BACTERIA IMPLEMENTATION GROUP

Monitoring and Research Workgroups
Meeting Agenda
Tuesday, January 26, 2016
2:00 PM to 4:00 PM
H-GAC, Conference Room A

Call to Order/Welcome/Introductions

Review Notes from January 23, 2015 Meeting

Discussion: Preparing BIG 2016 Annual Report – I-Plan Strategy 9.0 Mon. and 10.0 Research

Workgroup will:

- review the 2015 Annual Report,
- review the timeline for preparing the 2016 report,
- report on implementation activities accomplished in the 2015 calendar year,
- discuss definition of a geometric mean,
- review and discuss graphical representations of the moving bacteria geometric mean,
- discuss expectations for the 2016 Annual Report, and
- discuss focus and priorities for 2016 calendar year.

Discussion: Review I-Plan Strategy 9.0 Mon. and 10.0 Research Language

Workgroup will:

- review approved I-Plan wording
- discuss potential editorial changes
- agree on any updates, and
- develop recommendations, if necessary, that will be presented at the annual BIG meeting for approval.

Adjourn

Upcoming Meeting Schedule

BIG Annual Meeting: 1:00 PM on 5/24/2016

Instructions to call into BIG meetings:
To call in, dial 713-481-0090 (or 800-240-3895). You will be asked to enter your pass code, followed by the # sign. The pass code is 1084242. If you dial in before H-GAC, you will hear "music on hold". Once H-GAC dials in, the music will cease and the conference call will begin. During the course of the conference, you may hear beeps. A single beep indicates someone has joined the conference call. A double beep indicates someone has left the conference call. Remember--if you do press hold, everyone will hear your hold music.

In compliance with the Americans with Disabilities Act, H-GAC provides for reasonable accommodation for persons attending H-GAC functions. Requests should be received by H-GAC 24 hours prior to the function.

BACTERIA IMPLEMENTATION GROUP

Monitoring and Research Work Groups
Draft Meeting Summary
Friday, January 23, 2015
10:00 AM to 12:00 PM
Clayton Library: 5300 Caroline St. Houston, TX 77004

Call to Order/Welcome/Introductions

Linda Broach (TCEQ), Danielle Cioce (HC), Tom Ivy (Citizen), Robert Snoza (HCFCD)

Review Notes from Mar. 20, 2014 (Mon) and Mar. 20, 2014 (Research) Meetings

The workgroup reviewed notes from the previous meetings.

Discussion: Preparing BIG 2015 Annual Report – I-Plan Strategy 9.0 Mon. and 10.0 Research

Workgroup reviewed the 2014 Annual Report and discussed the timeline for preparing the 2015 report. The workgroup discussed the results of ambient monitoring carried out by H-GAC and Clean Rivers Program Partners. Of note the group discussed reasons for the declining trend in bacteria found for White Oak Bayou since 2008. The work group recommended the annual report update on the latest research and monitoring bacteria indicators being conducted by the City of Houston, information on the feral hog removal efforts in Barker reservoir, and LID and other BMP monitoring data. H-GAC staff noted that the East and West Fork stakeholders have identified interest in future monitoring in the rural and undeveloped portions of the their watersheds. Also, the BIG Animals and Agriculture work group requests the Monitoring and Research work group consider gathering data and current research on successful feral hog population reduction techniques.

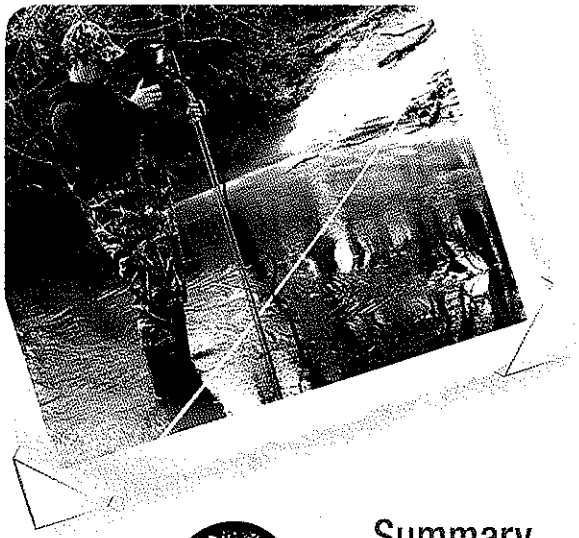
Discussion: Review I-Plan Strategy 9.0 Mon. and 10.0 Research Language

Workgroup reviewed the I-Plan and did not recommend any changes.

Adjourn

Upcoming Meeting Schedule

May 14, 2015: BIG Annual Meeting (Revised Date!)
January 29, 2015: BIG Geographic Framework Workgroup
January 29, 2015: BIG Residential Workgroup
February 2, 2015: Coordination and Policy



MONITORING AND I-PLAN REVISION

9

Summary

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

The review will address answers to the following questions:

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

Ambient vs Non-Ambient

Ambient monitoring routinely collects data without selecting for special conditions.

