Fall 2008

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Water Current

PART OF THE SCHOOL OF NATURAL RESOURCES

MEET THE FACULTY

Haishun Yang, Ph.D.

Haishun Yang is a research assistant professor in the University of Nebraska–Lincoln's Department of Agronomy and Horticulture, since 2001 as a post-doc associate and as a member of the faculty since 2003. His research interests include crop simulation modeling and decision support tool development; modeling of bioenergy system efficiency and greenhouse gas; soil carbon dynamics in different cropping systems on field and on regional scales; and agroecosystem carbon cycling in response to climate change.

Education:

B.S. Soil and plant nutrition, Beijing Agricultural University, China, 1984

M.S. Soil and water Sciences Wageningen University, The Netherlands, 1993

Ph.D. Soil science Wageningen University, The Netherlands, 1996

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2009 Tour looks at San Francisco Bay-Delta area

By Steve Ress

Organizers for the 2009 water and natural resources summer tour are taking a hard look at a number of water quantity and quality issues pertinent to Nebraska in San Francisco's Bay-Delta area.

Organizers have put tentative dates on the tour of June 14-19, 2009 and are estimating that the weeklong tour and individual airfare to-and-from the event may total about $1,500.

"That's a very preliminary figure. Airfare is tough to estimate and very much a moving target, considering the volatility of fuel prices and the state of the economy in general," said tour coorganizer and UNL Water Center associate director Mike Jess.

Planning committee members have met twice since this summer's tour of the Lower

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The 2009 Water and Natural Resources Tour will likely visit water quantity and quality projects in the Sacramento and San Francisco Bay-Delta areas of northern California. The tour is tentatively scheduled for June 14-19, 2009.

When water meets money topic of conference

By Steve Ress

"Blue Gold: When Water Meets Money" is the theme of this year's University of Nebraska–Lincoln Water, Law, Policy and Science conference.

The sixth annual UNL conference will be April 29 and 30, 2009 at Lincoln's Embassy Suites hotel and conference center.

"We wanted to get the dates out so people can mark their calendars and plan on attending. Over the next few weeks we will be finalizing our slate of topics and speakers, which will include both local and national experts from water science, economics and law," said UNL Water Center director Kyle Hoagland.

The conference pairs the latest science on a topic with related economic issues. For example, attendees will learn about the science of ecosystem services, followed by the economic value of ecosystem services including drinking water and public health.

Other topics under consideration are the basics of how water is valued, potential costs and economic impacts of global warning on water resources; the value of water for different societal purposes, such as agriculture, manufacturing and recreation; and water for irrigation and biofuels production.

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Director
Kyle D. Hoagland, Ph.D.

Associate Director
J. Michael Jess, P.E.

Director of Laboratory Services, Water Sciences Laboratory
Daniel D. Snow, Ph.D.

Editor
Steven W. Ress

Designer
Renee J. Lanik, UNL CIT

Layout
Anne M. Moore, UNL CIT

Water Center
University of Nebraska–Lincoln
506 Hardin Hall
Lincoln, NE 68583-0979
Phone: (402) 472-3305
Fax: (402) 472-3610
E-mail: sress1@unl.edu

http://watercenter.unl.edu

From the Director
Dr. Kyle Hoagland

Biofuels – Trends in Impacts on Water Demand, Supply and Quality

Given all of the recent political banter about America's need to become energy independent (often referred to as "energy security"), it was my good fortune to be invited to participate in an intensive two-day workshop on the "Sustainability of Biofuels" co-sponsored and organized by the U.S. Departments of Energy (DOE) and Agriculture (USDA), in Bethesda, Md, Oct. 28-29.

Overall aim of the meeting was to assess the state of the current science regarding all aspects of biofuels, to identify critical gaps in our knowledge, and to recommend future research directions. The final product of the workshop will be a summary report and, although not explicitly stated at the onset of the meeting, a joint grant program on biofuels, with the RFA closely based on this meeting.

That it was a joint conference was more important than was immediately evident. Interagency cooperation and collaboration is becoming an important new approach to addressing larger-scale environmental challenges such as climate change and energy, which reflects not only the complexity of these issues, but also a growing realization that under tight budgets, it's critically important for even large agencies like DOE and USDA to combine efforts to address such global issues.

More than a hundred university scientists and federal agency personnel including agronomists, hydrologists, economists, ecologists, foresters, physicists, sociologists, and others attended the meeting. Raymond Orbach and Gale Buchanan, Under Secretaries at DOE and USDA gave presentations, respectively. We also heard from those in charge of major external grant programs, Anna Palmisano, Associate Director for Science, for Biological and Environmental Research at DOE, and her counterpart at USDA, Steven Schafer, Deputy Administrator, Natural Resources and Sustainable Agricultural Systems, Agricultural Research Service (the research arm of USDA).

Other talks included economics, social and technological change, economics and land use, ecology of plants and soils, and water demand, supply, and quality (hence the catchy title), all delivered by top experts in these fields, including Ken Cassman, director of UNL's Center for Energy Sciences Research.

In light of this being the *Water Current*, not the *Biofuels Current*, I want to convey to you some of the highlights of the water discussions, because of the central role water plays in both grain-based and cellulosic ethanol production. The following five high priority water research questions were identified in a series of breakout sessions:

- What are the water quality and quantity impact factors for sustainability?
- What will be the trade-offs in water demand and supply between biofuels and other uses?
- How does feedstock production management impact water quality and quantity?
- What are the climate change interactions with hydrology, water quality and water quantity?
- What is the impact of current and needed spatial and temporal data availability?

This list doesn't look anything like a list that would take a group of experts two hours

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Charles A. Shapiro, Ph.D.

Charles Shapiro is a professor in the University of Nebraska–Lincoln Department of Agronomy and Horticulture, at the Haskell Agricultural Laboratory – Northeast Research and Extension Center, where he specializes as a soil scientist and crop nutritionist. His research interests include: Designing cropping systems that make effective use of materials used to improve crop nutrition and prevent environmental contamination; leading an integrated organic cropping systems conversion project at UNL's Haskell Agricultural Laboratory; and emphasizing maintaining soil fertility within an organic cropping system. His extension programming focuses on promoting the effective use of fertilizers, organic amendments and other cultural practices to optimize production and profit without causing contamination to the environment.

Shaprio collaborates with Natural Resources Districts to provide targeted nutrient management programs designed to reduce nitrate contamination of groundwater.

Education:

B.S., General Agriculture, Cornell University, 1974

M.S., Agronomy, University of Nebraska, 1978

PhD., Agronomy, University of Nebraska, 1982

Examples of Current Research/Extension Programs (brief descriptions):

Fate of cattle manure handling and management strategies on fate and transport of hormones in the feedlot and the field. A multi-disciplinary research project with researchers from UNO, UNL, and WCREC that will follow the fate of exogenous and endogenous hormones in cattle manure with the feedlot and after application to crop land and conservation buffers.

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Haishun Yang *(continued from page 1)*

Examples of Current Research:

(1) Develop computer models for life cycle analysis of biofuel and bioenergy systems.

(2) Develop computer model for deficit irrigation using crop simulation.

(3) Develop computer model for corn nitrogen recommendation for international users.

Examples of Past Research:

(1) Developed the Hybrid-Maize model, a computer simulation model for corn growth, development and yield.

(2) Developed the BESS model, a computer simulation model for life cycle analysis of corn ethanol.

Examples of Outreach Programs:

Invited to give presentations to extension educators and producers both in Nebraska and surrounding states about application of crop models in crop management.

Selected Publications:

Yang HS, T Setiyono, DT Walters, A Dobermann and KG Cassman,. 2008. Maize-N 2008, University of Nebraska (beta version).

AJ Liska, HS Yang, V Bremer, DT Walters, D Kenney, P Tracy, G Erickson, T Kolpfenstein, and KG Cassman. Biofuel Energy Systems Simulator (The BESS model, www.bess.unl.edu), Ver. 2007.1.0, 2008.2.0, & 2008.3.0, University and Nebraska.

Yang HS, A Dobermann, KG Cassman and DT Walters. Hybrid-Maize: A Simulation Model for Corn Growth and Yield (www.hybridmaize.unl.edu). Ver. 2004, 2005 & 2006. Nebraska Cooperative Extension CD9, University of Nebraska–Lincoln.

