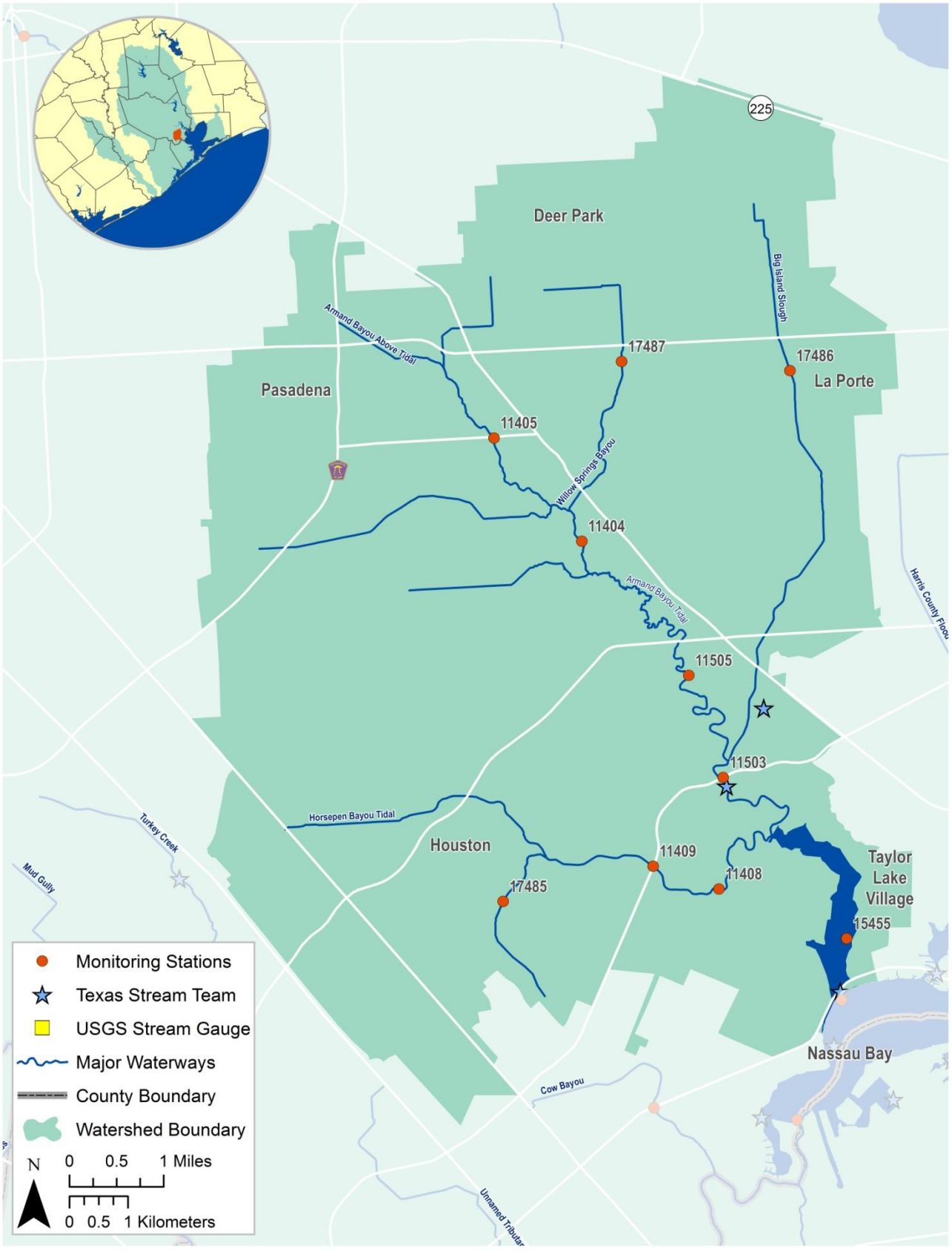
