April 2024 Update to the Texas Water Quality Management Plan

Prepared by
Water Quality Division, Office of Water

Draft TCEQ SFR-121/2024-03
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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY • PO BOX 13087 • AUSTIN, TX 78711-3087

Prepared by the
Office of Water
Water Quality Division

Draft WQMP updates for public comment are available on the TCEQ webpage:
www.tceq.texas.gov/permitting/wqmp/WQmanagement_comment.html

Developed in accordance with Sections 205(j), 208,
and 303 of the Clean Water Act
and applicable regulations thereto.

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Introduction

The Texas Water Quality Management Plan (WQMP) is the product of a wastewater treatment facility (WWTF) planning process developed and updated in accordance with provisions of Sections 205(j), 208, and 303 of the federal Clean Water Act (CWA), as amended. The WQMP is an important part of the State's program for accomplishing its clean water goals.[1]

The Texas Department of Water Resources, a predecessor agency of the Texas Commission on Environmental Quality (TCEQ), prepared the initial WQMP for waste treatment management during the late 1970s. The CWA mandates that the WQMP be updated as needed to fill information gaps and revise earlier certified and approved plans. Any updates to the plan need involve only the elements of the plan that require modification. The original plan and its subsequent updates are collectively referred to as the "State of Texas Water Quality Management Plan."

The WQMP is tied to the State's water quality assessments that identify priority water quality problems. WQMPs are used to direct planning for implementation measures that control and/or prevent water quality problems. Several elements may be contained in the WQMP, such as effluent limitations of wastewater facilities, total maximum daily loads (TMDLs), nonpoint source management controls, identification of designated management agencies, and groundwater and source-water protection planning. Some of these elements may be contained in separate documents, which are prepared independently of the current WQMP update process, but may be referenced as needed to address planning for water quality control measures.

This document, as with previous updates[2], will become part of the WQMP after completion of the public comment period, certification by TCEQ, and approval by the United States Environmental Protection Agency (EPA).

The materials presented in this document revise only the information specifically addressed in the following sections. Previously certified and approved WQMPs remain in effect.

[1] See the formal definition of a water quality management plan in Title 40 Code of Federal Regulations (CFR) 130.2(k).

[2] Fiscal Years 1974, 1975, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984/85, 1986/88, 1989, 1990, 1991, 1992, 1993/94, 1995, 1996, 1997/98, 02/1999, 05/1999, 07/1999, 10/1999, 01/2000, 04/2000, 07/2000, 10/2000, 01/2001, 04/2001, 07/2001, 10/2001, 01/2002, 04/2002, 07/2002, 10/2002, 01/2003, 04/2003, 07/2003, 10/2003, 01/2004, 04/2004, 07/2004, 10/2004, 01/2005, 04/2005, 07/2005, 10/2005, 01/2006, 04/2006, 07/2006, 10/2006, 01/2007, 04/2007, 07/2007, 10/2007, 01/2008, 04/2008, 07/2008, 10/2008, 01/2009, 04/2009, 07/2009, 10/2009, 01/2010, 04/2010, 07/2010,10/2010, 01/2011, 04/2011, 07/2011, 10/2011, BPUB 2011, 01/2012, 04/2012, 07/2012,10/2012, 01/2013, 04/2013, 07/2013,10/2013, 01/2014, 04/2014, 07/2014, 10/2014, 01/2015, 04/2015, 07/2015, 10/2015, 01/2016, 04/2016, 07/2016, 10/2016, 01/2017, 04/2017, 07/2017, 10/2017, 01/2018, 04/2018, 07/2018, 10/2018, 01/2019, Terra Verde 2019, 04/2019, 07/2019, 10/2019, 01/2020, 04/2020, 07/2020 10/2020, 01/2021, 04/2021, 07/2021, 10/2021, 01/2022, 04/2022, 07/2022, 10/2022, 01/2023, 04/2023, 7/2023, 10/2023, and 01/2024.

The draft April 2024 WQMP update addresses the following topics for water quality planning purposes:

1. Projected Effluent Limits Updates
2. Service Area Population for Municipal WWTFs
3. Designation of Management Agencies for Municipal WWTFs
4. TMDL Updates

The public comment period for the draft April WQMP update will be from May 10, 2024 through June 11, 2024.

The "Projected Effluent Limit Update" section provides information compiled from February 1, 2024 through April 30, 2024, and is based on Texas water quality standards (WQS). Projected effluent limits may be used for water quality planning purposes in Texas Pollutant Discharge Elimination System (TPDES) permit actions.

The "Service Area Population" and "Designation of Management Agencies" sections for municipal wastewater facilities were developed and evaluated by TCEQ in cooperation with the Texas Water Development Board (TWDB) and regional water quality management planning agencies.

The "Total Maximum Daily Load Update" section provides information on proposed wasteload allocations (WLAs) for new dischargers and revisions to existing TMDLs and was developed by the TCEQ TMDL Program in the Water Quality Planning Division.

Projected Effluent Limit Updates

Table 1 reflects proposed effluent limits for new dischargers and preliminary revisions to original proposed effluent limits for preexisting dischargers. Abbreviations used in the table heading include:

- BOD_5–5-Day Biochemical Oxygen Demand
- $CBOD_5$–5-Day Carbonaceous Biochemical Oxygen Demand
- DO–Dissolved Oxygen
- lbs/day–Pounds per Day
- MGD–Million Gallons per Day
- mg/L–Milligrams per Liter
- NH_3-N–Ammonia-Nitrogen

Effluent flows indicated in Table 1 reflect future needs and do not reflect current permits for these facilities. These revisions may be useful for water quality management planning purposes. The effluent flows and constituent limits indicated in the table have been preliminarily determined to be appropriate to satisfy the stream standards for dissolved oxygen in their respective receiving waters. These flow volumes and effluent sets may be modified at the time of permit action. These limits are based on the Texas WQS effective at the time of the production of this update. The WQS are subject to revision on a triennial basis.

Table 1. Projected Effluent Limit Updates

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
10549-002	1813	TX0054623	City of Blanco Blanco	0.225	10	18.77	2	3.75			4	Outfall number changed from 003 to 001; discharge routes and modeling changed; flow reduced; effluent limits revised
10847-001	0831	TX0027120	City of Aledo Parker	1.2	10	100.08	3	30.02			4	
11698-001	1206	TX0103781	Palo Pinto County Palo Pinto	0.07					20	11.68	2	
13785-001	0823	TX0093696	Marine Quest-Hidden Cove LP Denton	0.03	10	2.50	3	0.75			4	
13786-002	1203	TX0113913	Midway Water Utilities Inc. Hill	0.3	5	12.51	1.4	3.50			6	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
14377-001	1810	TX0125288	Guadalupe-Blanco River Authority Hays	0.8	5	33.36	1.7	11.34			6	Outfall 001 - Combined discharge from Outfalls 001, 002, and 003 shall not exceed a daily average flow of 4.0 MGD in the Final phase
14377-001	1810	TX0125288	Guadalupe-Blanco River Authority Hays	1.3	5	54.21	1.7	18.43			6	Outfall 002 - Combined discharge from Outfalls 001, 002, and 003 shall not exceed a daily average flow of 4.0 MGD in the Final phase
14377-001	1810	TX0125288	Guadalupe-Blanco River Authority Hays	2.7	5	112.59	1.4	31.53			6	Outfall 003 - Combined discharge from Outfalls 001, 002, and 003 shall not exceed a daily average flow of 4.0 MGD in the Final phase
16309-001	1102	TX0144258	Cullen RV Resort LLC Brazoria	0.008	5	0.33	2	0.13			4	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
16330-001	1243	TX0144410	South Central Water Company and Whitis Land Investments, Ltd. Bell	0.95	5	39.62	2	15.85			4	
16363-001	1414	TX0144711	The Village at Grape Creek, LLC Gillespie	0.02	10	1.67	3	0.50			5	
16374-001	1247	TX0144797	Cielo Gardens LP Williamson	0.9	5	37.53	2	15.01			4	
16395-001	1248	TX0144991	Hillwood Enterprises LP Williamson	0.99	7	57.80	2	16.51			4	
16406-001	1434	TX0145068	South Central Wastewater Travis	0.6	5	25.02	2	10.01			4	
16418-001	1243	TX0145181	221 Granger Road, L.L.C. Bell	0.8	5	33.36	2	13.34			5	
16425-001	1248	TX0145246	SVAG Investments LLC Williamson	0.325	10	27.11	2	5.42			4	
16438-001	1244	TX0145319	CSW Taylor 973 LP Williamson	0.26	7	15.18	2	4.34			4	
16440-001	0818	TX0145327	Sun Terrell TX WWTP, LLC Kaufman	0.3	10	25.02	3	7.51			5	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
16446-001	1248	TX0145351	Coupland Utilities, LLC and LandCrowd Developers LLC Williamson	0.2	5	8.34	2	3.34			6	
16447-001	1212	TX0145360	Sandow Municipal Utility District No. 1 Milam	0.9	7	52.54	2	15.01			6	
16449-001	0203	TX0145386	Carland, Inc. Grayson	0.25	10	20.85	3	6.26			4	
16452-001	1014	TX0145408	East Waller County Management District Waller	0.9	10	75.06	2	15.01			6	
16453-001	1428	TX0145416	Space Exploration Technologies Corp. Bastrop	0.2	10	16.68	2	3.34			5	
16461-001	1003	TX0145467	Texas Water Utilities, L.P. Liberty	0.17	10	14.18	3	4.25			4	
16462-001	1244	TX0145483	Limmer Holdings LLC Williamson	0.15	5	6.26	2	2.50			5	
16464-001	0507	TX0145491	I-30 Greenville Utility Services LLC Hunt	0.24	10	20.02	2	4.00			4	

State Permit Number	Segment Number	EPA ID Number	Permittee Name and County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
16466-001	1105	TX0145513	Brazoria County MUD No. 89 Brazoria	0.325	10	27.11	3	8.13			4	
16469-001	1213	TX0145581	Bartlett Farm LLC Williamson	0.2	10	16.68	3	5.00			4	
16470-001	1011	TX0145521	Crystal Springs Water Co. Inc. Montgomery	0.2	10	16.68	3	5.00			6	
16472-001	1244	TX0145530	Hwy 3349 Holdings LLC Williamson	0.96	10	80.06	3	24.02			4	
16473-001	1227	TX0145556	MLCED Hadley Utility LLC Johnson	0.3	10	25.02	3	7.51			4	
16479-001	2105	TX0145602	Paloma Wastewater Services LLC Dimmit	0.3	10	25.02	3	7.51			4	

Planning Information Summary

The Water Quality Planning Division of TCEQ coordinated with TWDB and regional planning agencies to compile the wastewater facility information in this section. Domestic facility financing decisions under the State Revolving Fund (SRF) loan program must be consistent with the certified and approved WQMP.

The purpose of this section is to present data reflecting facility-planning needs, including previous water quality management plan needs requiring revision. Data are also presented to update other plan information for TWDB's SRF projects. Table 2 contains the updated service area population information. The table is organized in alphabetical order and includes the following 10 categories of information:

1. *Planning Area* – Area for which facility needs are proposed. The facility planning areas are subject to change during the facility planning process and any such changes will be documented in a later water quality management plan update. All planning areas listed are also designated management agencies (DMAs) unless otherwise noted in the "Comments" column.
2. *Service Area* – Area that receives the provided wastewater service.
3. *Needs* – A "T" indicates a need for either initial construction of a WWTF, additional treatment capacity, or the upgrading of a WWTF to meet existing or more stringent effluent requirements. A "C" indicates a need for improvements to, expansion of, rehabilitation of, or the initial construction of a wastewater collection system in the facility planning area. "T/C" indicates a need for both treatment and collection system facilities. More detailed facility planning conducted during a construction project may define additional needs and those needs will be reflected in a future update to the WQMP. A "F" indicates a need for flood mitigation.
4. *Needs Year* – The year in which the needs were identified for the planning area.
5. *Basin Name* – The river basin or designated planning entity for a designated planning area. The seven water quality management planning areas designated by the Governor are each administered by a Council of Governments (COG), a Development Council (DC), or a Planning Council (PC). Basin names are shown for areas outside one of these planning areas. The designated planning areas and their associated administering entities are:
    a. Corpus Christi – Coastal Bend COG (CBCOG)
    b. Killeen-Temple – Central Texas COG (CTCOG)
    c. Texarkana – Ark-Tex COG (ATCOG)
    d. Southeast Texas – South East Texas Regional Planning Council (SETRPC)
    e. Lower Rio Grande Valley – Lower Rio Grande Valley Development Council (LRGVDC)
    f. Dallas-Fort Worth – North Central Texas COG (NCTCOG)

g. Houston – Houston-Galveston Area Council (H-GAC)

6. *Segment* – The classified stream segment or tributary into which any recommended facility may discharge existing or projected wastewater. In the case of no-discharge facilities, this is the classified stream segment drainage area in which the facilities are located.
7. *County* – The county in which the facility planning area is located.
8. *Date* – The date the planning information was reviewed by TCEQ.
9. *Comments* – Additional explanation or other information concerning the facility planning area.
10. *Population* – The base year and projected populations for each facility planning area. Population projections presented are consistent with the latest available statewide population projections or represent the most current information obtained from facility planning analyses.

The facility information in this section is intended to be used in the preparation of facility plans and the subsequent design and construction of wastewater facilities. Design capacities of the treatment and collection systems will be based upon the population projections contained in this document, plus any additional needed capacity established for commercial/industrial flows and documented infiltration/inflow volumes (treatment or rehabilitation).

The probable needs shown under the "Needs" heading are preliminary findings; specific needs for an area must be as established in the completed and certified, detailed engineering studies conducted during facility planning under the SRF and other state loan programs.

