Cotton Bayou Tidal: A Community Project to Protect Recreational Uses

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One Total Maximum Daily Load for Indicator Bacteria in Cotton Bayou Tidal[1]

Adopted May 22, 2024.

Approved by EPA July 26, 2024.

One Additional Total Maximum Daily Load for Indicator Bacteria in Cotton Bayou Above Tidal added through Addendum I, April 2026.

Via the April 2026 Update to the Texas Water Quality Management Plan (SFR-121/2026-03).

Approved by EPA July 28, 2026.

[1] https://www.tceq.texas.gov/downloads/water-quality/tmdl/cotton-bayou-recreational-124/as-476-cotton-bayou-tidal-bacteria-tmdl-adopted.pdf

Appendix I. Addendum One to One Total Maximum Daily Load for Indicator Bacteria in Cotton Bayou Tidal

Adding One TMDL for AU 0801E_01

One TMDL for Indicator Bacteria in Cotton Bayou Above Tidal

Introduction

TCEQ adopted *One Total Maximum Daily Load for Indicator Bacteria in Cotton Bayou Tidal* (TCEQ, 2024a) on May 22, 2024. EPA approved the TMDL on July 26, 2024.

This first addendum includes information specific to one additional AU for Cotton Bayou Above Tidal (AU 0801E_01) (also referred to in this addendum as the TMDL watershed). This AU is located within the watershed of the approved original TMDL for Cotton Bayou Tidal. 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 Cotton Bayou Above Tidal*[2] (Evans et al, 2025). 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 for Cotton Bayou Above Tidal in the *2024 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2024b), the latest EPA-approved edition. The impaired AU is AU 0801E_01, which is upstream of the original TMDL AU 0801C_01. Figure I-1 shows the location of the TMDL watershed added in this addendum in relation to the original Cotton Bayou Tidal watershed. The upstream AU 0801E_01 watershed delineation was completed using the original TMDL watershed

[2] www.tceq.texas.gov/downloads/water-quality/tmdl/cotton-bayou-recreational-124/as-515_cottonbayouabovetidal_tsd.pdf

boundary and GIS analyses that took into account elevation data from the U.S. Geological Survey and National Hydrography Dataset information.

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

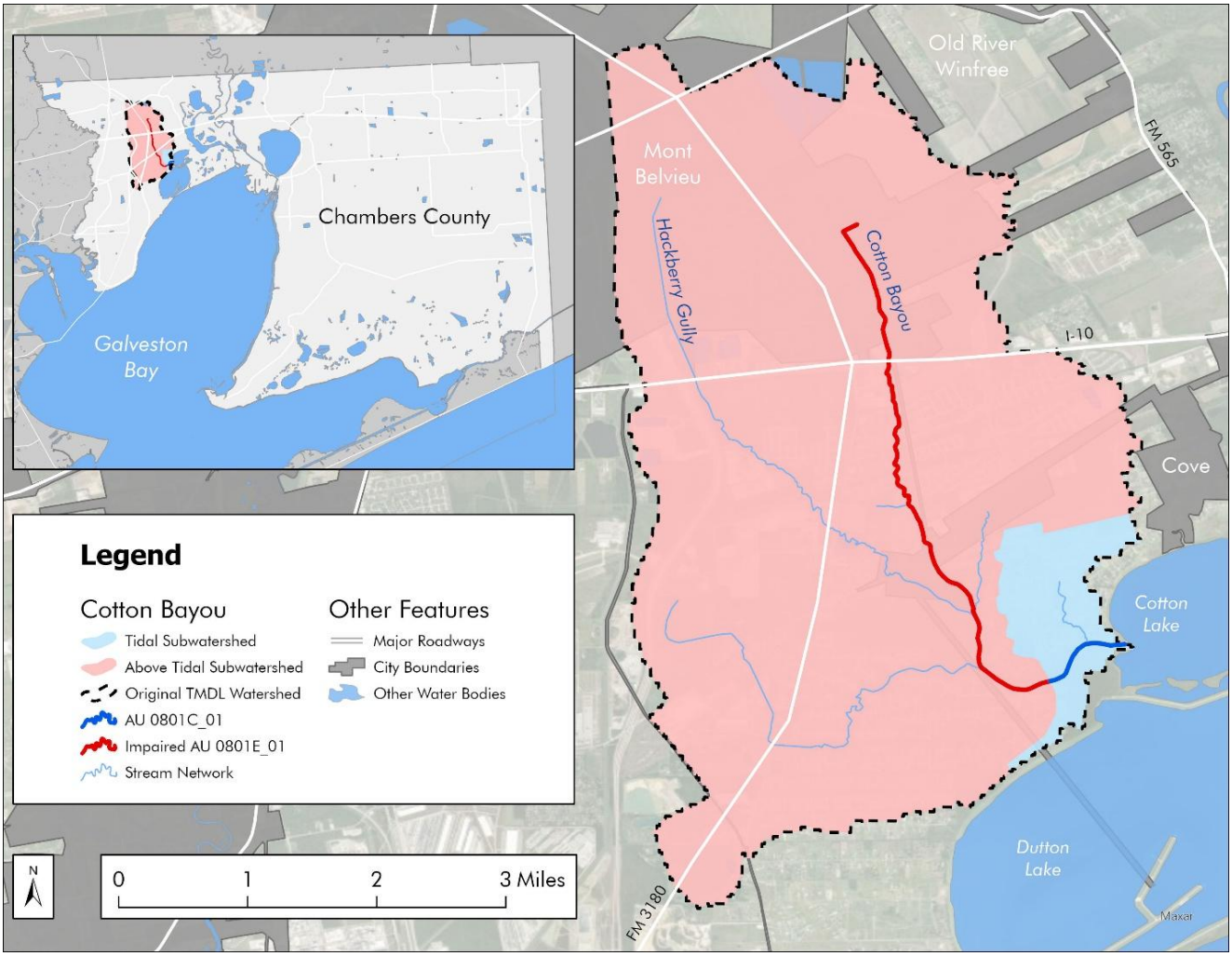

Figure I-1. Map showing the previously approved TMDL watershed and the Cotton Bayou Above Tidal AU 0801E_01 watershed

Table I-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) stations on the water body, as reported in the 2024 Texas Integrated Report (TCEQ, 2024b). The data from the assessment indicate nonsupport of

the primary contact recreation 1 use for the AU, because the geometric mean concentration for *E. coli* exceeds the freshwater geometric mean criterion of 126 colony forming units per 100 milliliters (cfu/100 mL) of water. Figure I-2 shows the locations of the TCEQ SWQM stations that were used in evaluating water quality in the 2024 Texas Integrated Report for the TMDL watershed.

