Texas State Soil and Water Conservation Board
State Nonpoint Source Grant Program
FY2015 Project 15-52

PROJECT SUMMARY PAGE			
Title of Project	Statewide Bacterial Source Tracking Program for FY 2015		
Project Goals	Support BST analyses across the State through (1) maintenance of analytical infrastructure at public BST laboratories; (2) further evaluation of the Texas *E. coli* BST Library, naturalized *E. coli*, and cosmopolitan or transient *E. coli* strains; and (3) further development of suitable source-specific bacterial markers for library independent BST; (4) targeted BST analysis; and (5) delivery of informational materials on the use and applicability of BST and the State-supported analytical labs.		
Project Tasks	(1) Project Administration; (2) Quality Assurance; (3) Analytical Laboratory Capacity, Library Exploration and Refinement, and Methods Development; (4) Targeted BST Analysis; (5) Outreach on Bacterial Source Tracking		
Measures of Success	• Updated BST template-SOPs • Targeted BST supporting watershed planning efforts • Evaluation of geographic & temporal stability of expanded Texas *E. coli* BST Library • Initiation of naturalized *E. coli* population characterization in selected watersheds • Development & evaluation of source-specific bacterial markers for library-independent BST • Outreach through website and delivery of BST informational materials to water resource professionals across the state and nation		
Project Type	Implementation ( ); Education ( ); Planning ( ); Assessment (X); Groundwater ( )		
Status of Waterbody on *2012 Texas Integrated Report*	Segment ID Statewide	Parameter of Impairment or Concern bacteria	Category 4 and 5
Project Location (Statewide or Watershed and County)	Statewide		
Key Project Activities	Hire Staff (X); Surface Water Quality Monitoring ( ); Technical Assistance ( ); Education ( ); Implementation ( ); BMP Effectiveness Monitoring ( ); Demonstration ( ); Planning ( ); Modeling ( ); Bacterial Source Tracking (X); Other ( )		
2012 Texas NPS Management Program Reference	• Component 1 – LTG Objectives 1, 2, 3, 6 • Component 1 – STG 1C • Components 2, 3, 5		
Project Costs	$215,842		
Project Management	• Texas Water Resources Institute • The University of Texas Health Science Center at Houston School of Public Health, El Paso Regional Campus • Texas A&M AgriLife Research, Department of Soil and Crop Sciences • Texas A&M Institute of Renewable Natural Resources		
Project Period	September 1, 2014 – May 31, 2016		

Part I – Applicant Information

Applicant							
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Co-Applicant							
Project Lead	George Di Giovanni, Ph.D.						
Title	Professor						
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Co-Applicant							
Project Lead	Terry Gentry, Ph.D.						
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Project Partners	
Names	Roles & Responsibilities
Texas State Soil and Water Conservation Board (TSSWCB)	Provide state oversight and management of all project activities and ensure coordination of activities with related projects.
Texas Water Resources Institute (TWRI)	Project Coordination, Administration, and Reporting (Task 1), Quality Assurance (Task 2), Field Collections (Task 3), and Outreach (Task 5).
The University of Texas Health Science Center at Houston School of Public Health, El Paso Regional Campus (UTSPH EP)	Work in conjunction with AgriLife SCSC to perform all work described in Tasks 2-5.
Texas A&M AgriLife Research – Department of Soil and Crop Sciences (AgriLife SCSC)	Work in conjunction with UTSPH EP to perform all work described in Tasks 2-5.
Texas A&M Institute of Renewable Natural Resources (IRNR)	Maintain BST website as described in Task 5.1.

Part II – Project Information

Watershed Information

Watershed or Aquifer Name(s)	Hydrologic Unit Code (12 Digit)	Segment ID	Category on 2010 IR	Size (Acres)
Statewide	N/A	N/A	4 and 5	N/A

Water Quality Impairment

Describe all known causes (i.e., pollutants of concern) and sources (e.g., agricultural, silvicultural) of water quality impairments or concerns from any of the following sources: *2012 Texas Integrated Report*, Clean Rivers Program Basin Summary/Highlights Reports, or other documented sources.

