New Waves
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How Healthy is the Upper Trinity River? Non- Point Source Pollution, Focus of TWRI Meetings in Ft. Worth, Lubbock

Water quality will be emphasized in two meetings hosted by the Texas Water Resources Institute this fall.

"How Healthy is the Upper Trinity River?: Biological and Water Quality Perspectives" is the title of a symposium TWRI will sponsor October 2 at Texas Christian University in Fort Worth. The meeting will focus on how water quality affects urban rivers.

Invited speakers include researchers from Texas A&M University, Texas Christian University, the University of North Texas, the University of Texas at Dallas, and the University of Texas at Arlington and state and federal agencies. Talks will focus on research that has been conducted regionally as well as solutions that may improve water quality.

The symposium will include keynote talks about long- term water quality trends in the river and a new effort by the U.S. Geological Survey to assess water quality in the region. Concurrent sessions will focus on biological issues, urban and agricultural runoff, water quality trends, and wastewater and water quality. A panel discussion will feature local, state and federal officials who will discuss the impact of new water quality standards for the river. The Texas Water Commission is expected to propose those regulations this month.

The registration fee is $15. Registrants responding before Sept. 28 will receive lunch and a proceedings. Late registrants will only receive a proceedings which will be available by early 1991.

The 23rd Water for Texas Conference will convene December 5- 6 in Lubbock. This year's theme is "Managing Non- Point Source Pollution." Non- point source pollution is one of the nation's most critical water problems, in part because so much runoff occurs. The other difficulty is that non- point source pollutants are much more difficult to identify, measure, and treat than conventional pollution sources.

The opening session will include national and state perspectives on agricultural and urban runoff. Individual sessions will focus on urban stormwater runoff, agricultural nutrient

management, and pesticide management. Agendas for state agencies responsible for curbing runoff will be featured in a panel discussion.

Registration for this conference is $100 and includes lunch and the proceedings. We hope to make the proceedings available in the middle of 1991.

Automated Surface Irrigation Systems

Researchers: Eduardo Latimer and Donald Reddell, Agricultural Engineering Dept., Texas A&M University, College Station, TX. Problem: Today's irrigators are caught in a squeeze between declining water supplies and increased pumping costs. While increased emphasis has been placed on sprinkler and trickle irrigation systems this past decade, surface irrigation remains the most widely used method of irrigating crops. Because so much land is irrigated and so much water is applied with surface irrigation, improved management techniques are needed. Conventional surface irrigation systems like furrow irrigation have water use efficiencies of only 65% and result in water waste.

Objective: To develop an automated surface irrigation system that can incorporate real-time measurement of the field's infiltration characteristics and can implement the use of discrete time cutback. These management techniques can result in more uniform water distribution along the field and reduce runoff.

Methodology: The experimental advance rate feedback irrigation system (ARFIS) is composed of four subsystems: an intelligent system (computer), a water sensing system, a flow control system, and a telemetry system. ARFIS senses the advance of water at two known distances along the furrow. Typically, one water sensor is placed halfway down the furrow while the other is located near the end of the furrow. Advance times are sent via telemetry to a computer that uses the data to estimate the furrow's infiltration characteristics. The predicted infiltration characteristics become the building block for the regulation of water flow into the furrow for the remainder of the irrigation event. Water flow into each furrow is regulated by solenoid valves. The telemetry system communicates between the computer, the sensing system, and the flow control system. Infrared and radio telemetry can be used with ARFIS.

Results: ARFIS has routinely achieved application and distribution efficiencies in excess of 85%. A cost analysis for a typical Texas irrigation scenario was performed in which 11 furrows were controlled using a single pair of water sensors and a flow valve. Annual net returns were $91 /acre greater using ARFIS than conventional furrow irrigation when infrared telemetry was used and $25/acre greater than conventional furrow irrigation when radio telemetry was utilized.

Related Publications: Latimer, E.A. and D. L. Reddell, "Components for an advance rate feedback irrigation system (ARFIS),"to be published in *Transactions of the ASAE, St.* Joseph, Ml.

Impact of Coal- Fired Utility Plants on Water Quality

Researcher: Bobby Wilson, Chemistry Department, Texas Southern University, Houston, TX.

Problem: Coal- fired power plants may produce contaminants such as ash residues that can't be removed by pollution control equipment. During combustion, metal oxides concentrate on the ash and produce trace metals and radio nuclides that run off into nearby cooling ponds and other water sources. Information from this type of study, which analyzes radio nuclide combustion chemistry, may be useful to compare the relative environmental damage caused by conventional and nuclear power plants.

Objective: To assess the levels of chemicals including barium, cadmium, copper, chromium, iron, mercury, lead, zinc, and others, and radionuclides in water columns and bottom sediments. Methodology: Sediments from five Houston- area lakes were sampled. Half of each sample was homogenized, digested, heated to near boiling, and centrifuged. The goal was to obtain a gamma- ray spectra analysis of the samples and to infer the behavior of natural radionuclides deposited in local lakes. Supernates were poured off and refrigerated. Analysis was done with an atomic absorption spectrophotometer. The remaining half of each sample was used to determine total organic carbon (TOC) levels and sediment size distribution. The amo unt of total mud and the clay content of the sediment was determined by shaking the flasks and allowing them to stand overnight. TOC was measured through a neutralization method. Radionuclides were analyzed by a non- destructive direct counting technique using a spectrometer, a multichannel analyzer, and computer software. Each sample was run twice for 80,000 seconds and was calibrated frequently. Lead levels in the coal being burned were also used to determine the amount of Po in fly ash samples.

Results: Coal contains trace amounts of naturally occurring radionuclides such as K- 40, U- 238, Th- 232, and their by- products. Concentrations of these natural radionuclides have been found in the fly ash. H high amounts of fly ash continue to be produced and no recycling or use of the fly ash is taking place, levels of naturally occurring radionuclides may increase in bottom sediments of area lakes. Concentrations of these naturally occurring radionuclides were found close to the surface of lakes near power plants in the Houston area. Levels of man- made radionuclides such as Cs- 137 were also found in nearby waters.

