



DIVINING ROD

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Tech Scientists Study Remote Sensing of ET in Mountain Areas

Researchers receive USGS national competitive research grant

by George Zamora, NM Tech

Over the course of the last two decades, hydrologists and other scientists have used emerging technologies such as satellite optical remote sensing to develop and refine several operational evapotranspiration (ET) algorithms that are now routinely used in hydrological studies in New Mexico and worldwide.

However, these remote sensing based algorithms have encountered significant difficulties when used by hydrologists or other water resources professionals to estimate evapotranspiration in mountainous regions because of variability in mountain meteorology, soils, and topography.

In an effort to improve the application of remote sensing algorithms to mountainous terrains, the U.S. Geological Survey recently awarded a research grant to fund a field study in New Mexico, titled *“Validation, Calibration, and Improvement of Remote Sensing ET Algorithms in Mountainous Regions.”* The multi-year research project is spearheaded by New Mexico Tech hydrology professor Jan Hendrickx, along with Tech post-doctoral researcher Jan Kleissl.

“Up until now, most of the work on evapotranspiration and water usage in New Mexico and elsewhere has focused on riparian areas and agricultural fields, which are relatively flat,” says Hendrickx.

“What we haven’t seen before is an extensive study in mountainous areas where most of the water that makes it down to the flat valley floors comes from,” he adds. “We’ve been focusing on the demand side, but not the supply side of water resources in New Mexico.”

(continued on page 2)



The scintillometer research team, from left to right: Kim Bandy, Jan Hendrickx, Whitney Defoor, the scintillometer, Jesus Gomez, and Jan Kleissl. Field photos by George Zamora.

INSIDE

51st Annual New Mexico Water Conference program page 3

NM Tech student studies transpiration water loss page 6

USGS awards national research awards page 8



(continued from page 1)

Mountains cover approximately 25 percent of the world's land area, accommodate 26 percent of the world's population, and generate about 32 percent of surface runoff on a global basis.

However, in New Mexico and other semi-arid mountainous regions, runoff from mountains can represent as much as 90 percent of the total surface runoff into lower-lying basins such as the Rio Grande or Colorado River.

As part of their study, Hendrickx and Kleissl will set up various measuring and recording stations at field sites located atop the Magdalena Mountains and within the Valles Caldera National Park in New Mexico.

The New Mexico Tech hydrologists are using scintillometers—novel scientific instruments that measure atmospheric optical disturbances over distances of up to three miles—to gauge turbulent heat fluxes at mountainous sites. Additional meteorological measurements taken, such as wind speed and direction, surface and air temperature, humidity, and barometric pressure, allow them to examine the determinants of ET in mountainous terrains, thus providing clues to improving ET algorithms there.



Setup of four instruments during the Scintillometer Intercomparison Study conducted by Kleissl and Hendrickx in the Sevilleta National Wildlife Refuge in Winter 2005.

In addition, other contributing factors, such as slope, topography, vegetation, solar radiation, and snow accumulation, are being considered by the scientists as they attempt to improve remote sensing ET algorithms.

“Of course, the mountainous terrain itself also contributes to complexities encountered in this study,” says Kleissl. “Driving to and from these field sites to set up stations and obtain measurements can be a difficult challenge, so accessibility becomes a big issue.

“It's much easier to conduct these types of studies in alfalfa or corn fields, but my undergraduate and graduate

research assistants and I are ready to take on the mountains,” he adds.

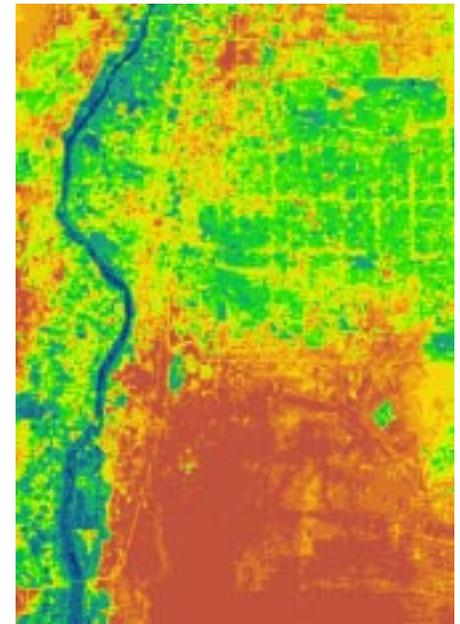
“In semi-arid regions, such as New Mexico and the rest of the Southwestern United States, evapotranspiration represents the greatest flux of water lost from agricultural fields, riparian areas, forests, rangelands, lakes, and rivers,” Hendrickx states. “It goes up into the atmosphere, and it's gone.

