New Waves
The Research Newsletter of the Texas Water Resources Institute
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TWRI Funds Four Projects at Texas A&M, North Texas

The Texas Water Resources Institute (TWRI) will fund three new projects and will continue to fund two projects in its 1993-94 research and technology transfer program . The new projects begin in September 1993 and run through August 1995.

The new projects include two studies at Texas A&M University and one study at the University of North Texas (UNT).

Determining the hazards associated with heavy metals in streambeds will be the focus of a study by Dick Loeppert and Klaus Raven of the Soil and Crop Sciences Department at Texas A&M University. The researchers hope to gauge the level of heavy metals that are transported in suspended solids and flow to streambeds. Surface dissolution and extraction techniques will be used as indices of bioavailability and environmental hazard.

The researchers plan to collect field samples of streambed sediments and microinvertebrates from sites near EI Paso, the Devil's River, and Houston.

The exchange of water and agricultural chemicals between surface and ground water in floodplains is the focus of an investigation by Clyde Munster of the Texas A&M University Agricultural Engineering Department. Goals of the study are to measure groundwater flows from agricultural floodplains that are near adjacent streams; to gauge the transport of nitrogen from fields to the streams; and to develop methods to determine the pollution potential from agricultural fertilizers. Munster plans to apply fertilizers and a non-reactive tracer (bromide) to a site in a floodplain near the Brazos River. Data will be gathered on the movement through soils and aquifers, groundwater flows, surface water runoff, and streamflows.

Tom Waller and Miguel Acevedo of the Institute for Applied Science at UNT were awarded a study to investigate the use of remotely sensed data from key species to evaluate toxic conditions in surface water. The researchers hope to identify and test organisms that municipalities can utilize to determine if toxic and nontoxic contaminants are present in stormwater runoff. The study will focus on whether bioelectric signals sent by the Asian clam into nearby waters can be detected, arnplified, and interpreted. Changes in the clam's heartbeat and other factors (for example, if the clams are open or shut) will help scientists identify when pollution is occurring. The study involves laboratory and field experiments.

TWRI will continue funding two research projects.

Duane Gardiner of the College of Agriculture at Texas A&M University is assessing the use of soil amendments to control adverse effects of irrigation with wastewater. The goal of the project is to determine whether furrow irrigating soils with treated wastewater may increase the levels of sodium in soils and shallow groundwater tables. The project will also assess how irrigation with treated effluent impacts hydraulic conductivity of soils and how it impacts short season yields of key crops. Gypsum has already been applied to celantro (an herb similar to parsley), broccoli, and bell peppers. A polymer (polyacrylamide) has also been tested that may help soils maintain their structure when Bermuda grass and grain sorghum are irrigated with effluents.

A project titled Volume-Duration-Frequency Relationships for Ungauged Catchments in Texas is being led by Juan Valdes of the Texas A&M University Civil Engineering Department. The project is being funded by the Water Resources Division of the U.S. Geological Survey and is administered through TWRI.

The study involves reevaluating flood frequency estimates utilizing new data and innovative techniques. Valdes has analyzed and compiled a comprehensive database of flood records from more than 900 gauging stations. A goal of the study is to better predict infrequent floods in rural areas where streamflow data is not typically available. Computer simulations of flood flows of varying durations and frequencies are now being performed. When completed, the project will result in a set of equations that managers can use to better estimate the risk of flooding in specific rural areas.

TWRI will also continue funding its public information program that is led by Ric Jensen. This program involves the publishing of this newsletter, two other newsletters (Texas Water Resources and On-Site Insights) and other activities.

So Long, Evelyn!

When you call us next time, don't be surprised if you don't recognize the voice that answers the phone. That's because TWRI's Senior Secretary Evelyn Teaff retired on May 31 after 20 years of service.

Over the years, Evelyn handled the Institute's correspondence; notified scientists of research opportunities; helped researchers submit preproposals; and prepare technical reports for printing . She also served as the hostess of many of the conferences sponsored by TWRI.

The Institute staff wishes Evelyn all the best. She plans to retire in Bryan and spend a lot of time enjoying life. She may be reached at 1404 Bennett, Bryan, TX 77802 or at (409) 779-6064.

Impact of Water Quality in Juarez, Mexico on Water Supplies and Public Health in the El Paso Area

Researchers: Irina Cech, and Amelia Essman, University of Texas School of Public Health, Houston, TX.

Problem: The cities of Juarez, Mexico, and El Paso straddle the Rio Grande Riverand have a combined population of nearly 2 million people. Both cities share the use of the Hueco Bolson aquifer. However, little is known about the groundwater quality in Juarez and there is concern that the aquifer may be contaminated with fecal coliform bacteria and nitrate-nitrogen from poorly treated sewage. Roughly 60% of the population of Juarez is served by sewer lines, but there are no sewage treatment facilities in the City. Instead, wastewater flows into a long ditch that flows through many residential neighborhoods before eventually being used to irrigate crops.

Objectives: To test the water quality of both well water and tap water from selected sites in Juarez for fecal coliform bacteria and nitrate-nitrogen, to identify potential sources of contamination, and to estimate potential health risks that may result from drinking the poor quality water.

Methodology: In 1987, water was tested for evidence of fecal bacteria and nitrates that could indicate possible contamination by sewage. Sites were sampled that represented different population densities, land uses, and elevations. A total of 42 samples were taken (30 of tap water and 12 of well water). Households in the Juarez area and in outlying colonias were sampled. Testing and analysis followed U.S. Environmental Protection Agency (EPA) recommended procedures for quality assurance and quality control.