The 2012 *Texas Integrated Report* identified 257 contact recreation use impairments (waterbody-pollutant combinations) and 15 oyster water use impairments due to excessive bacteria (*E. coli*, *Enterococcus spp.*, or fecal coliform). These bacteria impairments account for almost half of all impairments on the 2012 303(d) List. This is more than 3 times as many impairments as the next largest number of a specific impairment type/pollutant. These indicator bacteria originate from human (WWTF, OSSF) and animal (wildlife, pets, livestock, feral hogs) sources and reach waterbodies through point source discharges, direct deposition, and NPS runoff.

Project Narrative

Problem/Need Statement

According to the *2012 Texas Integrated Report*, there 272 impairments due to excessive bacteria. One key to effectively abating these impairments is the identification and assessment of fecal pollution sources. Proper evaluation of these sources is needed to target best management practices and develop bacterial total maximum daily loads (TMDLs) or watershed protection plans (WPPs). This information may also be useful to properly assess risk in contact recreation, as many waterborne pathogens causing human illness do not colonize nonhuman hosts.

Use of genetic and biochemical tests which allow identification of the original host species is referred to as bacterial source tracking (BST). The premise behind BST is that genetic and phenotypic tests can identify bacterial strains that are host specific so that the original host species and source of the fecal contamination can be identified. While there has been some controversy concerning host specificity and survival of *E. coli* in the environment (Gordon, Bauer et al. 2002), this indicator organism has the advantage of being correlated with the presence of fecal contamination and being used for human health risk assessments. Thus, BST of *E. coli* has direct regulatory significance and standardized culturing techniques for water samples available, such as EPA Method 1603 (USEPA 2005).

BST is a valuable tool for identifying sources of fecal pollution. Comprehensive BST has been completed by UTSPH EP and AgriLife SCSC for the following watersheds: (1) Lake Waco and Belton Lake, (2) San Antonio area, (3) Lake Granbury, (4) Buck Creek, (5) Leon and Lampasas Rivers, (6) Little Brazos River tributaries, (7) Big Cypress Creek, (8) Leona River and (9) Attoyac Bayou. A Texas *E. coli* BST Library has been developed based on known source isolates from these and other (i.e. Upper Trinity River and Upper Oyster Creek) watersheds. The Texas *E. coli* BST Library (ver. 6-13) currently contains 1,524 *E. coli* isolates obtained from 1,358 different domestic sewage, wildlife, livestock and pet fecal samples. While this represents a significant step towards development of a statewide *E. coli* BST library, there remains a need for continued expansion of the library to include additional known source isolates from different Texas watersheds and different animal hosts. As the library is expanded, this will allow continued evaluation of the library for geographical stability and the diversity of source specific isolates to identify specific needs for future expansion and refinement of the library. Further, use of the Texas *E. coli* BST Library provides for significant cost and time savings for the identification of NPS pollution in the development of TMDLs and WPPs.

A Task Force on Bacteria TMDLs, jointly established by TSSWCB and TCEQ in 2006, outlined a strategy to address current and future bacterial TMDLs and Implementation Plans (Jones et al. 2009). The Task Force recommended using library-independent methods such as *Bacteroidales* PCR for preliminary qualitative analyses and library-dependent methods (e.g., ERIC-PCR and RP) if more quantitative data are required. Continued support of established BST analytical infrastructure, further development and evaluation of the Texas *E. coli* BST Library, and selection and assessment of additional library-independent BST markers will help achieve these Task Force recommendations.