“Therefore, improving ET estimates in the mountains is crucial for determining the regional water balance, not only in New Mexico and the surrounding region, but also in similar mountainous areas worldwide,” Hendrickx points out.

Several government agencies besides the USGS have already expressed interest in using improved ET algorithms in their water resources planning, including the U.S. Bureau of Reclamation, the Interstate Stream Commission, the New Mexico Office of the State Engineer, and the Middle Rio Grande Conservancy District.

“Our goal is not so much to develop new models or algorithms for how evapotranspiration occurs in mountains as it is to improve current ET algorithms by using an integrated approach that considers the particular features of mountains,” Kleissl says. “These improved ET algorithms will still be able to be used in flat areas as well.”

In addition to the USGS funding, supplemental support for the ongoing research project currently is being provided by the Water Resources Research Institute, New Mexico Tech, and a National Science Foundation funded program—the Experimental Program to Stimulate Cooperative Research (EPSCoR).



An ET map of the South Valley of Albuquerque for a 22x32 km riparian, irrigated, desert, and urban area from LandSat7 (at 30 m resolution). Map courtesy of Sung-ho Hong and Jan Hendrickx.

See page 8 for list of 2006 USGS National Competitive Grants Program awards.



51st Annual New Mexico Water Conference

Water Quality for the 21st Century

Preliminary Program

Tuesday, October 3

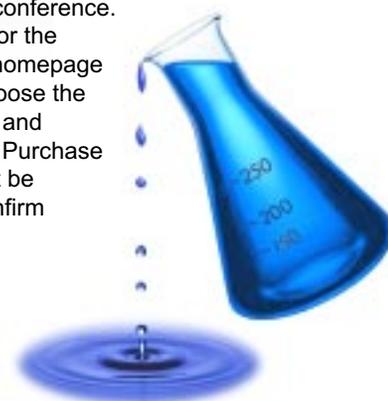
- 8:30 Welcome
Karl Wood, WRRRI Director
Martin J. Chavez, Albuquerque Mayor
- 9:00 A Brief History of the Development of New Mexico's Water Quality Standards and Steve Reynolds' Role in that Development
John Hernandez, WRRRI/NMSU
- 9:20 Current Water Quality Control Standards
Howard Hutchinson, NM Water Quality Control Commission
- 9:40 New Drinking Water Regulations
Dzung Kim Ngo Kidd, USEPA Region 6 Drinking Water Section
- 10:10 BREAK
- 10:40 Coordination of Water Quality and Water Quantity Issues in New Mexico
Perspective of State Engineer *John D'Antonio*, NM Office of the State Engineer
Perspective of Secretary *Ron Curry*, NM Environment Department
- 11:30 New Mexico Environment Department's Water Quality Goals
Marcy Leavitt, NM Environment Department
- 12:00 Luncheon
- 1:30 Albuquerque's Water Quality Program
John Stomp, City of Albuquerque's Public Works Department
- 2:00 Regulatory Challenges Faced by New Mexico's Small Communities
Matt Holmes, New Mexico Rural Water Association
- 2:30 Water Quality Challenges of the Irrigated Agriculture Community on the Lower Rio Grande
Gary Esslinger, Elephant Butte Irrigation District
- 3:00 BREAK
- 3:30 Isleta Pueblo's Perspective on NPDES Permitting and Storm Water Runoff
Jim Piatt, Pueblo of Isleta
- 4:00 Industry and Water Quality
Oil & Gas: *Frank W. Yates, Jr.*, Yates Petroleum Corporation
Mining: *Tom L. Shelley*, Phelps Dodge Mining Company
Produced Water: *David Brooks*, Oil Conservation Division, EMNRD
Electrical Power: *Matt Lavery*, Public Service Company of NM

Wednesday, October 4

- 8:10 NRCS Water Quality Programs
Linda Sheffe, Natural Resources Conservation Service
- 8:30 Groundwater Quality Contamination by Septic Tank Effluents
Dennis McQuillan, NM Environment Department
- 8:50 New Mexico's 319 Program: An Overview and a New Mexico 319 Success Story, the Cimarron Watershed Alliance, Inc.
David Hogge, NM Environment Department
Frank Atmore, Cimarron Watershed Alliance, Inc.
- 9:10 NMED's Pursuit to Establish Primacy for NPDES Permitting in New Mexico
Steve Baumgard, NM Environment Department
- 9:30 BREAK
- 10:00 Natural Sources of Saline Water in the Rio Grande
Fred Phillips, NM Tech
- 10:30 Water Quality Issues on the Navajo Nation
Arvin Trujillo, Navajo Nation Division of Natural Resources
- 11:00 Albert E. Utton Memorial Water Lecture:
100 Years Under the Water Code
G. Emlen Hall, UNM School of Law
- 12:00 Adjourn