Yang HS, A Dobermann, KG Cassman, and DT Walters. 2007. Developing crop simulation model to suit diverse users: example of Hybrid-Maize software. Proceedings of PMA06, Beijing.

Yang HS, A Dobermann, KG Cassman, and DT Walters. 2006. Features, Applications, and Limitations of the Hybrid-Maize Simulation Model. Agronomy Journal. 98, 737-748.

Yang HS. 2006. Resource management, soil fertility and sustainable crop production: experiences of China. Agriculture, Ecosystems & Environment, 116, 27-33.

Yang HS, A. Dobermann, J.L. Lindquist, D.T. Walters and K.G. Cassman. 2004. Hybrid-Maize - a maize simulation model that combines different crop modeling approaches. Field Crop Res. 87:131-154.

Yang HS and B.H. Janssen. 2000. A mono-component model of carbon mineralization with a dynamic rate constant. European Journal of Soil Science. 51:517-529

Web/e-mail addresses:

hyang2@unl.edu

www.hybridmaize.unl.edu;

www.bess.unl.edu

Nebraska Water Map Illustrates State Water Issues

By Steve Ress

Surface and groundwater, irrigation, precipitation, threatened and endangered species and other water-related issues are all colorfully addressed on a "Nebraska Water Map," available free from the University of Nebraska–Lincoln.

The 24-inch by 36-inch map depicts a wide range of basic, but important information about Nebraska's water resources, including a great deal about one of the state's greatest unseen resources….groundwater.

"We produced the map with the idea of raising the level of interest in basic water issues and facts for all Nebraskans," said UNL Water Center assistant director Lorrie Benson, who led a coalition of cosponsors to publish the map.

"It combines a great deal of science-based information that has been published in other forms, making them more accessible to the public," she said.

The poster-size map is actually a collection of more than a dozen color graphics, each depicting different aspects of the state's water riches and challenges.

Its centerpiece is a large state map showing important water features such as rivers,

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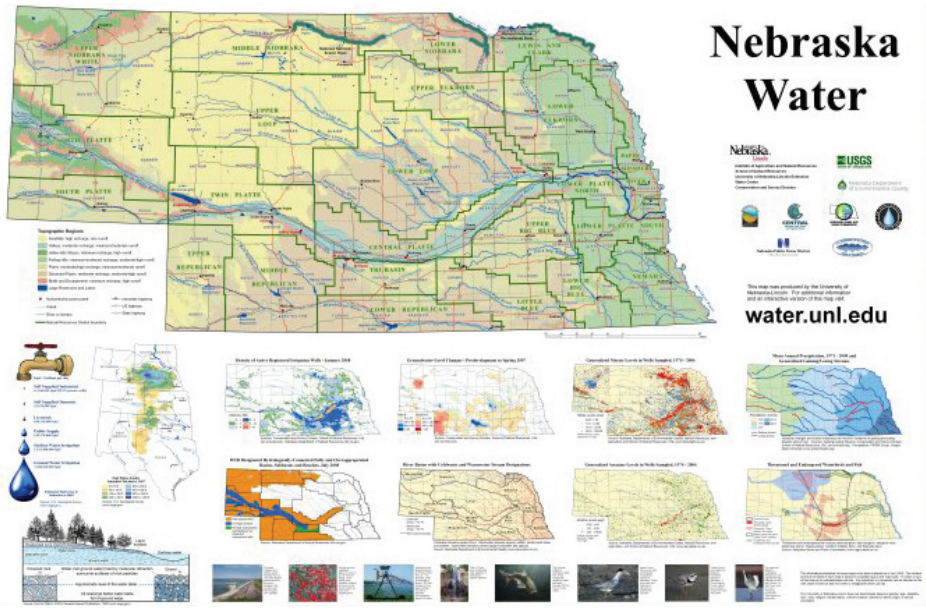

Fourteen lectures in UNL's Spring Semester Water Series

By Steve Ress

The University of Nebraska–Lincoln's traditional spring semester public water and natural resources seminar again hosts local, national and international experts addressing topics from dryland agricultural conservation to what's really contained in floodwaters.

The 14-lecture weekly series begins Jan. 14 and runs through April 22. All but one of the free lectures will be in the first floor auditorium of Hardin Hall on the northeast corner of N. 33rd and Holdrege Sts, UNL East Campus, Lincoln. Lectures are each Wednesday from 3:30 to 4:30 p.m., except March 18, when there is no lecture due to UNL spring break.

"This series of lectures is well-known for presenting a wide range of the latest research findings and credible information related to current water and climate change issues affecting Nebraska and the Great Plains," said seminar organizer and UNL Water Center assistant director Lorrie Benson.

"Public turn-out for these lectures is always high," she added.

Not all lecture slots had been filled when the *Water Current* went to press, but a sampling of speakers and topics included in this year's seminar includes the following:

Feb. 4, Mary P. Skopec of the Iowa Department of Natural Resources will speak on what's really contained in floodwaters, based on this year's widespread spring floods in Iowa.

Nanotechnology, or the control of matter on the atomic or molecular scale, offers both potential threats and scientific correction options for the environment, particularly for water. Michael Hochella of Virginia Polytechnic Institute and State University will discuss some of these issues in his Feb. 18 lecture.

The following week, UNL soil and water resources engineer Dean Eisenhauer of the Department of Biological Systems Engineering will present his findings on the hydrologic impacts of conservation practices for dryland agriculture.

March 11 presents a lecture cosponsored by UNL's Center for Great Plains Studies when Greg Ruark of the U.S. Forest Service talks on the historic presence of trees along Great Plains rivers. His lecture will be at the Great Plains Art Museum at Hewit Place, 1155 Q St., downtown Lincoln following a 3 p.m. reception.

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How Human Pharmaceuticals Threaten Water Quality: A Primer on Emerging Contaminants, Part Two

By Alan S. Kolok, Ph.D., Department of Biology, College of Arts and Sciences, University of Nebraska, Omaha

With regard to human health, we live in a truly remarkable time.

Many infectious diseases have largely been controlled. Witness that during the Civil War over 70 fatalities occurred per 1,000 troops due to infectious disease, while by World War II, about 80 years later, that rate had fallen to less than one per 1,000.

Partial credit for this profound increase in survivorship was due to widespread introduction and use of antibiotics and other pharmaceutical compounds.

While human pharmaceuticals have played an important role in developing modern society, it is important to understand what these compounds are.

Simply, pharmaceutical compounds are drugs. Drugs are substances that, when taken into a living organism, may modify one or more of its functions. Modern pharmaceuticals include: antibiotics, analgesics (i.e., pain relievers), antidepressants, beta-blockers (used as cardio-protectants), as well as hormones and hormone mimics. But why are these important to water quality?

Part of the answer is simply one of scale. Since the end of World War II, the production and use of pharmaceuticals has risen dramatically. In 2003 more than three billion prescriptions were dispensed in the U.S., with more than 45 percent of all residents being prescribed at least one pharmaceutical compound per month.

These consumption numbers are probably most impressive for aspirin, an over-the-counter pharmaceutical that has an annual U.S. consumption rate exceeding 10, 000 tons. The number of different pharmaceutical compounds prescribed in the U. S. is also quite large, and more than 90 different compounds are consumed at rates greater than 10 tons per year.

A second important factor relating pharmaceuticals to water quality is abundance.

Given the large amount of pharmaceuticals produced, it is inevitable that some of them won't be consumed. Many pharmaceuticals have a relatively short shelf life, that time period between prescription and expiration date, and once the expiration date has passed, the consumer is left with the problem of appropriate disposal.

Historically, the preferred way to deal with old pharmaceuticals was to flush them down the drain. Flushing, however, is an ineffective means of neutralizing them and their presence in household wastewater is likely to translate into their presence in local natural waterways.

Interestingly, the pharmaceutical community in Nebraska appears to understand the importance of keeping unused pharmaceuticals out of wastewater. For example, when six Omaha pharmacists were recently asked, "What is the appropriate method to dispose of unused and expired pharmaceuticals?" all of them advised crushing and mixing with solid wastes (coffee grounds, kitty liter) instead of flushing.

The general public, however, may not be as knowledgeable about appropriate disposal. When a class of 16 undergraduate students at the University of Nebraska at Omaha was posed the same question, 50

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University of Nebraska, Omaha biologist Alan Kolok delivers a presentation at UNL (photo: Brett Hampton, IANR).