Related Publications: Wilson, Bobby, *Investigations of Trace Metals in the Aqueous Environment,* Texas Southern University,Houston, TX, 1988.

Biological Degradation of Hazardous Wastes in Deep Injection Wells

Researchers: Regina Capuano, Geology Dept., University of Houston, and Charles Kreitler, Bureau of Economic Geology, University of Texas, Austin, TX.

Problem: Deep well injection is utilized to dispose of more than half the liquid hazardous waste (8.6 billion gallons) disposed of annually in the U.S. However, little is known about the chemical compositions of these wastes or about subsurface reactions that could degrade the hazardous wastes and make them less toxic. Injection wells could be a potential source of groundwater contamination if precautions are not taken. Recent legislation limits deep well injection unless fluids that are injected will not migrate out of the injection zone or to drinking water sources within 10,000 years. Deep well injection can also be allowed if the waste will no longer be hazardous because processes such as biodegradation have transformed the waste into substances that are not hazardous.

Objective: To compile data on the compositions of industrial waste injected into 98 active on- site Class I industrial waste disposal wells in Texas (these wells inject hazardous waste into formations that are below the deepest underground source of drinking water), to determine the most significant hazardous chemicals injected into the subsurface, and to assess the potential to degrade specific wastes in the subsurface.

Methodology: Data on the chemical composition of wastes disposed of in Class I injection wells in Texas were obtained from the Texas Water Commission for 1985 and 1986. Wastes were classified as either non- hazardous, acutely hazardous, and hazardous (ignitable). Total amounts were estimated for each constituent. Chemical properties of injected wastes were described and reactions which might make degraded wastes less toxic were summarized. Approaches now utilized for predicting reactions in subsurface environments including simulation modeling and laboratory experiments were reviewed.

Results: Data indicate that more than 5 bison gallons of hazardous industrial waste (nearly 60% of the national total) were injected into Texas wells in 1985. Roughly 80% of those wastes were from chemical manufacturing, 14% were from uranium mining, and the remainder were chloride, brine, metals, and other inorganic chemicals. The number of organic chemicals (125) was more than 300% greater than the number of inorganic compounds (40). The mass of all inorganic chemicals was roughly twice that of organic compounds, but the organic chemicals were two to six times more hazardous than the inorganics. Injecting a homogenous waste stream over a long period of time may be preferred over disposing different chemicals in the same well. Biologic and chemical zones may develop in the aquifer surrounding the injection well and may impact degradation rates. Pretreating the aquifer and/or the waste stream and altering conditions including temperature, pH, the composition of the waste stream, and microbial populations may optimize waste degradation.

Related Publications: Capuano, Regina, and Charles Kreitler, *Deep Well Injection: Chemical Wastes Disposed and Their Subsurface Reactions,* Bureau of Economic Geology, University of Texas, Austin, TX, 1989.

Mathematical Methods of Routing Floods through Reservoirs

Researcher: Michael McLatchy, Hydrology and Water Resources Division, Tarleton State University, Stephenville, TX.

Problem: Traditional methods of routing floods through reservoirs utilize the Puls technique. This method relies on the use of graphs and curves which relate the elevation of water supply and flood control pools to reservoir storage and discharge. Use of the traditional Puls technique is often time- consuming and leads to unnecessary errors. Values are shown on graphs and charts, and not in numeric form.

Objective: To replace the graphs of the traditional Puls method with a numerical technique (the Newton- Raphson method) that will allow scientists and engineers to rapidly route floods through reservoirs using readily available equipment including simple, hand- held programmable calculators.

Introduction: The Puls method involves solving a continuity equation which includes variables for reservoir inflow, reservoir outflow, and changes in storage. These variables are represented in a series of curves which allow managers to plot reservoir storage as a function of discharge levels. If inflows and initial pool elevations are known, the floods can be routed over a period of days. Combining the NewtonRaphson method with the Puls technique eliminates the need to represent storage and discharge relationships in graphs and curves. By using the Newton- Raphson iteration, relationships can be expressed mathematically.

Results: A hypothetical example and a case study were utilized to test the effectiveness of the Newton- Raphson method. The hypothetical example routed floods through a 1,000 acre reservoir enclosed by vertical rock walls everywhere except at the downstream end of a 200- foot spillway. Floods were routed over a 140- hour period. The case study examined a dam where discharge normally occurs through the penstocks of a hydroelectric plant. Scenarios were analyzed when all spillway gates were operable and when only some gates were operable (during large floods, spillway gates are used to control water releases from reservoirs to minimize flood damage). Results from using the Newton- Raphson method were similar to those obtained by using the graphical Puls technique but were compiled much more rapidly. The Newton- Raphson method may also be applied to solve other hydrologic problems in the future.

Related Publications: McLatchy, Michael, "Addition of Newton- Raphson to a Puls Method of Routing Floods through Reservoirs," Texas Flooding and Drainage Issues Symposium Texas Section, American Water Resources Association, Austin TX, 1989.

Hydrogeology of the Edwards Aquifer in Bell County

Researchers: Mark Myrick, Suzanne Dahl, Stan Cannata, and Joe Yelderman, Jr., Geology Dept., Baylor University, Waco, TX. Problem: The northern section of the Edwards Balcones fault zone Aquifer ("northern Edwards aquifer") extends into Austin and Bell County. This portion of the aquifer has been the subject of numerous studies because it provides water to several communities and is classified as part of a "major aquifer" by the State of Texas. The less productive Edwards Aquifer and associated limestones located in the Washita Prairie north of Bell County and west of the Balcones fault zone ("Washita Prairie aquifer") no longer provide water to communities and are not recognized as a major or minor aquifer by the state. As a result, this section has not been

extensively studied. This limestone aquifer contains significant amounts of groundwater and supplies several perennial springs and active wells.

Objective: To compare and contrast the fractured nature, porosity, and hydraulic conductivity of the northern Edwards aquifer with the Washita Prairie aquifer.

