Clean Rivers Program

HOW'S THE WATER?

2015 Houston-Galveston Area Council

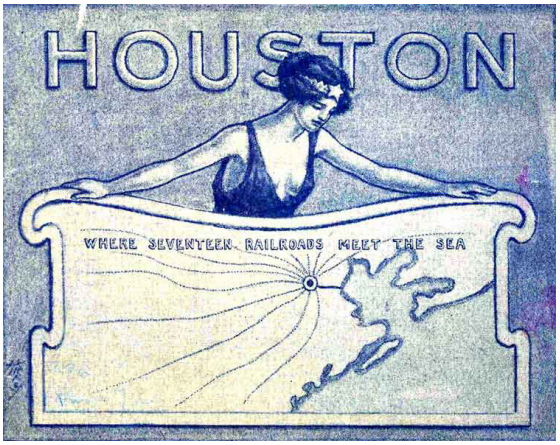
Basin Highlights Report

TABLE OF CONTENTS

IT'S ALL ABOUT WATER.

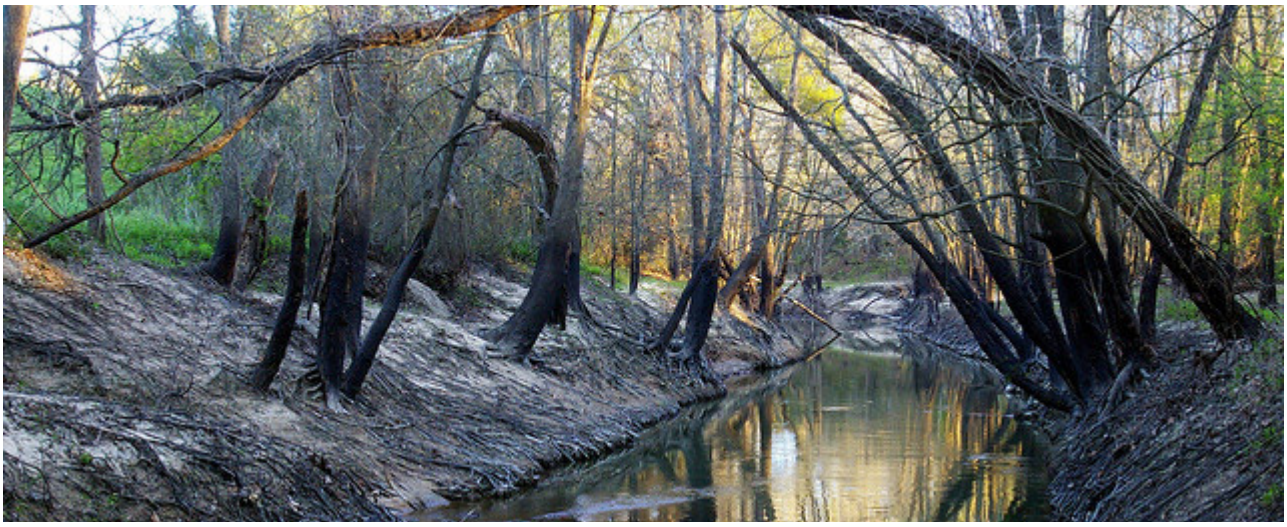
Water is our most precious resource. We drink it, bathe in it and play in it. We share our water with all of the other living things on the planet: plants, animals and microorganisms. **And without water, none of us can survive.**

In the Houston-Galveston region, there aren't scenic vistas with snow-covered mountains for skiing. We don't have mile after mile of beautiful fall foliage to take in.



But we do have over 16,000 miles of streams and shoreline that lead to one of the most productive estuaries in the United States.

Houston is the Bayou City. Water is a cornerstone of our regional economy, amounting to $4 billion annually through ecotourism, oyster harvesting and commercial fishing. It all hinges on clean water.



SO, HOW'S THE WATER?

The good news is that water quality in the region is improving. But there is still work to be done.

Currently, the region included in the Houston-Galveston Area Council's (H-GAC) service area has an adequate supply of water. However, recent drought has made us much more aware of what a precious resource our water is. It has reminded us that our fast-paced population growth will place greater demand on this finite resource.

H-GAC's Clean Rivers Program (CRP) is charged with collecting surface water samples and then analyzing the *quality* of those samples and communicating the results to the public.

H-GAC strives to find the sources of water quality problems and develop strategies and plans to maintain and improve the quality of our surface waters.

2015 BASIN HIGHLIGHTS REPORT

This Basin Highlights Report (BHR) will give you an overview of the current quality of our region's surface waters, as well as trends.

We will also take a detailed look at five specific waterbodies in the region to identify

- what are the specific water quality issues and trends;
- what are the sources of pollution;
- what is being done about the problems; and
- who is working on them?

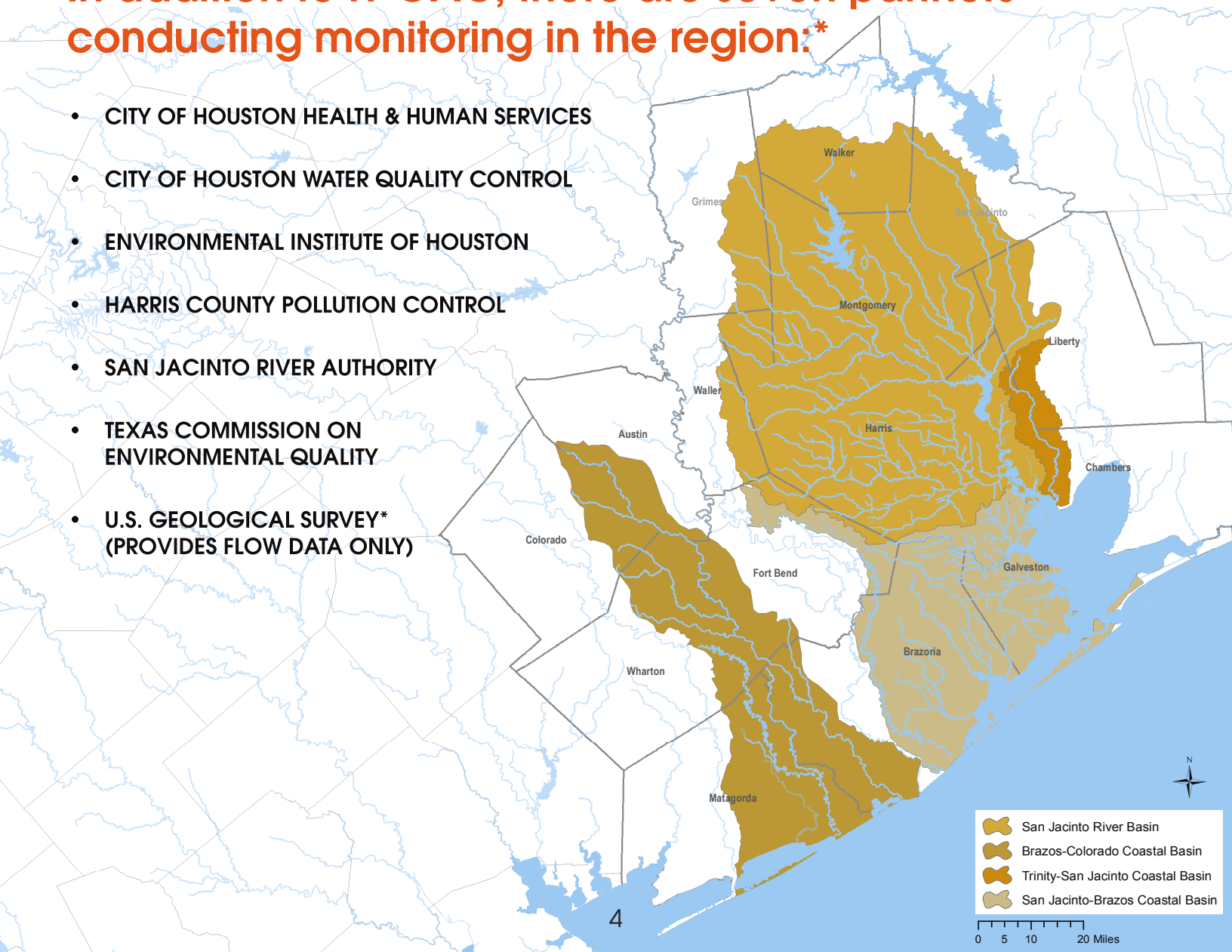
Assessment Basins

CRP is charged with monitoring and assessing the quality of the region's surface waters and providing information and recommendations to individuals, industry and local governments about what they can do to clean up and preserve local waterways, now and in the future.

H-GAC is the state-designated lead partner agency for the San Jacinto River Basin, the Trinity-San Jacinto Coastal Basin, the San Jacinto-Brazos Coastal Basin and the Brazos-Colorado Coastal Basin. These basins comprise the H-GAC CRP project area, which includes all or a portion of 15 counties, more than 400 sampling sites and seven regional partners.

In addition to H-GAC, there are seven partners conducting monitoring in the region:*

- CITY OF HOUSTON HEALTH & HUMAN SERVICES
- CITY OF HOUSTON WATER QUALITY CONTROL
- ENVIRONMENTAL INSTITUTE OF HOUSTON
- HARRIS COUNTY POLLUTION CONTROL
- SAN JACINTO RIVER AUTHORITY
- TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
- U.S. GEOLOGICAL SURVEY* (PROVIDES FLOW DATA ONLY)



DID YOU KNOW...

H-GAC's CRP was the first in Texas to coordinate with other local monitoring agencies, helping reduce unnecessary duplications in monitoring and saving approximately $150,000 annually?

That coordinated approach has become a model in collaboration for other CRPs across the state. Additionally, our CRP set the bar for reporting to the Texas Commission on Environmental Quality (TCEQ) and helped establish the revolving five-year report schedule that is now followed by all Texas CRPs.

Regional Issues

The H-GAC region includes the third most populous county and fourth most populous city in the United States and is projected to continue growing. More people equates to more wastewater discharges, dogs, septic systems and industry, all of which have an effect on our water.

The good news is that overall water quality is improving; however, more than 80% of the waterways in the H-GAC region fail to meet water quality standards, or screening criteria, for one or more parameters.

STANDARDS CRITERIA

BACTERIA

47%

stream miles* impaired

H-GAC's CRP tests for *E. coli* and Enterococcus bacteria which come from animal and human excrement.

High levels of these bacteria can cause gastrointestinal illness and infections, and their occurrence may indicate the presence of other dangerous pathogens in the water.

Sources of bacteria contamination may include

- discharge from wastewater treatment facilities (WWTF) with inadequate treatment, by-passes and sanitary sewer system overflows;
- runoff from on-site sewage facilities (OSSFs); and
- runoff contaminated with excrement from pets, wildlife and livestock.

*Stream miles are the distance measured along the center of a stream.

STANDARDS CRITERIA

DISSOLVED OXYGEN

27%
stream miles impaired

High levels of dissolved oxygen (DO) are a good thing, but low DO levels hinder the ability of waterways to sustain aquatic life, including fisheries. Fish kills are a common sign of low, or depressed, DO.

DO levels in the region may be negatively impacted by

- high concentrations of nutrients in area waterways;
- the amounts of debris and microscopic matter washing into or being discharged to streams;
- the loss of in-stream habitat to channel modifications or development; and
- reduced streamside canopy, as shaded streams are usually cooler and can support higher DO concentrations.

SCREENING CRITERIA

NUTRIENTS

28%
stream miles exceed state levels

Nutrients in the water, often from fertilizers, are a complex issue.

A certain level of nutrients is necessary for healthy oyster beds, a $30 million business for the region. But too much can cause taste and odor issues in drinking water sources.

High levels of nutrients can also lead to unsightly algal blooms, which in turn cause low DO, killing fish and other aquatic life.

Sources of nutrient pollution in the region may include

- wastewater and stormwater discharges;
- illegal dumping;
- urban runoff; and
- agricultural-related operations.

STANDARDS CRITERIA

PCBs & DIOXIN

76%

tidal waters* impaired

Contamination of PCBs and Dioxin are different than other water quality parameters.

Typically the result of pollution from industry, PCBs and Dioxin impact the food chain and are most often found in the fatty tissue of fish and larger aquatic life.

People who eat fish or shellfish contaminated by PCBs and Dioxin can develop long-term, serious illnesses, including reproductive and developmental problems, damage to the immune system, interference with hormone levels and even cancer.

*Tidal waters are waterways directly impacted by the changing tide.

WHAT IS...THE STATE WATER QUALITY STANDARD?

The Texas Surface Water Quality Standards create water quality goals to make sure our water is safe for drinking, recreational use and aquatic life, all of which contribute to a healthy economy.

There are many criteria for evaluating water quality, and H-GAC conducts monitoring of those criteria to help the state ensure local waterbodies meet standards for recreational uses, like swimming, wading and fishing.

Every two years, the TCEQ assembles monitoring data from CRP partners statewide into the Texas Integrated Report of Surface Water Quality (IR), which identifies waterbodies that are not meeting state standards and puts those waterbodies on the 303(d) list.

Waterbodies included on the 303(d) list are either called "impaired" or as having a screening level of "concern" by the TCEQ, depending on the type of criteria. This designation is the first step toward improving water quality in waterbodies that fail to meet state standards.

2015 REGIONAL WATER QUALITY SUMMARY

The numbers represent the percent of total segment length that is impaired or of concern for each parameter. Cells without numbers (blanks) represent stream segments that are currently meeting state standards but may be improving or degrading for each parameter.

Basin	Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other*	Frogs
Trinity-San Jacinto Coastal	Cedar Bayou Tidal	0901	100	100	100		100		
	Cedar Bayou Above Tidal	0902	100						
San Jacinto River	Buffalo Bayou Above Tidal	1014	10.8	79.4		70.7		2.2	
	Buffalo Bayou Tidal	1013	30.8	63.3		36.4		27.0	
	Caney Creek	1010	16.1	34.6					
	Cypress Creek	1009	41.0	84.6		84.6		10.4	
	East Fork San Jacinto River	1003		100					
	Greens Bayou Above Tidal	1016	9.0	91.2		80.3			
	Houston Ship Channel	1006	16.5	47.2	7.8	86.5	36.7	36.7	
	Houston Ship Channel Buffalo Bayou Tidal	1007	19.6	72.8		83.9	23.8	23.8	
	Houston Ship Channel/ San Jacinto River Tidal	1005				72.9	100	72.9	
	Lake Conroe	1012	11.0						
	Lake Creek	1015	66.3	11.4				36.8	
	Lake Houston	1002	19.6	6.6	14.1	41.3		0.1	
	Peach Creek	1011		100					
	San Jacinto River Tidal	1001					43.4	43.4	
	Spring Creek	1008	49.8	72.0	1.1	22.3		11.7	
	West Fork San Jacinto River	1004		61.5		18.1			
	White Oak Bayou Above Tidal	1017	11.4	84.6		80.8			
San Jacinto-Brazos Coastal	Armand Bayou Tidal	1113	56.5	64.7	24.7	17.7	24.7	10.2	
	Bastrop Bayou Tidal	1105	84.9	94.3		6.3			
	Chocolate Bayou Above Tidal	1108		100					
	Chocolate Bayou Tidal	1107		100			100		
	Clear Creek Above Tidal	1102	53.4	85.2		72.4	44.3	4.4	
	Clear Creek Tidal	1101	25.7	71.0	13.6	23.8	29.4		
	Dickinson Bayou Above Tidal	1104	41.3	41.3					
	Dickinson Bayou Tidal	1103	65.6	84.3	12.2		42.5		
	Old Brazos River Channel Tidal	1111			100				
	Oyster Creek Above Tidal	1110	66.3	42.2	42.2			100	
	Oyster Creek Tidal	1109		100					

Basin	Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other*	Frogs
Brazos-Colorado Coastal	San Bernard River Above Tidal	1302	61.8	75.5		9.5		13.0	3
	San Bernard River Tidal	1301		100	100				3
	Caney Creek Above Tidal	1305	59.7	14.4		59.7		14.4	3
	Caney Creek Tidal	1304	33.2	100					3
Bays & Estuaries	Barbours Cut	2436				100	100		2
	Bastrop Bay / Oyster Lake	2433							5
	Bayport Ship Channel	2438	100		100	100	100		1
	Black Duck Bay	2428			100	100	100		2
	Burnett Bay	2430			85.9	100	100	100	1
	Chocolate Bay	2432	23.4	41.4			38.7		3
	Christmas Bay	2434							5
	Clear Lake	2425	8.4	10.8	65.1	80.0	92.3	65.1	2
	Drum Bay	2435							5
	East Bay	2423		30.0	100		100		2
	Lower Galveston Bay	2439			100		100		2
	Moses Lake	2431		34.8	19.6		54.4		3
	San Jacinto Bay	2427				100	100	100	1
	Scott Bay	2429				100	100	100	1
	Tabbs Bay	2426				35.1	100		2
	Texas City Ship Channel	2437			100	100	100		2
	Trinity Bay	2422			100	60.6	100		2
	Upper Galveston Bay	2421			89.5	95.7	100		2
	West Bay	2424	15.0	9.3	11.4		88.5		3
	Gulf of Mexico	2501						44.0	4

Chart Key

1 frog
Severe, multiple water quality impairment(s) or concern(s) exist in a majority of the waterbody.

2 frogs
Significant, multiple water quality impairment(s) or concerns exist in the waterbody.

3 frogs
Water quality impairment(s) or concern(s) exist in a substantial portion of the waterbody.

4 frogs
Water quality impairment(s) or concern(s) exist in the waterbody.

5 frogs
No significant water quality impairments or concerns exist in the waterbody.

IMPROVING

DEGRADING

* Other includes parameters such as metals in water, metals in sediment, impaired habitat, impaired benthic macroinvertebrates, impaired fish communities, sediment toxicity, fecal coliform, mercury in fish tissue and fish contamination.

WATERSHED CHARACTERIZATIONS

In addition to the general overview of regional water quality issues and concerns provided in earlier sections of this BHR, H-GAC has highlighted the following five watersheds for characterization summaries: Cedar Bayou Tidal (0901); Bastrop Bayou (1105); West Fork San Jacinto River (1004); East Fork San Jacinto River (1003); and White Oak Bayou (1017).

EACH CHARACTERIZATION WILL INCLUDE...

Segment Description
A description of the segment, AU boundaries, historically monitored sites and sites believed to be responsible for any impairments or concerns

Hydrologic Characteristics
Streamflow variability, reservoir dynamics, seasonality of flow and typical flow trends

Land Use & Natural Characteristics
The land surrounding the segment, including cities, agricultural lands, permitted discharges, landfills, quarry operations, industrial areas, animal feeding operations and oil and gas operations

Description of Water Quality Issues
Identification of why the waterbody is listed and when it first appeared on the 303(d) list or why it is an area of interest, including the number of samples, parameters of concern or impairment, assessment results and appropriate state standards for comparison

Potential Sources of Water Quality Issues
Possible sources of water quality issues identified through the use of satellite imagery, watershed surveys and communications with stakeholders and staff from local and state agencies

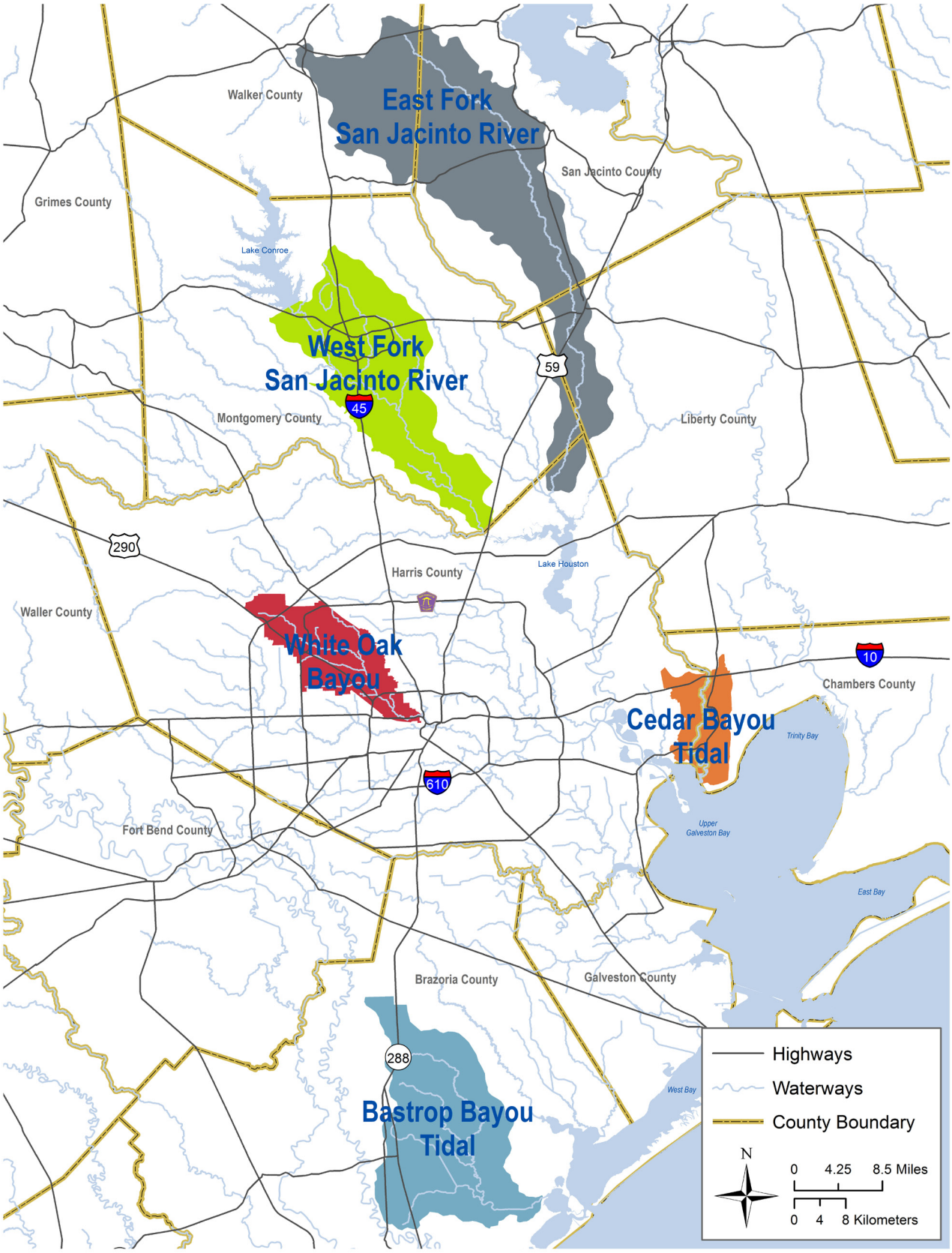
Potential Stakeholders
Companies, agencies, organizations or individuals who have a vested interest in the area

Recommendations for Improving Water Quality
Proposed next steps based on the potential sources of impairment or concern

Ongoing Projects
Current or future projects that will occur in the segment

Major Watershed Events
Anticipated or known occurrences that have the potential to either positively or negatively impact water quality

CHARACTERIZATION SITES



HERE ARE TWO THINGS YOU SHOULD KNOW BEFORE YOU READ THE CHARACTERIZATION SUMMARIES:

1. THREE OF THESE SEGMENTS ARE A PART OF THE BIG.

In 2008, H-GAC established the Bacteria Implementation Group (BIG), a 31-person stakeholder group working together to reduce bacteria in a large geographic area.

This group completed an Implementation Plan (I-Plan) in January 2013 that defined best management practices and voluntary actions that could be taken across the region to address bacteria. Early results are very positive.

You'll learn more about the BIG in the summaries for West Fork San Jacinto River (1004); East Fork San Jacinto River (1003); and White Oak Bayou (1017).

2. REMEMBER, THESE ARE ONLY SUMMARIES.

H-GAC has taken seven years worth of data and distilled it down to the highlights.

If you'd like to read about all the technical aspects of the analysis, including modeling and methodology, refer to Appendices A and B of this document, beginning on pages 63 and 64.

Common Acronyms

AU	Assessment Unit	OSSF	On-Site Sewage Facility
BIG	Bacteria Implementation Group	SSO	Sanitary Sewer Overflow
CRP	Clean Rivers Program	TCEQ	Texas Commission on Environmental Quality
EIH	Environmental Institute of Houston	TMDL	Total Maximum Daily Load
DO	Dissolved Oxygen	TSSWCB	Texas State Soil & Water Conservation Board
EPA	Environmental Protection Agency	USGS	U.S. Geological Survey
H-GAC	Houston-Galveston Area Council	WPP	Watershed Protection Plan
I-PLAN	Implementation Plan	WWTF	Wastewater Treatment Facility

CEDAR BAYOU TIDAL (0901)

DESIGNATED USES

High Aquatic Life, Contact Recreation, General, Fish Consumption

LENGTH
19 miles

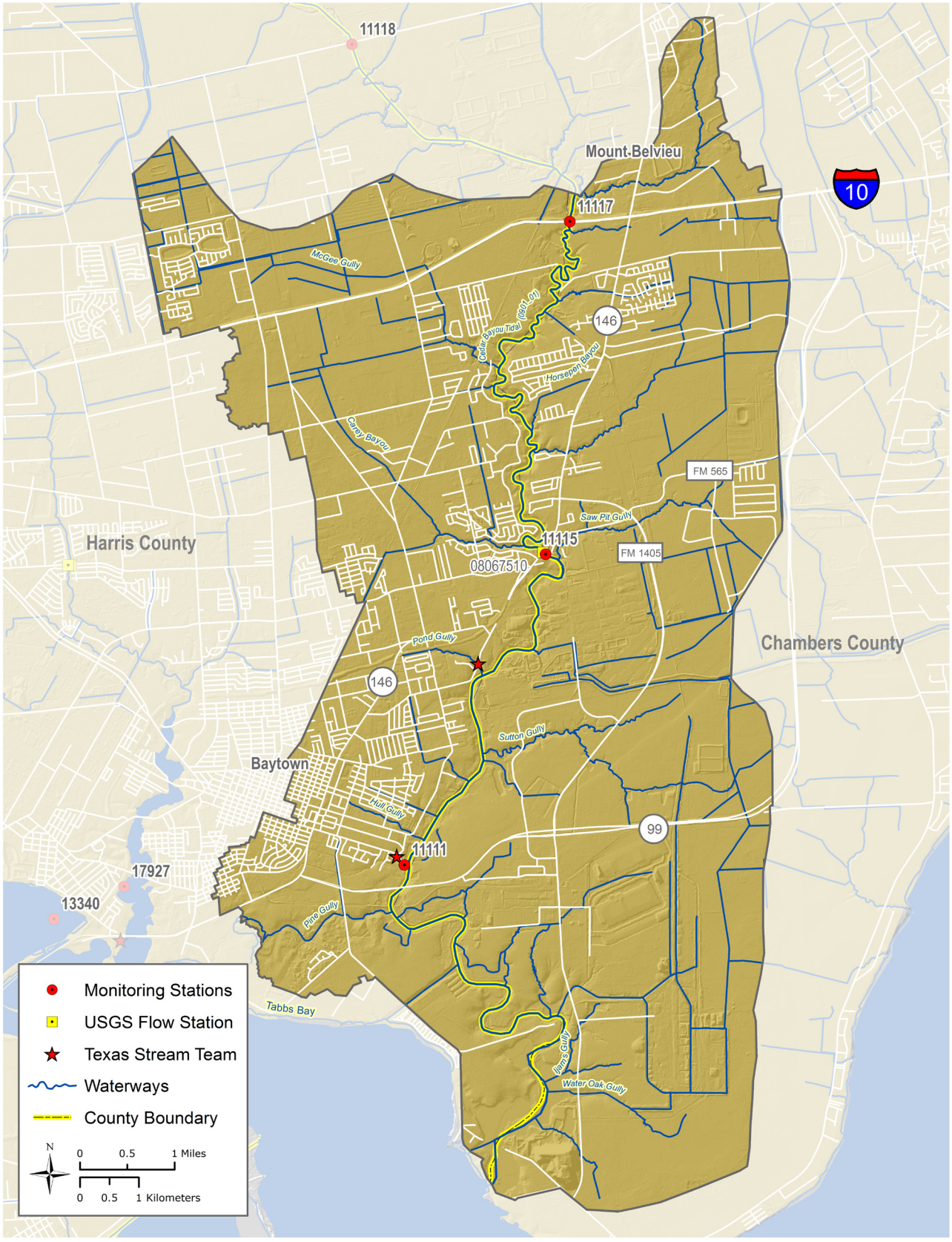
53.5 sq mi
watershed

2 Texas Stream Team sites
(volunteer monitoring)

3 ACTIVE MONITORING STATIONS IN 2015

28 total
permitted outfalls

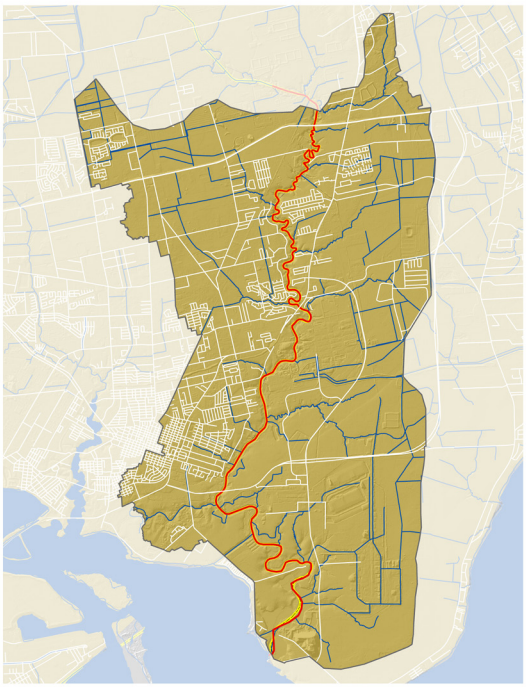
MONITORING STATIONS MAP



POTENTIAL SOURCES OF WATER QUALITY ISSUES?

