BIG

BACTERIA IMPLEMENTATION GROUP

2021 ANNUAL REPORT

JANUARY 1, 2020–DECEMBER 31, 2020

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

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)

Teague Harris, IDS Engineering Group (Utility District)

Cassidy Ince, Texas A&M Forest Service (Agriculture)

Andrew Isbell, Walker County (Rural County)

Carol LaBreche, City of Houston (Large City)

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

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

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)

Tina Petersen, Bayou Preservation Association (Conservation)

Sonia Phillips, City of League City (Small City)

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 & Carter, Inc.. (Business/Industry)

Linda Shead, Texas Coastal Partners (Conservation)

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

Shane Simpson, San Jacinto River Authority (Business/Industry)

Robert Snoza, Harris County Flood Control District (Urban County)

Michael Thornhill, SI Environmental (Utility District)

Scott Tuma, (Business/Industry)

Joanna Wilson, Gulf Coast Authority (Business/Industry)

Vacant, Rural County (Agriculture)

Vacant, (Rural Small City)

Vacant, Non-profit (Conservation)

Parenthetical indicates type of organization represented.

BIG ALTERNATES

Shaun Austin, Gulf Coast Authority

Camila Biaggi, Harris County

Susie Blake, City of League City

Matthew Carpenter, IDS Engineering Group

Nuguent Cotton, Harris County

John Ellis, US Geological Survey

Nick Ellis, Galveston Bay Foundation

Dale Everitt, San Jacinto County

Sasha Francis, Galveston Bay Foundation

Frank Green, Montgomery County

Greg Hall, City of Conroe

Jody Hooks, City of League City

Steve Hupp, Cypress Creek Flood Control Coalition

Scott Jones, Galveston Bay Foundation

Karen Kottke, AECOM

Jason M. Maldonado, Lockwood, Andrews and Newnam, Inc.

Mac Martin, Texas A&M Forest Service

Reuben Martinez, Montgomery County

Carl Masterson, Texas Coastal Partners

Clint Miller, Terracon

Lisa Montemayor, City of Houston

Paul Nelson, Bayou Preservation Association

Thomas Sample, US Geological Survey

Elaine Savage, Harris County

Aaron Schindewolf, San Jacinto River Authority

Kristen Schlemmer, Citizens' Environmental Coalition

Liz Stone, Quiddity Engineering

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

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.

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).

EXECUTIVE SUMMARY

Nearly half of the Houston-Galveston region's stream and shoreline miles continue to have bacteria levels higher than state standards for contact recreation[1]. 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, wildlife and invasive species, like feral hogs (Figure 1).

Figure 1. Captured feral hog.

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)[2] for Bacteria in the Houston-Galveston Region) on January 31, 2013.

The 2021 Annual Report is designed to track progress made in the BIG Project Area (Figure 2) from January 1, 2020 to December 31, 2020.

MAKING PROGRESS

The good news is we are making a difference. Overall, bacteria levels for waterways in the BIG project area have decreased or remained stable since the BIG began working to address the problem in 2008. Even during a period of continued population growth and area-wide development pressure.

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[3].

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. There is more work

[1] 2020 Basin Highlights Report -https://www.h-gac.com/clean-rivers-program/basin-highlights-summary-reports

