Draft Progress Report

Bacteria Implementation Group

Houston-Galveston Area Council

5/22/2012

Draft

IN MEMORIAM
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This annual report for the
Implementation Plan for Total Maximum Daily Loads in the Houston-Galveston Region
is prepared by the Houston-Galveston Area Council's
Community and Environmental Department
in collaboration with the
Bacteria Implementation Group,
a stakeholder group appointed by the H-GAC board of directors and
charged with the Implementation Plan's development and oversight.

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the U.S. Environmental Protection Agency
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OVERVIEW

The state of Texas sets standards to establish whether waterways are safe for recreational activities, such as swimming or wading. Most rivers, bayous, creeks, and streams in the Houston-Galveston region have bacteria levels that are higher than those deemed acceptable by the state.

Bacteria comes from many sources, including, but not limited to, improper operation and maintenance of wastewater treatment facilities and sanitary sewer systems, failing septic systems, runoff pollution, illegal dumping, and animal wastes.

More than four million people live in the affected area, which include waterways in parts of ten counties: Brazoria, Fort Bend, Galveston, Grimes, Harris, Liberty, Montgomery, San Jacinto, Walker, and Waller.

In 2008, a group of leaders from government, business, and the community was formed with a common goal to develop a plan for reducing bacteria in area waterways. On August 16, 2011, the Bacteria Implementation Group approved the *Implementation Plan for Seventy-Two Total Maximum Daily Loads for Bacteria in the Houston-Gavleston Region* in order to submit it to TCEQ for consideration.

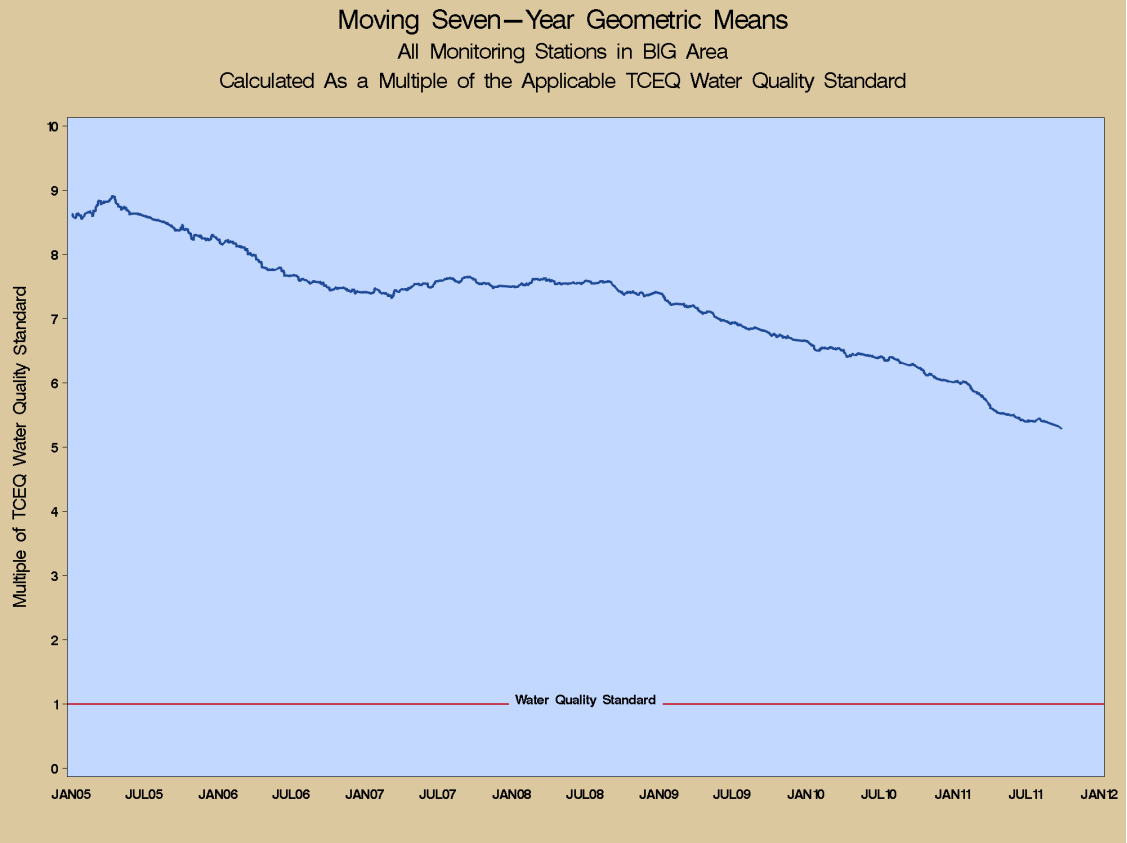
The I-Plan is a common-sense approach for reducing bacteria in our waterways and providing better services to citizens. It offers a menu of water protection activities to be completed by municipalities, industries, landowners, and residents.

The I-Plan includes provisions for assessing progress and updating the I-Plan. Annually, H-GAC is to prepare a report that may be used to identify whether progress is being made. This report is intended to help answer the following questions:

1) Do ambient water quality monitoring data indicate that bacteria levels are changing? If so, are the bacteria levels improving or degrading?
2) Do non-ambient water quality monitoring data indicate that implementation activities are reducing the load of bacteria?
3) Are implementation activities and controls being undertaken as described in this I-Plan? Which activities have been implemented, and which have not?

Question 1: Do ambient water quality monitoring data indicate that bacteria levels are changing? If so, are the bacteria levels improving or degrading?

The following chart describes how the seven-year geometric mean for bacteria levels has changed over time. It is based on ambient water quality data from all Clean River Program monitoring stations within the BIG project area. Because results include two different indicator bacteria—*E. coli* and *Entercoccus spp.*—the results have been calculated as a multiple of the applicable TCEQ water quality standard.



While overall water quality is still a long way from meeting the standard, the trend appears to be improving based on data that go back to 1998. Bacteria levels have decreased from almost nine times the standards to less than six. While the line describing changes is not intended to be predictive, it does suggest that a 25-year timeframe might not be an inappropriate goal for attaining water quality standards.

Of course, this line largely generalizes and over-simplifies water quality trends in the region. H-GAC has identified the ten monitoring stations with the highest bacteria levels in the BIG project area—the Most Wanted List. The Most Wanted List is more fully discussed later in this report, including a description of each station and the surrounding waterway, as well as a station-specific chart describing changes in the seven-year geometric mean for the station.

Because, from a regulatory perspective, we would like to remove waterways from the state's list of impaired waters, H-GAC has developed a similar list, called those Most Likely To Succeed, for waterways that are closest to meeting the state standard. Descriptive information is provided for each of those stations, too.

More information about ambient water quality monitoring data is available in the "Monitoring and Plan Revision" section of this report, and in the separate publication, ~~*How's*~~ *Where's the Water?*, H-GAC's annual report on ambient water quality monitoring in the region.

Question 2: Do non-ambient water quality monitoring data indicate that implementation activities are reducing the load of bacteria?

At this time, H-GAC has received no reports of non-ambient water quality monitoring data that indicate that implementation activities are reducing bacteria loading.

Stakeholders including Harris County Flood Control District, the City of Houston, and the University of Houston at Clear Lake have begun various projects to examine effectiveness of implementation activities in reducing bacteria loading. Descriptions of some of these projects are described in the "Research" chapter of this report.

H-GAC has begun working with stakeholders and TCEQ to develop a regional, non-ambient quality assurance project plan (QAPP). With input from stakeholders, H-GAC drafted a QAPP and sent it to TCEQ for consideration. Because the concept of a regional non-ambient QAPP is new, H-GAC expects that the process to finalize a carefully crafted and meaningful QAPP will not be quick.

[photo of wet-weather monitoring]

Question 3: Are implementation activities and controls being undertaken as described in this I-Plan? Which activities have been implemented, and which have not?

Although the plan has not yet been approved by the Texas Commission on Environmental Quality, stakeholders have already begun implementing its recommendations. Almost all recommendations have been acted on at some level, and much significant progress has been made.

The bulk of this annual report includes information about progress implementing the recommendations. Most of the information is based on reports given to H-GAC through the work group process by stakeholders who are already involved in the BIG planning effort. Twelve of the thirteen workgroups met between December 2011 and March 2012 to discuss progress towards implementation. (The Watershed Outreach work group will meet in summer 2012 to discuss the Most Wanted and Most Likely to Succeed lists.)

In general, workgroup participants indicated that progress towards implementing recommendations was appropriate. At its annual meeting on May 22, 2012, the Bacteria Implementation Group participated in an exercise to evaluate progress. The results of the exercise are illustrated in the following chart, and show that, in general, the BIG agreed with workgroup assessments of appropriate progress. [This may change based on exercise.]

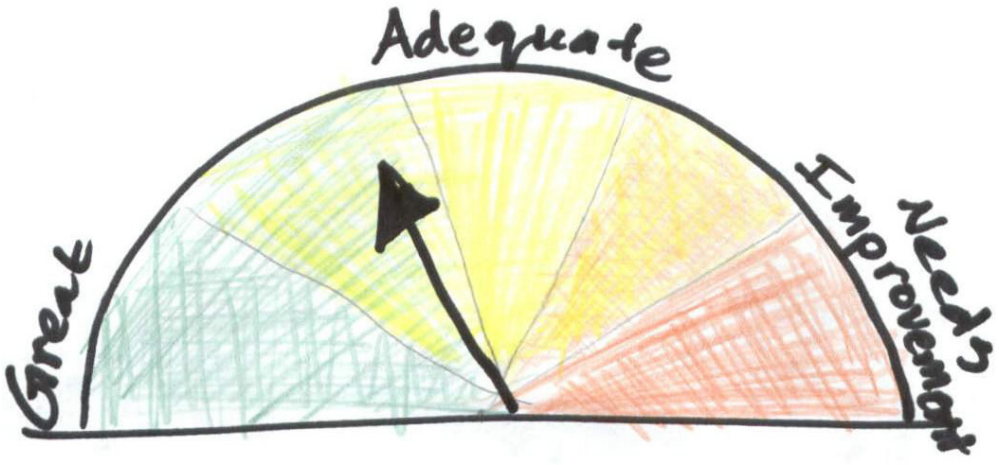


Figure 1: Is adequate progress being made to undertake activities described in the I-Plan?

Similar charts for each implementation strategy are included in the following sections.

In the future, electronic surveys and written requests for information will be used to gather information from more stakeholders. The annual report, in addition to describing progress towards implementation, will list stakeholder groups, such as cities and water quality permit holders, that provided information in response to the requests.

Implementation Activity 1.0: Wastewater Treatment Facilities

Main Summary

Wastewater treatment facilities (WWTFs) are a possible source of bacteria in waterways in the BIG project area, and the BIG has recommended several activities to address potential loading from the facilities. While TCEQ has not yet undertaken many of the recommendations, information is available that provides insight into progress.

The first two activities regarding WWTFs relate to monitoring of and limits for the effluent from WWTFs. Permit requirements and self-reported effluent data can provide insights into bacteria contributions from WWTFs.

TCEQ's Annual Enforcement Report provides information related to compliance and enforcement, the third activity related to WWTFs. Data from Fiscal Year 2011 will serve as a baseline for future comparison.

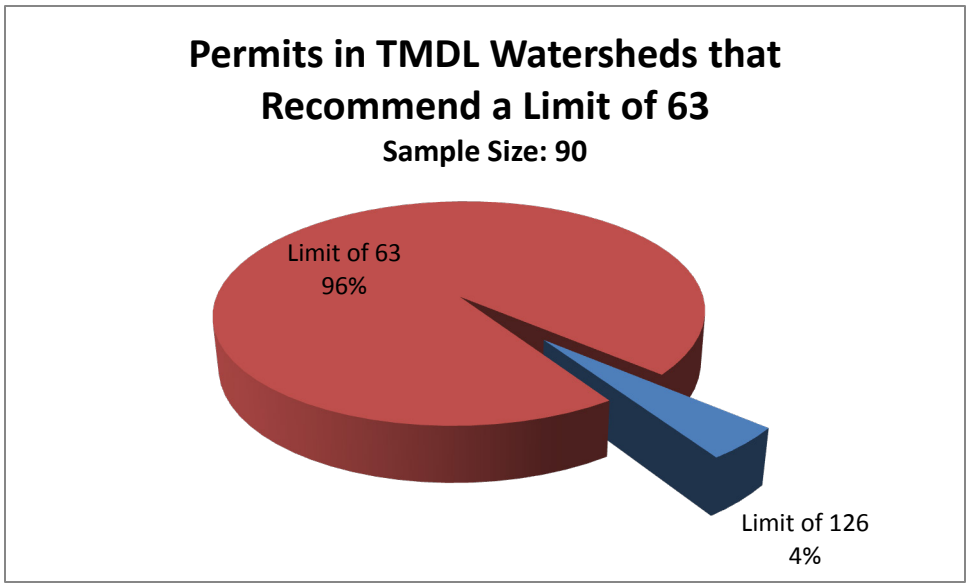
While some work has been done on the remaining activities relating to WWTFs, the focus has been on examining permit limits, effluent data, compliance, and enforcement.