CEDAR BAYOU TIDAL IS IMPACTED BY A LARGE DEGREE OF HUMAN ACTIVITY DUE TO THE DENSE URBAN AND INDUSTRIAL COMPLEXES IN THE AREA.

BACTERIA



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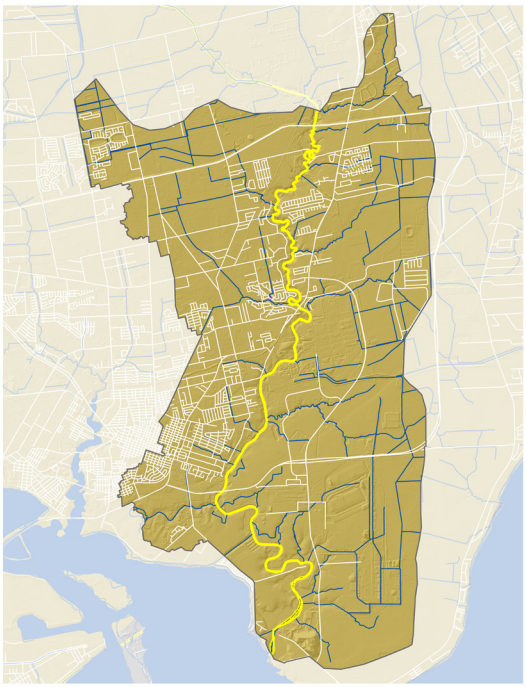
DISSOLVED OXYGEN



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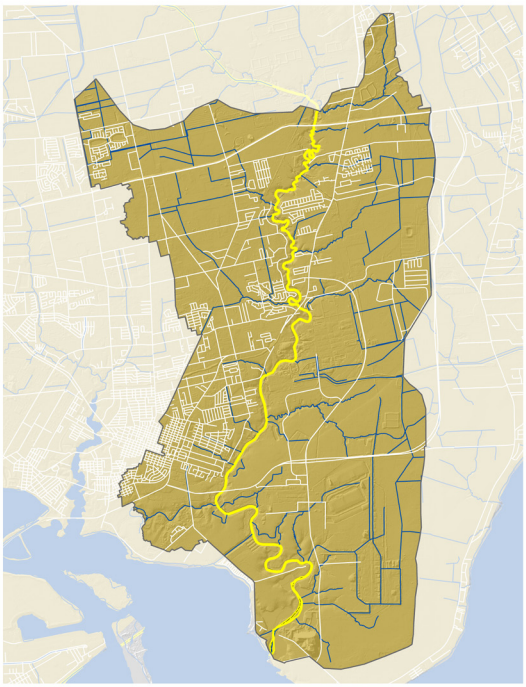
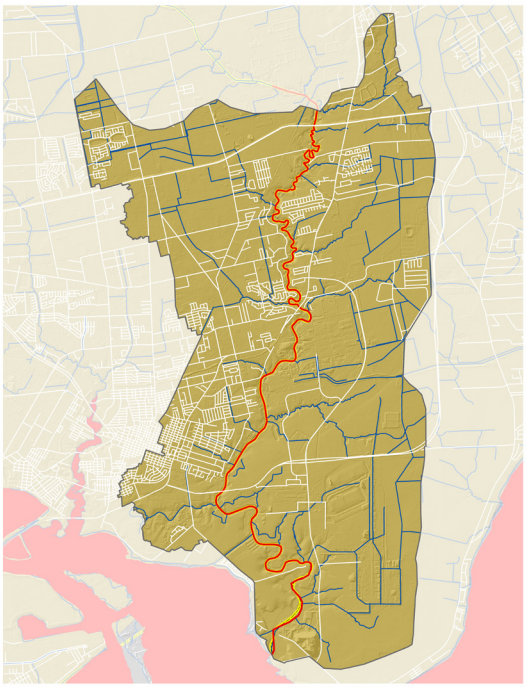
NUTRIENTS



Improving

PCB / DIOXIN



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Impairment Concern Unimpacted

LAND USE & NATURAL CHARACTERISTICS

Urban and industrial land uses in Cedar Bayou Tidal have expanded greatly in recent decades, and petrochemical industries are common in the area. Urban development generally increases as you move farther south toward the City of Baytown, with major transportation corridors such as I-10, SH 146 and SH 99 serving as concentrators of new growth. The western portions of the segment are dominated by urban and suburban residential development with industrial complexes and undeveloped land dominating the eastern reaches.

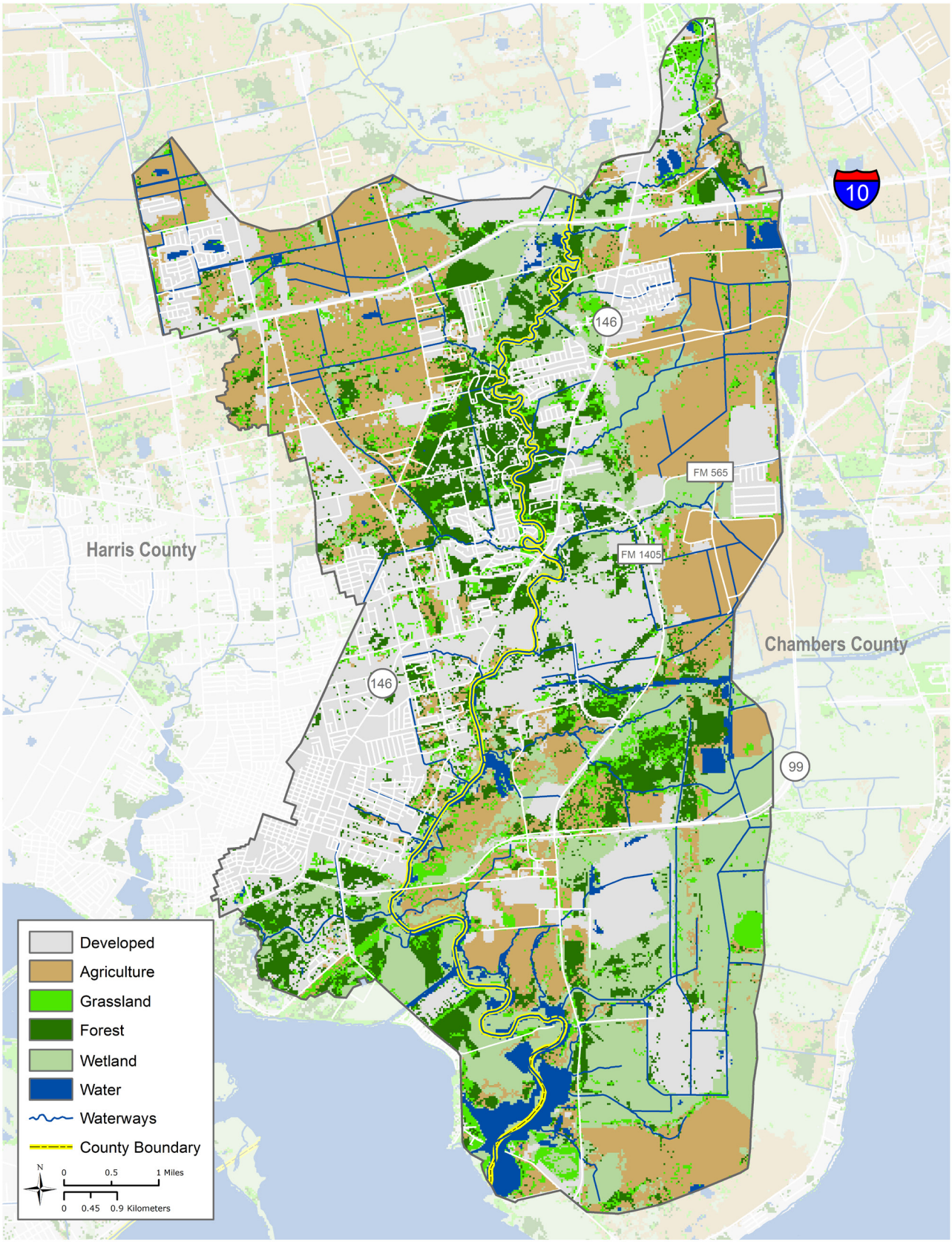
The primary urban centers of the watershed include the City of Baytown in the southwestern portion of the tidal segment and the City of Mont Belvieu near the tidal/above tidal segment boundary. Agricultural activity in the watershed is primarily relegated to the undeveloped areas at the fringe of the urban/industrial developments.

South of the Baytown area, the land uses include a variety of wetland and undeveloped land cover types. Specific uses of note in this area include a large solid waste landfill site adjacent to Cedar Bayou's east shore north of the mouth. Blocks of undeveloped bottomland forest, tidal wetland and coastal prairie can be found at the mouth of Cedar Bayou near its confluence with Upper Galveston Bay. Highly salt-tolerant plants are common to the coastal marshes and estuarine lakes in the lower reach.

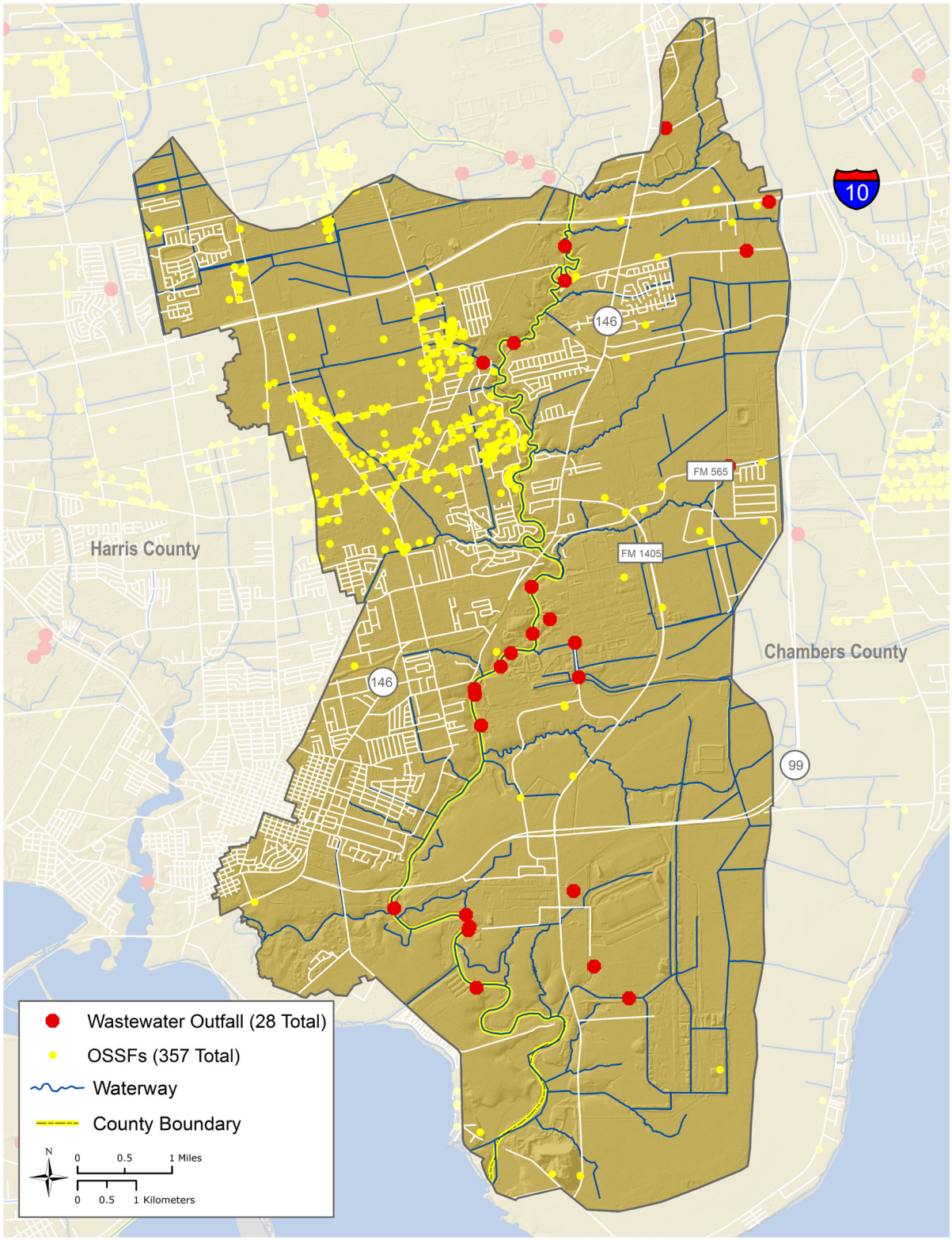
FOR MORE DETAILED LAND USE INFORMATION

VISIT WWW.H-GAC.COM/GO/WRIM.

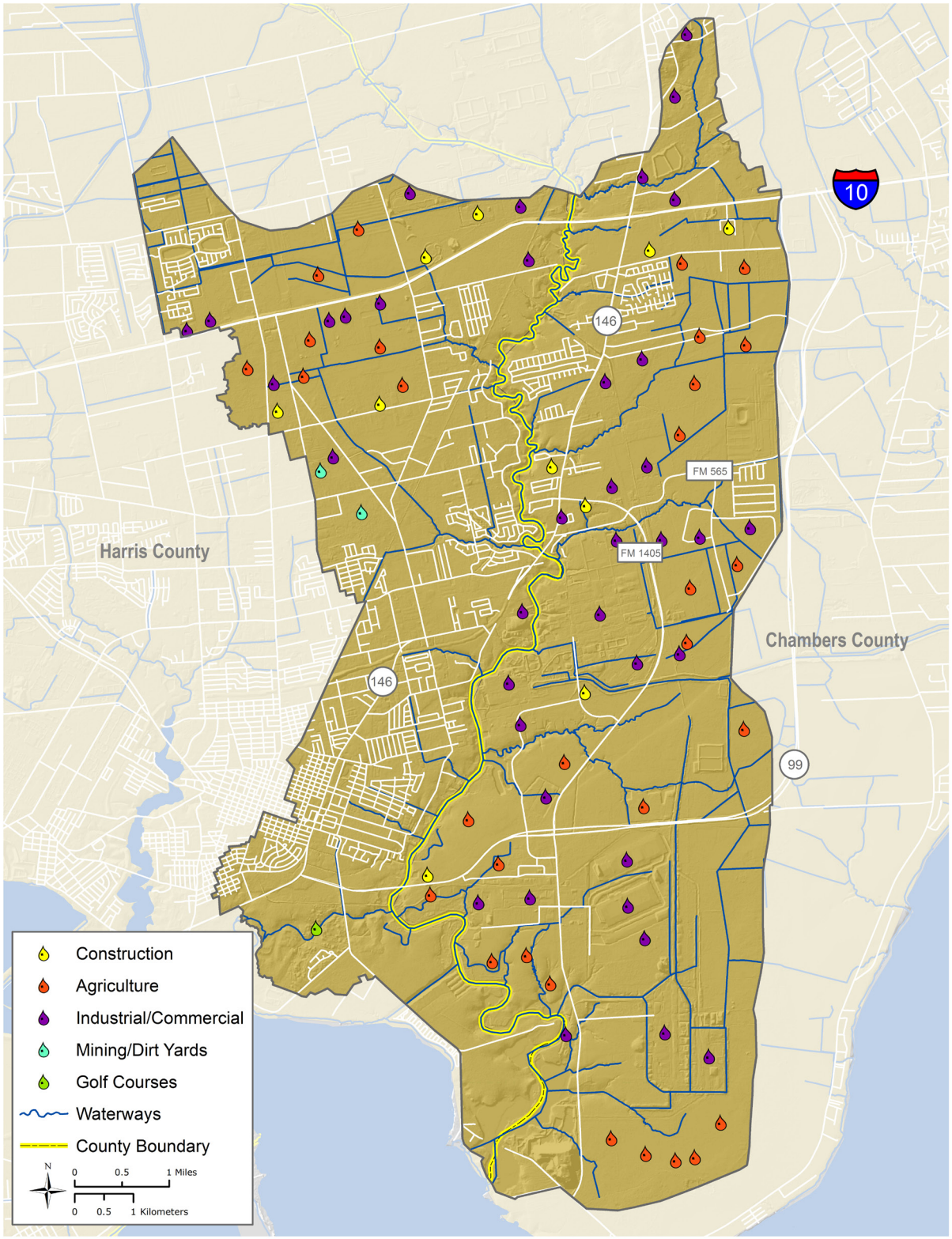
LAND USE


10
146
FM 565
FM 1405
Harris County
Chambers County
146
99
Developed
Agriculture
Grassland
Forest
Wetland
Water
Waterways
County Boundary
N
0
0.5
1 Miles
0
0.45
0.9 Kilometers

POLLUTION SOURCES: WASTEWATER



POLLUTION SOURCES: OTHER SOURCES



POTENTIAL STAKEHOLDERS

- Baytown and Mont Belvieu
- Colleges
- Commercial/industrial facilities
- Community groups
- Drainage districts
- Galveston Bay Estuary Program
- Galveston Bay Foundation
- Harris County Flood Control District
- Harris, Liberty and Chambers counties
- Homeowner's Associations
- Independent School Districts
- Lower Trinity River, Trinity Bay and Harris County Soil and Water Conservation Districts
- Residents and landowners
- Road and bridge departments in Harris, Liberty and Chambers counties
- Texas Commission on Environmental Quality (TCEQ)
- Texas State Soil & Water Conservation Board (TSSWCB)
- Texas Parks & Wildlife Department
- Various utility districts

Representatives from most of these entities currently participate in the Cedar Bayou Watershed Partnership through its development of a Watershed Protection Plan (WPP) for the watershed.

RECOMMENDATIONS

ACTIVITY	ENTITY RESPONSIBLE
Continue facilitating the development and approval of the watershed protection plan	H-GAC, TSSWCB & local stakeholders
Continue collecting water quality data to support actions associated with watershed protection plan implementation	TCEQ & CRP partners
Support, maintain and/or increase programs that conduct septic system inspections and oversee maintenance and repairs	County & local agencies & stakeholders
Continue ongoing public outreach to numerous groups throughout the watershed	H-GAC, CRP partners & other stakeholders
Coordinate with key stakeholders on future projects to maximize dollars and achieve greatest benefits for all projects	H-GAC
Find financial support to implement the watershed protection plan for this watershed	H-GAC & other stakeholders
Pursue new local partners to collect additional data to help better isolate problem areas and expand volunteer monitoring with Texas Stream Team	H-GAC

Ongoing Projects...

H-GAC, in partnership with Texas State Soil and Water Conservation Board (TSSWCB) and the Environmental Protection Agency (EPA), worked with local stakeholders to form the Cedar Bayou Watershed Partnership in 2011.

The Partnership includes representatives from local government, residents, industry, commerce, agricultural producers, community groups and other interested parties, all of whom seek to reduce high levels of bacteria and other sources of contamination through a WPP for Cedar Bayou.

The WPP is currently being developed and is scheduled for completion in early 2015.

Apart from the WPP, agricultural sources and feral hogs are being addressed by a variety of programs under the U.S. Department of Agriculture (USDA) - Natural Resources Conservation Service, TSSWCB, Texas A&M AgriLife and other organizations.

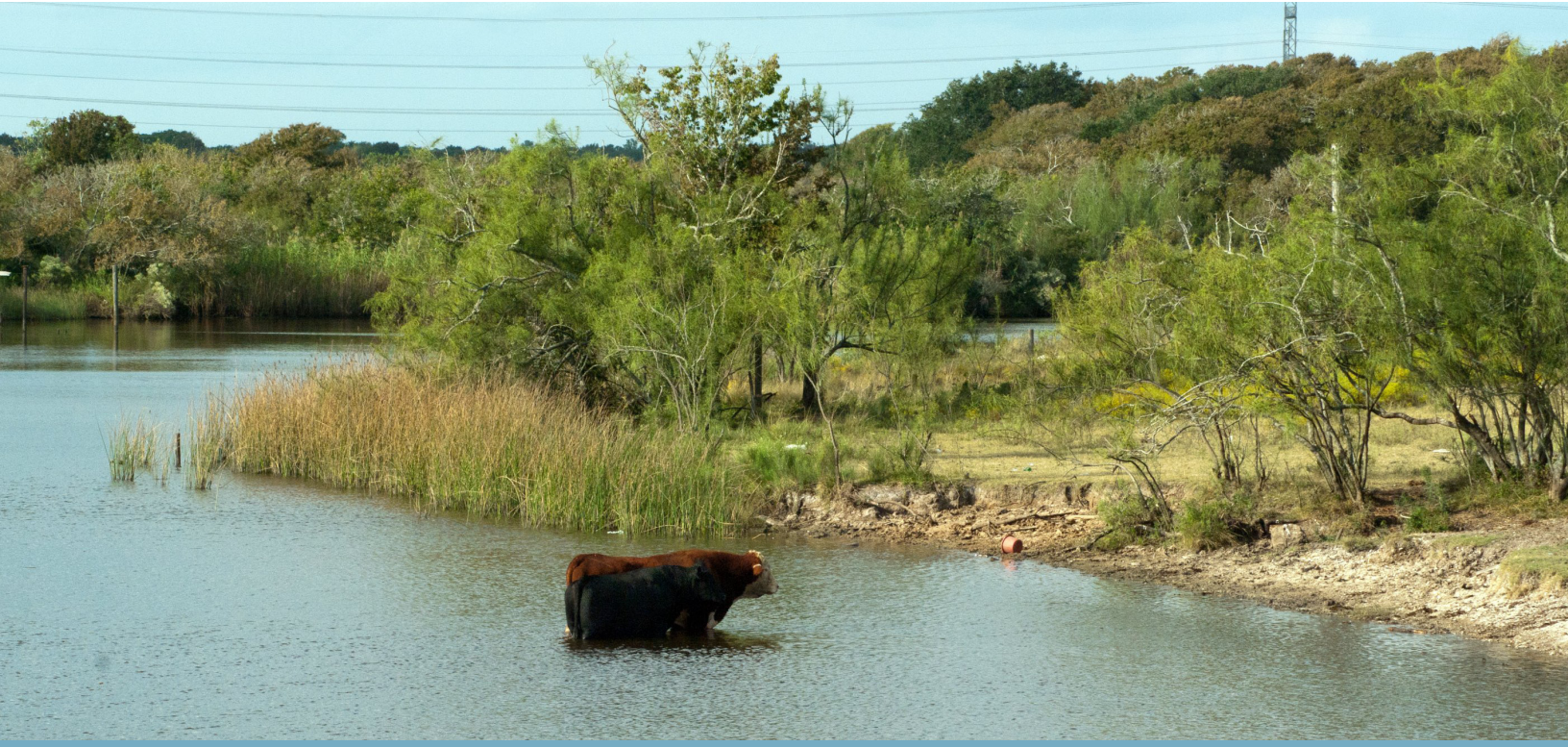
Major Watershed Events

The known or anticipated changes that have the potential to impact this segment include continued population growth, industrial growth, aging wastewater and storm sewer infrastructure, and future drought conditions. Increased development brings greater wastewater treatment facility flows, more land clearing and more impervious cover. Fertilized lawns and other landscapes and additional pet populations produce waste and pollution in stormwater runoff.

The City of Baytown recently joined the TCEQ's Sanitary Sewer Overflow Initiative, with a commitment to rehabilitate aging sewer infrastructure known to be a source of bacteria in the segment. Hydrologic modification above and beyond routine dredging efforts, which may impact flow conditions, has been proposed for parts of the segment downstream of the City of Baytown.

Recent efforts by WPP stakeholders and other local organizations resulted in removal of more than a dozen abandoned vessels from the segment, eliminating them as impediments to safety, sediment transport and as sources of legacy contamination. The photo below is of one vessel.

Patrolling for additional vessels will occur going forward. The largely undeveloped area east of the City of Baytown in Chambers County is designated for industrial growth and is expected to develop rapidly in the coming decade. Lastly, implementation of the new round of Texas Pollutant Discharge Elimination System (TPDES) stormwater permits in the watershed will bring additional action on urban bacteria sources.