Decommissioning Out-Of-Service Water Wells to Protect Water Quality

By David P. Shelton, Extension Agricultural Engineer, UNL Haskell Agricultural Laboratory

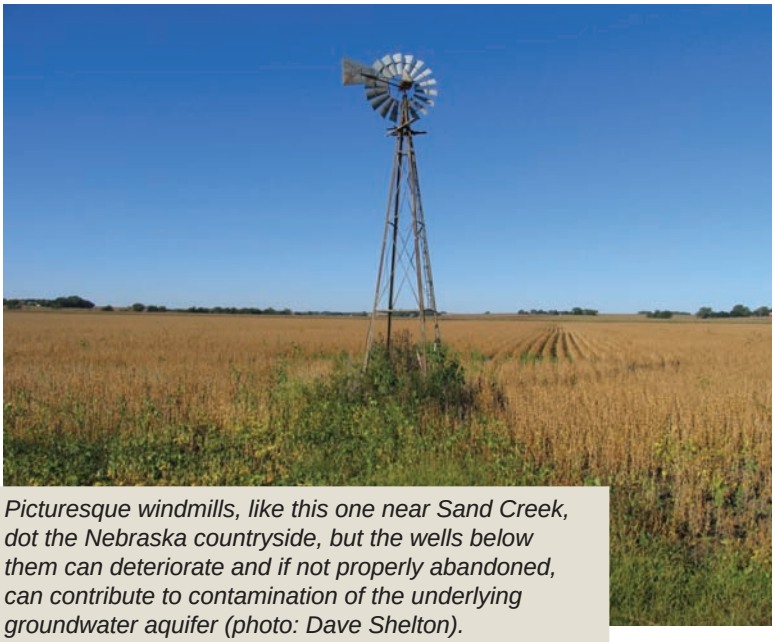
Windmills dot the Nebraska landscape – but did you ever stop to think that this picturesque scene could be contributing to groundwater contamination?

Not the windmill itself, but perhaps the well below. Often, these wells are deteriorating and no longer used, but the well shaft is still a direct connection from the ground surface to the underlying aquifer. This can allow surface runoff to flow directly to the water-bearing zones, often carrying organic wastes, fertilizers, and other chemical residues such as pesticides and petroleum products into the groundwater. Small animals can fall into these wells, further adding to the contamination. Contaminants that enter an old, out-of-service well can migrate to in-service water supplies such as a new well on the property, or a neighbor's well. Once groundwater is contaminated, it is difficult, if not impossible, to clean up, and the process is always expensive.

Unused wells, especially those that are old and/or in disrepair, or that do not meet current standards as an inactive well, pose a major threat to groundwater quality and represent a serious threat to human health and safety. State law defines these as illegal wells.

There are thousands of these wells on farmsteads, acreages, and other rural areas throughout the state. Early Nebraska settlers found that many areas had relatively abundant groundwater that could be obtained fairly easily. In many situations, it was common to have more than one well on each farmstead because it was easier to construct a well at the point of use rather than develop a central water well and distribution system. Farm consolidation, rural electrification, and general modernization took many of these old wells out of service. Also, throughout the years when a new well was drilled, the owner often neglected to properly decommission the old well.

UNL Extension agricultural engineer Dave Shelton (far right) helps a crew with the proper decommissioning of an out-of-service water well. Doing the job right contributes to better water quality for everyone (photo: Dave Shelton).



Picturesque windmills, like this one near Sand Creek, dot the Nebraska countryside, but the wells below them can deteriorate and if not properly abandoned, can contribute to contamination of the underlying groundwater aquifer (photo: Dave Shelton).

Not all out-of-service wells are located on farmsteads or in rural areas. There likely are hundreds, and possibly thousands, located in communities throughout the state. In the early development of communities, most households and businesses had an individual water-supply well. Most of these water wells have since been replaced by community water-supply systems, but in some cases, the old wells were not properly decommissioned.

While a windmill tower can be an almost sure sign, wells can be present at many other locations too. Some signs that an old well might exist include: concrete pads where the legs of a windmill tower once stood; depressions where an old well pit or the walls of a dug well may have collapsed; an old stock tank in an over-grown area; a small area that is fenced off, especially if there are also pipes sticking out of the ground; flat stones, a concrete slab, old boards, metal sheets, or other items that could be covering an old well shaft; and many others. Sometimes there are no signs. For example, one landowner discovered

a 36-inch diameter, 50-foot deep dug well when the front wheel of his tractor dropped into it. He did not know that this well was there, despite having grown up on that farm. (This well has now been properly filled and sealed.)

Nebraska regulations require that illegal wells be decommissioned following the requirements found in Title 178, Chapter 12, *Regulations Governing Water Well Construction, Pump Installation and Water Well Decommissioning Standards* of the Nebraska Department of Health and Human Services. With only one exception, Water well decommissioning must be carried out or supervised by an individual with a valid Nebraska Water Well Standards and Contractors' license.

The decommissioning process includes removal of well equipment (pump, piping, etc), disinfection, sealing, filling, capping, and reporting. The cost of decommissioning a well depends on several factors including accessibility, construction technique and materials, diameter, depth, condition, and contractor travel distance. Generally this is not particularly expensive. For example, in conjunction with a special water quality educational program in the Shell Creek Watershed in northeast Nebraska, 27 out-of-service wells were decommissioned during 2005, 2006, and 2007 at an average cost of $388 per well. Most of these wells were small-diameter domestic and livestock wells, although at least two were deeper, larger-diameter wells that cost approximately $850 and $1100 each.

Because of the importance of protecting water quality, nearly every Natural Resources District (NRD) offers an attractive incentive to assist well owners with the cost of decommissioning. Payment rates vary by NRD, but typically these programs will pay for 60 to 75% of the costs. With these cost-share payments, out-of-pocket expense to the well owner will often be on the order of $100 - a small price to pay to help assure that water quality and human health and safety are protected.

Additional information on well decommissioning, links to the NRDs, and many other water-related topics can be found on the *water.unl.edu* website.

How Human Pharmaceuticals Threaten Water Quality *continued from page 5*

percent responded that flushing was the most appropriate method of disposal.

Clearly, an educational campaign focused on the public might dramatically reduce, if not eliminate, this way of pharmaceuticals entering local waterways.

Flushing pharmaceuticals is not the only way they can enter the environment, as ingested pharmaceuticals can also ultimately find their way into local waterways.

Unlike food molecules, such as sugars or fats, which can be broken down and used as cellular building blocks or energy sources, the digestive fate of many pharmaceutical compounds are quite different.

These compounds will either pass through the body unaltered or be metabolized (chemically altered) in the kidney or liver before excretion. Importantly, as these compounds journey through your body, they may retain a portion, if not all, of their cellular function. Thus, many of the pharmaceuticals you ingest will ultimately be found in the liquid waste stream in a form that retains at least a portion of its biological potency.

And find them we do. A nationwide reconnaissance of the occurrence of Pharmaceuticals in U.S. waterways found that 80 percent of 139 streams sampled contained detectable levels of these compounds.

Fortunately, the concentrations found were generally low and rarely exceeded drinking-water guidelines. Nevertheless, pharmaceuticals and their metabolites are found in many waterways throughout the U.S., including waters used to supply drinking water.

But is this really a problem? If pharmaceuticals are found in the water in concentrations below drinking water guidelines, how can that be important?

As always, the devil is in the details. Pharmaceuticals are biologically active compounds, with many of them being direct cell signals. As discussed in my last *Water Current* article (Summer 2008) biologically active compounds can manifest effects at astonishingly low concentrations. Furthermore, these compounds do not exist in the environment in isolation, but rather occur in mixtures. One compound within the mixture can magnify or offset the effect of another, and given the fact that scores of these compounds can occur in the water simultaneously, evaluating the relative risk of such mixtures on fish, wildlife and drinking water is daunting.

The issue of pharmaceuticals in natural waters is a good-news, bad news proposition.

Bad news is that the compounds are broadly distributed in waters throughout the U.S. and that they may be having unforeseen effects on fish, wildlife and drinking water. Good news is that there is something we can do about it, called appropriate disposal.

Appropriate disposal of unused or expired prescriptions will directly reduce the load of pharmaceuticals in our water, and will enhance water quality within our state.