Specific recommended effluent quality for any wastewater discharges resulting from any of the facilities in this document will be in accordance with the rule in the Texas WQS in effect at the time the permit is issued for a specific facility.

Table 2. Service Area Population Updates

Planning Agency	Service Area	Needs	Needs Year	Basin Name / COG	Segment	County	WQMP Date	Comments	Year	Population
City of Lone Oak	City Boundary	T/C	2050	Sabine/NCTCOG	0507	Hunt	2/4/2024		2022	725
									2030	876
									2040	1111
									2050	1408
City of Bandera	Project Service Area	T/C	2050	San Antonio	1905	Bandera	3/12/24		2020	1875
									2030	2160
									2040	2316
									2050	2380
City of Port Lavaca	Project Service Area	T/C	2024	Bays and Estuaries	2453	Calhoun	4/4/2024		2023	12086
									2030	11503
									2040	10717
									2050	9985
Victoria County WCID No. 2	City Boundary	T/C	2060	Bays and Estuaries	2453	Victoria	3/12/24		2024	486
									2030	496
									2040	516
									2050	526
Presidio County	Project Service Area	T/C	2050	Rio Grande	NA	Presidio	4/11/24		2020	7144
									2030	9445
									2040	10174
									2050	10972

Designated Management Agencies

To be designated as a management agency for wastewater collection or treatment, an entity must demonstrate the legal, institutional, managerial and financial capability necessary to carry out the entity's responsibilities in accordance with Section 208(c) of the CWA (see below list of requirements). Before an entity can apply for an SRF loan, it must be recommended for designation as the management agency in the approved WQMP.

Designation as a management agency does not require the designated entity to provide wastewater services, but enables it to apply for grants and loans to provide those services. The facilities listed in Table 3 have submitted DMA resolutions to TCEQ. TCEQ submits this DMA information to EPA for approval as an update to the WQMP.

Section 208 (c) (2) Requirements for Management Agency

208(c)(2)(A): to carry out portions of an area-wide waste treatment plan.
208(c)(2)(B): to manage waste treatment works.
208(c)(2)(C): directly or by contract to design and construct new works.
208(c)(2)(D): to accept and utilize grants.
208(c)(2)(E): to raise revenues, including assessment of waste treatment charges.
208(c)(2)(F): to incur short and long term indebtedness.
208(c)(2)(G): to assure community pays proportionate cost.
208(c)(2)(H): to refuse to receive waste from non-compliant dischargers.
208(c)(2)(I): to accept for treatment industrial wastes.

Table 3. Designated Management Agencies

Planning Agency	Service Area	DMA Needs	DMA Date
City of Lone Oak	City Boundary	T/C	12/16/2022
City of Bandera	Project Service Area	T/C	1/19/2024
City of Port Lavaca	Project Service Area	T/C	2/27/2024
Victoria County WCID No. 2	City Boundary	T/C	2/28/2024
Presidio County	Project Service Area	T/C	12/13/2023

Total Maximum Daily Load Revisions

The TMDL Program works to improve water quality in impaired or threatened waters bodies in Texas. The program is authorized by and created to fulfill the requirements of Section 303(d) of the federal CWA.

The goal of a TMDL is to restore the full use of a water body that has limited quality in relation to one or more of its uses. The TMDL defines an environmental target, and based on that target, TCEQ and stakeholders develop an implementation plan with wasteload allocations for point source dischargers to mitigate human-caused sources of pollution within the watershed and restore full use of the water body.

TMDLs are developed based on intensive data collection and scientific analysis. After adoption by TCEQ, TMDLs are submitted to EPA for review and approval.

The attached appendixes may reflect proposed wasteload allocations for new dischargers and/or additions or revisions to TMDLs. Updates and addendums will be provided in the same units of measure used in the original TMDL document and will include the segment and assessment unit (AU) numbers of the affected segments. Also, note that for bacteria TMDLs, loads will typically be expressed as colony-forming units per day (cfu/day). On occasion, other expressions may be used due to different laboratory methods, such as counts or most probable number per day. For the purposes of the TMDL program, these terms are considered to be synonymous.

Appendix I. Updates to Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries

Segments 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E

This appendix provides updates to TMDLs previously submitted through the state's WQMP for: Buffalo and Whiteoak Bayous and Tributaries.

The report, *Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries for Segment Numbers 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E,* was adopted by TCEQ on April 8, 2009 and approved by EPA on June 11, 2009. Upon EPA approval, the TMDLs became part of the state's WQMP.

The Texas WQMP has since been updated 37 times prior to this update for this TMDL. The previous updates have revised the list of individual wasteload allocations (WLAs) in the original TMDL document. Additionally, TCEQ submitted addenda to the original TMDL in the April 2013, April 2015, and January 2021 WQMP updates. These addenda added three new AUs to the original TMDL project.

The purpose of this update is to make the following change to the TMDL (presented in Table I-1):

- Add one new permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for future growth (FG) in one AU. This was originally presented in Table 53 in the original TMDL document. The affected AU in this update is included here as Table I-2.

For AU 1014B_01, the existing FG allocations were insufficient to cover the increased flow to the AU for this update. To account for this, the total amount exceeded beyond the original FG allocation was added to the total TMDL allocation. This resulted in a change to the overall TMDL allocation for the one AU, which has been updated in Tables I-2 and I-3.

Table I-1 - Change to individual WLAs for the TMDL watershed

Updates Table 45, p. 99-103 in the original TMDL document.

The WLA is expressed in billion most probable number (MPN)/day *Escherichia coli* (*E. coli)*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
16452-001	001	TX0145408	1014B_01	EAST WALLER COUNTY MANAGEMENT DISTRICT	0.90	2.146	New permit

Table I-2 - TMDL summary calculations for one AU in the TMDL watershed

Updates Table 53, p. 116-117 in the original TMDL document.

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

AU	TMDL	WLA WWTF	WLA SW	LA	MOS	Upstream Load	FG
1014B_01	647.71	111.67	482.44	53.6	0	0	0.00

Table I-3 - TMDL final calculations

Updates Table 54, p. 118-119 in the original TMDL document.

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

AU	TMDL	WLA WWTF	WLA SW	LA TOTAL	MOS
1014B_01	647.71	111.67	482.44	53.60	0

Appendix II. Updates to Nine TMDLs for Bacteria in Clear Creek and Tributaries

Segments 1101, 1101B, 1101D, 1102, 1102A, 1102B, 1102C, 1102D, and 1102E

This appendix provides updates to TMDLs previously submitted through the state's WQMP for: Clear Creek and Tributaries.

The report, *Nine Total Maximum Daily Loads for Bacteria in Clear Creek and Tributaries: Segments 1101, 1101B, 1101D, 1102, 1102A, 1102B, 1102C, 1102D, and 1102E,* was adopted by TCEQ on September 10, 2008 and approved by EPA on March 6, 2009. Upon EPA approval, the TMDLs became part of the state's WQMP.

The Texas WQMP has since been updated 11 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document. Additionally, TCEQ submitted two addenda to the original TMDL in the October 2012 and October 2018 WQMP updates. These addenda added five new AUs to the original TMDL project.

The purpose of this update is to make the following changes to the TMDL (presented in Table II-1):

- Change the outfall location for an existing permit with a reduced flow.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for FG in two AUs. This was originally presented in Tables 18 and 21 in the original TMDL document. The affected AUs in this update are included here as Tables II-2 and II-3.

For AU 1102A_01, the change of the outfall location to AU 1102B_01 for Permit #16309-001/TX0144258 resulted in flow being removed from AU 1102A_01. This resulted in changes to the TMDL allocations for both AU 1102A_01 and 1102B_01, which have been updated in Tables II-2 and II-3.

Table II-1 - Changes to individual WLAs within the TMDL watershed

Updates Table 16, pp. 47 in the original TMDL document.

All loads expressed as MPN/day.

State Permit Number / EPA Permit Number	Outfall	AU	Permittee Name	Flow (MGD)	WLA – Fecal Coliform MPN/day	WLA – *E. coli* MPN/day	WLA – Enterococci MPN/day	TMDL Comments
16309-001/ TX0144258	001	1102A_01	CULLEN RV RESORT LLC	NA	NA	NA	NA	Removal of permitted flow due to outfall location change
16309-001/ TX0144258	001	1102B_01	CULLEN RV RESORT LLC	0.008	6.06E+07	3.82E+07	NA	New outfall location for existing permit with reduced flow

Abbreviations: NA, Not Applicable

Table II-2 - *E. coli* and Fecal Coliform TMDL Calculations for Freshwater Segments

Updates Table 18, p. 50 in the original TMDL document.

All loads expressed as MPN/day *E. coli*.

Segment	Sampling Location	Stream Name	Indicator Bacteria	TMDL	WLA WWTF	WLA SW	LA	MOS	FG
1102A	16477	Cowart Creek	*E. coli*	4.90E+10	9.73E+08	2.28E+10	2.28E+10	2.43E+09	0
1102B	16473	Mary's Creek/North Fork Mary's Creek	*E. coli*	2.46E+11	4.97E+10	1.32E+11	8.40E+09	1.23E+10	4.37E+10

Table II-3 - TMDL Allocation Table

Updates Table 21, p. 53 in the original TMDL document.

All loads expressed as MPN/day *E. coli*.

Segment	Stream Name	AU	Indicator Bacteria	TMDL	WLA WWTF	WLA SW	LA	MOS	FG
1102A	Cowart Creek	1102A_02	*E. coli*	4.90E+10	9.73E+08	2.28E+10	2.28E+10	2.43E+09	0
1102B	Mary's Creek	1102B_01	E. coli	2.46E+11	4.97E+10	1.32E+11	8.42E+09	1.23E+10	4.36E+10

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

Segments 1002, 1003, 1004, and 1004D

This appendix provides updates to TMDLs previously submitted through the state's WQMP for: Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds.

The report, *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 For Segments 1002, 1003, 1004, and 1004D,* was adopted by TCEQ on August 24, 2016 and approved by EPA on October 7, 2016. Upon EPA approval, the TMDLs became part of the state's WQMP.

The Texas WQMP has since been updated 16 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document. Additionally, TCEQ submitted an addendum to the original TMDL in the October 2018 WQMP update. This addendum added one new AU to the original TMDL project. A second addendum to the original TMDL was added in the January 2023 WQMP update. This addendum added one new AU to the original TMDL project.

The purpose of this update is to make the following change to the TMDL (presented in Table III-1):

- Add one new permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for FG in one AU. This was originally presented in Table 17 in the original TMDL document. The affected AU in this update is included here as Table III-2.

For AU 1003_01, the existing FG allocation was insufficient to cover the increased flow to the AU for this update. To account for this, the total amount exceeded beyond the original FG allocation was added to the total TMDL allocation. This resulted in a change to the overall TMDL allocation for the one AU, which has been updated in Tables III-2 and III-3.

Table III-1 - Changes to individual WLAs for the TMDL watersheds

Updates Table 13, p. 54-55 in the original TMDL document.

The WLA is expressed in billion MPN/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
16461-001	001	TX0145467	1003_01	TEXAS WATER UTILITIES, L.P.	0.17	0.4054	New permit

Table III-2 - TMDL summary calculations for one AU in the TMDL watersheds

Updates Table 17, p. 59 in the original TMDL document.

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

AU	Segment Name	TMDL	MOS	WLA WWTF	WLA SW	LA AU	LA TRIB	LA RES	LA TOTAL	FG
1003_01	East Fork San Jacinto River	875.76	43.32	20.88	1.75	809.81	0	0	809.81	0.00

Table III-3 - TMDL final calculations

Updates Table 18, p. 60 in the original TMDL document.

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

AU	TMDL	WLA WWTF	WLA SW	LA TOTAL	MOS
1003_01	875.76	20.88	1.75	809.81	43.32

Appendix IV. Addendum One to One Total Maximum Daily Load for Bacteria in Jarbo Bayou

Adding one TMDL for AU 2425B_02

One TMDL for Indicator Bacteria in Jarbo Bayou

Introduction

TCEQ adopted *One Total Maximum Daily Load for Bacteria in Jarbo Bayou* (TCEQ, 2018a) on January 24, 2018. EPA approved the TMDL on March 29, 2018. This document is the first addendum to the original TMDL report.

This first addendum includes information specific to one additional AU for Jarbo Bayou AU 2425B_02. This AU is located within the watershed of the approved original TMDL for Jarbo Bayou. 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 Total Maximum Daily Load for Indicator Bacteria in Jarbo Bayou* (Adams and Millican, 2024). 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 TMDL.

Problem Definition

TCEQ first identified the bacteria impairment within Jarbo Bayou AU 2425B_02 in the EPA-approved 2022 edition of the *Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2022). The water body includes only two AUs. The downstream AU 2425B_01 was included as part of the original TMDL. Figure IV-1 shows the watershed added in this addendum in relation to the entire watershed of the original TMDL.

The Texas Surface Water Quality Standards (TCEQ, 2022b) identifies 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 2022 Texas Surface Water Quality Standards. Enterococci is the indicator bacteria for assessing primary contact recreation 1 use in saltwater.