Results: Nitrate levels in Juarez groundwater were typically less than 10 mg/L (the EPA drinking water standard). More than 90% of the well water samples and 60% of the tap water samples tested positive for fecal coliform bacteria. Low Iying, densely populated areas of Juarez and sites along the wastewater canal were among the areas where fecal contamination was most often noted. These results suggest that the Hueco Bolson aquifer is contaminated by sewage. Findings of coliform in tap water suggest that the contamination may be widespread and is not isolated to wellhead areas. Because El Paso also draws drinking water from this aquifer, it could lead to increased contamination on the Texas side of the border.

Reference: Cech, Irina, and Amelia Essman, "Water Sanitation Practices on the Texas-Mexico Border: Implications for Physicians on Both Sides," *Southern Medical Journal*, November 1992.

Using Computer Automation to Improve Aquaculture Management

Researcher: Phillip G. Lee, University of Texas Marine Biomedical Institute, Galveston, TX.

Problem: U.S. aquaculture production accounts for only roughly 3% of the world total. Problems that limit production include variable climates, high labor costs, and increased competition for dwindling resources. More efficient production systems are needed that can lower labor costs, reduce the risk of large fish kills, and minimize environmental damage.

Objectives: Totest an automated control system that could run on a microcomputer to determine whether it can manage a closed, recirculating, aquaculture system.

Methodology: A supervisory control and data acquisition system (SCADA) was installed on two 3,000 L and two 15,000 L closed recirculating seawater aquaculture systems. Sensors monitor dissolved oxygen, salinity, oxidation/ reduction potential, water levels, flow rates, nitrate nitrogen, and head pressures. Inputs and outputs are interfaced to a microcomputer host. The system was designed so that it would alarm managers when key parameters reached critical levels.

Results: The system was installed for $8,000 and was adapted successfully for aquaculture. The labor needed to manage the system was reduced so that one half-time position costing $11,000 annually could be eliminated. An expert system shell was interfaced to the system and an expert system manager was able to operate the system independently under most conditions. Computer screens represented floor plans with color coding, simulated meter displays, and graphs of current or historical conditions. The system regularly alarmed operators when key parameters reached critical levels. All the screens were accessible by modems so the system could be managed at remote locations.

Reference: Lee, Phillip G., "Computer Automation for Recirculating Aquaculture Systems," to be Presented at American Society of Agricultural Engineering Summer Meeting, Spokane, WA, June 1993.

Water Quality Trends in Texas Reservoirs

Researcher: Ted Ground and Alan Groeger, Biology Department, Southwest Texas State University, San Marcos, TX.

Problem: Watersheds greatly influence the chemical and physical environment in many inland rivers and lakes, because they are the major sources of water, dissolved substances, and particulates. Other factors that influence lake water quality include geology, climate, and man-made contamination.

Objectives: To classify Texas reservoirs by their chemical and trophic properties and to identify the factors responsible for those characteristics.

Methodology: Data was obtained from the Texas Water Commission (TWC) statewide monitoring network, the Texas Water Development Board, and the U.S. Geological Survey (USGS). Eighty reservoirs, representing more than 40% of the major lakes in the state, were selected for analysis from the TWC water quality inventory. As many as three

TWC monitoring stations were selected from each lake. TWC and USGS data were utilized from 1982 to 1989. Variables selected from the TWC database included temperature, specific conductance, pH, chlorophyll, total nitrogen, total alkalinity, dissolved calcium, total phosphorus, total suspended solids, and secchi disk depth. The USGS provided data on those parameters as well as sodium, sulfate, chloride, and phytoplankton.

Results: Texas reservoirs show a distinct east-to west trend of increasing salinity (specific conductance). Reservoirs were classified into three categories by using total dissolved solids (TDS) values. There were 21 "rainfall dominated" lakes with TDS levels of less than 150 mg/L in east Texas; 34 "bedrock dominated" reservoirs with TDS levels of 151-350 mg/L in central Texas, and 25 "evaporation and chemical precipitation dominated" lakes with TDS values of more than 350 mg/L in west Texas. The reservoirs were also grouped according to alkalinity, pH, chloride and calcium. Sulfate, chloride, and calcium decreases from the west to the east. Alkalinity is much lower in east Texas lakes than in those from western and central parts of the state. Calcium carbonate levels in west Texas lakes may be due to the weathering of soils and to the dissolving of ancient marine lakebeds. Median values for pH, conductivity, and calcium are lower in east Texas lakes. Alkalinity accounts for more than 60% of the anions in central and east Texas lakes, but sulfate and chloride comprise most of the anions in west Texas reservoirs. Reservoirs in west and central Texas tend to be deeper than those in the east, but east Texas lakes tend to have larger surface areas and more shoreline development. Total phosphorus and chlorophyll levels were typically higher in east Texas reservoirs. Nearly half of the east Texas lakes were eutrophic, while central Texas lakes tended to be least productive. Total nitrogen was typically highest in east Texas reservoirs. Phytoplankton levels were highest in west Texas lakes, while macrophyte populations were highest in east Texas reservoirs. The study suggests that nutrient loading from geological and climatic factors may be dwarfed by contaminants and nutrients from man-made sources.