[2] BIG I-Plan - https://www.h-gac.com/bacteria-implementation-group/reports

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

BIG Project Area

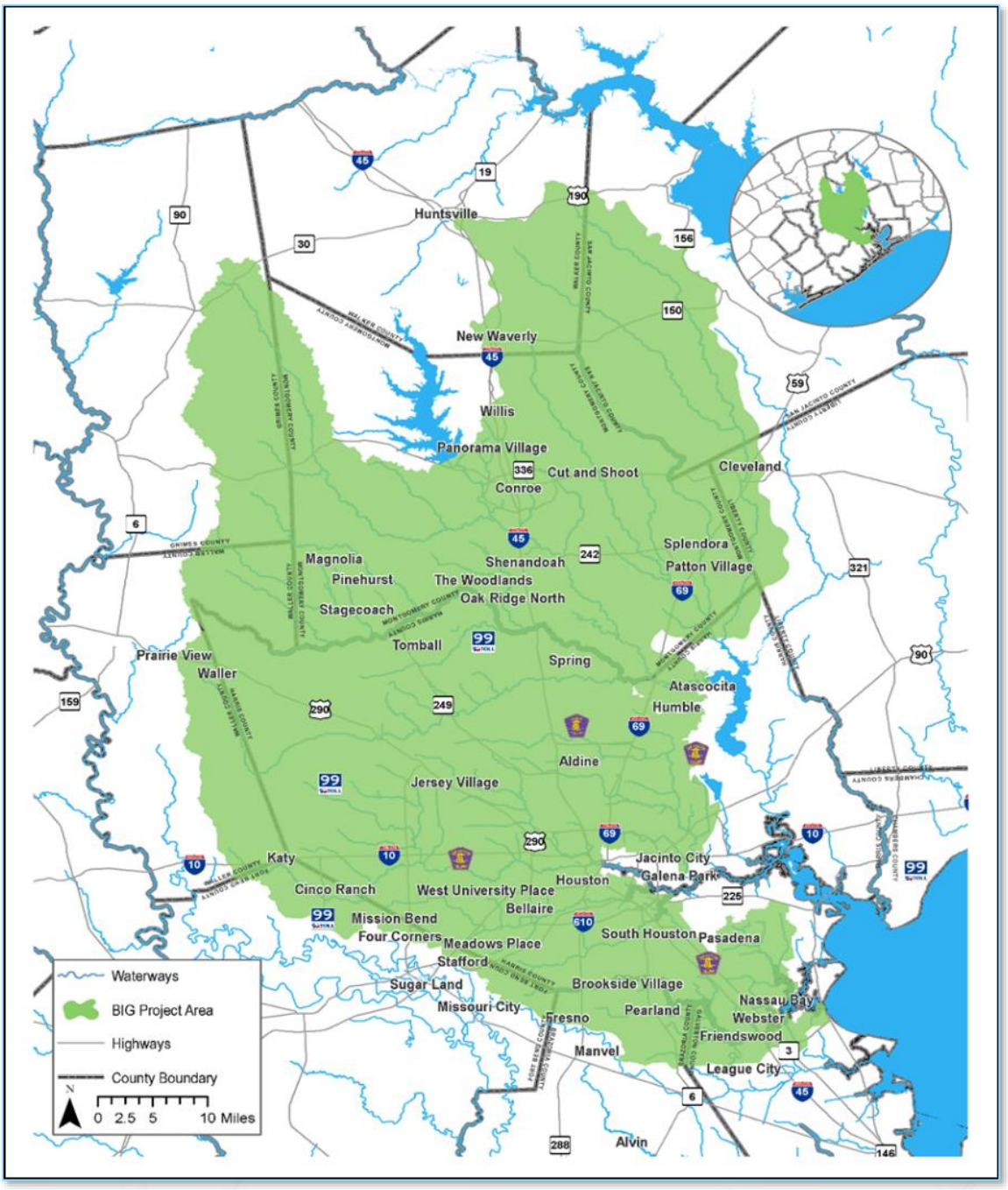

Figure 2. The BIG project area is approximately 3,260 square miles and has a population of nearly five million people. The area encompasses part of 10 counties much of the City of Houston and all or part of another 63 cities.