Permit Requirements for Effluent Monitoring and Bacteria Limits

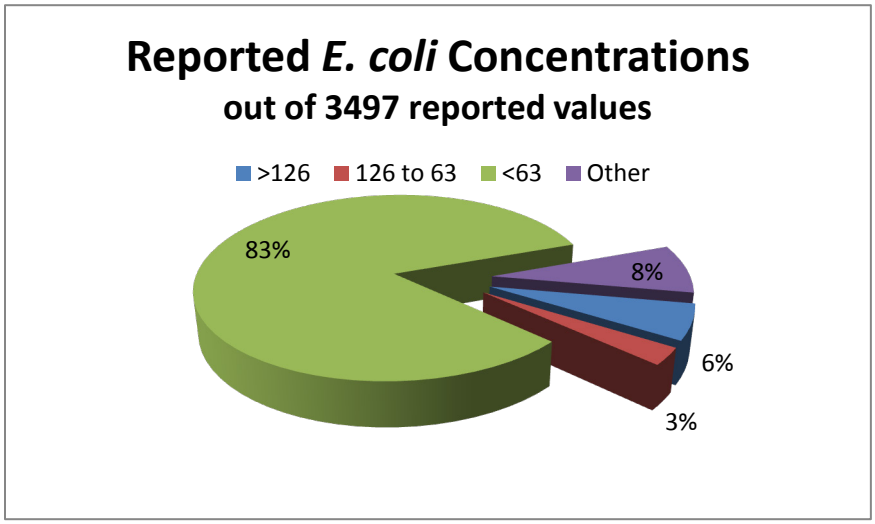
The BIG has recommended that permits for WWTFs in the BIG project area include more frequent monitoring requirements than those currently included in permits for WWTFs. Furthermore, the BIG has recommended that the more stringent bacteria limits required in some TMDL reports be applied to the entire BIG project area. While the TCEQ has not yet approved the recommendations, it did institute monitoring and effluent limits that apply to permit renewals and new permits since January 2010. Analyses of permits and of daily monitoring reports characterize bacteria monitoring in the project area.

The TCEQ has consistently included standard bacteria monitoring requirements and limits in new and renewed domestic WWTF permits, in accordance with its agreement with the Environmental Protection Agency.

Most of the TMDLs in the BIG project area, with the exception of the Clear Creek TMDL, require that WWTF permits include an *E. coli* bacteria limit of 63 counts per 100 milliliters for the geometric mean rather than 126. Out of a sample of 90 permit renewals subject to the lower limit, four had limits of 126 instead of 63. These oversights appear to be related to timing, as the renewal process for the four permits began shortly after TMDL approvals and do not appear to be indicative of an ongoing or systematic pattern.



H-GAC analyzed Discharge Monitoring Reports for permits in the 13-county region. As shown in the chart below, 83 percent of samples were below the limit of 63 counts of *E. coli* per 100 milliliters. Three percent of samples exceeded 63 but were still below 126. Six percent exceeded 126. Eight percent of the reports had no numeric value, because no value was reported. The data do not indicate the bacteria limit specified in the permit for the facility, and so the analysis did not compare bacteria levels to permit limits for individual facilities. Future analyses will determine what number of samples exceed permit limits, geometric means for each facility, and TCEQ's regulatory response to exceedences.

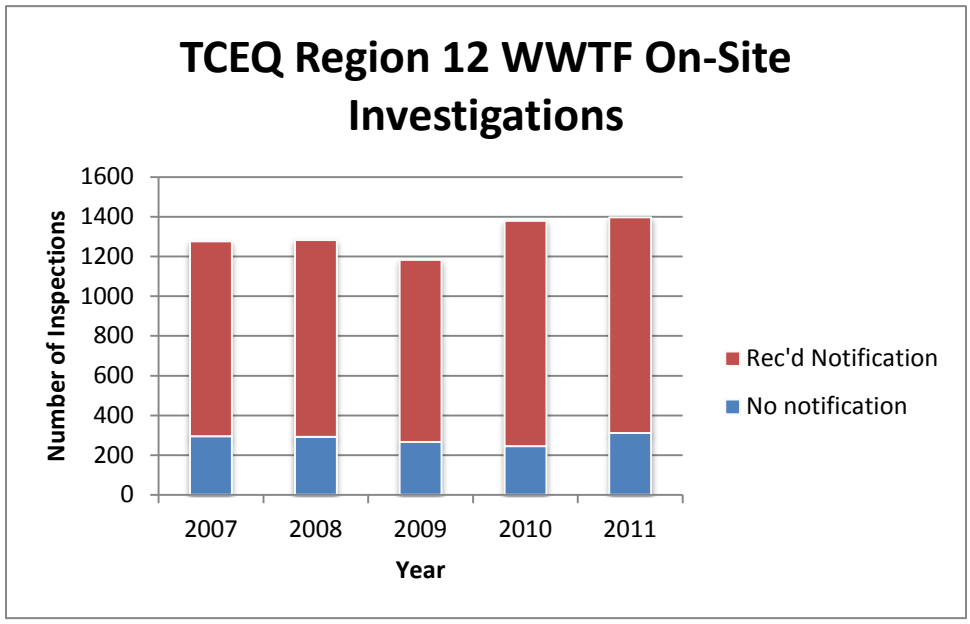


Compliance

BIG has set a goal of having all facilities inspected every two years. To meet the goal, the BIG has recommended that the TCEQ might need to allow for less time-consuming inspections, such as sampling-only investigations, or to increase the number of staff conducting investigations. Information describing TCEQ enforcement activities is available through three sources: the local TCEQ office, in TCEQ's Annual Enforcement Report compiled in Austin,[i] and from EPA's Integrated Compliance Information System.[ii]

According to EPA's Enforcement and Compliance History Online database, in 2009 (the most recent year for which data is available) the TCEQ inspected slightly more than 50% of major facilities with Clean Water Act permits—about 13% of all facilities in Texas--each year[iii]. For minor facilities, the annual rate of inspection is lower—about 5%.

In the 13-county region, local enforcement data indicate that about 22% of onsite inspections were unannounced in 2011, as shown in the following chart.



Additional Activities

1.4: TCEQ is in the process of updating portions of Chapter 217, Design Criteria for Domestic Wastewater Systems. While the update is not specific to BIG concerns, it does provide opportunities to incorporate recommendations that may decrease bacteria loading. Several BIG stakeholders, notably Harris County and the Houston Council of Engineering Companies, are participating in the process and providing comments, and other BIG stakeholders are encouraged to participate as well.

1.5: As H-GAC is able to analyze self-reported bacteria data, it will identify facilities with recurring bacteria exceedences. H-GAC will determine which of these facilities are making or have made upgrades to facilities to address elevated bacteria levels. This information is not yet available.

Call-out box: "In August 2011, TCEQ revised its regulatory guide to Resources for Texas Water and Wastewater Utilities. The guide describes sources for grants, loans, combined grants and loans, technical assistance, and other funding source clearinghouses. The guide is available on the TCEQ website by searching for RG-220."

[*Call-out box:* 1.6: The BIG identified consideration of regionalizing WWTFs severely or chronically noncompliant with permitted bacteria limits as an implementation activity. As more bacteria sampling data is available from WWTFs, a better definition of severely noncompliant facilities will be developed. In May 2011, H-GAC hosted a workshop to discuss possibilities for regionalization in the region. A white paper is available on the H-GAC website (link).]

[*Call-out box:* 1.7: If a facility chooses to use treated effluent for irrigation or washdown water at the facility itself, the facility is not required to get a permit or other authorization. As a result, the best way to identify whether facilities are using treated effluent for facility irrigation is to query them directly. This effort will be undertaken in the future.]

[*Call-out box:* In August 2011, TCEQ revised its regulatory guide to Resources for Texas Water and Wastewater Utilities. The guide describes sources for grants, loans, combined grants and loans, technical assistance, and other funding source clearinghouses.]

Implementation Strategy 2.0: Sanitary Sewer Systems

Main Summary

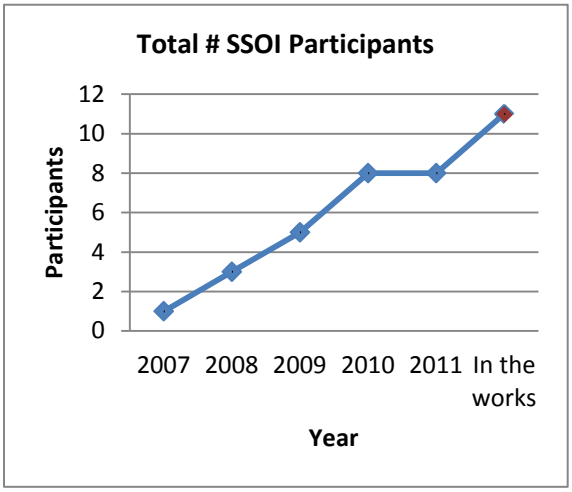
In general, implementation actions relating to sanitary sewer systems (SSSs) consist of encouraging improvements to SSSs, addressing lift station inadequacies, improving reporting of violations, strengthening controls on subscriber systems, and evaluating the penalty structure for sanitary sewer overflows (SSOs) and other sanitary sewer violations.

Efforts in the past year have focused on developing capacity—for both the provision of education and the collection of data in support of recommendations in the plan. Future efforts will focus on continued data collection and provision of educational opportunities.

Utility Asset Management Programs

The BIG has recommended the inclusion of utility asset management programs (UAMP) as a requirement in permits for wastewater treatment facilities. At this time, TCEQ has not chosen to include such a requirement in permits in the BIG project area. Nevertheless, activities in line with the recommendations are still occurring.

1) Within the BIG project area, the number of participants in the TCEQ's Sanitary Sewer Overflow Initiative (SSOI) has increased from three in 2008 to eight in 2011. (See chart #). While not a full UAMP, the plans developed in the voluntary SSOI program contain many of the elements of a UAMP.
2) The EPA has conducted listening sessions to seek stakeholder input to help the EPA determine whether and how to modify the National Pollutant Discharge Elimination System (NPDES) regulations as they apply to municipal sanitary sewer collection systems and SSOs. One possible recommendation the EPA has been considering is the inclusion in WWTF permits of Capacity, Management, Operations, and Maintenance (CMOM) requirements, which are similar to elements of a UAMP. In general, commentary was supportive of CMOM although several comments indicated that states might do an adequate or better job than the EPA of implementing CMOM or similar requirements. No decision has been made.
3) At H-GAC on September 1, 2011, the Texas Section of the American Water Works Association offered a seminar on financial planning for water utilities. Elements in the workshop were similar to elements that might be in a UAMP plan and apply to wastewater as well as water utilities. This workshop was conducted in support of the BIG's goal of providing workshops and educational opportunities related to UAMP.



[*Call-out Box:* CUPSS: EPA's voluntary Check Up Program for Small Systems. The EPA describes CUPSS as a free, easy-to-use, asset management tool for small drinking water and wastewater utilities. It has the potential to help utilities better identify needs and plan future investments, and maintain a desired level of customer service at the best appropriate cost. CUPSS has the potential to help reduce or eliminate SSOs and related sources of bacterial contamination of waterways. In addition to providing desktop software for managing assets, the CUPSS program offers a variety of free web-based, in-person, and self-paced training opportunities. More information is available at www.epa.gov/CUPSS.]

[*Callout Box:* City of Pasadena plans a CMOM Plan. The City of Pasadena began a program in 1985 to identify and correct infiltration/inflow (I/I) problems related to its sanitary sewer system and to eliminate sewage bypasses and overflows to various receiving waters during dry- and wet-weather conditions.

The City aggressively conducts television (TV) line inspections. The City responds to complaints from the MS4 Action Line to locate sanitary sewer leaks, cross connections to storm sewer systems, to rehabilitate the sanitary sewer system, and to construct major relief sewers to alleviate the sewage overflow problems. The City will continue its current plan to reduce I/I problems and plans to formalize these tasks in a Capacity, Management, Operations, and Maintenance (CMOM) plan. The City has prepared its own Sanitary Sewer Overflow Action Plan and is in the process of implementing it.

Between February 2010 and September 2011, the City replaced 2.44 miles of sanitary sewer main line (ML), installed/replaced 0.88 miles of sanitary sewer secondary line (SL), televised 4.73 miles of sanitary sewer ML, 2.1 miles of sanitary sewer SL, televised 2.31 miles of storm lines, smoke tested 2.69 miles of line, cleaned 30.44 miles of sanitary sewer ML, cleaned 0.53 miles sanitary sewer SL, and cleaned 9.95 miles storm lines.]

[*Callout Box:* EPA Sanitary Sewer Overflows and Peak Flows Listening Sessions. In 2010 and 2011, the EPA held several listening sessions to gather input on a variety of topics related to sanitary sewer systems. Several of the questions asked by the EPA are pertinent to reccommendations in the I-Plan.

- Should EPA develop a standard permit condition with requirements for capacity, management, operations, and maintenance programs based on asset management principles?
- What are the costs and benefits of CMOM programs and asset management of sanitary sewers?
- Should EPA clarify its standard permit conditions for SSO reporting, recordkeeping and public notification?"
- Should EPA require permit coverage for municipal satellite collection systems? (A municipal satellite collection system is essentially equivalent to the term subscriber system.)

H-GAC will monitor EPA actions relating to the listening sessions and possible rulemaking. Local stakeholders are encouraged to participate in the EPA process.]

Fats, Oils, and Grease

H-GAC has begun and will continue compiling information about local and exemplary fats, oils and grease (FOG) programs. Information is available on the BIG website. Once information is gathered, sample FOG regulations shall serve as models for possible model language for legal mechanisms, and example programs will serve as models for future program development.

