New Waves
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Non-Point Source Pollution Is Top Research Priority

Just released results from a workshop to identify critical research needs show that water quality issues (especially non- point source pollution) are the area that Texas should focus its attention on.

Nearly 200 participants from throughout Texas met in Austin November 18- 19 at a workshop titled "Water for Texas: Setting the Research Agenda." The meeting used a "grass roots" format in which individuals offered ideas on water- related areas that they felt most need to be investigated. A series of votes resulted in a final list of top priority issues:

Top 10 Research Needs

1. Develop and perform procedures to evaluate the actual effectiveness of best management practices (BMPs) for nonpoint pollution, including structural and nonstructural controls.
2. (Tie)
    - Quantify effects of point and non- point discharges on water quality, aquatic productivity, diversity, and ambient toxicity.
    - Remote sensing of water quality and associated Geographic Information System mapping, including locations of contamination sources.

4. Aquifer management (data collection and interpretation, natural recharge, artificial recharge, etc.).
5. Evaluate water conservation programs and integrate findings into longterm systems planning (municipal, commercial, industrial, agricultural, etc.).
6. Oil wells and their impact on water quality.
7. Economic, institutional, and legal aspects of innovative water allocation mechanisms, including transfers and market- based pricing.
8. Production agriculture-- conversion of irrigation systems, optimum cropping systems, specific crops for specific areas, etc.
9. Non- point sources: type and quantities, controlling factors, water quality impacts.
10. (Tie)
    - Recharge to aquifers amount and techniques.

- Develop and/or evaluate effective water quality monitoring strategies and identify key sites for the future.

The most critical need, according to the group, is to develop and utilize procedures to evaluate the actual effectiveness of best management practices (BMPs) to control non-point source pollution.

Non- point source pollution of surface waters typically occurs when pollutants and sediments are carried into streams by rainfall run- off following storms," said Wayne Jordan, Director of the Texas Water Resources Institute (TWRI) which cosponsored the event with the Texas Water Development Board (TWDB).

In certain areas, non- point source pollution of groundwater may also occur from widespread use of chemicals for protection of crops and turfgrasses, application of fertilizers to crops and urban landscapes and disposal of wastes by spreading on land or irrigation.

"Because increased attention is being focused on non- point source pollution by regulatory agencies, we need to know which strategies will best work to minimize pollution," Jordan said.

Quantifying the effects of point and non- point source pollution on water quality and aquatic ecosystems was the second highest priority.

The third highest priority was to utilize remote sensing information to develop a geographic information system (a computerized database that displays information on an electronic map) so that pollution sources and areas with poor water quality can be more rapidly and easily identified.

Jordan says the meeting was a first attempt to develop a statewide water research agenda, even though many individual groups and agencies already have their own research priorities. "Results of the workshop should be useful in expansion and coordination of those different agendas to make sure all critical issues are covered and that limited state resources are used as efficiently as possible."

Many of the research needs will be considered by the TWDB and other State and Federal agencies when they develop their research strategies. The Board is trying- to increase the amount of research funds available to scientists in Texas.

"Water research is very important to Texas and it is incumbent on each of us to do what we can to secure State and Federal money to fund worthwhile research projects," according to Craig Pedersen, executive administrator of the TWDB.

A listing of the top research needs is available from the TWRI and the TWDB. A proceedings with all the research needs and background papers from water experts will be published soon.

The Aquatic Ecosystem of the Lindenau Dam Site

Researchers: Bobby Whiteside, Tom Arsuffi, C. Berkhouse, M. Badough, and J. Peterson, Biology Dept., Southwest Texas State University, San Marcos, TX.

Problem: Variations exist in the physical, chemical and biological characteristics of river systems. Therefore, it is especially important to know the distribution, abundance, and composition of different groups of organisms in freshwater aquatic environments at potential reservoir sites which may alter characteristics of the river ecosystem

Objective: To assess the fish and aquatic benthic macroinvertebrate populations upstream and downstream of the proposed Lindenau Reservoir site along the Guadalupe River and Sandies Creek in DeWitt and Gonzales counties

Methodology: Fifteen sites upstream and downstream of the proposed reservoir were selected Water quality data was collected in April and July 1991 Fish were collected by seining in the spring (March and May) and summer (June) of 1991. Electroshocking was used to collect fish in March and June 1991. Hook and line sampling was carried out in May 1991. Benthic macroinvertebrates were collected in the spring and summer of 1991 using both qualitative and quantitative techniques. Qualitative samples were obtained using a dip net and by hand picking representative microhabitats. Quantitative sampling involved burying a sampler into shallow depths of the river substrate, followed by hand washing to remove attached organisms and dislodging free- living organisms. Fish and macroinvertebrate samples were preserved and identified to the lowest taxonomic level possible.

Results: Mosquito fish was the most abundant of 35 species that were collected and was found at 14 of 15 sites. Long- ear sunfish and bluegill were collected at 13 sites. Redfin shiner were collected at 12 sites. Species with limited distributions include thread fin shad, Mexican tetra, speckled chub, mimic shiner, fathead minnow, river carpsucker, and golden top-minnow. Birds Creek, the only site where golden top-minnow were collected, is notable because it was the only site that was obviously isolated from the rest of the river system at the time of this study. A diverse variety of benthic macroinvertebrates was also found that consisted mainly of 10 orders of immature insects. Mayflies, midges, and caddis flies were the most abundant at most sites during spring and summer. Densities of 18,278 midges and 5,064 mayflies were found per square meter.

Reference: Whiteside, Bobby, Tom Arsuffi, C. Berkhouse, M. Badough, and J. Peterson, *An Aquatic Biological Inventory of the Proposed Lindenau Reservoir Site,* Southwest Texas State University San Marcos. TX. 1991.

Coagulation and Transport of Particles in Surface Water

Researchers: Gerald Culkin and Desmond Lawler, Civil Engineering Dept., University of Texas, Austin, TX.