IANR/Extension Adopts "Water" Theme for 2008 Husker Harvest Days Show at Grand Island

GO BIG WATER !! Governor Dave Heineman displays one of the hundreds of T-shirts that left UNL's Husker Harvest Days display building to help advertise UNL's new water.unl.edu website.

NU President James B. Milliken talks with UNL associate geoscientist Mark Burbach at Husker Harvest Days.

Rachael Herpel and Lori Benson of the UNL Water Center talk with a Husker Harvest Days attendee.

NU President James B. Milliken and his wife Nana Smith talk to UNL Water Center associate director Mike Jess about the center's recently published Nebraska water map.

Meagan Sittler of the Drought Mitigation Center fields a Husker Harvest Days radio interview with KRVN's Mike LaPorte.

Dave Shelton demonstrates the benefits of conservation buffer strips at Husker Harvest Days.

Extension irrigation engineers Dean Yonts and Suat Irmak chant with NU Vice President and Institute of Agriculture and Natural Resources Harlan Vice Chancellor John Owens (center) about their Husker Harvest Days subsurface drip irrigation display.

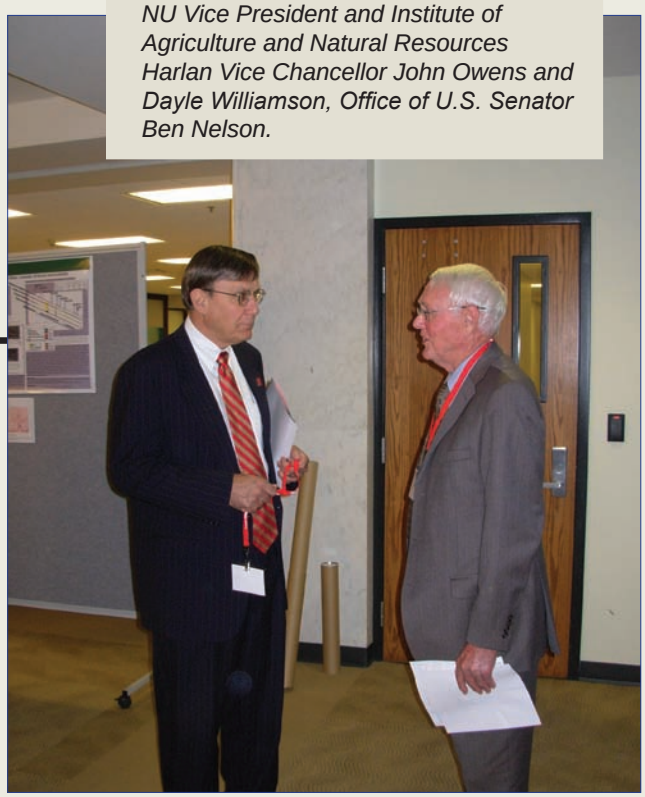
Wayne Woldt and Alan Corr demonstrate their groundwater flow sandtable model to show goers.

UNL Extension's presence at the 2008 Husker Harvest Days show, near Grand Island, adopted a theme-based approached to its exhibits for the first time since the first show in 1978. The debut theme was water.

UNL Extension water quality specialist Sharon Skipton talks about water quality programs to two interested show goers at Husker Harvest Days.

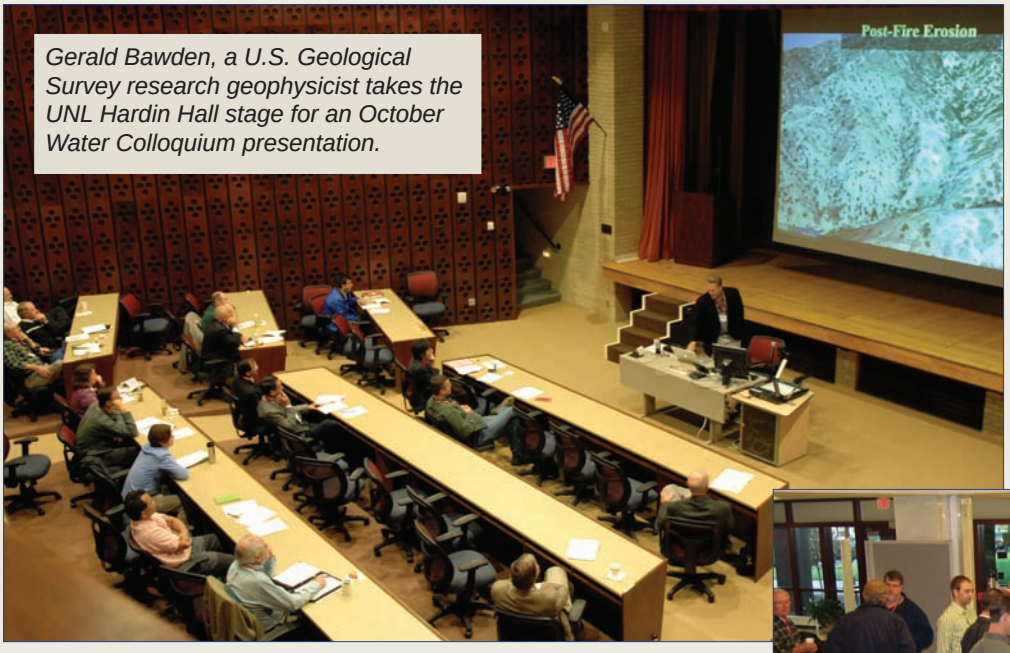
(Photos by Steve Ress and Lorrie Benson)

2008 Water Colloquium Oct. 16, 2008 UNL Hardin Hall, Lincoln



NU Vice President and Institute of Agriculture and Natural Resources Harlan Vice Chancellor John Owens and Dayle Williamson, Office of U.S. Senator Ben Nelson.

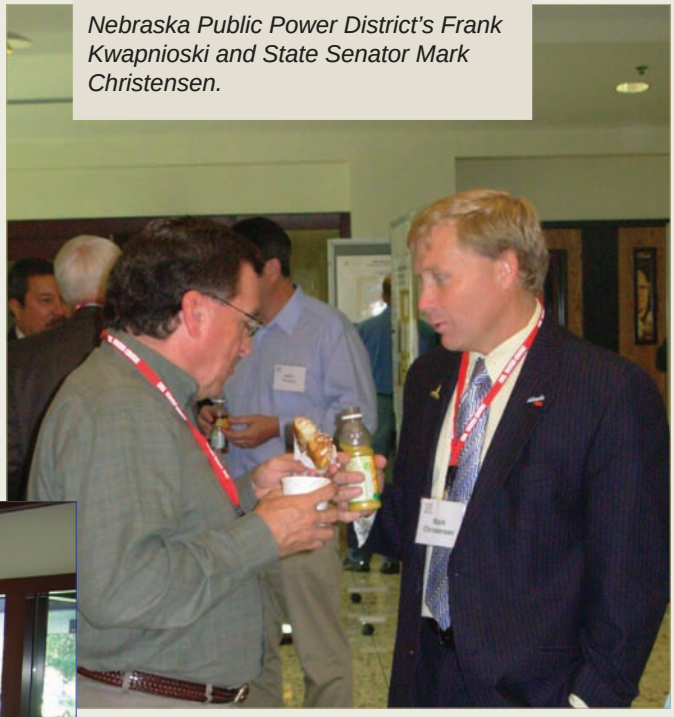
Michelle Schuelke looks through the 2008 Water Colloquium program.



Gerald Bawden, a U.S. Geological Survey research geophysicist takes the UNL Hardin Hall stage for an October Water Colloquium presentation.

