New Waves
The Research Newsletter of the Texas Water Resources Institute
Volume 15, Number 1, November 2002

TWRI, Environmental Defense Team Up to Produce Handbook About Water Conservation Strategies

A new report that describes water conservation strategies has been published by the Texas Water Resources Institute (TWRI) and Environmental Defense. The handbook, Efficient Water Use for Texas: Policies, Tools, and Management Strategies, was written by TWRI Science Writer Jan Gerston and Mark MacLeod of the Environmental Defense regional office in Austin, TX.

The purpose of the report is to provide examples of what has been accomplished in Texas through water conservation, and to inform people of strategies which have been used elsewhere that hold promise, according to TWRI Director C. Allan Jones.

"We developed this report to make sure that, in the water planning process, people had the information to fully consider and incorporate water conservation strategies into the development of water management strategies," Jones said. "We hope this handbook provides some talking points that planning groups will use and that this might help them consider utilizing water conservation as a key component of any planning activities."

The handbook provides an overview of strategies Texas cities and water districts have utilized to most efficiently use water resources, including encouraging homeowners to utilize low-flow devices, demand management measures, and structuring water rates to reward conservation.

The handbook discusses ways in which water conservation has been accomplished by industries and public institutions. It illustrates how industries are recycling and reusing water in manufacturing processes, highlights water conservation in the hotel industry, and illustrates how entities are promoting wastewater reuse. Much of the handbook describes opportunities to conserve water in agricultural activities. The handbook illustrates how research and extension efforts are promoting the adoption of efficient irrigation

technologies and management strategies, and developing crops that better survive droughts. Policies to encourage water use efficiency in agriculture are also described. The handbook summarizes laws passed by the Texas Legislature that encourage water conservation, reuse, and recycling.

Note: Gerston can be contacted at jgerston@tamu.edu or (979) 845-1852.

TWRI Funds 24 Soil and Water Conservation Grants for 2002-03

The Texas Water Resources Institute (TWRI) recently announced that it will fund 10 research projects and 14 extension programs dealing with soil and water conservation issues for 2002–03. Funds for this program are provided by the Texas Legislature, and TWRI administers this program for the Texas Agricultural Experiment Station (TAES) and Texas Cooperative Extension (TCE).

According to TWRI Director Allan Jones, soil and water conservation grants provide a way for researchers and extension professionals to work together on multidisciplinary projects. "This program provides annual funding for professionals within the Agriculture Program to develop truly innovative efforts that benefit the water resources community throughout Texas," Jones said. "It provides opportunities to study important issues that cross the lines of academic disciplines to address problems that need to be solved, and helps faculty attract more funding from additional sources."

Soil and Water Conservation Extension Grants Funded for 2002–2003

- "Cover Crops to Capture Rainfall to Augment Deficit Irrigation in Subsurface Drip Systems," John Sij, Todd Baughman, David Bordovsky, Texas Cooperative Extension, Vernon; and Stan Bevers, TCE, College Station.
- "Enhancing Capacity for Water Quality and Nutrient Management Education of Minority and Underserved Audiences," Jeffrey Koch, Prairie View Cooperative Extension; and Mark McFarland, TCE, College Station.
- "Forest Soils-Based Best Management Decision Support System," Darwin Foster, Forestry Extension, TAMU.
- "Junior Master Gardener Program," Lisa Whittlesey and Dee McKenna, TCE, TAMU.
- "Mills County Nitrate Education and Remediation Program," Monty Dozier, TCE, TAMU.
- "Natural Resources Conservation and Protection on the Colorado River Watershed," Billy Kniffen, TCE, Menard County; Scott Edmonson, TCE, Concho County; Michael Palmer, TCE, Irion County; and Marc Tucker, TCE, Schleicher County.
- "New Irrigation Technologies for Nursery and Floral Producers and Commercial Landscapes," Don Wilkerson, TCE, TAMU; Michael Arnold, TAMU Horticulture Department; and Bruce Lesikar, TAMU Biological and Agricultural Engineering Department.
- "Rangeland Rehabilitation through Water Conservation and Concentration," Alyson McDonald and Charles Hart, TCE, Fort Stockton.
- "Reclamation of the Upper Colorado River Watershed," Allan McGinty, TCE, San Angelo.

- "Training and Demonstration Support for Irrigated Crops and Livestock Production," Bob Robinson and John Sweeten, TCE, Amarillo.
- "Validation of Restoration Practices on Rangeland Health at the Landscape Scale," C. Wayne Hanselka and Steve Livingston, TCE, Corpus Christi; and David McKown and Rogelio Mercado, TCE, Alice.
- "Water for Texans," Larry White and Barron Rector, TCE, TAMU.
- "Wellhead Protection Program," Monty Dozier, TCE, TAMU.