Reference: Ground, Ted, and Alan Groeger, *Watershed Climate, Geochemistry, and Trophic Characteristics in Texas Reservoirs*, SWTSU, San Marcos, TX,1993.

Costs to Farmers of Banning Pesticides in the Lower Rio Grande Valley

Researchers: Kelly Bryant, Ron Lacewell, John Robinson, Alton Sparks, Jr., Agricultural Economics Department, Texas A&M University, College Station, TX, John Norman, Jr., Texas A&M University Research and Extension Center at Weslaco, and John Bremer, Texas A&M University Agricultural Research and Extension Center at Corpus Christi.

Problem: The U.S. Environmental Protection Agency (EPA) has encouraged all states to develop plans to manage the use of pesticides to prevent pollution risks to groundwater. The Texas Water Commission identified the Lower Rio Grande Valley as an area that is "highly vulnerable" to groundwater pollution. Leachable pesticides are also frequently used on crops in this region. This study examines the economic effect of prohibiting the use of three widely used chemicals in the Valley on area farmers. Atrazine is used on

corn, sorghum, and sugar cane acreage to control broadleaf weeds and annual grasses; dicrotophos is utilized to kill insects called "flea hoppers" that reduce cotton yields, and aldicarb is used by citrus growers to control mites.

Objectives: To estimate the net economic effect of bans of selected pesticides on a per acre, whole farm, and regional basis, and to identify alternative methods and costs of controlling pests in the region.

Methodology: The Valley contains more than 700,000 acres of cropland and pesticides are used on most of those acres. Pesticides that are widely used in the region that may contaminate groundwater were identified, and estimates of average application rates were obtained for key crops. To estimate the economic impact of pesticide bans, the "next best" pest management strategies for key crops (alternative pesticides, tillage practices, and integrated pest management) were identified. Crop enterprise budgets were used to determine changes in per acre costs and returns for key crops based on alternative management strategies. Projected changes in gross income, variable costs, and net income per acre were compared. Regional economic impacts were evaluated.

Results: If atrazine were banned, cyanizine would likely be used to control weedsforcorn and sorghum production. Ametryne would replace atrazine for sugar cane. Treatment costs per acre would increase by $8.25 for corn, $5.75 for sorghum and $11.44 for sugar cane. Banning atrazine would require farmers to cultivate their crops more often and this would cost $2.24 more per acre for corn and sorghum, and $11.44 for sugar cane. If dicrotophos were banned, acephate would likely be used to control insects on cotton crops. It costs $1.56 more per acre per treatment and would boost expenses by $2.34 per acre annually. If aldicarb were prohibited, two foliar applications of fenbutatin oxide would have to be applied. This would increase variable costs by nearly $20 per acre. Discontinued use of these pesticides in the Valley could reduce corn and sorghum yields by 3% and citrus yields by 10%. Banning these pesticides would reduce farmer net income by over $6 million annually.

Reference: Bryant, Kelly, Ron Lacewell, John Robinson, John Norman, Jr., Alton Sparks, Jr., and John Bremer, *Economic Impact of Withdrawing Specific Agncultural Pesticides in the Lower Rio Grande Valley*, (TR-157), Texas Water Resources Institute, Texas A&M University, College Station, TX.

Water Management in the Armand Bayou Coastal Preserve

Researchers: Gary Mitchell, Houston Galveston Area Council, and Duane Windsor, Jones School of Management, Rice University, Houston, TX.

Problem: Coastal preserves are a relatively new concept in Texas. The program provides the opportunity for the Texas Parks and Wildlife Department to act as preserve manager and to practice micro-management within small areas along the coast. However, the coastal preserve concept may need to be modified so that it can function more effectively. Omissions that may need to be corrected include developing a uniform set of objectives and standards that could be utilized to manage all preserves along the coast (currently,

goal setting is done only on a case by case basis) and integrating preserve management with other regulatory activities in nearby areas that affect the preserve ecosystem.

Objectives: To evaluate the effectiveness of major environmental regulatory programs in the Armand Bayou Coastal Preserve in terms of point source discharges, storm water runoff, wetland protection, habitat protection, and waste disposal, based on personal interviews with environmental managers and application of standard management techniques.

Methodology: Based on the results of the Environmental Inventory of Armand Bayou Coastal Preserve, and the Galveston Bay National Estuary Program Priority Problems List, key environmental problems facing the preserve were identified. The Regulatory Survey for the Armand Bayou Coastal Preserve provided information on the authority of state and federal agencies to regulate these problems. Using this information, survey instruments were designed to interview key staff of lead agencies. The interviews focused on the adequacy of the legal authority, resources, and administrative priorities associated with their programs, and on root causes that led to program deficiencies or barriers to more effective programs. A series of management recommendations was developed based on survey results.

Results: In broad terms, the study recommends that lead agencies in the preserve program must improve interagency cooperation and should focus on improved cooperation between the various agencies. Other general recommendations were that more baseline data should be developed, that Armand Bayou be utilized as a "pilot program," that a preserve monitoring system be implemented, and that administrative fines and penalties should and can be applied effectively. The report also notes that many agency managers fear that new programs regulating point source discharges and non-point source pollution may constitute unreasonable administrative burdens, that some of the best approaches to measure water quality like stream monitoring may be too costly and difficult to implement, and that wetlands protection rules trouble some agency staff because they may not be equitable.

