

## Implementation Strategy 10: Research

Bacterial contamination of waterways is a pressing concern for our region, as reflected in the TMDL studies this Plan addresses. The studies provide a general portrayal of the extent and character of bacterial contamination in the BIG area. Alone, however, they are not a sufficient basis for determining the most cost-effective courses of action to achieve contact recreation standards in currently impaired water bodies. This will undoubtedly be a dynamic process where we continually expand our knowledge of the sources and effects of bacteria in the waterways and where various management approaches are tested and refined. This section identifies potential research topics that will be critical to this undertaking.

Recognizing that many of these topics would be area-specific, the BIG was asked to prioritize those which would have the greatest impact on management actions across the planning area. The three topics that emerged comprise the management recommendations of this section. These topics are pertinent to the entire BIG area, are intended to be implemented as resources are available, and may be superseded as necessary for research needs specific to individual stakeholders. Research would be conducted using appropriate methodology and quality assurance that have been developed in consultation with TCEQ and EPA.

### Potential Research Topics

The I-Plan's stakeholders identified three priority research topics which address the following:

- Effectiveness of storm water activities
- Bacteria persistence and regrowth
- Appropriate indicators

Additional research topics were identified and, although important, they were not identified as top research priorities. Many of these topics are related to the three research priorities. As funding is available, these additional research topics should be considered.

A variety of funding sources should be pursued, with a variety of partners. It is unlikely that any one local entity will find it feasible to conduct this research. Given the large-scale character of the undertakings, entities should look to coordinate efforts with the various academic institutions of the greater Houston area, federal and state agencies like the EPA, CDC and Department of Health, water and environmental research groups like WERF and WEAT, and similar potential partners. A shared project, the result of an inter-local agreement or similar instrument, may allow local entities to feasibly investigate these issues. However, the more practical avenue is likely to be the BIG group as a whole advocating for a national or state-level entity to address these questions.

### Research Priority 10.1:

#### Evaluate the Effectiveness of Storm Water Implementation Activities

Additional monitoring of current and future stormwater projects in the planning area will help provide an area-specific set of data on the relative effectiveness of different management

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practices. This effort would draw from current and proposed activities undertaken by Phase I MS4 permitted entities. The effectiveness studies would include both structural measures (based on both traditional drainage engineering and sustainable infrastructure design methodologies, such as Green Infrastructure, Low Impact Development, and smart growth) and behavioral measures, such as public outreach, public reporting of illicit discharges, and efforts aimed at changing behaviors. The data collected and the results from the comparative evaluations should be made available to all stakeholders through the monitoring databases described in *Section 10: Monitoring and Plan Revision*.

## Research Priority 10.2:

### Further Evaluate Bacteria Persistence and Regrowth

To better understand the extent of human contributions to bacterial loading in waterways, the underlying base layer of background or endemic bacteria should be studied in greater detail. Previous studies of water bodies in the region, including evaluations of Buffalo and White Oak Bayous in Harris County (Brinkmeyer 2008<sup>1</sup>, and NSF 2007<sup>2</sup>), indicated that naturally occurring bacteria are prevalent and persistent in the slow-moving waterways of our region. While these naturally occurring bacteria are certainly supplemented with bacteria from human activities and other sources, the relationship and relative percentages of each should be studied in greater detail. Additionally, the character and cycle of bacteria in the waterway pertaining to regrowth potential requires further evaluation. More realistic and comprehensive simulations are required to more fully grasp the nature of bacterial behavior in the waterways. Implementing agencies that choose to conduct these studies for specific projects will make their data available for the rest of the stakeholders through the monitoring databases or through the H-GAC as a facilitator. The results could be used to provide more precise predictions of bacterial loading, by following the impact of loading over time within the waterway.