Table I-1. 2024 Texas Integrated Report summary

AU	TCEQ SWQM Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
0801E_01	18696; 22232	*E. coli*	31	Dec. 1, 2015 – Nov. 30, 2022	251.9

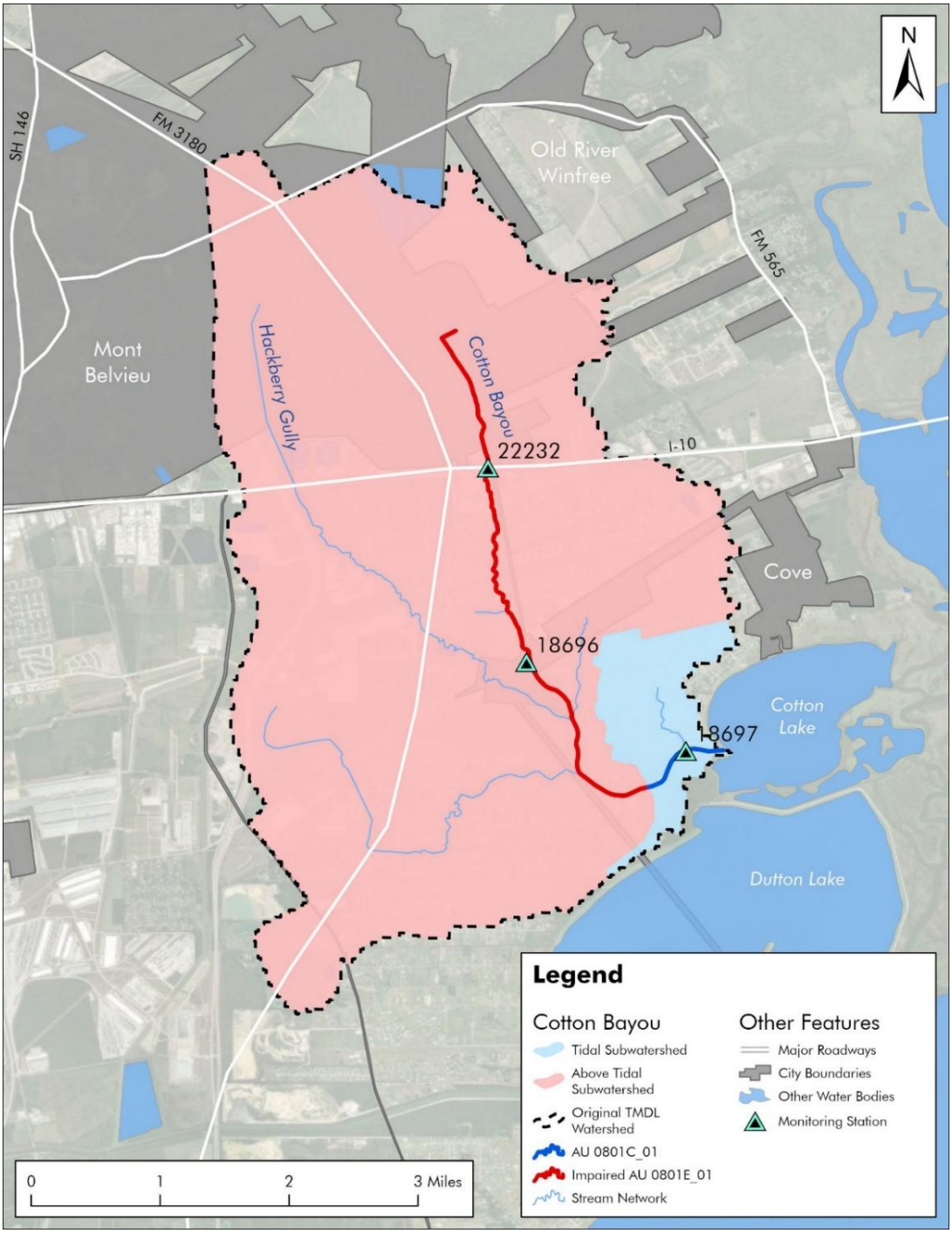

Figure I-2. Active TCEQ SWQM stations

Watershed Overview

The TMDL watershed is near the northern border of Galveston Bay and is bisected by Interstate Highway 10 in Chambers County (Figure I-1). Though the waterbody was

considered to be tidally influenced along its full length as recently as 2020, analyses conducted for the development of the Watershed Characterization Report (H-GAC, 2020) revealed that ambient conditions and biological assessments upstream of a point 0.7 miles from the confluence of Cotton Lake were more characteristic of an above-tidal stream. As a result, the waterbody was split into two AUs, a tidal AU (0801C_01) comprised of .7 miles and an above tidal AU (0801E_01) of 4.7 miles.

Much of the stream network in the TMDL watershed consists of modified channels; however, the watershed itself, as well as its principal tributary, Hackberry Gully, are more natural waterways. The TMDL watershed ultimately drains into Cotton Lake, forming a confluence where Cotton Lake receives tidal exchange that ultimately influences the tidal and non-tidal portions of Cotton Bayou.

Most of the land in the watershed is cultivated, grassland, and woody; however, development is increasing near Mont Belvieu and other areas experiencing the effects of urban sprawl. This pressure, as well as compounding stresses associated with cultivation and naturally occurring sources of bacteria, has impacted the water quality in the watershed and will continue to pose challenges as development increases in this region.

The 2024 Texas Integrated Report (TCEQ, 2024b) provides the following water body and AU description:

- Cotton Bayou Above Tidal (Segment 0801E, AU 0801E_01) – From a point 1.19 kilometers (0.74 miles) upstream of the confluence of Cotton Lake upstream to a point 1.89 kilometers (1.17 miles) north of Interstate Highway 10 in Mont Belvieu in Chambers County.