Soil and Water Research Projects Funded for 2002–2003

- "Efficient Irrigation and Fertilization Practices for Urban Landscapes," John Sloan, TAES, Dallas.
- "Development and Evaluation of Dual Application Pivots that Use Low-Energy Precision Application (LEPA) and Spray Irrigation," James Bordovsky, TAES, Plainview.
- "A Water Management Education Program," Ronald Kaiser, TAMU Recreation, Parks, and Tourism Sciences Department.
- "Restoration of Hydrologically Disfunctional Rangeland Watersheds and Wildlife Habitats and Improved Pastures in Western Texas," Darrell Ueckert, TAES, San Angelo; Chris Sansome, Allan McGinty, and Dale Rollins, TCE, San Angelo; Stephen Whisenant and Wayne Hamilton, TAMU Rangeland Ecology and Management Department; and Roger Gold, TAMU Entomology Department.
- "Development of a Multi-Scale Geographic Information System, Topography Based, Screening Model for the Assessment of Watershed Surface Water Pollutant Loading," Mauro DiLuzio, TAES, Temple; Jeff Arnold, U.S. Department of Agriculture Research Service (USDA/ ARS), Temple; and Steve Bednarz, USDA Natural Resource Conservation Service (USDA/NRCS), Temple.
- "Rainfall Partitioning with Juniper Communities," Keith Owens, TAES, Uvalde.
- "Utilizing Subsurface Drip Irrigation and Conservation Tillage in Crop Production Systems in the Texas Rolling Plains," John Sij, Jeffrey Slosser, and David Bordovsky, TAES, Vernon.
- "Limited Irrigation for Biotic and Abiotic Stress Management–A Precision Farming Approach to Water Conservation," Giovanni Piccinni, Daniel Leskovar, TAES, Uvalde; and Noel Troxclair and Charles Stichler, TCE, Uvalde.
- "Genetic Variability for Physiologic Traits Related to Water Use Efficiency in Sorghum," William Payne and Maria Balota, TAES, Amarillo.
- "Subsurface Drip Irrigation for Forage and Livestock Systems," David Forbes and Hagen Lippke, TAES, Uvalde.

Use of Computer Simulation Models to Predict In–Stream Flow Concentrations in Texas Rivers

Authors:

Sabu Paul, Saqib Mukhtar, and Patricia Haan, Biological and Agricultural Engineering Department, Texas A&M University, College Station, TX; and Marty Matlock, Agricultural Engineering Department, University of Arkansas, Fayetteville, AR.

Problem:

Salado Creek, which flows through Bexar County, TX, is one of 65 streams listed as an impaired water body in Texas by the Texas Commission on Environmental Quality. Before efforts can be made to restore this stream, data about the types and amounts of pollutants needs to be obtained and interpreted. The HSPF model is widely used to study issues related to fecal coliform and bacterial contamination in surface waters. However, factors that may make fecal coliform pollutants especially troublesome in warm-weather streams need to be studied.

Objectives:

1) To evaluate the applicability of HSPF as a tool to predict fecal coliform bacteria concentrations; 2) To determine the sensitivity of in-stream fecal coliform concentrations to changes in model parameters, and 3) To determine the fraction of variance of in-stream fecal coliform levels due to the most sensitive model parameters.

Methodology:

The watershed investigated in this study is a 123,000-acre site in Bexar County that is part of the San Antonio River Basin. This study was carried out using a variety of computer models included in the U.S. Environmental Protection Agency's BASINS program. The HSPF model was calibrated and validated for fecal coliform concentrations for this watershed. A sensitivity analysis of this model was carried out for peak in-stream fecal coliform levels. Then, a first order uncertainty analysis was conducted. Model calibration consisted of developing an overall water balance, calculating peak storm volumes, and determining the seasonal distribution of flows. Long-term hydrology calibration was carried out for a period covering 1970 to 1993. A "close calibration" was conducted by examining daily flows from 1991 to 1993. The HSPF model was tested to determine how well it can represent the dynamics of in-stream fecal coliform levels. A sensitivity analysis was undertaken to determine which model parameters may cause the greatest changes in fecal coliform levels in this watershed.

Results:

The parameters that most influence in-stream fecal coliform concentrations are the geographic areas that store the maximum amount of fecal coliform bacteria in pervious

land segments, and surface runoff events that introduce fecal coliform bacteria into the watershed. The model showed that warm stream temperatures and first-order decay rates also strongly influence in-stream fecal coliform levels. Finally, although this model is highly sensitive to several parameters, results of the first order analysis suggest that variances in one parameter (the maximum storage of fecal coliform bacteria on pervious land segments) may strongly influence the results of this model.

Reference:

Paul, S., P. Haan, M. Matlock, and S. Mukhtar, "An Analysis of the HSPF Model for Predicting In-Stream Fecal Coliform Concentrations," ASAE-CIGR Meeting Paper No. 022157. St. Joseph, MI, ASAE, 2002.

Notes:

A poster that describes this research is presented on the TWRI website as TWRI Special Report SR 2002-029. A 58-page report that describes this project is TWRI Special Report SR 2002-14. You can contact Paul at sabupaul28@hotmail.com or Matlock at mmatlock@uark.edu. This research was funded in part by a grant TWRI provided in 1999 to Matlock and Mukhtar that was supported by the U.S. Geological Survey.

Tradeoffs in Brush Management for Water Yield and Habitat Management in Texas

Authors:

J. Richard Conner, Agricultural Economics Department, and Christopher Narayanan and Urs Kreuter, Rangeland Ecology and Management Department, Texas A&M University, College Station, TX.

Problem:

Anticipated increases in the population of Texas are expected to create increased demands for water resources. For some time, the possibility of increasing water yields by clearing brush has received considerable study. Recently, the Texas Agricultural Experiment Station conducted studies to assess the feasibility and practicality of removing nuisance brush in the Twin Buttes watershed and the Edwards Aquifer recharge zone. Although various technical and modeling studies have been carried out, the willingness of landowners to participate in brush control has seldom been studied.