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

The Monitoring and Plan Revision Workgroup met jointly with the Research Workgroup on January 23, 2015, with four members in attendance. Under modifications to the I-Plan (Activity 9.4), the BIG approved modification to the I-Plan that will address the addition of new TMDL project areas to the BIG and voted to approve joining the Armand Bayou watershed to the BIG project area. BIG stakeholders reported removing sources of bacteria by conducting non-ambient sampling and tracking to source; HCFCD launched a BMP database; and several organizations are completing BMPs that include effectiveness monitoring that will wrap up in 2015.

2015 Focus

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

Implementation Strategies

9.1 Continue to Utilize Ambient Water Quality Monitoring and Data Analysis

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

Project Status

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

☐ Behind Schedule
■ **On Schedule**
☐ Ahead of Schedule

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

Implementation Effort

■ **H-GAC's CRP.** H-GAC's CRP continues to be the primary vehicle for water quality monitoring and data analysis in the project area (see Appendix G). Data is used to develop geomeans for each segment in the BIG Project Area (see Appendix H):

- The *2014 Basin Highlights Report How's the Water?* documents water quality impairments and trends based on data collected by seven organizations at 162 sites within the BIG project area (Table 9).
- Since September 2011, CRP monitors have been recording evidence of enterococci concurrent with *E. coli* samples in non tidal areas.
- CRP gathered observations of contact recreation while gathering ambient water quality data. Of the 162 sites monitored by CRP partners in 2014 in the BIG project area, 17 observed evidence of contact recreation. At those 17 sites there were 24 individuals observed in contact recreation activity (Table 10).

Table 9. CRP Monitoring in the BIG Project Area

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

Table 10. CRP Stations Where Contact Recreation was Observed or Inferred 2012-2014

Year	*CRP Sites Recording Observed or Inferred Contact Recreation*	*Observed Recreators*
2012	16	17
2013	25	87
2014	17	24

Table 10. For the years 2012-2014, CRP partners recorded evidence of contact recreation, either directly observed or inferred from the evidence. If observed, CRP monitors documented the number of individuals recreating at the time.

9.2 Conduct and Coordinate Non-Ambient Water Quality Monitoring

- **Interim Measure:** *H-GAC and BIG stakeholders will conduct non-ambient water quality monitoring activities including*
  - » *Developing a regional Quality Assurance Project Plan (QAPP); and*
  - » *Developing a regional non-ambient monitoring database.*

Project Status

☐ Not Started	☐ Behind Schedule	
☐ Initiated	■ **On Schedule**	– *This activity is On Schedule.*
■ **In Progress**	☐ Ahead of Schedule	
☐ Completed		

Implementation Effort

- ■ **Non-Ambient Water Quality Monitoring QAPP.** TCEQ determined that resources were not available to evaluate the QAPP. The BIG Monitoring Workgroup determined that the QAPP was important because it is a detailed plan written to ensure the quality and comparability of data from sample collection and processing through analysis and storage. BIG recommended that the QAPP be approved by H-GAC and reported back to the BIG workgroups.
- ■ **Regional BMP Database.** The HCFCD developed a regional BMP database modeled on the International Stormwater BMP Database. Currently, the database includes monitoring information for stormwater BMP projects developed by the HCFCD, as well as other BMP projects in the region. (www.bmpbase.org/LandingPage.aspx)
- ■ **Monitoring Data Implementation.**
  - The City of League City and TCWP completed the Gharardi Watersmart Park that contains monitored BMPs that will be evaluated through August 31, 2015.
  - BPA completed a QAPP and is starting preconstruction of water quality sampling at a future LID project in 2015.
  - BPA continued to conduct non-ambient monitoring to track down sources of bacteria in the BIG project area. For more details, see section 11. Geographic Priority Framework.
  - Harris County Birnamwood Drive LID monitoring project continues to collect water quality and quantity data.
  - Harris County is collecting water quality data as part of the feral hog removal project in Addicks and Barker reservoirs. Data collection and analysis should be completed in 2015.
  - Environmental Institute of Houston (EIH) at the University of Houston – Clear Lake retrofitted a detention basin in the Armand Bayou Watershed with a stormwater wetland to improve run-off in 2012. Wetland monitoring for water quality and habitat quality parameters was completed in August 2014. EIH has begun to share the results with resource agencies and interested parties, for more information please contact EIH. (www.eih.uhcl.edu)

9.3 Create and Maintain a Regional Implementation Activity Database

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

Project Status

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

☐ Behind Schedule
■ **On Schedule**
☐ Ahead of Schedule

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

Implementation Effort

■ **Regional Implementation Activity Database.** H-GAC with BIG partners from the Clear Creek watershed populated a demonstration database for web application development and demonstration in 2015. The implementation database will include provisions for local reporting efforts and provide annual tracking forms to collect information. The database will be compatible with HCFCD's database.