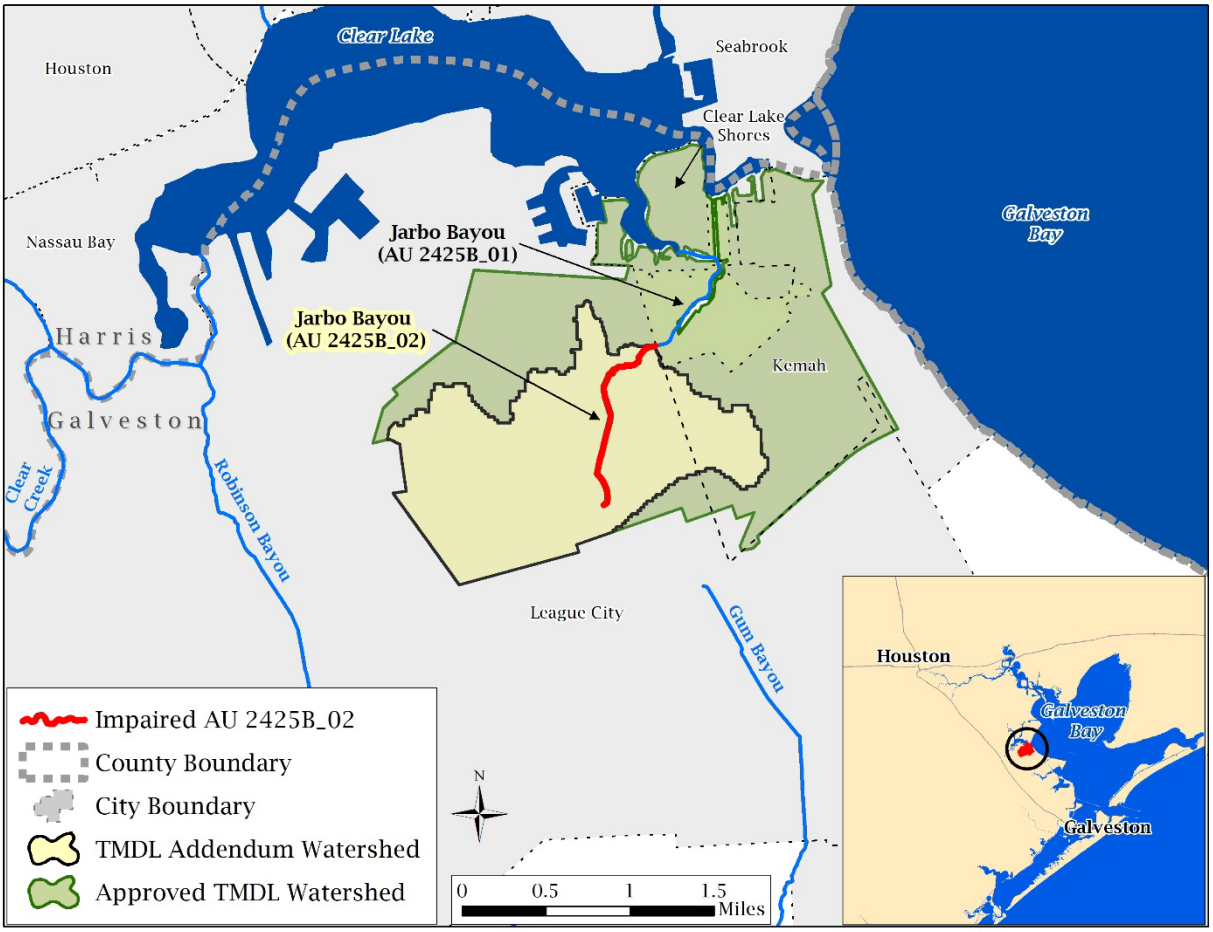

Figure IV-1. Map showing the previously approved TMDL watershed and the Jarbo Bayou AU 2425B_02 watershed added by this addendum

Table IV-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) station in the water body, as reported in the 2022 Texas Integrated Report (TCEQ, 2022). The data from the assessment indicate nonsupport of the primary contact recreation 1 use for the AU, because the geometric mean concentration for Enterococci exceeds the saltwater geometric mean criterion of 35 colony forming units per 100 milliliters (cfu/100mL) of water. Figure IV-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 IV-1. 2022 Texas Integrated Report summary

AU	TCEQ SWQM Station	Parameter	Number of Samples	Date Range	Enterococci Geometric Mean (cfu/100 mL)
2425B_02	16485	Enterococci	22	12/1/13 – 11/30/20	126.96

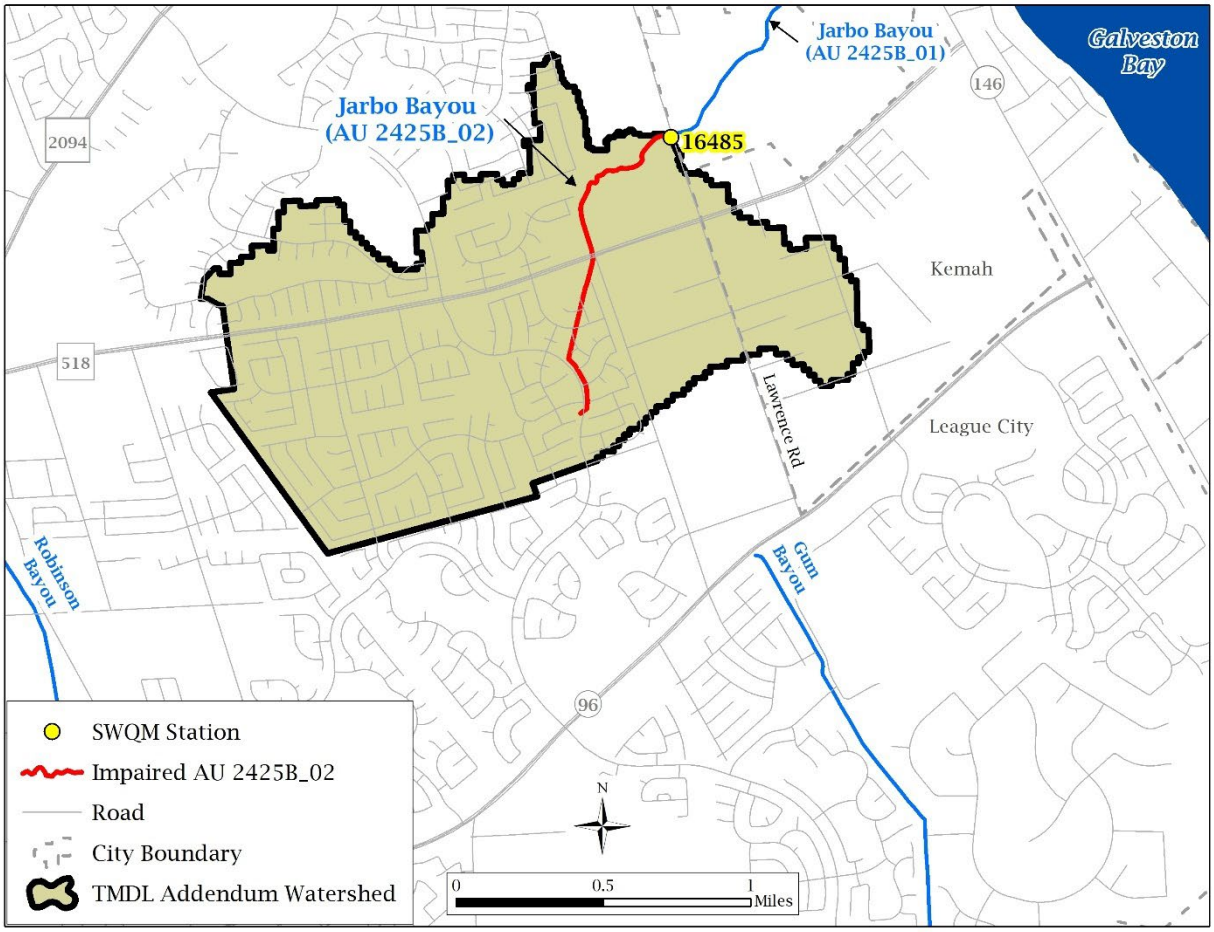

Figure IV-2. Active TCEQ SWQM station

Watershed Overview

The TMDL watershed (AU 2425B_02) is located within the Jarbo Bayou (2425B) watershed in the southeastern portion of the "Greater Houston" metropolitan area and entirely within Galveston County. Influenced by seawater from Galveston Bay, Jarbo Bayou begins approximately 0.67 miles upstream of Farm-to-Market 518 and flows 1.61 miles to the outlet at Clear Lake, which feeds into Galveston Bay. Jarbo Bayou consists of two AUs (2425B_01 and 2425B_02).

The 2022 Texas Integrated Report (TCEQ, 2022) has the following water body and AU descriptions:

- Jarbo Bayou (2425B) –From Clear Lake confluence with Clear Lake to 1.1 kilometers (0.67 miles) upstream of Farm-to-Market 518 in Galveston County.
  - AU 2425B_01 - From the Clear Lake confluence upstream to Lawrence Road
  - AU 2425B_02 - From Lawrence Road to the headwaters 1.1 kilometers (0.67 miles) upstream of Farm-to-Market 518

Climate

The TMDL watershed is within the Upper Coast climatic division, categorized as subtropical humid (Larkin and Bomar, 1983). The Gulf of Mexico is the principal source of moisture that drives precipitation in the region. Weather data were obtained for the 10-year period from January 2013 through December 2022 from the National Oceanic and Atmospheric Administration (NOAA) National Center for Environmental Information for the Houston National Weather Service Office located in League City (NOAA, 2023). Data from this 10-year period indicate that the average high temperatures typically peak in August (92.2 °F). During winter, the average low temperature generally reaches a minimum of 44.4 °F in January (Figure IV-3). Annual rainfall averages 64.2 inches. The wettest month was August (9.9 inches) while February (2.3 inches) was the driest month, with rainfall occurring throughout the year.

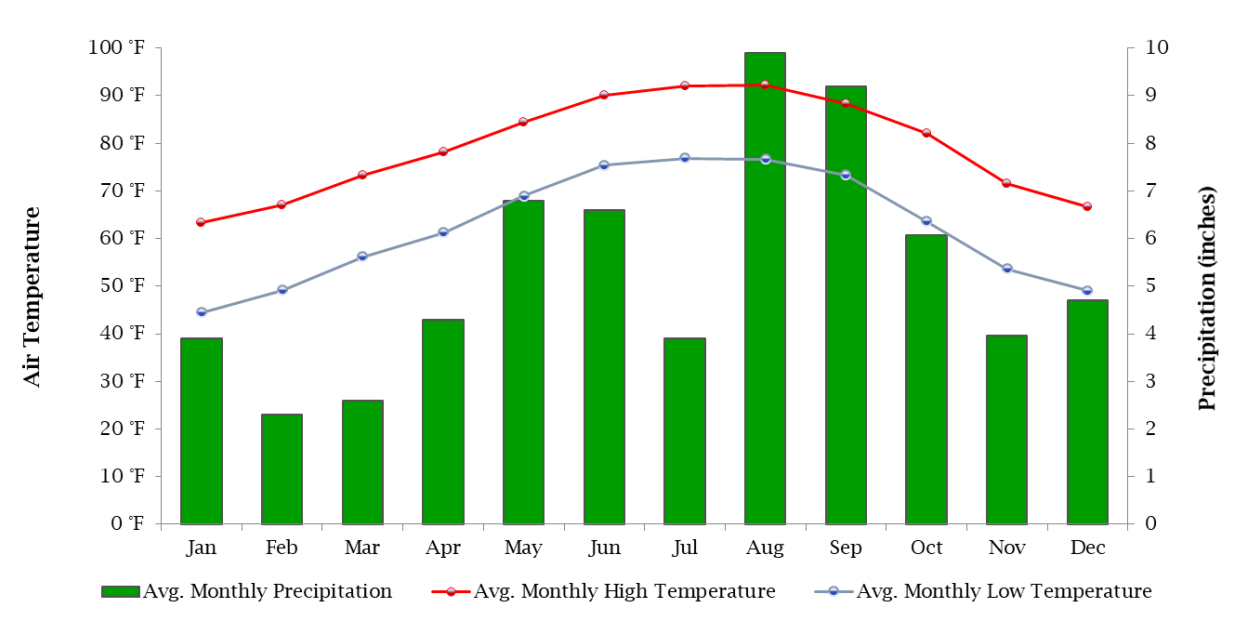

Figure IV-3. Average monthly temperature and precipitation (2013-2022) at the Houston National Weather Service Office

Population and Population Projections

The TMDL watershed is located within Galveston County. Current predominant population densities for this watershed are located in League City and Kemah. According to the 2020 U.S. Census Bureau (USCB), the addendum TMDL watershed had an estimated population of 8,137 people in 2020 (USCB, 2022).

A population projection through 2045 was estimated from Houston-Galveston Area Council (H-GAC) Regional Growth Forecast data (H-GAC, 2018). The forecast includes population projections for transportation analysis zones (TAZ), which are planning

areas used by H-GAC to provide analyses at a local scale. Table IV-2 provides a summary of the population projection for the added TMDL watershed.

Table IV-2. 2020 – 2045 population projection

Area	2020 Estimated Population	2045 Projected Population	Projected Population Increase	Percent Change
Jarbo Bayou	8,137	8,508	371	4.56%

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 portions of census blocks within the TMDL 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. Summed the results of blocks located wholly and/or partially within the watershed to obtain the 2020 population for the TMDL watershed.
4. Obtained the 2018 H-GAC Regional Growth Forecast (tabular data) and associated TAZs (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. Summed the results of TAZs located wholly and/or partially within the watershed to obtain the 2045 population projections.
7. Subtracted the 2020 watershed population (Step 4) from the 2045 population projection (Step 6) to determine the projected population increase. Subsequently, 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 U.S. Geological Survey (USGS) 2019 National Land Cover Database (NLCD) (USGS, 2021). The land cover for the addendum TMDL watershed is shown in Figure IV-4. A summary of the land cover data is provided in Table IV-3 and indicates that the addendum TMDL watershed is mostly Developed (Medium Intensity 58.13%, Low Intensity 19.18%, Open Space 10.28%, and High Intensity 9.74%).