Information on WRRRI's Homepage

Check WRRRI's homepage for updated information about the conference. You can also register for the conference using our homepage at wrrri.nmsu.edu. Choose the Water Conference link and follow the instructions. Purchase order or payment must be received by mail to confirm registration.





ENMU student investigates prehistoric water management

by Sara Ash, WRRI

Monica L. Murrell, a master's anthropology and applied archeology student at Eastern New Mexico State University, received one of WRRI's 2005 student research grants for her research entitled "An Investigation of Prehistoric Water Management in the Chupadera Arroyo Basin, Central New Mexico."

Archeological site LA 1073, known as the Pueblo Oso Negro, is located in the Chupadera Arroyo Basin. It dates back to the Pueblo IV period circa 1300-1450 A.D., a time characterized by widespread population aggregations occurring across the Greater Southwest. Since the closest permanent water supply lies two miles away from Pueblo Oso Negro, Murrell suspected that a depression adjacent to the pueblo likely met the domestic water needs of the prehistoric community. With the assistance of her advisor Dr. Phillip Shelley, Murrell conducted research to determine the nature of the depression, the seasonality of water storage, and how the basin was supplied with water.

Murrell conducted geoarchaeological analyses including particle size

distribution, particle morphology and surface texture, as well as weight loss on ignition tests to determine organic and carbonate content. These analysis methods were used to determine the depositional environment and mechanisms of sediment transport by wind, water, or gravity. The results of the analysis suggest a formerly aqueous environment in the depositional history of the feature. The particle size distributions demonstrate patterns characteristic of hydrological processes, while the particle morphology and surface texture of sand grains recovered from the feature were predominately characterized by rounding and polishing.

The presence of ostracodes and cattail pollen would further support that the depression stored water. Since cattails only grow in areas with permanently damp soil, the presence of cattail pollen would indicate a perennial water supply. While Murrell identified one species of ostracode and three species of gastropods within the depression, her pollen analysis results were inconclusive, and she was unable to determine the seasonality of the water storage.



Monica Murrell maps the depression using a Trimble GPS unit.

Using GIS software, Murrell conducted a watershed delineation analysis to determine the depression's contributive watershed. She found a spring-seep water source located within the boundary of the depression and discovered water about 8.8 feet below the ground surface, even though the water table is known to be over 1,500 feet deep.

The findings of Murrell's research suggest that the depression was once used as a water management feature. Murrell hopes that understanding relatively low-level technological solutions to water problems may provide methods to address current water problems without requiring large investments in technology and non-renewable energy.

After completing her master's degree in August 2005, Murrell began working as a cultural resources specialist for the Zuni Heritage and Historic Preservation Office in Zuni, New Mexico.



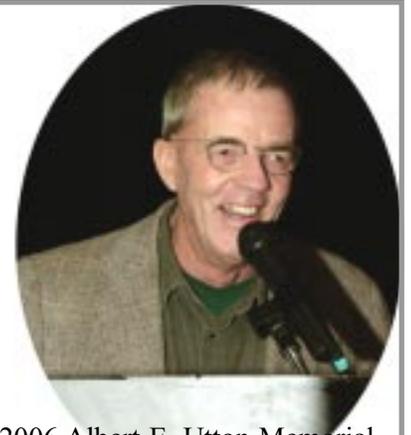
Overview of the depression being mapped with a GPS unit.



Albert E. Utton Memorial Water Lecture Presents Professor G. Emlen Hall University of New Mexico School of Law

100 YEARS UNDER THE WATER CODE

51st Annual New Mexico Water Conference
October 3-4, 2006
Hotel Albuquerque at Old Town



The New Mexico Water Resources Research Institute is very pleased to announce the 2006 Albert E. Utton Memorial Water Lecturer, G. Emlen Hall. Professor Hall will address the 1907 Water Code, which will be 100 years old in 2007. He will use the birthday to describe New Mexico's basic water law, emphasizing the law's wisdom, restraint, and capacity for change. Professor Hall will set the stage by providing the narrative behind the 1907 code and the ways in which it has changed – and hasn't changed – in a hundred years. This year's Utton lecturer says that the occasion will allow him to honor some of the wise, old water people including Morris Bean (the author of the code), Steve Reynolds, Phelps White, Al Utton himself, representatives of the Zuni Pueblo, and Sabino Samuel Vigil. Their contributions, as well as those of the authors of the recent Herrington case, share attributes that make reports of the code's demise premature.