9.4 Assess Monitoring Results and Modify I-Plan

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

Project Status

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

☐ Behind Schedule
■ **On Schedule**
☐ Ahead of Schedule

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

Implementation Effort

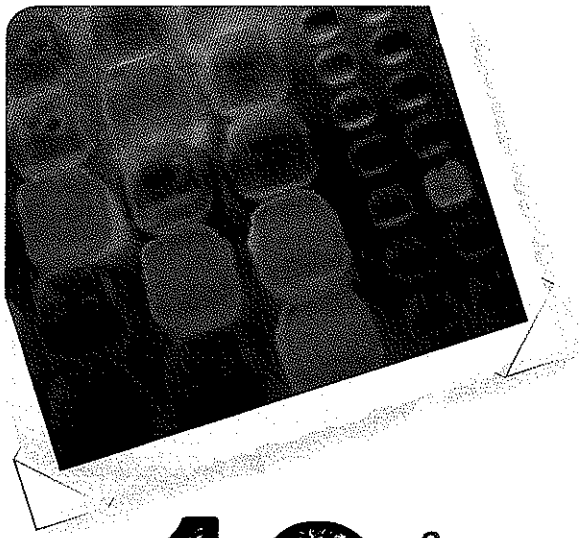
■ **BIG Bacteria Trend Line.** The BIG project area bacteria trend line continues to show improvements (see Appendix B). However, it seems that progress has slowed in the past year. H-GAC will continue to review available data to determine trends in bacteria levels.

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

- The HCFCD BMP database
- Harris County Birnamwood Drive LID monitoring project
- The City of League City and TCWP BMP park
- The BPA LID project

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

- On May 27, 2014, the BIG approved new language to augment implementation activity 9.4.5. New language incorporates adjacent watersheds outside of the BIG project area that are under a TMDL where the watershed's stakeholders request inclusion under the BIG I-Plan and the BIG approves the stakeholders' request. During that meeting, the BIG unanimously approved the addition of the Armand Bayou watershed.
- On October 21, 2014, the BIG approved the addition of 16 new assessment units within the BIG project area where TMDLs were completed and approved by TCEQ. There are 88 impaired assessment units in the BIG.



RESEARCH

10

Summary

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

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

On January 23, 2015, four members of the Research Workgroup met jointly with the Monitoring and Plan Revision Workgroup. The workgroup reviewed data related to ambient and non-ambient water quality. They discussed the status of feral hog and best management practice monitoring and research. A Clean Waters Initiative workshop on Microbial Source Tracking was held July 17, 2014, and included the following research topics:

- "Use of Bacterial Source Tracking to Characterize Texas Watersheds," Terry Gentry and Kevin Wagner, Texas A&M University
- "*E. coli* Source Tracking in Buffalo and White Oak Bayous," Robin Brinkmeyer, Texas A&M University – Galveston
- "MST: Latest qPRC Methods & Project Design Approaches," Mauricio Larenas, Source Molecular

2015 Focus

- H-GAC and BIG stakeholders aim to
  - Continue existing research and evaluate available data sources; and
  - Secure funding for additional projects, e.g. research to better understand the relationship between bacteria and sediment.

Implementation Strategies

10.1 Evaluate the Effectiveness of Stormwater Implementation Activities

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

Project Status

☐ Not Started	☐ Behind Schedule	
☐ Initiated	■ **On Schedule**	– *This activity is On Schedule.*
■ **In Progress**	☐ Ahead of Schedule	
☐ Completed		

Implementation Effort

■ **BMP Monitoring.**

- HCFCD actively monitors several stormwater sites within the region and developed a Regional BMP Database where stakeholders can access and evaluate effectiveness data. (www.bmpbase.org)
- City of League City, in cooperation with TCWP, installed a BMP park. Monitoring of the BMPs will be completed in 2015.
- Harris County Birnamwood Drive LID monitoring project continues to collect water quality and quantity data.
- BPA developed a monitoring QAPP for a future stormwater project and will begin monitoring in 2015.
- H-GAC developed a LID web resource page. (www.h-gac.com/community/low-impact-development/resources.aspx)
- University of Houston–Clear Lake completed a fully-monitored stormwater wetland on the UHCL campus in the Armand Bayou Watershed.