The Task Force further recognized the continuing need for BST-related R&D and encouraged such. A growing number of studies demonstrate the potential for *E. coli* to become "naturalized" in soils and sediments and become part of the normal soil/sediment microflora (Brennan et al., 2010; Byappahahalli et al., 2012; Ishii et al., 2006; Ishii et al., 2007). If large, naturalized *E. coli* populations are present at a site, they could potentially be released during runoff events and contribute to water quality impairments. However, it is unclear whether these isolates are sufficiently distinct from isolates derived from known-source fecal samples currently in the Texas *E. coli* BST Library to allow for differentiation of naturalized vs. freshly excreted *E. coli*. Studies are needed to isolate presumptive naturalized *E. coli* from selected sites and characterize them via ERIC-RP for comparison to the Texas *E. coli* BST Library in order to assess the possibility of differentiating "naturalized" *E. coli* populations from those contributed from fresh fecal deposition.

Lastly, the state of BST science, methodologies, application and confidence continues to evolve. Continued outreach and technology transfer is needed to foster dialogue and collaboration and bring water resource managers up to speed on advances in BST technologies, methodologies, applications and results.

Project Narrative

General Project Description

Due to the current and anticipated need for BST studies in Texas, statewide BST analytical infrastructure needs to be maintained appropriately. This not only includes the needed maintenance and repairs of analytical equipment; but also the continued support, training, and retention of skilled personnel. To meet the needs of the State, BST analytical capabilities will be maintained at both UTSPH EP and AgriLife SCSC BST laboratories. Financial support will be used to hire and train lab personnel at UTSPH EP and AgriLife SCSC, continue refinement and evaluation of the Texas *E. coli* BST library, initiate evaluation of naturalized *E. coli* populations, continue work on marker development and evaluation, and support targeted BST analysis for watershed plans as directed by the TSSWCB.

The Texas *E. coli* BST Library is dynamic, with new isolates being added with each successive BST project. Under this project, UTSPH EP and AgriLife SCSC will collaborate to evaluate and refine the Texas E. coli BST library through data exploration and analysis of presumptive naturalized, cosmopolitan, and transient *E. coli* isolates. In order to quantify and characterize the possibility of naturalized *E. coli* populations occurring in soil and ultimately runoff, AgriLife SCSC, with assistance from TWRI, will install four small exclosures in un-grazed rangeland, cropland, and managed hay pasture catchments at the USDA-ARS Grassland Research Center in Riesel. Individual soil samples will be collected and composited from inside and outside each exclosure and enumerated for *E. coli.* For each sample containing *E. coli*, E. coli isolates will be isolated, verified, and archived for future analysis by ERIC-RP and comparison to the Texas *E. coli* BST Library. Presumptive naturalized *E. coli* isolates will also be characterized with ERIC-RP through collaborative work with the City of Houston.

AgriLife SCSC and UTSPH EP will continue work to evaluate and further develop/refine source-specific bacterial PCR markers. Specifically, efforts will be made to evaluate 1) additional wildlife known source fecal samples for human Bacteroidales HF183 marker, 2) additional deer fecal samples from across the state analyzed for the Bacteroidales HF 183 marker, and 3) addition of library-independent qPCR markers to the Texas BST toolbox. Further, TWRI, AgriLife SCSC and UTSPH EP will cooperate with other entities nationwide to ensure that the most up-to-date and accurate BST approaches are implemented in Texas by attending and participating in BST-related meetings, seminars and workshops, as appropriate, to learn of new and improved BST methods being employed elsewhere.

Finally, delivering educational and informational programming regarding BST continues to be a critical need. To this end, IRNR will continue to host and maintain the BST website (http://texasbst.tamu.edu/).

