



**Texas State Soil and Water Conservation Board
Section 319(h) Nonpoint Source Program
FY 2006 Project 06-7 Grant Application**



NONPOINT SOURCE SUMMARY PAGE for the CWA, Section 319(h) Agricultural/Silvicultural Nonpoint Source Program			
Title of Project:	Monitoring and Educational Programs Focused on <i>Escherichia coli</i> Bacteria and Nutrient Runoff on Dairy Operations in the Leon Watershed.		
Project Goals/Objectives:	<ol style="list-style-type: none"> 1. Evaluate the presence of <i>Escherichia coli</i> bacteria and nutrients on livestock operations and determine the risks of movement of <i>E. coli</i> and nutrients to surface waters. 2. Educate livestock producers about best management practices to decrease <i>E. coli</i> bacteria and nutrients in runoff from livestock operations. 3. To determine the source(s) of <i>E. coli</i> in runoff from the sites and its relative contribution to the <i>E. coli</i> populations downstream of the waste application fields. 		
Project Tasks:	<ol style="list-style-type: none"> 1. Collect manure and wastewater samples from dairy operations in the Leon Watershed throughout the year. 2. Collect samples of surface water upstream and downstream of waste application fields and determine <i>E. coli</i> bacteria concentrations in all samples, and <i>E. coli</i> source of selected samples. 3. Install and evaluate selected best management practices (BMPs) on selected dairy fields. 4. Collect edge of field runoff water and erosion sediments to determine <i>E. coli</i> bacteria and nutrient load leaving the field based upon different BMPs. 		
Measures of Success:	<ol style="list-style-type: none"> 1. Improved use of buffer strips and other BMPs on livestock operations. 2. Reduced concentrations of <i>E. coli</i> and nutrients entering surface waters from livestock operations as measured by edge of fields and upstream and downstream sample collection. 		
Project Type:	Statewide (); Watershed Implementation/Education (X); Watershed Planning/Assessment (X); Watershed Protection ()		
Status of Water Body: 2002 Water Quality Inventory and 303(d) List	Segment ID: 1221	Parameter: Bacteria	Category: 5a
Project Location:	Leon River Below Lake Proctor		
Key Project Activities:	Hire Staff (); Monitoring (X); Regulatory Assistance (); Technical Assistance (); Education (X); Implementation (); Demonstration (); Other ()		
NPS Management Program Elements:	<ul style="list-style-type: none"> •Identification of nonpoint sources which potentially add significant pollution to impacted water bodies. •Identification of the BMPs and measures to reduce pollutant loadings from nonpoint sources. •Identification of programs to achieve implementation of BMPs. 		
Project Costs:	Federal:	\$438,357	Non-Federal Match: \$298,572
Project Management:	Total: \$736,929		
Project Management:	Texas AgriLife Research and Extension		
Project Period:	September 1, 2006 – August 31, 2010		

Part I – Applicant Information

Applicant							
Project Lead		Sam Feagley					
Title		Professor and State Soil Environmental Specialists					
Organization		Texas AgriLife Extension Service					
E-mail Address		sfeagley@ag.tamu.edu					
Street Address		Soil and Crop Sciences, Texas A&M University, TAMU 2474					
City	College Station	County	Brazos	State	Texas	Zip Code	77843-2474
Telephone Number	979-845-1460			Fax Number	979-845-0604		

Project Partners	
Names	Roles & Responsibilities
Sam Feagley	PI, nutrient and sediment runoff evaluation
Diane Boellstorff	Co-PI, data evaluation and water quality
Terry Gentry	Co-PI, source tracking
George D. Di Giovanni	Co-Investigator, source tracking
Todd Bilby	Co-PI, dairy science and data evaluation
Whit Weems	Assist with sample collection and education programs
Robert Scott	Assist with sample collection and education programs

Part II – Project Information

Project Type							
Surface Water	<input checked="" type="checkbox"/>	Groundwater	<input type="checkbox"/>				
Does the project implement recommendations made in a completed Watershed Protection Plan or approved TMDL Report or Implementation Plan?				Yes	<input type="checkbox"/>	No	<input checked="" type="checkbox"/>
If yes, identify the document.		(Note – The TMDL report is currently in the development stage.)					
If yes, identify the agency/group that developed and/or approved the document.					Year Developed		