10.2 Further Evaluate Bacteria Persistence and Regrowth

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

Project Status

☐ Not Started	☐ Behind Schedule	
☐ Initiated	■ **On Schedule**	– *This activity is On Schedule.*
■ **In Progress**	☐ Ahead of Schedule	
☐ Completed		

Implementation Effort

■ **Special Studies.**

- The City of Houston evaluated the susceptibility of the IDEXX QuantiTray method for *E. coli* to interference from different species of bacteria co-metabolizing the marker and causing false positives. The study concluded continued use of IDEXX method as they found no significant difference between the IDEXX method and EPA Method 1103.1.
- The City of Houston, Harris County, and HCFCD continue to implement the Unified Ambient Water Quality Monitoring Program to quantify diurnal bacteria fluctuations in area waterways.

10.3 Determine Appropriate Indicators

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

Project Status

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

☐ Behind Schedule
■ **On Schedule**
☐ Ahead of Schedule

– *Overall this activity is On Schedule. The City of Houston evaluated the use of* Bacteroidales.

Implementation Effort

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

- H-GAC's CRP continued collecting enterococci samples to supplement *E. coli* samples in freshwater.
- City of Houston conducted bacterial source tracking to investigate the source of Bacteroidales (an anaerobic fecal bacteria) using polymerase chain reaction (PCR) methods to distinguish between DNA markers for human and animal sources. PCR analysis demonstrated present/non present results of hog and deer fecal pollution in most of the project area bayous. Since the PCR marker for humans can survive chlorination without the Bacteroidales species being viable, this reinforced the knowledge that most of the bayous are effluent dominated (Table 11).

Table 11. DNA Bacteria Source Results Using PCR Methods

Location	*Hog*[1]	*Ruminant*[2]	*Human*[3]
Hunting Bayou	X	X	X
Garners Bayou		X	X
Halls Bayou	X	X	X
Vogel Creek	X	X	
Addicks Reservoir	X	X	X
Little White Oak Bayou	X	X	
Sims Bayou	X		X
Berry Bayou	X	X	X
Brays Bayou	X	X	X
South Mayde Creek			X

Table 11. City of Houston study determining sources of Bacteroidales sources using polymerase chain reaction (PCR) methods. 1 - Hog marker detects fecal pollution from domestic as well as feral hogs. 2 - Ruminant marker detects fecal pollution from ruminants, such as deer and cattle, and some other animals; but rarely picks up human sources. 3 - Ninety percent reliable for human sources, but some rare animal sources also test positive. Treated sewage will also test positive because the marker can survive chlorination without the species being viable. However, treated wastewater will have a lower concentration than the raw waste.

10.4 Additional Research Topics

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

Project Status

☐ Not Started	☐ Behind Schedule	
☐ Initiated	■ **On Schedule**	– *Activities are On Schedule.*
■ **In Progress**	☐ Ahead of Schedule	
☐ Completed		

Implementation Effort

■ **Research Abstracts.** BIG stakeholders provided eight research articles and/or abstracts for H-GAC's library relating to bacteria contributions and implementation measures. The collection included articles about:

- "Distribution and persistence of *E. coli* and enterococci in stream bed and bank sediments from two urban streams in Houston, TX," Robin Brinkmeyer et. al. Science of the Total Environment, 502 (2015) 650-658;
- "Pathogens in Urban Stormwater," Urban Water Resources Research Council, Pathogens in Wet Weather Flows Technical Committee, Environmental and Water Resources Institute, American Society of Civil Engineers (2014);
- "Lake Madeline Bacteria Study Final Summary Report," George Guillen, University of Houston – Environmental Institute of Houston, Technical Report 2-10 A, Nov.2010;
- "Best management practices to mitigate fecal contamination by livestock of New Zealand Waters," Rob Collins, et al., New Zealand Journal of Agricultural Research, 2007, Vol. 50: 267-278;
- "Can Stormwater BMPs Remove Bacteria? New Findings from the International Stormwater BMP Database," Jane Clary, et. al., May 2007; http:www.stormh20.com/may-2008/bacterial-research-bmps.aspx;
- "Challenges in Attaining Recreational Stream Standards for Bacteria: Setting Realistic Expectations for Management Policies and BMPs," Jane Clary, et. al, World Environmental and Water Resources Congress 2009: Great Rivers© 2009 ASCE;
- "Illnesses Associated with Non-Point Source Contamination of Recreational Water and Potential New Management Tactics to Minimize Health Risk," Shannon T. O'Hearn, ENSC 501 Independent Environmental Studies Project – Queen's University, 2014; and
- "Quantitative Health Risk Assessment of Recreational Water Users in Philadelphia," Neha Sunger, Thesis, Drexel University, Jan. 2013.

■ **Future Research Topics.** BIG members recommended research, should additional funding become available, to study the relationship between bacteria and biofilms, colloidal particles, total suspended solids, and turbidity, including

- Wet sieve analysis;
- Sample dilution;
- Use of filters smaller than 0.45 µm; and
- Testing sludge blankets from wastewater treatment facilities.