TEXAS WATER RESOURCES INSTITUTE

twri New Waves

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Fort Hood's New Weapon

Composted Dairy By-products as Soil Amendment

By Kellie Potucek

Fort Hood, in conjunction with the Texas Water Resources Institute (TWRI, College Station, TX), the Blackland Research & Extension Center (BREC, Temple, TX), and the USDA–Natural Resources Conservation Service (USDA–NRCS) is exploring the benefits of composted dairy by-product utilization in an effort to improve the area's environmental quality while maintaining its premier training facilities.

Fort Hood encompasses 339 square miles of Texas Hill Country terrain characterized by prairies, shallow soils, rolling hills, woodlands and rocky streams. Throughout its 62 years of operation, Fort Hood has used this land to train troops specializing in ground combat vehicles. Many of these vehicles are designed with forceful tread that rips through soil, uproots vegetation, and leaves behind a denuded, compacted surface prone to water runoff as well as soil erosion. These effects increase sedimentation which hinders the recovery of vegetation and impacts surrounding water resources.

The Department of Army and Department of Defense recognize the severity of these concerns and are actively pursuing methods to incorporate sound stewardship practices together with combat training requirements. Working through the Rangeland Revegetation Pilot Project and in close collaboration with the USDA–NRCS, TWRI, BREC and the Texas Agricultural Experiment Station (TAES) strive to assist the military in establishing management practices conducive to environmental prosperity and quality training facilities.

When soil is compacted, as is the case on the 67,000-acre West Range at Fort Hood, the surface seals and water infiltration rates are significantly reduced. Because water is not absorbed into the soil, it becomes runoff and begins to flow downhill. At the same time, as raindrops hit the soil, the impact detaches particles causing them to be swept away by runoff. These soil particles are collectively referred to as "sediment."

The problem with sediment is two fold. First, runoff ultimately ends up in water sources such as rivers and lakes. At Fort Hood, runoff flows and their accompanying sediment are impacting the main drinking water source for surrounding communities, Lake Belton. Second, top soils contain nutrients essential to growth and survival of plants. Erosion robs the land of these nutrients, reducing vegetation's ability to restore itself. Amending impacted soils increases the capacity for rangeland revegetation.

Regrowth of vegetation is a chief focus in the Fort Hood ecological restoration process because it inherently combats water runoff and soil erosion. Plant cover shields top soil from direct raindrop impact, root networks restrain soil, and plant litter creates a coarse surface area that reduces velocity of runoff flows. The vegetation also serves as a filter to help remove sediment from water.

While commercial fertilizers are traditionally used as soil amendments, the research team is studying whether composted dairy by-products will provide an efficient substitute. Composted materials are obtained through the processing of dairy cattle manure. Composting dairy manure destroys most disease microbes, parasites and weed seeds. The result is a product high in nutrient value that may prove to be extremely beneficial in the fight against vegetation loss and soil erosion.

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New Dairy Compost Publications Available

By Jenna Smith

Six publications, funded through the Texas Cooperative Extension and the Texas Commission on Enviromental Quality Dairy Compost Utilization Project, are currently available from the Texas Water Resources Institute discussing compost use in varying environments.

Using Compost in the Urban Environment addresses compost application methods in city parks, residential lawns and businesses.
Using Organic Matter to Improve Sports Fields outlines successful methods of creating and maintaining a sports field by incorporating compost into the management program.
Using Compost for Soil Erosion Control, Sediment Control and Revegetation provides information on compost application methods and compost as a source for soil erosion and revegetation control.
Improving Compost Use through Application Methods lists equipment and techniques for various types of applications. Information about items to consider before selecting equipment and applying compost is also included in this fact sheet.
Dairy Manure Compost Facilities is a quick reference for individuals wishing to contact a compost facility or purchase dairy compost from the Bosque or Leon River Watersheds.
Incentives to Purchase Dairy Compost details the specifications that both public entities and private producers must meet to participate in the program as well as the guidelines that must be followed when applying for the incentive payment.