Maintain Function at Lift Stations

After many lift stations lost power during Hurricane Ike, concerns were raised about the ability of those stations to maintain function during power outages and other events; these concerns are reflected in the BIG's recommendations regarding function at lift stations. Currently, the TCEQ is in the process of upgrading portions of Chapter 217 (previously Chapter 317), including Subchapter B, which addresses emergency power requirements. Stakeholders are encouraged to participate in the public participation opportunities presented by this process to ensure that the BIG's recommendations are considered.

The Texas Water/Wastewater Agency Response Network (TXWARN), a mutual aid program for utilities, has seen an increase in participation. The TXWARN website lists 237 participating entities, including public and private utilities and consultants, in the TCEQ Region 12 Area. Participation can greatly improve response and recovery times during emergencies. The ability of Galveston's utility to rapidly resume services after Ike is an example of how the program can help. (http://www.txwarn.org/.)

[*Callout Box:* Nottingham Country MUD Installs Generators. As part of its wastewater collection and treatment systems, Nottingham Country Municipal Utility Districts operates a wastewater treatment plant with treated wastewater. The treated effluent is discharged to Mason Creek and flows through George Bush and into Buffalo Bayou. Nottingham Country MUD also operates a lift station that is situated about midway in the District. In both cases, power interruption can result in contamination of Mason Creek, and in the case of the lift station, create an SSO into streets and neighborhoods that also affects Mason Creek and George Bush Park. In order to mitigate both situations, the MUD recently expended funds to provide emergency generators at both facilities. The MUD executes maintenance programs for both generators as well as for generators for water supply.]

Reporting Requirements

The BIG recommends improvements to reporting requirements for (SSOs). However, electronic infrastructure must be improved before such recommendations can be implemented. Three developments are underway that could result in sufficient electronic infrastructure to allow electronic reporting.

1) Broadband internet service is a precursor to the ability to provide electronic reporting of SSOs. The Texas Department of Agriculture, through Connected Texas, recently surveyed the availability of broadband internet service throughout Texas and is planning

to extend the availability to underserved areas. Preliminary review indicates that the vast majority of the project area has some type of broadband internet service, often mobile wireless broadband. H-GAC will continue to analyze coverage in the BIG project area to determine availability of broadband internet service. It will then monitor opportunities for improving access in unserved or underserved areas.

2) TCEQ regularly applies to the EPA 2012 Information Exchange Grant Program (http://www.epa.gov/exchangenetwork/grants/index.html), which funds development of improved access to, and exchange of, high-quality environmental data from public and private sector sources through the National Environmental Information Exchange Network. An exchange grant might be an appropriate funding program to facilitate electronic reporting of SSOs by permittees and/or operators. (In the past, the program helped fund database integration between EPA and TCEQ for reporting discharge monitoring reports from WWTF.) At a request from H-GAC, TCEQ is considering applying for a grant to facilitate SSO reporting. H-GAC will continue to talk with TCEQ about the possibility.

3) EPA Updates Web Tool Providing Clean Water Violation Trends and State Enforcement Response (Press release: http://yosemite.epa.gov/opa/admpress.nsf/1e5ab1124055f3b28525781f0042ed40/8766584ebb314fea8525785d004de550!OpenDocument)

Subscriber Systems

H-GAC is planning to collect contact information for WWTF permit holders. This information will be used to contact permit holders and ask them about subscriber systems and to share information about training opportunities. H-GAC will work to acquire copies of example subscriber contracts for informational purposes.

Penalties for Violations

TCEQ, in response to House Bill 2694, TCEQ Sunset Legislation, updated its penalty policy for violations, effective September 1, 2011 (http://www.tceq.texas.gov/assets/public/comm_exec/pubs/rg/rg253/penaltypolicy2011.pdf). The changes largely have to do with raising maximum criminal penalties to match civil penalties for similar violations. Determination of penalties is dependent, in part, on compliance history. TCEQ is in the process of considering changes to its compliance history and enforcement policies, also in response to House Bill 2694. Comments on these two policies were due on March 23, 2012, and May 14, 2012, respectively. Other than TCEQ's rulemaking, no action has been taken relating to this activity.

Implementation Strategy 3.0: OSSF

Main Summary

Because of how quickly the OSSF workgroup agreed that mapping OSSF was a priority, H-GAC with the cooperation of stakeholders has been able to develop a comprehensive map of permitted systems in the region and to begin to identify likely locations of older, unpermitted systems at greatest risk of failing. The map will facilitate efforts to address failing systems.

In addition to identifying and addressing failing systems, the BIG has recommended education and regulatory action to prevent and remediate failing systems. Efforts are already underway to provide education programs to a variety of audiences. Examples of regulatory measures are being collected and shared so that they may be considered and possibly emulated.

Progress has been made towards all three activities—address failing systems, increase appropriate maintenance, and improve regulatory mechanisms. H-GAC and stakeholders will continue to implement these efforts, which are being emulated across the state and provide opportunities for collaboration.

Identify and Address Failing Systems

The BIG recommended a four-step approach to identify and address failing OSSF.

1) Map permitted and unpermitted OSSF in the region.
    - H-GAC has mapped about 70% of the permitted systems in the region. The remaining 30% could not be geocoded because of data format and errors. Authorized Agents in the project area have been very cooperative about the provision of data, as shown in the table [reference table].
    - H-GAC has acquired and distributed GPS receivers to authorized agents for use identifying new OSSFs
    - H-GAC has conducted an analysis of probable locations of unpermitted/ grandfathered systems, and we will refine and expand the process in the near future
2) Identify target areas, timelines, and costs. H-GAC has been working with stakeholders to define criteria to use to identify target areas and to quantify costs for repair and replacement of failing systems.
3) Address target areas and pursue funding. H-GAC has begun to pursue funding sources that could be used to address failing OSSFs at a regional level.
4) Reevaluate the plan and continue. H-GAC has arranged to convene representatives of authorized agents and other stakeholders on an annual basis and has done so twice. The most recent meeting, held in March 2012, featured discussions related to the BIG, technical issues, regional initiatives and challenges, and statewide developments. The meeting was approved by TCEQ for continuing education credits for designated representatives and other registered professionals.

[Callout box: Westfield Estates. The Westfield Estates Watershed Protection Plan (Westfield Estates WPP) addresses bacterial impairment in Westfield Estates, a neighborhood of about 450 households and businesses in the Halls Bayou watershed in Harris County. Halls Bayou, Segment 1006D, is impaired for bacteria and is within the BIG project area. Residential homes and businesses are served solely by OSSFs. Approximately 20 to 40 percent of OSSFs appear to be in violation of permit requirements and are leaking bacteria. Preliminary source tracking studies of standing ditch water in the neighborhood indicate the sources of bacteria include humans (16%), dogs (33%) chickens (17%), and unknown non-human sources (34%). Findings from a series of studies (in 1999 and from 2004 to 2006) indicated that the Westfield Estates neighborhood has the highest need for public sewer services, and greatest potential for its residents to be exposed to waterborne pathogens in Harris County.

H-GAC worked with stakeholders to develop a formal Watershed Protection Plan. The following plan activities are underway in the community:

- In 2012, four OSSF were replaced for about $45,000 using funds from Supplemental Environmental Projects. TCEQ's SEP program offsets penalties from environmental violations to select beneficial local projects. This effort was a joint collaboration between the Harris County Soil and Water Conservation District (who oversaw the funding and implementation of the project), the East Aldine Management District (who provided technical expertise and helped manage eligibility determination), Harris County Watershed Protection Group (who provided implementation support and site inspection services), Sunbelt Freshwater Supply District (who assisted with implementation planning), and H-GAC project staff (who helped facilitate partnership discussions).
- Approximately 350 low flow kits, consisting of faucet aerators, water-efficient showerheads, and other materials are being distributed for use in residences in the project area.
- Residents are being offered free pump outs of their OSSF tanks when they install low flow devices and/or attend educational workshops
- An educational workshop is being offered to provide information to residents about how to maintain an OSSF.
- Nearby WWTFs have been expanded to accommodate sewage from Westfield Estates and other area communities currently lacking sanitary service. Future improvements include expansion of the sanitary sewer system to connect Westfield Estates to the WWTF. Depending on funding, sewer service may be available within five to ten years.

Partners in the project include Harris County Public Infrastructure Department and Harris County Precinct 2, East Aldine Management District, Sunbelt Freshwater Supply District, the Harris County Soil and Water Conservation District, and H-GAC. Funding sources include the Texas Water Development Board's Economically Distressed Areas Program, SEP funds, TCEQ's 319 program, local funds, and in-kind donations from project partners.]

Address Inadequate Maintenance of OSSF

BIG stakeholders are concerned that homeowners do not know enough about maintain an OSSF to identify problems and solutions in order to prevent failures. The BIG has begun implementing recommendations from the implementation plan.

- Homeowner education. H-GAC has created a website, www.h-gac.com/go/septic, to share educational material. In addition to providing general information, the site will include content specific to homeowners/homebuyers, local governments, and real estate professionals. The first phase of website development focuses on gathering and sharing existing information, including existing collateral material.
- Encourage repair and pumpout logs be kept by homeowners and/or maintenance providers. H-GAC has begun identifying education campaigns relating to pumpout logs.
- Coordinate with real estate industry. H-GAC has developed a curriculum for real estate inspection professionals to learn how to properly inspect a septic facility during a point of sale home inspection. The curriculum is being submitted to the Texas Real Estate Commission to be approved for the provision of continuing education for real estate property inspectors. H-GAC conducted a pilot workshop based on the curriculum, which was well received, and informed improvements to the curriculum.

Legislation and Other Regulatory Actions

Legislation and other regulatory actions offer opportunities to better manage OSSF. The following activities are related to recommendations in the plan:

- Texas Onsite Wastewater Treatment Research Council (TOWTRC) Fee. As a result of Sunset Legislation, the TOWTRC was dissolved and TCEQ has assumed its responsibilities, although it does not yet have authorization to spend revenue from the research fee charged for new OSSF permits. Once the transition has been completed and TCEQ has begun funding research, the workgroup will revisit the issue, as well as the possibility of a biennial, statewide forum to consider issues related to OSSF.
- Model order, ordinance, or resolution. The I-Plan recommends that each community shall examine their order or ordinance within five years, and that one shall update its order or ordinance within five year. The table [reference to table] lists authorized agents in the project area and the year their OSSF regulations were updated. Links to the orders and ordinances are available at www.h-gac.com/go/septic.

Authorized Agent	Year Updated	Data Completeness
Harris County	2011	Up-to-date
Brazoria County	2010	Up-to-date
City of Brookside Village	2010	Through summer 2010
Waller County	2009	Up-to-date, with gaps
Walker County	2008	Through summer 2010
Montgomery County	2007	Up-to-date, with gaps
Liberty County	2007	Up-to-date, with gaps
San Jacinto County	2006	**
City of Manvel	2005	Through summer 2010
Fort Bend County	2005	Through summer 2010
SJRA	2004	Through summer 2010
Grimes County	2004	**

** Grimes and San Jacinto Counties, which are in the BIG project area and are authorized by TCEQ to oversee OSSF permitting, were not covered under the quality assurance project plan (QAPP) approved by TCEQ and EPA for collecting and processing geospatial data related to OSSF. H-GAC did not collect data from them because the data would not be covered by the QAPP. Approval of a proposed amendment should cover data collection from Grimes and San Jacinto Counties, at which time, data will be requested from those jurisdictions.

[Pie chart showing distribution of permitted facilities by county/Authorized Agent]

[Gold star list (AAs who are up-to-date with data provision or provide data regularly)]

IA 4.0: Storm Water & Land Development

Main Summary

Local governments and organizations are developing a growing capacity to address water quality concerns, including bacteria, by managing storm water. In general, this strategy focuses on building upon existing programs by sharing knowledge and developing voluntary incentives to increase implementation.

Individual stakeholders have continued existing programs and adapted their activities to better address bacteria— a few examples are provided on the following pages. At the same time, H-GAC has been compiling and sharing information about activities undertaken by operators of municipal separate storm sewer systems (MS4s). These efforts will serve as a baseline for comparing future progress.

Action on the remaining activities in the plan should start in the next year. Renewal of the Texas MS4 general permit in 2012 and expansion of the permitted area will provide opportunities to evaluate, expand, and improve activities related to storm water.

Existing Programs

Local governments that operate an MS4 are nearing the end of their first permit cycle. Each operator is responsible for developing and implementing programs that relate to the six minimum control measures required of the permit (see box). Eighty MS4 permit areas are at least partially inside the BIG project area and have already begun addressing the requirements of the MS4 program. Of these, three permits are large "Phase I" permits which have been through multiple permit cycles, have additional requirements, and serve as examples.

[*Callout Box:* **MS4 Permits**. Current Minimum Control Measures

- Illicit discharge detection and elimination
- Construction site runoff control
- Post construction runoff control
- Pollution prevention/good housekeeping
- Public education and outreach
- Public participation/involvement

TCEQ is in the process of renewing general permit TXR040000 for Phase II (Small) MS4s in the state. The revised general permit will combine public education, outreach, and involvement into one activity; add oversight of industrial facilities to some permits; and refine requirements for the existing minimum control measures.

The three Phase I MS4 permit holders in the BIG project area are the City of Pasadena, TxDOT, and the Joint Task Force, which consists of the City of Houston, Harris County, Harris County Flood Control District, and TxDOT. These permits are set to renew in 2013.]

