New Waves
The Research Newsletter of the Texas Water Resources Institute
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Gulf Coast Hazardous Substance Research Center established at Lamar University

A new university consortium has been established at Lamar University to conduct research that may result in more effective hazardous waste management.

The Gulf Coast Hazardous Substance Research Center (Center) was created by the Superfund Amendments and Reauthorization Act of 1986, and additional legislation was passed by the Texas Legislature that year.

Texas universities that are center members include Texas A&M University, the Texas Engineering Experiment Station, Lamar University, the University of Houston, and the University of Texas. For the current biennium, $1.2 million has been appropriated for the Center. Approximately 80% of the Center's effort will be concentrated in the areas of waste minimization and alternate technology development. The remaining 20% is reserved for projects that could support and enhance the application of this technology.

Research projects will usually be conducted by the faculties of the member universities on their own campuses. Research proposals can be submitted by faculty members at member universities for review by the Center's science and industry advisory committees. Multiuniversity interdisciplinary proposals are strongly encouraged to provide an integrated approach to hazardous waste problems.

Projects have already been selected that were funded with state appropriations. Water-related projects that were selected include the following:

> "Feasibility Study of Groundwater Detoxification," KuYen Li, Chemical Engineering Department, Lamar University
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> "Microbial Degradation of Hazardous Wastes to Nontoxic End Products," T. Rick Irvin, Veterinary Anatomy Department, Texas A&M University, James Bonner and Robin Autenrieth, Civil Engineering Department, Texas A&M University, and Aydin Akgerman, Chemical Engineering Department, Texas A&M University
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> "Hydrogen Peroxide/Ultra- Violet Irradiation Process for the Treatment of Contaminated Groundwater," Tim Symons, Civil Engineering Department,

University of Houston, H. William Prengle, Chemical Engineering Department, University of Houston

"Choosing Landfill Sites: Stable Isotope Analysis of Groundwater as an Evaluation Tool," William Lawrence, Geosciences Department, University of Houston

For more information about the Center or its programs, contact: William Cawley, Director, Gulf Coast Hazardous Substance Research Center, PO Box 10011, Lamar University, Beaumont, TX 77710. The phone number is (409) 880-8707.

Furrow Diking Technology for Agricultural Water Conservation in Texas: An Initial State-Wide Assessment

Principal Investigators: J. Hari Krishna and Gerald Arkin, Texas Agricultural Experiment Station (TAES), Blackland Research Center, Temple, TX.

Project Duration: May 1985-August 1987.

Funded by: Texas Water Resources Institute and Texas Agricultural Experiment Station, Texas A&M University, College Station, TX.

Problem: Approximately 75% of the state's cropped area is under dryland farming. Water conservation is of critical importance in dryland agriculture, and furrow-diking has emerged as an efficient and low-cost technique to conserve water and increase soil moisture for crop production. Although diking is becoming increasingly popular in Texas, the long- term effects of diking on crop yields in different Texas regions were unclear and had not been quantified.

Objectives: To determine the feasibility and potential of furrow diking in Texas by: 1) Synthesizing results of previous Texas studies; 2) Analyzing rainfall and runoff at representative locations; and, 3) Assessing the impact of diking on crop yields in selected Texas regions.

Methodology: Research data and publications on previous furrow diking experiments in Texas were reviewed. A runoff prediction method based on the modified curve number methodology was combined with three crop models for sorghum, corn and cotton that were developed earlier at the Blackland Research Center. The combined models, SORDIKE, CORDIKE and COTDIKE, were validated with data from several Texas sites, and modified to simulate non-diked, diked part year, and diked all year scenarios. The models were run with daily weather data from Temple, Uvalde, Lubbock, Vernon, and Corpus Christi. Runoff amounts and crop yields were simulated for sorghum, corn and cotton under diked and nondiked conditions at each of the locations.