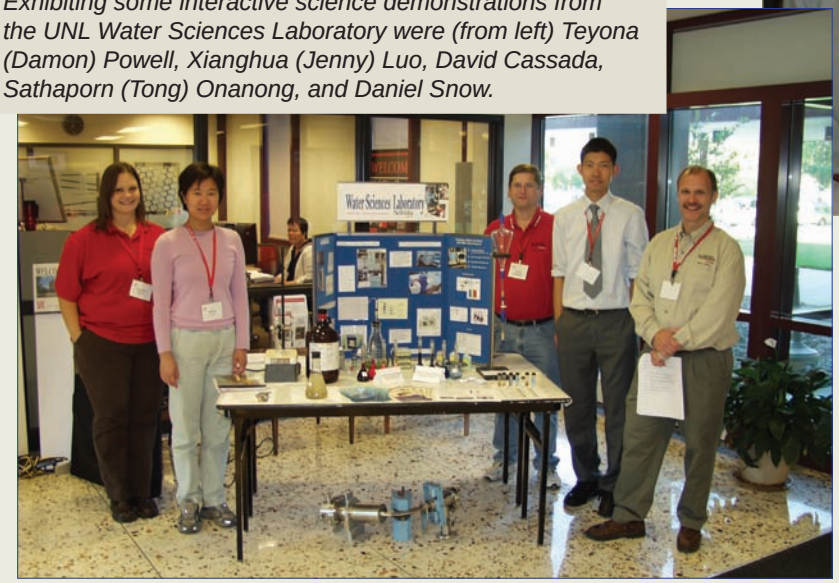
Attendees enjoy refreshments and social time before the start of October's Water Colloquium at UNL's Hardin Hall.

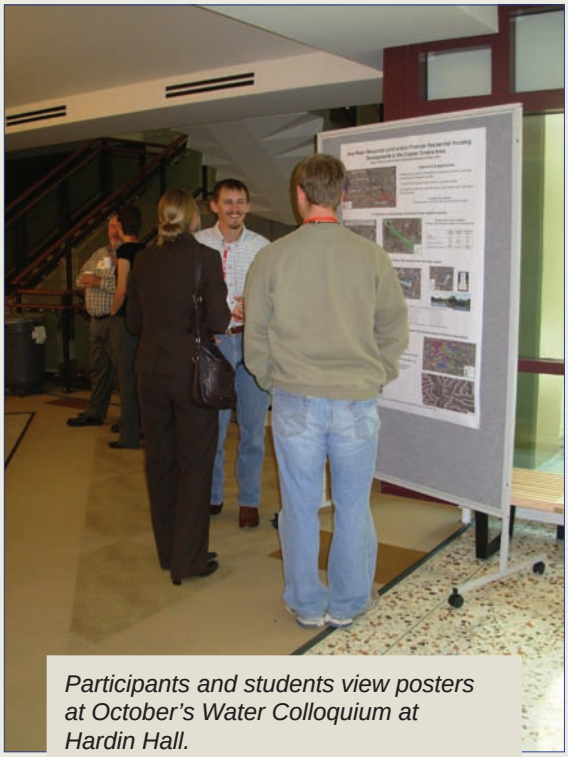
Viewing posters at October's Water Colloquium.



Nebraska Public Power District's Frank Kwapnioski and State Senator Mark Christensen.

Exhibiting some interactive science demonstrations from the UNL Water Sciences Laboratory were (from left) Teyona (Damon) Powell, Xianghua (Jenny) Luo, David Cassada, Sathaporn (Tong) Onanong, and Daniel Snow.





Participants and students view posters at October's Water Colloquium at Hardin Hall.

Rachael Herpel, UNL Water Center and Gary Willson, director of the Great Plains Cooperative Ecosystems Studies Unit, review statewide UNL research and outreach efforts at October's Water Colloquium event at UNL's Hardin Hall.

(Photos by: Brett Hampton, Duane Mohlman and Steve Ress)

Water Resources Advisory Panel Updates Priorities

By Rachael Herpel, Outreach and Education Specialist, UNL Water Center

The University of Nebraska–Lincoln's Water Resources Advisory Panel (WRAP) met Sept. 16 for updates on three projects developed in response to WRAP's research priorities.

UNL's Erkan Istanbulluoglu and Durelle Scott described how they selected a large aquatic site with a dense infestation of invasive species (i.e., *Phragmites australis*) for their study of riparian vegetation impacts on water quantity, quality, and stream ecology.

Site selection was challenging because the mainstem of the Republican River has undergone vast herbicide treatments; however, a wetland site that mimics the river was found roughly 600 meters north of it.

Instruments were deployed and tested for accuracy between March 20 and April 27. In early May they were installed at the site. Normal 10-foot towers had to be extended to 20 feet to be taller than the *Phragmites* being studied. Water quality monitoring equipment was also installed at three locations.

After collecting baseline data, *Phragmites* will be removed and evapotranspiration monitoring continued. UNL researchers are working with Christopher Kucharik at University of Wisconsin-Madison to use the Integrated BIophere Simulator (IBIS) to conduct the modeling portion of this project.

UNL's Suat Irmak described how the Bowen ratio energy balance system (BREBS) is being used to measure evaporative losses from plants from different surfaces in Nebraska. The project is working to establish a large scale and comprehensive surface energy flux measurement network for as many surfaces as possible, making it the largest of its kind in the nation.

The project goal is to make NU a leader in the evapotranspiration and surface energy flux measurement and modeling. Additional federal funds are being sought for the project.

Surfaces where BREBSs have been installed include: irrigated and dryland corn, irrigated seed corn, irrigated and dryland soybeans, irrigated grassland, dryland grassland, dryland winter wheat/Sudan grass rotation (this field will be planted to switch grass to measure surface energy fluxes, crop coefficients, and actual water use and water efficiency of switch grass).

The project goal is to make NU a leader in the evapotranspiration and surface energy flux measurement and modeling.

Additional systems have been installed on disk tilled and no-till soybean/corn rotation on 80 acres of center pivot irrigated fields side-by-side with same plant variety, same soil type, same irrigation system and irrigation management, same planting date and depth, same herbicide, pesticide, and insecticide management.

Another BREBS is being installed to measure evaporative losses for *Phragmites* / cottonwood/willow mixed plant community in the Platte River near Central City.

UNL's Ron Yoder described the Center Pivot Water Conservation Project. This grew out of a meeting between four major pivot manufacturers, Lindsay, Reinke, T-L and Valmont, and Governor Heineman in 2006. Manufacturers wanted to be part of the solution to Nebraska's water management issues.

At the suggestion of then Nebraska Department of Natural Resources director Ann Bleed, UNL researchers began meeting bi-monthly with them to discuss issues. From these discussions came a project proposal, which was funded, by NET, manufacturers, NDNR, and UNL beginning this year.

Project coordinator is UNL extension educator Chuck Burr, Holdrege, who is working with UNL engineers to develop materials for a three-level education program. Materials will be reviewed in November and the irrigator training meetings will be held from December to February 2009. These meetings will be promoted through pivot dealer networks, reaching an audience that has not been reached through previous extension programming.

The meeting ended with WRAP concluding that the existing list of water research priorities, developed nearly two years ago, needs updating. A subcommittee was formed to update the list.

Current WRAP members are: Ann Bleed, P.E. and former director NDNR; Mark Brohman, Nebraska Environmental Trust; Brian Dunnigan, NDNR; Eugene Glock, Cedar Bell Farms; Frank Kwapnioski, Nebraska Public Power District; John Miyoshi, Lower Platte North NRD; Marian Langan, Audubon Nebraska; Mike Linder, Nebraska Department of Environmental Quality; Kirk Nelson, Nebraska Game and Parks Commission; Jerry Obrist, City of Lincoln Water System; Lee Orton, Nebraska Well Drillers Association; Jay Rempe, Nebraska Farm Bureau Federation; Ed Schrock, farmer and former state senator; Dennis Strauch, Pathfinder Irrigation District; and Dayle Williamson, Office of Senator Ben Nelson.

An Update on Nebraska's CLEAR Lake Restoration Program

Nebraska's Community Lake Enhancement and Restoration (CLEAR) Program is helps bring small community lakes back to health and ecological vibrancy.

The Nebraska Department of Environmental Quality (NDEQ), Nebraska Game and Parks Commission (NGPC), and University of Nebraska–Lincoln (UNL) developed CLEAR in 2000. The CLEAR Team, which is comprised of representatives from these three entities, brings expertise in water quality, fisheries management and education to communities seeking to improve their lakes. CLEAR was designed as a one-stop process for communities to secure project funding.

Community involvement is a key element in the partnership. Communities coordinate restoration efforts with the assistance of appropriate partners. On most projects, local elementary and high school teachers have been involved in educational activities related to water quality and lake management.

Primary funding sources are the Nebraska Environmental Trust (NET), U.S. Environmental Protection Agency/NDEQ Clean Water Act Section 319, and the participating community. In 2001, CLEAR secured a master grant of $1.85 million from NET and $710,000 from EPA/NDEQ to create a joint funding pool from which individual projects could be developed.