H-GAC has coordinated several activities to increase the capacity of our community to address storm water. First, H-GAC has initiated an annual series of workshops as part of the Clean Waters Initiative to address the six minimum control measures of a Phase II MS4 permit. These workshops are designed to provide a forum to learn from peers about successful programs and an opportunity to identify opportunities for collaboration.

[*Call out box:* What participants have said about the CWI Storm Water Workshops: "Learning more with each workshop," "Liked interactive format, examples, photos, actual field experience, and the prizes approach," "Good discussion on issues," "good overall survey of local issues" "a good amount of detail presented…all presentations were very informative," covered basics well and provided a broad scope at the same time," "I'm a regular customer"]

Second, H-GAC has acquired copies of the 2010 annual reports for MS4 operators in the H-GAC region. H-GAC has posted these reports online and is analyzing them to identify innovative practices, opportunities for collaboration, and suggestions for future report content. Moreover, the reports include specific contact information for each MS4 that can be used to collect future reports and storm water management plans and communicate information about storm water opportunities.

Together, the meeting information for the CWI workshops, the MS4 documents, and analysis of reports will form the basis of the online library of local storm water and land development best management practices and controls.

Voluntary Expansion

The BIG recommends activities to voluntarily improve and geographically expand storm water programs. While efforts have not focused on these activities, grant applications have been made to support recommendations in the I-Plan. In particular, applications have focused on providing technical assistance to analyze local regulations and programs that might support or prevent participation in existing recognition programs, identify opportunities to facilitate implementation of low impact development, and monitor effectiveness. If funded, the grants projects would help implement recommended activities in the I-Plan which address various aspects of voluntary storm water program improvements and expansion.

Regulations require that, if a place is designated by the Bureau of the Census as an urbanized area, the area become subject to MS4 permit requirements. On August 24, 2011, the Bureau of the Census released, in the Federal Register, its "Urban Area Criteria for the 2010 Census." New maps based on the census designation are scheduled to be released in October 2012. Presumably, new MS4s—previously unpermitted entities—will be included in the new delineation of urban areas, and thus will become subject to the MS4 Phase II General Permit. H-GAC is already working with stakeholders to offer a welcome program to local governments that will become subject to MS4 Phase II permit requirements.

Financing

Various stakeholders have continued conversations with TCEQ regarding the possibility of allowing reimbursement to developers through the MUD financing process for water quality features. As of March 2012, these conversations were unresolved. At least one application has been made by a local developer for approval for reimbursement for water quality features, and BIG stakeholders look forward to learning of the results of the consideration.

Harris County reported that, in April 2011, Harris County and Harris County Flood Control adopted new criteria to facilitate low impact development in the county (http://www.eng.hctx.net/watershed/lid_green_infra.html). Harris County is hopeful that the new criteria will accommodate the low impact development in the county.

IA 5.0: Construction

Main Summary

The BIG identified construction associated with development and redevelopment as a possible source of bacteria loading. While construction sites may not be considered significant sources of bacteria, they are a source of runoff that may be associated with elevated bacteria loading.

BIG stakeholders indicated that regulations and best management practices should provide sufficient controls for reducing contaminated runoff from construction sites. However, a lack of compliance with and enforcement of existing regulations and recommended practices was identified as an opportunity for improvement. The BIG recommended increasing compliance and enforcement by increasing site inspections and providing more robust education and training for people involved in construction.

In conjunction with activities related to storm water and land development, H-GAC has been gathering data regarding compliance, enforcement, education, and training that can be used as a baseline for future comparison.

Increased Compliance

The BIG recommends that local governments and MS4 operators evaluate their construction inspection program to determine whether staff resources are sufficient to adequately enforce existing guidelines and hire additional staff if necessary and as resources are available. MS4 operators have reported that they have already begun evaluating their construction inspection programs and are making changes to their programs as a result.

- Harris County determined that both construction inspectors and OSSF inspectors spend a great deal of their time traveling between sites because of the distance between the sites. By cross training the two types of inspectors, Harris County is able to decrease the territory assigned to each inspector, thereby decreasing the time required to travel between sites. The decreased travel time gives inspectors more time to conduct inspections, effectively increasing the resources available to inspect construction sites.
- The City of Houston identified a growing need for inspections and recently added another inspector to their Storm Water Construction group. [table showing inspection data.]

[*Callout Box:* Renewal of the TCEQ Construction General Permit (CGP) TXR150000. The TCEQ is in the process of renewing the TPDES general permit for Construction Storm Water, TXR150000, which expires on March 5, 2013. Changes to the permit will be guided in part by changes to the EPA's renewed CGP, which was renewed on February 16, 2012. The EPA CGP's i does not include turbidity limits, although it does provide additional information about restrictions on erosion and sediment control, pollution prevention, and stabilization. More information is available at http://www.tceq.texas.gov/permitting/stormwater.]

Education and Training

Education regarding construction practices forms the basis for two recommendations of the BIG: the development and distribution of educational material, and the coordination of training workshops. H-GAC has begun gathering examples of existing educational material to be used to develop new material. The TCEQ, Harris County, the City of Houston, and Construction EcoServices reported that they have educational material that they use and distribute.

Several local organizations continue to offer training on storm water construction activities.

- H-GAC offers storm water programs as part of the Clean Waters Initiative Workshops;
- The Houston Chapter of the Association of General Contractors offer multiple classes each year; and,
- Some cities, including Pearland and Missouri City, offer or require pre-development meetings or trainings and contractor registration.

[*Callout Box:* Galveston Bay Construction Alliance. In 2006, the Galveston Bay Estuary Program awarded the City of Baytown a grant to develop a video to train construction site operators on how to comply with TPDES storm water regulations. The project was a part of the efforts of the Galveston Bay Construction Alliance to improve water quality and prevent stormwater pollution in the Galveston Bay area. Alliance members include the cities of Baytown, Pasadena, Seabrook, League City, Webster, La Porte, Friendswood, and Texas City, and Chambers County. Some of the cities are also using the video to train staff and in-house contractors.]

IA 6.0: Illicit Discharges and Dumping Elimination (IDDE)

Main Summary

The BIG is concerned about illicit discharges and dumping as sources of non-point source loading of bacteria into waterways in the project area. The TMDL reports support this concern, documenting multiple and illicit dry-weather discharges with elevated levels of bacteria. Anecdotal evidence suggests that unscrupulous mobile waste haulers also contribute bacteria to the waterways.

In response to the concerns about illicit discharges and dumping, the BIG has recommended that stakeholders focus on three activities. First, local governments should detect and eliminate illicit discharges specific to bacteria. Second, local governments should consider improving regulatory mechanisms relating to the regulation and enforcement of illicit discharges. Finally, the I-Plan recommends monitoring and controlling waste hauler activities through regulatory mechanisms and by exploring fleet tracking programs. Changes to the TCEQ's general permit for MS4 Phase II communities, which go into effect in late 2012, will lead to more robust reporting and tracking of illicit discharges.

The IDDE work group expressed continued concern about environmentally questionable practices by some waste haulers. The workgroup recommends that the BIG consider petitioning TCEQ to require generators or grease trap waste and grit trap waste and owners of on-site sewage facilities (OSSF, commonly known as septic systems) to keep all manifest records, or "trip tickets" for a period of three years from the date of pick up by the waste hauler and to make them available to regulatory authorities upon request. This recommendation could be incorporated into "Implementation Activity 3.2.2: Encourage repair and pump out logs be kept by homeowners and/or maintenance providers." Local governments that have been authorized by TCEQ to oversee OSSF permitting and enforcement may also consider such a requirement. Alternatively, informing OSSF owners and potential owners of the importance of verifying and retaining pump out trip tickets may serve to address concerns about tracking dishonest practices.

Detect and Eliminate, Regulate and Enforce

MS4 operators are required to map their storm sewer system, develop techniques for detecting illicit discharges, and establish enforcement procedures for removing the source of illicit discharges. Based on a review of annual reports from many of the approximately 120 MS4 operators in the region, most operators have regulatory mechanisms in place at this time and

procedures for detecting illicit discharges. However, almost none of the MS4 Phase II year-three annual reports indicate the number of illicit discharges detected.

Many of the Phase II operators have implemented new regulations as a requirement of their permit. However, H-GAC has not finished compiling existing regulations or tracking whether those regulations have been revised.

Waste Haulers

The hauling of liquid waste from OSSF, grease traps, and grit traps continues to be a significant concern to the Illicit Discharges and Dumping Workgroup, in urban, suburban, and rural environments. The workgroup identified the following activities in particular on which to focus efforts:

- Compile regulations pertaining to liquid waste haulers.
- Identify registered haulers in the region.
- Identify entities with environmental enforcement units (civil and criminal).
- Provide training for prosecutors, attorneys, judges, law enforcement and local environmental investigators, with a focus on obtaining CLEs for prosecutors and attorneys and possibly TCLOSE credit for law enforcement. H-GAC's environmental enforcement roundtable and environmental enforcement circuit rider programs may serve as a forum and model, respectively, for such training.
- Identify ways to make waste hauling more accountable, possibly through the manifest/trip ticket mechanism.

[*Callout Box:* Renewal of the TCEQ's MS4 Phase II General Permit: The current TCEQ MS4 Phase II General Permit requires that operators have techniques and procedures in place for detecting and eliminating illicit discharges, and that they map their storm sewer system. The draft general permit renewal, proposed to become effective on August 13, 2012, contains more extensive requirements for IDDE. Specifications detail program development, MS4 mapping, identification of priority (high risk) areas, source investigation and elimination, public reporting, education and training, and dry weather field screening. These additional specifications should result in more robust IDDE programs and more information that can be tracked and measured as part of the BIG's annual evaluation of progress.]

[*Callout Box:* City of Webster adopts New Illicit Discharges Regulations. On November 16, 2012, The City of Webster adopted a new article in Chapter 86 of its code of ordinances. The new article prohibits any discharge into the MS4 that is not composed entirely of stormwater, with a limited number of exceptions such as air conditioning condensation. The article describes enforcement requirements, such as compliance and penalty information. In general, such changes to regulatory mechanisms are required by MS4 permits, to the extent allowable by law. The City of Webster's ordinance is fairly representative. The ordinance is available at

http://library.municode.com/HTML/12477/level3/PTIICOOR_CH86UT_ARTIVRECOSIERCOILDISTFAMAIN.html#TOPTITLE.]

[Callout Box: City of Pasadena's Dry-Weather Screening Program. Each year, the City of Pasadena screens approximately half of the major storm water outfalls for discharges during dry weather. The screening includes a visual check for flow in the storm sewer for characteristics such as: color, biota, odor, surface scum, turbidity, and oil sheen. When necessary, the City performs lab tests, such as analyses for copper, phenols, and detergents. If the results of the laboratory analyses confirm an illicit discharge, corrective action will be pursued through standard procedures, which can include legal action. For sites that require a follow-up investigation, the City will visit those sites within four to 24 hours. Sites with no discharge and no indication of a recent discharge will be visited only once. Sites with significant standing water in the conveyances will be labeled as "No flow" and will have a follow-up visit within four to 24 hours from the initial visit.

During this Reporting Period, Pasadena's storm water team screened 77 outfalls in three bayous. Of the outfalls screened, twelve were wet; all of them were due to potable water or ground water. The Water Distribution Department was notified and the leaks were repaired.]

[Callout Box: Harris County's Dry Weather Screening Program consists of screening 220 sites each year, comprised of a combination of major outfalls and commercial inspections. Active discharges at major outfalls during dry weather are investigated and enforcement action is taken when warranted. Commercial inspections consist of inspections at commercial facilities such as plant nurseries, restaurants, fueling stations, automotive and boat care; and vehicle and equipment washing. The approach for the commercial inspections is aimed at public outreach as well as enforcement. The data from the screened outfalls and the commercial inspections is maintained in a database at Harris County Pollution Control Services Department.

Agriculture and Animals

Main Summary

Bacteria loads from agricultural practices and animals are identified in the TMDL reports as nonpoint sources of concern.

Existing agricultural management programs are traditionally voluntary, unless large populations of animals are involved and require a confined animal feeding operation (CAFO) permit. The BIG has recommended that agricultural activities focus on promoting increased participation in existing voluntary and incentive-based programs for erosion control, nutrient reduction, and livestock management.

Feral hogs are a widespread, costly, damaging source of bacteria in our waterways, and it is for these reasons, among others, that the BIG chose to focus attention on managing feral hog populations as an implementation activity. Many initiatives to eliminate feral hogs and provide landowner education are being developed at the statewide scale, and BIG stakeholders are increasingly participating in these programs.

Agriculture

Agricultural incentive programs with the broadest participation in the region include the Environmental Quality Incentives Program (EQIP) of the Natural Resources Conservation Service (NRCS) and the Water Quality Management Plan (WQMP) program administered by the Soil and Water Conservation Districts. This year, the focus has been on collecting data to use as a baseline for measuring future progress: the BIG set a goal of 5% increase in participation each year.