Problem: Suspended solids and trace amounts of dissolved contaminants are found throughout natural aquatic environments. The transport, fate, and effects of these dissolved substances are highly related to the transport and fate of solids. Most models that predict the fate and transport of suspended solids use simplified representations of the processes and are unable to accurately simulate real world situations.

Objectives: 1) To formulate a 2-dimensional, unsteady solids transport model that transports multiple classes of discrete sized particles, 2) to couple particles in the water column and sediment bed using size-dependent sedimentation and resuspension values, 3) to link the particle transport model to a model of size-dependent coagulation, and 4) to use the model to evaluate coagulation, sedimentation, and resuspension in real systems.

Methodology: A numerical model was developed to evaluate the size-dependent processes that transport and transform discrete particles in natural systems. A finite difference representation of a 2dimensional unsteady transport model provided the model f framework. Processes affecting particle transport and fate within the water column include advection and dispersion within the flow field, coagulation and settling. Coupled exchange of discrete particles between the water column and sediment bed was also incorporated into the model. The model was used to test the advantages of discrete particle modeling and the significance of size dependent processes including coagulation. A case study involved developing a simplified representation of Austin's Town Lake was conducted to spatially examine the significance of various processes.

Results: A 2-dimensional general simulation model of discrete size-dependent, particle transport and f ate was developed, tested and applied. The modeling demonstrated that competing processes significantly modified influent size distributions. Results of the case study of Town Lake demonstrated the importance of size-dependent modeling. Results suggest that coagulation is an important process in the transport and fate of dissolved materials when unstable particles are present in the water column, especially in hard and saline waters. The researchers suggest that size-dependent modeling of discrete particles should be used when there is high bed resuspension flux near tributaries.

Reference: Culkin, Gerald, and Desmond Lawler, *Particles in Surface Waters: Coagulation and Transport* (TR 152), Texas Water Resources Institute, Texas A&M University, College Station, TX.

Groundwater Quality at Feedlots in the Texas High Plains

Researchers: John Sweeten, Jeff Harris, and Brent Auvermann, Agricultural Engineering Dept., Texas Agricultural Extension Service, College Station, TX; Tom Marek, Texas Agricultural Experiment Station, Amarillo, TX; Wayne Wyatt, Don McReynolds, Keith Whitworth, and Dan Seale, High Plains Underground Water Conservation Dist. (UWCD) No. 1, Lubbock, TX; Tom McDonald, Texas Cattle Feeders Assn., Amarillo, TX; and

Tony Molihagen and Lloyd Urban, Environmental Sciences Laboratory (ESL), Texas Tech University, Lubbock, TX.

Problem: Most of the large commercial feedlots in Texas, including 87 with more than 5,000 head of cattle, are located in the Texas High Plains. Most of the feedlots operate under Texas Water Commission (TWC) permits that do not allow discharge of wastewater. The feedlots collect runoff and wastewater either in man- made holding ponds or in natural or modified playa lakes. There are concerns that these feedlots may be degrading groundwater quality in the Ogallala Aquifer and other groundwater formations by increasing the levels of nitrate and salinity.

Objectives: To measure the quality of groundwater, especially nutrients and salinity, beneath selected cattle feedlots, and to determine the lateral extent of contamination, where contamination has occurred.

Methodology: Criteria used to select the wells included: 1) feedlot capacity of more than 5,000 head; 2)operating least least 20 years; 3) operating under a TWC permit that allows wastewater to be collected in holding ponds or playas before being irrigated; 4) surrounded by irrigated farmland; 5) in the High Plains UWCD boundaries; and 6) wells are accessible and in use. Thirteen feedlots met the criteria and two 40,000- head sites were selected: a site on a modified playa lake in Castro County, and a site in Parmer County on an unmodified playa. In Castro County, four wells were sampled on the feedlot site and 10 irrigation wells were sampled off- site. In Parmer County, four feedlot wells and 11 irrigation wells were sampled. Wells were selected both from feedlot production wells and irrigation wells outside the feedlot area. Runoff in playa lakes and man- made holding ponds was also sampled. Samples were taken in June and July 1991 and analyzed by the ESL at Texas Tech University.

Results: Results from Castro County show that very low levels of nutrients, including nitrate, ammonia, nitrite, total nitrogen (TKN), orthophosphate, potassium, and salt ions were found in the groundwater samples. The peak nitrate levels (2.23 mg/L) were found in an irrigation well upgradient from the feedlots. All nitrite and organophosphate levels were less than 1 mg/L. In contrast, feedlot runoff water stored in playa lakes had much higher specific conductance, total alkalinity, TKN, orthophosphate, potassium, sodium and chloride than the groundwater. The Parmer County feedlot showed similar levels of pH and total alkalinity compared to the Castro County feedlot. However, it had much higher specific conductance values (average of 727 microhms). Nitrate (average of 5.2 mg/L) and chloride (average of 69 mg/L) were generally higher in the Parmer County groundwater. Values for these ions did not violate EPA drinking water standards.

Reference: J. Sweeten, J. Harris, B. Auvermann, T. Marek, W. Wyatt, D. McReynolds, K. Whitworth, D. Seale, T. McDonald, T. Mollhagen and L. Urban, *An Assessment of Ground Water Quality at Two Texas High Plains Feedlots,* TAEX, College Station, TX, 1991.

Competitive Sport Fishing in Texas and the U.S.

Researchers: Harold Schramm, Range and Wildlife Mgmt. Dept., Texas Tech University, Lubbock, TX (now at U.S. Fish and Wildlife Service, Washington, DC); M. Armstrong, Arkansas Fish and Game Commission; N. Funicelli, Gainesville (FL) National Fisheries Laboratory, U.S. Fish and Wildlife Service; D. Green, Natural Resources Dept., Cornell University; D. Lee, California Dept. of Fish and Game; R. Manns, Fishery Information Services; B. Taubert, Arizona Fish and Game Commission, and S. Waters, lowa Dept. of Natural Resources.

