New Waves
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Texas A&M, Texas Tech Study Asks Why More Farmers Don't Take Part in Low-Interest Loans for Water Conservation

Researchers at Texas A&M University and Texas Tech University are cooperating in a survey to identify factors that influence farmers' decisions about whether they should participate in a program that provides low-interest loans to increase conservation.

The Texas Legislature approved the low-interest loan program in 1985. The program established a fund that the Texas Water Development Board (TWDB) uses to loan money to participating water districts. The districts can then loan money directly to individual farmers to cover the cost of purchasing and installing water conservation equipment, to convert irrigated acreage to dryland farming, and to purchase equipment for furrow dikes and water harvesting.

So far, more than 192 loans totaling $6 million have been made by the TWDB to participating districts. TWDB officials suggest that roughly 67,000 acre feet of water has been saved because of the program.

In the study, which is funded by the TWDB, Ron Lacewell of the Texas A&M University Agricultural Economics Department is leading efforts to survey water districts, farmers, and lenders in the Lower Rio Grande Valley and the Winter Garden region along the western part of the Edwards Aquifer. Eduardo Segarra of the Texas Tech University Agricultural Economics Department is surveying those groups in the High Plains.

Preliminary survey results suggest that general awareness about the program and participation by water districts is highest in the High Plains. There have been concentrated efforts by the High Plains Underground Water Conservation District #1 to promote the program and to provide technical assistance. The program is less active in other parts of Texas because many irrigators do not believe water is scarce and may not realize how conservation will benefit them.

The survey also revealed that many water districts do not participate in the program because they do not want to take responsibility for "banking work." For example, districts that participate are liable for half the amount of the outstanding balance if a farmer defaults (TWDB covers the other half). Many farmers in the Lower Rio Grande Valley who were surveyed said that there were opportunities to significantly increase water conservation, but few irrigators knew about the program. In many cases, the farmers

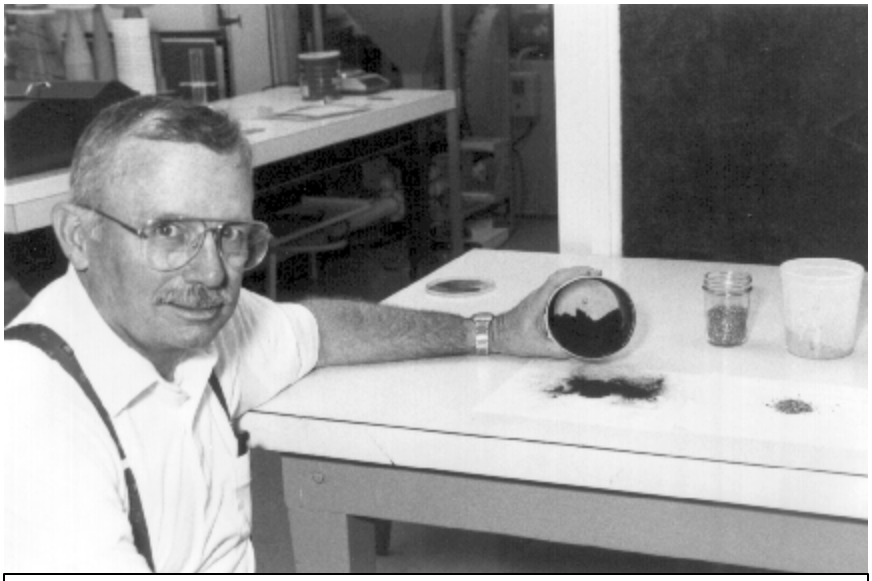
indicated a need for more education and technical assistance in on-farm water conservation practices.

After the survey results are analyzed, a technical report will be published that will contain recommended policy changes to broaden the appeal of the program to farmers, water districts, and lenders across Texas.

See related technical report abstract.
For more information, call Lacewell at (409) 845-8476 or Segarra at (806) 742-2022.

Cotton Gin Trash Can Be Converted to Water Treatment Aid, A&M Ag Engineers Show

Researchers at the Agricultural Engineering Department at Texas A&M University are working to determine whether "trash" left over from cotton ginning operations can be given a new life as an activated carbon (AC) product that can help treat wastewater.



Calvin Parnell (above) has been working to convert cotton gin trash to activated carbon (above).

The studies are led by researchers Calvin Parnell and Wayne LePori and graduate student Sergio Capareda.

The engineers believe that AC produced by the system has the potential to be an economical way to treat wastewater. The AC can't be used to treat drinking water because it still contains small levels of metals and other by-products. Also, it's not as effective at treating all pollutants as similar products that are produced by commercial manufacturers. The treatment ability, or iodine rating, of commercial forms of AC typically ranges from 600 to 1,100 while the iodine rating of AC from gin trash is typically only 200 to 400.

On the other hand, producing activated carbon from gin trash makes it cost only 10% of the cost of commercially produced activated carbon products. AC from the gin trash is also effective at lowering chemical- and biochemical oxygendemanding substances and some metals from wastewater. Finally, Parnell expects there may be a sizable demand to begin using AC in wastewater plants throughout Texas soon. That's because state and federal regulatory agencies are urging that cities shift from traditional chlorine-based treatment technologies to those like AC that are more beneficial to the environment.

For details, call Parnell at (409) 8453985.

Freshwater Inflow and Water Quality Trends for Copano Bay

Researchers : David Shormann, Dean Stockwell, and Terry Whitledge, The University of Texas at Austin, Marine Science Institute.

Problem: Little research has been conducted on the physical, chemical, and biological processes in Copano Bay. Approximately 25% of its drainage basin is farmland, so the potential for receiving large amounts of agricultural runoff is great. Research began in September 1991, while Copano Bay was being plagued by persistent brown tide blooms, and chlorophyll levels of around 45 micrograms/L.

Objectives: To study the effects of freshwater inflow on the physical, chemical, and biological processes in Copano Bay, a shallow (average depth of 4.5 feet) 51,000 acre estuary located north and west of Rockport, Texas.

Methodology: Water samples were collected every two weeks from September 1991 through March 1992. Water quality parameters that were sampled and analyzed include ammonia, total nitrogen, nitrate, nitrite, silicate, phosphate, chlorophyll, salinity, temperature, dissolved organic carbon, primary productivity, and particulate carbon. Gauged inflow data were obtained from U.S. Geological Survey for the four main tributaries: Mission River, Aransas River, Chiltipin Creek, and Copano Creek. Rainfall data were collected, and ungauged runoff was estimated.

Results: Rainfall during the six month sampling period was 35% greater than the annual average rainfall. It was estimated that 88% of the nitrogen (nitrate, nitrite, and ammonium) and 95% of the phosphorous (orthophosphate) was contributed from stormwater runoff. Fertilizer was applied to the cropland around Copano Bay in late December, and heavy rains immediately followed. The resulting runoff caused a 20-fold increase in the average nitrate concentration in Chiltipin Creek. Since 85% of Chiltipin Creek's drainage basin is cropland, this increase in nitrate is likely a direct result of fertilizer runoff. The heaviest runoff occurred during the last three sampling events, and the average N/P ratio in the estuary was about 3.9. While a cause-effect relationship cannot be assigned, it should be noted that the average N/P ratio of fertilizer applied to fields in Copano Bay's drainage basin is also about 3.9. The Aransas River and Chiltipin Creek contributed 43% of the nitrogen and 52% of the phosphorous load to the estuary, while only contributing 32% of the freshwater. It was estimated that sewage accounted for 10% of phosphorous input to the Aransas River. The phosphorous loading to Copano Bay is similar to other eutrophic estuaries. The persistent high phytoplankton biomass numbers (about 30 micrograms chl/L) also attest to the eutrophic conditions. Fortunately, Copano Bay is shallow and well mixed, so low dissolved oxygen concentrations are not a problem for fish and shellfish. Research also suggests that Copano Bay accumulates nutrients, sediments, and particulate organic material. Better control of sediment loss from farmlands in the drainage basin, and a reduction of the sewage loading are steps that could be taken to improve the water quality of this important estuary.