Results: Past furrow diking research in the High Plains and Rolling Plains has generally indicated a favorable response to diking. However, the increases in crop yields varied

considerably among locations, and between years at any particular location. To evaluate long-term benefits, the three furrowdike models were run for 25 years (1960-1984) using historic weather records and soil and crop related data. The long-term average annual runoff in the sorghum/corn growing season ranged from 15 to 30 millimeters in the High Plains, Rolling Plains and Edwards Plateau regions and from 50 to 70 millimeters in the Coastal Bend and Blacklands. Depending upon the location and the length of time that the dikes are left in the field, mean annual sorghum yields could increase by 300 to 1000 kg/ha, corn yields by 200 to 800 kg/ha and cotton lint yields by 10 to 30 kg/ha. Furrow diking promises to be a valuable management practice in semi-arid and sub-humid regions and is likely to be applicable to about 3.5 million ha of cropped area in Texas.

Publications: Krishna, J.H., G.F. Arkin, J.R. Williams and J.R. Mulkey. "Simulating furrow dike impacts on sorghum yields," *ASAE Transactions*, Vol.30(1): 143 147, ASAE, St. Joseph, MI, 1987.

Hydrochemical Investigation of the Comal Hueco Spring Systems, Comal County, Texas

Principal Investigators: Samuel R. Rothermel and Albert E Ogden, Southwest Texas State University, San Marcos, TX

Project Duration: April 1982 to July 1983.

Funded by: Edwards Aquifer Research and Data Center, Southwest Texas State University, San Marcos, TX.

Problem: There is a lack of information about the hydrology of the Comal Hueco spring system. Information is essential if the springs are to be protected.

Objectives: To better understand the nature of recharge and flow to the springs.

Methodology: Several dye- trace experiments were performed. A large portion of the investigation involved weekly sampling and analysis of water chemistry of four outlets of Comal Springs and two of Hueco Springs. Rating curves were produced for each spring orifice. Annual seasonal trends, discharge trends and storm event trends were analyzed to determine flow characteristics, spring type, current pollution levels and future pollution potential.

Results: Comal Springs was interpreted to be a deep- flow conduit system with long transport distances, but with some local recharge during high water table conditions. Hueco Springs was determined to be a mixed vadose/phreatic conduit system with a rapid flow, storm water runoff recharge component and a deeper, base flow component of "older", more distant recharge water. The quick flow through- time of recharge waters of Husco Springs is indicated by significant fluctuations in temperature, specific conductance nitrate content, and elevated fecal coliform counts. The dissolved oxygen content of Comal Springs is lower than Hueco Springs suggesting less local recharge. The temperature of Comal Springs is higher than the mean annual air temperature which

suggests a deep flow of groundwater with a recharge from a more distant source. The flow of Hueco Springs could be enhanced by placing artificial recharge structures at the headwaters of Blinders or Elm Creeks. Local recharge structures will not increase the longevity of Comal Springs. To preserve the flow of Comal Springs, groundwater use must not increase significantly in the future.

Publications: Rothermel, Samuel R. and Albert E. Ogden. *Hydrochemical Investigation of the Comal and Husco Spring Systems, Comal County, Texas.* EARDC Number R1- 87. August 1987. Edwards Aquifer Research and Data Center, Southwest Texas State University, San Marcos, TX.

Water Reuse: A Report to the Clear Lake City Water Authority

Principal Investigators: Richard C. Allison, Roger Durand and Aneta C. McAnally, University of Houston- Clear Lake, Houston, TX.

Project Duration: July 1987-January 1988.

Funded by: Clear Lake City Water Authority and Bureau of Research, University of Houston- Clear Lake.

Problem: The study addressed: 1) Use of treated effluent nationally, statewide, and in the HoustonGalveston area; 2) Health effects of using reclaimed wastewater for irrigation; 3) Public attitudes toward the use of treated effluent; and, 4) Water quality in the Clear Lake City area.

Objectives: To learn how and where water reuse can be practiced effectively and safely for urban landscape irrigation.

Methodology: Findings were based upon: 1) A synthesis of published materials identified by means of a comprehensive computer- based library search; 2) Original data derived from two surveys of representative samples of area residents; 3) Unstructured interviews with state officials; and 4) Analyses of water quality and quantity records of the Clear Lake City Water Authority.

Results: The study found a strong consensus among area residents for using treated effluent as an irrigation source for public parks and golf courses, and that wastewater effluent was a cost- effective source for irrigation. Adverse risks to public health can be minimized by proper monitoring and control of effluent quality.