BASTROP BAYOU (1105)

DESIGNATED USES

High Aquatic Life, Contact Recreation, General

LENGTH
19 miles

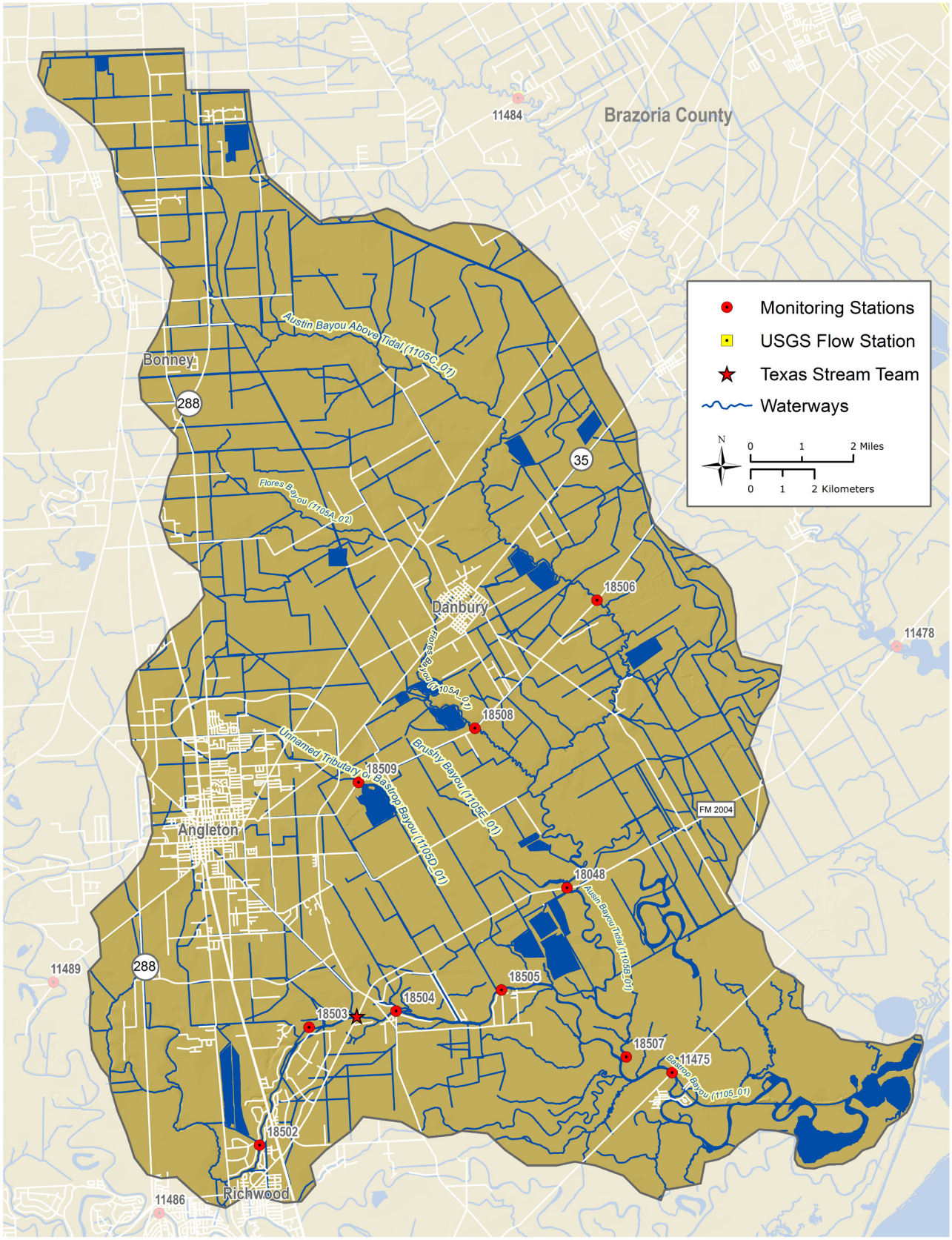
217 sq mi
watershed

1 Texas Stream Team site
(volunteer monitoring)

10 ACTIVE MONITORING STATIONS IN 2015

8 total
permitted outfalls

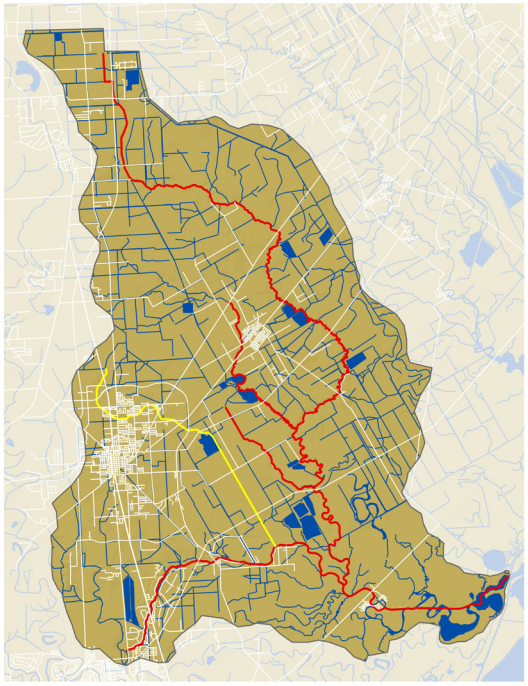
MONITORING STATIONS MAP



POTENTIAL SOURCES OF WATER QUALITY ISSUES?

BASTROP BAYOU IS DOMINATED BY RURAL AND AGRICULTURAL LAND USES AND HAS A HIGH CONCENTRATION OF ON-SITE SEWAGE FACILITIES.

BACTERIA



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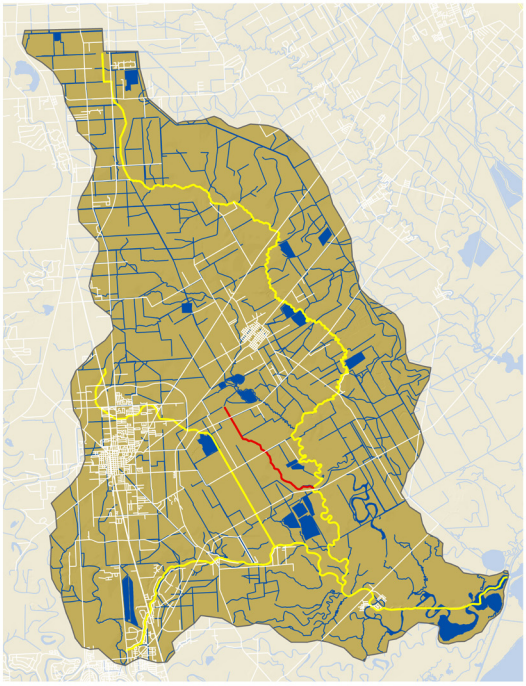
DISSOLVED OXYGEN



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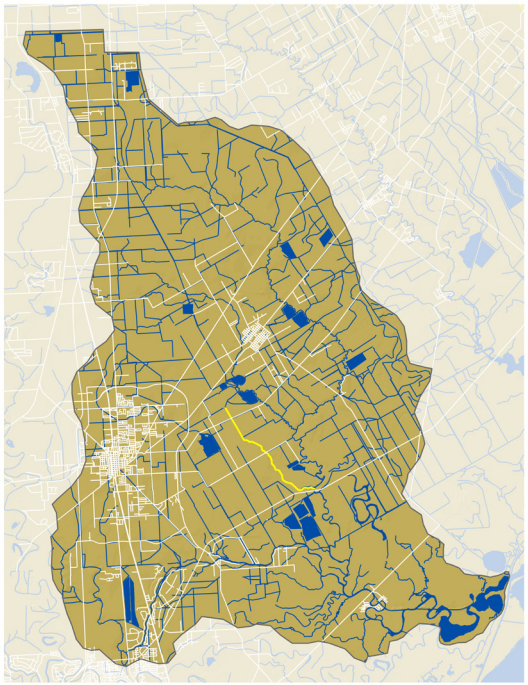
NUTRIENTS



Deteriorating.

Impairment Concern Unimpacted

LAND USE & NATURAL CHARACTERISTICS

The Bastrop Bayou watershed contains four primary land use/land cover types – hay/pasture lands (29%), emergent herbaceous wetlands (22%), cultivated crop lands (19%) and woody wetlands (11%). Bastrop Bayou plays an integral role in Brazoria County's commerce through agricultural and seafood production. The upper watershed, which includes Austin Bayou and Flores Bayou, provides an extensive freshwater wetland habitat which is home to endangered or threatened shorebirds as well as waterfowl, grassland species and birds of prey.

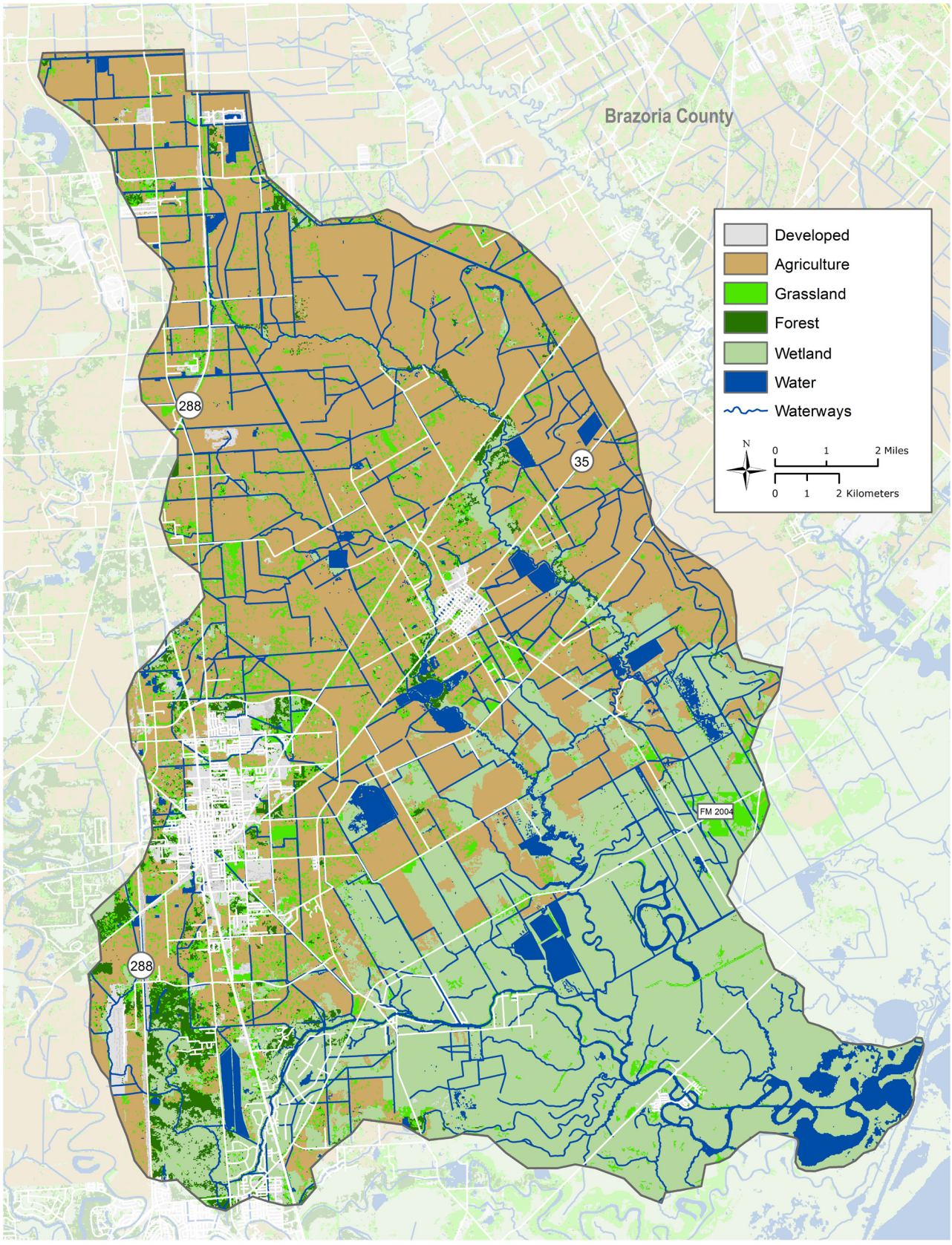
Brazoria National Wildlife Refuge is located in the tidal portion of the watershed adjacent to Bastrop and Christmas bays along the southern shoreline. Bastrop Bayou eventually flows into Christmas Bay Coastal Preserve which hosts sea grass beds important to Texas' coastal ecology.

Although the watershed is dominated by rural and agricultural land uses, projected growth will likely accelerate urban and residential development in coming years. The City of Angleton is located along the northwestern portion of the Unnamed Tributary of Bastrop Bayou at the intersection of SH 288 and SH 35 and is the most developed residential area in the watershed. Additionally, the City of Danbury, portions of northeastern Richwood and northeastern Lake Jackson, and a number of other small communities fall within the Bastrop Bayou watershed.

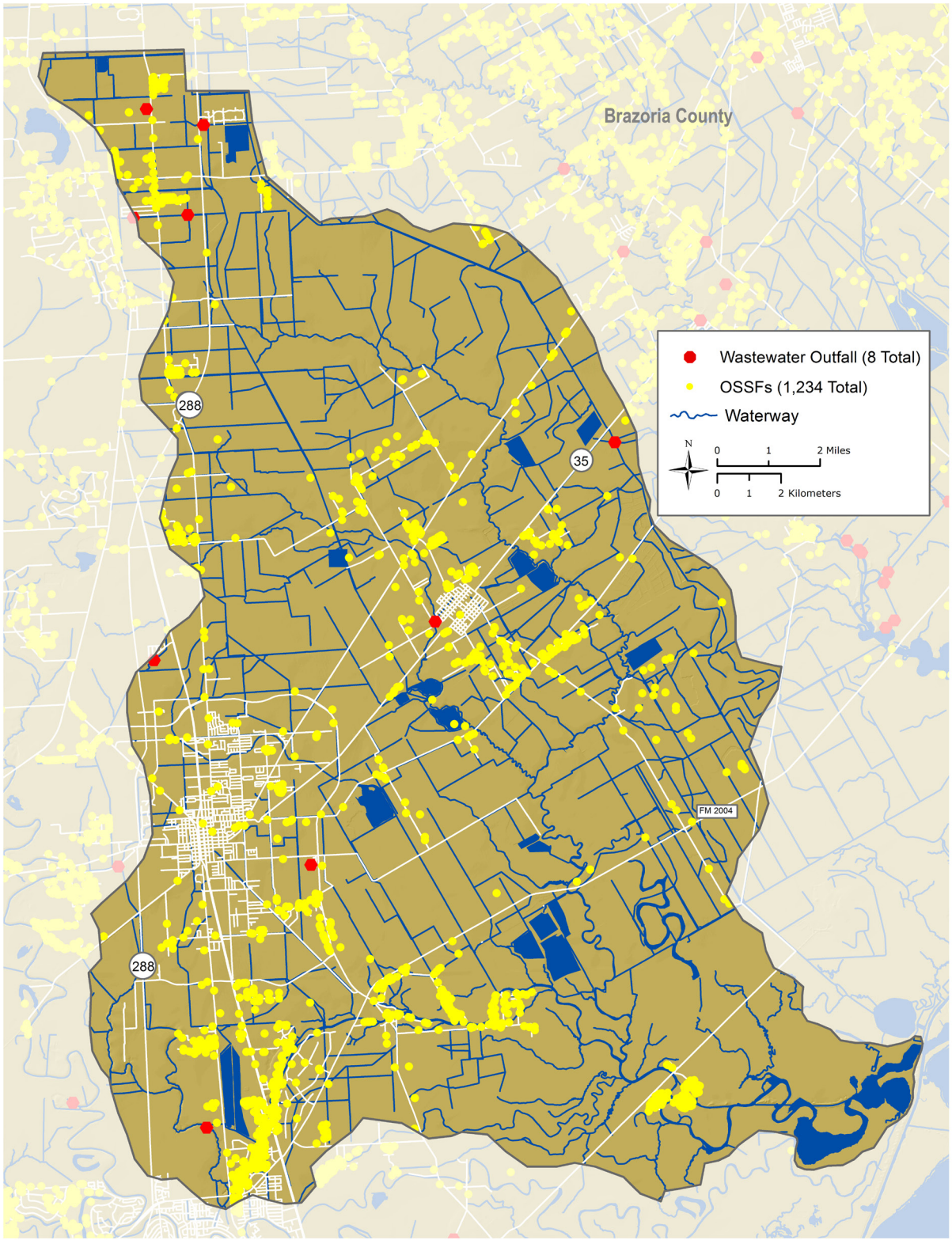
FOR MORE DETAILED LAND USE INFORMATION

VISIT WWW.H-GAC.COM/GO/WRIM.

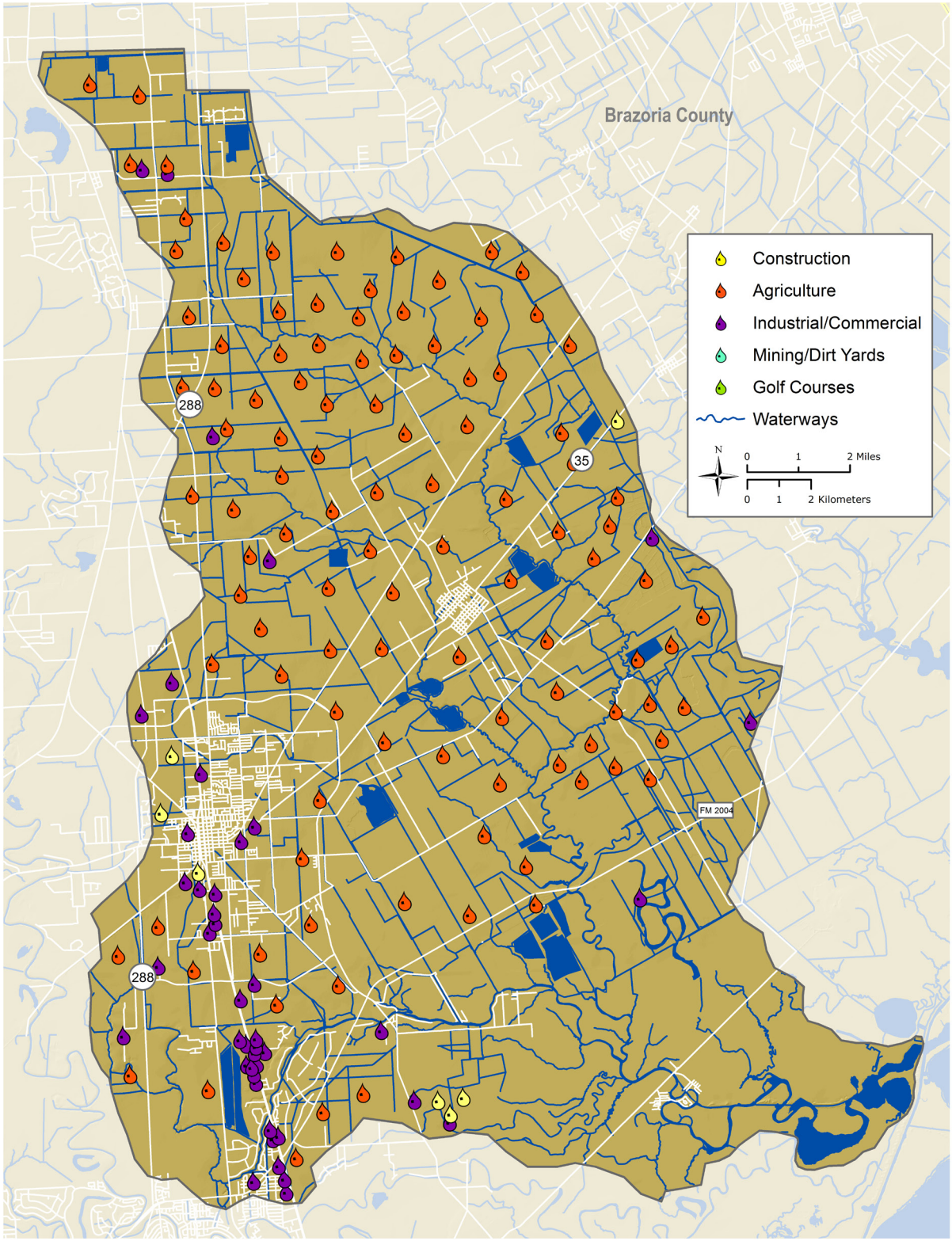
LAND USE


Brazoria County
Developed
Agriculture
Grassland
Forest
Wetland
Water
Waterways
N
0 1 2 Miles
0 1 2 Kilometers
288
35
FM 2004
288

POLLUTION SOURCES: WASTEWATER



POLLUTION SOURCES: OTHER SOURCES



POTENTIAL STAKEHOLDERS

- Agricultural producers
- Angleton, Lake Jackson, Danbury, Richwood and Demi John
- Brazoria County Health Department
- Brazoria County
- Brazoria National Wildlife Refuge
- Commercial/industrial facilities
- Community groups
- Drainage districts
- Galveston Bay Estuary Program
- Galveston Bay Foundation
- Homeowner's Associations
- Independent School Districts
- Residents & land owners
- Special districts (municipal utility districts, freshwater supply districts, etc.)
- TCEQ
- Texas Parks & Wildlife Department
- TSSWCB
- USDA – Natural Resources Conservation Service

Representatives from most of these entities have participated or currently do participate on the WPP committee for the bayou.

RECOMMENDATIONS

ACTIVITY	ENTITY RESPONSIBLE
Address bacteria and various other concerns through stakeholder involvement and best management practices	H-GAC, Stakeholders and concerned citizens
Support, maintain and/or increase programs that replace failing OSSFs and oversee maintenance and repairs	County/local agencies & stakeholders, discharge permitees
Continue collecting water quality data and expand monitoring efforts to support actions associated with watershed protection plan implementation and future modeling	TCEQ, H-GAC & CRP partners
Coordinate with key stakeholders on future projects to maximize dollars and achieve greatest benefits for all projects	H-GAC
Pursue new local partners to collect additional data to help better isolate problem areas and expand volunteer monitoring with Texas Stream Team	H-GAC

Ongoing Projects...

Development of the Bastrop Bayou WPP was facilitated by H-GAC prior to 2014, in partnership with TCEQ, Galveston Bay Estuary Program (GBEP), TSSWCB, Brazoria County and other concerned stakeholders. Key implementation efforts identified in the WPP include remediation of failing OSSFs, installation of pet waste stations, facilitation of partner efforts and education and outreach activities. The WPP is currently under review by the TCEQ and EPA.

In keeping with the goals of the WPP, H-GAC developed an approved third-party Supplemental Environmental Project (SEP) to provide assistance to low-income homeowners to repair or replace failing OSSFs, with a specific focus in and around the Bastrop Bayou project area. Brazoria County is also addressing OSSF issues through an SEP. The community of Demi John is addressing failing OSSFs through planned installation of sanitary sewer.

Contamination from urban areas in the watershed, including the City of Angleton, is being partially addressed through the implementation of TPDES stormwater permits. Agricultural sources and feral hogs are being addressed by a variety of programs under the USDA, TSSWCB, Texas A&M AgriLife and other organizations. An annual River, Lakes, Bays `N Bayous Trash Bash event is held in the watershed to reduce trash along lower Bastrop Bayou and to educate residents.

Major Watershed Events

The known or anticipated changes that have the potential to impact this segment include continued population growth, industrial growth, aging wastewater infrastructure and future drought conditions. Development brings more impervious cover, OSSFs, increased flows from WWTFs, more land clearing, fertilized lawns and other landscapes, and pets producing waste.

As a coastal watershed, Bastrop Bayou will be impacted from time to time by major weather events, including hurricanes, and experiences periodic drought conditions. Drought may change salinity levels and impact stream ecology.

WEST FORK SAN JACINTO RIVER (1004)

DESIGNATED USES

Contact Recreation, High Aquatic Life Use, Public Water Supply

LENGTH
40 miles

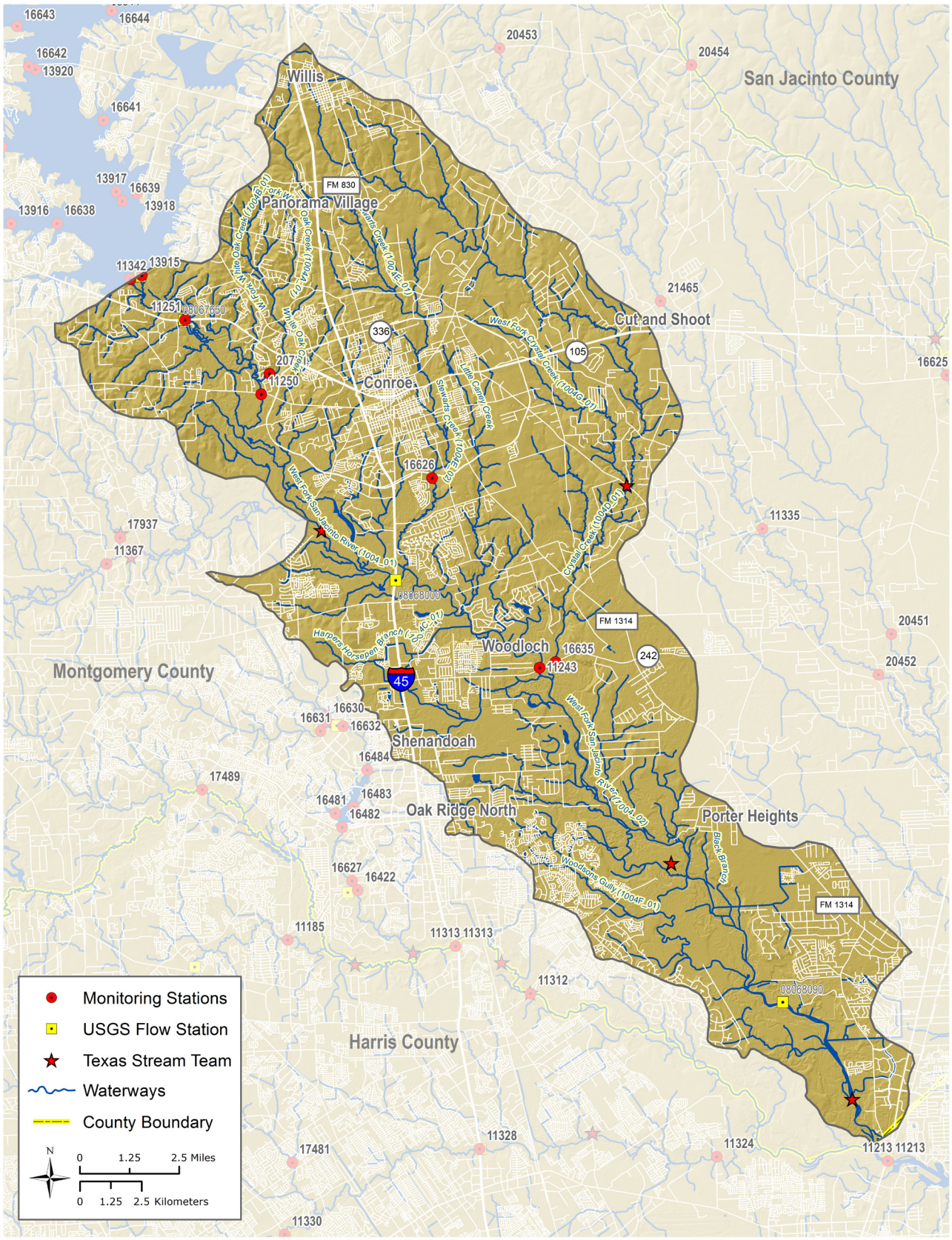
216 sq mi
watershed

3 Texas Stream Team sites
(volunteer monitoring)

6 ACTIVE MONITORING STATIONS IN 2015

30 total
permitted outfalls

MONITORING STATIONS MAP



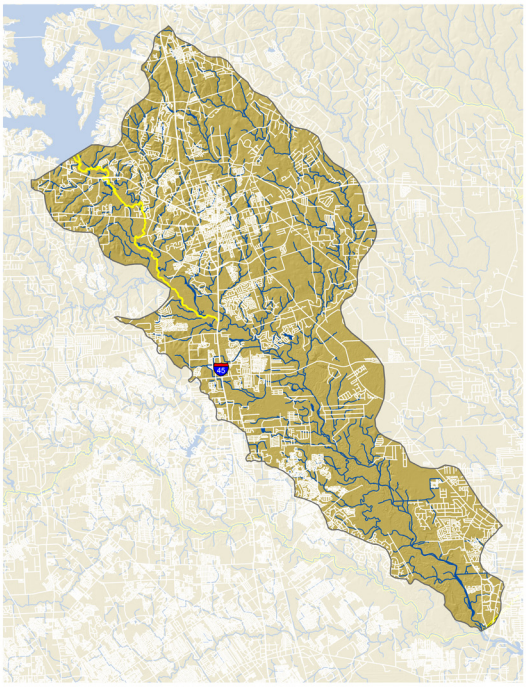
POTENTIAL SOURCES OF WATER QUALITY ISSUES?

WATER QUALITY ISSUES STEM FROM A VARIETY OF SOURCES SINCE WEST FORK IS A MIX OF RURAL, AGRICULTURAL AND URBAN LAND USES.

BACTERIA

No Change

NUTRIENTS



Deteriorating.

Impairment Concern Unimpacted

Additionally...

There are 24 domestic and six industrial wastewater outfalls in the watershed. Numerous sanitary sewer overflows have been reported in the watershed. Causes include inflow and infiltration problems and blockages from debris, grease and/or tree roots.

Due to rapid growth in the watershed outside of areas serviced by sanitary sewers, OSSFs are common. The failure rate for OSSFs in the region is approximately 12%.

LAND USE & NATURAL CHARACTERISTICS

Forests are the dominant land use/land cover at 30%, with developed open space (14%), woody wetlands (14%) and developed low intensity areas (13%) equally represented in the segment. The City of Conroe sits in the northern portion of this segment where development is concentrated along the I-45 corridor and SH 105.

