BIG '16

ANNUAL REPORT

BACTERIA IMPLEMENTATION GROUP

This annual report for the Implementation Plan for Ninety- Five Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region (I-Plan) is prepared by the Houston-Galveston Area Council's Community and Environmental Planning Department in collaboration with the Bacteria Implementation Group (BIG), a stakeholder group appointed by H-GAC's Board of Directors and charged with the I-Plan's development and oversight

The preparation of this report was financed in part through grants from the U.S. Environmental Protection Agency and the Texas Commission on Environmental Quality.

More information about the project, including the full I-Plan, can be found at: www.h-gac.com/BIG.

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IMPLEMENTING THE BIG I-PLAN

The 33 member Bacteria Implementation Group (BIG) consists of government, business, and community leaders working together with other stakeholders from across the region to implement the BIG I-Plan to help reduce bacteria in area waterways.

BIG Members

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David Brown, US Geological Survey (Resource Agency/Academia)
Richard Chapin, City of Houston (Large City)
Marilyn Christian, Harris County (Urban County)
Catherine Elliott, Harris County Flood Control District (Urban County)
Rick Felan, Gulf Coast Waste Disposal Authority (Business/Industry)
Greg M. Hall Jr., City of Conroe (Small City)
Teague Harris, IDS Engineering Group (Utility District)
Steve Hupp, Bayou Preservation Association (Conservation)
Jason Iken, City of Houston (Large City)
Tom Ivy, Environmentally Concerned Citizen (Conservation)
Scott Allen Jones, Galveston Bay Foundation (Conservation)
Helen Lane, Houston Audubon Society (Conservation)
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Mitchell Page, Schwartz, Paige & Harding, LLP (Utility District)
David Parkhill, San Jacinto River Authority (Business/Industry)
Raymond Pavlovich, Nottingham County MUD (Utility District)
Linda Pechacek, LDP Consultants, Inc. (Public)
Jim Robertson, Cypress Creek Flood Control Coalition (Conservation)
Linda Shead, Texas Coastal Partners (Conservation)
Brian Shmaefsky, Lone Star College, Kingwood (Resource Agency/Academia)
Earl Smith, City of League City (Small City)
Aaron Wieczorek, City of Houston (Large City)
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Vacancy, (Agriculture)
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Parenthetical indicates type of organization represented.

BIG Alternates

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Kathlie Bulloch, City of Houston
Ralph Calvino, AECOM
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Danielle Cioce, Harris County
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Jessalyn Giacona, Buffalo Bayou Partnership
Frank Green, Montgomery County
Denise Hall, Harris County
Jody Hooks, City of League City
Carol LaBreche, City of Houston
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Jason M. Maldonado, Lockwood, Andrews and Newnam
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Scott Nichols, Montgomery County
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Robert Snoza, Harris County Flood Control District
Michael Thornhill, Si Environmental, LLC
Jennifer Wheeler, Harris County
Carolyn White, Harris County Flood Control District
Jim Williams, Sierra Club

Be Part of the Solution

The BIG project, the first of its kind in the state, is successful thanks in no small part to your support. We are eager to build on this success and seek the continued commitment of our partners and renewed interest and participation of our stakeholders.

Many of the implementation activities in the I-Plan are voluntary. MS4 Phase I and Phase II operators, local governments, farmers and ranchers, OSSF owners, pet owners, and residents can help reduce the amount of bacteria entering waterways.

Learn more by visiting www.h-gac.com/BIG.

Many stakeholders participated in the development of the I-Plan and this Annual Report (see Appendices A and E).

EXECUTIVE SUMMARY

Half of the Houston-Galveston region's stream and shoreline miles have bacteria levels higher than state standards for contact recreation. High bacterial concentrations may cause gastrointestinal illnesses or skin infections in swimmers or others who come into direct contact with the water. Since 2008, a group of government, business, and community leaders as members of the Bacteria Implementation Group (BIG) have joined together to develop and implement a plan, the BIG Implementation Plan (I-Plan), to reduce bacteria and improve water quality so that the region's waters support contact recreation where appropriate. The Texas Commission on Environmental Quality (TCEQ) approved the I-Plan (formally known as the Implementation Plan for Seventy-Two Total Maximum Daily Loads for Bacteria in the Houston-Galveston Region) in January 2013. The 2016 Annual Report is designed to track progress made by the BIG during the period of January 1, 2015 - December 31, 2015.

Three BIG Ideas to Consider

- **Reduce or Eliminate Sanitary Sewer Overflows (SSOs)** – Develop and implement a routine illicit discharge detection and elimination (IDDE) program and prioritize rehabilitation and replacement of aging and/or undersized infrastructure, including collection systems, lift stations, and wastewater treatment facilities (WWTFs). Coordinating with other partners, develop and implement effective education and outreach with residents concerning the handling of fats, oils, and grease. Example programs include the City of Houston's Corral the Grease, and the Galveston Bay Foundation's Cease the Grease programs.

- **Address Failing On-Site Sewage Facilities (OSSFs) (commonly referred to as septic systems)** – OSSFs are wastewater infrastructure, albeit on a much smaller and localized scale. Like all infrastructure, OSSFs require periodic inspections, routine maintenance, and sometimes eventual replacement to function properly. Residents, cities and counties should participate in OSSF function and maintenance training, encourage real estate OSSF inspections at the time of sale and increase the number of inspections. Local governments, as needed, should seek and make funding available to help incentivize OSSF rehabilitation or replacement and promote connections to centralized waste treatment for areas with chronically failing OSSFs.

- **Decrease and Disconnect Impervious Surfaces** – Consider expanding traditional development methods to include alternative practices that decrease use of and/or disconnect impervious surfaces in redevelopment and new built areas. These practices interrupt and slow rainfall run-off offering bacteria reduction measures the opportunity to work before the run-off reaches the storm sewer. Low impact development (LID) and green infrastructure along with other practices have been designed to reduce pollutant loads while not adversely impacting flood management. Cities and counties can encourage the use of these practices by removing potential ordinance barriers and offering incentives for their use.

Implementation Strategies

Since different sources contribute to the bacteria issue in the BIG project area, there is no one-size-fits-all solution for the problem. This I-Plan is a common-sense approach for reducing bacteria in our waterways. Municipalities, industries, landowners, and residents can consider a menu of water protection and implementation activities addressed by the following 11 strategies:

1. Wastewater Treatment Facilities
2. Sanitary Sewer Systems
3. On-Site Sewage Facilities
4. Stormwater and Land Development
5. Construction
6. Illicit Discharges and Dumping
7. Agriculture and Animals
8. Residential
9. Monitoring and I-Plan Revision
10. Research
11. Geographic Priority Framework

Making Progress

Overall, bacteria levels for waterways in the BIG project area are going down. Since 2005, when stakeholders discussed the problem during the total maximum daily load (TMDL) project, bacteria levels in waterways have decreased from above eight times the state's contact recreation standard to above four times the standard (Figure 1). Stakeholders formed the BIG in 2008.

To accomplish the stated goal of the BIG for waterways to meet the contact recreation standard, there is still a long way to go. The good news is the BIG appears to be making a difference. Many stakeholders are actively implementing and tracking progress. Partners within the BIG are examining the effectiveness of implementation activities in reducing bacteria, including installing and monitoring structural best management practices; addressing bacteria impairments as part of their MS4 program; committing resources to address aging and failing infrastructure, educating and training local wastewater treatment operators, developers, and water quality service providers; and conducting public education and involvement campaigns. By working together, we can continue to identify what's working and what still remains to be implemented.

Of note, the Armand Bayou TMDL and plan for implementation was approved by the TCEQ Commissioners in August 2015. Stakeholders for the Armand Bayou watershed recommended the watershed join the BIG project area and stakeholders begin to implement the BIG I-Plan. The BIG approved this decision in June 2015. The 2016 Annual Report reflects the addition of Armand Bayou to the BIG project area. The I-Plan was initially written for 72 TMDLs. With additional TMDLs completed within the BIG project area and the inclusion of Armand Bayou, the I-Plan now covers 95 TMDLs.

Figure 1. Seven-year Bacteria Trend in BIG Area, With and Without Armand Bayou

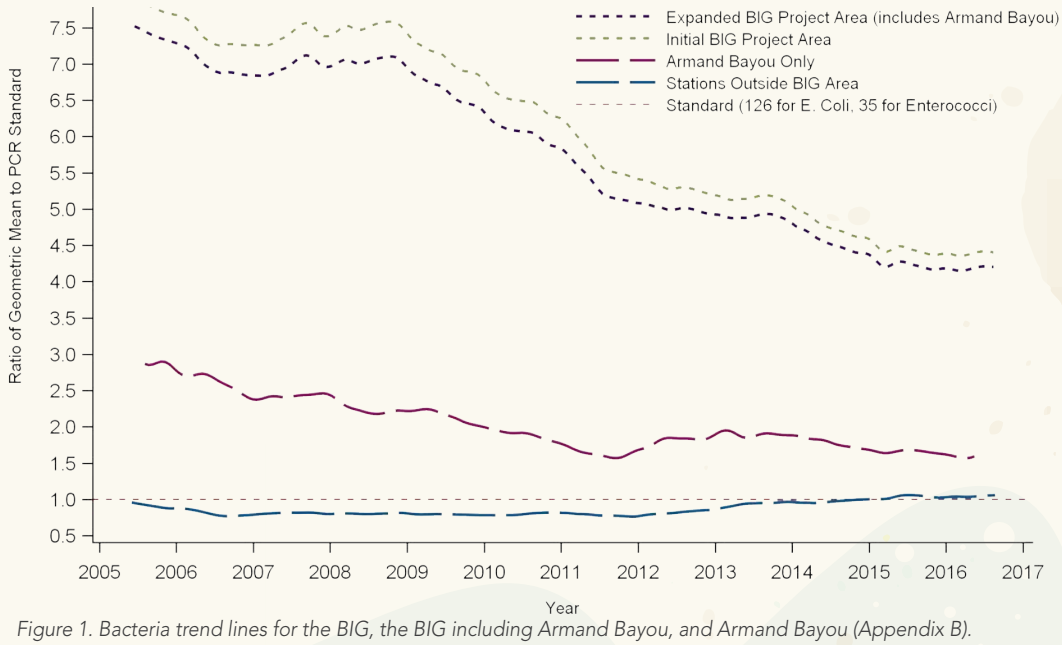


Figure 1. Bacteria trend lines for the BIG, the BIG including Armand Bayou, and Armand Bayou (Appendix B).

BIG PROJECT AREA

The information on this map represents the most current information available to H-GAC and is for general informational purposes only. H-GAC does not implicitly or expressly warrant its accuracy or completeness and neither assumes nor will accept liability for its use.

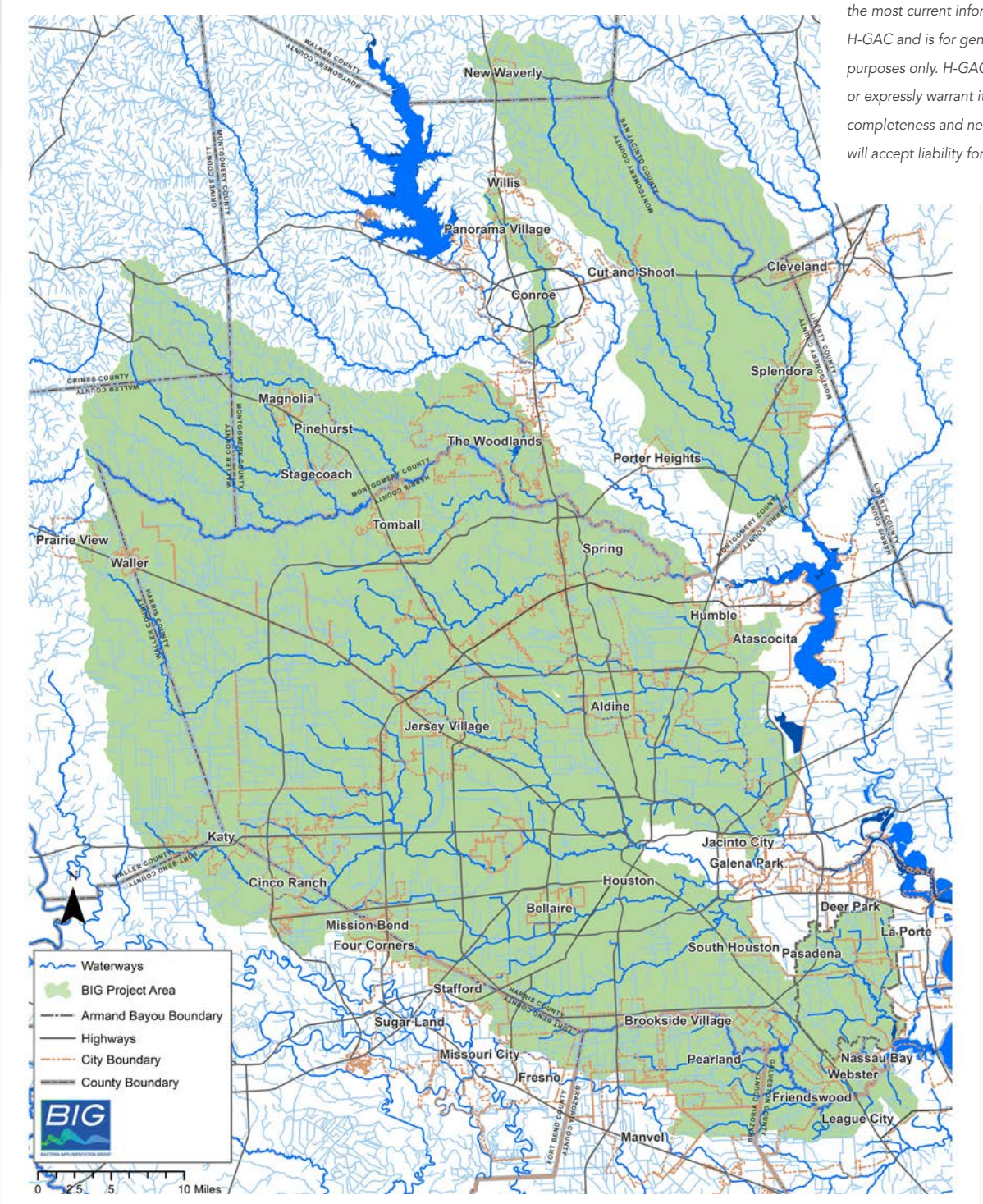


Figure 2. The BIG project area is approximately 2,200 square miles and has a population of about four million people. The area encompasses much of the City of Houston and part or all of another 55 cities and 10 counties.

SPOTLIGHT ON SUCCESS

Highlighting successful projects is an important part of the BIG Annual Report. The BIG hopes by focusing on bacteria reduction projects that are having an impact, presenting cost saving opportunities for organizations on tight budgets, increasing knowledge and understanding, improving operation and maintenance, and/or contributing unique and novel approaches will foster a sharing of information and lessons learned, and ultimately result in expanded use across the BIG project area. While several projects follow, please note this list is not exhaustive and does not reflect the entirety of successful projects carried out by the BIG in 2015.

Galveston Bay Action Network

The Galveston Bay Foundation (GBF) developed the Galveston Bay Action Network (GBAN), www.galvbay.org/gban, using grant funding from the Texas Coastal Management Program. GBF asks citizens to 'Be the Eyes on Your Bay' by reporting chemical spills and dumping of wastes that pollute the environment and threaten public health and the economy.

GBAN is an interactive tool for submitting and viewing water and land based pollution reports across the four counties that touch Galveston Bay (Brazoria, Chambers, Galveston, and Harris), which includes a large portion of the BIG Project Area. The tool is a bridge between residents seeking ways to help reduce pollution and the authorities who can assist in acting on those reports. GBAN pollution reports are sent directly to the appropriate authorities – eliminating the need for users to research where to send the concern

Low Impact Development Outreach

In 2015, the Houston-Galveston Area Council (H-GAC) was developing the Designing for Impact: A Regional Guide to Low Impact Development to encourage local governments to consider LID practices in public and private sector development and redevelopment projects. Over the next 20 years, population growth is expected to fuel development and redevelopment in the Houston-Galveston region including estimates of 6 million parking spaces, 680 million square feet of non-residential buildings and 3.5 billion square feet of residential buildings. LID is an alternative stormwater management method to slow or capture stormwater across a project site, decrease impervious surfaces, which affords the opportunity to improve water quality, along with other benefits in the process.

To develop the guidebook, H-GAC hosted the Designing for Impact Design and Vision workshop in June 4, 2015. H-GAC invited local LID experts present and assist H-GAC guide the seventy-five local government, non-profit, and professional attendees through design and build out scenarios. Information gathered at the workshop help to inform the guidebook on LID, barriers to LID, LID best management practices, and regional case studies.

Additional outreach included development of an interactive webpage, www.h-gac.com/go/LID, to serve as a regional LID resource. Over fifty LID projects are highlighted. An information form was created that will allow organizations to submit LID projects to continuously update the webpage.

Bayou Preservation Association and the City of Houston

In the summer of 2015, the Bayou Preservation Association (BPA) and the City of Houston continued their successful public-private partnership. The organizations joined again to uncover illicit discharges with the hopes of eliminating them from the BIG's top ranked bayous based on elevated bacteria concentrations (Appendix H).

During a short period in the summer, BPA's interns visited Hunting, Brays, Sims, White Oak and Buffalo bayous. They identified several locations within the bayous with elevated E. coli bacteria concentrations. All locations are reported to local jurisdictions, including the cities of Houston and Bellaire, for thorough investigations to identify causes and remedial solutions. A site on Hunting Bayou with a leak identified in 2014 was revisited by BPA. BPA found that the City of Houston's temporary fix was leaking. The City of Houston corrected the leak and is currently working on a permanent fix. In Berry Gully, a Sims Bayou tributary in the City of South Houston, BPA found a hole in an exposed sewer main. The City of South Houston responded and is working to replace the sewer line.