Publications: *Water Reuse:A Report to the Clear Lake City Water Authority,* Bureau of Research, University of Houston Clear Lake, 1988.

Model Study of Service Spillway: Lake Bosque Project

Principal Investigators: James, Wesley P., Mary C. Scott and Michael Reedy, Texas A&M University, Texas Engineering Experiment Station (TEES), College Station, TX.

Project Duration: May 1987- February 1988

Funded by: Brazos River Authority, Waco, TX.

Problem: The current spillway is non- uniform, causing uneven flows to come into the spilling basin, and resulting in poor energy dissipation. It may also lead to increased erosion downstream.

Objective: To create effective energy dissipation in the stilling basin.

Methodology: A 1:40 scale physical model of the Lake Bosque service spillway was constructed and tested for the 10- year, 50- year and 100- year flows. Tests were conducted of stilling basin widths of 125, 150, 170, 190 and 250 feet.

Results: The study indicated that 150 feet was about the smallest width of stilling basin that could be used and have a good jump performance. The performance of the model was improved by using curved transitions in the chute walls. Vanes of at least 40 feet can be effective in improving the performance of the jump by distributing the flow more uniformly across the inlet of the stilling basin. The addition of floor baffle blocks to the stilling basin also improved the performance of the jump. An S- shaped ogee weir section was more efficient than the broadcrested weir.

Interactions of an Introduced Cichlid with the Native Fauna of the Lower Rio Grande, Texas and Mexico

Principal Investigators: R.J. Edwards, Pan American University, Edinburg, TX, and M.G. Wood, Del Mar College, Corpus Christi, TX.

Project Duration: September 1980- May 1987.

Funded By: Pan American University Faculty Research Council, and National Science Foundation.

Problem: Since it was imported in the early 1960's, the blue tilapia has become so abundant it may be taking over the Rio Grande from native fish.

Objectives: To discover the characteristics of the blue tilapia which make it adaptable to the Rio Grande environment.

Methodology: Several hundred seine collections of fish from the Lower Rio Grande River (below Falcon Reservoir) were taken in all seasons from 1980- 1987. Monthly collections were taken at two locations (a river and an irrigation canal) in Hidalgo County from 1983- 1984. Basic life history data were gathered on blue tilapia populations and compared with similar data from native cichlids inhabiting the Rio Grande. Analyses of summer food habits and habitat utilizations were taken from fish captured in the Rio Grande in the late summer of 1986.

Results: Although a severe winter freeze in late 1983 killed many thousands of blue tilapia, the species bounced back to re- colonize the entire river within a year. Studies conducted since 1980 show extensive ecological overlap between blue tilapia and native fish. The success of the blue tilapia and the similarity of its ecology to those of the existing fish suggest that such characteristics as generalized food habits, good colonizing ability, rapid reproduction and adaptability to often stressful environments are important factors in determining the species composition of the fish community.

Publications: *Proceedings of the 67th Annual Meeting of the American Society of Ichthyologists and Herpetologists,* The University of the State of New York, Albany, NY, June,1987.

Texas Ranks 47th in National Environmental Study

Texas ranks ahead of only three states in addressing major environmental issues, according to a study by the Fund for Renewable Energy and Environment.

The study -*The Stats of the States: 1988* - reports that Texas placed near the bottom in such categories as surface water quality, pesticide regulation and energy pollution control. On the positive side, Texas ranked second nationally in its efforts to reduce pesticide contamination. The report is available from: Renew America,1001 Connecticut Ave. NW, #719, Washington, DC, 20036. The phone number is (202) 466-6880.

Toxics Reported in Dallas Sewer System

Dangerous amounts of toxic metals, solvents and other compounds may have been dumped into the Dallas sewer system last year, according to a report in the *Dallas Morning News.* According to Dallas Water Utilities records, chemicals dumped into the sewer system included arsenic, barium, copper, cyanide, zinc, ethyl benzyne and other heavy metals and suspected carcinogens. These pollutants can cripple microorganisms used at wastewater treatment plants and may lower dissolved oxygen levels in the Trinity River. Dallas fined industrial polluters $95,000 last year.

