New Waves
The Research Newsletter of the Texas Water Resources Institute
Volume 9, Number 2, August 1996

## *TWRI Fellowship Aids TAMU Ph.D. Student Research*

For many years, the Texas Water Resources Institute (TWRI) has utilized its "Ph.D. Fellowship Program" to recruit outstanding doctoral candidates to academic departments at Texas A&M University (TAMU). The fellowship program awards supplemental funds to new Ph.D. candidates who have already been offered an assistantship at a TAMU academic department. The goal of the program is to enhance the ability of TAMU to be nationally competitive in recruiting outstanding Ph.D. candidates. "Obviously we want to attract the best and the brightest Ph.D. candidates to TAMU for graduate study," says TWRI Director Wayne Jordan. "This program puts us on a level playing field with the major research universities in the nation."

*Dr Jordan and Kami Merrill talk about her research project. Kami is investigating groundwater management strategies for Central Texas that may prolong the life of aquifers.*

One of the students now being funded through this program is Kami Merrill, who is pursuing a Ph.D. in the Agricultural Economics Department under the supervision of agricultural economics researcher Ronald Griffin. Merrill's research concentrates on developing management strategies that are economically efficient and sustainable for the Simsboro groundwater formation. Three challenges now face regional water users who pump groundwater from the Simsboro: 1) municipal pumpage often exceeds recharge; 2) saltwater intrusion has been observed at some sites; and 3) well fields are becoming congested, and many of the ideal sites to drill new wells have already been developed. The goal of Merrill's research is to examine alternative management strategies for the aquifer which are economically efficient and

sustainable. Merrill hopes to establish dynamically and spatially efficient methods to pump water from the Simsboro, and to investigate sustainable management options and policy options that could reduce the risk of mining the aquifer. The economic model is set up in a discrete time, optimal control framework that maximizes net benefits. It will utilize a hydrogeologic model to simulate how pumping at different rates affects groundwater levels.

Jordan says this is just one example of how the TWRI Ph.D. Fellowship program, if properly utilized, can benefit both TAMU academic programs and prospective graduate students. "We hope to use the Ph.D. Fellowship program to help examine some of the critical water issues facing Texas. Investing in the recruitment of high quality graduate students ultimately leads to quality Ph.D. research dissertations that are an essential part of university research."

Some of the students recruited through this program previously include Ron Fix in the Geography Department, Deanna Cross in the Plant Pathology and Microbiology Department, Mary Paasch in the Agricultural Engineering Department, and Janice Stroud in the Agricultural Economics Department. Their studies focused on the use of global positioning systems for use in geographic information systems, the use of wetlands to improve water quality, and biodegradation of pesticide residues which may be contaminating water supplies. For more information on how to apply for or participate in the Ph.D. Fellowship Program, contact TWRI at (409) 845-1851 or twri@tamu.edu.

## *Blimp Ride Provides Editor New Perspective on Water Issues*

A friend of mine has a bumper sticker on his truck that sums up much of his philosophy about life. It reads, "It's hard to soar with the eagles when you're surrounded by a bunch of turkeys." I got a new perspective about that saying this summer when I got to ride the MetLife "Snoopy 2" Blimp over San Antonio.

When I received a note that blimp coordinator Doug Serafin invited me to ride the blimp during Fiesta Week, at first I thought it was a practical joke. 'Why would they ask me to ride this?" I thought. I often see blimps floating over parades and football games but never considered getting aboard myself. I asked myself, "Do I really want to do this?"


After more than a little trepidation, my wife Karen and I boarded the 130 foot long by 38 foot wide by 45 foot high blimp and took our ride. The ride was not without consequences. Because the blimp sometimes pitched in a sharp downward angle, the back of my camera opened and I overexposed some

film. Since we rode during the heat of midday and there was little circulation, Karen didn't feel too well during and shortly after the ride. Floating gently over San Antonio provided a new perspective about water resources in the region. For example, I could see the trickle of water flowing down rivers in the region. The golf courses, landscapes and rangeland all looked a dull brownish-green. The aerial view also reinforced the notion that San Antonio, despite being a major urban area, is still surrounded by large expanses of rangeland and crops.

Serafin added that MetLife is eager to work with scientists who may want to use the blimp for research purposes during the many times the blimp is in the region. Scientists have the used the blimp before to take aerial photographs and videos that are later useful for landscape analyses. To obtain more details about using the blimp for research or for general information, contact the MetLife blimp unit at (212) 578-5616.

## *SWT Scientist Receives Grant to Improve Edwards Aquifer Computer Model*

Southwest Texas State University has been awarded a grant by the U.S. Geological Survey Austin District to refine a computer model that simulates flows in the Edwards Aquifer. The grant was awarded to Nisai Wanakule of the SWTSU Edwards Aquifer Research and Data Center. Previously, Wanakule developed a lumped parameter model to simulate the impact of Edwards Aquifer pumping on monthly groundwater levels and flows at Comal and San Marcos Springs. That research was funded in part by TWRI. The focus of this project is to revise and expand the capabilities of the model. Wanakule will revisit stream loss analyses and revise recharge functions by incorporating new information on recharge studies done by the University of Texas Bureau of Economic Geology and HDR Engineering, Inc. Other tasks include refining the model so that daily impacts can be simulated and investigating efficient solution methods for the model's vector differential equations. Wanakule will also recalibrate and verify the model with the new set of streamflow data and water levels and incorporate a water quality component into the model using mixing cells and simple first order kinetics. For details, contact Wanakule at (512) 245-2329 or nisai@eardc.swt.edu.

## *Using a GIS to Assess Contamination Risks to Texas Aquifers*

**Researchers:** Thomas Evans and David Maidment, Center for Research in Water Resources, University of Texas (UT), Austin.

**Problem:** Federal and state water quality regulations have created a need to assess the vulnerability of groundwater supplies to contamination by agricultural chemicals. A statistical approach that examines the probability of contamination of key aquifers to specific contaminants can be calculated numerically and would be especially useful to regulators and policy makers. Developing this information with a geographic information system (GIS) would provide the added benefits of more efficient and expanded data analyses and generation of easily understood maps and databases.

**Objectives:** 1) To develop a spatially variable statistical model capable of representing data from thousands of water quality measurements throughout Texas; 2) To apply this model to identify spatial patterns of nitrate detection in regions of Texas and within key Texas aquifers; 3) To rank the importance of soil conditions, precipitation rates, fertilizer sales, and other factors in accurately predicting nitrate contamination risks; 4) To evaluate the use of a GIS to empirically analyze historical data; and 5) To evaluate the use of publicly available computerized data to estimate groundwater contamination risks.

**Methods:** Nitrate measurements were obtained from the Texas Water Development Board's (TWDB) groundwater data system for 1962-93. More than 38,000 records containing groundwater well data (including locations, aquifers, and primary use) for this period were obtained from TWDB. Soils information, including data on soil horizons, organic carbon content, and soil thickness, were converted from the U.S. Department of Agriculture (USDA) STATSGO database. Precipitation data were obtained from the National Climate Data Center. Nitrate measurement data from selected municipal wells was provided by the Texas Natural Resource Conservation Commission (TNRCC). Texas was divided into 7.5 minute quadrangles and five aquifers (Ogallala, Seymour, Edwards, Carrizo-Wilcox, and Hueco-Mesilla Bolson) were chosen for additional analysis. Nitrate fertilizer sales data were input to the GIS. TWDB nitrate and well measurement data were converted so they could be used with an Arc/Info GIS. Nitrate levels were converted to nitrogen so they could better be compared to drinking water standards. Exceedance probabilities were calculated for four nitrate levels (0.1, 1, 5 and 10 milligrams per liter or mg/L).