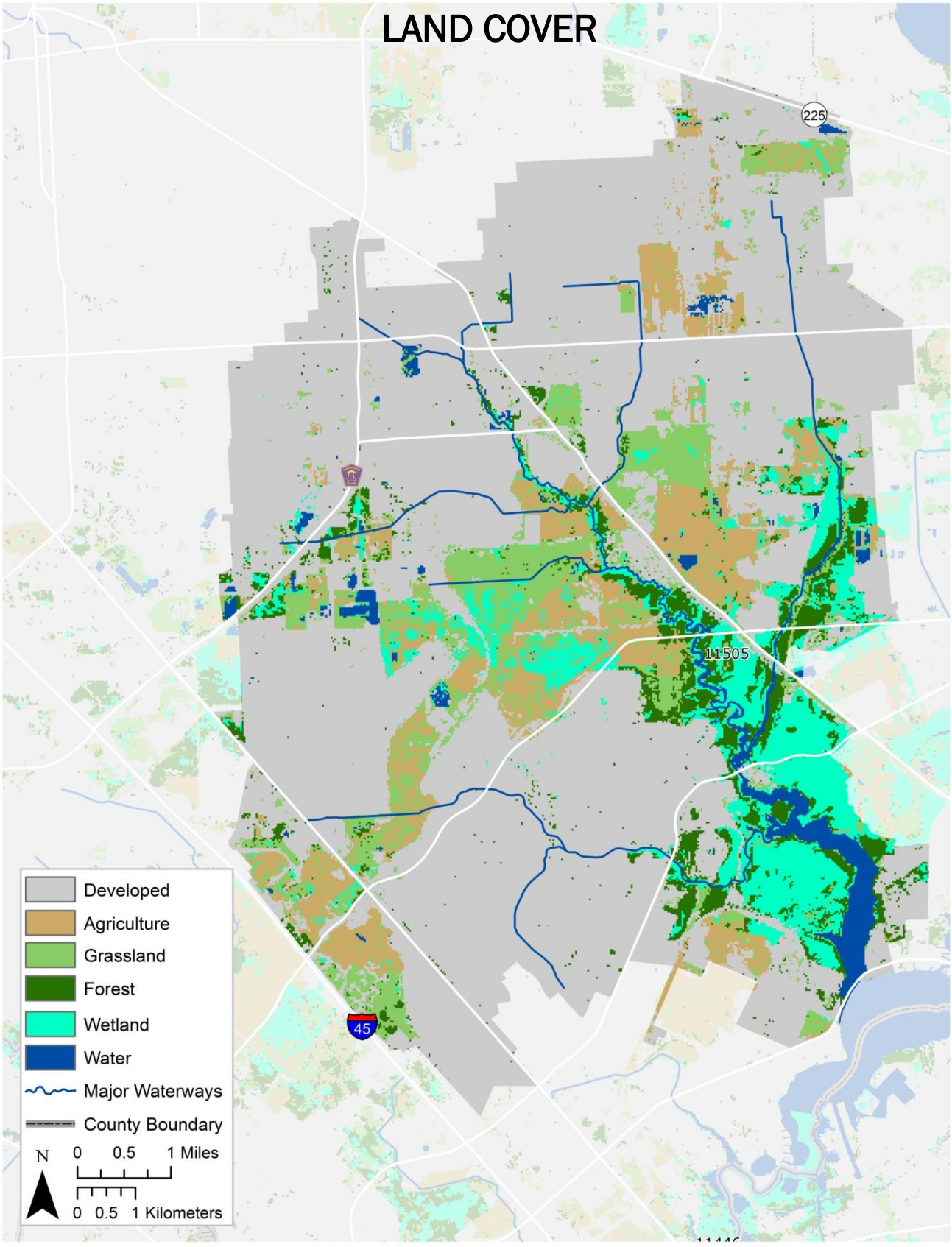
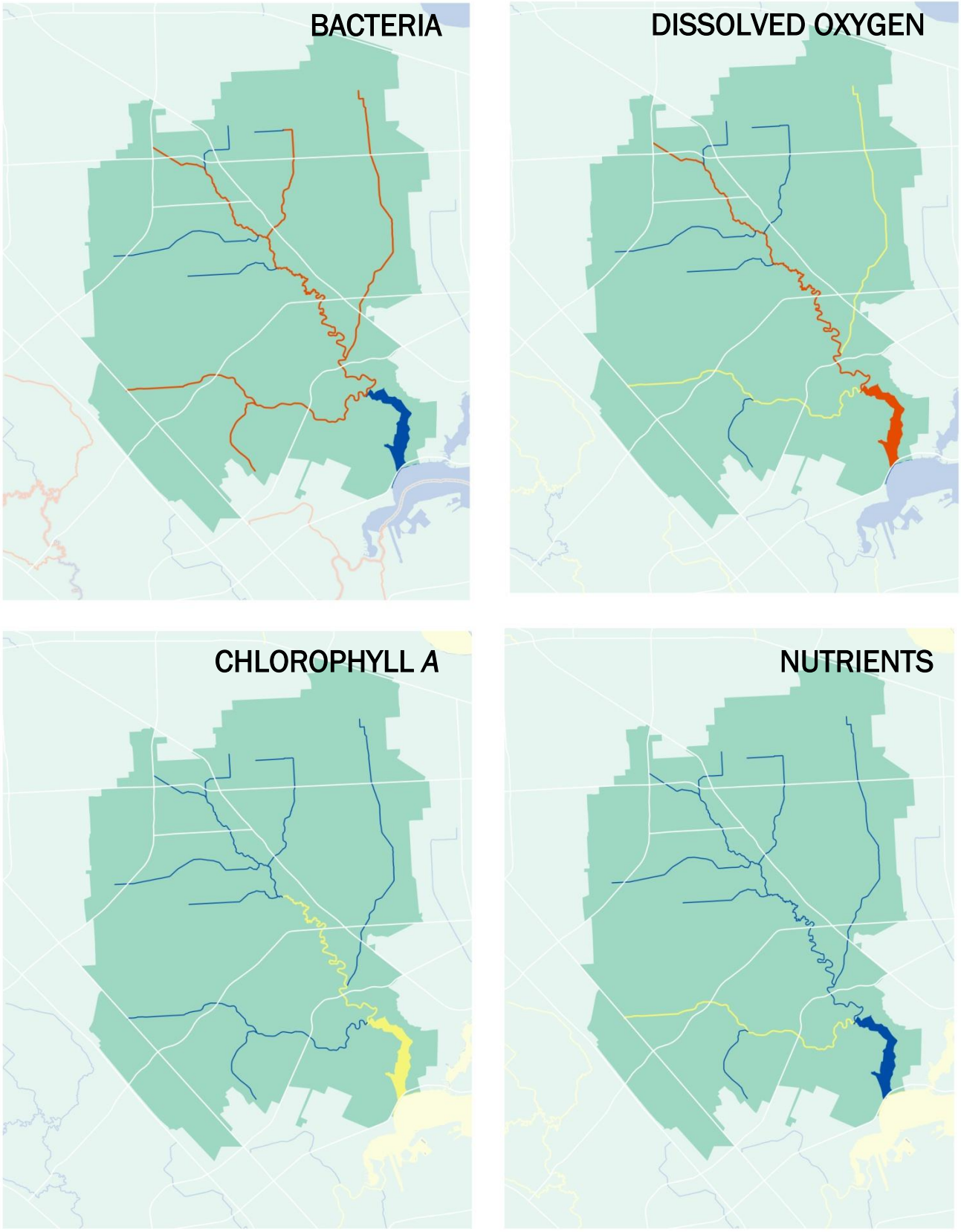
ARMAND BAYOU TIDAL - SEGMENT 1113

