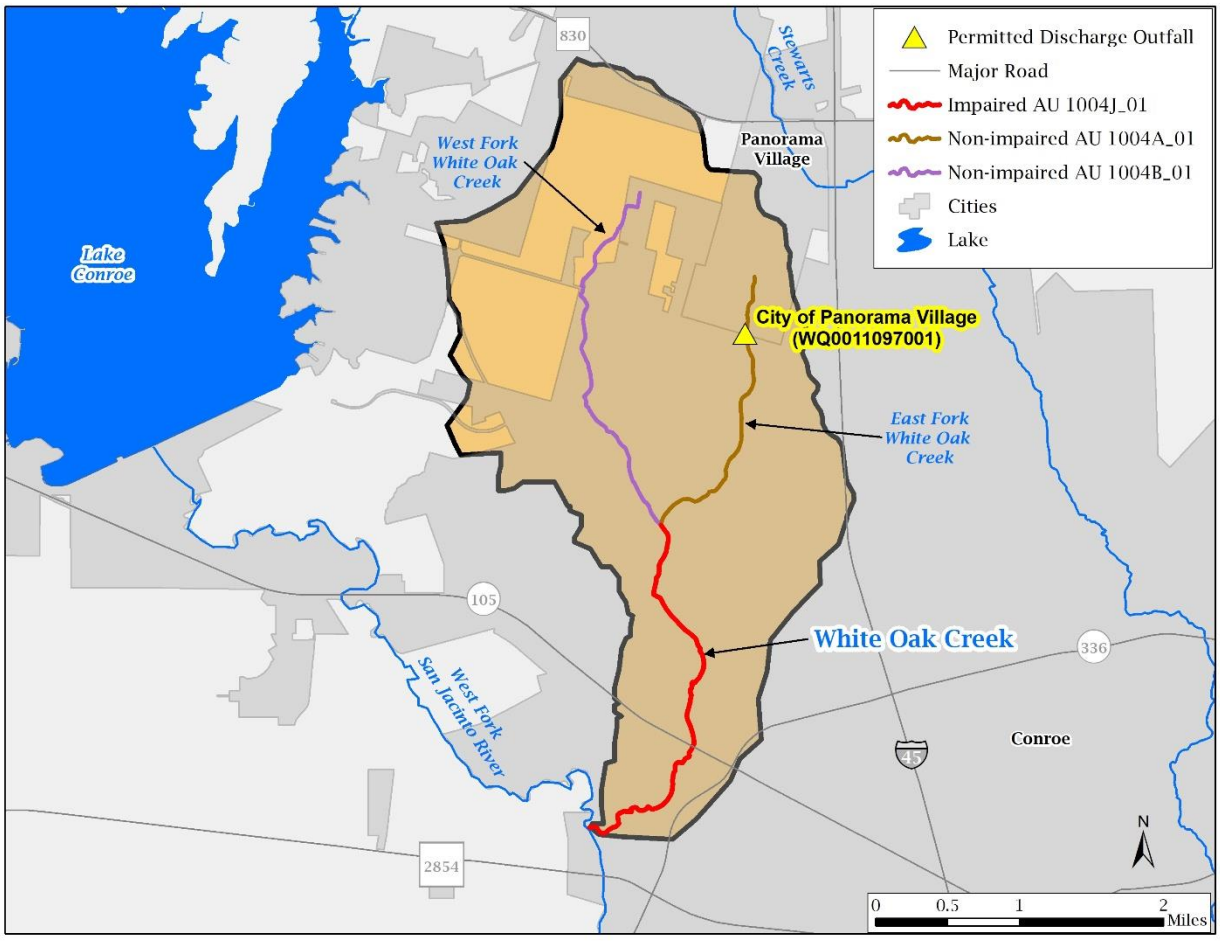

Figure VI-5. WWTF in the TMDL watershed

TCEQ/TPDES Water Quality General Permits

Certain types of activities are required to be covered by one of several TCEQ/TPDES wastewater general permits:

- TXG110000 – concrete production facilities

- TXG130000 – aquaculture production
- TXG340000 – petroleum bulk stations and terminals
- TXG640000 – conventional water treatment plants
- TXG670000 – hydrostatic test water discharges
- TXG830000 – water contaminated by petroleum fuel or petroleum substances
- TXG870000 – pesticides (application only)
- TXG920000 – concentrated animal feeding operations
- WQG100000 – wastewater evaporation
- WQG200000 – livestock manure compost operations (irrigation only)

A review of active general permit coverage (TCEQ, 2022b) in the TMDL watershed as of April 11, 2022, found no active general wastewater permit authorizations of the types described above.

Sanitary Sewer Overflows

A summary of sanitary sewer overflow (SSO) incidents that occurred during a six-year period from 2016 through 2021 in Montgomery County was obtained from TCEQ Central Office in Austin. The summary data indicated no SSO incidents had been reported within the TMDL watershed.

TPDES-Regulated Stormwater

When evaluating stormwater for a TMDL allocation, a distinction must be made between stormwater originating from an area under a TPDES-regulated discharge permit and stormwater originating from areas not under a TPDES-regulated discharge permit. Stormwater discharges fall into two categories:

1. Stormwater subject to regulation, which is any stormwater originating from TPDES-regulated MS4 entities, stormwater discharges associated with regulated industrial facilities, and construction activities.
2. Stormwater runoff not subject to regulation.

Discharges of stormwater from a Phase II MS4 area, regulated industrial facility, construction area, or other facility involved in certain activities must be covered under the following TCEQ/TPDES general permits:

- TXR040000 – Phase II MS4 General Permit for MS4s located in urbanized areas
- TXR050000 – Multi-sector General Permit (MSGP) for industrial facilities
- TXR150000 – Construction General Permit (CGP) for construction activities disturbing more than one acre or are part of a common plan of development disturbing more than one acre

A review of active stormwater general permit authorizations (TCEQ, 2022b) in the TMDL watershed as of April 11, 2022, found no active MSGP authorizations and six CGP

authorizations within the watershed. There are currently one combined Phase I/II permit and three Phase II MS4 authorizations within the TMDL watershed (Table VI-5). Figure VI-6 shows the urbanized area defined by the USCB that accounts for MS4 coverage within the TMDL watershed.

Table VI-5. TPDES MS4 permits associated with the TMDL watershed

Entity	TPDES Permit	EPA ID	Authorization Type
Texas Department of Transportation	WQ0005011000	TXS002101	Combined Phase I and II MS4
Montgomery County	General Permit (TXR040000)	TXR040348	Phase II MS4
City of Conroe	General Permit (TXR040000)	TXR040441	Phase II MS4
City of Panorama Village	General Permit (TXR040000)	TXR040550	Phase II MS4