Climate

The National Oceanic and Atmospheric Administration (NOAA) operates a weather station in the City of Baytown near the TMDL watershed. From this station (GHCND:USC00410586), daily, monthly, and annual averages for weather parameters including temperature and precipitation have been assessed for the period from 2006 through 2024 (NOAA, 2025). Data from this 19-year period indicate that the average monthly high temperature typically reaches a maximum of around 90°F in August, and the average monthly low temperature reaches a minimum of about 40°F in January (Figure I-3). Annual rainfall averages 62.4 inches. The wettest month is August (7.57 inches) while February (2.92 inches) is the driest month. The driest months typically occurred in late winter or early spring, and the wettest periods in summer.

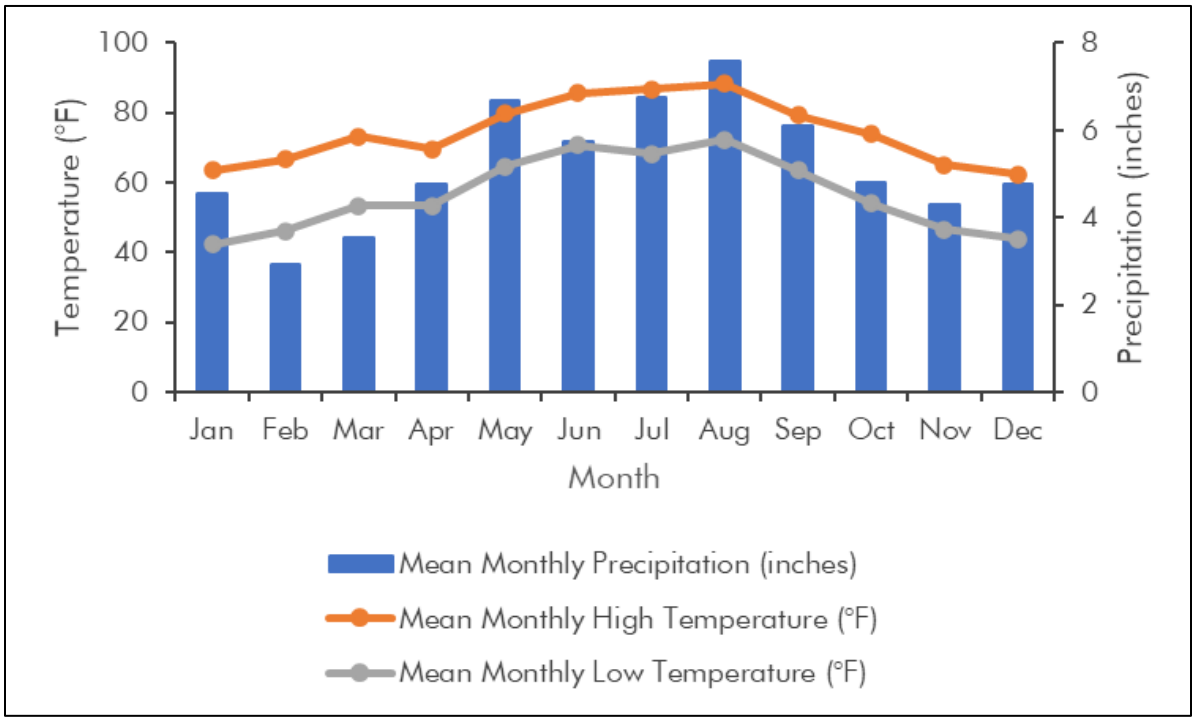

Figure I-3. Average monthly temperature and precipitation (2006–2024) at the GHCND:USC00410586 weather station

Population and Population Projections

The TMDL watershed is located within Chambers County. Current predominant population densities for this watershed are located in the cities of Mont Belvieu and Cove. According to H-GAC's Regional Growth Forecast methodology, the TMDL watershed had an estimated population of 11,747 people in 2020. The Regional Growth Forecast methodology uses the U.S. Census Bureau (USCB) decadal survey or in the intervening years, the American Community Survey, to estimate populations of census block groups (H-GAC, 2024).

A population projection through 2050 was developed using data from H-GAC's Regional Growth Forecast to be consistent with the original TMDL. Table I-2 provides a summary of the population projection for the TMDL watershed.

Table I-2. 2020 – 2050 population projection

Area	2020 Estimated Population	2050 Projected Population	Projected Population Increase (2020-2050)	Percent Change (%)
Cotton Bayou Above Tidal	11,747	32,197	20,450	174.09%

The following steps detail the method used to estimate the 2020 and projected 2050 populations in the TMDL watershed.

1. The H-GAC regional forecast team utilized 2020 USCB block-level data to create a synthetic population base for the region, representing individuals and households with demographic attributes.
2. USCB block data were spatially intersected with the TMDL watershed boundary to estimate the baseline 2020 population, assuming uniform distribution of population within each block.
3. H-GAC staff applied the same spatial overlay method to estimate the watershed population for future years using the regional forecast, which allocates population at the USCB block level.
4. Population projections for the year 2050 were developed using the H-GAC Demographic Evolution Model, which simulates births, deaths, and migration over time for each synthetic individual.
5. The projected population increase was calculated by subtracting the 2020 watershed population from the 2050 projection. This difference was then divided by the 2020 population to determine the percent growth for the TMDL watershed.

Land Cover

The land cover data for the TMDL watershed were obtained from H-GAC's Land Cover Data Set (H-GAC, 2022). The land cover for the TMDL watershed is shown in Figure I-4. A summary of the land cover data is provided in Table I-3 and indicates that the TMDL watershed is mostly developed (61.6%).

