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Tapan Pathak, Ph.D.

Tapan Pathak is an extension educator in climate variability in the University of Nebraska–Lincoln’s School of Natural Resources since April 2010. Currently responsible for application of climate variability and climate change science to communicate risks, adaptation, and mitigation strategies to diverse clientele across Nebraska.

Education:
Ph.D., Agricultural Engineering, University of Florida, Gainesville, Fl., 2009
M.S., Irrigation Engineering, Utah State University, Logan, Utah, 2004
B.Tech. Agricultural Engineering, Gujarat Agricultural University, Gujarat, India, 2000

Fall Events Focus on Nebraska Water Law, Great Plains Climate and Ecosystems

By Steve Ress, UNL Water Center

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Attendees can choose to register for either or both events, dependent on their interests and needs, said event organizer and UNL Water Center assistant director Lorrie Benson.

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Water Tour Visits North Central Nebraska July 12-14

By Steve Ress, UNL Water Center

The University of Nebraska–Lincoln’s annual water and natural resources tour will focus on ground and surface water issues in north central Nebraska over three days in mid-July.

The tour leaves Kearney Tuesday, July 12 and returns there Thursday, July 14. A variety of stops and points of interest in the Niobrara and Loup River basins will be featured, with overnight stops in Ainsworth and Valentine.

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May Water for Food Conference; Water Tour, Symposium and Water Law Conference All Coming Up

The third annual Global Water for Food conference, May 1-4 here in Lincoln, was an unqualified success no matter how you measure it. There were more than 450 participants representing more than two dozen countries and a very full slate of internationally recognized speakers on all topics related to the conference. It was very energizing to listen to many different perspectives on water availability, cropping practices, irrigation practices, and international cooperation to feed a fast growing global population. It was simply a fantastic conference and wonderful opportunity to interact with colleagues from around the globe.

At that conference, the University of Nebraska Medical Center (UNMC) in Omaha and the Water Center organized a Water Quality Interest Group meeting of NU faculty. Special thanks to Rachael Herpel and Ann Bleed for helping develop and run this session. During the meeting, faculty explored how water quality issues may be addressed as part of the Water for Food Institutes’ programming. The faculty participants discussed the following topical areas:

- How can wastewater be reused and/or impaired waters be used safely for food production?
- How can the role of ecosystem services be identified, modeled, and measured in agriculture dominated ecosystems?
- How can we develop a systems approach, incorporating various models, to understanding the trade-offs and constraints on decisions that protect water quality in an agriculture dominated landscape?
- How can water quality be protected for multiple uses (e.g., domestic use, food processing, industrial use, ecosystem services) in an agricultural environment?
- What design, legal, economic, political and cultural frameworks are necessary to protect water quality as agriculture expands?

It is anticipated that further sessions will be held to further develop topical areas, and that some elements of these topics will be used to develop future Water for Food Conference sessions.

I want to recognize several individuals and groups for assistance to the Water Center and Nebraska water community on special projects. Rachael Herpel has been doing double duty since mid-fall, in working at the Water Center and assisting the nascent Water for Food Institute with conference preparations and developing its expertise database. She has done a great job and as one can imagine, is especially relieved that this year’s Water for Food Conference is now completed.

Dr. Xun-Hong Chen in UNL’s School of Natural Resources graciously agreed to prepare a specialized workshop in May on the use of MODFLOW, a groundwater model, for...
Tapan Pathak, Ph.D. continued from page 3

Examples of Current Research/Extension Programs:

My current work responsibilities include application of climate variability and climate change science to communicate risks, adaptation, and mitigation strategies to diverse clientele across Nebraska. In order to better communicate climate information to diverse clientele, I am planning to interact with extension professionals, crop consultants, and local producers to learn about ongoing research and extension activities, discuss ways to incorporate climate information in decision-making, and learn the climate information needs of clients. Through this collaborative, information-gathering process I am envisioning a strong climate extension program for Nebraska.

Examples of Past Research/Extension Programs:

Prior to joining UNL, from 2005 to 2010, I was a research assistant at University of Florida. My dissertation was on forecasting cotton yield in the southeastern United States using climate forecasts and other climate information as a way to adapt to a variable climate. I used climate indices as an early indicator of crop yield and a crop simulation model for in-season updates of cotton yield forecasts. From 2002 to 2004, I worked on my M.S. research at Utah State University, which focused on validating existing potato yield models and various agricultural assessments using airborne multispectral remote sensing imagery.

Examples of Outreach Programs:

Newsletters and scholarly articles on climate, water, and agriculture related topics.

Selected Publications:


Royce, F., G.A. Baigorria, H. Hu, C. Fraisse, and T.B. Pathak. 2008. ENSO classification and summer crop yields in the Southeastern USA. Workshop on climate change impacts and adaptation to agriculture, forestry and fisheries at the national and regional levels. WMO/South East Climate Consortium. Orlando, FL.


Web address:

http://snr.unl.edu/aboutus/who/people/faculty-member.asp?pid=1279
Statewide Groundwater Monitoring Paints Mixed Picture

By Steve Ress, UNL Water Center

Statewide groundwater monitoring by the University of Nebraska–Lincoln paints a picture that can be interpreted many ways.