TDA Survey Shows High Levels of Nitrates

A survey by the Texas Department of Agriculture (TDA) indicates that high nitrate levels exist in many West Texas water wells, causing concern about drinking water supplies for more than 1 million Texans. Preliminary results from the TDA study suggest that 47 wells sampled in Comanche, Knox and Haskell counties exceeded federal nitrate standards. Some wells had nitrate concentrations of 44 parts per million - 15 times greater than EPA standards. The report has not yet been published.

Del Rio Becomes First City in Texas to Enact Wellhead Protection Ordinances

The city of Del Rio has begun a program to protect its drinking water wells, making it the first Texas municipality to enact welihead protection legislation. The objective of the

program is to protect the public water supply by regulating activities in the area surrounding water wells.

Del Rio's ordinances, which went into effect in late 1987, are intended to protect San Felipe Springs. The springs are part of a honeycombed limestone formation that is susceptible to contamination. The boundaries of the welihead protection area define the limits at which it would take roughly five years for polluted water to reach the springs, allowing the city response time before its water supply is threatened.

"Flower Garden" Coral Reefs May be Designated as National Marine Sanctuary

The Flower Garden Banks, a huge forest of coral reefs in the Gulf of Mexico south of Beaumont, may be designated as a national marine sanctuary to stop damage caused by pollution and other activities. The complete reef system spans 100 miles along the outer continental shelf and includes two massive coral "mountains" that rise 600 feet from the ocean floor to within 60 feet of the surface. The National Oceanic and Atmospheric Administration's Estuarine Management Division is considering regulations that would protect the area. Those rules could include a ban on anchoring in the area, and other limitations.

Red Drum, Sea Trout are Focus of TPWD Studies

Biologists with the Texas Parks and Wildlife Department (TPWD) are stepping up efforts to learn more about two popular sport fish: red drum and spotted seatrout. Current research efforts include joint studies with the National Marine Fisheries Service (NMFS) to gather data on adult red drum populations in the Gulf of Mexico. The studies will give TPWD officials more information on spawning, age, growth and population size of red drum. Another study involves examining the diversity of seatrout (speckled trout) populations in the Gulf of Mexico to determine if there is one or more main species in the area.

EPA Develops Personal Computer Software for Wasteload Allocation Modeling

The U.S. Environmental Protection Agency has recently developed a water quality model for use in developing wasteload allocations and NPDES permits. The model is "user friendly", and will allow permit writers and water quality modelers to more easily develop technically defensible permit limits.

The model is available at no cost and can be used on IBM- compatible personal computer systems. For more information on how to obtain the model, or for additional information, contact: D. King Boynton, US EPA, Monitoring and Data Support Division (WH-553), 401 M Street SW, Washington, DC 20460.

Abstracts, Newsletters are Available from TWRI

Free subscriptions to the U.S. Geological Survey's *Selected Watsr Resources Abstracts* are available to academic departments and university libraries in Texas from the Texas Water Resources Institute. The abstracts are an excellent source of recently published information on many water-related fields and are a valuable reference tool. It should be noted, however, that a finite number of free subscriptions are available. Also, please limit your request to one free subscription per academic department per university. Also, TWRI's *Texas Water Resources* newsletter is available free on request. This quarterly newsletter examines water issues in an in- depth manner. Sludge reuse, urban water losses, marketing of water rights and brush control have been covered in recent issues. To request a free subscription to either newsletter, please contact: Texas Water Resources Institute, 301 Scoates Hall, Texas A&M University, College Station, TX 77843-2118 or call (409) 845-8571.

Manual Describes Dam Instrumentation

The 1987 *Concrete Dam Instrumentation Manual,* published by the United States Department of the Interior, describes the various instrumentation systems used by the Bureau of Reclamation. The manual intended for use by designers, engineers, instrument readers, dam operators and dam safety personnel, discusses the purpose and current usage of each type of system and their advantages and limitations. Installation, monitoring and data handling procedures for each system are outlined. The publication is free from the National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.

