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Groundwater Modeling Projects Greater Withdrawal than Expected

The High Plains Ogallala Area Regional Water Management Plan (OWP) has asked the Water Resources Center to develop a groundwater modeling system that will simulate long-range water use to evaluate diverse conservation scenarios. The model will help water managers plan for present and future use of diminishing water resources. The High Plains area is heavily dependent on irrigated water agriculture with most of the irrigation water coming from the Ogallala aquifer. Water levels in this large but finite aquifer have steadily decreased since the 1950s.

The study area, which is bordered on the north by the Canadian River and on the south and east by the Caprock, has previously been modeled by the Texas Water Development Board (TWDB). The TWDB model (GWSIM-III) can simulate only one aquifer layer, but it can adjust pumpage rates during simulations.

Troy Dorman, Texas Tech doctoral candidate in civil engineering, used the MODFLOW model, three BASIC programs, and EXCEL spreadsheet calculations to create a modeling system that can fulfill the OWP goals of simulating multiple aquifer layers and adjusting pumpage rates.

MODFLOW was also modified beyond its inherent capabilities to calculate the volume of water in storage. Data acquired from the TWDB was formatted for the MODFLOW groundwater model. Results from MODFLOW compared well with those from GWSIM-III.

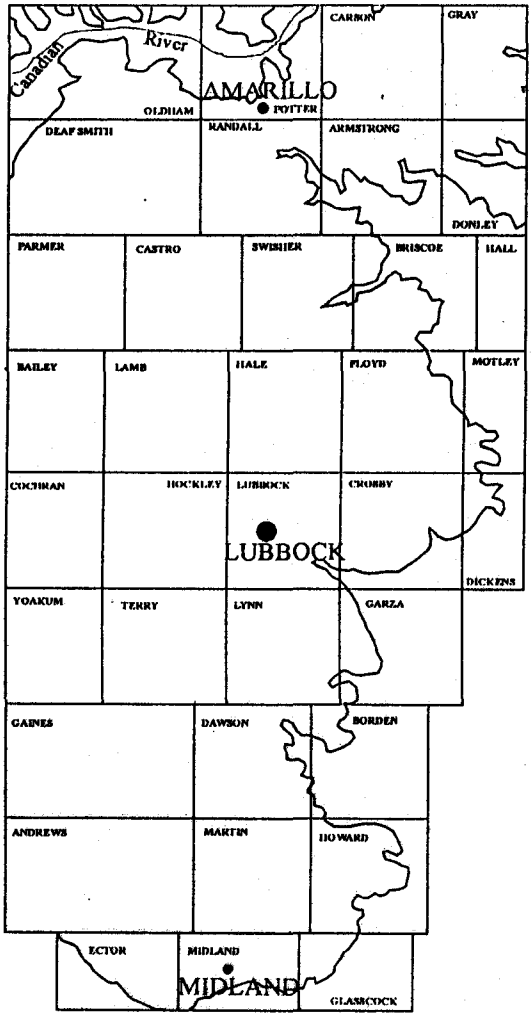
The modeling simulated water use from 1990 to 2040 in ten five-year increments. Two sets of pumpage data representing projected withdrawals were used.

Dorman and Ken Rainwater, associate professor of civil engineering, developed four scenarios to test the applicability of the modeling process. One scenario represented no change in water use while the other three represented various levels of conservation.

Results from the modeling were presented as saturated thickness maps for each ten-year period and included discussion of areas that were simulated to have adequate or inadequate water storage.

Dorman concluded that the new demand forecast projects a

(See "Modeling Aids Water Management," page 4)



Study Area and Aquifer Limits

High Explosives Contamination Target of Bioremediation at Pantex

A consortium of engineers and scientists at Texas Tech, Texas A&M—College Station, and the University of Texas at Austin continues its work to safely facilitate Pantex's stated mission to implement remediation of subsurface contamination by the year 2000. One task of the remediation project is to investigate the application of bioremediation to subsurface soils and groundwater contaminated with high explosives (HEs) and chlorinated solvents.

Bioremediation involves using microorganisms to convert contaminants to less harmful species to remediate contaminated zones. The technology experiences a high level of public acceptance because of its low cost and minimal environmental impact.

Prior to the early 1980s, activities and methods of disposal at the Pantex facility resulted in subsurface contamination by concentrations of HEs and chlorinated solvents. Investigations of the site revealed that the HEs have contaminated the perched aquifer above the Ogallala aquifer and have moved off site to neighboring farmland. In an effort to remediate the contaminated areas, engineers and scientists are collaborating to develop the means by which HEs can be effectively degraded by microorganisms.

Engineers have determined that the best way to remove HE from the groundwater is to pump HE-contaminated water from the perched aquifer through granular activated carbon (GAC). The GAC absorbs the HEs from the contaminated water; however, no facility exists that is capable of regenerating the HE-contaminated GAC. A solution to this problem is to establish a microbial biofilm, containing HE-degrading bacteria, on the GAC. Remediation of HE-contaminated water would occur as the water passes over the biofilm and comes in contact with the bacteria.

Goals related to the bioremediation project are to identify and evaluate the HE-degrading potential of bacteria found in soil and water samples, determine optimal growing conditions, and assess whether significant remediation of HE-contaminated groundwater at Pantex is feasible using the biofilms.