Reference: Shormann, David, *The Effects of Freshwater Inflow and Hydrography on the Distribution of Brown Tide in South Texas Bays*, M.S. Thesis, The University of Texas at Austin, Marine Science Institute, Port Aransas, TX,1992.

Assessing Non-Point Source Pollution in Playa Lakes

Researchers: Tony Molihagen, Lloyd Urban, and R. Heyward Ramsey, Water Resources Center, Texas Tech University, Lubbock, TX; A. Wayne Wyatt and Don McReynolds, High Plains Underground Water Conservation District No. 1, Lubbock, TX; and J. Tom Ray, Brazos River Authority, Waco, TX.

Problem: Since Texas Senate Bill 818 was passed in 1991, river authorities have been required to identify and assess the sources of surface and ground water contamination in their watersheds. Stormwater runoff in the High Plains is the greatest source of water for playa basins. As a result, playa lakes are important indicators of non-point source pollutants. Because playas help recharge groundwater, water quality in these lakes also influences the quality of the Ogallala Aquifer.

Objectives: To measure the water quality in 100 selected playa lakes sited on agricultural lands in the High Plains.

Methodology: Topographic maps were used to locate and identify playas that were likely to be sampled. Watersheds with known or conspicuous point sources of contaminants were not sampled. Efforts were made to collect a number of samples from each county that were proportionate to the total number of playas in the region. Grab samples of playa lake water were collected by the District in September and October, 1992. EPA-approved methods were utilized to test for conventional contaminants. An enzyme-based assay was used to detect pesticides. Follow-up samples were collected at the playa lakes with the highest pesticide levels and confirmed by using gas chromatography and mass spectrometry.

Results: Measured values for most conventional water quality parameters appear to be consistent with previous studies. Most (97) of the 99 playa lakes that were tested contained detectable levels of residues of triazines (atrazine and related herbicides). Aldicarb was found in 26 samples. Roughly 40% of the "total" triazine levels were higher than the EPA limit for atrazine for drinking water. The source of the pesticides was not identified, but could probably be attributed to a combination of rainfall patterns, soil characteristics, land use practices, and other factors. Even though the presence of triazine herbicides was widespread, levels were lower than those reported in other regions of the U.S. and do not signal an immediate threat to human or environmental health in the area.

Reference: Molihagen, Tony, Lloyd Urban, R. Heyward Ramsey, A. Wayne Wyatt, Don McReynolds, and J. Tom Ray, *Assessment of Non-Point Source Contamination of Playa Basins in the High Plains of Texas*, Water Resources Center, Texas Tech University,1993.

Impact of Natural Salt Pollution on Water Supplies in Reservoirs in the Brazos River

Researchers : Ralph Wurbs, Awes Karama, Ishtiaque Saleh, and C. Keith Ganze, Civil Engineering Department, Texas A&M University, College Station, TX.

Problem: The Brazos River, like many others in the Southwest, suffers from natural salt pollution. Millions of years ago, the region was covered by a shallow inland saltwater sea. Today's salt-bearing geologic formations were formed when the sea evaporated. Salts such as sodium chloride and others significantly affect the amount of usable water that is available from the Brazos. Water in the three main-stem reservoirs in the headwaters of the Brazos is unsuitable for municipal use and irrigation of many crops without costly desalinization processes. Downstream, the water quality improves significantly as it is diluted with good quality water from streams and tributaries. Population and economic growth are creating increased demands for river water, especially since groundwater is being depleted at many sites. New strategies are needed to evaluate the amount of usable water produced by the reservoir system and to better manage the available supplies.

Objectives: 1) To develop a better understanding of the natural salt pollution problem and its impact on water management in the Brazos River basin, 2) to develop expanded reservoir system simulation modeling capabilities that incorporate salinity considerations, 3) to formulate and evaluate approaches to improve reservoir system yields and reliability estimates while dealing with salt considerations, and 4) to perform a water reliability study for a major system of reservoirs in the Brazos River basin.

Methodology: Tasks that were performed included: 1) compiling and analyzing available information; 2) developing a general reservoir system simulation model called RESSALT; 3) formulating methodologies for performing reservoir simulation studies using RESSALT; 4) developing RESSALT input files; and 5) performing reservoir system simulation analyses. The study focused on sensitivity analyses of the effects of alternative management strategies and modeling assumptions on estimates of salinity levels and water supply reliabilities. The impact of a series of salt control dams on reservoir system yields was also analyzed. Reservoir system operating policies were also evaluated.

Results: The primary source of salinity in the Brazos River is groundwater emissions in west Texas watersheds. In these areas, the river is characterized by extremely high salt levels and low streamflows. During the study period (1964-86) average total dissolved solids (TDS) levels were 3,600 milligrams per liter (mg/L) above Possum Kingdom Dam and chloride levels averaged 1,500 mg/L. Water supply reliability has usually been expressed in terms of water supplies, not water quality. In this case, however, extremely high salinity levels in upstream reservoirs on the main stem of the Brazos make the water virtually unusable. The simulation modeling suggests that system reliability drops from 99% to 69% when the amount of available water in the system is confined to usable levels of salts (TDS, chlorides and sulfate). Salt control dams increased the system reliability from 68% to 73%.

Reference: Wurbs, Ralph, Awes Karama, Ishtiaque Saleh, and C. Keith Ganze, *Natural Salt Pollution and Water Supply Reliability in the Brazos River Basin* (TR-160), Texas Water Resources Institute, Texas A&M University, College Station, TX, 1993.

Hydrogeology of the Brazos River Alluvial Aquifer from Waco to Marlin

Researchers: Scott Harlan, Joe Yelderman and Peter Allen, Geology Department, and Thomas Bratcher, Mathematics Department, Baylor University, Waco, TX.

Problem: The Brazos River floodplain and nearby terrace formations between the towns of Waco and Marlin form a complex hydrogeologic system. This alluvial aquifer system flows from north of Waco to the Gulf Coast, is one of the largest alluvial aquifers in Texas, and is considered a major aquifer by state agencies. The aquifer is thought to be highly vulnerable to pollution, based on results from the use of the DRASTIC methodology. An improved understanding of the hydrogeology of the aquifer needs to be developed so that the quality of water in the aquifer can be protected.

Objectives: To evaluate the flow patterns, geochemistry, and hydrogeology of the Brazos River alluvial groundwater between Waco and Marlin.

Methodology: Data for the study were collected from 1984 to 1986. Water levels in 82 existing wells were measured on three occasions. Data were also collected from a well on a terrace and a well on the floodplain for eight months. To study the channel morphology and to take baseline measurements, the researchers took two "float trips" down the river from Waco to Marlin. Geologic cross sections of the alluvial aquifer were modified. Hydrochemical data were collected and tests were performed for organic and inorganic chemicals and trace metals. Statistical analyses utilized a split-plot factorial design to identify significant chemical trends that may be related to time and location.