## Research Priority 10.3:

### Determine Appropriate Indicators

An indicator species is an organism whose presence is highly correlated to the presence of another organism (or group of organisms). *E. coli* or Enterococcus are used as indicator bacteria based on their pervasiveness and correlation between their presence and the presence of a wide range of potential microbial pathogens. However, that general correlation may not be precise enough to justify their exclusive use in monitoring for this I-Plan. While these indicators are generally accepted nationwide, they may not reflect the unique balance of microbial pathogens and water quality characteristics of our semi-tropical urban bayous and local water bodies. Many studies, including the data used to formulate the 1986 EPA guidance on bacteria limits for recreational waters, were conducted in areas and water bodies greatly different from the BIG area. The potential need for alternate, supplemental, or multiple

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<sup>1</sup> Dr. Robin Brinkmeyer, et. al. November 11, 2008, *Population Dynamics of Escherichia coli and Enterococcus spp. in Buffalo Bayou and White Oak Bayou*  
[http://www.hgac.com/community/water/resources/documents/tmdl\\_population\\_dynamics\\_of\\_ec\\_and\\_es.pdf](http://www.hgac.com/community/water/resources/documents/tmdl_population_dynamics_of_ec_and_es.pdf)

<sup>2</sup> NSF International Engineering & Research Services, January 17, 2007, *Regrowth Potential of Water Pathogens in Sediment and Sewage Treatment Plant Effluent and Affinity of Water Pathogens to Attach to Soil Fractions*  
<http://pno.hcpid.org/research/research.htm>

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indicators should be determined to refine the Plan's monitoring approach and further assist stakeholders in identifying sources.

The EPA is currently studying the question of appropriate indicators. The results of their inquiry, due in October of 2012, should be incorporated into future revisions of the I-Plan. Additional consideration of the best indicator(s) for our area could help supplement their findings by providing a more specific understanding of local correlations between indicators and pathogens. Stakeholders are encouraged to participate in EPA's discussion of indicators and to encourage EPA to consider environments similar to those in the Houston region.

## Research Priority 10.4:

### Additional Research Topics

A variety of additional research topics were identified by stakeholders. The following list gives a brief description of broad groups of research topics and some possible research questions. Research addressing these topics should be conducted as resources are available.

- *Wastewater Treatment Facilities (WWTFs)*: Studies should examine the correlation between bacteria levels in effluent and in-stream bacteria levels. Have in-stream bacteria levels changed as a result of TCEQ's new rules that limit bacteria levels in effluent? Research may also be conducted to identify how other constituents in wastewater effluent may influence in-stream bacteria levels. How are in-stream bacteria levels influenced by sludge discharges, nutrients, and stormwater discharges from WWTFs?
- *Health Risks*: The studies should include cumulative review of epidemiological studies, collection of new epidemiological data, and/or microbial risk assessment efforts aimed at determining human health risks from recreational activities in, on, or near bayous in the BIG region. What is the relationship between the levels of pathogens and indicators in different watersheds?
- *Recreational use*: Generally, eight or more illnesses above the background level are considered problematic. Does the rate of illness from contact recreation in impaired waterways in the project area exceed this threshold? What is the level of recreation on the waterways?
- *Land use*: Research could analyze the correlations between land use, turbidity, and in-stream bacteria levels. Some land use types may lead to increased turbidity, and may be associated with increased bacteria levels. Historical land use prior to development may also influence in-stream bacteria levels. Is there a correlation between impervious surfaces and in-stream bacteria levels?
- *Modeling*: The document, "Bacteria Total Maximum Daily Load Task Force Final Report," edited by Kathy Wythe of the Texas Water Resources Institute (TWRI)<sup>3</sup>, contains summary information about the selection and application of various water quality models for use in Texas. However, many questions were raised by the authors regarding how well the models work, how they can be improved to be more accurate, and how well they function as predictive models. Research could be done to provide answers to the questions raised in the

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<sup>3</sup> <http://twri.tamu.edu/reports/2009/tr341.pdf>

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report. One particular input for which further information could be done is to improve the flow data available for classified stream sections.

- *Unimpaired waterways:* A minority of sampled waterways in the project area are *not* considered impaired for bacteria. Why do these assessment units have relatively low bacteria levels? How could this information be applied to lower bacteria levels in impaired waterways?