Problem: Organized competitive sport fishing has been a growing and changing activity during the past 20 years. Quantitative information is needed on the number and types of tournaments held, fish caught and killed, and related issues.

Objective: To survey fishery management agencies in the U.S. and Canada on competitive sport fishing in fresh and marine waters.

Methodology: Sixty- two agencies were surveyed regarding competitive sport fishing in inland waters and 29 agencies were surveyed regarding these activities in marine waters. Questions in the survey involved species of fish caught; whether the contests were regulated, restricted or monitored; if statistical information was collected after the competitions, and biological and economic aspects associated with the events.

Results: More than 20,600 sport fishing events were reported. Competitive sport fishing was reported in inland waters by all agencies. Tagged fish events were reported in inland waters in 47 states. Only 21 agencies reported marine competitions. Nearly 78% of the inland sport fishing events were for black bass followed by trout and salmon (each 8%), while billfish (24%), tuna (15%) and mackerel (9%) were most common for marine competitions. Conservative estimates suggest Texas averaged 402 inland events annually which attract an average of 21 participants who spent a total of nearly 11,000 angler days per year. There were also 33 marine events in Texas, most of which lasted more than 3 days and attracted between 277 and 1,000 participants who spent a total of 23,767 angler days per year. The most often cited problems were that some events focused attention on species that were already depleted and that such events may introduce exotic species into new waters. Management problems involve conflicts between competitive and noncompetitive anglers. The competitions also help many agencies, including those in Texas, collect data on fisheries resources.

Reference: Harold Schramm, M. Armstrong, N. Funicelli, D. Green, D. Lee, R. Manns, B. Taubert, and S. Waters, "Status of Competitive Sport Fishing in North America," *Fisheries*, Vol.16, No. 3, May- June 1991.

Impact of Urbanization on Streamflows in Forested Areas

Researchers: Mingteh Chang and Alexander Sayok, School of Forestry, Stephen F. Austin State University, Nacogdoches, TX.

Problem: The LaNana Creek watershed near Nacogdoches in East Texas is largely dominated by forests. Its southern section, however, includes rapidly urbanizing portions of the City of Nacogdoches. The effects of urbanization on streamflows need to be investigated so that floodplains can be accurately calculated and flooding losses can be avoided.

Objective: To evaluate the differences in streamflows and other hydrological characteristics before and after urbanization occurred in the Nacogdoches portion of the watershed by using existing data collected at a single station.

Methodology: 20 years of USGS streamflow data were divided to represent an early period with little urbanization (1965- 72) and a later period with increasing urbanization (1973- 84). The dates coincided with the completion of a highway loop that increased urban development. A mass curve was generated by plotting accumulated annual streamflows versus accumulated annual precipitation. Daily flows were also compared to measure the duration and nature of streamflows. To do this, the percent of time that daily discharges reached key flow levels were computed. Different factors that may account for the difference in streamflows during the two time periods were isolated. Climate data were also compared for both periods. The impact of urbanization on annual streamflows was evaluated using a hydro- climatic model developed for the early period.

Results: Significant differences in streamflows were apparent between the two periods. Average annual streamflow was 5.7 inches greater for the later period than for the earlier period and could not be solely attributed to differences in rainfall and temperatures. Median daily flows were 300% greater after urbanization, annual maximum daily streamflows were also greater, and the frequency of small flows was reduced. When storm characteristics were similar, peak flows were higher and direct runoff was greater after urbanization had occurred.

Reference: Chang, Mingteh, and Alexander Sayok, "Hydrological Responses to Urbanization in the Forested LaNana Creek Watershed," *Tropical Hydrology and Caribbean Water Resources*, American Water Resources Association, Bethesda, MD, 1990.

TWRI Studies Focus On Planning Aids, Pollution

Four projects highlight this year's Texas Water Resources Institute (TWRI) research program. The projects run from Sept. 1 through Aug. 31, 1992.

New projects focus on developing a Geographic Information Systems (GIS) to assist in regional water supply planning, and assessing if agricultural chemical use may be contaminating the shallow Seymour Aquifer.

A project entitled "An Expert GIS for Water Management" will be studied by Daene McKinney and David Maidment of the Civil Engineering Department at the University of Texas at Austin. The project involves building an expert GIS with data on surface water supplies and demands in the Corpus Christi region. The system will allow decision

makers to consider factors such as economic, legal, and environmental issues when evaluating new water supplies.

A project entitled "Relationship Between Crop Production Activities and Groundwater Quality: Texas Rolling Plains" is being studied by Ron Lacewell of the Texas A&M University Agricultural Economics Department, Paul Dyke of the Texas Agricultural Experiment Station Blackland Research Center at Temple, Jimmy Williams of the USDA/ Agricultural Research Service at Temple, and John Lee of the Agricultural Economics Department at Purdue University. The researchers will try to determine if a cause and effect relationship exists between crop production activities and groundwater pollution of the Seymour Aquifer. Farm management practices will be identified that lessen pollution risks.

Two other studies are ongoing.

A project entitled "Effectiveness of Native Species Buffer Zones for Nonstructural Treatment of Urban Runoff" is being studied by Mary Leigh Wolfe of the Texas A&M University Agricultural Engineering Department and Tom Thurow of the Texas A&M University Rangeland Ecology and Management Department. Previously, instruments were placed at a site that receives urban runoff to gauge if vegetative filter strips reduce pollutant levels. This phase involves more field data collection and analysis.

"Water Flow Regime Through a Highly Structured Soil" is the title of a project being investigated by Kevin McInnes, Tom Hallmark, and Larry Wilding of the Texas A&M University Soil and Crop Sciences Department. Earlier, an instrument called a flow interceptor was developed to observe the rate that water moves through macropores in clay soils. Now, efforts will include using the device to gather field data at clay sites along the Brazos River.