**Results:** Recent measurements from the TNRCC water utility database were found to yield elevated nitrate levels, if they were sited in quadrangles with high exceedance probabilities. Increased nitrate levels were not well correlated with nitrogen fertilizer sales. In fact, while fertilizer sales are highest in East Texas, the analysis suggests that this region is relatively unaffected by human factors. Nitrate values of 1 mg/L seem to be the best indicator of nitrate contamination risks. Vulnerability to nitrate contamination may be due to the ease with which pollutants can enter aquifers. The Seymour Aquifer is the only groundwater system where nitrate was often detected at levels of 5 and 10 mg/L. It was also demonstrated that this GIS system makes it much easier to rapidly analyze and interpret complex data. In a test case, it took 30 minutes to collect information manually from a single well, while the GIS gathered and analyzed this information in less than 3 minutes. Suggestions for future work include testing this framework for other agricultural contaminants and obtaining and using more detailed soils data.

**Reference:** Evans, Thomas, and David Maidment, *A Spatial and Statistical Assessment of the Vulnerability of Texas Groundwater to Nitrate Contamination* (Technical Report 260), CRWR, UT, 1995.

## *Water Marketing Along the Texas Rio Grande*

**Researchers:** James Jonish, Neil Terry, and David Yoskowitz, International Center for Arid and Semi-Arid Land Studies, Texas Tech University, Lubbock, TX.

**Problem Statement:** Recently, there has been increased interest in policies and experiences associated with water marketing. In regions of water scarcity like the Rio Grande, water marketing has been identified as a particularly viable strategy to transfer water supplies and water rights from lower-valued to high-valued users. More work needs to be done to document and analyze trends in water marketing along the Texas-Mexico border.

**Objectives:** 1) To identify the institutional nature of water rights and uses of surface water on the Texas portion of the Rio Grande watershed; and 2) To empirically examine recent permanent and spot water market transactions along the Rio Grande, including the nature of buyers and sellers, transaction prices, and quantities.

**Methods:** A literature review was conducted to examine the institutional nature of water rights and uses in the region. The literature search developed information on such issues as the amount of Class A (municipal) and Class B (irrigation) water rights, types of use, and regional patterns. Operations of the Texas Natural Resource Conservation Commission (TNRCC) Rio Grande watermaster were also reviewed. Different versions of water marketing were also investigated, including permanent or "term" exchanges of water rights; transfers that cover a fixed period; "spot" market transfers that are usually only one-time exchanges; and option contracts that can be used during droughts and other special circumstances. Data were compiled on water marketing in the region from 1991-93 and for spot water transactions from 1993-95. Ordinary least square regressions that include information on the price per acre foot (AF), the volume of water involved, the location where the transaction occurred, and whether the buyer was a municipality or a mining company were developed to examine variations in spot prices in detail.

**Results:** In 1992, there were 1,220 entities along the Texas portion of the Rio Grande with active water rights. Irrigation districts and individual irrigators accounted for 88% of these users (3 million AF), while cities held roughly 8.8%. Water use patterns in the U.S. and Mexico are similar. The U.S. irrigates roughly 900,000 acres in the entire Rio Grande basin, compared to 1.1 million acres in Mexico. Results show that agricultural users constitute the majority of water sellers in the region, while municipal users are usually the buyers. Water transfers are usually from agricultural use (85 - 90% of surface water use) to municipal water use (8 - 10% of surface water use). The price per AF varies considerably. Lease or term prices range from $15 - $20 per year annually, versus $300 - $700 per AF for a one-time cost or permanent sale. Data for 417 spot water transactions were obtained from the TNRCC watermaster office. Analyses show that most spot transactions involve irrigation purchases, followed by mining and municipal use. The cost of spot mining transactions was 28 times greater than the price of irrigation or municipal spot purchases. The average spot transaction was 227 AF and totaled more than 87,849 AF. Irrigation spot purchases predominantly occurred in the first and second quarter of the year. Municipal purchases mainly occurred in the last two quarters after their surface water allocations had expired and irrigation demands declined.

**Reference:** Jonish, James, Neil Terry, and David Yoskowitz, "Water Marketing Along the Texas Rio Grande," in *Proceedings of UCOWR 1996*, San Antonio, TX.

## *Using Neural Networks to Predict Water Demands*

**Researchers:** Miriam Heller and Qin Wang, Industrial Engineering Department, University of Houston, Houston, TX.

**Problem Statement and Background Information:** Improving the accuracy of potable water demand forecasts plays a critical role in the integrated management of ground and surface waters. Accurate short-term water demand forecasts are essential elements of surface water management and can be used to time releases of water from reservoirs and develop strategies for water pricing to encourage conservation. Improvements in supervisory control and data acquisition systems (SCADA) will soon offer water utilities vast quantities of real-time water demand data. New water demand predictors are needed to handle this large amount of data, provide real-time modeling, and address the non-linear character of water demand data. Neural networks meet these requirements and have proven to be an effective alternative to traditional methods of predicting water demands. These networks consist of many simple processors connected with one another to relay weighted information signals under non-linear conditions. There is still a need to improve the accuracy of neural network forecasting, especially in the area of developing model weights that reflect historic trends.

**Objectives:** 1) To review, evaluate, and apply the use of neural networks to predict water demands; 2) To compare the use of the Box-Jenkins method and neural networks to analyze complex data sets, and 3) To develop and test a hybrid Box-Jenkins neural network (HBNN) and compare it to the Box-Jenkins and network models.

**Methods:** Neural networks are simulation models that consist of processing elements or nodes that are interconnected in a massive, parallel fashion. The basic structure consists of an input layer of nodes that receive external inputs, hidden layers, and an output layer. Each node in the hidden layer processes a weighted sum of incoming input signals. Each node in the output layer generates an estimate of its contribution to the output signal. In this study, time-series forecasts of water demand were first calculated using a back-propagation neural network and the linear-based Box-Jenkins model. In the exploratory phase, differencing was used to identify and separate trends and seasons from many sources of non-stationary data. A large, seasonal, non-stationary data set was analyzed. The HBNN was tested using water demand data for Washington, DC for the summers of 1983-86. This data set could not be accurately modeled using traditional methods due to large trends in water demand and variability. A HBNN model was developed and tested that uses the Box-Jenkins procedure to identify lag components of the data, which input variables to the neural network. A gainback propagation algorithm was used to train the neural network.

**Results:** The HBNN method was extended in this study so that seasonal, non-stationary, time series could be analyzed and daily water demand forecasts could be developed. The hybrid method of forecasting proved to be superior to conventional linear forecasting tools and to pure neural networks. The hybrid neural network shows marked improvement in interpreting and training complex data sets because it is able to identify seasonal lags. The time required to train and test the neural network using the hybrid

method is reduced significantly because it allows the use of smaller and more appropriate network input structures. The method can be implemented on-line and specialized circuits already exist. Neural network predictors could operate with SCADA systems, permitting water utilities with opportunities for real time integrated water resources management.

