Appendix 5: Comments from Expert Advisory Group

The Bacteria TMDL Task Force solicited feedback from the Expert Advisory Group on the contents of the Task Force Report Drafts One and Two. Those drafts, as well as the Expert Advisory Group's comments and recommendations have been posted on the Texas Water Resources Institute's Web site at http://twri.tamu.edu/bacteriatmdl

Most comments and recommendations have also been collected in Appendix 5 of Draft Three of the Task Force Report.

Comments from TCEQ and TSSWCB staff were submitted as Track Changes within Drafts One and Two of the Task Force Report. They can be viewed on the Web site.

Texas Parks and Wildlife Department's Role in the Bacterial TMDL Process

October 20, 2006

Texas Parks and Wildlife Department ("the Department") is the state agency with primary responsibility for protecting the state's fish and wildlife resources (Parks and Wildlife Code §12.0011(a)). Further, the Department is tasked with providing information on fish and wildlife resources to entities that make decisions affecting those resources (Parks and Wildlife Code §12.0011(b)(3)).

Texas Parks and Wildlife Department has purview over the wild animals, wild birds, and aquatic animal life of the state (Parks and Wildlife Code §61.005). The Department's authority extends, through the definition of "wildlife," to any wild mammal, animal, wild bird, or any part, product, egg, or offspring, of any of these, dead or alive (Parks and Wildlife Code §68.001).

The Department's authority is limited to indigenous species through the definition of "wild." Exotic livestock is specifically excluded. "Wild," when used in reference to an animal, means a species, including each individual of a species that normally lives in a state of nature and is not ordinarily domesticated. This definition does not include exotic livestock defined by Section 161.001(a)(4), Agriculture Code (Parks and Wildlife Code §1.101). The Agriculture Code defines "exotic livestock" as grass-eating or plant-eating, single-hooved or cloven-hooved mammals that are not indigenous to this state and are known as ungulates, including animals from the swine, horse, tapir, rhinoceros, elephant, deer, and antelope families (Agriculture Code §161.001(a)(4)). Thus, certain species, such as feral swine, axis deer, and sika deer, do not fall within the scope of the Department's authority to protect or manage.

The Department recognizes that water is the basis for a significant recreational resource in Texas that includes boating, fishing, swimming, sailing, diving, bird watching and paddle sports (Texas Parks and Wildlife Department, Land and Water Conservation and

(TPWD's comments continued)

Recreation Plan, Recreation Priorities on Texas Waters, pg. 64). As such, the Department has established as one of its major goals to maintain or improve water quality and quantity to support the needs of fish, wildlife and recreation (Texas Parks and Wildlife Department, Land and Water Conservation and Recreation Plan, Goal 7, pg. 75). The Department recognizes that the Texas Commission on Environmental Quality ("the Commission") is the state agency with primary responsibility for protecting water quality (Water Code §26.011). The Department supports the Commission's efforts to improve and restore water quality through the Total Maximum Daily Load (TMDL) process. Within the scope of its authority, as outlined above, the Department is committed to assisting the Commission and the Texas State Soil and Water Conservation Board ("the Board") in their efforts to restore full use of water bodies for which the contact recreation use is impaired.

Specific Comments

1. "Begin with the end in mind." In order to assist in restoring impaired water bodies, it is important to develop data that are useful to the stakeholders who will ultimately implement the recommended best management practices. This may mean different things to different stakeholders.

2. One of the tools available to the Department is to assist private landowners in developing habitat management plans. These plans contain a comprehensive treatment of past and existing management and habitat conditions, existing wildlife species to be managed, list of landowner goals, and management recommendations that detail how to achieve those goals on a specific parcel. In order to develop such plans, there is a need to have species-specific information about contributions to bacterial loads. At present, the TMDL process does not provide the information the Department would need.

3. The approach currently taken in bacterial source tracking (BST) studies needs

(TPWD's comments continued)

refinement. Overall, the library needs to be extended to include more taxa with rigorously collected samples with adequate replication for each species.

a) Field sampling methods need to be improved. We understand that at least some samples have been collected from deposited fecal matter. This provides opportunity for contamination. The Department would recommend killing and gutting specimens to avoid the potential for contamination.

b) It is not clear that the BST library sampling is adequate from a statistical design perspective. We believe that the library lacks adequate replication. With the information available to us now about bacterial strains and promiscuity, we would recommend that ten or more samples be collected for each species, e.g. ten samples of great blue herons, ten samples of American egrets, etc.

c) In developing the library, it is important to have a sense of the species in each watershed that may be contributing the largest bacterial load to the water body. In general, one would expect these to be the species that spend time on or near the water. These are not necessarily the largest species in the watershed, nor would they necessarily be the species with the greatest biomass in the watershed.

City of Waco/Baylor University Comments

November 13th, 2006

Comment Contributors:

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General Comments on the Formation of the Bacterial TMDL Task Force Commissioned by TCEQ and the TSSWCB

1. The main task force membership does not fairly represent municipal stakeholders around the state in that it does not include a municipal representative from a city or cities that would typically be impacted by the future bacterial TMDL guidelines. These municipalities, water boards, and water authority groups will be financially responsible for implementing the TMDL assessments and implementations, yet are not represented on the task force. Representation for these entities in the Expert Advisor group to the Task Force is not sufficient in that comments from the Expert Advisor group are currently considered but not required to be included in the document. It is recommended that a municipal representative be added to the main Task Force.

2. The task force does unfairly represent professionals who have represented or worked for industries that have polluted Texas waterways in the past. The majority of scientists and advisors in the primary task force have been publicly involved in research or investigations paid for by representatives of private industries. For example, several of the task force representatives recently

completed a (BST) project financed by the Texas Farm Bureau. It is critical to the integrity of this process that the actual and perceived fairness and objectivity that there is input from a Task Force that fairly represents ALL of the major stakeholders. To foster this objectivity, it is recommended that input be solicited from other nationally recognized BST scientists in addition to the current task force members.

3. It is requested that all of the main task force members fully disclose and describe to the Expert Advisor Group and to the public any current or previous business, research, or consulting activities, or holdings or financial interests that might be related to this process so that any potential conflicts of interest may be identified.

General Comments on the First Draft of the Bacterial TMDL Task Force Report

1. Recommendations and decisions regarding what methods to recommend for use in developing bacterial TMDL guidelines should be made on the basis of objective scientific data, water quality reports, and economic data available from recent studies both within the state of Texas and around the nation. This does not necessarily mean that years of additional research are required before a method can be recommended. A number of studies have been published in scientific, peer-reviewed journals and reports from state or federal agencies that provide insight into the methods that are currently available. All possible modeling and BST methods that have been published in scientific journals or used in other states should be thoroughly considered for their potential application in Texas. In addition, the TMDL Task Force Report should be expanded to include input from other nationally known BST scientists that provides an objective overview of the benefits and limitations of these methods and references appropriate scientific data and federal reports.

(City of Waco/Baylor University Comments continued)

2. It is not sufficient to recommend a method simply because it has been used in Texas previously. In addition, it is also not sufficient to include a partial list of methods that have been used by a few scientists within the state. Currently, there are only a few dozen scientists that conduct BST research in the nation, and there are only a handful in the state of Texas. These Texas researchers include Drs. George Di Giovanni, Joanna Mott, Rene Massengale, and Suresh Pillai among a few others. Therefore, although evidence from current and previous Texas studies should be considered, this cannot be the sole basis for method recommendations.

3. In considering recent BST studies both from within the state of Texas and around the nation, it is also important to take into consideration the limitations of these studies, both scientific and financial.

Comments on the Bacterial Source Tracking Section of Draft #1

1. This is a good start to the draft BST section for the Task Force report. I compliment Drs. Di Giovanni and Mott for their initial review and assessment of the BST information available and their summary of the work that has been completed in Texas in the past.

2. The list of methods reviewed as potential TMDL BST methods is incomplete in that it does not include studies from BST scientists in the state or around the nation other than Drs. Di Giovanni and Mott. As stated in the earlier section, all major methods should be objectively reviewed for their potential benefits and limitations and applicability as a TMDL assessment method. The current list is incomplete. Other methods may also be appropriate for consideration including repPCR, routine ARA, and carbon-utilization profiling. A list of recent BST studies utilized in other watersheds can be provided upon request.

(City of Waco/Baylor University Comments continued)

3. A discussion of the general benefits and limitations of bacterial source tracking studies should be included in the document. This additional section should address library-based methods versus library-independent methods, library representativeness, library size, sample site selection, source category selection, and the statistical methods used to evaluate the library and analysis. This section should list scientific evidence that illustrates these benefits and limitations of the BST methods.

4. A general section describing BST should be included that explains the basic concepts of creating a known-source library, average rates of correct classification (ARCC) values, positive-predictive values (PPV), negative-predictive values (NPV), and other concepts and statistics. This will ensure that lay persons and non-technical reviewers and readers will be able to read and understand the content of the report. This is important if all stakeholders are to be provided with equal access to the TMDL development process and understanding of that process.

5. Ribotyping is a method that has shown good results in past BST studies; however, it does require technicians with more training despite its automation. Highly trained technicians are required for set-up, operation, troubleshooting and maintenance of the equipment. This method is significantly cost prohibitive and is the most costly method proposed in the document. The riboprinter is approximately $125,000-$150,000 and the reagent cost per assay is $40-65 depending on the quantities used. It is surprising that this method is promoted so strongly by the task force members over other much less expensive methods such as repPCR, PFGE, or ARA. Riboprinting may be feasible for larger water labs, but certainly not for small labs or municipalities with limited staffing and resources.

(City of Waco/Baylor University Comments continued)

6. RepPCR has been cited in the scientific literature several times as a cost-efficient, sensitive method of analyzing *E. coli* and Enterococci. It does require additional training of lab personnel but is actually less labor-intensive than ribotyping. In addition, repPCR produces 25-30 DNA bands in a DNA gel compared to the 10-15 bands produced by ribotyping, therefore increasing the sensitivity of repPCR over ribotyping. A separate method, ERIC-PCR, is listed in the document; however, it is listed as labor-intensive and its benefits are not adequately highlighted. This method has been used for genetic analysis of large numbers of isolates with reasonable discrimination; however, it is not clear as to the target DNA actually being amplified with this primer set in *E. coli*. It is recommended that the alternative repPCR of *E. coli* isolates using the BOX A1 primer set be added to the list of possible methods in the report based on recently published studies by Carson et al. 2003 (AEM 2003 69:1836) and on a project currently being completed by Dr. Massengale in the North Bosque watershed.

7. Several nationally published studies have estimated the minimum library size for known source samples. These studies should be listed and an appropriate minimum library size suggested. A list of these publications can be provided.

8. Targeted BST that focuses on collecting water samples in an area of known contamination or higher bacterial levels can improve BST sample design as recommended by Peter Hartel (J Environ Qual 2003). This should be added to the document.

9. Input from a modeling expert should be included regarding the minimum number of water sampling sites that should be included in assessment and a method for how to select the minimum number of water sampling sites. Inadequate sample site selection and numbers can limit the significance of TMDL assessments or any watershed study. We want to ensure that future TMDL assessments pinpoint sources of contamination as accurately as possible; thus, selection of a sufficient

number of sampling sites in appropriately selected locations will be necessary. It will also be necessary to include guidance in the Task Force Report regarding how to determine the number and location of these sites in a given watershed.

10. A discussion should be included pertaining to the selection of source categories for TMDL assessments. That discussion should review the types of animal categories to be included in a source library, how these categories should be selected, and how many samples should be isolated. Libraries consist of bacterial isolates from known source categories of fecal contamination. Previous research projects have included libraries that compared individual and combined animal categories with varying success. For example, a more detailed library may compare *cattle vs. human vs. wildlife vs. poultry vs. horse* while a more general library may compare *human vs. nonhuman*. Different goals for BST should be identified and then an appropriate plan developed for library category selection and creation. This point was also brought up in the public comments submitted by Texas Parks and Wildlife (Draft Appendix 5).

11. A recommendation to limit clonal isolates by appropriate sample collection and bacterial strain isolation. In addition, previous research has shown that selection of a few isolates (2-5 *E. coli*) from each fecal sample limits the probability of obtaining clonal isolates in the library. Clonal isolates artificially inflate the average rates of correct classification and representativeness measurements of a library and should not be included.

Parsons Comments

November 9, 2006

Comments on TX Bacteria TMDL Task Force Report (October 30, 2006 Draft)

Suggest the document be revised from a discussion report to an issue driven and recommendations oriented format. For example various issues identified in current TX TMDLs could be discussed.

The Task Force should consider developing Recommendations/Positions on key components of a TMDL required by USEPA which are: water quality target; Pollutant Source Identification; linkage between pollutant sources and receiving waters; WLA; LA; MOS; seasonal variability; and public comment.

Water Quality Target:

- Note in the document that the task force will **not** address water quality standards issues as directed by TCEQ. All Task Force recommendations will be based on the premise that the current Texas designated uses (Contact Recreation and Shellfish Harvesting) and corresponding numeric water quality criteria (*E. coli*, Enterococcus, fecal coliform) are valid.
- Task Force should consider and take a position on the concept that adopted TMDLs can be modified in the future if the water quality target is modified through the WQS triennial review process or a water body specific UAA is approved. The Task Force should recommend that TCEQ and TSSWCB establish policies and procedures for modifying WLAs and LAs in approved TMDLs. (see USEPA Memo dated August 2, 2006)

Pollutant Source Identification

- Task Force should agree on the complete list of possible bacteria sources that should be verified and discussed in a TMDL and recommend subcategories under point and nonpoint sources.

  For Example:
  Point sources – WWTP (major, minor), SSOs, CAFO facilities and lagoons, TPDES Phase I and Phase II Stormwater jurisdictions, wastewater collection systems? illicit discharges?
  Nonpoint sources – septic systems, sediment resuspension/bacteria regrowth, wildlife, exotic wildlife species, livestock, domestic pets, marinas, illicit discharges, compost sites, etc.

- It would be useful for the Task Force to also identify a list of data gaps corresponding to each of the point and nonpoint source subcategories and make recommendations on how to move forward with TMDL development despite these gaps and identify action items to address these gaps in the future. Stakeholders must understand that these data gaps create uncertainty which will

(Parsons Comments continued)

be costly to reduce and they must also understand that data gaps create the need for assumptions which ultimately serve as the basis for the required Margin of Safety.

- Task Force should make recommendations on Bacteria Source Tracking in this section since this type of data will greatly enhance the scientific basis and provide more specificity to the Pollutant Source Identification portion of the TMDL.

Linkages between pollutant sources and receiving waters
This corresponds strongly to the Bacteria Fate and Transport Models section of the Task Force's First Draft Report.

- The Task Force could consider developing a short list of criteria or a decision tree tool to assist stakeholders, TCEQ and TSSWCB in selecting when to use a dynamic model or a simplistic model approach.
- The TCEQ and TSSWCB need a deliverable from the Task Force that provides them with a set of recommendations that address specific stakeholder issues and concerns (to date and anticipated) with both complex and simplistic modeling approaches. This exercise should also consider issues associated with modeling to support TMDLs on tidal streams and shellfish waters not supporting designated uses. This section could be organized in the following manner.