The publications can be found at http://compost.tamu.edu

Dairy Compost Purchase Incentives include Private Producers

By Cecilia Gerngross

Since September 2000, public entities have been eligible to receive a rebate of $5 per cubic yard of dairy manure compost purchased through the Composted Manure Incentive Program, sponsored by Texas Commission on Environmental Quality. Recently, however, arrangements have been made for private producers outside of the Bosque Watershed and within the Upper Leon or Cross Timbers Soil and Water Conservation Districts (SWCD) to receive a reduced price of $4 per cubic yard on compost purchased. Public entities or private producers wanting more information on the specifications and guidelines of dairy manure compost incentives can consult *Incentives to Purchase Dairy Compost* or contact participating SWCDs.

Texas Water Resources Institute
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THE TEXAS A&M UNIVERSITY SYSTEM

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The Texas A&M University System

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from cover

In April of 2003, TWRI and BREC established a 75 acre demonstration area at Fort Hood. Compost was introduced to the soil and a native seed mix was then distributed throughout. Water quality and vegetation has since been monitored. After initial promising results, the area was increased to 200 acres. The research team is testing the application of various levels of compost and seed in this extended area.

The compost used in this research is acquired from the Bosque River Watershed in North Central Texas. Currently, this watershed is in crisis due to the overwhelming amount of manure generated by surrounding dairy farms. Increasing numbers of cattle per acre quickly saturate man-made lagoons built to contain animal waste. The resulting overflows impact water quality most notably with high levels of phosphates. Removing the excess manure from the watershed in the form of compost is vital to reversing these effects. The TAES Rangeland Revegetation Pilot Project is assisting this effort.

In short, dairy compost utilization fights environmental concerns on two fronts. First, the ongoing TAES research suggests that dairy compost amends poor quality soils with nutrients necessary to enhance vegetation growth. Second, removal and treatment of manure reduces waste, improving environmental quality within the North Bosque River Watershed.

Fort Hood's proactive approach in addressing environmental concerns will help to secure the future of the area's ecosystem and quality of its training facilities and help maintain the environmental and economic viability of the Bosque River Basin dairies. Additionally, research will contribute to the health and preservation of environments downstream.

Groundwater Educational Program

Landowner and citizen information on groundwater leasing, marketing and sales

Groundwater leasing, marketing and sales will be the focus of a conference series set for April 1 in San Antonio, July 29 in Alpine and September 14 in Nacogdoches.

The conference series, organized by The Texas A&M University System, Texas Cooperative Extension, Texas Department of Agriculture and USDA Natural Resources Conservation Service, is designed for landowners, realtors, bankers and members of conservation districts involved in groundwater transactions.

Ronald Kaiser, a professor at Texas A&M University whose specialty is water marketing, law and policy and one of the conference organizers, said these day-long conferences will describe laws governing groundwater sales and exports, implications for landowners and communities, and negotiation of sales arrangements. These conferences seek to inform landowners about the opportunities and issues associated with selling and leasing the water under their land and how they can protect their interests.

Kaiser said, "Buying and leasing water is not a new idea. Landowners and cities have been buying and selling water for more than 100 years. However, in the last five years, cities have increasingly sought to acquire groundwater from rural areas and move it to growing population centers. It is a hot topic, and the political and public interest is definitely up."

Speakers at the conferences include a number of experts and attorneys who deal with water issues. A question and answer forum will be included in the conferences to allow participants to interact with experts.

Conference cooperators and supporters include the Texas Water Resources Institute, Texas Alliance of Groundwater Districts, Texas Farm Bureau, Environmental Defense Sierra Club, Department of Natural Resources at Sul Ross State University, College of Forestry Stephen F. Austin State University, and the City of San Antonio.

Registration until 10 days prior to the conference is $55 per conference. Late registration is $75. Space is limited at each site. To register, call Kathryn Nachlinger at (979) 845-5419 or register online at http://texaswater.tamu.edu. For additional conference information, contact Val Silvy at (979) 845-2027 or vasilvy@ag.tamu.edu.

Over-Watering of Yards a Problem

Deep and Infrequent Irrigation is Key for Efficient Water Use

By Jenna Smith

A mature walnut tree sits on a lawn of St. Augustine grass, dotted with crape myrtles, rose bushes, ficus trees and dwarf yaupon hedges. The landscape, along with the sandy loam soil at the Texas A&M Research and Extension Center in Weslaco, makes it the ideal site for studying water requirements of a common residential landscape system, not just of individual plants.