Objectives:

To gather information from rural landowners in these watersheds about their attitudes on brush control and the conditions under which they would be willing to take part in brush management programs.

Methodology:

Six hundred questionnaires were sent to randomly selected landowners in the Edwards Aquifer Recharge Zone and the Twin Buttes watershed, which includes the Middle and South Concho River. In the questionnaire, participants were asked several questions about the nature of their operations, as well as their willingness to take part in brush control programs, based on various scenarios. Many of the questions involved the use of a Liekert scale, in which respondents can rank issues from least important to most important. Some of the more interesting questions pertaining to water resources include whether the presence of water resources was viewed as an important component of their rangelands, the water conservation practices they may have employed, the amount of brush that is thought to occur near stream banks, and whether they would be in favor of maintaining a buffer near riparian zones where brush control would not be practiced. The questionnaire asked these people about the amount of financial compensation they would need before they would participate, and whether they had taken part in other federal or state programs that may have encouraged brush management.

Results:

131 usable surveys were returned from landowners in the Edwards Aquifer Recharge Zone. Roughly 88% of them said surface water is an important resource, while 80% said that increasing streamflow was important. Increasing water yield and streamflow was an important reason to manage brush, 87% of participants said. Roughly three-fourths of respondents said they had practiced water conservation measures on their lands. The landowners also said they felt strongly that they should be compensated for developing new water resources, with 34% of them saying that a 50% cost-share was desired. In contrast, 141 usable surveys were returned from landowners in the Twin Buttes watershed. Roughly 71% said that it was important to improve riparian areas as part of their range management efforts. Nearly 75% responded that it is important to manage brush to increase water yields and streamflows. 71% of participants said they had utilized water conservation practices on their lands. Participants said they felt economic compensation would be desired if landowners were to build fences, but no so much for the creation of new water sources. Roughly 33% of landowners said they believed it would be important to be financially compensated for participating in these programs, and an optimal cost-share level of 80% was identified. More landowners in the Edwards Aquifer region felt is important that they be compensated for creating new water resources, compared to people sampled in the Twin Buttes watershed.

Reference:

Conner, J.R., C. Narayanan and U. Kreuter, Tradeoffs in Brush Management for Water Yield and Habitat Management in Texas: Twin Buttes Drainage Area and Edwards Aquifer Recharge Zone, 2002, Report Submitted to the TAMU Agricultural Economics Department.

Notes:

This research was funded by the Texas Agricultural Experiment Station and was carried out in conjunction with a project to assess the ecosystem and wildlife implications of brush management that is funded by the U.S. Army Corps of Engineers.

Managing and Treating Produced Water from Oil and Gas Operations for Beneficial Reuse

Authors:

David Burnett, Maria Barrufet, and Mustafa Siddiqui, Petroleum Engineering Department; William Fox, Rangeland Ecology and Management Department, Gene Theodori, Rural Sociology Department, and Sefa Koseoglu, Chemical Engineering Department, Texas A&M University, College Station, TX.

Problem:

Oil and gas production is a major part of the Texas economy. In the process of extracting oil and gas resources a substantial amount of produced water (commonly known as oilfield brines) is brought to the surface. For example, more than 400 million gallons of produced water are generated daily in the Permian Basin of West Texas, and much of these oilfield-produced waters can be treated and reused. To date, produced waters have been considered as a waste product with little value and are placed in disposal wells. Because so much of Texas oil and gas production occurs in arid and semi-arid areas, there may be a tremendous opportunity to treat these contaminated brines to levels so they can be reused for landscape irrigation, ecosystem rehabilitation, and other beneficial uses.

Objectives:

To determine if it is feasible to treat oilfield-produced waters, to define appropriate uses for treated oilfield brines, to ascertain if the use of treated oilfield produced waters is safe for the environment, and to identify policy and regulatory strategies that can provide incentives for treating and reusing oilfield brines.

Methodology:

This project consists of four major tasks. First, a water treatment project is developing portable units that can treat oilfield brines on-site. Designing the portable treatment units included considering such factors as variations in waste stream and flow volumes and making sure treatment systems operate safely and reliably. These treatment trains were evaluated for their ability to reduce levels of total organic carbon, salinity, total dissolved solids, and several other parameters. The performance of membranes used for treatment was also evaluated. Secondly, a water reuse project aims to identify beneficial uses for treated oilfield brines. This part of the project involves developing criteria to design and

operate field sites near oil and gas production areas where rangeland and ecological habitats could be restored. Several candidate sites throughout West Texas were identified and evaluated. Third, efforts are being developed to ensure the environment will not be harmed. This includes work to protect the quality of existing water resources from any adverse effects of the treatment and reuse of oilfield brines, to evaluate the performance of filtration units at remote sites, and to create protocols to monitor how soils, grasses, and wildlife may be affected by the reuse of oilfield brines. Finally, programs are being developed to help policy makers and the public realize that treated oilfield brines may be a benefit for their communities and to increase public acceptance. This part of the project involves examining applicable state and federal regulations, determining if liability issues may be present, identifying successful strategies that have been used in other states, and developing strategies to see how community members near reuse sites can become involved in identifying how they want the treated brine to be reused.