Results: The Brazos River alluvial aquifer is a shallow, unconfined aquifer. Deposits include the floodplain and terraces which are comprised of clay, silt, sands and gravel. The thickness of floodplain sediments varies from a few feet to more than 80 feet. Terrace deposits were as thick as 50 feet. Groundwater in the terraces is restricted to domestic and livestock wells producing less than 50 gallons per minute (gpm), while irrigation wells in the floodplain may yield more than 800 gpm. The terraces are easily recharged and can store small amounts of groundwater. In general, the groundwaters flow towards the nearest stream crossing. Flow in the floodplain is toward the Brazos River and is slightly downstream. Rainfall on the alluvium is the major source of recharge to the aquifers, but lateral flows from bedrock formations and losses from streams and lakes also contribute smaller amounts of recharge. Chemical analyses indicate that the groundwater in the Brazos River alluvial aquifer is primarily comprised of calcium and bicarbonate ions. Groundwater samples collected from the floodplain contained higher levels of calcium, sulfate, and magnesium than samples taken from the terraces. Variations in some parameters are a function of recharge and discharge relationships, flow patterns, residence time and differences in mineral compositions.

Reference: Harlan, Scott, *Hydrogeologic Assessment of the Brazos River Alluvial Aquifer from Waco to Marlin*, TX, M.S. Thesis, Baylor University, Waco, TX, 1990.

Long-Term Study of the Use Of a Man-Made Wetland by Aquatic Species in the Nueces River Delta

Researchers: Brien Nicolau, John Adams, and Wes Tunnell, Center for Coastal Studies, Texas A&M University at Corpus Christi, Corpus Christi, TX.

Problem: The expansion of the Corpus Christi Ship Channel resulted in a loss of wetlands. As a result, a mitigation project was required in which 200 acres of man-made marshes and wetlands would be constructed. The success of the man-made wetlands (especially as it relates to the growth of salt marsh vegetation such as smooth cordgrass) was required to be evaluated over a four year period. Such long-term studies are essential to more fully assess the performance of such projects, but are not conducted often. This research represents the second and third years of those studies.

Objectives: To evaluate the water quality and vegetation of manmade wetlands in Nueces Bay, and to assess the use of these wetlands by aquatic organisms.

Methodology: Hydrological, water quality, and biological samples were taken at four sites representing natural and man-made wetlands and marshes from September 1990 to August 1992. Hydrological monitoring gathered data on flows, water levels, and circulation patterns. Water quality parameters that were sampled included salinity, temperature, dissolved oxygen, and pH. Biological samples that were collected included benthic infauna (organisms that live in the mud such as marine segmented worms and sea hoppers); epifauna (invertebrates that live on the surface of the mud, including shrimp and blue crabs); and nekton (small fish including anchovies, menhaden, sheepshead minnows, and gobies).

Results: The salt marsh that was planted at the man-made wetlands site has failed. This is largely because the site had construction problems including steep slopes and the low elevation, which was below mean sea level. The low elevation, coupled with high salinities at the end of a drought, inhibited plant growth. Despite the poor plant growth, the use of the site by aquatic species is increasing. Species diversity at the man-made wetlands continues to rise. The functional habitat at the mitigation site is becoming more like a nearby natural wetland. Transplanting of additional salt marsh at the mitigation site appears to be feasible now that salinities are lower due to flooding and reservoir releases. The study recommended that low-lying areas be elevated and this is being done.

Reference: Nicolau, Brien, John Adams, and Wes Tunnell, *Estuarine Faunal Use in a Mitigation Project: Nueces River Delta* (years two and three), Center for Coastal Studies, Texas A&M University at Corpus Christi, July 1993.

Higher Education Coordinating Board Awards 31 ATP/ ARP Research Projects Worth $5.1 Million

Thirty water-related research projects worth more than $5.1 million were funded in October by the Texas Higher Education Coordinating Board's research programs.

Examples of water-related projects that were funded by the Board include studies dealing with hurricanes and severe weather, investigations of pollutant flows in groundwater systems, numerous aquaculture projects, methods to clean up and restore polluted wetlands, and improved ways to estimate crop water use. A list of the projects that were funded is shown on page 9. In this issue of New Waves, we have summarized some of the projects that were funded. We will feature summaries of additional projects in future issues of New Waves.

Twelve water-related projects worth $1.72 million were funded at eight universities through the Board's Advanced Research Program (ARP). Fifteen water-related projects worth $2.93 million were funded at eight universities by the Board's Advanced Technology Program. A new category, the ATP Development and Transfer Projects, was created to foster the commercial development of research projects that were funded previously. Four water-related projects at four universities worth $500,000 were funded through this program.

The University of Texas at Austin was awarded the most water-related research projects (10.5), followed by Texas A&M University (6.5), the University of Houston (4), Texas Tech (3) and Southwest Texas State University (1.5). Four universities, Rice University, Southern Methodist University, the University of Texas at Dailas, and the University of Texas at Pan American, each were awarded one project. The University of Texas at Arlington, Texas A&M University-Kingsville, and South Plains College each were awarded one-half project (their scientists were listed as collaborators on one study).

Most of the water-related research projects were awarded for projects dealing with environmental science and engineering (37%) followed by agriculture and aquaculture (24%), and marine science and technology (23%). Other areas that received funding for water research studies include earth science (8%), atmospheric science (4%), chemistry (3°/O), and biotechnology (2%).

For more information on any of these projects, contact David Gardner or Gayla Peters at the Higher Education Coordinating Board at (512) 483-6154.

SMU Study to Convert Industry Waste for Wastewater Treatment

Converting waste shot blast into a material that can treat industrial wastewater is the goal of a research project at Southern Methodist University.

Waste-shot blast is a by-product of finishing operations in the manufacturing of ductile and iron castings that is now discarded in landfills. Preliminary studies suggest that it can

be used to remove heavy metals and synthetic organic chemicals in batch and fixed bed reactors that use adsorption technology.

The project is being conducted by Ed Smith of the Civil Engineering Department. Goals of the study are to quantify the capacity of waste-shot blast to adsorb selected industrial pollutants; to determine if waste-shot blast can be converted to a granular form that can be utilized in fixed bed reactors, and to develop processing and recycling methods to enhance the pollutant removal ability. The ultimate goal is to develop a cost-effective process by which waste-shot blast can be recycled for waste water treatment or other strategies to remediate sites that have been polluted by hazardous waste.

For details, call Smith at (214) 768-3883.

Rice U. Tests Performance of Rotating Disk Membranes

A research project at Rice University will assess the performance of rotating disk membrane filters in treating wastewaters from the petrochemical industry.

Mark Wiesner of the Environmental Science and Engineering Department is the lead investigator in the study. The rotating disk membrane filters may be suitable for a variety of operations including treating production waters from oil and gas production; cleaning up hazardous and industrial wastes, and removing salts in desalinization projects.

Previous tests suggest that rotating disk membrane filters may be as much as 10 to 100 times more efficient than existing membrane technologies. In this study, Wiesner will work with the Shell Development Company to test the effectiveness of membrane and pretreatment technologies in treating produced waters that are generated from oil and gas operations. An eventual goal is to refine the technology so that can be commercialized and widely used.

For details, contact Wiesner at (713) 285-5203.

Texas Tech Seeks "Environmentally Friendly" Way to Control Fish Gender

Is there any environmentally "friendly" way to influence the sex of fish? That's the question Texas Tech University researchers will address in a new research project.

Reynaldo Patino of the Texas Cooperative Fish and Wildlife Research Unit is leading the study. Until now, the most commonly used way to control the sex of juvenile catfish was to apply steroids. Other methods such as gynogenesis coupled with hormone treatments require technical expertise, are time and labor consuming, and require continued maintenance of the broodstock. Patino will assess if changing the temperature that catfish fry are reared at will change their sex. Experiments will be conducted at temperatures from 70 to 90 degrees F. Fish fry that are exposed to higher temperatures are likely to become males, while those at lower temperatures will probably become females. If

successful, this technique may be used for other aquaculture species. For details, call Patino at (806) 742-2851.