If you look only at the last year to three years, the news is generally good as groundwater levels under most of Nebraska continued to gain, or at least slow their declines.

Overall, groundwater levels under most of Nebraska changed less than a foot from spring 2009 to spring 2010, but when you look at the data from the past 10 or more years the picture isn’t quite as rosy.

“We’ve had a few years of average to above-average precipitation, which have helped groundwater levels over much of the state, but if you look at the longer term, our groundwater levels are continuing to decline,” said UNL School of Natural Resources groundwater geologist Jesse Korus.

“Nebraska Statewide Groundwater-Level Monitoring Report 2010,” which Korus co-authored with other UNL groundwater experts, says “Long term groundwater level changes in Nebraska primarily reflect aquifer depletion in areas of dense irrigation development and increases in (groundwater) storage due to seepage from canals and reservoirs.”

This and much more information is contained in the 19-page illustrated report that details and maps changes in Nebraska groundwater levels from Spring 2009 to Spring 2010, over the past 10 years, from predevelopment of irrigation to Spring 2010, as well as average daily streamflows in 2009 and other related information.

“Increases in precipitation over most of the state since 2007, which also helped reduce demands for irrigation, have meant generally good news for Nebraska groundwater levels, but the long term trend is still that groundwater levels continue to decline from the period of predevelopment of irrigation to the present,” report co-author and assistant geoscientist Mark Burbach echoed.

Looking just at the past year, the news is better.

From 2009 to 2010, groundwater levels under most of Nebraska generally changed less than a foot. There were rises in scattered locations, but there were also a few places showing declines.

“Some, but not all of these trends are reflective of statewide precipitation patterns in 2009, compared to the long-term norms,” Korus said.

Groundwater level rises of more than two feet occurred around Lake McConaughy, Keith and Perkins Counties and under most of the southern Panhandle. Much of the western and northern Sandhills experienced rises of one to

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The Lincoln-based Groundwater Foundation is currently seeking abstracts from potential presenters and exhibitors for its national conference, Oct. 4-6, in Omaha.

Conference theme is “Let’s Keep It Clean: Exploring a Collaborative Approach to Groundwater Protection” and will focus on the knowledge, technology and practices to assist communities in local groundwater protection.

The conference will be more than lectures in a hotel conference room. It will include field-based tours showcasing innovative solutions and programs that have been developed and implemented in Nebraska. Groundwater plays a vital role in our lives – we rely on it and it relies on us working together to protect and use it wisely so that it will be available for future generations.

What are communities doing to create a collaborative approach to groundwater protection? What needs to be done on a community-wide basis to safeguard groundwater? When do we need to act and who will do so? Answers to these questions and more will provide conference participants with the knowledge and tools needed to build a far-reaching, collaborative groundwater protection strategy. One that when implemented truly makes a difference in protecting groundwater for future generations.

Conference sponsors are Nebraska Department of Environmental Quality, Senninger Irrigation, Valmont Industries and the Water Research Foundation.

To learn more or submit an abstract go to www.groundwater.org/pe/conference.html, email info@groundwater.org or call 1-800-858-4844 to request the call for presentation brochure.

The tenth annual Sand Hills Discovery Conference is Thursday, July 14 in Ainsworth.

At the conference, participants can learn more about sand hills lakes, rivers and creeks as well as other topics and learn more about the unique area that is the Sand hills of Nebraska.

Area tours are being offered the day before and the day after the conference that will include fossil digs, a Dutch oven workshop, hands-on science workshop and a driving tour through the sand hills.

One hour of undergraduate or graduate college credit is available from Wayne State College. For more information on the conference, go online to www.sandhillsdiscovery.org or phone (866) 387-2740 or (402) 387-2740.

Law, will focus on current Nebraska water law. It is designed to benefit practicing attorneys, but is open to anyone and can benefit water professionals and managers in many other professional venues.

Law conference registration will be available about Aug. 1. More information on the day’s agenda, topics and speakers will be posted online, as available, at watercenter.unl.edu

CLE credit for practicing attorneys will be applied for, Benson said.

At the same location the following day, focus shifts to Great Plains climate, water and ecosystems in a symposium showcasing “Natural, physical and social sciences research and innovative programming that includes effects of climate change.”

According to Benson, “The geographic focus will be the Great Plains, including research or programming that’s transferrable to the Great Plains.”

Invitations to present at the symposium are now open and will remain so through June 13.

Requested oral presentations are for approximately 10-15 minutes, including two to five minutes for questions. Abstracts should be no more than 300 words and contain all pertinent information on presenters, contact information and topic. More than one abstract may be submitted.

Posters are also being solicited through June 13.

The one-day event is being co-hosted by the U.S. Geological Survey Nebraska Water Science Center.

For more information, check online at watercenter.unl.edu, or call Benson at (402) 472-7372.

Registration details for both events will be posted online about August 1.
about 16 attendees. This training was previously unavailable in our region. As with many things Dr. Chen does here at UNL, this workshop will be an invaluable and well-received service to our state and regional stakeholders.