Mining and Energy Symposium Proceedings

The American Water Resources Association has recently published a report detailing key water issues associated with mining. *Water Resources Related to Mining and Energy - Preparing for the Future* has sections on emerging water issues for electric utilities, planning for water use and development, arctic water availability, water marketing, and others. To order, contact: American Water Resources Association, 5410 Grosvenor Lane, Suite 220, Bethesda, Maryland 20814, or call (301) 493-8600.

TAEX Publishes Red Drum Aquaculture Handbook

The Texas Agricultural Extension Service (TAEX) has published a 400-page manual providing current, comprehensive information on redfish farming. The report, *Manual on Red Drum Aquaculture,* summarizes a June 1987 conference hosted by TAEX, the University of Texas Marine Science Institute, the National Coastal Resources Research and Development Institute, the U.S. Department of Agriculture, the U.S. Fish and Wildlife Service, and the Texas A&M University Sea Grant Program. The report is available for $25 from: George Chamberlain, Texas A&M University Agricultural Research and Extension Center at Corpus Christi, Route 2, Box 589, Corpus Christi, TX 78410. The phone number is (512) 265-9203.

League of Women Voters Publishes Handbook on Drinking Water

The League of Women Voters has published a report on the quality of drinking water in the U.S. The report, *Safety on Tap: A Citizen's Drinking Water Guide,* contains chapters on sources of contamination; treatment processes; the Safe Drinking Water Act; federal, state and local responsibilities; alternatives; issues"at the heart" of water quality; and a guide to citizen action.

The report is available for $7.95 from: League of Women Voters, 1730 M Street, NW, Washington, DC 20036. The phone number is (202) 429-1965.

Sea Grant Office Offers New Publications

The Texas A&M University Sea Grant program has numerous recent publications available, including:

- *Annotated Guide to the Barnacles of the Northern Gulf of Mexico,* (TAMU-SG-86-402), $3.00.
- *Proceedings of the Shrimp Yield Prediction Workshop,* (TAMU-SG-86-110), $10.00.
- *Proceedings of the 18th Dredging Seminar* (TAMU-SG86-105), $10.00.
- *Biennial Report,* 1983-1985,(TAMU-SG-86109), Free.

To order any of these publications, contact the Sea Grant office at (409) 845-7524, or write to: Sea Grant College Program, Texas A&M University, College Station, TX 77843-4115.

Oceanography Proceedings are Available

Proceedings are available from the Workshop III of the Japan and East China Seas Study (JECSS). Papers presented at the workshop included the topics of circulation, storm surge, tidal currents, water properties, modeling and suspended sediment. Excerpts from the proceedings were published in *Progress in Oceanography,* Vol.17, No.3 and 4.

JECSS Workshop IV was held September 1 5,1987, in Tsukuba, Japan. Topics included current and circulation, water masses, tides, waves, chemical properties, suspended matter and geochemistry in east Asian seas. Details of the meeting were reported in the February 2,1988 issue of *EOS* magazine.

The JECSS newsletter is also being published at Texas A&M University's Department of Oceanography, and subscriptions are available at no cost. For more information on any of these items, contact: Dr. Takashi Ichiye, Oceanography Department, Texas A&M University, College Station, TX 77843, or call (409) 845-2306.

EPA Lists Hazardous Waste Sites in New Report

The U.S. Environmental Protection Agency (EPA) recently published a new report that provides an overview of current hazardous waste management practices in the U.S. The

report - *The Hazardous Waste System* - includes information on currently operating land disposal facilities, incinerators, and deep well injection systems. According to the report, Texas has 8 land disposal facilities, 7 commercial deep well injection systems and 1 incineration facility currently receiving RCRA hazardous wastes. Copies of the report are available free by calling EPA's RCRA Hotline at (800) 424-9346.

NOAA Report Lists Pollutants in Fish, Mussels

The National Oceanic and Atmospheric Administration (NOAA) recently produced a report detailing contaminant concentrations in tissues of oysters and mussels, and livers of bottom- dwelling fish. The report is titled A *Summary of Selected Data on Chemical Contaminants in Tissues Collected During 1984, 1985, and 1986.* It lists the amount of such contaminants as PCBs, PAHs, pesticides, arsenic, cadmium, chromium, lead, silver, mercury, tin and others that were found during a nationwide sampling program.