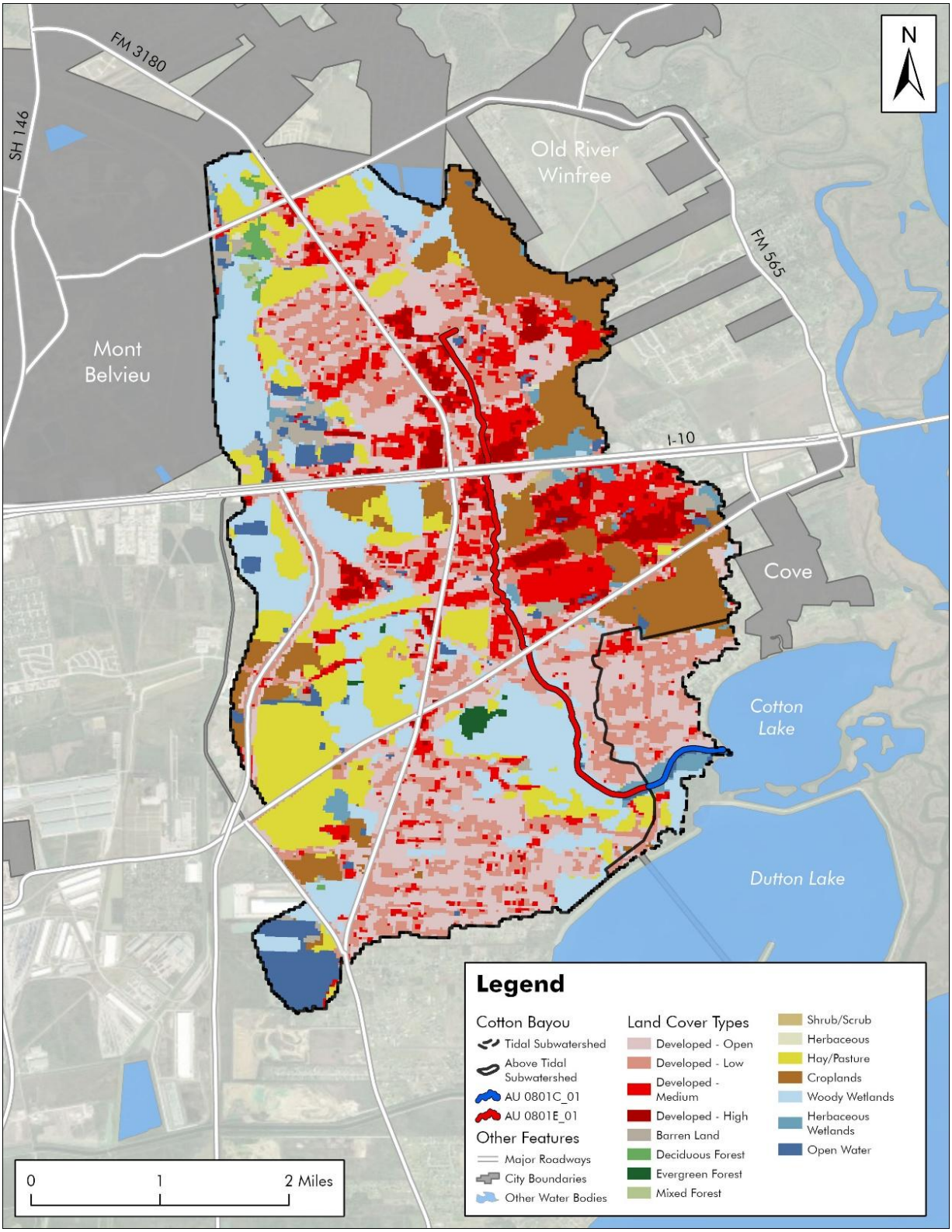

Figure I-4. Land cover map showing classifications

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

H-GAC 2022 Land Cover Categories	Area (acres)	% of Total
Open Water	202.4	2.1%
Developed – High Intensity	707.2	7.2%
Developed – Medium Intensity	1,747.60	17.9%
Developed – Low Intensity	1,774.50	18.2%
Developed – Open Space	1,785.20	18.3%
Barren Land	2.03	0.02%
Forest/Shrubs	59.6	0.6%
Pasture/Grassland	1,065.90	10.9%
Cropland	853.3	8.7%
Wetlands	1,572.50	16.1%
Total	**9,770.23**	**100%**

Endpoint Identification

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

Source Analysis

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

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

Except for WWTFs, which receive individual wasteload allocations (WLAs; see the Wasteload Allocation section), the regulated and unregulated sources in this section are

presented to give a general account of the different sources of bacteria expected in the watershed. These are not meant to be used for allocating bacteria loads or interpreted as precise inventories and loadings.

Regulated Sources

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

Domestic and Industrial WWTFs

As of May 2025, there were eight domestic WWTFs with TPDES permits within the TMDL watershed (Table I-4, Figure I-5). All permits except for one (WQ0016277001) have outfalls that exist within the TMDL watershed, however every permit's discharge path ultimately flow into AU 0801E_01.

Table I-4 TPDES-permitted WWTFs discharging in the TMDL watershed

AU	TPDES Number	NPDES[a] Number	Permittee	Outfall Number	Bacteria Limits (cfu/ 100 mL)	Primary Discharge Type	Daily Average Flow – Permitted Discharge (MGD)
0801E_01	WQ0011109001	TX0085961	Tiki Leasing Company, Ltd.	1	35 (Enterococci)	Domestic Wastewater	0.032
0801E_01	WQ0011449001	TX0066656	Aqua Texas, Inc.	1	126 (*E. coli)*	Domestic Wastewater	0.90
0801E_01	WQ0014807001	TX0053317	City of Mont Belvieu	1	126 (*E. coli)*	Domestic Wastewater	3.0
0801E_01	WQ0015245001	TX0135348	3180 Maverick Investments, LLC	1	126 (*E. coli)*	Domestic Wastewater	0.015
0801E_01	WQ0015887001	TX0140333	Chambers County Improvement District No. 3	1	126 (*E. coli)*	Domestic Wastewater	0.80
0801E_01	WQ0016031001	TX0141631	Parkland Development LLC	1	126 (*E. coli)*	Domestic Wastewater	0.1
0801E_01	WQ0016120001	TX0142531	Golive Acquisitions LLC	1	126 (*E. coli)*	Domestic Wastewater	0.015
0801E_01	WQ0016277001	TX0143987	PTX Holdings, LLC	1	35 (Enterococci)	Domestic Wastewater	0.245