**Reference:** Heller, M., and Q. Wang, "Improving Potable Water Demand Forecasts with Neural Networks," in *Proceedings of UCOWR 1996*, San Antonio, TX.

## *Water Quality from South Texas Aquaculture Facilities*

**Researchers:** Marco Lopez-Ivich, David McKee, and Virenda Sharma, Biology Department, Texas A&M University-Corpus Christi (TAMUCC); Diana Martinez and Edward R. Jones, College of Science and Technology, TAMUCC, and Tzachi Samocha and Addison Lawrence, Texas Agricultural Experiment Station Shrimp Mariculture Project, Corpus Christi, TX.

**Problem:** Texas is now the leader of farm-raised shrimp in the U.S. and produces roughly 78% of the nation's total. With a long coastline and a large amount of coastal land, Texas aquaculture has the potential to grow substantially. There are concerns that these facilities may be discharging poor quality wastewater into the Arroyo Colorado and other South Texas coastal waters. The Texas Natural Resource Conservation Commission (TNRCC) now requires that each aquaculture facility that discharges more than 10 million gallons per day of wastewater and/or produces more than 40,000 pounds of fish or shrimp per year obtain a water discharge permit. In Texas, there has been a trend toward intense aquaculture production, which includes high stocking rates, increased feeding rates, and supplemental aeration. Intense production has led to higher yields, but also has increased public concern about the environmental impact of these discharges.

**Objectives:** 1) To characterize water quality parameters in effluent water from three South Texas aquaculture facilities, and 2) To identify correlations and trends among these parameters.

**Methods:** Three commercial aquaculture facilities in South Texas were evaluated for influent and effluent water quality from June through October 1994. The facilities include Texas Shrimp Village (TSV) in Arroyo City, Harlingen Shrimp Farm (HSF) in Bayview, and the Southern Star Farm (SSF) in Arroyo City, which raises shrimp and eels. TSV and SSF pump water from the Arroyo Colorado into their distribution canals and discharge effluents into the Arroyo Colorado downstream. HSF pumps water from the Laguna Madre and discharges effluents back into the lagoon. Samples were taken three times a

week at SSF, twice weekly at TSV, and weekly at HSF. Samples were analyzed for dissolved oxygen (DO), salinity, pH, ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen, total phosphorus, total reactive phosphorus, five day carbonaceous biochemical oxygen demand (CBOD-5), total suspended solids (TSS), and settleable solids. Water quality data that were collected include grab samples, a 24-hour study, wastewater discharges from discharge canals and ditches, and samples from intensively farmed ponds. Data from the facilities were compared and correlations identified using a coefficient matrix. The quality and quantity of effluents were compared to standards set by TNRCC permits.

**Results:** More than 4,130 pounds per acre of shrimp were produced during the study period at TSV and 1,585 pounds per acre at HSF, while 1,013 pounds per acre of eels were grown at SSF. Effluent pH levels at TSV and SSF were lower than influent values, but were still within TNRCC limits. At HSF, effluent pH values were higher than influent concentrations but were still lower than TNRCC criteria. Levels of DO in effluents were generally below TNRCC limits at all farms. Effluent nutrient concentrations and net loads were generally higher at TSV, and mean levels of ammonia-nitrogen at TSV and SSF were greater than TNRCC daily limits on many occasions. Effluent TSS levels were higher than influent concentrations and daily mean values were greater than TNRCC permit criteria. In spite of greatly varying stocking densities at the three facilities, TSS levels were similar at all sites. However, TSS total net loads and net loads per hectare were higher at TSV. Higher CBOD-5 concentrations and net loads were found at HSF, despite its relatively low stocking density. CBOD-5 values at TSV were often higher than influent values. During heavy rains, the agricultural area south of SSF and TSV may have contributed significant amounts of solids. The results suggest that overfeeding the shrimp may be occurring and that more efficient diet and feed strategies may lessen high nutrient levels that are now being found.

**Reference:** Lopez-Ivich, M., *Characterization of Effluents from Three Commercial Aquaculture Facilities in South Texas*, M.S. Thesis, TAMUCC, 1996.

## *Modeling Surface and Ground Water Interactions on the Lower Reach of the Brazos River*

**Researchers:** Kesava Chakka and Clyde Munster, Agricultural Engineering Department, Texas A&M University, College Station, TX.

**Problem:** River floodplains are vulnerable to nonpoint source pollution due to shallow water tables, close proximity to streams, and interactions between surface and ground water. Therefore, floodplains represent unique hydrological challenges. For example, agricultural chemicals used in crop production that leach into groundwater may eventually flow into adjacent rivers. Conversely, flooding events with high river stages can potentially cause surface water to recharge groundwater supplies. Accurate methods to simulate these complex interactions can be particularly useful in assessing environmental risks from agricultural chemicals applied to river floodplains, as well as polluted surface water transport to groundwater supplies in floodplain aquifers.

**Objectives:** 1) To simulate surface and ground water interactions with computer model simulations; 2) To compare simulated results with actual field data, and 3) To identify the interrelationships between surface and ground water levels and water quality in the region.

**Methods:** The research site was located at the Texas A&M University research farm, on the Brazos River in Burleson County, TX. The site was instrumented for monitoring groundwater and surface water runoff and was planted with a corn crop. The field was cleared for agriculture in 1993 and has a slope of 0.3%. The floodplain aquifer is located below a 22-foot thick clay layer that is underlain by successive layers of sand, coarse sand and gravel. An impermeable layer of shale is located at depths of 70 feet. Four fully screened monitoring wells were located in a transect perpendicular to the river. One well was located as close to the river as possible to monitor river stages. Water levels were continuously monitored during the 1994 and 1995 growing seasons. The U.S. Geological Survey (USGS) computer simulation model, Variably Saturated Two Dimensional Transport model or VS2DT, was used to simulate groundwater flow. VS2DT uses two-dimensional finite difference methods to simulate saturated and unsaturated groundwater flow patterns. A cross-section of the floodplain aquifer, through the four monitoring wells, was represented by a finite difference grid that consisted of 142 horizontal nodes (1,320 feet) and 57 vertical nodes (42 feet). Pressure head boundary conditions were used in the model to simulate groundwater flows and were allowed to change daily based on field observations. Model inputs require hydraulic conductivity, specific storage, porosity, and Brooks and Corey parameters for unsaturated hydraulic conductivity for each soil layer. A field pump test was conducted at the research site to evaluate aquifer properties. Groundwater withdrawals at the research site pumping well were simulated by the model.

**Results:** Surface and ground water interactions were successfully simulated for the 1994 and 1995 growing seasons. Simulated groundwater levels closely matched field measured water levels. Simulated floodplain aquifer discharge to the Brazos River at low or normal river stages averaged 1.30 cubic feet per second per mile (cfs/mi). Simulated recharge from the Brazos River to the floodplain aquifer at flood or high river stages averaged 1.26 cfs/mi. From the field research and model simulations, it was determined that rainfall had very little effect on aquifer water levels. Aquifer water levels were primarily influenced by river stage. These successful groundwater flow simulations will provide a base for detailed chemical transport simulations in the floodplain along with the lower reach of the Brazos River.

