



DIVINING ROD

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Arsenic Removal from Contaminated Water Studied by NMSU Researcher

by Cathy Ortega Klett, WRRRI, with Alison Sawyer, Waste-management Education and Research Consortium

The City of Albuquerque and a number of other U.S. municipalities draw drinking water supplies from groundwater containing elevated levels of arsenic arising in many cases from natural sources.

The current U.S. Environmental Protection Agency (EPA) acceptable threshold limit for arsenic is 50 ppb (parts per billion) and this standard can be met in many cases without special water treatment, often by blending water supplies.

There are new proposals to tighten this standard to 1 ppb, which will result in cities having to either seek new drinking water supplies or remove arsenic from their current supplies. Until recently, there have been no cost-effective water treatment technologies that could remove arsenic at such low concentrations.

Two years ago, Professor Michael Johnson of New Mexico State University's Chemistry and Biochemistry Department was provided funding through WRRRI's Seed Money Research Program to develop a cost-effective method of removing arsenic from contaminated water supplies.

Dr. Johnson and Robert Wingo, a master's candidate in environmental chemistry, have developed new chemical procedures using ferrate [iron(VI)] to remove extremely low

concentrations of arsenic and arsenic containing compounds from water.

Dr. Johnson's approach uses ferrate, K_2FeO_4 , to simultaneously convert all the forms of arsenic to the arsenate ion and subsequently precipitate it from water as highly insoluble ferric arsenate. This work has proved effective in lowering dissolved arsenic to levels below 1 ppb.

Besides being more cost-effective than "old" methods, this approach has several advantages over previous methods. It reduces the amount of sludge production and there are minimal pretreatment requirements compared to traditional methods.

The ferrate method was not the first technique tried by Johnson. "We started out using chlorine in our initial research, which is inexpensive and easy to handle," said Johnson. "However, the EPA's concern about discharging chlorine into the environment made us look at alternative removal techniques."

Johnson has developed a research partnership in this effort with Lee Ciampi of Pearl Environmental, Wayzata, Minnesota. The collaboration greatly enhances the study because the company is developing new

production methods to decrease the cost of ferrate and increase its availability. Because of Johnson's earlier work, Pearl Environmental became interested in the research on ferrate application. Ferrate had not been commercially available until now, through Pearl Environmental's efforts.

The project has been supported by several New Mexico entities in addition to the WRRRI—NMSU's Waste-management Education and

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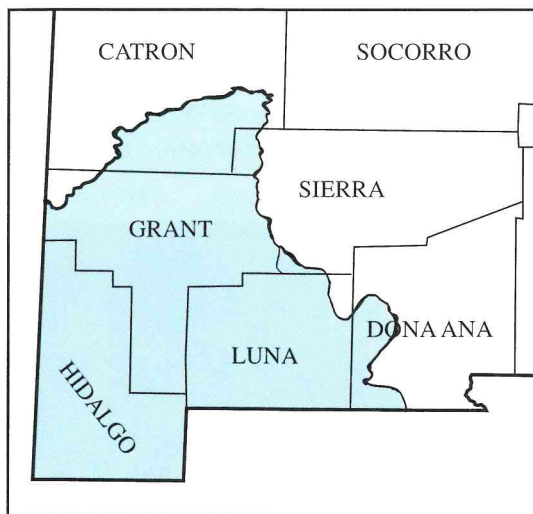
Michael Johnson, associate professor in chemistry and biochemistry at NMSU, prepares solutions for a series of arsenic studies. Photo by Alison Sawyer.



GIS to Assist Water Management and Planning in Southern New Mexico

GIS coverages of the border region encompassing southwestern New Mexico will play an important role in regional water management and planning. Bob Creel of the New Mexico Water Resources Research Institute (WRRI) will lead an effort that will employ an interdisciplinary team comprising a GIS technician and hydrology, geology and geochemistry investigators to map the region.

The project, partially funded by the U.S. Environmental Protection Agency, will concentrate on the border region of southwestern New Mexico including portions of Luna, Hidalgo, Grant and Catron counties in New Mexico (see study area map). This effort is in response to groundwater quality concerns, especially in light of the area's total dependence on groundwater for drinking water.



The border region is one of the fastest growing population centers with over 3 million people projected by 2015. Groundwater levels in parts of the region have declined and projected water demand will put additional strain on the area's scarce water resources. Local, state and federal agencies concur that a better understanding of shared transboundary water resources is needed. The environmental and economic impacts of the North American Free Trade Agreement have provided an additional impetus to monitoring the area's natural resources.