[a] NPDES = National Pollutant Discharge Elimination System

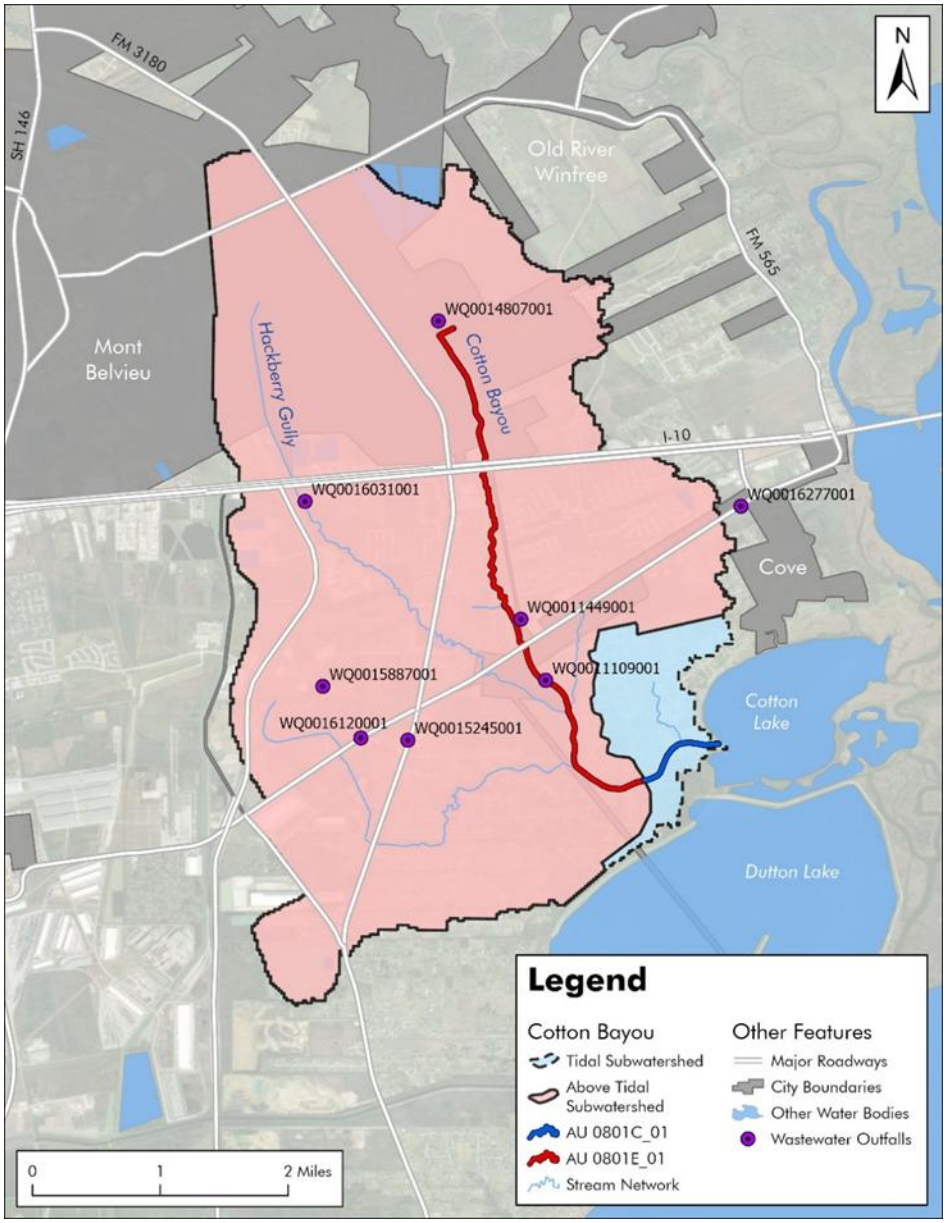

Figure I-5. WWTFs outfalls in the TMDL watershed

TCEQ/TPDES Water Quality General Permits

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

- TXG110000 – concrete production facilities
- TXG130000 – aquaculture production
- TXG340000 – petroleum bulk stations and terminals

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

A review of active general permit coverage (TCEQ, 2025a) in the TMDL watershed as of May 2025, found no active general wastewater permit facilities or operations.

Sanitary Sewer Overflows

A summary of SSO incidents that occurred between 2021 and 2024 in Chambers County was obtained from TCEQ Central Office in Austin (TCEQ, 2025b). The summary data indicated 35 SSO incidents had been reported within the TMDL watershed. Common causes for SSO events were equipment failure, inflow and infiltration, power outages, and causes notes as "Other" (e.g., a collapsed sewer line). The SSOs had a total discharge of 525,153.01 gallons with a minimum of 0.01 gallons and a maximum of 88,000 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:

Stormwater subject to regulation, which is any stormwater originating from TPDES-regulated MS4 entities, stormwater discharges associated with regulated industrial facilities, and construction activities.

1. 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 urban 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, 2025a) in the TMDL watershed as of May 2025 found no active MSGP authorizations but numerous CGP authorizations within the watershed. Additionally, there are currently two Phase II MS4 permit authorizations and one combined Phase I/II MS4 authorization within the TMDL watershed (Table I-5). Figure I-6 shows the urban area defined by the USCB that accounts for MS4 coverage within the TMDL watershed.

Table I-5. TPDES MS4 permits

Entity	TPDES Permit	EPA ID	Authorization Type
City of Mont Belvieu MS4	TXR040000	TXR040499	Phase II
Chambers County MS4	TXR040000	TXR040438	Phase II
TXDOT Statewide MS4	WQ0005011000	TXS002101	Combined Phase I and II