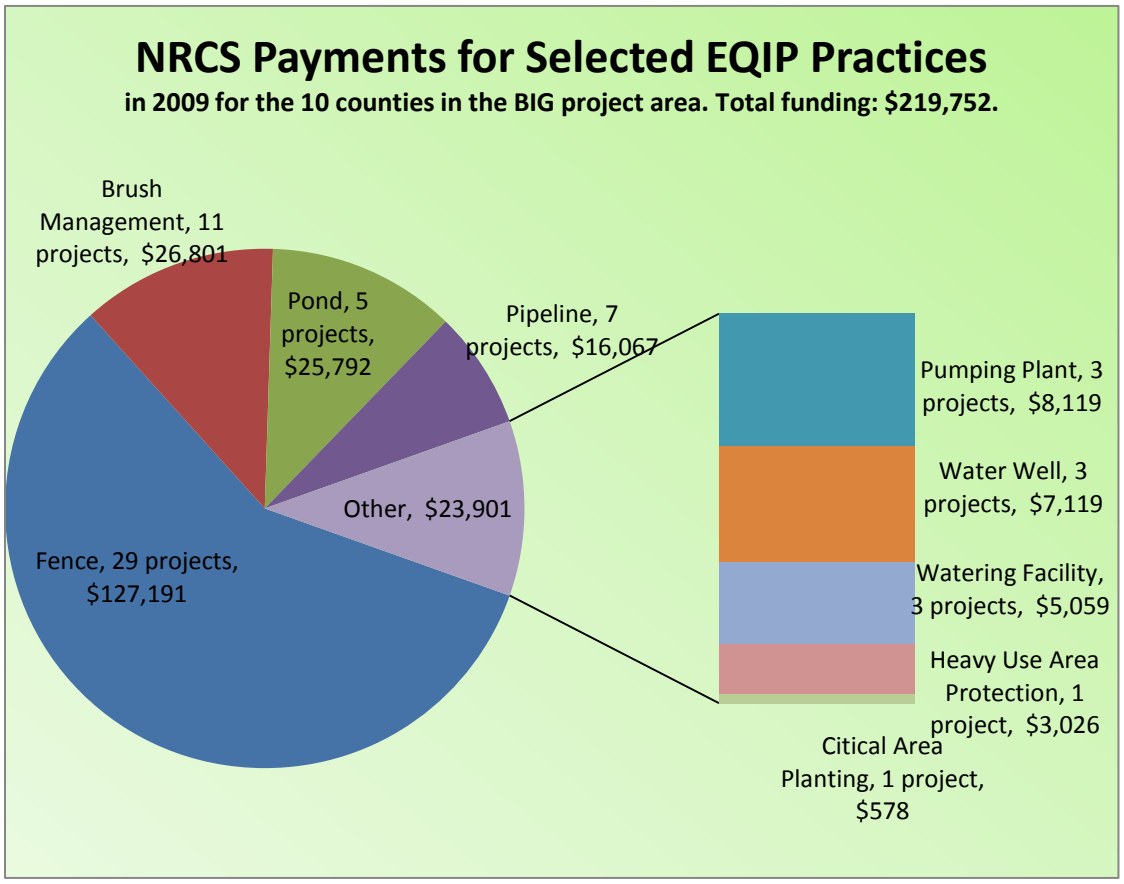
H-GAC has undertaken two projects to try to increase participation. The first is general education—making sure that when priority practices are selected at the county level each year, the decision-makers know that bacteria impairments are widespread and that practices to address bacteria should be strongly considered. Second, H-GAC is providing data for a project, managed by the Conservation Fund, to better understand participation in incentive-based programs in this region, using behavioral economics.

[*Callout Box*: NRCS priority practices for counties in the BIG project area that are related to keeping cattle out of waterways or that are specific to water quality. WQMP projects address these same practices. The numbers indicate the practice as identified in the NRCS Field Office Technical Guide.

- 516-Pipeline
- 378-Pond
- 533-Pumping Plant
- 642-Water well
- 614-Watering Facility

- 382-Fence
- 472-Access control
- 578-Stream crossing
- 561-Heavy use area protection
- 342-Critical area planting
- 412-Grassed waterway
- 590-annual testing]

In addition to tracking changes in participation, we will need to be cognizant of changing land use trends: the BIG project area is one of the most rapidly urbanizing areas of the state. While the total number of farms is increasing, they are increasingly small hobby farms not managed by professional farmers.



Feral Hogs

Texas AgriLife Extension Service estimates that statewide annual economic damage caused by feral hogs is $500 million. Unless aggressive control measures are undertaken, the feral hog problem is expected to worsen in the years ahead. Moreover, their waste is a documented source

of bacteria loading into waterways in the BIG project area. For these reasons, the BIG felt it was appropriate to focus on managing the population of destructive, non-native hogs.

A number of statewide initiatives are underway to address the feral hog population. Participation in these programs will help meet the BIG's goal of offering two feral hog workshops each year.

First, the Texas AgriLife Extension Service, in conjunction with the Texas State Soil and Water Conservation Board's Plum Creek Watershed Project, has been developing an extensive feral hog education program. Grant funding has been applied for that would bring workshops, training, and support to the BIG project area and the H-GAC region in general.

Second, in 2011, the Texas Department of Agriculture offered its second Hog Out County grant competition to eliminate hogs and provide education to residents. In the H-GAC region, Fort Bend and Austin Counties both participated, recording the removal of 850 hogs and participation by 244 people.

Third, the Texas Legislature approved legislation that allows helicopters, known as 'pork choppers,' to be used to hunt feral hogs. As of October 2010, just over a month after the passage of the regulation, 18 people had received permits for aerial wildlife management from the Texas Parks & Wildlife Department. Pork choppers are increasingly being considered the most effective means of eliminating feral hogs.

Local efforts, such as the City of Pearland's contract with two feral hog removal companies, also help manage feral hog populations.

[Callout Box: AgriLife Extension Feral Hog Fact Sheets:

- Box Traps for Capturing Feral Hogs
- Box Traps for Feral Hogs
- Corral Traps for Capturing Feral Hogs
- Door Modifications for Feral Hog Traps
- Feral Hog Transportation Regulations
- Feral Hogs and Disease Concerns
- Feral Hogs Impact Ground-nesting Birds
- Feral Hogs Negatively Affect Native Plant Communities
- Making a Feral Hog Snare
- Managing Feral Hog Damage
- Placing and Baiting Feral Hog Traps
- Recognizing Feral Hog Sign
- Snaring Feral Hogs]

Implementation Strategy 8.0: Residential Sources

Main Summary

Homeowners, through individual actions, can make a difference in the quality of water in our region. However, they must first recognize the value of our waterways, understand the problem, and know how they can make a difference. Fortunately, there are many excellent programs to educate the public and encourage behavioral changes. For this reason, the BIG has recommended expanding homeowner education efforts in the BIG project area.

The ongoing identification of existing education efforts, particularly those related to bacteria, has been a focus this year. Stakeholders have identified pet waste education and FOG (fats, oils, and grease) education programs as prime opportunities for development and coordination. Efforts to develop and expand these types of programs have already begun.

Expand Homeowner Education Efforts throughout the BIG Project Area

The interim, measureable milestone for the activity includes an annual two percent increase in the number of communities participating in new or expanding programs. We will focus this year on identifying existing programs targeting residential education, including MS4 programs that address bacteria and communities participating in the *Harris County Regional Watershed Education Program*. The data collected this year will be used as a baseline against which progress will be measured.

Continue or begin a homeowner education program based on existing models

Local communities and organizations offer many excellent homeowner education programs that may help reduce bacteria loading in the BIG project area. The following programs, which include both new and continued initiatives, are available in large portions of the project area:

- The Galveston Bay Estuary Program has introduced its Back the Bay campaign which will begin in 2012.
- H-GAC placed additional watershed signs throughout the region, including in Halls Bayou and in the Lake Houston watershed.
- In March 2012, H-GAC hosted a Clean Waters Initiative workshop on public education, outreach, and involvement activities undertaken by MS4 operators in the H-GAC region.
- H-GAC is participating in the development of the "Don't Mess with Texas Water" campaign, required by House Bill 451, which was passed by the 2011 Texas Legislature.
- Rivers, Lakes, Bays, 'n' Bayous Trash Bash was held at 17 sites in the region, including nine in the BIG project area. Additional cleanup events have also been held on Clear Creek, Greens Bayou, Little White Oak Bayou, Brays Bayou, and others.
- H-GAC has ordered and will be programming educational kiosks that will be distributed on loan (2-12 months) to interested parties for placement in city and county permit offices, schools, nature centers, libraries, and other public places throughout the TMDL areas.

- H-GAC recently launched its Pet Waste Pollutes campaign to address pet waste that gets washed into waterways and causes bacterial pollution. Information about pet waste pollution and what can be done about it is available at www.petwastepollutes.org. To go along with the website, H-GAC has developed a pledge to pick up and a "pitch the poo" game for booths and events, and is distributing thousands of branded dog waste bag dispensers. Future additions to the campaign include a proud pooch picture gallery for dogs whose owners have taken the pledge and articles for inclusion in newsletters.

Conduct pilot studies to evaluate results of education efforts

The second interim, measureable milestone for the activity includes one pilot study in the BIG project area every five years. In 2011, the Galveston Bay Estuary Program conducted a pilot study relating to general education and awareness of Galveston Bay. The pilot study measured the effectiveness of the Back the Bay campaign, comparing knowledge and self-reported behavior in two communities: one control city and one city which received targeted education.

Back the Bay is an education and awareness campaign created in 2011 by the Galveston Bay Estuary Program. Back the Bay educates residents about protecting Galveston Bay, a nationally significant estuary. The campaign offers simple tips and resources for the 4.5 million residents in the Houston-Galveston region who affect the health of the Bay. A key message of the Back the Bay campaign reminds residents, "You're more connected to Galveston Bay than you think." The campaign works to improve the environmental quality of the Bay through three main pillars: habitat preservation, water conservation and water quality. For more information and to take the Back the Bay pledge, visit www.backthebay.org.

Monitoring and Plan Revision

Main Summary

The BIG recommended that the BIG review progress on an annual basis and determine whether changes need to be made to the I-Plan or its implementation. The review is to be based on answers to the following questions:

1) Do ambient water quality monitoring data indicate that bacteria levels are changing? If so, are the bacteria levels improving or degrading?
2) Do non-ambient water quality monitoring data indicate that implementation activities are reducing the load of bacteria?
3) Are implementation activities and controls being undertaken as described in this I-Plan? Which activities have been implemented, and which have not?

The Clean Rivers Program continues to provide ambient water quality data that can be reviewed. H-GAC and BIG stakeholders have begun developing the capacity to collect non-ambient water quality data. H-GAC has also been working with stakeholders to gather information from stakeholders that can be used as a baseline for future comparisons.

[Brief statement about conversation at annual meeting.]

Continue to Utilize Ambient Water Quality Monitoring and Data Analysis

The BIG recommended that stakeholders continue the Clean Rivers Program in the BIG project area, which is being done. In the BIG project area, H-GAC manages the Clean Rivers Program, a statewide program for monitoring surface water quality. H-GAC coordinates 8 program partners who conduct sampling and lab analysis under a regional quality assurance project plan (QAPP) for ambient water quality monitoring. Professional monitors from those eight organizations sample ambient water quality at over 370 sites. While overall funding has remained relatively stable, H-GAC made adjustments to program elements, eliminating non-essential lab parameters and adding more parameters, such as nutrients. The Clean Rivers Partners have added quarterly sampling for *Enterrococcus* bacteria at all freshwater sites, to supplement *E.coli* sampling. H-GAC will share any information about conclusions or patterns as it becomes available. H-GAC's Clean Rivers Program has also acted on the recommendation to include codes in the sampling information for recording contact recreation and evidence thereof. The recommendations for tracking contact recreation is being considered by the state.

As part of its responsibilities for administering the local program of the statewide Texas Stream Team volunteer monitoring program, H-GAC oversees 45 active volunteers at 42 sites in ten watersheds. Five of the volunteers sample for bacteria. Galveston Bay Foundation and Bayou Preservation Association help recruit and manage volunteers. All of the volunteer monitoring is conducted under a quality assurance project plan (QAPP). The data is used to augment professional monitoring data, but is not regulatory in nature. Data is also used to screen sites to see if professional monitoring is required.

The Basin Highlights Report, an annual report on the Clean Rivers Program, provides additional information about the ambient water quality monitoring program. Additional data are available in the Water Resources Information Map, the on-line map and database with water quality monitoring data (http://arcgis02.h-gac.com/wrim/) and a free I-Phone application ("How's the Water?").

Conduct and Coordinate Non-Ambient Water Quality Monitoring

H-GAC applied for and received funding to develop a regional non-ambient water-quality monitoring database. After working with BIG stakeholders and Clean Rivers Program partners, H-GAC drafted a template for a QAPP. H-GAC has submitted the draft to TCEQ for review and is awaiting comments. The QAPP will be able to accommodate non-ambient monitoring, monitoring during stormwater events and measuring the effectiveness of implementation activities or policies such as low impact development. Once a QAPP has been approved, H-GAC will seek funding and partners to conduct non-ambient water quality monitoring under the QAPP.

Create and maintain a regional implementation activity database

H-GAC began collecting information about which implementation activities have been undertaken. For example, H-GAC requested and received NOIs and Annual Reports for each of the MS4 operators in the BIG project area. The information contained in the reports will be compiled, along with information about other activities, in order to inform the development of the annual report and to help guide the BIG as it deliberates possible changes to the I-Plan. A database is being developed to organize and share the information, and link activities to any available non-ambient water quality monitoring data.

Assess Monitoring Results and Modify I-Plan

The BIG recommends that it assess progress towards meeting the goals of the I-Plan. H-GAC has compiled information in this annual report, with input from the workgroups, that is intended to facilitate the BIG's assessment of progress.

[More information here about results of discussions at the annual meeting regarding changes to the I-Plan and progress.]