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

USGS Awards Two Projects to Texas Scientists

The U.S. Geological Survey awarded two projects to Texas A&M University scientists as part of national matching grant program

Jim Heilman of the Horticulture Department and Joe McFarland of the Agricultural Engineering Department were funded for a study titled "Simulation of Effects of Climatic Change on Surface Water Balances of Agricultural Lands." The project will involve determining how global warming may affect evapotranspiration rates and surface water balances in Texas.

Ron Lacewell of the Agricultural Engineering Department is working with Paul Dyke of the Texas Agricultural Experiment Station at Temple and John Lee of the Agricultural Economics Department of Purdue University in a study titled "Effect of Agricultural Practices on Surface Water Ouality." The project will focus on the major off- site economic and environmental costs associated with erosion and sedimentation.

Coordinating Board Funds $3 Million of Water-Related Projects

The Texas Higher Education Coordinating Board announced the projects it would fund as part of its $40 million Advanced Technology Program and its $20 million Advanced Research Program.

Among the projects were 8 waterrelated advanced research projects totaling roughly $1.01 million, and 15 water- related advanced technology projects worth more than $2.5 million.

Water- related subject areas that were funded include pollution- related studies (8 projects totaling $1.4 million), marine science (5 projects for $1 million), aquaculture (3 projects totaling $395,000), agriculture (3 projects totaling $263,000) and hydrology (2 projects for $135,000).

Summaries of some of the projects are listed below. Details of many projects will appear in future issues of *New Waves.* For details, call the Higher Education Coordinating Board at 512- 483- 6111.

Advanced Research

"Mapping Sulfur and Ammonia Emissions in Texas: A Mobile Research Laboratory, Phase II," Purnedu Dasgupta, Chemistry and Biochemistry Dept., Texas Tech University.

"Designing Crops with Improved Drought Tolerance,"John Mullet, Biochemistry and Biophysics Dept., Texas A&M University, and Darrell Rosenow, Texas Agricultural Experiment StationLubbock.

"Simulation of Near- Surface Contaminant Migration," John Killough and Marcelo Rame, Chemical Engineering Dept., University of Houston.

"Modeling of Solid- Fluid Separation in Supercritical Water Environments," Ernest Gloyna, Center for Energy Studies, University of Texas- Austin.

"Field Assessment of Reproductive indices and Stress Proteins in Fish as Biomarkers of Environmental Contamination," Peter Thomas, Marine Science Dept., University of Texas at Austin, and Cynthia Howard, Biology and Allied Health Sciences, University of Houston- Clear Lake.

"Bioinorganic Chemistry of Vanadium in the Marine Environment," Carl Carrano, Chemistry Dept., Southwest Texas State University.

"Plant Pigments and Radionuclides as Tracers of Organic Carbon Flux in the Sabine-Neches Estuary," Tom Bianchi, Biology Dept., Lamar University, and M. Baskaran, Marine Science Dept., Texas A&M University- Galveston.

"Models for Determining Effects of Genetic Changes in Root Characteristics in Water Transport in Plant- Soil Systems," Ronald Anderson, Mathematics Dept., Texas Tech University.

"Dynamics of Surf- Zone Turbulence," Francis Ting, Civil Engineering Dept., Texas A&M University.

Advanced Technology

"Biology and Public Health Significance of Vibrio Vulnificus in Texas Oysters,"John Schwarz, Marine Biology Dept., Texas A&M University at Galveston, and Rita Gander, UT Southwestern Medical Center at Dallas.

"Growth Modeling, Electrical Conductivity Analysis for Improved Product Quality Evaluation in Catfish Aquaculture," Brian Murphy, Delbert Gatlin, Wildlife and Fisheries Sciences Department, Texas A&M University.

"Playa Irrigation Strategies to Enhance Habitat for Wetland Wildlife," Loren Smith, Range and Wildlife Management Dept., Texas Tech University.

"Inexpensive Remotely Addressable Soil Moisture Sensors," Purnendu Dasgupta, Chemistry and Biochemistry Dept., Texas Tech University, and Jesse Yeh, Science Dept., South Plains College, Levelland.

"Optimization of Nutritional and Environmental Factors for Intensive Aquaculture of Red Drum," Delbert Gatlin and Bill Neill, Wildlife and Fisheries Science Department, Texas A&M University.

"Seawater Solar Pond: A Low- Cost Energy Source for Mariculture," Richard Bannerot and Stanley Kleis," Mechanical Engineering Department, University of Houston.

"Surfactant Remediation of Aquifers Contaminated by Non- Aqueous Phase Liquids," W.H. Wade and G.A. Pope, Petroleum and Geosystems Engineering Center, University of Texas- Austin.

"Cellular Biomarkers in Polychaetes for Use in Mitigating Marine Sediment Toxicity Produced by Petrochemical Industries," Lloyd Fitzpatrick and Art Goven, Biology Department, University of North Texas.

"Expansion of Texas Oyster Production via Hatchery Technology and Recycling Coal Combustion By- Products," Sammy Ray and Andre Landry, Marine Biology Department, Texas A&M University at Galveston.

"The Relatively Insignificant Role of Mixing in Flocculation," Desmond Lawler, Civil Engineering Department, University of Texas- Austin.

"Imaging Software for GroundPenetrating Radar with Application for Engineering and Environmental Site Evaluations," George McMechan, Geosciences Dept., University of TexasDallas.

"Investigation of Ecological Effects of a Persistent Brown Tide in the Laguna Madre," Edward Buskey and Kenneth Dunton, University of Texas Marine Science Institute at Port Aransas.

"Tactical and Operational Management of Oil Spill Cleanup Operations," Wilbert Wilhelm, Jan Wolter, Texas Engineering Experiment Station, Texas A&M University.

"Development of a Quantitative Video Image Capture and Analysis System Used to Sample Benthic Marine Communities," Mary Wicksten, Biology Department, Texas A&M University.

"Numerical Prediction of Wave Kinetics for 2- Dimensional Irregular Waves," Jun Zhang and Robert Randall, Civil Engineering Department, Texas A&M University.