Example
Dynamic Modeling Approach (HSPF Model, SWAT)
Stakeholder Issue #1: Stakeholders disagree with the fecal production rates used for livestock and the county-wide census data used as inputs for the model.
Technical Response, Rebuttal, and Recommendation:
Stipulate recommendations that directly address each issue – aim the recommendations at how to move forward with TMDL development despite uncertainty.
Future Action Items: Longer term action items aimed at reducing uncertainty that would typically happen outside of the TMDL process.

Other issues needing to be address that have been expressed **include but are not limited to**:

Stakeholder Issue #2: Stakeholders question the assumption that conventional treatment of wastewater results in the discharge of little to no bacteria loads in the effluent from minor and major WWTPs.

Stakeholder Issue #3: Models have difficulty estimating bacteria loads from sediment resuspension and regrowth.

Stakeholder Issue #4: Are the assumptions made about fecal loading from direct deposition sources (wildlife, pets with access to water) appropriate?

(Parsons Comments continued)

Stakeholder Issue #5: Are the percent failure rates used for septic systems and the corresponding transport of bacteria load from septic systems to receiving streams acceptable?

Stakeholder Issue #6: What modeling approach is appropriate/best suited for developing TMDLs for Shellfish Waters

Simplistic Modeling Approach (Load Duration Curve)
Stakeholder Issue #1: Stakeholders do not see the benefit of using a tool that cannot simulate pollutant loading and transport.
Technical Response, Rebuttal, and Recommendation:
Stipulate recommendations that directly address each issue – aim the recommendations at how to move forward with TMDL development despite uncertainty.
Future Action Items: Longer term action items that would typically happen outside of the TMDL process.

Stakeholder Issue #2: Given limited flow data for streams throughout TX and that flow data is one of two key variables in LDCs, what is the most reliable (acceptable to the stakeholders) method for estimating stream flow on ungaged streams.
Technical Response, Rebuttal, and Recommendation:
Stipulate recommendations that directly address each issue – aim the recommendations at how to move forward with TMDL development despite uncertainty.
Future Action Items: Longer term action items that would typically happen outside of the TMDL process.

TMDL Calculations – WLA, LA, MOS

- Task Force should concur on the complete list of categories that should be included in the WLA and LA and how the numbers should be expressed (e.g., daily loads, monthly, percent reduction goal, combination).
- Task Force should concur on the use of an implicit MOS for bacteria TMDLs or establish a detailed rationale for utilizing an explicit MOS. Task Force should list and explain examples that would qualify as part of an implicit MOS.

Public Comment
- Task Force should summarize stakeholder concerns about the current TCEQ and TSSWCB stakeholder participation process.
- Task Force could make recommendations on how to improve stakeholder understanding of a key hurdle in most TMDLs – data limitations that create uncertainty.

Bacteria Source Tracking
- The table in the draft report is a very good informational matrix.

(Parsons Comments continued)

- The Task Force needs to make a recommendation that more BST should be done to support TMDL development projects in the future around the state.
- Rather than describe the different methods, the report should summarize in bullets the lessons learned from the 5 different BST projects done in TX.
- The Task Force should summarize a consensus recommendation that the TCEQ and TSSWCB should support the use of two methods on all future BST projects – ERIC-PCR and Riboprinting (with at least 2 enzymes).
- The Task Force should make recommendations on what is an acceptable confidence level for the Rate of Correct Classification and a rationale for whether or not the existing known source library is of sufficient size to maintain the RCC for BST projects throughout TX.

Recommended Decision-Making Process for Texas TMDL and Implementation Plan Development

- Task Force could make recommendations to TCEQ and TSSWCB that a policy and corresponding procedures should be established and disseminated on when TMDL implementation plans or Watershed Protection Plans should be initiated (e.g. once a TMDL has been issued for public comment, once a TMDL has been adopted by the TCEQ and TSSWCB, other?). The Task Force could consider developing a recommendation on whether a WPP can be developed in lieu of a TMDL.
- Task Force should try to clarify the current understanding or misunderstandings of the differences between a TMDL Implementation Plan and a WPP. While both are aimed at restoring beneficial uses by achieving pollutant reductions, they have different components and are typically executed differently. For example, a TMDL implementation plan is typically pollutant specific and to date have been prepared by TCEQ or TSSWCB. A WPP can and probably should address more than TMDL pollutants in a 303(d) listed watershed and can addresses a larger watershed area. A WPP can incorporate both restoration and protection objectives and can be initiated by TCEQ, TSSWCB, or any other organization.

Research and Development Needs

- Some of these Task Force recommendations would be derived from the Future Action Items identified above in response to stakeholder concerns or criticisms.

TEXAS DEPARTMENT OF TRANSPORTATION – HOUSTON DISTRICT
Comments on the Bacterial Total Maximum Daily Load
Task Force Report First Draft, October 30, 2006

Comments Submitted November 13, 2006

Introduction

The Houston District of the Texas Department of Transportation (the District) operates over 3,000 miles[1] of roadway in the Houston metropolitan area. Various surface water bodies in the District's jurisdiction currently are listed as impaired because their contact recreational uses have been found by the Texas Commission on Environmental Quality (TCEQ) to be impaired. This has triggered a number of bacteria Total Maximum Daily Load (TMDL) studies in the region. Since the District is among the many entities that discharge stormwater into regional surface water bodies, and since urban stormwater frequently contains elevated bacteria levels, the District is very interested in the deliberations and findings of the Bacterial TMDL Task Force (Task Force). We appreciate the opportunity to provide comments and to assist the Task Force in its work.

General Comments

1. **Incorporate Discussion of Adaptive Management, Phased TMDLs, and Phased Implementation:** We believe that the Task Force should include an up-to-date discussion and consideration of the most recent guidance from EPA regarding options for developing phased TMDL's , the use of adaptive management, and phased implementation. We urge the Task Force to consider and incorporate elements from the August 2, 2006 EPA memorandum from Benita Best-Wong to all EPA regions[2] so that these concepts can be included.

2. **Incorporate Discussion of Wet Weather Concentrations and Loads:** Urban stormwater frequently can contain elevated bacteria concentrations and loads, however, the impact of these episodic events on attainment of contact recreational uses is not clear and certainly, no consensus on how to deal with wet weather has emerged. Approaches to consider stormwater loads during TMDL development and implementation planning are similarly not straightforward. We urge the Task Force to consider the November 22, 2002 EPA memorandum from Robert Wayland to all EPA regions[3] so that wet weather issues can be addressed.

3. **Problem Identification is Required:** The District believes that the Task Force should attempt to define the existing problems with and limitations to the TMDL process, as implemented in Texas, prior to suggesting or recommending new research and development approaches. For example, if bacteria fate and transport models are, in fact, adequate for TMDL development and implementation plan decision-making, then new models might not be required. We are not sure how a new model that might be marginally better in simulation accuracy or a new source identification method that might be slightly better in source identification will substantially improve the Texas TMDL program. We suggest that the problems may not lie in the tools available but rather the regulatory objectives to which the existing tools are being applied.

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[1] See http://www.dot.state.tx.us/hou/
[2] See http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.html
[3] See http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf

(TxDOT – Houston District comments continued)

Bacteria Fate and Transport Models

1. **Higher Level of Detail Required:** The evaluation of models and source identification tools appears to be a reasonably complete description of the available tools, but provides only a very superficial evaluation of their utility to the task at hand. This is perfectly understandable for a first draft, and is not intended as criticism of the draft, however, the District urges the Task Force to include more details about fate and transport models and their selection for various Texas waterbodies. For example, an estuarine environment would certainly require a different model than a recreational lake or an urban stream.
2. **Model Selection Challenges:** On page 2, it is mentioned that model selection is a challenging problem "due to the numerous water quality models that are available", but it should be added that the characteristics of each watercourse and the nature of the pollutant loads also drive the decision.
3. **Load Duration Curve:** The disadvantages of this method are not completely described. Other disadvantages include (a) The inability of managers to assess water quality responses for varying implementation or load reduction scenarios. (b) Older observed data may skew the TMDL towards sources that are no longer relevant due to changes in the watershed and the LDC only applies to points in the stream at which samples were taken. (c) The TMDL duration and frequency targets cannot be directly compared to the LDC.
4. **SWAT:** The model is not well explained, therefore, we feel that additional information should be provided. For example, what are the required data? What is the model development and set-up time? Does the model account for re-suspension from the bed stream and from deposition sources? What are the disadvantages and advantages of this model?
5. **SWMM:** Information about required data, model development and set-up time should be provided.
6. **WASP:** More information should be provided concerning data requirements, model development and set-up time, and advantages and disadvantages of model usage.
7. **Include Discussion of STORM and TPM:** Appendix 1 states that the EPA includes STORM and TPM as suitable models for pathogens. Why are STORM and TPM not described in this section? They were not evaluated by Ward and Benaman (1999), so they were not ruled out by that study.

Bacteria Source Tracking

1. **Bacteria Source Tracking is Not a Silver Bullet:** Information should be provided about the advantages and disadvantages of BST in general. Disadvantages include their propensity to be subject to false positives and negatives, the possibility of the EC population changing when exposed to environmental conditions, the possibility of the EC genetic sequence changing over time, questions about the stability of a host-based EC library, and the lack of a standard algorithm used for pattern matching. Also, the advantage of the ability of a BST method to distinguish between individual species is debatable. BST methods that distinguish between categories, i.e., humans, livestock, wildlife will most likely provide the necessary information to reduce the appropriate loadings.

BST Methods Should be Evaluated More Evenhandedly: There are three genotypic tools (ERIC-PCR, Ribotyping, and PFGE) described in detail, yet only one ARA tool (KB-ARA) is sufficiently described. There is no discussion why only one ARA tool is presented. More

(TxDOT – Houston District comments continued)

discussion is needed as to why EPIC-PCR, Ribotyping, and PFGE were chosen for comparison. Why are they "versatile and feasible"?

2. **Expand Discussion of KB-ARA:** What are the advantages of the KB-ARA method over other ARA methods?

Recommended Decision-Making Process for Texas TMDL and Implementation Plan Development

1. **Examine Other State Programs First:** Appendix 2 notes that Texas has not finalized any TMDLs since January 1996. Prior to developing decision-making recommendations for Texas, the District urges the Task Force to closely examine decision-making in other states and to more fully understand the policy and procedural differences among Region 6 states that has led to the striking differences in TMDL approval rates.

2. Consider Technical and Regulatory Requirements as well as Stakeholder Acceptance: We urge the Task Force to not just consider technical and regulatory requirements for both TMDL and implementation plan development, but also stakeholder acceptance. Since stakeholder rate payers may be faced with paying extremely large implementation costs in efforts to achieve TMDL load reductions, if meaningful stakeholder involvement and buy-in is not secured, administrative appeals and litigation could result, further delaying TMDL and implementation plan adoption in Texas.

3. Research and Development Needs

1. **Consider National Guidance and Recommendations First:** The EPA and the National Academy of Sciences have both produced significant publications identifying research needs. The District urges the Task Force to consider these publications when identifying research needs for Texas. These publications include Reckhow, Donigian, et. al., 2001;[4] Shoemaker, Dai, and Koenig, 2006;[5] and EPA, July 2002.[6] While these references don't explicitly and directly address bacteria TMDL issues, they do include important findings regarding the process, policy issues, scientific rigor, and equity issues that impact bacteria TMDL development and implementation.

Appendix 1: EPA Bacteria TMDL Guidelines

1. **Source Assessment:** The draft report suggests using point source effluent monitoring data. This would be fine for discharge permits that require compliance monitoring for bacteria, however, most municipal wastewater treatment plants are not required to monitor for bacteria under the assumption that chlorine residual is an adequate indicator of adequate disinfection process operation. A recent study conducted by Harris County on behalf of the Stormwater Joint Task Force[7] suggests that this may significantly underestimate the bacteria load from wastewater point sources. While the controls necessary to address elevated bacteria loads from WWTP's are available and are straightforward to implement, failure to identify WWTP's as a significant load will

Linkage Analysis: On page 27 pathogen concentrations in streams are said to be dominated by advection, dispersion, and die-off. We believe that re-growth and bed re-suspension are

[4] See http://www.nap.edu/catalog/10146.html#orgs
[5] See http://www.epa.gov/ORD/NRMRL/pubs/600r05149/600r05149.pdf
[6] See http://www.epa.gov/ORD/NRMRL/pubs/600r05149/600r05149.pdf
[7] The JTF includes the City of Houston, Harris County Flood Control District, Harris County, and the Houston District of TxDOT.

(TxDOT – Houston District comments continued)

also significant factors, especially in shallow and narrow waterways. We believe that these processes far exceed the impact of dispersion on instream bacteria concentrations.

Appendix 2: State Approaches to Bacterial TMDL Development

1. **Investigate State to State Disparity in TMDL Adoption:** In the review of work in other EPA regions it is noted that Texas has yet to produce an approved bacteria TMDL while other states in Region 6 have been more successful and states in other regions have been quite prolific in the production of TMDL documents. We believe that a full understanding of the reasons for the disparity would be a very useful product for the Task Force to generate.
2. **Interview State TMDL Coordinators:** The appendix indicates a lack of information on state website. If a state website does not include adequate information on TMDL and implementation plan development, we suggest the Task Force interview state TMDL coordinators or project managers to obtain key information about approaches and methods.

Texas Parks and Wildlife Department Comments

November 13, 2006

Texas Parks and Wildlife Department appreciates the opportunity to comment on the Bacterial TMDL Task Force Report, First Draft dated October 30, 2006.

Overall, the first draft is not what had been anticipated, given the scope of work of the task force as delineated in your email of October 17, 2006 to the Task Force expert advisers:

1. Review EPA TMDL guidelines and approaches taken by selected states to TMDL and implementation plan development.
2. Evaluate scientific tools, including microbial fate and transport modeling, microbial source tracking, and others.
3. Suggest alternative approaches to TMDL development, emphasizing scientific quality, timeliness, and cost effectiveness.
4. Suggest alternative approaches to TMDL implementation plan and watershed protection plan development, emphasizing scientific quality, timeliness, and cost effectiveness.
5. Develop a 3- to 5-year science roadmap to guide and improve our understanding of microbial fate and movement in Texas environments.

We recognize that two sections of the document are not yet available. That, of and by itself, makes it difficult to comment, as the information that is presented lacks context. However, we find the discussion in the sections that are available, Bacteria Fate and Transport Models and Bacteria Source Tracking, to focus on what has already been done in Texas rather a comprehensive review, critique and comparison of tools that are available. As such, we wonder if item 2 above, "evaluate scientific tools" has actually been addressed.

Given that this is a preliminary draft, we offer only the following general comments.