The website will be used to disseminate educational materials, project updates, science updates, and other outreach efforts to advance the science and application of BST in Texas and nationally. To provide greater outreach to water resource managers in Texas, the project team will promote the use of and provide resources on BST by participating in meetings, conferences, workshops, seminars, and other appropriate venues. As needed to support this, TWRI, UTSPH EP, and AgriLife SCSC will develop additional flyers, one-pagers, tri-folds or other appropriate printed media to 1) discuss the appropriate application of BST in identifying fecal contamination sources and 2) promote the analytical laboratory capability of public BST labs which the State has invested. As appropriate, TWRI will also include information about BST in its publications. Additionally, TWRI, UTSPH EP, and AgriLife SCSC will periodically meet with natural resource agencies to advance the general knowledge and understanding of agency staff on BST and to develop action strategies to address issues raised by agency staff regarding the use of BST in Texas.

Project Goals (Expand from Summary Page)

Support BST analyses across the State through (1) continued personnel support and operation and maintenance of analytical infrastructure at public BST laboratories; (2) continued development, updating and implementation of statewide BST template-SOPs for ERIC-PCR, RiboPrinting, and *Bacteroidales* PCR along with coordination amongst other entities conducting BST in the state to standardize methodologies employed; (3) delivery of information and materials that give an overview of BST activities in Texas to date and describe the use, capabilities and applicability of BST and the services provided by the State-supported analytical labs to local, state and national stakeholder audiences; (4) continued development of the Texas *E. coli* BST Library through evaluation of naturalized, cosmopolitan, and transient *E. coli* isolates; (5) further development of suitable source-specific bacteria markers for library independent BST; and (6) targeted BST.

Measures of Success (Expand from Summary Page)

- Updated BST template-SOPs for ERIC-PCR, RiboPrinting, and *Bacteroidales* PCR ensuring that template-SOPs include current methods, technologies and approaches.
- Maintain needed level of training of AgriLife SCSC and UTSPH EP personnel.
- Continued operation and maintenance of BST analytical equipment and support of personnel needs to sustain operating capability and expand the utilization of BST applications statewide.
- Targeted BST supporting watershed planning efforts in the Arroyo Colorado and other watersheds as directed by TSSWCB
- Evaluation of geographical and temporal stability of the Texas *E. coli* BST Library and diversity of source specific, cosmopolitan, transient, and naturalized *E. coli* isolates
- Initiation of naturalized *E. coli* population characterization in selected watersheds
- Development/evaluation of new source-specific bacterial markers (e.g., new markers for human, cattle, poultry, feral hog) for library-independent BST
- Continued outreach through a BST state of the science website (http://texasbst.tamu.edu/) that serves as a repository for collected/produced BST information and source of BST related materials, updates, meeting announcements for educational opportunities
- Continued outreach through delivery of BST informational materials describing the state of the science, applicability, usefulness, and analytical capabilities of State-supported BST laboratories to water resource professionals across the state and nation

***2012 Texas NPS Management Program* Reference (Expand from Summary Page)**
Components, Goals, and Objectives
Component 1 – Explicit short- and long-term goals, objectives, and strategies that protect surface… water.
LTG 1 – Objective 1 – Focus … available resources in watersheds and aquifers identified as impacted by NPS pollution
LTG 1 – Objective 2 – Support the implementation of state, regional, and local programs to prevent NPS pollution through assessment…
LTG 1 – Objective 3 – Support the implementation of state, regional, and local programs to reduce NPS pollution, such as the implementation of strategies defined in TMDL I-Plans, [and] WPPs…
LTG 1 – Objective 6 – Develop partnerships … to facilitate collective, cooperative approaches to manage NPS pollution.
Short-Term Goal One – Data Collection and Assessment – Objective C – Conduct special studies to determine sources of NPS pollution and gain information to target… BMP implementation.
Component 2 – Working partnerships and linkages to appropriate State, interstate, Tribal, regional, and local entities, private sector groups, and Federal agencies.
Component 3 – Balanced approach that emphasizes both statewide NPS programs and on-the-ground management of individual watersheds.
Component 5 – …Progressively address these identified waters by conducting more detailed watershed assessments…

References

Brennan, F. P., V. O'Flaherty, G. Kramers, J. Grant, and K. G. Richards (2010) "Long-term persistence and leaching of *Escherichia coli* in temperate maritime soils." Appl Environ Microbiol **76**(5): 1449-1455.