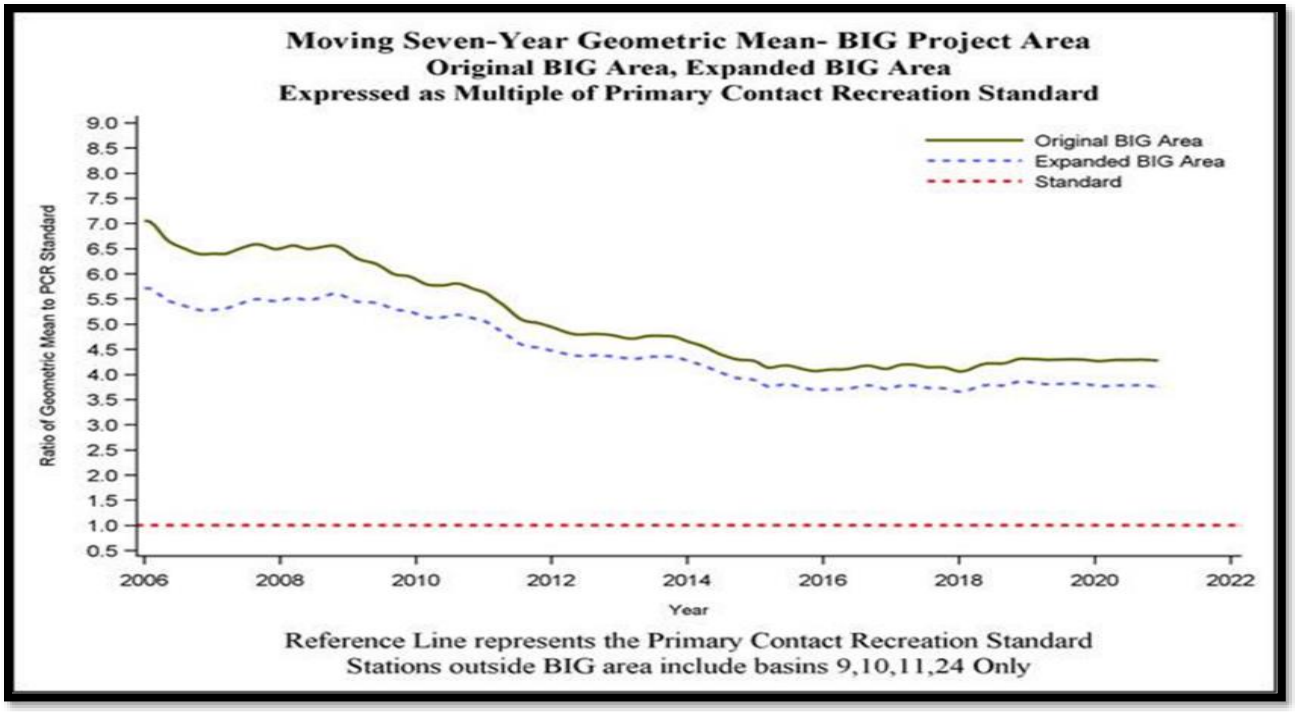

Figure 3. Bacteria trend lines for the BIG Area, Original Project Area and Expanded Project Area 2006-2021.

to do for the BIG and the region if goals of the I-Plan – to reduce bacteria concentrations in the region's waters and eventually fully support contact recreation are to be accomplished.

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 municipal separate storm sewer system (MS4) program; committing resources to address aging and failing infrastructure (Figure 4); educating and training local wastewater treatment operators, developers, and water quality service providers; and conducting public education and involvement campaigns. By working together, the BIG and its partner organizations can continue to identify what is working and what remains to be implemented.

Figure 4. Targeted monitoring to identify bacteria sources.

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 last 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.

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 2020.

Exploration Green

Exploration Green[4] (EG) is a multi-use park serving the region and supporting the goals of the BIG. The project is the result of public and private partners, including the Clear Lake City Water Authority (CLCWA), civic organizations, consultants, and private citizens. One result has been the founding of the not-for-profit Exploration Green Conservancy which worked with the Galveston Bay Foundation to establish a perpetual conservation easement for EG.

EG is expected to improve water quality within the Horsepen/Armand Bayou watershed. EG is establishing wetlands within retention areas (Figure 5); and volunteers have been encouraged to participate in planting events and maintain a nursery. EG partners have commissioned a study to monitor the benefits of the wetland plants.