G. Emlen Hall is a law professor at UNM's School of Law. He received an A.B. from Princeton University and a J.D. from Harvard University. Em is editor in chief of the *Natural Resources Journal*. His research and writing focus on the history of land and water in the Southwest. He has written two books on water issues: *Four Leagues of Pecos: A Legal History of the Pecos Grant from 1800 to 1936* (1984) and *High and Dry: The Texas-New Mexico Struggle for the Pecos River* (2002). Prior to joining the UNM law faculty in 1983, he spent seven years at the Office of the State Engineer. During his time there, he wrote an administrative history of the Pecos River Compact from its inception in 1949 to 1974. This was the beginning of his research for his recent book, *High and Dry*. When Em first arrived in New Mexico in 1969, he wrote for and edited the *New Mexico Review*, a monthly investigative journal. He also practiced law in Pecos, where he lived and served as village planner, attorney, and municipal judge for the Village of Pecos. He has worked for Northern New Mexico Legal Services and the New Mexico Land Grant Demonstration Project.

51st New Mexico Water Conference to include tour of the Albuquerque Water Treatment Plant

Join us Monday afternoon October 2 for a tour of Albuquerque's Water Treatment Plant currently under construction and scheduled to begin operating during the summer of 2008. The plant will treat San Juan/Chama river water, eventually treating about 90 million gallons of surface water a day. The tour will begin at 1:00 pm at the conference site, Hotel Albuquerque at Old Town, with an overview of the project. Participants will board the tour bus at 1:30 and travel to the Rio Grande to see the inflatable bladder dam, diversion channel, and start of construction of the raw water pump station. The tour group will also be able to see the pilot treatment plant at this site. The pilot plant produces treated surface water that mimics the Water Treatment Plant processes for testing and tasting purposes. The bus will then travel to the water treatment plant site and take a driving tour of the construction. The water treatment plant features grit basins, ponds, a settled water pump station, rapid mix, flocculation/sedimentation, ozonation, filtration, and finished water storage and pumping facilities. The bus should arrive back at the hotel around 4:30. Space is limited on the bus, so please make sure you sign up early for the tour.

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has approved
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legal education
credits for the
**51st Annual
New Mexico
Water Conference**



At three field sites in northern New Mexico, Sue White, an environmental engineering major at New Mexico Tech, and her faculty sponsor Fred Phillips investigated sap flow in pinon-juniper, ponderosa pine, and mixed conifer ecosystems. White's project was an extension of a summer transpiration project funded by Nathan McDowell from Los Alamos National Laboratory (LANL). LANL set up the three monitoring sites, one located at the lab and two at the Valles Caldera National Preserve. With the assistance of a WRI student research grant, White used these sites to continue monitoring data in the fall and winter of 2005.

White aimed to determine the relative quantities of transpiration of the pinon-juniper ecosystem, as well as to compare the data collected in the fall and winter with that of the summer. She collected meteorological data, tree-leaf-area to sapwood-area ratios, and sapwood-area to ground-area ratios. Unfortunately, site complications and malfunctions delayed the collection of data. Heavy cloud cover prevented the solar energy collectors from adequately charging the batteries at two sites. Because of these complications, White only analyzed data collected from September 16- 21, 2005, using different methods from Granier, Ewers, and Oren.

From this data, White determined that the juniper had the highest transpiration per unit sapwood area, but the lowest transpiration per unit leaf area. According to White, this balance is consistent with trees' hydraulic adjusting to minimize cavitation.

Although White's research did not go as well as she had hoped, she learned a lot from the experience and found her love for ecology. She is grateful to have had this research experience because it has motivated her to pursue ecological studies. White graduated from New Mexico Tech in May of 2006. She plans on attending the University of New Mexico for her master's degree.

2005 WRI student grant recipient studies transpiration water loss from PJ forests

by Sara Ash, WRI



Sue White and Karen Brown (LANL) installing dendrometers at the Ponderosa Site.



The power set-up at the Spruce Site.



Congratulations to Outstanding Student Presenters!