The CLEAR team requested and got additional NET and 319 funds totaling more than $1.8 million in 2005 to extend the program. Communities were required to provide 15 percent of the total project cost.

Total expenditures for both CLEAR grants include $2,900,000 NET funds, $1,512,000 Section 319 funds and $850,000 as cash and in-kind services by local communities totaling $5,262,000.

Projects in 23 communities have been completed to date. In addition, CLEAR used other resources to assist three other communities in implementing similar projects that did not meet the qualifying conditions for the CLEAR program.

Overall, small community lake projects funded through CLEAR resulted in significant water quality benefits. On average, total phosphorus decreased 62 percent, turbidity decreased 42 percent, total nitrogen decreased by 65 percent, chlorophyll was down 17 percent and water clarity improved 515 percent.

Side benefits have included educational opportunities for youth, experience for local leaders in working with state and federal programs and improved aesthetics in the heart of the community. All participating communities have reported a significant increase in park use for events such as community gatherings, family reunions, picnicking and children fishing in the restored ponds after the project was completed.

The CLEAR Team continues to assist new communities in developing potential projects for their community lakes.

(Source: Resource, October 2008, an electronic newsletter of the Nebraska Environmental Trust)

Tracking Contaminants With Stable Isotopes *continued from page 20*

Most commercial nitrogen fertilizer, such as anhydrous ammonia, is manufactured from atmospheric N_2. The process used for making anhydrous ammonia does not cause much sorting of the isotopes so that the product usually carries air's isotope signature with it. In contrast, nitrogen in organic fertilizers, such as livestock manure, tends to accumulate more nitrogen-15 than air because of sorting processes, such as volatilization, that affect it.

If more nitrogen fertilizer of any form is repeatedly applied than can be used by plants, the excess nitrogen may be converted to nitrate in soil and in time, leaches into the water table. As long as no other chemical sorting affects this nitrate, then the nitrogen isotope composition is similar to the source.

If most of the nitrogen in groundwater nitrate is from excess applied as commercial fertilizer, then it isotopic composition is similar to atmospheric N_2. If more of the nitrogen in groundwater nitrate is from an organic source, such as manure, then it tends to be significantly heavier than atmospheric N_2. Because this difference can be very, very small we need to make the measurement with high precision made possible with a stable isotope mass spectrometer.

As with any tracking or "finger-printing" method, isotope analysis should not be used alone to identify the source of a contaminant. Even with multiple lines of evidence detailing potential sources, history and hydrology, it can be very difficult to identify contaminant sources in ground water.

Nevertheless, tracing contaminant sources with isotopes remains a powerful technique in helping to understand, manage and protect our groundwater. Tracking sources of contaminants is only one of the many uses of stable isotope analysis.

For more information on stable isotope methods used by the UNL Water Sciences Laboratory, go online to watercenter.unl.edu/WaterSciLab

From the Director continued from page 2

to come up with, does it?! Therein lies the beauty of these multidisciplinary meetings, namely consensus building at the "grassroots level" involving the social dimensions of water management up front and at the beginning of the process rather than as a late add-on.

While these central questions or themes may appear to be overly general, and therefore of limited value, discussions went much deeper, details of which will be included in the full report. For example: water quality parameters viewed as most important with respect to biofuel production were nitrogen, phosphorus, pesticides, sediments, and antibiotics (of potential concern in biofuel facility effluent).

In general, I found two other aspects of the meeting rather surprising. First, a majority of workshop discussions focused on so-called second-generation biofuels, namely cellulosic (which could be switchgrass, corn stover, tree products, or even mixed-species, mid-succession forest stands).

Very few talks or subsequent discussions even mentioned grain-based ethanol, with one notable exception. UNL agronomist Cassman gave an outstanding talk on the pros and cons of corn-based biofuel production (and why we need to pay attention to it), which he integrated into food supply, world population needs, and climate change, in a very compelling talk that was very well received by an 8 a.m. audience!

I encourage you to look at his slides, as well as those of the other talks, when they are posted on the DOE/USDA web sites (we'll post the URL on water.unl.edu when it becomes available). In any case, we have an international expert on biofuels right here in Nebraska!

Second, is was clear to me that both the mega-departments hosting the workshop were "behind the curve" with respect to use of the terminology "sustainability" versus the more recently embraced concepts of "resilience" and adaptive management, despite the fact that their sister agency, the Department of Interior, has mandated use of adaptive management for all of it's agencies (for example, USGS, BOR, and BLM). Several speakers noted that sustainability is an ill-defined, mushy term that is difficult to use as a measure of success. Nevertheless, when I raised the issue it also raised some eyebrows – the good news is that I wasn't thrown out of the meeting!

In other news ……

- Planning is progressing for both our series of spring semester water seminar lectures that will begin in January and run through April, and for our sixth annual Water Law, Policy and Science Conference, that will be at Lincoln's Embassy Suites Hotel in late April. See more on both these spring events in this issue.
- Mike Jess, Steve Ress and other members of the annual water tour planning committee are taking a very hard look at holding this coming summer's water and natural resources tour in the San Francisco Bay-Delta area of California. Tentative dates are June 14-19, 2009. Though travel expenses and especially airfares are very tough to pin-down, we're thinking the weeklong tour and travel expenses to-and-from should be about $1,500 total. We'll keep you posted.
- Our recently release state water map is simply gorgeous. Get a free copy of the map and take a look at the online version at our new UNL "water portal" web site (everything water at UNL) at water.unl.edu
- Hope we had the chance to see you at Husker Harvest Days in Grand Island in September, or at our annual Water Colloquium in Lincoln in October. If not, the Water Center will be at Kearney's Gateway Farm Expo in mid-November and at the annual Nebraska Water Resources Association/Nebraska State Irrigation Association conference, also in Kearney, just before Thanksgiving.

When water meets money topic of conference continued from page 1

Several conference sessions will be devoted to water marketing and banking, exploring the basics of these topics as well as emerging best practices and ideas to reduce costs and make markets more efficient.

A second day law track specially designed for attorneys and professionals new to water law and others needing a better understanding of water law issues will be offered.

Conference information and registration options will be available online at watercenter.unl.edu.

Conference cosponsors are the University's Office of Research, Water Resources Research Initiative, Institute of Agriculture and Natural Resources, Water Center, School of Natural Resources, College of Journalism and Mass Communications and College of Law.

Charles A. Shapiro *(continued from page 3)*

Limited Irrigation On-Farm Demonstration Project. Demonstrate and validate water saving techniques for irrigating corn at the farm level across the state on production sized fields. This is a joint project with the Nebraska Corn Board and UNL funded by NRCS.

Nitrogen and Irrigation Management Demonstrations. In cooperation with the NRDs promote efficient irrigation practices and nitrogen management to reduce the potential for nitrogen leaching while maintaining profitable corn yields.

Establishment of certified organic areas at four University of Nebraska–Lincoln field laboratories. A team of interested scientists have established organically grown areas at HAL, ARDC, SCREC, and the HPAL where research related to the needs of the organic farming community can be researched. To date the organic areas have attracted additional funding in researching the use of flaming weeds and the development of wheat varieties that serve the needs of the organic food industry.

Examples of Past Research/Extension Programs:

Comprehensive Nutrient Management Programming. Since about 2000 a workgroup at UNL has been planning and implementing a program to provide the livestock industry assistance in developing farm-specific manure management plans that would improve the manure management on their operations and comply with state and federal regulations. These efforts are on-going, but the major focus was to transition existing operations into compliance with new regulations that included land application of manure.

Conservation Reserve Program Land Management. During the mid to late 1990s the first wave of CRP land was scheduled to return to crop production from grassland. A multi-year research and extension effort was initiated and delivered on the effects of residue management and crop choice for land going back into row crop production. Data from these experiments were used statewide to help producers manage the transition in an economic and ecologically sound manner.

Examples of Outreach Programs:

Ongoing efforts in nutrient management include publications, websites, radio programs, and applied research designed to provide the agriculture community with the information they need to make decisions about which nutrients to apply, how to apply them and at what rates.

Selected Publications:

Wortmann, C.S. and C.A. Shapiro. 2007. The effects of manure application on soil aggregation. Nutr. Cyclc Agroecosytems. 80:173-180. Online: DOI 10.1007/s10705-007-9130-6.