THECB Awards 35 Water Resources Research Projects

Recently, the Texas Higher Education Coordinating Board (THECB) funded a significant number of water resources and environmental research projects. Data from the board show that water resources and environmental projects accounted for 16 advanced research program (ARP) studies totaling $1.74 million, and 17 advanced technology program (ATP) projects worth roughly $3.92 million. One water resources project was awarded through the ATP Technology Transfer and Development program for $228,912.

The projects can also be grouped into subject areas. In the advanced research program (ARP), the board awarded water resources and environmental grants in the following categories: atmospheric sciences (three projects, $258,877); biological sciences (two projects, $249,219); earth sciences (two projects, $209,800); engineering (two studies, $299,606); marine sciences (seven projects, $702,577). In the ATP, the Board funded water resources and environmental grants in these areas: aquaculture and agriculture (six projects, $1.09 million); computer engineering (one project, $169,933); environmental science and engineering, recycling, and water resources (seven projects, $2.07 million), and marine technology (three projects, $565,248).

In this and future issues of New Waves, we'll feature summaries of many of these projects as well as ways to contact the scientists conducting the research. A complete list of projects that have a broad connection to environmental and water science are shown below.

1997 Advanced Research Program (ARP) Grant Recipients

Atmospheric Sciences
"Detection of Localized Structures In Hurricane Windfields," $58,754, Richard Peterson,Texas Tech University (TTU).
"Numerical Model Study of Hurricane Boundary Layer Winds," $69,488, Chia-Bo Chang and Arthur Doggett, TTU.
"Improving the Detection and Warning of Severe Weather Using Doppler Radar," $130,815, Michael Biggerstaff, Texas A&M University (TAMU).

Biological Sciences
"Mutational Analysis of Circadian Rhythmicity in Zebrafish," $156,246, Gregory Cahill, University of Houston (UH).
"Global Change in the 21st Century: the Effect of Elevated CO2 on Grassland Water Budgets," $92,973, Robert Jackson, University of Texas at Austin (UT).

Earth Sciences
"Tracing Fluid Flow in the Vicinity of Salt Domes in Geopressured Sedimentary Basins," $94,000, Regina Capuano, UH.

"Computation of Transport Properties from Thin-Section Images," $115,800, Kishore K. Mohanty, UH, and $51,200, Liwen Shih, University of Houston - Clear Lake (UHCL).

Engineering

"Effective Waste Treatment by Wetlands with Wetting and Drying Cycles," $185,400, Nick Parker and Clifford Fedler, TTU.

"Studies On Salinity and Temperature Transients in Sea Water Aquaculture Ponds," $114,206, Nagaraja Shamsundar and Stanley Kleis, UH.

Marine Sciences

"Roles of Nitrogen to Phosphorus Supply Ratio and Grazer Pressure in Maintenance of the Texas Brown Tide," $58,903, Hudson DeYoe, University of Texas at Pan American (UTPA), and $53,979, Terry Whitledge, University of Texas Marine Science Institute (UTMSI).

"Pollutant Induced Feminization of Male Fish: Is It a Problem in Texas Estuaries?," $78,375, Peter Thomas, UTMSI.

"Transport Mechanisms in Larval Fish Recruitment: Do Nearshore Retention Zones Promote Stochastic Immigration?," $97,416, Joan Holt and Scott Holt, UTMSI.

"Investigation into Non Steady-State Sediment-Water Exchange Processes," $100,991, Gary Gill, Texas A&M University at Galveston (TAMUG).

"The Use of Stable Isotope Tracers and Fatty Acid Signatures to Determine the Diet of Marine Mammals," $88,200, Graham Worthy, TAMUG.

"Reconstruction of Terrestrial 129-I Inputs into Marine Environments," $96,358, Peter Santschi, TAMUG.

"Numerical Wave Tank Simulations for Irregular Multi-Directional Waves," $128,355, Moo-Hyun Kim; Jose Roesset, Texas Engineering Experiment Station (TEES).

1997 Advanced Technology Program (ATP) Grant Recipients

Agriculture and Aquaculture

"Public Health, Vibrio and Texas Oysters: Post-Harvest Remediation," $198,867, John Schwarz, TAMUG.

"Enhancement of Red Drum Growth through Environmental Manipulation of Anabolic Hormone Cycles," $166,023, Duncan MacKenzie, TAMU.

"Novel Technology to Accelerate Gene Discovery for Texas Agriculture," $191,565, John Mullet, Texas Agricultural Experiment Station (TAES).

"Methods for Improved Detection and Prevention of Shrimp Baculovirus Disease," $195,278, Linda Guarino and Paul Frelier, TAES.

"Developing Multiple Stress Resistant Sorghum for Texas Using Molecular Markers," $159,158, Gary Peterson and Darrell Rosenow, TAES.

"Hierarchies and Coalitions in Cooperative Regional Water Management in Texas," $179,274, Bruce McCarl and Fred Boadu, TAES.

Computer and Information Engineering

"Numerical Modeling of Subsurface Flows in Porous Media," $169,933, Richard Ewing and Joseph Pasciak, TAMU.

Environmental Science Engineering, Recycling, and Water Resources
"Remote Sensing of Rio Grande Delta Marshes," $74,139, Frank Judd and Robert Lonard, UTPA, and $84,783, Melba Crawford, UT.
"Cost-Effective Waste Treatment through Aquatic Protein Production," $189,000, Clifford Fedler and Nick Parker, TTU.
"Novel Mass Spectrometric Strategies for Analysis of Fire Ant Killers in Soil and Water," $85,635, Jennifer Brodbelt, UT, and $92,466, Stephan Bach, University of Texas at San Antonio.
"Computer Modeling for Risk Assessment and Design in Environmental Remediation Using Parallel Finite Elements," $221,364, Mary Wheeler and Graham Carey, UT.
"Capacity Building for Resource Assessment and Responsible Development, Texas-Mexico Border Region," $485,214, Jay Raney, UT; $104,510, Eric Rieken, UTPA; $111,128, Charles Groat, University of Texas at El Paso; $70,785 Gene Paull, University of Texas at Brownsville, and $129,732, Juan Hinojosa, Texas A&M International University.
"Measuring Atmospheric Precipitable Water Vapor in Texas Using the Global Positioning System," $173,250, Robert Nerem and P. Abusali, UT.
"GPS and Texas High Resolution Geoid for Coastal Environmental Management, Engineering, and Hazard Assessment," $107,111, Gary Jeffress, Texas A&M University - Corpus Christi (TAMUCC), and $92,510, Carlos Aiken, University of Texas at Dallas, and $77,595, Bob Schutz, UT.

Marine Technology
"Aquaculture Technologies for the Enhancement of Marine Fisheries Resources," $186,571, Connie Arnold and Joan Holt, UTMSI.
"BBOBS: A New Generation of Broadband Ocean Bottom Seismograph," $148,007, Yosio Nakamura and Jay Pulliam, UT.
"Brillouin LIDAR for Ocean Temperature and Sound Velocity Profiling," $230,670, Edward Fry and George Kattawar, TAMU.

1997 ATP Development and Transfer Grant Recipients
"Pilot-Scale Commercial Production of Specific-Pathogen-Free Shrimp in a Biosecure Facility," $126,021, Phillip Lee, UT Medical Branch at Galveston, and $102,891, Addison Lawrence, TAES.