Results of the survey show that many Texas sites reported heavy levels of pollution. Copano Bay, near Corpus Christi, had the highest levels of cadmium and arsenic in mollusk tissues of any site tested in the country. Portions of Galveston Bay, Matagorda Bay, and San Antonio Bay also displayed significant levels of pollutants in mollusk tissues. However, pollutant levels in fish livers were significantly less. The report is available from: National Status and Trends Program, Ocean Assessments Div., NOAA,11400 Rockville Pike, Rockville, MD 20852.

TWC Reports Examine Drought, Groundwater Protection

A historical summary of Texas droughts and a strategy to protect Texas' groundwater are the subjects of two new publications of the Texas Water Commission. *Texas Drought: its Recent History* (LP 87-04) provides specific data on Texas droughts from 1931-1985, reviews long-term precipitation patterns, and analyzes the frequency of droughts of different durations. *Texas Groundwater Protection Strategy* is a summary report that outlines goals, needs and recommendations to protect water quality in Texas aquifers.

Both publications are available from: Texas Water Commission, PO Box 13087, Capitol Station, Austin, TX 78711 - 3087. The phone number is (512) 463-7835

New TWDB Publication Lists Water-Saving Plants and Shrubs

A guide to native and adapted landscape plants that may save water has recently been published by the Texas Water Development Board. The book, *A Directory of Water Saving Plants*, identifies plants that can survive on as little as 10 inches of water per year; lists characteristics of the plants such as color and foliage; and lists geographic regions where the plants will grow best. The directory is available from: Texas Water Development Board, PO Box 13231, Capitol Station, Austin, TX 78711-3231.

UTEP Professor says Portable Water Purifiers May be Used in Colonias

A professor with the Civil Engineering Department at the University of Texas at El Paso is helping to install portable water purifiers in the colonias of the Rio Grande Valley. Dr.

Howard Applegate, a civil engineering professor and part of UTEP's Center for Inter-American and Border Studies, is helping installing the devices in colonias such as Bosque Bonito, where there are no city or county water or sewer lines.

The $750 machine is about the size of a carry- on suitcase and uses three filters and six ultraviolet lights to purify water and kill bacteria. The machines can filter about 10 gallons per minute. Dr. Applegate and the machine's inventor, Al Gough, hope to start a university- sponsored program to make the purifiers affordable and available to colonia residents.

TCU Researchers Use Remote Sensing to Study Metroplex Watersheds

Scientists from Texas Christian University are using remote sensing to study watershed erosion in the DallasFort Worth area. The studies utilize Landsat data, a geographic information system and the Universal Soil Loss Equation to identify critical erosion areas in the Lake Arlington and Lake Weatherford watersheds. The investigations are being funded by local planning agencies as part of their watershed management programs.

New Mexico Study suggests Salty Water May be Used to Pay Water Debt to Texas

Researchers at New Mexico State University have suggested that New Mexico's 15 billion acre-feet supply of saline groundwater could be utilized to supplement freshwater irrigation, and could be used to help to pay the state's water debt to Texas.

Agricultural economist Robert Lansford, together with other NMSU researchers, recently completed a study, *Optimization of Irrigation Scheduling with Altemative Saline Water Supplies in the Roswell- Artesia Basin (WRRI Report No. 207),* which found that farm profits increased by 17 percent when a third of total irrigation water came from saline sources. According to the study, cotton and barley are the best candidates for supplemental irrigation with saline water. Even though saline water tends to dry out the soil and decrease the movement of freshwater into plant cells, those problems could be offset if greater amounts of saline water were applied.

To order the report or for more information, contact: New Mexico Water Resources Institute, Box 30001, New Mexico State University, Las Cruces, NM, 88003- 0001. The phone number is (505) 646-4337.

UTEP Researchers Use Solar Pond to Produce Fresh Water

Researchers at the the University of Texas at El Paso have been using a state-of-the-art salt gradient solar pond to produce heat, electricity and fresh water from a brackish water source.