Tarkalson, D.D., J.O. Payero, S.M. Ensley, and C.A. Shapiro. 2006. Nitrate accumulation and movement under deficit irrigation in soil receiving cattle manure and commercial fertilizer. Ag. Water Management. 85:201-210.

Echarvarria-Chairez, F.G., C. A. Shapiro. G.W. Hergert and W. Kranz. 2006. Representacion del moviemiento de bromuro con la tecnia de visualizacion volumetrica (Representation of Bromide Movement by the Volume Visualization Technique). Terra Latinoamerica. 24:27-35.

Mamo, M., D. Ginting, W. Zanner, D. McCallilster, R. Renken, and C. Shapiro. 2005. Phosphorus stratification and potential for runoff loss following long term manure applications. J. of Soil & Water Conserv. 60(5):243-250.

Wortmann, C.S., R.K. Koelsch, C.A. Shapiro, R.L. DeLoughery, D. Tarkalson. 2005. Manure use planning: an evaluation of a producer training program. Journal of Extension. 43(4):4RIB5 (http://www.joe.org/joe/2005august/rb5.shtml)

Shapiro, C., W.L. Kranz, C.S. Wortmann. 2005. Salt thresholds for liquid manure applied to corn and soybeans. Trans. of ASAE. 48(3):1005-1013.

Kranz, W.L., C.A. Shapiro, B.E. Anderson, M.C. Brumm, M. Mamo. 2005. Effect of swine lagoon water application rate and alfalfa harvest frequency on dry matter production and N harvest. Applied Engineering in Agriculture. 22(2):211-216.

Regional publications:

Wortmann, C., M. Al-Kaisi, M. Helmers, J. Sawyer, D. Devlin, C. Barden, P. Scharf, R. Ferguson, W. Kranz, C. Shapiro, R. Spalding, D. Tarkalson, J. Holz, D. Francis, and J. Schepers. 2007. Nitrogen management for water quality protection in the Midwest. Regional Publication. RP189.

Wortmann, C. S., M. Helmers, A. Mallerino, C. Barden, D. Devlin, G. Pierzynski, J. Lory, R. Massey, J. Holz, C. Shapiro, and J. Kovar. 2005. Agricultural Phosphorus Management and Water Quality Protection in the Midwest. Heartland Regional Water Coordination Initiative. RP-188.

Web/e-mail addresses:

cshapiro@unl.edu
http://nerec.unl.edu/shapiro.shtml

Our Opinion: *The Grand Island Independent:*

UNL Makes Major Commitment to Water Research

The University of Nebraska raised the bar this week with its display at Husker Harvest Days. It was a dramatic improvement of the university's physical presence and the central topic was important to every person in Nebraska: water.

The displays explained groundwater and surface water issues. Sitting above the largest underground water feature in the world, the Ogallala Aquifer, Nebraska relies on the aquifer to fuel much of its agribusiness economy. In addition, there were notable displays dealing with irrigation, conservation buffer strips, wastewater and drinking water issues.

The university has developed a deep pool of expertise in water conservation and water management issues. The UNL Water Center is positioned to make major contributions to the state and nation on water issues. Separately, the National Drought Mitigation Center has been instrumental in determining strategies for dealing with the impact of drought on the land for developing strategies to plan for drought.

University President James B. Milliken is committed to making the university a strategic partner to Nebraska farmers in issues involving irrigation and water conservation. "In Nebraska, there's nothing more important than having a leadership role in that area," Milliken noted. "I think it's very important that we demonstrate to Nebraskans what our commitment is here and (help them) understand what the university is doing in terms of its research."

Clearly the university is focused on water issues, research and conservation measures. A major element of the programs is the subsequent outreach to farmers and ranchers to get the information in their hands. The Husker Harvest Days event is the perfect venue to bring eyeballs to their effort. With more than 100,000 strolling through the HHD campus, the word will get out quickly that the university is serious about water research.

For those interested in learning more about the UNL programs, the university has created a Web site to house a wide variety of the UNL water research. Farmers, ranchers and marketers are able to go to heep://water.unl.edu and get quick access to the latest water information.

Clearly when it comes to water research, there is no place like Nebraska.

(Editor's note: Reprinted from the opinion page of the Sept. 12 edition of *The Grand Island Independent.* See photos of UNL's new Husker Harvest Days exhibitis in this issue.)

2009 Tour looks at San Francisco Bay-Delta area *continued from page 1*

Republican River basin. They reviewed post-tour surveys from 2007 and 2008 and for the coming year identified three possible alternatives for 2009: North Platte River drainage of Colorado and Wyoming; interconnected Snake River/basalt aquifer of southern Idaho; and the Bay-Delta region of northern California.

"After learning that the U.S. Bureau of Reclamation wasn't planning a Centennial celebration for Pathfinder Dam, we eliminated that choice and since issues involving integrated use of surface and groundwater in the Snake River/basalt aquifer are similar to the Pecos and Republican river basins which we have recently toured, that option also was eliminated," Jess said.

That left a Bay-Delta tour, which would be an excellent opportunity to compare and contrast endangered species recovery efforts in the Platte River valley and in northern California, he said.

Because of its central location and competitive airfares, Sacramento was selected as the preferred destination.

Similar to 2007's trip to New Mexico, committee members envision tour participants independently making arrangements for travel to-and-from Sacramento. All lodging, food, ground transportation and related expenses would be included in tour registration costs. Rather than different lodging for each day of the trip, preference for a single location in or near Sacramento is being explored.

Committee members also asked that a half-day be set-aside for free time in San Francisco.

David Kracman of Lincoln's The Flatwater Group has volunteered to assist in planning and has already initiated contact with several individuals. Tentative plans call for a preliminary planning trip to California in January 2009.

Fourteen lectures in UNL's Spring Semester Water Series *continued from page 1*

On March 25, Dave Rus of the U.S. Geological Survey's Nebraska Water Science Center, talks on the water balance of riparian woodlands along the Platte River and the following Wednesday, April 1, University of Cincinnati geologist Ken Hinkel presents a study of the thermal effects of large bodies of water on local and regional climate.

Colorado State University environmental soil chemist Thomas Borch takes the Hardin Hall stage on April 8 to talk about the occurrence and fate of steroid hormones in rivers due to run-off and other sources.

Other speakers in the series hail from the University of Alabama, the Swiss Federal Institute for Forest, Snow and Landscape Research and UNL, among others.

"These speakers cover a very broad and timely slate of water and climate-related topics that there is wide interest in locally and regionally," said UNL Water Center director Kyle Hoagland.

After they are presented, the weekly lectures will be available for viewing online at watercenter.unl.edu.

For more information on the lecture series, contact the UNL Water Center at (402) 472-3305.

Seminar cosponsors are UNL's Institute of Agriculture and Natural Resources, Water Center, Water Resources Research Initiative and School of Natural Resources

Nebraska Map Illustrates *continued from page 5*

major streams, lakes, canals and reservoirs. Counties, roadways, major cities and towns, and prominent topographic features are also depicted, along with Nebraska's 23 Natural Resources Districts.

Surrounding this large map are smaller maps and graphics showing the High Plains groundwater aquifer, annual precipitation, how and where water is used in Nebraska, where registered irrigation wells are located, where groundwater nitrate and atrazine contamination can be found, how groundwater and surface water interact and other information.

"It's a wonderful educational tool and it also looks great when you hang it on your wall," Benson said. "With water being so very much on everyone's mind, the vastness of Nebraska's surface and groundwater resources and the challenges posed to both water quantity and quality, one of the biggest challenges was deciding what information we would have to leave off, since there wasn't room for everything."

An online version of the map, which is under construction, amplifies much of the information on the printed map, as well as presenting additional information not contained on it. It can be found at water.unl.edu.

"The map is just one basic Nebraska water information source available on that site, which has content from and links to all things water at UNL," said Benson.

Print copies of the map are available first-come, first-served through the UNL School of Natural Resources Nebraska Maps and More store on the first floor of Hardin Hall, northeast corner N. 33rd and Holdrege Sts., UNL East Campus, Lincoln. Phone (402) 472-3471 or visit the store online at nebraskamaps.unl.edu. If requesting larger quantities for educational or programmatic use, contact Benson at the UNL Water Center at (402) 472-3305 or email lbenson2@unl.edu.