Results:

A process module was developed that has the capacity to convert oilfield brines into fresh waters that can be put to beneficial uses. In theory, the process module involves the use of microfiltration, ultrafiltration, nanofiltration, and reverse osmosis as well as clay filters. Results show that the use of organic clay materials has great promise in lowering oil contents of produced waters. Through the various treatment mechanisms that were tested, the crude oil content of these produced waters were cut from 200 parts per million (ppm) to 8 ppm, while salinity was reduced from 42,5000 ppm to 100 ppm. Working with rangeland specialists in Cooperative Extension, the research team developed criteria for candidate sites where oilfield produced waters might be reused. For example, the best size for field demonstration sites is thought to be 2 or 3 acres, and these treatment systems should apply 1 inch of treated fresh water each month for two years. Strategies that may foster the reuse of oilfield produced waters include providing tax credits to oil and gas production firms and identifying agencies and organizations that want to support the reclamation of arid lands.

Reference:

Burnett, D., M. Barrufet, M. Siddiqui, B. Fox, and S. Koseoglu, Management of Produced Water in Oil and Gas Operations: Produced Water Treatment and Re-Use in Field Demonstrations of Natural Habitat Restoration. This PowerPoint presentation is presented on the TWRI website as Special Report SR 2002-030. You can view the report by going to the TWRI website and choosing technical reports.

Note:

Burnett can be contacted at (979) 845-2274 or d-burnett@spindletop.tamu.edu.

Railroad Commissioner Visits Texas A&M, Endorses Concept of Reusing Produced Water

This project to treat and reuse oilfield brines (see related story above) was initially funded by TWRI, but has now grown to an interdisciplinary effort that involves faculty and extension professionals from several departments.

Texas Railroad Commissioner Michael Williams endorsed the project in a visit to TAMU in October 2002. TAMU researcher David Burnett is now looking for people in the private sector, researchers and agencies, that might also want to participate in this project.

You can contact him at (979) 845-2274 or d-burnett@spindletop.tamu to learn how you can take part.

Policy Issues and Possible Solutions for Water Resources Issues Affecting the Rio Grande/ Rio Bravo Basin

Author:

Jurgen Schmandt, Lyndon B. Johnson School of Public Affairs, University of Texas at Austin, and the Houston Advanced Research Center (HARC).

Problem:

The Rio Grande/Rio Bravo watershed is the fifth largest river system in North America and supports rapidly growing cities as well as a large irrigated agricultural industry along the Texas-Mexico border. In large part because much of region is arid or semi-arid, water supply and water quality problems persist in many of the basin's subwatersheds. Even despite these difficulties, the potential exists to substantially improve the way in which the waters along the Texas-Mexico border are managed, thus providing enough water for urban, agricultural, and ecological use.

Objectives:

This paper presents an overview of many of the water resources issues affecting two sub-watersheds—the Paso del Norte which includes the El Paso/ Juarez region, and the Lower Rio Grande Valley. The paper also provides some policy recommendations about the management of these two subwatersheds and the Rio Grande as a whole.

Background Information:

Schmandt suggests that two provisions of a 1906 international agreement to manage the Rio Grande are especially important to understanding water resources in the Paso del Norte. First, Mexico receives about 60,000 acre-feet of Rio Grande water each year in exchange for withdrawing long-standing complaints about charges of overuse of water in upstream areas. This allotment represents the main source of water for irrigation districts in the Juarez region. Secondly, the 1906 convention expanded the authority of the existing International Boundary Commission to manage the waters of the Rio Grande from El Paso to the Gulf of Mexico. While the 1906 convention was being negotiated, the United States acted to improve year-round water availability by developing the Elephant Butte reservoir in New Mexico that, at the time, was the largest dam in the world. Elephant Butte provides water to farmers in Southern New Mexico. Later, in 1936, the United States developed the Caballo Reservoir. Due to the way in which these reservoirs are managed as a system, in-stream flows downstream from the Caballo Reservoir are often interrupted from October to February when waters are stored in the reservoir to optimize the generation of hydroelectric power. During the last three years, the Paso del Norte Water Task Force has begun to lay the foundation for transboundary water planning for the segment of the Rio Grande from Elephant Butte to Fort Quitman, which is downstream of El Paso/ Juarez. Schmandt also discusses the fundamental differences regarding water supplies in both the Paso del Norte and the Lower Rio Grande Valley watersheds. First, groundwater resources in the Paso del Norte are declining while aquifers are seldom used in the Lower Rio Grande Valley due to high salinity. Second, the bulk of the waters that flow into the Paso del Norte flow from the United States while, in the Lower Rio Grande, they originate in Mexico. Releases from Amistad and Falcon reservoirs account for roughly 95% of the flows into the Lower Rio Grande.

Discussion:

Schmandt notes that one issue that has restricted more complete studies of water resources issues in the Rio Grande is the lack of integrated databases with information from both Mexico and the United States. To remedy this, Schmandt participated with a team of experts to study the watershed as it crosses the international boundary of both countries, and this information is presented on the HARC website, http://www.harc.edu/mitchellcenter/mexico/downloads.html. In addition, Schmandt outlined several policies and strategies that might improve the way in which the watershed is managed. Some of these include— 1) A binational Rio Grande/Rio Bravo Council could be created to develop and update a basin-wide water management plan; 2) A scientific advisory committee could be established to coordinate water resources research in the region; and 3) Task forces could be implemented in each of the four reaches of the Rio Grande that join the Texas-Mexico border that would provide guidance about hydrological, environmental, and economic issues that may be affected by water resources management.

Reference:

Schmandt, J., "Bi-national Water Issues in the Rio Grande/Rio Bravo Basin," Water Policy, Volume 4, 137-155, 2002.