Methodology: Landsat images, aerial photographs, and fracture traces observed on topographic maps were compared to field fracture measurements and groundwater flow directions. Well yields were compared to fracture densities and effective porosities measured in the field were related to areas of known faulting. Results: Lineations in the northern Edwards aquifer and the Washita Prairie aquifer are related to regional structural trends. The orientation becomes increasingly random as the distance from the fault areas increases. Lineation density correlates directly with zones of faulting, but shows no apparent pattern away from faulting. Field measurements of fractures show variations between shales and limestones as well as local variations in the direction and density. Values of effective porosity in all lithologies are similar (1 to 4%). Closer to faulting, fracture density increases and directional orientations are more pronounced. However, orientations are controlled more by local than regional structural trends. The dominant direction of groundwater f low in the Washita Prairie is parallel to the topography and slope, while in the northern Edwards aquifer groundwater flows parallel to the geologic dip. Only the northern Edwards aquifer exhibits appreciable directional flows related to faulting.

Related Publications: Myrick, Mark, Suzanne Dahl, Stan Cannata, and Joe Yelderman, Jr., "The Effect of Fractures on Porosity and Anisotropy in a Portion of the Edwards Aquifer," *Symposium Proceedings on the International Conference on Fluid Flow in Fractured Rocks,* Georgia State University, Atlanta, GA,1988.

Trinity, Red Rivers Flow Over Their Banks, Cause Massive Flooding

Heavy rains caused some of the worst flooding in Texas history in May and June. Hardest hit were the Trinity, Brazos, and Red river basins. Nearly a year's worth of rain (22 inches) fell from January to April in Dallas and Fort Worth. May rains produced an extra 5 to 10 inches in the region.

Texas Senator Lloyd Bentsen sought $130 million in federal aid ($80 million for flood victims and $50 million for agricultural losses) to help recover from flood damage. As a result of flooding and other weather events, 65 Texas counties were declared "presidential disaster areas." Roughly 6.000 applicants requested loans and grants to rebuild after the floods, but many flood prone areas did not join federal flood insurance programs. This may limit the amount of federal aid they receive unless they apply to join those programs.

Much of the worst damage occurred in Liberty, south of Livingston Dam where 200 homes were destroyed and losses totaled more than $11 million. Trinity River Authority officials were forced to release record flows of more than 108,000 cubic feet per second (cfs) enough water to completely fill the Astrodome in roughly 12 minutes as waters

roared from upstream areas. The releases caused widespread flooding in low- lying areas south of the dam where residents had built in flood- prone areas.

The U.S. Army Corps of Engineers officials said that flood control dams along the river prevented worse damage. Even though flows rose to more than 80,000 cfs, the Corps says flows without the dams could've exceeded 250,000 cfs.

Flooding along the Red River was concentrated from Denison Dam and Lake Texoma to Texarkana. At Texarkana, there were fears that levees would collapse and cause further damage. One worker said that standing on the levees was like "walking on jelly." TV stations issued emergency calls for volunteers to protect levees and sandbag damage-prone areas.

Although the floods have ended, agricultural damages could be especially significant. Statewide losses could top $1 billion. Widespread erosion and heavy losses of topsoil were also noted.

Tunnel Proposed to Lessen Austin Flooding

A new flood prevention proposal by the U.S. Army Corps of Engineers would build two 14- foot diameter tunnels to convey Austin stormwaters from Shoal Creek to Town Lake and Lake Austin.

In the $82 million plan, tunnels would be located along Shoal Creek. The creek and its tributaries would also be channelized. The tunnels will ease water levels in the streams during floods. A 1981 flood along Shoal Creek resulted in five deaths. Planning and engineering studies could take five years.

Similar proposals have been criticized in the past because of concerns that the runoff might contaminate Lake Austin. The Corps indicates there will be no significant adverse environmental impacts.

Major Oil Spills Jolt Gulf of Mexico, Houston Ship Channel

Two major oil spills rocked the Texas coast this summer and some state and federal water officials fear lasting environmental damage my result.

The first spill took place when the tanker Mega Borg caught fire 60 miles southeast of Galveston on June 9. The Mega *Borg* was unloading crude oil onto another tanker when the spill occurred.

Estimates suggest the tanker lost as much as 3 million gallons of oil. The U.S. Coast Guard said that only roughly 12,000 gallons remained on the water after much of the oil had burnt or evaporated (75,000 gallons of oil were recovered). An oil slick that was 18 miles long and 10 miles wide formed that was observed as far as 37 miles away from the ship. Despite concerns the spill could form tar balls that would wash up on Galveston beaches, only a few minor incidents were noted. The Coast Guard called off its cleanup efforts in late June.

In late July, the tanker *Shinoussa* collided with two barges in the Houston Ship Channel. Final estimates suggest that up to 700,000 gallons of oil were spilled into Galveston Bay.

State officials said the *Shinoussa* accident displayed many of the ingredients of a "worst case" scenario. The accident occurred near Red Fish Island one of the Bay's best oyster harvesting areas. In spite of the oysters' self- cleansing powers, they could be vulnerable to pollution because they are not mobile. There were also fears that the white shrimp populations could be hurt (shrimp migrate through marshes and wetlands at this time of year).

The damage was extensive enough to close the Ship Channel temporarily to ship traffic, and sport and commercial fishing were temporarily banned in parts of the Bay.

University researchers evaluated impacts of the spills and helped develop solutions to deal with the crisis. Carl Oppenheimer of the Marine Sciences Department at the University of Texas at Austin developed an oil- eating microbe from naturally occurring bacteria that breaks down oil and converts it into fatty acids. Roughly 100 pounds of the microbes were applied on two 100- foot long patches of oil from the Mega *Borg* accident, and they devoured most of the oil. Microbes were also applied to an oily area and consumed 70% of the oil without producing toxic byproducts. The microbes were also used to clean up the *Shinoussa* accident.

Mahlon Kennicutt II of Texas A& M University's Geochemical and Environmental Research Group (GERG) collected samples from the Mega *Borg* spill to study the fate of spilled oil and its impact on the ecosystem. Other GERG researchers assessed pollutant levels in the area before the spill occurred.

Some positive developments may come from the accidents. The owners of the Mega *Borg* will pay $275,000 to fund studies examining the impact of the accident. Also, many state agencies are calling for stricter measures to guard against future spills including mobilization of quick response teams, widespread use of microbes, and the use of offshore ports.