Byappanahalli, M. N., B. M. Roll, and R. S. Fujioka (2012) "Evidence for occurrence, persistence, and growth potential of *Escherichia coli* and enterococci in Hawaii's soil environments." Microbes Environ **27**(2): 164-170.

Gordon, D. M., S. Bauer, et al. (2002). "The genetic structure of *Escherichia coli* populations in primary and secondary habitats." Microbiology **148**(5): 1513-1522.

Ishii, S., W. B. Ksoll, R. E. Hicks, and M. J. Sadowsky (2006) "Presence and growth of naturalized *Escherichia coli* in temperate soils from Lake Superior watersheds." Appl Environ Microbiol **72**(1): 612-621.

Ishii, S., D. L. Hansen, R. E. Hicks, and M. J. Sadowsky (2006) "Beach sand and sediments are temporal sinks and sources of *Escherichia coli* in Lake Superior." Environ Sci Technol **41**(7): 2203-2209.

Jones, C.A., K. Wagner, G. Di Giovanni, L. Hauck, J. Mott, H. Rifai, R. Srinivasan, and G. Ward. 2009. Bacteria Total Maximum Daily Load Task Force Final Report. Texas Water Resources Institute Technical Report TR-341. College Station, TX: Texas A&M University.

USEPA (2005). Method 1603: Escherichia coli (E. coli) in water by membrane filtration using modified membrane-thermotolerant Escherichia coli agar (Modified mTEC). Washington, DC, Office of Research and Development, Government Printing Office.

Tasks, Objectives and Schedules				
Task 1	Project Administration			
Costs	$11,000			
Objective	To effectively administer, coordinate and monitor all work performed under this project including technical and financial supervision and preparation of status reports.			
Subtask 1.1	TWRI will prepare electronic quarterly progress reports (QPRs) for submission to the TSSWCB. QPRs shall document all activities performed within a quarter and shall be submitted by the 15th of March, June, September, and December. QPRs shall be distributed to all Project Partners and posted on the project website.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 1.2	TWRI will perform accounting functions for project funds and will submit appropriate Reimbursement Forms to TSSWCB at least quarterly.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 1.3	TWRI will host coordination meetings or conference calls with the TSSWCB, UTSPH EP, and AgriLife SCSC at least quarterly to discuss project activities, project schedule, communication needs, deliverables, and other requirements. TWRI will develop lists of action items needed following each project coordination meeting and distribute to project personnel.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 1.4	TWRI will work with AgriLife SCSC and UTSPH EP to develop a Final Report that summarizes activities completed, conclusions reached during the project, and the extent to which project goals and measures of success have been achieved.			
	Start Date	Month 1	Completion Date	Month 21
Deliverables	• QPRs in electronic format • Reimbursement Forms, and necessary supporting documentation, in hard copy format • Final Report in electronic and hard copy formats			

Tasks, Objectives and Schedules				
Task 2	Quality Assurance			
Costs	$2,000			
Objective	Develop and implement data quality objectives (DQOs) and quality assurance/control (QA/QC) activities to ensure data of known and acceptable quality are generated through this project. Update and implement statewide BST template-SOPs.			
Subtask 2.1	TWRI will work with UTSPH EP, AgriLife SCSC, and IRNR to develop a QAPP for activities in Tasks 3-5 consistent with *EPA Requirements for Quality Assurance Project Plans (QA/R-5)* (May 2006) and the *TSSWCB Environmental Data Quality Management Plan* (August 2007).			
	Start Date	Month 1	Completion Date	Month 3
Subtask 2.2	TWRI will submit revisions and necessary amendments to the QAPP as needed.			
	Start Date	Month 4	Completion Date	Month 21
Subtask 2.3	AgriLife SCSC and UTSPH EP will maintain and update, at least annually, the 7 statewide BST template-SOPs for collection of fecal samples for BST, isolation of *E. coli*, archival of *E. coli* isolates, ERIC-PCR, RP, pre-processing of water samples for *Bacteroidales* PCR, and *Bacteroidales* PCR consistent with *EPA Guidance for Preparing Standard Operating Procedures (SOPs) (QA/G-6)* and the *TSSWCB Environmental Data Quality Management Plan* so that they include the most recent advances in BST science, methodologies, markers and technologies.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 2.4	AgriLife SCSC and UTSPH EP will coordinate to ensure that needed personnel training is kept on par between the groups to ensure congruity statewide.			
	Start Date	Month 1	Completion Date	Month 21