Determining the Presence of Fecal Coliform Bacteria and Nitrates in Private Well Water Samples of Texas

Authors:

Monty Dozier, Texas Cooperative Extension, Texas A&M University, College Station, TX, and Dennis Hoffman, Texas A&M University Blackland Research and Extension Center, Temple, TX.

Problem:

Throughout rural areas of Texas, many residents rely on individual wells as their source of water for drinking, irrigation, livestock, and other purposes. The quality of drinking water wells may be compromised by the presence of fecal coliform bacteria and nitrates. High levels of fecal coliform bacteria indicate possible contamination from organisms that can result in outbreaks of such diseases as hepatitis, dysentery, and intestinal infections. Nitrates have been linked to potentially fatal "blue baby" syndrome and pose other health threats. More work needs to be done to educate rural landowners about the quality of their well water in order to protect public health and the environment. Fecal coliform and nitrate testing are relatively economical and rapid ways to screen water wells for possible adverse health effects.

Objectives:

To teach rural Texas about groundwater quality and strategies to protect groundwater resources by utilizing Texas Cooperative Extension's Tex*A*Syst program.

Methodology:

In this program, a mobile laboratory is taken to field locations to screen water wells on-site for the presence of fecal coliform bacteria and nitrates. The program operates under the premises that all results will be anonymous and not used for regulatory purposes. This training is offered to groups ranging in age from public school children to mature adults. Participants are given an opportunity to visually observe collected samples to detect if fecal coliform bacteria appear to be present. The program also teaches people about the varied sources of fecal coliform including septic tanks, livestock pens, floodwaters, and wastewater plants. It also educates citizens about pollution pathways and to how to shock or disinfect wells that have been contaminated. Pre- and post-testing are conducted as

part of the educational component of this work to determine the extent to which participants' knowledge of these issues may be increased.

Results:

From May 1999 to November 2001, more than 3,319 samples were obtained. Of these, roughly 7.5% were positive for fecal coliform bacteria. Occurrences of fecal coliform bacteria were as high as 9% in the Northern High Plains, but only 3.6% in the Southern High Plains. In screening done throughout the Texas Hill Country, roughly half the wells were found to include fecal coliform bacteria. According to Dozier, the program provides a way to teach youth and adults about the potential problems posed by fecal coliform bacteria as well as a way to protect public health.

Reference:

Dozier, M., and D. Hoffman, Determining the Presence of Fecal Coliform Bacteria in Private Water Well Samples of Texas, (TWRI Special Report SR 2002-021).

Notes:

This project was supported in part through the Soil and Water Conservation Grants program which is administered by TWRI. This report is available on the research reports page of the TWRI website. Finally, Dozier has been working with TWRI Communications Manager Ric Jensen to teach people about the results of this screening program at workshops provided for managers of small water systems. To learn more, contact Dozier at (979) 845-2761 or m-dozier@tamu.edu.

Restoring Bottomland Hardwood, Wetland Near Dallas Landfill Site is Goal of TAMU Investigation

Texas A&M University (TAMU) graduate student Matthew Simmons is working to restore a bottomland hardwood forest in the Dallas area. Simmons is working with TAMU researchers Ben Wu and Steve Whisenant. His research is supported in part by a grant from Texas Water Resources Institute (TWRI) and the United States Geological Survey.

Simmons, Wu, and Whisenant are all members of the TAMU Rangeland Ecology and Management Department. Simmons' research is being conducted at the Castle Road Landfill near Garland, TX. The wetland is being created in the landfill's "borrow pit"—a site where large amounts of soil had to be removed to fill and cap the landfill.

So far, Simmons has selected tree species he will later plant in the region. The trees Simmons chose are indigenous to the region, flood-tolerant, and able to grow well in the clay soils at the site. Simmons purchased tree seedlings that met these criteria and planted them in containers at the site in the spring of 2002. More seedlings will be planted in 2003.

According to Simmons, hydrology is one of the most significant factors to consider when restoring a wetland or a bottomland hardwood forest. Therefore, part of his experiment calls for creating topographic variation that will produce a hydrologic gradient.

Simmons says this project will demonstrate how wetlands can be developed near rapidly growing areas, thus preserving needed habitats and providing green space. Another benefit is that experiments at this site will evaluate plant materials, variations in slope, and soil amendments that can be used to restore wetlands. This evaluation process may be useful in other restoration projects.

For more information, contact Simmons at (979) 845-0352 or mattsimmons@neo.tamu.edu, Wu at b-wu@tamu.edu, or Whisenant at s-whisenant@tamu.edu.

TWRI Study Aims to Develop Real-Time Estimates of Rainfall Runoff, Will Present Findings on the Web

Graduate student Jennifer Hadley and researcher Raghavan Srinivasan of Texas A& M University are carrying out a project to develop a database that will better estimate runoff and display results in real-time. This work is funded in part by a grant from the Texas Water Resources Institute and the U.S. Geological Survey (USGS).

Hadley, who works with Srinivasan in the Texas A&M University Spatial Sciences Lab, is working to create a digital map of Texas that uses a 2.5 x 2.5-square mile grid. Using a curve number method developed by the Natural Resources Conservation Service, Hadley hopes to calculate daily runoff. The NRCS curve number method predicts runoff based on land use, soil moisture, soil types, and precipitation.

