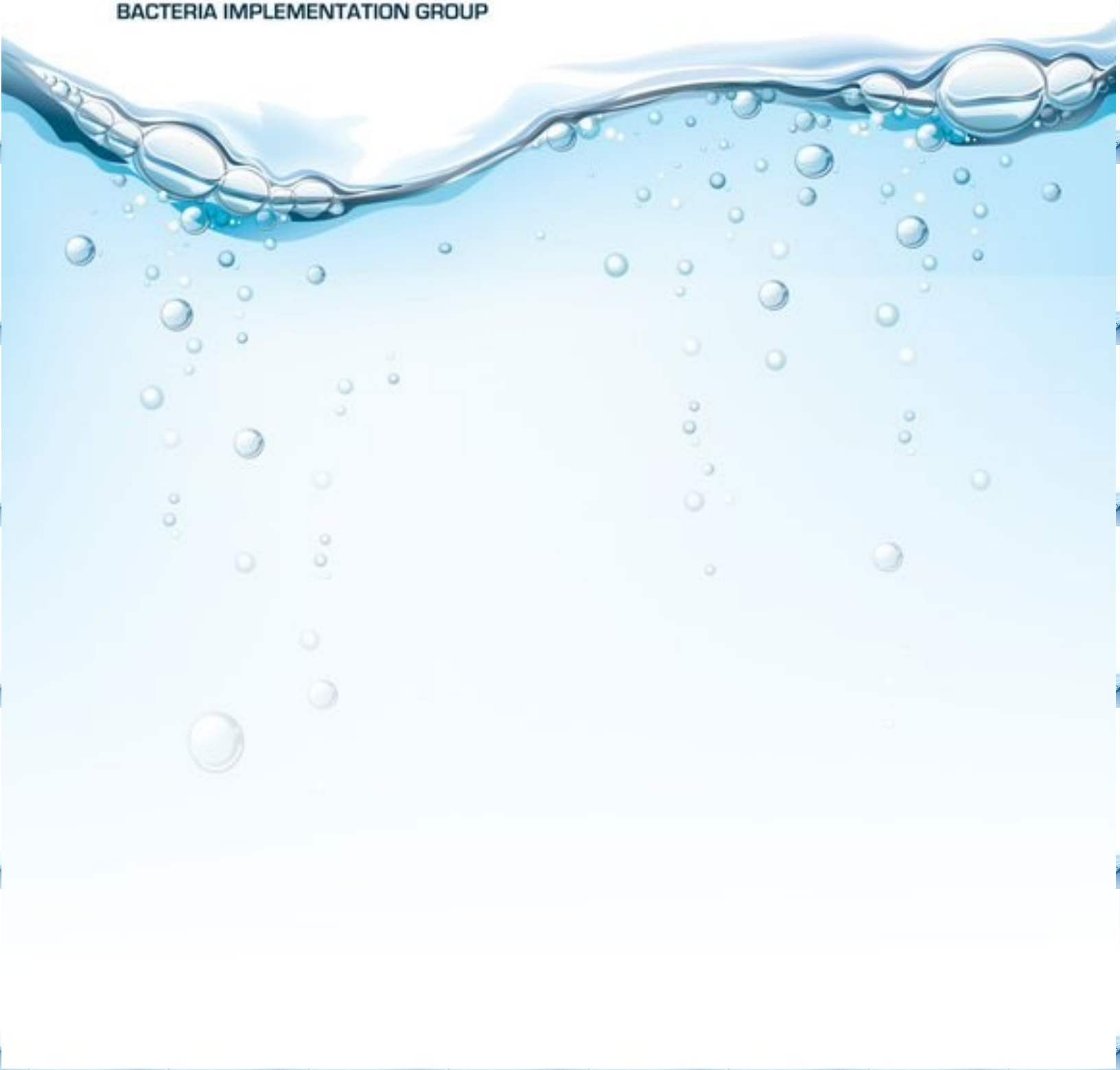
BIG

BACTERIA IMPLEMENTATION GROUP

2020 ANNUAL REPORT

JANUARY 1, 2019–DECEMBER 31, 2019



IMPLEMENTING THE BIG I-PLAN

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

BIG MEMBERS

Rep. Ernest Bailes IV, San Jacinto County (Agriculture)

Sarah Bernhardt, Bayou Preservation Association (Conservation)

Ralph Calvino, Terracon (Business/Industry)

Jerry Caraviotis, Harris County (Urban County)

Richard Chapin, City of Houston (Large City)

Danielle Cioce, Harris County (Urban County)

Charlotte Cisneros, Galveston Bay Foundation (Conservation)

Christine Cooper, City of Conroe (Small City)

Tom Douglas, Houston Sierra Club (Conservation)

Denise Ehrlich, Gulf Coast Authority (Business/Industry)

Catherine Elliott, Harris County Flood Control District (Urban County)

Teague Harris, IDS Engineering Group (Utility District)

Andrew Isbell, Walker County (Rural County)

Carol La Breche, City of Houston (Large City)

Helen Lane, Houston Audubon Society (Conservation)

Michael Lee, US Geological Survey (Resource Agency/Academia)

Mac Martin, Texas A&M Forest Service (Agriculture)

Cathy McCoy, Harris County Soil and Water Conservation District #442 (Agriculture)

Jack Murphy, City of League City (Small City)

Scott Nichols, Montgomery County (Rural County)

Becky Olive, AECOM (Business/Industry)

Mitchell Page, Schwartz, Page & Harding, LLP (Utility District)

Linda Pechacek, LDP Consultants, Inc. (Public)

Rachel Powers, Citizen's Environmental Coalition (Conservation)

Patrick Rightmyer, City of Houston (Large City)

Jim Robertson, Cypress Creek Flood Control Coalition (Conservation)

Scott Saenger, Jones and Carter (Business/Industry)

Aaron Schindewolf, San Jacinto River Authority (Business/Industry)

Linda Shead, Texas Coastal Partners (Conservation)

Brian Shmaefsky, Lone Star College, Kingwood (Resource Agency/Academia)

Hon. Leah Tarrant, (Rural Small City)

Michael Thornhill, SI Environmental (Utility District)

Scott Tuma, (Business/Industry)

Parenthetical indicates type of organization represented.

BIG ALTERNATES

Shaun Austin, Gulf Coast Authority

Camila Biaggi, Harris County

Susie Blake, City of League City

Kathlie Bulloch, City of Houston

Matthew Carpenter, IDS Engineering Group

Nuguent Cotton, Harris County

John Ellis, US Geological Survey

Dale Everitt, San Jacinto County

Frank Green, Montgomery County

Greg Hall, City of Conroe

Jody Hooks, City of League City

Scott Jones, Galveston Bay Foundation

Karen Kottke, AECOM

Jason M. Maldonado, Lockwood, Andrews and Newnam

Reuben Martinez, Montgomery County

Carl Masterson, Texas Coastal Partners

Clint Miller, Terracon

Lisa Montemayor, City of Houston

Paul Nelson, Bayou Preservation Association

Scott Nichols, Montgomery County

Anne Olson, Buffalo Bayou Partnership

Michael Page, Schwartz, Page & Harding, LLP

Tina Petersen, Harris-Galveston Subsidence District

Nick J. Russo, Harris County

Scott Saenger, Jones & Carter, Inc.