Deliverables	• QAPP for Tasks 3-5 approved by TSSWCB in both electronic & hard copy formats • Approved revisions and amendments to QAPP • Updated statewide BST template-SOPs

Tasks, Objectives and Schedules				
Task 3	Analytical Laboratory Capacity, Library Exploration and Refinement, and Methods Development			
Costs	$82,842			
Objective	Support BST analyses across Texas, through continued operation and maintenance of BST laboratory analytical infrastructure, including equipment and personnel. Evaluate and refine the statewide *E. coli* BST library through data exploration and analysis of presumptive naturalized, cosmopolitan, and transient *E. coli* isolates. Presumptive naturalized *E. coli* isolates will be obtained through collaborative work with the City of Houston and a total of 25 isolates will be analyzed using ERIC-RP. Presumptive naturalized *E. coli* will also be collected from the Riesel watersheds and archived for further analysis in FY16. Develop and refine library-independent markers.			
Subtask 3.1	UTSPH EP and AgriLife SCSC will maintain BST analytical equipment (e.g., RiboPrinter) and general laboratory equipment. This includes securing maintenance contracts, replacement parts, and expendable supplies and purchase of a new computer for the UTSPH EP RiboPrinter system.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 3.2	UTSPH EP and AgriLife SCSC will retain (or hire) lab personnel, Graduate Students, and/or Postdoctoral Research Associates to 1) maintain laboratory operating capacities and technical expertise to conduct BST studies across the state, 2) aid in the evaluation, expansion and maintenance of the Texas *E. coli* BST Library, 3) evaluate library-independent methods and markers, and 4) provide support on TSSWCB projects.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 3.3	In order to quantify and characterize the possibility of naturalized *E. coli* populations occurring in soil and ultimately runoff, AgriLife SCSC, with assistance from TWRI, will install four small exclosures (built from plastic barrels, or similar) in each of 3 designated catchments (un-grazed rangeland, cropland, managed hay pasture) at the USDA-ARS Grassland Research Center in Riesel. Small, mesh-covered windows will be installed in each plastic container to allow for gas exchange. The open end of each exclosure will be buried in the soil to exclude inputs of *E. coli* from animals or water. One month after installation, four individual soil samples will be collected and composited from inside each exclosure. Four soil samples will also be collected and composited from outside of each exclosure. *E. coli* will be enumerated for each sample using EPA Method 1603. For each sample containing *E. coli*, up to 5 *E. coli* isolates will be isolated, verified, and archived. In FY16, these isolates will be analyzed by ERIC-RP for comparison to the Texas *E. coli* BST Library. A total of 25 presumptive naturalized *E. coli* isolates will also be characterized with ERIC-RP through collaborative work with the City of Houston.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 3.4	UTSPH EP and AgriLife SCSC will collaborate to evaluate the geographical and temporal stability, composition, average rates of correct classification (accuracy), diversity of source specific isolates, and further development and refinement needs of the Texas *E. coli* BST library, as the library is updated with new known-source isolates.			
	Start Date	Month 1	Completion Date	Month 21