The cities of Shenandoah, Woodloch and Oak Ridge North, along with The Woodlands Township, lie in the central and western portions of the segment. The unincorporated communities of Porter and Kingwood populate the southern end of the segment. Commercial development is clustered along the main highways, crisscrossing the segment with many low-density single-family homes and neighborhoods scattered throughout.

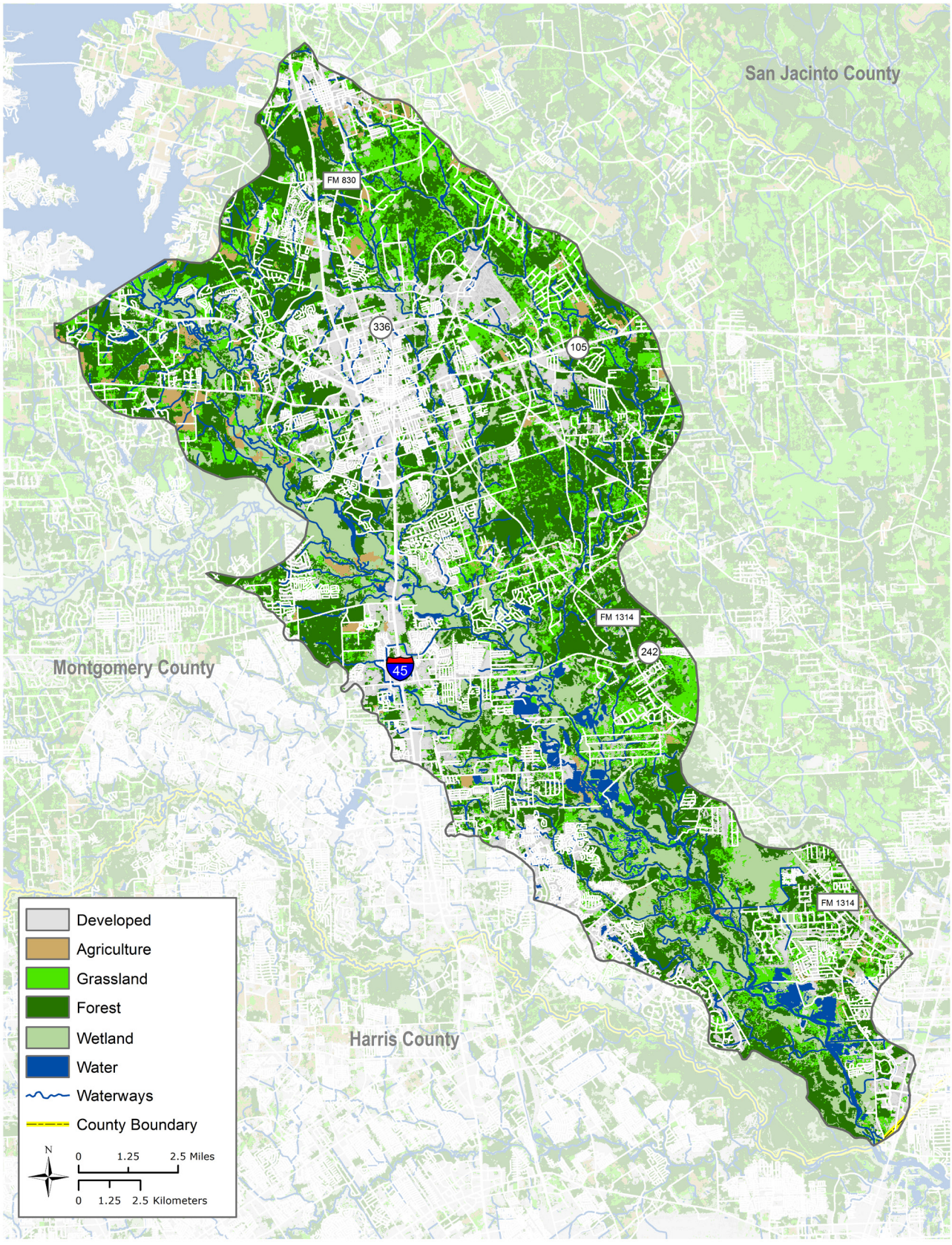
The Crystal Creek watershed, located southeast of Conroe, is dominated by forests and open space in the lower reach and by low-density development in the northern reach.

The population in the West Fork is significantly higher than surrounding watersheds, resulting in more OSSFs. Numerous natural areas, parks and golf courses are located within the watershed. Finally, the West Fork San Jacinto River flood plain supports a wide riparian corridor comprised of forests, woody wetlands, herbaceous wetlands and shrub/scrub lands.

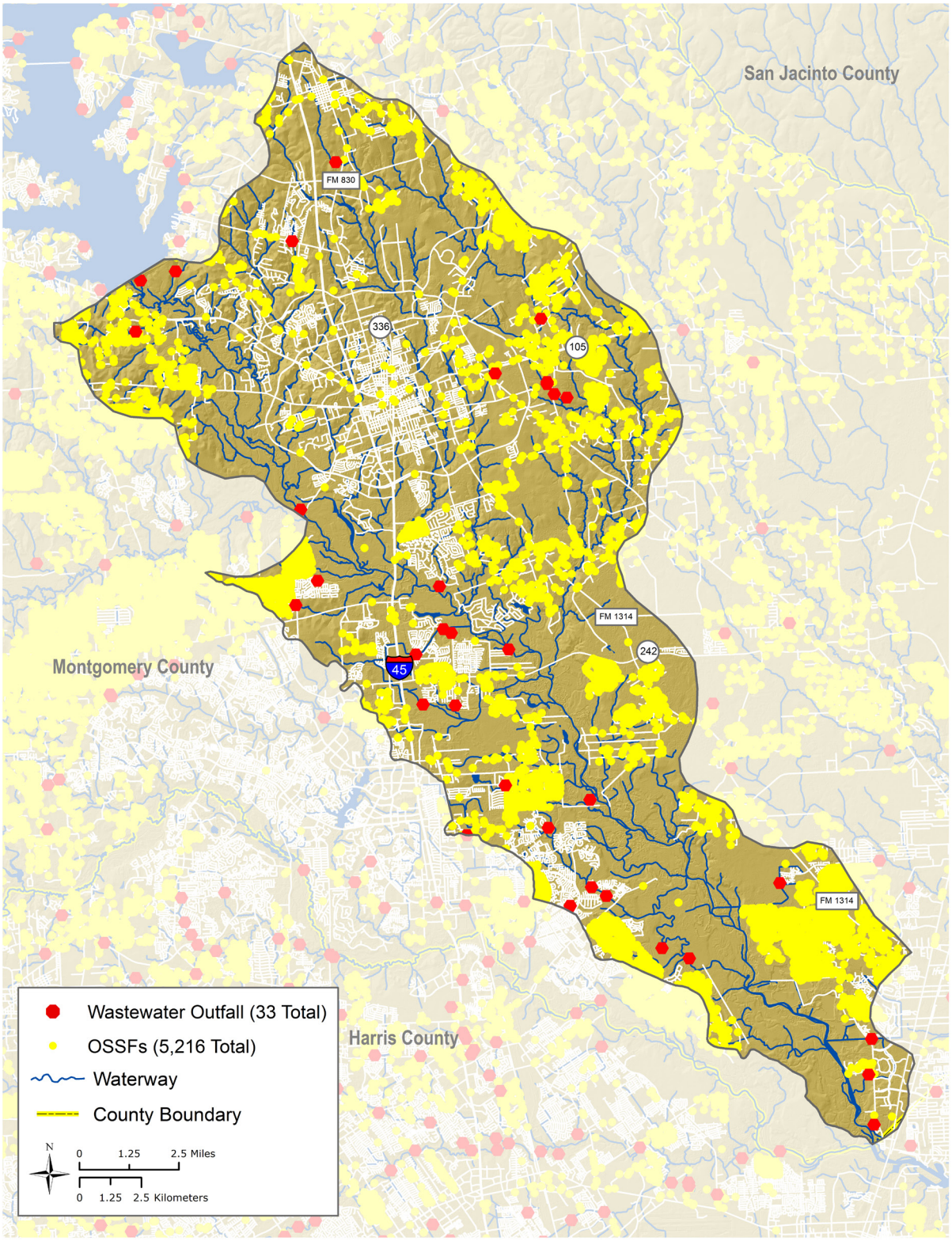
FOR MORE DETAILED LAND USE INFORMATION

VISIT WWW.H-GAC.COM/GO/WRIM.

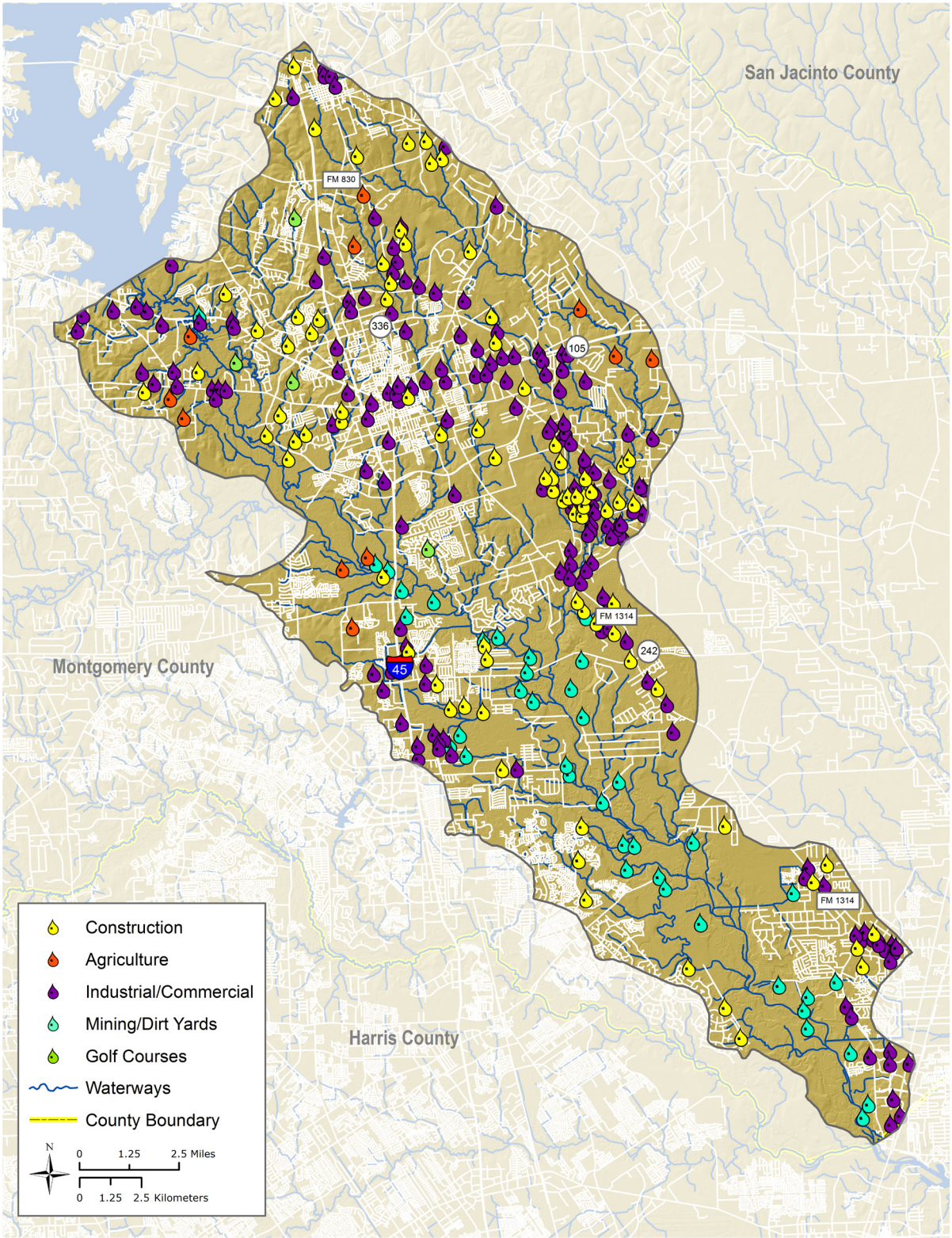
LAND USE


San Jacinto County
FM 830
336
105
FM 1314
242
45
Montgomery County
FM 1314
Harris County
Developed
Agriculture
Grassland
Forest
Wetland
Water
Waterways
County Boundary
N
0 1.25 2.5 Miles
0 1.25 2.5 Kilometers

POLLUTION SOURCES: WASTEWATER



POLLUTION SOURCES: OTHER SOURCES



POTENTIAL STAKEHOLDERS

- Colleges
- Commercial/industrial facilities
- Conservancies/environmental groups
- Drainage districts and flood control districts
- Galveston Bay Foundation
- Homeowner's Associations
- Houston, Conroe, Cut and Shoot, Pinehurst, Shenandoah and The Woodlands
- Independent School Districts
- Law enforcement/environmental enforcement agencies
- Lone Star Groundwater Conservation District
- Montgomery and Harris counties
- San Jacinto River Authority
- Texas A&M Forest Service
- TCEQ
- Texas State Soil and Water Conservation Districts and Board
- Utility districts

There are representatives from most of these entities currently serving on the Watersheds of the East and West Forks of the San Jacinto River Total Maximum Daily Load (TMDL) Steering Committee.

RECOMMENDATIONS

ACTIVITY	ENTITY RESPONSIBLE
Begin implementing the I-Plan for bacteria reduction	Stakeholders
Continue collecting water quality data and expand monitoring efforts to support actions associated with TMDL and I-Plan implementation	TCEQ, H-GAC & CRP partners
Support, maintain, and/or increase programs that conduct septic system inspections and oversee maintenance and repairs	County/local agencies & stakeholders
Continue ongoing public outreach to numerous groups throughout the watershed	H-GAC, CRP partners & other stakeholders
Address the various concerns found in this segment summary through stakeholder participation in the BIG	H-GAC, local agencies & other stakeholders
Coordinate with key stakeholders on future projects to maximize dollars and achieve greatest benefits for all projects	H-GAC
Pursue new local partners to collect additional data to help better isolate problem areas and expand volunteer monitoring with Texas Stream Team	H-GAC

Ongoing Projects...

In 2013, H-GAC began stakeholder outreach for a TMDL project to address bacteria impairments in the East/West Forks of the San Jacinto River. Following submission of a Technical Support Document created by the Texas Institute for Applied Environmental Research at Tarleton State University to TCEQ in July 2013, H-GAC began coordinating public meetings for this project. Stakeholders unanimously voted to join the BIG and agreed to implement the TCEQ-approved BIG I-Plan in October 2014.

Moving forward, the TMDL stakeholders will work with the BIG to discuss bringing the two groups together. BIG members will vote to either approve including the East/West Forks of the San Jacinto River watersheds (including Crystal Creek and the western arm of Lake Houston) in the BIG project area or provide comments and feedback to the TMDL stakeholder work group. TCEQ's Commissioners must also approve the merger through adoption of a TMDL in lieu of a separate I-Plan.

Major Watershed Events

The known or anticipated changes that have the potential to impact this segment include Montgomery County's partial conversion to surface water due to groundwater conservation district requirements. As a result, a large surface water treatment facility is being constructed at the dam on the southeast corner of Lake Conroe to provide drinking water to area residents.

Continued development is expected in the West Fork, with new areas of impervious surface, more industry and residential development. Development brings more OSSFs or WWTF flows, more land clearing, fertilized lawns and other landscapes, and pets producing waste.

West Fork stakeholders have expressed interest in preparing for future development and growth through the use of several mechanisms, including conservation, infrastructure improvements and water reuse. These options will be explored further in conjunction with the BIG.

EAST FORK SAN JACINTO RIVER (1003)

DESIGNATED USES

Contact Recreation, High Aquatic Life Use, Public Water Supply

LENGTH
81 miles

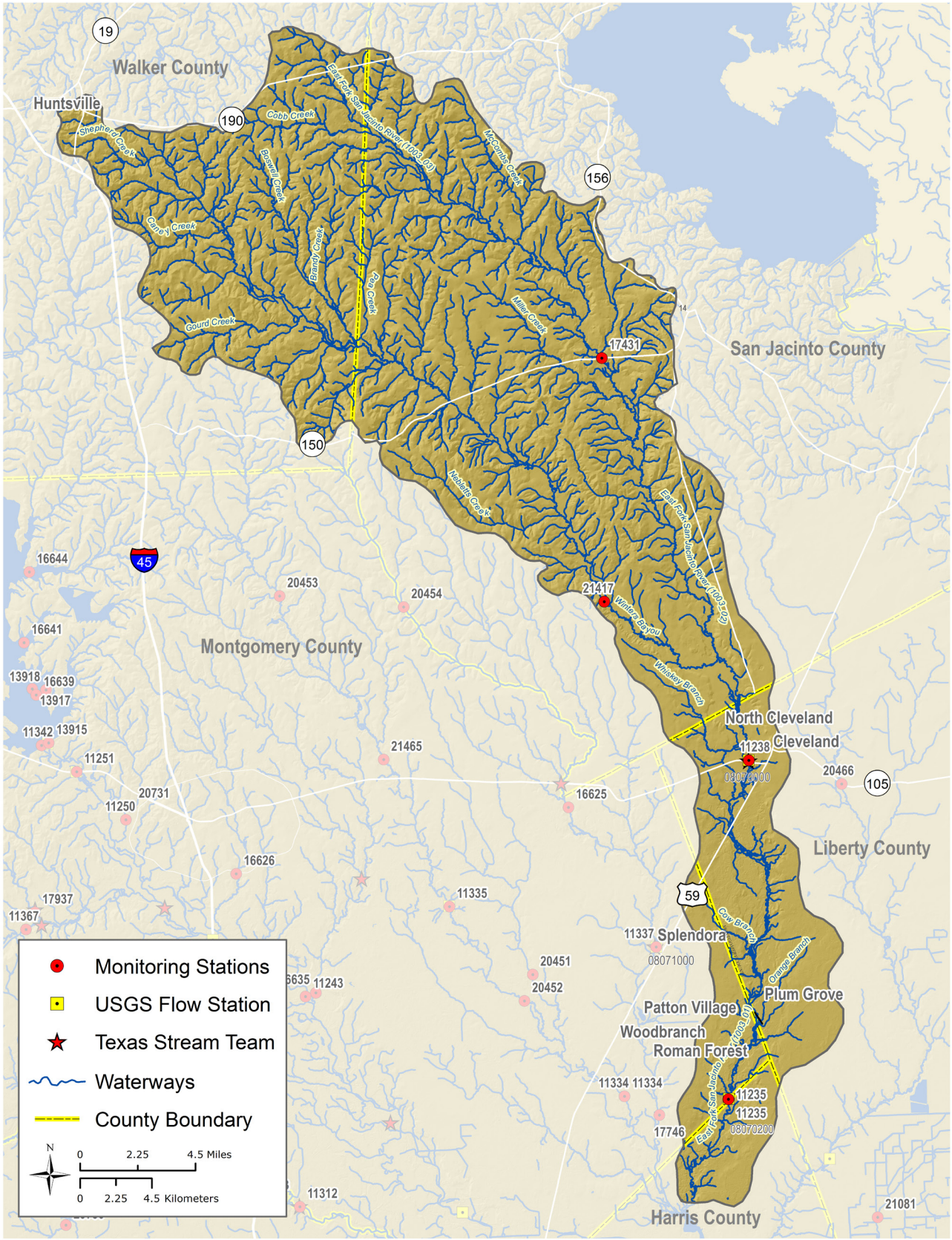
404 sq mi
watershed

0 Texas Stream Team sites
(volunteer monitoring)

4 ACTIVE MONITORING STATIONS IN 2015

5 total
permitted outfalls

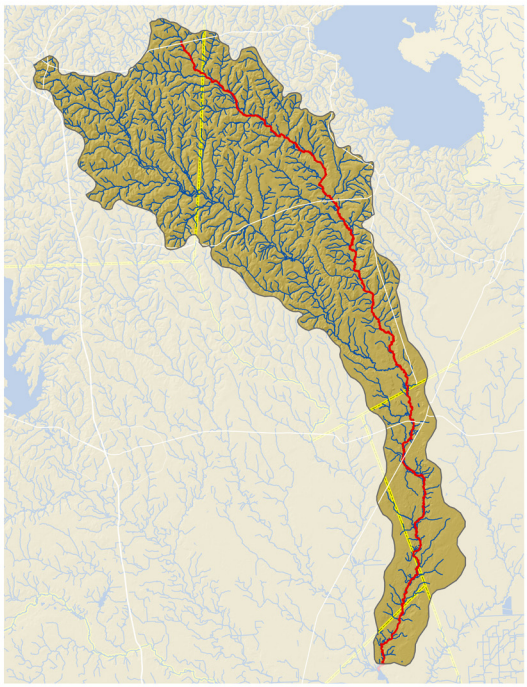
MONITORING STATIONS MAP



POTENTIAL SOURCES OF WATER QUALITY ISSUES?

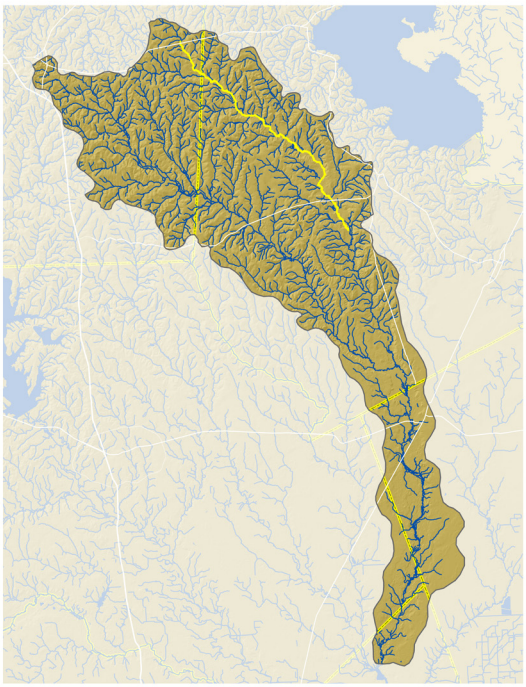
EAST FORK IS PRIMARILY RURAL, WITH A SIZABLE PORTION OF THE POPULATION USING ON-SITE SEWAGE FACILITIES INSTEAD OF SANITARY SEWER.

BACTERIA



No Change

NUTRIENTS



Improving.

Impairment Concern Unimpacted

Additionally...

The East Fork San Jacinto River is home to large populations of cattle, poultry, horses, sheep and goats. Many have direct access to smaller streams and tributaries, or their fields and pastures border the waterways.

Illegal dumping has also been an issue in this watershed, including improper disposal of solid and liquid waste in or around the waterways.

LAND USE & NATURAL CHARACTERISTICS

The East Fork San Jacinto River segment is primarily gently rolling, undeveloped rural hills. More than 50% of the land cover is forest. The Sam Houston National Forest covers most of the northern portion of the watershed.

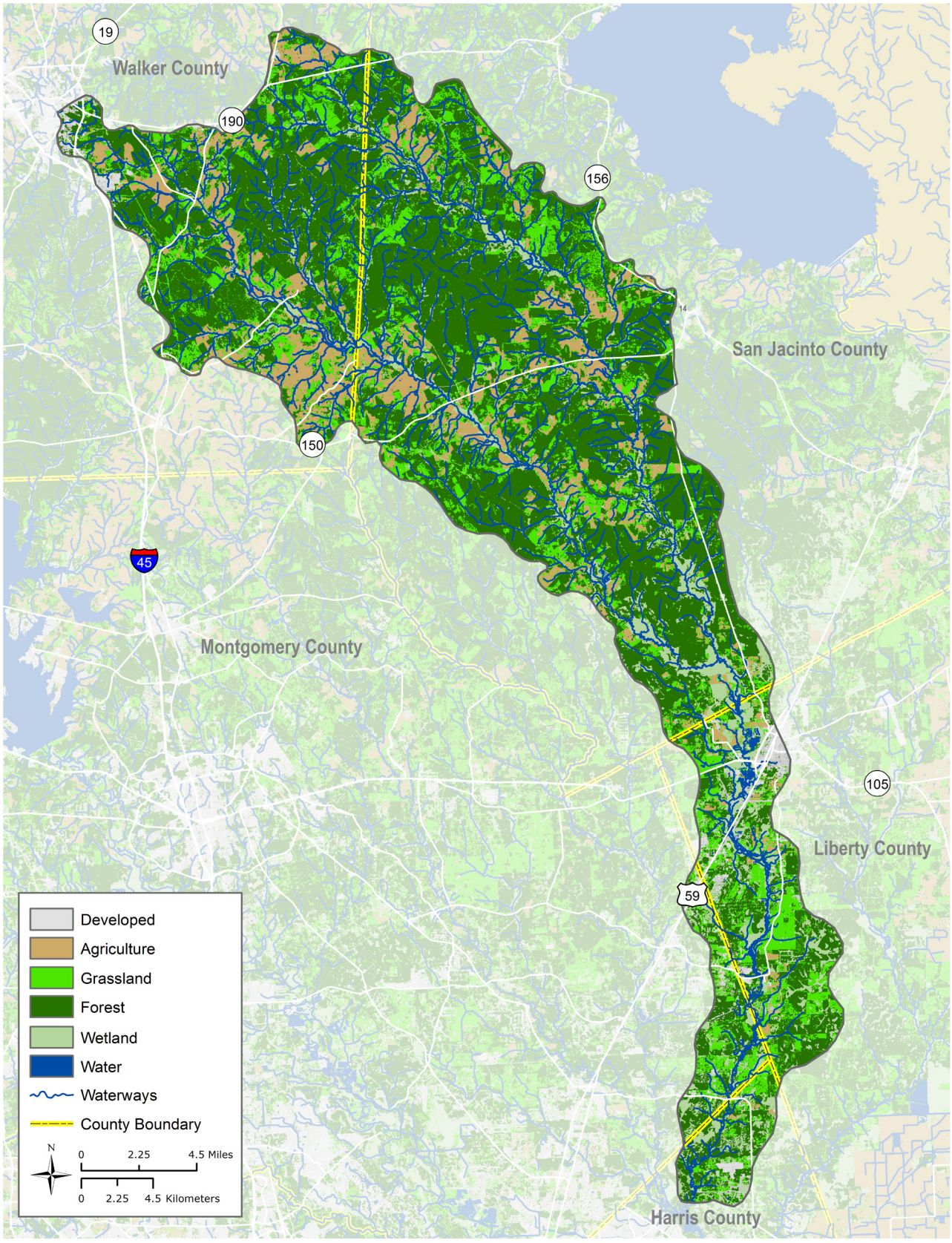
Other notable land use/land covers are woody wetlands (13%), hay/pasture (10%), grasslands (8%) and shrubs/scrub (7.5%).

Commercial and residential developments are scattered throughout the segment and depend primarily on OSSFs to manage wastewater disposal. The City of Cleveland is located in the middle of the watershed along the US 59 corridor. There are four active WWTFs that discharge to the East Fork.