Thomas Sample, US Geological Survey

Elaine Savage, Harris County

Kristen Schlemmer, Citizens' Environmental Coalition

Linda Shead, Buffalo Bayou Partnership

Richard "Dick" Smith, Cypress Creek Flood Control Coalition

Robert Snoza, Harris County Flood Control District

Desta Takie, City of Houston

Lam Tran, City of Houston

Roberto Vega, Harris County Flood Control District

Jim Williams, Sierra Club

Many stakeholders participated in actions in support of the I-Plan, many of which are documented in this Annual Report

The Houston-Galveston Area Council (H-GAC) facilitates the BIG and supports and supplements implementation of the I-Plan through a grant from the Texas Commission on Environmental Quality (TCEQ).

Be Part of the Solution

The BIG project is and will continue to be successful in no small part to the individual actions of each stakeholder. We are eager to build on each success and seek the continued commitment of our partners and renewed interest and participation of our stakeholders.

Most of the implementation activities in the I-Plan are voluntary. Municipal Separate Storm Sewer Systems (MS4) Phase I and Phase II operators, local governments, farmers and ranchers, septic system owners, pet owners, and residents can help reduce the number of bacteria entering waterways by selecting one or more of these activities to implement.

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

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. Fecal wastes come from a variety of sources, including human, pets, domesticated animals, and wildlife (Figure 1).

Figure 1. Pet waste control at a local park

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. The Texas Commission on Environmental Quality (TCEQ) approved the I-Plan (formally known as the Implementation Plan for Seventy-Two Total Maximum Daily Loads (TMDL) for Bacteria in the Houston-Galveston Region) on January 31, 2013. The 2020 Annual Report is designed to track progress made in the BIG Project Area (Figure 2) from January 1, 2019 to December 31, 2019.

MAKING PROGRESS

The good news is we are making a difference. Overall, bacteria levels for waterways in the BIG project area have decreased since the BIG began working to address the problem in 2008.

Bacteria levels in waterways have decreased from above six times the state's contact recreation standard to four times the standard (Figure 3). Bacteria conditions have improved in 57 of the 227 assessment units that make up the BIG project area. In fact, two assessment units, 1004_01 and 1004D_01 on the West Fork of the San Jacinto River and Crystal Creek, respectively, now meet the contact recreation standard and were delisted for the TCEQ's 2016 Texas Integrated Report[1].

As a region, we have seen progress, however as Figure 3 shows, the bacteria trend has leveled out with a perceptive increase in recent years. Clearly, there is more to do to reach the goal of the I-Plan - reduce bacteria concentrations in the region's waters and eventually fully support contact recreation.

[1] https://www.tceq.texas.gov/assets/public/waterquality/swqm/assess/16txir/2016_delist.pdf

BIG Project Area

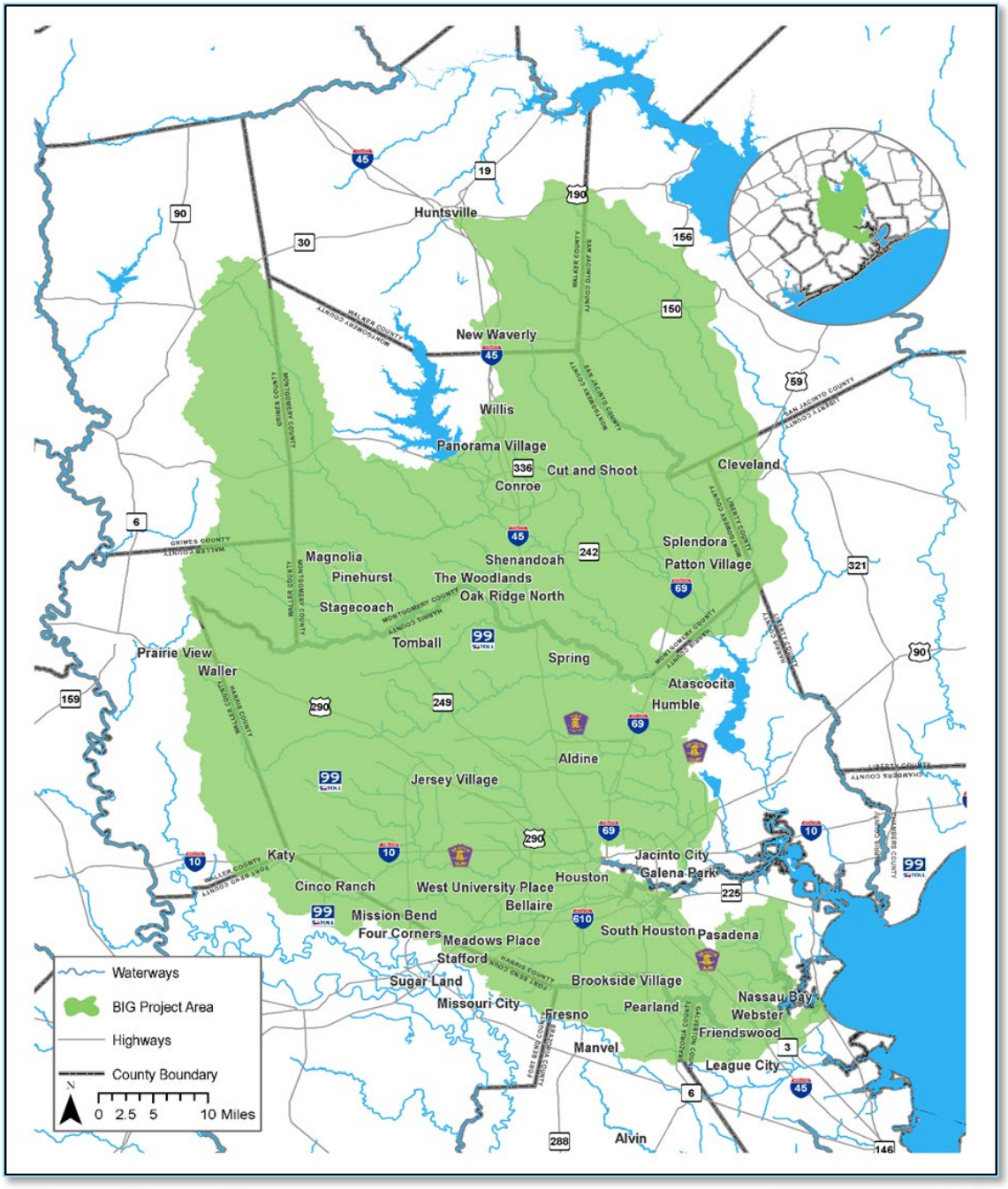


Figure 2. The BIG project area is approximately 3,260 square miles and has a population of nearly five million people. The area encompasses part of 10 counties much of the City of Houston and all or part of another 63 cities.