2006 Water Research Symposium

Oral Presentation Winners

Frederick Partey, New Mexico Tech
Arsenic Sorption onto Laterite Iron Concretions: Temperature Dependence

Lydia Zeglin, UNM

Controls on Water Quality in a Heavily Managed Aridland River

Chelsea Crenshaw, UNM

Nitrogen Dynamics in Hyporheic Sediments using $^{15}\text{NO}_3\text{-N}$ Tracers

Poster Presentation Winners

Sarah Shannon, UNM

Degradation of Arsenic Bearing Residuals in a Landfill Environment Due to Anaerobic Bacteria

Elizabeth Rodriguez, El Paso Community College

Drought Tolerance of Bluebonnets



Chris Nunn Garcia 1943-2006

Chris Nunn Garcia, a longtime friend of the New Mexico WRRI, died of lung cancer on July 23, 2006 in Albuquerque. Over the years, Chris participated in several Annual New Mexico Water Conferences, dating back to 1987 when she spoke on urban purchases of water from farms and whether the market was the answer to western water scarcity. At about the same time, Chris received a grant through the WRRI, and the results were published by the institute in 1991 in a report entitled, "Expediting Changes in Water Use – Hydrologic Criteria and Market Transactions." The report was co-authored by Shaul Ben-David, Julie Urban, and John Shomaker, who were with the University of New Mexico at the time, and A.W. Blair and K. Stevens of New Mexico State University.

Born Susan Christopher Nunn, Chris worked in academics, public policy research, and community service. After giving birth to three children, she graduated from the University of New Mexico with a bachelor's degree and



Chris Nunn Garcia and her husband, Albert Ernest Garcia.

later received a Ph.D. in natural resources economics and law from the University of Wisconsin Madison. An award-winning teaching professor and highly regarded multi-disciplinary academic, Chris built many community projects, including founding the New Mexico Regional Water Planning Dialogue and running several major projects for the UNM Law School's Utton Center for Transboundary Resources.

Chris will be remembered very fondly by all of us who had the privilege to work with her.

WRRI Honored by National Water Group

The New Mexico Water Resources Research Institute (WRRI) received a "Friends of UCOWR" award recently at the organization's annual meeting held in Santa Fe. The Universities Council on Water Resources has 83 member universities and recognizes educational institutions, individuals, and groups that have made a significant contribution to increased public awareness of water resources development, use, or management.

The award recognized the New Mexico WRRI, which was formed in 1963 and used as a model to authorize



WRRI staff present to accept UCOWR award included from left, Director Karl Wood, Bobby Creel, Kris Fury, and Quita Ortiz.

the 1964 Water Resources Act. The Act led to the formation of 53 more institutes, one in each state and territory, by New Mexico's U.S. Senator Clinton P. Anderson and others. The New Mexico WRRI was chosen as one of the top five in a national review of all 54 water institutes in 2000.

In making the award, WRRI staff was touted for "...the energy and skill they have provided in the development of this year's annual UCOWR/NIWR conference, and especially its Director, Karl Wood, for the service he has given to UCOWR as a member of the Board of Directors and President."



USGS announces national research awards

The U.S. Geological Survey selected eight proposals for funding under the fiscal year 2006 National Institutes for Water Resources and U.S. Geological Survey National Competitive Grants Program. The program received 61 proposals requesting a total of \$8.5 million. Given that less than \$1 million was available, many excellent proposals could not be funded, according to John E. Scheffter, Chief of the Office of External Research at the USGS. Proposal abstracts are available at http://water.usgs.gov/wrri/06grants/national/national_index.html.

Evaluating Alternatives for Watershed-Scale Design of BMPs

John W. Nicklow, Southern Illinois University (\$90,948; 2 years)

Application of Wireless and Sensor Technologies for Urban Water Quality Management

William A. Arnold, Miki Hondzo, Raymond Hozalski, and Paige Novak, University of Minnesota in collaboration with Paul Capel, USGS Minnesota Water Science Center (\$149,176; 2 years)

Validation, Calibration, and Improvement of Remote Sensing ET Algorithms in Mountainous Regions

Jan Hendrickx and Jan Kleissl, New Mexico Institute of Mining and Technology in collaboration with David Stannard, Branch of Regional Research, Water Resources Discipline, Central Region, U.S. Geological Survey, and Alan Flint, USGS California Water Science Center (\$74,795; 2 years)

Collaborative Research on In Situ Denitrification and Glyphosate Transformation in Ground Water: NAWQA Eastern Iowa Basins Study Unit

Scott Korom, University of North Dakota in collaboration with Paul Capel, USGS Minnesota Water Science Center (\$91,988; 3 years)

An Econometric Investigation of Urban Water Demand in the U.S.