AG Rules That State May Intervene in Groundwater Regulation, Catfish Farm Closes

Two significant developments recently occurred in the ongoing struggle to manage water resources in the Edwards Aquifer region.

First, an Attorney General's opinion ruled that State agencies have the authority to regulate the Edwards Aquifer and possibly other groundwater systems. The ruling clarified a provision of the Texas Water Code that the State "shall make and enforce rules and regulations for conserving, protecting, preserving, and distributing underground, subterranean, and percolating water." That provision had not been enforced previously because a 1941 ruling by the Attorney General's office had said it was "unconstitutionally vague."

What does the new ruling mean? One result has been that the Texas Water Commission (TWC) has issued an ultimatum to water users in the San Antonio area that the TWC may develop a water management plan soon if a local agreement cannot be reached. Ultimately, this could extend the State's involvement in groundwater management to other parts of Texas.

Secondly, the Living Waters Catfish Farm has turned off its massive twri pumps temporarily until appropriate permits can be obtained from State and Federal agencies.

The farm was sued by the Edwards Underground Water District and the San Antonio River Authority because its operations were increasing coliform levels and violating water quality provisions of the Texas Water Code.

The suit also charged the aquaculture operation with unlawful waste of water because more than 94% of the water that was pumped was being discharged into the Medina River. Others were upset that the volume of water pumped (as much as 35,000 gallons per minute or 50 million gallons per day) were negating conservation efforts in the area.

Oyster Harvesting Dispute May Cost Texas $30 Million

A legal argument about whether Texas shellfish harvesting regulations are constitutional may have cost the State's oyster industry as much as $30 million this year.

A judge in Calhoun County ruled earlier this year that the Texas Department of Health (TDH) rules governing oyster harvesting were unconstitutional. He said that boundary lines defining open areas and sites closed to harvesting that may have been polluted were not clearly marked.

Because the Texas laws were overturned, the Food and Drug Administration (FDA), the Federal agency that regulates seafood and shellfish nationally, said they would not approve any Texas oysters for interstate sale. As a result, many states would not accept any Texas oysters, regardless of whether they came from Calhoun County or not.

The situation was cleared up somewhat when the TDH told the FDA that it would continue to enforce the existing rules while appeals were being heard. The regulations were finally ruled as valid and constitutional in early December.

EPA Sets Tougher Landfill Regulations

The EPA has set new Federal standards for municipal landfills in an effort to prevent leaching of chemicals that could pollute groundwater supplies and soils.

The rules require that landfills be equipped with monitor wells to check for contamination. Groundwater samples will have to be taken and analyzed twice a year from active landfills and once each year from closed landfills. Now, less than a quarter of landfills nationally are regularly monitored and only 15% have liners to protect the ground from seepage. The new rules also state that groundwater polluted by landfills will also have to be cleaned up. New landfills will have to be equipped with a special clay and plastic liner to prevent leaks.

Roughly 6,000 public landfills across the U.S. receive more than 75% of the trash dumped each year. Nearly 25% of the worst EPA toxic waste sites are former landfills.

Pacific Shrimp Get Into Laguna Madre

State officials are fearful that Pacific shrimp being raised in coastal aquaculture operations that were accidentally released into the Arroyo Colorado in November may be migrating into the Laguna Madre and threatening native shrimp populations.

The result could be damaging to both the aquaculture operations and to commercial shrimp harvesters, according to the Texas Parks and Wildlife Department (TPWD).

TPWD research vessels found the Pacific shrimp both within the Arroyo Colorado and in one case in the Gulf Intracoastal Waterway. The findings angered commercial shrimpers and worried State biologists who think the Pacific shrimp may impact native shrimp species.

The Pacific shrimp could also replace the native populations if they breed in larger numbers or survive longer. However, no definitive data exists on whether this may occur. Also, a whole new variety of shrimp may result from cross- breeding.

Texas' Spending on the Environment Ranks Near Bottom

Two recent reports suggest that Texas consistently ranks near the bottom nationally in water and environmental related issues.

The August 1991 issue of *Fiscal Notes,* which is published by the Texas Comptroller's Office, includes state- by- state comparisons of per capita spending on the environment and information on State government environmental- related expenditures in FY 1988.

Texas ranked last nationally in per capita environmental spending at just $6.76 per person, according to data collected by the Council of State Governments. Some states spent more than $100 per person. Texas expenditures for water and environmental issues in FY 1988 (the last year for which data was available) included $15.7 million for fish and wildlife, $11.4 million for water resources, $4.4 million for marine and coastal programs, $3.7 million for water quality, and $2.6 million for drinking water.

Fiscal Notes also reported Texas' publicly traded environmental companies earned nearly $6 billion in 1989. More than $33 million of that figure came from water infrastructure while $300 million originated from waste management equipment. Copies can be obtained by calling 800-531-5441 extension 34900.

Another new report, *The Green Index,* estimates that Texas is 46th nationally in dealing with environmental issues. Texas ranks 36th in water pollution, 35th in agricultural pollution, 46th in total pounds of toxics released to public sewers, and 43rd in forestry and aquatic life. Texas was 50th in total toxics released, total toxics injected underground, and spending on water quality and development. The book is available by calling 800-828-1302.

Whooping Cranes to Get Man-Made Home in Mesquite Bay

Endangered whooping cranes will soon enjoy a new man- made home in the Mesquite Bay area of the Aransas National Wildlife Refuge.

A Houston firm, Mitchell Energy and Development, is using dredged materials to build a 15- acre marsh habitat specifically designed for the cranes. This is the first attempt to design and create habitat specifically for the birds.

The process involves four stages. First, a rectangle- shaped levee was created with bottom soil to create an island perimeter. Then, the levee was filled with 65,000 cubic

yards of dredged material from a channel used by Mitchell to gain access to a nearby oil well site. Later, interlocking concrete mats were placed on the outside banks of the levee for protection and stabilization. This summer, native vegetation will be planted to duplicate the cranes' preferred environment.