Using sensors placed in 64 different areas and depths, Roger Havlak, extension program specialist for turfgrass and water management with the Texas A&M University Department of Soil & Crop Sciences, measured both potential evapotranspiration from weather stations and actual evapotranspiration. Potential evapotranspiration is the maximum amount of water lost in a cropping system in a given time period from both plants and evaporation. Actual evapotranspiration is soil moisture loss of a landscaping system consisting of trees, turfgrass and shrubs.

Havlak found that the top eight inches of soil lost the greatest fraction of soil water through plant absorption and evaporation. If the soil moisture content remained high, plants would utilize water in the top eight inches of soil, but, in a water-stressed environment, plants were capable of extracting water from as deep as 24 inches below the topsoil.

"Plants are opportunistic," he said. "They will use as little energy as possible to maintain themselves. If homeowners irrigate lightly and frequently and do not build water reservoirs deep in the soil, drought conditions that dry the topsoil could possibly injure or even kill the plants. Thus, deep and infrequent irrigation is recommended."

Havlak said system zoning is another useful tool for water conservation. It involves applying water in different zones, separated by water requirements of the plants and application methods. Because water loss rates are normally different among plants in landscapes, he said, this approach is also recommended.

Havlak used the ratio of actual evapotranspiration to potential evapotranspiration to calculate the landscaping coefficient for the Weslaco landscape. Landscaping coefficients remained less than 1 during the study with monthly coefficients ranging from 0.51 to 0.67.

"We are already working with several municipalities to analyze and compare homeowner water consumption rates to weather station potential evapotranspiration rates to determine the number of homeowners possibly over-watering their landscapes as well as the potential savings that may be realized if potential evapotranspiration was used," he said. "This could certainly be a useful tool for municipalities to use in their day-to-day assessments for conserving water."

The potential evapotranspiration value from the weather station was an excellent predictor of water loss rates within the Weslaco landscape system. However, because of the differences among plant varieties and soil types throughout Texas, Havlak and the turfgrass staff at Texas A&M plan to introduce an additional five to ten sites within the next five years, beginning in April 2004 at Texas A&M University Riverside Campus, near Bryan, Texas.

The Texas Evapotranspiration Network can be accessed at http://texaset.tamu.edu.
The turfgrass site at Texas A&M is http://aggie-turf.tamu.edu.

Where Is Salvaged Water Going?

Examining the Effects of Saltcedar Control on the Pecos River

By April Smith

The Pecos River Ecosystem Project has consisted of aerial herbicide treatment to more than 10,000 acres of saltcedar. For every acre treated, it is estimated to salvage between three and five acre-feet of water per year. Research is ongoing, and there are still more than 200 river miles to be treated. If the river reclaims much of its water supply, where would all of this water flow?

"We want to find out where the salvaged water is going, and determine the impacts of saltcedar control on the Pecos River," said Alyson McDonald, a doctorate student at Texas A&M University and a hydrology assistant with Texas Cooperative Extension at Fort Stockton.

In the past year, McDonald has been conducting borehole explorations to examine soil characteristics, which will determine spatial variability in hydrological properties.

Six new monitoring wells equipped with water level sensors and loggers have been established near the Pecos River, adjacent to areas where saltcedar was treated and untreated, in order to better understand subsurface flow regimes.

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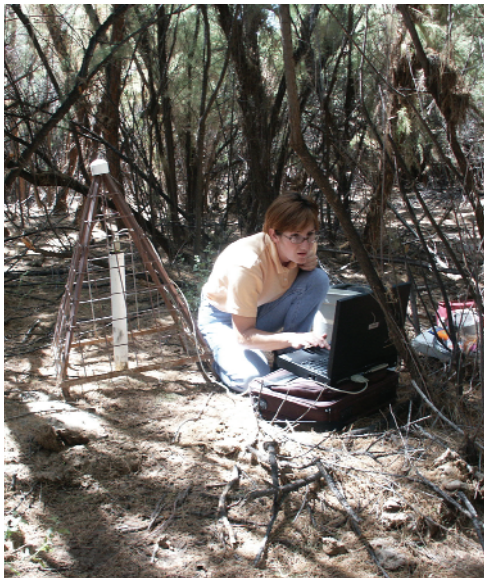