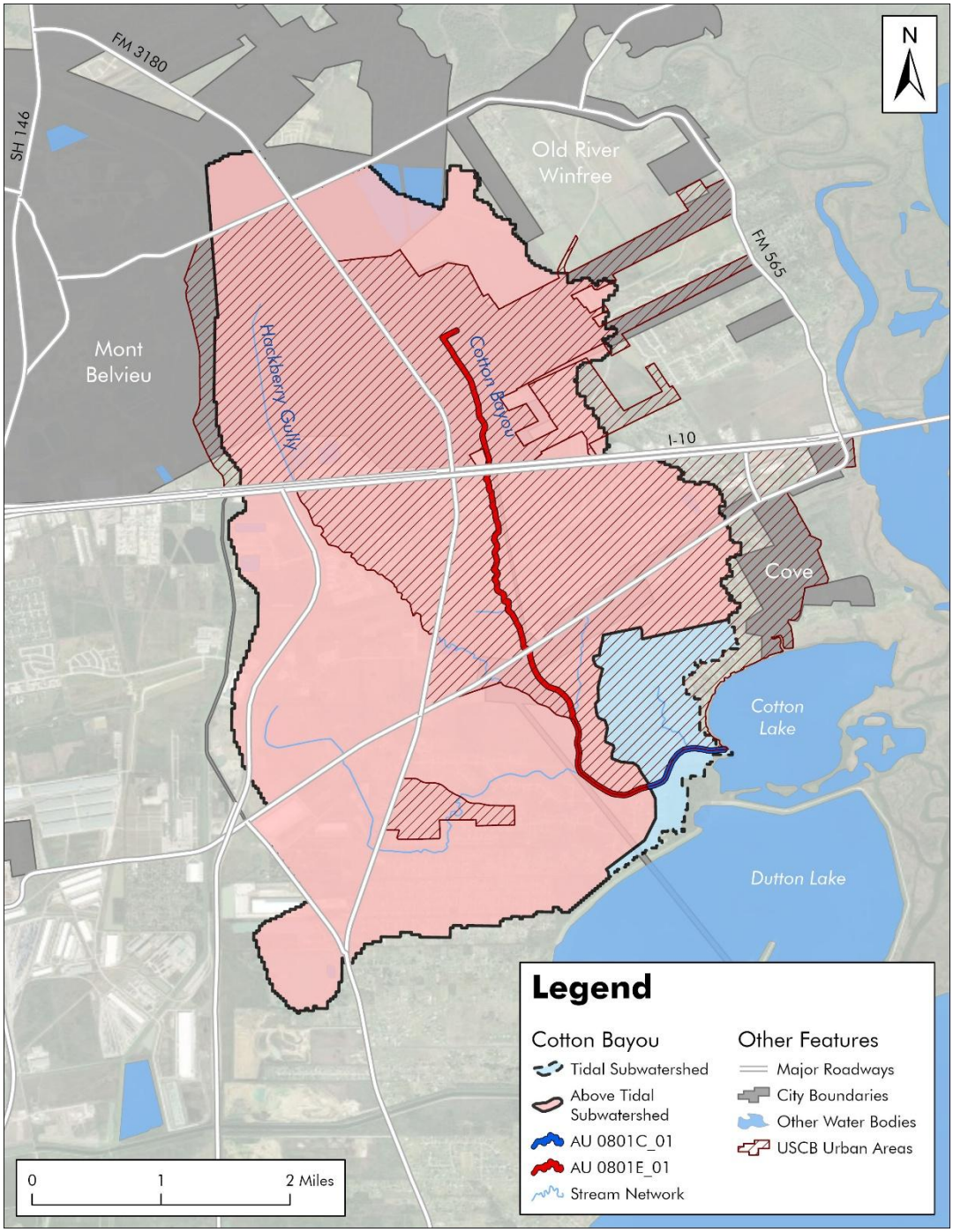

Figure I-6. Regulated stormwater areas based on Phase I and Phase II MS4 coverage as defined by the urban area

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. Livestock are present throughout the more rural portions of the TMDL watershed.

Table I-6 provides estimated numbers of selected livestock in the watershed based on the 2022 Census of Agriculture conducted by U.S. Department of Agriculture (USDA NASS, 2024). The county-level estimated livestock populations were reviewed by Texas State Soil and Water Conservation Board (TSSWCB) staff and were distributed based on GIS calculations of pastureland in the watershed, based on the 2022 H-GAC Land Cover Data Set (H-GAC, 2022). These livestock numbers, however, were not used to develop an allocation of allowable bacteria loading to livestock.

Table I-6. Estimated livestock populations

AU	Cattle and Calves	Hogs and Pigs	Poultry	Sheep and Lambs	Horses
0801E_01	309	1	42	10	7

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 I-7 summarizes the estimated number of dogs and cats within the TMDL watershed. Pet population estimates were calculated as the estimated number of dogs (1.50) and cats (1.80) per pet-owning household according to data from the American Veterinary Medical Association 2023–2024 U.S. Pet Statistics (AVMA, 2024). The number of households in the TMDL watershed was estimated using 2024 H-GAC Regional Growth Forecast data and the number of pet-owning households was calculated by multiplying the number of households by 45.5% for dogs and 32.1% for cats (AVMA, 2024). The actual contribution and significance of bacteria loads from pets reaching the TMDL watershed is unknown.

Table I-7. Estimated households and pet population

Estimated Households	Estimated Dog Population	Estimated Cat Population
3,596	2,454	2,078

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 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, 2020a). The TMDL watershed is located entirely within the DMU Urban Houston, for which there is no deer density data. However, because the TMDL watershed is close to DMU 13, density data from this DMU was used to estimate deer populations for the TMDL watershed. In the ecoregion surrounding the TMDL watershed, TPWD deer population estimates recorded from 2008 through 2019 average one deer for every 217.52 acres (TPWD, 2020b). By applying this factor to the acreage in the TMDL watershed, the deer population is estimated to be 45.

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. Feral hog population estimates may be weighted more heavily in riparian areas where animals are protected from the stresses associated with development and have more direct access to water resources. Considering these factors, in addition to insights from local stakeholders, feral hog population estimates were:

- 8.9 per square mile in low intensity development
- 12.7 per square mile in developed open space, barren land, and cropland
- 16.4 per square mile in pasture/grassland, forest/shrubs, and wetlands
- no hogs in other developed areas or open water

Using these assumptions, the total feral hog population of the TMDL watershed is estimated to be 146. The *E. coli* contribution from feral hogs and wildlife could not be determined based on existing information.

On-site Sewage Facilities

The estimated number of OSSFs in the TMDL watershed was determined using known OSSF locations, 911 addresses, and WWTF service boundaries. These data indicate that there are 542 documented OSSFs located within the TMDL watershed (Figure I-7) plus an additional 1,701 unregistered OSSFs for a total of 2,243 units (Evans et al., 2025). Several pathways of the liquid waste in OSSFs afford opportunities for bacteria to enter ground and surface waters if the systems are not properly operating. Properly designed and operated, however, OSSFs would be expected to contribute virtually no fecal bacteria to surface waters (Weiskel et al., 1996).