**Reference:** Chakka, K., *Evaluation and Simulation of Non-Point Source Agricultural Transport in Variably Saturated Soil Medium*, Ph.D. Dissertation, TAMU Agricultural Engineering Department, 1996, or K. Chakka and C. Munster, "Simulation of Groundwater-Surface Water Interaction on the Lower Reach of the Brazos River," in *Proceedings of UCOWR 1996*, San Antonio, TX, 1996.

## *UTMSI to Study Why Brown Tide Persists*

For more than six years, the "brown tide" has plagued the waters of the Laguna Madre and Baffin Bay off the South Texas coast. The tide, which is the result of a widespread phytoplankton bloom, has many adverse impacts. It reduces the amount of sunlight that penetrates underwater and supports fragile seagrasses, while decreasing the quality of sport fishing in the region. The brown tide is especially critical because the Laguna Madre is a vital and unique ecosystem. It constitutes the largest undisturbed seagrass habitat in Texas, it supports a large and diverse food web, and it provides a nursery habitat for fish.

Recently, researchers at the University of Texas Marine Science Institute at Port Aransas (UTMSI) were awarded a grant from the Texas Higher Education Coordinating Board to investigate why the brown tide has persisted so long. UTMSI biologists Ed Buskey and Paul Montagna hope to answer some of these questions. Ultimately, they hope to develop management techniques to offset the impacts of this brown tide invasion and help lessen the chances that the blooms will occur again.

In this project, Buskey and Montagna will investigate two major theories. The first is that alterations in the nutrient supply to the Laguna Madre could favor the growth of organisms other than the brown tide. Specifically, the researchers hope to test the hypothesis that the brown tide organisms can use nitrite or ammonia for growth, but are unable to utilize nitrate. The second major focus of the research will investigate why several species of benthic and phytoplankton grazers that feed on the brown tide under controlled conditions and at other sites have not flourished during this prolonged brown tide invasion. Specifically, Buskey and Montagna want to determine if a dominant copepod species in the region *(Acartia tonsa)* is consuming large amounts of microzooplankton. Under normal conditions, these benthic and phytoplankton grazers would be available in large enough numbers to potentially consume large amounts of the brown tide organisms.

The research will involve many specific tasks, including investigating whether the brown tide releases chemicals which inhibit the growth of other species, quantifying rates of benthic regeneration, examining how changes in nutrients impact the phytoplankton community structure, and assessing the balance between brown tide growth and microzooplankton grazing.

For details, contact Buskey at (512) 749-6711 or Montagna at (512) 749-6775 or paul@utmsi.zo.utexas.edu.

## *Rice U. Researchers to Develop Improved Methods to Model Groundwater Systems in Three Dimensions*

Researchers at Rice University are developing advanced computer systems to better model and interpret groundwater systems and other geologic structures. The work is led by Joe Warren and Ron Goldman of the Computer Science Department. It was funded by the Texas Higher Education Coordinating Board's Advanced Research Program.

The ultimate goal of the research is to develop a computer modeling system that can be used to create and edit three-dimensional representations of geologic systems, including underground aquifers. Specifically, the research will allow users to apply various complex algorithms to generate meshes that can be utilized for finite element analyses.

Warren says this project improves upon existing technology in many ways. It allows the user to easily insert new layers and faults as they are needed. It also incorporates smooth geology into three-dimensional models using fractal-based subdivision. Both techniques require fewer inputs from the user and result in higher-quality, more accurate models. Ultimately, the researchers hope these techniques will be useful for simulating and analyzing groundwater flow paths and the migration of subsurface pollutants. For details, contact Warren at (713) 527-8101 or jwarren@rice.edu.

## *UT Researchers Investigate Ways to Incorporate Real Time Global Positioning Systems into Lake Surveys*

Researchers at the University of Texas at Austin are working to incorporate real time collection of geographic information into reservoir survey methods. The lead researchers in the project are Bob Morton of the UT Bureau of Economic Geology (BEG) and Bob Schutz of the Center for Space Research (CSR). The research is funded by the Texas Higher Education Coordinating Board.

BEG researchers led by Jim Gibeaut have been developing improved methods to more accurately survey reservoirs for some time. For example, their previous studies dealt with combining a geographic positioning system (GPS) with electronic motion sensors, narrow beam digital fathometers, digital-gyro compasses, portable computers and custom software.

In this project, BEG and CSR researchers hope to develop a method to obtain real time horizontal and vertical positions of a moving survey boat and integrate that information with the improved survey system. The new method will utilize GPS technology and is designed to work well in shallow waters (1 to 100 feet deep). BEG and CSR researchers will test the system in the laboratory and in the field, and will compare results to traditional surveying methods. Morton says this new technique will provide information that will benefit studies of coastal erosion, hydrodynamic modeling, and dredging and may even improve the accuracy of navigation charts.

For details, contact Bob Morton at (512) 475-9547 or mortonr@begv.beg.utexas.edu.

## *UH, UT Scientists Team Up to Develop New Probe to Measure Heat Flows from Shallow Seafloors*

*Researchers deploy this probe to measure heat flow off the Texas coast.*

Developing a new technique to accurately and inexpensively measure geothermal heat flow in shallow seafloors is the goal of a project now underway by researchers at the University of Houston (UH) and the University of Texas at Austin (UT). The project is led by Seiichi Nagihara of the UH Geosciences Department and Kenneth Griffiths of the UT Institute for Geophysics. It was funded by the Texas Higher Education Coordinating Board.

Measuring geothermal heat flow in shallow seafloors is an important part of the offshore oil and gas exploration industry. Geothermal heat flow helps professionals study maturation of sediments and find oil and gas seeps where wells may be drilled. Currently, methods used to measure heat flow on seafloors are expensive and complicated. Methods used today only work well on seafloors deeper than 3,000 feet and require a fairly large and stable ship equipped with precise record-keeping capabilities, bow thrusters and a heavy duty winch. Hiring such a vessel costs $10,000 per day. This method requires a 33-foot long probe that can be easily bent and rendered useless if the ship moves even slightly.

Nagihara and Griffiths believe that they can develop an inexpensive, accurate, and easy to use method to measure offshore geothermal heat flow. In this project, they are testing a 20-foot long, expendable, thin (1-inch diameter), seafloor probe that contains many temperature sensors. This probe could be deployed from a medium sized boat and would freefall through the water column and penetrate into seafloor sediments. While falling, it would transmit data back to the ship via a thin electronic cable. The device, designed for one-time-only use, could be left in the seafloor and would not have to be retrieved for reuse. For details, contact Nagihara at (713) 743-3413 or nagihara@uh.edu.

## *UTMB, TAES Scientists to Develop "Pathogen Free" Shrimp*

Researchers with the University of Texas Medical Branch in Galveston (UTMB) and the Texas Agricultural Experiment Station (TAES) in Corpus Christi are teaming up with a private company to develop shrimp broodstock that are free from specific pathogens. The end result could be a greatly enhanced supply of shrimp that can be used in aquaculture operations. The project was awarded by the Texas Higher Education Coordinating Board. Lead scientists include Phillip Lee of UTMB and Addison Lawrence of TAES. They will be working with TEX-AIM of Port Aransas, which is a commercial provider of shrimp broodstock.