Information on the region's water quality and quantity has been gathered by numerous entities over the years for a variety of purposes. The data exist in different formats, differ in degree of resolution and data quality, and often

are not readily accessible. The need for aggregation and analysis of existing data is apparent.

The project has six main objectives. First, existing well data from various entities will be evaluated for accuracy and subsequently transposed into a common database format developed for international data transfer. Well data will be collected from sources including the U.S. Geological Survey, New Mexico Environment Department, and the New Mexico Office of the State Engineer. The well data will be incorporated into GIS format and presented on maps of the region.

Second, transboundary aquifers will be identified and characterized as to their lateral and vertical extent, saturated thickness, and volume of usable and marginal quality water in storage. Potential recharge zones will be identified and the potential for contamination will be assessed. Investigators will digitize and map the surface extent of the aquifers and other adjacent and/or contributing groundwater aquifers into Arc/Info GIS coverages.

Third, existing groundwater quality analyses from federal, state and municipal agencies will be compiled and evaluated for accuracy. Again, this data will be transferred to a common database format. Data on concentrations of dissolved constituents including major cations and anions and other selected trace elements will be compared. The chemical quality of surface and groundwater from adjacent aquifers will be studied for potential interaction. Aquifer susceptibility to nonpoint and point source contamination will be determined. The DRASTIC model will be utilized to produce a natural sensitivity index/map of the aquifers. All existing data will be evaluated for its suitability for groundwater models using a GIS-based analysis to identify areas of weak coverage. A collection/monitoring program will be recommended.

Fourth, the hydrologic interaction of surface and groundwater will be studied. Depth to groundwater and direction of groundwater flow will be determined for each aquifer. Flow models simulating potential pathways for groundwater traverse will be developed. Interaction between aquifers and rivers will be determined along with the potential for transboundary subsurface groundwater flow. Existing river loss and gain studies will be examined to evaluate the groundwater flow direction and the loss and gain of the rivers due to interaction with the surrounding aquifer.

Fifth, pumpage data by type of user (irrigation, municipal, industrial, domestic, and livestock) will be

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Reports Available

New Mexico Water Conference Proceedings

The 42nd Annual New Mexico Water Conference Proceedings, *Water Issues of Eastern New Mexico*, is now at the printers. The proceedings contains seventeen papers presented last October in Tucumcari including discussions of the history and hydrology of the Eastern Plains, and how the water resources of the area have been managed over the years.

Seven technical papers are included in response to last fall's Call for Papers. These include presentations on the Taylor Well Field in Las Vegas, La Luz Well Field in Alamogordo, groundwater relationships along the New Mexico-Texas stateline, water rights considerations for conjunctive use of surface and groundwater, a new technology for denitrification of groundwater, an Anasazi water-conservation gardening technique using cobble mulch, and cloud seeding for rain enhancement.

In addition, comments made by participants of three panels (policy makers discussing local growth and water issues, regional water planning, and agricultural conservation) are included.

Copies of the proceedings will be available for \$15.75. Send requests to Cynthia Rex with checks made payable to NMWRRI, MSC 3167, Box 30001, Las Cruces, New Mexico 88003. Conference participants will receive their free copies of the proceedings as soon as they are available.

New Mexico First Report on Water and Land Resource Management

Participants in the 19th *New Mexico First* Town Hall meeting gathered in Albuquerque on June 26-29th to consider how New Mexico's public and private leadership should manage our land and water resources for the best use, now and during the next two decades.

The New Mexico WRRI prepared the 80-page background document on the state's water and land resources for the Town Hall meeting. The document provided participants with the essential factual background on topics such as New Mexico water rights law, surface and groundwater hydrology, and related land issues, in an easy to understand format.

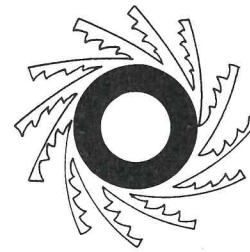
The final report produced by *New Mexico First* includes detailed recommendations made at the Town Hall meeting. Copies of the report are available for \$15 from *New Mexico First*, toll free 1-800-663-0001 or in Albuquerque 505-242-3205 or by email: townhall@nmfirst.org.

Mark your calendars

43rd New Mexico Annual
Water Conference

Las Cruces
October 22-23, 1998

Water Challenges on the
Lower Rio Grande



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collected and quantified. Pumpage effects on water levels and water quality will be estimated by reviewing the historical record of observation wells. Existing aquifer simulation computer models will be reviewed and recommendations will be made for additional modeling efforts.