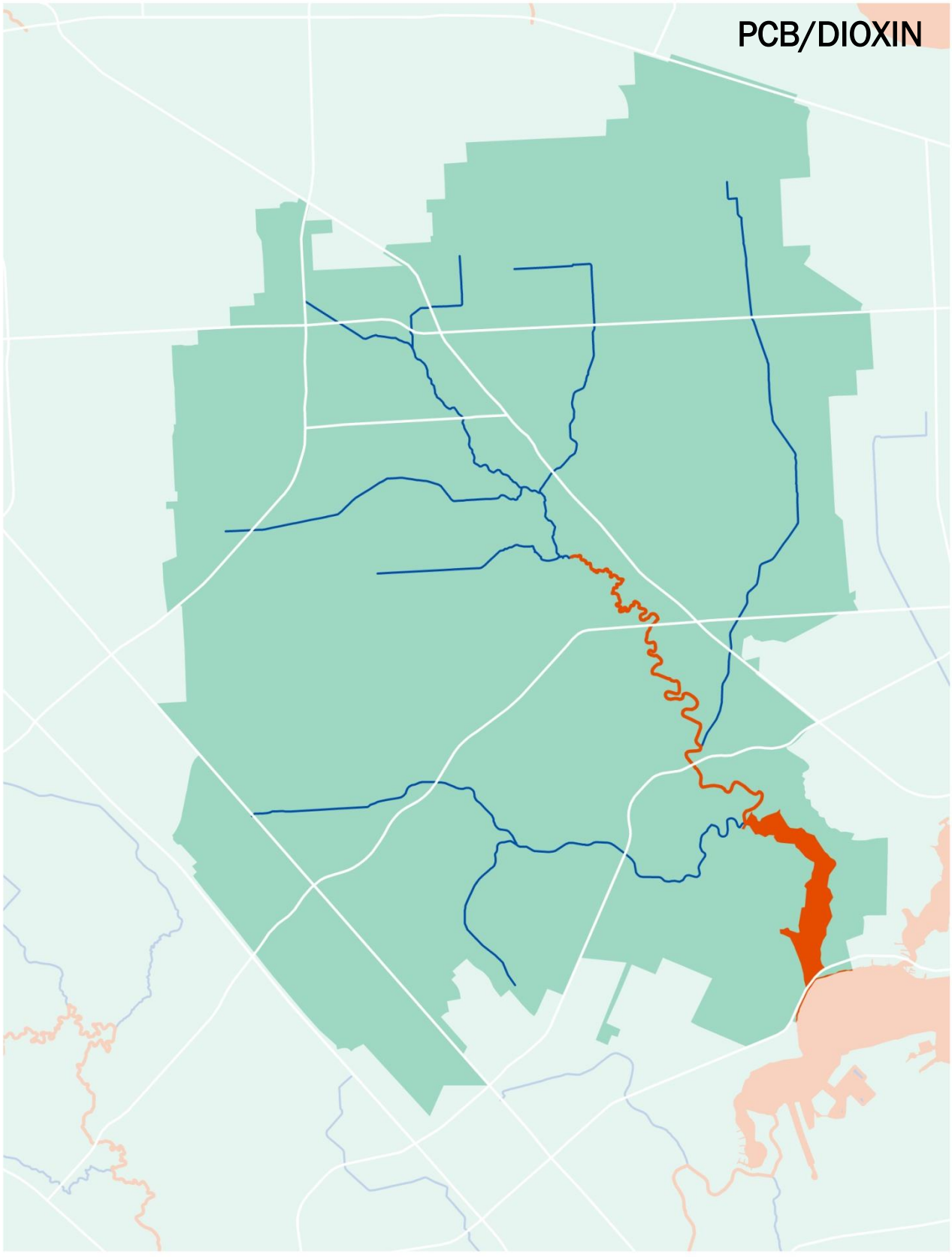


ARMAND BAYOU TIDAL - SEGMENT 1113

LAND COVER

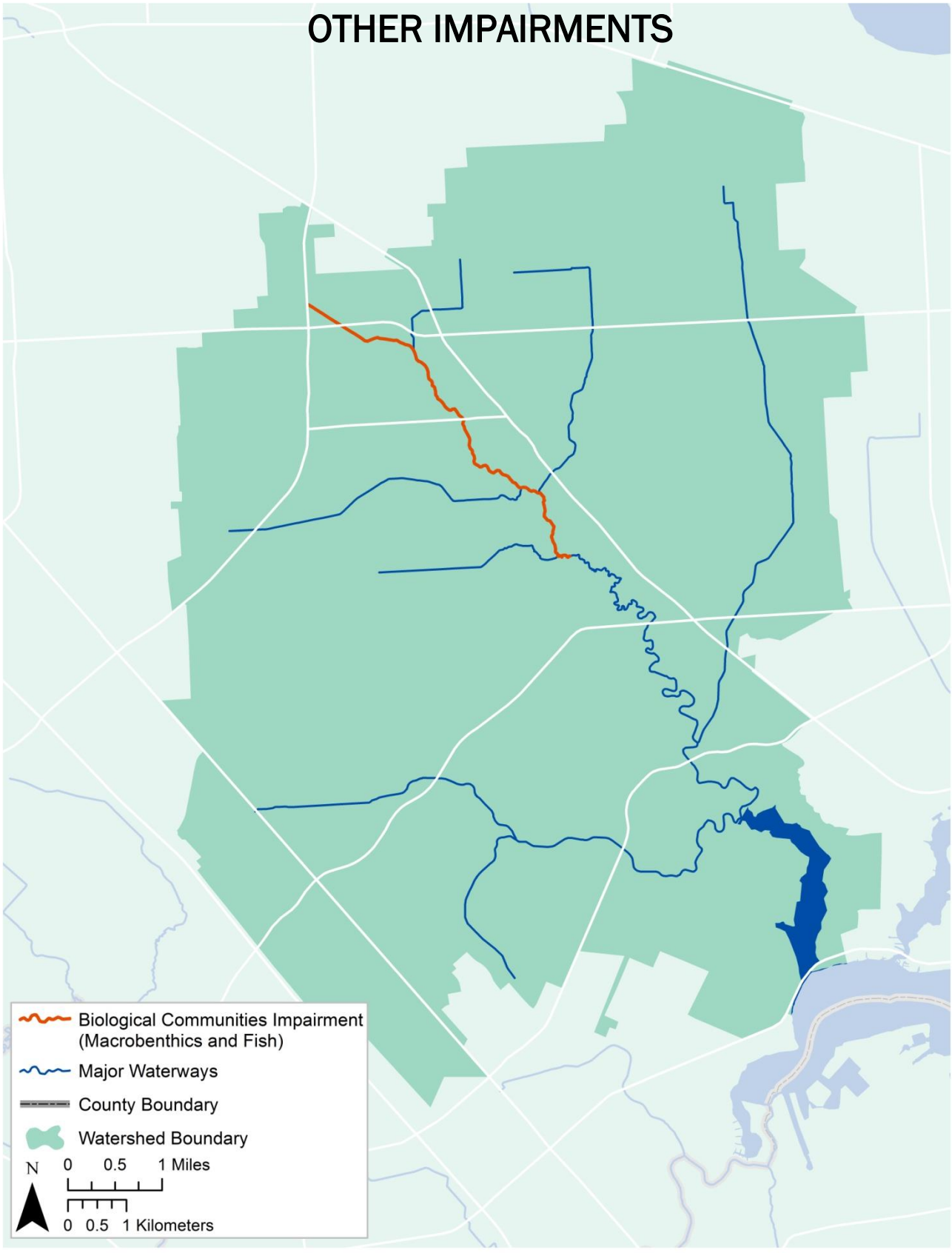



BACTERIA
DISSOLVED OXYGEN
CHLOROPHYLL A
NUTRIENTS
Impairment
Concern
No Impairments or Concerns


PCB/DIOXIN
Impairment
Concern
No Impairments or Concerns

ARMAND BAYOU TIDAL - SEGMENT 1113

OTHER IMPAIRMENTS



Segment Number: 1113	Name:	Armand Bayou Tidal			
Length:	9 miles	**Watershed Area:**	59 square miles	**Designated Uses:**	Primary Contact Recreation 1; High Aquatic Life
Number of Active Monitoring Stations:	10	**Texas Stream Team Monitors:**	1	**Permitted Outfalls:**	5

Description:	Segment 1113 (Tidal Stream w/ high ALU): From the Clear Lake confluence (at NASA Road 1 bridge) in Harris County to a point 0.8 km (0.5 mi) downstream of Genoa-Red Bluff Road in Pasadena in Harris County (includes Mud Lake/Pasadena Lake) Segment 1113A (Perennial Stream w/ high ALU): Armand Bayou Above Tidal (unclassified water body) — From the upper segment boundary of Armand Bayou Tidal, 0.8 km (0.5 mi) downstream of Genoa-Red Bluff Road), upstream to Beltway 8 in Harris County Segment 1113B (Tidal Stream w/ high ALU): Horsepen Bayou (unclassified water body) — From the Armand Bayou confluence to the SH 3 Segment 1113C (Perennial Stream w/ intermediate ALU): Unnamed tributary to Horsepen Bayou (unclassified water