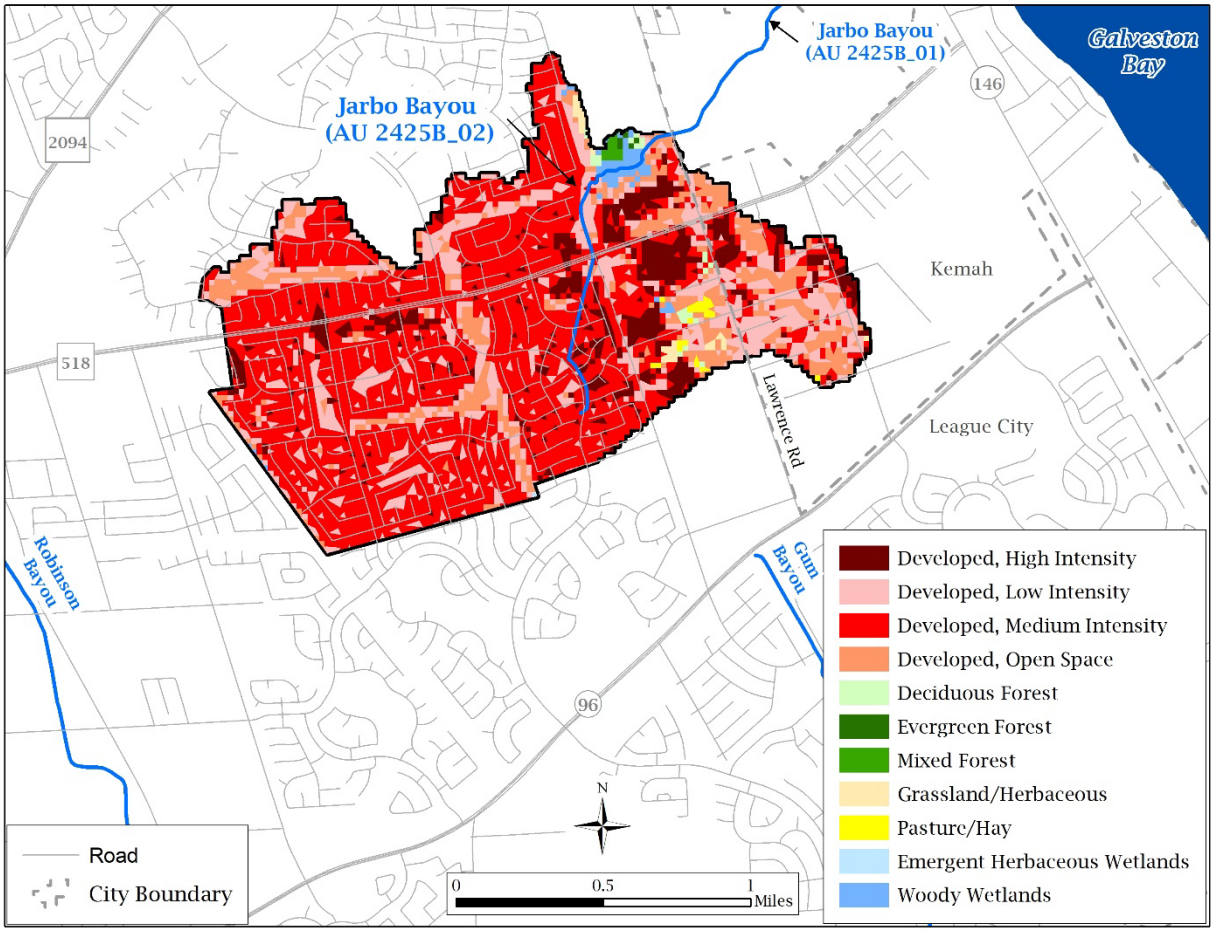

Figure IV-4. Land cover map showing classifications

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

2019 NLCD Classifications	Area (Acres)	% of Total
Developed, High Intensity	119.00	9.74%
Developed, Low Intensity	234.32	19.18%
Developed, Medium Intensity	710.31	58.13%
Developed, Open Space	125.60	10.28%
Deciduous Forest	5.03	0.41%
Evergreen Forest	1.08	0.09%
Mixed Forest	2.71	0.22%
Grassland/Herbaceous	6.12	0.50%
Pasture/Hay	4.90	0.40%
Emergent Herbaceous Wetlands	0.16	0.01%

2019 NLCD Classifications	Area (Acres)	% of Total
Woody Wetlands	12.69	1.04%
Total	1,221.92	100%

Endpoint Identification

The endpoint for the TMDL is to maintain the concentration of Enterococci below the geometric mean criterion of 35 cfu/100 mL, which is protective of the primary contact recreation 1 use in saltwater.

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 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 sanitary sewer overflows (SSOs), stormwater discharges from regulated construction sites, and municipal separate storm sewer systems (MS4s).

Domestic and Industrial WWTFs

As of May 2023, there were no WWTFs with TPDES permits within 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, 2023a) in the TMDL watershed, as of May 2023, found no active general permit authorizations.

Sanitary Sewer Overflows

A summary of SSO incidents that occurred during a six-year period from 2016 through 2022 in Galveston County was obtained from TCEQ headquarters in Austin (TCEQ, 2023b). The summary data indicated that three SSO incidents had been reported within the TMDL watershed. The SSOs had a total discharge of 5,002 gallons with a minimum of one gallon and a maximum of 5,000 gallons.

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, 2023a) in the

TMDL watershed found one combined Phase I/ II MS4 permit authorization, two Phase II MS4 permit authorizations, and four CGP authorizations located within the TMDL watershed as of May 2023 (Table IV-4). The areas covered by the CGP authorizations are not discussed further, since MS4 permits cover 100% of the watershed (Figure IV-5).

Table IV-4. TPDES MS4 permits

Regulated Entity	TPDES Permit	EPA ID	Authorization Type
Texas Department of Transportation	WQ0005011000	TXS002101	Combined Phase I and II MS4
City of League City	TXR040249	N/A	Phase II MS4
City of Kemah	TXR040096	N/A	Phase II MS4

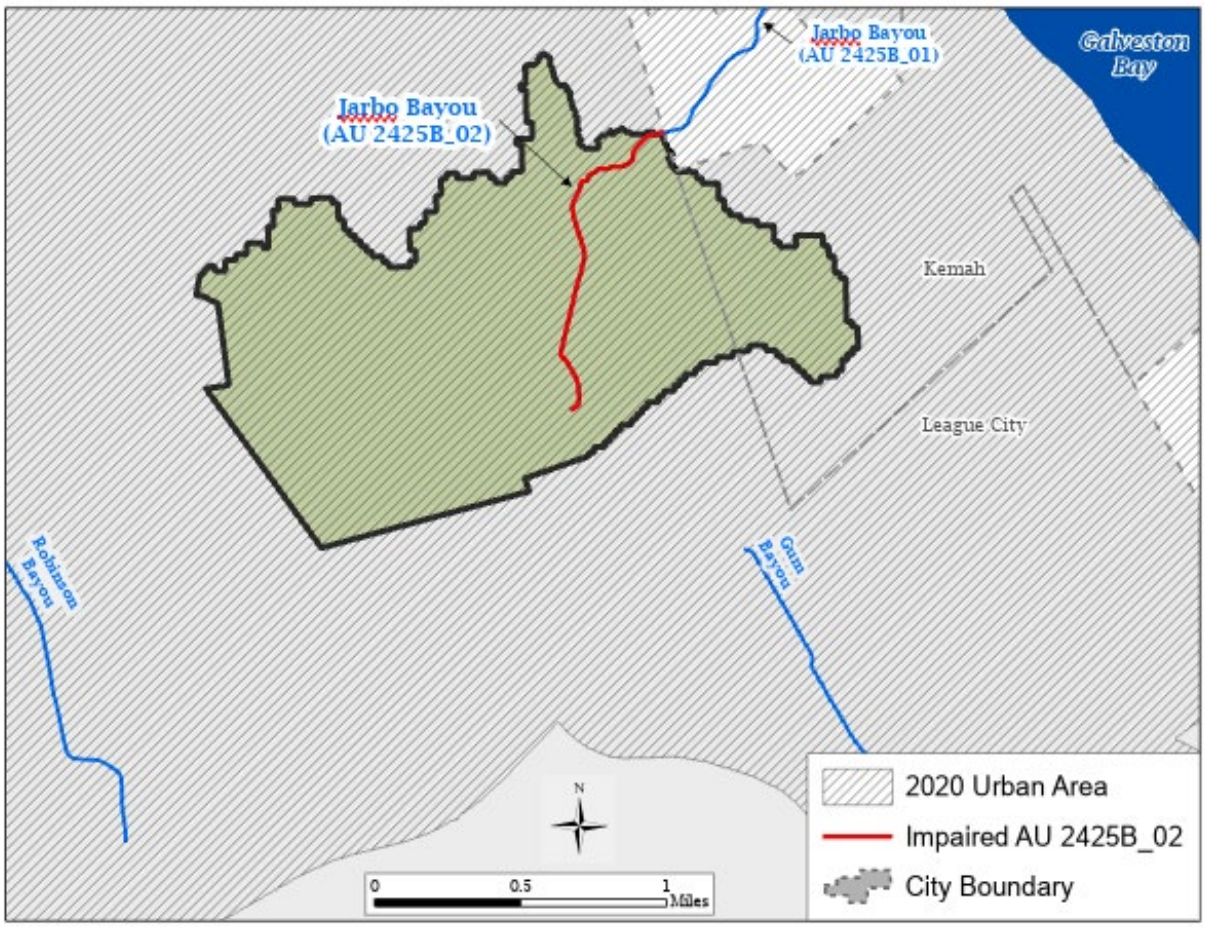

Figure IV-5. Regulated stormwater areas based on MS4 permit authorizations as defined by the urban area

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, land application fields, 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. Agricultural activities were not a source in this highly urbanized watershed.

Fecal bacteria from dogs and cats are transported to water bodies by runoff in both urban and rural areas and can be a potential source of bacteria loading. Table IV-5 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 data (USCB, 2010). The actual contribution and significance of bacteria loads from pets reaching the TMDL water body is unknown.

Table IV-5. Estimated households and pet population

Estimated Households	Estimated Dog Population	Estimated Cat Population
2,877	1,767	1,315

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.

The Enterococci contribution from feral hogs and wildlife in the TMDL watershed cannot be determined based on existing information. However, due to the watershed's urbanized nature, it is anticipated that the contribution would be minimal.

On-site Sewage Facilities

The estimated number of OSSFs in the TMDL watershed was determined using data supplied by H-GAC. Data from these sources indicate that there are approximately 10 OSSFs located within the TMDL watershed (Figure IV-6). 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.

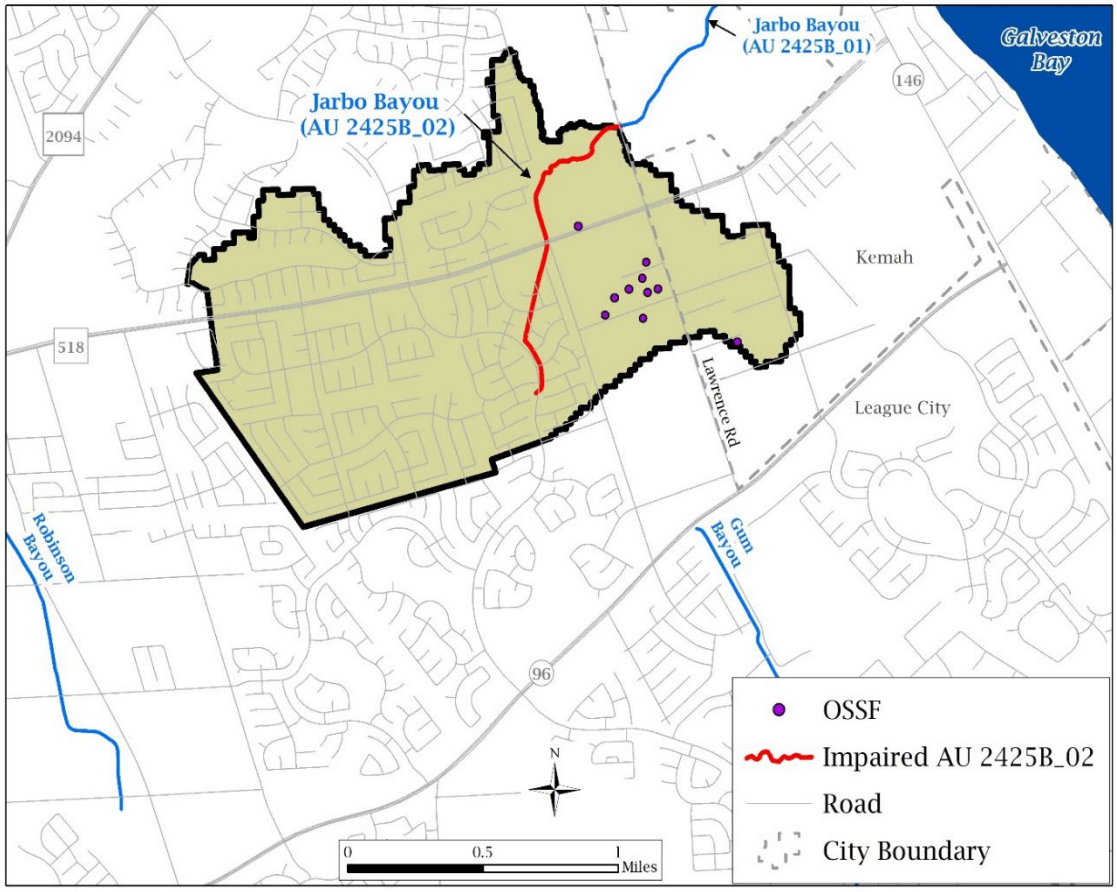

Figure IV-6. Estimated OSSFs located within the TMDL watershed

Linkage Analysis

The modified load duration curve (MLDC) method was used to examine the relationship between instream water quality and the source of indicator bacteria loads. Inherent to the use of MLDCs 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 MLDC to define the TMDL pollutant load allocation. The MLDC method allows for estimation of TMDL loads by utilizing the cumulative frequency distribution of streamflow and measured pollutant concentration data (Cleland, 2003) with adjustments to include tidal influences for the modified method (ODEQ, 2006). 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, 2024) provides details about the linkage analysis along with the MLDC method and its application.