Subtask 3.5	Using known source fecal material, AgriLife SCSC and UTSPH EP will utilize the best available bacterial indicators to evaluate and further develop/refine source-specific bacterial PCR markers. Specifically, efforts will be made to evaluate 1) additional wildlife known source fecal samples for human Bacteroidales HF183 marker, 2) additional deer fecal samples from across the state analyzed for the Bacteroidales HF 183 marker, and 3) addition of library-independent qPCR markers to the Texas BST toolbox. These fecal samples will primarily have been collected and archived as part of previous studies including the Arroyo Colorado project. Depending upon the outcome of the Arroyo Colorado sample collection, additional samples may be needed for specific animal groups (i.e., avian wildlife). If additional samples are needed, TWRI will collect and provide these samples to AgriLife SCSC and UTSPH EP, as appropriate.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 3.6	TWRI, AgriLife SCSC and UTSPH EP will cooperate with other entities nationwide to ensure that the most up-to-date and accurate BST approaches are implemented in Texas by attending and participating in BST-related meetings, seminars and workshops, as appropriate, to learn of new and improved BST methods being employed elsewhere.			
	Start Date	Month 1	Completion Date	Month 21
Deliverables	• Highlights of work performed included in QPRs and Final Report			

Tasks, Objectives and Schedules				
Task 4	Targeted BST Analysis			
Costs	$100,000			
Objective	Perform BST Analysis for Targeted Watersheds as directed by the TSSWCB			
Subtask 4.1	UTSPH EP will perform targeted BST analysis to support the Arroyo Colorado watershed protection plan development efforts.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 4.2	AgriLife SCSC will perform targeted BST analysis to support watershed protection plan development efforts as directed by the TSSWCB.			
	Start Date	Month 1	Completion Date	Month 21
Deliverables	• BST analysis for the Arroyo Colorado and other watersheds as directed by the TSSWCB.			

Tasks, Objectives and Schedules				
Task 5	Outreach on Bacterial Source Tracking			
Costs	$20,000			
Objective	Further outreach regarding BST and its application through improving the statewide knowledge base regarding current BST practices, scientific advances, improvements in the application of BST and incorporating information from other areas of the nation into the BST approaches utilized in Texas.			
Subtask 5.1	IRNR will host and maintain the http://texasbst.tamu.edu website to disseminate educational materials, project updates, science updates, notify readers about educational opportunities, and other outreach efforts to advance the science and application of BST in Texas and nationally.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 5.2	TWRI, UTSPH EP, and AgriLife SCSC will promote the use of and provide resources on BST by participating in meetings, conferences, workshops, seminars, and other appropriate venues. TWRI, UTSPH EP, and AgriLife SCSC will distribute educational brochures developed. As needed, TWRI, UTSPH EP, and AgriLife SCSC will develop additional flyers, one-pagers, tri-folds or other appropriate printed media, that can be used to 1) discuss the appropriate application of BST in identifying fecal contamination sources and 2) promote the analytical laboratory capability of public BST labs which the State has invested. As appropriate, TWRI will include information about BST in general, and this project specifically, in the txH2O magazine and Conservation Matters e-mail newsletter. Finally, TWRI, UTSPH EP, and AgriLife SCSC will periodically meet with natural resource agencies to advance the general knowledge and understanding of agency staff on BST and to develop action strategies to address issues raised by agency staff regarding the use of BST in Texas.			
	Start Date	Month 1	Completion Date	Month 21
Subtask 5.3	TWRI, UTSPH EP, and AgriLife SCSC will work with public and private laboratories and other researchers/academia across the state which are exploring the use of BST or engaged in BST in Texas about the methods and approaches recommended by the Task Force and being implemented by the State. UTSPH EP and AgriLife SCSC will work to ensure that methodologies and QA/QC mechanisms adopted by these other laboratories are as congruent as possible with SOPs utilized by UTSPH EP and AgriLife SCSC (subtask 2.1).			
	Start Date	Month 1	Completion Date	Month 21
Deliverables	• Summaries of outreach efforts included in QPRs and Final Report			