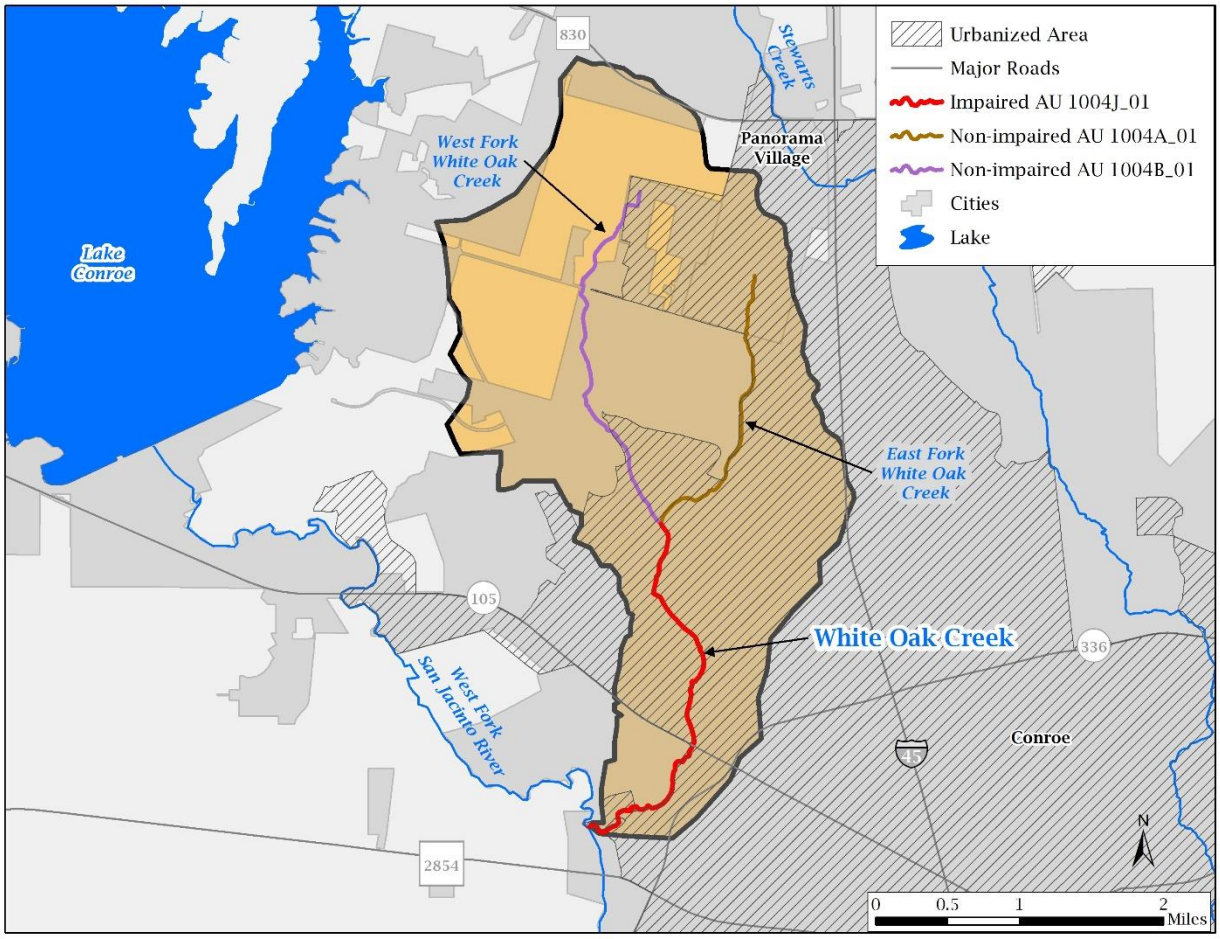

Figure VI-6. Regulated stormwater areas based on Phase I and Phase II MS4 permits as defined by the urbanized area

Illicit Discharges

Pollutant loads can enter water bodies from MS4 outfalls that carry authorized sources as well as illicit discharges under both dry- and wet-weather conditions. The term "illicit discharge" is defined in TPDES General Permit TXR040000 for Phase II MS4s as "Any discharge to a municipal separate storm sewer system that is not entirely composed of stormwater, except discharges pursuant to this general permit or a separate authorization and discharges resulting from emergency firefighting activities." Illicit discharges can be categorized as either direct or indirect contributions.

Unregulated Sources

Unregulated sources of bacteria are nonpoint and can originate from wildlife and feral hogs, various agricultural activities, agricultural animals, urban runoff not covered by a permit, failing on-site sewage facilities (OSSFs), and domestic pets.

Unregulated Agricultural Activities and Domesticated Animals

A number of agricultural activities that do not require permits can be potential sources of fecal bacteria loading. Livestock are present throughout the more rural portions of the project watershed.

Table VI-6 provides estimated numbers of selected livestock in the watershed based on the 2017 Census of Agriculture conducted by U.S. Department of Agriculture (USDA NASS, 2019). The county-level estimated livestock populations were reviewed by Texas State Soil and Water Conservation Board staff and were refined to better reflect actual numbers within the TMDL watershed. The refinement was performed by dividing the total area of suitable grazing land in the watershed by the total area of suitable grazing land in Montgomery County. This ratio was then applied to the county-level livestock data. These livestock numbers, however, were not used to develop an allocation of allowable bacteria loading to livestock.