Ronald C. Griffin, The Texas A&M University (\$103,683; 2 years)

Microtopography Effects on Vegetative and Biogeochemical Patterns in Created Wetlands: A Comparative Study to Provide Guidance for Wetland Creation and Restoration

Changwoo Ahn, George Mason University in collaboration with Gregory Noe, Branch of Regional Research, Water Resources Discipline, Eastern Region, U.S. Geological Survey (\$58,115; 2 years)

West-Wide Drought Forecasting System: A Scientific Foundation for NIDIS

Anne Steinemann, Dennis Lettenmaier, and Andrew Wood, University of Washington in collaboration with Michael Dettinger, Branch of Regional Research, Water Resources Discipline, Western Region, U.S. Geological Survey and Randall Hanson, USGS California Water Science Center (\$250,000; 3 years)

Identifying High-Infiltration and Groundwater Recharge Areas

Stephen J. Ventura, John M. Norman, and Cynthia A. Stiles, The University of Wisconsin – Madison in collaboration with Randall Hunt, USGS Wisconsin Water Science Center (\$90,952; 2 years)

USGS releases pesticides report

The U.S. Geological Survey has published a report documenting pesticides in streams and groundwater across the U.S. for the years 1992-2001. The data included groundwater sites as well as streams in urban and agricultural areas. Overall, the report indicates that pesticides are found in urban and agricultural streams

throughout the year and are less common in groundwater. Pesticide levels found were seldom at concentrations likely to affect human health. The report does raise concern about levels of pesticides that may affect aquatic life or fish-eating wildlife. The report entitled "Pesticides in the Nation's Streams and Ground Water, 1992-2001" is available online at <http://pubs.usgs.gov/circ/2005/1291>.



UNM doctoral student studies mycorrhizal colonization

by Sara Ash, WRII

Riparian forests are effective filters for surface water and groundwater, and understanding whether different types of vegetation have different filtering capacities helps water managers make informed decisions about riparian areas. Along the Middle Rio Grande, non-native salt cedars have supplanted native cottonwood land cover since 1935. A 2005 WRII student research grant recipient and University of New Mexico doctoral student, Jennifer Follstad Shah studied mycorrhizal associations in salt cedar and cottonwood trees to determine their respective filtering capabilities.

Some studies have shown that salt cedars form mycorrhizal colonies comparable to cottonwoods; however, other studies have shown that salt cedars are non-mycorrhizal. According to Follstad Shah, "Mycorrhizae are fungi that colonize plant roots and augment the capacity for plants to acquire water and nutrients in exchange for carbon fixed through photosynthesis." To obtain further insight into mycorrhizal colonization in salt cedars, Follstad Shah, with the help of her faculty advisor, UNM biology professor Cliff Dahm, studied two different types of mycorrhizal colonization: arbuscular mycorrhizae (AM) and ectomycorrhizae (EM).

Follstad Shah collected root samples from both cottonwood and salt cedar trees along the Middle Rio Grande in February 2005 and July 2006 to test for both AM and EM colonization. The root samples were processed by the U.S. Geological Survey, Fort Collins Science Center, and then assessed using Johnson's gridline intersect method. The data from February 2005 show only 6 percent AM colonization in the roots of salt cedar, while EM colonization is altogether absent. Cottonwood trees show a much greater percentage of both



A stand of cottonwoods at Bosque del Apache National Wildlife Refuge that receives regular overbank flooding. The flood in this photo occurred in Spring 2001. Individuals in photo from left to right are graduate student researchers Jennifer Follstad Shah and Teresa Tibbets, and then-undergraduate student Leslie Cryan. Photo by J. Schuetz.

AM and EM colonization, 24 percent and 48 percent respectively.

According to Follstad Shah's findings, salt cedars do not form strong mycorrhizal associations, confirming two separate studies conducted in the Mojave Desert and along the Verde River. While the data from July 2006 have not been processed, Follstad Shah expects they will reveal similar trends.

Follstad Shah incorporated her student grant research into her doctoral dissertation, entitled "Effects of flood regime and riparian plant species on soil

nitrogen cycling along the Middle Rio Grande: Implications for restoration." She asserts, "cottonwood and salt cedar consume all forms of nitrogen (organic and inorganic) at comparable rates, despite differences in mycorrhizal association." These findings suggest it likely "that both salt cedar and cottonwood are equally able to filter surface water and groundwater."