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During 1995-96, scientists identified individual HE-degrading bacteria. Soil samples were taken from areas known to be contaminated with HEs, such as HE-disposal sites at Pantex. Playa lake sites in and around Lubbock were also sources for bacteria capable of degrading HEs, although these sites are not contaminated with HEs.

Proposed work for 1997-98 involves developing and refining analytical techniques, evaluating the biodegradability of the target compounds with new isolates of bacteria, and developing and evaluating biofilms for HE degradation.

Evaluation of the bacteria's nutritional needs will include determining patterns of carbon and nitrogen utilization and the effect of various C:N ratios on the bacteria's growth. By manipulating C:N ratios, scientists will be able to establish the optimum C:N ratio for each bacterial strain. The information will aid development of a culture medium that will encourage the bacteria's growth on the biofilm.

Once bacteria and their optimal growing conditions are established, scientists will determine optimum parameters and conditions for maximum HE degradation in the minimum amount of time both within biofilms and separately. The degradation studies will define the rate and extent of transformation and mineralization of the targeted HEs. As HEs degrade, they have the potential of forming intermediate compounds that can be less, more, or as toxic as the parent compound. The disappearance of HEs will be monitored and the presence of intermediate compounds quantified to calculate a materials balance on the biodegradation

(See "Application of Biofilm Studied," page 4)

Economic Considerations Focus for Quarterly Ogallala Water Plan Meeting

An overview of economic considerations for selecting water management techniques was the focus at the High Plains Ogallala Area Regional Water Management Plan (OWP) committee meeting. The June 13 committee meeting was held at Texas A&M University Agricultural Research and Extension Center, Amarillo.

Dr. James Jonish, Texas Tech professor of economics, outlined the economics of the OWP as well as the evaluation process and the private and social costs and benefits associated with implementing conservation practices.

The OWP scope of services raises technical, volumetric, economic, and environmental considerations. For each aspect, what is saved or augmented and what is feasible must be questioned. Identifying the most effective alternative is best accomplished by comparing costs and benefits among several alternatives.

During the evaluation process, water managers must classify projects according to purpose (e.g., replacement, cost reduction, expansion) and determine the cost of the project and the expected net return or benefit of the project. Costs and benefits on private and social levels must also be considered. Social costs (pollution, depletion of resources) and benefits (playa management, improved water quality), in particular, need special consideration because they rarely are evaluated by private decision makers. Governmental command and control is a common approach to social costs, and within this approach, the private sector should be allowed to address problems how it deems best. Because development of the OWP is based on interests and concerns of end users, the OWP could be instrumental in guiding the private sector in solving social costs of water management.

In other business, Darrell Peckham, Texas Water Development Board (TWDB), reported that the OWP scope of services has been accepted by the TWDB. The contract provides matching funds for up to $600,000 of approved expenses.

Planning Team Reports

Management team leaders reported on recent work accomplished by their respective teams. Leon New, representing agriculture interests, said his team continues to count center pivot irrigation sprinklers in the Texas High Plains. Counts in 37 of the 47 counties participating in the OWP have recorded 12,698 pivots, irrigating 1,822,311 acres. Approximately 4 million acres are irrigated in the Ogallala Aquifer region.

Representing the public relations committee, Patricia Bruno revealed the new logo for the OWP. Ideally, the logo will become immediately recognizable to the public and will become synonymous with the High Plains Ogallala Area Regional Management Plan. The logo will be used in news releases and other media information.

The Ogallala Water Plan

Approved logo of the Ogallala Water Plan

The next meeting of the OWP planning committee will be September 26 at West Texas A&M University, Canyon. The oil and gas industry will be the focus, and interested persons are invited to

(See "OWP Meetings Scheduled," page 4)

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Application of Biofilm Studied

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process. Further degradation studies will determine growth rates, half saturation concentrations, appropriate inhibition constants, and substrate utilization rates.

Finally, engineers will assess data relative to HE-degradation by biofilms to determine the feasibility of using the biofilms to achieve significant remediation of HE-contaminated groundwater at Pantex. The question remains whether the technique will be most effective when the biofilm is established on the GAC prior to pumping contaminated water through or when the water is pumped through first, the HEs absorbed, and a biofilm established. Methods for evaluating the ability of the biofilm to degrade HEs will involve pumping water containing various concentrations of HEs for various periods of time over the film and/or removing the HEs from the groundwater by first pumping it over GAC and then establishing the biofilm on the HE-contaminated GAC. The subsequent presence and concentrations of HEs will be monitored by filtrate analysis for both methods.

The research will continue into 1998. Determining how to keep the biofilm viable and establishing the conditions necessary for it to retain its HE-degrading abilities is a task that remains for 1997.

Modeling Aids Water Management

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greater withdrawal rate than was previously expected. Recommendations will include measures that can be implemented to improve the accuracy of the projections.

Future modeling work will involve incorporating the BASIC programs into MODFLOW, enabling MODFLOW to adjust pumpage rates in wells during simulations. This will allow water resource managers to quickly compare different scenarios of long-term water conservation and see the effect on aquifer storage levels.

The OWP, a regionwide effort involving agribusiness, political, academic, and social organizations, was started to develop and implement a plan for conserving available water resources. The OWP includes 49 counties.

OWP Meetings Scheduled

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attend. Management team leaders will hold their next meeting September 25 in Canyon, Texas. For more information, contact Lloyd V. Urban at 806/742-3597 or Wayne Wyatt at 806/762-0181.

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