Mitchell officials also point out the $750,000 price tag of building the marsh is still cost-effective compared to conventional ways of dealing with dredged material.

Corps Completes Cooper Lake, Restarts Wallisville, Proposes Seawall

Three Corps of Engineers projects, all in different phases of development, are making the news.

Cooper Lake, a 441,200 acre foot flood control, water supply, and recreation reservoir project was dedicated in September. The $140 million dam is sited near Commerce.

Work is scheduled to begin soon on the redesigned Wallisville Reservoir south of Houston. The $80 million project will be a "nonoverflow dam on the Trinity River that will stop saline water from the Gulf of Mexico from lessening the quality of Trinity River water now used for irrigation. The project will also reduce the need to release freshwater from Lake Houston to lessen salinity levels.

The Corps also recommends that a 7-mile concrete block and rock seawall be built along Sergeant Beach in Matagora County. The structure would halt beach erosion that threatens the Gulf Intracoastal Waterway. The seawall would prevent the Gulf of Mexico from eroding a thin strip of the beach that is the sole barrier between the Gulf and the canal. The project is vital because a break in the canal could interrupt shipping and navigation valued at $20 million a day. The $75 million project must first be authorized by Congress. Half of the project cost would be paid for by Waterway users. Work is scheduled to begin in 1994 and the project is scheduled to be completed in 1998.

Volunteers Sought for Drinking Water Tests

Forty-five large Texas cities are now searching for hundreds of volunteers who want to participate in regular home water testing required by the new revisions to the primary drinking water regulations.

The rule requires that cities with over 50,000 people begin testing for lead, copper, and other substances from January to June. The tests will be conducted in individual homes, but can be carried out by water utility personnel or residents with special training.

Utilities are looking for volunteers that live in "high risk" houses that may be vulnerable to contamination from lead and copper from pipes and fixtures. Homes built after 1982 and houses with lead pipes and service lines pose the highest risk.

Fort Worth is one of five cities nationally that participated in an American Water Works Association study. Roughly 100 homes are being sampled to evaluate a model that simulates the flow of water through plumbing at new homes.

U.T. Water Resources Faculty Position to Open

A position for a visiting faculty member in the Civil Engineering Department at the University of Texas at Austin is anticipated for one or two semesters during the 1992-93 academic year.

The opening is being created by David Maidment who teaches a surface water hydrology course and is planning to be on leave.

Expertise will ideally include surface water hydrology, but persons qualified in other areas of water resources, from a recent Ph.D. graduate to an established person, will be considered.

Salary is open to negotiation based on qualification and on the level of involvement in UT's programs.

Interested persons are asked to contact Ed Holley, Civil Engineering Dept., University of Texas, Austin, 78713 or by calling 512-471-5602.

Ways to Deal With Drinking Water Hazards Outlined in New Book

An easy to read guide to hazardous substances in drinking water and how to deal with them has recently been published.

The book, *Drinking Water Hazards: How to Know if There Are Toxic Chemicals in Your Water and What to do If There Are,* was written by John Stewart. Chapters in the book explains contaminants and water quality impairments including hardness, heavy metals, biological contaminants, radioactivity, nitrate, fluoridation, synthetic organic chemicals, pesticides, and others. The book also tells users how to conduct inexpensive screening tests to determine if contamination may exist, and how to choose a water testing laboratory. Information on bottled water, legal issues, and ways to minimize waste and pollution are also included.

The book is available from Envirographics, Box 334, Hiram, OH. 44234 or by calling 216-527-5207.

State Plan Will Help Protect Aquifers from Agricultural Contamination

Protecting groundwater supplies from contamination by agricultural chemicals is the aim of a new management plan that has been approved by the Texas Water Commission and other State agencies.

The report, *The Texas State Management Plan for Agricultural Chemicals in Ground Water, focuses* on preventing pollution. State and local governments are given the primary responsibility for protecting groundwater quality. Key features of the plan are that the use of agricultural chemicals should not impair any current use of groundwater or pose a health hazard, that drinking water supply wells be protected, and that groundwater quality monitoring should be focused on areas vulnerable to contamination. The plan also

proposes that chemical specific safe uses be designated. For example, some chemicals could be prohibited (temporarily, permanently or during certain times of the year) in areas where they were likely to cause pollution or that allowable rates of use could be reduced in high risk areas.

The plan was written by the Agricultural Chemicals Subcommittee of the Texas Groundwater Protection Committee and has now been sent to the EPA for approval.

Lamar University Begins Pollution Prevention Center

Lamar University has developed a new way to access data on pollution prevention and hazardous waste technologies.

The Texas Pollution Prevention Information Center (PPIC) is part of the Gulf Coast Hazardous Substance Research Center.

In January 1992, computer users with a modem can access the Center's library by dialing 800-252-688.

Modems should be at least as fast as 1200 baud.

On-line information that can be accessed includes a list of the Center's library holdings, a list of experts in pollution prevention, and regularly updated progress reports of research being funded by the Center. The PPIC also includes a reference library which contains many technical reports by the EPA and State agencies, and environmental case studies.

For more details, contact the Center at 409-880-8897.

TWC Studies Cover Mega Borg Oil Spill, Groundwater

New publications dealing with the Mega Borg oil spill, fish kills in the Trinity River, groundwater protection in El Paso, and other topics are available from the Texas Water Commission (TWC).

The Mega Borg Incident (LP 9105) reviews how the oil spill occurred, how emergency teams responded to it, the role of bioremediation in dispersing the spill, and environmental impacts.

Ground Water Protection Strategy for the City of El Paso (R 91 - 01) details how officials developed a groundwater protection program. TWC officials suggest this may be a strategy other communities may want to follow.

Other reports from the TWC include *Analysis of Fish Kills and Water Quality Conditions in the Trinity River: Assessment of Biotic Integrity, Analysis of Fish Kills and Associated Water Quality Conditions in the Trinity River: Rise Event Studies* and *Intensive Survey of Amarillo Creek* .