Reference: Mitchell, Gary, and Duane Windsor, Regulatory Effectiveness Study for the Armand Bayou Coastal Preserve, Galveston Bay National Estuary Program (GBNEP 13), 1991.

Lamar University Gulf Coast Hazards Center Seeks Proposals

The Gulf Coast Hazardous Substance Center at Lamar University has issued its annual request for proposals (RFP).

The Center is interested in research focusing on waste minimization and pollution prevention strategies for specific industries; reuse and recycling; and hazardous waste treatment. The Center has funded projects dealing with treating water contaminants; bioremediation of polluted aquifers; and other water-related areas.

The RFP will be sent to researchers at Texas A&M University, Lamar University, the University of Houston, and the University of Texas at Austin. Full proposals are due in November. For more details, call the Center at (409) 880-8768.

New Navigation System Tested in Houston Ship Channel

A new computerized navigation system is being tested in the Houston Ship Channel that may lessen the risk of accidents and may keep the Channel open during foggy weather and other times when visibility is low.

In broad terms, the system works like this. Data files contain numeric information on the width and location of the channel throughout its length. On-board the ship, specific coordinates for longitude and latitude are determined using the global positioning system. After the position has been determined, it is transformed into channel coordinates (how far along the channel the ship is and how near it is to the center line).

The vessel's location, the specific route the ship was intended to travel, and a map of the ship channel are then shown on an electronic chart. The system is being tested as a cooperative effort between the Houston Port Authority, the U.S. Coast Guard, and the U.S. Army Corps of Engineers. It will be installed aboard a tanker that travels the Channel several times a week so that the technology can be tested under a variety of weather conditions.

AWWA Research Foundation RFP

The American Water Works Association Research Foundation is accepting proposals through July 15 for many topics.

Specific areas that the foundation is now considering include soil treatability pilot studies to design and model an aquifer treatment system; biofouling in membrane processes; effect of disinfection methods of the inactivation of *Cryptosporidium*; radon removal using granular activated carbon; and a national assessment of particle removal by conventional filtration.

These topic areas all have budgets of at least $250,000. The Foundation requires 25% of the total project budget to be in-kind contributions such as labor, lab services, and cash. For details, call the Foundation at (303) 347-6117.

On-Site Wastewater Council Seeks Proposals

The On-Site Wastewater Treatment Research Council is now accepting unsolicited research proposals dealing with on-site wastewater treatment and disposal. The types of projects that are generally considered by the Council include new and innovative methods to treat and dispose of wastes on-site. Proposals can be accepted from university researchers and extension agents and state or local regulatory agencies. For details, call the Council at (512) 463-8260.

Legislators Near Compromise on Edwards Aquifer

Texas legislators spent much of May working furiously to beat the clock. The goal wasn't to win a game show prize--it was much more serious. The senators and representatives were trying to broker a compromise on how to manage the Edwards Aquifer before a federal judge's May 31 deadline.

As of this writing, the hard work appeared to be paying off. House and Senate officials had each drafted their own versions of bills to manage the aquifer and were meeting in a conference committee to hammer out the final details.

There are some similarities. Both proposed bills would create a regional Edwards Aquifer authority which would regulate groundwater in Bexar, Atascosa, Caldwell, Comal, Guadalupe, Hays, Uvalde and Medina counties. Both proposals call for the Authority to be governed by an appointed board and to work with an advisory committee or council. Finally, both bills call for pumping to initially be reduced to 450,000 acre feet (AF) per year, and to be cut to 400,000 AF by the year 2008.

However, the bills also differ significantly in many respects. Generally, the House bill is more sensitive to rural and agricultural interests, while the Senate bill is more keen to urban concerns.

For example, the Senate proposal would issue water rights based on historic that can be pumped to meet. It allocates at least 2 AF per year per irrigated acre to agricultural producers. The Senate bill authorizes the Authority to buy water rights, buts lets landowners sell up to half the water rights they are allocated.

The House bill lets individual counties decide how pumping will be regulated. It also provides for compensation to landowners whose "groundwater property rights" are taken by a regulatory authority. The House proposal dictates that only underground water conservation districts may control the sale or lease of water rights.

Dry Hydrants Convert Rural Wells into a Tool to Fight Fires

Fighting fires in rural areas can be difficult because it's hard for emergency crews to get to the water they need. That's because, in most cases, there aren't any fire hydrants once you leave the city limits.

However, a new program by the Texas Forest Service (TFS) and other agencies is providing a big boost to rural firefighters and may save homeowners money in the process. TFS is helping local resource and conservation districts and water districts throughout the state install "dry hydrants." Dry hydrants are non-pressurized pipe systems that can be installed in ponds, lakes or streams to provide a steady supply of water to tanker trucks. The cost of converting a site to a dry hydrant is typically only $300 to $800. In general terms, sites for dry hydrants should have access to at least 50,000 gallons of water and should be within three miles of other dry hydrants.

Firefighters can pump water directly from these hydrants to refill tanker trucks. In the past, many farmers let fire departments tap into their irrigation wells. That was often too slow (flows were limited to 300 gallons per minute when it usually takes 1 ,000 gpm to fill a tanker truck in time to effectively fight a fire).

Dry hydrants have been installed in Brazos County and the Texas Panhandle. In addition to making rural homeowners safer, the program may lower fire insurance rates for local homeowners by reducing the risk of fires. For details, call Bruce Miles of TFS at (409) 845-2641.