1. The issue of data quality is not addressed anywhere in the document. We believe that data quality should be a major discussion point. The selection of non-biased sampling locations and the use of methodologies providing proven, accurate, reproducible data results are requirements for any meaningful TMDL modeling effort. We are concerned that the use of source tracking is one of the least accurate such methods. The BST authors seem to acknowledge this themselves on pg. 15, where they note efforts to "explore issues of geographical and temporal stability of BST libraries, refine library isolate selection, and determine accuracy of water isolate identification."
2. Numerical estimates of uncertainty, reliability, reproducibility, and sensitivity are not presented in either the modeling or BST sections. The BST section makes some effort in this regard, but we find the characterization of "high," "moderate," etc. not to be

(TPWD comments continued)

helpful without the anchor of some numeric analysis. Further, it would be helpful to present information for BST regarding the tendency for false positives (or negatives).

3. In the modeling section, we found it helpful that a specific example was presented for BLEST. We note however, that the use of this tool for Buffalo and White Oak Bayous was presented as if it was beneficial use. A discussion on the limitations of this method should also be included. We are particularly interested in reliability of the calculations.

4. The BST section provides some discussion of and comparison between techniques, but does not provide the information necessary to determine if BST has the potential to be useful in bacterial TMDLs in Texas. We felt the section lacked a clear, detailed discussion of both the sampling requirements and problems with the method, such as selecting unbiased sample locations, fecal library issues with variable media, cross contamination, geographical variations, etc.; and the large variation in analytical data which necessitates a high number of samples to show statistically valid results.

5. In the BST section, the authors note on pg. 14 that the use of a three-way split of pollution sources into domestic sewage, livestock and wildlife source classes would likely be more scientifically justified. In this context, what does "scientifically justified" mean?

We note that such general classification would not be meaningful or useful for Texas Parks and Wildlife Department in any efforts to manage wildlife or its habitat.

6. In the BST section on pg. 14, please correct and clarify the sentence that reads "Library-independent methods .... than library-independent methods." We suspect that one of these should read "library-dependent, but we aren't sure which one. Could the authors provide more discussion or examples of library-independent methods?

7. Editorially, we note that the BST section is not consistent in its use of language. In some places BST is used, while other paragraphs use MST. Some paragraphs refer to "this study."

8. Appendix 2 presents information on bacterial TMDL development in other states. Much information is presented, but it is difficult to interpret. It would be helpful to provide a context for the discussion, such as consideration of which TMDLs have been implemented successfully and resulted in actual water quality improvements. It would seem that successful examples would be most important to Texas. Alternatively, it would be helpful if other states have critiqued the various available techniques and to understand their decision-making process.

Respectfully submitted on behalf of Texas Parks and Wildlife Department,

Dr. Patricia Radloff, Coastal Fisheries Division
Dr. David Sager, Inland Fisheries Division
Dr. Duane Schlitter, Wildlife Division

HARRIS COUNTY
PUBLIC INFRASTRUCTURE DEPARTMENT
10000 Northwest Frwy., Suite 108
Houston, Texas 77092
(713) 316-4877

November 15, 2006

C. Allan Jones, Ph. D., Director
Texas Water Resources Institute
1500 Research Parkway, Ste. 240
College Station, TX 77843-2118

SUBJECT: BTMDL Task Force Report – First Draft, October 30, 2006

Dear Dr. Jones:

Harris County appreciates the opportunity to comment on the referenced report. We applaud the efforts taken by you and the other members of the Task Force in guiding future work in the field of water quality. Transmitted herewith for consideration by the Task Force please find attached my comments on the First Draft of the Report.

If you need further information or have any questions regarding these comments, please call me at (713) 316-4877 or Alisa Max at (713) 290-3089.

Sincerely,

John Blount, P.E.
Deputy Director
Planning & Operations

Attachments: Comments on BTMDL Task Force Report

cc: Kevin Wagner – TWRI
Pat Smiley, P.E. – Harris County
Alisa S. Max, P.E. - Harris County
Trent Martin - Harris County
Joe Myers, P.E. - Harris County Flood Control District
Catherine Elliot - Harris County Flood Control District

1. The section on Bacterial Source Tracking should be incorporated into a broader section that more rigorously addresses how to calculate loading into a selected model, with bacterial source tracking being one means of doing it. For areas in which sampling is done instead of, or in unison with, bacterial source tracking, discussion should be included to discuss how samples should be taken, and what level of reliability should be sought out for the sample results.
2. A section should be added to discuss the need for development of consistent methodologies for usage of each model, including acceptable methodologies for determining, calculating, and calibrating model inputs. This should also include what maximum acceptable deviations should be allowed during model calibration when compared to historical events. A handbook should be developed for each recommended model that details the recommended methods.
3. Guidelines should be given as to when data collected for other sources besides the TCEQ (and its consultants) could be used.
4. Guidelines should be given for consistent and defendable data collection methodologies. For example, the Buffalo/White Oak Bayou Bacteria TMDL project team determined a bacteria regrowth equation in WWTP effluent based on a small-scale experiment whose methodology was not explained. Harris County conducted a bacteria regrowth in WWTP effluent study which found much, much greater levels of regrowth. Similarly, recent studies by Harris County found that bacteria inputs from WWTPs are much greater than what the Buffalo/White Oak Bayou Bacteria TMDL project team earlier determined. Which is correct?
5. A recommendation should be presented that allows Stakeholders to participate in a detailed manner in bacteria TMDL development, not just being presented with the answers. Stakeholders with technical knowledge could be a real asset in assisting with the design of bacteria TMDL studies required.
6. Bacteria must not be viewed in a vacuum. If other influencing pollutants - such as nutrients, dissolved oxygen, or pH - are responsible for the growth, die-off, or longevity of bacteria, then those other pollutants need to be considered. This becomes especially important as the project moves into implementation.
7. A section should be allotted for the treatment of bacterial regrowth, resuspension, and other bacterial life history issues.
8. Guidelines should be given for consistent and defendable policy decisions so as not to unfairly influence scientific modeling. For example:
    a. In the Buffalo/White Oak Bayou Bacteria TMDL: Since illicit discharges are not allowable or permitted, contribution (allocation) from illicit discharges has been modeled as zero. This is in obvious contradiction to reality.
    b. Inputs from urban wildlife are sometimes allocated to background, but are sometimes not, since habitats for urban wildlife are the result of anthropomorphic disturbances.
    c. Older fecal coliform data is simply converted to *E. coli* at a ratio of 200:126. In reality, Harris County studies conclude that each stream (and

(Harris County comments continued)

likely each wastestream) has its own particular ratio, which must be sampled in order to be determined.

d. When is the use of the geometric mean appropriate?

9. A recommendation should be included that the Bacteria TMDL team should use consistent terminology with the Permits teams, unless they specifically note otherwise.
10. Harris County is very pleased with the emphasis placed on a state-wide bacteria source tracking library and methodology. One comment related to BST - does BST differentiate between bacteria that is a product of regrowth in the external environmental versus bacteria that is from a discharge itself? These are two separate inputs into most models and spreadsheets, and the proposed implementation plan should be vastly different depending upon if the problem is based on regrowth versus direct pollutant loading.
11. It should be noted that recommended reductions should be within the realm of achievability (*i.e.*; within the rates of existing best available technology at the time of TMDL adoption), or else it should be recommended that a UAA or re-evaluation of other loadings should be performed prior to adoption of any TMDL. For example, it should not be assumed, as is the case with the Buffalo/White Oak Bayou Bacteria TMDL, that 100% reduction in bacteria can be achieved from any one point source loading unless realistic existing technologies can achieve that.
12. Similarly, policy should be developed to recommend that a TDML which finds that background levels exceed the desired standard should perform a UAA or re-evaluation of other loadings. Harris County conducted a study on an un-impacted stream and found that this stream could not meet primary contact recreation standard, despite its near-pristine condition. Big Creek in Fort Bend County, another un-impacted stream per TCEQ's own judgment, also cannot meet primary contact recreation stream standards.
13. As of the time of this comment, TCEQ has not released the BLEST model, which is being used for the Buffalo Bayou and White Oak Bayou Bacteria TMDLs. We request that the models discussed in the paper are available to the public. We request to be provided with a copy of the model.
14. An appendix should be developed to examine how different stream types influence how a TMDL and implementation plan is approached. For example, how to approach concrete flood control channels, effluent-dominated streams, rural streams, *etc.*
15. It would be helpful if Appendix 2 also included information related to what these approved TMDLs are doing for implementation, if there is any measure of success or failure being found with the implementation, if the stream is rural, urban or mixed, and if the stream appears to be effluent dominated.
16. Appendix 4: Please correct John Blount's affiliation on the expert advisor list. John is with Harris County.

LRCA Comments

November 13, 2006

1. Would it be prudent to discuss the fecal coliform versus *E. coli* question in the document? The Texas Surface Water Quality standard is now written for *E. coli* but most of the data collected has been fecal coliform.
2. Have any TMDLs been performed for pathogens in Texas? If so, which pathogens?
3. Appendix 3 is very similar to information found in a previous section. Could a similar table, to the one included for BST be included?
4. Is pollutant trading a possibility for bacteria TMDLs?
5. A summary of what was learned from EPA regions 3, 4 and 7 might be helpful.
6. The BST section that Drs. Mott and DiGiovanni wrote seems to be very comprehensive. Obviously, other sections have not been written yet.

Jerry Guajardo
Sr. Aquatic Scientist
Lower Colorado River Authority
(512) 473-3333 Extension 7633

Texas Department of Agriculture Comments

December 15, 2006

1. Stakeholder involvement should be a priority from the initial sampling phase. Having landowners willing to provide multiple sampling locations that are representative of the watershed or stream segment is preferable to limiting sampling to public access points such as bridges or relying on literature values. Stakeholders can provide insight that may not be apparent to someone from outside the watershed.

2 Acceptable uncertainty is adequately addressed at this point in the draft (pages 42-44). We need to make sure that the cost of this uncertainty is equally distributed amongst all potentially responsible parties, not just agriculture. Again, a different approach using tiers of water segments might be an option. First use the cheaper faster methods for all impaired watersheds, as this would be beneficial and cost effective. Move to higher tiers and the more complicated/expensive methods when there is too much uncertainty or difficulty.

3. We strongly believe that all point sources should be sampled at their outfall. Recent studies indicate that there are bacteria regrowth issues associated with current effluent disinfection systems. Actual sampling of the effluent as it enters the stream segment will provide hard numbers that can be used in the load assessment and can be used to show stakeholders that "real numbers" are being used instead of permit limits or literature values. As seen at recent bacteria TMDL stakeholder meetings, stakeholders are reluctant to accept assumptions when actual data can easily be collected.

4. We support the model and method matrix (toolbox approach, page 30) for options for particular TMDLs. Each water segment and stakeholder group needs to be assessed on a case by case basis for maximum success.

5. This draft adequately discusses the survivability question for *E.coli*. Some research needs to be done not on just the survivability of *E.coli*, but other major waterborne pathogens as well that may not survive as well or not as this indicator species, especially in estuarine or marine waters. We did not see this mentioned in the draft.

6. The ERIC-PCR/KB-ARA tandem methods (pg 27), especially using the KB method alone (ease of use and inexpensive) with very initial screening and the combined method for more defined work. Ultimately, the implementation plan needs to be based on the genotypic tests in which are more definitive. I also would think if a sound endeavor to use the PFGE method (pg 25) as CDC and the food industry use this a lot. The recent spinach and lettuce contaminations that have occurred indicates that it may be important in the future to relate TMDL info to possible epidemiological studies. We also heavily support using previously used methods in Texas to allow for comparisons across watersheds and prudent use of previous expenditures.

(TDA comments continued)

7. The research need to accurately calculate livestock and wildlife, stoking rates pg 36) and their distribution in a watershed should be emphasized.

December 15, 2006

Comments of Myron Hess on behalf of the National Wildlife Federation on Second Draft (Dec. 4, 2006) of Bacteria Total Maximum Daily Load Task Force Report

I provide these comments unencumbered by expert knowledge of the technical aspects of this issue. However, I hope that these comments might help provide some broader perspective that could be useful in developing a document that will be reasonably accessible and valuable to readers who are not technical experts.

Page 7, Discussion of Statistical and Mass Balance Bacteria Models. A number of previous comments by others have noted the need for consistent treatment of different modeling approaches in the text. The discussion likely would come across as more balanced and would be more accessible if, for each model, the discussion were divided into specific and consistent topic subheadings. The following subheadings might be considered:

What It Is
Data Requirements
Ease of Application
Value in Supporting Implementation
Examples of Previous Usage
Specific Strengths
Specific Limitations

Pages 12-13, Discussion of SELECT. It is unclear how this Methodology relates to Table 1. There isn't much information to allow a comparison with other methods.

Page 13, Discussion of SPARROW. It is unclear how this Methodology relates to Table 1. There isn't much information to allow a comparison with other methods.

Page 13, Discussion of Mass Balance Method. Add the acronym "(MB)" to match the reference in Table 1.

Pages 15-19, Discussion of Mechanistic Hydrologic/Water Quality Bacteria Models. The discussion would be much more accessible if, for each model, the discussion were divided into specific and consistent topic subheadings. In addition, use of consistent subheadings should help in ensuring a somewhat more balanced presentation of the various methods. The following subheadings might be considered:

What It Is
Data Requirements
Ease of Application
Value in Supporting Implementation
Examples of Previous Usage

(NWF comments continued)

Specific Strengths
Specific Limitations

Pages 18-19, Important Considerations for Bacteria Modeling. I think these are important summary points and a good addition to the document. It seems that their value would be strengthened by expanding on them somewhat. For example, the third and fourth bullet points note uncertainties about sediment settling and re-suspension processes and about bacterial regrowth and death, respectively. Is there something that can be done in the short-term to address these uncertainties? If not, how should these uncertainties affect the decision-making process, if at all? With respect to the last bullet point addressing uncertainty, it would be useful to provide some discussion of how this uncertainty should be considered in relation to the requirement in a TMDL for an adequate margin of safety.

Page 22, Table 2. The column regarding accuracy of source identification seems a bit ambiguous in the absence of some definition of the terms "moderate" and "high." In particular, it would be helpful to have an explanation of how those terms relate to the range of "rates of correct classification" discussed on page 28. For example, it would be helpful to know if the accuracy characterizations in Table 2 refer to a three-way split, a seven-way split, or something else. It seems extremely important for this document to help inform expectations about what level of source discernment can realistically be expected for BST work. The discussion on page 28 provides useful information but it is not clear how it relates to some of the summary information, particularly the information in Table 2.

Page 30, Discussion of BST library. A more direct discussion of the geographical reach of an individual library would be helpful. It seems from the current discussion that there is an open issue of the extent to which a particular library can be relied upon outside of the watershed of collection. However, there is no clear statement as to the geographical extent to which use of a library should initially be limited absent a demonstration of validity outside of that initial area.

Page 33, Recommended Decision-Making Process for Texas TMDL and I-Plan Development.

Step 4, Load Duration Curves. The references to Step 2 in the discussion appear more properly to be references to Step 3.

Step 5, Bacteria Source Tracking. The reference to Step 2 in the discussion appears more properly to be a reference to Step 3.

Step 6, TMDL Development. It would be very helpful to have some elaboration on what is to be considered in determining whether "data is sufficient" for Step 6. Elaboration in this document on that issue could go a long ways in establishing realistic

(NWF comments continued)

expectations that could be very important in achieving buy-in from stakeholders down the road.