EPA Says Houston Ship Channel is "Toxic Hot Spot"

The U.S. Environmental Protection Agency listed a stretch of the Houston Ship Channel as a "toxic hot spot" due to high levels of toxic dioxin and nickel.

The EPA originally named only one segment of the Ship Channel as a toxic hot spot. However, environmental groups urged that the area from the San Jacinto River to Galveston Bay be included. Areas designated as toxic hot spots must impose strict permits to limit toxic discharges by 1991. The toxic hot spot designation was pushed by Clean Water Action and other environmental groups. They charged that loopholes in the wastewater discharge registration process allow companies to release pollutants into the environment that are not accounted for in effluent permits. In 1987, 570,000 pounds of methanol, 340,000 pounds of ethylene glyclol, and 6.8 million pounds of ammonia were released into the Ship Channel that were not accounted for in wastewater permits.

Other Texas streams were also assigned toxic hot spot status because of dioxin levels including Lake Sam Rayburn, the Neches River near Lufkin, the Sulphur River near Texarkana. Little Saline Creek near Tyler and Stewart Creek near Frisco were put on the list because of lead pollution.

In a related story, high levels of dioxin have been found in fish, oysters, and crabs taken from the area where the Ship Channel enters Galveston Bay. Crabs contained 54.8 parts per million of dioxin - the highest level found in a three- state area.

Desert Springs to be Saved

Texas' only remaining desert spring and the endangered species that call it home will be preserved after a Pecos County commissioner reached an agreement with a conservation group.

The Diamond Y Spring, outside Fort Stockton in west Texas, provides the only habitat for the Leon Springs pupfish, two snail species, and the puzzle sunflower.

The Texas Nature Conservancy purchased 1,500 acres to protect the springs from overpumping and contamination from nearby oil wells. Springs in the area once provided 35 millions of gallons of water per day. Springflows have since diminished and were especially low this summer.

Water Level in Edwards Aquifer Plummets, Cities OK Water Saving Ordinances

Residents along the Edwards Aquifer coped with water shortages and low water levels this summer.

In late June, the aquifer dropped to 623.9 feet above sea level (ASL). The last time it fell below 623 feet was in 1956 after a long drought. The average aquifer level for July is 665 feet ASL. By August, rainfall boosted the aquifer level to nearly 644 feet ASL.

Due to the low water levels, the Edwards Underground Water District (EUWD) required 26 cities in the region including San Antonio to submit plans to reduce water use. San Antonio implemented mandatory conservation measures for the first time in 35 years. Days were designated for watering lawns and landscapes, depending on the address; waste was prohibited; watering of golf courses was banned; restaurants served water only on request; and car washing was limited to specified days when only hoses or buckets could be used. 'Water police" patrolled the city looking for water wasters, and roughly 60 offenders were fined $200 each. EUWD also distributed 25,000 water conservation kits designed to cut water use in showers and toilets.

The U.S. Fish and Wildlife Service threatened to invoke the Endangered Species Act and take control of the aquifer if steps were not taken to insure springflows. Federal funding might have been denied to the region if the Act were enforced. Because cities

implemented conservation measures, the Guadalupe- Blanco River Authority said it would delay filing a lawsuit to invoke the Act.

Meanwhile, officials with the water district that controls Medina Lake said that they would like to hear shortly if EUWD wants to purchase the water rights in the lake for $100 million. H purchased, the lake could be used to recharge about 40,000 acre feet of water to the Edwards Aquifer annually.

Texas State Aquarium Opens in Corpus Christi, May Provide Research Opportunites

The first stage of the Texas State Aquarium opened in July in Corpus Christi, and the facility should offer opportunites for researchers as well as tourists. As many as 1 million tourists are expected to visit the aquarium annually.

Exhibits now on display focus on the Gulf of Mexico and depict marine plant and animal species that can be found on barrier islands and in the Flower Gardens coral reef. A large exhibit displays how marine species live near the base of a simulated offshore oil and gas platform.

The aquarium also hopes to incorporate research into its programs. Opportunities will exist to study and observe the life and environments of marine organisms. Specific areas of marine sciences such as physiology, nutrition, ethology, parasitology, ecology, seawater system technology, and others could be made available for research projects involving scientists and graduate students from Texas universities. In addition, a facility for research and education is now being developed.

For details, contact: Texas State Aquarium, P.O. Box 331307, Corpus Christi, TX 78463 or call 512- 881- 1300.

High Plains Water District Measuring Ogallala Water Levels

An in- depth survey is being carried out by the High Plains Underground Water Conservation District No. 1 (HPUWCD) in Lubbock to assess current water levels in the Ogallala Aquifer.

Every five years the District conducts detailed measurements (one well is measured for each square mile) to up- date its hydrologic atlas series. The atlases include contour maps that reflect the altitude of the land surface, the base of the aquifer and the water table,and the saturated thickness of the groundwater system. The data can be used to determine the amount of water under a piece of land, the depth to the water table, how far wells need to be drilled to reach the aquifer, and the direction of groundwater movement.

For details, contact: High Plains Underground Water Conservation District No. 1, 2930 Avenue Q. Lubbock, TX 79405 or call 806762- 0181.

Edwards Aquifer, Salt- Water Pollution, Focus of UT Reports

Groundwater is the focus of two new reports by the Bureau of Economic Geology at the University of Texas.

Hydrogeology of the Northern Segment of the Edwards Aquifer (Austin Region) was co-authored by Rainer Sanger, Edward Collins and Charles Kreitler. The study was based on geologic mapping and fracture analysis near Round Rock and Georgetown. It describes groundwater flow characteristics, faulting patterns, recharge and aquifer chemistry.

Identification of Sources and Mechanisms of Salt- Water Pollution Affecting Groundwater Quality: A Case Study, West Texas was co- authored by Bernd Richter, Alan Dutton, and Charles Kreitler. This report studied the chemical and physical nature of saline groundwater to attempt to determine if natural or manmade forces caused the salinity. Aquifer samples were taken, salinity patterns were mapped, and isotope analyses were conducted. Results suggest that manmade pollution may be impacting some of the wells.