body) — From the Horsepen Bayou confluence to Reseda Road Segment 1113D (Tidal Stream w/ high ALU): Willow Springs Bayou (unclassified water body) — From the Armand Bayou confluence to a point 2.8 km (1.8 mi) upstream to an unnamed tributary Segment 1113E (Tidal Stream w/ high ALU): Big Island Slough (unclassified water body) – From the Armand Bayou confluence upstream to a point 2.4 km (1.5 mi) north of Spencer Hwy Segment 1113F (Perennial Stream w/ high ALU): Unnamed Tributary of Armand Bayou Above Tidal (unclassified water body) – From the Armand Bayou Above Tidal confluence upstream to an unnamed tributary 0.48 km (0.3 mi) upstream of Beltway 8 Segment 1113G (Perennial Stream w/ high ALU): Unnamed Tributary of Armand Bayou Above Tidal (unclassified water body) – From the Armand Bayou Above Tidal confluence upstream to an unnamed tributary 1.4 km (0.86 mi) upstream of Red Bluff Road Segment 1113H (Perennial Stream w/ high ALU): Unnamed Tributary of Armand Bayou Above Tidal (unclassified water body) – From the Armand Bayou Above Tidal to the confluence of an unnamed tributary 3.4 km (2.1 mi) upstream and south of Genoa-Red Road 1113I (Perennial Stream w/ high ALU): Unnamed Tributary of Willow Springs Bayou (unclassified water body) – From the Will Springs Bayou confluence upstream to a point 0.37 km (0.23 mi) east of Center Street