Step 7, **TMDL-IP Development.** It would be beneficial to have some discussion of the factors that should inform a decision about whether detailed simulation modeling studies are "needed." This is the kind of information that could make a real difference on the ground. Also, it appears that the reference in the Step 7 discussion to flow data from "Step 2" should be a reference to Step 3.

Page 65, Appendix 4. It is extremely important to acknowledge that all TMDLs are not created equal in terms of their value in achieving actual water quality improvement. Texas has proceeded down a path of spending more time in developing TMDLs that are designed to achieve stakeholder buy-in and to result in meaningful implementation of water quality improvements. Many of the TMDLs developed in other states, particularly those driven by litigation, take a very different approach. In fairness, the discussion should acknowledge that more explicitly. For example, the following text could be added just before Table 1 on page 65: "TMDLs that are prepared hurriedly to meet court-mandated deadlines may not be sufficiently specific or achieve adequate stakeholder acceptance to support development of comprehensive implementation plans, particularly where multiple sources and types of sources are involved. Accordingly, the approval of a large number of bacteria TMDLs does not necessarily represent a significant improvement in water quality."

As previous comments by others have indicated, it would be helpful, to the extent the information is reasonably available, to have an additional column in Table 1 of Appendix 4 that summarizes information about how many implementation plans have been developed and implemented in other states.

Texas Parks and Wildlife Department Comments

December 15, 2006

General Comments

This draft is much improved over the earlier drafts, particularly the modeling section. The bacteria source tracking section still does not provide quantified estimates of quality or accuracy, or sampling requirements, much less a comprehensive comparison of the methods. Methods used outside of Texas and by researchers other than the authors do not have sufficient information provided in the text or comparisons made with the methods discussed in the text. Considering that the purpose of this document is the evaluation of methods which will be used in a regulatory process requiring legally defensible data, the accuracy of the method results and sampling constraints are critical issues that must be addressed.

Providing general USEPA information in an appendix is not helpful. Comparisons of the methods need to be presented together to allow a more focused review rather than requiring the reader to dig out the information from other publications or appendices. We feel that it would be helpful to incorporate much of this information in the text.

While the modeling section of the report now at least acknowledges the importance of the data inputs being used (pages 18 and 19), we suggest that information be presented about the limitations of the different models and the reliability of the calculations.

If the readers are nonspecialists, after reading this document they are likely to be confused and uncertain of what any given model or BST method will reliably do. In addition to what is presented, can the material be summarized for the nonspecialist?

The term "wildlife" as used in this document is contrary to the regulatory definition of wildlife for the State of Texas. To eliminate confusion in this document and future TMDL studies, it is recommended that the term "wildlife" be deleted from this document and replaced with a more accurate term such as "non-domestic animals." At a minimum, the term "wildlife" should be clearly and openly defined for this document as including native wildlife, exotic animals and feral domestic animals such as feral hogs, ducks, cats, dogs, etc.

Acronyms need to be defined. A table of acronyms would be helpful.

Modeling Section

Table 1 – Bacteria modeling matrix – Runoff has not been included as a “LA Source.” Should “in-stream processes” be adjacent to “sediment transport?”

(TPWD comments continued)

Pg. 6 – The list of "dispersed (or nonpoint) sources" should include agricultural sources such as livestock, pastures and livestock holding facilities, as they may be major contributors.

Pg. 13 – For the SELECT tool, the text notes that, "The populations of agricultural animals, wildlife, and domestic pets will be calculated and distributed throughout the watershed according to appropriate land use." For the BLEST tool (pg. 14) the text notes that sources include wildlife and domesticated animals. We note that models are only as reliable as their input data and that estimation of the input parameters has been a source of concern for stakeholders. While research needs have been noted in a following section, can the modeling section provide a decision tool which identifies how to approach estimating input parameters with the data available today?

BST Section

Page 20 - The last sentence of the first paragraph notes that detailed discussion of topics related to quality control and quality assurance are "outside the scope of this report." It is suggested that this sentence be deleted and that information about quality control and quality assurance be included as part of the method evaluation.

As we understand it, the purpose of this report is to recommend methods and processes to be used in Texas TMDL regulatory efforts, which requires legally defensible data. As such, how can the authors ignore issues of quality control and quality assurance, since decisions on appropriate methods cannot be made without considering the validity of the results.

The authors seem to be presenting the methods as if they are already approved for use in the Texas regulatory process rather than fulfilling the task force's role of "evaluating scientific tools, including bacteria fate and transport modeling and bacterial source tracking (BST)" and "suggesting alternative approaches using bacteria modeling and BST for TMDL and I-Plan development, emphasizing scientific quality…" (from page 2 under Task Force charges, emphasis added.

In the last sentence of the second paragraph it is stated that bacterial source tracking has the advantage of direct regulatory significance. We feel that this statement is premature. Until the accuracy and quality of the results from this method are determined to be defensible in a legal (regulatory) context its significance cannot be measured. At this point, the information provided has not shown that the methods generate regulatory quality data.

The authors have declined to consider library size and representativeness. We disagree with this, as the construction and content of the library determines the accuracy of any library-dependent method. While internal accuracy can be measured by rates of correct classification, absolute accuracy cannot be determined without evaluation of the library.

(TPWD comments continued)

We recommend discussion of the shortcomings of library methods and feel that improvement of libraries is critical. This includes the need to expand the libraries with more species representatives, larger samples of individual species and samples with more geographic and temporal variation.

Page 22 (Table 2) - The table provides only qualitative information and does not provide any quantified comparisons. Definitions should be provided for the qualitative terms used (moderate, high, low, easy, etc.). The definitions should provide a numeric range of a quantified factor as a percentage (e.g., moderate = rate of correct classification of 50-75%). At a very minimum there should be text explaining the terms used. As it stands, it is not possible for a reader to understand the meaning of the table entries. Later in the document the authors consider a rate of correct classification of 60% as "relatively high" (page 28). Considering this is little better than the 50% expected in "flipping a coin," our confidence in these descriptive phrases instead of numerical values is minimal.

Page 23 - In the first paragraph the authors appear to imply that the libraries of isolates can be combined and used across the state in different studies by various researchers. There are obvious questions about the validity of combining libraries. Do isolation techniques vary between studies or are accepted, standard methods used for all libraries? It appears that there are no accepted standard methods (e.g., fecal material collection methods) to guarantee that all libraries are comparable or accurate. We wonder if it is scientifically valid to combine libraries from different studies and suggest that for libraries to be combined one must conduct an evaluation to determine that common methods and data quality exist. We recommend that a cautionary note be included in this document.

Pages 23-26 - In each of the method descriptions general, non-numeric terms are used to describe the ability of the method to resolve different closely related bacterial strains. As noted earlier for Table 2, these terms are not useful in making vital comparisons between the methods. As commented for Table 2 numerical ranges (e.g., 40-50%) or a numerical definition of the terms needs to be made to allow the reader to evaluate the methods.

Page 25 – In describing pulsed-field gel electrophoresis, the sentence, "While this allows higher confidence in the matches made, typically fewer environmental isolates are identified compared to other BST techniques," is used as a negative. Could the authors elaborate on this statement? Does it mean that fewer samples are analyzed or does it imply that pulsed-field gel electrophoresis has fewer false positives than other methods?

Page 26 - The Carbon Source Utilization method is not compared with the other methods. It was noted that this method was used in Texas and other states with at least some in conjunction with KB-ARA. The studies should be discussed and comparisons provided. The studies should also be cited.

(TPWD comments continued)

Page 27 – It would be helpful to provide a table illustrating the results from the Lake Waco and Belton Lake study and comparisons of the methods. This table should include information on the accuracy, blind controls, library quality, ability to identify water isolates, sample size, and statistical analyses results noted in the text. This information is vital in evaluating methods and should be shared.

The authors note percent congruence between some methods (we assume congruence means agreement). This should be clarified. This whole section should be expanded to provide the reader with more information on the comparisons and study parameters.

Page 28 – It is an improvement to the report that some mention of accuracy has been included. However, not enough information is provided. It would further improve the report to include an explanation of how rates of correct classification are determined. A table, (as requested for page 27) would be helpful. The accuracy values provided were 83%, 95%, 83%, 72%, 73%, 22 to 83%, 83%, and 60%. In general, we believe that field techniques that have accuracies below 80% should be used very cautiously as they may not hold up to critical review. Indeed, as noted before any accuracies near 50% are no better than flipping a coin.

The "rate of correct classification" analysis seems to address library internal accuracy. Has any work been done to determine absolute accuracy, rather than internal consistency? This is essentially a question of the accuracy of the library, particularly as relates to promiscuity of bacterial strains, statistical soundess, and sampling techniques. Stated another way: For a particular identification, from how many animals could the particular *E. coli* strain have come? How many of those animals are included in the library? Do we have adequate statistical replication to be certain? Could the strain have been introduced in a sample that was collected off the ground?

All that being said, we find it more defensible to use source tracking to identify a three-way split (domestic sewage, livestock, non-domestic animals) based on the limited information provided. However, source tracking for classes beyond this level (i.e., individual taxa) presently generates data that is suspect for regulatory actions and should not be proposed until the issues noted in these comments and the significant method development items noted in this report are addressed.

As a future goal, TPWD would support a separation of bacterial contributions into human, livestock, domesticated animals, native wildlife and exotic/feral wildlife. To be most helpful, even the native wildlife should be further separated into categories such as avian wildlife and mammalian wildlife. While it is desirable to have information down to taxa, with the present state of the science, it does not seem possible.

Page 29 - The statements in this section such as " no single BST method should be solely relied upon," "choosing the methods include the level of resolution needed," and "uncertainties regarding geographical stability of markers and the difficulty in

(TPWD comments continued)

interpreting results in relation to regulatory water quality standards and microbial risk" reinforce the difficulty in using BST techniques in a regulatory process. As noted above, we believe that BST should not presently be used beyond three-way splits until the method questions and problems are addressed and highly accurate standard techniques can be implemented for BST.

There is great detail in the report about library-dependent methods. Could more information be provided about how library-independent methods work? Is there potential to expand library-independent methods to other species, or are they inherently limited?

Page 30: The idea of combining BST libraries is again broached here. As commented earlier (page 23), only libraries using common accurate methodologies should be considered for combination and even in such situations the data need to be thoroughly examined for accuracy before such an action takes place. We agree that geographic and temporal stability need to be determined before such actions can be considered. These cautionary notes need to be more fully expressed in the text.

In Appendix 4, it is noted that, "BST does not tell you how much each source contributes to bacterial contamination, only the different kinds of sources." This suggests that BST is useful as a qualitative, rather than a quantitative tool. Based on our limited experience with BST, the cited rates of correct classification, and the identified research needs, this viewpoint seems supportable. It is difficult to endorse quantitative use of BST given the unresolved questions with the technique. We then wonder how reliable BST data will be as input to the various modeling tools.

Pages 32-33 - The recommended decision-making process outlines a procedure that might take several years. How quickly do bacterial strains mutate? It seems that there may be concerns about temporal variability of *E. coli* strains on relatively short time frames. Do we know if it is possible to use BST in a regulatory process that may span 5-10 years?

<u>Recommended Decision-Making Process</u>

Page 32 - The document has a section on the decision-making process for TMDL and implementation plan development, which identifies potential members for stakeholder work groups. As commentors have noted elsewhere in the document, stakeholder buy-in is critical to the success of the TMDL and implementation plan process. In order to facilitate understanding, communication and participation, we suggest that TCEQ and TSSWCB form a separate small work group in addition to the Task Force whose focus would be to create a blueprint for a successful stakeholder process. Such a blueprint could be used by staff of both agencies statewide in TMDL, implementation plan and watershed protection plan processes. We envision that it would address stakeholder group membership, attendance at meetings, and communication to stakeholders.

(TPWD comments continued)

It is critical that the state and local agencies be specifically included in the stakeholder group to ensure TMDL and other regulatory issues, are addressed in a manner appropriate to the relevant authority. Failure to do so could unwarranted expense or controversy.

Research and Development Needs

We do not disagree with any of the research needs that have been identified. That being said, in order to best serve the state, we believe that the list must be prioritized to address regulatory needs and to generate data that is defensible and that will stand up to the legal process. As it is now, the list seems to be ambitious for a 3-5 year horizon, even as a research "wish list."

Pages 41 and 42: We recommend adding bullets for BST research and development needs to develop standard methods to be used in library development and sampling for BST studies. Noting the issues listed under BST research and development needs along with the comments provided above suggests that BST is not presently at a point to be a critical component in a regulatory, legally defensible process. The use of BST should be at most as additional information in a weight-of-evidence approach to help in decisions using a three-way split (human, livestock, non-domestic animals).

Appendix 1

Please add Pat Radloff and David Sager to the list of experts.

Appendix 4

Have the authors found any example of any state which has successfully improved water quality by implementing a bacterial TMDL?

Appendix 5

In response to comment aw79: The commenter is correct. This should read: "Overall, the library needs to be extended to include more taxa with rigorously collected samples with adequate replication for each species."

Respectfully submitted on behalf of Texas Parks and Wildlife Department,

Dr. Patricia Radloff, Coastal Fisheries Division
Dr. David Sager, Inland Fisheries Division
Dr. Duane Schlitter, Wildlife Division

TEXAS DEPARTMENT OF TRANSPORTATION – HOUSTON DISTRICT
Comments on the Bacterial Total Maximum Daily Load
Task Force Report Second Draft, December 4, 2006

Comments Submitted December 18, 2006

Introduction

As a stakeholder in many Texas bacteria TMDLs, the Houston District of the Texas Department of Transportation (the District) is very interested in the deliberations and findings of the Bacterial TMDL Task Force (Task Force). We appreciate the opportunity to provide comments on the Bacterial Total Maximum Daily Load Task Force Report Second Draft and to assist the Task Force in its work.

Task Force Charge

We believe that the charge to the Task Force should be placed in the introductory statements of the report, but we believe that it should be stated verbatim from the charge issued as posted on the TWRI Bacteria TMDL website[8].

Bacteria Fate and Transport Models

1. **Table 1 Bacteria Modeling Matrix:** The revisions to this section of the document have strengthened it with a higher level of detail. We feel that Table 1 should be moved to the end of the section to allow the reader to digest the different models, acronyms, and TMDL information presented within the section and the table should be introduced with a short paragraph that presents the matrix and explains how to use the matrix in detail. Other comments directed to Table 1 include:
    - The watercourse type breakdown is slightly confusing. We propose to rename Fresh/Saltwater Estuarine to simply Estuarine.
    - Several tools are described throughout the section such as SELECT and SPARROW, yet are not included in Table 1.
    - All of the mass balance (MB) watercourse boxes should be checked.
    - The MB, BLEST, BSLC, and BIT boxes for TMDL Implementation should be checked. Also, these methods account for some spatial variations, so perhaps the 1-D box should be checked.
    - The HSPF, SWAT, and SWMM boxes for 1-D should be checked.
    - The SWMM boxes for river/stream and TMDL development and implementation should be checked.
    - The HSPF and SWMM boxes for steady state time scale should be checked. A constant-value time series can be used to create a steady-state simulation.
    - The SWAT box for time varying should be checked. The model allows for a daily, monthly or yearly time step. The SWAT box for single storm event should be unchecked because of the large time steps.
    - Additional estuarine models should be included in the mechanistic/hydrologic/WQ section of the matrix that are capable of simulating coastal hydrodynamics and water quality.