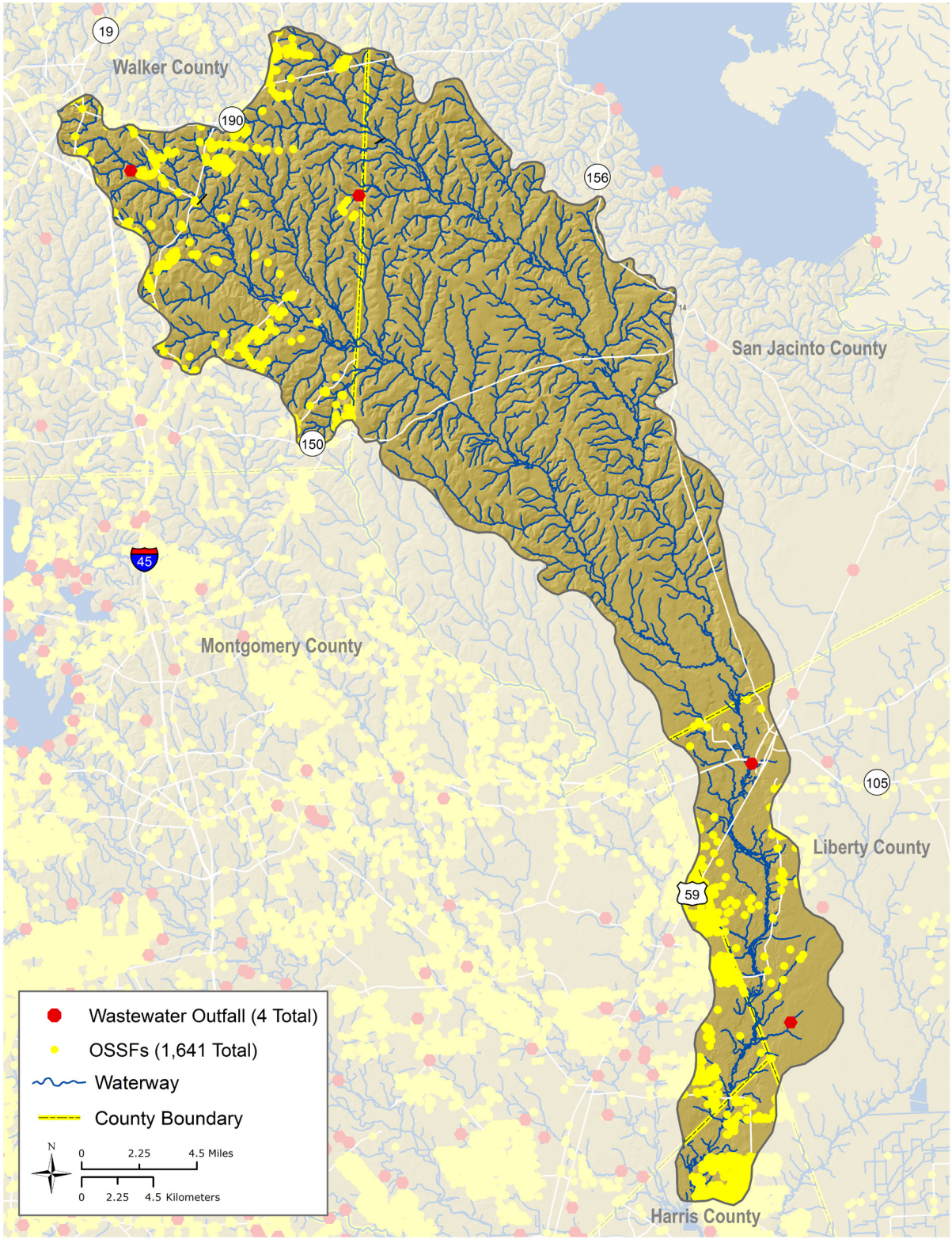
FOR MORE DETAILED LAND USE INFORMATION

VISIT WWW.H-GAC.COM/GO/WRIM.

LAND USE

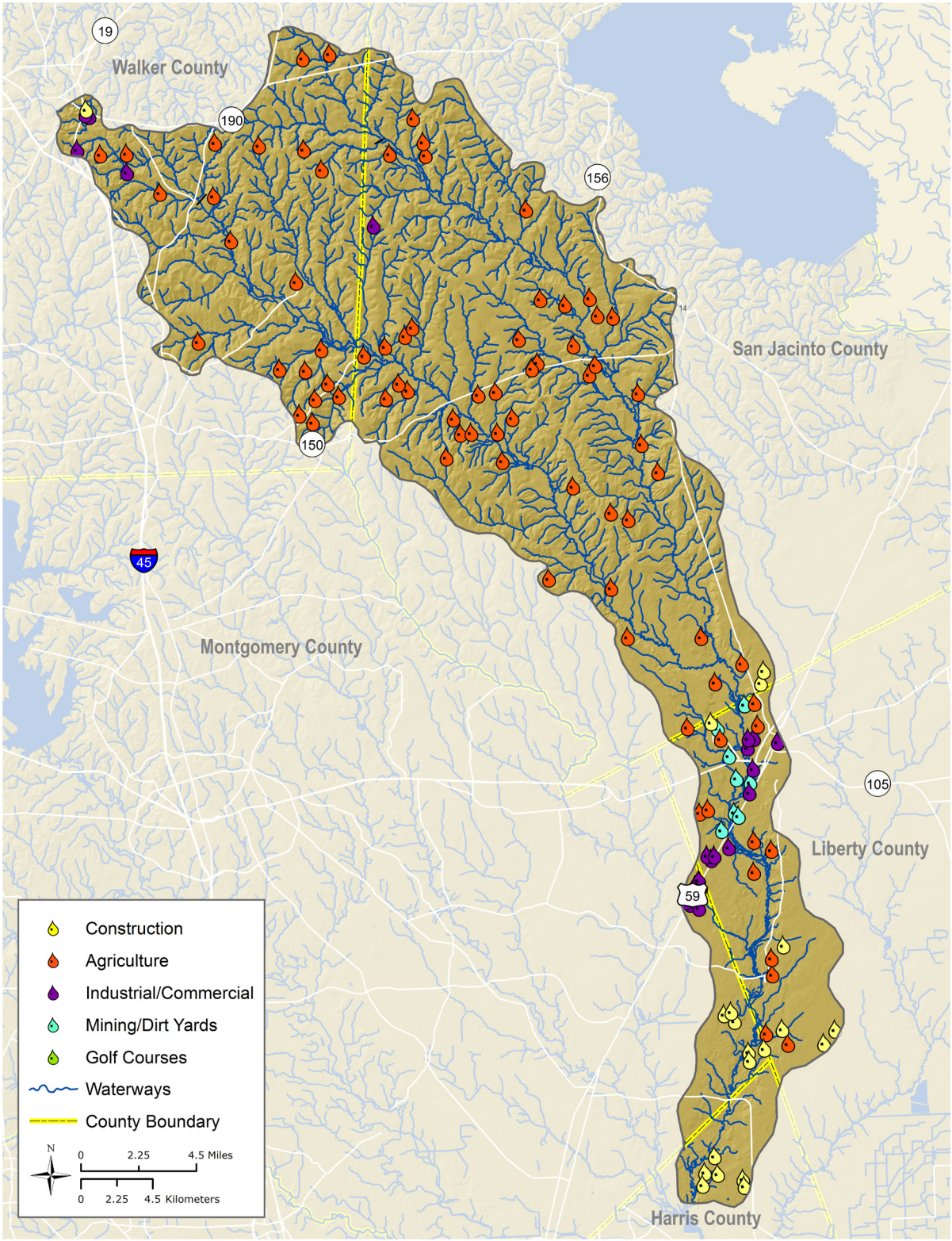

19
Walker County
190
156
San Jacinto County
150
45
Montgomery County
105
Liberty County
59
Harris County
Developed
Agriculture
Grassland
Forest
Wetland
Water
Waterways
County Boundary
N
0 2.25 4.5 Miles
0 2.25 4.5 Kilometers

POLLUTION SOURCES: WASTEWATER



Because it is outside of H-GAC's service area, WWTF and OSSF data for San Jacinto County is unavailable for this map.

POLLUTION SOURCES: OTHER SOURCES



POTENTIAL STAKEHOLDERS

- Colleges
- Commercial/industrial facilities
- Conservancies/environmental groups
- Drainage districts
- Galveston Bay Foundation
- Homeowner's Associations
- Houston (Kingwood), Plum Grove, Roman Forest, Huntsville, Cold Spring, and Cleveland
- Independent School Districts
- Law enforcement/environmental enforcement agencies
- Lone Star Groundwater Conservation District
- Montgomery, San Jacinto, Liberty and Walker counties
- Sam Houston National Forest
- San Jacinto River Authority
- Texas A&M Forest Service
- TCEQ
- Texas State Soil and Water Conservation Districts and Board
- Utility districts

There are representatives from most of these entities currently serving on the Watersheds of the East and West Forks of the San Jacinto River TMDL Coordination Committee.

RECOMMENDATIONS

ACTIVITY	ENTITY RESPONSIBLE
Begin implementing the I-Plan for bacteria reduction	Stakeholders
Continue collecting water quality data to support actions associated with TMDL/I-Plan implementation	TCEQ, H-GAC & CRP partners
Support, maintain, and/or increase programs that conduct septic system inspections and oversee maintenance and repairs	County/local agencies & stakeholders
Continue ongoing public outreach to numerous groups throughout the watershed	H-GAC, CRP partners & other stakeholders
Address the various concerns found in this segment summary through stakeholder participation in the BIG	H-GAC, local agencies & other stakeholders
Coordinate with key stakeholders on future projects to maximize dollars and achieve greatest benefits for all projects	H-GAC
Pursue new local partners to collect additional data to help better isolate problem areas and expand volunteer monitoring with Texas Stream Team	H-GAC

Ongoing Projects...

In 2013, H-GAC began stakeholder outreach for a TMDL project to address bacteria impairments in the East/West Forks of the San Jacinto River. Following submission of a Technical Support Document created by the Texas Institute for Applied Environmental Research at Tarleton State University to TCEQ in July 2013, H-GAC began coordinating public meetings for this project. Stakeholders unanimously voted to join the BIG and agreed to implement the TCEQ-approved BIG Implementation Plan (I-Plan) in October 2014.

Moving forward, the TMDL stakeholders will work with the BIG to discuss bringing the two groups together. BIG members will vote to either approve including the East/West Forks of the San Jacinto River watersheds (including Crystal Creek and the western arm of Lake Houston) in the BIG project area or provide comments and feedback to the TMDL stakeholder work group. TCEQ's Commissioners must also approve the merger through adoption of a TMDL in lieu of a separate I-Plan.

Major Watershed Events

The known or anticipated changes that have the potential to impact this segment include Montgomery County's partial conversion to surface water due to groundwater conservation district requirements and population growth.

Additionally, land use in the East Fork is expected to shift from rural to developed, with new areas of impervious surface, more industry and residential development. Development brings more OSSFs or WWTF flows, more land clearing, fertilized lawns and other landscapes, and pets producing waste.

East Fork stakeholders have expressed interest in preparing for future development and growth through the use of several mechanisms, including conservation, infrastructure improvements and water reuse. These options will be explored further in conjunction with the BIG.

WHITE OAK BAYOU (1017)

DESIGNATED USES

Limited Aquatic Life, Contact Recreation

LENGTH
26 miles

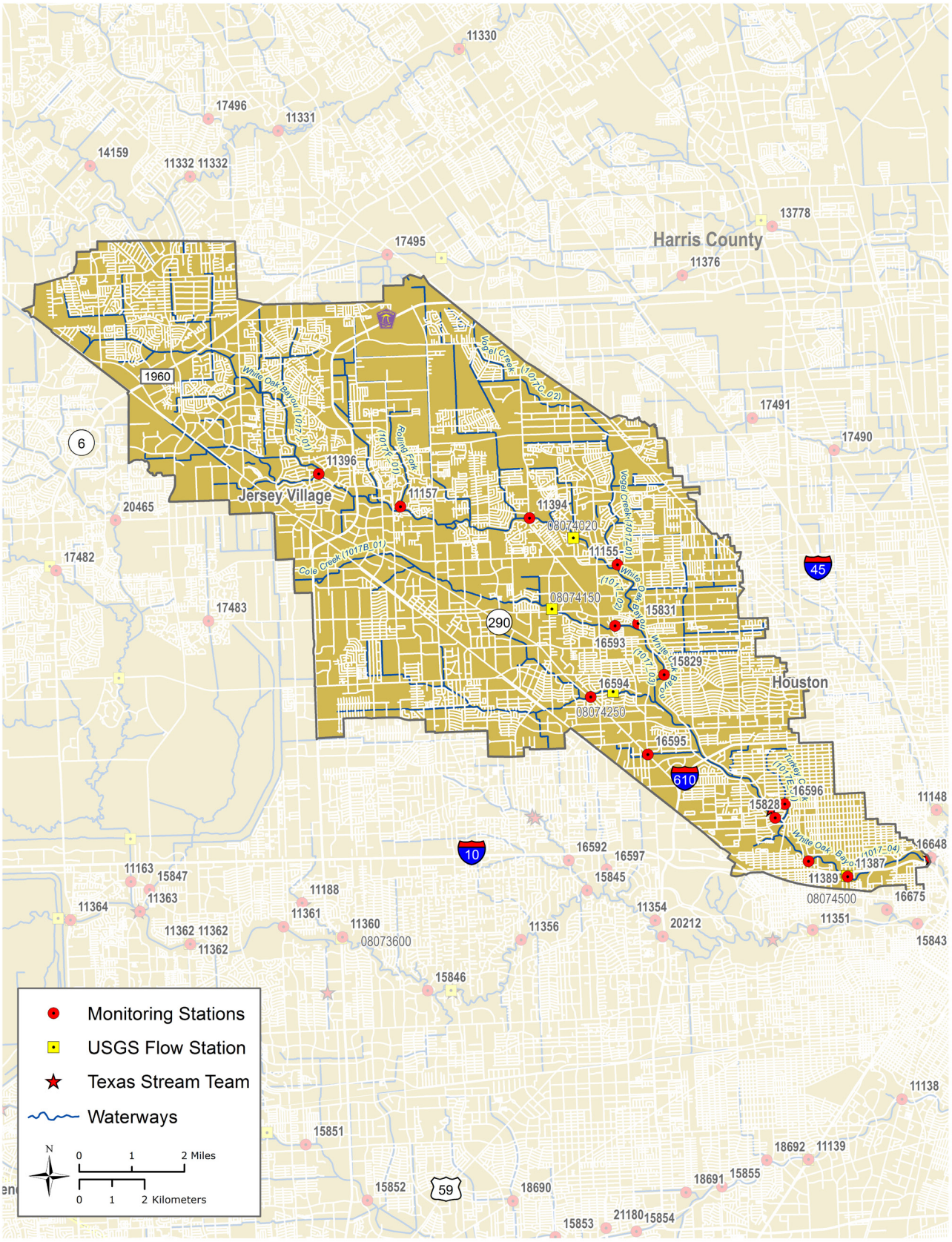
88 sq mi
watershed

1 Texas Stream Team site
(volunteer monitoring)

13 ACTIVE MONITORING STATIONS IN 2015

48 total
permitted outfalls

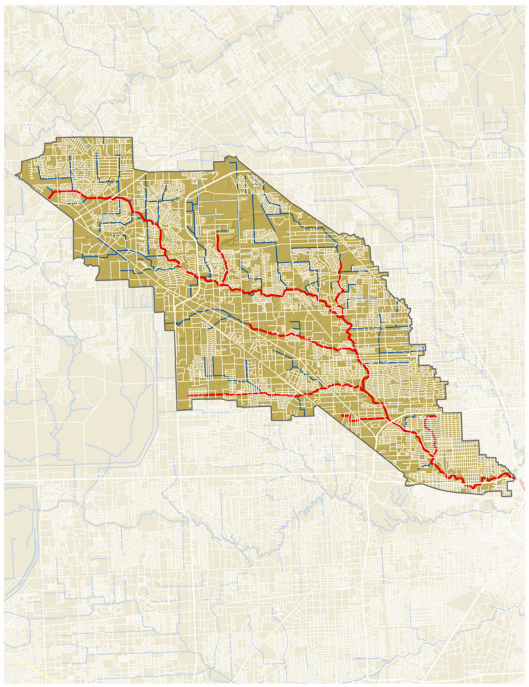
MONITORING STATIONS MAP



POTENTIAL SOURCES OF WATER QUALITY ISSUES?

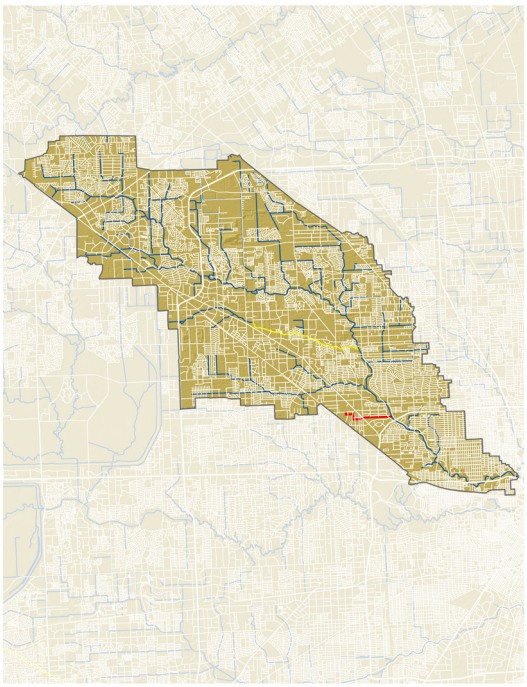
WHITE OAK BAYOU IS HIGHLY URBANIZED AND IMPACTED BY A LARGE DEGREE OF HUMAN ACTIVITY.

BACTERIA



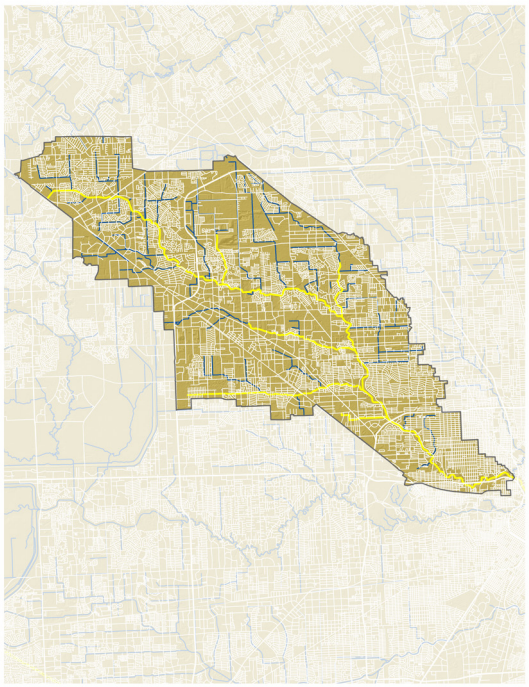
Improving

DISSOLVED OXYGEN



Improving

NUTRIENTS



Deteriorating

Impairment Concern Unimpacted

LAND USE & NATURAL CHARACTERISTICS

The White Oak Bayou segment is one of the most highly urbanized watersheds in the Houston-Galveston region. The four dominant land cover/land uses are medium intensity developed (38%), low intensity developed (22%), high intensity developed (17%) and open space (14%). Deciduous, evergreen and mixed forests make up only 6% of the land use/land cover.

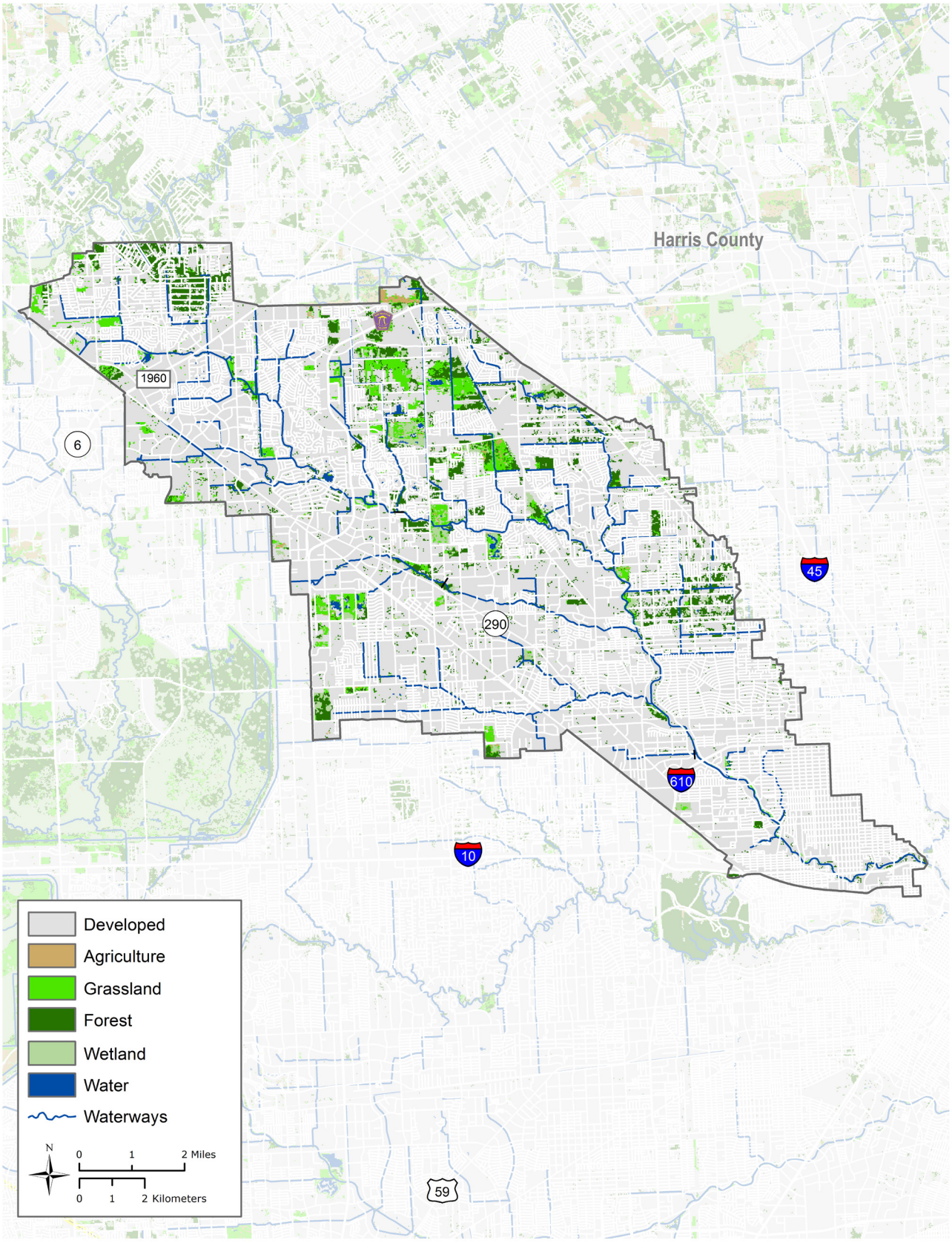
The area continues to develop rapidly as single family homes are replaced with townhouses and apartments, and the population continues to grow in this area. Most homes and businesses are on sanitary sewer; however, there are still pockets of OSSFs in the watershed. The area along the bayou is used heavily for recreation.

A walking, hiking and biking trail runs along the bayou between N. Main Street upstream and Studewood Street. The West White Oak Bayou trail begins at W. 11th Street and parallels White Oak Bayou upstream to Alabonson Road. Upstream of Antoine Drive are several stormwater detention basins constructed and maintained by the Harris County Flood Control District (HCFCD). Many of these have a trail system around each basin. There are also a number of neighborhood parks located throughout the watershed, many of which are used as dog parks.

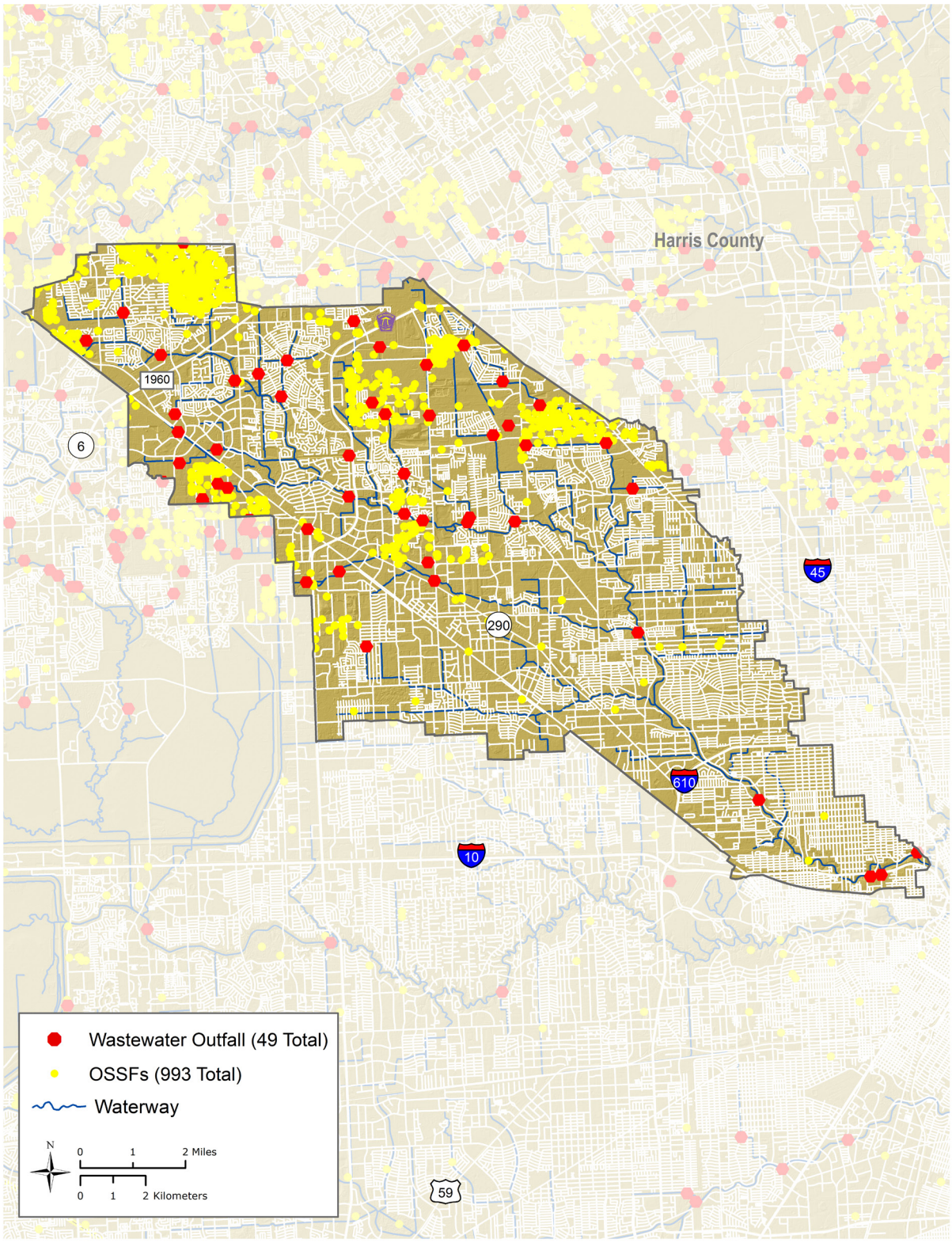
FOR MORE DETAILED LAND USE INFORMATION

VISIT WWW.H-GAC.COM/GO/WRIM.