Expand the geographic scope of the I-Plan as appropriate

H-GAC's contract with TCEQ includes stakeholder involvement for the development of TMDLs for waterways that were added to the list of impaired waterways. Most of the newly listed waterways are tributaries within existing watersheds and the I-Plan already applies to them.

- Clear Creek watershed: Assessment Units 1101A_01, 1101C_01, 1101E_01, and 1102G_01
- Houston Metro and Buffalo/Whiteoak watersheds: Assessment Units 1007T_01, 1007U_01, 1007S_01, 1007V_01, 1017C_01 and 1007A_01

- Lake Houston watershed: Assessment Units 1008B_01, 1008B_02, 1008C_01, 1008C_02, 1008E_01, and 1011_01

TCEQ will be developing additional TMDLs for assessment units within the Lake Houston watershed but outside of the current BIG project area:

- Lake Houston watershed (outside current BIG project area): Assessment Units 1002_06, 1003_01, 1003_02, 1003_03, 1004_01, 1004_02, and 1004D_01

Once TMDLs for the assessment units have been adopted by the TCEQ, stakeholders from these watersheds may petition the BIG to incorporate the watersheds into the I-Plan. The BIG shall consider such requests at its annual meeting. In the next year, stakeholders within the watersheds will be approached to determine whether they intend to participate in the BIG I-Plan.

Neither the Cedar Bayou Watershed Protection Plan stakeholder group nor the Upper Oyster Creek TMDL I-Plan stakeholder group have chosen to ‘sign on’ to the I-Plan, largely because they address more than bacteria impairments. The Oyster Creek Plan, which is further along than Cedar Bayou, has chosen to include many of the activities in the plan and to indicate support and collaboration rather than formally adopting the BIG I-Plan.

Implementation Strategy 10.0: Research

Main Summary

A lack of meaningful data was a recurring discussion theme during the BIG planning process. As a result, the BIG explicitly identified research and support for research as key strategies to pursue. Research topics focus on the effectiveness of stormwater implementation activities, bacteria persistence and regrowth, and appropriate indicators to denote health risk presented by contact recreation.

Some research on these topics is being done locally and is described below, along with descriptions of national efforts and selected research publications. Abstracts for the research articles are available on the BIG's research workgroup page.

Local participation will be key to making sure that national research efforts apply to the BIG project area and that BIG priorities are addressed. In particular, the Research Work Group encourages individual stakeholders to participate in the EPA's recreational criteria process, which is examining appropriate indicators to denote health risk.

Evaluate the Effectiveness of Stormwater Implementation Activities

In December 2010, the National Stormwater BMP Database published the "Pollutant Category Summary: Fecal Indicator Bacteria," which examines and summarizes findings included within the database. The document is available on-line at: http://www.bmpdatabase.org/Docs/BMP%20Database%20Bacteria%20Paper%20Dec%202010.pdf. In general, conclusions indicate that more data and analysis are needed. Based on current data, the category of BMP most likely to be effective is retention (wet) ponds. Source controls and volume reduction may also be effective at reducing bacteria loads.

University of Houston – Clear Lake has recently installed a wetland on campus designed to treat stormwater from the 19-acre campus. UH-CL is sampling bacteria levels of the water going into and coming out of the wetland to see if the wetland effectively reduces bacteria levels. Water from Horsepen Bayou is pumped into the system during dry weather to maintain the wetland. The introduction of bayou water to the wetland may provide an opportunity to determine whether 'offline' treatment might be able to reduce in-stream bacteria levels.

The City of League City recently received a Nonpoint Source Program grant to examine stormwater BMPs in a park setting. Practices to be installed in the park may include: swales, rain gardens, pervious pavement, rainwater harvesting, and vegetated buffers. The features will serve as examples for the public and will be monitored for effectiveness. Ultimately, the results will be used to evaluate and develop stormwater ordinances and to encourage retrofits of commercial, residential, and public properties.

The City of Houston is implementing an erosion control project in Memorial Park and is hopeful that minimizing soil erosion might reduce bacteria loading. The City is sampling both water and sediment to see if there are changes in bacteria levels that correlate to the project.

Geosyntech has received a grant from the Water Environment Research Foundation to examine 'advanced' green infrastructure that responds to real-time data. For example, they are installing equipment on rainwater harvesting facilities that can query local rainfall predictions to determine release rates from the facilities and thus maximize the effectiveness of harvesting.

Further evaluate bacteria persistence and regrowth

E. coli has been considered a reliable indicator of fecal pollution because it was believed to live primarily within the gastrointestinal tract of warm-blooded organisms (commensal) and could not survive for an extended period outside this environment. Recent evidence suggests that some strains have adapted to other environments. A team of researchers affiliated with several institutions has sequenced the genomes of nine strains of *E. coli* that have adapted to the environment and cannot be distinguished from commensal *E. coli* by standard culture-based methods such as Colilert®. Knowledge of the genomes of these environmental strains will allow development of molecular assays to quantify commensal and environmental strains and to more accurately assess the extent of fecal pollution in aquatic systems. (http://www.sciencedaily.com/releases/2011/04/110411152527.htm)

H-GAC is developing is seeking funding to investigate naturalized populations of *E. coli* in local waterways. If funded, H-GAC would work with a team at the Georgia Institute of Technology headed by Dr. Konstantin Konstantinidis. Along with other researchers, he has sequenced the genomes of many naturalized strains of *E. coli* and is developing a molecular assay to quantify the relative contributions of environmental and fecal sources. (See Selected Research Articles for further information.)

A significant proportion of bacterial loading in our waterways comes from a variety of nonpoint sources. Knowledge of the relative contributions of various sources to the total load can increase the effectiveness of TMDL and Watershed Protection Plans. The Texas Water Resource Institute/Texas A&M Institute of Renewable Natural Resources sponsored a conference in Feburary 2012 on bacterial source tracking (BST) to acquaint the environmental and regulatory community with new technologies, current research strategies, and significant findings. Most presenters were cautiously optimistic about the potential of BST, noting some successes and many contradictory and counterintuitive results. Orin Shanks of the EPA Office of Research and Development stated that most of the PCR methods are not ready for broad application, although the cost of PCR analysis is falling rapidly. At present, regulatory acceptance of BST methods is limited. The conference drew participants from throughout the United States, including many from organizations in the BIG area (City of Houston, TCEQ Region 12, AECOM, H-GAC). Presentations can be viewed or downloaded at http://texasbst.tamu.edu/2012-conference/.

Selected Publications:

- Konstantinidis et al. 2011. "Genome sequencing of environmental Escherichia coli expands understanding of the ecology and sequencing of the model bacteria species." Proceedings of the National Academy of Sciences. www.pnas.org/cig/doi/10.1073/pnas.1015622108
- Satoshi Ishii,1 Winfried B. Ksoll,3 Randall E. Hicks,3 and Michael J. Sadowsky. 2006. Presence and Growth of Naturalized Escherichia coli in Temperate Soils from Lake Superior Watersheds. Applied and Environmental Microbiology 72(1): 612-621
- Beth L. Mote,a Jeffrey W. Turner,a,b* and Erin K. Lippa. 2012.Persisitence and Growth of the Fecal Indicator Bacteria Enterococci in Detritus and Natural Estuarine Plankton Communities. Applied and Environmental Microbiology 78(8):2569-2577
- [Placeholder: Brinkmeyer research]

Determine appropriate indicators

EPA has recently published draft information pertaining to recreational water quality standards (http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/upload/recreation_document_draft.pdf) for the purpose of soliciting scientific views. Highlights include discussions of new analytical techniques involving quantitative polymerase chain reactions, new statistical terminology, predictive modeling, sanitary surveys, epidemiological studies, and the development of quantitative microbial risk assessment (QMRA). The research, the impetus for which was a settlement agreement and consent decree, is meant to inform an update to the recreational water quality criteria in late 2012. BIG stakeholders have participated in the process and submitted technical comments on the draft report.

Harris County and Harris County Flood Control District are undertaking an analysis of H-GAC's Clean Rivers Program water quality data to identify possible correlations between bacteria levels and other water quality parameters such as total suspended solids or nutrients. A final report is expected this year.

H-GAC's Clean Rivers Program will be collecting enterococci samples to supplement *E. coli* samples in freshwater. Once sufficient samples have been created, the data will be analyzed to determine correlations between the data.

Harris County Flood Control District, in cooperation with H-GAC and the City of Houston Public Works Department, are conducting sampling to better describe diurnal patterns in bacteria levels.

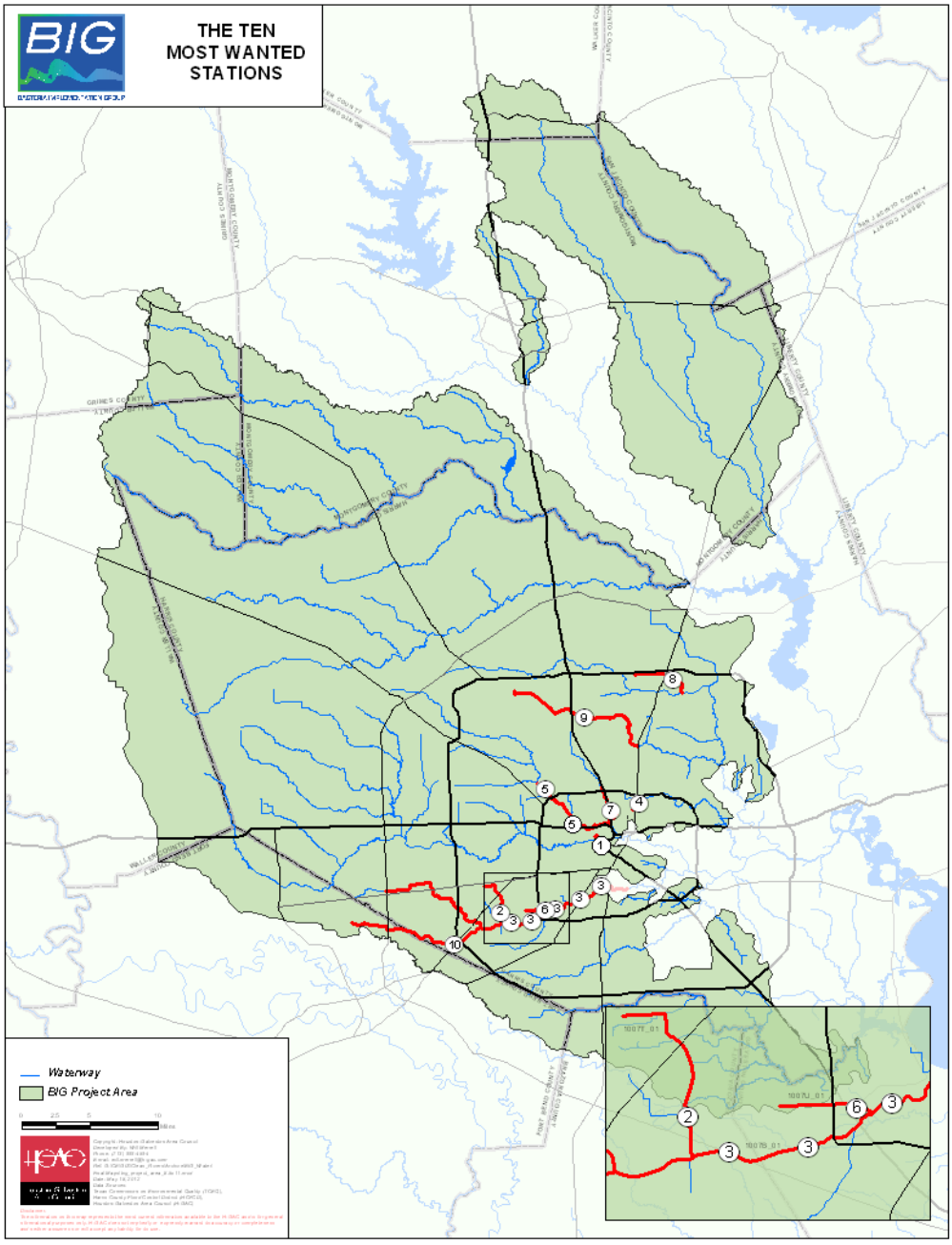
Selected Publications:

- Toothman , Byron R. , Lawrence B. Cahoon , Michael A. Mallin. 2009. Phosphorus and carbohydrate limitation of fecal coliform and fecal enterococcus within tidal creek sedimentsHydrobiologia 636:401-412.