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 is working and what remains to be implemented.

Since the first annual report was published in 2013, the BIG project area (Figure 2) has expanded. The first expansion included the Armand Bayou TMDL project area in 2015. The second expansion in 2016 included the East and West Fork of the San Jacinto TMDL project Area. The latest expansion incorporated the Jarbo Bayou watershed in 2018. The original project area was 2,202.7 square miles. The expanded area is now 3,259.89 square miles, roughly the size of Delaware and Rhode Island, combined. The I-Plan was initially written for 72 TMDLs. With additional TMDLs completed within the BIG project area and with the expanded area, the I-Plan now covers 126 TMDLs.

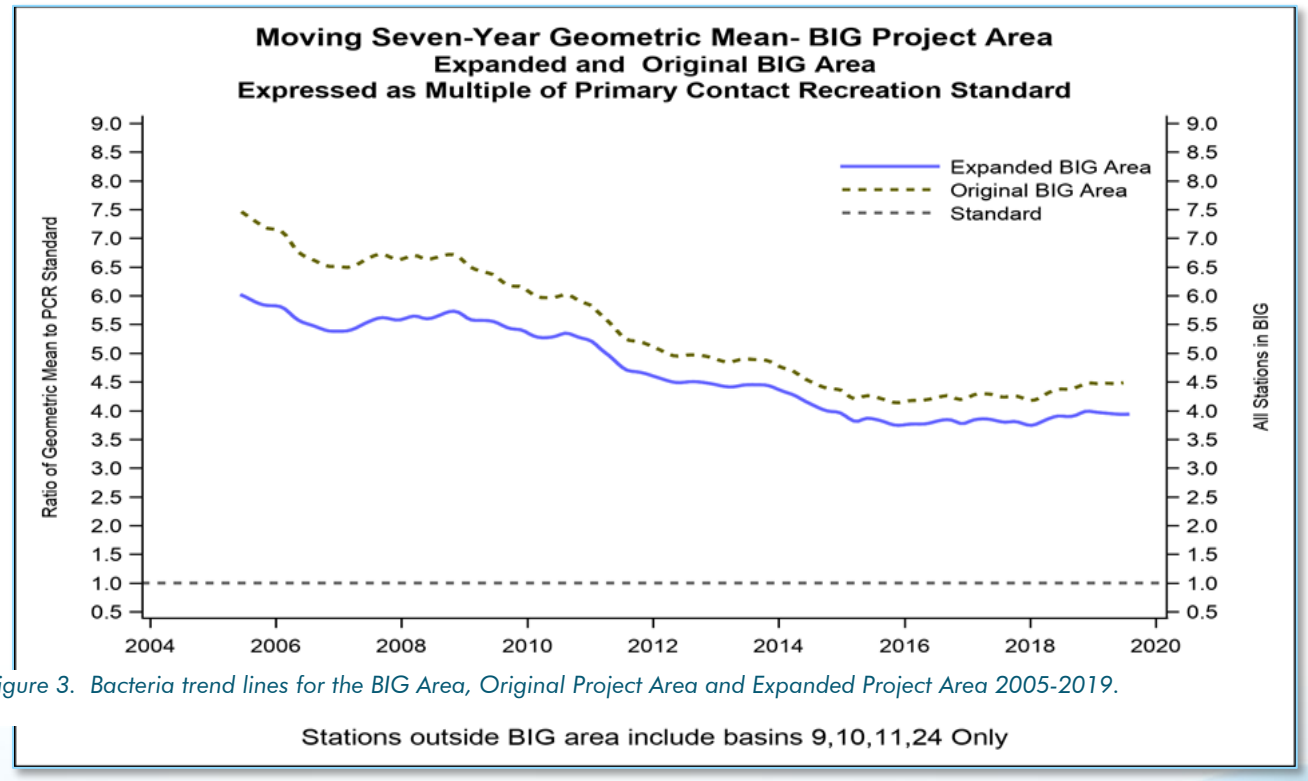


Figure 3. Bacteria trend lines for the BIG Area, Original Project Area and Expanded Project Area 2005-2019.

SPOTLIGHT ON SUCCESS

Highlighting successful projects is an important part of the BIG Annual Report. The BIG hopes by focusing on model 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 the expanded use of bacteria reduction projects 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 in 2019.

Urban Forests – A Multi-Benefit Practice to Improve Watershed Health and Protection

The Texas A&M Forest Service (TFS) is working with local and regional partners through four projects to study and implement the use of tree plantings on a large scale to improve stormwater and protect water supplies (Figure 4).

1. TFS with agencies and organizations across the Greater Houston Area, are projected to plant over 211,000 trees in 2020. Native tree species that provide high levels of stormwater runoff reduction, air pollution reduction, erosion control and carbon sequestration were selected for these plantings. These efforts tie into the Houston Resilience Plan to establish 4.6 million new native trees by 2030. According to our latest data, Houston currently has about 33 million trees. The benefits of these trees include:

- Reducing stormwater runoff by 173 million cubic feet/year.
- Providing $53 million dollars in residential energy savings.
- Storing over 2 million tons of carbon
- Providing $20 million in health benefits

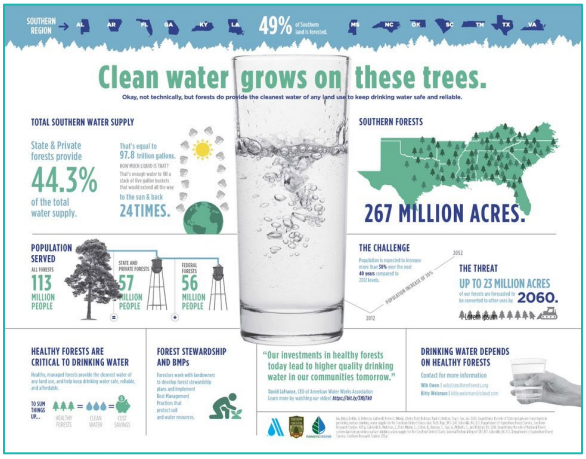


Figure 4. Southern Region Forest Infographic

2. TFS is implementing the use of trees in watershed protection plans. TFS has been running stormwater models using I-Tree Hydro. This model quantifies the effects of changes in tree canopy cover and impervious surfaces on the hydrologic cycle. It was developed to model urban vegetation effects and to aid natural resource managers and urban planners in management and planning decisions. I-Tree Hydro was integrated into the Cypress Creek Watershed Protection Plan. The results of the model indicated that increasing the forest canopy would yield the greatest benefits. By increasing canopy coverage by just seven percent with proper spacing, 409,000 new trees would render an annual reduction of 371 million gallons of stormwater runoff once reaching maturity.

3. TFS is also conducting a study to find out on the relationship of flooding to urban forests in Houston. The study will look at the growth rates and tree species diversity of areas heavily impacted by Hurricane Harvey to determine species most resilient to flood impacts. The ultimate goal being incorporating these more resilient species into future plantings for

continued watershed protection amongst other benefits.