Revisions to WWTF Design Criteria

On November 4, 2015, TCEQ adopted revisions to 30 Texas Administrative Code (TAC) Chapter 217 Design Criteria for Domestic Wastewater Systems and "re-adopted" previously repealed rules in 30 TAC 317.

- Changes to 217 through the adopted rulemaking adds new definitions and clarifies existing definitions; adds design criteria and approval requirements for rehabilitation of existing infrastructure; adds design criteria for new technologies, including cloth filters and air lift pumps; updates existing requirements or develops new requirements to reflect modern practices, standards, and trends; and modifies rule language to improve readability and enforceability.

- Re-proposal to 317 adopts 30 TAC Chapter 317 by restoring the status quo for enforcement of all pre-Chapter 217 facilities. Adoption of Chapter 317 brings existing facilities not under Chapter 217 back under TCEQ regulation to promote safety and proper operation of wastewater systems and to meet statutory requirements.

PROGRESS REPORT

Ultimate Success for the BIG will be achieved when the waters assessed by the state are no longer considered impaired, meaning they meet the state water quality contact recreation standard. Achieving that goal requires annually assessing progress to determine what is working and what is not working, looking critically at what each of the BIG partners is doing to further the goals set forth in the I-Plan, sharing information, and coordinating future implementation activities. This Annual Report is meant to be a mechanism for annual assessment, encouraging efforts that appear to be working and redirecting implementation that seems to be falling short. It is also an opportunity to look at the I-Plan to see if expectations are being met or if some activities need further refinement.

Most of the information in this report is based on reports given to H-GAC through the workgroup process by stakeholders already involved in the BIG's planning effort.

The BIG workgroups met in separate meetings between November 2015 and January 2016 to discuss implementation. This report includes activities through December 2015.

This report is divided into 11 sections and appendices. Each section includes a summary of the implementation strategy, a focus for next year, and individual implementation activities in-line with the activities set out in the I-Plan. There are 38 implementation activities described in the I-Plan and laid out in this report. For each activity goals, an assessment, and a summary of implementation efforts conducted throughout the year are presented.

The assessment of each activity includes determining progress made toward achieving the activity's interim goal: Not Started, Initiated, In Progress, or Completed. Additionally, each activity is assessed based on the BIG partner's efforts to advance the activity over the year: Behind Schedule, On Schedule, or Ahead of Schedule.

Overall, 37 activities, one more than in 2014, are listed as In Progress with one remaining as Initiated (Appendix C). For the year 2015, Six activities are considered Ahead of Schedule, 28 are On Schedule, and four have been assessed as Behind Schedule. One activity was moved to Behind Schedule from On Schedule, three moved up from Behind Schedule to On Schedule and three were shifted from On Schedule to Ahead of Schedule since the 2014 report. In 2016, the BIG intends to look address those activities that are Behind Schedule and request feedback from the TCEQ on TCEQ implementation of the I-Plan.

Figure 3. BIG Implementation Progress Report

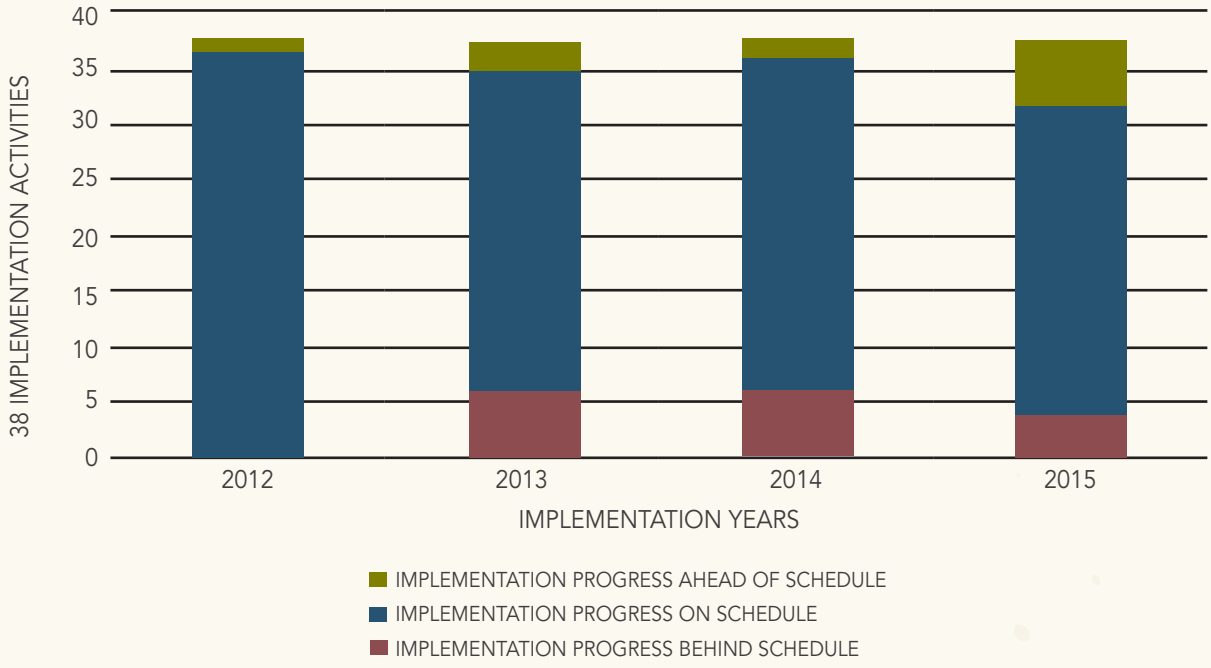


Figure 3. BIG Implementation progress reported since 2012 for the thirty-eight implementation activities

WASTEWATER TREATMENT FACILITIES

1

Summary

Wastewater Treatment Facilities (WWTF) effluent is a potential source for bacteria in the BIG project area. When operated properly and under most conditions, WWTFs meet state permit limits. Texas Pollutant Discharge Elimination System (TPDES) permits have been renewed, bacteriological testing requirements (except in specific circumstances) have been added to the permits to better demonstrate adequate disinfection of effluent prior to being discharged to the receiving stream, since chlorine residual alone was not always reliable as an indicator of adequate disinfection.

Many of the BIG region's waterways are considered to be effluent dominated, having minimal natural flows. The information learned through discharge monitoring can help WWTF operators enhance plant operation and direct resources, when needed, toward maintenance and planned upgrades.

Bacteria results from DMRs* submitted in 2015 by 451 BIG project area WWTF operators suggest that 96.5 percent of the 4,302 highest single grab/daily maximum bacteria samples reported (Table 1), met the WWTF required bacteria limits for *E. coli* or enterococci. That is a slight decrease from the 97.4 percent reported for 2014.

The Wastewater Treatment Facilities Workgroup met with the Sanitary Sewer Systems Workgroup on December 8, 2015. Seventeen members reported over the past year the focus of implementation has been directed toward: 1) continuing to track the revision of Texas Administrative Code Title 30, Chapter 217 and reinstating Chapter 317, 2) the addition of two TCEQ employees to review plan sets and 3) facility design and upgrades. H-GAC continued to update data on WWTF permit limits, effluent data, compliance, and enforcement.

**H-GAC used data from the TCEQ's DMR database, TCEQ's Central Registry, and H-GAC's permit database for the BIG project area.*

2016 Focus

- H-GAC and BIG stakeholders plan to
  - Implement a survey of BIG project area WWTF operators;
  - Evaluate WWTF permits in the Armand Bayou watershed to determine if they will be required to meet the 63 MPN/100mL;
  - Conduct literature review on efficacy of different disinfection practices;
  - Recommend WWTF research topics to area universities; and
  - Follow-up with WWTFs to determine if plans and specification applications to the TCEQ were being carried out to improve operation and assist in meeting effluent standards. Applications are made for plant improvements, rehabilitations, expansions, modifications, upgrades, and reuse/reclaim effluent.

Implementation Strategies

1.1 Impose More Rigorous Bacteria Monitoring Requirements

– **Interim Measure:** *Within five years, all of the WWTF permits should have had renewals initiated to include more rigorous monitoring requirements.*

Project Status

☐ Not Started
◘ **Initiated**
☐ In Progress
☐ Completed

◘ **Behind Schedule**
☐ On Schedule
☐ Ahead of Schedule

– *With each WWTF permit renewal, facilities are being required to initiate bacteria monitoring at the state specified frequency. The BIG I-Plan proposed more stringent monitoring frequencies than the state required. However, the TCEQ (source: TCEQ) does not plan to incorporate the BIG proposed monitoring frequencies at this time.*

Implementation Effort

- **Increased Monitoring:** The BIG recommended in the I-Plan that the TCEQ apply more stringent monitoring frequencies for WWTFs in the BIG project area. The BIG's Coordination and Policy Work Group reviewed a draft letter that will be presented to the BIG. Once approved, the letter will be sent to the TCEQ. The letter would request renewed or new permits be issued with the BIG I-Plan recommended frequencies.
- **Education:** January 28, 2015, H-GAC hosted a Clean Waters Initiative (CWI) workshop on Water Quality Case Studies. TCEQ presented on Bacteria Sampling at WWTFs.

Table 1: 2015 Bacteria Permit Limit Compliance Taken From DMR Database*

Number of Geomean Results Reported from Permittees with Limits in Permit	4,093
Number of Samples Below Daily Average Limit	4,078
Percentage of Samples Below Daily Geomean Limit	99.6%
Number of Highest Single Grab/Daily Max Samples Reported for WWTF DMR Monitoring Period	4,302
Number of Highest Single Grab/Daily Max for WWTF DMR Monitoring Period Below Limit	4,152
Percentage of Highest Single Grab/Daily Max for WWTF DMR Monitoring Period Below Limit	96.5%

Table 1. Number and percentage of samples taken in 2015 that fell below WWTF bacteria limits for facilities within the BIG project area.

Additional samples are potentially collected by WWTFs during the monitoring period depending on their permits with the state, but only the highest value reported during the monitoring period is used for this analysis.

What is a Geomean?

Bacteria data are often summarized using a geometric mean. H-GAC calculates the mean of the natural logarithms of each bacteria value and then converts the logarithm back into a number by exponentiation.

E. coli and enterococci data can be standardized for comparison by dividing the geometric mean by the water quality standard to produce a relative geometric mean.

What is a Single Grab/ Daily Max?

WWTF reporting typically requires a single grab bacteria sample or a daily maximum bacteria sample during the reporting period. A single grab sample is an individual sample collected in less than 15 minutes. A daily maximum sample is the maximum concentration measured on a single day, by the sample type specified in the permit, within a period of one calendar month.

1.2 Impose Stricter Bacteria Limits for WWTF Effluent

– **Interim Measure:** *Within five years, all of the WWTF permits should have had renewals initiated to include more stringent limits for bacteria in effluent.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *The majority of WWTFs in the BIG project area have undergone permit renewals that have included the more stringent bacterial limit and performance criteria dealing with the geometric mean and individual maximum results.*

Implementation Effort

◘ **Permit and DMR Findings.** H-GAC analyzed WWTF permits from the H-GAC permits database, TCEQ's Permit Application and Registration Information Systems (PARIS), TCEQ's Central Registry, and TCEQ's DMR dataset and made the following observations

– In 2015, there were 542 permitted industrial, municipal, and private WWTFs in the BIG project region (source: H-GAC GIS Data and TCEQ's Central Registry and PARIS databases).

» 500 were found to be submitting data of any kind in the DMR database (source: TCEQ DMR dataset). Of the 500, 452 facilities report bacteria data (Table 2).

» 441 WWTFs report *E. coli* as their reportable bacteria and six WWTFs (one in Armand Bayou) are using enterococci as their reportable bacteria (Table 2). No limit could be found for five permittees, which is down from 48 permittees reported in 2014.

» Ninety percent (or 396), of the 441 facilities in the BIG project area in 2015 using *E. coli* have the more stringent bacteria limit of 63 MPN/100 mL (Table 2). This is 2 percent lower than what was reported in 2014. This figure can be explained due to the drop (-14) in the number of WWTFs with reportable limit of 63 MPN/100mL and the increase (+9) in facilities with 126 MPN/100 mL.

» It should be noted that not all plants using *E. coli* as their reportable bacteria in the BIG project area will be required by the state to have a 63 MPN/100mL limit. As an example, WWTFs in the Clear Creek watershed will have limits of 126 MPN/100mL since the TMDL study demonstrated that limit would allow the waterbody to meet state contact recreation standards.

» WWTF operators reported 4,093 *E. coli* daily average results in 2015, up from 4,002 results reported in 2014 as the region's bacteria reporting values continue to increase (Table 1).

◘ **Future Research.** BIG stakeholders asked H-GAC, as data and funding become available, to conduct further research on the following topics:

– Age of WWTFs to identify any potential correlations with exceedances (or bacteria levels in general)
– Correlation to rainfall events
– Differences between UV and chlorination disinfection

H-GAC currently lacks the funding to conduct additional studies.

Table 2: Total Number of BIG WWTF By Type from 2015 DMR

Permit Type	*Permittees Submitting DMRs in 2015 (TCEQ Data)*	*Number of Permittees Reporting with E.coli Geomean Limit of 63 MPN/100 mL (TCEQ DMR)*	*Number of Permittees Reporting with E. Coli Geomean Limit of 126 MPN/100 mL (TCEQ DMR)*	*Number of Permittees Reporting with Enterococci Geomean Limit of 35 MPN/100 mL (TCEQ DMR)*	*No Bacteria Geomean Limit in H-GAC Permit Database*
Industrial	14	9	3	2	0
Muni. Domestic	341	296	37	1	4
Pvt. Domestic	97	91	5	0	1
Total	452	396	45	6	5

Table 2. BIG project area WWTFs reporting DMRs to the TCEQ in 2015. WWTFs are broken out into type of facility, reporting limits per the permit reviewed either through H-GAC's permit database or the TCEQ's Central Registry. WWTFs with 'No Geomean' submitted data to the TCEQ DMR but as of the date data was pulled for the Annual Report, no limit could be determined.

Figure 4. BPA interns conducting a water quality investigation on Cypress Creek.

1.3 Increase Compliance and Enforcement by the TCEQ

– **Interim Measures:** *Each year, TCEQ can address low numbers of investigations and renewals by increasing*

- *The number of unannounced inspections conducted;*
- *The number of focused sampling investigations;*
- *The percent of plans and specifications reviewed;*
- *The percent of DMRs reviewed;*
- *The number of other investigations conducted; and*
- *The ability of the TCEQ to conduct focused sampling investigations.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

◘ **Behind Schedule**
☐ On Schedule
☐ Ahead of Schedule

– *H-GAC does not have information from the TCEQ to address all of this activity's interim measures. BIG stakeholders will continue to work with TCEQ to obtain data to evaluate the interim measure in the future. Local compliance data and DMR data will be used until that time.*

Implementation Effort

◘ **Compliance and Enforcement. H**-GAC analyzed Harris County Pollution Control Services (HCPCS) inspections of WWTFs in Harris County for 2015 with the same WWTFs' DMR self-reporting data in 2015. The following observations were found:

- HCPCS inspectors reported in 2015, 91.5 percent compliance with the single grab limit down from 93.7 percent compliance in 2014, but still above the 91.0 percent reported in 2013 for unannounced compliance inspections within Harris County (Table 3).
- WWTFs in Harris County that submitted DMR reports (self-reporting) for the same plants sampled by HCPCS indicated 97 percent compliance, down from 98 percent in 2014, but up from 96 percent in 2013, for single grab/daily max samples in compliance with permitted bacteria levels (Table 3).
- The WWTFs' compliance rate appears to fall between 92 percent and 97 percent for 2015 from WWTFs in Harris County's BIG Project Area using both the HCPCS and WWTF DMR data.
- Large facilities (>10 million gallons daily [MGD]) and the smallest facilities (>0.1 MGD) were less than 90 percent compliant under HCPCS compliance inspection data. Large WWTFs' self-reporting resembles HCPCS data. The smallest facilities DMR data did not closely mirror the HCPCS data.
- For WWTFs in the BIG Project Area, >0.1 MGD and >10 MGD WWTFs were the highest category of WWTF to exceeded the single grab/daily max permit limit 25 percent or more in 2015, both with seven facilities each (Table 4). This was a decrease for the smallest facilities, down from 18 in 2014, but an increase of five for the largest category.

◘ **Focused Sampling Investigations.** The TCEQ has not approved focused sampling investigations.

◘ **Focused Investigation.** The TCEQ reported no focused investigations were carried out in 2015. Focused investigations are targeted investigations rather than multi-day compliance investigations. Using focused investigations, TCEQ can potentially cut down on time investigating each WWTF and increase the number of WWTFs visited per year, increase the time available to spend at WWTFs that are having issues, and identify plants that would benefit from additional owner/operator education.