In this project, Hadley and Srinivasan will modify the Soil and Water Assessment Tool (SWAT) model to generate soil moisture data in real-time. This will allow the researchers to automatically calculate runoff by observing a list of site-specific conditions. The model will utilize ESRI's ArcInfo geographic information system software to analyze input data and to automatically generate accurate runoff maps.

Hadley plans to develop an online map of Texas that displays current runoff conditions. This information should prove useful for such purposes as flood prevention and mitigation, reservoir operations, and watershed management practices.

For more information, contact Hadley at jlhadley@tamu.edu or Srinivasan at srin@brc.tamus.edu. The website address for the Spatial Sciences Lab is http://www-ssl.tamu.edu/.

Baylor Graduate Student Studies Role of Periphyton, Algae, in Controlling Phosphorus Levels in Streams

A Baylor University graduate student is studying how the presence of suspended clay particles may affect how lotic periphyton (algae, bacteria, and protozoans attached to stream bottoms) process phosphorus. The research is being carried out by Baylor University graduate student June Wolfe and Baylor Biology Department researcher Owen Lind.

These studies are being conducted at the Blackland Research and Extension Center in Temple, where Wolfe works. The goal of this study is to examine the effect of suspended clay particles on the ability of periphyton to influence water quality. By studying the interaction of benthic communities with phosphorus, the researchers can determine the role of algae, bacteria, and protozoans in the transport, uptake, transformation, and release of phosphorus and other nutrients.

When phosphorus becomes available to benthic communities, these organisms take up the phosphorus, use it for a time, and release it when they die. In this manner, periphyton act as a sort of buffer that modulates the phosphorus load that goes on to reach reservoirs. Wolfe wants to see how clay interferes with this process.

Wolfe obtained periphyton cultures by inoculating laboratory streams with rocks collected from a nearby river. Periphyton are expected to grow on gravel placed in the

laboratory streams. Clay and phosphorus will then be added into the system and the nutrient processing by the periphyton will be measured. In these studies, Wolfe will vary such factors as water temperature, pH, light, and climate.

According to Wolfe, little research has been done to examine clay and phosphorus interaction in streams. Clay is often found in aquatic environments, and even small amounts of rainfall will cause water to muddy when clays are present. Specifically, Wolfe wants to examine whether clay absorbs and holds nutrients, thus making them less available for absorption by periphyton. Conversely, he wants to learn if clay particles will act as a carrier that fosters the uptake and release of nutrients.

According to Wolfe, this study will be beneficial because it may offer a better understanding of biotic processes taking place in lotic waters. The study is expected to provide insights about nutrient management in regions where clay soils are widespread.

"Examining the impact of clay soils on phosphorus concentrations may lead to strategies to better manage and protect water resources," Wolfe said. "This could include improved methods to control erosion and ways to better time fertilizer applications on clay soils. You have to understand a process before you can manage it."

For more information on this research, contact Wolfe at (254) 774-6016 or wolfe@brc.tamus.edu.

TWRI, Texas Cooperative Extension Create Water Resources Management Specialist Position for West Texas

Texas Cooperative Extension has teamed up with the Texas Water Resources Institute (TWRI) to assist water resources management in West Texas by creating a new water management specialist for the region. The goal of this effort is to help agricultural producers, urban residents, and water providers to conserve water and protect the quality of water resources.

Mike Mecke, who formerly worked for the San Antonio Water System, began his new job duties as an Extension Program Specialist in Water Management in September 2002. Based in the District 6 Extension Center in Fort Stockton, Mecke will work in 23 West Texas counties and will assist residents in a broad region stretching from Del Rio north to Big Spring and west to El Paso.

According to TWRI Director Allan Jones, this is the first instance in which TWRI and Extension have joined forces to fund and support a water management specialist. "It was obvious to us that this arid part of West Texas needed help in better managing their scarce water resources," Jones said, "so creating an Extension position and linking it to TWRI made a great deal of sense to us. This is just part of an effort to better integrate TWRI into research and extension efforts. Mecke will complement ongoing efforts to increase the efficiency of water use in the TWRI Rio Grande Basin Initiative."

According to Mecke, this new position will involve working on diverse water resources issues. “I expect that I provide guidance on several water resources issues, including the sustainable management of ground and surface waters, water quality and conservation in farming systems and urban areas, watershed and streambank management, and educational programs. There are many opportunities for Extension and TWRI to make a difference in this region, and I’m excited to be part of it.” Mecke will assist regional groups in developing water plans and will provide training to water districts in the region.

To learn more, contact Mecke at (915) 336-8585 or mbmecke@ag.tamu.edu.

TWRI, TAES, A&M–Corpus Christi Researchers to Track Sources of Bacterial Pollution

Could the use of high-tech methods help determine the source of bacterial pollution in rivers and streams? That’s the question being explored in a new project being carried out by scientists with the Texas Agricultural Experiment Station (TAES) in College Station and El Paso and Texas A&M University–Corpus Christi.

The project, “Development of Bacterial Source Tracking Libraries and Assessment of Bacterial Sources Impacting Lakes Waco and Belton,” is led by TAES scientists George Di Giovanni and Suresh Pillai and Joanna Mott of Texas A&M–Corpus Christi. The Texas Farm Bureau will be responsible for the field sampling via subcontracts with Parsons Engineering, Inc. of Austin and the City of Waco Drinking Water Laboratory. The Brazos River Authority will provide field support for data collection and analyses and will work with the Texas Water Resources Institute (TWRI) in public outreach efforts. This project, which is funded by the Texas State Soil and Water Conservation Board, and the U.S. Environmental Protection Agency, was developed in association with TWRI.