4. TFS provided a training for the City of Houston's Sourcewater Protection (SWP) Team. This team is a part of the City's Drinking Water Operations and is tasked with monitoring and assessing the quality of Houston's drinking water resources. This monitoring is predominantly taking place in the largely forested Lake Houston Watershed. In order to meet the growing surface water demands, Lake Houston will be the largest source of drinking water in the world by the end of 2020. TFS and Sourcewater Protection are both part of the Texas Forest and Drinking Water Partnership. This initiative works to increase understanding and communication between the forest and drinking water sectors and is part of a larger, regional collaborative called the Southeastern Partnership for Forests and Water. TFS's Houston office has been working closely with SWP to help educate them on the benefits of forested watersheds in producing clean water. Forests are very effective at preventing sediment and other forms of non-point source pollution from reaching nearby water bodies.

City of Houston Sanitary Sewer Overflow Tracking

Sanitary Sewer Overflows (SSOs) are considered a large contributor of indicator bacteria to area streams. Identifying, reporting, and correcting SSOs is a challenge for local governments. Tracking SSO reports over time is an additional challenge for local governments and planning organizations like the BIG, as a lack of consistent and uniform reporting within and across all local jurisdictions poses a problem for analysis and solution generation.

The City of Houston initiated in 2019 the use of a new inspection management software, INFOR. The INFOR platform allows for a unified database that can track incidents reported through the 3-1-1 service request and inspectors, manage corrective actions taken and generate analysis and reports.

Figure 5. Broken Sanitary Sewer Line

Inspectors and technicians enter information directly through mobile forms into a database. INFOR captures:

- Nature of Event (location, volume, source, route)
- Potential Danger
- Date/Time/Duration
- Steps taken to prevent recurrence and mitigate adverse effects
- Resource usage (man hours, vehicle usage)
- Photo and File attachments

The database software can then be used to generate reports for end users and track future actions. An integrated mapping application allows for the inclusion of pipe routing and other key features.

Boater Wastes: New for the BIG, a Seasoned Program for the Galveston Bay Foundation

The expansion of the Big Project Area into the Jarbo Bayou watershed in 2018 brought with it a new source of indicator bacteria, boater

wastes. This new source is being incorporated within the I-Plan and the Galveston Bay Foundation (GBF) is the lead partner in addressing this mobile source.

Boat sewage, one of the primary sources of fecal bacteria found in Galveston Bay, can be a public health risk for oyster consumption in addition to contact recreation. GBF continues to implement several boater waste management measures that can lead to direct improvements in water quality from this illicit discharge to Jarbo Bayou, Clear Lake and Galveston Bay. Among these measures, GBF will:

- collect, analyze, and share water quality data and bacteria levels with the boater community,
- encourage a decrease in illegal dumping of sewage by boaters through resources sharing with marinas,
- collaborate with authorities to increase reporting and enforcement of illegal boater waste discharges, and
- work with communities to identify effective public education programs.

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 contact recreation standard (Figure 6). 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.

This report is based on information given to H-GAC through the workgroup process by stakeholders already involved in the BIG's planning effort. The BIG met in separate meetings between March 2019 and May 2019 to discuss implementation. This report includes activities through December 2019.

I-PLAN

There are 11 implementation strategies and 38 implementation activities described in the I-Plan and laid out in this report. Activity goals, an assessment, and a summary of implementation efforts conducted throughout the 2019 calendar year are presented for each (Table 1).

The BIG is revising the I-Plan. The process started in 2018 and will wrap up in 2020. The goal of the revision is to:

- Update the I-Plan with new information and lessons learned after five years of implementation;
- Adjust strategies and activities due to the expansion of the project area and need to include management of forest lands and boater wastes; and
- Address activities that have not seen significant progress or have been completed.

Figure 6. Water is always a big draw for recreation

THREE BIG IDEAS TO CONSIDER

With 11 strategies that include 38 activities (Table 1), the BIG focused and prioritized implementation. A review of available data and an assessment of current actions taken by BIG stakeholders suggest three key implementation strategies for local communities to consider addressing when committing resources to reduce bacteria. The first two BIG Ideas, Reduce or Eliminate Sanitary Sewer Overflows and Address Failing Onsite Sewage Facilities, directly target untreated or partially treated sewage. The third, Reduce Peak Stormwater Runoff, is a broader strategy that expands the landscape's capacity to naturally reduce bacteria and can be an important component of a robust stormwater management plan.

1. **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. Coordinate with other partners to develop and implement effective education and outreach with residents concerning the handling of fats, oils, and grease (FOG). Example programs include the City of Houston's Corral the Grease and the Galveston Bay Foundation's Cease the Grease programs.

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

3. **Reduce Peak Stormwater Runoff** – Concrete and other impervious surfaces, particularly when linked together (i.e. gutter to driveway to roadway) increase the speed at which stormwater – and the bacteria it carries – reaches a water body. Pervious surfaces, such as native grasses and specialized, pervious concrete, interrupt the flow and decrease the volume of water to a water body and create a more disconnected drainage system (Figure 7). This allows natural processes time to mitigate bacteria. Consider expanding traditional development

methods to include alternative practices that decrease use of and/or disconnect impervious surfaces in redevelopment and new built areas. LID and green infrastructure along with other best practices are 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.

The brochure, "BIG Ideas for Cleaner Water 2017: Local Government Strategies for Improving Water Quality," covers these topics in greater detail. The brochure is available on H-GAC's website[2]. Appendix C provides common resource links to available funding, outreach and education materials, more detailed reporting and data information to assist in the implementation of these three strategies and other activities of the I-Plan.

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 the region's 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

Figure 7. Bioswales with curb inlets along Bagby Street, Houston

[2] http://www.h-gac.com/community/water/tmdl/BIG/reports.aspx

2019 IMPLEMENTATION

The assessment of each activity includes determining progress made toward achieving the activity's interim goal: Not Started, Initiated, In Progress, or Completed (Table 1). Additionally, each activity is assessed based on the BIG partner's efforts to advance the activity over the year: Behind Schedule, On Schedule, Ahead of Schedule, or Completed and in Tracking (Table 1). Completed and in Tracking signifies that the activity has been completed and the BIG will continue to track. In a future I-Plan update, the activity will be reviewed to determine if a new activity is needed, a change to the assessment measure is required, or if the activity should continue and be tracked.

Overall, six activities have been completed and 32 are In Progress. The six completed activities and five of the In Progress activities have been placed into Tracking (11) to evaluate changes over time or are identified to be reviewed during the I-Plan update. Three activities were considered Ahead of Schedule and 24 On Schedule (Figure 8, Table 1). The BIG has conducted an extensive plan review in the 2019 reporting year and will review the activities that are Behind Schedule or those Completed and In Tracking to determine if the activities are appropriate and the measures valid.