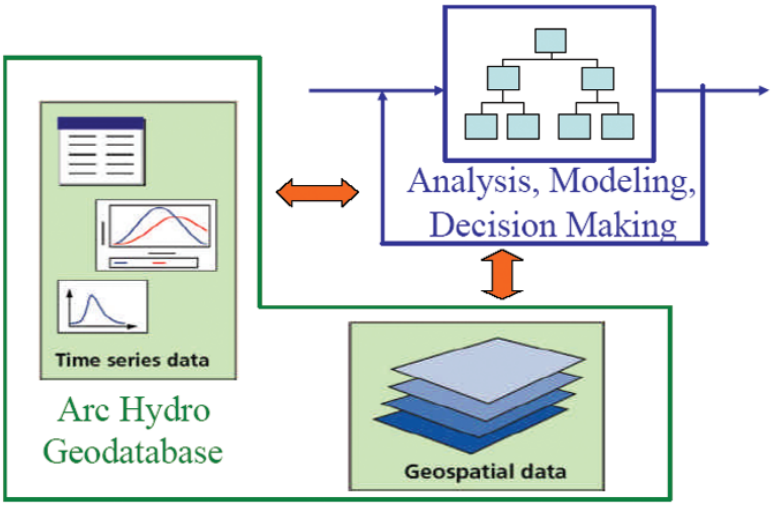

What Lies Beneath

Groundwater Data Model Research

By Kellie Potucek

In an effort to standardize the process for groundwater data assembly and storage, a groundwater data model is in the works at the University of Texas Center for Research in Water Resources. Graduate student, Gil Strassberg, and his advising professor, David Maidment, began their research on the new data model, Arc Hydro Groundwater, in March of 2003.

"By modeling groundwater systems, we develop a better understanding of how water flows in the subsurface, therefore enabling better management and utilization of this resource," explains Strassberg.

Wide acceptance and implementation of Arc Hydro, a surface water data model, highlighted the need for a complementing groundwater information system. This need was amplified by current conflicting methodology in describing groundwater information such as geologic layers. Without a standard, cooperation and data sharing between individuals within the groundwater field is difficult and the water planning process is hindered.

While a number of environmental agencies are confronting the task of data assembly, CRWR's research is unique in that the final product will provide a full conceptual model of groundwater systems. The researchers' ultimate goal is to integrate Arc Hydro with the new groundwater component in order to describe surface water and groundwater simultaneously.

Through researching existing data models, Strassberg is identifying relevant aspects of groundwater systems, such as aquifers, wells, cross sections, and solids, to be incorporated in the new data model. Additionally, he has begun to establish a method to conceptually describe three dimensional subsurface properties and represent measurements at wells and boreholes.

As part of the data model design process, a data model interface was designed for MODFLOW, the most common software package used in groundwater modeling. The model allows for the storing of inputs and outputs within geographic information systems. It has been tested to integrate model inputs and outputs from the Texas Water Development Board Groundwater Availability Models.

The groundwater component of Arc Hydro is estimated to be complete by the summer of 2005.

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Multiple water releases from Red Bluff Reservoir will be scheduled beginning this summer to detect seasonal changes in the shallow aquifer's response to saltcedar control. A team including McDonald and Dr. Charles Hart, associate professor and Extension Range Specialist, will use data from seepage runs and monitoring wells to calculate a water balance, which includes water inputs and water losses.

These measurements will establish a relationship between ground and surface water. McDonald and the rest of the team will use this data to make a subsurface flow net, a map that shows seepage patterns.

According to McDonald, patterns in water flow and soil stratigraphy are apparent in data collected through 2003. The total water loss, including evapotranspiration, is dependent on the depth to the water table. There is also the presence of a clay layer throughout the area about 10 feet below the soil surface. McDonald said the team should be able to map this clay layer, making water measurement easier if there is limited percolation through this layer.

"We hope to create a model useful for other arid or semiarid regions to evaluate the efficacy of saltcedar control, and whether it can be used to meet their goals," said McDonald.

McDonald received a grant from TWRI, funded by the U.S. Geological Survey, providing for the purchase of water-monitoring equipment for use in this study.

"The average Texan should view this project as an important component of local water management plans to meet future needs," said McDonald. "We're not finding a new source; we're just manipulating the water balance to meet future needs."