Finally, the New Mexico WRRI will coordinate with the International Boundary and Water Commission, U.S. Section, for any data exchange, review and evaluation. A binational data report of officially exchanged data will be prepared. The report will include electronic media database tables, GIS coverages for each aquifer, and corresponding attribute tables, maps, and graphics to illustrate the characteristics of the studied aquifers. A final report to EPA will incorporate all data and provide conclusions and recommendations.

The project commenced in September 1997 and will conclude in 1998. In addition to Bob Creel of the New Mexico WRRI, John Kennedy, GIS coordinator also from the WRRI, Marta Rimmenga from New Mexico State University's Statistics Center, Barry Hibbs, a geologist/geochemist from Cal State, Los Angeles, and John Hawley, retired from the New Mexico Bureau of Mines and Mineral Resources, will participate on the study team.



TMDLs—What Are They?

by David Hogge, NMED, Evaluation and Planning,
Surface Water Quality Bureau

TMDL stands for “Total Maximum Daily Load” and can be described as a watershed or basin-wide “budget” for the amount of pollutants that can be assimilated without causing the stream to exceed the state water quality standards. TMDLs also may be established for a portion of a watershed.

In actuality, a TMDL is a planning document. The “allowable budget” is determined by scientific study of a stream to ascertain the greatest loading or amount of a particular pollutant that may be introduced into a water-course or stream reach from all sources.

Three components make up the TMDL: the sum of all load allocations, that is, the pollutant loads contributed by nonpoint sources; wasteload allocations, which are those

portions of the total loading set aside for contributions of the pollutant from point source discharges; and a margin of safety (MOS) to account for uncertainty.

According to Section 303 (d) of the federal Clean Water Act, TMDLs must be developed for surface waters that do not meet water quality standards.

TMDL allocations are the amounts of pollutants that can be discharged from each category. The TMDL does not specify how dischargers must attain their particular load allocation. In other words, the TMDL will not prescribe best management practices for a discharger or otherwise tell the discharger how to meet their goal; it merely sets the numerical allocation.

Trading is allowed between or within the load allocation and the wasteload allocation categories. However, the MOS cannot be “traded.”

For point sources, the TMDL may require more stringent effluent limitations that will later be incorporated into an NPDES (National Pollutant Discharge Elimination Systems) permit. NPDES permits set effluent quality limitations and require implementation of best available technologies.

Nonpoint sources are not regulated through a permit program. The New Mexico Environment Department has advocated and implemented a voluntary approach to non-point source pollution prevention.

The ultimate goal is for the state’s surface waters to meet water quality standards, which are set by the New Mexico Water Quality Control Commission (WQCC) after public input. According to the New Mexico Water Quality Act, any person can propose changes to the standards. Federal law requires the WQCC to review the standards at least once every three years and New Mexico currently is in a review year.

Standards adopted by the WQCC must be approved by the U.S. Environmental Protection Agency (EPA). If the EPA does not approve the standards adopted by the state, EPA may refer them back to the state or promulgate their own standards.

New Mexico’s surface water quality standards are published in the NM Administrative Code (20 NMAC 6.1) and the document entitled, *State of New Mexico Standards for Interstate and Intrastate Streams*.

The federal Clean Water Act allows states the right to first establish TMDLs. The New Mexico legislature has empowered the WQCC to create the planning “budgets.” Normally, the bulk of the work is done by the Environment Department and their plan is submitted to the WQCC for consideration. However, if the State does not promulgate TMDLs to EPA’s satisfaction, EPA is required to do so.



Beaver Pond on the upper Rito Peñas Negras Project.
Photo by David Hogge.

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Federal and state statutes require public participation. Participation is encouraged for permittees (point sources), affected landowners (nonpoint sources), regulatory or management agencies, local governments, public interest groups, and concerned citizens. Watershed associations or similar local organizations are encouraged to foster planning, communication and consensus among those interested.

To date, three TMDLs have been adopted by the WQCC: the Twining Water and Sanitation District (Rio Hondo) in the Taos Ski Valley area; Red River above the town of Red River to below the town's wastewater treatment facility; and the Rio San Jose below Grants to the Pueblo of Acoma.