After completing her Ph.D. in biology, Follstad Shah was awarded an NSF Postdoctoral Fellowship in Bioinformatics. To develop a quantitative expression to better incorporate resource supply into the Metabolic Theory of Ecology, she will be assessing the degree to which data from fluvial ecosystems support the theory. After completing her fellowship in December 2008, she plans to seek a tenure-track position at an academic institution or employment with a research-based government agency or consulting firm.



Cottonwood gallery forest in South Albuquerque. This site does not experience overbank flood events. Photo by J. Follstad Shah.



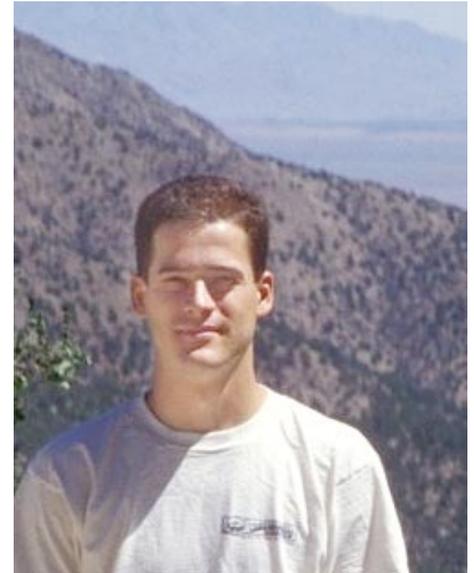
WRI student grant recipient has research published

A recipient of a 2003-2004 WRI Student Research Award, Sam Earman recently had his work published in the *Journal of Geophysical Research* (2006, vol. 111, D09302, 18 pages). Sam indicates that all the lab work and a significant portion of the field work for the paper was funded by the research grant.

The paper is entitled, "Isotopic exchange between snow and atmospheric water vapor: Estimation of the snowmelt component of groundwater recharge in the southwestern United States." His co-authors on this publication include Andrew R. Campbell, formerly of New Mexico Tech, Fred M. Phillips, faculty member and Sam's advisor at New Mexico Tech, and Brent D. Newman of Los Alamos National Laboratory.

Sam completed his doctoral degree in the fall of 2004 at New Mexico Tech. He is currently a post-doctoral researcher in the Division of Hydrologic Sciences at the Desert Research Institute (DRI) in Reno, Nevada. Sam uses natural tracers (major ions, trace elements, stable and radio isotopes) to understand how groundwater is recharged in mountain areas and flows from mountains to basins, how much recharge is from snowmelt and what impact climate change might have on recharge rates. He is involved in the Basin and Range carbonate aquifer system study, a joint U.S. Geological Survey-DRI project examining groundwater resources in Nevada's Lincoln and White Pine counties.

Reprints are available from the WRI. Please call Cathy Ortega Klett at 505-646-1195 for copies.



New Mexico Tech hydrologist co-authors paper in *Science*

New Mexico Tech hydrology professor Fred M. Phillips is the co-author of a research paper published in a recent issue of the prestigious journal *Science*.

Phillips was one of nine co-authors of the research paper, titled "Near-Synchronous Interhemispheric Termination of the Last Glacial Maximum in Mid-Latitudes," which studies isotopic records from polar ice cores as markers of the globally asynchronous warming at the end of the last glaciation during the late Quaternary time.

Phillips, who has been on the New Mexico Tech faculty for more than 25 years, has been the past recipient of numerous national and international awards for his research contributions made to the scientific fields of



hydrogeology, geomorphology, and Quaternary geology, which covers the last 1.7 million years of Earth's geologic history.

Most of Phillips' diverse research in the geosciences stems from a technique he pioneered of using measured ratios of radioactive isotopes of chlorine formed by cosmic-ray reactions in rocks and other landforms to more accurately date geological events of the past million years, such as earthquakes, landslides, and glaciers.

Phillips will present a talk on "Natural Sources of Saline Water in the Rio Grande" at the upcoming 51st Annual New Mexico Water Conference (see page 3).