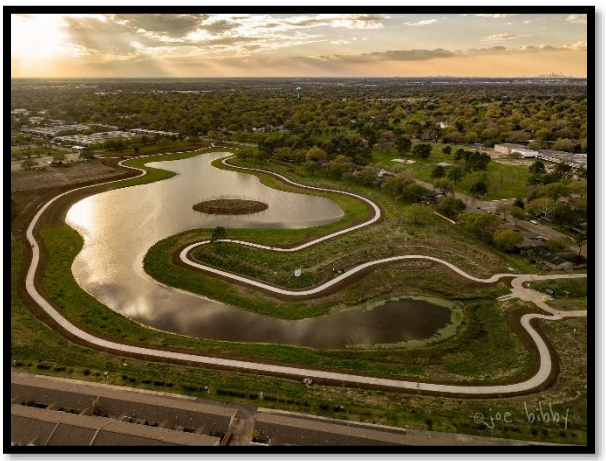

Figure 5. Aerial photo of one of the basins at EG.

Funding has come from the CLCWA for purchase of the golf course and excavation; Texas Parks and Wildlife, private foundations, and civic clubs for planting, wetland restoration, signage, trails (Figure 6),

[4] https://www.explorationgreen.org/

and amenities; Harris County and City of Houston for bike trails; and CLCWA setting a portion of future water rates for sustained park maintenance.

Figure 6. Recreational trails are a key feature of EG.

When finally completed in late 2023, EG, a 200-acre former golf course, is anticipated to have a storage capacity of 1,680 acre-feet or ½-billion gallons of water[5]. EG is expected to contain 38 acres of water surface area, 39 acres of wetlands, 4 habitat islands, 101 acres of upland/island areas, permanent depth of 6 feet, additional 8 feet of water storage and over 5 miles of biking/walking trails.

City of Houston Green Development Incentives

The City of Houston established the Green Development Incentives[6] program to promote the use of green infrastructure through municipal and private projects. The incentives were determined by a study funded through Houston Endowment.

The city wants a robust green infrastructure program to encourage use in new development and redevelopment leading to economic, social, and environmental benefits.

The program seeks to incentivize by:

- Integrated green stormwater infrastructure development rules
- Property tax abatement
- Award and recognition program
- Increased permitting process certainty and speed.

Watershed Protection Planning

H-GAC is working with the Texas Commission on Environmental Quality to expand watershed protection plans (WPP) within the BIG Project Area. WPPs are similar in process to the I-Plan established for the BIG. WPPs that are created will focus on smaller watersheds within the BIG project area. The goal of each watershed protection plan will be to encourage local watershed stakeholders to participate in plan development to address water quality concerns and for eventual plan execution.

The result of the watershed protection plan enactment within the BIG project area is expected to be more granular. Implementation of WPPs is anticipated to happen alongside implementation of the BIG I-Plan.

H-GAC has established stakeholder groups within five watersheds[7]. Plans have been completed in two, having been approved by the U.S. EPA, and another plan is in

[5] Exploration Green! A Case Study in effective Floodplain Management, FEMA Hazard Mitigation, 2018
[6] http://www.houstontx.gov/igd/

[7] www.westfork.weebly.com
www.cypresspartnership.com
www.springcreekpartnership.com

review. The remaining two WPPs are being planned for the future.

The five watershed WPPs are (Figure 7):

- West Fork of the San Jacinto River WPP
- Cypress Creek WPP
- Spring Creek WPP (in progress)
- Clear Creek WPP (future)
- East Fork of the San Jacinto River WPP (future)

Figure 7. Watershed Protection Plan projects within the BIG project area

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. 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. This report includes activities through December 2020.

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 2020 calendar year are presented for each (Table 1).

The BIG is revising the I-Plan. The goal of the revision is to:

- Update the I-Plan with new information and lessons learned after five years of implementation;

www.clearcreekpartnership.com
www.eastforkpartnership.com

- 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.

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. 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 (Figure 8) 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[8]. 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.

Figure 8. Pet waste station, League City, TX.

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

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

2020 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 9, Table 1). The BIG began a plan review beginning in the 2019 reporting year and focused review on those activities that are Behind Schedule or Completed and In Tracking to determine if the activities remain appropriate and the measures valid. The I-Plan update will incorporate this review.