[8] See http://twri.tamu.edu/bacteriatmdl/

(TxDOT—Houston District comments continued)

2. **Load Duration Curve:** The LDC section has been strengthened significantly, but the following sentence should be added: *Among the disadvantages of the LDC method is that TMDL duration and frequency targets cannot be directly compared to the LDC.* Also, we suggest adding the following short discussion: *There is a potential for linkage between models and bacteria source tracking (BST). These methods can be used to complement each other. For example, several bacteria TMDL studies have been utilized the LDC model combined with BST to determine bacteria loads and allocations.*

Bacteria Source Tracking

1. **Entry Pathways Not Identified:** Many of the comments that were expressed in Drafts 1 and 1.5 have been addressed by the revisions to this section. It should be noted in the Regulatory Expectations section that no BST method will identify the entry pathway to the water body and that the methods only identify the sources. This means that bacteria from a particular animal may be deposited in the watershed and then be conveyed to the water body by various transport mechanisms and conveyances, each owned and operated by different watershed stakeholders. This is critical to developing implementation actions. The report should acknowledge this missing information in this section.
2. **Identification of only Some Sources:** Another limitation that should be recognized is that the sources identified to date in BST work are not a complete inventory. In discussions following the last draft, it was noted that no unique signature had been identified for soil or stream sediment bacteria. The same is probably true for bacteria that grow in streams following wastewater disinfection. BST studies that focus on only selected intestinal sources are thus limited in their ability to characterize the full range of sources of indicator bacteria. The report should acknowledge this limitation.

Recommended Decision-Making Process for Texas TMDL and Implementation Plan Development

4. **Process Steps:** We support the inclusion of a road map for TMDL development and implementation. The steps outlined appear to be a good start in documenting the approach. We urge the Task Force to reconfigure the material into a flow diagram, with actions and decision points. This will allow the process to incorporate adaptive management, phased TMDL's and Phased Implementation.
5. **Margin of Safety:** A discussion of the determination of where the margin of safety will be incorporated into the TMDL should be included in Steps 4, 5, and 6. Step 5 of the decision-making process refers to a BST decision matrix. We recommend including this matrix in the BST section or if it is referring to the EPA decision matrix, the appropriate Appendix should be referenced.
6. **Steps 6 and 7 Should Incorporate Discussion of Adaptive Management, Phased TMDLs, and Phased Implementation:** We believe that the Task Force should include an up-to-date discussion and consideration of the most recent guidance from EPA regarding options for developing phased TMDL's , the use of adaptive management, and phased implementation. We urge the Task Force to consider and incorporate elements from the August 2, 2006 EPA memorandum from Benita Best-Wong to all EPA regions[9] so that these concepts can be

[9] See http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.html

(TxDOT—Houston District comments continued)

7. included. Specifically, we suggest the following language be inserted into the Task Force Report:

The TCEQ should adhere to the policy provisions of the EPA memorandum regarding TMDL implementation as follows:

Phased TMDLs: *The use of the term "phased TMDLs" should be limited to TMDLs that for scheduling reasons need to be established despite significant data uncertainty and where the state expects that the loading capacity and allocation scheme will be revised in the near future as additional information is collected.*

The phased TMDL approach would be used in situations where limited existing data are used to develop a TMDL and the state believes that the use of additional data or data based on better analytical techniques would likely increase the accuracy of the TMDL load calculation and merit development of a second phase TMDL. Such significant uncertainty may arise, for example, because the State is using a surrogate to interpret a narrative standard, or because there is little information regarding the loading capacity of a complex system such as an estuary and it is difficult to predict how the a water body will react to the planned load reductions. An example of a phased TMDL could be a TMDL for phosphorus in a lake watershed where there are uncertain loadings from the major land uses and/or limited knowledge of in-lake processes. In such a case, the loading capacity of the water body may be difficult to establish and the State may decide to include a schedule for establishing a revised TMDL based on follow-up monitoring. ***Phased TMDLs may also occur when a revision of the applicable standard is underway and will necessitate development of a second phase, revised TMDL to comply with the new standard [emphasis added].***

All phased TMDLs must include all elements of a regular TMDL, including load allocations, wasteload allocations and a margin of safety. As with any TMDL, each phase must be established to attain and maintain the applicable water quality standard. In addition, EPA recommends that a phased TMDL document or its implementation plan include a monitoring plan and a scheduled timeframe for revision of the TMDL. (These elements would not be an intrinsic part of the TMDL and would not be approved by EPA, but may support a rationale for approving the TMDL.)

Since phased TMDLs will in all likelihood need to be revised and therefore require more overall effort, States should carefully consider the necessity of such TMDLs, for example to meet consent decree deadlines or other mandatory schedules Upon revision of the loading capacity, wasteload, or load allocations, the TMDL would require re-approval by EPA.

TMDLs with Adaptive Implementation Provisions: *Adaptive implementation is an iterative implementation process that makes progress toward achieving water quality goals while using any new data and information to reduce uncertainty and adjust implementation activities. The National Research Council report suggests that adaptive implementation include "immediate actions, an array of possible long-term actions, success monitoring, and experimentation for model refinement." By using the adaptive implementation approach, one can utilize the new information available from monitoring following initial TMDL implementation efforts to appropriately target the next suite of implementation activities.*

Phased TMDLs are an example of the adaptive implementation approach because each new phase utilizes new information to reevaluate the original TMDL. However, even for TMDLs where there is little uncertainty regarding the loading capacity of the water body and the

necessary load reductions, an adaptive implementation approach can be a useful tool. Implementation of TMDLs can take many years and when uncertainty about the effectiveness of implementation activities exists, TMDLs would benefit from containing elements that would facilitate adaptive implementation such as, for example, provisions for a flexible load allocation/waste load allocation scheme. EPA is currently working to clarify how TMDLs can be written to provide for adjustments in the load and wasteload allocations in approved TMDLs.

EPA understands that not all TMDLs can be implemented using adaptive implementation methods due to the more intensive monitoring and added administrative steps associated with this iterative approach. Nonetheless, EPA believes that in appropriate cases it should be feasible for States to develop TMDLs that facilitate implementation of practicable controls while additional data collection and analysis are conducted to guide implementation actions. Follow-up monitoring is integral to the adaptive implementation approach. Monitoring addresses uncertainty in the efficacy of implementation actions and can provide assurance that implementation measures are succeeding in attaining water quality standards, as well as inform the ongoing TMDL implementation strategy. If adaptive implementation activities reveal that a TMDL loading capacity needs to be changed, the revision would require EPA approval. In most cases adaptive implementation is not anticipated to lead to the re-opening of a TMDL. Instead, it is a tool used to improve implementation strategies.

TMDLs with Staged Implementation: *The third type of TMDL, described in the Great Lakes Initiative, is different from the two preceding types. While not a "phased TMDL," it is a TMDL that anticipates implementation in several distinct stages. It is also different from the adaptive implementation scenario because it is anticipated that the load and wasteload allocations will not require any significant adjustments. Instead, implementation actions will be staged over a period of time. For example, EPA has approved mercury TMDLs where the wasteload allocation to point sources (which would be implemented within five years through the NPDES process) was predicated on long-term reductions in atmospheric mercury deposition. We believe that the appropriate terminology for such a TMDL, if a label needs to be applied, would be "staged implementation."*

8. **Step 6 Should Incorporate Discussion of Wet Weather Concentrations and Loads:** Urban stormwater frequently can contain elevated bacteria concentrations and loads, however, the impact of these episodic events on attainment of contact recreational uses is not clear and certainly, no consensus on how to deal with wet weather has emerged. Approaches to consider stormwater loads during TMDL development are similarly not straightforward. We urge the Task Force to consider the November 22, 2002 EPA memorandum from Robert Wayland to all EPA regions[10] so that wet weather issues can be addressed when developing TMDL's with stormwater loads. Specifically, we suggest the following language be inserted into the Task Force Report:

   TMDL's with NPDES-regulated storm water discharges should be developed using the following approaches:

   a) NPDES-regulated storm water discharges must be addressed by the wasteload allocation (WLA) component of a TMDL.

[10] See http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf

(TxDOT—Houston District comments continued)

b) NPDES-regulated storm water discharges may not be addressed by the load allocation (LA) component of a TMDL.

c) Storm water discharges from sources that are not currently subject to NPDES regulation may be addressed by the load allocation component of a TMDL.

d) It may be reasonable to express allocations for NPDES-regulated storm water discharges from multiple point sources as a single categorical wasteload allocation when data and information are insufficient to assign each source or outfall individual WLAs.

e) In cases where wasteload allocations are developed for categories of discharges, these categories should be defined as narrowly as available information allows.

f) The WLAs and LAs are to be expressed in numeric form in the TMDL.

g) EPA expects TMDL authorities to make separate allocations to NPDES- regulated storm water discharges (in the form of WLAs) and unregulated storm water (in the form of LAs). EPA recognizes that these allocations might be fairly rudimentary because of data limitations and variability in the system.

9. **Step 7 Should Incorporate Discussion of Wet Weather Concentrations and Loads:** Urban stormwater frequently can contain elevated bacteria concentrations and loads, however, the impact of these episodic events on attainment of contact recreational uses is not clear and certainly, no consensus on how to deal with wet weather has emerged. Approaches to consider stormwater loads during TMDL implementation planning are similarly not straightforward. We urge the Task Force to consider the November 22, 2002 EPA memorandum from Robert Wayland to all EPA regions[11] so that wet weather issues can be addressed when developing TMDL implementation plans with stormwater loads. Specifically, we suggest the following language be inserted into the Task Force Report:

TMDL implementation plans with NPDES-regulated storm water discharges should be developed using the following approaches:

a) WQBELs for NPDES-regulated storm water discharges that implement WLAs in TMDLs may be expressed in the form of best management practices (BMPs) under specified circumstances. If BMPs alone adequately implement the WLAs, then additional controls are not necessary.

b) EPA expects that most water quality based effluent limits (WQBELs) for NPDES-regulated municipal and small construction storm water discharges will be in the form of BMPs, and that numeric limits will be used only in rare instances.

c) When a non-numeric water quality-based effluent limit is imposed, the permit's administrative record, including the fact sheet when one is required, needs to support that the BMPs are expected to be sufficient to implement the WLA in the TMDL.

d) The NPDES permit must also specify the monitoring necessary to determine compliance with effluent limitations. Where effluent limits are specified as BMPs, the permit should also specify the monitoring necessary to assess if the expected load reductions attributed to BMP implementation are achieved (e.g., BMP performance data).

e) NPDES permit conditions must be consistent with the assumptions and requirements of available WLAs.

[11] See http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf

(TxDOT—Houston District comments continued)

f) The storm water permit should also provide a mechanism to make adjustments to the required BMPs as necessary to ensure their adequate performance.

Research and Development Needs

1. **Previous Comments:** Some of our comments concerning research and development needs were submitted in a separate document on December 13, 2006. These comments are repeated here:

   - **Research Indicator Bacteria Sources in Runoff:** There is a need to understand why indicator bacteria concentrations in rainfall runoff tend to be very high—frequently two orders of magnitude greater than the concentration deemed suitable for swimming. Such high runoff concentrations can be understood in watersheds where there is a high density of intestinal waste sources (e.g. a cow pasture), but it is more difficult to understand in watersheds that have minimal wildlife uses such as parking lots, streets, or large roofs. Monitoring for many years by the City of Austin has demonstrated that runoff from all types of watersheds, from those with no impervious cover to 100% impervious cover, have Event Mean Concentrations of both Fecal Coliform and Fecal Streptococcus that are high. The geometric mean of FC observations was 42,625 cfu/dL and the Fecal Strep geomean was 69,004 cfu/dL (COA-ERM/WQM 2006-1). Research to better quantify the sources of bacteria from a range of watershed types would be essential to understanding how we might expect to achieve the existing criteria for swimming in streams that have a significant runoff component.
   - **Research Pathogen Sources in Stormwater:** A related research need is to address other bacteria forms such as *Shigella, Campylobacter,* and *Staphylococcus* in runoff from these watersheds. The historical focus on indicator bacteria to identify a human sewage source has been useful, but has been complicated by the knowledge that the same indicator bacteria are common in runoff from all types of watersheds, as well as being common in stream sediments and soils. While it may be tempting to dismiss the risk of disease from swimming in waters with high concentrations of indicator organisms that are not from human waste, it is not so easy to dismiss the risk from other potential pathogens such as those listed above. Research on the sources and the human health significance of these bacterial forms is needed.
   - **Conduct Studies to Better Define Indicators and Disease Risk for Freshwater Streams and Bayous:** Original EPA studies to identify indicator bacteria criteria to protect contact recreational uses were conducted in lakes with designated swimming areas and nearby wastewater discharge points (EPA, 1986). Studies need to be performed to develop a scientific basis for appropriate freshwater contact recreation criteria for streams, bayous, and rivers, particularly in tropical climates. Criteria should address incidental contact with riparian waters during boating and wading activities.