Table VI-6. Estimated livestock populations

AU	Cattle and Calves	Hogs and Pigs	Goats and Sheep	Horses
1004J_01	109	9	21	21

Fecal bacteria from dogs and cats is transported to water bodies by runoff in both urban and rural areas and can be a potential source of bacteria loading. Table VI-7 summarizes the estimated number of dogs and cats within the TMDL watershed. Pet population estimates were calculated as the estimated number of dogs (0.614) and cats (0.457) per household (AVMA, 2018). The number of households in the TMDL watershed was estimated using 2010 Census household and population data (USCB, 2010) to obtain the ratio of people to households. This ratio was applied to the 2020 White Oak Creek population data (USCB, 2021) to estimate the number of households in the TMDL

watershed. The actual contribution and significance of bacteria loads from pets reaching White Oak Creek is unknown.

Table VI-7. Estimated households and pet population

AU	Estimated Households	Estimated Dog Population	Estimated Cat Population
1004J_01	3,986	2,447	1,822

Wildlife and Unmanaged Animals

Fecal bacteria are common inhabitants of the intestines of all warm-blooded animals, including wildlife such as mammals and birds. In developing bacteria TMDLs, it is important to identify by watershed the potential for bacteria contributions from wildlife. Wildlife are naturally attracted to riparian corridors of water bodies. With direct access to the stream channel, the direct deposition of wildlife waste can be a concentrated source of bacteria loading to a water body. Fecal bacteria from wildlife are also deposited onto land surfaces, where they may be washed into nearby water bodies by rainfall runoff.

For feral hogs, a study by Timmons et al. (2012) estimated a range of feral hog densities within suitable habitat in Texas from 8.9 to 16.4 hogs per square mile. The average hog density (12.65 hogs/square mile) was multiplied by the hog-habitat area of 4.96 square miles in the TMDL watershed. Habitat deemed suitable for hogs includes the following classifications from the 2019 NLCD land cover: Forest, Wetlands, Pasture/Hay, Shrub/Scrub, and Grassland/Herbaceous. Using this methodology, the estimated feral hog population is 63 in the TMDL watershed.

For deer, the Texas Parks and Wildlife Department (TPWD) has published data showing deer population-density estimates by Deer Management Unit (DMU) and Ecoregion in the state (TPWD, 2021). The TMDL watershed is located within portions of DMU 14 and the DMU Urban Houston for which there is no deer density data. Due to the lack of deer density data for DMU Urban Houston, density data from DMU 14 was used to estimate deer populations for the TMDL watershed. For the 2020 TPWD survey year, the estimated deer population density for DMU 14 was 25.03 deer per 1,000 acres and applies to all habitat types within the DMU. Applying this value to the entire area of the TMDL watershed returns an estimated 139 deer within the TMDL watershed. The *E. coli* contribution from feral hogs and wildlife in the TMDL watershed could not be determined based on existing information.

Onsite Sewage Facilities

The estimated number of OSSFs in the TMDL watershed was determined using data supplied by the Houston-Galveston Area Council. These data indicate that there are 299 OSSFs located within the TMDL watershed (Figure VI-7). Several pathways of the liquid

waste in OSSFs afford opportunities for bacteria to enter ground and surface waters, if the systems are not properly operating. Properly designed and operated, however, OSSFs would be expected to contribute virtually no fecal bacteria to surface waters (Weiskel et al., 1996).