Percent of Stream Impaired or of Concern

Segment ID	PCBs/Dioxin	Bacteria	Dissolved Oxygen	Nutrients	Chlorophyll *a*	Other
1113	100	48	48	-	100	-
1113A	-	100	100	-	-	100
1113B	-	100	100	100	-	-
1113C	-	100	-	-	-	-
1113D	-	100	-	-	-	-
1113E	-	100	100	-	-	-

Segment 1113

Standards	Tidal Stream	Perennial Stream	Screening Levels	Tidal Stream	Perennial Stream
Temperature (°C/°F):	35/ 95	35 / 95	Ammonia-N (mg/L):	0.46	0.33
Dissolved Oxygen *(24-Hr Average)* (mg/L):	4.0	5.0 / 4.0	Nitrate-N (mg/L):	1.10	1.95
Dissolved Oxygen *(Absolute Minima)* (mg/L):	3.0	3.0	Orthophosphate Phosphorus (mg/L):	0.46	0.37
pH (standard units):	6.5-9.0	6.5-9.0	Total Phosphorus-P (mg/L):	0.66	0.69
Enterococci (MPN/100mL) (grab):	104		Chlorophyll *a* (µg/L):	21	14.1
Enterococci (MPN/100mL) (geometric mean):	35				
E. coli (MPN/100 mL) (grab):		399			
E. coli (MPN/100 mL) (geometric mean):		126			

FY 2016 Active Monitoring Stations

Site ID	Site Description	Frequency	Monitoring Entity	Parameter Groups
11404	Armand Bayou at Genoa-Red Bluff	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11405	Armand Bayou at Fairmont Parkway	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11408	Horsepen Bayou downstream of Middlebrook Dr.	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll *a*
11409	Horsepen Bayou at Bay Area Blvd	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll *a*
11503	Armand Bayou at Bay Area Blvd.	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll *a*
11503	Armand Bayou at Bay Area Blvd.	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
11503	Armand Bayou at Bay Area Blvd.	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll *a*
11505	Armand Bayou tidal at Exxon Oil Rd.	Quarterly	TCEQ	Field, Conventional, Bacteria, Chlorophyll *a*

15455	Armand Bayou tidal at Clear Lake Park of Fishing Pier in Mud Lake/Pasadena Lake	Monthly	HCPHES	Field, Conventional, Bacteria
17485	Unnamed Trib Horsepen at Penn Hills	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
17486	Big Island Slough at Hillridge	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria
17487	Willow Spring at Bandridge	Nine Times / Year	COH / HHS	Field, Conventional, Bacteria

Water Quality Issues Summary

Issue	2014 Assessment *I – Impaired* *C – Of Concern*	Possible Causes / Influences / Concerns Voiced by Stakeholders	Possible Solutions / Actions To Be Taken
Elevated Levels of Indicator Bacteria	1113 I 1113A I 1113B I 1113C I 1113D I 1113E I	▪ Rapid urbanization and increased impervious cover ▪ Constructed stormwater controls failing ▪ Animal waste from hobby farms ▪ Improper or no pet waste disposal ▪ Poorly operated or undersized WWTFs ▪ WWTF non-compliance, overflows, and collection system by-passes ▪ Direct and dry weather discharges ▪ Waste haulers illegal discharges/improper disposal ▪ Developments with malfunctioning OSSFs	▪ Improve compliance and enforcement of existing stormwater quality permits ▪ Encourage Water Quality Management Plans or similar projects for agricultural properties ▪ Improve construction oversight to minimize TSS discharges to waterways ▪ Add water quality features to stormwater systems ▪ More public education on pet waste disposal ▪ Impose new or stricter bacteria limits than currently designated by TCEQ ▪ Increase monitoring requirements for self-reporting ▪ Regionalize chronically non-compliant WWTFs ▪ Require all systems to develop and implement a utility asset management program and protect against power outages at lift stations ▪ More public education regarding OSSF operation and maintenance ▪ Ensure proper citing of new or replacement OSSFs
Dissolved Oxygen Concentrations	1113 I 1113A I 1113B C 1113E C	▪ Excessive nutrients and organic matter from agricultural production, and related activities ▪ Excessive nutrients and organic matter from WWTF effluent, SSOs, malfunctioning OSSFs, illegal disposal of grease trap waste, and biodegradable solid waste (e.g., grass clippings and pet waste) ▪ Vegetative canopy removed	▪ Encourage Water Quality Management Plans or similar projects for agricultural properties ▪ Improve compliance and enforcement of existing stormwater quality permits ▪ More public education regarding disposal of household fats, oils, and grease ▪ Improve operation and maintenance of existing WWTF and collection systems ▪ Regionalize chronically non-compliant WWTFs