Table 3: WWTFs in the BIG Project Area Inspected by Harris County Pollution Control Services

Relative Plant Size / Permitted (MGD)	Data Source	Number of Highest Single Grab/ Daily Max for WWTF DMR Monitoring Period	Number of Highest Single Grab/Daily Max for WWTF DMR Monitoring Period Meeting Limit	Percentage of Highest Single Grab/ Daily Max for WWTF DMR Monitoring Period Meeting Limit	Data Source	Number of Random Samples Collected	Number of Samples Meeting TCEQ Grab/ Single Sample Limit	Percent HCPCS Samples Meeting TCEQ Permit Limit
< 0.1 MGD	DMR	351	342	97.4%	HCPCS	154	129	83.8%
0.1-0.5 MGD	DMR	648	642	99.1%	HCPCS	85	81	95.3%
0.5-1 MGD	DMR	756	739	97.8%	HCPCS	92	91	98.9%
1-5 MGD	DMR	865	828	95.7%	HCPCS	96	90	93.8%
5-10 MGD	DMR	200	193	96.5%	HCPCS	17	17	100.0%
> 10 MGD	DMR	156	128	82.1%	HCPCS	14	11	78.6%
Total	DMR	2976	2872	96.5%	HCPCS	458	419	91.5%

Table 3. Domestic WWTFs in Harris County found within the BIG project area reporting to the DMR database that underwent Harris County Pollution Control Services (HCPCS) inspections and that had permit limits at the time of inspection. The random grab sample collected by HCPCS is compared to single grab/daily max samples, number of samples meeting permit limits, and percentage meeting.

Table 4: Permittees with 25% or More Excursions Above Permit Limit

Plant Size/Permitted Flow	Daily Geomean	Daily Max or Grab
Variable or Unknown	1	1
< 0.1 MGD	7	7
0.1-0.5 MGD	.	1
0.5-1 MGD	.	1
1-5 MGD	.	5
5-10 MGD	.	2
> 10 MGD	.	7

Table 4. WWTFs in the BIG project area in 2015 are reporting to the DMR database where 25 percent or greater samples taken exceeded the facility's permit limit.

1.4 Improved Design and Operation Criteria for New WWTFs

– **Interim Measure:** *Every five years, at least 20% of local governments should consider whether to adopt stricter requirements. Note: The I-Plan indicates the revision process should start in year six of implementation.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
☐ On Schedule
◘ **Ahead of Schedule**

– *This activity is Ahead of Schedule. While the I-Plan did not anticipate activities for six years, the TCEQ is currently addressing new criteria.*

Implementation Effort

- **TCEQ Reviewers.** TCEQ reported two new staff have been added to the region to review plan sets specifications and design.
- **WWTF Design Express Reviews.** Harris County screened 43 WWTF plan sets for compliance with state disinfection standards in 2015. Of those, two were referred to outside consultants for in-depth plan review where modifications had to be made.
- **New State Design Criteria of Domestic WWTFs.** November 4, 2015, TCEQ adopted revisions to Chapter 217 of the Texas Administrative Code(TAC) to update WWTF standards and criteria with current engineering practices and to reflect the current permitting practices. TCEQ also reinserted Chapter 317 to ensure WWTFs established prior to 2008 were included in the TAC, ensuring TCEQ regulatory authority. In 2015, BIG stakeholders continued to track progress of the changes to Chapter 217.

1.5 Upgrade Facilities

– **Interim Measure:** *WWTFs not meeting effluent limits should upgrade or repair their facilities to comply with individual permits. Over 25 years, WWTFs requiring upgrades in order to meet bacteria limits in their permits will have been upgraded.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is In Progress and On Schedule due to the availability of data. Additional work is needed to determine whether the upgrades at WWTFs were completed to comply with bacteria effluent standards for individual permits*

Implementation Effort

◘ **Monitoring Upgrades.** A total of 100 plants in counties included in the BIG submitted applications to expand, improve, upgrade, rehabilitate, or modify in 2015 (Table 5). Data on facility upgrades was retrieved from the TCEQ website. (www18.tceq.texas.gov/wwps/)

Table 5. Track Approval of Wastewater System Plans and Specifications Applications

Jan 1, 2013 to Jan 1, 2016																
Application Type	Harris			Galveston			Brazoria			Fort Bend			Montgomery			Total
	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015	2013	2014	2015	
Improvements	12	14	21	0	1	2	1	0	3	1	0	18	1	3	10	87
Rehabilitation	13	13	9	1	0	4	0	0	2	0	0	2	0	5	4	53
Reuse/Reclaim	2	1	0	0	0	0	0	0	0	0	1	2	2	1	0	9
Expansions	6	6	9	0	0	0	0	0	1	0	1	3	0	1	1	28
Modifications	2	4	1	0	0	0	0	0	0	0	1	0	0	0	1	9
Upgrade	1	2	3	0	0	0	0	0	0	2	0	0	0	1	1	10
Generator	1	2	1	0	0	2	0	0	0	0	0	0	0	1	0	7
Total	37	42	44	1	1	8	1	0	6	3	3	25	3	12	17	203

Table 7. Wastewater system plans and specification applications submitted to the TCEQ per year by county. Application approvals can be reviewed at www18.tceq.texas.gov/wwps/

1.6 Consider Regionalization of WWTFs

– **Interim Measures:**

  – *Regulators should develop criteria for identifying chronically non-compliant WWTFs.*

  – *Regulators should document the number of non-compliant WWTFs identified using said criteria.*

  – *Regulators should document the number of chronically non-compliant WWTFs that have considered regionalization.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule.*

Implementation Effort

◘ **Regulatory.** The US EPA and TCEQ have developed criteria for chronically non-compliant WWTFs and identified those WWTFs. TCEQ will share documented WWTFs with the BIG to assist with tracking future regionalization.

◘ **Regionalization.**

  – BIG stakeholders reported no WWTFs were regionalized in 2015 (source: Harris County Community Services Department).

  – Harris County Pollution Control Services (HCPCS) reported they meet routinely with WWTF representatives to discuss violations, and action plans to achieve compliance, including the possibility of regionalization.

1.7 Use Treated Effluent for Facility Irrigation

– **Interim Measure:** *Every five years, one WWTF in the project area shall install a new irrigation system that uses treated effluent.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the five-year target.*

Implementation Effort

◘ **Reuse/Reclaim.** In 2015, two applications for reuse/reclaim water were submitted to the TCEQ for Fort Bend County (Table 5). Information was extracted from the TCEQ website. (www18.tceq.texas.gov/wwps/)

SANITARY SEWER SYSTEMS

2

Summary

Failure of sanitary sewer systems (SSSs), commonly due to blockages from fats, oils and grease (FOG), equipment malfunctions, or operator errors (Table 6) often results in sanitary sewer overflows (SSOs). SSOs discharge untreated sewage to the surface and sometimes into area waterways. The microbial pathogens and other pollutants present in SSOs can cause or contribute to contamination of drinking water supplies, water quality impairments, beach closures, shellfish bed closures, and other environmental and human health problems. In 2015 there were 878 reported SSOs in the BIG project area releasing an estimated 2.6 million gallons of untreated waste (Table 6).

The Sanitary Sewer Systems Workgroup met with the Wastewater Treatment Facilities Workgroup on December 8, 2015. Seventeen members reported efforts over the past year focused on increased education, data collection, and source elimination activities that support this implementation activity. H-GAC gathered and analyzed data on SSOs gathered by TCEQ's Region 12 Office.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Host an annual conference on asset management for SSSs;
  - Work with the TCEQ to improve the SSO reporting system;
  - Survey WWTF operators to gather appropriate contact information, begin tracking utility asset management programs (UAMPs), identify subscriber system contacts, and gather example subscriber system contract language; and
  - Check on the progress of the sponsors for "Cease the Grease" and "Corral the Grease" to determine if there is room for a unified regional message on FOG education.

Implementation Strategies

2.1 Develop Utility Asset Management Programs (UAMP) for Sanitary Sewer Systems

– Interim Measures:

- *Within five years, H-GAC, the TCEQ, or another appropriate entity shall offer at least eight educational workshops for owners, operators, and engineers.*
- *After 10 years, all WWTF permits will have UAMPs.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

- *This activity is currently On Schedule to meet the five-year target. H-GAC has held three workshop since 2013. The current pace of workshops, including events held by TCEQ should meet the interim measure of eight in five years*

Implementation Effort

◘ **Education.**

- April 22, 2015, H-GAC hosted, through its Clean Waters Initiative (CWI), a Utility Asset Management workshop.

◘ **TCEQ's Voluntary SSOI.** TCEQ's voluntary Sanitary Sewer Overflow Initiative (SSOI) allows eligible municipalities to direct resources toward corrective actions rather than pay enforcement penalties. In 2014, there were 32 WWTF operators within the BIG project area listed in the SSOI (source: TCEQ). The Clean Water State Revolving Fund provides low-cost financial assistance for planning, acquisition, design, and construction of wastewater, reuse, and stormwater infrastructure..

◘ **Infrastructure Funding.**

- Texas Water Development Board offers State Revolving Funds to assist local communities to rehabilitate and replace existing infrastructure. (https://www.twdb.texas.gov/financial/programs/CWSRF/)
- EPA's water infrastructure and resiliency finance center website, (http://water.epa.gov/ infrastructure/ waterfinancecenter.cfm) serves as a resource to explore innovative finance solutions, including public-private partnerships.
- The Texas Water Infrastructure Coordination Committee is comprised of state and federal funding agencies, technical assistance providers, and regulatory agencies. The Committee seeks to identify and develop solutions to water and wastewater infrastructure compliance issues and to determine affordable, sustainable, and innovative funding strategies for the protection of public health and efficient use of government resources. (www.twicc.org)

2.2 Address Fats, Oils, and Grease

– Interim Measures:

- *Within five years, H-GAC and other local entities will*
  - » *Compile and share all existing regulations within the project area;*
  - » *Examine each community's regulations and policies;*
  - » *Distribute flyers or other collateral material; and*
  - » *Develop and promote website.*
- *Within five years, one community shall adopt new regulations.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the five-year target.*

Implementation Effort

◘ **Tracking.** Operators in the BIG project area reported on SSO events and total volume released to the TCEQ (Table 6 and Figure 3).

- There were 878 reported SSOs releasing almost 2.6 million gallons of untreated waste in 2015, up from 680 events and 1.6 million gallons in 2014.
- Of the 883 events reported in 2015, blockages from Fats, Oil, Grease, Roots and other causes remain the largest number at 694 events or 79%.
- Texas Senate Bill 912 made changes to SSO reporting which may result in fewer reports. The legislation which became effective September 1, 2015, provides for a volume-based exemption from reporting for certain accidental discharges or spills from WWTFs.
- Combined, the volume of untreated waste from SSOs attributed to blockages was slightly larger than the 75 SSO events related to rainfall and infiltration, which released 949,000 and 911,000 gallons respectively.
- Reflecting on 1.3 in the previous section, the significant rainfall which contributed to the spike in SSOs could have played a role in WWTF compliance reporting for the small (<0.1 MGD) and the large (>10 MGD) WWTFs,

◘ **Model FOG Education Programs.** BIG suggested that a regional message be developed based on the following programs:

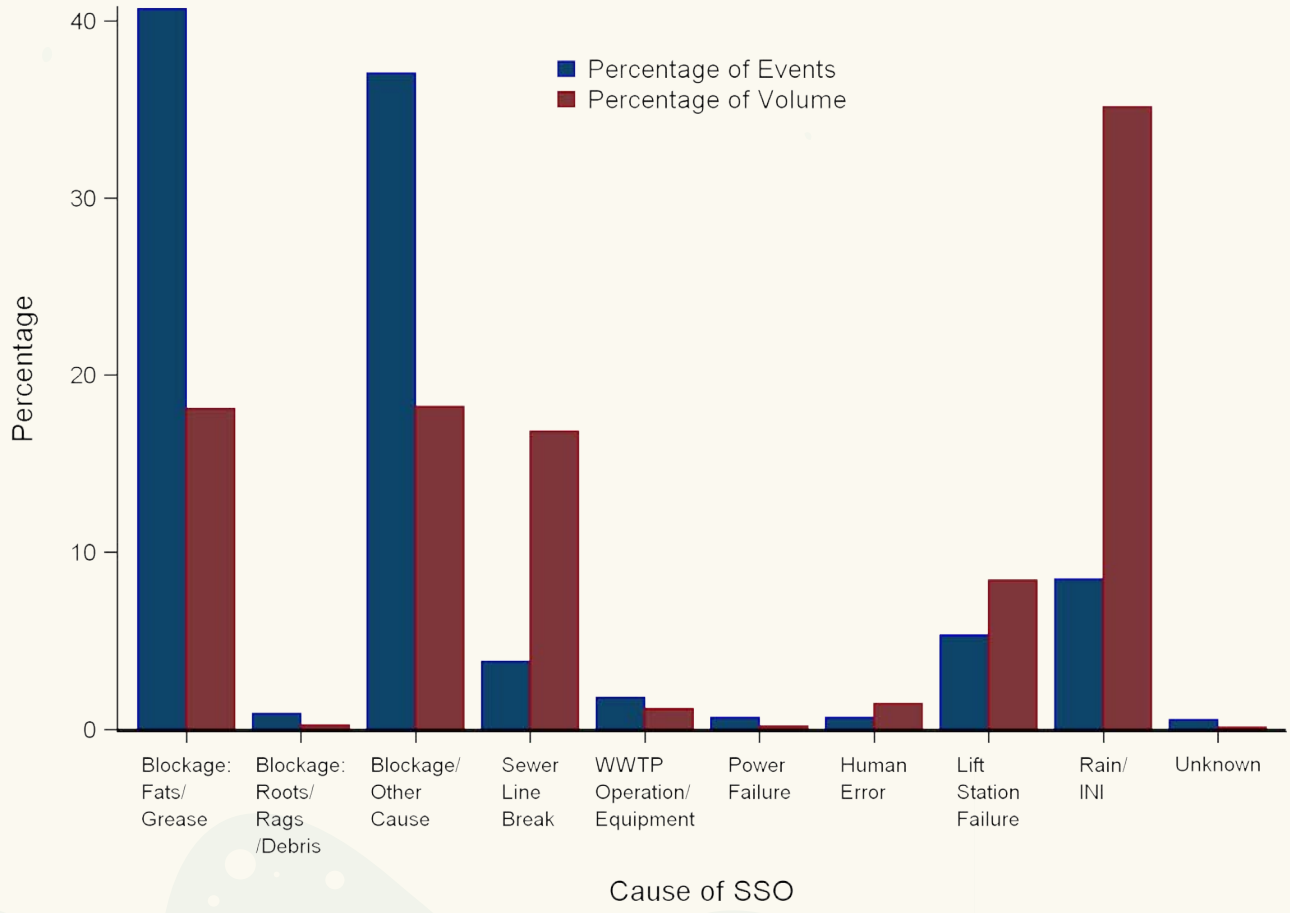
- Galveston Bay Foundation (GBF) has received funding to develop Cease the Grease, a FOG program in the BIG region. GBF has been hosting technical stakeholder meetings to coordinate Cease the Grease with local partners. (http://galvbay.org/ceasethegrease/)
- The City of Houston's Corral the Grease and Grease Busters programs have been in operation for several years. The City participates in a large apartment complex management meeting each year to allow apartment managers to sign up to receive Corral the Grease materials. Apartment complexes referred by the City's stoppage crews as having grease issues in sewer main lines were targeted with educational materials. The City of Houston maintains the Corral the Grease website (www.publicworks.houstontx.gov/pud/corral_grease.html)
- The BIG and other wastewater professionals have identified non-flushable items, such as sanitary wipes, as an emerging concern for SSOs. The San Jacinto River Authority and Payne Communications & Associates created the Patty Potty campaign to address this topic. (www.pattypotty.com)

Table 6. SSOs in the BIG Project Area 2015

Cause	Number of Events	Estimated Overflow, 1000 Gallons
Blockage in Collection System Due To Fats/Grease	359	470
Blockage Due To Roots/Rags/Debris	8	6
Blockage in Collection System-Other Cause	327	473
Collection System Structural Failure	31	437
WWTP Operation or Equipment Malfunction	16	30
Power Failure	6	5
Human Error	6	38
Lift Station Error	47	219
Rain / Inflow / Infiltration	75	911
Unknown Cause	5	4
Total	883	2592

Table 6. The number and volume of SSOs reported to the TCEQ in 2015

Figure 3. SSO Events and Estimated Volume - Percent of Total by Cause



2.3 Encourage Appropriate Mechanisms to Maintain Function at Lift Stations

– **Interim Measure:** *Every five years, 10% of SSSs shall be compliant with recommendations.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
☐ On Schedule
◘ **Ahead of Schedule**

– *This activity is Ahead of Schedule to meet the five-year target.*

Implementation Effort

◘ **Emergency Power Requirements.** The TCEQ approved the revision of Title 30, Chapter 217 and reinstated Chapter 317 of the Texas Administrative Code. Of importance to SSSs are Subchapters B and C of Chapter 217, which address emergency power requirements.

◘ **Tracking.**

– In 2015, WWTF operators reported 47 SSOs due to malfunctioning lift stations with an estimated overflow volume of 219,000 gallons, similar to 2014 with 50 SSOs and 254,000 gallons respectively (Table 6 and Figure 3).

– SSO events related to power failures went down in 2015 to six events and 5,000 gallons compared to seven events and 211,000 gallons in 2014.

– Eighteen lift station applications to upgrade, rehabilitate, improve and/or add alternative power were made in 2015 by counties served by the BIG. Information was extracted from the TCEQ's Approval of Wastewater System Plans and Specifications Applications database. (www18.tceq.texas.gov/wwps/)

2.4 Improve Reporting Requirements for SSOs

– **Interim Measures:** *Within five years, the U.S. Environmental Protection Agency (EPA) and TCEQ will develop appropriate database structure and technology for collecting and sharing information regarding SSOs.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
☐ On Schedule
◘ **Ahead of Schedule**

– *This activity is Ahead of Schedule to meet the five-year target. EPA completed the National Pollution Discharge Elimination System (NPDES) Electronic Reporting Rule*

Implementation Effort

◘ **Reporting.**

– On Sept. 24, 2015, the EPA signed the final rule requiring NPDES regulated entities to electronically submit specific permit and compliance monitoring information over filing paper reports. The rule will be rolled out over two phases, with some of the requirement provided below:

» Phase I – December 21, 2016. All NPDES regulated entities required to submit discharge monitoring reports (DMRs) must do so electronically using NetDMR; and NPDES regulated entities include facilities that discharge wastewater (for example, facilities classified as major or minor dischargers, individually permitted facilities, and facilities covered by general permits).