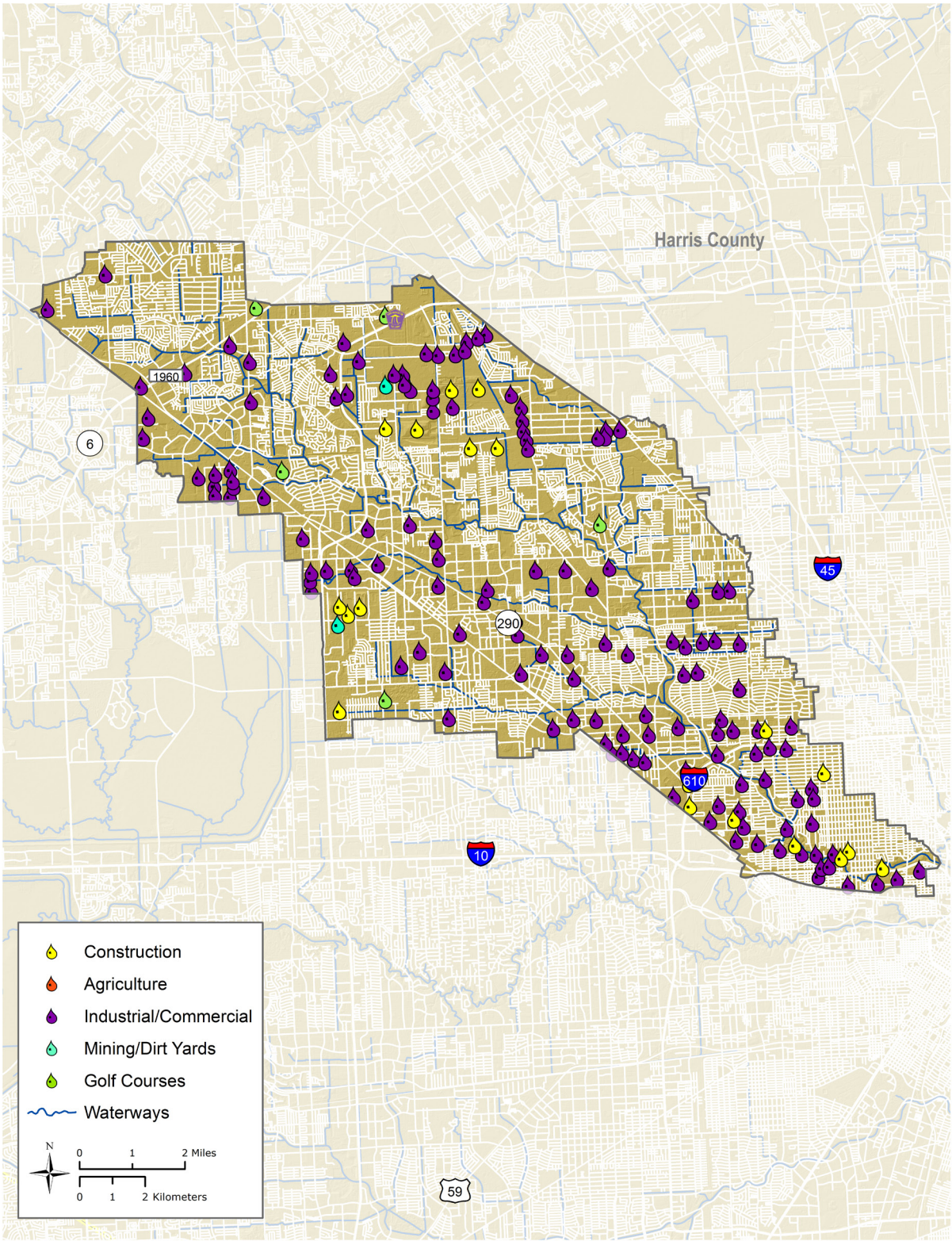
LAND USE


Harris County
1960
6
290
45
610
10
59
Developed
Agriculture
Grassland
Forest
Wetland
Water
Waterways
N
0 1 2 Miles
0 1 2 Kilometers

POLLUTION SOURCES: WASTEWATER



POLLUTION SOURCES: OTHER SOURCES



POTENTIAL STAKEHOLDERS

- Colleges
- Commercial/industrial facilities
- Harris County
- Harris County Flood Control District
- Harris-Galveston Subsidence District
- Homeowner's Associations
- Houston, Jersey Village & several smaller communities
- Independent School Districts
- Road & bridge departments in Harris County
- Utility districts

There are representatives from most of these entities currently serving on the Bacteria Implementation Group (BIG) Steering Committee.

Ongoing Projects...

In 2009, a TMDL for Buffalo and White Oak Bayous was approved by TCEQ. White Oak Bayou subsequently became a part of the BIG Implementation Plan (I-Plan) for bacteria reduction, which was approved by TCEQ January 31, 2013. Stakeholders are currently addressing bacteria impairments and concerns in the various manners identified through a consensus process.

There has been a significant reduction in bacteria levels since stakeholders began discussing implementation activities in 2008. The annual E. coli geometric mean declined by almost 75% since 2008. While there is currently no means for correlating this decline with implementation efforts of BIG partners, the period of decline coincides with bacteria reduction activities carried out by BIG partners.

In 2008, the Joint Taskforce, consisting of the City of Houston, Harris County, HCFCD and the Texas Department of Transportation, developed the Bacteria Reduction Plan in response to the bacteria impairment and to address their MS4 Phase I permit requirements.

The Bacteria Reduction Plan (Reduction Plan) includes adaptive components for monitoring, assessment and best management practices. As part of the Reduction Plan, the City of Houston initiated a program to identify and fix illicit discharges. Additionally, voluntary illicit discharge detection programs like those investigations carried out by Bayou Preservation Association used data provided by the BIG, monitored the area for illicit discharges and notified local jurisdictions concerning the need for repairs.

During this time, HCFCD saw completion of five regional stormwater detention basins in White Oak Bayou that were designed with water quality enhancement features to treat stormwater. HCFCD also completed conveyance improvements and channel rehabilitation projects to remove excess sediment deposits, regrade and revegatate eroding channel slopes, and repair outfall pipe structures.

RECOMMENDATIONS

ACTIVITY	ENTITY RESPONSIBLE
Continue implementing the I-Plan for bacteria reduction	Stakeholders
Continue collecting water quality data and expand monitoring efforts to support actions associated with TMDL and I-Plan implementation	TCEQ, H-GAC & CRP partners
Support, maintain, and/or increase programs that conduct septic system inspections and oversee maintenance and repairs	County/local agencies & stakeholders
Continue ongoing public outreach to numerous groups throughout the watershed	H-GAC, CRP partners & other stakeholders
Continue to work with the BIG to implement the I-Plan recommendations for bacteria reduction	H-GAC
Coordinate with key stakeholders on future projects to maximize dollars and achieve greatest benefits for all projects	H-GAC & BIG stakeholders

Major Watershed Events

The known or anticipated changes that have or may impact this segment include continued population growth, aging infrastructure and future drought conditions.

Development and infilling high intensity development brings greater WWTF flows, more land clearing and more impervious cover. Fertilized lawns and other landscapes, plus additional pet populations, produce waste and pollution in stormwater runoff.

APPENDIX A
BHR METHODOLOGY

For this Basin Highlights Report, H-GAC compiled routine monitoring data from the TCEQ Surface Water Quality Monitoring Information System (SWQMIS), a database that serves as the repository for TCEQ surface water quality data for the state of Texas. All data used for these analyses was collected under a TCEQ-approved Quality Assurance Project Plan. By using a seven-year window for data, H-GAC maintained consistency with the IR and was able to detect data anomalies.

A conservative trend analysis of ambient data, that is, data collected in the field by trained water quality monitors, was completed using up to three representative monitoring stations in the classified portion of each segment to detect trends at the watershed level for H-GAC's Regional Water Quality Summary "Frog Chart," (pages 8-9 and Appendix C of this document). This trend analysis used a non-parametric method (Spearman correlation) that is not typically changed by censored and extreme values in the data.

Trends in the five watersheds selected for detailed analysis and characterization were identified by comparing the results of non-parametric correlation with several other methods, such as simple linear regression, LOESS regression and correlation of flow-adjusted residuals, linear regression of annual medians, and seasonal Kendall/Theil-Sen Slope estimation.

Any results from the preferred non-parametric method that were inconsistent with the results of other techniques underwent further review. Survival analysis (Tobit analysis in SAS PROC LIFEREG) was also applied to parameters and assessment units where more than 15%of the data was reported as below the measured quantity limit. For other analyses, censored data was analyzed as one-half of the measured quantity limit.

Trends were considered statistically significant if the p-value was below 0.054. Data from USGS gauging stations and the TCEQ Discharge Monitoring Report database were also included in our analysis, when appropriate. Comparisons of data collected in dry and wet weather periods were made, with wet weather defined as significant rainfall within two days of sampling (as reported by sampling staff and documented in SWQMIS).

APPENDIX B
DETAILED CHARACTERIZATIONS

CEDAR BAYOU TIDAL (0901)

Additional information on Cedar Bayou Tidal (0901) can be found on pages 13-22 of this document.

SEGMENT DESCRIPTION
Located at the north end of Galveston Bay, Cedar Bayou Tidal lies in the coastal plain between the Trinity and San Jacinto Rivers. The City of Baytown is situated in the mid-western portion of the watershed with commercial and residential developments continuing to expand northward along the SH 146 corridor to I-10.

The eastern shore between SH 146 and SH 99 supports several industrial complexes, with additional large industrial facilities located at the juncture of the bayou and I-10. The southwestern extent of the City of Mont Belvieu is located in the northeast corner of the watershed. Cultivated lands are situated in the northwest and northeast areas of the watershed where turf grass farms and pasture lands are the primary agricultural activities. Wetland areas are located primarily in the south and southeast portion of the watershed as well as along the bayou in the north central area.

There are several small tributaries draining into Cedar Bayou, most of which have been channelized for flood control purposes. Cary Bayou is the largest and drains a major portion of Baytown. Smaller waterways include Ellis Branch, Ash Gully, MaGee Gully and Pond Gully. Smith Gully, Sutton Gully and Saw Pit Gully are small tributaries draining the east side of the watershed.

Cedar Bayou does not support its contact recreation designation due to high bacteria concentrations found in the water. The Texas State Department of Health Services has issued fish consumption advisories due to high levels of PCBs and Dioxin found in edible fish tissue collected from the bayou. Additionally, there are concerns for high chlorophyll *a* concentrations above the screening criteria and depressed Dissolved Oxygen (DO) concentrations in this segment.

The tidal segment of Cedar Bayou has three active routine monitoring stations and two special study monitoring sites being sampled in FY2015. H-GAC collects from two sites and deploys a 24-hour DO sonde at one location on a quarterly basis. H-GAC also operates an automatic sampling station to conduct stormwater monitoring on Cary Bayou to collect data for modeling purposes; TCEQ monitors one station on a quarterly basis; and the Environmental Institute of Houston (EIH) is contracted to conduct the special study monitoring at the other two sites. The United States Geological Survey (USGS) operates one tidal stage gage at SH 146 but there is no flow gage in this segment due to it being a tidal water body.

The Texas State Soil & Water Conservation Board (TSSWCB) is currently working with H-GAC and a diverse group of local stakeholders to develop the Cedar Bayou Watershed Protection Plan (WPP) through a 319(h) grant from the EPA. Cedar Bayou's current contact recreation and PCBs and Dioxin impairments occur in the tidal segment. The WPP is currently in development and is expected to be finished in early 2015. The focus of the stakeholders' efforts has been addressing sources of elevated bacteria levels in the waterway and planning for the impacts of future growth.

TABLE 1. MONITORING STATIONS IN CEDAR BAYOU TIDAL

STATION	DESCRIPTION	COLLECTING ENTITY	ASSESSMENT UNIT
11111	CEDAR BAYOU TIDAL AT ROSELAND PARK NEAR WEST BANK 245 M UPSTREAM OF SPUR 55	FO	0901_01
11115	CEDAR BAYOU TIDAL MID CHANNEL 45 M DOWNSTREAM OF SH 146 NORTHEAST OF BAYTOWN STATION	HG	0901_01
11117	CEDAR BAYOU TIDAL AT I-10 EASTBOUND BRIDGE SOUTH OF MONT BELVIEU EAST SIDE OF BAYOU	HG	0901_01

KEY

FO - TCEQ GS - USGS HG - H-GAC HW - City of Houston UI - EIH

HYDROLOGICAL CHARACTERISTICS

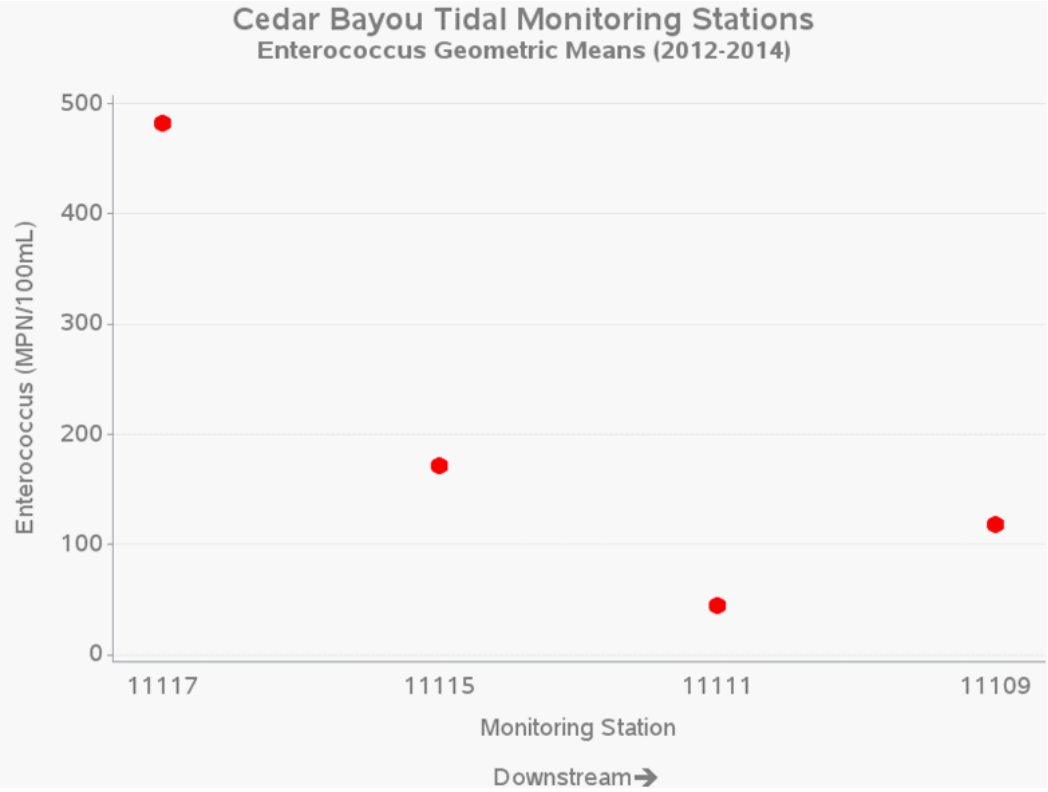
Cedar Bayou is a slow moving, tidally-influenced waterbody which meanders 19 miles south from upstream of the I-10 westbound feeder road to Upper Galveston Bay. This tidal waterbody and all its small tributaries drain an area of 53.5 square miles. Sections of the bayou are routinely dredged under the jurisdiction of two navigation districts and are deep enough to support barge and commercial boat traffic up to the SH 146 bridge.

Even at the I-10 eastbound feeder road located at the north end of the segment, the bayou is naturally too deep to wade. South of Baytown, an artificial channel connects Cedar Bayou with Tabbs Bay. The channel originally served to increase water flow to large-scale water users in the tidal segment. Toward its mouth, the bayou widens to include a series of shallow estuarine lakes on either side of the dredged channel.

DESCRIPTION OF WATER QUALITY ISSUES

Designated uses for the tidal segment of Cedar Bayou include High Aquatic Life, Contact Recreation, Fish Consumption and General Uses. Cedar Bayou Tidal currently has impairments for contact recreation (elevated levels of indicator bacteria) and PCBs and Dioxin in edible fish tissue. These impairments have persisted over the last three Integrated Reports (IR). The PCBs and Dioxin impairments are being addressed under a Total Maximum Daily Load (TMDL) for the broader Galveston Bay system. In addition, a concern for chlorophyll *a* has existed since 2010.

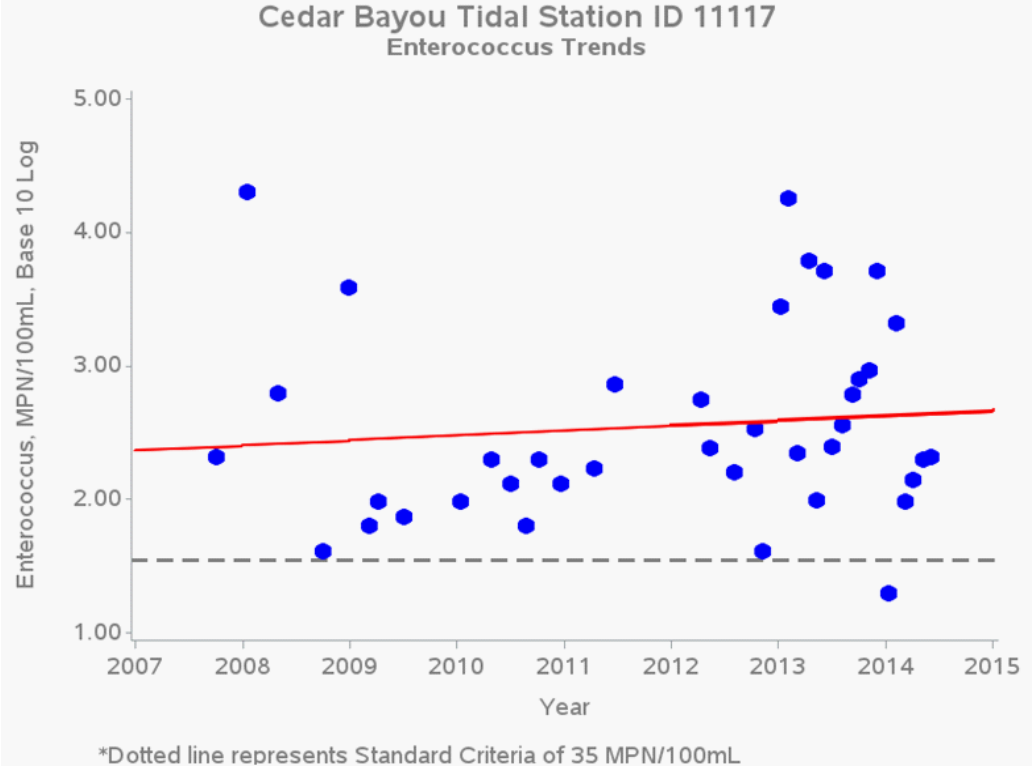
FIGURE 1



Bacteria

The tidal segment of Cedar Bayou is highly susceptible to bacterial contamination through wastewater and stormwater outfalls and aging collection systems; failing on-site sewage facilities (OSSF); and sheet flow from residential, agricultural and undeveloped areas. Monitoring data displays decreasing levels further downstream from I-10 showing the highest concentration of enterococci near the tidal/above tidal segment boundary at station ID 11117 (see Figure 1).

FIGURE 2

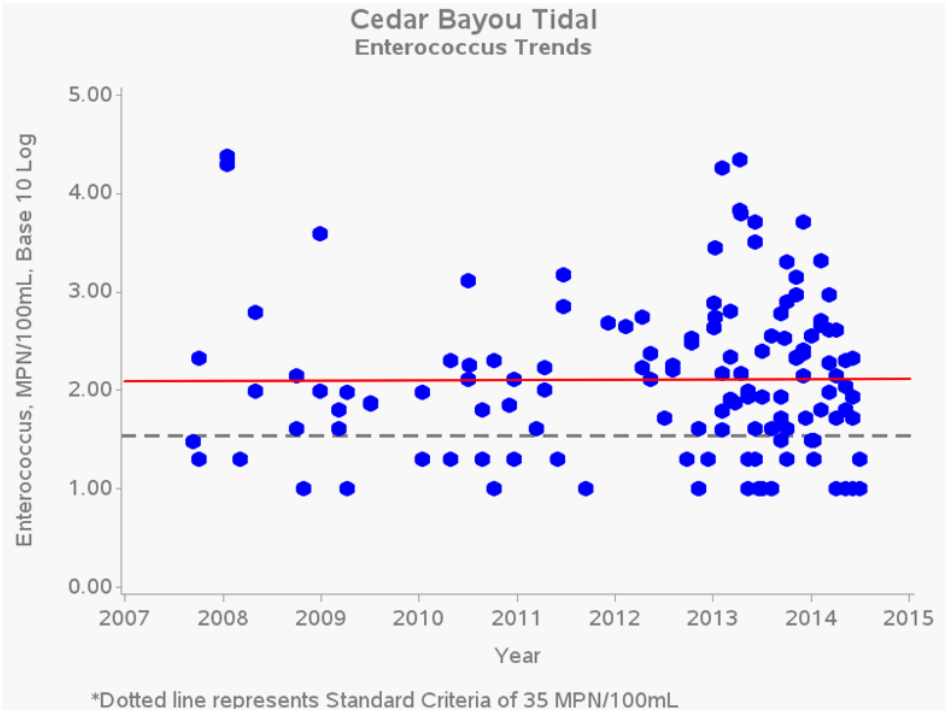


This trend is likely due in part to the widening channel and increased tidal influences as the stream approaches its confluence with Upper Galveston Bay. H-GAC's analysis of enterococci data shows station ID 11117 to be the only station with a deteriorating bacteria trend (see Figure 2).

All other stations show stable or improving trends in bacteria, resulting in the overall tidal segment having no significant trend since 2007.

However, the majority of ambient data collected is still significantly higher than the 35 MPN/100mL standard set for Enterococcus (see Figure 3).

FIGURE 3



DO & Chlorophyll a

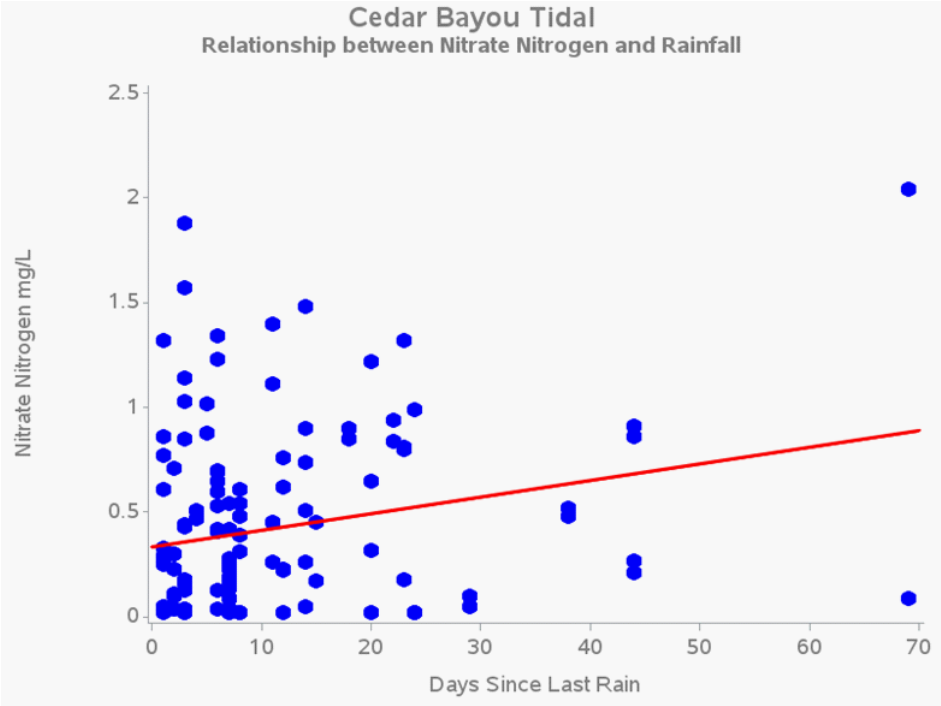
H-GAC's data analysis for DO and chlorophyll *a* show stable and/or improving levels throughout the tidal segment overall. Although there is an existing concern for chlorophyll *a* since the 2010 IR, monitoring data collected since 2012 show chlorophyll *a* levels consistently lower than the 14.1 mg/L screening criteria with only six out of 112 samples exceeding the screening level.

A regression plot showing nitrate nitrogen levels against rainfall data shows increasing nutrient levels during extended periods of no rain (see Figure 4).

This is likely due to streams becoming less diluted during periods of low natural flow. While not a concern for this segment, H-GAC's nutrient data analysis identifies total nitrogen as a greater threat to water quality than total phosphorus in the tidal segment of Cedar Bayou.

The overall health of the tidal segment seems to be gradually improving; however, the high levels of bacteria and the nitrogen trends are still a cause for concern.

FIGURE 4



While the focus of current efforts under the WPP is on bacterial contamination, best management practices (reduction of human and pet waste, protection of riparian corridors, etc.) and concurrent efforts (implementation of Texas Pollutant Discharge Elimination System {TPDES} stormwater permits) may also affect nutrient levels.

POTENTIAL SOURCES OF WATER QUALITY ISSUE(S)

Cedar Bayou Tidal is impacted by a large degree of human activity due to the dense urban and industrial complexes in the area. Potential point sources of contamination include domestic and industrial effluent overflows or discharges with inadequate treatment, sanitary sewer collection system overflows and contaminated urban stormwater runoff.

There are 28 wastewater treatment outfalls in the segment. The bayou receives stormwater flow from the City of Baytown, which is regulated under a TPDES Phase II stormwater permit, and other industrial areas on its east bank. However, a significant source of bacteria and nutrients includes nonpoint source surface runoff contaminated with human waste from failing OSSFs, animal waste from pets, livestock, feral hogs and wildlife, and fertilizers. PCBs and Dioxin contamination in edible fish tissue is likely influenced by prominent sources in the Galveston Bay system, including the San Jacinto Waste Pits.

A large landfill is located on the eastern shore of the southeast extent of the Bayou that may potentially pose a contamination threat through leachate or surface flow, but multiple redundant measures and regulatory controls are currently in place to prevent these issues. Additionally, a series of small prior landfill sites of unknown status have been identified that could be sources of water quality contamination.

BASTROP BAYOU TIDAL (1105)

Additional information on Bastrop Bayou Tidal (1105) can be found on pages 23-32 of this document.

SEGMENT DESCRIPTION

Located in the central coastal area of Brazoria County, Bastrop Bayou extends west from its confluence with the Intracoastal Waterway through the City of Richwood Village to SH 288. The watershed is mostly rural with urban development limited to the cities of Angleton, Richwood Village and Danbury plus the unincorporated communities of Demi John, Bastrop Holiday Beach, Sasco and Lang Shores. Rural homesteads are scattered throughout the watershed. OSSFs are the primary means of sewage disposal outside of areas served by sanitary sewer.

The primary land use is agricultural, including some rice production, row crops, hay and cattle grazing. The Bastrop Bayou watershed also includes a portion of the Brazoria National Wildlife Refuge, located along the coast off of FM 2004. Bastrop Bayou has four major tributaries – Austin Bayou, Flores Bayou, Brushy Bayou and an *Unnamed Tributary of Bastrop Bayou.

Each of the unclassified segments is described below:

- 1105A – Flores Bayou: From a point 2.6 km (1.6 miles) downstream of County Road 171 upstream to SH 35 in Brazoria County
- 1105B – Austin Bayou Tidal: From the Bastrop Bayou Tidal confluence to the FM 2004 bridge crossing in Brazoria County
- 1105C – Austin Bayou Above Tidal: From FM 2004 upstream (Austin Bayou Tidal upper boundary) to 0.3 km (0.19 miles) upstream of SH 288 in Brazoria County
- 1105D – Unnamed Tributary of Bastrop Bayou: From the Bastrop Bayou Tidal confluence to 0.57 km (0.35 miles) upstream of SH 288 in Brazoria County
- 1105E – Brushy Bayou: From the confluence with Austin Bayou Above Tidal (1105C) upstream to end of canal approximately 0.4 miles upstream of FM 210 crossing east of the City of Angleton in Brazoria County

**It is important to note that in the 2012 Integrated Report (IR), this segment is listed as "Unnamed Tributary to Bastrop Creek." However, the description given indicates the segment originates at the confluence with Bastrop Bayou, not Bastrop Creek. In either case, unclassified segment 1105D is intended to reference the same segment as described in the IR.*

The segment has ten active routine monitoring stations in FY2015. H-GAC contracts with CRP partner EIH to collect samples from nine locations throughout the watershed. TCEQ monitors the tenth station at the downstream tidal location at Demi John.