To order either report or for additional details, contact: Bureau of Economic Geology, University of Texas at Austin, Box Y. Austin, TX 78713 or call 512- 471- 1534.

Texas Beaches Among Most Polluted in U.S.

Texas has some of the most polluted beaches in the U.S. according to *Cleaning North America's Beaches.* The report charges that the Gulf of Mexico has the highest level of debris among North American coasts and says that trash from 33 countries washed ashore to Texas in 1989. The study noted that beaches on South Padre Island and Galveston had especially high levels of trash.

For details, contact: The Center for Marine Conservation, 1725 DeSales Street NW, Washington, DC 20036 or call 202- 429- 5609.

Texas Shortchanged, Comptroller's Office Says

Dollars We Deserve: Part II is a new study done by the Texas Comptroller's Office. The study says Texas could receive an additional $3 million per year from the federal government for its leaking underground storage tank program. The report also says that updated data on sewage treatment needs could result in an additional $85 million in federal aid. For details, contact: Economic Analysis Center, Texas Comptroller's Office, PO Box 13528, Austin, TX 78711 or call 512- 463- 4600.

Massive Water Encyclopedia *Provides Comprehensive Look at Water Issues*

The Water Encyclopedia is a 795- page book with sections on climate, the hydrology cycle, water use, water quality, environmental problems, water resources management and water laws. The encylopedia includes more than half a million facts and figures, 630

tables, and 112 diagrams and maps. Universities with programs in water resources are also listed.

To order, contact Geraghty and Miller,125 E. Bethpage Road, Plainview, NY,11803 or call 516- 249- 7600.

Water Use Trends, Hydrologic Conditions are Focus of National Water Summary

Information on municipal, agricultural and industrial water use, droughts and floods, instream flows, water demand forecasting, and other topics is included in the *1987 National Water Summary.*

The 551- page report, published by the U.S. Geological Survey, summarizes floods, droughts, and water pollution that occurred in 1986 and 1987.

The summary also contains much information specific to Texas. For example, although only 11 % of Texas farms are irrigated they account for a third of the State's agricultural sales. Freshwater withdrawals are shown by county and river basins for both surface and groundwater. The sources, uses, and disposition of freshwater in the state are also displayed.

To order the report, contact: Books and Open File Reports Section, U.S.G.S. Federal Center, Box 25425, Denver, CO 80225 or call 303- 236- 7476. A 10- page section with information specify to Texas can be obtained by contacting: U.S.G.S., 801 Cameron Road, Building 1, Austin, TX 78753 or call 512- 832- 5791.

Texas Water and Wildlife Evaluates Impact of New Reservoirs on Environment

Impacts to fish and wildlife resources from the possible development of 44 Texas reservoirs have been quantized in a new report by the Texas Parks and Wildlife Department.

The study, *Texas Water and Wildlife: An Assessment of Direct Impacts to Wildlife Habitat from Future Water Development Projects,* was co- authored by Roy Frye of the Texas Parks and Wildlife Department and David Curtis of the Fish and Wildlife Service.

Dryland Agriculture Proceedings Published by Texas A&M University

Proceedings from an international conference on dryland agriculture have been published by the Agricultural Communications Department at Texas A&M University.

The 965 page book - *Challenges in Dryland Agriculture: A Global Perspective* - includes sections on topics such as water conservation and use, agroclimatology, environmental

issues, residue and soil surface management, soil erosion, socioeconomic issues, cropping systems, and others.

The book was edited by Paul Unger, Tom Sneed, Wayne Jordan, and Ric Jensen and is available for $60 from: Agricultural Communications Dept., Texas A&M University, College Station, TX 77843 or by calling 409- 845- 2211.

The study describes proposed dam locations and lists endangered wildlife species and rare or unique plants and animals living near each project. The report estimates that more than 851,000 acres of wildlife habitat would be lost if all 44 reservoirs were constructed.

For details, contact: Texas Parks and Wildlife Department, 4200 Smith School Rd., Austin, TX 78744.

Ship Channel Pollution Documented in Study

A new report by Clean Water Action may have played a key role in cleaning up the Houston Ship Channel.

The study, *Toxic Oversight: How Millions of Pounds of Toxic Chemicals are being Dumped into the Houston Ship Channel and Galveston Bay,* was written by Hank Cole. Clean Water Action claimed many industries along the Ship Channel dump toxic chemicals into the water, because loopholes in State and Federal guidelines allow them to discharge pollutants that are not covered by wastewater permits. Cole compared discharge permits to data industries submit to EPA to determine the amount of chemicals that were released. Results suggest that in 1987, roughly 10.7 million pounds of toxic chemicals were discharged into Galveston Bay that were not covered by wastewater permits.

For details, contact: Texas Clean Water Action, 815 Brazos, Austin, TX 78701 or call 512- 474- 0605.

NMFS Reports Study Effects of Salinity on Aquatic Species in Texas Bays

Reports describing the impacts of salinity on aquatic species in Galveston Bay and Lavaca .Bay, and the importance of oyster reefs as habitat for young shrimps, crabs, and fishes have recently been published by the National Marine Fisheries Service (NMFS).

Utilization of Marsh and Associated Habitats along a Salinity Gradient in Galveston Bay (NMFS SEFC 250) was coauthored by R.J. Zimmerman, T.J. Minello, M.C. Castiglione and D.L. Smith. The report describes how salinity levels influence food production within the estuary and explains how juvenile aquatic species are distributed in local marshes. Over the long term, levels of freshwater inflows may affect predatorprey relationships. *The Use of Juncus and Spartina Marshes by Fisheries Species in Lavaca Bay with Reference to the Effects of Floods* (NMFS SEFC 251) was coauthored by R.J. Zimmerman, T.J. Minello, D.L. Smith and J. Kostera. This study compared the extent that aquatic species utilized coastal and delta marshes. Results suggest that seasonal differences in tidal inundation were the main cause for variations in aquatic species

populations. The study also measured densities of aquatic animal species before and after three floods in 1986 and 1987. Results suggest that short term floods do not deter estuarine animals from using marshes and deltas. *Oyster Reef as Habitat for Estuarine Macrofauna* was co- authored by R.J. Zimmerman, T.J. Minello, T.J. Baumer, and M.C. Castiglione. The report assesses oyster reefs as nursery habitats for juvenile penaeid shrimp, blue and stone crab, and fish species. The report found that juvenile stone crabs live on the reefs during both summer and winter, but that young brown and white shrimp, blue crabs and spotted seatrout were found most often in marshes and mud flats.