The problem, the researchers say, is that no specific pathogen free (SPF) shrimp broodstock are grown and maintained in the continental US. SPF broodstock are critical because shrimp are vulnerable to diseases that inhibit growth, increase mortality, and cause deformities. If mariculture is to be successful in Texas, Lee and Lawrence argue a large number of SPF shrimp larvae will have to be grown and available in the region to support these operations. They hope to show that SPF shrimp broodstock can successfully be grown in Texas on a large scale and to develop and implement a modern shrimp grow-out facility as a pilot plant.

The project consists of four main components: 1) a closed, recirculating aquaculture production system will be developed and tested; 2) an intelligent computerized control system will be developed and implemented to monitor and correct for changes in water quality and shrimp health; 3) SPF broodstock production in recirculating aquaculture production systems will be demonstrated; and 4) maturation and reproduction of SPF broodstock in recirculating systems will be demonstrated.

For more information, contact Lee at (409) 772-2133 or nrcc@mbian.utmb.edu, or Lawrence at (512) 749-4625

## *Treating Shrimp Viruses is Goal of TAMU Study*

Proponents of Texas aquaculture will tell you that shrimp have the potential to be one of the major aquaculture species produced in this region. Already, more than five commercial shrimp farms operate along the Texas Gulf Coast. However, shrimp diseases pose a serious threat to commercial aquaculture operations. Currently, there are no treatments available to cure viral infections of shrimp and the only recourse when viral outbreaks occur is to destroy the whole crop to prevent the virus from spreading. In part, that's because it's been difficult to identify and produce medications that can kill the viruses without harming the shrimp.

Researchers at Texas A&M University (TAMU) have recently been awarded a grant by the Texas Higher Education Coordinating Board to develop methods to control a major class of shrimp viruses called baculoviruses. The research is led by Linda Guarino and Donald Jarvis of the TAMU Entomology Department.

The project will focus on isolating and characterizing genes that have been shown to be important for the replication and infectivity of insect baculoviruses, which could lead to

ways to combat shrimp baculoviruses. In the study, the researchers will determine if viral-encoded RNA polymerase (an enzyme that is essential for viruses to develop) can be inhibited in shrimp. They hope to develop antibodies that could work against the membrane protein of baculovirus particles and slow the spread of virus infection. Eventually, the researchers hope that these methods will be widely used in commercial shrimp aquaculture operations in Texas and elsewhere.

For details, contact Guarino at (409) 845-7556 or Lguarino@bioch.tamu.edu.

## *LCRA, UT, CRMWD Use Airborne Surveying Method to Seek Leaking Oil Wells*

A team of scientists from the University of Texas at Austin (UT), the Lower Colorado River Authority (LCRA), and the Colorado River Municipal Water District (CRMWD) are taking to the skies of West Texas to search for sites where abandoned oil wells may be contaminating groundwater supplies. The work is led by Jeff Paine of the UT Bureau of Economic Geology (BEG), Jeff Saunders of LCRA, and Okla Thornton of CRMWD.

*LCRA is using airborne electromagnetic surveying to detect the location of leaking oil wells.*

The project centers around the use of airborne electromagnetic surveying (AEM) to target leaking wells. In this technique, a helicopter or airplane is equipped with devices to measure minute variations in the Earth's magnetic field, the conductance of electricity through soils, and a global positioning system. These aircraft are flown at low or stall speeds when taking these surveys. Electric conductivity can be correlated to concentrations of saltwater and oilfield brines. AEM can also gather data on groundwater quality conditions at depths of up to 300 feet. These data can then be plotted on a grid so that detailed maps can be generated.

Recently, the team began efforts to correlate the AEM data with field conditions. Extensive water quality samples were taken from across a 35-square mile area in Runnels County in West Texas. AEM maps were used to target 30 wells that merited additional studies. Many locations identified by the AEM surveys were found to have oil wells that were causing water quality problems.

Saunders says that AEM technology is an excellent way to identify all the oil wells within a targeted region. That's important because there are often no comprehensive records that display where these potential pollutants are sited. For details, contact Saunders at (800) 776-5272 or gsaunder@lcra.org.

## *Rice U. Researchers Field Test Methods to Remove Groundwater Pollutants at Military Bases*

Researchers at Rice University are leading a team effort to field test remediation strategies to clean up groundwater contamination at military bases.

Phil Bedient of the Environmental Science and Engineering Division at Rice University is leading the studies. Others involved in the project include the U.S. EPA National Risk Management Research Lab in Ada, OK; the University of Oklahoma, the University of Arizona, and Michigan Tech University. The project is being funded by EPA through the U.S. Defense Department SERDP program.

Hill Air Force Base (AFB) near Salt Lake City, UT, was the first site investigated in this project. Bedient and others are demonstrating the use of such technologies as surfactants, co-solvents and air sparging to remove non-aqueous phase liquids (NAPLs) from groundwater. These techniques are tested in 5 small cells that are 30' deep and measure 10' x 15'. There are 60 groundwater sampling points in each cell. Specific methods that are likely to be tested include solubilization and mobilization of surfactants along with alcohol flushing.

Various delivery systems and tracer tests will be an integral part of the studies. Sites are selected based on the type and horizontal extent of contamination, depth to confining clay layers, and sufficient water supplies. Military bases in Texas including Carswell and Kelly AFB are candidates for future studies. Ultimately, Bedient hopes to develop a multimedia manual and a computerized decision support system that site managers can use to select the most appropriate technology. The studies will last until 1999.

For details, contact Phil Bedient at (713) 527-4951 or bedient@rice.edu.

## *TAMUK Examines Long Term Impact of Effluent Irrigation*

Throughout much of Texas, the interest in utilizing wastewater to irrigate crops and landscapes is increasing. Areas with water shortages view wastewater irrigation as a way to stretch scarce water supplies. Because wastewater irrigation is fairly new in many areas, there are few studies that assess the long-term impact of wastewater irrigation on groundwater supplies and soils. Such a study was recently performed by Duane Gardiner and Mallikarjuna Patil of the Agronomy and Resource Sciences Department at Texas A&M University-Kingsville (TAMUK).

The project centered on three fields near Kingsville. The first field was never irrigated. The second field was irrigated with raw wastewater for 41 years (1937 to 1978) followed by another 15 years (1978 to 1990) of irrigation with treated wastewater. The third field was also irrigated with treated wastewater from 1978-90. The soils consisted primarily of Victoria clays, and were sampled along transects spaced throughout each field. Soil samples were analyzed for sodium and such heavy metals as copper, iron, manganese and zinc. Although there was little information available on the quality of wastewater,

Gardiner estimated historical values based on present values. Analysis of variance (ANOVA) techniques were used to compare results among fields.

Gardiner says the results show that some metals built up in the irrigated fields, apparently in response to wastewater irrigation. Copper and zinc levels were significantly higher in the second field than in the first field. Concentrations of cadmium and nickel were higher in the field that had not been irrigated than in fields that were irrigated, suggesting that leaching loss due to additional water application exceeded the loading rate. Sodium levels were higher in both irrigated fields, but not as high as one would calculate based on the amount of sodium added in the wastewater. Apparently, much of the sodium has leached out of the irrigated fields. Gardiner also said that soil copper levels can be used to estimate the amount of water that would have been added to the soils over the years because it is relatively immobile. For details, contact Gardiner at (512) 593-3691 or d-gardiner@tamuk.edu.

## *UT Press Books Focus on Caddo Lake, Big Bend*

Many books that explore water and environmental themes have recently been published by the University of Texas (UT) Press.