Houston Water, Wastewater Rates Rise to #1 in U.S.

After years of near misses by the NFL's Oilers and the NBA's Rockets, many Houstonians have been waiting for the day when they can rise and chant "We're Number One."

They can now claim that distinction in at least one category that they may wish they didn't have. As a result of a City Council vote in March, Houston residents will now be paying more for water and sewer services than people living in any other U.S. city.

The rate increase marked the eighth time in nine years that Houston raised the prices its customers pay for water and wastewater service. The new rates are will total roughly $41.90 a month for customers using the city-wide average of 7,000 gallons. The new rates will be greater than second-place Austin ($40.27) and third place Boston ($39.18). Rates of other Texas cities include Dallas ($29.32), San Antonio ($23.46) and El Paso ($15.93).

According to City officials, the major factors that led to the high rates include improvements to the stormwater system that have been required by state and federal agencies and converting much of the City from ground to surface water. There is one positive note, however. A bill that required the City to provide all Houston residents with water and wastewater service has been amended so that now only 85% of those in the City will need to be hooked up by 1998. That should save the City about $120 million.

New Herbicide May Boost West Texas Water Supplies

A "new generation" herbicide is being tested that could remove pesky salt cedar trees and produce additional water for West Texas.

Salt cedars, originally planted along the Pecos River in New Mexico in the early 1900s to limit erosion, have now spread over stream and river beds in much of the region, according to Ron Sosebee of Texas Tech University's Range and Wildlife Management Department.

Large salt cedars can consume as much as 200 gallons of water a day‹as much water as a small family needs and twice the amount used by native vegetation. Alan McGinty, a range specialist with the Texas Agricultural Extension Service in Fort Stockton, says that salt cedars can cost farmers $200 to $1,000 in losses per acre . That's because the water

consumed by the trees isn't available for crops and therefore lowers yields. Previous methods to control salt cedar involved burning the trees and plowing their roots, but they were not effective and increased erosion

The herbicide, called "Arsenal," works by inhibiting a vital enzyme that slows the plant's metabolism until it dies. Since the herbicide targets only plants and can be applied at small application rates, its manufacturers say it doesn't harm nearby ecosystems.

Houston Privatizes Sludge Management Program

At least three cities in Texas have turned over the management and operation of some of their water utility operations to private companies in an effort to reduce costs and increase efficiency.

Professional Services Group, Inc. (PSG) of Houston is one of many companies throughout the U.S. that offers "privatization" services for water utilities. Privatization refers to companies that operate, maintain, and sometimes own what traditionally have been public utility functions. For example, PSG manages Houston's sludge hauling, application, and disposal program for a fixed per-ton fee. They provide the sludge to farmers free of charge (it's worth up to $100 per acre as a fertilizer). Since they've begun, the costs have been significantly lowered.

PSG also operates Burkburnett's wastewater plant, trains employees on current and complex regulations, and installed a computerized process control and maintenance program. In Conroe, they established an industrial wastewater pre-treatment program, revised the City's sewer ordinance, and submitted an enforcement response guide to EPA.

For more information on the benefits of privatization, call PSG at (713) 623-6161.

Waco Water Sales Reduce Need for Lake Bosque Project

For some time, the Brazos River Authority was trying to develop the Lake Bosque project to supply drinking water for Waco and surrounding communities.

It now appears that the project may not be built, however. That's because the City of Waco, which has historically kept its water for its own use and which only sold water to other towns in emergencies, now appears ready to sell water from Lake Waco to nearby communities.

Part of the reason for Waco's decision is that rapid growth that was anticipated in the 1970s, and an accompanying need for more water, didn't materialize in the 1980s. Water from Lake Waco will cost much less than developing Lake Bosque (roughly $9 more per household per month compared to as much as $50 extra per month).

Lake Bosque was to be constructed in Bosque County, which is northwest of Waco. Clifton and Meridian would have taken water directly from the lake, which would have released water into Lake Waco. The City of Waco would have utilized water out of Lake Waco and would have supplied it to nearby communities.

New TWRI Reports Focus on Water Rights Models, Pesticides Bans, Edwards Aquifer Issues

Three new technical reports are available from the Texas Water Resources Institute (TWRI).

Water Rights Analysis Package Model Description and Users Manual (TR 146) was written by Ralph Wurbs, David Dunn, and W. Brian Walls. The report describes a computer model that can be used to simulate the streamflows and reservoir storage capabilities in river basins. The model can be used to simulate the impact of water rights on the amount of water that is available in key watersheds. The report includes an overview of the model, a description of system components, computations performed by the model, the combined use of the model with other models, and data input and output requirements.

Economic Impact of Withdrawing Specific Agricultural Pesticides in the Lower Rio Grande Valley (TR 157) was written by Kelly Bryant, Ron Lacewell, John Robinson, John Norman, Jr., Alton Sparks, Jr., and John Bremer. The report (see "Abstracts" in this issue) assesses the impact that bans of three pesticides (atrazine, dicrotophos, and aldicarb) could have on farmers that rely on these chemicals. The cost of using alternative best management practices that farmers could use to duplicate the effect of these benefits were identified. The net cost of the bans was estimated for individual farmers and for the region.