Watershed Information				
Watershed Name(s)	Hydrologic Unit Code (8 Digit)	Segment ID	305 (b) Category	Size (Acres)
Leon Watershed	12070201	1221	5a	44 miles

Project Narrative

Problem/Need Statement

In 2002, the Leon River below Lake Proctor was listed as being impaired for bacteria according to the Texas Water Quality and 303 (d) lists. Due to the listing for impairment, the Leon River Watershed was selected by the Texas Commission on Environmental Quality (TCEQ) for the development of a TMDL. As of January 2006, the TMDL was in the developmental process. Part of the TMDL development includes modeling the various sources of bacteria in the watershed. However, much of the data used for the model was taken from literature sources due to a lack of actual data from the watershed. The limited data available from the watershed creates challenges in the determination of implementation strategies that will be the most successful in decreasing the amount of bacteria entering surface water in the Leon Watershed.

During the development of the TMDL for the Leon Watershed, livestock and waste application fields were implicated as being significant sources of bacterial loading to the Leon River. Through the finalization of the TMDL and the initiation of the implementation stage, an increased knowledge of the actual levels of bacteria in livestock waste and best management practices that reduce the runoff of bacteria from waste application fields will assist in decreasing movement of bacteria to surface water.

Actual data taken from sources in the Leon Watershed would assist in the development and implementation of the TMDL. Monitoring of bacterial sources listed in the TMDL will be beneficial in determining the sources of greatest bacterial concentrations and will assist in determining the risks associated with a variety of management practices on livestock operations.

Decreasing nutrient and bacteria loads in a watershed is dependent on the education of residents in the watershed. Providing resources to educate residents as to the best management practices that can be used to reduce movement of bacteria to surface waters is essential to the development of a successful TMDL implementation phase. Collection of data in the watershed will provide and increase understanding of bacteria loads in the watershed and will provide knowledge for areas that should be targeted to reduce the risks of bacteria from moving off the land and into surface waters.

Project Narrative

General Project Description

The overall objective of the project is to collect watershed specific data in an effort to quantify the major sources of *E. coli* bacteria on dairy operations. Information and data collected during the monitoring phase will be used in the development of an educational program focusing on best management practices (BMPs) to reduce the movement of *E. coli* bacteria and nutrients to surface waters. The educational program will equip dairy producers with the knowledge and understanding needed to reduce the possibility that their operations will be a source of bacteria and nutrients to the Leon River. The monitoring and the educational programs will be designed to coordinate with the development of a TMDL implementation plan or a watershed plan, and will provide information and assistance for future watershed planning needs.

The objective of the first task will be to determine the concentration of *E. coli* bacteria and nutrients present in dairy manure and wastewater throughout a period of 1 year. Samples of wastewater from dairy lagoons on 3 operations will be collected on a monthly basis. This information will be supplemented with the collection of manure and wastewater samples during field application over a 3 year period. The samples will be analyzed to determine the forms and sources of manure containing the greatest bacteria and nutrient concentrations, thus posing the greatest opportunity for improvement in management strategies.

The goal of the second task will be to assess the concentrations of *E. coli* bacteria and nutrients in surface waters that are located adjacent to waste application fields. Currently, buffer strips are used to reduce the movement of manure and wastewater to surface waters. Monitoring surface waters at upstream and downstream sites will assist in determining if the bacterial and nutrient concentrations are being increased as a result of the waste application field. In particular, application and storm events will be monitored as these events pose the greatest opportunities for movement of bacteria and nutrients to surface water.