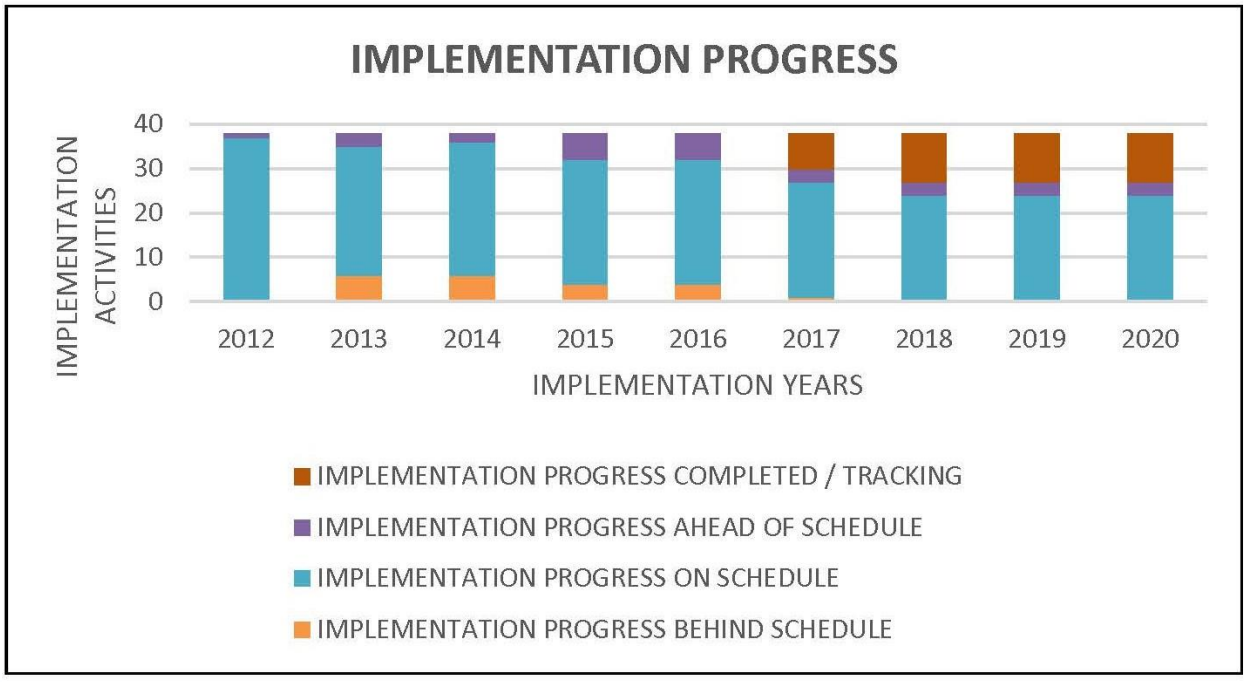

Figure 9. Implementation tracking for all 38 I-Plan Activities. Note: Completed and in Tracking is a new category added for the 2019 Annual Report.

Table 1. 2020 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. No change is to the status of this measure is reported, the BIG is modifying this measure with the I-Plan update.	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 2020, there were 690 active permits in the project area, with 548 submitting discharge monitoring reports (DMRs) with 528 reporting bacteria in their DMRs. Wastewater treatment facilities with bacteria permits: 510 domestic and 18 Industrial. 449 (84%) reported 63 cfu/100 mL as their limit in 2020.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**
	1.3	Increase Compliance and Enforcement by the TCEQ	WWTF DMRs report 97.7 percent compliance with their permit limit, up slightly from 96.9 percent the year prior.	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 2020, Harris County	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule

Strategy	#	Activity	Achievements	Progress	Status
			screened 66 wastewater treatment facility plan sets for compliance with 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.	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 there were no new wastewater treatment facility regionalization/consolidation projects in 2020.	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[9], San Jacinto River Authority[10] and H-GAC[11]. There were 900 reported SSOs in 2000 attributed to grease blockages releasing approximately 363,502 gallons of untreated sewage into the waterways.	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.	Not Started	Behind Schedule
				Initiated	On Schedule
				In Progress	Ahead of Schedule
				Completed	**Tracking**