Methods to Evaluate Success of Wetland Restoration Efforts Being Developed at Texas A&M, Texas A&M-Kingsville

Developing methods to evaluate the success of wetland remediation efforts is the focus of a study by researchers at Texas A&M University and Texas A&M University-Kingsville.

Lead scientists in the study are Jim Bonner of the Texas A&M Civil Engineering Department and Andrew Ernest of the Texas A&M-Kingsville Environmental Engineering Department.

The project is needed because many efforts to rehabilitate wetlands and marshes that have been damaged by oil spills have been unsuccessful. In some cases, the cleanup efforts even led to greater problems that existed previously.

The study consists of monitoring four levels of treatment methods ranging from experiments in beakers, small drums, and wave tanks to actual field studies. Some of the wave tank studies in this project will be conducted by Nick Kraus of the Blucher Institute for Surveying at Texas A&M University-Corpus Christi. Both on- and off-shore treatment processes will be evaluated.

The researchers hope to develop protocols to assess if bioremediation efforts are working. The success of these projects will be gauged by examining the amount of oil wastes and hydrocarbons that are removed, the level of biological activity throughout the treatment process, and the impact on the environment.

For details, call Bonner at (409) 845-9770 or Ernest at (512) 595-3041.

UH Researchers Seek to Learn More About Water Budgets of Hurricanes

Researchers at the University of Houston are investigating the water budget of hurricanes in an attempt to develop more information on how these storms develop and what their impact may be.

James Lawrence of the Department of Geosciences is leading the project. The study focuses on utilizing data on stable isotopes of rain and atmospheric water vapor to better define the water balance of severe coastal storms.

The research will be comprised of field studies, laboratory isotopic analyses of water samples, meteorological experiments, and modeling efforts. In the study, rain and water vapor samples will be collected inside hurricanes both at the ground level and in the upper atmosphere. Stable isotope ratios will then be determined. A working cloud microphysical model of isotope ratios in storms will be modified to include dynamics and turbulent flux from the sea. Model results will be applied to specific conditions to simulate the isotope ratios and relate them to structure and features of hurricanes.

Preliminary studies have shown that hurricanes and tropical storms have distinctly lower isotope ratios than summer rains. It has been speculated that recirculation of water inside hurricanes may be the mechanism that lowers the isotope ratios.

For details, call Lawrence at (713) 7433410.

UT to Use Satellite Data to Track Coastal Pollutants

A project being conducted by researchers at the University of Texas at Austin will utilize satellite data to rapidly monitor environmental hazards in Texas bays and estuaries and the Gulf of Mexico.

The project is being led by Byron Tapley and John Lundberg of the Center for Space Research. The research involves gathering satellite data, thermal imagery, radar, information from drifting buoys, and ocean color. That information will be utilized as inputs into computer simulation models that predict circulation patterns and eddies in the Gulf. The result will be that pollution events could be monitored instantly in "real time."

The project may increase the ability to rapidly monitor environmental hazards. This would not only help reduce pollution, but could also benefit navigation, commercial fisheries, and offshore drilling operations.

For details, call Tapley at (512) 471 -5573 or Lundberg at (512) 471-5863.

SWT Biologists Study if Fish Genes Yield Water Pollution Clues

Biologists at Southwest Texas State University are working to develop an inexpensive method that utilizes information on genetic damage to fish to assess human health risks from pollution in rivers, streams and aquifers.

Ronald Walter and Tom Arsuffi are heading the studies. The overall goal of the research is to develop transgenic fish that harbor lambda phage reporter genes. Information from these reporter genes would allow scientists to determine how much mutation had occurred in fish tissues. Similar systems utilizing transgenic mice have been used for some time to assess the risk from toxic chemicals in terrestrial ecosystems. The researchers at SWT hope to develop a similar method to assess contamination risks in aquatic ecosystems.

The research will focus on the use of the Japanese rice fish (the medaka) in a transgenic fish system. Lambda phage transgenes will be constructed which can be rescued from fish DNA. This will allow scientists to perform rapid assays of mutation frequencies. Later, transgenic fish will be treated with a toxic agent and the transgenes will be recovered from brain, liver, testes, eye, and gill tissues. An index will be developed that relates pollutant levels to the amount and type of genetic damage that may occur.

For details, call Walter or Arsuffi at (512) 245-2032.

District Uses Wetlands to Treat, Recycle Waters

The Tarrant County Water Control and Improvement District (TCWCID) is testing if a pilot scale wetlands plant can improve water quality and increase supplies.

TCWCID provides water supplies for many cities in the Fort Worth-Dallas area and operates Richland Chambers Reservoir, which is 70 miles southeast of Dallas and serves as a water supply for upstream areas. The reservoir receives all its flows from tributaries of the Trinity River. During the summer months, flows of the Trinity are largely comprised of treated wastewater discharged from the Dallas-Fort Worth area.

The goal of the studies is to determine if flows from the Trinity can be diverted into wetlands located near the reservoir, where they would receive more treatment. That water

could be of good enough quality to be routed into the reservoir for additional water supplies. The project consists of three wetlands trains, each of which consist of nine cells. The cells have been planted with native plants and other species on a 6 acre site between the reservoir and the river and treat flows of 100,00 gallons per day. Settling ponds will detain flows for 24-hours and the wetland cells will store and treat the water for a week. The wetlands also can remove sediments, nutrients and toxic chemicals before they enter the reservoir.

For details, call Woody Frossard of the TCWCID at (903) 389-3928.

Water Transfer from Oklahoma Put On Hold

A proposal that would have transferred water to North Texas has been put on hold. The North Texas Municipal Water District had explored the possibility of buying up to 130 million gallons per day from the Sardis Reservoir in Southeast Oklahoma at a cost of $373 million. The plan was originally approved by the Oklahoma Water Resources Board in June. Later, the Oklahoma Attorney General's office ruled that the Board did not have the authority to negotiate the deal because of procedural problems. The Attorney General's ruling came after Oklahoma citizens and lawmakers protested the transfer. They claimed it could lower the water levels in Sardis and Hugo Lakes, which are widely used for boating and bass fishing, and could endanger future water supplies.

Justice Department Ruling Jeopardizes Implementation of Edwards Authority

The implementation of the Edwards Aquifer Authority was put on hold by a decision from the U.S. Justice Department. The agency was created by the Texas Legislature earlier this year to manage groundwater in South Central Texas.

The Mexican American Legal Defense Fund (MALDEF) had argued that the legislation that created the Authority would infringe upon the rights of Hispanics, because it called for a board that was appointed rather than elected. MALDEF contended that few Hispanics would be appointed to serve on the Authority's Board of Directors, since none of the agencies that make appointments have a Hispanic majority. The most likely repercussions of the decision are that the Governor could call a special session of the Legislature to rewrite the law, or could appeal the Justice Department ruling to a Federal court. Another option is that a special master could be appointed to set up court-monitored plans. In the meantime, the bill creating the Authority cannot be implemented.

Many other items pertaining to the aquifer need to be noted. A University of Texas at Austin study by Alan Dutton of the Bureau of Economic Geology suggests the aquifer holds roughly 215 million acre feet (AF). That's four times as much water than was previously estimated. A report by the Edwards Underground Water District recommends that stronger standards be developed to manage growth along the aquifer recharge zone to prevent pollution. A proposal to transfer water from Medina Lake to San Antonio customers is being criticized in Bandera County, where part of the lake is located.

Lakeside residents contend that transferring more than 25,000 AF of water annually from the lake could lower lakeside property values and deplete water levels in nearby wells.

Port of Houston Tries New Methods to Dry Dredge Spoils

For many years, it's been a challenge to dispose of materials that are dredged when canals and ship channels are maintained, widened, and deepened. Recently, officials with the Port of Houston began utilizing an innovative method to manage dredge sites that saves land and money.