» Phase II – December 21, 2020. All NPDES regulated entities will be required to submit notice of intent (NOI) and notice of termination (NOT) among others; and NPDES regulated entities required to submit MS4 program reports, SSO event reports among other reports will be required to submit electronically.

– Texas Senate Bill 912 provides for a volume-based exemption from reporting for certain accidental discharges or spills from WWTFs and became effective September 1, 2015.

2.5 Strengthen Controls on Subscriber Systems

– Interim Measures:

- *By year three, H-GAC will work with attorneys for WWTFs, municipal utility districts, and stakeholders to develop model contract language.*
- *Within five years, H-GAC will develop a list of subscriber systems.*
- *As funds are available, H-GAC will initiate a circuit rider program.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the three- and five-year targets. Stakeholders are tracking this issue.*

Implementation Effort

- **Subscriber System Example Contracts.** Three example contracts were gathered and placed on the H-GAC website. (www.h-gac.com/community/water/tmdl/BIG/resources-and-information.aspx)
- **Tracking.** A WWTF survey will be conducted in 2016. Responses will be used to collect data on individual subscriber systems and subscriber system contracts and look for opportunities to share information and improve contract language between WWTFs and subscriber systems.

2.6 Penalties for Violations

– Interim Measure: *Within five years, the TCEQ will have an appropriate penalty policy in place.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the five-year target.*

Implementation Effort

- **Penalty Policy.** The TCEQ is currently working on Enforcement Initiation Criteria revision 15. The draft is currently in review.
- **SSO Investigations.** TCEQ inspectors can conduct focused SSO investigations. TCEQ reported that there were no inspections conducted in 2015.

ON-SITE SEWAGE FACILITIES

3

Summary

Properly functioning and maintained On-Site Sewage Facilities (OSSF) contribute negligible amounts of bacteria to waterways. Therefore, BIG stakeholders have primarily focused on unpermitted, failing, or poorly maintained OSSFs.

H-GAC staff partners with local governments to continually update the OSSF Information System, a GIS-based online mapping tool displaying OSSF data. The OSSF Information System helped identify probable locations of older, unpermitted systems at higher risk of failing. Staff identified 31,517 permitted systems in the BIG project area (Appendix D).

The On-Site Sewage Facilities Workgroup met with the Illicit Discharges Workgroup on December 17, 2015. Thirteen stakeholders reported continued focus over the past year on education and regulatory action to prevent and remediate failing systems. Efforts are already underway to provide education programs to a variety of audiences. Harris County continues to work with the East Aldine Management District. H-GAC coordinated with the TCEQ to develop an approved supplemental environmental project (SEP) to address low-income residences with failing OSSFs.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Continue to update maps with OSSF location data and establish priority areas;
  - Continue to allow only higher performing systems that are electronically monitored to be installed in unincorporated Harris County within bacteria impaired watersheds; and
  - Continue to seek SEP funds to maintain, repair, and replace failing systems in priority areas.

Implementation Strategies

3.1 Identify and Address Failing Systems

– Interim Measures:

- *H-GAC will work with the TCEQ, authorized agents, and other interested parties to create an inventory of OSSFs with a focus on identifying known or suspected failing systems.*
- *Within one year, H-GAC and local authorized agents will create an initial map.*
- *Within two years, H-GAC and local authorized agents will identify target areas.*
- *Every five years, owners will repair or replace 500 failing OSSFs.*
- *Authorized agents will continue to collect and share OSSF data on an ongoing basis.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
☐ On Schedule
◘ **Ahead of Schedule**

- *This activity is Ahead of Schedule to meet the five-year target, to repair and replace 500 failing systems. Harris County reports that with East Aldine Management District, they abandoned 550 OSSFs in Harris County (H-GAC's OSSF Database).*

Implementation Effort

◘ **Mapping.** H-GAC staff, with the input from BIG stakeholders, continued to refine and update the OSSF permit database. The mapping system allows the public to view OSSF permit data and access basic analyses. (www.h-gac.com/go/ossf) Highlights of the system include

- Layers showing permitted OSSFs by age, authorized agent, and residential properties with a high chance of having an old or otherwise unpermitted system; and
- Tools, such as maps (Appendix D), to assist in future system repair and replacement prioritization.

◘ **Data.** Authorized agents continue to provide data to H-GAC. OSSF data is used to refine the mapping system and prioritize areas for education and potential repair and replacement as funding becomes available.

◘ **Address Failing Systems.** Harris County and East Aldine Management District continue to install sewer service in the Aldine region using grant funding. Harris County and East Aldine Management District had made 266 connections to new sanitary sewer systems in 2015 for a total of 439 connections since 2014. By the end of 2015, 550 OSSFs have been abandoned, up from 302 reported in 2014. Many of the abandoned OSSFs were failing as evidenced by violations (source: Harris County).

3.2 Address Inadequate Maintenance of OSSFs

– Interim Measures:

- *Each community will examine its regulations and policies.*
- *Existing regulations will be compiled and shared among BIG stakeholders.*
- *Flyers or collateral material will be distributed among BIG stakeholders.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule. Regulations and educational information have been compiled and are available through the H-GAC website.*

Implementation Effort

◘ **Wastewater Professional Education.** Harris County hosted its 5th Annual Harris County On-Site Wastewater Seminar on May 5, 2015, which was attended by 106 regional on-site wastewater professionals

◘ **Real Estate Industry Coordination.** H-GAC developed and maintains a curriculum for real estate inspection professionals to learn how to properly inspect an OSSF during a point-of-sale home inspection. H-GAC is planning to hold workshops in 2016. Workshops offer a Texas Real Estate Commission-approved course (6 Continuing Education Credits) on the benefits of visually inspecting OSSFs.

◘ **Homeowner Education.**

- H-GAC maintains a website to share educational materials. (www.h-gac.com/go/septic) In addition to providing general information, the site offers content specific to homeowners/homebuyers, local governments, and real estate professionals.
- March 29, 2015, Texas A&M AgriLife Extension in conjunction with the Double Bayou Watershed Partnership hosted a free residential OSSF workshop. The workshop provides a basic understanding of the operation and maintenance for a conventional septic system and explains the impact of activities within the home.

3.3 Legislation and Other Regulatory Actions

– Interim Measures:

- *The TCEQ should host biennial meetings to review OSSF regulations.*
- *Local authorized agents will meet annually.*
- *Every five years, one community shall revise or adopt new regulations.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule.*

Implementation Effort

◘ **Meetings.** The TCEQ reported Authorized Agent meetings are anticipated to resume in 2016.

◘ **Education.**

- January 28, 2015, H-GAC hosted the CWI workshop on Water Quality Case Studies. Walker County's OSSF Tracking Program was highlighted.
- May 5, 2015 Harris County hosted the 5th Annual On-Site Wastewater Seminar for water professionals.

STORMWATER AND LAND DEVELOPMENT

4

Summary

Regional growth and development have reinforced the importance of stormwater management. Bacteria sources, such as waste from pets, wildlife, and even humans, can be washed into storm drains and discharged into local waterways. Stormwater systems are designed to remove stormwater from developments quickly and efficiently. As a result, stormwater in urbanized areas often bypasses natural vegetative barriers. Without these filters, "sheet flow" (stormwater flowing across the landscape) tends to result in more concentrated bacteria loading to waterways.

In general, this strategy area focuses on building upon existing stormwater programs by sharing knowledge and developing incentives to increase voluntary implementation. The Stormwater and Land Development Workgroup met with the Construction Workgroup on January 15, 2016. Nine stakeholders reported progress in implementing low impact development (LID); tracking stormwater management projects with an emphasis on effectiveness monitoring; progress on providing education and training opportunities; and continuing to track MS4 Phase II Notices of Intent (NOIs).

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Follow up on information provided by MS4 Phase II permittees and consider content for a second survey.
  - Finish developing a web-based MS4 Phase II Tracking System with stakeholders to facilitate improved tracking;
  - Continue examining local regulations and how they might inhibit LID projects.
  - Coordinate with local builders/developers and trade organizations to implement the recognition and awards program; and
  - Build a Wall of Fame on the H-GAC website to highlight, at least five local programs annually.

Implementation Strategies

4.1 Continue Existing Programs

– Interim Measures:

- *Eighty MS4 programs will be continued.*
- *As many as 200 additional MS4s will be added to TCEQ Region 12 during the new permit cycle; many will be in the BIG project area.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule as existing programs continue and new requirements include addressing impaired waterbodies.*

Implementation Effort

◘ **Established Programs.** The City of Houston, Harris County, Harris County Flood Control District (HCFCD), and Texas Department of Transportation (TxDOT) continue to operate under a Phase I MS4 TPDES permit, calling themselves the Joint Task Force. With the addition of Armand Bayou watershed to the BIG project area, the City of Pasadena, a Phase I community, was added in 2015

◘ **Continued Program Administration.** The history of approved, pending, expired, denied, and terminated NOIs for small MS4s can be reviewed at the TCEQ's Water Quality General Permits and Registration Search. (www2.tceq.texas.gov/wq_dpa/index.cfm) A review of that registry finds there are 129 permit/registration numbers for MS4 Phase II for the BIG project area: 124 BIG original project area, one TxDOT, and four in the Armand Bayou watershed. This is eight more than were reported in 2014.

4.2 Model Best Practices

– **Interim Measure:** *Each year, BIG stakeholders will hold four to six networking meetings and will highlight five local programs.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule as four meetings were reported in 2015.*

Implementation Effort

◘ **BMP Database.** HCFCD continues to maintain the Regional Best Management Practices (BMP) Database for stakeholders to access and evaluate the effectiveness of structural BMPs. (www.bmpbase.org) The database provides access to BMP effectiveness data set to the International Stormwater BMP Database standards. HCFCD encourages entities to submit qualified BMP effectiveness data from other projects in the region. In cases where projects did not collect desired performance data, HCFCD remains interested in collecting the projects' geographic location and available metadata.

◘ **LID Tracking.** H-GAC developed a LID tracking and resources website. (www.h-gac.com/community/go/LID) The site currently displayes 59 LID projects in the H-GAC region, most of which are located in the BIG project area and provides an on-line form for submitting new projects.

◘ **Education.** H-GAC, through its CWI, conducted four workshops supporting BMPs: Pet Waste and Trash Pick-up (February 25, 2015), Instream Water Quality Monitoring (April 1, 2015), Designing for Impact Design and Vision LID (June 4, 2015) and Regional Water Conservation (September 15, 2015).

4.3 Encourage Expansion of Stormwater Management Programs

– **Interim Measure:** *Within the next five years:*

  – All permit holders shall expand or focus their existing programs.

  – Thirty previously unpermitted entities shall develop new programs.

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the five-year target. New TPDES permit requirements will encourage MS4 Phase II operators to address impaired waterbodies with appropriate management measures.*

Implementation Effort

◘ **New General Permit Eligibility.** A review of the TCEQ's General Permit Registry for MS4 Phase II, revealed eight permits are new to the MS4 Phase II program within the BIG project area. (www2.tceq.texas.gov/wq_dpa/ index.cfm)

◘ **New MS4 Permit Requirements.** Under the TPDES General Permit, MS4 Phase II entities will be required to address their stormwater discharges to impaired waterbodies. The BIG will attempt to track measures implemented to address bacteria impairments. Twenty-three of 26 respondents to the 2015 MS4 questionnaire noted they would be addressing bacteria impairments through their stormwater management program.

◘ **MS4 Assistance.** H-GAC found, through the 2015 questionnaire 14 of 26 felt that current ordinances and codes were a barrier to implementing bacteria reduction measures. In 2015, H-GAC developed a proposal to work with local governments to review ordinance and remove barriers. H-GAC is actively pursuing grant funding.

◘ **Implementation.** The City of League City Rain Water Harvesting Initiative provided a rebate to its residents in the spring of 2015 for the purchase of rain barrels.

4.4 Promote Recognition Programs for Developments that Voluntarily Incorporate Bacteria Reduction Measures

– **Interim Measures:**

  – *Within five years, BIG stakeholders should develop a recognition program and subsequently recognize communities and participants.*

  – *Each year, two communities will analyze regulations and programs to accommodate participation in existing programs.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the five-year target. Additional work must be made to identify communities which have analyzed regulations and other hurdles in an effort to meet the requirements of existing recognition programs.*

Implementation Effort

◘ **Recognition Program.** H-GAC will continue to work with BIG partners, including the land development community, to finish the BIG recognition program. Twenty-six MS4 Phase II provided responses to the 2015 MS4 questionnaire; four cities provided data for use in the demonstration tracking database; and 13 MS4 Phase II provided the location for acquiring their Stormwater Management Program (SWMP). For their assistance, each organization was recognized on the Annual Report's Wall of Fame, Appendix E.

◘ **Regulations.** H-GAC found, through the 2015 questionnaire 14 of 26 felt that current ordinances and codes were a barrier to implementing bacteria reduction measures. In 2015, H-GAC developed a proposal to work with local governments to review ordinance and remove barriers. H-GAC is actively pursuing grant funding.

4.5 Provide a Circuit Rider Program

– **Interim Measure:** *Each year, H-GAC will contact 50 stakeholders and provide five in-depth community consultations.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

◘ **Behind Schedule**
☐ On Schedule
☐ Ahead of Schedule

– *This activity is Behind Schedule to meet the yearly target of providing five in-depth community consultations.*

Implementation Effort

◘ **2015 MS4 Questionnaire.** As noted under implementation activity 4.3, MS4 operators would be most interested in workshops covering MS4 funding.

◘ **Education.** Communities throughout the BIG region hosted workshops geared toward MS4 Education.

- MS4 Education. H-GAC, through its CWI, conducted four workshops supporting BMPs: Pet Waste and Trash Pick-up (February 25, 2015), Instream Water Quality Monitoring (April 1, 2015), Designing for Impact Design and Vision LID (June 4, 2015) and Regional Water Conservation (September 15, 2015).
- Additional Education benefiting MS4s.
  - » Texas Riparian & Stream Ecosystem Workshop (February 25, 2015)
  - » In 2015, Galveston Bay Foundation held 9 Rain Barrel Workshops to educate homeowners on the water quality and conservation benefits of collecting rain water. Homeowners purchased 423 barrels at a reduced price during the workshops.

4.6 Petition the TCEQ to Facilitate Reimbursement of Bacteria Reduction Measures

– **Interim Measure:** *Within three years, BIG stakeholders should receive letters of commitment or similar support from the TCEQ.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to address the need for reimbursement; however, the TCEQ did not provide letters of commitment. Activity needs to be tracked to ensure the reimbursement process is working.*

Implementation Effort

◘ **TCEQ Reimbursement.** TCEQ reported during the International Low Impact Development Conference (January 19-21, 2015) in Houston, they did not feel there is a need for additional rule-making to address developer reimbursement for installed water quality practices. The TCEQ stated current rules are sufficient to allow reimbursement and they are prepared to work with developers to assist in the reimbursement process.

CONSTRUCTION

5

Summary

Rapid population growth and increasing densification of the BIG project area have led to more widespread and intense development activity that contributing to bacterial loading. Although construction sites for typical building and transportation projects are not significant sources of bacteria, urbanization inevitably results in more stormwater runoff. This runoff conveys sediments, nutrients, fertilizers, and other contaminants downstream.

The Construction Workgroup met together with the Stormwater and Land Development Workgroup on January 15, 2016. Nine BIG stakeholders reported on their ability to conduct compliance and enforcement at construction sites and offer beneficial construction site education. The group recommended that H-GAC add questions seeking the number of operators conducting compliance and enforcement inspections in the next survey of MS4 Phase II permittees.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Solicit information and participation via survey from MS4 Phase II permittees;
  - Quantify and document inspections and enforcements in annual reports or survey results;
  - Provide educational materials and opportunities for contractors; and
  - Work with professional organizations.

Implementation Strategies

5.1 Increase Compliance with and Enforcement of Stormwater Management Permits

– Interim Measures:

- *In year one, MS4 operators should evaluate needs or requirements for staffing an appropriate construction inspection program.*
- *In year two, BIG stakeholders should develop and begin offering educational material and training.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule as construction education and training is being offered and improving compliance.*

Implementation Effort

◘ **Compliance and Enforcement.**

- The City of Houston and Harris County reported they continue to meet inspection requirements found in their MS4 permits. The City of Houston conducts multiple inspections of all NOIs and Construction Site Notices (CSN) for projects of an acre or more and some sites less than an acre.
- The 2015 MS4 Phase II survey recorded 18 of 26 respondents indicating they implement bacteria reduction efforts under the Minimum Control Measure (MCM) – Fourteen of 26 MS4 Phase II operators stated they currently conduct construction site inspections.

◘ **Training and Education.**

- January 22, 2015. H-GAC's Environmental and Enforcement Roundtable included a presentation by the TCEQ's Small Business and Local Government Assistance program, which supports education and technical assistance for MS4s and stormwater construction permits.
- Both Harris County and the City of Houston reported that informal on-site compliance education at construction sites is increasing compliance.
- Nine of 17 MS4 Phase II operators responding to the 2015 MS4 Questionnaire reported they provide Stormwater Pollution Prevention Plan (SWP3) education.