Reports Available

WRRI has published Technical Completion Report No. 335, *Study of Potential Water Salvage on the Tucumcari Project Arch Hurlley Conservancy District: Phase I – A Pre-appraisal-level Study of the Potential Amount of Saved-water and the Costs of Alternative Methods of Reducing Carriage Losses from District Canals* by J. Phillip King, John W. Hawley, John W. Hernandez, John F. Kennedy, and Eluid Martinez. The research was financed in part by the U.S. Bureau of Reclamation, Department of Interior through The Colorado Plateau Cooperative Ecosystem Studies Unit. The 200-page report includes a CD-ROM with plates and appendices. The study found that the cost of “saving” 12,600 acre-feet of water, now lost to canal seepage from the Main Conchas Canal, to be a little more than \$25 million or about \$2,000 per acre-foot of water saved. Further reduction of seepage losses would require the lining of laterals within the irrigation District. The 2005 cost of lining laterals was estimated to be \$500 to \$1,000 per acre-foot. It was concluded that reducing total system losses can be achieved most effectively by lining laterals used to supply farm turnouts.

Southwest Consortium for Environmental Research & Policy has published three reports of special interest to the New Mexico water community. Contact the WRRI at 505-646-1195 for copies of the reports. Further information can be found at www.scerp.org.

Pilot Study Examining Pathogen Incidence and Distribution Patterns in the Rio Grande by Kevin Oshima and Geof Smith of New Mexico State University (W-01-4). The primary objective of this study was to analyze the pathogen distribution patterns for the region of the Rio Grande between Las Cruces and Ciudad Juárez-El Paso. The results from the study provide an initial characterization of pathogen distribution in this stretch of the Rio Grande. The study represents the most comprehensive assessment of microbial water quality within this section of the Rio Grande and one of a few studies of its kind in North America.

Vulnerability of Borderland Water Resources: Developing Indicators for Selected Watersheds on the U.S.-Mexico Border – The Paso del Norte Region by Christopher Brown, NMSU, Alfredo Granados, La Universidad Autonoma de Ciudad Juárez, Janet Greenlee and Brian Hurd of NMSU (W-03-02). After convening a panel of scientists from the U.S. and Mexico that identified sources of watershed vulnerability, indicators to measure the vulnerability, and the geo-spatial data needed to build indicators, the geo-spatial data were analyzed in a GIS framework and a series of GIS maps were produced. The maps depict the spatial variability of select indicators of watershed vulnerability in the Paso del Norte region. The project team discusses the benefits of project outcomes to the wider scientific community and closes the report with recommendations for future investigations.

Optimization of Methodologies to Isolate Cryptosporidium, Giardia and Phage from Raw and Treated Sewage by Kevin H. Oshima, Geof Smith, Allyssa A. Martinez, Nai Guy, Guadalupe Vidal, Laura E. Jones and Zully Villanueva, New Mexico State University (EH-04-03). In this study, ultrafiltration and immunomagnetic separation methodologies were optimized to determine and quantify the presence of the *Cryptosporidium*, *Giardia*, and enteroviruses in raw and treated sewage at three wastewater treatment facilities located in Las Cruces, El Paso, and Ciudad Juárez. The WRRI contributed to the funding of this project.

U.S. Geological Survey has published *Volatile Organic Compounds in the Nation's Ground Water and Drinking-Water Supply Wells* (Circular 1292), which is part of the USGS series of publications on *The Quality of Our Nation's Waters*. This long-term investigation by the USGS National Water-Quality Assessment (NAWQA) Program provides the most comprehensive national analysis to date on the occurrence of volatile organic compounds (VOCs) in aquifers used as an important supply of drinking water, based on analytical results from over 4,000 wells sampled between 1985 and 2002. USGS reports and selected companion materials are available on the Internet at: http://water.usgs.gov/nawqa/vocs/national_assessment.



Conference Registration Form

To attend the 51st Annual New Mexico Water Conference, please complete one form for each person or register online at: wrrri.nmsu.edu and choose the Water Conference link. To register by mail, send this form and check or payment information to NMWRRI, NMSU, MSC 3167, P.O. Box 30001, Las Cruces, NM 88003-8001. Make checks payable to NMWRRI.

Registration from September 1 through September 26 is \$225. After September 26 and at the door, registration is \$250. The registration fee will be refunded if written notice of cancellation is received by September 26, 2006. A \$25 cancellation fee will be charged.

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The conference will be held at the Hotel Albuquerque at Old Town at 800 Rio Grande Blvd, NW in Albuquerque's Old Town. A block of rooms has been reserved at the Hotel Albuquerque for conference participants. Individual reservations can be made by calling the Hotel directly at 505-843-6300 or 1-800-237-2133. Identify yourself as a participant of the New Mexico Water Conference.

Albuquerque has sleeping accommodations at a range of prices. The Albuquerque Convention and Visitors Bureau's website provides a list of hotels at: <http://www.abqcvb.org/>

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