				▪ More public education regarding OSSF operation and maintenance More public education on pet waste disposal ▪ Work with drainage districts and agencies to change practices of clear cutting and channelizing waterways to protect from solar heating ▪ Conserve or restore trees and habitat along waterways to maintain/create shade to cool water
Elevated Nutrients	1113B	C	▪ Agricultural runoff from row crops, fallow fields, and animal operations ▪ Fertilizer runoff from urbanized properties, such as landscaped areas, residential lawns, and sport fields ▪ Nutrient loading from WWTF effluent, sanitary sewer overflows, and malfunctioning OSSFs	▪ Encourage Water Quality Management Plans or similar projects for agricultural properties ▪ Reduce or manage fertilizer runoff from agricultural areas ▪ Implement YardWise and Watersmart landscape practices ▪ Install and/or conserve riparian buffer areas along all waterways ▪ More public education regarding nutrients ▪ Monitor phosphorus levels at WWTFs to determine if controls are needed
Elevated Chlorophyll *a* Concentrations	1113	C	▪ Fertilizer runoff from surrounding watershed promote algal growth in waterways ▪ Nutrient loading from WWTF effluent, sanitary sewer overflows, and malfunctioning OSSFs promotes algal growth	▪ Improve compliance and enforcement of existing stormwater quality permits ▪ Improve stormwater controls in new developments ▪ More public education regarding nutrients
Impaired Macrobenthic and Fish Communities	1113A	I	▪ Loss of habitat due to channelization of waterway ▪ Erosion from construction sites including roads, and commercial and residential developments ▪ Erosion from agricultural properties	▪ Work with drainage districts to install/construct habitat that doesn't interfere with water movement ▪ Strategically plant vegetation to enhance tree canopy and slow bank erosion to create more habitat
PCBs/Dioxin in Edible Fish Tissue	1113	I	▪ Concentrated deposits outside boundaries of the waste pits located adjacent to San Jacinto River and I-10 bridge ▪ Unknown industrial or urban sources	▪ Remove or contain contamination from locations already identified ▪ Encourage additional testing to locate all unknown sources/deposits

Segment Discussion:

Watershed Characteristics: The majority of this watershed is densely developed and includes portions of the Cities of Houston, La Porte, Deer Park, and Pasadena. In addition to residential and commercial development, there are also a number of large industrial facilities, as well as Ellington Air Field. The main segment is primarily lined with forestlands and wetlands while grasslands and agricultural land uses are common throughout the central portions of the watershed. The Johnson Space Center, University of Houston-Clear Lake, and the Armand Bayou Nature Center are located in the southern reaches. The vast majority of this watershed is served by wastewater treatment facilities (WWTF), although there are a few scattered areas of on-site sewage facilities (OSSF) present as well.

Water Quality Issues: The 2014 Texas Integrated Report (IR) lists two assessment units of the classified water body (segment 1113), and three tributaries (1113B_01, 1113D_01, and 1113E_01) as impaired for contact recreation due to elevated levels of Enterococci. Two unclassified segments (1113A_01 and 1113C_01) are also impaired for contact recreation due to elevated levels of *E. coli*. The TCEQ assessment data and H-GAC analyses are summarized below:

Assessment Unit	TCEQ Assessment (2005-2012) Geomean (MPN/100 mL) / % Grab Exceedance	HGAC Analysis 2001-2008 Geomean (MPN/100 mL) / % Grab Exceedance	HGAC Analysis 2008-2015 Geomean (MPN/100 mL) / % Grab Exceedance
1113_01	27 / NA	NA / NA	16 / 10.0
1113_02	41 / NA	26 / 20.0	44 / 29.3
1113_03	48 / NA	22 / 20.0	67 / 21.7
1113A_01	345 / NA	254 / 41.4	140 / 21.2
1113B_01	67 / NA	36 / 21.6	109 / 46.4
1113C_01	187 / NA	243 / 32.4	152 / 27.9
1113D_01	709 / NA	881 / 77.5	557 / 51.6
1113E_01	501 / NA	776 / 70.4	261 / 36.2

The 2014 Texas IR also lists AU's 1113_02, 1113_03, and 1113A_01 as impaired for depressed dissolved oxygen (DO). DO grab measurements were below the 24 hour minimum for 50% of measurements for 1113_02, 100% for 1113_03, and 50% for 1113A_01. 1113_03 and 1113A_01 are also in non support for 24 hour DO average, and both have a concern for water quality screening levels for dissolved oxygen grab samples.