*Caddo Was...A Short History of Caddo Lake* was written by Fred Dahmer. This book describes the history, colorful characters, natural beauty, and poetry of Caddo Lake. Dahmer describes the region as "a cypress-strewn, moss-hung, mysterious body of water" that stretches from Texas into Louisiana.

*Saving the Best of Texas: A Partnership Approach to Conservation*, was written by Richard Bartlett and contains photographs by Leroy Williamson. It explores past and ongoing efforts of individuals and federal, local and state agencies and private groups to preserve Texas' natural landscapes and the many plants and animals they support. The book also describes many ecoregions of Texas.

*The Story of Big Bend National Park* was written by John Jameson. This book provides a comprehensive history of the park from its founding in 1944 to current conditions. The book contains sections dealing with major natural resources issues including water supplies and water quality in the Rio Grande.

*The Sea Turtle: So Excellent a Fishe*, was written by Archie Carr. This book tries to explain how turtles guide themselves across seas, why females lay so many eggs, where young turtles go after they have hatched, and the "arribada" phenomenon in which tens of thousands of Ridley's turtles come ashore to nest on a beach.

*Habitat Conservation and Planning: Endangered Species and Urban Growth*, was written by Timothy Beatley. The book focuses on the concept of habitat conservation plans as a way to maintain ecological health and diversity. A case study of Austin's Balcones Canyonland Conservation Program is included. The book describes such issues as land development and endangered species, the federal endangered species act, the

politics of habitat conservation, and methods to gauge the success of habitat preservation efforts.

*Aransas: A Naturalist's Guide*, was written by Wayne and Martha McAlister. The book provides a comprehensive overview of the natural and cultural history of the Aransas National Wildlife Refuge. Sections of the book focus on the whooping cranes, snakes, fish, invertebrates, and other animals that live in the region, plant life in the refuge, and land use issues.

For details, contact the UT Press at (512) 471-7233.

## *TAMU Press Books Describe Ship Technology, Historical Issues*

New water and environment related books from the Texas A&M University Press cover such topics as the development of water related technologies, policy issues, and ecosystems.

*Changing Tides: Twilight and Dawn in the Spanish Sea (1763-1803)*, was written by Robert Weddle. The book describes the discovery and exploration of the Gulf of Mexico and features accounts of hurricanes, shipwrecks, and political intrigue.

*The Development of the Rudder: A Technological Tale*, was written by Lawrence Mott. This book attempts to explain the evolution of rudders from Roman times through the middle ages to the era when Columbus and other seafarers explored the seas.

*Ships' Bilge Pumps: A History of the Their Development (1500-1900)* was written by Thomas Oertling. Bilge pumps are used to rapidly pump water out of the helms of ships that have sprung leaks and help the ships stay afloat. This book traces the use of bilge pumps throughout time and examines leaks in ship hulls.

*Caught in the Net: The Conflict Between Shrimpers and Conservationists*, was written by Anthony Margavio and Craig Forsyth. The book describes the ongoing controversy over the federal government's efforts to require that commercial fishermen use turtle excluder devices. In 1989, the conflict became so pitched that many shrimpers attempted to blockade ports and waterways along the Texas coast.

*Geo-Texas: A Guide to the Earth Sciences*, was written by Eric Swanson. This book, which is geared to public school teachers and students as well as to a general audience, provides entertaining accounts of natural phenomena. It contains sections on Texas weather, groundwater, geology, and the Gulf of Mexico.

To order any of these books or for more information, contact the Texas A&M University Press at (800) 826-8911.

## *TWRI to Create On-Site Wastewater WWW Site*

Recently, TWRI was awarded a grant to develop a World Wide Web (WWW) site for the Texas On-Site Wastewater Treatment Research Council. That site is now being created

by TWRI student workers Jonathan Jones and Sergio Acosta and information specialist Ric Jensen. When finished this fall, this WWW site will contain extensive information about the council and its role in on-site wastewater issues and will provide general information about septic tanks and alternative on-site wastewater systems. It will also have links to other sites.

Improvements have been made to TWRI's WWW site, Texas WaterNet (http://twri.tamu.edu). TWRI worked with the American Water Works Association Texas Section to publish a searchable database of water reuse programs in Texas and put it on the WWW site. Newsletters and technical reports are also on-line.

For details, contact TWRI at (409) 845-1851 or twri@tamu.edu.

## *UH Researcher Tells History of Disinfection By-Products*

A new videotape has been produced by a University of Houston (UH) researcher that explains history and policy issues associated with disinfection by-products in drinking water.

The 47-minute video, titled *1974 Revisited-An Historical Review of the Disinfection By-Products Issue*, was produced by James M. Symons of the UH Civil and Environmental Engineering Department. Symons worked at the U.S. Environmental Protection Agency (EPA) research center in Cincinnati in 1973 when trihalomethanes (THMs) were first discovered. Since that time, he has been active at EPA and UH in researching methods to control THMs.

"I think this video will make an excellent presentation for consulting engineers, water treatment plant managers, and other water professionals, and it will be useful in university classrooms, short courses and water and environmental seminars," Symons says.

To order or preview the video, contact Symons at (713) 743-4265 or jsymons@uh.edu.

## *UCOWR '96 Proceedings Now Available*

The Universities Council on Water Resources (UCOWR) has recently published the proceedings of its 1996 conference.

*UCOWR '96 Proceedings: Integrated Management of Surface and Ground Water* contains papers that were given at the annual UCOWR meeting in San Antonio. This proceedings includes many papers that were presented by scientists at Texas universities

and professionals with agencies and private firms in the state. Sessions of the meeting focused on the Edwards Aquifer, El Paso/Juarez surface water and groundwater issues, conjunctive use of surface and ground water, artificial recharge, computer models and applications, internet resources, innovative integrated use scenarios, international case studies, legal issues, and economic issues. Other recent books that can be ordered from UCOWR include the *Proceedings of the First and Second International Conference on Ground Water Ecology* are also available. These two volumes describe conferences held in 1992 and 1994. The proceedings from the 1994 conference includes papers by scientists at Texas Christian University and Southwest Texas State University.

For details, contact UCOWR at (618) 453-6453 or on the WWW at http://www.uwin.siu.edu.

## *Texas A&M Economists Analyze if USDA Programs Increase Edwards Aquifer Water Use*

A critical debate in the ongoing water controversy in the Edwards Aquifer concerns whether or not federal irrigation policies lead to excessive water use. The Sierra Club filed a lawsuit requesting that many U.S. Department of Agriculture programs be modified or withdrawn so that farm water use would be lessened. In response, researchers at Texas A&M University (TAMU) utilized simulation models and data sets to assess the impact of USDA commodity programs on agricultural water use in the region.

The study was conducted by Ron Lacewell, Bruce McCarl, and Manzoor Chowdhury of the TAMU Agricultural Economics Department. The researchers obtained information about participation in USDA commodity programs in the region from a 1995 survey by the National Agricultural Statistical Service. That survey revealed that roughly 42% of the irrigated cropland in the region participated in USDA commodity programs (most of the acreage was in cotton, corn and sorghum). Regional weather data from 1989 was collected to represent a dry year, 1992 for a wet year, and 1994 for a normal year. Cotton irrigation strategies and yields were simulated with the integrated crop and economic management model. Irrigation strategies and yields for corn, grain sorghum, and wheat were modeled with the erosion productivity impact calculator. A discrete, stochastic, economic optimization model was used to simulate economic decisions farmers would make about irrigating crops or using dryland farming methods.