The focus of this effort is to identify the specific sources of E. coli bacteria, which may originate in human and animal wastes. Methods now used to identify E. coli and other fecal coliform bacteria do not provide information on whether the source of pollution is from sewage, runoff of animal wastes, or failing septic tanks. Another complication is that some strains of E. coli can cause disease and health problems, while other strains are relatively harmless.

Di Giovanni says methods are needed to differentiate between specific sources of E. coli so that we can know the origin of these pollutants. By developing reference data on many different specific types of E. coli bacteria, better insights may be developed about what is causing pollution and strategies could be crafted about how to best prevent future contamination.

Throughout this study, personnel with Parsons Engineering, Inc. will collect samples from the Bosque River and Leon River watersheds. The City of Waco Drinking Water

Laboratory will grow the bacteria on special plates that preserve the samples so they may be safely transported. Samples will be sent to the TAMU Agricultural Research and Extension Center in El Paso, where Di Giovanni will isolate E. coli strains using two bacterial source tracking methods—repetitive sequence polymerase chain reaction and automated ribotyping. Specific characteristics of E. coli isolates, will be further studied by Pillai at the Environmental Microbiology and Food Safety Laboratory at TAMU. Pillai will utilize pulsed-field gel electrophoresis, which is a method now being used by the Centers for Disease Control and Prevention to track bacterial strains associated with foodborne illnesses. Mott will carry out studies at the Environmental Microbiology Laboratory at A&M University–Corpus Christi and will assess how E. coli isolates respond to a panel of antibiotic stresses. Mott will use computer-aided image analysis software to observe how bacterial strains grow in the presence of antibiotics.

This project will help water resource managers develop strategies to protect water quality by accurately identifying sources of fecal contamination. This effort will develop one of the most comprehensive bacterial source tracking databases in the nation that contains multiple assay data on numerous strains of E. coli isolates from different sources of contamination. This project may represent the first of many efforts to involve TAMU System scientists in studying issues related to fecal coliform bacteria.

Notes: For details, contact Di Giovanni at (915) 859-9111 or gdigiovanni@ag.tamu.edu, Pillai at spillai@poultry.tamu.edu or (979) 845-2994, or Mott at (361) 825-6024 or jmott@falcon.tamucc.edu.

Website Describes How Climate Change May Affect Water Resources Along the Texas Coast

The Union of Concerned Scientists has developed a new website that presents a thorough look at how Texas and the Gulf Coast may be affected by climate change.

The website, "Gulf Coast's Ecological Heritage at Risk," contains information for teachers, students, and the public. For example, information for teachers includes a curriculum and resource materials. Particularly interesting, the website provides an in-depth look at how climate change may affect two Texas ecosystems—the Big Thicket and the Laguna Madre. On a broader scale, it discusses how climate change may affect Texas in such diverse ways as freshwater resources, human health, coastal development, fisheries, agriculture and forestry, and tourism and recreation.

This web project complements a lengthy report that the Union of Concerned Scientists published earlier in 2002 about these issues.

The web address is http://www.ucsusa.org/gulf/index.html.

A&M–Commerce Scientist Examines Past Climates to Study Potential Climate Changes

Will this planet ever experience an Ice Age comparable to the one that settled on Earth more than 20,000 years ago or will temperatures continue to rise as part of a global warming? The study of paleoclimatology, or the research of past climates, might yield clues to some of these questions. Researcher Patrick Ng'ang'a, a faculty member in the Biology, Earth and Environmental Sciences Department at Texas A&M University—Commerce, is testing water and sediment core samples from the bottom of the Rift Valley Lakes of East Africa.

He uses these samples to calibrate core samples from other lakes in the region that can be used to determine past climate trends up to 50,000 years ago. It is important for scientists to study paleoclimatology so they can predict upcoming events and help society prepare for coming climate changes, Ng'ang'a said. Ng'ang'a is currently analyzing sediments from Lake Manyara collected by a Duke University graduate student in the 1970s. The sample had been in a refrigerated archive for the last few decades. From the samples, he uses several scientific methods to determine past climate changes evident in the sediments.

Ng'ang'a is in the planning stages to obtain a core from Caddo Lake, the only natural lake in Texas. He plans to apply the same methods to reconstruct past climate changes in this part of North America. This study will attempt to understand recent changes in atmospheric wind patterns that might be responsible for bringing mold-laden dust from other parts of the world to Texas.

For more information, contact Ng'ang'a at (903) 468-3218 or patrick_nganga@tamu-commerce.edu.

Texas A&M Engineers Mimic Attributes of Fish to Design Ships, Submarines that Are Harder to Detect

From the tiniest guppy to a large marlin, several types of fish can maneuver through waters without being easily detected - an ability the U.S. Navy recently asked Texas A&M University (TAMU) engineers to copy to make its ships and submarines more efficient and undetectable.

Researchers Othon Rediniotis and Dimitris Lagoudas of the TAMU Aerospace Engineering Department said conventional propellers used by ships and submarines generate visible wakes that allow them to be identified and tracked by satellites. However, because fish move more efficiently through waters they don't leave wakes and are less likely to be detected. As a result, the Navy wants to develop vessels that swim like fish, have greatly reduced "wake signatures," and are harder to observe. "The military wants at least small vehicles to maneuver more like fish do, rather than like

clunky submarines," Rediniotis said. "Right now, the vehicles maneuver slowly because they move using propellers and are not using body motion to propel themselves."