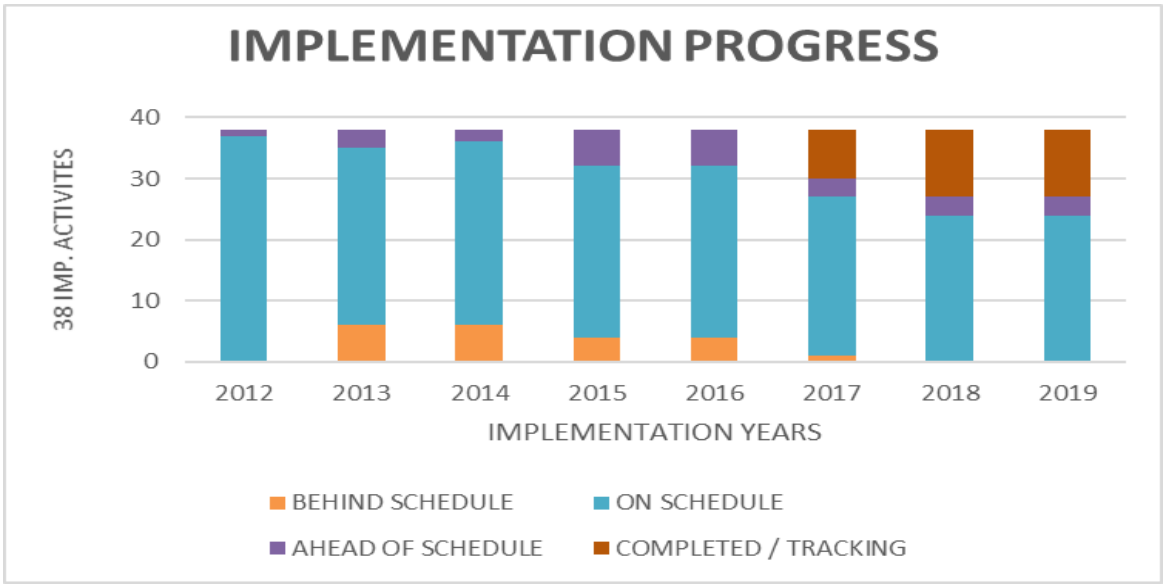


Figure 8. Implementation tracking for all 38 I-Plan Activities. Note: Completed and in Tracking is a new category added for the 2019 Annual Report.

Table 1. 2018 Implementation Progress

Strategy	#	Activity	Achievements	Progress	Status
1.0 Wastewater Treatment Facilities	1.1	Impose More Rigorous Bacteria Monitoring Requirements	More strict monitoring frequency requirements found in the I-Plan have not shown up in wastewater permits. The BIG submitted a letter which requested TCEQ consider this measure in 2017. It was determined that the monitoring frequency can be changed at the request of the wastewater treatment facility. A general adjustment of the frequency to the recommendation found in the I-Plan would not be carried out. In 2019, No change is to the status of this measure is reported, the BIG recommends modifying this measure with the I-Plan revision.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	1.2	Impose Stricter Bacteria Limits for WWTF Effluent	More stringent limits have been implemented for wastewater permits. Activity is programmatically complete. In 2019, there were 636 active permits in the project area, with 540 submitting discharge monitoring reports (DMRs) with 523 reporting bacteria in their DMRs. Wastewater treatment facilities with bacteria permits: 506 domestic and 17 Industrial. 449 (84%) reported 63 cfu/100 mL as their limit in 2019.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	1.3	Increase Compliance and Enforcement by the TCEQ	The TCEQ reports performing compliance and enforcement capabilities within the BIG region. TCEQ provided inspection data for the period of 2013-2018 in July of 2019. No trends could be established. During the period 541 permittees reported 1,094 bacteria limit exceedances in which TCEQ completed 1,083 inspections, 36,139 file reviews and issued 2,198 citations. WWTF DMRs report 96.8 percent compliance with their permit limit. Harris County Pollution Control Service reported for the same period, 93.3 percent compliance for those WWTFs inspected by the county.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	1.4	Improved Design and Operation Criteria for New Plants	Title 30 Chapter 217 of the Texas Administrative Code was updated to reflect current permitting practices of TCEQ and updated wastewater treatment facility standards and criteria. Harris County reviews new wastewater treatment facility plan sets and specifications. In 2019, Harris County screened 36 wastewater treatment facility plan sets for compliance with	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule

Strategy	#	Activity	Achievements	Progress	Status
			state disinfections standards. None needed to be referred to outside consultants for in-depth plan review.	**Completed**	**Tracking**
	1.5	Upgrade Facilities	TCEQ's Permit Central Registry provides general information on the number of wastewater treatment facility upgrades by county. The information lacks specificity on the number of non-compliant wastewater treatment facilities that have been upgraded. H-GAC Provided a Clean Water Initiative Workshop on Funding Sources for Water and Wastewater-related Infrastructure, February 26, 2019.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	1.6	Consider Regionalization of WWTFs	The U.S. Environmental Protection Agency (EPA) and TCEQ maintain non-compliant lists. TCEQ through the latest Chapter 217 requires new wastewater treatment facilities to consider regionalization if an existing plant is within a three-mile radius. The city of Houston reported that one wastewater treatment facility was taken offline due to flooding from Hurricane Harvey and potential for future inundation. The waste was redirected to another facility.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	1.7	Use Treated Effluent for Facility Irrigation	TCEQ's Permit Central Registry provides general information on the number of wastewater treatment facility applications for reuse by County.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

Strategy	#	Activity	Achievements	Progress	Status
2.0 Sanitary Sewer Systems	2.1	Develop Utility Asset Management Programs (UAMPs) for Sanitary Sewer Systems	TCEQ's voluntary sanitary sewer overflow initiative has 16 wastewater treatment facility operators participating as of 2018. H-GAC, TCEQ and EPA offer technical training and workshops tailored to encourage the use of life-cycle maintenance and dedicated wastewater treatment facility and sanitary sewer funding. The City of Houston and the EPA have agreed to the city's plan to address the city's sanitary sewer overflows.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	2.2	Address Fats, Oils, and Grease	Several model fats, oils and grease (FOG) programs are available from the City of Houston[3], San Jacinto River Authority[4] and H-GAC[5].	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	**Ahead of Schedule**
				Completed	Tracking
	2.3	Encourage Appropriate Mechanisms to Maintain Function at Lift Stations	The TCEQ upgraded portions of Title 30, Chapter 217 of the TAC, which addressed emergency power requirements. TCEQ's Permit Central Registry provides general information on the number of Lift Station applications made by county. H-GAC Provided a Clean Water Initiative Workshop on Funding Sources for Water and Wastewater-related Infrastructure, February 26, 2019.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	2.4	Improve Reporting	There is not a searchable database online. H-GAC receives annual updates on the number of sanitary sewer overflows in the project area through a request to TCEQ.	Not Started	Behind Schedule

[3] https://www.protectourpipes.org
[4] http://www.pattypotty.com/
[5] https://coastalcommunitiestx.weebly.com/materials.html