Dredge spoils contain as much as 80% water and have to be disposed of over a large area. After a layer of dredge spoil is applied and allowed to dry, additional dredge materials are added. This increases the water content by 30 to 40%. A crust often forms on the top layer of dredge, which traps watery materials beneath it.

To lessen the amount of land that is needed, the Port adopted a "crust management" program. Ditches and trenches are dug along the perimeter and interior of a site with a "marsh buggy." The ditches allow water from the dredged material to run off, reducing the volume of dredge spoil by 60% and speeding drying times. They also produce relatively dry dredge material that can be used to build and raise levees.

The process may also double the life of disposal sites. Crust management costs only about $0.20 per cubic yard, compared to conventional methods which cost roughly $1.20 per cubic yard. The process was explained in the December issue of the Port of Houston magazine. For details, call the Port Authority at (713) 670-2644.

Plan to Extend Waterway Protested

A proposal to extend the Gulf Intracoastal Waterway from Brownsville to Mexico is being criticized by environmentalists who claim it could lead to disaster.

The waterway, which is roughly 12-feet deep and 125-feet wide, is a marine highway for barges, ships, and pleasure boats. It now extends along the Texas border and much of the rest of the gulf.

Environmentalists contend that dredging the proposed extension of the channel could threaten endangered species by stir ring up toxic sediments. They also said that cutting the channel across the Rio Grande could allow polluted freshwater to flow into the Laguna Madre.

Some critics suggest that periodic maintenance of a stretch of the waterway from Brownsville to Corpus Christi be discontinued because of ecological concerns. Shipping officials contend that the only economically viable alternative to barge traffic is to increase the number of truck or railroad traffic or to shift to expensive offshore barges.

TWRI Publishes Report on Managing Dairy Wastes, Acquires COMPAS

The Texas Water Resources Institute has published a new technical report on the impact of large dairies in Erath County on ground and surface water quality.

The report, *The Expanding Dairy Industry: Impact on Ground Water Quality and Quantity with Emphasis on Waste Management System Evaluation for Open Lot Dairies* (TR-155), was co-authored by John Sweeten of the Texas A&M University Agricultural Engineering Department and Mary Leigh Wolfe of the Agricultural Engineering Department at Virginia Tech University in Blacksburg, VA.

The goals of the research were to assess the impact of large confined dairies on water use and quality of aquifers near Stephenville, to develop best management strategies to prevent point and non-point source pollution from the dairies, to determine dairy water use, and to provide information that dairy operators could use to design and maintain their facilities. Results show that groundwater was not contaminated by nutrients or minerals from the dairies, that properly sized and operated settling basins can lower contaminant levels in lagoons, and that two-stage anaerobic lagoons significantly improve water quality. The report is available free by calling TWRI at (409) 845-1851.

Also, the Institute has recently developed the capability to utilize the COMPAS software system. COMPAS is a hypertext database that was developed by the Texas Natural Resource Conservation Commission. It allows users to gain access to information on many water-related issues in Texas, including water rights, water quality, wastewater, recreation, coastal lands, and wetlands. For details or to schedule a demonstration of COMPAS, call Ric Jensen at (409) 845-8571.

Nymphs, Big Thicket, Earth Day Are Topics of NT Books

Reports dealing with nymphs that live in Texas streams, the ecology of the Big Thicket, and the environmental consequences of Earth Day have been published by the University of North Texas (UNT) Press.

Nymphs of North American Stonefly Genera (Plecoptera) was co-authored by University of North Texas biologist Kenneth Stewart and Bill Stark of Mississippi College. It catalogs hundreds of species of nymphs and stoneflies that live in stream ecosystems.

The Big Thicket: An Ecological Perspective, was written by Pete Gunter of the Philosophy Department. The book includes a description of each of the streams, wetlands, bayous, and swamps that lie within the preserve. Conditions for canoeing and other recreational activities are described.

After Earth Day: Continuing the Conservation Effort, was edited by Max Oleschlaeger of the Philosophy Department. It contains essays on conservation themes that were presented at a conference on the 20th anniversary of Earth Day that was held at UNT. Sections of the book focus on conservation policies, environmental science, conservation and the economy, and environmental philosophy.

For ordering information, call (817) 565-2142.

Baylor Book Explores Waters of Texas Blacklands

A new book that focuses on the water resources, environment, and culture in the Blackland Prairie has been produced by Baylor University. The book, *The Texas Blackland Prairie: Land, History, and Culture*, was edited by Joe Yelderman of the Baylor Geology Department and Rebecca Sharpless of the Baylor Institute for Oral History. It was published by the Baylor Texas History Section. The report contains papers dealing with the Texas Blackland Prairie‹a region of Central Texas that is characterized by black soils that stretches from the Red Riverto San Antonio. The book includes sections on geology, the nature of water and its distribution, groundwater, erosion, and the evolution of agricultural practices that have been used in the area. To order, call (817) 755-1268.

UT Reports Assess Pollutants in Highway Runoff, Edwards Aquifer Management

Two new technical reports dealing with pollutants from highway runoff and management of the Edwards Aquifer are available from the Center for Research in Water Resources at the University of Texas at Austin.

A Review and Evaluation of Literature Pertaining to the Quantity and Control of Pollution from Highway Runoff and Construction (Report 239) was co-authored by Randall Charbeneau, George Ward, Joseph Malina, Michael Barrett, Robert Zuber and E. R. Collins. The report contains information on pollutant sources, factors affecting highway runoff, effects on receiving waters, highway construction practices, and methods to control pollution from highway runoff.

Management of the Edwards Aquifer: A Critical Assessment (Report 244), was coauthored by Daene McKinney and David Watkins. The report includes information on legal issues, economics and development, environmental concerns, and hydrologic modeling and simulation.

To order the report, call (512) 471 -3131.

Sea Grant Report Describes Seafood-Linked Revenues

The Texas A&M University Sea Grant Program has produced a new report describing the economic importance of the seafood industry in Texas. The report, *The Importance of Seafood Linked Employment and Payroll in Texas*, was written by seafood marketing specialist Michael Haby of the Sea Grant Marine Advisory Service (MAS) Program, Richard Edwards of the Texas A&M University Agricultural Economics Department, and marine agents E. Anthony Reisinger, Richard Tillman, and William Younger of the Sea Grant MAS Program. The report shows that more than 30,000 jobs in Texas are directly related to the seafood industry that create an estimated payroll of more than $326 million

annually. Most of the jobs are in food service or production. To order, call (409) 762-9800.

Proceedings Highlights Texas On-Site Wastewater Issues

A proceedings that deals with on-site wastewater issues in Texas has been published by the Texas On-Site Wastewater Treatment and Research Council.

The proceedings contains papers that were given at the Council's annual meeting in Austin in October 1993. It was edited by Terri Chapman and Chris Guzman of the City of Austin Water and Wastewater Utilities.

Topics covered in the proceedings include the use of cluster systems, sand filters, shallow drainfields and constructed wetlands, and the remediation of failed systems. Case studies assess how on-site systems perform near Lake Livingston and Galveston Island, and innovative technologies that are being utilized along the Texas-Mexico border. To order, call (512) 322-3656.

Texas A&M Researchers Develop System to Remove Nitrogen from Drinking Water Wells

Researchers in the Texas A&M University Civil Engineering Department are developing an insitu treatment system that may help protect drinking water wells from nitrate contamination.