On July 25, 1997, two environmental interest groups, Forest Guardians and Southwest Environmental Center, jointly filed a lawsuit against the EPA alleging that TMDLs had not been developed by the State. The State of New Mexico was not a litigant in this suit. EPA and plaintiffs negotiated a consent decree and settlement agreement avoiding formal litigation.

EPA and the New Mexico Environment Department have signed a Memorandum of Understanding outlining tasks the State will complete to meet the terms of the settlement. Similar litigation has occurred in more than 30 states.

A schedule for TMDL development has been established to address certain watersheds and stream segments. The consent decree schedule, which is supervised by the Court, reaches 10 years into the future. The settlement agreement reaches 20 years into the future. If New Mexico fails to promulgate a TMDL by the appropriate deadline, the EPA must develop the TMDL within two years.

For more information on TMDLs, contact the Environment Department's Surface Water Quality Bureau at <http://www.nmenv.state.nm.us>.



Timeline depicting TMDL Development in New Mexico

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Lower Pecos River	█									
Lower Rio Grande	█	█								
Domestic Water Supply		█	█							
Santa Fe River		█	█							
Middle Rio Grande		█	█	█						
Gila Watershed		█	█	█	█					
San Francisco River		█	█	█	█					
San Juan River					█	█	█	█		
Rio Puerco					█	█	█	█	█	█



USGS Reports

The U.S. Geological Survey has published the following New Mexico related publications since the last issue of the *Divining Rod*. Copies are available for inspection at the USGS District Office in Albuquerque (4501 Indian School Road NE, Suite 200). The Water Resources Research Institute library also has the reports on file. They may be ordered from the USGS, Federal Center, Box 25286, MS 517, Denver, CO 80225. You may call 303-202-4210 for price information.

- **Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Water-quality data for water-column, suspended-sediment, and bed-material samples collected at selected surface-water sites in the upper Rio Grande Basin, June and September 1994** by Lynn K. Miller, Robert L. Moquino, and Bruce A. Hill (OFR 97-644)
- **Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Shallow ground-water quality and land use in the Albuquerque area, central New Mexico, 1993** by Scott K. Anderholm (WRIR 97-4067)
- **Concentrations of selected trace elements and other constituents in the Rio Grande and in fish tissue in the vicinity of Albuquerque, New Mexico, 1994 to 1996** by Ralph Wilcox (OFR 97-667)
- **Seismic investigation of the buried horst between the Jornada del Muerto and Mesilla ground-water basins near Las Cruces, Doña Ana County, New Mexico** by Dennis G. Woodward and Robert G. Myers (WRIR 97-4147)
- **Water-quality assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas—Summary and analysis of water-quality data for the basic-fixed-site network, 1993-95** by Denis F. Healy (WRIR 97-4212)
- **Low-flow water-quality and discharge data for lined channels in northeast Albuquerque, New Mexico, 1990 to 1994** by Robert L. Gold and Robert McBreen (OFR 97-811)

USGS Deputy Director Named

Dr. Thomas Casadevall has been appointed Deputy Director of the U.S. Geological Survey. Upon the completion of Mark Schaefer's tenure as Acting Director, Dr. Casadevall also became Acting Director of the Survey. Dr. Casadevall earned his B.A. degree in geology from Beloit College (1969), his M.A. (1974) and Ph.D. (1976) degrees in geology and geochemistry, respectively, from Pennsylvania State University.

After serving one year as a USGS-National Research Council postdoctoral research associate and one year as an adjunct professor at the Escuela Politecnica Nacional in Quito, Ecuador teaching geochemistry and volcanology, Tom joined the USGS as staff geochemist in 1978.

His career with the USGS has included assignments at the Hawaii, Cascades, and Alaska Volcano observatories, and in the USGS-Volcanological Survey of Indonesia cooperative program. He has served as project chief for studies of geology and mineral deposits of the western San Juan Mountains, Colorado; and as Assistant Chief, Branch of Volcano and Geothermal Processes. Tom Casadevall is recognized worldwide as a leading authority on volcanic hazards and aviation safety, and served as an integral member of the USGS strategic planning committee.

Since April of 1996, Tom has served as USGS Regional Director, Western Region. He has written more than 90 technical publications in his areas of expertise.



Water on the Moon?

New Mexico scientists hope to find water on the moon. They've sent a water locator aboard the National Aeronautics and Space Administration's Lunar Prospector, launched recently from Cape Canaveral, Florida. The craft, part of NASA's new Discovery Series, is expected to map the moon during the next year. Los Alamos scientist and project leader Bill Feldman said a water discovery could bring on a lunar land rush in the next century. If water exists and can be tapped, he said, it could help sustain life for to-be-settled lunar colonies and produce hydrogen for rocket fuel.