[9] https://www.protectourpipes.org
[10] http://www.pattypotty.com/
[11] https://coastalcommunitiestx.weebly.com/materials.html

Strategy	#	Activity	Achievements	Progress	Status
	2.4	Improve Reporting Requirements for SSOs	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. TCEQ appears to be notified of sanitary sewer overflows as required. In 2020, there were 2000 sanitary sewer overflows reported with an estimated 7.7 million gallons of untreated effluent released in the project area. Citizen reporting tools are available to assist local governments find illicit discharges and illegal dumping – 311[12] and the Galveston Bay Action Network[13] are examples.	Not Started	Behind Schedule
				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 are no plans to add subscriber systems as permittees.	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**

[12] www.CleanBayous.org
[13] www.galvbay.org/gban

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 2020, 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. In 2020 there were no new sewer connection made. 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 44 connections to new sanitary service in 2020 for a total of 276 since 2017. 32 OSSFs were abandoned in 2020 for a total of 508 since 2017. Many of the abandoned OSSFs were failing as evidenced by violations. H-GAC addresses failing systems through a supplemental environmental project. No new systems were repaired or replaced in 2020. Since 2018, 11 systems have been repaired or replaced, while 12 await funding.	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 its 11th annual OSSF seminar. Due to COVID, this event was held as a webinar over two days.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
	3.3	Legislation and Other		Not Started	Behind Schedule

Strategy	#	Activity	Achievements	Progress	Status
		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.	Initiated	**On Schedule**
				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 were 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 were to 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[14]. H-GAC manages a LID/Green Infrastructure online resource[15].	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

[14] www.bmpbase.org
[15] www.h-gac.com/community/go/LID

Strategy	#	Activity	Achievements	Progress	Status
	4.3	Encourage Expansion of Stormwater Management Programs	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: 1. H-GAC is receiving a grant award to evaluate available BMP monitoring data to recommend practices best suited to this region. Award was secured in 2020 and the project will start in 2022. 2. Workshops were slowed due to COVID in 2020.	Not Started	Behind Schedule
				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. The next round will pick up in February 2023.	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[16]. There are 90 projects that can be located via an interactive map on the website with 75 found in the BIG project area.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

[16] https://www.h-gac.com/low-impact-development/designing-for-impact

Strategy	#	Activity	Achievements	Progress	Status
	4.6	Petition TCEQ to Facilitate Reimbursement of Bacteria Reduction Measures	TCEQ maintains a process for developer/builder reimbursement for water quality features through the establishment of utility district bond issuance. 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. H-GAC hosts workshops to encourage the use of best practices and compliance with MS4 requirements.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking
6.0 Illicit Discharge Detection and Elimination	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 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 targeted monitoring surveys within the BIG. Project got underway in 2020. H-GAC received in 2019, funding through the Clean Rivers Program to conduct targeted monitoring surveys which got underway in 2020. A model targeted monitoring program for local governments is available online[17].	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

[17] http://www.h-gac.com/community/water/tmdl/BIG/documents/Top5-Least5-Final%20Report-06-5-17.pdf

Strategy	#	Activity	Achievements	Progress	Status
	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[18]. Citizen reporting tools are available to assist local governments find illicit discharges and illegal dumping – 311[19] and the Galveston Bay Action Network[20] are examples. • In 2020, there were 53 pollution reports to GBAN. Of these, one was an abandoned vessel, four were for chemicals or discolored water, and 12 were for sanitary or storm sewer overflows.	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[21]). 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
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. The Forest Service has an urban forest program and works with local governments to improve forest and water quality. 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.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

[18] http://www.h-gac.com/community/environmental-enforcement/workshops.aspx
[19] www.CleanBayous.org
[20] www.galvbay.org/gban
[21] https://www.trackmyfog.com/