Freshwater Inflows

Studying the Health of Benthic Microalgae in Coastal Bays and Estuaries

By April Smith

Demands for freshwater resources in Texas watersheds are forecasted to increase steadily due to population and economic growth and associated requirements for drinking water and agricultural irrigation. As a result, freshwater inputs into coastal bays and estuaries will likely be reduced, leading to higher salinities of Texas estuaries.

Alyce Lee, a doctorate student at Texas A&M University in the Department of Oceanography, is researching the effects of light, nutrients and salinity on benthic microalgae (BMA) community structure and productivity. BMA are microscopic, filamentous photosynthetic plants that live in the upper few millimeters of sediment surface layers. They inhabit shallow water and intertidal systems where there is sufficient light and nutrients. BMA are considered major primary producers in estuarine and coastal environments, and play a vital role in the food web serving as a carbon source for higher trophic levels.

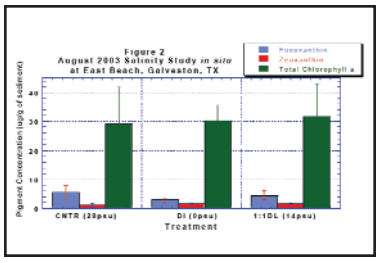
"The goal of my research is to provide a valuable tool for estuarine and ecosystem managers to use to determine the health of their system," said Lee.

Lee has done two experiments to date, one on Galveston Island's East Beach and one in the laboratory. Lee's experiments are conducted using sediment cores and water samples taken from the bay, as well as laboratory-produced samples of varying salt concentrations. Lee is trying to show that a 25 percent increase in salinity will result in a significant shift in BMA community composition, resulting in a reduction of BMA biomass and primary production.

If the food quality or species composition of the BMA community is altered due to higher salinities, higher trophic levels could be negatively impacted. This could have significant implications on the tourism and fishing industries by ultimately resulting in lowered shrimp, oyster and fish yields.

"By examining the status of these organisms you obtain insights into ecosystem health," said Lee. "BMA are good indicators of ecosystem health because they respond quickly to changes in their environment, whether negative or positive."

"People need to realize life thrives in sandy areas and those areas are still extremely important for estuarine diversity," said Dr. James Pinckney, Lee's supervisor and assistant professor in the Department of Oceanography at Texas A&M.



Tracking Hormone Movement in Soils and Water

Examining Degradation, Adsorption and Movement Characteristics of Estrogenic Compounds

By April Smith

Land application of manure presents an environmental loading of estrogens that may result in regional surface or ground water concentrations significantly above ambient levels. Dr. Ann Kenimer, associate professor in the Department of Biological and Agricultural Engineering, is leading research to investigate the behavior of estrogenic compounds inherent to dairy waste. Kenimer received a $10,000 Water Resources Research Equipment Grant through TWRI to facilitate this research.

Kenimer's research assistant, Jeff Ullman, conducts the majority of the laboratory investigation. The research is in its infancy and will continue throughout this year. Results may lead to better management practices (BMP) for animal feeding operations to reduce the amount of estrogenic compounds in lagoon effluent. The study consists of three stages.

Stage One: Preliminary monitoring will provide baseline hormone concentrations not previously explored in livestock waste. Ullman will identify background levels of the hormones that form naturally during degradation of lagoon effluent.

Stage Two, part one: Degradation rates of the estrogenic compound 17β-estradiol will be determined by applying effluent at representative, agronomic land disposal rates to soils typical of Texas concentrated animal feeding operations (CAFOs). The samples will be placed under sunlight lamps simulating field conditions and maintained at room temperature.

Stage Two, part two: Principal metabolites identified in part one will then be evaluated in-situ to determine adsorption characteristics, which will improve understanding of runoff patterns. Alternately, effluent containing these same metabolites will be added to leaching columns and representative rainfall rates will be simulated. Analysis of estrogenic compounds at various depths in the columns will be conducted to determine leaching properties of 17β-estradiol and key metabolites.