U.S. Water News, February 1998



Upcoming Meetings

The Great Plains Symposium 1998: The Ogallala Aquifer
"Determining the Value of Water"

Bureau of Reclamation

March 10-12, 1998, Lubbock, TX

Joint Conference on the Environment

Waste-management Education and Research Consortium,
Western Region Hazardous Substance Research Center, and
New Mexico Hazardous Waste Management Society

March 31- April 1, 1998, Albuquerque

Team Wetlands: 101 Ways to Win for Wetlands

Terrene Institute

April 15-17, 1998, Hyatt Crystal City, Arlington, VA

Challenge '98: A Working Symposium on Reducing the
Impacts of Urbanization on Southwestern Wetland and
Riparian Resources

New Mexico Riparian Council

April 16-18, 1998, Univ. of New Mexico, Albuquerque

Sustainability Workshop: Regional Water Resources

Los Alamos National Laboratory, Environmental Manage-
ment Division

April 28, 1998, Santa Fe Sweeney Center

New Mexico Water Law Compliance Course

Government Institutes

May 19, 1998, Hyatt Regency Albuquerque

Balancing Resource Issues

Soil and Water Conservation Society

July 5-9, 1998, San Diego, CA

Cross Currents in Water Policy

Universities Council on Water Resources

August 4-7, 1998, Hood River, OR



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Research Consortium, Los Alamos National Laboratory and others. The research also provides undergraduate students with a hands-on approach to water quality research and water analysis. NMSU undergraduates Bernie Lorenz, Department of Chemistry and Biochemistry, and Cooper Harrelson, Department of Chemical Engineering, are participating on the project.

The WRI will publish Dr. Johnson's research results as part of its technical completion report series this spring.

Web Sites Worth Watching

<http://wrri.nmsu.edu>

New Mexico Water Resources Research Institute's Home Page

<http://www.epa.gov/OWOW>

Wetlands, Oceans and Watersheds Online

Environmental Protection Agency: Browse through EPA newsletters, fact sheets, brochures, publications, regulations, press releases and Congressional testimony; order EPA publications online; request STORET water quality data; and more.

<http://www.uwex.edu/erc/ywc/>

Educating young people about water: Provides materials, searchable by grade level or by subject, that can help users develop community-based, water education programs that target youth.

<http://enso.unl.edu/ndmc>

National Drought Mitigation Center Web Site: The Climatology section is now up and running, featuring climographs of seasonal precipitation and temperature patterns for various U.S. cities and links to other on-line climatology resources.

<http://www.waterwiser.org>

U.S. Water News internet columnist Kevin Wolf says this site ought to win an award. It is "information rich, easy to use and search, up to date, well organized, and offers interactive opportunities to get involved." The Water Efficiency Discussion Forum is said to be superb. New to the site is a searchable index to hundreds of water-related bibliographies and references.

<http://h2o.usgs.gov/public/watuse/index.html>

U.S. Geological Survey: Topics include a site description of the USGS National Water-Use Information Program, a Fact Sheet describing water use in the U.S. and the complete text of the report "Estimated Use of Water in the U.S. in 1990," USGS Circular 1081.



Congratulations Students

During the holidays, WRRI's student assistant Mohammed Hossan brought his new wife Erra Sharif and her parents to visit the institute. Mohammed and his in-laws are from Bangladesh, where he and his wife hope to return after Erra completes her engineering degree.

Mohammed graduated in December with a master's in computer science and has accepted a position in Illinois. While at the WRRI, Mohammed was responsible for augmenting WRRI's Home Page on the Internet and computer programming on various WRRI projects.

John Kennedy, another WRRI student assistant also graduated in December with a master's degree in geology, and is now WRRI's Geographic Information Systems Coordinator.

The WRRI congratulates both Mohammed and John.



Front row from left: Darlene Reeves, Erra Sharif, Mohammed Hossan, Mr. and Mrs. Sharif; back row from left, John Kennedy, Bob Creel, Cathy Ortega Klett, and Cynthia Rex.



Tom Bahr, Director

New Mexico Water Resources Research Institute

Catherine Ortega Klett, Editor

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New Mexico Water Resources Research Institute
MSC 3167, New Mexico State University
PO Box 30001
Las Cruces NM 88003-8001
(Address Correction Requested)

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