- Surbeck,C.Q., S.C. Jiang, S.B. Grant. 2010. Ecological Control of Fecal Indicator Bacteria in an Urban Stream. Environmental Science and Technology 44:631-637.
- Zhang et al. 2012. Development of predictive models for determining enterococci levels at Gulf Coast beaches. Water Research 46 (2012): 465-474
- Maraccini et al. 2012. Diurnal Variation in Enterococcus Species Composition in Polluted Ocean Water and a Potential Role for the Enterococcal Carotenoid in Protection against Photoinactivation. Applied and Environmental Microbiology 78(2): 305-310
- Rogers, et al. 2011. Decay of Bacterial Pathogens, Fecal Indicators, and Real-Time Quantitative PCR Genetic Markers in Manure-Amended Soils. Applied and Environmental Microbiology 77(17):4839-4848
- Flood et al. 2011. Lack of correlation between enterococcal counts and the presence of human specific fecal markers in Mississippi creek and coastal waters. Water Research 45(2):872-878
- Sauer, et al. 2011. Detection of the human specific Bacteroides genetic marker provides evidence of widespread sewage contamination of stormwater in the urban environment. Water Research 45(2011):4081-4091.
- Noble, et al. 2010. Comparison of Rapid Quantitative PCR-Based and Conventional Culture-Based Methods for Enumeration of Enterococcus spp. and Escherichia coli in Recreational Waters. Applied and Environmental Microbiology 76(22):7437-7443

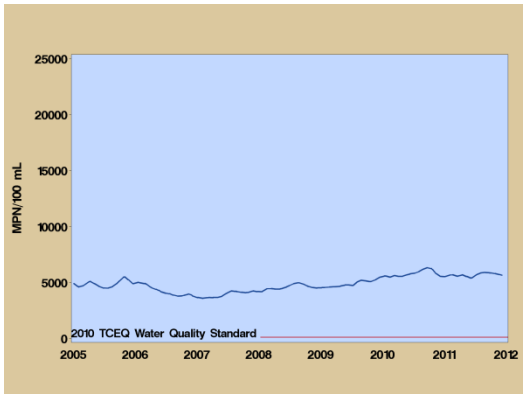
Most Wanted & Most Likely Succeed

Most Wanted: The ten Assessment units with the stations with the highest geometric means for bacteria relative to the state standard



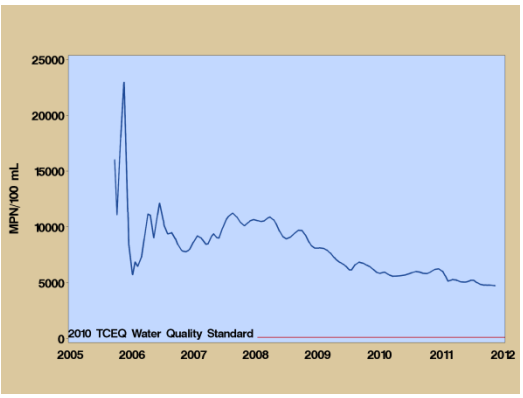
1) Assessment Unit 1013C_01: Glennwood Cemetery (5807)

- Station 16675.
- Geomean for 65 *E. coli* samples: 5807.
- Geomean relative to standard: 46 times the standard.
- Description: An unnamed tributary of Buffalo Bayou at Glennwood Cemetery, not far from the intersection of Lubbock and Sawyer Streets just upstream of downtown Houston. Adjacent to the Houston Police Officers Memorial and Eleanor Tinsley Park. This assessment unit is the most upstream assessment unit for this waterbody. The area is undergoing construction currently to upgrade the biking and running trails along the Bayou.
- KM 493K.
- First listed in 2002.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/16675s.jpg



2) Assessment Unit: 1007T_01: Bintliff Ditch

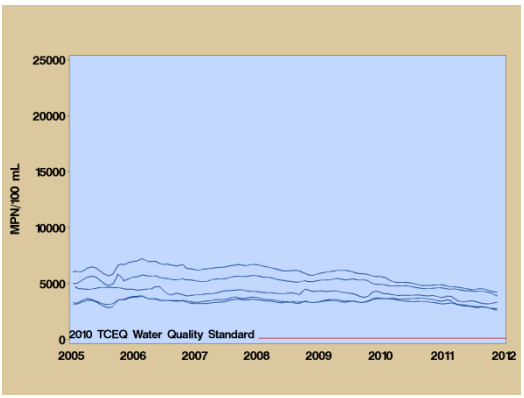
- Station 18690.
- Geomean for 55 *E. coli* samples: 5107.
- Geomean relative to standard: 41 times the standard.
- Description: A tributary of Brays Bayou near the intersection of Bissonet at Fondren in southwest Houston. This assessment unit is the most upstream assessment unit for this waterbody. May be showing improvement.
- KM 530Q.
- First listed in 2010.



3) Assessment Unit 1007B_01: Brays Bayou

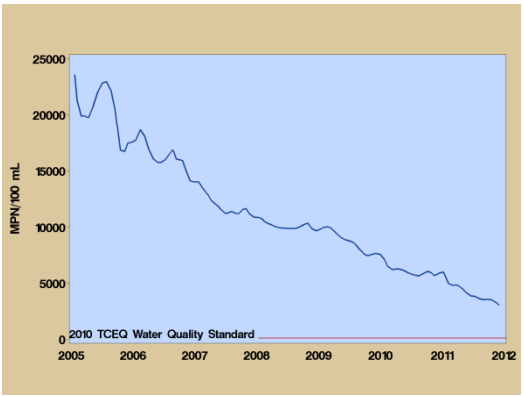
- Five monitoring stations, from the Meyerland area outside the 610 Loop east to Hermann Park: 15854, 15853, 11138, 15859, 15855.
- First listed in 2002.
- Station 15854:
  - Geomean for 66 *E. coli* samples: 4410.
  - Geomean relative to standard: 35 times the standard.
  - Description: Brays Bayou at South Rice Ave.
  - KM 531U.
  - May be showing improvement.
- Station 15853:
  - Geomean for 65 *E. coli* samples: 4218.
  - Geomean relative to standard: 33 times the standard.
  - Description: Brays Bayou at Hillcroft.
  - KM 531S.
  - May be showing improvement.
- Station 15859:
  - Geomean for 66 *E. coli* samples: 2964.
  - Geomean relative to standard: 24 times the standard.
  - Description: Brays Bayou at Greenbriar.
  - KM 532M.
- Station 15855:
  - Geomean for 66 samples: 2931.
  - Description: Brays Bayou at Stella Link Road.
  - Geomean relative to standard: 23 times the standard.
  - KM 532N.
- Station 11138:
  - Geomean for 65 *E. coli* samples: 3510.
  - Geomean relative to standard: 28 times the standard.
  - Description: Brays Bayou at Almeda Road.
  - KM 533F.

- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/15854s.jpg



4) Assessment Unit 1007R_01: Schramm Gully

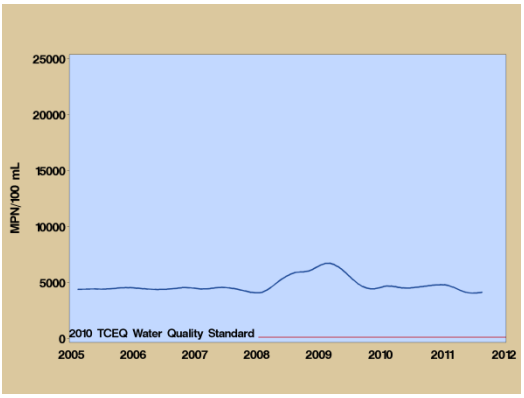
- Station 15869
- Geomean for 66 *E. coli* samples: 4397
- Geomean relative to standard: 35 times the standard.
- Description: Tributary of Hunting Bayou at Cavalcade St. in northeast Houston.
- KM 454X.
- First listed in 2002.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/15869s.jpg



5) Assessment Unit 1017_04: White Oak Bayou

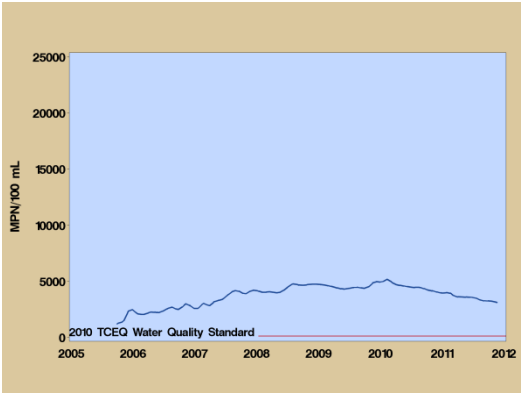
- Two monitoring stations, one downstream of Heights Blvd, the other at West TC Jester, both northwest of downtown Houston: 11387, 16637.
- First listed in 1996.
- Station 11387:

  - Geomean for 26 *E. coli* samples: 4130.
  - Geomean relative to standard: 33 times the standard.
  - Description: Whiteoak Bayou at Heights Blvd.
  - KM 493E.
- Station 16637:
  - Geomean for 27 *E. coli* samples: 3637.
  - Geomean relative to standard: 33 times the standard.
  - Description: Whiteoak Bayou at Heights Blvd.
  - KM 493E.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/11387s.jpg



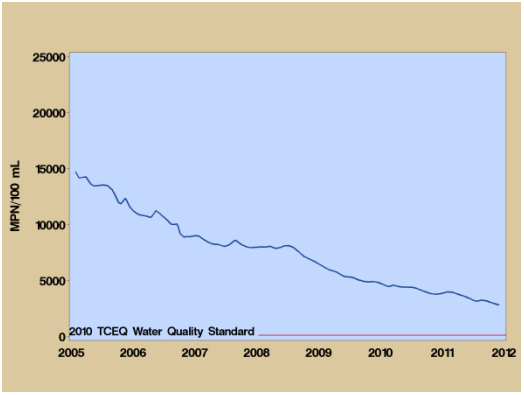
6) Assessment Unit 1007U_01: Mimosa Ditch

- Station 18691.
- Geomean for 56 *E. coli* samples: 3613.
- Geomean relative to standard: 29 times the standard.
- Description: Tributary of Brays Bayou at Newcastle Drive near the south boundary of Bellaire.
- KM 531R.
- First listed in 2010.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/18691s.jpg



7) Assessment Unit 1013A_01: Little White Oak Bayou

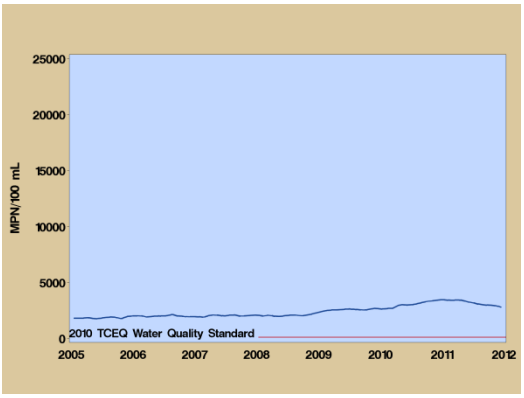
- Station 11148.
- Geomean for 66 *E. coli* samples: 3478.
- Geomean relative to standard: 28 times the standard.
- Description: Little White Oak Bayou at Trimble Street/North Edge of Hollywood Cemetery north of downtown Houston.
- KM 453Y.
- First listed in 2002.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/11148s.jpg



8) Assessment Unit 1016D_01: Unnamed Tributary of Greens Bayou

- Station 16676.
- Geomean for 66 *E. coli* samples: 3336.

- Geomean relative to standard: 26 times the standard.
- Description: Unnamed Tributary of Greens Bayou at Smith Rd in Northeast Houston.
- KM 375X.
- First listed in 2002.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/16676s.jpg



9) Assessment Unit 1006D_02: Halls Bayou at Airline

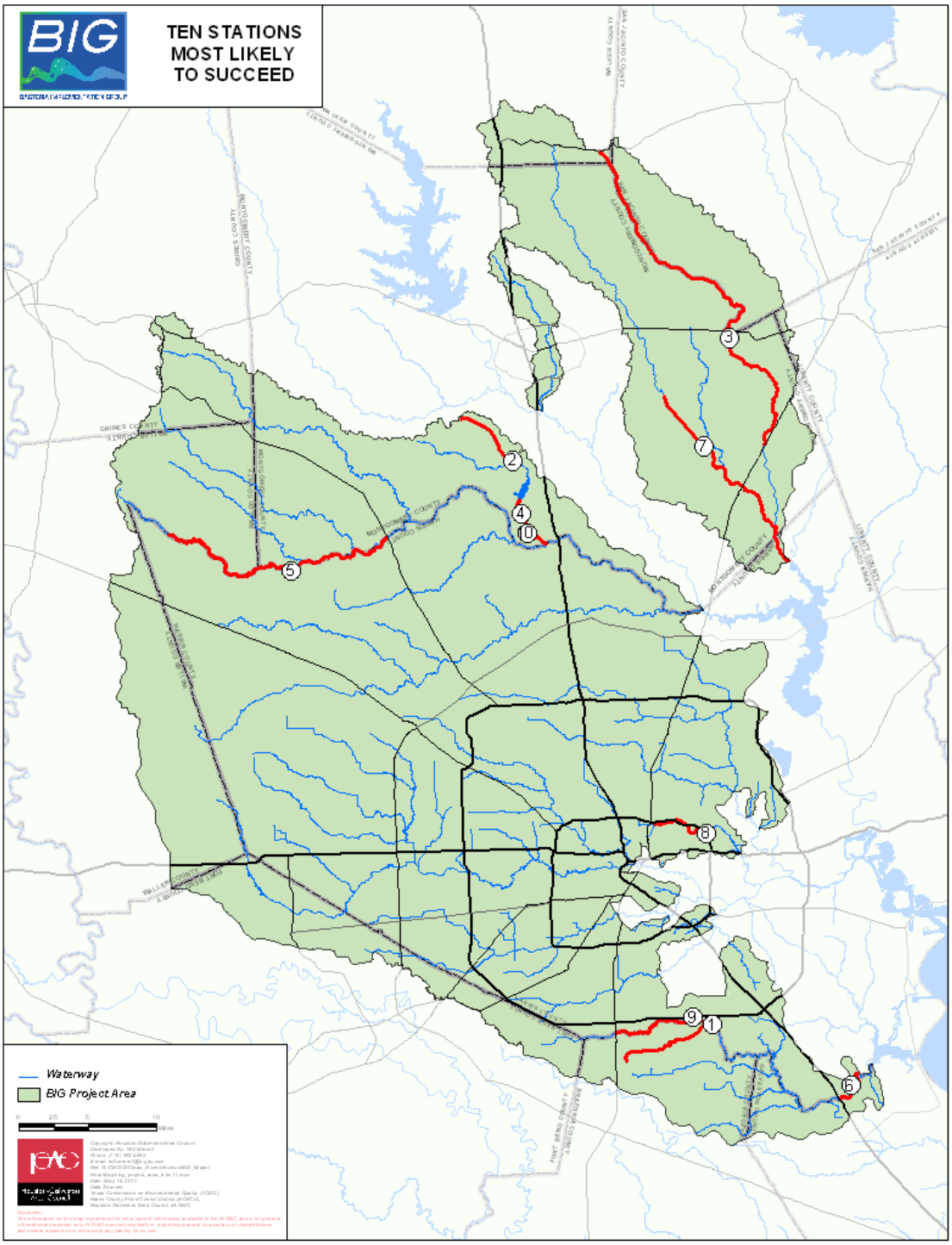
- Station 17490.
- Geomean for 66 *E. coli* samples: 2416.
- Geomean relative to standard: 19 times the standard.
- Description: Halls Bayou at Airline Road in North Houston.
- KM 375X.
- First listed in 2002.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/17490s.jpg

10) Assessment 1007C_01: Keegans Bayou

- Station 11169.
- Geomean for 65 *E. coli* samples: 2178.