As a result, Rediniotis and Lagoudas are using wires made of Shape Memory Alloys (SMAs) to mimic the motion of a fish's muscles. SMAs are materials that dramatically expand or shrink with temperature change but return to their original shape after the temperature returns to normal. When heated, the wire's length shrinks up to 8%. By using springs and attaching the wires to a metal skeleton, engineers can cause the vehicle to flex back and forth, similar to a fish's body, by alternately heating and cooling the wires. "In a sense, we're using the Shape Memory Alloys as muscles," Lagoudas said. Rediniotis and Lagoudas said the technologies created for these vehicles could be used to develop unmanned vehicles to inspect offshore drilling sites and to map ocean floors.

This project was funded by the Office of Naval Research and Aeroprobe Corporation. For more information, contact Rediniotis at (979) 845-1658 or rediniotis@tamu.edu.

TWRI, Cooperative Extension, Publish Handbook About Groundwater Districts

The Texas Water Resources Institute (TWRI) and Texas Cooperative Extension (TCE) have published a new handbook that provides information on Texas groundwater conservation districts.

The book, "Questions about Groundwater Conservation Districts in Texas" was written by Bruce Lesikar of TCE and the Texas A&M University Biological and Agricultural Engineering Department; Ronald Kaiser of the TAMU Recreation, Parks, and Tourism Sciences Department; and TWRI water resources education program coordinator Valeen Silvy. Lesikar and Kaiser also serve as TWRI Associates.

Many topics related specifically to groundwater conservation districts in Texas are covered, including how these districts are created, administered, and managed. The handbook also describes rules and fees associated with groundwater conservation districts. In addition, the handbook provides an overview of Texas aquifers, Texas water law, and Texas water planning.

The 34-page handbook is written in an easy-to-understand style and is intended to provide ready answers to several of the questions that commonly arise.

Cooperative Extension Publishes CD with OSSF Fact Sheets, Enables Local Governments to Customize Information

A set of six CDs that contains the Texas Cooperative Extension fact sheets about on-site wastewater treatment systems (OSSFs) has been published by Texas Cooperative Extension specialist Bruce Lesikar. The CDs are available for purchase for $995 by contacting the Texas Cooperative Extension Bookstore, online at http://tcebookstore.org.

The CD includes Adobe Acrobat PDF files of each fact sheet Lesikar has published for Extension, including materials in both English and Spanish. Some of the topics covered by the fact sheets include how to select the right OSSF for your situation, maintenance needs, and ways to assure wastewater effluents are disinfected. The fact sheets also present information on several OSSF technologies, including conventional septic tanks and drainfields, aerobic systems, low pressure dosing, drip irrigation, and many others. The CDs also include all the graphics, page design, and text used to develop the fact sheets. By having these resources, entities with Macintosh computers will be able to reproduce the fact sheets and print them with their agency's logo.

The fact sheets can be purchased online at http://tcebookstore.org. Lesikar can be contacted at b-lesikar@tamu.edu.

Texas Tech Book Describes Changes in Texas Natural History

The Texas Tech University (TTU) Press has published a new book that documents how the ecology of Texas has changed over the past 100 years. The book, "Texas Natural History: A Century of Change," was written by TTU researcher David Schmidly. The book presents an exhaustive look at how ecosystems and habitats have changed in Texas over time. Detailed information is also presented about changes in Texas aquatic habitats, including river and lake ecosystems. The book also discusses natural resources challenges Texas will face in the near future, including water use, land fragmentation, and habitat preservation.

You can read more about the book at the TTU Press web site, http://www.ttup.ttu.edu.

New TWRI Report Examines Costs to Rehabilitate Canals

The Texas Water Resources Institute (TWRI) continues to publish many new technical reports, presentations, and posters on the research reports section of its website.

A new TWRI technical report is Economic and Conservation Evaluation of Capital Renovation Projects: Harlingen Irrigation District Cameron County No. 1—Canal Meters and Telemetry Equipment, Impervious-Lining of Delivery Canals, Pipelines Replacing Delivery Canals, and On-Farm Delivery-Site Meters (TR-202). This report was written by M. Edward Rister, Ronald Lacewell, Allen Sturdivant, John Robinson, Michael Popp, and John Ellis.

Other recently posted technical and special reports include: Estimate of Seepage Losses from Canals in the Paso del Norte Region Using Ponding Tests (SR 2002-047) by Zhuping Sheng, J. Phillip King, L. Brown, Nick Ronquillo; Site Specific Management of Row and Vegetable Crops with Center Pivot Irrigation Under Traditional and Conservation Tillage (SR 2002-046) by Nyland Falkenberg, Giovanni Piccinni, Megan Laffere, Ben Masters, and H.O. Watkins, and Wildlife Co-ops and Groundwater Management in Texas (SR 2002-45) by Matt Wagner, Urs Kreuter, and Ronald Kaiser. Still other new special reports include Shared and Unique Features of Predator-Associated Morphological Divergence in Three Livebearing Fishes by R. Brian Langerhans, Craig Layman, A. Mona Shokrollahi, and Thomas J. DeWitt (SR 2002-044), The Effect of Initial Community Composition on Phytoplankton Succession under Continuous and Pulsed-Flow Conditions, by Yesim Buyukates and Daniel Roelke, and The Pecos River Ecosystem Project (SR 2002-041) by Charles Hart.