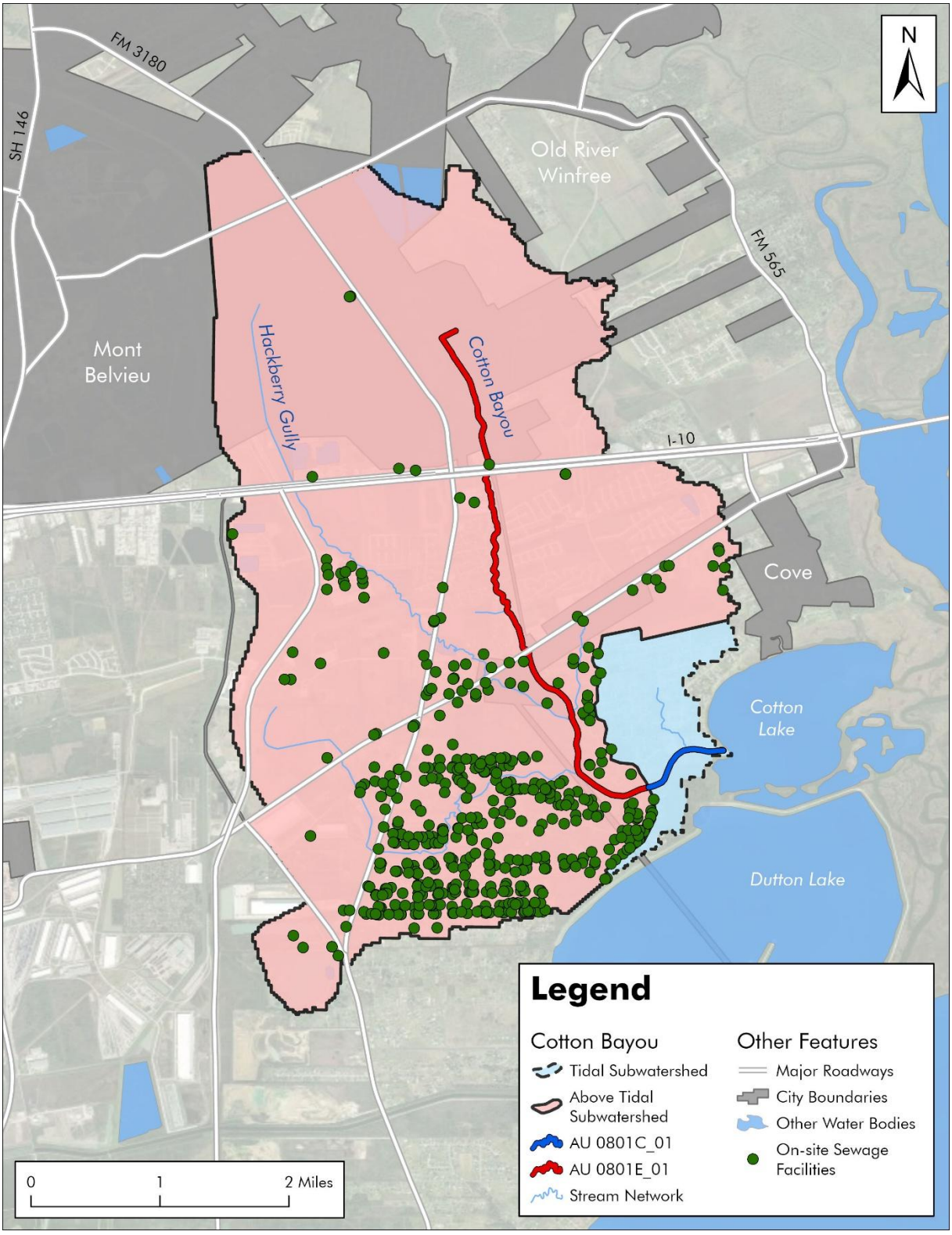

Figure I-7. Permitted OSSFs located within the TMDL watershed

Linkage Analysis

The load duration curve (LDC) method was used to examine the relationship between instream water quality and the source of indicator bacteria loads. Inherent to the use of LDCs as the mechanism of linkage analysis is the assumption of a one-to-one relationship between instream loadings and loadings originating from point sources as regulated and from the landscape as unregulated sources. Further, this one-to-one relationship was also inherently assumed when using the LDC to define the TMDL pollutant load allocation. The LDC method allows for estimation of TMDL loads by utilizing the cumulative frequency distribution of streamflow and measured pollutant concentration data (Cleland, 2003). In addition to estimating stream loads, this method allows for the determination of the hydrologic conditions under which impairments are typically occurring, can give indications of the broad origins of the bacteria (i.e., point or nonpoint source), and provides a means to allocate allowable loadings. The technical support document for this addendum (Evans et al, 2025) 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 18696 in Figure I-8 show exceedances of the geometric mean criterion have commonly occurred regardless of streamflow conditions. The allowable load at the single sample criterion (399 cfu/100 mL) is included on the LDC for comparison with individual *E. coli* samples, although it is not used for allocation purposes.