A total of four sites within two fields will be selected for the evaluation of BMPs. Within each of the four sites, buffer strips, managed and unmanaged, will be established to give a total of 9 plots. The two fields will consist of three manured (wastewater, vacuum manure, dry manure) fields (corn, hay, and pasture). The manured fields will have buffer strips, one managed and one unmanaged. Each field will be set up for edge of field monitoring using ISCO samplers. An ISCO will be placed prior to the buffer at the edge of the field and after each buffer at the edge of that land management unit (LMU). Runoff from storm events will be collected by the ISCOs. Grab samples will be collected up and down stream from the LMU. *Escherichia coli* numbers and nutrients will be analyzed from each runoff sample and dissolved oxygen will be analyzed on the grab samples. Bacterial source will be analyzed on selected downstream samples.

Rainfall simulations will also be conducted on the field and the buffer strips. Rainfall simulations will be conducted to measure simulated runoff *E. coli* and nutrient (runoff and soil samples: nitrate-N, P, K, Ca, Mg, Na, S, pH, and electrical conductivity (EC)) levels from field sites. A Phosphorus Index (PI) will be determined for each of the fields and specific locations within each plot for the simulations will be selected that best represents the PI characteristics and properties upon which the characterization was based. The rainfall simulations will be conducted using a Tlaloc 3000 rainfall simulator built by Joern=s Inc. All rainfall simulation procedures will be conducted in accordance with the Sera-17 National P Project guidelines for rainfall simulations. A total of 4 rainfall simulations will be conducted at each of the 9 locations. Runoff samples (100 mL) will be collected during each simulation at seven intervals (5, 10, 15, 20, 25, and 30 minutes plus a composite) after runoff is initiated. Each of the timed interval samples will be acidified to pH 2 in the field with HCl. Two composite samples will be collected, one for all sample analyses except NO₃⁻-N that will be acidified and one for NO₃⁻-N that will not be acidified. Total runoff volume will be recorded. Water samples will be analyzed for *E. coli* and nutrients. Soil samples (0-2, 2-6, and 0-6 inches) will also be collected for each rainfall simulation.

Water Quality Impairment

Describe all known causes (pollutants of concern) of water quality impairments from any of the following sources: 2002 Water Quality Inventory and 303(d) List, 2002 Summary of Waterbodies with Water Quality Concerns (Secondary Concerns List) or Other Documented Sources (ex. Clean Rivers Program Basin Summary or Basin Highlights Reports).

In the 2002 Water Quality Inventory and 303 (d) List, the Leon River Below Lake Proctor was listed as being impaired for bacteria. The areas listed included the portion of segment north of Gustine and the portion of segment west of U.S. Hwy 281.

The 2002 Summary of Water Bodies with Water Quality Concerns lists the Portion of segment west of U.S. Hwy 281 of the Leon River Blow Lake Proctor as having an Algal Growth Concern with the concern being excessive algal growth.

The 2002 Summary of Water Bodies with Water Quality Concerns lists the Upstream portion of the segment of the Leon River Blow Lake Proctor as having an Algal Growth Concern with the concern being excessive algal growth.

Project Goals

The overall goal of the project will be to educate dairy producers in the Leon Watershed and neighboring communities as to the implementation of BMPs to reduce the risks of *E. coli* bacteria and nutrients (runoff water and soil samples: nitrate-N, P, K, Ca, Mg, Na, and S plus pH and EC) from entering surface water. The project will include monitoring and demonstration activities to assist in the quantification and source (on selected samples) of bacteria and nutrient concentrations in dairy manure and wastewater. The data collected in the watershed will increase the knowledge of BMPs individuals can implement to assist in reducing bacterial loads on the entire watershed.

Specific aims of this project are to develop a database of manure and wastewater samples. Collection of the samples will provide a means to determine the variation in bacteria and nutrient concentrations in different forms of manure and from lagoons receiving different manure sources. The database will also include temperatures of manure at the time of collection to determine the affect of temperature on *E. coli* survival.

The information collected during the monitoring and demonstration tasks will be used to develop educational materials targeted at dairy producers. Educational materials and programs will focus on educating dairy and other livestock producers as to the presence of *E. coli* bacteria and nutrients in the watershed. The educational programs will focus on BMPs producers can use to reduce the risk of the movement of *E. coli* bacteria and nutrients to surface waters. In addition to education on management practices, results of the monitoring and assessment activities will be shared with producers to highlight the areas of greatest concern when dealing with *E. coli* bacteria and nutrients.