Strategy	#	Activity	Achievements	Progress	Status
	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 typically host 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[22]. Workshops in 2020 were held up due to COVID-19. Galveston Bay Foundation provides outreach and education, including: • Rain barrel workshops – 288 distributed in 2020 to 202 participants at 8 events. • Boater waste education – four events reaching 800 individuals in 2020. Texas AgriLife's Texas Coastal Watershed Partners' outreach and technical assistance, included: • Exploration Green – volunteers and planting events. • Galveston and Brazoria County (includes Clear Creek and Jarbo Bayou) Coalition seeks to implement watershed-based plans in the two counties. Bayou Preservation Association 17th Annual Symposium – October 1-2, 2020: Bayou Diversity.	Not Started	Behind Schedule
				Initiated	**On Schedule**
				In Progress	Ahead of Schedule
				Completed	Tracking

[22] 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. In 2020, GBF collected and analyzed 465 water quality samples and processed 53 bacteria samples with the assistance of 55 water quality monitoring volunteers at 53 bay-wide locations. Of these, eight of the bacteria samples (approximately 15%) exceeded the single grab recreational limit of 104 MPN.	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[23]	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	Not Started	Behind Schedule

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

Strategy	#	Activity	Achievements	Progress	Status
		Results and Modify I-Plan.	project area and added additional TMDLs. In 2020 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 2022.	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. H-GAC received a grant from the TCEQ's Galveston Bay Estuary Program to evaluate available performance data to develop a recommended list. Project will begin in 2022.	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 completed a bacteria source-tracking project in the region in 2020. No new studies in 2020.	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[24]. Recent paper was published in 2019[25]	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

[24] John F. Griffith, SCCWRP Commission, Sept. 8, 2017
[25] 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[26], 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

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

Appendix A Acknowledgments

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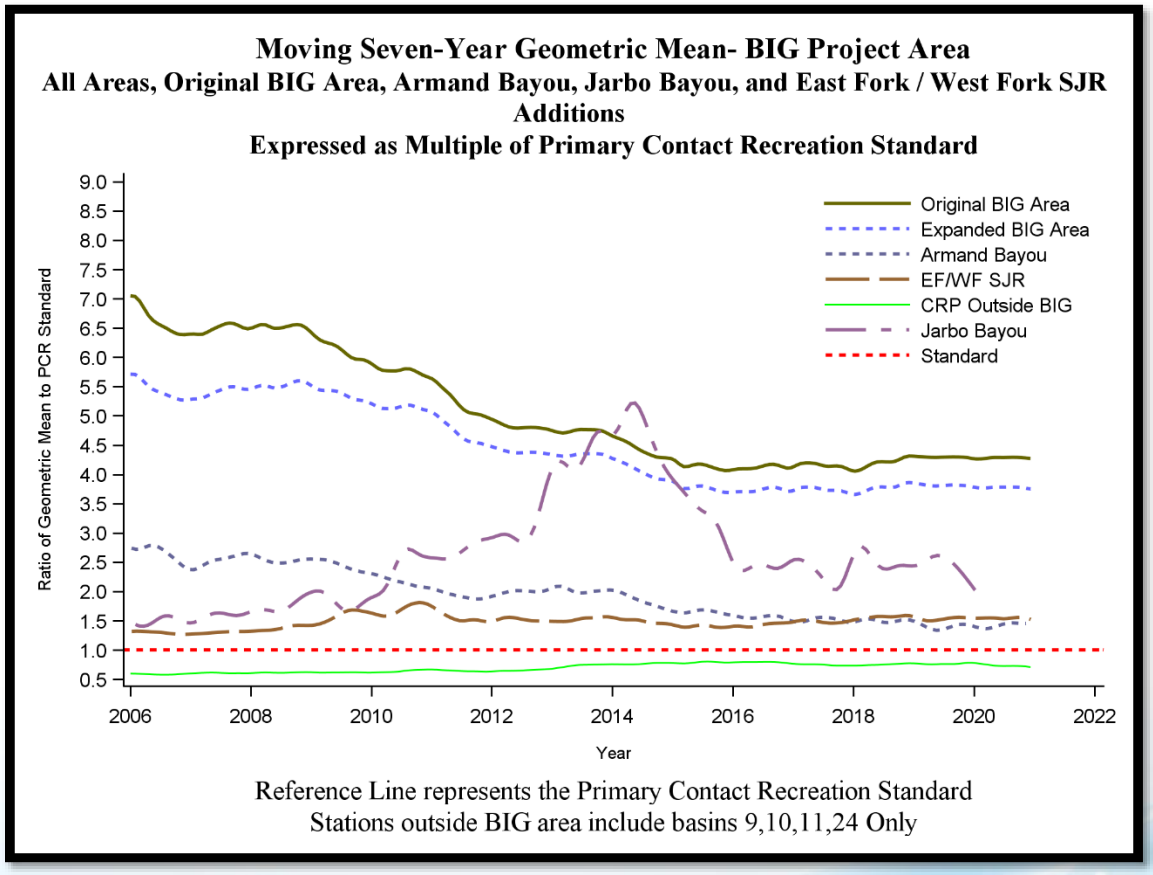
Appendix B
Bacteria Trends