The Enterococci event data plotted on the MLDC for TCEQ SWQM Station 16485 in Figure IV-7 shows exceedances of the geometric mean criterion have commonly occurred under all three flow regimes. The allowable load at the single sample criterion (130 cfu/100 mL) is included on the MLDC for comparison with individual Enterococci samples, although it is not used for assessment or allocation purposes.

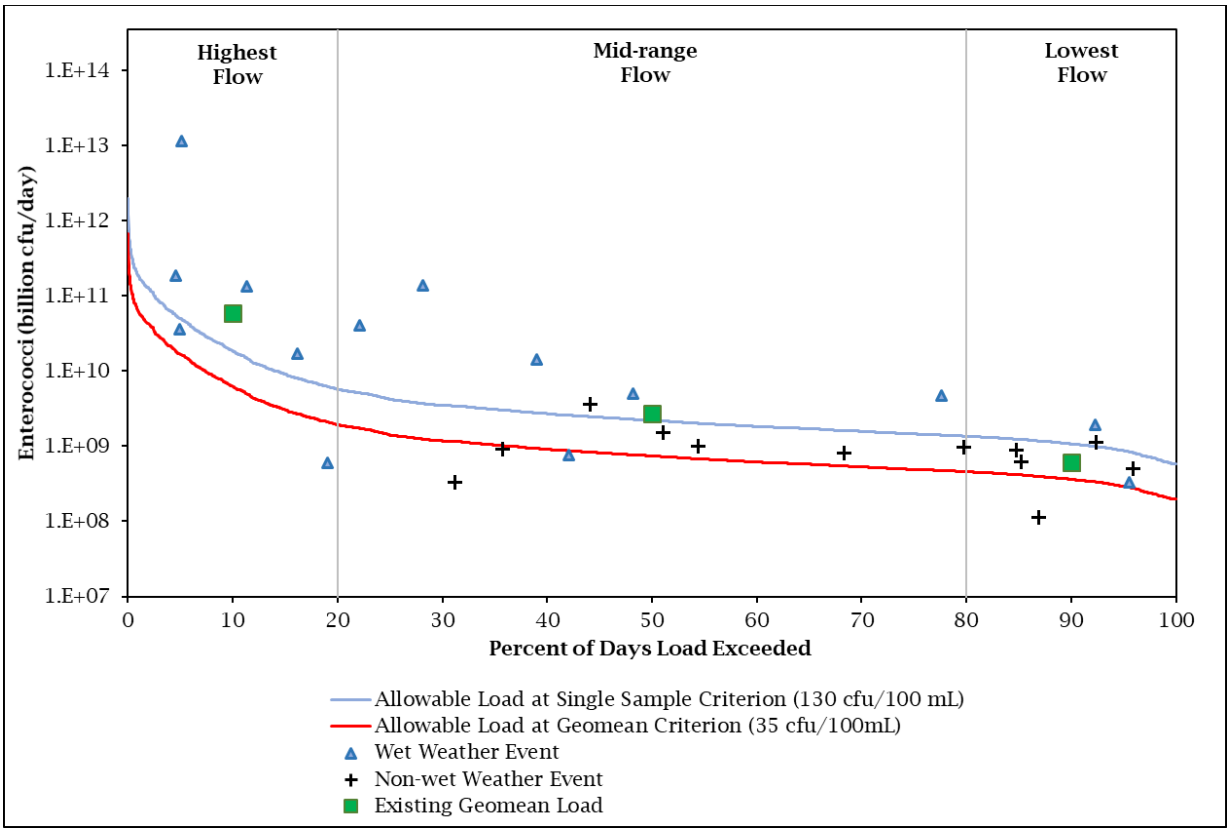

Figure IV-7. MLDC for TCEQ SWQM Station 16485

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

For the remainder of this report, some calculations have been rounded and may not lead to the exact final amounts listed in the text, tables, or figures.

AU-Level TMDL Calculation

To be consistent with previously completed TMDLs in the original watershed, the TMDL for Jarbo Bayou AU 2425B_02 was derived using the median flow within the Highest flow regime (or 10% load duration exceedance) of the MLDC developed for TCEQ SWQM Station 16485. This station represents the location within the TMDL watershed where an adequate number of Enterococci samples were 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 an assigned instream geometric mean criterion. Due to the absence of any permitted dischargers in the TMDL watershed, the WLA_{WWTF} component is zero. In the event a WWTF is permitted in the TMDL watershed, the water quality criterion (23 cfu/100 mL) will be used as the WWTF target to provide instream and downstream load capacity, and to be consistent with the previously developed TMDL.

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.

The TMDL watershed is almost 100% covered by MS4 permits. However, even in highly urbanized areas such as the TMDL watershed, there remain some areas of potential direct deposition of bacteria loadings from unregulated sources, such as wildlife. To account for these unregulated areas, the stream length based on the TCEQ definition of AU 2425B_02 and average channel width as calculated based on recent aerial imagery was used to compute an area of unregulated stormwater contribution. The percentage of land under the jurisdiction of stormwater permits in the TMDL watershed is 99.7%.

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 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 the population projections for the entire TMDL watershed. A new WWTF must accommodate daily wastewater flow of 75–100 gallons per capita per day (gpcd) as required under Title 30, Texas

Administrative Code, Chapter 217, Subchapter B, Section 217.32 (30 TAC 217.32). Conservatively using the higher daily wastewater flow capacity (100 gpcd), and multiplying it by a potential population change, would result in a conservative FG permitted flow. Based on the information in Table IV-2, the projected population change between 2020 and 2045 within the TMDL watershed is 371. Multiplying the projected population growth of TMDL watershed by the higher daily wastewater flow capacity, yields a value of 0.037 MGD for the TMDL watershed. This value would be considered the full permitted discharge of a potential future 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 MLDC 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 IV-6 summarizes the TMDL calculations for the TMDL watershed. The TMDL was calculated based on the median flow in the 0–20 percentile range (10% exceedance, Highest-flow regime) from the MLDC developed for TCEQ SWQM Station 16485. Allocations are based on the current geometric mean criterion for Enterococci of 35 cfu/100 mL for each component of the TMDL (with the exception of the WLA_{WWTF}, which uses 23 cfu/100 mL).

Table IV-6. TMDL allocation summary

All loads expressed as billion cfu/day Enterococci

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
Jarbo Bayou	2425B_02	6.240	0.312	0	5.878	0.018	0.032

The final TMDL allocations (Table IV-7) needed to comply with federal requirements include the FG component within the WLA_{WWTF} (40 CFR Section 103.7).

Table IV-7. Final TMDL allocation

All loads expressed as billion cfu/day Enterococci

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
Jarbo Bayou	2425B_02	6.240	0.312	0.032	5.878	0.018

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 Enterococci concentrations obtained from eight years (2014—2022) of routine monitoring data

collected in the warmer months (May through September) against those collected during the cooler months (November through March). The months of April and October were considered transitional between warm and cool seasons and were excluded from the seasonal analysis. Differences in Enterococci 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 Enterococci data indicated that there was no significant difference (α=0.05) in indicator bacteria between cool and warm weather seasons for the TMDL watershed (p=0.7106). Seasonal variation was also addressed by using all available flow and indicator bacteria records (covering all seasons) from the period of record used in MLDC 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, 2024) was published on the TCEQ website on March 5, 2024. Project staff presented information about this addendum at the annual spring meeting of the H-GAC Bacteria Implementation Group in Houston, TX on May 23, 2023. The public had an opportunity to comment on this addendum during the public comment period (May 10 through June 11, 2024) 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.[c] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[d]

TCEQ accepted public comments on the original TMDL report from February 7 through March 7, 2016. No comments were submitted related to the original TMDL. A revision of the original TMDL report was completed due to a new WWTF permit in the watershed which led to substantial changes in the original TMDL calculations and a second public comment period on the original TMDL was held from July 7 through August 21, 2017. Again, no comments were submitted related to the revised original TMDL.

Implementation and Reasonable Assurance

The water body covered by this addendum is within the existing bacteria TMDL watershed for Jarbo Bayou AU 2425B_01. That TMDL watershed, including its upstream AU 2425B_02 of the same name, is within the area covered by the

[c] www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html

[d] www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html

implementation plan (I-Plan) developed by the Bacteria Implementation Group 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.

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Appendix V. Updates to Fifteen TMDLs for Indicator Bacteria in Watersheds Upstream of Lake Houston

Segments 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011

This appendix provides updates to TMDLs previously submitted through the state's WQMP for: Watersheds Upstream of Lake Houston.

The report, *Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston for Segment Numbers 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011,* was adopted by TCEQ on April 6, 2011 and approved by EPA on June 29, 2011. Upon EPA approval, the TMDLs became part of the state's WQMP.

The Texas WQMP has since been updated 45 times prior to this update for this TMDL. The previous updates have revised the list of individual WLAs in the original TMDL document. Additionally, TCEQ submitted four addenda to the original TMDL in the October 2013, October 2019, October 2020, and April 2022 WQMP updates. These addenda added 10 new AUs to the original TMDL project.

The purpose of this update is to make the following changes to the TMDL (presented in Table V-1):

- Add one new permit.
- Remove a cancelled permit.
- Remove an expired permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for FG in four AUs. This was originally presented in Table 18 in the original TMDL document. The four affected AUs in this update are included here as Table V-2.

For AUs 1009_02, and 1009E_01, the existing FG allocations were insufficient to cover the increased flow to the AUs for this update. To account for this, the total amount exceeded beyond the original FG allocation was added to the total TMDL allocation for each AU. These changes in flow resulted in a change to the overall TMDL allocation for both AUs, which have been updated in Tables IV-2 and IV-3. The overall numbers for the other AUs did not change and did not result in a change to the overall TMDL allocations.

Table V-1 - Changes to individual WLAs for the TMDL watershed

Updates Table 16, p. 49-56 in the original TMDL document.

The WLA is expressed in billion MPN/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
14924-001	001	TX0131741	1009_04	SOUTH CENTRAL WATER COMPANY	NA	NA	Cancelled permit
15244-001	001	TX0135330	1009E_01	BETHESDA LUTHERAN COMMUNITIES, INC.	NA	NA	Expired permit
16470-001	001	TX0145521	1011_01	CRYSTAL SPRINGS WATER CO. INC.	0.2	0.477	New permit

Table V-2 - TMDL summary calculations for four AUs in the TMDL watershed

Updates Table 18, p. 61 in the original TMDL document.

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

AU	Sampling Location	Segment Name	TMDL	WLA $_{WWTF}$	WLA $_{SW}$	LA	MOS	FG
1009_01	11331	Cypress Creek	614.27	117.47	196	270	30.8	0.00
1009_04	11324	Cypress Creek	1550	239.81	469	648	77.4	115.79
1009E_01	14159	Little Cypress Creek	92.66	23.54	16.14	48.42	4.56	0.00
1011_02	17746	Peach Creek	422	17.53	34.5	348.5	21.1	0.37

Table V-3 - TMDL final calculations

Updates Table 19, p. 62 in the original TMDL document.

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

AU	TMDL	WLA $_{WWTF}$	WLA $_{SW}$	LA $_{TOTAL}$	MOS
1009_02	614.27	117.47	196	270	30.8
1009E_01	92.66	23.54	16.14	48.42	4.56

In addition, Table V-4 below provides an update to Table 11 found in the October 2013 addendum to this TMDL project (*Addendum One to Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston: Six Additional Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake*

Houston for Segments 1008B, 1008C, 1008E, and 1011). One of the permits discussed earlier in this update also affects one AU in this addendum.

Table V-5 below provides updates to Table 12 found in the October 2013 addendum to this TMDL project. The addendum added six AUs that were not included in the original TMDL. The AU affected here (1011_01) was included as an upstream loading to 1011_02 in the original TMDL. One of the permits (16470-001/TX0145521) affects the loading of 1011_01 as well as the original TMDL AU 1011_02.

For AU 1011_01, the existing FG allocation was insufficient to cover the increased flow to the AU for this update. To account for this, the total amount exceeded beyond the original FG allocation was added to the total TMDL allocation. This resulted in a change to the overall TMDL allocation for the one AU, which has been updated in Tables V-5 and V-6.

Table V-4 - Changes to individual WLAs in the Peach Creek watershed

Updates Table 11, p. 23 in the TMDL addendum document.

The WLA is expressed in billion MPN/day *E. coli*.

State Permit Number	Outfall	EPA Permit Number	AU	Permittee Name	Flow (MGD)	WLA	TMDL Comments
16470-001	001	TX0145521	1011_01	Crystal Springs Water Co. Inc.	0.2	0.477	New permit

Table V-5 - TMDL summary calculations for one AU in the Peach Creek watershed

Updates Table 12, p. 26 in the TMDL addendum document.

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

AU	Stream Name	TMDL	MOS	WLA WWTF	WLA SW	LA AU	LA RES	LA TOTAL	FG
1011_01	Peach Creek	225.18	10.7	13.33	3.05	198.1	0	198.1	0.00

Table V-6 – TMDL addendum final calculations

Updates Table 13, p. 27 in the TMDL addendum document.