2. **Consider National Guidance and Recommendations First:** The EPA and the National Academy of Sciences have both produced significant publications identifying research needs. The District urges the Task Force to consider these publications when identifying research needs for Texas. These publications include Reckhow, Donigian, et. al., 2001;[12] Shoemaker, Dai, and Koenig, 2006;[13] and EPA, July 2002.[14] While these references don't explicitly and

[12] See http://www.nap.edu/catalog/10146.html#orgs
[13] See http://www.epa.gov/ORD/NRMRL/pubs/600r05149/600r05149.pdf

(TxDOT—Houston District comments continued)

3. directly address bacteria TMDL issues, they do include important findings regarding the process, policy issues, scientific rigor, and equity issues that impact bacteria TMDL development and implementation. Specifically, we suggest the following language be inserted into the Task Force Report:

   From Reckhow, Donigian, et. al., 2001:

   - ***Suggested TMDL Program Changes:*** *Develop appropriate use designations before water body assessment and refine them before TMDL development and employ use of adaptive implementation.*
   - ***Water Quality:*** *Assigning tiered designated uses is an essential step in setting water quality standards. Once designated uses are defined, criterion chosen to measure use attainment should be logically linked to the designated use.*
   - ***TMDL Development:*** *Uncertainty must be explicitly acknowledged. End the practice of arbitrary selection of the margin of safety (MOS) and require uncertainty analysis to determine the MOS. Assessment and monitoring programs need to be coordinated so that TMDL development and modeling data needs are more closely met.*
   - ***TMDL Implementation:*** *A Use Attainability Analysis (UAA) should be considered for all water bodies before a TMDL plan is developed.*

   From Shoemaker, Dai, and Koenig, 2006:

   - ***Statistical Modeling of Pathogens.*** *Guidance and additional techniques for modeling pathogens using statistical techniques are needed. Building statistical models that associate sources or localized loading potentials could help support evaluation of management alternatives. Simple spreadsheet tools could be developed to facilitate analysis.*
   - ***Guidance.*** *Examples, guidance and applications of modeling E. coli and enterococci should be developed. An expanded dataset and compilation of available source loading and die-off characteristics would assist in parameterizing models. Increased data collection will assist in developing calibrated applications.*
   - ***Genetic Tracer Analysis.*** *Genetic source typing can provide a discrete representation of the sources present at a particular location. Guidance and examples are needed on how to link genetic source typing information with dynamic modeling applications.*
   - ***Growth and Die-off Rates.*** *Models typically represent bacteria behavior by using a first-order decay term. However, in many systems, bacteria appear to die-off or regrow depending on environmental conditions. Development of second-order equations or functional relationships that more accurately represent bacteria growth and die-off rates would significantly improve modeling accuracy. The regrowth potential is of particular concern in coastal areas with shellfish beds and beaches.*
   - ***Shellfish Areas.*** *In tidally influenced areas, often located in the vicinity of shellfish beds and beaches, specialized modeling techniques are needed to evaluate loading and associated pathogen counts. The ability to comply with water quality standards for pathogens in tidal areas strongly correlate to the tidal circulation and configuration of*

[14] See http://www.epa.gov/owow/tmdl/20needsreport_8-02.pdf

(TxDOT—Houston District comments continued)

the shoreline. Areas with poor flushing potential are particularly prone to high pathogen counts, in some cases due to highly localized sources. Some options proposed for simulation of these tidal areas include linkage of watershed models such as HSPF and LSPC to the Tidal Prism Model. Other techniques have included simplified loading estimates using monitoring data or genetic tracer information in combination with receiving water models such as the Tidal Prism Model. Additional research is needed to better characterize sources and develop protocols for linking monitoring with models.

From EPA, 2002:

- ***Improve guidance for allocation development and methods to translate allocations into implementable control actions.*** *Once the linkage is made between pollutant sources and instream water quality, the available assimilative capacity is allocated among the watershed's point and nonpoint sources. Allocation is a critical juncture in the steps of TMDL development from modeling through implementation of point and nonpoint control actions. Social and economic considerations also complicate allocation decision-making. Office of Research and Development activities such as alternative futures assessment, watershed risk assessment, modeling, sustainable ecosystems, socioeconomic and pollutant trading research are all potentially relevant.*
- ***Improve information on BMP, restoration or other management practice effectiveness, and the related processes of system recovery.*** *As management practices are typically implemented under limited budgets, post-evaluation is often dropped despite the fact that this is among the most widely cited needs. Practically every type of Best Management Practice (BMP) or restoration technique needs effectiveness research. Researchers must also consider that recovery of impaired systems is intimately linked to effectiveness, and recovery is not just the inverse of degradation. EPA's investment in effectiveness research is substantial, and Office of Research and Development should continue to closely track the programs and practitioners who are their clients.*
- ***Develop adaptive implementation approaches for doing TMDLs.*** *The National Research Council recommended that "TMDL plans should employ adaptive implementation.... foster the use of strategies that combine monitoring and modeling and expedite TMDL development." There is widespread agreement that adaptive management on a watershed basis is a sound and practical approach for TMDLs, but the need for more specific research remains. EPA researchers might develop or evaluate adaptive management strategies, or focus on related tools such as recovery forecasting models, post-implementation monitoring methods, and alternative futures analysis.*
- ***Revisit the scientific basis for use designations.*** *The National Research Council panel called "tiered designated uses" an essential step, claiming that there should be substantial stratification and refinement of uses with scientific, social and economic input about the desired state for each water body. EPA researchers might study the few states that have begun to use tiered uses; Office of Research and Development might also use their skills in endpoint development to facilitate states' refinement of designated uses. Research in watershed classification and reference condition of different water body types may prove important.*
- ***Assist states in translating narrative standards into numeric criteria.*** *The uncertainties inherent in evaluating impairment qualitatively rather than quantitatively even affect the top three listed impairments (sediment, nutrients, and pathogens), which in many states*

(TxDOT—Houston District comments continued)

have qualitative or weak quantitative criteria. But among TMDL developers, numeric criteria are sometimes but not always preferred. Office of Research and Development's narrative/numeric translation support could work with states on translators, develop the basis for new numeric criteria (e.g., for effluent dominated streams, odor, aesthetics, fish advisories), further incorporate flow considerations, and support Office of Water in triennial reviews of state water quality standards.

- ***Clarify and quantify selected parameters used in criteria definitions.*** *On this issue the National Research Council panel stated, "All chemical criteria and some biological criteria should be defined in terms of magnitude, frequency, and duration." Even beyond clarifying these three key parameters, criteria can and should go farther (in definition and in application) when necessary to establish a more reliable relationship between the designated use and the criterion meant to protect it. Temporal considerations are particularly in need of improvement, and regionalized syntheses of episodic stressor behavior would be useful. Researchers might also address flows at which standards must be met, wet weather conditions, and sediment lethality.*
- ***Evaluate defensible scientific standards for listing and de-listing.*** *Specifically, the National Research Council panel's recommendation of a two-part impaired waters list (preliminary and final lists) has implications for monitoring research, sampling methods development and statistical analysis, usually occurring in a data-limited environment. Strengthening the scientific basis might include statistical guidance for listing decisions, methods for combining multiple lines of evidence (e.g. biomonitoring and chemical monitoring), improving the analysis of the role of flow as ultimately affecting the designated uses, and methods for uncertainty analysis.*

HARRIS COUNTY
PUBLIC INFRASTRUCTURE DEPARTMENT

1001 Preston, 5th Floor
Houston, Texas 77002
(713) 755-4400

December 15, 2006

C. Allan Jones, Ph.D., Director
Texas Water Resources Institute
1500 Research Parkway, Ste. 240
College Station, TX 77843-2118

SUBJECT: BTMDL Task Force Report – Second Draft, December 4, 2006

Dear Dr. Jones:

Harris County appreciates the opportunity to comment on the referenced report. We are deeply appreciative of the time and effort taken by you and the other members of the Task Force in guiding future work in the field of water quality. Transmitted herewith for consideration by the Task Force please find attached Harris County's comments on the Second Draft of the Report.

If you have any questions regarding these comments or need further information, please call me at (713) 316-4877 or Alisa Max at (713) 290-3089.

Sincerely,

John Blount, P.E.
Deputy Director
Planning & Operations

Attachments: Comments on BTMDL Task Force Report

cc: Kevin Wagner – TWRI
Alisa S. Max, P.E. – Harris County
Trent Martin – Harris County
Joe Myers, P.E. – Harris County Flood Control District
Catherine Elliot – Harris County Flood Control District

Comments on Bacteria Total Maximum Daily Load Task Force Report
Second Draft – dated December 4, 2006

John Blount, P.E. – Harris County

1. The Bacteria Source Tracking section describes several commonly-used BST tools. However, a TCEQ study for Buffalo and White Oak Bayous and another for Orange County was recently initiated to examine enteric viruses. These studies have a source tracking component. Since enteric viruses appears to be a currently-used tracking methodology, Harris County recommends changing the name of this section from "Bacteria Source Tracking" to "Microbial Source Tracking" and include a discussion and analysis on enteric viruses.

2. Recommended Decision-Making Process for Texas TMDL and I-Plan Development – Page 32. "Step 2" describes "Sanitary Surveys". The connotation of this phrase denotes sanitary sewerages. However, surveys in this context involve efforts far beyond the scope of WWTPs and collection systems. Therefore, Harris County recommends changing the name from "Sanitary Survey" to "Source Survey".

   Also, please change the phrase, "cities and municipalities" to "local governments". This broader concept includes special districts and counties, in addition to cities and municipalities.

3. Recommended Decision-Making Process for Texas TMDL and I-Plan Development – Page 33. "Step 3" states that monitoring should not begin until input from the stakeholders is received. Harris County is in full agreement with this statement and appreciates its inclusion.

   Also, we request that a statement be added that water quality in one waterway should not be extrapolated and applied for another waterway.

   Lastly, in "Step 5", it is our understanding that BST does not distinguish the means in which the bacteria arrived in a stream (ie- did the human bacteria come out of a pipe or did it regrow from other human bacteria already in the stream). These means are different inputs into most models and could also influence greatly the implementation approaches proposed. Understanding how the bacteria arrived in the stream is also vital in determining what the ratio of human: non-human truly means with respect to reducing point loads into the stream.

4. Recommended Decision-Making Process for Texas TMDL and I-Plan Development – Page 34, "Step 7". Harris County requests that a discussion of adaptive management occur here, including mention of the potential for adverse economic impact in implementing BMPs that are not shown to be effective. Harris County is adamant, as an entity that will be responsible for implementation, that due science prove the effectiveness of a BMP before its use is required. We do not believe that wasting taxpayers' money on ineffective "solutions" is palatable.

(Harris County comments continued)

5. "Bacteria Source Tracking", Page 20. Please include a discussion on the limitations of BST regarding regrowth of bacteria. If regrowth of bacteria occurs, such as is seen in urban streams, then researchers must address if bacteria from different sources re-grow at the same rates; otherwise, differential regrowth rates would badly skew any conclusions.

   Also, fecal indicator bacteria has been found in high numbers from a number of non-animal sources, from rooftops and gardens to mulch stockpiles and forests. Some study designs, such as the BST Study completed for Buffalo and White Oak Bayous in Harris County, assign all bacteria isolates to an animal group. This approach ignores contributions of bacteria from non-animal sources. We recommend including in this discussion an examination and recommendation to address subject bacteria from non-animal sources.

6. Research and Development Needs – Page 35. This section addresses tools and methods for TMDL and I-Plan development. Although important, an equally-important - if not more important - need is the research required for development of tools and methods for *implementation*. That is, once a TMDL and I-Plan is in place, how can local governments and stakeholders feasibly and effectively achieve desired results?

7. Characterization of Sources – Page 36. Please add among the studies needed, studies to quantify bacteria production/shedding from non-animal sources, such as mulch, gardens, or other organic-rich environments.

8. Characterization of Sources – Page 37. The description of studies to improve characterization of loadings from WWTPs states that "(r)e-growth of bacteria after incomplete disinfection can be another concern worthy of more study." Please remove the word "incomplete" from this sentence. Harris County has found that even fully-disinfected WWTP effluent provides a superb growth media for indicator bacteria.

9. Characterization of Kinetic Rates and Transport Mechanisms – Page 40 The last paragraph describes studies to quantify suspended bacteria in stream water column and sediments. Included for consideration is a "…need to consider die-off and regrowth of bacteria under various…"conditions. Harris County requests that bacteria die-off and regrowth be studies of their own; *i.e.*; have its own bullet point. In addition to the conditions listed (sediment, nutrient, water temperature) please include "occurrence of WWTP effluent".

10. In general, this report does not delve into implementation, which was a stated objective for the Task Force. If the Task Force agrees that an assessment of implantation needs and strategies is beyond its scope, then Harris County requests

(Harris County comments continued)

11. that the Task Force recommend that an independent group, comprised of practitioners as well as academia and under the auspices of TSSWCB and TCEQ, be developed to form a white paper on this subject.

12. Table 1 – please add a row to address complexity and/or cost. Also, please note that no model is believed to adequately model bacteria regrowth. This could be a particular hindrance for effluent dominated streams.

13. The concept in the Load Reduction Curve of "Exceeds Feasible Management" is a great concept that should be added to other models.

14. Determination of Effectiveness of Control Measures, Page 42. Harris County disagrees with the statement that determination of effectiveness of various controls is beyond the scope of TMDL and I-Plan development. It is critical to recognize where to draw the line for "exceeds reasonable management". The only true way to know this is to understand how effective treatment controls are. Rather than considering effectiveness of controls as a separate issue from TMDL and I-Plan development, Harris County would like to see a fuller treatment of this subject incorporated into these discussions.

    Also, please change the word "could" to "should" in the second sentence of each bullet point.

15. Harris County's comments from the First Draft are referenced by hyperlink. Please include these and future comments from Harris County in full text. The County can provide comments in electronic format if it would facilitate this request.

16. Several comments from our previous review have not been addressed in this draft. They include Comments # 1, 2, 3, 4, 8, 9, 10, 11, 12, 13, 14, and 15. Please address those comments as well.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1445 ROSS AVENUE, SUITE 1200
DALLAS, TX 75202-2733

DEC 20 2006

Dr. Allan Jones
Director, Texas Water Resources Institute
1500 Research Parkway, Suite 240
2118 TAMU
College Station, TX 77843

Dear Dr. Jones,

Thanks for your leadership and active involvement with the Texas Bacteria Task Force (TBTF) which was formed on September 27, 2006. Since the TBTF was formed, we have had several discussions within EPA on the technical and scientific issues inherent with the establishment of bacteria criteria and the development of Total Maximum Daily Loads (TMDLs) nationwide and particularly in Texas. At the same time, several members of my staff have participated in the TBTF teleconferences held on October 24, 2006, and November 27, 2006, respectively.

Enclosed with this letter, you will find a table summarizing various approaches used by other states to develop bacteria TMDLs, a document with a list of options related to bacteria modeling, and a document with possible options for establishing bacteria criteria. Electronic copies of the TMDLs will be sent via e-mail directly to you. Please note that this information does not include all available TMDLs and options used by other states nationwide.

EPA looks forward to seeing recommendations from the TBTF for expedited development of bacteria TMDLs using more practical methods such as mass balance or load duration curve. As we have stated previously, requiring bacteria source tracking (BST) data as part of the TMDL development will significantly delay timely development and approval of TMDLs. EPA supports the use of BST, as needed, in the implementation phase of TMDLs.

I look forward to receiving a copy of the final recommendations developed by the Texas Bacteria Task Force by the end of January 2007. If you would like to discuss the enclosed information or need additional information, please contact me at (214) 665-7101.