Strategy	#	Activity	Achievements	Progress	Status
		Requirements for SSOs	TCEQ appears to be notified of sanitary sewer overflows as required. In 2019, there were 767 sanitary sewer overflows reported with an estimated 14,4 million gallons of untreated effluent released in the project area. Down from recent years though no discernible trend is found.	Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	2.5	Strengthen Controls on Subscriber Systems	TCEQ was asked via letter from the BIG to consider adding a permit requirement to document subscriber systems or require subscriber system permits. There has been no change to the status. The BIG recommends revising this measure.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	2.6	Penalties for Violations	The TCEQ is revising its Enforcement Initiation Criteria, revision 15. TCEQ inspectors can conduct focused sanitary sewer overflow investigations during rain events even if the facility has never reported a sanitary sewer overflow.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**

Strategy	#	Activity	Achievements	Progress	Status
3.0 Onsite Sewage Facilities	3.1	Identify and Address Failing Systems	H-GAC maintains the on-site sanitary sewage facility permit database that shows permits by age, authorized agent, and the number of on-site sewage facilities per square mile. In 2019, there were 49,856 permitted OSSFs and an estimated 172,537 without permits. Harris County and the East Aldine Management District continued to install sewer service in the East Aldine region using grant funding. Harris County and East Aldine Management District had made 35 connections to new sanitary sewer system in 2019 for a total of 846 connections since 2014. 80 OSSFs were abandoned in 2019 for a total of 1,493 abandoned since 2014. Many of the abandoned OSSFs were failing as evidenced by violations. Harris County and the Airline Improvement District continue to install sewer service in the Airline region using grant funding. Harris County and the Airline Improvement District had made 57 connections to new sanitary service in 219 for a total of 232 since 2017. 94 OSSFs were abandoned in 2019 for a total of 476 since 2017. Many of the abandoned OSSFs were failing as evidenced by violations. H-GAC addresses failing systems through a supplemental environmental project.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	**Ahead of Schedule**
				Completed	Tracking
	3.2	Address Inadequate Maintenance of OSSF	Model on-site sewage facility regulations and policies are available online. H-GAC created a website for homeowners, homebuyers, local governments, and real estate professionals. Harris County hosted the 9th Annual Onsite Wastewater Seminar on May 21, 2019, with 166 water quality professionals in attendance. Montgomery County hosted an OSSF conference on June 6, 2019. H-GAC Provided a Clean Water Initiative Workshop on OSSF Remediation Projects, May 22, 2019.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	3.3	Legislation and Other Regulatory Actions	House Bill 2771 was enacted in September 2017 to create a dedicated fund using $10 from OSSF application fees. TCEQ will use the fund for competitive research grants. Harris County hosted the 9th Annual Wastewater Seminar on May 21, 2019 with 166 water quality professionals in	Not Started	Behind Schedule
				Initiated	**On Schedule**

Strategy	#	Activity	Achievements	Progress	Status
			attendance. The daylong event presented new innovations, best practices, and rules and enforcement updates.	**In Progress**	Ahead of Schedule
				Completed	Tracking
4.0 Stormwater & Land Development	4.1	Continue Existing Programs	Two phase I municipal separate storm sewer systems (MS4s) permits (Joint Task Force [JTF] and Pasadena) and 129 MS4 phase II permits are partially or fully found in the BIG project area. A review of MS4 Phase II permit annual reports continues to see these programs identify best practices, begin linkages to impaired waters, and support educational opportunities. TCEQ renewed the MS4 Phase II permit on January 24, 2019. Permittee applications are due on December 21, 2020. Notable changes include a lower benchmark for TSS, 50 mg/L; requirement to post annual reports on MS4 website; and Level 4 MS4s control of floatables and evaluation of flood management practices for impact on water quality.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	4.2	Model Best Practices	Harris County Flood Control District continues to host and update the Regional BMP Database[6]. H-GAC manages a LID/Green Infrastructure online resource[7]. H-GAC hosted the Clean Waters Initiative Workshop on MS4 Minimum Control Measures, May 16, 2018.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	4.3	Encourage Expansion of Stormwater	There are over 129 municipalities and utility districts in the BIG project area subject to the MS4 Phase II General Permit. Workshops to encourage the use of bacteria reduction measures:	Not Started	Behind Schedule

[6] www.bmpbase.org
[7] www.h-gac.com/community/go/LID

Strategy	#	Activity	Achievements	Progress	Status
		Management Programs	1. H-GAC Clean Waters Initiative Workshops: • MS4 Stormwater Management and Low Impact Development, November 20, 2019. 2. TCEQ held conferences on water quality and permitting at two conferences: • Environmental Trade Fair, May 14-15, 2019, • Stormwater BMP Performance and Optimization: A Focus on BMP Performance Studies, Design, Operation and Maintenance, June 27-28, 2019 and • Autumn Environmental Conference and Expo, October 8-10, 2019. 3. Texas AgriLife Extension hosted the Managing Our Stormwater – From Gutter to Stream workshop on June 12, 2019. 4. Galveston Bay Rain Barrel Workshops June 15 and July 13, 2019.	Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	4.4	Promote Recognition Programs for Developments that Voluntarily Incorporate Bacteria Reduction Measures	H-GAC developed an award program, Water Innovation Strategies of Excellence Awards (WISE). The program was released in 2018 and the second annual awards were to be given in May 2020 for projects completed in 2019 or prior. The awards were delayed due to COVID-19. They are expected to be awarded in February 2021.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	4.5	Provide a Circuit Rider Program	H-GAC maintains a LID and green infrastructure website and toolkit[8]. There are 71 projects that can be located via an interactive map on the website. H-GAC hosted the Clean Waters Initiative Workshop on MS4 Stormwater Management and Low Impact Development, November 20, 2019.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule

[8] www.h-gac.com/community/go/LID

Strategy	#	Activity	Achievements	Progress	Status
				Completed	Tracking
	4.6	Petition TCEQ to Facilitate Reimbursement of Bacteria Reduction Measures	TCEQ reimburses for water quality features. Contact TCEQ for questions or coordination for reimbursement.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
5.0 Construction	5.1	Increase Compliance With and Enforcement of Stormwater Management Permits	The City of Houston and Harris County manage mature programs to address construction site compliance. City of Houston reports onsite education is a big factor in ensuring compliance.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
6.0 Illicit Discharge	6.1	Detect and Eliminate Illicit Discharges	Analysis of MS4 annual reports indicated that MS4 operators have regulatory mechanisms in place and procedures for detecting illicit discharges, including mapping to meet 10-year	Not Started	Behind Schedule

Strategy	#	Activity	Achievements	Progress	Status
			goal. Reporting of the number identified and addressed remains a work in progress. H-GAC and Bayou Preservation Association prepared a contract with TCEQ to conduct dry and wet weather discharge monitoring surveys within the BIG. Project got underway in 2020. H-GAC received in 2019, additional funding through the Clean Rivers Program to conduct dry and wet weather discharge monitoring surveys beginning in 2020. A model wet and dry weather discharge monitoring program for local governments is available online[9].	Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	6.2	Improve Regulation and Enforcement of Illicit Discharges	MS4 Phase II operators review and implement regulations as a permit requirement. H-GAC continues to compile existing regulations. H-GAC maintains an online resource of enforcement topical presentations given at environmental workshops held at H-GAC[10]. Citizen reporting tools are available to assist local governments find illicit discharges and illegal dumping – 311[11] and the Galveston Bay Action Network[12] are examples.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	6.3	Monitor & Control Waste Hauler Activities	No waste hauler tracking fleet program has been identified for a pilot project. City of Houston maintains a mature waste hauler tracking program. Potential online tracking programs have been developed (e.g. Track My FOG[13]). Dallas maintains a program that uses Scantron device (XC2 and Pearson Scan Tool Software) to upload manifests.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