TABLE 2. MONITORING STATIONS IN BASTROP BAYOU TIDAL

STATION	DESCRIPTION	COLLECTING ENTITY	ASSESSMENT UNIT
18508	FLORES BAYOU IMMEDIATELY UPSTREAM OF DANBURY-ANGLETON ROAD/BRAZORIA CR 210 EAST OF ANGLETON	UI	1105A_01
18507	AUSTIN BAYOU MID CHANNEL 189 M UPSTREAM OF CONFLUENCE WITH BASTROP BAYOU TIDAL UPSTREAM OF CR 227 IN BRAZORIA COUNTY	UI	1105B_01
18048	AUSTIN BAYOU AT FM 2004 APPROXIMATELY 4 MILES SOUTHEAST OF ANGLETON TEXAS IN BRAZORIA COUNTY	UI	1105C_01
18506	AUSTIN BAYOU IMMEDIATELY UPSTREAM OF DANBURY-ANGLETON ROAD/BRAZORIA CR 210 EAST OF DANBURY	UI	1105C_01
18509	BRUSHY BAYOU IMMEDIATELY UPSTREAM OF BRAZORIA CR 210 EAST OF ANGLETON	UI	1105D_01
11475	BASTROP BAYOU TIDAL AT CR 227 NEAR MIMS	FO	1105_01
18502	BASTROP BAYOU OFF BAYOU WOOD DR DUE EAST OF BRAZORIA CR 201 AT BASTROP BAYOU DR APPROX 1.1 KM UPSTREAM OF SH 288B IN RICHWOOD	UI	1105_01
18503	BASTROP BAYOU TIDAL APPROXIMATELY 15 M OFF NORTH BANK AND 1.55 KM UPSTREAM OF FM 2004 IN RICHWOOD VILLAGE	UI	1105_01
18504	BASTROP BAYOU TIDAL MID CHANNEL AT NORTH END OF BAS-TROP BEACH ROAD 350 M DOWNSTREAM OF FM 523 SE OF ANGLETON	UI	1105_01
18505	BASTROP BAYOU TIDAL 38 M NORTH OF N END OF COMPASS DR/ BRAZORIA CR 504 APPROXIMATELY 4.4 KM DOWNSTREAM OF FM 523 SE OF ANGLETO	UI	1105_01

KEY

FO - TCEQ GS - USGS HG - H-GAC HW - City of Houston UI - EIH

H-GAC worked to develop a Bastrop Bayou WPP in partnership with the TCEQ, GBEP, TSSWCB, Brazoria County and concerned citizens. The WPP is aimed at addressing elevated levels of bacteria, identified in the Texas IR, and other stakeholder priorities. The Draft WPP is currently under review by TCEQ and EPA. H-GAC is currently working with TCEQ and local partners on a series of implementation efforts in the watershed, including remediation of failing OSSFs, installation of pet waste stations, facilitation of partner efforts and education and outreach activities.

HYDROLOGICAL CHARACTERISTICS

Bastrop Bayou and its tributaries drain an area of 217 square miles. Bastrop Bayou has a length of approximately 19 miles and the unclassified tributaries have a combined length of roughly 63 miles. There are four primary tributaries to Bastrop Bayou: Austin Bayou (1105B & 1105C); Flores Bayou (1105A); Unnamed Tributary of Bastrop Bayou (1105D); and Brushy Bayou (1105E).

Stormwater from the City of Angleton used to be drained through Brushy Bayou to Austin Bayou, and thence to Bastrop Bayou. To alleviate flooding, Brushy Bayou was split near CR 210 (southeast of Angleton) by excavating a channel for the upper portion of the bayou to drain directly to Bastrop Bayou. That drainage system is now the Unnamed Tributary of Bastrop Bayou (1105D).

The lower portion of Brushy Bayou (1105E) still flows into the tidal portion of Austin Bayou. There are no USGS flow gages located within this watershed.

DESCRIPTION OF WATER QUALITY ISSUES

The Draft 2014 IR indicates that Recreational, General and Aquatic Life Uses are not fully supported in all assessment units (AUs) within this watershed due to high levels of indicator bacteria, ammonia nitrogen and depressed DO.

Bacteria

The majority of the 2014 303(d) listings involve impaired recreational use due to high bacteria levels. The water quality standard for the designated indicator was exceeded in six of seven AUs during the period of record.

One AU will be listed as a concern due to the small sample size available to assessors, but five are considered impaired. One was not assessed because no data have been collected. Two unclassified AUs in this watershed were added to the 303(d) list in 2010 (Flores and Austin bayous). The table below shows the results of three TCEQ assessments and the H-GAC analysis for this report.

H-GAC found no statistically significant bacteria trends in this watershed. However, if data collected at station 20783 on Brushy Bayou (1105E) prior to 2007 had been included in the trend analysis, a decrease in bacteria density might be suggested.

TABLE 3. COMPARISON OF SEVEN-YEAR GEOMETRIC MEANS FROM ASSESSMENTS & H-GAC ANALYSIS

ASSESSMENT UNIT	YEAR ADDED TO TEXAS IR	2012 IR	2014 IR (DRAFT)	H-GAC ANALYSIS
1105_01(1)	2012	43	73	77
1105A_01(2)	2010	147	137	131
1105B_01(1)	-		41	44
1105C_01(3)	2012 (Concern)	129	166	236
1105D_01(3)	2012 (Concern)	160	236	188
1105E_01(2)	2010	652	566	370 (4)

1: Indicator is enterococci: Water quality standard (WQS) = 35 MPN/100 mL

2: Indicator is *E. coli*: WQS = 126 MPN/100 mL

3: Listed as a concern on the basis of a withdrawn single-sample standard

4: Does not include data collected before 6/1/2007

Dissolved Oxygen

Brushy Bayou (1105E_01) is listed as impaired due to depressed DO screening levels and grab sample minima. It was first listed in 2010. The classified reach of Bastrop Bayou and three unclassified tributaries have been listed as of concern for nonsupport of aquatic life uses based on the same parameters since the 2010 assessment.

H-GAC did not find a statistically significant trend for single-sample DO concentration anywhere in the watershed. H-GAC collected 24-hour DO data in 2012 and 2013 at station 18509 in AU 1105D_01 and found the mean DO to be 4.74 mg/L and the mean minimum DO as 2.34 mg/L, which supports the DO concern (the current standards for these parameters are 5.0 and 3.0 mg/L respectively). Since there have been no active sampling stations on Brushy Bayou since October 2006, routine and 24-hour DO monitoring should be initiated during the next fiscal year to confirm continued concerns and impairments.

Nutrients
TCEQ has identified a concern for nonsupport of general uses in Brushy Bayou due to high levels of ammonia during the assessment period. A large proportion of ammonia data from Bastrop Bayou has been reported below the limit of quantitation, so H-GAC used Tobit analysis to identify possible trends.

H-GAC data analysis suggests that ammonia is increasing in Bastrop Bayou and three tributaries, while total phosphorus and/or nitrate are increasing in Bastrop Bayou and two tributaries. Trend analysis was not conducted on data from Brushy Bayou because few results exist for the period selected for analysis.

Note on Impairments in Brushy Bayou, 1105E_01: Brushy Bayou has been modified to improve stormwater drainage (see "Hydrological Characteristics"). A portion of historical Brushy Bayou was separated from the main channel and was renamed Unnamed Tributary of Bastrop Bayou, segment 1105D_01. Station 18509 was the only active monitoring station on Brushy Bayou prior to the split and is now located on the Unnamed Tributary of Bastrop Bayou. The remaining portion of Brushy Bayou was designated as 1105E_01.

TABLE 4. SUMMARY OF WATER QUALITY IMPAIRMENTS, CONCERNS & TRENDS: SEGMENT 1105 BRUSHY BAYOU

AU ID	BAC	DO	NUT	CHLOR-A	PCBS & DIOXIN	OTHER	FROG COUNT	COMMENTS
1105A_01	X						2	
1105A_02								*Not Assessed in 2014
1105B_01	X	C					2	
1105C_01	X	C					1	
1105D_01	C	C					1	
1105E_01	X	X	X				2	
1105_01	X	C					1	

X = Impairment C= Concern.

Improving Degrading

See pages 8 - 9 of this document for a full explanation of the Regional Water Quality Summary (Frog Chart)

*Current data was insufficient to conduct assessment - no active monitoring stations.

POTENTIAL SOURCES OF WATER QUALITY ISSUE(S)
H-GAC has identified a variety of potential sources of water quality issues in the Bastrop Bayou watershed.

H-GAC's modeling efforts have identified failing OSSFs as a primary source of bacterial contamination within the watershed. Due to a large volume of residential properties with OSSFs along the segment waterways, the potential for bacterial contamination through surface runoff and contaminated groundwater originating from failing OSSFs is high.

Other potential sources of pollution include sanitary sewer overflows and runoff from livestock and agricultural production, pet waste, feral hogs and wildlife. Illegal dumping has also been an issue in this watershed and includes improper disposal of solid and liquid waste in or around the waterways.

WEST FORK SAN JACINTO RIVER (1004)

Additional information on West Fork San Jacinto River (1004) can be found on pages 33-42 of this document.

SEGMENT DESCRIPTION
Flowing southeast from the Lake Conroe Dam to the confluence of Spring Creek located just upstream of US Highway 59 on the western arm of Lake Houston, this watershed is primarily forested with residential and commercial development scattered throughout.

The City of Conroe, the most densely populated area, is located at the upper end of the watershed amid gently rolling hills. Several small communities are located in the middle and lower areas. All have the potential to affect water quality. Besides the major tributaries of Lake Creek and Spring Creek, the West Fork San Jacinto River has several other tributaries such as Base, Camp, Crystal, East Fork Crystal, West Fork Crystal, Caney, Egypt, Little Caney, Stewarts and White Oak creeks, as well as Harpers, Horsepen, Rice, Black, Sand and Sandy branches, Black Slough, and Woodsons Gully.

For the purposes of this report, only the main stem of the West Fork San Jacinto River, which has two assessment units (AUs), and the five unclassified tributaries, are addressed.

The five tributaries are as follows:

- 1004A – East Fork White Oak Creek: Perennial stream from the confluence with White Oak Creek upstream to the confluence of an unnamed tributary 0.4 km upstream of League Line Road in the city of Panorama Village.
- 1004B – West Fork White Oak Creek: Perennial stream from confluence with White Oak Creek and West Fork San Jacinto River upstream to an on-channel impoundment on West Fork White Oak Creek 1.2 km upstream of League Line Road
- 1004 D – Crystal Creek: From the West Fork of the San Jacinto River confluence to the confluence of the east and west forks of Crystal Creek
- 1004E – Stewarts Creek: From the headwaters northwest of old Montgomery Road to confluence with West Fork San Jacinto River
- 1004F – Woodsons Gully: Perennial stream from the confluence with West Fork San Jacinto River upstream to the confluence with an unnamed tributary approximately 1.9 KM upstream from Riley-Fussel Road.

The West Fork San Jacinto River is divided into two AUs, both of which appear in the Draft 2014 Texas IR as not supporting contact recreation use due to bacteria levels exceeding the state standard. Bacteria concentrations are also elevated in two tributaries (Crystal Creek and Stewarts Creek).

There are six active monitoring stations sampled by three agencies in this segment during FY2015. The City of Houston- Water Quality Control Division monitors four sites, while H-GAC and TCEQ monitor one station each.

TABLE 5. MONITORING STATIONS IN WEST FORK SAN JACINTO RIVER

STATION	DESCRIPTION	COLLECTING ENTITY	ASSESSMENT UNIT
20731	WHITE OAK CREEK AT MEMORIAL DRIVE IN CONROE	HG	1004B_01
16635	CRYSTAL CREEK AT SH 242 SOUTHEAST OF CONROE	HW	1004D_01
16626	STEWARTS CREEK 175 METERS DOWNSTREAM OF SH LOOP 336 SOUTHEAST OF CONROE	HW	1004E_02
11243	WEST FORK SAN JACINTO RIVER IMMEDIATELY UPSTREAM OF SH 242	HW	1004_01
11250	WEST FORK SAN JACINTO RIVER AT FM 2854 WEST OF CONROE	FO	1004_02
11251	WEST FORK SAN JACINTO RIVER IMMEDIATELY DOWNSTREAM OF SH 105 NW OF CONROE	HW	1004_02

KEY

FO - TCEQ GS - USGS HG - H-GAC HW - City of Houston UI - EIH

HYDROLOGICAL CHARACTERISTICS

West Fork San Jacinto River and its tributaries (except for Lake, Cypress and Spring creeks) drain an area of 216 square miles. The main river channel (the classified portion of the segment) has a length of approximately 40 miles with a combined length of approximately 88 miles if the unclassified tributaries are added to the main waterway.

H-GAC downloaded and analyzed flow data from USGS gaging stations 08068000 and 08068090 located at I-45 just north of FM 1488 and upstream of the confluence with Spring Creek west/southwest of the City of Porter, respectively. The mean flow between January 2007 and January 2015 was 322 cubic feet per second (CFS) at the downstream gage.

DESCRIPTION OF WATER QUALITY ISSUES

The Draft 2014 Texas IR found a continued impairment for contact recreation use due to bacteria and general use concerns due to high nutrient levels.

Bacteria

The most significant water quality problem in this watershed is *E. coli*. Both AUs in the classified portion of the river were added to the 303(d) list in 2002 on the basis of interpretation of both fecal coliform and *E. coli* data. Two unclassified tributaries (Crystal Creek, assessment unit 1004D_01, and Stewarts Creek, assessment unit 1004E_02) were added to the 303(d) list of impaired waters in 2006.

Although Stewarts Creek was removed from the 303(d) list in 2012 as a result of an approved TMDL, the waterbody is still impaired with high bacteria concentrations. Current data also show high *E. coli* levels in East Fork White Oak Creek (1004A_01), but insufficient data existed during the 2014 assessment to evaluate its current status.

TABLE 6. COMPARISON OF SEVEN-YEAR GEOMETRIC MEANS FROM ASSESSMENTS & H-GAC ANALYSIS

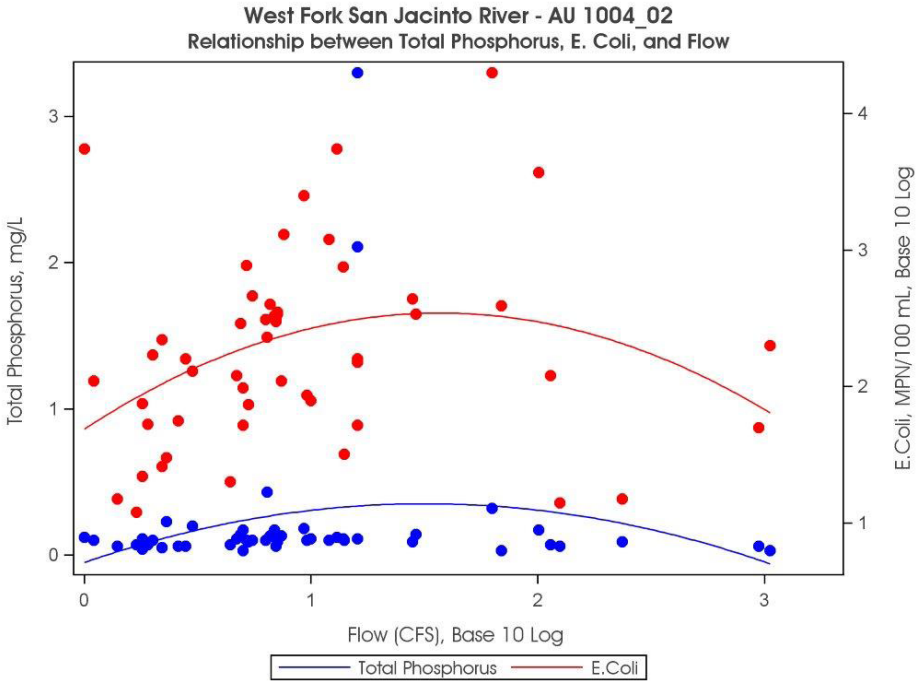
ASSESSMENT UNIT	YEAR ADDED TO TEXAS IR	2012 IR (MPN/100 ML)	2014 IR (DRAFT) (MPN/100 ML)	H-GAC ANALYSIS (MPN/100 ML)
1004_01	2002	179	149	116
1004_02	2002	170	184	191
1004D_01	2006	338	137	59
1004A_01		-	-	1640
1004E_02*		283	315	229

Nutrients

The lower portion of the river between the Spring Creek confluence upstream to the Stewart Creek confluence (1004_01) was placed on the list of concerns in 2010 for screening levels of nitrate and orthophosphorus. The orthophosphorus concern has since been removed, but the concern for nitrate remains because concentrations remain high; 14 of 23 samples reviewed during the 2014 assessment exceeded the current screening level. H-GAC data show 68% of samples collected in this AU during the most recent seven-year period exceeded the screening limit of 1.95 mg/L, with a median concentration of 2.71 mg/L. Total nitrogen concentrations are increasing in 1004_02.

The relationships between total phosphorus, *E. coli*, and flow suggest that stormwater and surface runoff during rain events could be the principal sources of nutrient and bacteria loading in this watershed. This conclusion is consistent with the Technical Support Document for the Total Maximum Daily Load (TMDL) project for the East and West Forks of the San Jacinto River.

FIGURE 5



Several statistically significant trends were detected, primarily in unclassified tributaries:

- *E. coli* and total phosphorus levels are decreasing in Stewarts Creek (1004E_02);
- pH is increasing slightly in Crystal Creek (1004D_01); and
- Increasing total nitrogen concentrations, a slight increase in total Kjeldahl nitrogen, a small decrease in total suspended solids at station 11250 and a small decrease in pH at station 11251 in the upper portion of the classified waterbody (1004_02) were detected.

TABLE 7. SUMMARY OF WATER QUALITY IMPAIRMENTS, CONCERNS & TRENDS: SEGMENT 1004 WEST FORK SAN JACINTO RIVER

AU ID	BAC	DO	NUT	CHLOR-A	PCBS & DIOXIN	OTHER	FROG COUNT	COMMENTS
1004A_01								*Not Assessed in 2014
1004B_01								*Not Assessed in 2014
1004C_01								*Not Assessed in 2014
1004D_01	X						4	
1004E_01								*Not Assessed in 2014
1004E_02	X						3	
1004F_01								*Not Assessed in 2014
1004G_01								*Not Assessed in 2014
1004_01	X		X				3	
1004_02	X						3	

X = Impairment C= Concern.

Improving Degrading

See pages 8 - 9 of this document for a full explanation of the Regional Water Quality Summary (Frog Chart)

*Current data was insufficient to conduct assessment - no active monitoring stations.

POTENTIAL SOURCES OF WATER QUALITY ISSUE(S)

The Technical Support Document for the East and West Forks of the San Jacinto and Lake Houston Watershed TMDL lists a variety of potential point and nonpoint sources for the West Fork San Jacinto River.

Elevated bacteria and nutrient concentrations stem from sources such as municipal collection system overflows, failing OSSFs, agricultural areas, pet waste, feral hogs, and wildlife. Illegal dumping has also been an issue in this watershed and includes improper disposal of solid and liquid waste in or around the waterway.

There are 24 domestic and six industrial wastewater outfalls in the watershed. The domestic wastewater treatment facilities (WWTFs) have a total permitted flow of 19.62 MGD. Numerous sanitary sewer overflows have been reported in the watershed. Causes include inflow and infiltration problems and blockages from debris, grease and/or tree roots. Due to rapid growth in the watershed outside of areas serviced by sanitary sewers, OSSFs are common. The failure rate for OSSFs in the region is approximately 12%.

Additionally, there are two Superfund sites located within the West Fork San Jacinto. The United Creosoting site is located at the intersection of North First Street and Hilbig Road in Conroe. The United Creosoting Company operated from 1946 through 1972. Wood was treated at the facility with coal tar (creosote) and pentachlorophenol (PCP) for preservation to produce formed lumber structures, such as telephone poles and railroad ties. Wastewater was diverted into two lagoons located on the property. The site was first included on the National Priorities List (NPL) in 1984. As part of the remediation process, 30,000 tons of contaminated soil was removed and disposed of offsite. Continued groundwater monitoring has determined that the remedial actions at the site continue to protect human and environmental health. The property has since been approved for redevelopment for both residential and commercial use.

The second Superfund site, The Conroe Creosoting Company, is located at the north side of SH 105 on East Davis Street, east of the Conroe city limits. From 1946 to 1997 wood was treated at the site with creosote, PCP and copper-chromated-arsenic to preserve and produce formed lumber structures. In the fall of 2002, the EPA removed over 250,000 cubic yards of contaminated soil, which was stored onsite in a Resource Conservation and Recovery Act vault. In 2008, redevelopment was approved for the site for commercial and industrial use.

EAST FORK SAN JACINTO RIVER (1003)

Additional information on West Fork San Jacinto River (1003) can be found on pages 43-52 of this document.

SEGMENT DESCRIPTION

With its headwaters in eastern Walker County just north of SH 190, the East Fork San Jacinto River flows south approximately 81 miles to the eastern arm of Lake Houston. The largest tributary, Winters Bayou, flows southeast from the City of Huntsville to its confluence with the East Fork San Jacinto River north of the City of Cleveland.

Smaller tributaries include Orange Branch, Miller Creek and Whiskey Branch. The Sam Houston National Forest is located in the upper two-thirds of the watershed where small ranchettes, hobby farms and homesteads are scattered throughout the gently rolling hills. Timber harvesting, grass, hay and pasture lands are the dominant agricultural activity supporting small to medium sized cattle operations.

Additionally, there are several existing and abandoned sand and gravel operations located in the lower portion of the watershed which is relatively flat and slopes toward Galveston Bay.

The cities of Cleveland, Plum Grove and Roman Forest are located in the lower third of the watershed. Subdivisions and commercial development are interspersed throughout the forested lands in this area creating a patchwork of development. OSSFs are the primary means of sewage disposal outside of areas served by sanitary sewer.

The East Fork is divided into three assessment units (AU). All AUs appear in the Draft 2014 Texas IR as not supporting contact recreation use due to bacteria levels which exceed the state standard. All other uses, such as high aquatic life use and public water supply, are fully supported. This segment has four active routine monitoring stations.

TABLE 8. MONITORING STATIONS IN EAST FORK SAN JACINTO RIVER

STATION	DESCRIPTION	COLLECTING ENTITY	ASSESSMENT UNIT
11235	EAST FORK SAN JACINTO RIVER AT FM 1485	HW	1003_01
11235	EAST FORK SAN JACINTO RIVER AT FM 1485	GS	1003_01
11238	EAST FORK SAN JACINTO RIVER IMMEDIATELY UPSTREAM OF SH 105 WEST OF CLEVELAND	HW	1003_02
17431	EAST FORK SAN JACINTO RIVER IMMEDIATELY DOWNSTREAM OF SH 150 WEST OF COLDSPRING	HG	1003_03
21417	WINTERS BAYOU AT TONY TAP ROAD NEAR CLEVELAND	HG	1003_02

KEY

FO - TCEQ GS - USGS HG - H-GAC HW - City of Houston UI - EIH

Three agencies monitor in this segment. The City of Houston Water Quality Division monitors two stations: one at FM 1485 and one at SH 105 west of Cleveland; H-GAC monitors at SH 150 west of Coldspring and on Winters Bayou at Tony Tap Road; and the USGS maintains a gage at FM 1485 and collects monthly water quality and biased flow data.

HYDROLOGICAL CHARACTERISTICS

The East Fork San Jacinto River and its tributaries drain an area of 404 square miles. The river has a length of roughly 81 miles, and Winters Bayou, the primary tributary, has a length of approximately 46.05 miles.

USGS gaging stations 08070000 and 08070200 are located on the SH 105 bridge west of Cleveland and at the FM 1485 bridge east of New Caney, respectively.

USGS gage 08070200 is located at the furthest downstream road crossing in the lower quarter of the segment. The mean flow between January 2007 and December 2014 at this gage was 143 CFS.

DESCRIPTION OF WATER QUALITY ISSUES

This entire segment is impaired for contact recreational use due to high levels of *E. coli*. All three AUs were added to the 303(d) list in 2006. TCEQ has identified no other impairments in this segment. There has been very little change in *E. coli* density in this segment since 2006.

TABLE 9. COMPARISON OF SEVEN-YEAR GEOMETRIC MEANS FROM ASSESSMENTS & H-GAC ANALYSIS

ASSESSMENT UNIT	YEAR ADDED TO TEXAS IR	2012 IR (MPN/100 ML)	2014 IR (DRAFT) (MPN/100 ML)	H-GAC ANALYSIS (MPN/100 ML)
1003_01	2006	193	178	218
1003_02	2006	158	193	164
1003_03	2006	197	147	420*

* A result of 10,000 MPN/100 mL elevated the geometric mean of this AU

With the exception of contact recreation use, the 2014 assessment indicates that all uses are fully supported. None of the data collected during the period of record exceeded any nutrient screening level, so no concerns for nutrient screening levels were identified.

H-GAC trends analysis suggests that the concentration of ammonia nitrogen (NH3-N) in 1003_01, the most downstream AU, is increasing. However, 93% of the data was reported below the limit of quantitation.

Survival analysis using Tobit regression can be applied to datasets with a large proportion of censored data. These results support the trend identified by nonparametric correlation and linear regression. Nevertheless, the highest value recorded was 0.1 mg/L – the limit of quantitation – so this trend is not important at present.

TABLE 10. SUMMARY OF WATER QUALITY IMPAIRMENTS, CONCERNS & TRENDS: SEGMENT 1003 EAST FORK SAN JACINTO RIVER

AU ID	BAC	DO	NUT	CHLOR-A	PCBS & DIOXIN	OTHER	FROG COUNT	COMMENTS
1003_01	X						3	
1003_02	X						3	
1003_03	X						3	

X = Impairment C= Concern.

See pages 8 - 9 of this document for a full explanation of the Regional Water Quality Summary (Frog Chart)

POTENTIAL SOURCES OF WATER QUALITY ISSUE(S)

H-GAC has reviewed the Technical Support Document for Total Maximum Daily Loads for Indicator Bacteria for four watersheds, including the East Fork. There are five WWTFs within the watershed, totaling approximately 1.035 MGD of permitted flow. There have been few reported sanitary sewer overflows. Since there is limited sanitary sewer service in the watershed, the majority of homes and businesses are on OSSFs, which can become sources of contamination if they fail.

The watershed is home to large populations of cattle, poultry, horses, sheep and goats. Many have direct access to the smaller streams and tributaries, or their fields and pastures border the waterways.

Other potential sources of pollution include runoff pollution from pet waste, feral hogs and wild animal/bird populations. Illegal dumping has also been an issue in this watershed and includes improper disposal of solid and liquid waste in or around the waterways.

WHITE OAK BAYOU (1017)

Additional information on White Oak Bayou (1017) can be found on pages 53-62 of this document.

SEGMENT DESCRIPTION
This watershed is almost entirely developed with pockets of parklands and grasslands or wooded acreages scattered throughout. The watershed contains widespread residential development with the densest urban population located within and immediately outside of the I-610 loop.

High density commercial development is concentrated along the US 290 corridor but is also scattered throughout the watershed. Where open grassland was once the primary land cover, subdivisions and commercial developments have rapidly expanded to the north and northwest of Jersey Village.

Nearly all of the waterways throughout the watershed have been channelized, leaving grassy banks and little, if any, vegetative canopy. The main channel in the lower 9.1 miles of the segment has both a concrete bottom and concrete sides half way up the banks. All grass banks throughout the entire watershed are mowed on a regular basis.

White Oak Bayou has four assessment units (AUs) and six unclassified tributaries where samples are collected on a regular basis.

The unclassified tributaries are described below:
- 1017A – Brickhouse Gully (unclassified water body): From the While Oak Bayou confluence to 1.1 km (0.68 miles) upstream of Gessner Road
- 1017B – Cole Creek (unclassified water body): From the White Oak Bayou confluence to Flintlock Street
- 1017C – Vogel Creek (unclassified water body): From the White Oak Bayou confluence to a point 3.2 km (2.0 miles) upstream
- 1017D – Unnamed Tributary of White Oak Bayou (unclassified water body): From the White Oak Bayou confluence to Hempstead Hwy, south of US 290 in Harris County
- 1017E – Unnamed Tributary of White Oak Bayou (Turkey Creek) (unclassified water body): From the White Oak Bayou confluence near W 11th Street, to upstream of 26th Street, south of Loop 610 West.
- 1017F – Rolling Fork Creek (unclassified water body): From the White Oak Bayou confluence to 3.9 km (2.4 miles) upstream

There are 13 routine monitoring stations being sampled on a regular basis during FY2015. Seven sites are located on the main body of water; the remaining sites are located at the furthest downstream road crossing of each tributary described above. The City of Houston Health & Human Services Department collects samples at 11 sites nine months out of the year, while TCEQ collects samples from two sites on a quarterly basis. The USGS operates two flow gage stations (08074020 and 08074500), and Harris County Flood Control District operates 13 gages within the watershed.