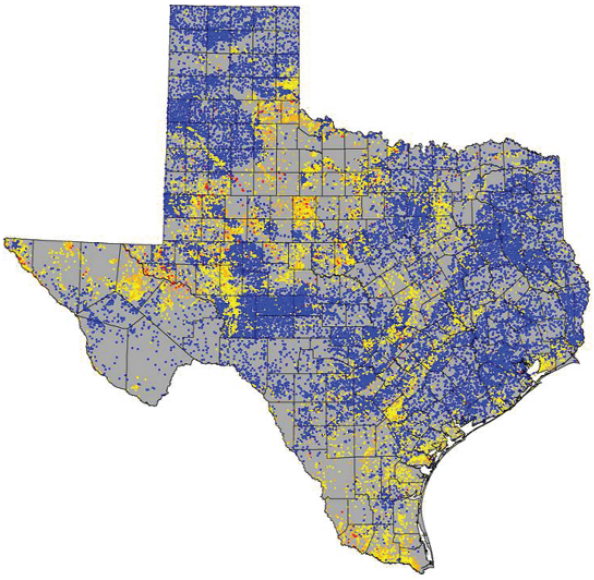
Stage Three: Utilize laboratory scale data including degradation rates, adsorption characteristics and profile movement to modify a small-scale watershed approach into a real-world situation.

"The hope is to better understand these chemicals and their affects," said Ullman. "If we can keep CAFO managers at the forefront of these issues, then we can help them develope BMP's to limit the transport of these compounds to waters of concern."

Developing Alternative Water Resources

Using Desalinization Technology in West Texas

By William E. Fox



The Texas Water Resources Institute proposes taking water-treatment science out of the laboratory and demonstrating promising new technologies to West Texas communities in need of drought-proof, alternative water resources. The Research and Implementation Program, carried out in collaboration with scientists and engineers of The Texas A&M University System, is designed to demonstrate new technologies and obtain scientifically credible, local data for water treatment practices. The program will illustrate how the data can be used to improve the quality and quantity of water supplies and help guide communities in their decision making.

This program is based on a five step approach. First, scientists and engineers work with local stakeholders to facilitate and define the water resource needs of local communities, and how desalination technologies might fit into their planning. The facilitation provides the answers to such questions as, "What is needed? How can we achieve it? How will it benefit our community?"

The next step involves the integration of the various stakeholders' interests and coordination of the consensus building process to determine opportunities for development of new water resources. This step provides for the review of potential approaches and technologies as well as estimating costs and identifying funding sources.

From the alternatives identified, the program works with local officials and stakeholders to select priority alternatives and develop a demonstration program. Partners are identified at this stage for regulation issues, funding or building duties, and appropriate state and federal agencies involvement.

Once a demonstration is determined, A&M System scientists and engineers design, build and operate the selected technology for a pilot scale demonstration. Outcomes from demonstration implementation include field testing, more accurate cost estimates and identification of any other obstacles to large-scale implementation.

Lastly, the A&M System program works with local officials to evaluate all aspects of the program including monitoring of stakeholder opinions and technology, optimization studies based upon demonstration results and planning of capital upgrades.

If you are interested in this project or for further information please contact Mr. David Burnett at (979) 845-2274.

Chamber of Research

Controlled Environment Assists Soil and Water Studies

By Kellie Potucek

In the absence of a controlled environment, accurate research of reduced soils is virtually impossible. Because redox conditions powerfully impact the chemistry of soil, sediment, and water, exposure to oxygen severely corrupts the integrity of samples.

Texas A&M University recently purchased a controlled environment chamber to support research of reduced soil, sediment, and water. The cost was offset by a Water Resources Research Equipment Grant awarded through TWRI. Professor Richard Loeppert, of the Soil and Crop Sciences Department, led the quest for the chamber acquisition.

"In the handling of natural soil and water samples, the maintenance and control of redox potential is of paramount importance," explained Loeppert.

Samples are immediately contained after removal from their natural environment and are placed in the chamber by way of a side compartment. Pressure and redox conditions are controlled and maintained via nitrogen pumps. Sealed glove-like apparatuses enable researchers to manipulate samples within the chamber.

The valuable data to be obtained through use of the equipment far outweighs its $15,000 price tag. Currently, studies are chiefly centered on the reactions of minerals under wetland conditions, but a variety of other projects will also benefit. Additionally, the chamber is used to prepare samples for Fourier transform infrared spectroscopy, x-ray diffraction, and scanning electronic microscopy analysis.

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