Tasks, Objectives and Schedules						
Task 1:	Development of a QAPP.					
Costs:	Federal:	\$5,000	State:	\$3,508	Total:	\$8,508
Objective:	To develop a QAPP to outline the protocol and procedures used during the collection and analyses of samples for the entire project.					
Subtask 1.1:	Develop QAPP for entire project.					
	Start Date:	Month 1		Completion Date:	Month 6	
Deliverables	•QAPP.					

Tasks, Objectives and Schedules						
Task 2:	Evaluation of <i>E. coli</i> concentrations in manure and wastewater from dairy operations.					
Costs:	Federal:	\$121,757	State:	\$83,348	Total:	\$205,105
Objective:	To determine the concentrations of <i>E. coli</i> bacteria and nutrients in manure and wastewater on dairy operations throughout a year.					
Subtask 2.1:	Collection of wastewater samples from dairy lagoons on a monthly basis to determine <i>E. coli</i> and nutrient concentrations. Genetic fingerprints of <i>E. coli</i> isolates will be compared to a developing statewide source tracking library (Texas AgriLife Research-El Paso AREC). <i>E. coli</i> will be isolated from each potential source and fingerprinted using a combination of the enterobacterial repetitive intergenic consensus sequence-polymerase chain reaction technique (ERIC-PCR) and RiboPrinting. Dairy lagoon wastewater samples will also be analyzed for <i>Bacteroides</i> the presence of the ruminant genetic marker. Nutrient analyses will include nitrate- by the Cd reduction method; P, K, Ca, Mg, Na, and S by inductively coupled plasma (ICP), and; pH and EC.					
	Start Date:	Month 1		Completion Date:	Month 36	
Subtask 2.2:	Collection of dairy wastewater samples at the time of field application to determine <i>E. coli</i> and nutrient concentrations. Samples will be collected approximately 6 times per year.					
	Start Date:	Month 20		Completion Date:	Month 47	
Subtask 2.3:	Collection of manure (6 times per year) being applied to the field that has been removed from the facility via a vacuum system and scraped from the lot to determine <i>E. coli</i> , and nutrient concentrations.					
	Start Date:	Month 20		Completion Date:	Month 47	
Deliverables	<ul style="list-style-type: none"> •<i>E. coli</i> and nutrient concentrations in dairy wastewater over the period of 1 year •<i>E. coli</i> and nutrient concentrations in fresh dairy manure •<i>E. coli</i> and nutrient concentrations of dairy manure and wastewater at the time of application 					

Tasks, Objectives and Schedules						
Task 3:	Evaluation of <i>E. coli</i> and nutrient concentrations in surface water upstream and downstream of dairy waste application fields.					
Costs:	Federal:	\$143,830	State:	\$97,348	Total:	\$241,178
Objective:	To determine the concentration of <i>E. coli</i> , bacterial source (selected samples), and nutrients in surface waters at locations upstream and downstream of a waste application field.					
Subtask 3.1:	Collection of surface water samples prior to, during, and after wastewater has been applied to a waste application field bordering a stream segment. Water samples will be grab samples collected from the stream on a monthly basis when water levels allow for sample collection.					
	Start Date:	Month 20		Completion Date:	Month 47	
Subtask 3.2:	Collection of surface water from upstream and downstream sites on a stream segment bordering a waste application field during storm events. Water samples will be grab samples collected from the stream. Samples will be collected for enumeration from 8 to 10 storm events.					
	Start Date:	Month 20		Completion Date:	Month 47	
Subtask 3.3:	<i>E. coli</i> will be isolated from edge of field runoff samples, collected after storm events, and upstream and downstream grab samples four times per year. These isolates will be compared to the environmental library from Subtask 2 to determine the source(s) of the isolates and the relative contribution of each source to the total <i>E. coli</i> load. Water samples will also be analyzed for <i>Bacteroides</i> human and animal genetic markers. Nutrients, pH, and EC will be analyzed as listed in Subtask 2.1.					
	Start Date:	Month 20		Completion Date:	Month 47	
Deliverables	<ul style="list-style-type: none"> •<i>E. coli</i> and nutrient concentrations in surface water from locations upstream and downstream of waste application fields during application events. •<i>E. coli</i> bacterial source (selected samples) and nutrient concentrations in surface water adjacent to waste application fields during storm events. •Identification of the source(s) contributing <i>E. coli</i> to downstream sites. 					