TABLE 11. MONITORING STATIONS IN WHITE OAK BAYOU

STATION	DESCRIPTION	COLLECTING ENTITY	ASSESSMENT UNIT
16594	BRICKHOUSE GULLY AT US 290 IN NORTHWEST HOUSTON 2.03 KM UPSTREAM OF CONFLUENCE WITH WHITEOAK BAYOU	HH	1017A_01
16593	COLE CREEK IMMEDIATELY UPSTREAM OF BOLIVIA BLVD 792 METERS UPSTREAM OF CONFLUENCE WITH WHITEOAK BAYOU IN NW HOUSTON	HH	1017B_02
11155	VOGEL CREEK IMMEDIATELY DOWNSTREAM OF WEST LITTLE YORK ROAD	HH	1017C_01
16595	UNNAMED TRIBUTARY OF WHITE OAK BAYOU AT US290 INTERSECTION AT MANGUM ROAD IN NORTHWEST HOUSTON	HH	1017D_01
16596	UNNAMED TRIBUTARY OF WHITE OAK BAYOU AT W 14TH IN WEST HOUSTON 516 METERS UPSTREAM OF CONFLUENCE WITH WHITE OAK BAYOU	HH	1017E_01
11157	ROLLING FORK CREEK IMMEDIATELY DOWNSTREAM OF LAKE LANE	HH	1017F_01
11394	WHITEOAK BAYOU AT NORTH HOUSTON ROSSLYN ROAD	HH	1017_01
11396	WHITEOAK BAYOU IMMEDIATELY DOWNSTREAM OF TAHOE DRIVE	HH	1017_01
15831	WHITEOAK BAYOU AT WEST TIDWELL ROAD IN NORTHWEST HOUSTON	HH	1017_02
15829	WHITEOAK BAYOU IMMEDIATELY DOWNSTREAM OF WEST 43RD STREET IN NORTHWEST HOUSTON	HH	1017_03
11387	WHITEOAK BAYOU IMMEDIATELY DOWNSTREAM OF HEIGHTS BOULEVARD IN HOUSTON	FO	1017_04
11389	WHITEOAK BAYOU AT NORTH SHEPHERD STREET IN HOUSTON	HH	1017_04
15828	WHITEOAK BAYOU IMMEDIATELY DOWNSTREAM OF WEST TC JESTER BOULEVARD IN HOUSTON	FO	1017_04

KEY

FO - TCEQ GS - USGS HG - H-GAC HW - City of Houston UI - EIH

In the Draft 2014 Texas IR, all of White Oak Bayou and its tributaries are listed for not supporting contact recreation use due to elevated bacteria levels. All of White Oak Bayou and five of its six unclassified tributaries have concerns for elevated nutrients, and two unclassified tributaries have concerns for aquatic life use due to low DO measurements.

This segment is a part of the BIG, a large TMDL I-Plan project addressing bacteria impairments in the region's waterways.

HYDROLOGICAL CHARACTERISTICS

White Oak Bayou and its tributaries drain an area of 88 square miles. The main stem of White Oak Bayou (the classified portion of the segment) has a length of roughly 26 miles. When adding the unclassified tributaries, it has a combined length of roughly 52 miles.

H-GAC downloaded and analyzed discharge flow data from both USGS gaging stations - 080742020, located at Alabonson Road, and 08074500, located at the downstream Heights Boulevard bridge. The mean monthly flow at Alabonson Road between January 2007 and January 2015 was 70.6 CFS, while the mean monthly flow at Heights Boulevard was 171.7 CFS.

DESCRIPTION OF WATER QUALITY ISSUES

The most recent TCEQ assessment identified impaired recreational use due to high levels of indicator bacteria, aquatic life uses due to depressed DO and numerous exceedances of nutrient screening levels.

Bacteria

Routine water quality monitoring has found extremely high levels of fecal indicator bacteria throughout White Oak Bayou for at least 20 years, with the contact recreation use of the classified portion being listed as impaired since 1996. Subsequently, a TMDL was adopted by TCEQ and approved by EPA. The White Oak Bayou TMDL became a part of the BIG I-Plan and was adopted in 2013. Since then, H-GAC has detected significant encouraging trends.

H-GAC trend analysis found that *E. coli* density appears to be declining in the upper reach of the watershed (AU 1017_01), as well as in Cole Creek (AU 1017B_02). It is possible that the slight decline in 1017_01 is due to changes at one of the two stations, as there is no trend at the second station, but this trend is supported by analysis of flow-adjusted concentrations and is unlikely due to reduced stormwater runoff alone.

TABLE 12. SUMMARY OF WATER QUALITY IMPAIRMENTS, CONCERNS & TRENDS: SEGMENT 1017 WHITE OAK BAYOU

AU ID	BAC	DO	NUT	CHLOR-A	PCBS & DIOXIN	OTHER	FROG COUNT	COMMENTS
1017A_01	X		X				1	
1017B_01								*Not Assessed in 2014
1017B_02	X	C	X				1	
1017C_01	X		X				2	
1017C_02								*Not Assessed in 2014
1017D_01	X	X	X				1	
1017E_01	X						2	
1017F_01	X		X				2	
1017_01	X		X				2	
1017_02	X		X				2	
1017_03	X		X				2	
1017_04	X		X				1	

X = Impairment C= Concern.

Improving Degrading

See pages 8 - 9 of this document for a full explanation of the Regional Water Quality Summary (Frog Chart)

*Current data was insufficient to conduct assessment - no active monitoring stations.

However, *E. coli* levels are increasing in 1017E_01 (an unnamed tributary in the lower reach of the watershed). Seasonally adjusted Kendall / Sen Slope analysis suggested additional trends in Brickhouse Gully (1017A_01) and Vogel Creek (1017C_01) where *E. coli* levels appear to be falling in those tributaries. Seasonal adjusted analysis also supported the trend found in 1017E_01.

TABLE 13. COMPARISON OF SEVEN-YEAR GEOMETRIC MEANS FROM ASSESSMENTS & H-GAC ANALYSIS

ASSESSMENT UNIT	YEAR ADDED TO TEXAS IR	2012 IR (MPN/100 ML)	2014 IR (DRAFT) (MPN/100 ML)	H-GAC ANALYSIS (MPN/100 ML)
1017_01*	1996	405	375	315
1017_02*	1996	796	643	609
1017_03*	1996	721	638	643
1017_04*	1996	3209	2794	2761
1017A_01*	2002	2279	1446	1062
1017B_02*	2002	2081	1539	925
1017C_01	2010	361	368	345
1017D_01	2002	2309	1158	1430
1017E_01*	2002	1311	962	1305
1017F_01	2012	552	711	605

*Classified 4a; impaired but not listed on 303(d)

Dissolved Oxygen

TCEQ has identified an aquatic life use impairment in Cole Creek (1017D_01) and a concern in an unnamed tributary (1017B_02).

The default trend analysis methods did not suggest significant change, but Sen Slope analysis of seasonally adjusted data indicate that DO levels may be increasing in two assessment units on the main channel (1017_03 and 1017_04) and decreasing in two unclassified tributaries (Vogel Creek and Rolling Fork Creek).

Nutrients
High nutrient levels are a problem throughout the watershed (with the exception of an unnamed tributary, 1017E_01).

TABLE 14. PERCENTAGE OF SAMPLES EXCEEDING NUTRIENT SCREENING LEVELS, 2007-2014

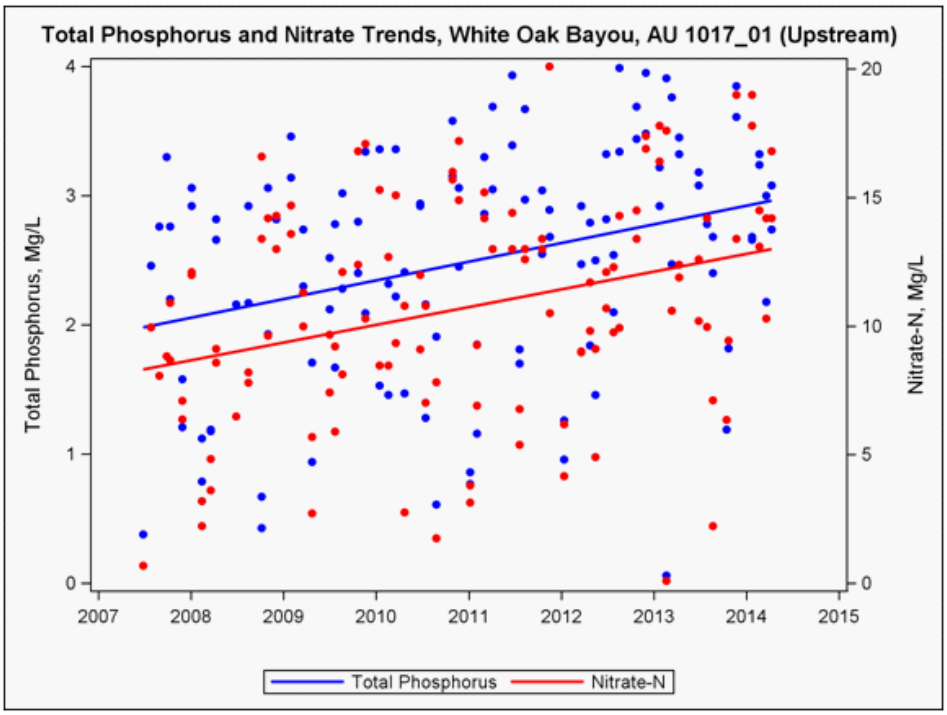
ASSESSMENT UNIT	TOTAL PHOSPHORUS	NITRATE	AMMONIA-N
1017A_01	25.8	40.3	3.2
1017B_02	50.8	15.9	15.9
1017C_01	73.3	71.7	28.3
1017D_01	1.7	0.0	27.1
1017E_01	0.0	0.0	3.2
1017F_01	98.3	100	10.2
1017_01	95.9	97.5	18.2
1017_02	93.7	96.8	6.3
1017_03	73.3	91.7	5.0
1017_04	67.9	84.3	1.7

H-GAC analyses detected significant nutrient trends in all four AUs in the classified portion of the bayou; unfortunately, the situation is deteriorating in all.

Three AU showed significantly increasing concentrations of both total phosphorus and nitrate, while only nitrate was increasing in 1017_03. Nutrient levels appear to be increasing in three tributaries as well – Brickhouse Gully (total phosphorus), Cole Creek (nitrate) and Vogel Creek (total phosphorus and nitrate).

Nitrate levels appear to be declining in two unnamed tributaries (1017D and 1017E). Flow data is available at three monitoring stations, so it was possible to run a trend analysis on flow-adjusted concentrations for three AUs. Flow-adjusted concentrations do not support the nitrate trend in 1017_04 detected by other methods.

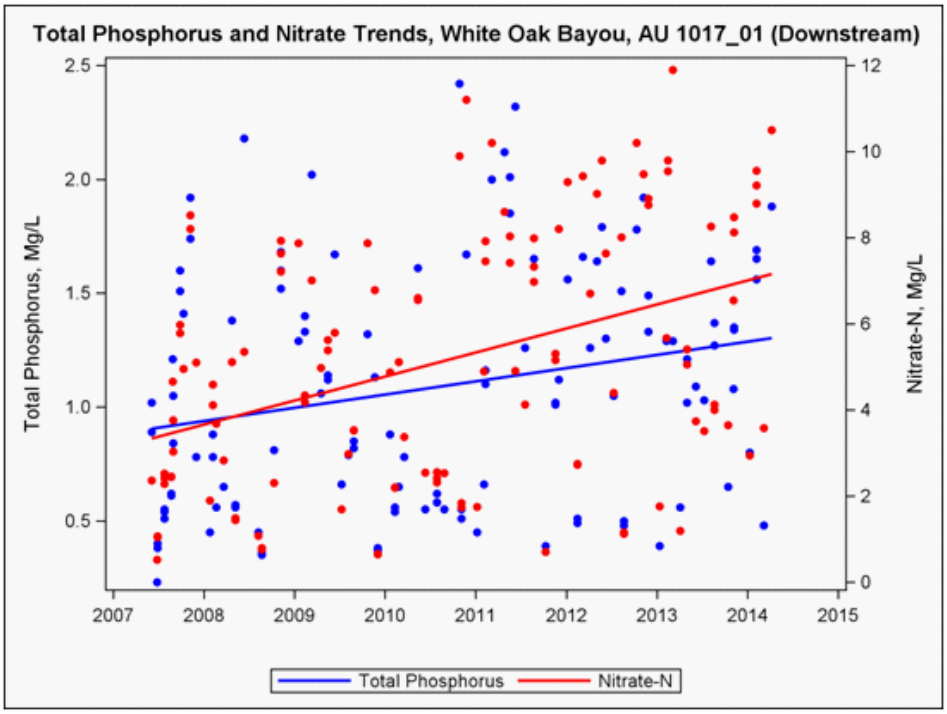
FIGURE 6



Tobit regression was applied to the detection of ammonia trends because it is frequently reported as less than the quantitation limit.

Ammonia concentration appears to be stable in this watershed with the exception of 1017_04 and 1017A_01 (Brickhouse Gully) where the data suggest increasing concentrations.

FIGURE 7



Dissolved Oxygen
One unnamed tributary of White Oak Bayou (1017D) was added to the 303(d) list in 2002 for depressed DO, and it remains on the Draft 2014 IR. The DO concentration in 19 of 68 samples collected during the period of record fell below the grab screening level of 3.0 mg/L. Cole Creek (1017B) is listed as of concern for DO. Trend analysis using the default methods (nonparameteric correlation and linear regression of natural logs on collection date) failed to detect significant changes in the past seven years.

However, DO concentrations are subject to seasonal variation, and the seasonal Mann-Kendall/Sen Slope estimation method may be more reliable. The results of that analysis suggest that DO concentrations are increasing in 1017_03 and 1017_04 in the lower portion of White Oak Bayou and decreasing in Vogel Creek (1017C) and an unnamed tributary 1017E.

The Influence of Domestic Wastewater
White Oak Bayou has relatively little base flow. The TCEQ Central Registry of wastewater permit information identifies 48 permitted facilities that discharge effluent in the White Oak Bayou watershed. The majority (38) is municipal wastewater treatment facilities (WWTFs), and there are four industrial and six private permittees. The municipal plants are permitted to discharge up to 78.7 MGD.

TABLE 14. PERCENTAGE OF SAMPLES EXCEEDING NUTRIENT SCREENING LEVELS, 2007-2014

PERCENTAGE EFFLUENT	NUMBER OF DAYS (TOTAL = 1639)	PERCENTAGE OF DAYS
<25	194	11.8
<50	360	22.0
>50	1279	78.0
>75	1044	63.7
>90	744	45.4

Domestic wastewater is rich in phosphorus and nitrogen compounds and most wastewater treatment plants in the area do not remove much of it. Because a significant portion of the flow (most during dry weather) in White Oak Bayou is treatment plant effluent, it is not surprising that the concentration of nutrients in this waterway is usually quite high.

An analysis that incorporates DMR (discharge monitoring report, submitted monthly by permitted waste water dischargers) data with ambient water quality and flow monitoring provides strong evidence that domestic waste is the principal cause of nutrient problems in the Bayou.

As Figure 8 shows, as the ratio of waste water to total flow increases during dry weather, the concentration of nitrate nitrogen and total phosphorus increases. Figure 9 displays the relationships between total phosphorus, *E. coli* and effluent domination. While *E. coli* density is somewhat higher during low domination/high flow conditions, the association is not as strong as that seen in watersheds where stormwater is the most important source of bacterial contamination.

FIGURE 8

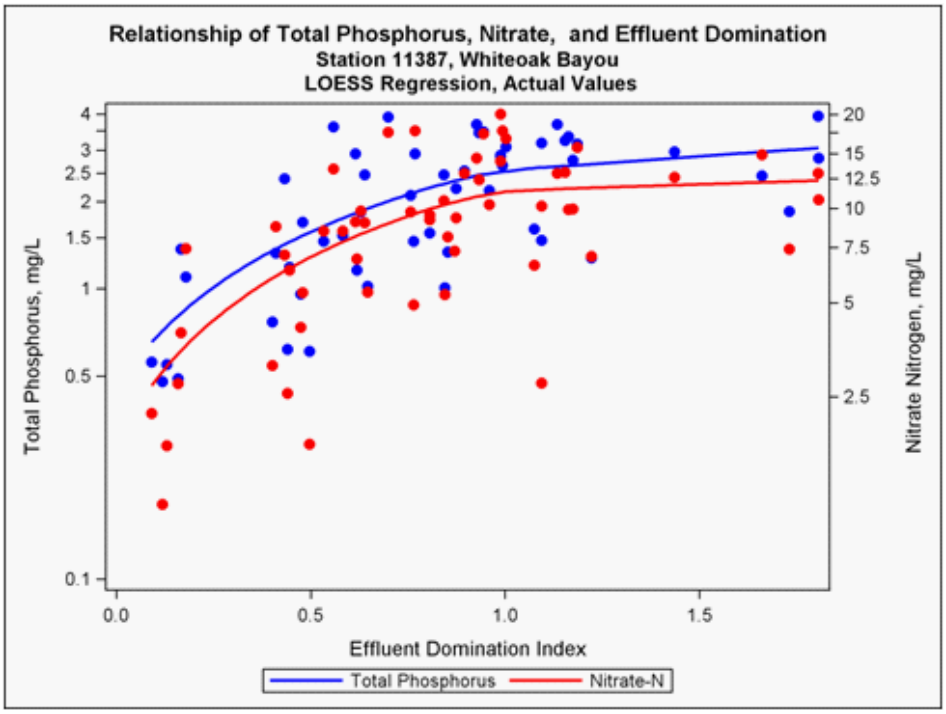
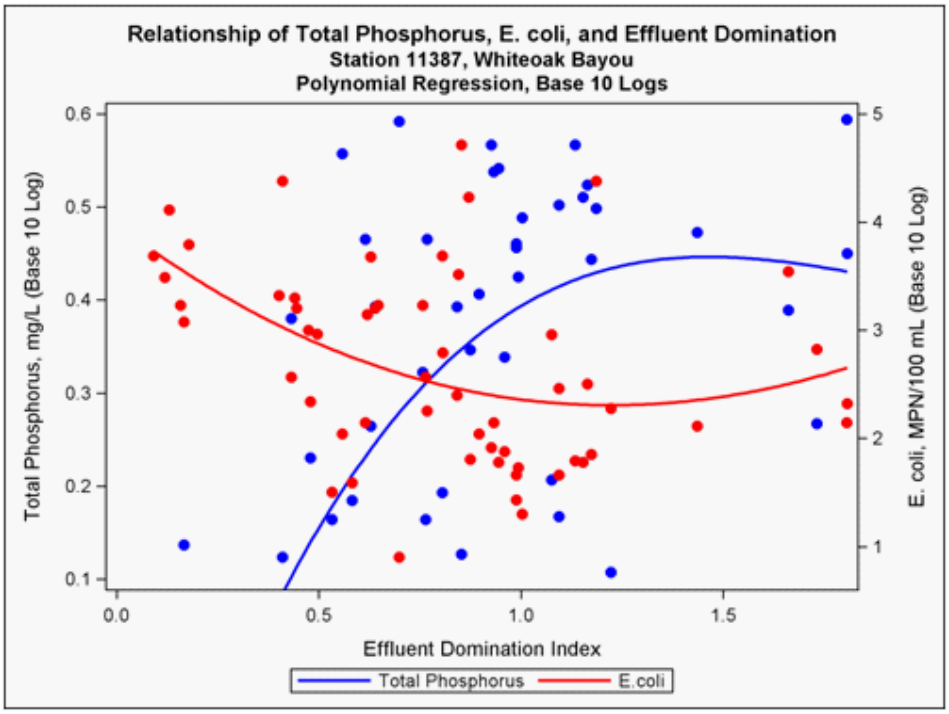
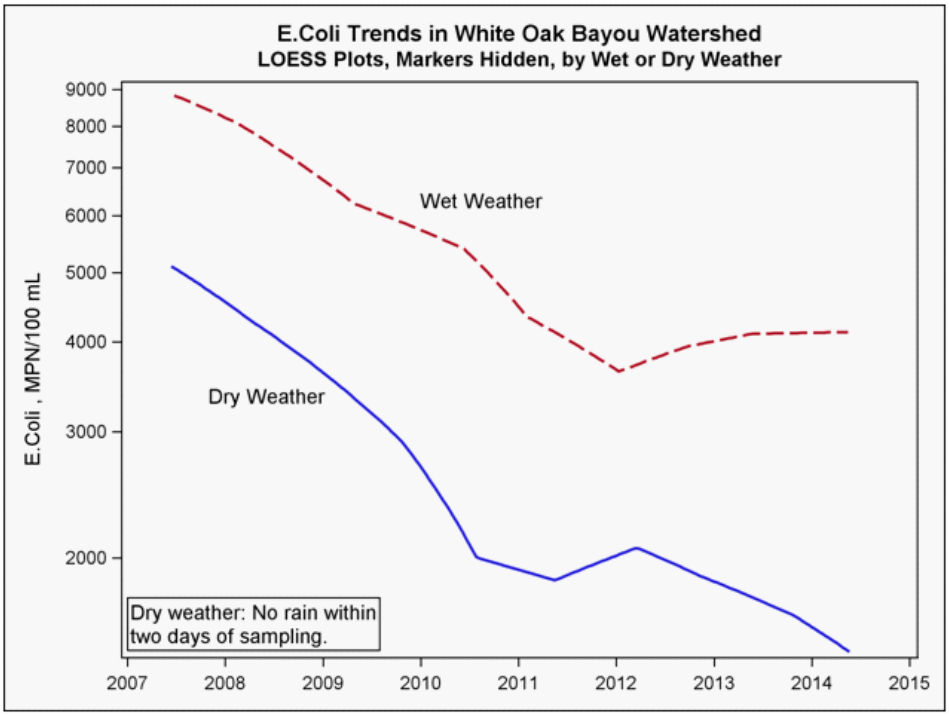


FIGURE 9



The data suggest that most bacteria measured in this watershed are introduced during wet weather. Although the dry weather levels are about five times the water quality standard, *E. coli* density is highest in wet weather. The geometric mean from all stations in the watershed is roughly 2200 MPN/100 mL during wet periods and 570 MPN/100 mL during dry periods. The good news is bacteria concentrations are declining over time during both wet and dry periods as seen in Figure 10.

FIGURE 10



POTENTIAL SOURCES OF WATER QUALITY ISSUE(S)

H-GAC has reviewed the "Technical Support Document for the TMDL for White Oak Bayou." This is a highly urbanized watershed, and potential sources of water quality include WWTF effluent from both domestic and industrial uses – which is a major portion of the flow of White Oak Bayou, especially during dry conditions. There is also a potential source from sanitary sewer overflows, OSSFs and waste from pets.

Due to the rapid growth and construction in this watershed, there has been an increase of impervious surfaces with urban runoff and an introduction of sediments into the waterways. There are also some surrounding industrial sources that could be contributing to the water quality issues in the watershed.

The Jones Road Groundwater Plume, a Superfund Site, is located in the northeast corner of the watershed, approximately a half mile from the intersection of Jones Road and FM 1960. The site was added to the Superfund National Priorities List in 2003. A dry cleaning business unintentionally leaked tetrachloroethylene (a dry cleaning solvent and known carcinogen) onto the property, which percolated into the Chicot aquifer and contaminated adjacent residential and commercial water wells. In 2008, residents and businesses affected by the ground water plume were connected to a municipal water distribution system and the contaminated wells plugged with concrete.

APPENDIX C

ACKNOWLEDGEMENTS

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APPENDIX D

ALTERNATE VIEW OF REGIONAL WATER QUALITY CHART

The numbers represent the percent of total segment length that is impaired or of concern for each parameter. Cells without numbers represent stream segments currently meeting state standards but may be improving or degrading for each parameter.

The "Other" category includes parameters such as metals in water, metals in sediment, impaired habitat, impaired benthic macroinvertebrates, impaired fish communities, sediment toxicity, fecal coliform, mercury in fish tissue, and fish contamination.

IMPROVING | DEGRADING

No significant water quality impairments or concerns exist in the waterbody.

Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other
Lake Conroe	1012	11.0					
Old Brazos River Channel Tidal	1111			100			
Bastrop Bay / Oyster Lake	2433						
Christmas Bay	2434						
Drum Bay	2435						

Water quality impairment(s) or concern(s) exists in the waterbody.

Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other
Cedar Bayou Above Tidal	0902	100					
Lake Houston	1002	19.6	6.6	14.1	41.3		0.1
Chocolate Bayou Above Tidal	1108		100				
Caney Creek	1010	16.1	34.6				
Gulf of Mexico	2501						44.0

Water quality impairment(s) or concern(s) exist in a substantial portion of the waterbody.

Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other
San Jacinto River Tidal	1001					43.4	43.4
East Fork San Jacinto River	1003		100				
West Fork San Jacinto River	1004		61.5		18.1		
Spring Creek	1008	49.8	72.0	1.1	22.3		11.7
Cypress Creek	1009	41.0	84.6		84.6		10.4
Peach Creek	1011		100				
Buffalo Bayou Tidal	1013	30.8	63.3		36.4		27.0
Buffalo Bayou Above Tidal	1014	10.8	79.4		70.7		2.2

Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other
Lake Creek	1015	66.3	11.4				36.8
Greens Bayou Above Tidal	1016	9.0	91.2		80.3		
Clear Creek Tidal	1101	25.7	71.0	13.6	23.8	29.4	
Dickinson Bayou Above Tidal	1104	41.3	41.3				
Oyster Creek Tidal	1109		100				
Oyster Creek Above Tidal	1110	66.3	42.2	42.2			100
San Bernard River Tidal	1301		100	100			
San Bernard River Above Tidal	1302	61.8	75.5		9.5		13.0
Caney Creek Tidal	1304	33.2	100				
Caney Creek Above Tidal	1305	59.7	14.4		59.7		14.4
West Bay	2424	15.0	9.3	11.4		88.5	
Moses Lake	2431		34.8	19.6		54.4	
Chocolate Bay	2432	23.4	41.4			38.7	

Significant, multiple water quality impairment(s) or concerns exist in the waterbody.

Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other
Houston Ship Channel / San Jacinto River Tidal	1005				72.9	100	72.9
Houston Ship Channel	1006	16.5	47.2	7.8	86.5	36.7	36.7
Houston Ship Channel / Buffalo Bayou Tidal	1007	19.6	72.8		83.9	23.8	23.8
White Oak Bayou Above Tidal	1017	11.4	84.6		80.8		
Clear Creek Above Tidal	1102	53.4	85.2		72.4	44.3	4.4
Bastrop Bayou Tidal	1105	84.9	94.3		6.3		
Armand Bayou Tidal	1113	56.5	64.7	24.7	17.7	24.7	10.2
Upper Galveston Bay	2421			89.5	95.7	100	
Trinity Bay	2422			100	60.6	100	
East Bay	2423		30.0	100		100	
Clear Lake	2425	8.4	10.8	65.1	80.0	92.3	65.1
Tabbs Bay	2426				35.1	100	
Black Duck Bay	2428			100	100	100	
Barbours Cut	2436				100	100	
Texas City Ship Channel	2437			100	100	100	
Lower Galveston Bay	2439			100		100	

Severe, multiple water quality impairment(s) or concern(s) exist in a majority of the waterbody.

Watershed	Segment	DO	Bact	Chlor	Nut	PCB	Other
Cedar Bayou Tidal	0901	100	100	100		100	
Dickinson Bayou Tidal	1103	65.6	84.3	12.2		42.5	
Chocolate Bayou Tidal	1107		100			100	
San Jacinto Bay	2427				100	100	100
Scott Bay	2429				100	100	100
Burnett Bay	2430			85.9	100	100	100
Bayport Ship Channel	2438	100		100	100	100	

This report prepared in cooperation with the Texas Commission on Environmental Quality under the authorization of the Texas Clean Rivers Act.

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