Mike Stallard and Yavuz Corapcioglu are leading the study. The goal is to develop a treatment system that utilizes large wells and denitrifying bacteria to intercept contaminated groundwater that is upgradient from drinking water wells. Anoxic conditions could be maintained in the treatment wells to foster the growth of the bacteria. The bacteria could then oxidize organic matter and break down nitrates. Contaminated groundwater would be denitrified and returned to the aquifer near the top of the treatment wells.

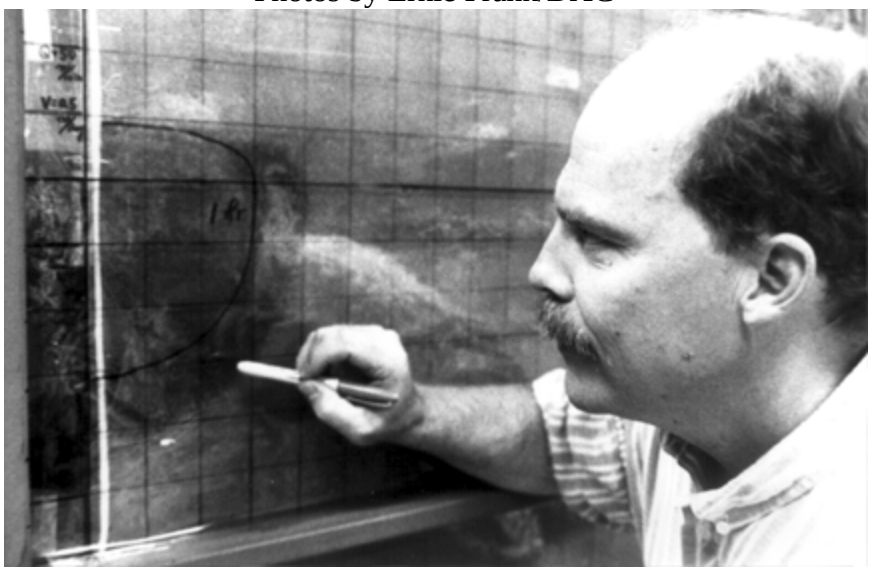
The researchers have designed and constructed an artificial groundwater tank and have developed small scale well treatment systems. The tank is filled with fine-grain sand and is equipped so that the piezometric head can be monitored. Access Dorts have been installed along the sides and bottom of the tank so that water can be introduced or withdrawn, samples can be collected, and head conditions can be monitored. The tank contains two sections: an upper chamber contains dentrifying bacteria and a lower portion that is filled with varying water levels. A methanol feed system will be used to determine how much nitrogen is being removed.

Recently, the researchers have traced the movement of pollutants and recirculation patterns inside the tank. The researchers filled the tank with water, sand and a pH-sensitive solution. This data will help the scientists better predict nitrate movement under field conditions. In the future, they hope to install treatment wells with varying depths

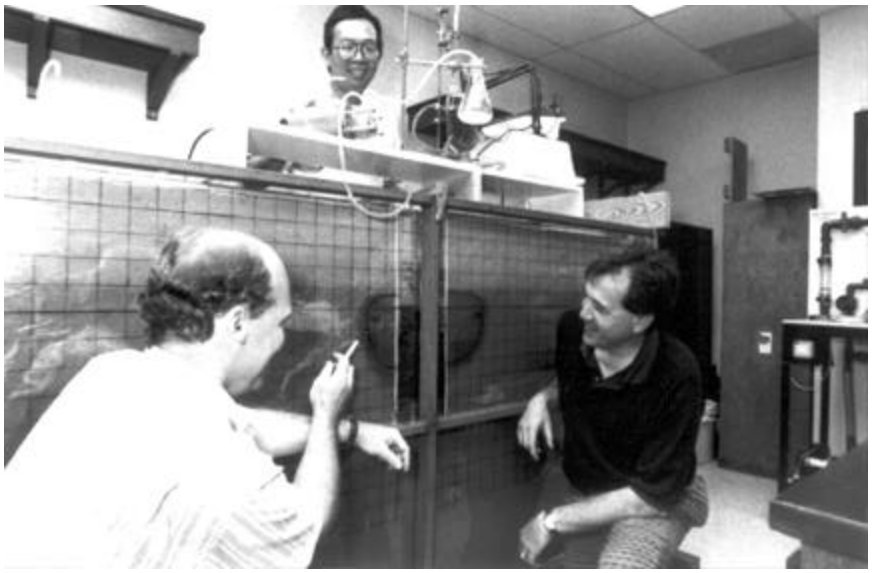
and nitrate loadings and to develop computer software that can be used to operate the system.

For details, call Stallard at (409) 845-1404.

Photos by Ernie Frank/DAC



Mike Stallard measures the movement of nitrates and water recirculation in an artificial groundwater tank.



Mike Stallard (left) and Yavuz Corapcioglu (right) are examining this groundwater simulation tank to determine if levels of nitrate are being reduced. The goal is to develop a system that can remove nitrates from wells used for drinking water.

Tech Studies if Cattle Wastes Can Be Used to Grow Fish

Researchers at Texas Tech University are investigating whether wastewaters from cattle feedlots and dairies can be utilized to grow fish and algae in lagoon-based aquaculture systems.

In the project, Nick Parker of the Range and Wildlife Science Department is cooperating with Clifford Fedler of the Civil Engineering Department. The researchers anticipate that a typical feedlot with 50,000 head of cattle could support a 30 acre lagoon that could produce 165,000 pounds of "harvestable" fish or 60,000 pounds of live baitfish per year.

The researchers sampled effluents from cattle feedlots and dairies and tested them for standard water quality parameters. Systems to treat the effluent were then evaluated to determine if they could produce aquaculture and algae. Preliminary test results suggest that aerating the effluents without providing additional treatment did not reduce ammonia levels enough to support fish. When additional aeration was used together with filtration, ammonia levels were lowered by 97%, but the water quality was still too poor to let most fish species survive. The researchers hope that integrating aquatic plants or other vegetation to the system may further improve water quality by removing nutrients.

Fish produced in this system could be utilized for swine, poultry and fish feed or could be sold as bait. Another advantage is that lagoons now utilized for cattle operations could easily be converted to support aquaculture operations.

For details, call the Texas Tech Water Resources Center at (806) 742-3597.

UT Saves Millions by Recycling, Recovering, "Wasted" Water

Engineers at the University of Texas at Austin have discovered that recovering wasted water from building water chillers can save water and money. Since 1981, UT has saved more than 800 million gallons worth more than $2.5 million.

UT provides chilled water to air condition dormitories and other campus facilities. The university distributes the chilled water through a network of underground tunnels.

Myron "Rusty" Osborne, an engineering assistant at the UT Utilities and Energy Management Department initiated a pilot project in 1980. The goal of the pilot project was to recover water that was being discharged from water chillers in older buildings. This "once-through" water was recycled from the dormitories to the cooling towers.

Recently, the water recovery program took a "quantum leap" when engineers decided to begin recycling once-through cooling water. This has been especially profitable because water and wastewater rates increased by 436% between 1980 and 1990.

The program also hopes to eliminate waste and recover water from research laboratories. Some individual labs consumed roughly 15.7 million gallons of water per year worth more than $90,000. The recycling program was so efficient that, in many labs, the payback period for labor and materials was as short as a week.

Other recycling efforts at UT include recovery of water used to clean swimming pools and water that drips from the fins of chilled water coils. For more details, call Osborne at (512) 471-5050.

UTSA Study Assesses if Runoff Pollutes Edwards Aquifer

A recent study at the University of Texas at San Antonio examined how stormwater runoff influences groundwater quality in the Edwards Aquifer. The aquifer is one of Texas' groundwater systems that is most vulnerable to pollution, because large amounts of stormwater often enter the aquifer rapidly.