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

AU	TMDL	WLA_{WWTF}	WLA_{SW}	LA_{TOTAL}	MOS
1011_01	225.18	13.33	3.05	198.1	10.7

Appendix VI. Updates to Four TMDLs for Indicator Bacteria in Neches River Tidal

AUs 0601_01, 0601_02, 0601_03, and 0601_04

This appendix provides the first update to the original TMDLs through the state's WQMP for Neches River Tidal.

The report, *Four Total Maximum Daily Loads for Indicator Bacteria in Neches River Tidal for Assessment Units 0601_01, 0601_02, 0601_03, and 0601_04,* was adopted by TCEQ on July 19, 2023 and approved by EPA on October 11, 2023. Upon EPA approval, the TMDLs became part of the state's WQMP.

The purpose of this update is to make the following changes to the TMDL (presented in Table VI-1):

- Add one new permit replacing an expired permit.
- Remove one expired permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for FG in four AUs. This was originally presented in Table 23 in the original TMDL document. The four affected AUs in this update are included here as Table VI-2.

In Table 24 of the original TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for FG within each AU. These overall numbers for the four AUs did not change, and this results in no changes to the overall TMDL allocations.

Table VI-1 - Changes to individual WLAs for the TMDL watershed

Updates Table 17, p. 45 in the original TMDL document.

The WLA is expressed in billion cfu/day Enterococci.

AU	State Permit Number	Outfall	Permittee Name	Flow (MGD)	WLA	TMDL Comments
0601_04	14049-001	1	VIDOR MHP NO. 1 LLC	N/A	N/A	Expired permit
0601_04	14049-002	1	VIDOR MHP NO. 1 LLC	0.025	0.033	New permit replacing expired permit

Table VI-2 - TMDL summary calculations for four AUs in the TMDL watershed

Updates Table 23, p. 51 in the original TMDL document.

All loads expressed as billion cfu/day Enterococci.

AU	TMDL	WLA WWTF	WLA SW	LA	FG	MOS
0601_04	21,974.37	86.151	4,236.65	16,531.23	21.620	1,098.72
0601_03	22,231.26	117.949	4,907.48	16,064.67	29.601	1,111.56
0601_02	22,841.80	124.547	5,450.61	16,093.30	31.257	1,142.09
0601_01	24,760.77	144.420	5,438.70	17,903.37	36.246	1,238.04

Appendix VII. Addendum Three to 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

Adding one TMDL for AU 1003A_01

One TMDL for Indicator Bacteria in Winters Bayou

Introduction

TCEQ adopted *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* (TCEQ, 2016) on August 24, 2016. EPA approved the TMDLs on October 7, 2016. Two addenda to the original TMDLs were submitted to EPA through the October 2018 and January 2023 WQMP updates, respectively (TCEQ, 2018 and TCEQ, 2023a). Those addenda added two AUs. This document is the third addendum to the original TMDL report.

This third addendum includes information specific to one additional AU for Winters Bayou (AU 1003A_01). This AU is located within the watershed of the approved original TMDLs for the East and West Fork 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 Total Maximum Daily Load for Indicator Bacteria in Winters Bayou* (Adams and Millican, 2024). 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 indicator bacteria impairment for Winters Bayou in the *2022 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2022a), the latest EPA-approved edition. The water body only includes one AU, which is the impaired AU 1003A_01 being addressed in this addendum. Figure VII-1 shows the watershed added in this addendum

in relation to the entire watershed of the original TMDLs, and also includes the watersheds from the two previously approved addenda.

The Texas Surface Water Quality Standards (TCEQ, 2022b) 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 2022 Texas Surface Water Quality Standards. *E. coli* are the indicator bacteria for assessing primary contact recreation 1 use in freshwater.

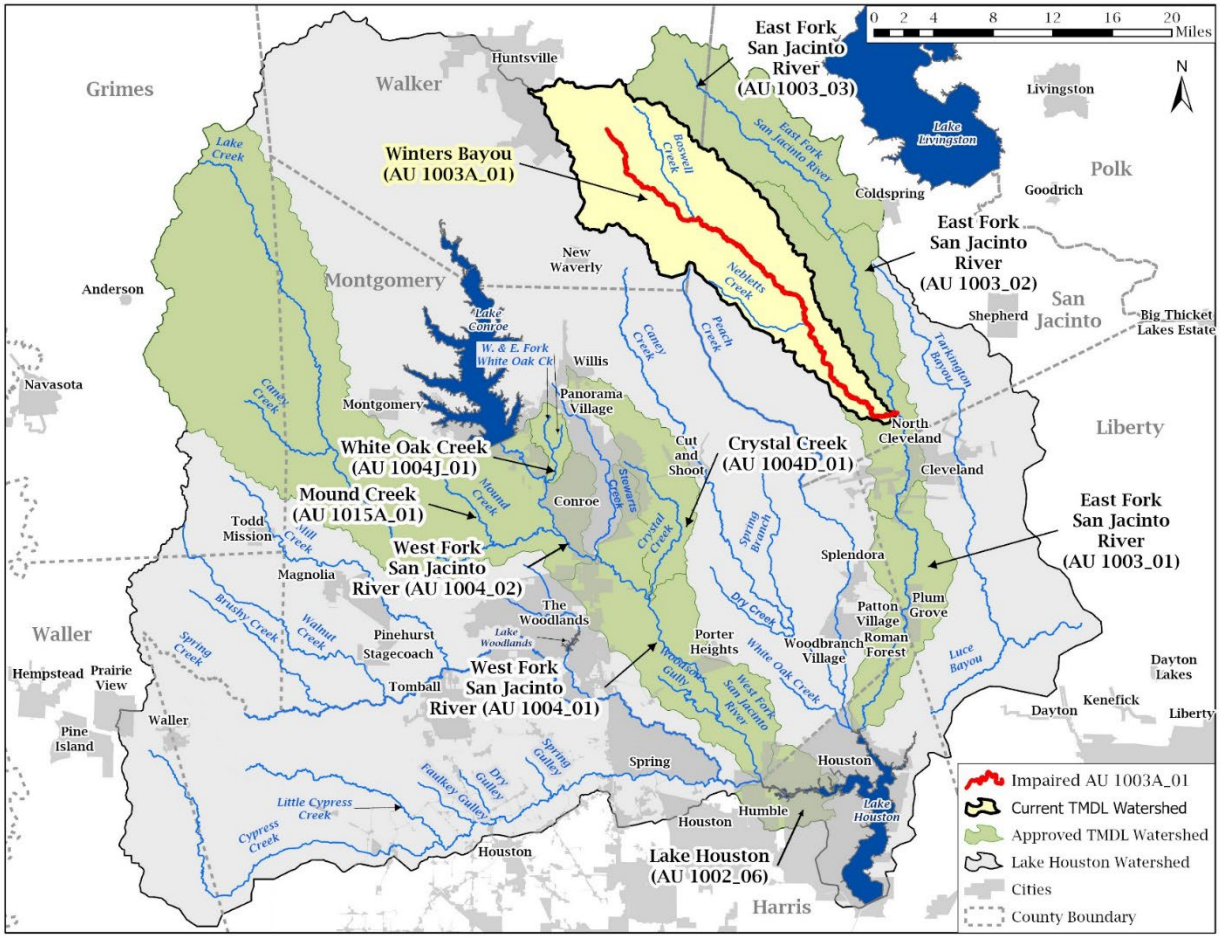

Figure VII-1. Map showing the previously approved TMDL watersheds and the Winters Bayou AU 1003A_01 watershed added by this addendum

Table VII-1 summarizes the ambient water quality data for the TCEQ SWQM stations in the water body, as reported in the 2022 Texas Integrated Report. 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 cfu/100mL of water. Figure VII-2 shows the locations of the TCEQ

SWQM stations that were used in evaluating water quality in the 2022 Texas Integrated Report for the water body added by this addendum.

Table VII-1. 2022 Texas Integrated Report summary

AU	TCEQ SWQM Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
1003A_01	21417; 21933; 21935; 21936; 21937	*E. coli*	63	Dec. 1, 2013 – Nov. 30, 2020	164.06

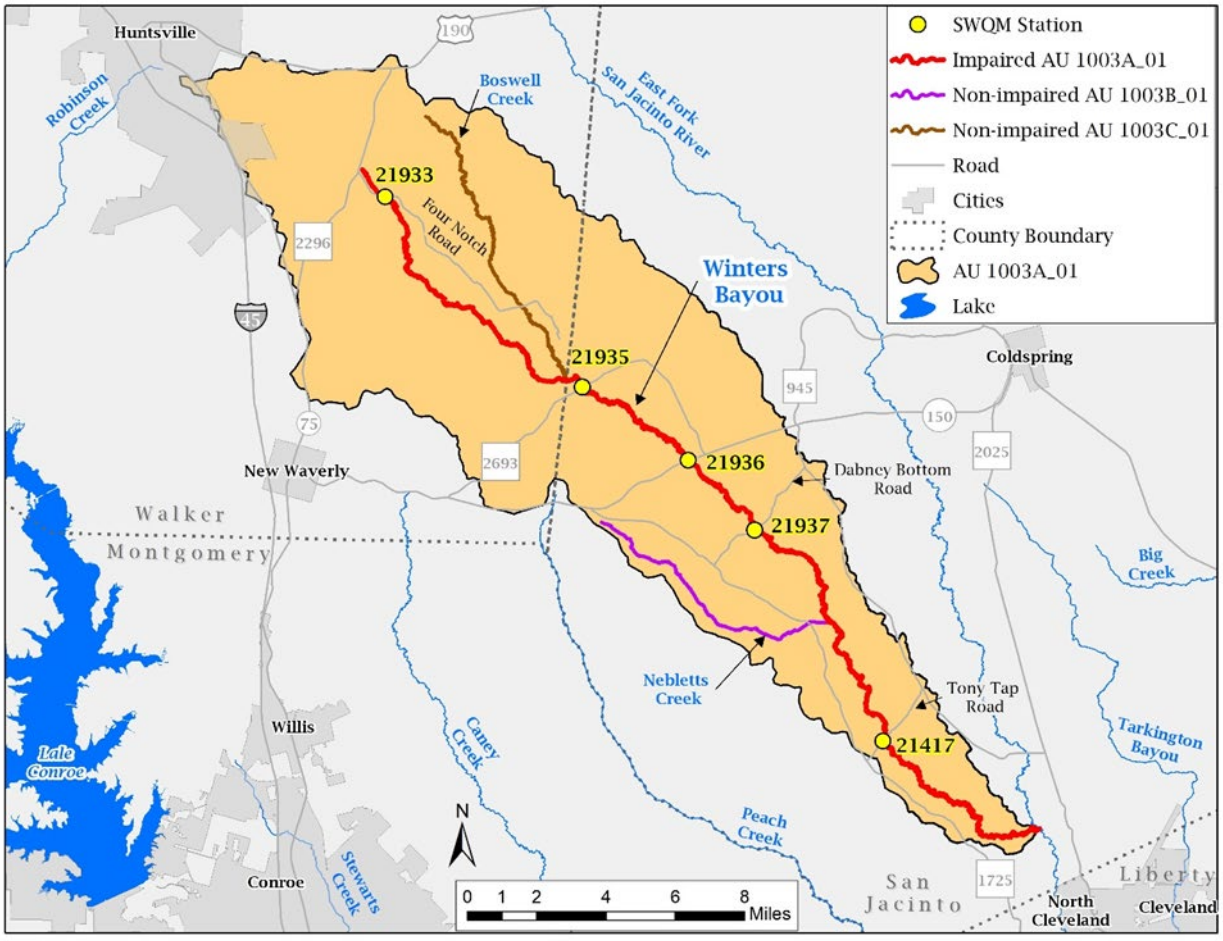

Figure VII-2. Active TCEQ SWQM stations

Watershed Overview

The Winters Bayou watershed drains 170.7 square miles (109,265 acres) and is located within Walker and San Jacinto Counties. Winters Bayou is an unclassified, perennial

freshwater stream that is a tributary of the East Fork San Jacinto River (Segment 1003) that eventually flows into Lake Houston.

The Winters Bayou watershed includes the contributing subwatersheds of Nebletts Creek (AU 1003B_01) and Boswell Creek (AU 1003C_01), along with that of AU 1003A_01, and is located within the Lake Houston watershed in the San Jacinto River Basin.

The 2022 Texas Integrated Report provides the following water body and AU description:

- Winters Bayou (1003A) - From the confluence with East Fork San Jacinto River to 0.17 mi upstream of Dorrell Road at the confluence of Phelps Creek.
    - AU 1003A_01 – From the confluence with East Fork San Jacinto River to 0.17 miles upstream of Dorrell Road at the confluence of Phelps Creek.

Climate

The Winters Bayou watershed is within the Upper Coast and East Texas climatic divisions, which are categorized as subtropical humid (Larkin & Bomar, 1983). The Gulf of Mexico is the principal source of moisture that drives precipitation in the region. For the 10-year period from 2012–2022, weather data were obtained from 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 high temperatures typically peak in August (94.6 °F). During winter, the average low temperature generally reaches a minimum of 38.2 °F in January (Figure VII-3). Annual rainfall averages 49.3 inches. The wettest month was May (7.4 inches), while February (2.5 inches) was the driest month, with rainfall occurring throughout the year.