Sincerely,

Miguel I. Flores
Director
Water Quality Protection Division

Enclosures
Attachment 1 – Examples of Bacteria TMDLs
Attachment 2 – Options for Bacteria TMDL Modeling
Attachment 3 – Options for Establishing Bacteria Criteria

Attachment 1: Examples of Bacteria TMDLs								
	State/ Region	TMDL Project	EPA Approval Date	Modeling Approach	Water Quality Standard	BST Study Completed	Wildlife	Stakeholder Group
1	SC/4	Hanging Rock and Lick Creek Fecal Coliform TMDLs	Aug-03	Watershed Characterization System (WCS) and the Non-Point Source Model (NPSM).	200/100mL (geometric mean); No more than 10% of the samples collected during any 30 day period shall exceed 400/100mL.	No	Deer used as surrogate for all wildlife.	No
2	SC/4	Thompson Creek Fecal TMDL	Jan-04	Bacterial Indicator Tool (BIT) and Hydrolocial Simulation Program Fortran (HSPF) at one station; Load Duration Curve (LDC) at the second station.	200/100mL (geometric mean); No more than 10% of the samples collected during any 30 day period shall exceed 400/100mL.	No	Deer and raccoon population density used to estimate in-stream contributions from the wildlife sources. Assumed 30 ct/100 mL background concentration under base flow conditions.	No
3	GA/4	Ogeechee River Basin Fecal Coliform TMDLs	Mar-05	Load Duration Curve (LDC)	200/100mL (geometric mean) May-Oct; 1000/100mL (geometric mean) Nov-Apr; 4000/100mL (single sample maximum) Nov-Apr; 300/100mL lakes, reserviors; 500/100mL freshwater streams.	No	White-tailed Deer have a significant presence in the basin, but no individual loading is calculated.	Involved in implementation phase.
4	IN/5	Plummer Creek E. Coli TMDLs	Jun-06	Load Duration Curve (LDC)	126/100mL (geometric mean); 235/100mL (single sample maximum)	No	Wildlife contribution acknowledged, but not quantified.	No
5	MO/7	Shoal Creek Fecal Coliform TMDL	Nov-03	Soil and Water Assessment Tool (SWAT)	200/100mL shall not be exceeded during the recreational season in waters designated for whole-body-contact recreation or at any time in losing streams. The recreational season is from April 1 to October 31.	DNA Source Tracking	Turkey, Deer, Geese and Raccoons.	Involved in assessment and TMDL development.
6	MO/7	Little Sac Fecal Coliform TMDL	Aug-06	Soil and Water Assessment Tool (SWAT)	200/100mL shall not be exceeded during the recreational season in waters designated for whole-body-contact recreation or at any time in losing streams. The recreational season is from April 1 to October 31.	DNA Source Tracking	Wild Geese have a significant presence in the watershed.	Involved in assessment and TMDL development.
7	KS/7	Chetopa Creek Fecal Bacteria TMDL	Oct-02	Load Duration Curve (LDC)	2000/100mL (single sample maximum)	No	No	No
8	NE/7	Loup River Basin E. Coli TMDLs	Jan-06	Load Duration Curve (LDC)	126/100mL (geometric mean) May- Sept.	No	Big game, upland game, furbearers, waterfowl and other non-game species. Considered part of background, but not quantified.	No
9	NM/6	Middle Rio Grande Fecal Coliform TMDL	May-02	No	Segment-specific standards apply. 1000/100mL (geometric mean); 2000/100mL (single sample maximum).	No	Wildlife contribution acknowledged, but not quantified.	No
10	LA/6	Sabine River Fecal Coliform TMDL	Oct-06	Load Duration Curve (LDC)	400/100mL (Primary) May-Oct; 2000/100mL (Secondary) and Nov-Apr.	No	Wildlife contribution acknowledged, but not quantified.	No
11	LA/6	Bayou Segnette	Jul-04	Bacterial Indicator Tool (BIT)	400/100mL (Primary) May-Oct; 2000/100mL (Secondary) and Nov-Apr.	No	Wildlife and Waterfowl considered part of background. Quantified based on population density estimates.	No
12	LA/6	Bayou Lafourche	Jul-04	Bacterial Indicator Tool (BIT)	400/100mL (Primary) May-Oct; 2000/100mL (Secondary) and Nov-Apr.	No	Wildlife and Waterfowl considered part of background. Quantified based on population density estimates.	No

(EPA comments continued)

Attachment 2: Options for Bacteria TMDL Modeling

1. Include Level of Stakeholder Concern in Decision Matrix for Model Selection

An action item that resulted from the most recent conference call held by the task force on November 27, 2006, is to develop a decision matrix to assist with model selection. Since the TMDL development process in Texas includes significant stakeholder involvement, it may be helpful to include an assessment of the level of stakeholder concern or involvement as a criterion in model selection. Based on the draft report distributed by the task force on November 21, 2006, several modeling approaches (simple to complex) are being evaluated. It has been suggested that stakeholders tend to prefer complex models such as the Soil and Water Assessment Tool (SWAT). In light of this, it may be feasible to use simple modeling approaches such as mass balance or Load Duration Curve (LDC) in cases where stakeholder concern is minimal.

2. Comparison of Modeling Results obtained from a Simple Modeling Approach with those from a Complex Model

TCEQ has already drafted a number of bacteria TMDLs using complex models such as the Hydrological Simulation Program Fortran (HSPF). It may be helpful to recalculate the reductions for one of the draft bacteria TMDLs using a simple approach such as the Load Duration Curve (LDC). If both methods yield similar reduction requirements, it will help demonstrate the usefulness of the LDC method and help address stakeholder concerns.

Attachment 3: Options for Establishing Bacteria Criteria

1. Revise the Single Sample Maximum Criteria for Enterococci in Saltwater

The enterococci criterion of 89 colonies per 100 ml in the 2000 *Texas Surface Water Quality Standards* is based on EPA's *Quality Criteria for Water - 1986*, EPA 440/5-86-001 (the "Gold Book"). However, the recommended value for freshwater was inadvertently adopted in the TX WQS as the single sample maximum for saltwater. Additionally, EPA's Gold Book contains errors on several single sample maximum values for both freshwater and saltwater criteria. The correct value for an enterococci criterion in saltwater (moderate use level) is 158 colonies per 100 ml. EPA recommends that the state update the single sample maximum enterococci criterion for saltwater in the next revision. EPA's 1986 criteria document for bacteria is found at the following website: http://www.epa.gov/waterscience/beaches/files/1986crit.pdf.

(EPA comments continued)

2. Update the Standard Deviation in the Calculation of the Single Sample Maximum Criteria

EPA's 1986 criteria document recommends the use of state data to calculate a standard deviation, rather than the default values. In the 2000 Texas standards, the single sample maximum criteria for *E. coli* in freshwater is calculated with a state-specific standard deviation. Since most states, including Texas, focused on fecal coliform bacteria for assessing contact recreation uses, data for *E. coli* was limited to 126 stations in seven river basins. The Texas Surface Water Monitoring Program has collected extensive data for both *E. coli* and enterococci in recent years. This information may be used to recalculate the standard deviation used in the *E. coli* criterion and to develop a state-specific standard deviation for the enterococci criteria.

3. Consider the Adoption of Single Sample Maximum Criteria based on the level of use

EPA's 1986 criteria document provides geometric mean densities as well as four different single sample values (75th percentile, 82nd percentile, 90th percentile, and 95th percentile) that are appropriate for different levels of recreational usage. The moderate use level (82nd percentile) is used for the single sample maximum criteria in the 2000 Texas standards. Criteria based on a higher level of use (75th percentile) could be adopted for waters frequently used for swimming (e.g., Barton Springs, Padre Island beaches). Criteria based on a lower level of use (90th or 95th percentile) may be appropriate for other water bodies.

4. Consider Other Risk Levels for the Criteria to Protect Recreation Uses

The 2000 Texas standards include a risk level of 0.8% (i.e., 8 illnesses per 1000 swimmers). For freshwater, EPA recommends that states adopt criteria reflective of risk levels up to and including 1.0% (i.e., 10 illnesses per 1000 swimmers). For marine waters, EPA recommends that states adopt criteria reflective of risk levels up to and including 1.9% (or 19 illnesses per 1000 swimmers). Please table below for comparison of geometric mean and single sample maximum values at different risk levels for freshwater *E. coli* criteria.

EPA could consider approving criteria for the protection of primary contact recreation in inland freshwaters, at risk levels above 1% (up to a maximum of 1.9%) provided that states submit scientifically defensible information to show that the relationship between illness and indicator concentrations holds beyond 1.0% in freshwater. However, without this additional information, EPA expects criteria with a risk level above 1.0% would not be protective of the primary contact recreation use. This is because EPA's existing epidemiological data for freshwater are not adequate to establish a relationship between illness rates higher than 1.0% and the corresponding bacteria concentrations.

(EPA comments continued)

E. coli criteria for freshwater (bold font indicates current criteria in §307.7(b)(1)(A)(i) of 2000 Texas *Surface Water Quality Standards*).

Risk Level (% of swimmers)	Geometric Mean Density	Single Sample Maximum Allowable Density (colonies per 100 ml)			
		75th percentile	82nd percentile	90th percentile	95th percentile
0.8	**126**	235	298 *	409	575
0.9	161	301	382	523	736
1.0	206	385	489	668	940

* The single sample maximum in the 2000 Texas standards is 394 colonies per 100 ml. This value was calculated with a standard deviation based on water quality data from the state's monitoring programs (see additional information in option 2).

5. Conduct Use Attainability Analyses

For water bodies where there is reason to believe that recreational activities do not occur, even on a limited basis, a use attainability analysis could be conducted to determine if the recreation use is attainable. Use attainability analyses are required to demonstrate that a Clean Water Act §101(a)(2) goal use (e.g., contact recreation) is not attainable. If the use attainability analysis successfully makes this demonstration, a standards revision is required to change the designated or presumed use.

6. Use the Single Sample Maximum Criteria for Specific Purposes rather than Use Attainment Decisions

EPA notes that the term "maximum" in single sample *maximum* has led to some confusion as a plain reading would lead one to infer that a single sample maximum is a value not to be exceeded. The single sample maximum values in the 1986 bacteria criteria were not established as "never-to-be exceeded" or "maximum" values. States have the discretion to determine whether to include a single sample maximum in their water quality standards for inland waters. For example, states could establish water quality standards that include single sample maximum criteria for inland waters, but only for use in beach monitoring and notification programs. Likewise, while a single sample maximum criterion for coastal waters must be included in water quality standards, the state may decide not to use this value for determining attainment of standards under the Clean Water Act as long as this is clearly specified in the state's standards.

Single sample maximum criteria are useful in several Clean Water Act applications. Single sample maximums provide a valuable tool against which to measure individual grab samples as part of a monitoring and notification program to protect public health. Single sample maximums can also be helpful in water body assessments, particularly when states collect insufficient data to reliably average and compare to the geometric

(EPA comments continued)

mean component of the criteria. Lastly, single sample maximums can serve as daily limits in certain NPDES permits.

7. Limit Application of Bacteriological Criteria in Waters Affected Solely by Non-human Sources

The following paragraph is found in the final rule promulgating EPA's recommended indicators and criteria for use in coastal recreation waters. (Rule and other information at: http://www.epa.gov/waterscience/beaches/bacteria-rule.htm). While this rule is specific to coastal waters, the policy regarding the application of bacteriological criteria in waters impacted by non-human sources applies to inland freshwaters as well:

"States and Territories must apply the *E. coli* and enterococci criteria to all coastal recreation waters. If, however, sanitary surveys and epidemiological studies show the sources of the indicator bacteria to be non-human and the indicator densities do not indicate a human health risk, then it is reasonable for the State or Territory to not consider those sources of fecal contamination in determining whether the standard is being attained. This is the approach taken in the 1986 bacteria criteria document. It would be reasonable for a State or Territory to use existing epidemiological studies rather than conduct new or independent epidemiological studies for every water body if it is scientifically appropriate to do so."

TAMU's Biological and Agricultural Engineering Comments

January 9, 2007

Pathogen Transport in Surface and Subsurface Systems at Different Space and Time Scales - A Roadmap: Fundamental Understanding to Advanced Modeling

The task force has produced a very comprehensive report on the need and possible approaches to be undertaken to address the daunting task of bacteria TMDL for sustaining and improving the quality of water resources in the state of Texas in the coming years and decades. While we agree with most of the issues and approaches proposed, we tried to summarize the vision of the Biological and Agricultural Engineering faculty emphasizing a focused need of basic science and engineering questions relating bacteria TMDL below:

Faculty Expertise:
Binayak Mohanty – Flow and Transport Physics and Conceptual Modeling, Biogeochemistry in un/saturated medium, Spatial Variability, Scaling Techniques, Forward/Inverse Numerical Modeling, Air/Space-Based Remote Sensing, and
4-Dimensional Data Assimilation

Vijay Singh – Watershed Hydrology, Surface Hydrologic Modeling, Entropy Theory / Monitoring Design, and Data Analyses

Patti Smith – Surface Hydrologic Modeling, Land Cover Land Use Change Effects on Hydrology, Stochastic Modeling and Uncertainty Analyses

Raghupathy Karthikeyan – Contaminant Fate and Transport and Applications of GIS

Clyde Munster – Watershed Hydrology, Best Management Practices, Field Experiments, GIS, and Applied Modeling

Yong Huang – Physicochemical Processes in Water Engineering, Dynamics of Colloidal Processes in Aquatic Systems, Geochemistry, Contaminant Transport, and Field Studies

Saqib Mukhtar – Animal Waste Management, Water Quality, Education and Outreach

Bruce Lesikar – Waste Water Treatment, Education and Outreach

&
Others

Biological and Agricultural Engineering
Texas A&M University

January 9, 2007

(TAMU BAEN comments continued)

Statement of need/Description: This program will address the critical issue facing the State of Texas regarding the presence of pathogens in our water resources. The Total Maximum Daily Load (TMDL) process has identified pathogens as a major contributor to the degradation of the State's water resources. While we agree that there does need to be a methodology in place that maximizes benefit while reducing time of implementation and cost as described in "Recommended Decision-Making Process for Texas TMDL and I-Plan Development", we also believe that fundamental research remains to be done in all areas concerning the fate and transport of bacteria in Texas waterways. Effective methods are needed to remove, track, describe and model pathogens.

Relevance/Background: Bacterial TMDLs are being developed for the Leon River, White Oak Bayou and Buffalo Bayou. These TMDLs are attempting to allocate the pathogen load in the water resources to the sources in the watershed. The end goal is to improve the quality of the water resource by reducing the concentration of pathogens to a level below acceptable water quality standards. Effective implementation of this program will require a thorough understanding of where the pathogens are originating, how effective are the best management practices at preventing pathogens from reaching the streams, what processes are occurring during transport to the water resource, what happens to the pathogens while in the water resource and how can this process be modeled. In addition, we need to quantify the limitations of current technologies and models used to measure, monitor and predict indicator bacteria species, in the form of uncertainty estimates on measured and predicted values. All of these questions will need to be answered through a comprehensive approach to evaluating pathogen cycling in the environment.

Goals: These recommendations will develop methods to describe and predict the processes associated with pathogen load, transport, die-off, and regrowth in our water resources.

1. <u>Source, Fate and Transport – Data Collection, Process Understanding, and Modeling</u>

    a. Determine background levels of bacteria in representative watersheds in the various regions throughout the State of Texas. Samples would be collected at the source, catchment, stream, and lakes/reservoirs. Study catchments will include both rural and urban settings. This would permit an assessment of existing bacteria levels as a function of climate, land use, topography, soil type, wildlife population, etc. Bacteria

(TAMU BAEN comments continued)

growth/die-off/regrowth patterns will be very different in the humid gulf coast region to the more arid regions of west and north Texas.

b. Determine the effect of sediment resuspension on the rate of bacteria growth/die-off/regrowth patterns.
c. Develop multi-scale data collection protocols in the surface and subsurface systems. In the surface system samples will be collected at the source, catchment, stream, and lakes/reservoirs. Study catchments will include both rural and urban settings. In the subsurface system data will be collected for a better understanding of spatio-temporal evolution of bacteria at the pore, core, pedon and plume scales. Relative significance of surface versus subsurface transport processes will be evaluated. In addition, most important surface and subsurface environmental factors controlling bacteria fate and transport will be determined.
d. Determine the true bacterial loads from "permitted" WWTP.
e. Establish protocols and QC plans for the collection of water samples for evaluation of bacteria concentrations including quantifying the uncertainty in these measured data.
f. Develop biogeochemistry-based fate and transport modeling and scaling rules for pathogen loads in surface and subsurface systems across space-time scales.