John Burgess conducted the studies for his M.S. Thesis in Civil Engineering. He worked with UTSA Engineering researchers Weldon Hammond and Stuart Birnbaum. The studies consisted of gathering hydrology and water quality data during three storm events in the spring of 1990 from West Elm Creek, which lies over the Edwards recharge zone. Samples were taken a few hours later at selected downstream water wells which received recharge from the creek.

Results of the study show that levels of dissolved oxygen, total organic carbon, phosphorus, and fecal streptococci and colifoform bacteria increased as runoff waters flowed into and recharged the groundwater wells. The initial rush of large volumes of runoff into the aquifer probably elevated dissolved oxygen levels by increasing aeration. As the storm continued, more oxygen-demanding materials began to flow in and a small oxygen sag developed. The study results also show that nitrate nitrogen levels were highest in the groundwater samples at the beginning of storms, but recharge diluted them in the aquifer as the storm continued. Analyses also suggest that animal wastes were the main reason the fecal bacteria levels increased. The conductivity, pH, total nitrogen and temperature in the wells declined when the surface runoff arrived.

For details, call Weldon Hammond or Frank Masch at the UTSA Engineering Division at (210) 691-5746.

UT-Arlington Tests 2-D Models of River Flows

Testing if two-dimensional models provide better simulations of river flows is the aim of research at the Civil Engineering Department at the University of Texas at Arlington. Max Spindler and graduate student Peter von Zweck simulated the flow along the Elm Fork of the Trinity River upstream of Dallas using a 1- and 2-dimensional model. Tests were conducted with a 2-dimensional model that was developed by the Federal Highway Administration and 1-dimensional model that was developed by the Corps of Engineers. Results of the study show that the 2-dimensional model performed better at predicting lateral flows and at estimating the flows of complex reaches of the river with multiple branches. The researchers say that the results of this study could be improved if more recent data on floods and high water marks were available. For details, call Spindler at (817) 273-3763.

North Texas Researchers Develop Computerized DRASTIC Rankings

Researchers at the Institute of Applied Sciences at the University of North Texas have utilized computer technology to help assess which groundwater systems might be most vulnerable to pollution.

For some time, state water and environmental agencies have utilized DRASTIC ratings to gauge the pollution potential of major and minor aquifers. DRASTIC is a system that integrates data on such factors as the depth to groundwater, recharge, aquifer media, soil type, topography, impact of the vadose zone, and hydraulic conductivity. After this information is entered, a DRASTIC score is developed. The DRASTIC method can be used to assess general groundwater pollution potential or the risks that pesticides may pose to groundwater quality. Higher scores indicate greater pollution risk. Until now, few efforts to computerize statewide DRASTIC information have been undertaken. This makes it hard to update the maps and the rankings as conditions change and to access the complex data that went into the rankings.

In the project, Sam Atkinson and John Thomlinson of the Center for Remote Sensing and Land Analyses, entered information on each of the DRASTIC parameters into a geographic information system (GIS). The Texas Water Development Board (TWDB) supplied information on the depth to water data and the aquifer media. Recharge data were obtained for each river basin and zone, The USDA Soil Conservation Service provided information on soil media, while data on topography were borrowed from U.S. Geological Survey maps. Information on the impact of the vadose zone was furnished by the Bureau of Economic Geology at the University of Texas.

Results of the project suggest that alluvial aquifers may be more vulnerable than other groundwater systems. Studies also show that roughly 20% of Texas has relatively high pesticide DRASTIC rankings, compared to just 5% of the state that has high regular DRASTIC scores. This may be because slopes play a significant role in pesticide DRASTIC rankings.

Atkinson says there are two major benefits of the research. First, information on all the DRASTIC parameters for any site can be easily accessed because the GIS is linked to an extensive database. Also, as new and better information becomes available the DRASTIC ratings and GIS maps can be easily updated.

For details, call Atkinson at (817) 5652694.

Baylor Researcher Tests On-Site Wastewater Systems

Before innovative on-site wastewater treatment systems can be sold in Texas, they have to be evaluated and approved by the Texas Natural Resources Conservation Commission (TNRCC). Until a few years ago, that meant that most companies had to send their products to the National Sanitation Foundation (NSF) in Ohio to have the appropriate tests performed.

Dudley Burton of the Environmental Studies Department at Baylor University has worked with manufacturers in the country to perform some of the standard tests the various state regulators and TNRCC require. Burton's research program has developed into the Individual On-Site Waste Water Treadment System Testing and Certification Program. Baylor's program is one of only three in the nation accredited by the American National Standards Institute (ANSI). Baylor's certified units are currently being installed in much of the southern United States.
Much of Burton's testing involves aerobic systems. Aerobic units may be cost-effective in areas with rocky and shallow soils, because the area that has to be excavated is significantly smaller. Burton has also tested methods of increasing aeration and systems that increase dissolved oxygen.

The trials, which are referred to as "ANSI/NSF 40 tests," are meant to evaluate the performance of treatment units under normal conditions. Most of the tests are performed at the Brazos River Authority's Wastewater Treatment Plant, which supplies wastewater for the tests and helps analyze water quality at a laboratory at the plant. For details, call Burton at (254) 710-3405.

Dudley Burton of Baylor University (above) evalutes aerobic on-site wastewater systems like this one at a field laboratory in Waco.

Dudley Burton of Baylor University gathers a water quality sample to see how well an aerobic on-site wastewater system provides treatment.

UT Study Searches for Sources of Salty Groundwater that Flow into Lake Meredith

Searching for the sources of saline groundwater that make the water in Lake Meredith too salty for drinking or many other uses is the goal of a research project being conducted by scientists at the Bureau of Economic Geology at the University of Texas at Austin. For example, salinity levels have doubled in Lake Meredith in the last decade, and chlorides are now greater than 430 milligrams per liter (mg/L) and sulfates are more than 300 mg/L.

The study was conducted by Tom Gustavson, Jeff Paine, and Arten Avakian. The project focused on identifying highly saline groundwater sources in an area along the Canadian River in eastern New Mexico. More than 2,200 measurements of conductivity were taken at 1,073 sites. Most of the areas that were sampled were located along seven segments of the Canadian River and its tributaries using such techniques as electromagnetic and vertical soundings. Geologic structures including joints were examined to determine how they may influence the flow of saline groundwater.

The results identified and located four areas that contribute high amounts of salts and 18 individual peaks. The highest conductivities were found downstream of a gravel pit between Ute Reservoir and a bridge that crosses Highway 54. Ultimately, the information could be used to identify the ideal sites for saline groundwater extraction programs that could improve water quality in Lake Meredith.

The study was funded by the Texas Water Development Board. For more information, call Gustavson at UT at (512) 471-1534.

Tarleton State Researchers Study North Bosque River

Scientists with the Texas Institute for Applied Environmental Research at Tarleton State University have established a large-scale monitoring system on the North Bosque River and its tributaries. Larry Hauck, Tim Jones, and other Institute researchers are gathering water quality samples and flow measurements at selected sites during base and storm flows. Samples are analyzed at the Institute laboratory on the Tarleton State campus. Biological samples of benthic macroinvertebrates are being taken and analyzed using kick nets, sweep nets and dredges to provide added water quality and environmental data.

Information from the monitoring efforts will be utilized to characterize background water quality and biological conditions, to investigate cause and effect relationships, to verify numerical models, and to monitor if best management practices are improving water quality. A water quality model of the watershed is being developed that will incorporate information on the area's topography, hydrology, water quality, and runoff.

For details, call (817) 968-9567.