ILLICIT DISCHARGES AND DUMPING

6

Summary

Illicit discharge detection efforts have found illegal connections, discharges, and dumping activities resulting in illegal bacterial loads entering in the project area's storm sewer and watershed. BIG stakeholders have widely cited septic waste haulers as a source of contamination when transport waste from OSSFs and grease and grit traps are not properly disposed. While regulations dictate proper methods for disposing of waste at treatment facilities and recording information on manifests, evidence indicates illicit discharges and illegal dumping occurs. Because these discharges can happen in so many locations, there are no flow-adjusted estimates for waste hauler contributions to bacteria levels in area waterways.

In response to these concerns, the BIG recommends that stakeholders focus on three activities: 1) detect and eliminate illicit discharges specific to bacteria; 2) improve local government mechanisms to regulate and enforce illicit discharges; and, 3) monitor and control waste hauler activities through regulations and fleet tracking programs.

The Illicit Discharges and Dumping Workgroup met jointly with the OSSF Workgroup on December 17, 2015. Thirteen stakeholders discussed the challenges facing waste hauler tracking and ensuring waste actually makes it to a proper disposal site. Attendees suggested continuing efforts to document illegal dumping, identifying locations to install motion sensing cameras, developing a CWI workshop on illegal dumping and use of cameras, and revising the MS4 survey to include questions regarding tracking of honey trucks.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Identify a local government to implement a pilot tracking program;
  - Host a CWI workshop on illegal dumping and use of tracking cameras; and
  - Conduct a survey of MS4 Phase II operators, including questions covering illicit discharge detection activities and tracking of honey trucks.

Implementation Strategies

6.1 Detect and Eliminate Illicit Discharges

– Interim Measures:

- *Within 10 years, MS4 operators will complete initial surveys and maps.*
- *Each year, MS4 operators will identify the number of illicit discharges found and resolved each year.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

- *This activity is On Schedule to meet the 10-year target. Current TPDES MS4 permits require permittees complete surveys and develop maps. Additional effort is needed to routinely capture the number of illicit discharges identified and resolved by MS4 Phase II operators each year.*

Implementation Effort

◘ **Illicit Discharge Implementation.** The Joint Task Force (Harris County, City of Houston, TxDOT, and HCFCD) continue illicit discharge detection and elimination (IDDE) programs to identify and track illicit discharges. Maintaining strong IDDE programs is likely one reason for the declining bacteria seen in the BIG project region (Appendix B).

◘ **IDDE Reporting.**

- BPA continued, with the assistance of the City of Houston, to conduct a source identification and elimination project. BPA presented to BIG stakeholders on July 24, 2015. For more details, see Section 11. Geographic Priority Framework.
- In 2015, H-GAC with a grant from the Galveston Bay Estuary Program, started an IDDE project in the BIG Project Area using the Top Ten Most Wanted/Top Ten Least Wanted Lists.
- CleanBayous.org maintains an illegal dumping notification system used to notify participating small MS4s for the purpose of correction.
- Galveston Bay Action Network is an online resource for reporting fish kills, spills, SSOs, and other incidents. (www.galvbay.org/gban)

Figure 6. BPA interns conducting a water quality investigation of P138 in Halls Bayou.

6.2 Improve Regulation and Enforcement of Illicit Discharges

– Interim Measures:

- *Within five years, BIG stakeholders will compile and share all existing regulations in the project area.*
- *Within five years, all communities shall examine their regulations, and one shall adopt new or revised regulations.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the five-year target.*

Implementation Effort

◘ **Compile MS4 Regulations.**

- Three respondents to the 2015 MS4 Phase II questionnaire stated they would be willing to share their codes, ordinances, and regulations with the BIG. Five of 26 respondents plan on developing new ordinances or regulations as part of their second Stormwater Management Program (SWMP). H-GAC, along with the BIG, will continue to compile a list of ordinances and add them to ordinances currently available on the BIG website. (www.h-gac.com/community/water/tmdl/big/workgroups/illicit-discharges-and-dumping-workgroup.aspx)
- Harris County and the City of Houston reported that their regulations are publicly available on their respective websites and at Clean Water Clear Choice. (www.cleanwaterways.org/downloads/)

6.3 Monitor and Control Waste Hauler Activities

– Interim Measure: *Within five years, one waste hauler fleet tracking pilot program shall be started by local stakeholders.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

◘ **Behind Schedule**
☐ On Schedule
☐ Ahead of Schedule

– *This activity is Behind Schedule to meet the five-year target. BIG partners have yet to identify a local program interested in starting a pilot program.*

Implementation Effort

◘ **Tracking.**

- The City of Houston reported that it maintains a successful waste hauler tracking program and reviews waste hauler receipts during inspections at WWTFs.
- Illegal Dumping Surveillance Camera Sharing Program. H-GAC, with administering agencies, Fort Bend, Galveston, and Walker counties, maintains a camera resource sharing program for local governments. Cameras are only used for illegal dumping enforcement. (www.h-gac.com/community/environmental-enforcement/illegal-dumping-surveillance-camera-sharing-program.aspx)

◘ **Education.** January 28, 2015, H-GAC hosted the CWI workshop on Water Quality Case Studies. The H-GAC Camera Sharing Program was a highlighted presentation.

7 ANIMALS AND AGRICULTURE

Summary

Animals and agricultural practices contribute to increased bacteria levels in sediment runoff to waterbodies. Cattle and poultry are the most common agriculture animals of concern in the BIG project area. However, clusters of other animals—such as horses, swine, sheep, and goats— also may contribute to water quality impairments throughout the area. Of particular interest to BIG stakeholders are feral hogs, considered a state and national problem, estimated to cause $52 million in crop loss in the state each year. Feral hogs damage property due to their rooting and wallowing. They also defecate, often directly into waterways, contributing large amounts of bacteria and nutrients into the environment.

Most agricultural management programs are either voluntary or apply only to confined animal feeding operations (CAFOs) designated by the EPA. These operations are not present in the BIG project area. On January 20, 2016, six members of the Animals and Agriculture Workgroup met and recommended continuing agriculture related outreach and education events, supporting use of individual water quality management plans and following up with the Natural Resource Conservation Service (NRCS) and San Jacinto River Authority on nutrient management programs.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Continue to encourage agriculture producer involvement in existing Texas State Soil and Water Conservation Board (TSSWCB), Texas AgriLife Extension, and Texas Water Resources Institute (TWRI) programs;
  - Continue to provide technical support and education opportunities;
  - Gather latest information on nutrient management programs; and
  - Continue to track results of Harris County's feral hog management project.

Implementation Strategies

7.1 Promote Increased Participation in Existing Programs for Erosion, Control Nutrient Reduction and Livestock Management

– **Interim Measure:** *Each year, participation by farmers and ranchers in financial and technical assistance programs should increase by 5%.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the annual target.*

Implementation Effort

◘ **Implementation.**

- TSSWCB reported there were no new water quality management programs in the BIG project area.
- NRCS and TSSWCB continued to report owners have placed 8,816 acres under federal funding and technical assistance agriculture programs (Conservation Technical Assistance, Environmental Quality Incentives Program, and Wildlife Habitat Incentive Program) to implement agricultural BMPs.

◘ **Education and Resources.**

- The Texas Water Resources Institute (TWRI), as part of its Lone Star Healthy Streams (LSHS) Program, hosts a website to educate Texas farmers, ranchers, and landowners about proper grazing, feral hog management, and riparian area protection to reduce the levels of bacterial contamination in streams and rivers.
- Best Management Practices: http://lshs.tamu.edu/bmps/
  - » Publications and Presentations: http://lshs.tamu.edu/publications/
  - » February 27, 2015. Texas Riparian & Stream Ecosystem Workshop – Dickinson Bayou.
- H-GAC CWI Workshops. June 24, 2015 CWI on Agriculture and Invasive Species and November 17, 2015. CWI Overview on Texas Land Trends

7.2 Promote the Management of Feral Hog Populations

– **Interim Measure:** *During the next five years, AgriLife Extension will host two feral hog management workshops per year for landowners, local governments, and other interested people.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
☐ On Schedule
◘ **Ahead of Schedule**

– *This activity is Ahead of Schedule to meet the five-year target.*

Implementation Effort

◘ **Education and Resources.**

- AgriLife Extension conducted 1 two-hour feral hog programs in the BIG area in 2015.
- AgriLife Extension Online: (Biology, Damages, Management and Control, Videos and Webinars) http://articles.extension.org/feral_hogs
- o June 24, 2015. H-GAC CWI on Agriculture and Invasive Species.

◘ **Implementation.** In 2015, Harris County Precinct 3 continued feral hog trapping activities in Addicks and Barker reservoirs as part of a Coastal Impact Assistance Program grant received in 2013. Baseline water quality monitoring began in September 2014 and was completed in April 2015. Since trapping operations under the grant began in June 2014, 342 feral hogs were removed from the reservoirs by the end of 2015. More than 18,506 pounds of hog meat have been donated to the Houston Food Bank for distribution. The grant period ends on September 30, 2016.

Figure 7. Vegetative buffer strip agriculture BMP.

RESIDENTIAL

8

Summary

Communities can improve water quality by changing overall attitudes and individual behavior—one homeowner at a time. Enforcement, or the threat of enforcement, may be effective with stakeholders regulated by permits, but it has less impact on individuals. Changing attitudes and behaviors of individuals presents an opportunity for long-term water quality improvement and support for existing permitted programs, like MS4 Phase II. This strategy's focus is empowering residents and communities through volunteer activities and educational outreach.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Develop objectives and evaluation measures to better assess results of education efforts;
  - Continue identifying regional opportunities to address pet waste and FOG concerns utilizing education and/or regulatory action; and
  - Encourage MS4 Phase II operators to focus on bacteria reduction public education and outreach.

Implementation Strategies

8.1 Expand Homeowner Education Efforts throughout the BIG Project Area

– Interim Measures:

- *Local governments and appropriate agencies should begin or continue homeowner education programs. Each year, participation should increase by 2%.*
- Every five years, H-GAC and BIG stakeholders will conduct at least one pilot study to evaluate the results of education efforts.

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

- *This activity is On Schedule to meet yearly education targets. Local MS4 Phase II operators are focusing more on education efforts. Additional work is needed to evaluate and derive environmental results from education as part of a pilot study.*

Implementation Effort

◘ **Education.** Local organizations and communities continued to offer many homeowner education programs that help reduce bacteria loading in the BIG project area. In addition to the listed programs, events, and website repositories, other formal and informal resources are available to increase awareness and understanding.

◘ **MS4 Programs.**

- City of League City Rain Water Harvesting Initiative provided a rebate to its citizens in the spring of 2015 for the purchase of rain barrels.
- In the recent TCEQ MS4 Phase II permit, stormwater education and involvement were combined into one minimum control measure – MCM 1. Phase II operator's responses to the 2015 MS4 questionnaire reported that 23 respondents will address bacteria under MCM 1. Under the previous permit 18 of 26 reported the use of educational outreach and 16 of 26 reported public involvements.
- MS4 Phase II entities report participating in CleanBayous.org or CleanWaterways.org to support residential and public, commercial and industrial, construction, business, and municipal employee outreach and education goals.

◘ **Outreach and Involvement.**

- The 2015 Rivers, Lakes, Bays N' Bayous Trash Bash® took place at nine sites in the BIG project areas, with 2,790 volunteers, 54 tons of trash collected, 66 tires recycled and 71 stream miles cleaned. Outreach displays and/or activities were available during the event and included themes like picking up pet waste, FOG programs, LID, water conservation, and watershed education.
- H-GAC's ongoing "Pet Waste Pollutes" campaign aims to reduce pet waste that drains into waterways and causes bacterial pollution. Pet waste bag dispensers were distributed at the 2015 Trash Bash®. This type of programming is supplemented by educational outreach efforts such as new online resources pertaining to other programs and model ordinances. (www.petwastepollutes.org) The campaign is also useful for reporting data. For instance, the City of Houston demonstrated a progressive increase in pet waste-related citations and convictions over the past seven years.
  - » H-GAC and Harris County jointly hosted an educational booth at the Reliant Park World Series of Dog Shows July 2015, which annually attracts more than 40,000 spectators, participants, and vendors.
  - » H-GAC staff hosted an educational booth at the Sam Houston Area Council Boy Scout Fair, a two-day event open to area scouts and their families with roughly 35,000 individuals in attendance.
  - » Harris County manned an education booth at the Texas Home and Garden Show held at Reliant Park in the Spring and Fall of 2015.

- **Online Tools and Resources.** Online educational resources include free support tools and downloadable materials to support the missions of local MS4 programs:
  - – Cease the Grease - http://galvbay.org/ceasethegrease/
  - – Corral the Grease - https://www.publicworks.houstontx.gov/pud/corral_grease.html
  - – Back the Bay – www.backthebay.org
  - – Pet Waste - www.h-gac.com/community/pet-waste/default.aspx
  - – Clean Water Clear Choice - www.cleanwaterways.org
  - – Patty Potty – www.pattypotty.com
  - – Low Impact Development - www.h-gac.com/community/low-impact-development/default.aspx
  - – Galveston Bay Action Network Environmental Reporting Tool - www.galvbay.org/gban
  - – OSSF Mapping Tool - http://arcgis02.h-gac.com/ossf/
  - – Regional BMB Database - https://www.hcfcd.org/interactive-mapping-tools/bmpbase-regional-bmp-database/
  - – Water Resources Information Map (WRIM) - www.h-gac.com/go/wrim
  - – Texas Watershed Steward Program - http://agrilifeextension.tamu.edu/solutions/texas-watershed-steward/
- **Training and Reporting.**
  - The CWI website houses all past CWI workshops and announcements for upcoming workshops that help local governments, landowners, and citizens develop effective strategies to reduce pollution in our waterways. (www.h-gac.com/CWI). 2015 workshops included: Water Quality Case Studies (January 28, 2015), Pet Waste and Trash Pick-up (February 25, 2015), Asset Management for Sanitary Sewer Systems (April 22,2015), In Federal and State In-Stream Water Quality Monitoring (April 1, 2015), Agriculture and Invasive Species (June 24, 2015), Regional Water Conservation (September 15, 2015), Galveston Bay Report Card Review (October 13, 2015), and Overview on Texas Land Trends (November 17, 2015).
  - In 2015, Galveston Bay Foundation held 9 Rain Barrel Workshops to educate homeowners on the water quality and conservation benefits of collecting rain water. Homeowners purchased 423 barrels at a reduced price during the workshops.
  - Texas Stream Team (TST) hosts volunteer water quality monitoring training in the region. In 2015, one training event was held. Four volunteers attended.

Figure 8. Fats, Oils and Grease education during Trash Bash© at White Oak Bayou site in Jersey Village.

MONITORING AND I-PLAN REVISION

9

Summary

To assess I-Plan progress, the BIG is required to monitor ambient water quality data and the progress of all implementation activities. Using these data, the BIG produces this annual report. This keeps BIG stakeholders apprised of progress and helps to determine if the I-Plan or any of its individual elements require revisions to their implementation strategies or schedules. The monitoring data, in particular, will be an important indicator of whether I-Plan guidance results in the desired reduction of bacteria loading. A more in-depth evaluation will occur every five years, as resources are available and with stakeholder participation.

The review will address answers to the following questions:

- Do ambient water quality monitoring data indicate that bacteria levels are changing?
  - » If so, are the bacteria levels increasing or decreasing?
- Are implementation activities and controls being undertaken as described in the I-Plan?
- Which activities have been implemented and which have not?
- Do non-ambient water quality monitoring data indicate that implementation activities are reducing bacteria loads?

Ambient vs Non-Ambient

Ambient monitoring routinely collects data without selecting for special conditions.

Non-ambient monitoring targets data collection for a specific often non-routine purpose and considers special conditions such as time, precipitation events, and location.

The Monitoring and Plan Revision Workgroup met jointly with the Research Workgroup on January 26, 2016, with nine members in attendance. Under modifications to the I-Plan (Activity 9.4), the BIG approved a modification to the I-Plan which lead to the Armand Bayou watershed fully joining the BIG project area. BIG stakeholders reported continued collection of non-ambient sampling tied to BMPs. H-GAC continued to develop the BIG Regional Implementation Plan tracking database and several organizations completed BMPs in 2015.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Continue ambient water quality monitoring and analysis;
  - Strengthen implementation tracking and coordination of non-ambient efforts through completion and analysis of data; and
  - Continue to develop a BIG Regional Implementation Plan Database.

Implementation Strategies

9.1 Continue to Utilize Ambient Water Quality Monitoring and Data Analysis

– **Interim Measure:** *Each year, H-GAC and BIG stakeholders will monitor ambient water quality to help determine if waterbodies are meeting state standards for bacteria.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule to meet the annual target.*

Implementation Effort

– Texas Stream Team (TST). In 2015, there are seventeen volunteer TST monitors at sixteen active monitoring sites in the BIG Project Area.

– H-GAC's CRP. H-GAC's Clean Rivers Program (CRP) continues to be the primary vehicle for water quality monitoring and data analysis in the project area (see Appendix F). Data is used to develop geometric means for each segment in the BIG Project Area (see Appendix G):

– The 2015 Basin Highlights Report How's the Water? documents water quality impairments and trends based on data collected by seven organizations at 173 sites (includes 11 in the Armand Bayou watershed) within the BIG project area (Table 7).(www.h-gac.com/community/water/publications/hows-the-water-basin-highlights-report-2015.pdf)

– CRP gathered observations of contact recreation while gathering ambient water quality data. Of the 173 stations monitored by CRP partners in 2015 in the BIG project area, CPR monitors recorded at evidence of contact recreation at 22 stations. CRP monitors also noted direct observations of 38 individuals engaged in a contact recreation activity while onsite at some of the 22 locations (Table 8).