The project involves the use of a solar pond with three main layers. The top layer is cold and has little salt content; the bottom layer is hot and very salty; and a mid- layer gradient zone has increasing salinity with depth. The gradient zone acts as an insulator, and

sunlight is trapped in the bottom. That trapped sunlight provides operating temperatures from 150 to 200 degrees F. and delivers thermal energy on demand. The project shows that it is possible for solar ponds to provide the heat and electricity required to feasibly produce potable water from brackish water.

The project is a joint effort between UTEP, the U.S. Bureau of Reclamation, and other agencies. University research with this project has involved studies about wind/wave interaction, flow in stratified fluids, computer modeling and others. For more information on the project, contact: Dr. Andrew H.P. Swift, Department of Mechanical and Industrial Engineering, The University of Texas at El Paso, El Paso, TX 79968- 0521. The phone number is (915) 747-5450.

EPA Awards Fellowships to Texas A&M Environmental Engineering Division

The U.S. Environmental Protection Agency recently awarded a $30,000 grant to fund graduate research fellowships to the Environmental Engineering Division at Texas A&M University. Recipients of the fellowships are expected to be named early this summer.

The one- year award will be used to sponsor three to five fellowships in the fields of hazardous and toxic waste management and groundwater protection. Texas A&M University was only one of three schools in the nation to receive this award.

Network Helps Track Stranded Marine Mammals

The Texas Marine Mammal Stranding Network is a voluntary organization that provides a coordinated response and medical assistance to beached whales, porpoises, and other marine mammals. When a stranded animal is found alive, first aid is administered and attempts are made to move it to a treatment facility. Even animals that are found dead or die soon after discovery are still valuable to research and education. When called to a site, the stranding team collects valuable data such as length, sex, weight, evidence of internal injuries, tissue samples and teeth.

Agencies such as the Texas A&M University Department of Veterinary Anatomy, the U.S. Fish and Wildlife Service, Texas A&M University at Galveston, the Texas Parks and Wildlife Department, and others take part in the network. For more information, contact: Raymond Tarpley, Texas Marine Mammal Stranding Network, Department of Veterinary Anatomy, Texas A&M University, College Station, TX 77843. The phone number is (409) 845-4344.

Texas A&M Agricultural Economists Study Effects of Canal Ownership on Irrigation Use, Price

The form of canal ownership may have a significant impact on irrigation water use and water costs, according to an analysis performed by James Mjelde and Jayson Harper of the Texas A&M University Agricultural Economics Department. The study found that canal systems that had changed from private to public ownership exhibited greater water

use per acre, but that the average cost per acre for the first crop irrigation water decreased. The paper, "Implications of Public Ownership of Irrigation Canal Systems in the Texas Rice Belt: Impacts on Water Use and Water Price", was published in the December 1987 issue of *Resource Management and Optimization.*

Texas Water Development Board Requests Proposals

The Texas Water Development Board (TWDB) is now accepting research proposals in the following areas: water supply; water quality; hazardous waste management; water financing and economics; structural and non-structural flood protection; and water resource- related legal and social issues. The research should address practical problems. TWDB has allocated $100,000 to fund these projects, and may fund up to 100% of research costs. The availability of matching funds or services will be taken into consideration.

Proposals must be submitted by May 15, 1988. Send proposals to: M. Reginald Arnold II, Executive Administrator, Texas Water Development Board, PO Box 13231, Capitol Station, Austin, TX 787113231. For more information, call (512) 463-7926.

AWWA Research Foundation Issues Call for Research Proposals

The American Water Works Association Research Foundation is accepting requests for proposals (RFPs) in 18 subject areas until May 1, 1988. Funding for the research studies will be awarded on a competitive basis. Anyone interested in submitting a proposal can obtain the official forms from the Foundation.

Project areas in which the Foundation is accepting proposals include: restoration of water supply wells; advanced oxidation processes in wastewater treatment; taste and odor associated with chlorine dioxide used as a preoxidant; lead control strategies; microorganisms on granular activated carbon; biological treatment of drinking water; history of plastic pipe failures; application of fiber optics to drinking water analysis; and others.

For a complete list of topics or more detailed information, contact: RFP Desk, AWWA Research Foundation, 6666 W. Quincy Ave., Denver, CO 80235, or call (303) 794-7711.