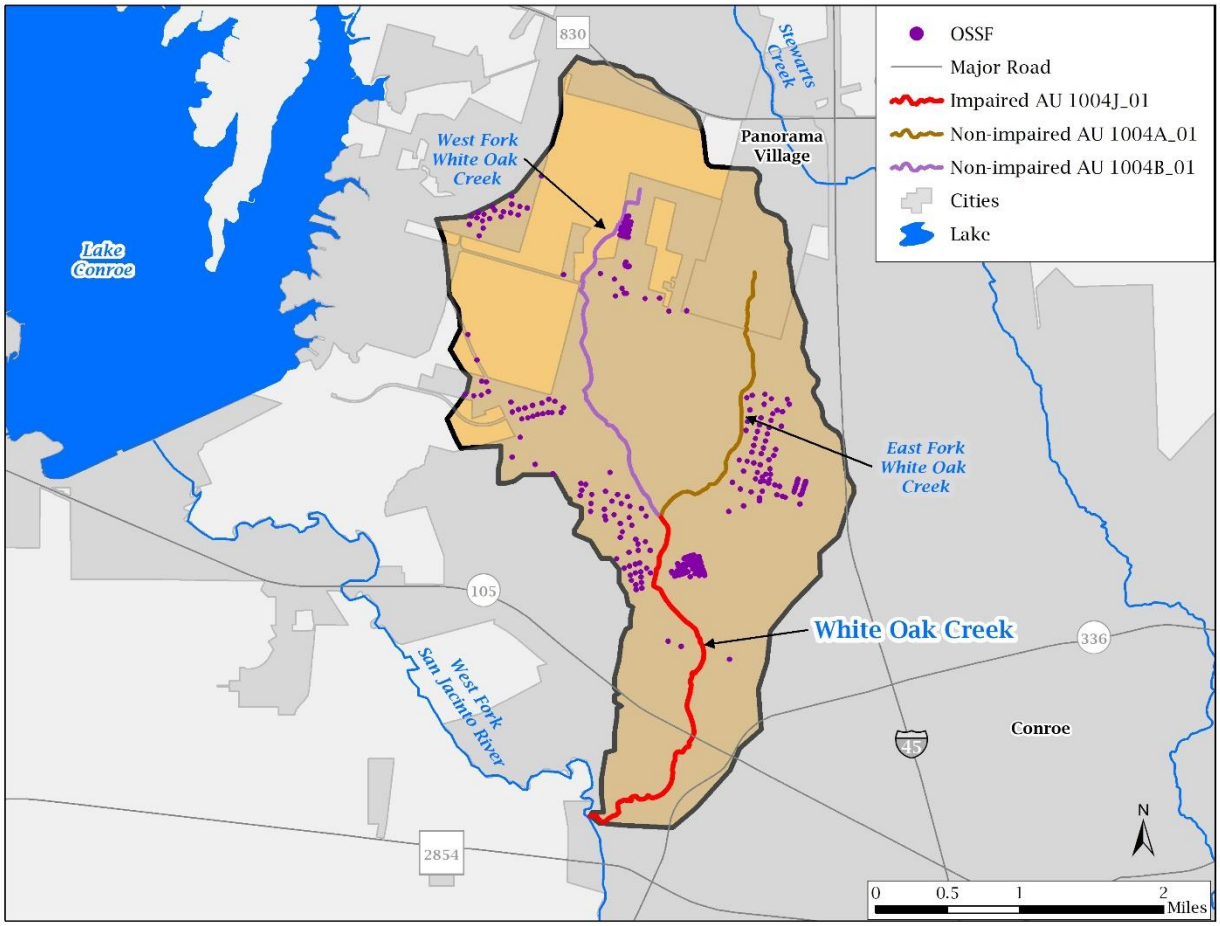

Figure VI-7. OSSFs in the TMDL watershed

Linkage Analysis

The load duration curve (LDC) method was used to examine the relationship between instream water quality and the source of indicator bacteria loads. Inherent to the use of LDCs as the mechanism of linkage analysis is the assumption of a one-to-one relationship between instream loadings and loadings originating from point sources as regulated and from the landscape as unregulated sources. Further, this one-to-one relationship was also inherently assumed when using the LDC to define the TMDL pollutant load allocation. The LDC method allows for estimation of TMDL loads by utilizing the cumulative frequency distribution of streamflow and measured pollutant concentration data (Cleland, 2003). In addition to estimating stream loads, this method

allows for the determination of the hydrologic conditions under which impairments are typically occurring, can give indications of the broad origins of the bacteria (i.e., point or nonpoint source), and provides a means to allocate allowable loadings. The technical support document for this addendum (Adams and Millican, 2022) provides details about the linkage analysis along with the LDC method and its application.