Figure 9. The City of Houston Urban Street Rebuild on Almeda Road automated sampler for the BPA LID BMP preconstruction monitoring project.

Table 7. CRP Monitoring in the BIG Project Area

Organizations	Number of Stations in Initial BIG Project Area	Number of Stations in Armand Bayou	Total Number of Stations
TCEQ	10	4	14
Environmental Institute of Houston	10	0	10
Harris County Pollution Control	1	1	2
Houston Health and Human Services	111	6	117
Houston Water Quality Control	7	0	7
San Jacinto River Authority	9	0	9
Houston-Galveston Area Council	14	0	14
Total	**162**	**11**	**173**

Table 7. CRP monitoring partners and the number of monitoring stations in the initial BIG Project Area and stations in the Armand Bayou area.

Table 8. CRP Stations with Contact Recreation Observed or Inferred 2012-2015

Year	Evidence of Contact Recreation Observed or Inferred	Individuals Observed Involved in Contact Recreation
2012	16	16
2013	25	79
2014	18	27
2015	22	38

Table 8. During routine ambient monitoring, CRP partners record observed or inferred evidence of contact recreation. IF evidence of contact recreation, either observed, i.e. a person swimming, or inferred, i.e. a rope swing, then the monitor recorded contact recreation occurring at the site. If people were observed, CRP monitors document the number of individuals recreating at the time.

9.2 Conduct and Coordinate Non-Ambient Water Quality Monitoring

– **Interim Measure:** *H-GAC and BIG stakeholders will conduct non-ambient water quality monitoring activities including*

» *Developing a regional Quality Assurance Project Plan (QAPP); and*

» *Developing a regional non-ambient monitoring database.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule.*

Implementation Effort

◘ **Non-Ambient Water Quality Monitoring QAPP.** There are currently two non-ambient water quality monitoring QAPPs that have been approved by the TCEQ:

– BPA project. The City of Houston is working on improvements to Almeda Road in the Medical Center area as part of Urban Street Rebuilds that will include LID. BPA completed a QAPP for a preconstruction water quality sampling project. BPA will follow up with a post construction sampling once the LID features are installed.

– H-GAC Top 5/Least 5 Project. H-GAC developed a non-ambient monitoring QAPP to collect bacteria samples in hopes of detecting illicit discharges from BIG waterbodies identified on the Top Ten prioritized lists.

◘ **Regional BMP Database.** The HCFCD developed a regional BMP database modeled on the International Stormwater BMP Database. Currently, the database includes monitoring information for stormwater BMP projects developed by the HCFCD, as well as other BMP projects in the region. (www.bmpbase.org/LandingPage.aspx)
Monitoring Data Implementation.

– The City of League City and the Texas Coastal Watershed Program (TCWP) completed the Gharardi Watersmart Park that contains monitored BMPs that were evaluated through August 31, 2015.

– BPA completed a QAPP in 2015 and is starting preconstruction water quality sampling prior to installation of a LID project on Almeda Rd., part of the Urban Street Rebuilds project.

– BPA continued to conduct non-ambient monitoring to track down sources of bacteria in the BIG project area. For more details, see section 11. Geographic Priority Framework.

– Harris County Birnamwood Drive LID monitoring project continues to collect water quality and quantity data.

– Harris County is collecting water quality data as part of the feral hog removal project in Addicks and Barker reservoirs. Data collection and analysis was completed in 2015.

– Environmental Institute of Houston (EIH) at the University of Houston – Clear Lake retrofitted a detention basin in the Armand Bayou Watershed with a stormwater wetland to improve run-off in 2012. Wetland monitoring for water quality and habitat quality parameters was completed in August 2014. EIH has begun to share the results with resource agencies and interested parties, for more information contact EIH. (www.eih.uhcl.edu)

9.3 Create and Maintain a Regional Implementation Activity Database

– **Interim Measure:** *Each year, BIG stakeholders will provide a report on the activities they implemented during the year. H-GAC will compile and share this information in a database.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule and has met the annual target.*

Implementation Effort

◘ **Regional Implementation Activity Database.** H-GAC continued to develop the implementation database that includes a web application in 2015. The implementation database will include provisions for local reporting efforts and provide annual tracking forms to collect information. (http://h-gac.maps.arcgis.com/apps/MapSeries/index.html?appid=a75ba4bb46ca40658066c5755a8dba6e)

9.4 Assess Monitoring Results and Modify I-Plan

– **Interim Measure:** *Each year, H-GAC will assess monitoring in annual reports to identify whether progress is being made and communicate the results to the BIG. The BIG will determine if changes or updates to the I-Plan are needed.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule and has met the annual target.*

Implementation Effort

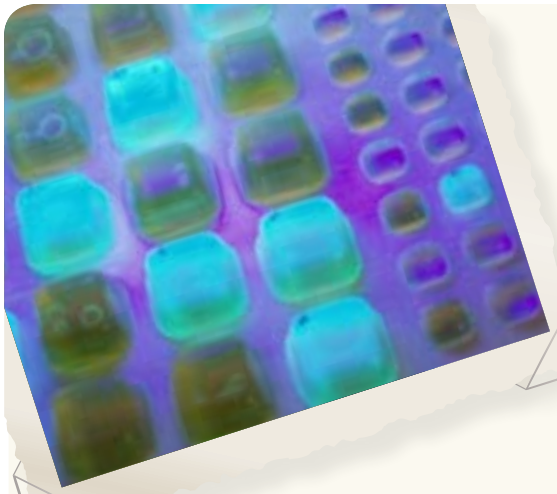
◘ **BIG Bacteria Trend Line.** The BIG project area bacteria trend line continues to show improvements (see Appendix B). However, it seems that progress has slowed in the past year. H-GAC will continue to review available data to determine trends in bacteria levels.

◘ **Non-Ambient Water Quality Monitoring. Data has not been provided to H-GAC at this time to understand the impact of specific implementation activities that have been undertaken in the BIG project area. However, there are projects underway that will be able to provide data and analysis:**

- The HCFCD BMP database
- Harris County Birnamwood Drive LID monitoring project
- The City of League City and TCWP Gharardi Watersmart park
- The BPA LID project on Almeda Rd.
- H-GAC Top 5/Least 5

◘ **Modifications to the I-Plan.** Workgroups reviewed the I-Plan to determine if any modifications might be needed.

- On June 22, 2015, the BIG approved the addition of seven new assessment units within the BIG project area where TMDLs were completed and approved by TCEQ, including the addition of Armand Bayou. There are 95 impaired assessment units in the BIG project area.



RESEARCH

10

Summary

BIG stakeholders support new research initiatives that could result in useful findings and recommendations for reducing bacteria. TMDL studies provide a general overview of the extent and source of the presence of bacteria. However, these studies are not sufficient to determine the most cost- effective courses of action to achieve water quality standards for contact recreation. The BIG has identified three top research priorities: 1) effectiveness of stormwater management activities, 2) bacteria persistence and regrowth, and 3) appropriate indicators to identify health risks presented by contact recreation in impaired waters.

These topics are pertinent to the entire project area. However, research is often driven by the availability of resources. While some research is being conducted within the region, BIG's active participation and advocacy at the state and national levels will help ensure regional priorities are addressed. Local participation will also help to ensure findings and recommendations produced elsewhere are transferable to the project area.

On January 26, 2016, the Research Workgroup met jointly with the Monitoring and Plan Revision Workgroup. Nine stakeholders reviewed data related to ambient and non- ambient water quality. They discussed the status of bacteria studies and potential future research.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Continue existing research and evaluate available data sources; and
  - Secure funding for additional projects, including
    - » analysis of E. coli species colonizing soil,
    - » bacteria seasonal variation study,
    - » determining location of a representative sample at a WWTF, and
    - » appropriateness of a single grab maximum vs. a geometric mean in evaluating compliance.

Implementation Strategies

10.1 Evaluate the Effectiveness of Stormwater Implementation Activities

– **Interim Measure:** *BIG stakeholders will monitor current and future stormwater projects and analyze their effectiveness.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule.*

Implementation Effort

◘ **BMP Monitoring.**

- HCFCD actively monitors several stormwater sites within the region and developed a Regional BMP Database where stakeholders can access and evaluate effectiveness data. (www.bmpbase.org)
- City of League City, in cooperation with TCWP, installed a BMP park. Monitoring of the BMPs was completed in 2015.
- Harris County Birnamwood Drive LID monitoring project continues to collect water quality and quantity data.
- BPA completed in 2015 a QAPP and is starting preconstruction water quality sampling prior to installation of a LID project on Almeda Road, part of the Urban Street Rebuilds project.
- H-GAC developed a LID web resource page. (www.h-gac.com/community/low-impact-development/resources.aspx)

10.2 Further Evaluate Bacteria Persistence and Regrowth

– **Interim Measure:** *BIG stakeholders will conduct special studies to better understand the extent of human contributions to bacterial loading. Data from these studies should be included in monitoring databases.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *This activity is On Schedule.*

Implementation Effort

◘ **Special Studies.**

- The City of Houston, Harris County, and HCFCD continue to implement the Unified Ambient Water Quality Monitoring Program to quantify diurnal bacteria fluctuations in area waterways

10.3 Determine Appropriate Indicators

– **Interim Measure:** *H-GAC and BIG stakeholders should help determine the need for alternative, supplemental, or multiple bacteria indicators to refine the I-Plan.*

Project Status

☐ Not Started
☐ Initiated
☒ **In Progress**
☐ Completed

☐ Behind Schedule
☒ **On Schedule**
☐ Ahead of Schedule

– *Overall this activity is On Schedule.*

Implementation Effort

☒ **Tracking Indicator Research.** BIG tracks ongoing and future research to identify potential indicator bacteria, as funding is made available:

– EPA completed a review of Coliphages as potential replacement to current fecal indicator bacteria. EPA plans to continue study in 2016.

– EPA. "Review of Coliphages as Possible Indicators of Fecal Contamination for Ambient Water Quality", April 17, 2015. EPA Office of Water – Office of Science and Technology Health and Ecological Criteria Division. Document 820-R-15-098.

10.4 Additional Research Topics

– **Interim Measure:** *H-GAC and BIG stakeholders should conduct additional research on WWTFs, health risks, recreational use, land use modeling, unimpaired waterways, nutrients, and other constituents as funds are available.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
◘ **On Schedule**
☐ Ahead of Schedule

– *Activities are On Schedule.*

Implementation Effort

◘ **Research Abstracts.** BIG members investigated opportunities to mitigate bacteria and nutrient loading to waterways through stream restoration and streambank stabilization. Preliminary research results and conclusions are provided here, however additional research is needed (Source HCFCD):

- Research (Brinkmeyer et al., 2014) indicates that *E. coli* and enterococcus in stream sediments can account for as much as 90 pecent of observed daily loads. Most sampling stations in the Buffalo Bayou and White Oak study indicate high concentrations of bacteria, especially within the top 1 cm of sediments. Incubation experiments with sediments collected from the bayous, then sterilized, and reinnoculated with *E. coli* demonstrated the ability of these bacteria to replicate outside of an animal host, with doubling rates of 48 to 60 hours.
- Near bank erosion of streams is a significant contributor to sediment load in area streams and bayous. HCFCD found through planning level assessments that Buffalo Bayou contributes as much as 17,000 tons of sediment per year from its streambanks (HCFCD, 2012).
- Studies, conducted by HCFCD, of Halls Bayou and Buffalo Bayou found approximately 60 percent of the annual sediment load is produced by eroding streambanks. This is consistent with national research where approximately 66 percent of the annual sediment load in urban streams was derived from their failing banks.
- Brinkmeyer et al., 2014, using the assumptions that the top 1 cm of sediment is resuspended in the water column and a doubling rate of 48 to 60 hr, found the contribution of *E. coli* from Buffalo Bayou sediment, alone, is conservatively 1010 Most Probable Number/day.
- Nutrient loading from streambank sediments may also be a contributing factor in bacteria regrowth (Formica, et al. 2004 and Formica and Van Eps 2012), and is worthy of additional local research.

◘ **Future Research Topics.** BIG members recommended research, should additional funding become available, including

- fate and transport of streambed and streambank sediments and associated bacteria and nutrients with the stream water column;
- Wet sieve analysis;
- Sample dilution;
- Use of filters smaller than 0.45 µm.; and
- Testing sludge blankets from wastewater treatment facilities.

GEOGRAPHIC PRIORITY FRAMEWORK

11

Summary

For the BIG project area to achieve state standards for contact recreation, a wide range of community stakeholders must be responsible for implementing the I-Plan. While some initiatives span the entire project area, others focus on targeted watersheds.

As regional organizations and local jurisdictions work to establish their priorities, they should consider five main categories of concern: 1) bacteria level, 2) accessibility of waterbody, 3) use level, 4) implementation opportunities, and 5) future land use changes. To assist with prioritization, H-GAC continues to publish the Top Ten "Most Wanted"/"Most Likely to Succeed" lists (Top 10 lists) based on either the 10 assessment units with the highest observed concentrations or the 10 assessment units with concentrations just above the contact recreation standard.

2016 Focus

- H-GAC and BIG stakeholders aim to
  - Host meetings in regional watersheds to encourage local stakeholder feedback and participation;
  - Continue to use the Top 10 streams lists to prioritize implementation; and
  - Use the Top 5/Least 5 Project, to begin to addressing the Top 10 lists using funding provided by GBEP.

Implementation Strategies

11.1 Consider Recommended Criteria When Selecting Geographic Locations for Projects

– **Interim Measure:** *Communities should consider bacteria, accessibility, opportunities, use, and future use when selecting locations for projects.*

Project Status

☐ Not Started
☐ Initiated
◘ **In Progress**
☐ Completed

☐ Behind Schedule
☐ On Schedule
◘ **Ahead of Schedule**

– *This activity is Ahead of Schedule. Priority criteria have been developed and are in use. Activity requires tracking to ensure stakeholders continue to prioritize implementation.*

Implementation Effort

◘ **BIG's Geographic Prioritization.** H-GAC cross compared the 2014 and 2015 Top 10 "Most Wanted" streams and Top 10 "Most Likely to Succeed" streams (see Appendices H and I):

- Seven Assessment Units (AUs) improved but remained on the list between 2014 and 2015: 1013C_01, 1016D_01, 1017_04, 1007I_01, 1007U_01,1007T_01 and 1013A_01
- One AU remained unchanged: 1007F_01
- Two AUs were new to the list having degraded: 1007R_01 and 1017E_01
- Two AUs improved and dropped off the list: 1101D_01, and 1014N_01

◘ **Top 10 "Most Likely to Succeed" List.** (Appendix I)

- Five AUs improved between 2014 and 2015 and remained on the list: 1008I_01, 1007A_01, 1102A_02, 1008C_02 and 1010_02.
- Five AUs were new to 'Most Likely to Succeed' list, many are from the Armand Bayou watershed and were not rated prior to Armand Bayou being included in the BIG project area in 2015: 1008E_01, 1113A_01, 1016B_01, 1113C_01, and 1113_02.
- Due to Armand Bayou being included on this listing, Five AUs dropped from the list: 1008_02, 1102_04, 1009_01, 1008H_01, and 1008B_02.

◘ **Top Five/Least Five Project.** Beginning in 2015, H-GAC and BIG partners have been using the Top Ten Lists to investigate five AUs from each list, screening for bacteria, seeking to identify potential sources and reporting those sources to local jurisdictions. All monitoring is being collected under a TCEQ approved QAPP. Any sources that were reported as corrected will receive follow up monitoring to verify improved conditions.

◘ **Top 10 "Most Wanted" Streams List.** Bayou Preservation Association and the City of Houston are working together to tackle the "Most Wanted" list. BPA conducts reconnaissance and additional wet and dry weather monitoring to track down bacteria source locations. When likely targets are identified, the information is passed on to the City of Houston or other local authorities to address:

- 2015 BPA visited Hunting, Brays, Sims, White Oak and Buffalo bayous. They identified several locations within the bayous with elevated *E. coli* bacteria concentration.
- When revisiting a site on Hunting Bayou with a leak identified in 2014, BPA found the City of Houston's temporary fix was leaking. The City of Houston corrected the leak and is currently working on a permanent fix.
- In Berry Gully, a Sims Bayou tributary n the City of South Houston, BPA found a hole in an exposed sewer main. The City of South Houston responded and is working to replace the sewer line.