Results suggest that the impact of USDA commodity programs has been to encourage farmers to plant crops that use less water. Lacewell suggests many farmers would likely switch to vegetables, hay, and other crops that use more water if the USDA commodity programs were not in place. The analysis also suggests that farmers in the region would probably pump more water for irrigation (regardless of weather conditions) if USDA commodity programs were not in effect. Part of the reason may be that farmers in the region have adopted a particular cropping pattern and irrigation strategy over time which is the major factor that influences their irrigation management decisions. For details, contact McCarl at (409) 845-1706 or mccarl@tamu.edu or Lacewell at (409) 845-2333.

## *TAMUK Scientists Recover Mastodon, Other Species that Once Roamed the Lower Nueces River Valley*

*TAMUK researchers work to excavate and preserve this mastodon skill that was found in the lower Nueces River valley near Kingsville.*

Researchers at Texas A&M University-Kingsville (TAMUK) recently recovered the latest in a series of prehistoric animals that lived in the ancestral Nueces River Valley of South Texas. In March, Jon Baskin and Ronny Thomas of the TAMUK Geosciences Department recovered the skull and part of one tusk of a 13,000 year old mastodon from river deposits in the Lower Nueces River Valley. Since October 1994, fossil remains of about 25 now extinct fauna have been found including Columbian mammoths, giant tortoises, giant armadillo-like animals, ground sloths, tapirs, horses, large peccaries, camels, llama, bison, large flightless predaceous birds and American lions. This diverse assemblage of animals abruptly became extinct about 10,000 years ago at the end of the last "ice age." Stratigraphic and faunal studies suggest a drastic change from wetter, high rainfall, to dryer, more arid climates started in South Texas about 10,000 years ago. TAMUK is now developing a natural history exhibit titled "When Elephants Roamed South Texas" that will be displayed at the Conner Museum on campus. For more information, contact Thomas about the mastodon at (512) 593-2101 and the Conner Museum about the exhibit at (512) 595-2810.

## *Rice U. Studies How Particle Sizes Impact NPS Pollutants*

Non-point source pollutants from urban areas constitute a major threat to water quality. Recently, researchers at Rice University characterized how the variations in particle size of non-point source pollutants from a Houston watershed may impact water quality. The study was led by researcher Mark Wiesner and graduate student Gregory Characklis of Rice's Environmental Science and Engineering Department. The goal of the study was to characterize the size of particulate materials in urban runoff and to quantify the amount of heavy metals and other contaminants which piggy-back onto these particles. While some work has been done previously to study large particles, this project focused on smaller particle sizes. Wiesner believes that small particle sizes may represent a significant available surface area that pollutants can become attached to. In the research, water and

suspended solids samples were collected from Brays Bayou during stormwater runoff and normal flow periods. The samples were sorted by particle size and levels of heavy metals. Special care was taken to discern the relative amounts of contaminants that were associated with various particle sizes. Results suggest that the amount of heavy metals attached onto small particles in stormwater events may be significant, and pollutant loadings in runoff from a single storm event may be equal to months of background flow. They also observed that different contaminants enter urban waters at various times during a storm, potentially complicating stormwater management strategies. For details, contact Wiesner at (713) 285-5129 or wiesner@rice.edu.

## *TAEX Creates Web Site With PET Data*

The Texas Agricultural Extension Service (TAEX) has developed a World Wide Web (WWW) site that contains extensive potential evapotranspiration (PET) data. The service (at http://www.agen.tamu.edu/pet) contains summaries of daily weather and PET data from weather stations located in Central and South Texas. The effort is led by TAEX agricultural engineer Guy Fipps. The WWW site includes a calculator which allows users to determine irrigation water requirements of crops and turfgrasses. Weather stations that are now "on-line" include College Station, San Antonio, Rio Hondo, San Juan, Harlingen and Medina County. By adding a planned "link" to the North Plains PET Network later this fall, the Web site will cover about half of the 6 million irrigated acres in the state. For details, contact Fipps at (409) 845-7454 or g-fipps@tamu.edu.

## *HARC Examines Water and Sustainable Development on Texas-Mexico Border*

The Houston Advanced Research Center (HARC) has been awarded a grant from the U.S. Environmental Protection Agency to examine water and sustainable development management strategies for the Lower Rio Grande/Rio Bravo watershed in south Texas and northeast Tamaulipas. The work is led by Jurgen Schmandt and Dan Sisbarro of HARC and Ismael Aguilar Barajas of Instituto Tecnologico y de Estudios Superiores (ITESM) in Monterrey, Mexico.

The project involves developing a binational database with water, ecological, population and economic information that can be used for watershed analyses. An integrated assessment of the binational watershed will be conducted. The project will help area leaders plan for droughts and will develop baseline and future scenarios to better understand the region and plan for the future under drought, climate change, and sustainable development conditions. Local communities and decision makers will be involved through workshops and surveys.

Roughly 15 graduate students at the University of Texas at Austin (UT) LBJ School of Public Affairs and ITESM will work together to develop policy reports on drought and water management in the study region. These courses will be taught by Schmandt, George Ward, and Chandler Stolp of UT, and by Barajas and Enrique Vogel of ITESM.

For details, contact Sisbarro at (713) 363-7913 or sisbarro@admin.harc.edu.

## *TAMUCC Researchers Design, Implement System to Monitor Air, Sea, Sediment Interactions in Corpus Christi Bay*

Dredging associated with the Gulf Intracoastal Waterway has raised environmental concerns for sensitive estuarine and lagoonal waters. The U.S. Army Corps of Engineers (USACE) and local organizations responsible for navigation and commerce wish to conduct dredging activities in an economical and environmentally safe manner. Few measurements are available for relating sediment movement in the Laguna Madre with waves and currents that set the sediment in motion and transport it. To collect such data, the Port of Corpus Christi Authority and the USACE Galveston District sponsored a project with the Conrad Blucher Institute for Surveying and Science (CBI) at Texas A&M University-Corpus Christi (TAMU-CC) to conduct a year-long monitoring project of the wind, waves, current, and sediment movement in Corpus Christi Bay. Lead scientists are Cheryl A. Brown, Daryl B. Slocum, and Nicholas C. Kraus of CBI.

*TAMUCC researchers developed and instrumented this device to obtain extensive hydrology data.*

The thrust of the project involves the creation of the Lagoon-Air-Sea-Sediment Interaction (LASSI) System. LASSI is a stand-alone offshore marine data-collection system located on a platform installed within the Corpus Christi Ship Channel about 2 miles from the entrance to the port. LASSI went on line in December, 1995. The heart of the system is a 486 microcomputer with a 1 gigabyte hard drive. Smart system software has the capability to dynamically change the sampling intervals and data-collection rates. Presently, LASSI is logging 25 channels and generating 120 megabytes of raw data per week. The data are transmitted 6 miles across the bay to CBI through a radio-transmitted local area network (LAN) connection and an ethernet card.