To order, contact the TWC Library at 512-463-7834.

USGS Reports Describe River Flooding, Groundwater

New reports by the U.S. Geological Survey summarize recent floods in Texas and groundwater pumping conditions in coastal Texas counties.

USGS FY 1990 Yearbook includes selections on natural hazards, water quality, water resources investigations, information systems, and other activities. 1990 Texas floods are highlighted. *Records of Wells, Drillers' Logs, WaterLevel Measurements, and Chemical Analyses* have recently been compiled in separate reports for Brazoria, Fort Bend and Waller counties and Harris and Galveston counties. *Guidelines for Collection and Field Analysis of Water Quality Samples from Streams in Texas was* written by Frank Wells, Willard Gibbons, and Michael Dorsey describes site selection, sampling techniques for specific pollutants and sample filtration and preservation.

To order any report, contact: USGS, 8011 Cameron Rd. Bldg. 1, Austin, TX, 78753 or call 512-873-3020.

TWDB Produces New Booklet with Texas Water Facts

Texas Water *Facts,* is a new easy to read 28- page color brochure published by the Texas Water Development Board. The booklet presents a broad overview of Texas water issues including average annual rainfall, major rivers, average monthly residential water bills, and surface and ground water use. Regional water problems and water issues are identified. The booklet costs $1 and can be ordered by contacting the TWDB at 512-4445-1467.

Galveston Bay Proceedings Published

Limited copies of the Proceedings of the 1991 Galveston Bay Characterization Workshop are now available free from the Galveston Bay National Estuary Program.

The Proceedings cover such topics as point and non- point source pollution, toxic materials in waters, birds, and aquatic organisms; oil spill impacts, oilfield produced water, nutrients, pollutant transport, habitat studies; ecological surveys; physical features, inflow and hydrology, salinity, modeling, and information synthesis. To order, call 713-332-9937.

Economics of Ferry Operations

The feasibility of recovering some or all the costs incurred by providing free public ferry service between Galveston and Port Bolivar and between Aransas Pass and Port Aransas was evaluated recently by the Texas Transportation Institute (TTI) at Texas A&M University.

William Luker of TTI conducted the study for the Texas Department of Transportation. He found that costs to operate and maintain the ferry between Galveston and Port Bolivar are five times higher than they are at Aransas Pass. If a toll is implemented at Galveston, Luker recommends it recover only 60% of the costs because higher tolls could reduce the

amount of tourists who ride the ferry. Local commuters could be asked to pay only a small annual fee to use the ferry. A feasible and cheaper alternative might be to build a bridge between Galveston and Port Bolivar while still allowing the ferry to be operated as a tourist attraction.

The results varied for the ferry between Aransas Pass and Port Aransas. All the costs to operate and maintain the ferry can be repaid with tolls of less than $1 per vehicle per trip. Bridge construction would be more expensive at this site and could pose obstacles to ship channel traffic For details, call Luker at 409-845-9959.

Stephen F. Austin State Researchers Use IBI to Compare Stream Water Quality

Scientists at Stephen F. Austin State University are using a matrix that combines biological and water chemistry data to gauge the health of streams and rivers.

Jack McCullough and Ron Ahle of the Biology Department utilized the index of biological integrity (IBI) to compare the overall water quality of La Nana, Carizzo, and Tuscosso bayous in East Texas. Information was compiled on fish populations, indicator species, species richness and diversity, and functional feeding groups. The data were collected in stream reaches thought to be impacted by manmade pollution and from isolated areas where pollution was not believed to have occurred. This information was combined with habitat assessments to develop an overall evaluation of the quality of each stream. The data from the two relatively unpolluted streams could be used as a baseline against which other East Texas streams could be compared in future studies.

Many researchers and policy makers believe the IBI has a good potential as a tool for evaluating stream quality because it is more comprehensive than numeric criteria and because it reflects overall ecosystem health.

In a separate project, McCullough and R.C. Griffin compared the same three bayous with physical and chemical data. Information was gathered at three sites of each bayou over a year and was analyzed for temporal differences.

For more information, contact: Jack McCullough, Biology Department, Stephen F. Austin State University, Nacogdoches, Texas 75962 or call 409- 568- 3601.

Brackish Clam May Monitor Pollution in Texas Waters, Lamar University Researcher Says

The brackish clam may provide clues as to how pollution is affecting aquatic life in Texas bays, rivers, and estuaries, according to research at Lamar University.

The U.S. EPA now allows mussels to be tested to gauge the adverse impacts of pollutants in aquatic environments. However, the mussel species native to the Gulf Coast are so small that it requires as many as 30 individuals to collect the amount of tissue needed to

run the tests. Also, the mussels require saline water and are not usable in upstream portions of estuaries or fresh waters.

Richard Harrel of Lamar's Biology Department is trying to determine if the brackish clam *(Rangia Cuneata)* may be a suitable alternative. Because the clam is much larger than the mussels, fewer clams need to be gathered. The clam is also easily found and is adapted to Gulf conditions.

Tests are now being conducted where the clams are exposed to heavy metals in the laboratory and in surface waters that receive some of the metals. Additional data has been obtained on the accumulation of dioxin by the clams from beds located above and below a paper mill effluent outfall in the Neches River.

The studies are now in their first year. Harrel hopes that the EPA will consider the widespread use of the clam for biomonitoring after more data has been gathered.

For details, contact Harrel at 409-880-8255.

CCSU Helps Kick Off Adopt-A-Wetlands Program

Schoolchildren in the Corpus Christi area will be getting a firsthand opportunity to observe and protect marshes and swamps in a pilot "Adopt-A-Wetlands" program. The activity is cosponsored by Corpus Christi State University, the U.S. Fish and Wildlife Service, the Texas Parks and Wildlife Department, the EPA, and the U.S.D.A./ Soil Conservation Service.