APPENDICES

APPENDIX A

ACKNOWLEDGMENTS

Texas Commission on Environmental Quality

Chris Loft

Linda Broach

Bryan Eastham

Marty Kelly

Kimbalyn Laird

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Nwachukwu Sam Okonkwo

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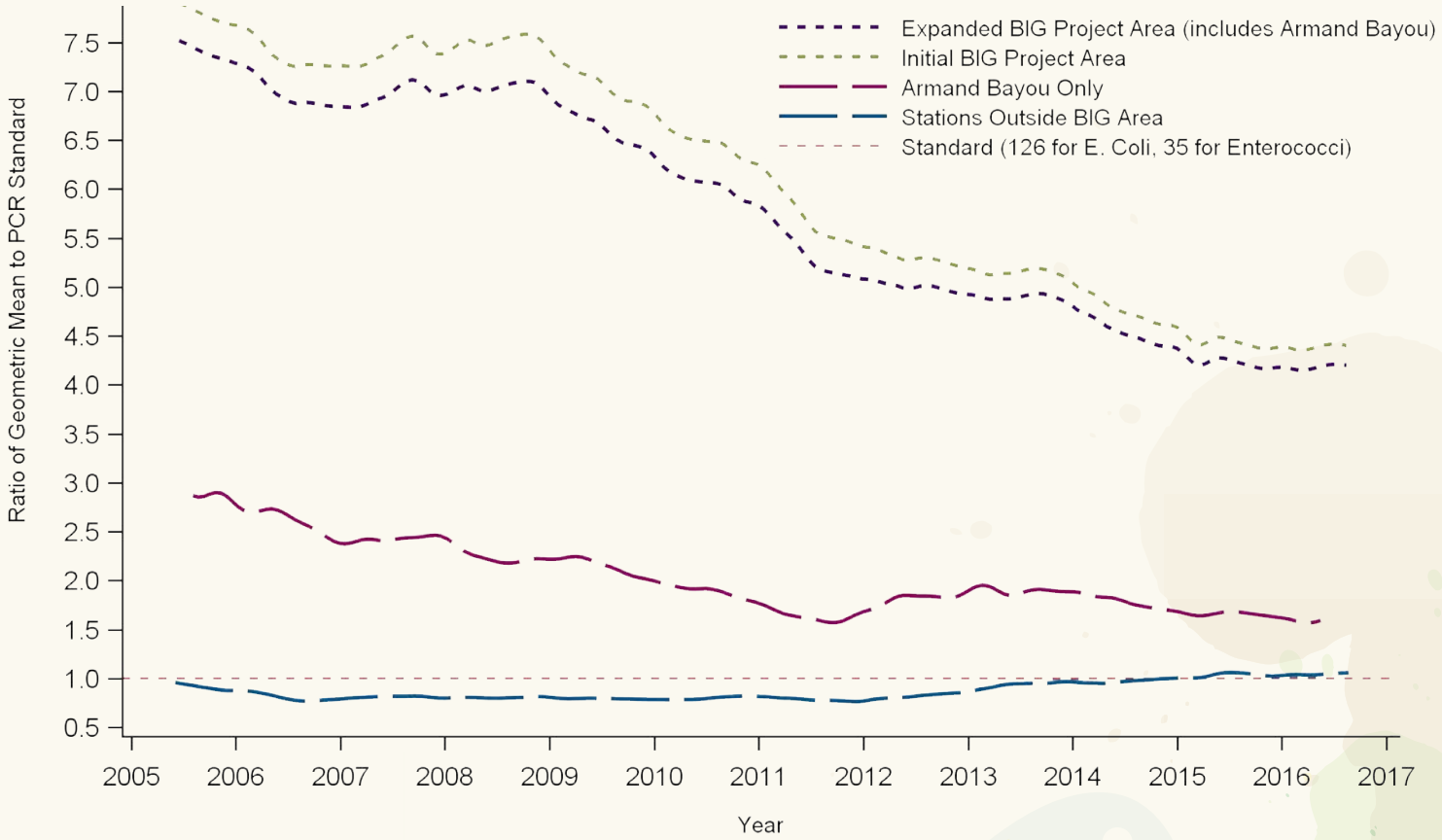
APPENDIX B

BACTERIA TRENDS

This chart illustrates how the seven-year geometric mean for bacteria levels has changed over time. It is based on ambient water quality data collecting indicator bacteria samples (*E. coli* and Enterococci) from all Clean Rivers Program monitoring stations within the BIG project area through the calendar year 2015. Included are bacteria trend lines for the BIG, the BIG including Armand Bayou, and Armand Bayou alone using a ratio of the geometric mean with that of the state's contact recreation standard, either *E. coli* and Enterococci (126 MPN/100mL or 35 MPN/100mL). Red dash line represents the standard and the green trend line is the bacteria geometric mean ratio for all areas outside of the BIG project area sampled by the CRP. The state standard is shown here as a straight line at 1, which is the ratio of the standard to itself.

While the overall bacteria trend in the BIG project area continues to decline, it appears to be leveling out with the area's relative geometric mean at just above four times the state's water quality standard for bacteria.

Appendix B Figure 1. Seven-year Bacteria Trend in BIG Areas, With and Without Armand Bayou



APPENDIX C

TRACKING PROGRESS

Appendix C Table 1. Tracking implementation Progress for Thirty-Eight I-Plan Activities

Section	*Activity*	*Progress*	*Status*
1.1	WWTF: Rigorous Bacteria Monitoring	Initiated	Behind Schedule
1.2	WWTF: Strict Bacteria Limits	In Progress	Ahead of Schedule
1.3	WWTF: Increased Compliance and Enforcement by TCEQ	In Progress	Behind Schedule
1.4	WWTF: Improved Design and Operation Criteria	In Progress	Ahead of Schedule
1.5	WWTF: Upgrade Facilities	In Progress	On Schedule
1.6	WWTF: Consider Regionalization	In Progress	On Schedule
1.7	WWTF: Treated Effluent	In Progress	On Schedule
2.1	SSS: Utility Asset Management	In Progress	**On Schedule***
2.2	SSS: Fats, Oils, and Grease	In Progress	Ahead of Schedule
2.3	SSS: Maintain Function at Lift Station	In Progress	On Schedule
2.4	SSS: Improve Reporting Requirements	In Progress	**Ahead of Schedule***
2.5	SSS: Stregnthen Controls on Subscriber Systems	**In Progress***	**On Schedule***
2.6	SSS: Penalties for Violations	In Progress	On Schedule
3.1	OSSF: Identify and Address Failing Systems	In Progress	**Ahead of Schedule***
3.2	OSSF: Address Inadequate Maintenance	In Progress	On Schedule
3.3	OSSF: Legislation and Other Regulatory Actions	In Progress	On Schedule
4.1	Stormwater: Continue Existing Programs	In Progress	On Schedule
4.2	Stormwater: Model Best Practices	In Progress	**On Schedule***
4.3	Stormwater: Encourage Expansion of Stormwater Programs	In Progress	On Schedule
4.4	Stormwater: Promote Recognition Programs	In Progress	On Schedule
4.5	Stormwater: Provide a Circuit Rider Program	In Progress	Behind Schedule
4.6	Stormwater: Reimbursement of Bacteria Measures	In Progress	On Schedule
5.1	Construction: Increase Compliance and Enforcement	In Progress	On Schedule
6.1	Illicit Discharge and Dumping: Detect and Eliminate	In Progress	On Schedule
6.2	Illicit Discharge and Dumping: Improve Regulations and Enforcement	In Progress	On Schedule
6.3	Illicit Discharge and Dumping: Monitor and Control Waste Hauler Activities	In Progress	**Behind Schedule****
7.1	Animals and Agriculture: Promote Increased Participation	In Progress	On Schedule
7.2	Animals and Agriculture: Promote Management of Feral Hog Populations	In Progress	On Schedule
8.1	Residential: Expand Homeowner Education Efforts	In Progress	On Schedule
9.1	Monitoring and I-Plan Revision: Ambient Water Quality Monitoring	In Progress	On Schedule
9.2	Monitoring and I-Plan Revision: Non-Ambient Water Quality Monitoring	In Progress	On Schedule

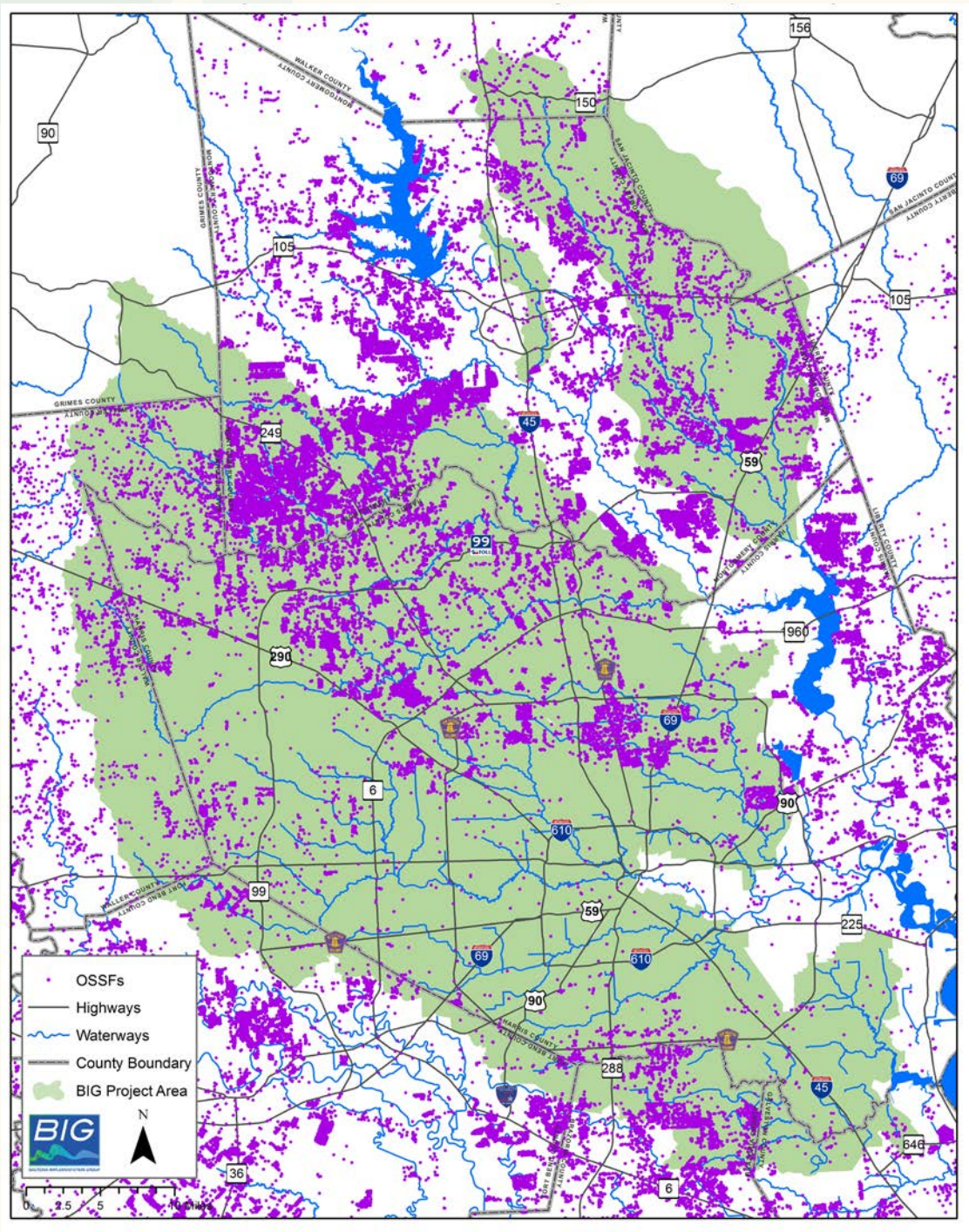
Appendix C Table 1. Tracking implementation Progress for Thirty-Eight I-Plan Activities

Section	*Activity*	*Progress*	*Status*
9.3	Monitoring and I-Plan Revision: Implementation Database	In Progress	On Schedule
9.4	Monitoring and I-Plan Revision: Assess Monitoring Results and Modify I-Plan	In Progress	On Schedule
10.1	Research: Effectiveness of Stormwater Activities	In Progress	On Schedule
10.2	Research: Evaluate Bacteria Persistence and Regrowth	In Progress	On Schedule
10.3	Research: Determine Appropriate Indicators	In Progress	On Schedule
10.4	Research: Additional Research Topics	In Progress	On Schedule
11.1	Geographic: Consider Priority Criteria in Project Location	In Progress	**Ahead of Schedule***

*Appendix C Table 1. Tracking implementation progress. Bolded text denotes a change from the previous year. *Activity's Progress or Status graded higher over the previous year's assessment. **Progress or Status of Activity was downgraded over the previous year's assessment.*

APPENDIX D

OSSF INFORMATION SYSTEM



APPENDIX E

"WALL OF FAME"

Authorized agents for on-site sewage facilities (OSSFs) and operators of municipal separate storm sewer systems (MS4s) Phase II were asked via e-mail and/or phone to provide data and information for this annual report. The "Wall of Fame" acknowledges participating stakeholders for their contributions. Additional stakeholders, including wastewater treatment facility permit holders, will be asked to provide data and information in the coming year.

On-Site Sewage Facilities

RELIABLY SUBMITTED DATA AND SUBMITTED A COMPLETE PERMIT DATA SET

- City of Manvel
- Brazoria County*
- Fort Bend County
- Galveston County
- Harris County
- Liberty County
- San Jacinto River Authority
- Waller County
- Walker County
- Texas Commission on Environmental Quality
-

** Also submitted some violation data*

Note: *Austin, Chambers, Colorado, Matagorda and Wharton counties, while outside of the BIG project area, have provided information in support of the OSSF mapping program initiated by the BIG.*

Municipal Separate Storm Sewer Systems

RESPONDED TO MS4 PHASE II QUESTIONNAIRE

- City of Missouri City
- City of Meadows Place
- Montgomery County MUD No. 94
- Brazoria Drainage District No. 4
- Fort Bend County MUD No. 57
- Cinco Sourthwest MUD No. 1
- City of Pearland
- City of League City
- City of West University Place
- City of Katy
- City of Deer Park
- Harris-Fort Bend Counties No. 1
- Grand Lakes MUD No. 4
- Grand Lakes MUD No. 1
- Southwest Harris County MUD No. 1
- City of Hunters Creek Village
- Fort Bend County MUD No. 122
- Fort Bend County MUD No. 123
- Fort Bend County MUD No. 57
- Fort Bend County MUD No. 34
- Fort Bend County MUD No. 35
- Fort Bend County MUD No. 130
- City of Stafford
- Montgomery County MUD No. 84
- Montgomery County MUD No. 15

SHARED MS4 PHASE II DATA FOR DATABASE TRACKING

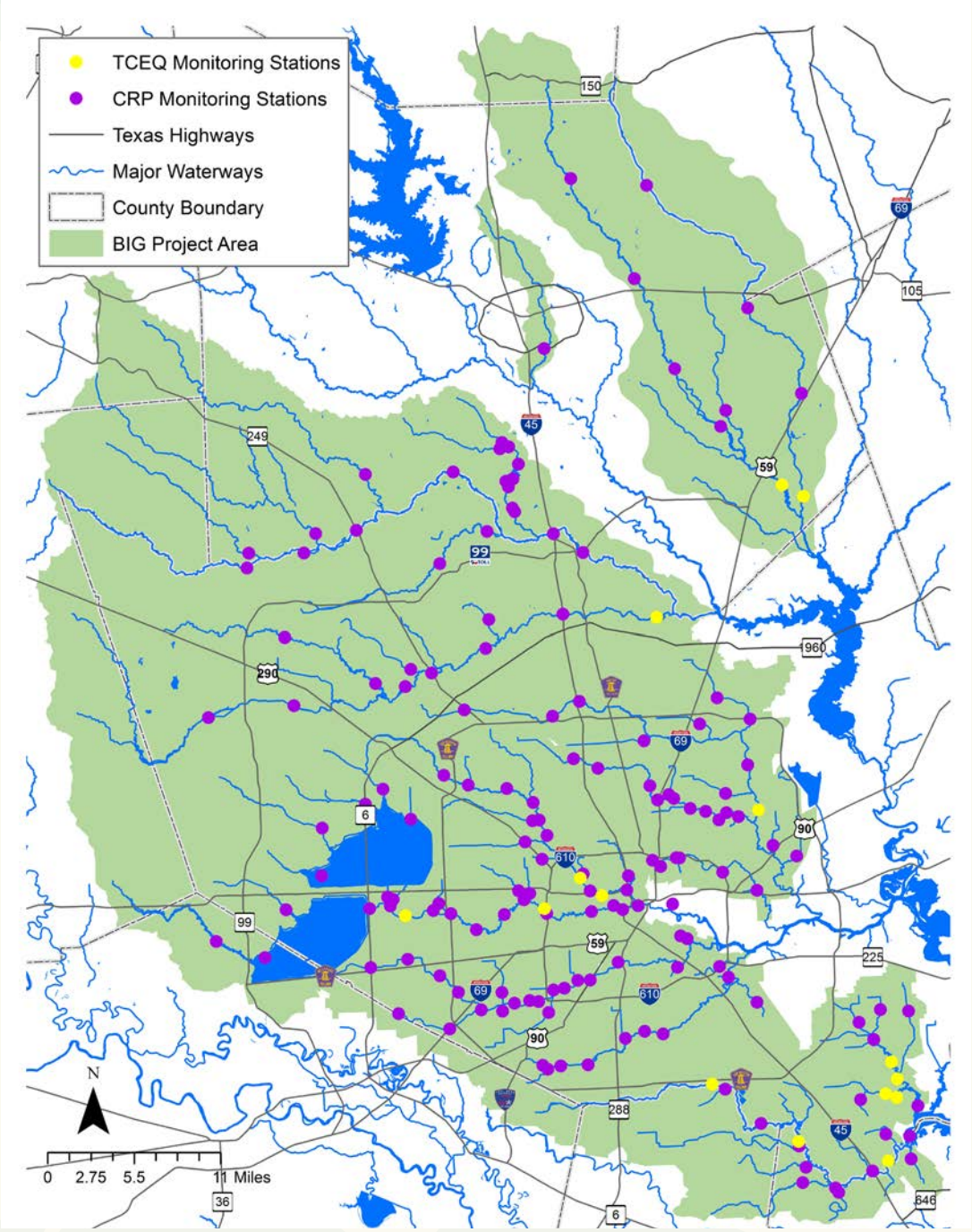
- City of Friendswood
- City of League City
- City of Nassau Bay
- City of Pearland