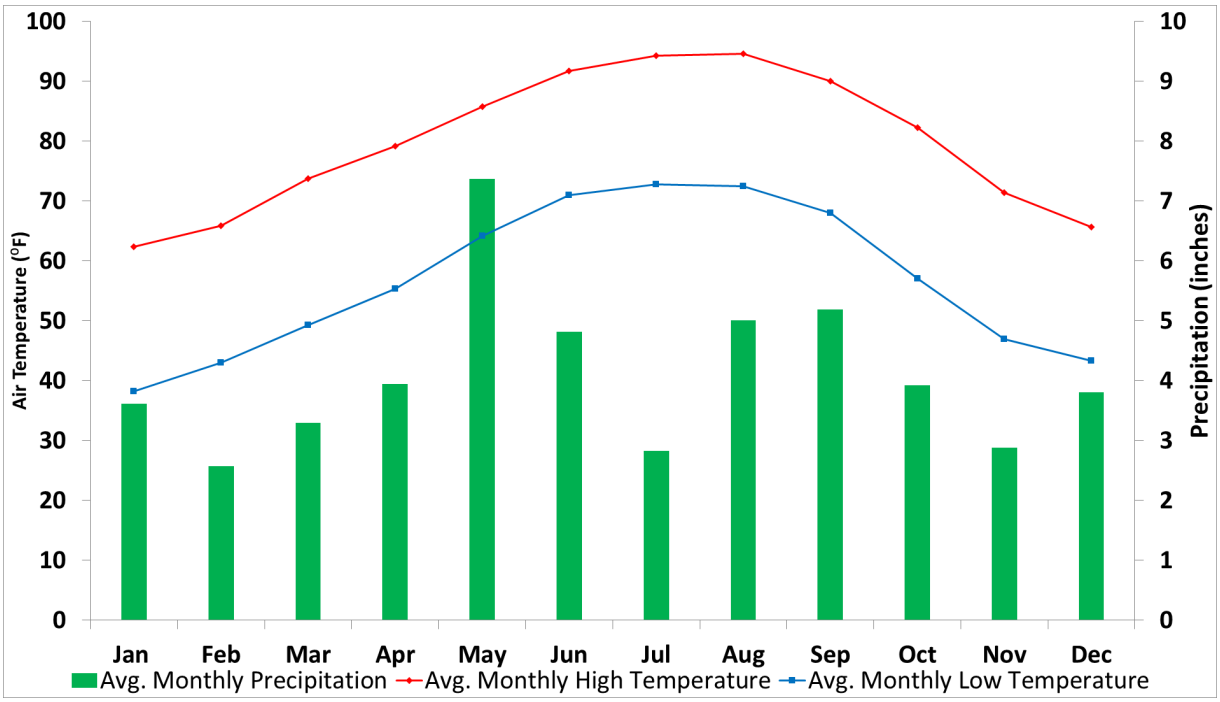

Figure VII-3. Average monthly temperature and precipitation (2012–2022) at the Conroe North Houston Regional Airport weather station

Population and Population Projections

The Winters Bayou watershed is located in Walker and San Jacinto counties. The only current predominant population density for this watershed is a small portion of the City of Huntsville. According to the 2020 USCB data, the added Winters Bayou watershed had an estimated population of 7,494 people in 2020 (USCB, 2021).

A population projection through 2070 was developed using data from the Water User Group (WUG) data from the 2021 TWDB Regional Water Plan (TWDB, 2021). Table VII-2 provides a summary of the population projection for the added TMDL watershed.

Table VII-2. 2020 – 2070 population projection

Area	2020 Estimated Population	2070 Projected Population	Projected Population Increase (2020 – 2070)	Percent Change (%)
Winters Bayou	7,494	8,127	633	8%

The following steps detail the method used to estimate the 2020 and projected 2070 populations in the Winters Bayou 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, population was estimated by multiplying the block population to the proportion of its area in the watershed.
4. Obtained the WUG data from the 2021 TWDB Regional Water Plan to be used for population projections (TWDB, 2021).
5. Projected 2070 populations were allocated based on proportion of the WUG area within the TMDL watershed.
6. Subtracted the 2020 watershed population from the 2070 population projections to determine the projected population increase. Subsequently, 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 Winters Bayou watershed were obtained from USGS 2019 NLCD (USGS, 2021). The land cover for the addendum TMDL watershed is shown in Figure VII-4. A summary of the land cover data is provided in Table VII-3 and indicates that the addendum TMDL watershed is mostly rural with evergreen forest (50.43%) and pasture/hay (18.54%) as the dominant land covers.

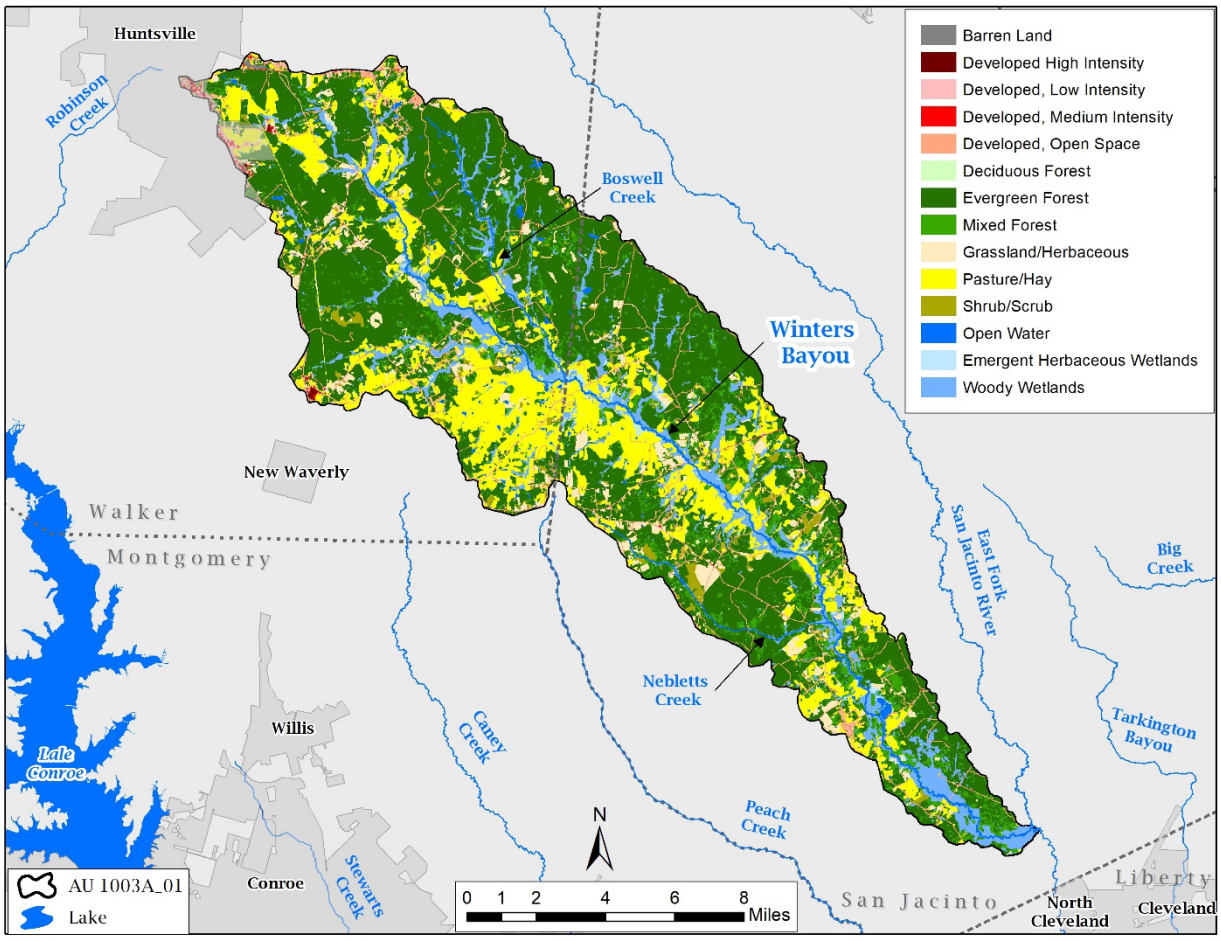

Figure VII-4. Land cover map showing classifications

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

2019 NLCD Land Cover Classifications	Area (Acres)	% of Total
Barren Land	101.12	0.09%
Developed, High Intensity	114.74	0.11%
Developed, Low Intensity	1,294.11	1.18%
Developed, Medium Intensity	332.90	0.30%
Developed, Open Space	3,933.44	3.60%
Deciduous Forest	76.23	0.07%
Evergreen Forest	55,102.45	50.43%
Mixed Forest	7,966.98	7.29%
Grassland/Herbaceous	5,134.01	4.70%

2019 NLCD Land Cover Classifications	Area (Acres)	% of Total
Pasture/Hay	20,258.85	18.54%
Shrub/Scrub	2,596.26	2.38%
Open Water	765.18	0.70%
Emergent Herbaceous Wetlands	556.51	0.51%
Woody Wetlands	11,032.23	10.10%
Total	**109,265.01**	**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 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 Winters Bayou watershed include one WWTF outfall and stormwater discharges from regulated industrial activities.

Domestic and Industrial WWTFs

As of March 25, 2022, there was one municipal WWTF and one industrial WWTF with TPDES permits within the Winters Bayou watershed (Table VII-4, Figure VII-5).

Table VII-4. TPDES-permitted WWTFs discharging in the Winters Bayou watershed

AU	TPDES Number	NPDES[a] Number	Permittee	Outfall Number	Bacteria Limits (cfu/ 100 mL)	Primary Discharge Type	Daily Average Flow – Permitted Discharge (MGD[b])
1003A_01	WQ0014996001	TX0028169	Universal Forest Products Texas LLC	001	63	Treated domestic wastewater	0.02
1003A_01	WQ0004249000	TX0123421	Steely Lumber Co., Inc.	001	N/A	Wet decking wastewater, utility wastewater, and stormwater	Report

[a] NPDES: National Pollutant Discharge Elimination System

[b] MGD = million gallons per day

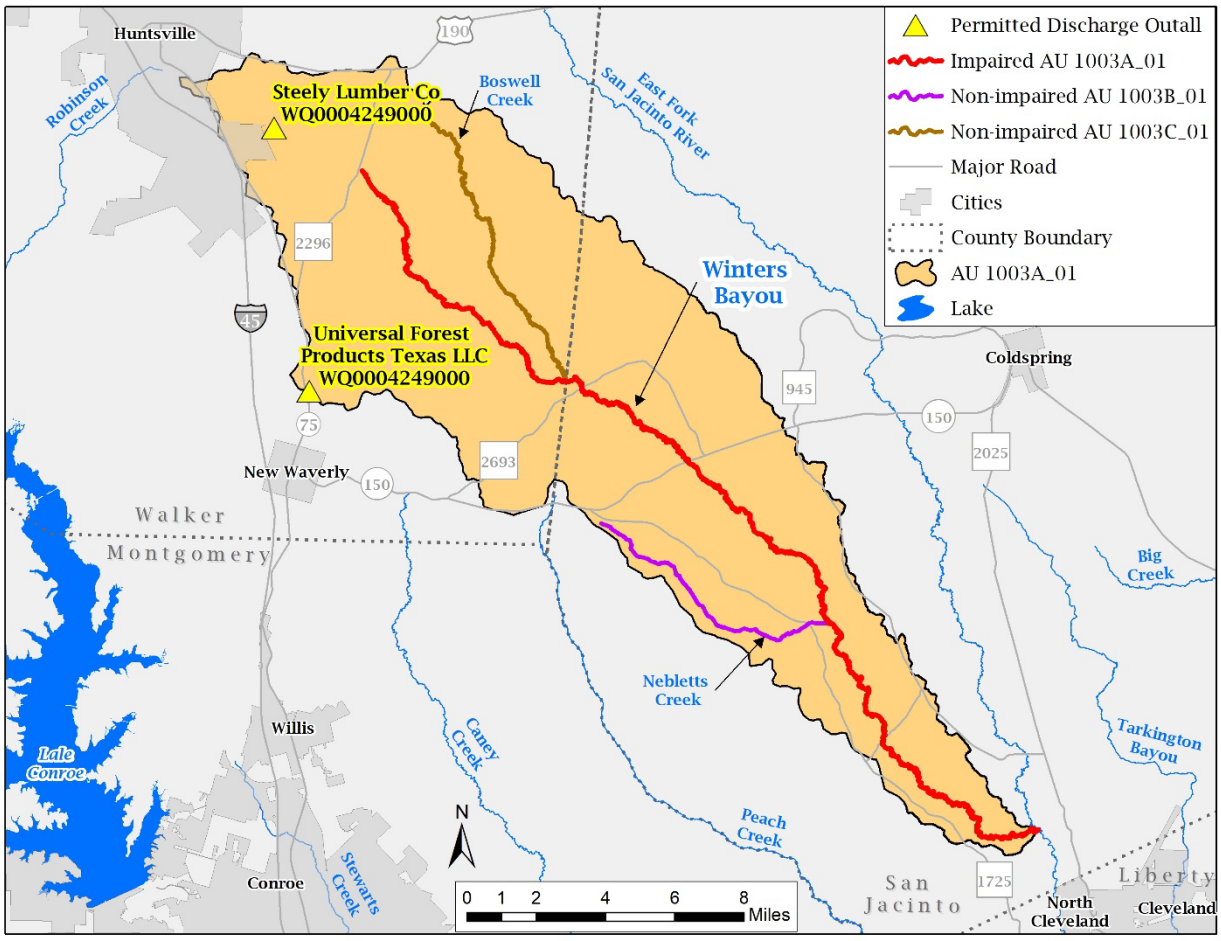

Figure VII-5. WWTFs in the Winters Bayou watershed

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, 2023b) in the Winters Bayou watershed as of January 12, 2023, found one active permit for a concrete production facility. The regulated areas do not have bacteria reporting or limits in their permits. They were assumed to contain inconsequential amounts of bacteria; therefore, it was unnecessary to allocate bacteria loads based on these activities. No other active wastewater general permit authorizations were found.