Part III – Financial Information

Budget Summary		
Category	Costs	
Personnel	$	57,641
Fringe Benefits	$	16,737
Travel	$	2,306
Equipment	$	0
Supplies	$	6,957
Contractual	$	98,109
Construction	$	0
Other	$	15,475
Total Direct Costs	$	197,225
Indirect Costs (≤ 15%)	$	18,617
Total Project Costs	$	215,842

Budget Justification		
Category	Total Amount	Justification
Personnel	$ 57,641	• TWRI Associate Director (0.1 FTE) = $8,304 • TWRI Program Manager (0.08 FTE) = $5,786 • TWRI Program Coordinator (0.10 FTE) = 3,976 • TWRI Communications Coordinators (0.16 FTE) = $5,632 • SCSC Associate Professor (0.091 FTE) = $9,824 • SCSC Postdoctoral Associate (0.5 FTE) = $21,000 • SCSC Undergraduate Student Labor (0.15 FTE) = $3,119
Fringe Benefits	$ 16,737	• Calculated at 18.0% of Personnel (10.3% for Graduate Students) to cover FICA, UCI, WCI, and retirement. Additional $647/mo. ($300/mo. For Graduate Students) prorated per %FTE is calculated for group health insurance.
Travel	$ 2,306	• TWRI Associate Director & Program Coordinator ($744) o Per diem ($75) o Lodging ($150) o Mileage ($519) • SCSC Assist. Prof. & Grad Students ($1,562) o National Meetings ($812) o State Meetings ($750)
Equipment	$ 0	• N/A
Supplies	$ 6,957	• SCSC supplies = $5,250 o Supplies for collecting naturalized *E. coli* samples ($800) o Supplies for *E. coli* enumeration in soil samples ($30 x 24 = $720) o *E. coli* isolation and verification supplies ($20 x 120 = $2,400) o Marker Eval/Development Supplies ($1,330) • Other project research supplies: printer toner and riboprinter supplies = $1,707
Contractual	$ 98,109	• UTSPH EP = $98,109
Construction	$ 0	• N/A
Other	$ 15,475	• GITR Lab Services (1 week/year @ $1,666.25/wk) = $1,666 • RiboPrinter Preventative Maintenance and Service (for RiboPrinters at both UTSPH EP and AgriLife SCSC) (TWRI) = $12,000 • General Maintenance/fees on equipment (SCSC) = $799 • NELAP Lab accreditation fees (SCSC) = $1,010
Indirect	$ 18,617	• 15% of Modified Total Direct Costs (Total minus Contractual >$25,000 per contract and Equipment)

Contractual Budget Justification – UTSPH EP		
Category	Total Amount	Justification
Personnel	$ 59,768	• El Paso PI (0.112 FTE in FY15) = $14,991 • El Paso Research Associate (0.6 FTE for 7.65 mos. in FY15) = $18,233 • El Paso Research Assistant (1.0 FTE for 7.65 mos. in FY15 + $780 longevity) = $26,544
Fringe Benefits	$ 17,995	• El Paso PI (0.112 FTE in FY 15 @ 24%) = $3,598 • El Paso Research Associate (0.6 FTE for 7.65 mos. @ 30%) = $4,319 • El Paso Research Assistant (1.0 FTE for 7.65 mos. @ 30%) = $10,078
Travel	$ 1,766	• PI travel & registration for state meetings
Equipment	$ 0	• N/A
Supplies	$ 5,783	• Presumptive naturalized *E. coli* isolation from water samples ($8*25) = $200 • ERIC-RP supplies ($8*25 ERIC, $45*25 RP) = $1,325 • Library independent marker supplies and sequencing = $3,664 • General Maintenance (Biological Safety Cabinet, freezers and refrigerators) = $594
Contractual	$ 0	• N/A
Construction	$ 0	• N/A
Other	$ 0	• N/A
Indirect	$ 12,797	• 15% of Modified Total Direct Costs