Map cooperators are UNL's Institute of Agriculture and Natural Resources, School of Natural Resources, Extension, Water Center and Conservation and Survey Division, the U.S. Geological Survey, Nebraska Department of Environmental Quality, Nebraska Department of Natural Resources, Central Nebraska Public Power and Irrigation District, Nebraska Game and Parks Commission, Tern and Plover Conservation Partnership, The Groundwater Foundation, Nebraska Public Power District and U.S. Bureau of Reclamation.

NEWS BRIEFS

Send Us Your Water-Centric Pictures

Have you got any good water photos you'd like to share? Send them to us.

The UNL Water Center is always interested in good water-related photographs of our state and surrounding states and we would like the chance to publish a few of yours, so if you have any good water-centric pictures, please send them to us and we will publish some of the best ones in upcoming issues of the Water Current, as well as on our website at watercenter.unl.edu. You will receive full credit for the submission if we publish it, of course.

Submitted photos can be on any water-related topic and should be from Nebraska or surrounding states. Send them as an attached JPG of at least 300 dpi quality to sress1@unl.edu. If you have questions about your submission, address inquiries to the same email address, or phone (402) 472-9549.

Good picture taking!

This picture of the U.S. Bureau of Reclamation's Pathfinder dam and reservoir, in neighboring Wyoming, is an example of the water-centric photos we hope you, our readers, will submit for publication in upcoming issues of the Water Current.

China: Olympic-Sized Growth in Carbon Emissions

Between 2000 and 2007, carbon emissions from fossil fuel combustion worldwide increased 22 percent to an estimated 8.2 billion tons, according to the latest Vital Signs Update released by the Worldwatch Institute. China accounted for a staggering 57 percent of the growth in emissions during this period, while India contributed 8 percent and the United States and Europe contributed 4 and 3 percent, respectively.

Despite the dramatic rise in China's fossil fuel emissions, the United States is still the leading emitter of carbon dioxide (CO_2) from fossil fuels. Americans still outpace the Chinese more than 4 to 1 in terms of per capita emissions, and they outpace Indians more than 13 to 1 and Africans 18 to 1. Nevertheless, the rapid, coal-dependent development of China has become the most important driver of current growth in global CO_2 emissions. Coal provides 70 percent of commercial energy in China and 56 percent in India.

The combustion of fossil fuels, primarily coal, oil, and natural gas, accounts for about 74 percent of all CO2 emissions and for roughly 57 percent of all greenhouse gas emissions globally.

In December 2009, the parties to the United Nations Framework Convention on Climate Change intend to reach agreement on a new climate change protocol to limit carbon emissions, building on the Kyoto Protocol originally signed in 1997. The question of how emissions from China and other rapidly growing developing countries will be regulated in this new agreement is one of the most contentious issues that negotiators must navigate before the agreement can be reached.

"Industrial countries are largely responsible for the global climate crisis the world now faces," said Christopher Flavin, President of the Worldwatch Institute. "But recent emissions trends demonstrate that it will require an active partnership between industrial and developing countries if the climate is to be stabilized."

(Source: Worldwatch Institute)

Strategy to Assess Nation's Groundwater Availability

Scientists proposed a strategy to study the nation's groundwater supply as part of a federal effort to help address increasing national competition for water.

Groundwater declines have led to concerns about future availability of groundwater, which provides half the country's drinking water and is essential to the vitality of agriculture and industry, as well as to the health of rivers, wetlands, and estuaries.

The U.S. Geologcial Survey's report, "Ground-Water Availability in the United States" examines what is known about the nation's groundwater availability and outlines a strategy for future national and regional studies that would provide information to help state and local agencies make informed water-availability decisions. View the report on-line at at http://pubs.usgs.gov/circ/1323.

The approach outlined in the report is designed to provide useful regional information for state and local agencies who manage groundwater resources, while providing the building blocks for a national assessment.

The report places the regional studies by the USGS Ground-Water Resources Program as a long-term effort to understand groundwater availability in major aquifers and it contains information about 30 regional principal aquifers and five case studies to illustrate the diversity of water-availability issues. The report is written for a wide audience interested or involved in the management, protection, and sustainable use of the Nation's water resources.

Determining groundwater availability is a complex process. Issues affecting groundwater vary from location to location and commonly require analysis in the context of groundwater flow systems to achieve a meaningful perspective. Even if water resources are abundant regionally, heavy water use in centralized areas can create local stresses. As water-related problems evolve in complex ways, an up-to-date and comprehensive evaluation of groundwater resources that builds on the foundation of previous studies is needed to meet society's ever-changing water demands.

USGS provides science for a changing world. For more information, visit www.usgs.gov.

Bleed Receives Kremer Award

Ann Bleed was picked to receive The Groundwater Foundation's 2008 Maurice Kremer Groundwater Achievement Award.

The award was established in 1985 to recognize Nebraskans who have made a substantive contribution to the conservation and protection of Nebraska's groundwater.

Selection Committee member and past Kremer honoree, Jim Goeke said "Ann Bleed has always been devoted to doing what was right for the water resources and citizens of Nebraska. Her devotion, dedication, and empathy were evident with her creation of the *Atlas of the Sand Hills*. She has worked tirelessly for the best interests of Nebraska while at the Department of Natural Resources and richly deserves recognition for her efforts and contributions."

Bleed, who began her career as an assistant professor at UNL's Water Center and Conservation and Survey Division, moved into state government in 1988 as State Hydrologist with the Department of Water Resources (DNR). When that department merged with the Natural Resources Commission to form the Department of Natural Resources in 2000, she became its deputy director.

She was appointed DNR's acting director in 2005 and director in 2007.

Bleed is now a senior program manager at CDR Associates, which specializes in providing collaborative decision resources, particularly in the area of water and natural resources.

Bleed was presented the Kremer Award at the Nebraska Water Resources/Nebraska State Irrigation Association Conference in November in Kearney.

Past Kremer recipients include: 1986, Vincent Dreeszen; 1987, Maurice Kremer; 1988, Eugene Reed; 1989, Val Kuska; 1990, Warren Fairchild; 1991, Ralph Marlette; 1992, Ted Filipi; 1993, Robert B. Crosby; 1994, Virginia Smith; 1995, Fred Salmon and Family; 1996, Frank A. Smith; 1997, Robert B. Daugherty; 1998, Les Sheffield; 1999, Richard Harnsberger; 2000, Wayne Madsen; 2001, Jim Goeke; 2002, Eugene Haarberg; 2003, Chris Beutler; 2004, Darrell Watts; 2005, Roger Patterson; 2006, Senator Ed Schrock; 2007, Jim Cook.

University of Nebraska Lincoln | WATER CENTER

103 Natural Resources Hall
P.O. Box 830844
Lincoln, NE 68583-0844

Tracking Contaminants With Stable Isotopes

By Daniel D. Snow, PhD, UNL Water Sciences Laboratory

Several of the newer methods offered at the University of Nebraska–Lincoln Water Sciences Laboratory are for high precision analysis of stable isotopes of hydrogen, carbon, nitrogen and oxygen.

The lab processes a wide variety of samples for isotope analysis including water, rocks, soil, plants and animal tissue. One of the common uses for stable isotope analysis is for tracking or "finger-printing" contaminants.

To understand how to use isotope analysis for this purpose requires some background in how isotopes behave in the environment.

Most elements occur in nature in more than one atomic form, or isotope. For example, while over 99.99% of hydrogen consists of a single proton and electron, about 0.015% also has a neutron. This "heavier" isotope (called deuterium) occurs in all the same chemical forms as hydrogen, but does not react quite the same way.

Because it has a different mass, deuterium is sorted or "fractionated" during some chemical changes the element undergoes.

Evaporation is a good example of this sorting process. If a pan of water is left out, as the water evaporates the isotopically lighter water molecules are preferentially removed leaving the remaining water with a higher concentration of deuterium.

This sorting of isotopes in nature can provide scientists with a means for tracking that element.

Because nitrate is common in Nebraska's groundwater, there is much interest in methods to understand how to reduce or minimize sources of this contaminant.

Nitrification, or oxidation, of ammonia in soils is considered to be one of the largest contributors to groundwater nitrate but it is not always clear what sources of ammonia are the most prevent.

Nitrogen isotope analysis is one tool that can help identify the sources of nitrogen producing nitrate. Most (99.64%) of the nitrogen (N_2) in the air we breathe consists of two molecules mass of 14. About 0.36% of atmospheric N_2 has different isotope with a mass of 15.

continued on page 13