The *E. coli* event data plotted on the LDC for TCEQ SWQM Station 20731 in Figure VI-8 show exceedances of the geometric mean criterion have commonly occurred regardless of streamflow conditions. The allowable load at the single sample criterion (399 cfu/100 mL) is included on the LDC for comparison with individual *E. coli* samples, although it is not used for assessment or allocation purposes.

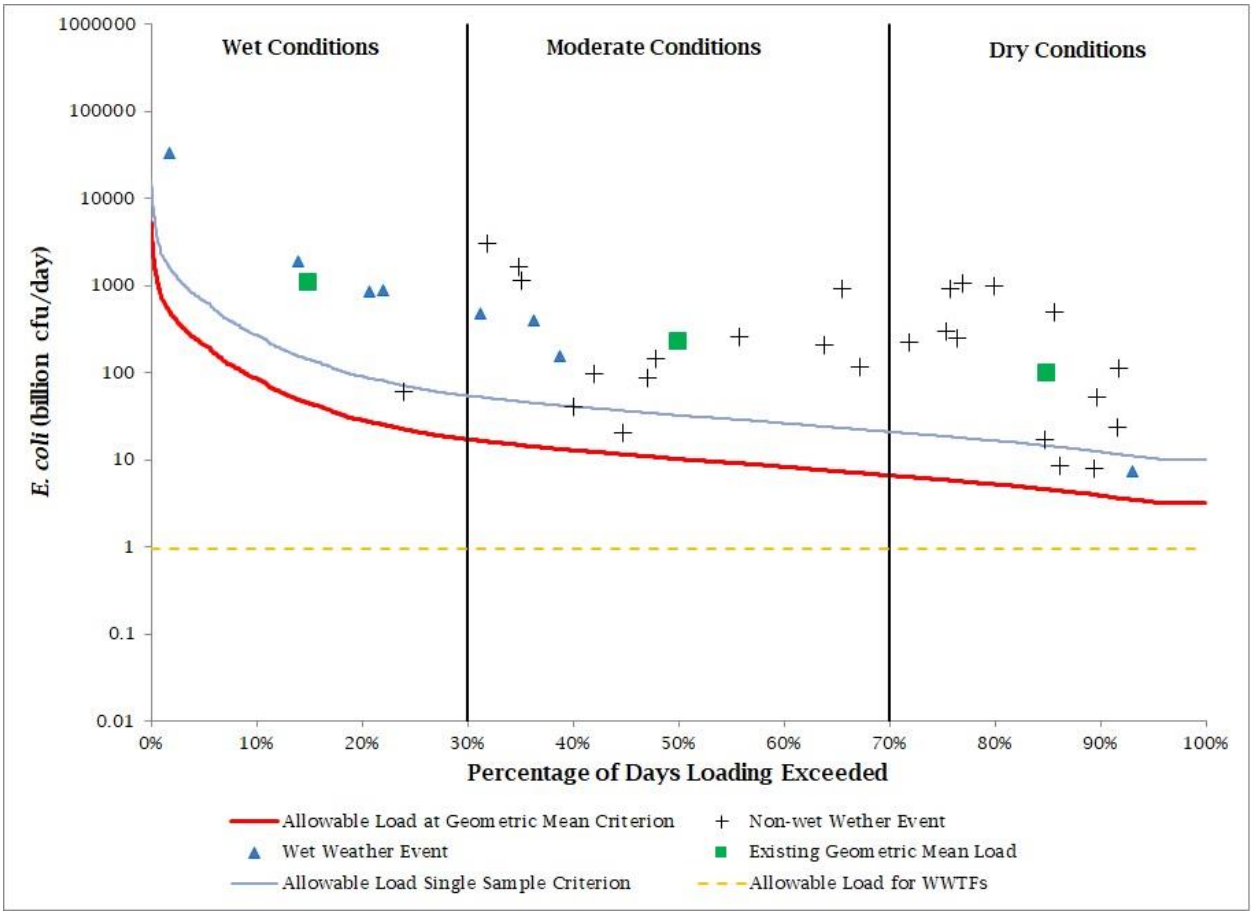

Figure VI-8. LDC for TCEQ SWQM Station 20731

Margin of Safety

The margin of safety (MOS) is designed to account for any uncertainty that may arise in specifying water quality control strategies for the complex environmental processes that affect water quality. Quantification of this uncertainty, to the extent possible, is the basis