For details, contact: National Marine Fisheries Service, 4700 Ave. U. Galveston, TX 77551 or call 409- 766-3500.

Results of TDA Water Well Testing Program Published

Results from the Texas Department of Agriculture's(TDA) program to test pesticide levels in water wells have been published in a new report.

The 188- page report, *Testing for Pesticide Residues in Texas Well Water,* was written by Lea Aurelius. The report describes sampling and testing procedures that TDA utilized in As well water testing program in 1987 and 1988 as well as results from that program. The study also discusses possible implications for human health and sources of contamination. Major findings suggest that nine pesticides were detected in 10 of the 188 wells that were tested for pesticides. More than had (101 of 182) of the wells tested for nitrate exceeded the safe drinking water standard for nitrate. Roughly a quarter (28 of the 110) of the wells tested for arsenic had arsenic concentrations higher than recommended limits for drinking water.

For more details, contact: Texas Dept. of Agriculture, PO Box 12847, Austin, TX 78711, or call 512- 463- 7549.

TWC, TWDB Studies Emphasize Water Quality

Studies on groundwater protection, aquifer quality, and pollution in the Rio Grande have recently been published by state water agencies.

The Joint Groundwater Monitoring and Contamination Report was published by the Texas Water Commission (TWC). The report explains recent state legislation that established a groundwater protection policy, describes the roles of state agencies in protecting aquifers from contamination, and lists 2,444 contamination incidents reported by each agency through 1989. Three Texas Water Development Board (TWDB) studies describe aquifer quality in

Dripping Springs (Report 322), Terlingua (Report 323), and El Paso County (Report 324).

Water quality in the Rio Grande in the Del Rio and Laredo areas is described in *Intensive Survey of the Rio Grande* (IS 90- 13). The report focused on the impact of untreated wastewater on increasing bacteria and nutrient levels in the river. Fiscal requirements for

water districts are described in *Annual Audit Report Requirements for Texas Water Districts and Authorities* (LP- 172).

To order a copy, contact: Library, TWC, PO Box 13087, Capitol Station, Austin, TX 78711 or call 512- 463- 7834.

Handbook Details Municipal, Industrial Wastewater Systems

A comprehensive review of Texas' municipal, industrial, and agricultural wastewater facilities is provided in a new reference book titled *Texas Wastewater Systems.*

The directory profiles all of the permitted wastewater facilities in Texas. Up to 40 hems of information are enclosed for each facility including the plant operator, plant location, average daily flows, permit expiration date, treatment techniques used, and whether biomonitoring and pretreatment programs are required, The book is available from: Austin Publishing Co., 9600 Great Hills Trail, 150 W. Austin, TX 78759 or by calling 512- 343- 1218.

Beneath the Bottom Line Assesses Agriculture, Groundwater Pollution

Reducing waste and misuse of agricultural chemicals, improving knowledge of how chemicals interact with the environment, and modifying subsidy programs may be tactics that the federal government could use to reduce the potential for groundwater contamination, according to a summary report by the Office of Technology Assessment.

The 78- page report, *Beneath the Bottom Line: Agricultural Approaches to Reduce Agrichemical Contamination of Groundwater,* was written by Alison L. Hess. The full report will be published this fall. The summary suggests that improving the efficiency of agrichemical handling and application and reducing overall pesticide and fertilizer use integrated pest management could reduce the potential for chemicals to enter groundwater supplies. Federal farm programs that encourage farmers to apply large amounts of agricultural chemicals in order to receive aid should also be reviewed, the study says. In 1986, 57% of commercial farms used pesticides and 75% used fertilizers. Use of agricultural chemicals increased 15% nationally from 1974 to 1985.

To order a copy of the summary, contact: Government Printing Office, Washington, DC 20402 or call 2027833238. Ask for report 052- 003- 01191 - 3.

Texas A&M Scientists Work to Prevent Buildup of THMs, Other Disinfection Byproducts

Scientists have known for some time that adding chlorine to disinfect drinking water supplies may produce potentially toxic chemicals called trihalomethanes. Now, attention is being focused on other disinfection byproducts that may also cause health problems.

Bill Batchelor of the Civil Engineering Department at Texas A& M is developing a simulation model that could predict the concentrations of different byproducts produced by alternative treatment processes. The model could provide insights into whether steps

such as modifying the type or amount of disinfectant that is used or removing the toxic byproducts after they were formed could be taken to reduce health risks.

The model considers production of total organic halogens (TOX) as well as THMs and will examine the impact of such factors as pH and bromide levels that produce disinfection byproducts.

For details, contact Bill Batchelor, Environmental and Water Resources Engineering Div., Civil Engineering Dept., Texas A&M University, College Station, TX, 77843 or call 409- 845- 3011.

Rice University Studies Suggest Rain May Add to Pollution

According to recent Rice University studies, rainfall may also aggravate some pollution problems by flushing contaminants into groundwater systems. Rice researchers Phil Bedient and Bill Wise worked with Ph.D. student ChiChung Chang to study a petroleum spill which occurred 20 years ago at Traverse City, Ml. Oil from the spill became trapped and immobilized in the subsurface above the groundwater table.

The researchers found that when rainwater passes through soils it captures partially soluble contaminants. Those pollutants dissolve from the trapped oil and migrate down to the water table. This study shows that spills that took place years ago can be affected as much as recent spills. For details contact Phil Bedient, Environmental Sciences & Engineering Dept., Rice University, Box 1892, Houston, TX 77251.

Texas Tech Developing Water Management Guidelines for Cotton Farmers

Scientists at Texas Tech University are working with the High Plains Underground Conservation District (HPUWCD) to develop management strategies that cotton farmers in the southern High Plains can use to improve their water use efficiency.