2. <u>Develop tools and models for tracking pathogen</u>
    a. Utilize advanced genetic / molecular biology (including nano- and atomic scale) techniques to monitor/characterize the pathogen characteristics which tie pathogens in our surface and subsurface water resources to their source.
    b. Develop streamline based history matching techniques and other inverse modeling tools to model bacterial fate and transport in surface and subsurface systems.

3. <u>Describe the processes associated with pathogen transport during the use of various best management practices (BMPs) utilized to manage waste</u>.
    a. Evaluate the effectiveness of current BMPs used for sediment/nutrient control to reduce bacterial loads. It seems that some of the current BMPs used for stormwater control won't be effective for retaining bacteria.
    b. Develop new BMPs that address all constituents of concern in stormwater runoff.

4.

(TAMU BAEN comments continued)

5. Evaluate methods to improve the current models used to predict pathogen transport from the various sources to our water resources.
    a. Evaluate the parameter uncertainty in models to use as a guide for pinpointing where time and effort is best spent to improve predictions of water quality. A recent uncertainty analysis of HSPF showed that peak in-stream fecal coliform concentrations are most sensitive to the parameter used to represent the maximum storage of fecal coliform bacteria on pervious land segments and to the amount of surface runoff needed to remove 90% of the water quality constituent from a pervious land segment. A subsequent First Order Analysis showed that 99.86% of the variance in simulated peak in-stream fecal coliform concentration was contributed by the maximum storage parameter. These results were directly related to the difficulty in finding reliable values for these types of parameters given the current state of research. This leads to the question, can the model as it is be improved or would it be better to develop a new bacteria subroutine that relies less on assumption and more on the basic transport and dynamic nature of bacteria in water and on the land surface? The other question that needs to be asked is if we do develop more physically based models that include an even wider range of parameters does this decrease or increase the uncertainty in the model results. Certainly a more physically based, process model may reduce model uncertainty, but may increase parameter uncertainty as more and more parameters are added to the mix.
    b. Establish modeling protocols for urban vs. rural watersheds. The approach to modeling these is likely to be very different.

6. Develop basic approaches to modeling pathogen transport from the source to State water resources.
    a. Perform experiments from lab to field scale to understand how bacteria move both across the surface and through the soil profile.

7. Develop the informational resources to convey this knowledge to the engineering consultants, decision makers and general public.
    a. Key to this process is risk assessment and communication. What are the risks associated with the various pathways of human contamination by fecal coliform? How do you communicate the science to stakeholders? The perception today is that we are just guessing (what we like to call estimating). How do we change that perception?

(TAMU BAEN comments continued)

Capitalizing on the expertise of BAEN water faculty, the following six overarching research objectives are proposed to accomplish a comprehensive understanding of bacteria/pathogens fate and transport and to develop predictive models.

Broad Research Objectives

1. *To identify, characterize, and quantify pathogen sources.*

Key Sources:

- Livestock
- Wildlife
- Pets
- Human

2. *To study key governing processes of fate and transport of microbial pathogens in terrestrial water and soil (porous media).*

Key Processes:

- Advection and Dispersion
- Deposition/Adsorption and Release
- Inactivation and Die-off
- Coupled Bio-Geo-Chemical processes
- Dominant Transport Mechanism under Laminar and Turbulent Flow Conditions
- Preferential Transport over Land and in Subsurface
- Other (Space and Time) Scale-Appropriate Transport Processes!

3. *To investigate key anthropogenic and environmental factors and their characteristic properties (and inter-relationships) controlling the fate and transport processes of microbial pathogens in surface water and porous media for rural/urban catchments/watersheds.*

Key Factors:

- 3-D Hydrologic Setup, Initial/Boundary Conditions, and Forcings
- Precipitation
- Temperature
- Stream flow
- Runoff
- Infiltration
- Irrigation and Drainage
- Pathogen Type

(TAMU BAEN comments continued)

- Soil and Mineralogy
- Topography
- Vegetation
- Animal Populations
- Sediment
- Nutrients
- Agricultural/Cropping Practice
- Waste water treatment facilities
- Soil and Water Management Practice
- Surface/Ground Water Interface and Interaction

4. *To develop (deterministic/stochastic) conceptual and numerical models to describe the transient pathogen transport in runoff, stream, and unsaturated/saturated porous media with embedded hydrological, and biogeochemical heterogeneity at multiple spatial scales.*

Spatial Scales:

- Molecular/Process scale
- Pore Scale
- Continuum/Column Scale
- Representative Elementary Area/Volume Scale
- Plot/Pedon Scale
- Field/BMP Scale
- Catchment Scale
- Watershed/Aquifer Scale

5. *To test the conceptual and computer model with controlled experiments at lab and field scales and develop inverse modeling algorithms for model parameter(s) estimation and study the process/parameter uncertainty*

- Micromodel Experiments
- Controlled Lab Column/Lysimeter Experiments
- Field/Catchment-Scale Experiments
- In-Stream Pathogen-Sediment-Nutrient Interaction Experiments
- Novel BMP/Pathogen Experiments
- Watershed Monitoring and Data Analyses
- Inverse Modeling and Data Assimilation
- Parameter Uncertainty Analyses

(TAMU BAEN comments continued)

6. *To identify and quantify scaling features (spacing, extent, support) for developing long-term monitoring protocol for pathogens across space and time in terrestrial environment*

- Time Series Analyses
- Entropy Analyses
- Geostatistical Analyses
- GIS Tools
- Insitu vs. Possible Remote Sensing Techniques
- Discrete vs. Lumped Measurement Techniques

United States Department of the Interior

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January 25, 2007

MEMORANDUM

To: Robert L. Joseph
Director, USGS Texas Water Science Center

From: Donald M. Stoeckel
Hydrologist, USGS Ohio Water Science Center

Subject: Texas Bacteria TMDL Task Force -- Report draft 12/4/2006 and meeting 12/18/2006

At your request, I've been a participant in the Texas Bacteria TMDL Task Force meetings that began in October 2006. The task force is closing in on a final product. I would like to offer the following comments related to the most recent report draft and the discussions at the meeting on 12/18/2006. As requested by the Task Force leaders, my comments are formulated as recommended text for the final report (plain text) with explanations (italics).

deleted USGS internal comments—DMS

Thank you for inviting me to participate in this process. The experience has been an education for me and I hope I've been able to provide useful information to the Task Force.

The statement made during the meeting of 12/18 that library-dependent MST is capable of providing quantitative allocation of fecal contamination to sources is debatable. My perspective is that quantitation by library-dependent MST is so uncertain as to be suitable for simple presence and absence categorization (or possibly major, minor, or absent categorization). The following hypothetical data set illustrates this point.

Taken at face value, the results in the following example indicate that each source contributes to each sample except, probably, wildlife in sample 4. The ARCC of 62% would be taken by many

(USGS comments continued)

MST researchers as evidence that the library was capable of accurately classifying isolates. In the current state of the science, water-quality modelers would be tempted to take the data at face value and, for sample 1, allocate 10% of the fecal load to human sources, 52% to domestic animals, and 38% to wildlife.

Hypothetical sample data

# isolates	Total	Human	Domestic	Wildlife
Sample 1	100	10	52	38
Sample 2	100	35	46	19
Sample 3	100	15	72	13
Sample 4	100	42	56	2

Hypothetical quality-control data (compare to Wiggins et al., 2003, Stoeckel et al., 2004 and Moore et al., 2005)

# isolates	Total	Human	Domestic	Wildlife
Human (+)	100	**62**	12	26
Domestic (+)	100	23	**58**	19
Wildlife (+)	100	12	23	**65**

Rates of correct classification are **BOLD**
The average rate of correct classification is 62%
NOTE: higher accuracy than observed in studies cited

Minimum detectable percentage (MDP; calculated as in Whitlock et al., 2002 and Wiggins et al., 2003)

	Human	Domestic	Wildlife
Frequency of misclassification	18%	18%	23%
Average misclassification	19%		
Standard deviation:	3%		
MDP (Avg+4*SD):	**31%**		

Credible evidence of presence based on MDP

	Human	Domestic	Wildlife
Sample 1	No	Present	Present
Sample 2	Present	Present	No
Sample 3	No	Present	No
Sample 4	Present	Present	No

Proportion true identity in each class (P; bold is true positive)

# isolates	Human	Domestic	Wildlife
Human (test)	**0.64**	0.24	0.12
Domestic (test)	0.13	**0.62**	0.25
Wildlife (test)	0.24	0.17	**0.59**

Lower confidence limit per sample (True positive*test result)

	Human	Domestic	Wildlife
Sample 1	6	32	22
Sample 2	22	29	11
Sample 3	10	45	8
Sample 4	27	35	1

Upper confidence limit per sample (test + false negative)

	Human	Domestic	Wildlife
Sample 1	26	61	52
Sample 2	45	58	35
Sample 3	27	78	33
Sample 4	50	66	21

Credible evidence that one source contributes more than another

	Human	Domestic	Wildlife
Sample 1	<Domest	>Human	No
Sample 2	No	No	No
Sample 3	<Domest	>Others	<Domest
Sample 4	>Wildlife	>Wildlife	<Others

(USGS comments continued)

Refinement of interpretation to include a minimum detectable percentage (MDP) is recommended (USEPA MST guide document) to guard against false-positive results. In general, library-dependent methods have been shown to find all sources in all samples. (See the results of the Southern California Coastal Waters Research Program methods-comparison study, Journal of Water and Health, Harwood et al., Myoda et al., 2003.) The MDP calculated from the hypothetical quality-control data in this example is 31% -- in sample 1, there is not credible evidence that humans contribute at all. In fact, by this criterion, no more than two sources can be credibly depicted as "present" in any of the four hypothetical samples.

The process for bracketing percent classifications with confidence intervals has not yet been proposed in the literature. In the example, I calculated a conservative minimum confidence limit by reducing the observed values by the misclassification rate for positive-control isolates in the quality-control data. I calculated a conservative maximum limit by increasing the observed values by the number of isolates that might have been misclassified to another source. Credible evidence that one source contributes more than another was indicated if the upper and lower confidence limits for two categories did not overlap. Continuing with the example of sample 1, there was no credible difference between domestic and wildlife inputs (human was previously categorized as "no credible evidence of presence").

I hope this example is a convincing illustration of my perspective that, in most cases, library-dependent methods cannot provide quantitative allocation of fecal contamination loads to source with sufficient certainty to be incorporated into water-quality models.

This issue is raised, in part, in the summary passage for regulatory expectations on page 28
"Alternatively, a higher number of E. coli isolates (e.g. 50) can be analyzed from fewer water samples to identify statistically significant differences in pollution sources. However, this will only provide pollution source identification on very limited time scales, and not an overall assessment of the waterbody." *The implication is that statistically significant differences may be calculated by use of library-dependent methods. This implication was stated explicitly during the meeting of December 18th.*

Consider adding the following:

Although quantitative allocation of fecal contamination to source categories is a goal of most TMDL projects, uncertainty in classification limits our capacity for absolute quantitation. In some cases, library-dependent methods may enable identification of a source that contributes more fecal contamination than other sources, or identification of sources for which there is no credible evidence of substantial contamination. The results of library-dependent classification are conservatively seen as semiquantitative and suitable for sample-level classification of sources as "contribution not detected" or "contribution detected" with possible refinement to "contribution detected greater than (alternative source)." This information may not be suitable for incorporation into quantitative water-quality models.

ERIC-PCR
Consider adding two aspects to this section:

ERIC primers are used much less commonly than the BOX A1R primer in the literature; many of the early MST studies and related studies used REP primers.

(USGS comments continued)

Repetitive DNA elements include BOX, ERIC, and REP (reference Versolavic). Each has been used for rep-PCR in microbial source tracking studies (reference Carson, Dombek, Hassan , Stoeckel, and/or Myoda, in addition to the others).

In general, rep-PCR fingerprints are not reproducible from lab-to lab. Though the major bands in a fingerprint are generally present, the calculated similarities can be quite low. At this point, the only way to share rep-PCR fingerprints among laboratories is to use Sadowsky's HFERP or Diversilab's reagent packs and/or the Bioanalyzer. Consider the following sentence to complement the mention of the Ribotyper in the next section.

Though the rep-PCR banding patterns for a primer tend to be generally stable, minor differences between laboratories result in low between-laboratory similarity and currently limit the ability to generate a composite library in multiple laboratories. Two analytical strategies that enhance data similarity between laboratories are the use of horizontal fluorophore-enhanced rep-PCR (HFERP; Johnson et al., 2004) or a commercially packaged product such as the DiversiLab system (http://www.bacbarcodes.com/).

Future directions
I have comments on two passages in this section:

"More importantly, these library-independent methods can only detect a limited range of pollution sources. For example, the Bacteroidales PCR (Bernhard and Field 2000; Dick, Bernhard et al. 2005) can detect fecal pollution from ruminants, humans, horses and pigs; but no further discrimination is possible."

Further discrimination may be possible as the field progresses – the limitation is in the number of source-associated markers that have been developed and validated thus far.

"Identification libraries consisting of thousand of isolates from different geographical regions in Texas have already been established for ERIC-PCR, PFGE, RiboPrinting, CSU and KB-ARA patterns. In addition, several thousand more E. coli isolates from source samples have been archived and are available to researchers. Library development is one of the most costly components of BST studies. It would be most economical to build upon the libraries already established in Texas. It is recommended that agencies use contractors that use BST methods that will strengthen and expand the current Texas library."

Questions raised related to the geographical and temporal stability of library-independent markers are also relevant to libraries (as mentioned in the next paragraph of the document). The apparent advantage of having existing libraries may be not be useful in all areas of Texas, and the investment represented by existing libraries will almost certainly diminish in value over decades. Maintenance and updating the existing library with additional isolates to keep it relevant is a heavy liability.

I believe the economic tradeoff between developing and validating more source-associated markers and investing further in library development is not as clear as stated. The process of extracting the composite sample DNA and testing for markers is less costly than cultivating multiple fecal indicator isolates and typing them by molecular methods.

(USGS comments continued)

Also, the recommendation to use contractors and expand the current Texas library may be a reflection of opinion as much as it is a reflection of the state of the science. It will be very difficult to ensure comparability of data as multiple facilities add to the library database. Library expansion and application over larger areas and timeframes may not generate the anticipated high-quality data needed for application in TMDL efforts. Consider the following test for this paragraph:
If pursued, expansion of the current Texas library should incorporate accepted and consistent methods by experienced organizations, with substantial quality control, so data potentially can be combined into a statewide database.

References:

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