Tasks, Objectives and Schedules						
Task 4:	Evaluation of BMPs on loads of <i>E. coli</i> and nutrients in runoff from dairy fields.					
Costs:	Federal:	\$157,770	State:	\$107,348	Total:	\$265,118
Objective:	To determine the effectiveness of different BMPs on reducing <i>E. coli</i> bacteria and nutrients in runoff from dairy fields.					
Subtask 4.1:	Selected and establishment of 2 field sites with managed and unmanaged buffer strips to give a total of 9 plots, two fields (two manured fields (corn, hay, and pasture) and six buffer strips (.					
	Start Date:	Month 12		Completion Date:	Month 47	
Subtask 4.2:	Implement BMPs on the four field sites and collect runoff to estimate the loads of <i>E. coli</i> and nutrients in runoff from dairy fields.					
	Start Date:	Month 24		Completion Date:	Month 47	
Subtask 4.3:	Conduct yearly rainfall simulations on each of the plots to determine runoff of bacteria and nutrients. Runoff samples will be analyzed according to protocol listed in Subtask 2.1 for nutrients. Soil samples will be collected from each of the rainfall simulation plots (0-2, 2-6 and 0-6) and analyzed for 2:1 water:soil pH and EC; Cd reduction nitrate-N; and Mehlich-3 by ICP for P, K, Ca, Mg, Na, and S.					
	Start Date:	Month 20		Completion Date:	Month 47	
Deliverables	•Evaluation of BMPs on the effectiveness of removing <i>E. coli</i> bacteria and nutrients in runoff from dairy fields with different cropping strategies.					

Tasks, Objectives and Schedules						
Task 5:	Education of dairy producers and the community as to the presence of <i>E. coli</i> bacteria and nutrients in manure and wastewater, and BMPs to decrease <i>E. coli</i> bacteria and nutrients in runoff from dairy fields.					
Costs:	Federal:	\$10,000	State:	\$7,020	Total:	\$17,020
Objective:	To develop an educational program to relate the information collected during the monitoring and evaluation periods, and to educate producers as to the effectiveness of BMPs on reducing <i>E. coli</i> bacteria and nutrients in runoff from dairy fields.					
Subtask 5.1:	Educational session on <i>E. coli</i> bacteria and nutrients present in lagoons and manure and wastewater during application periods.					
	Start Date:	Month 16		Completion Date:	Month 47	
Subtask 5.2:	Field day to show results of BMP implementation on controlling <i>E. coli</i> bacteria and nutrients in runoff from dairy fields.					
	Start Date:	Month 26		Completion Date:	Month 47	
Subtask 5.3:	Develop final report and educational materials and publications.					
	Start Date:	Month 12		Completion Date:	Month 47	
Deliverables	<ul style="list-style-type: none"> •Retrospective-post survey to evaluate the effectiveness of the educational program on <i>E. coli</i> bacteria and nutrients present in lagoons and manure and wastewater during application periods. •Survey to evaluate intentions of implementation after the field day to show results of BMP implementation. •Educational materials and publications. •Final report. 					

Measures of Success
<p>Determination of the success of the overall project will be through the evaluation of <i>E. coli</i> bacteria and nutrient concentrations in water samples entering stream segments in the Leon Watershed that are adjacent to fields receiving manure and wastewater from dairy operations. Although the levels of <i>E. coli</i> bacteria and nutrients in the surface water is the ultimate measure of success, this multi-year project will include a combination of monitoring, result demonstrations, and educational activities on which successes will be measured.</p> <p>The success of the first year of the project will be measured by the development of a database of <i>E. coli</i> and nutrient concentrations of manure and wastewater samples. The concentrations of bacteria and nutrients will be related to the source of manure and the weather during the time of collection. In addition, collection of manure during application events will assist in determining the loads of bacteria and nutrients applied to land. The collection of manure and wastewater samples will provide estimates of <i>E. coli</i> and nutrient concentrations in different forms of manure to determine if various manure forms pose lesser or greater risks during land application.</p> <p>Successfulness of educational programs will be determined through the use of a retrospective-post survey tool. The survey tool would allow participants to rate their knowledge of various topics before and after the educational event. The results of the surveys will provide an assessment of increase in knowledge of the program participants.</p>