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 and TECHNICAL ASSISTANCE	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	https://www.epa.gov/waterfinancecenter
	Low Impact Development / Green Infrastructure	Guidance on use and maintenance (H-GAC)	https://www.h-gac.com/low-impact-development

IMPLEMENTATION RESOURCES			
RESOURCE	**NAME**	**USE**	**WEBSITE**
		City of Houston Incentives for Green Infrastructure	http://www.houstontx.gov/igd/
	Natural Resources Conservation Services Environmental Quality Incentives Program	Resource Conservation for Agriculture and Silviculture	https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives
	Onsite Sewage Facility	Homeowner, real estate, and inspector technical assistance and funding	https://www.h-gac.com/on-site-sewage-facilities
	Texas Parks and Wildlife Landowner Incentive Program	Enact conservation practices on private lands	https://tpwd.texas.gov/landwater/land/private/lip/#menu
	Texas Water Infrastructure Coordination Committee	Identify and develop solutions to water and wastewater	https://twicc.org/resources/funding.html
	USDA Rural Development Grant	Rural Wastewater Infrastructure	https://www.rd.usda.gov/programs-services/water-waste-disposal-loan-grant-program

IMPLEMENTATION RESOURCES			
RESOURCE	**NAME**	**USE**	**WEBSITE**
	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 Waterways	Water quality outreach and education	www.cleanwaterways.org
	Clean Waters Initiative Workshops	Technical workshops covering a variety of water quality information	https://www.h-gac.com/clean-water-initiative-workshops
	Coastal Communities	Nonpoint source outreach and education information	https://www.h-gac.com/coastal-communities
	Fats, Oils, Grease, Wipes	Protect Our Pipes	https://www.publicworks.houstontx.gov/protect-our-pipes
		Patty Potty	www.pattypotty.com
	Lone Star Healthy Streams	Agriculture BMPs	http://lshs.tamu.edu/bmps/
	Municipal Public Education	Regional Public Education Services Program	https://www.hcfcd.org/Resources/Education-Materials/Regional-Public-Education-Services-Program
		Coastal Communities	https://www.h-gac.com/coastal-communities
	Onsite Sewage Facility	Public outreach and education	https://www.h-gac.com/on-site-sewage-facilities
	Pet Waste	Basic information on pet wastes	www.h-gac.com/community/pet-waste/default.aspx

IMPLEMENTATION RESOURCES			
RESOURCE	**NAME**	**USE**	**WEBSITE**
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	Ambient monitoring data	https://www.h-gac.com/clean-rivers-program/data
	EPA Enforcement and Compliance History Online	Permit tracking and compliance database	https://echo.epa.gov/
	HCFCD BMP Database	Best Management Practices Monitoring	www.bmpbase.org
	LID Tracking	Low Impact Development Resource	https://www.h-gac.com/low-impact-development/designing-for-impact
	Onsite Sewage Facility	Mapping tool	https://datalab.h-gac.com/ossf/
	Wastewater and Stormwater	Permit look up	www.tceq.texas.gov/agency/data/lookup-data/status-stormwater-wastewater.html

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