The Edwards Aquifer: An Economic Perspective (TR 159) was written by Ron Griffin and Bruce McCarl of the Texas A&M University Agricultural Economics Department, John Merrifield and Robert Collinge of the Economics and Finance Division of the University of Texas at San Antonio, and Peter Emerson of the Environmental Defense Fund's Austin office. The report characterizes the current management system as being "broke and needs fixing." Such "myths" as change will impose undue hardships, new water projects will be a positive solution, and water markets will injure users are examined and management challenges are outlined. The report recommends that groundwater rights be adjudicated so they can be transferred, that an Edwards Aquifer watermaster office be established to facilitate water marketing, that springflows be protected, and that rural opportunities be preserved (perhaps by placing a modest tax on water sales outside of affected counties).

Also, subscribers who read the *Texas Water Resources* newsletter need to contact TWRI by June 30 if they wish to remain on the mailing list or they will be dropped. This is being done to conserve costs. Also, people who want to read about septic tanks and on-site wastewater might want to receive TWRI's quarterly newsletter, *On-Site Insights*. A comprehensive index to the *New Waves* newsletter is also available.

For details on any of these publications, call TWRI at (409) 845-1851.

LCRA Publishes Handbooks on Colorado River, Recreation

Two colorful and easy to read guides about the Colorado River have recently been published by the Lower Colorado River Authority (LCRA).

The State of the River: 1993 is LCRA's "State of the River" Report and describes water quality conditions in the river. The report says that the news about the river is basically good‹the Highland Lakes continue to maintain their high quality and the river downstream of Austin is much improved. Much of the credit for the turnaround, which reversed poor water quality in the 1980's, is given to public concerns that led to better quality water. The report also mentions that there are still challenges that need to be addressed including increased stormwater runoff from urban areas, natural and man-made salinity, and greater competition for use of the river from different groups. The report contains many informative charts and graphs and excellent color photos. Limited copies are available at no cost. To order a copy, call LCRA at (800) 776-5272, extension 3235.

The Lower Colorado River Guide is an excellent tool for canoeists and river rafters. It contains information on how to plan for a river trip, what to bring, river water quality, hazards to avoid (low-lying dams), how fast recreational users can expect to float, and the rights of canoeists and rafters when it comes to accessing take-off sites. The guide costs $5 and can be ordered by calling (800) 776-5272 ext. 4083.

Texas-Mexico Water Issues Outlined in New UT Report

Many of the key issues involving how to manage water resources along the Texas-Mexico border have been outlined and explained in a new book from the LBJ School of Public Affairs at the University of Texas at Austin.

The book, *Challenges in the Binational Management of Water Resources in the Rio Grande/Rio Bravo,* was written by David Eaton and David Hurlbut of the LBJ U.S.-Mexican Policy Studies Program.

Chapters in the book include information on historical and current patterns of surface and ground water use; surface water quality and problems associated with poorly treated sewage from Mexico; and results of public opinion polls about how residents feel about water issues in Laredo, TX, and Nuevo Laredo, Mexico. The book also outlines key policy issues that may have to be corrected (for example, a lack of coordinated policy on groundwater pumping encourages to all users to pump and deplete the resource before others do the same, thus encouraging overuse) and identifies alternative policy and management measures that could remedy some of these problems.

The book is for sale by the LBJ School. Call (512) 471-4962 to order a copy.

State Auditor's Report Stresses that Texas Water Agencies Need Better, More Coordinated, Management

A new report by the Texas State Auditor's Office says that there are several key areas in which state water management policy may need to be reformed so that it can operate more effectively.

The report, *Texas Water Resources Management: A Critical Review,* was published in March. According to the publication, Texas lacks a comprehensive system to effectively manage water resources. As a result, weaknesses identified in previous studies remain unaddressed. The report also suggests the State cannot ensure an adequate supply of good quality water for all Texans under the current legal and institutional framework. This is because Texas' outdated water law obstructs efforts to extend available supplies and does not provide incentives for conservation. Finally, local communities will have to pay billions of dollars to build and maintain water-related infrastructure to comply with federal and state regulations, with small communities facing potentially crippling compliance costs.

Besides outlining the problems, the report also makes a number of policy recommendations. Some of these include more coordinated water planning efforts to develop and implement effective policies throughout state agencies; the creation of regional planning councils over watersheds, groundwater supplies and river basins; expansion of the watermaster program to all the state's river basins, and the creation of grant programs for small communities that are unable to meet the costs of new water quality and public health regulations.

To order the report, contact the State Auditor's Office at (512) 479-4700.

Gulf Coast Hazard Center Proceedings Focus on Treatment of Water-Borne Contaminants

Technical papers with information on how to treat many water-borne contaminants and summaries of related research are included in a proceedings titled *Emerging Technologies: Metals, Oxidation, and Separation.*

The proceedings were published by the Gulf Coast Hazardous Substance Research Center at Lamar University, and summarize papers that were presented at their Annual Symposium in February,1993.

Some of the topics that are covered in the proceedings include supercritical water oxidation, treating waterborne hazardous wastes with ultraviolet and visible (UV/Vis) light and hydrogen peroxide, separating heavy metals from industrial waste streams with membrane technology, and using adsorption and ion exchange to remove metallic ions.

The proceedings can be ordered by calling the Center at (409) 880-8768.

Texas Tech Report Summarizes Impact of Non-Point Source Pollutants on Playa Lakes

A new technical report about how playa lakes in the Texas panhandle may be affected by runoff and non-point source pollution has been produced by the Water Resources Center (WRC) at Texas Tech University.