The program allows students in grades kindergarten through 12 to monitor a wetland area during a 9 to 12 month period. Field experiences include sampling, collecting and documenting data on wildlife and plant populations and surveying sites for wetlands restoration and enhancement. Classroom learning activities are also included. Areas that have already been adopted include Redfish Bay, the Nueces River delta, and Oso Bay.

CCSU biology professor Wes Tunnell, a leader of the project, said the program is designed to let students get out and observe a wetland ecosystem so they can gain a greater appreciation for the importance of conservation. If successful, the program could be expanded Statewide.

For details, contact Tunnell at 512-994-6810 or Nivra Kelly of the U.S. Fish and Wildlife Service at 512-888-3346.

UT Medical Branch Study Suggests Chlorination Byproducts May Cause Abdominal Diseases

Chlorination, the primary method of disinfecting drinking water, may be causing abdominal disorders in 31 million Americans and may cause cancer, according to researchers at the University of Texas Medical Branch (UTMB) at Galveston.

Ahmed Ahmed, a researcher at UTMB, carried out a 10-year study in which rats were exposed to chlorination by-products called haloacetonitriles or HANs. HANs are formed when chlorine reacts with algae or other impurities during water treatment. When the rats were given a single dose of HANs (the amount consumed daily by most Americans), more than 37% of the chemical remained in their bodies for more than 2 days.

Instead of being flushed out, HANS apparently linger in the body. High concentrations accumulated in the rat's gastrointestinal tissue, overwhelming their digestive system's defenses against toxicity and diseases. Previously, HANS were thought to be harmless.

For details, contact UTMB at 409-772-2618.

UH Researchers Developing 3-Dimensional Model of Galveston Bay

A researcher in the Civil Engineering Department at the University of Houston is working on a three-dimensional model of Galveston Bay that he hopes may produce a more life-like representation of the Bay.

Keh-Han Wang is inputting data on the boundaries, shape, depths (bathymetry), freshwater inflows, tides, and winds of the Bay. From this information, the simulation model will generate three- dimensional plots of changing circulation patterns, water levels, and salinity profiles. The model improves upon existing twodimensional models now being used because Wang says those simplified models cannot accurately mimic the flow patterns in the Bay.

The research will provide information on the impact of freshwater inflows and winds on circulation patterns and salinity distribution, and may answer questions related to navigation and shipping and how pollutants travel within the Bay.

For details, contact Wang at 713-749-2765.

Treated Wastewater May Boost Yields, Cut Need for Fertilizers, A&I Study Says

Treated city wastewater and effluent from uranium mines may boost yields of vegetables and other crops in South Texas and lessen the need for additional fertilizers, according to a Texas A&I University study.

Duane Gardiner is a researcher in Texas A&I's (now Texas A&M-Kingsville) Agriculture Department who specializes in soil properties. He conducted a study this summer to determine the impact of furrow irrigating bell peppers with city wastewater on soils. Groundwater quality will be monitored in the future. No additional fertilizer was needed because the wastewater contained sufficient nitrogen.

The crop yields are impressive. Crops irrigated with as much as 25 inches of wastewater during the study produced 15 tons of peppers per acre, compared to just 2 tons per acre

for non- irrigated areas. Other crops such as cabbage and green herbs may be grown in the future. No sizeable increase in groundwater nitrate or salinity levels was noted.

Gardiner wants to examine whether using the effluent will increase soil crusting, lessen infiltration, and boost nitrate and salinity levels in groundwater. Gypsum may be a treatment that could be successfully applied to reduce the crusting. In a similar study involving wastewater from a uranium mine, gypsum treatments improved water infiltration.

For details, contact Gardiner at 512-595-3713.

Rice Geologists Trace Natural History of Galveston Bay

Geologists at Rice University are trying to determine how short-term rises in sea levels and hurricanes have influenced the size and shape of Galveston Bay.

In the project, John Anderson, Fernando Siringan, Brad Hoge, and Wendy Smyth of Rice's Geology and Geophysics Department have been acquiring a grid of high resolution seismic profiles and sediment cores from throughout the Bay to gain insights into how the Bay physically evolved.

Ongoing analyses are concentrating on understanding the salinity structure in the Bay and in measuring long-term changes in vegetation. Sediment cores are now being collected from transects that extend from the deepest portions of the Bay to the shoreline. Profiles of the Bay bottom are being developed to study changes in sedimentation rates, including the impact of man-made alterations. Radiometric data will be utilized to estimate the rate of sea level rise.

There are already some interesting results. The researchers theorize that Galveston Bay was originally carved out of the Texas coast about 100,000 years ago.

Storms which occurred as long as 4,000 years ago are expected to have had a much greater impact of the Bay's shape than those which took place in the last century. Also, sediment cores that penetrate beyond or just beneath the bay fill suggest that rapid flooding may have occurred during the Holocene era .

A paper on the subject was included in the Proceedings of the Galveston Bay Characterization Workshop from February 1991. For more details. contact John Anderson at 713-527-4880.

Playa Lake Beds Can Slow Pollutants, Tech Study Suggests

Are playa lakes the Ogallala Aquifer's friend or foe? That's the topic of an investigation by Tony Mollhagen, Ken Rainwater and Yu-Chi Chen of the Water Resources Center at Texas Tech University.

There are concerns that herbicides such as atrazine and simazine and insecticides like diazinon and parathion that are applied to agricultural crops may be migrating through

playa lakes into the Aquifer. In addition, pollutants in stormwater and irrigation tailwater may also seep through playa lake beds to degrade groundwater quality.

In the project, researchers collected soil samples and analyzed them for conventional soil characteristics. Soil column experiments were used to determine factors that control how pollutants are adsorbed and dispersed.

Results suggest that playa soils can significantly delay pollutant movement but can not prevent it. For example, atrazine can penetrate through 12 inches of playa lake bottoms in two days and through an 18 foot deep layer of clay in 75 days. Insecticides were much more strongly adsorbed than the herbicides.

For details, contact Mollhagen at 806-742-0161.