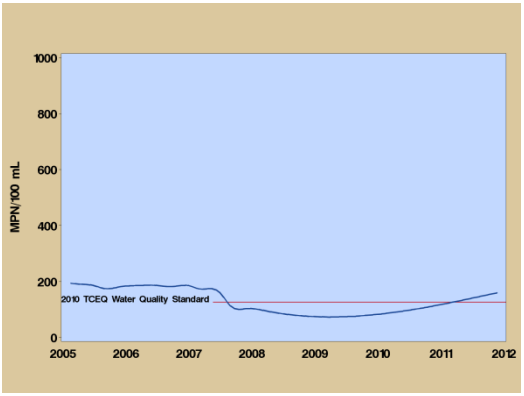
- Geomean relative to standard: 17 times the standard.
- Description: Keegans Bayou at Roark Road near US 59 just southwest of Houston City Limits
- KM 469C.
- First listed in 2002.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/11169s.jpg

Most Likely to Succeed: The ten assessment units with the stations with the lowest geometric means, relative to the state standard for bacteria, that exceed the state standard



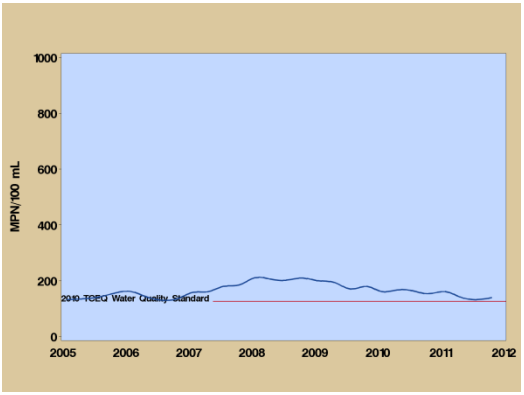
1) Assessment Unit 1102C_01: Hickory Slough

- Station 17068.
- Geomean for 20 *E. coli* samples: Geometric Mean: 127.
- Geomean relative to standard: 1.01 times the standard.
- Description: Hickory Slough, a tributary of Clear Creek above tidal at Robinson Drive in Pearland.
- KM 615B.
- First listed in 2008.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/17068s.jpg



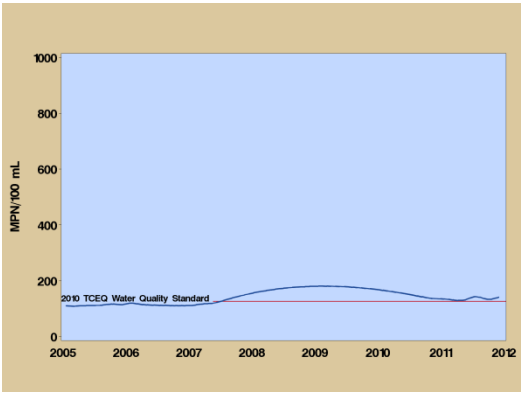
2) Assessment Unit 1008B_01: Upper Panther Branch

- Station 16629.
- Geomean for 27 *E. coli* samples: Geometric Mean: 138.
- Geomean relative to standard: 1.1 times the standard.
- Description: Upper Panther Branch at Research Forest Dr. in the Spring Creek watershed.
- KM 217T.
- First listed in 2010.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/16629s.jpg



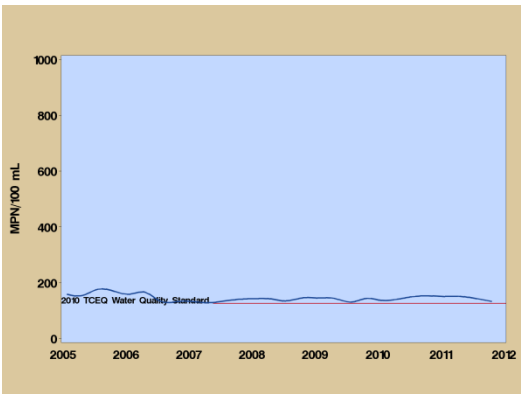
3) Assessment Unit 1011_01: Peach Creek

- Station 16625.
- Geomean for 24 *E. coli* samples: Geometric Mean: 133.
- Geomean relative to standard: 1.1 times the standard.
- Description: Peach Creek at Old HWY 105.
- KM 192C.
- First listed in 2010.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/16625s.jpg



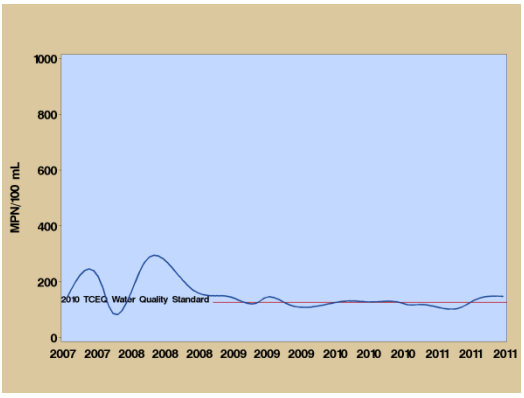
4) Assessment Unit 1008C_02: Lower Panther Branch

- Station 16627:
- Geomean for 27 *E. coli* samples: 147.
- Geomean relative to standard: 1.2 times the standard.
- Description: Lower Panther Branch at Sawdust Road in the Spring Creek Watershed.
- KM 251U.
- First listed in 2010
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/16627s.jpg



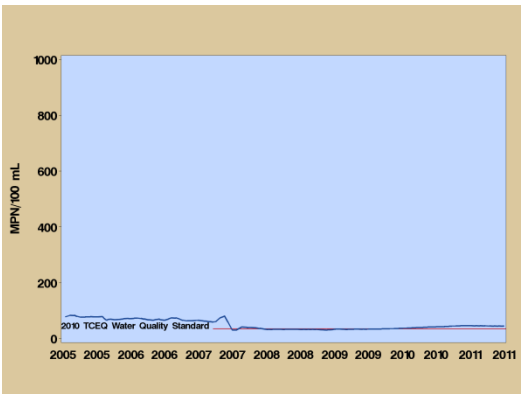
5) Assessment Unit 1008_04: Spring Creek at Roberts Cemetery Road West in Spring Creek Watershed

- Station: 18868
- Geomean for 18 *E. coli* samples: Geometric Mean: 148.
- Geomean relative to standard: 1.2 times the standard.
- Description: Peach Creek at Old HWY 105.
- KM 285M.
- First listed in 2010.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/No_Image_Available.jpg



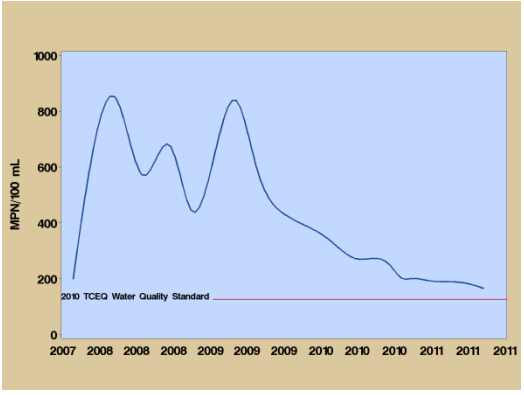
6) Segment ID 1101_03 Clear Creek Tidal at SH 3

- Station 11446
- Geomean for 57 Enterrococci samples: Geometric Mean: 44.
- Geomean relative to standard: 1.2 times the standard.
- Description: Clear Creek Tidal at SH3 near Webster.
- KM 658D.
- First listed in 2010.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/11446s.jpg



7) Segment ID: 1010_03 Caney Creek at Firetower Road, Caney Creek Watershed

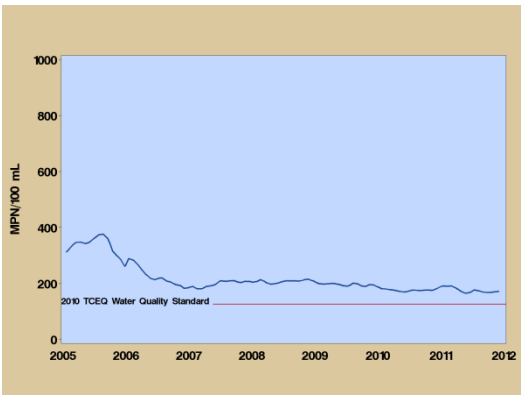
- Station 20452.
- Geomean for 16 *E. coli* samples: Geometric Mean: 167.
- Geomean relative to standard: 1.3 times the standard.
- Description: Caney Creek at Firetower Road, Caney Creek.
- KM 221V.
- First listed in 2010.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/20452s.jpg



8) Segment 1007R_03 Hunting Bayou at North Loop East, in Houston Ship Channel/Buffalo Bayou Tidal

- Station 11129.
- Geomean for 66 *E. coli* samples: Geometric Mean: 170.
- Geomean relative to standard: 1.4 times the standard.
- Description: Hunting Bayou at North Loop East.
- KM 455Y.
- First listed in 2010.

- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/11129s.jpg



9) Segment ID 1102_02 Clear Creek at Telephone Road, Clear Creek Watershed

- Station 11452.
- Geomean for 44 *E. coli* samples: Geometric Mean: 182.
- Geomean relative to standard: 1.4 times the standard.
- Description: Clear Creek at Telephone Road.
- KM 575W.
- First listed in 2010.
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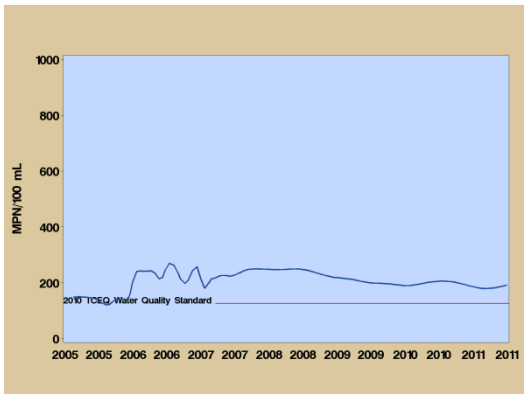
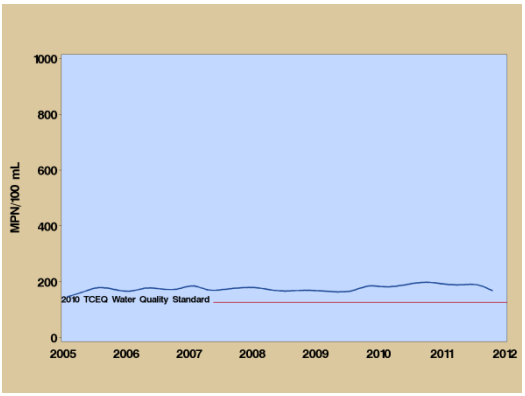


Folder of station photos: \\ntfs05\media\CommunityEnvironmental\Photos\Program Areas\Water Resources\Regional Monitoring\Monitoring Photos by Organization\Misc Stations

10) Segment ID 1008C_01: Lower Panther Branch at Sawdust

- Station 16628.

- Geomean for 27 *E. coli* samples: Geometric Mean: 185.
- Geomean relative to standard: 1.5 times the standard.
- Description: Garners Bayou at Old Humble Road.
- KM 251U.
- First listed in 2010.
- Photo: http://arcgis02.h-gac.com/Reference/WRIM/StationPics/16628s.jpg



Appendices

- References
- Table of Acronyms

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[i] http://www.tceq.texas.gov/assets/public/compliance/enforcement/enf_reports/AER/FY11/enfrptfy11.pdf

[ii] http://www.epa-echo.gov/echo/dashboard/data_dictionary_dashboard.html#alleaSNC and http://www.epa.gov/compliance/resources/reports/srf/srf-rd1-rev-tx.pdf (where it says that based on data it looks like TX is doing well but data entry is problematice) and http://www.epa-echo.gov/echo/state_framework.html and finally http://www.epa.gov/compliance/state/srf/index.html

[iii] http://www.epa-echo.gov/echo/dashboard/charts_all.php?state=TX