[9] http://www.h-gac.com/community/water/tmdl/BIG/documents/Top5-Least5-Final%20Report-06-5-17.pdf
[10] http://www.h-gac.com/community/environmental-enforcement/workshops.aspx
[11] www.CleanBayous.org
[12] www.galvbay.org/gban
[13] https://www.trackmyfog.com/

Strategy	#	Activity	Achievements	Progress	Status
7.0 Animals, Agriculture	7.1	Promote Increased Participation in Existing Programs for Erosion Control Nutrient Reduction, and Livestock Management	Natural Resource Conservation Service and Texas State Soil and Water Conservation Board manage and promote land management programs in the project area. The Texas Forest Service works with landowners with forest product management. Stakeholders recommended expanding the use of water quality management plans and conservation management plans. One suggestion is to seek a modification to property tax assessments to allow stacking of water quality property tax exemption on to an agriculture or conservation land exemption. Texas Forest Service held a Vegetative Control Goals Workshop on June 15, 2019.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	7.2	Promote the Management of Feral Hog Populations	County Extension Agents report holding one-on-one meetings with landowners to address feral hogs.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
8.0 Residential	8.1	Expand Homeowner Education Efforts Throughout the BIG Project Area	H-GAC continues a series of Clean Water Initiative workshops covering topics from water quality data, watershed-based plans, MS4 minimum control measures and wastewater technology. Information available online[14].	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

[14] www.h-gac.com/cwi

Strategy	#	Activity	Achievements	Progress	Status
9.0 Monitoring and I-Plan *Revision*	9.1	Continue to Utilize Ambient Water Quality Monitoring and Data Analysis	The region's Clean Rivers Program's ambient monitoring data forms the backbone of assessments used in this report. Eight monitoring partners collect ambient data at 208 monitoring sites in the BIG project area. Additional data is provided by the network 19 Texas Stream Team volunteers.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	9.2	Conduct and Coordinate Non-Ambient Water Quality Monitoring	Harris County Flood Control District continues to monitor water quality at several detention basins. Data is uploaded to their BMP database. Harris County wrapped up monitoring at Birnamwood Drive LID project.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	9.3	Create and Maintain a Regional Implementation Database	H-GAC maintains an online Regional Implementation database[15]	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	9.4	Assess Monitoring	The BIG produces an annual report. The I-Plan has been modified through four addendums that expanded the project	Not Started	Behind Schedule

[15] http://h-gac.maps.arcgis.com/apps/MapSeries/index.html?appid=a75ba4bb46ca40658066c5755a8dba6e

Strategy	#	Activity	Achievements	Progress	Status
		Results and Modify I-Plan.	area and added additional TMDLs. In 2019 there were 126 impaired AUs with TMDLs. In 2018, the BIG began the process to revise the I-Plan to codify changes and updates. The process will be completed in 2020.	Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
10.0 Research	10.1	Evaluate the Effectiveness of Stormwater Implementation Activities	Harris County Flood Control District continues to monitor BMPs installed at detention basins. City of Houston is evaluating LID installation on Almeda Rd.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	10.2	Further Evaluate Bacteria Persistence and Regrowth	Texas Water Resource Institute continued a bacteria source-tracking project in the region in 2019.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	10.3	Determine Appropriate Indicators	EPA continues to study the use of Coliphage as surrogates for pathogens. EPA evaluated validations for two coliphage measurements methods for ambient water with an aim to publish draft criteria in 2018[16]. Recent paper was published in 2019[17]	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	10.4		House Bill 2771 went into effect on September 1, 2017. The bill requires TCEQ to award competitive grants using funds	Not Started	Behind Schedule

[16] John F. Griffith, SCCWRP Commission, Sept. 8, 2017

[17] Boczek, L. U.S. EPA: Proposals and Method for Coliphage as Surrogates for Environmental Pathogens. WEFTEC, Chicago, Illinois, Sept. 21-25, 2019

Strategy	#	Activity	Achievements	Progress	Status
		Additional Research Topics	collected from the $10 on-site sewage facility permit fee. Eligible projects include research and demonstration projects for on-site sewage facility treatment technology that improves water quality, reduces costs, and/or wastewater reuse	Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
11.0 Geographic Priority	11.1	Consider Recommended Criteria When Selecting Geographic Locations for Projects	H-GAC developed the Top 10 "Most Likely to Succeed" and "Most Wanted" Streams lists to help local stakeholders prioritize water quality improvements. Geographic prioritization continues to be used to target areas. One model project The Top Five / Least Five project was completed in 2017[18], which can form the basis for local government investigations. Based on the model project and previous investigations by BPA and BIG stakeholders, H-GAC and Bayou Preservation Association prepared a contract with TCEQ to conduct wet and dry weather discharge monitoring surveys within the BIG project area. Project got underway in 2020. H-GAC received in 2019, additional funding through the Clean Rivers Program to conduct wet and dry weather discharge monitoring surveys beginning in 2020.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	**Ahead of Schedule**
				Completed	Tracking