Data are collected for a 9-minute interval every half hour. The system records measurements of the wind speed and direction, and water surface elevations (by pressure gauge currents through the water column and at a point near the bottom by acoustic sensors). Suspended sediments are measured through the water column by optical sensors and are ground-truthed by periodic automated water sampling. LASSI is providing data for long-term monitoring of tides, as well as short time scale motion of individual sediment suspension and transport events. Ship wakes are also recorded. LASSI has been designed to be robust and modular so that other instruments can be added.

A smaller version of LASSI is now under construction that will serve as a roving station in Corpus Christi Bay, with measurements of the roving station compared to those with

the larger platform and its baseline data record through different seasons. A similar LASSI system is now being installed in Lavaca Bay under the sponsorship of ALCOA.

For details, contact Kraus at (512) 994-2376 or kraus@cbi.tamucc.edu or visit their World Wide Web site at http://www.cbi.tamucc.edu.

## *UH Engineers Examine Impact of 1994 Floods on Utilities*

During the middle of October 1994, the heavens opened up over Houston and dumped as much as 30 inches of rain over the area. As a result, low lying subdivisions and streets flooded, 20 people lost their lives, and as many as 12,000 residents were forced from their homes. The flooding also affected water utilities in the region in some obvious and subtle ways. Recently, a researcher at the University of Houston (UH) Civil Engineering Department and a professional with the City of Houston Water Utilities teamed up to assess the specific toll the flooding took on water and wastewater services in the area and identified potential measures that could be taken now to reduce future flood damages.

The assessment was conducted by Jerry Rogers of the UH Civil Engineering Department and Kathlie Suyn Jeng of the Houston Public Works Department. First, they identified specific instances where floodwaters harmed utility operations. For example, the Belleau Woods subdivision is sited in a floodplain near Lake Houston and relies on groundwater. The floodwaters submerged the booster pumps, electrical, and chemical feed systems and pulled a 5,000 gallon tank from its foundation. As a result, the suburb was without water service for a week. Elsewhere, operations at the Chocolate Bayou Wastewater Treatment Plant in Southeast Houston and the Gulf Meadows Wastewater Treatment Plant near Hobby Airport were also disrupted by flooding. At Chocolate Bayou, for example, the rising waters inundated the motor control center, shorted a major breaker, and left the plant without power.

Rogers and Jeng evaluated the broad options that a utility like Houston can take to prepare for such flood events in the future and identified three strategies: 1) Relocate plants outside the floodplain; 2) Divert flood flows to other areas, and 3) Waterproof electrical components. Waterproofing sensitive areas to safeguard electrical systems seems to be the most cost effective and easily implemented of these options, Rogers says. For details, contact Rogers at (713) 743-4276 or Jeng at (713) 223-1095.

## *SFASU, TRA Develop Method to Determine Effectiveness of Constructed Wetlands for Wastewater Treatment*

How do you know if a constructed wetland is the appropriate technology to treat wastewater on a specific site? Until recently, that was a hard question to answer. Now, thanks to a recent research project that involved scientists at Stephen F. Austin State University (SFASU), it is easier to determine if wetlands are the right choice.

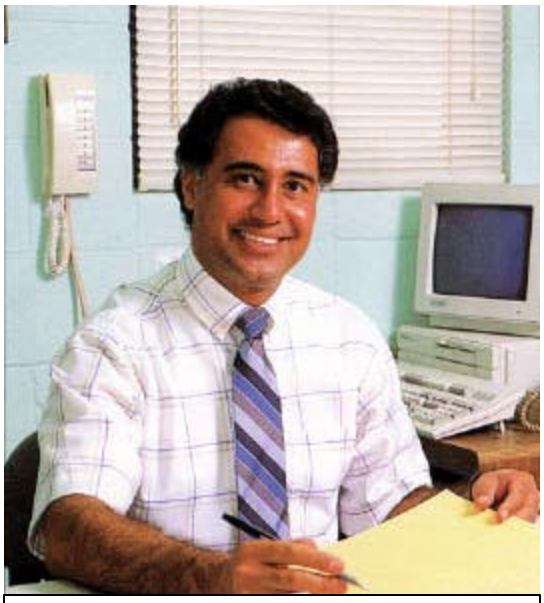
The project was led by Richard Browning and Sam Scott of the Trinity River Authority. Other participants include Dan Schellenberg of Second Nature Systems in Kennard, Kent Adair and P.R. Blackwell of the SFASU Tucker Center and College of Forestry; Kent Awtrey of the Pineywoods Resource Conservation and Development, Inc. (RC&D), Inc., in Nacogdoches; Febe Ortiz of the Southeast Texas RC&D, Inc., in Beaumont; and Gene Lindemann and Harrell Geron of the U.S. Department of Agriculture Natural Resources Conservation Service (USDA/ NRCS) in Temple.

The goal of the project was to develop a ranking system that utilizes data on hydrology, slopes, soils, habitats, and other factors that impact the effectiveness of constructed wetlands to treat wastewater in the region. After going through an evaluation process, water managers are provided with new information on costs for construction, operations and maintenance, and systems performance. Much of the SFASU work involved using a geographic information system (GIS) to develop maps of the watershed that display where conditions exist that impact the feasibility and performance of constructed wetlands. SFASU and others used ARC/INFO hardware and software, the USDA STATSGO database, and other information sources to create maps that display such factors as flood frequency, precipitation, groundwater depth, soil types, drainage, natural vegetation, and open lands. For details, contact Schellenberg at (409) 638-4263.

## *TAMU El Paso Environmental Lab Receives Accreditation*

Researchers and agencies in Texas needing analysis of samples through an accredited laboratory now have a new facility were they can send their samples. In July, the American Association for Laboratory Accreditation accredited the Frank Hernandez Environmental Laboratory at the Texas A&M University Research and Extension Center in El Paso.

The scope of accreditation includes drinking water, effluent water, and solid/hazardous waste for metals, nutrients, and wet chemistry tests. The accreditation is significant, according to laboratory director Mehdi Ali. "The accreditation means the laboratory has met the general requirements for the competence of calibration and testing laboratories to conduct complex environmental analysis," Ali says. "We have successfully demonstrated through our participation in the US Environmental Protection Agency (EPA) performance evaluation studies that we are capable of accurately performing intense and sophisticated chemical analyses," Ali says. The importance of laboratory accreditation is that it certifies that the lab can provide clients results with a high level of confidence and accuracy and that they have developed and are applying an approved quality assurance and quality control plan.



*Lab director Mehdi Ali.*

The laboratory accepts samples from educational institutions, research centers, and other agencies. The laboratory features sophisticated, computer controlled analytical instruments, 4,500 square feet of laboratory space, and a highly trained technical staff. It is designed to analyze soil, water, plant, sludge and other hazardous waste, and biota samples for metals, salts, nutrients, and routine wet chemistry tests.

Major instruments at the laboratory includes an inductively coupled plasma (ICP) spectrometer; a nitrogen, carbon, hydrogen, sulfur, and oxygen (NCHS-O) analyzer; an atomic absorption/emission (AA/AE) spectrophotometer; a graphite furnace atomic absorption (GF/AA) spectrophotometer; a hydride generation system; an ion chromatograph (IC), a gas chromatograph (GC), an ultraviolet, variable wavelength spectrophotometer, and other equipment for routine analysis.

For a detailed description of the laboratory's capabilities, pricing information, and additional details about the lab and its analytical services contact Ali at (915) 859-1908, ext. 10, or a-ali101@tamu.edu.