The report, *Assessment of Non-Point Source Contamination of Playa Basins in the High Plains of Texas* (Phase I) was co-authored by Tony Molihagen, Lloyd Urban, and Heywood Ramsey of the WRC, Wayne Wyatt and Don McReynolds of the High Plains Underground Water Conservation District No. 1, and Tom Ray of the Brazos River Authority. Personnel with the Soil Conservation Service, the Texas Agricultural Extension Service, and the U.S. Geological Survey also contributed to the report.

The report describes efforts to sample 99 playa lakes for both standard water quality parameters and pesticides. Results suggest that there are detectable levels of trazine herbicides and/oraldicarb in virtually every basin that was studied (the levels are not high enough to pose a threat to human health and the environment). Many of the playas also showed higher than normal levels of dissolved salts.

The report was summarized in the April 1993 issue of the WRC Newsletter. For details, call the Center at (806) 742-3597.

Texas Tech Scientists Receive $1.6 Million Grant to Study Impact of Sludge Application

A team of scientists from Texas Tech University have received a $1.6 million grant to gauge the environmental effects of spreading sludge on 128,000 acres of rangeland near the West Texas town of Sierra Blanca.

The study is being led by Ron Sosebee and David Wester of Tech's Range and Wildlife Manaqement Department. and Richard Zartman of the Agronomy, Horticulture, and Entomology Department.

Broad goals of the project are to assess the effects of this beneficial use of sludge on arid rangelands. Specific research objectives are to measure how sludge affects the growth of native plants; to determine if sludge is an effective soil amendment; to gauge if heavy metals are building up in plants and soils; and to measure the impact of sludge application on surface and ground water quality and on surface water runoff.

The study is important because there has been a lot of public opposition to sludge application projects, in large part because many people don't know about the potential benefits. If benefits far outweigh risks, this research could pave the way for other sludge projects throughout the State.

For details, call Wester or Sosebee at (806) 742-2841.

Vis/UV Light, Hydrogen Peroxide System Oxidizes Hazardous Wastes, UH Researchers Say

Researchers at the University of Houston are developing and testing a system that utilizes visible/ultraviolet light (Vis/UV) and hydrogen peroxide to treat water borne hazardous wastes.

The research is being carried out by Steven Shimoda and H. William Prengle of the Chemical Engineering Department and Jim Symons of the Civil Engineering Department. It is being funded by the Gulf Coast Hazardous Substance Research Center at Lamar University.

The process uses hydroxyl radicals to oxidize organic contaminants in groundwaters. The amount of contaminants and total organic carbon that is being converted to less hazardous substances can be estimated by measuring the amount of the hydrogen peroxide that remains (more hydrogen peroxide disappears as the level of treatment increases). Studies were carried out using both continually stirred and tubular flow reactors. In laboratory tests, the system successfully degraded benzene and chlorinated compounds.

The researchers hope that this technology may be a simple way to treat groundwater leachates and industrial wastewater organic contaminants that can be used by small water utilities in remote areas.

For details, call Prengle at (713) 743-4340.

Heavy Rains Cause Many Soils in Dallas-Fort Worth to Shift, Become Unstable, UT-Arlington Geologist Says

Heavy rains in the Dallas-Fort Worth area in recent years have shifted soils and caused landslides at highways, the DFW Airport, and maybe a nearby dam, according to a University of Texas at Arlington scientist.

Donald Reaser, an associate professor in the Geology Department, says that landslides and earthflows should be expected whenever heavy rains fall, especially on areas with moderate or steep slopes. The cause of the problem is that many of the soils consist of unstable clays that regularly swell and shrink.

For example, chunks of an earthen dam that hold Lake Waxahace in Ellis County have recently shifted, causing a need for millions of dollars in repairs to stabilize that site. Although the terminals and main runways at DFW Airport are in little danger because extra steps were taken to stabilize them when they were built, many of the airport's runway aprons "have cracked like shattered glass," Reaser said. In east Dallas, telephone poles are leaning so much near railroad tracks that there is fear that trains may crash into them.

Can anything be done? Reaser suggests that soil tests be performed before new structures are constructed and that builders and developers should consider soils as one of the factors in deciding where to build. If people decide to build on unstable soils, they should take extra steps to guard against soil shifting

For details, call Reaser at (817) 273-2984.

UT Engineers Create Decision Support Tools to Choose Low-Cost Methods to Treat Hazardous Wastes

Engineers at the University of Texas at Austin are developing a computer decision support system that may make it easier for managers and engineers to find the most effective and least cost methods to treat waters that are polluted by hazardous wastes.

Choosing the appropriate technology to treat water-borne hazardous wastes is a complex decision. Not only is there a wide array of chemical pollutants at different levels, there are also many different potential treatment options and most of these are poorly understood. In addition, there are a multitude of federal and state regulations that have to be considered.

Desmond Lawler and Gerald Speitel are developing simulation models for a variety of treatment processes including air stripping, air stripping with off-gas treatment, liquid phase absorption, combined biodegradation and adsorption, steam stripping and biodegradation. A computer-based expert system for decision analysis is being created.

Lawler and Speitel are also working to increase the understanding of one treatment option (simultaneous biodegradation and liquid phase absorption). They want to determine if this process can be as effective as air stripping off-gas treatment (the method now used most often) when the benefits of biodegradation are factored in.

For details, contact Lawler at (512) 471-4595.