[18] http://www.h-gac.com/community/water/tmdl/BIG/reports.aspx

Appendix A Acknowledgments

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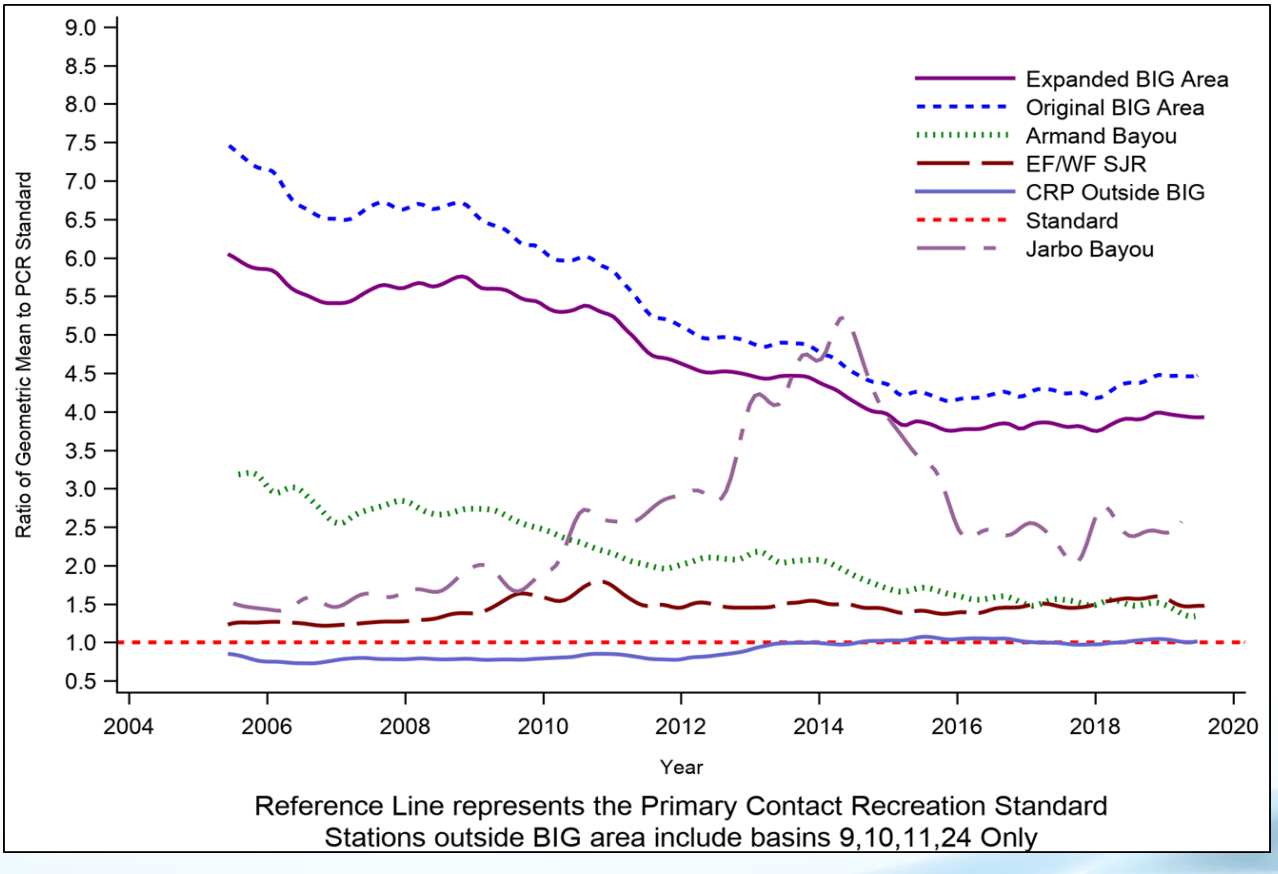
Appendix B
Bacteria Trends

The area's relative geometric mean is just above four times the state's water quality standard for bacteria (Appendix B - Figure 1). This is down overall from six times the standard in 2006. While the overall bacteria trend in the BIG project area continues to decline, it appears to have leveled out with a potential increase with recent geometric means. The background, those areas outside of the BIG project area has also seen a general rise over the same timeframe.

Appendix B - Figure 1 illustrates how the rolling seven-year geometric mean for bacteria levels has changed over time (2005-2018). 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 2018. Included are bacteria trend lines for the BIG (short dashed royal blue line), the Expanded BIG (solid dark purple line) including Armand Bayou, Jarbo Bayou and East and West Fork of the San Jacinto River (EF/WF SJR), Armand Bayou (short dashed green line), EF/WF SJR (long dashed brown line), Jarbo Bayou (long-short dashed light purple line) and bacteria trend for CRP areas outside of the BIG project area (solid light blue line).

The lines were generated using a ratio of the geometric mean of the rolling seven years with that of the state's contact recreation standard, either *E. coli* or Enterococci, 126 colony forming units (cfu)/100mL or 35 cfu/100mL, respectively. The short dashed red line represents the standard normalized by dividing by the standard. This allows both standards to be used on the same graph. The geometric means were also divided by the appropriate standard.



Appendix C
Implementation Resources

IMPLEMENTATION RESOURCES			
RESOURCE	**NAME**	**USE**	**WEBSITE**
FUNDING	319 Nonpoint Source Grant	Non permitted Nonpoint Source Reduction Measures	https://www.tceq.texas.gov/waterquality/nonpoint-source/grants
	319 Nonpoint Source Grant	Agriculture and Silviculture Nonpoint Source Measures	https://www.tsswcb.texas.gov/programs/texas-nonpoint-source-management-program
	320 Estuary Program	Water Quality Improvement, Conservation, Restoration, Public Outreach and Education, and Research	https://gbep.texas.gov/
	Clean Water State Revolving Fund	Low cost financial assistance for wastewater, reuse, and stormwater infrastructure	http://www.twdb.texas.gov/financial/programs/CWSRF/
	EPA Water Infrastructure and Resiliency	Resource to explore innovative finance solutions	http://water.epa.gov/ infrastructure/ waterfinancecenter.cfm
	NRCS EQUIP	Resource Conservation for Agriculture and Silviculture	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/
	Texas Parks and Wildlife Landowner Incentive Program	Enact conservation practices on private lands	https://tpwd.texas.gov/landwater/land/private/lip/#contact
	Texas Water Infrastructure Coordination Committee	Identify and develop solutions to water and wastewater	www.twicc.org
	USDA Rural Development Grant	Rural Wastewater Infrastructure	https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program
	USDA Waste and Environmental Program	Multiple assistance programs	https://www.rd.usda.gov/programs-services/all-programs/water-environmental-programs
	Water Quality Management Plan	Soil and Water Conservation for Agriculture and Silviculture	www.tsswcb.texas.gov/index.php/programs/water-quality-management-plan
Outreach and Education	Clean Water Clear Choice	Water quality outreach and education	www.cleanwaterways.org
	Clean Waters Initiative Workshops	Technical workshops covering a variety of water quality information	www.h-gac. com/CWI

IMPLEMENTATION RESOURCES			
RESOURCE	**NAME**	**USE**	**WEBSITE**
	Coastal Communities	Nonpoint source outreach and education information	www.h-gac.com/coastal-communities/default.aspx
	Fats, Oils, Grease, Wipes	Cease the Grease	http://galvbay.org/ceasethegrease/
		Protect Our Pipes	www.protectourpipes.org
		Patty Potty	www.pattypotty.com
	Lone Star Healthy Streams	Agriculture BMPs	http://lshs.tamu.edu/bmps/
	OSSF	OSSF mapping system	http://arcgis02.h-gac.com/ossf/
		Public outreach and education	www.h-gac.com/go/septic
	Pet Waste	Basic information on pet wastes	www.h-gac.com/community/pet-waste/default.aspx
Reporting	City of Houston Bureau of Pollution Control and Prevention	Service helpline and pollution reporting	www.houstontx.gov/311 and 713.837.0311
	Galveston Bay Action Network	Pollution reporting in five counties surrounding Galveston Bay	www.galvbay.org/gban
	HCFCD Citizen's Service Hotline	Telephone reporting system	713.684.4197
	Illegal Dumping	Pollution reporting system for MS4s	www.cleanbayous.org
Data	Clear Rivers Program	Water Resource Information System	www.h-gac.com/go/wrim
	HCFCD BMP Database	Best Management Practices Monitoring	www.bmpbase.org
	LID Tracking	Low Impact Development Resource	www.h-gac.com/community/go/LID
	Wastewater and Stormwater	Permit look up	www.tceq.texas.gov/agency/data/lookup-data/status-stormwater-wastewater.html

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