SHARED MS4 PHASE II SWMP AND NOI DOCUMENTS

- Brazoria Drainage District No. 4
- Cinco Southwest MUD No. 1
- City of League City
- Grand Lakes MUD No. 1
- Grand Lakes MUD No. 4
- Harris-Fort Bend Counties MUD No. 1
- City of Hunters Creek Village
- City of Missouri City
- Montgomery County MUD No. 94
- City of Nassau Bay
- City of Pearland
- Southwest Harris County MUD No. 1
- City of West University Place
- Harris-Fort Bend County MUD No. 1
- Fort Bend County MUD No. 122
- Fort Bend County MUD No. 123
- Fort Bend County MUD No. 57
- Fort Bend County MUD No. 34
- Fort Bend County MUD No. 35
- City of Stafford
- Montgomery County MUD No. 84

APPENDIX F

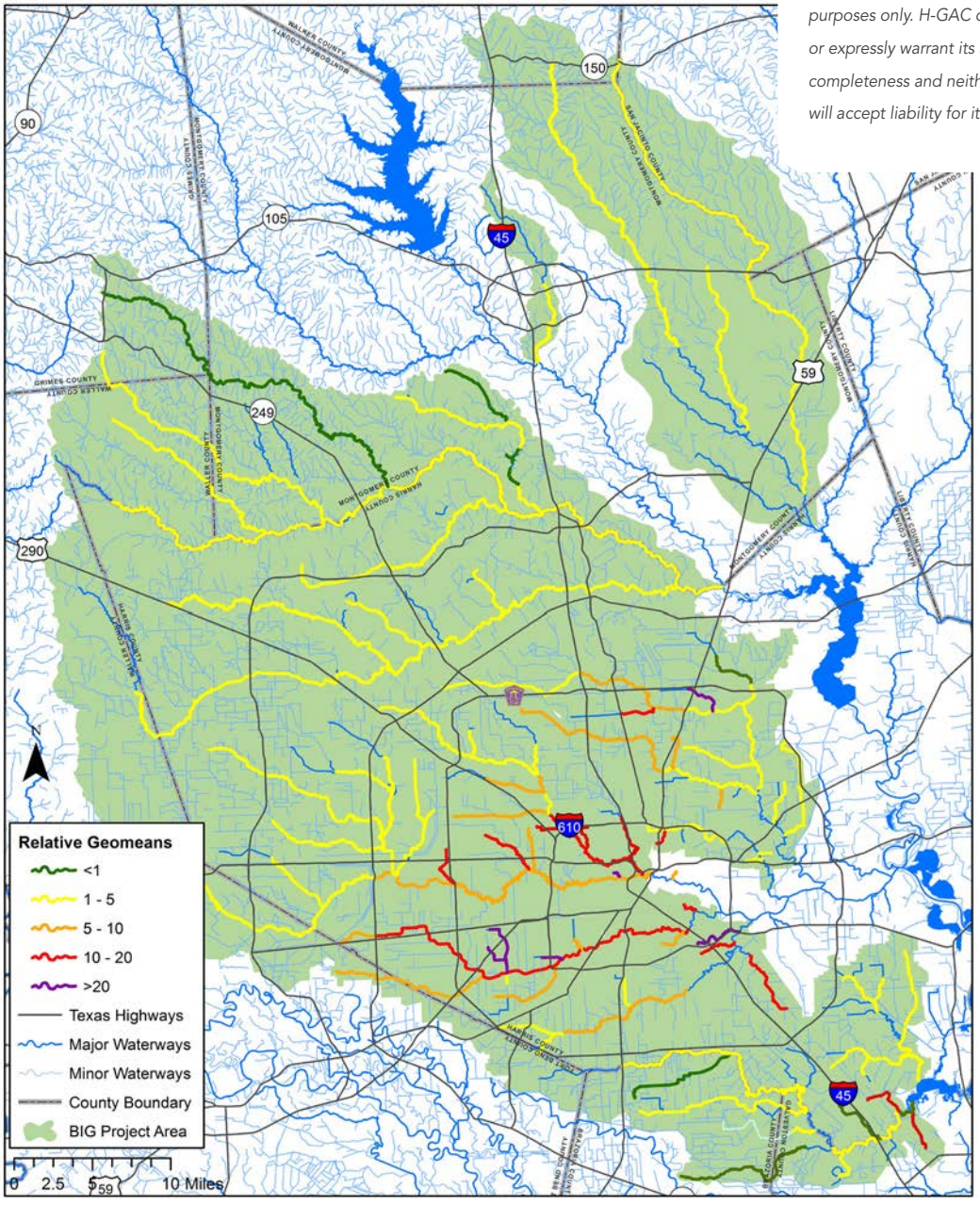
CRP MONITORING SITES IN THE BIG REGION



APPENDIX G

BACTERIA GEOMEANS WITHIN BIG AREA

The information on this map represents the most current information available to H-GAC and is for general informational purposes only. H-GAC does not implicitly or expressly warrant its accuracy or completeness and neither assumes nor will accept liability for its use.



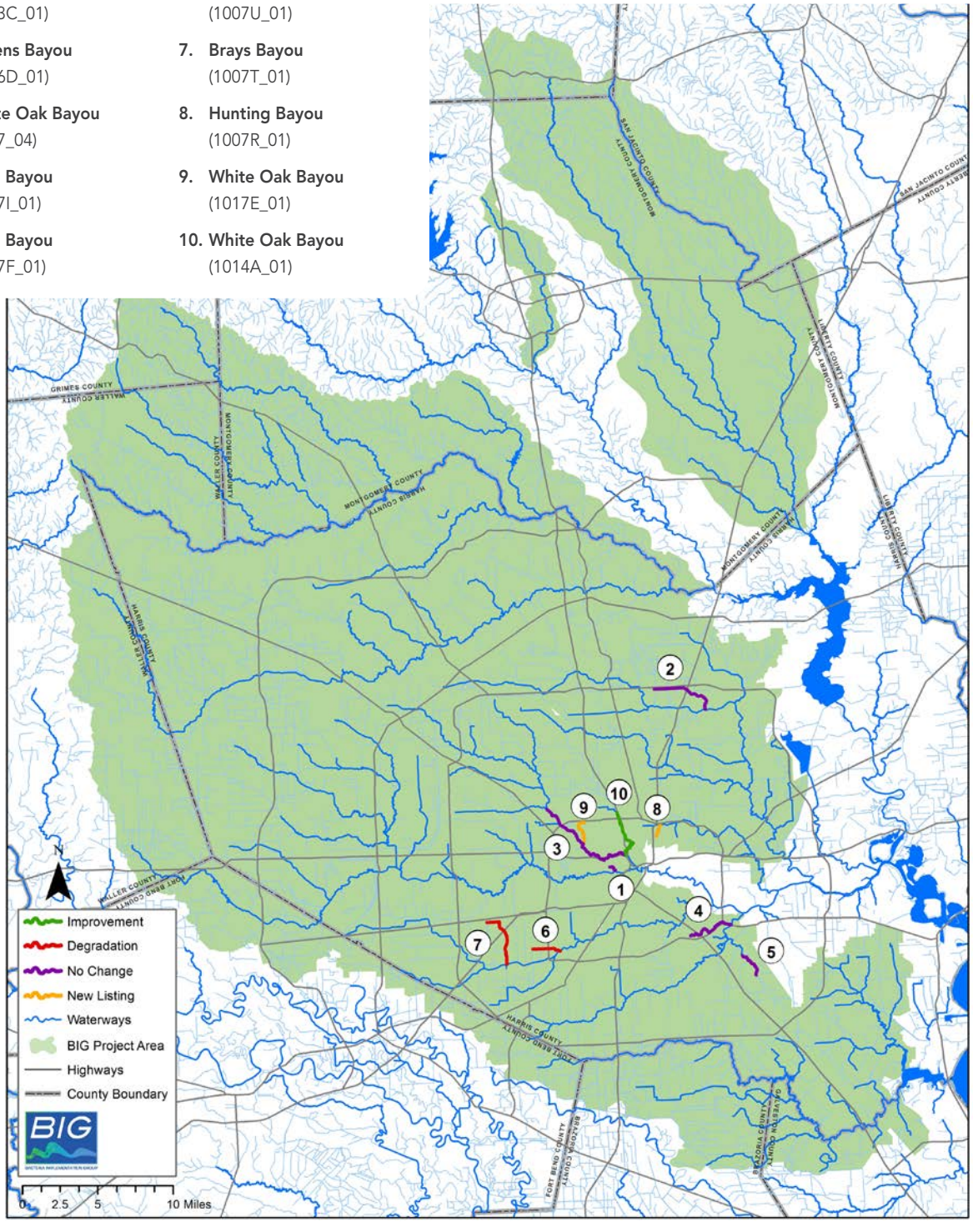
APPENDIX H

TOP 10 "MOST WANTED" STREAMS

Rank	Assessment Unit	Parameter	Relative Geomean (MPN/ 100 mL)	Geomean (MPN/ 100 mL)	AU Status	Assessment Unit Description	Watershed
1	1013C_01	*E. coli*	30.48	3840	Improved	Unnamed tributary located approximately 1.8 miles upstream of the Buffalo Bayou/White Oak Bayou confluence between IH-10 and Memorial Drive west of IH-45 in Harris County	Buffalo Bayou
2	1016D_01	*E. coli*	24.06	3032	Improved	Unnamed tributary of Greens Bayou from the confluence with Greens Bayou, west of El Dorado Country Club to Lee Road, west of US Hwy 59 in Harris County	Greens Bayou
3	1017_04	*E. coli*	20.79	2620	Improved	White Oak Bayou, Brickhouse Gully confluence to a point immediately upstream of the confluence of Little White Oak Bayou in Harris County	White Oak Bayou
4	1007I_01	*E. coli*	20.62	2598	Improved	Plum Creek f rom the Sims Bayou confluence to Telephone Road in Harris County	Sims Bayou
5	1007F_01	*E. coli*	18.61	2345	No Change	Berry Bayou from a point 2.4 km (1.5 mi) upstream of the Sims Bayou confluence to SH 3	Sims Bayou
6	1007U_01	*E.coli*	15.57	1962	Improved	Mimosa Ditch from the Brays Bayou confluence upstream 2.9 km (1.8 mi) to the Chimney Rock bridge crossing	Brays Bayou
7	1007T_01	*E. coli*	15.36	1936	Improved	Bintliff Ditch from the Brays Bayou confluence to 0.57 km (0.35 mi) upstream of the Fondren Road bridge crossing	Brays Bayou
8	1007R_01	*E. coli*	13.82	1742	Degraded New Listing	From Bain Street to Sayers Street (South Fork)	Hunting Bayou
9	1017E_01	*E. coli*	13.22	1665	Degraded New Listing	From the confluence with White Oak, near W 11th Street, to just upstream of W 26th Street, south of Loop 610 W in Harris County	White Oak Bayou
10	1014A_01	*E. coli*	12.36	1558	Improved	Little White Oak Bayou, from the White Oak Bayou confluence to Yale Street in Harris County	White Oak Bayou

Top 10 "Most Wanted" Streams

1. **Buffalo Bayou** (1013C_01)
2. **Greens Bayou** (1016D_01)
3. **White Oak Bayou** (1017_04)
4. **Sims Bayou** (1007I_01)
5. **Sims Bayou** (1007F_01)
6. **Brays Bayou** (1007U_01)
7. **Brays Bayou** (1007T_01)
8. **Hunting Bayou** (1007R_01)
9. **White Oak Bayou** (1017E_01)
10. **White Oak Bayou** (1014A_01)



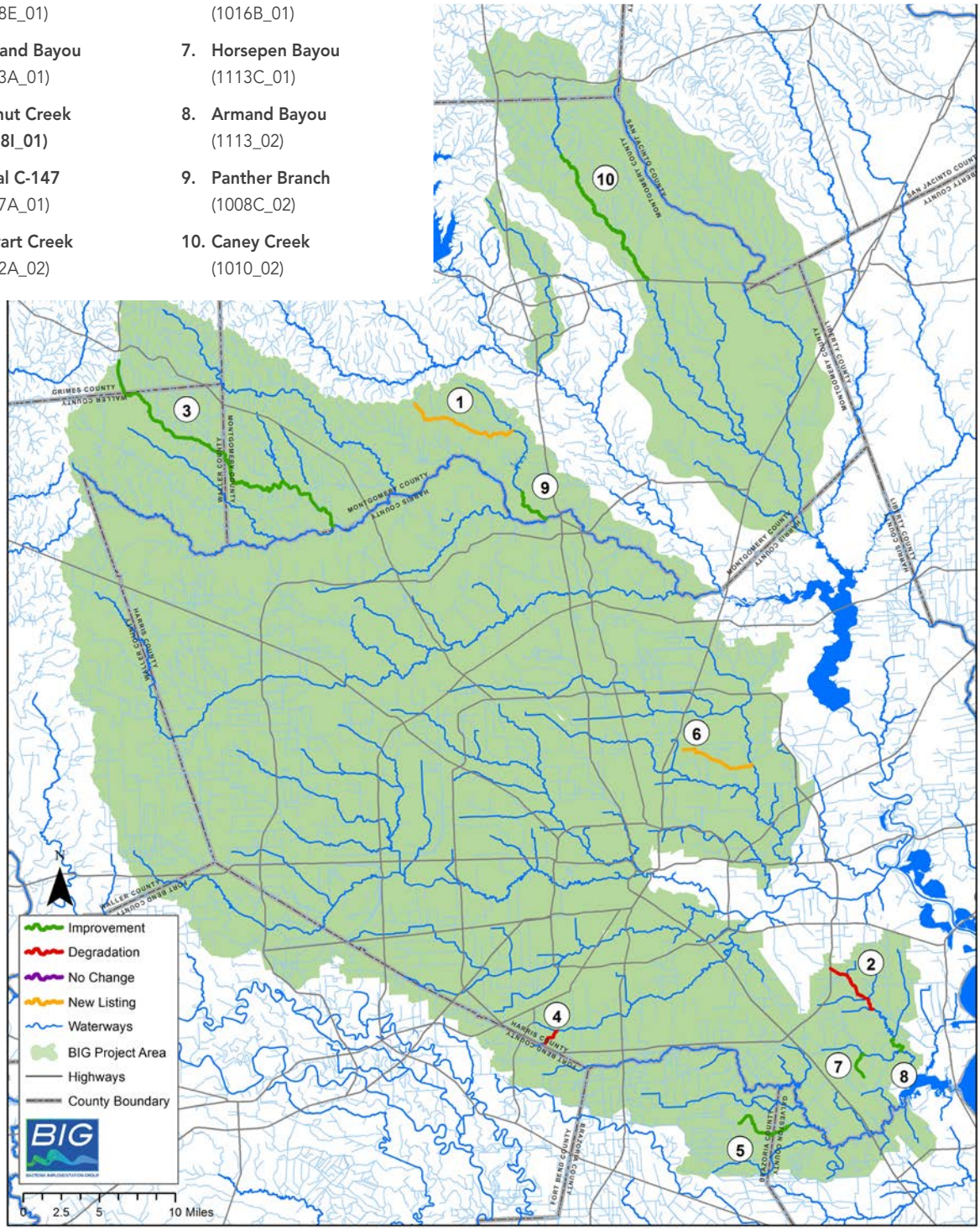
APPENDIX I

TOP 10 "MOST LIKELY TO SUCCEED" STREAMS

Rank	*Assessment Unit*	*Parameter*	*Relative Geomean (MPN/ 100 mL)*	*Geomean (MPN/ 100 mL)*	*AU Status*	*Assessment Unit Description*	*Watershed*
1	1008E_01	*E. Coli*	1.01	128	New Listing	Bear Branch from upper Panther Branch confluence to south of FM 1488	Bear Branch
2	1113A_01	*E. Coli*	1.09	137	New Listing	Armand Bayou to upper segment boundary of Armand Bayou Tidal	Armand Bayou
3	1008I_01	*E. Coli*	1.15	146	Improved	Walnut Creek, from the Spring Creek confluence to a point 41.1km upstream.	Walnut Creek
4	1007A_01	*E. Coli*	1.18	149	Improved	From the Sims Bayou confluence upstream to a point 0.71 km (0.44 mi) east of Beltway 8	Canal C-147
5	1102A_02	*E. Coli*	1.2	151	Improved	Cowart Creek, confluence with Clear Creek to Sunset Drive	Cowart Creek
6	1016B_01	*E. Coli*	1.2	151	New Listing	Unnamed tributary, From confluence with Greens Bayou to Hirsch Road in Harris County	Greens Bayou
7	1113C_01	*E. Coli*	1.21	152	New Listing	Unnamed tributary of Horsepen Bayou from confluence to Reseda Dr.	Horsepen Bayou
8	1113_02	*Enterococci*	1.22	43	New Listing	Armand Bayou from confluence with Horsepen Bayou to Big Island Slough	Armand Bayou
9	1008C_02	*E. Coli*	1.22	153	Improved	Lower Panther Branch, from Saw Dust Road to the Lake Woodlands Dam	Panther Branch
10	1010_02	*E. Coli*	1.26	159	Improved	Caney Creek from FM 1097 to SH105	Caney Creek

Top 10 "Most Likely to Succeed" Streams

1. **Bear Branch** (1008E_01)
2. **Armand Bayou** (1113A_01)
3. **Walnut Creek (1008I_01)**
4. **Canal C-147** (1007A_01)
5. **Cowart Creek** (1102A_02)
6. **Greens Bayou** (1016B_01)
7. **Horsepen Bayou** (1113C_01)
8. **Armand Bayou** (1113_02)
9. **Panther Branch** (1008C_02)
10. **Caney Creek** (1010_02)



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