Sanitary Sewer Overflows

A summary of SSO incidents that occurred during a six-year period from 2016 through 2022 in Walker and San Jacinto counties was obtained from TCEQ Central Office in Austin (TCEQ, 2023c). The summary data indicated that five SSO incidents had been reported within the Winters Bayou watershed. The SSOs had a total discharge of 2,610 gallons, with a minimum of 60 gallons and a maximum of 2,000 gallons.

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 –MSGP for industrial facilities
- TXR150000 – 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, 2023b) in the Winters Bayou watershed as of March 1, 2023 found no active MSGP authorizations or CGP authorizations within the watershed. There are currently no Phase I MS4 permits and no Phase II MS4 authorizations within the Winters Bayou watershed.

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, land application fields, urban runoff not covered by a permit, failing 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 VII-5 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 data for San Jacinto and Walker counties were refined to better reflect actual numbers within the Winters Bayou 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 San Jacinto and Walker counties. 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 VII-5. Estimated livestock populations

AU	Cattle and Calves	Hogs and Pigs	Poultry	Sheep and Lambs	Goats	Horses	Mules and Burros
1003A_01	5,307	58	6,578	149	252	384	74

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 VII-6 summarizes the estimated number of dogs and cats within the Winters Bayou 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 Winters Bayou watershed was estimated using 2010 Census data (USCB, 2010). The actual contribution and significance of bacteria loads from pets reaching the Winters Bayou watershed is unknown.

Table VII-6. Estimated households and pet population

AU	Estimated Households	Estimated Dog Population	Estimated Cat Population
1003A_01	2,931	1,800	1,339

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 159.64 square miles in the Winters Bayou 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 2,019 in the Winters Bayou 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, 2023). The Winters Bayou watershed is located entirely within DMU 14. For the 2022 TPWD survey year, the estimated deer population density for DMU 14 was 25.61 deer per 1,000 acres and applies to all habitat types within the DMU. Applying this value to the entire area of the Winters Bayou watershed returns an estimated 2,798 deer within the Winters Bayou watershed. The *E. coli* contribution from feral hogs and wildlife in the TMDL watershed could not be determined based on existing information.

On-site Sewage Facilities

The estimated number of OSSFs in the Winters Bayou watershed was determined using data supplied by San Jacinto County 911 for San Jacinto County and Walker County data was supplied by the Houston-Galveston Area Council. Data from these sources indicate that there are approximately 2,633 OSSFs located within the Winters Bayou watershed (Figure VII-6). 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.

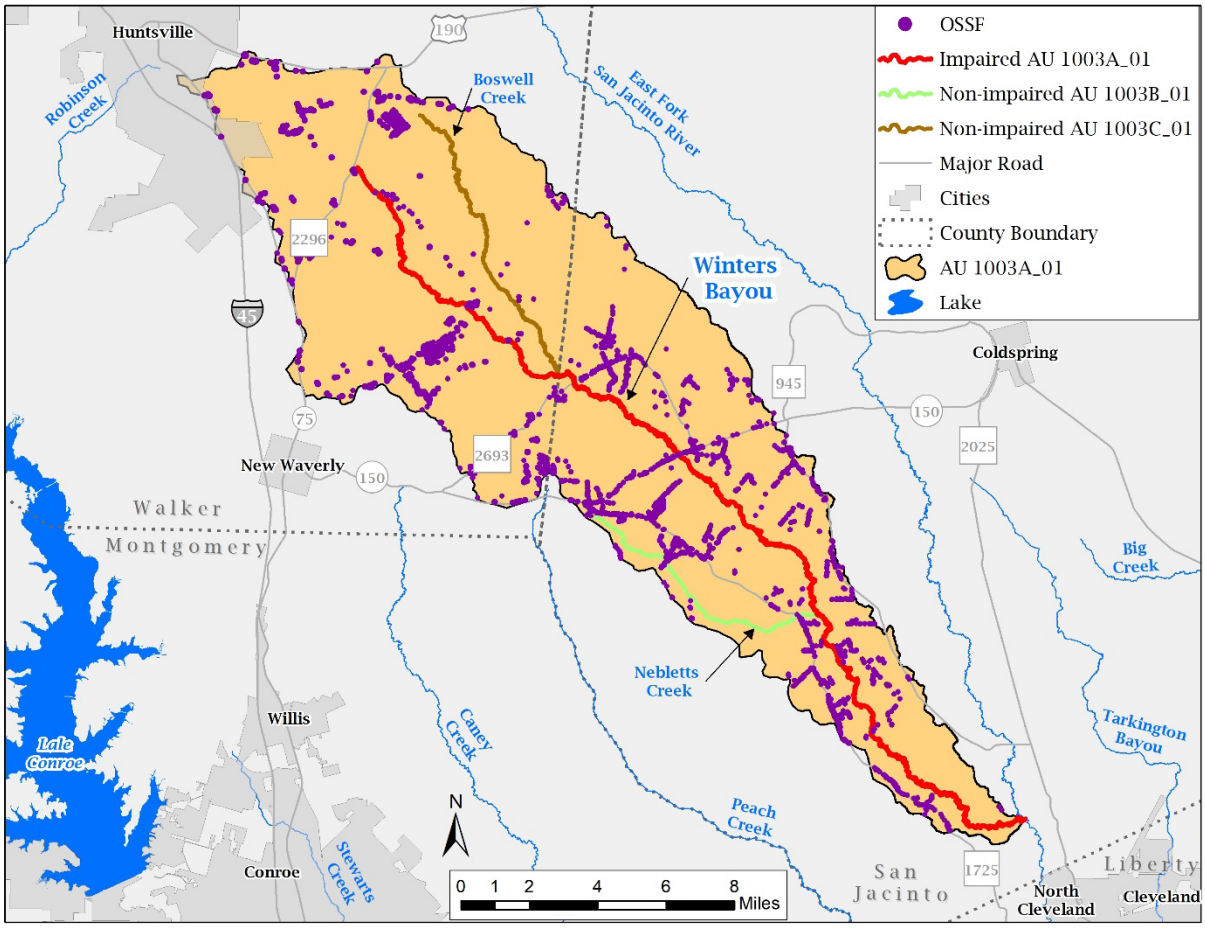

Figure VII-6. Estimated OSSFs located within the Winters Bayou watershed

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, 2024) 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 21417 in Figure VII-7 show exceedances of the geometric mean criterion in wet conditions and were mostly below the geometric mean criterion in both moderate and dry 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.

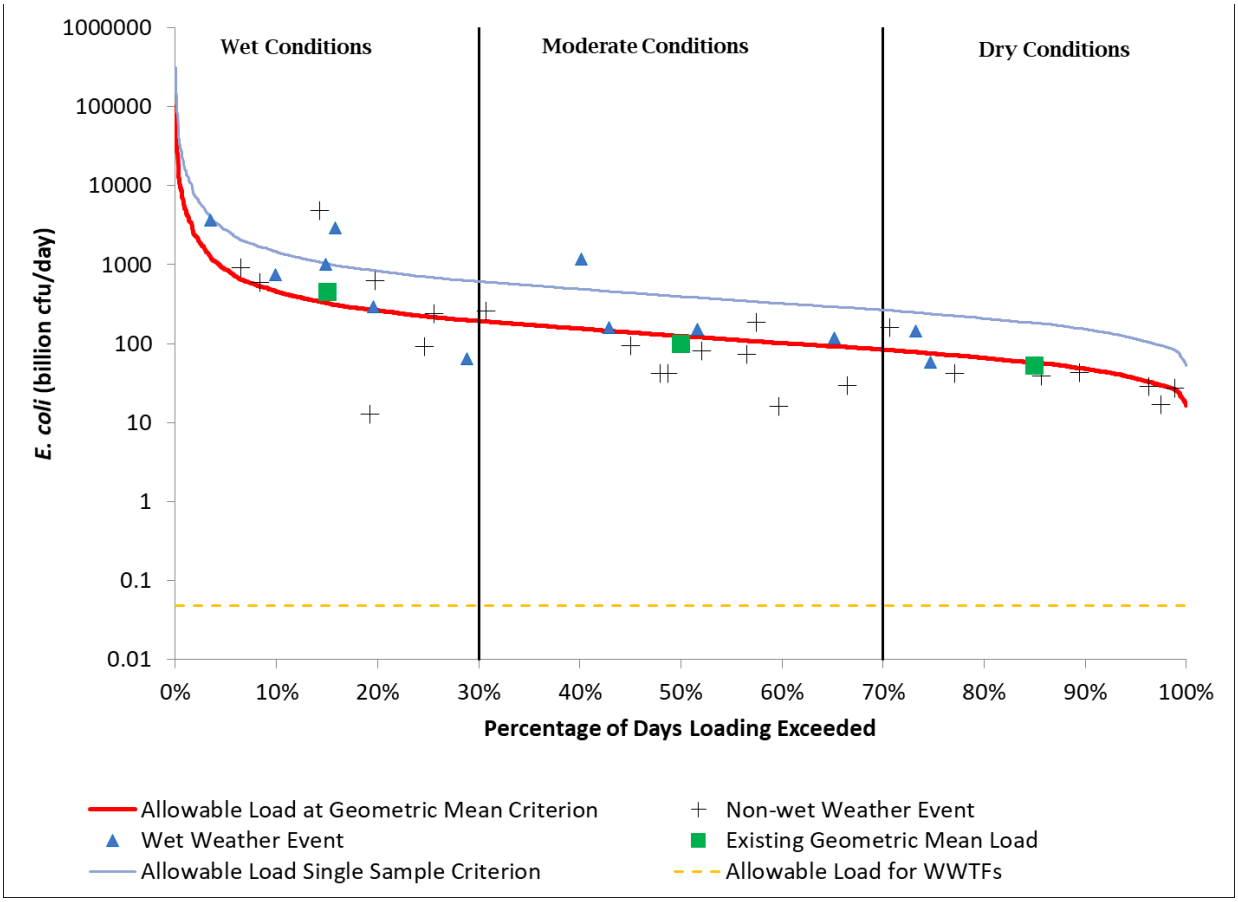

Figure VII-7. LDC for TCEQ SWQM Station 21417

Margin of Safety

The 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

For the remainder of this report some calculations have been rounded and may not lead to the exact final amounts listed in the text, tables, or figures.

AU-Level TMDL Calculation

To be consistent with previously completed TMDLs in the original watershed, the TMDL for Winters Bayou was derived using the median flow within the wet conditions flow regime (or 15% load duration exceedance) of the LDC developed for TCEQ SWQM Station 21417. This station represents the location within Winters Bayou 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 VII-7 presents the WLA_{wwtf} and the resulting total allocation for Winters Bayou (AU 1003A_01).

Table VII-7. WLAs for TPDES-permitted facilities

AU	TPDES Number	Permittee	Bacteria Limit (cfu/100 mL *E. coli*)	Full Permitted Flow (MGD)	WLA_{WWTF} (billion cfu/day *E. coli*)
1003A_01	WQ0014996001	Universal Forest Products TX LLC	63	0.02	0.048

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.

There are no MS4 permits in the Winters Bayou watershed. The acreage associated with the general stormwater permit for one concrete production facility was estimated by importing the location information associated with the facility into a geographic information system, and measuring the estimated disturbed area based on the most recently available aerial imagery. For this TMDL, the area disturbed associated with the concrete production facility represents the regulated stormwater coverage for Winters Bayou AU 1003A_01, which is about 0.0006% of the watershed.

Load Allocation

The 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 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 the population projections for the entire TMDL watershed. Recent population and projected population growth between 2020 and 2070 for the TMDL watershed are provided in Table VII-2. The projected population percentage increase within the watershed was multiplied by the corresponding WLA_{WWTF} to calculate future WLA_{WWTF}. The permitted flows were

increased by the expected population growth for AU 1003A_01 between 2020 and 2070 to determine the estimated future flows.

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 VII-8 summarizes the TMDL calculations for the Winters Bayou watershed. The TMDL was calculated based on the median flow in the 0-30 percentile range (15% exceedance, wet conditions flow regime) from the LDC developed for the TCEQ SWQM Station 21417. 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 VII-8. TMDL allocation summary

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
Winters Bayou	1003A_01	326.567	16.328	0.048	0.186	310.000	0.005

The final TMDL allocations (Table VII-9) needed to comply with federal requirements include the FG component within the WLA_{WWTF} (40 CFR Section 103.7).

Table VII-9. Final TMDL allocation

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
Winters Bayou	1003A_01	326.567	16.328	0.053	0.186	310.000

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 2022) of routine monitoring data collected in the warmer months (May through September) against those collected during the cooler months (November through March). The months of April and October were considered transitional between warm and cool seasons and were excluded from the seasonal analysis. 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 Winters Bayou. Seasonal variation was also addressed by using all available flow and indicator bacteria 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, 2024) was published on the TCEQ website on March 6, 2024. Project staff presented information about this addendum at the annual spring meeting of the H-GAC Bacteria Implementation Group in Houston, Texas on May 23, 2023. The public had an opportunity to comment on this addendum during the public comment period (May 10 through June 11, 2024) 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.[e] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[f] TCEQ accepted public comments on the original TMDL report from June 18 through July 19, 2010. No comments were submitted.

Implementation and Reasonable Assurance

The water body covered by this addendum is within the existing bacteria TMDL watershed for the East and West Fork of the San Jacinto River. That TMDL watershed, including Winters Bayou, is within the area covered by the I-Plan developed by stakeholders for the TMDL watershed, 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.

[e] www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html

[f] www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html

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