The assessment unit 1113B_01 has concerns for nutrient screening criteria for nitrate nitrogen (nitrate) and total phosphorus (TP). According to the TCEQ assessment data, 76% of the nitrate samples exceeded the screening criteria level of 1.10 mg/L and 54% of TP samples were above the screening criterion of 0.66 mg/L.

Additionally, Assessment Unit 1113A_01 was added to the 2014 IR for impaired fish community and impaired macrobenthic community.

The Texas Department of State Health Services has issued a fish consumption advisory for the assessment units of the classified segment due to concentrations of PCBs and Dioxin in edible fish tissue.

Special Studies/Projects: H-GAC has been tasked by the TCEQ to implement a basin-wide approach for addressing bacterial impairments for the San Jacinto-Brazos Coastal Basin which includes Armand Bayou. Development for the basin-wide TMDL began in September of 2015 and will result in a final Basin 11 Summary Report in September of 2016 that will summarize basin characteristics, water quality impairments, potential bacteria sources, and recommendations for bacterial reduction. This segment is also included in the TMDL project, the Galveston Bay System Survey for Dioxin and PCBs.

Trends: Regression analysis of water quality data revealed a total of 31 statistically significant parameter trends for the six AUs located in the Armand Bayou Tidal Watershed. The main stem had a total of six statistically significant parameter trends including increasing chloride, nitrate, salinity, specific conductance (SPCond), sulfate, and total dissolved solids (TDS). Four parameter trends were detected for 1113A including decreasing trends for *E. coli* and (TP) and increasing trends for pH and salinity. Regression analysis for 1113B data revealed four increasing trends – enterococci, pH, salinity, and sulfate. Five statistically significant trends were identified for 1113C including decreasing chloride, *E. coli*, and SPCond while pH and sulfate levels are increasing over time. The 1113D AU had six statistically significant trends – increasing chloride, DO, pH, and sulfate and decreasing nitrate and Secchi transparency. Finally, regression analysis for 1113E data revealed six statistically significant trends including decreasing chloride, *E. coli*, SPCond, sulfate, and TP while the only increasing trend detected was for pH.

All segment AUs in the Armand Bayou Tidal watershed are currently listed as impaired for bacteria in the 2014 Texas Integrated Report. Moving seven-year bacteria geometric mean plots show a gradual improvement in bacteria concentrations in five out of the six AUs, including the main stem, and AUs 1113A, 1113C, 1113D, and 1113E. Enterococci geomeans for Horsepen Bayou Tidal continue to increase to levels approximately three times above the 35 MPN/100 mL water quality standard. The main stem and all AUs, whether improving or degrading, continue to have geometric mean concentrations that exceed the state water quality standard for indicator bacteria.

Horsepen Bayou Tidal is the only AU in this segment with a nutrient concern listed in the 2014 Integrated Report. Regression analysis of nitrate and TP data for Horsepen Bayou Tidal revealed no statistically significant changes over time; however, the majority of samples collected during the period of record exceed the screening criteria for both parameters.

DO impairments are present for the main stem and for AU 1113A. A DO concern is present for AUs 1113B and 1113E. No statistically significant DO trends were detected during the period of record for these AUs. However, DO concentrations at or below the 3.0 mg/L DO minimum standard still occurs on an infrequent basis. The main stem is also listed as having a concern for aquatic life use support due to elevated levels of chlorophyll *a*. Although no statistically significant trend was detected, the majority of chlorophyll *a* concentrations for the main segment exceed the 21 µg/L screening criteria for tidal streams during the period of record.

Regression analysis of pH data revealed a statistically significant increasing trend for five of the six AUs located in the Armand Bayou Tidal watershed. Reasons for increasing pH may include; 1) detergents and soap-based products from WWTF effluents making water more basic over time, 2) increased tidal influences contributing more dissolved constituents and minerals that impact pH, or, 3) algal photosynthesis removing carbon dioxide in water causing pH concentrations to rise.

Recommendations
Address concerns found in this segment summary through stakeholder participation.
Continue collecting water quality data to support actions associated with TMDL development or any future watershed protection plan development and possible modeling.
Support the efforts of Texas Agrilife to update the watershed protection plan for this segment.