Dan Krieg of the Texas Tech Plant and Soil Sciences Department is working on guidelines that relate cotton lint yield to water, nitrogen, and heat unit availability during various stages of cotton plant growth and development.

The research involved providing sufficient nitrogen before planting that would meet the nitrogen requirements of water stored in the soil. Midseason fertility management is based on water supplies. Using this approach, dryland yields approach a bale per acre in most years. Krieg also recommends linking irrigation and nitrogen applications according to climate conditions. Farmers should be able to produce yields of roughly 1,000 pounds per acre with the same amount irrigation they now apply if nitrogen and phosphorus levels are provided to meet yield goals. Cotton farmers who irrigate can expect net profits of roughly $200 per acre, while dryland farmers can realize net gains of roughly $50 per acre.

The research was described in the April 1990 issue of *The* Cross *Section.* To receive a free copy, call the HPUWCD at 806- 762- 0181. To reach Krieg, contact: Plant and Soil Sciences Department, Texas Tech University, PO Box 4169, Lubbock, TX, 79409 or call 806- 742- 1631.

Microbes May Degrade Wastes

Studies that use microorganisms to convert pollutants into harmless byproducts are now underway at Incarnate Word College.

Arthur Cleveland of the Biology Dept. is studying if microorganisms can degrade wastes on- site. He helped develop a process that employs bacteria to treat a variety of wastes. The process utilizes a small biogenerator that operates on tapwater. For details, contact: Arthur Cleveland, Biology Dept., Incarnate Word College, 4301 Broadway San Antonio, TX 78217 or call 512-828-1261.

Southwest Texas Scientists Help Rescue Endangered Species from Springs

Researchers at Southwest Texas State University (SWTSU) are studying endangered species that inhabit Comal Springs. Their goal is to help save the species if the springs go dry.

The San Marcos salamander, the fountain darter, and other species living near the springs could be threatened if flows decline. Native populations of fountain darters in Comal Springs died out after the drought in the 1950s and were reintroduced in the 1970s from species captured at San Marcos Springs.

SWTSU researchers have been taking part in rescue missions to capture and remove the threatened species before the springs go dry. The species could be reintroduced at a later date when the water levels in the springs return to normal.

Rescue missions involving teams from SWTSU, the Texas Parks and Wildlife Department, and the U.S. Fish and Wilidlife Service were conducted. Bobby Whiteside of SWTSU's Aquatic Station helped collect fountain darters, while Glen Longley of the Edwards Aquifer Center and graduate students helped gather salamanders. Overall, 540 fountain darters and 80 salamanders were rescued.

Tom Arsuffi of SWTSU's Biology Department has also been studying and collecting invertebrate species that live only in the springs including burrowing mayflies, beetles, and a crustacean sideswimmer. These species would become extinct if the springs go dry because they don't exist elsewhere. In contrast, the fountain darter and the San Marcos salamander would not become extinct if the springs go dry because they also live in the San Marcos River.

For additional details, contact: Tom Arsuffi, Biology Department., Southwest Texas State University, San Marcos, TX, 78666 or call 512- 245- 2329.

Environmental Research Institute Established at Tarleton State University

Tarleton State University has formed a research center that will focus on environmental problems.

The Institute for Applied Research and Public Policy will investigate environmental problems with policy implications. The Texas Water Development Board, the Texas Soil and Water Conservation Board, and the Environmental Protection Agency provided funding to study the impact of dairies on water pollution.

Much of the initial research is expected to focus on agricultural nonpoint source pollution. Institute Director Ron Jones said it will seek solutions to cope with water pollution from the roughly 300 dairies located within 50 miles of Stephenville. The area has been designated as one of the biggest problem areas for agricultural runoff in the state.

For details, contact: Institute for Applied Research and Public Policy, Tarleton State University, Stephenville, TX, 76402 or call 817- 968- 9567.

Water Quality Research Highlights 1990-91 TWRI Program

Three projects dealing with water quality highlight this year's research program of the Texas Water Resources Institute (TWRI).

TWRI is continuing to fund two ongoing projects from last year. Mary Leigh Wolfe of Texas A&M University's Agricultural Engineering Department and Tom Thurow of Texas A&M's Range Science Department are investigating the use of vegetative buffer strips to control urban runoff. This year's research will include collecting data from a 2acre site in Austin that provides runoff to Barton Creek and the Barton Springs-Edwards Aquifer. The site has been planted with grasses, shrubs, and trees, and the effectiveness of the various buffer strips will be compared to select the most promising treatments. Ultimately, the study may help city planners develop more effective runoff control ordinances.

John Sweeten of the Texas Agricultural Extension Service and Wolfe are evaluating wastewater systems that can be used at Texas dairies. Solids settling basins, lagoons that provide primary and secondary treatment, and ponds to retain runoff are being studied. Dairies of different sizes have been instrumented to monitor the amount and quality of wastewater that flows from them into settling basins and lagoons. Water quality data will be utilized to evaluate the best treatment techniques. Technology transfer efforts including computer programs and fact sheets are being developed to get dairy operators to use the new information.

TWRI is also initiating a study to determine how contaminants flow from soils and the root zone to groundwater supplies. The project, "Water and Solute Flow through a Highly Structured Soil," will be conducted by Bill Bland of the Texas Agricultural Experiment Station at Temple and Kevin McInnes and Larry Wilding of the Texas A&M University Soil and Crop Sciences Department. The researchers hope to identify soils that allow

pollutants to flow rapidly through and pollute aquifers and to improve models that simulate the potential for specific agricultural chemicals to pollute aquifers.

For details on any project, call TWRI at 409- 845- 1851.

Corpus Christi State to Establish Tidal Gauge Network

Corpus Christi State University (CCSU) scientists are taking part in an effort to establish a statewide network of 14 tidal gauges that will provide valuable information when hurricanes and tropical storms threaten the Texas coast.

The project is a cooperative effort between CCSU's Blucher Institute, the Texas Water Development Board, the Texas General Land Office, and the National Ocean and Atmospheric Administration (NOM).