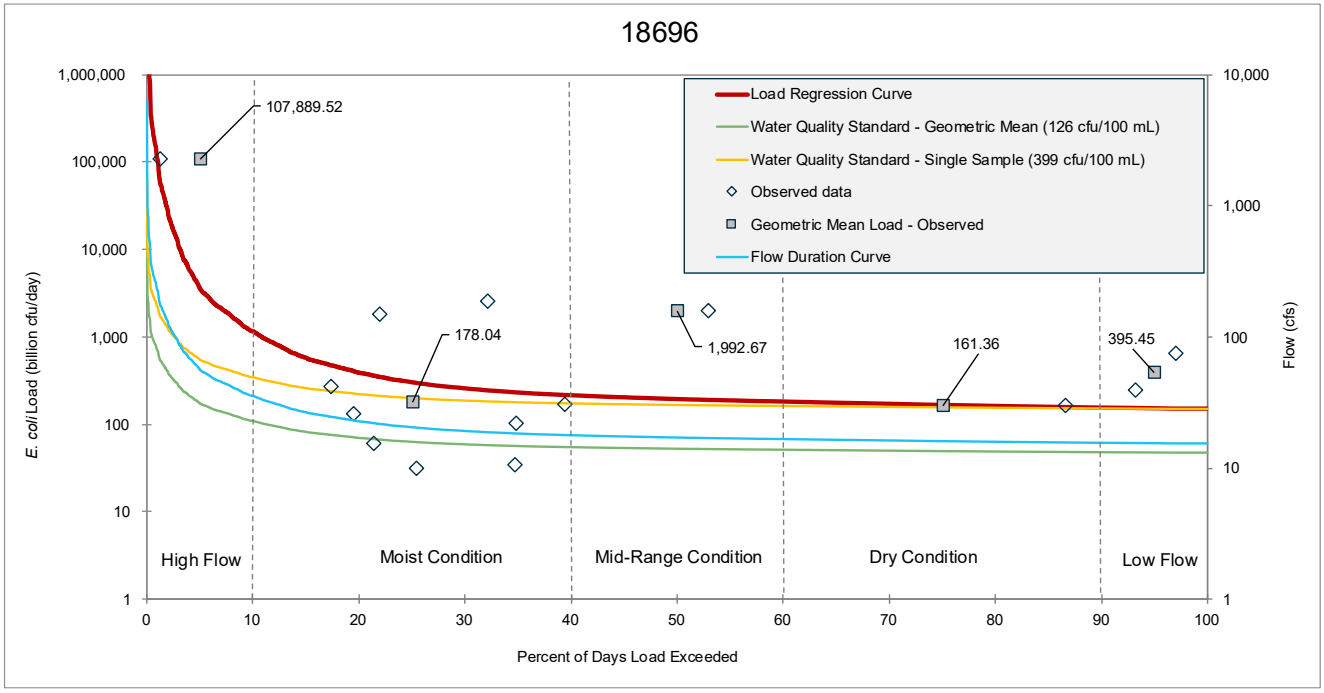

Figure I-8. LDC for TCEQ SWQM Station 18696

Margin of Safety

The margin of safety (MOS) is designed to account for any uncertainty 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 water body 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 the previously completed TMDL in the original watershed, the TMDL for Cotton Bayou Above Tidal AU 0801E_01 was derived using the median flow within the high flow regime (or 5% load duration exceedance) of the LDC developed for TCEQ SWQM Station 18696. This station represents the location within the TMDL watershed where an adequate number of *E. coli* samples were collected to analyze the bacteria impairment.

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 the instream geometric mean criterion assigned for the TMDL AU. The assigned water quality criterion for AU 0801E_01 is for freshwater (126 cfu/100 mL *E. coli*) which is used as the WWTF target to provide instream and downstream load capacity. Internal permitting procedures assigned two permits near the tidal boundary the tidal criterion limit of 35 cfu/100 mL Enterococci. For consistency with the water quality standard in AU 0801E_01, wasteload allocations were calculated using the freshwater criterion 126 cfu/100 mL *E. coli*. It is assumed that WWTFs operating as permitted will meet the primary contact recreation 1 standard regardless of if their bacteria limits are for freshwater or tidal waters.

Table I-8 presents the WLA_{WWTF} for each WWTF and the resulting total WLA_{WWTF} allocation for the TMDL watershed.

Table I-8. WLAs for TPDES-permitted facilities

AU	TPDES Number	Permittee	Full Permitted Flow (MGD)	WLA_{WWTF} (billion cfu/day *E. coli*)
0801E_01	WQ0011109001[a]	Tiki Leasing Company, Ltd.	0.032	0.153
0801E_01	WQ0011449001	Aqua Texas, Inc.	0.900	4.293
0801E_01	WQ0014807001	City of Mont Belvieu	3.00	14.309
0801E_01	WQ0015245001	3180 Maverick Investments, LLC	0.015	0.072
0801E_01	WQ0015887001	Chambers County Improvement District No. 3	0.800	3.816
0801E_01	WQ0016031001	Parkland Development LLC	0.100	0.477
0801E_01	WQ0016120001	Golive Acquisitions LLC	0.015	0.072
0801E_01	WQ0016277001[a]	PTX Holdings, LLC	0.245	1.169
		Total	**5.107**	**24.358**

[a] Assigned the tidal criterion limit of 35 cfu/100 mL per their permit.

Regulated Stormwater

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

Acreages associated with MS4s (5,249.82 acres) and areas authorized by CGP outside of the MS4 areas (930.47 acres) were calculated using geographic information system shapefiles as well as aerial imagery by measuring the estimated disturbed area at each facility location (or the "area disturbed" listed for CGP authorizations). The percentage of land under the jurisdiction of stormwater permits in the TMDL watershed is 63.26%.

Load Allocation

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

Allowance for Future Growth

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

The FG component of the TMDL watershed was based on population projections and current permitted wastewater dischargers for the entire TMDL watershed. Recent population and projected population growth between 2020 and 2050 for the TMDL watershed are provided in Table I-2. The projected population percentage increase within the watershed was multiplied by the corresponding WLA_{WWTF} to calculate future WLA_{WWTF}.

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

Summary of TMDL Calculations

Table I-9 summarizes the TMDL calculations for the TMDL watershed. The TMDL was calculated based on the median flow in the 0-10% percentile range (5% exceedance, high flow regime) from the LDC developed for the TCEQ SWQM Station 18696. Allocations are based on the current geometric mean criterion for *E. coli* of 126 cfu/100 mL for each component of the TMDL.

Table I-9. TMDL allocation summary

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
Cotton Bayou Above Tidal	0801E_01	173.537	8.677	24.358	62.056	36.040	42.406

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

Table I-10. Final TMDL allocation

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

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
Cotton Bayou Above Tidal	0801E_01	173.537	8.677	66.764	62.056	36.040

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 23 years (2001 through 2024) 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 the TMDL watershed (p=0.271). 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 (Evans et al, 2025) was published on the TCEQ website on March 10, 2026. Project staff presented information about this addendum at the annual meeting of the Cotton Bayou stakeholders in Mont Belvieu, Texas on June 18, 2025. The public had an opportunity to comment on this addendum during the public comment period (May 8 through June 9, 2026) 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.[3] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[4] TCEQ accepted public comments on the original TMDL report from October 27 through November 30, 2023. The original TMDL report received one comment regarding concern over WWTF regulation in TMDL watersheds which was resolved by staff and did not lead to any modifications of the TMDL document itself.

Implementation and Reasonable Assurance

The water body covered by this addendum is within the existing bacteria TMDL watershed for Cotton Bayou Tidal. The original TMDL watershed, which includes Cotton Bayou Above Tidal AU 0801E_01, is within the area covered by the *Implementation Plan for One Total Maximum Daily Load for Indicator Bacteria in the Cotton Bayou Watershed*. The implementation plan (I-Plan) was developed by stakeholders and was approved by the Commission on July 9, 2025. 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.

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

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