for assigning an MOS. The TMDL in this report incorporates an explicit MOS of 5% of the total TMDL allocation.

Pollutant Load Allocation

The TMDL represents the maximum amount of a pollutant that the stream can receive in a single day without exceeding water quality standards. The pollutant load allocations for the selected scenarios were calculated using the following equation:

TMDL = WLA + LA + FG + MOS

Where:

WLA = wasteload allocations, the amount of pollutant allowed by regulated dischargers

LA = load allocations, the amount of pollutant allowed by unregulated sources

FG = loadings associated with future growth from potential regulated facilities

MOS = margin of safety load

AU-Level TMDL Calculation

To be consistent with previously completed TMDLs in the original watershed, the TMDL for White Oak Creek was derived using the median flow within the "Wet Conditions" regime (or 15% load duration exceedance) of the LDC developed for TCEQ SWQM Station 20731. This station represents the location within White Oak Creek where an adequate number of *E. coli* samples was collected.

Margin of Safety Calculation

The TMDL in this report incorporates an explicit MOS of 5%.

Wasteload Allocation

The WLA is the sum of loads from regulated sources, which are WWTFs and regulated stormwater.

Wastewater Treatment Facilities

TPDES-permitted WWTFs are allocated a daily wasteload (WLA_{WWTF}) calculated as their full permitted discharge flow rate multiplied by one-half the instream geometric mean criterion. One-half of the water quality criterion (63 cfu/100 mL *E. coli*) is used as the WWTF target to provide instream and downstream load capacity and to be consistent with the original TMDL report. Table VI-8 presents the WLA for the WWTF (which is also the total allocation for the AU within the TMDL watershed).

Table VI-8. WLA for TPDES-permitted facility

AU	TPDES Number	Permittee	Bacteria Limit (cfu/100 mL *E. coli*)	Full Permitted Flow (MGD)	WLA_{WWTF} (billion cfu/day *E. coli*)
1004J_01	WQ0011097001	City of Panorama Village	63	0.40	0.954

Regulated Stormwater

Stormwater discharges from MS4, industrial, and construction areas are also considered regulated point sources. Therefore, the WLA calculations must also include an allocation for regulated stormwater discharges (WLA_{SW}). The percentage of the land area included in the project watershed that is under the jurisdiction of stormwater permits is used to estimate the amount of the overall runoff load that should be allocated as the permitted stormwater contribution in the WLA_{SW} component.

Acreages associated with MS4s as defined by the 2020 Conroe/The Woodlands urbanized area (2,888 acres) and CGP authorizations outside the urbanized area but within the TMDL watershed (281 acres) were calculated using geographic information system shapefiles (or the "area disturbed" listed for CGP authorizations). The percentage of land under the jurisdiction of stormwater permits in the TMDL watershed is 57.22%.

Load Allocation

The load allocation (LA) component of the TMDL corresponds to direct nonpoint runoff and is the difference between the total load from stormwater runoff and the portion allocated to WLA_{SW}.

Allowance for Future Growth

The future growth (FG) component of the TMDL equation addresses the requirement of TMDLs to account for future loadings that might occur as a result of population growth, changes in community infrastructure, and development. Specifically, this TMDL component takes into account the probability that new flows from WWTF discharges may occur in the future. The assimilative capacity of water bodies increases as the amount of flow increases. The allowance for FG in this TMDL report will result in protection of existing uses and conform to Texas' antidegradation policy.