2005 Texas Nonpoint Source Management Program Document Reference

Goals &/or Milestone(s)

Development of a database to evaluate the concentrations of *E. coli* (concentration and source on selected samples), and nutrients in dairy manure and wastewater during land application and storage in lagoons.

Determination of the ability of natural and improved buffer strips to prevent *E. coli* bacteria and nutrients from moving to surface waters.

Educational programs for dairy producers and the community to transfer information and strategies for implementation of BMPs.

Part III – Financial Information

06-07 "Monitoring and Educational Programs Focused on Fecal Coliforms Bacteria and Nutrient Runoff on Dairy Operations in the Leon Watershed" Budget Revision 01/07/2009			
Federal 319(h)	\$438,357	% of total project	59.48%
Non-Federal Match	\$298,572	% of total project (at least 40%)	40.52%
Total \$ Cost	\$736,929	Total project %	100%
Category			
	Federal	Non-Federal Match	Total
Personnel	\$165,506	\$159,085	\$324,591
Fringe Benefits	<u>\$41,966</u>	<u>\$36,406</u>	<u>\$78,372</u>
Subtotal Personnel & Fringe	\$207,472	\$195,491	\$402,963
Travel	\$22,560		\$22,560
Equipment			
Supplies	\$98,090		\$98,090
Contractual	\$46,058	\$12,215	\$58,273
Construction			
Other	\$7,000		\$7,000
Subtotal	<u>\$173,708</u>	<u>\$12,215</u>	<u>\$185,923</u>
Total Direct Costs	\$381,180	\$207,706	\$588,886
Indirect Costs (15%)	\$57,177	\$54,003	\$111,180
Unrecovered IDC		\$36,863	\$36,863
Total Project Costs	\$438,357	\$298,572	\$736,929

The §319(h) Nonpoint Source Program has a 60/40% match requirement. Your entity will be reimbursed 60% from federal funds and must contribute a minimum of 40% of the costs to conduct your project. The 40% match must be from non-federal sources and should be described in your budget detail. Indirect costs are limited to 15%. The project budget generally covers a three year period.

Budget Justification		
Category	Total Amount	Justification
Personnel & Fringe Benefits	\$207,472	Salary for 1.25 FTE Extension Assistants and 3 undergraduate/graduate students assisting with sample collection, sample analyses, and data compilation. Fringe for the Extension Assistants is 15.6% plus \$435/month for 1.25 FTE for insurances. The fringe for student workers is 8.35%.
Travel	\$22,560	Reimbursement for costs associated with sample collection, per diem for rainfall simulations, educational programs, and one national meeting per PI and Co-PIs per year.
Equipment	\$	
Supplies	\$105,090	Sampling containers and supplies for bacteria and nutrient analyses. Purchase of ISCO samplers for edge of field runoff collection, incubation and filtration supplies for fecal bacteria analyses, and sampling supplies. Ten ISCO samplers, outside storage boxes for each ISCO, 20 deep cell marine batteries, 10 solar panels for an estimated \$5,000 per ICSSO.
Contractual	\$46,058	Dr. George D. Di Giovanni (Texas AgriLife Research, El Paso AREC) will assist with source tracking. Based on ERIC-PCR fingerprints, approximately 200 selected <i>E. coli</i> isolates will be fingerprinted using RiboPrinting. Approximately 100 samples will be analyzed for <i>Bacteroides</i> genetic markers. Composite ERIC-RP fingerprints will be analyzed with the developing statewide BST library. Total of \$40,050 + 15% IDC.
Construction	\$	
Other	\$	
Indirect	\$57,177	Calculated using 15%.