SW Texas State Researchers Identify, Inventory Aquatic Species in Edwards Aquifer

When most of us think of the fish and insects that live in water, we naturally think of species that live above ground in lakes and rivers. However, Glenn Longley and a team of biologists at Southwest Texas State University have focused in other direction --below the ground. They're inventorying and learning more about aquatic species that live in the Edwards Aquifer.

Longley, the Director of the Edwards Aquifer Research and Data Center, recently presented a talk to the First International Conference on Groundwater Ecology that summarizes SWT's research in this area. He reported that more than 40 species that live underground have been found in the Edwards Aquifer. These include flatworms, snails, seed shrimp, pill bugs, scuds, marine crustaceans, blind shrimp, beetles, two species of

blind catfish (widemouth and toothless blindcats), and two species of blind salamanders (Texas and Blanco).

Some of these species are extremely rare, Longley says, and could be threatened by slight changes in water quality. The aquifer contains the only beetle in the western hemisphere that spends its entire life cycle in water. The blind catfish are only found at water levels deeper than 1,350 feet near San Antonio.

Longley says that many of these species apparently originated in marine waters. He says that one of the mysteries that researchers are trying to solve is how these species migrated inland and how they adjusted to fresh water.

For details, call Longley at (512) 245-2329.

TAES Study Measures If Rice Irrigation Adds Pesticides, Nutrients to Downstream Areas

Determining if pesticides and herbicides used in rice production are contaminating downstream areas is the goal of a study by researchers with the Texas Agricultural Experiment Station at Beaumont.

The study, being funded by the Environmental Protection Agency and the State Soil and Water Conservation Board, and is led by agricultural engineer Garry McCauley, and with help from technicians Jonnie Hunt and Kerry Austin.

The goal of the study is to determine if rice growers could lessen non-point source pollution loadings by utilizing best management practices. The results are important because half of the major rivers in Texas flow through rice production areas to the Gulf of Mexico. Three fields were selected for study in Colorado, Wharton and Matagorda counties. Levels of different forms of nitrogen (including nitrate, ammonia, urea) and agricultural chemicals such as furadan, benlate, and methyl parathion were measured.

Study results suggest that nearly all of the pesticides will decrease to low levels if producers will keep irrigation water in the fields for sufficient time after the chemicals are applied. For example, furadan levels decreased significantly within 18 days after it was applied; benlate dissipated to low levels roughly a month after it was applied; and methyl parathion declined to non-detectable levels only three days after it was applied. Although nitrate-nitrogen generally declined to non-detectable levels within a week, the research suggests that pre-plant applications of liquid urea can result in relatively high nitrate levels.

For details, contact McCauley at (409) 752-2741.

Rice Receives $19 Million to Help Clean-Up Military Bases

Rice University has been awarded a $19 million grant from the Department of Defense (DOD) to develop new technologies to clean up hazardous wastes at military facilities.

Currently, more than 17,600 sites at 1,877 military bases need to be cleaned up to meet DOD environmental standards.

C. Herb Ward, director of the Rice Energy and Environmental Systems Institute, will serve as the program director of the DOD Advanced Applied Technology Demonstration Facility. Other universities participating in the program include Lamar University, the University of Texas at Austin, Stanford University, Louisiana State University, and the University of Waterloo (Canada).

Goals of the project are to develop and demonstrate new environmental remediation programs to clean up contaminated soils and aquifers at hazardous waste sites. The program will utilize several DOD sites for implementing carefully monitored pilot tests and demonstrations of new technologies. Engineering manuals for proven clean-up technologies will be prepared for full-scale commercialization.

For details, call the Institute at (713) 527-5438.

UNT, TWU, Corps of Engineers, Study How Wetlands Treat Wastes; Ecosystem Interactions

A pair of studies now being conducted at the U .S. Army Corps of Engineers' Lake Lewisville Aquatic Ecosystem Research Facility are providing new information on the use of wetlands to improve water quality.

In one project, Robert Doyle, a researcher at the University of North Texas who also works for the Corps, has been studying whether constructed wetlands can remove atrazine. The study utilized two treatments. One set of wetlands was intermittently flooded while the other was continuously flooded. Both treatments received waters that contained 20 micrograms per liter of atrazine for 10 to 21 days. Afterwards, soils, surface water, and pore water (in the sediments) were monitored to determine the fate of the pesticide.

The results show that the wetlands systems removed roughly half the atrazine in only 8-9 days, while it took up to two months to degrade the pesticide in a "control" tank that contained water but not wetlands plants and microbes. Preliminary findings suggest that only 10% of the atrazine had built up in sediments. Other processes that may play a key role include microbial activity and plant uptake.

In a separate study, Kimberly Mauermann, a graduate student at Texas Women's University in Denton, worked with Center director Mike Smart to investigate the ability of red-eared turtles to eat submerged aquatic plants that are commonly associated with reservoirs, ponds, and wetlands. Mauermann said that there are probably more than 200 turtles that regularly travel from nearby Lewisville Lake to the site and dine on plants in ponds and wetlands that are used in field studies. This prompted her to design a study to determine which types of vegetation the turtles most prefer. The results suggest that the turtles' favorite plants are native species like water celery, followed to a lesser extent by southern naiad and hydrilla. Personnel at the site are now trapping and relocating the

turtles, but haven't yet developed a solution to keep them from preying on the site's vegetation.

For details, call the Lake Lewisville Aquatic Research Center at (214) 436-2105.