The gauges will record data on water levels, wind speed and direction, barometric pressure, and temperature. That information will be relayed to NOM satellites that will then transmit the data back to the Institute. The network will help define tidal boundaries and will also provide important data for shippers, commercial fishing fleets, and recreational boaters.

So far, 10 gauges have been installed from Sabine Pass to Port Isabel. The final four gauges are set to be installed in Nueces Bay, Port Aransas, the Kingsville area, and at an offshore location by January of 1991.

For details, contact: Blucher Institute, Corpus Christi State University, 6300 Ocean Drive, Corpus Christi, TX, 78412 or call 512- 994- 2376.

Lamar Study Shows Opposition to Waste Facility

Results of a survey of Liberty and Harris County residents by a Lamar University researcher show they don't want a proposed facility to store industrial hazardous waste in underground salt domes in their area.

Stuart Wright, a sociologist at Lamar, said he wanted to determine if a small group of highly vocal activists were fighting the project or if the opposition was more widespread. Results show that nearly 75% of the people surveyed opposed the facility, even though n may improve the area's economy. Roughly 67% of those surveyed did not feel the facility could be safely operated, despite assurances from the company sponsoring the project that state- of- the- art technologies would be utilized. Roughly 70% of those polled doubted that state and federal agencies would effectively monitor and enforce safety standards at such a site.

For details, contact: Stuart Wright, Sociology Dept., Lamar University, Beaumont, TX, 77710 or call 409- 8808547.

ETSU Scientists Study Impact of Power Plants on Lakes

Do power plants help or harm the ecology of lakes they discharge effluents into? That's the issue being studied by biologists at East Texas State University.

Biologists Fred Klaus and Robert Williams compared two lakes boated near a lignite-fired power plant in Titus County. Lake Bob Sandlin does not receive effluents from the power plant. Lake Monticello is a heated lake operated by a local utility. The lakes are adjacent to one another and are separated only by a small dam.

Klaus and Williams measured populations of water fleas and rotifers in both lakes in a year- long study to compare how conditions impacted the ecosystems. Results suggest that the largest detrimental effect of the power plant is when temperatures in Lake Monticello increase greatly in the summer as effluents are discharged. Apparently, the organisms are already under stress from the summer heat and effluents only make matters worse. Lake Monticello benefitted from the power plant discharges in the winter when they made the water temperature more tolerable. This indicates that power plants could aid aquaculture production in winter months. For details, contact Fred Klaus, Biology Dept., East Texas State University, Commerce, TX, 75428 or call 214-886- 5347.

Colorado River is Focus of University of Texas Study

Researchers at the University of Texas at Austin are investigating if wastewater discharges from the City of Austin are causing rooted and attached aquatic vegetation and algae to grow in the Colorado River.

Neal Armstrong of UT's Civil Engineering Department is conducting a long- term study to estimate point and nonpoint loadings of nutrients to the river from the Highland Lakes to Bay City. Part of his effort includes developing a water quality model to simulate nutrients and the growth of submerged vegetation in the river.

Results suggest that light availability, nutrient levels, and water currents play key roles in influencing levels of aquatic vegetation. Factors that inhibit light penetration such as turbidity and shading from the vegetation also limit algal growth. Large and sudden floods that occasionally occur scour submerged aquatic vegetation from the river.

For details, contact Center for Research in Water Resources, Balcones Research, the University of Texas, Austin, TX 78712 or call 512- 471 - 3131.

TWRI Announces Call for Research Proposals; Deadline Oct. 29

Preproposals for research and technology transfer projects are now being accepted for the Texas Water Resources Institute's FY 1991 Cooperative Research Program. The program is funded by the U.S. Geological Survey. TWRI is particularly interested in projects dealing with groundwater quality and urban water management.

Detailed instructions for submitting preproposals are available by calling TWRI at 409845- 1851. Preproposals must be submitted to TWRI no later than November 1.

Preproposals will be evaluated by the Institute Director and TWRI's 14- member Advisory Committee. Later, full proposals of selected projects will be required.

Researchers should be aware that the program requires that federal funds be matched with nonfederal dollars at a ratio of 2- to- 1. Funding for selected projects will begin Sept. 1, 1991 and will run through August 31, 1992.

TWRI anticipates funding three or four research projects with budgets of up to $25,000.

Applications for USGS Matching Grants Due Nov. 20, UT Awarded Two Grants This Year

The U.S. Geological Survey (USGS) is accepting proposals for its FY 1991 water resources research matching grant program. The program covers a wide range of subjects including aspects of the hydrologic cycle, water supply and demand, conservation, means of increasing water supplies, and others.

Guidelines and application forms are available from the Texas Water Resources Institute by calling (409) 8451851. Proposals must be received by the USGS in Reston, VA by November 20. Funding for selected projects will begin in September 1991.

Last year two studies were awarded to researchers at the University of Texas.

Allen Dutton of the Bureau of Economic Geology received a matching grant for a study titled "Paleohydrology of the NonGlaciated Great Plains: Climatic and Geomorphologic Implications." The study will investigate groundwater flow patterns of the Ogallala Aquifer in the Texas High Plains. Isotope analysis and simulation models will be used to compare current groundwater chemistry to long- term patterns of paleohydrology.

Jack Sharp of the Geology Dept. received a grant for a study titled "Hydrodynamic, Hydrochemical, and Hydrothermal Investigation of Bank Storage Effects in Stream Aquifer Systems." This project will develop a method to study processes where streams interact with aquifers. The Colorado River and its alluvial aquifer will be used as a case study in the project.

Hazardous Waste Center at Lamar University Issues Request for Proposals

The Gulf Coast Hazardous Substance Research Center is now accepting research proposals. Scientists from the Texas Engineering Experiment Station/ Texas A&M University, the University of Houston, Lamar University and the University of Texas are eligible to apply.

Priority will be given to studies dealing with waste minimization and bioremediation.

Proposals are due by Nov. 1. To obtain details on submitting a proposal contact: Hazardous Substance Research Center, Lamar University, P.O. Box 10613, Beaumont, TX, 77710 or call 409-880- 8768.