The FG component of the TMDL watershed was based on population projections and current permitted wastewater dischargers for the entire TMDL watershed. Recent population and projected population growth between 2020 and 2045 for the TMDL watershed are provided in Table VI-2. The projected population percentage increase within the watershed was multiplied by the corresponding WLA_{WWTF} to calculate future WLA_{WWTF}.

FG of existing or new point sources is not limited by this TMDL as long as the sources do not cause bacteria to exceed the limits. The assimilative capacity of water bodies increases as the amount of flow increases. Consequently, increases in flow allow for increased loadings. The LDC and tables in this TMDL report will guide determination of the assimilative capacity of the water body under changing conditions, including FG.

Summary of TMDL Calculations

Table VI-9 summarizes the TMDL calculations for the TMDL watershed. The TMDL was calculated based on the median flow in the 0-30 percentile range (15% exceedance, "Wet Conditions" regime) from the LDC developed for the TCEQ SWQM Station 20731. Allocations are based on the current geometric mean criterion for *E. coli* of 126 cfu/100 mL for each component of the TMDL (with the exception of the WLA_{WWTF} and FG terms, which use one-half the criterion).

Table VI-9. TMDL allocation summary

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
White Oak Creek	1004J_01	44.397	2.220	0.954	22.867	17.097	1.259

The final TMDL allocations (Table VI-10) needed to comply with federal requirements include the FG component within the WLA_{WWTF} (40 CFR Section 103.7).

Table VI-10. Final TMDL allocation

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
White Oak Creek	1004J_01	44.397	2.220	2.213	22.867	17.097

Seasonal Variation

Federal regulations require that TMDLs account for seasonal variation in watershed conditions and pollutant loading [40 CFR Section 130.7(c)(1)]. Analysis of the seasonal differences in indicator bacteria concentrations were assessed by comparing *E. coli* concentrations obtained from nine years (2013 through 2021) of routine monitoring data collected in the warmer months (April through September) against those collected during the cooler months (October through March), which maintains consistency with the previously completed TMDL addendum (TCEQ, 2018a). Differences in *E. coli* concentrations obtained in warmer versus cooler months were then evaluated by performing a Wilcoxon Rank Sum test (also known as the "Mann-Whitney" test). This analysis of *E. coli* data indicated that there was no significant difference (α=0.05) in indicator bacteria between cool and warm weather seasons for White Oak Creek (p=0.1256). Seasonal variation was also addressed by using all available flow and *E. coli*

records (covering all seasons) from the period of record used in LDC development for this project.

Public Participation

TCEQ maintains an inclusive public participation process. From the inception of TMDL development, the project team sought to ensure that stakeholders were informed and involved. Communication and comments from the stakeholders in the watershed strengthen TMDL projects and their implementation.

The technical support document for this TMDL addendum (Adams and Millican, 2022) was published on the TCEQ website on December 8, 2022. Project staff presented information about this addendum at the annual spring meeting of the Bacteria Implementation Group (BIG) in Houston on May 24, 2022. The public had an opportunity to comment on this addendum during the public comment period (February 17 through March 21, 2023) for the WQMP update in which this addendum is included. Notice of the public comment period for this addendum was emailed to stakeholders and posted on the TCEQ's TMDL Program News webpage.[4] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[5] TCEQ accepted public comments on the original TMDL report from March 6 through April 4, 2016. Six comments were submitted, and none of them referred directly to the AU in this TMDL addendum.

Implementation and Reasonable Assurance

The water body covered by this addendum is within the existing bacteria TMDL watershed for the East and West Forks of the San Jacinto River. That TMDL watershed, including White Oak Creek, is within the area covered by the implementation plan (I-Plan) developed by the BIG for bacteria TMDLs throughout the greater Houston area, which was approved by the commission on January 30, 2013. The I-Plan outlines an adaptive management approach in which measures are assessed annually by the stakeholders for efficiency and effectiveness. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals and expresses stakeholder commitment to the process. Please refer to the original TMDL document for additional information regarding implementation and reasonable assurance.

[4] www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html
[5] www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html

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