A faculty panel has been assisting the Water Center and Water Sciences Laboratory (WSL) as the WSL evolves to address its success in developing many new analytical methods and in receiving a record number of samples for the past year. I thank Drs. Alan Kolok, Ed Harvey, Steve Comfort, John Gates, and Noah Clayton of the UNL Office of Research for serving on this panel. The lab’s success has created new challenges in providing rapid sample turnaround times and in setting priorities.

Based on their input, the lab now has additional explicit policies and operating procedures to increase sample turnaround times, and additional procedures for gathering data that will be used in the future to continue to improve its services to the Nebraska water community.

In concluding, let me highlight several coming Water Center events. The first is our July 12-14 water and natural resources tour of north central Nebraska and the Niobrara and Loup River basins. Highlights of this tour will be hearing the challenges and opportunities of the Niobrara Scenic River designation and developments on the Snake River near Merritt Reservoir on a possible change of ownership of the historic and scenic Snake River Falls. Part of a day canoeing the Niobrara should be fun, as well and I am very excited to be participating in part of the tour for the first time as interim director of the Water Center. I want to thank our primary co-sponsors... Central Nebraska Public Power and Irrigation District, the Kearney Area Chamber of Commerce and Nebraska Public Power District..... for their tremendous help and involvement in keeping these annual tours going.

Preparations are well in hand for our Fall Research Symposium on October 13th. Theme is “Climate, Water and Ecosystems-Shaping the Great Plains.” This event will showcase natural, physical, and social sciences research and innovative programming that includes effects of climate change or variability in the Great Plains regions. Research or programming that’s transferable to the Great Plains will be part of the program. It will also include a session related tools which can be used to help manage watersheds.

There is still time to submit abstracts for platform presentations or posters. This can be done by going to watercenter.unl.edu and submitting by June 14. This is another event that wouldn’t be possible without co-sponsors and this case we thank the U.S. Geological Survey Nebraska Water Science Center and the Robert B. Daugherty Water for Food Institute for their gracious involvement.

The day before the symposium, on Oct. 12, we hold our annual Water Law Conference in partnership with the University of Nebraska College of Law, focusing. The conference will touch on a broad range of water law issues, including Clean Water Act requirements and enforcement, transactions involving water rights, and due process rights associated with water rights. The primary audience is the practicing bar, but this conference will be useful to anyone interested in water quality or quantity, especially water professionals and managers.
The 100-Gallon Challenge

By John C. Fech, UNL Extension Educator

Wow, that’s a catchy title, isn’t it?
The Hundred-Gallon Challenge.
But what exactly is it?  Fair question. Simply put, it’s a group of common sense best management practices that will A.) Reduce stormwater runoff, B.) Soften peak demand of water systems while meeting the needs of plant and domestic water consuming activities, and C.) Reduce the volume of water needed to grow turf grass and landscape plants and carry on the daily routines of our lives.

Fellow University of Nebraska–Lincoln Extension Educator Sharon Skipton and I are touting this challenge…..the 100 Gallon Challenge…..a program we adapted from the San Diego Water Department…to encourage adoption of sound management principles by homeowners and service professionals like lawn care providers and housing developers.

The good news is that these principles can be implemented as part of an overall goal of “going green.”

The challenge contains practices set in the model of changes to everyday behavior. Ten practices have been chosen for outside/landscape use and ten for inside/domestic use. They are divided into “easy to do/low cost”, “low cost/some time required” and “moderate to high cost/some time required” - a sort of low, medium and high set of options.

The numbers that follow each option represent the number of gallons per week that will be saved by implementation.

No Cost/Easy to Do:

- Water only between 4 a.m. and 8 a.m. to reduce evaporation and interference from wind. (40-70*).
- Adjust irrigation sprinklers to prevent spraying the street, sidewalk and other non-pervious surfaces. (30-50*).
- Reduce each lawn irrigation cycle by 2 minutes (50-90*).
- Use a bucket of soapy water to wash your car, using a hose only for rinsing. Use a self-closing nozzle to make it easier. (30-70*).
- Use a broom instead of a hose to clean driveway and sidewalks. (20-40*).

Low or No Cost/Easy to Do:

- Do not use the toilet as a wastebasket; use trash cans for waste other than sanitary waste. @ ____ times per week (1.6 gallons per time*).
- Install aerator on faucet @ ____ # faucets (35 gallons per faucet per week*).
- Turn off water while brushing teeth @ ____ brushings per week (4 gallons per brush*).
- Do not rinse dishes before putting them in the dishwasher @ ____ loads per week (5 gallons per load*).
- Fill the bathtub only half full while bathing @ ____ baths per week (18 gallons per bath*).

Low Cost/Some Time Required:

- Repair leaks in hoses, valves and sprinkler heads. (10-50*).
- Repair or replace leaking outdoor hose bibs. (90-100*).

Medium Cost/Some Time Required:

- Replace showerhead with water-saving model @ ____ 4-minute showers per week (12 gallons per shower*).
- Fix leaking toilet valve @ ____ # toilets (154 gallons per toilet per week*).

Moderate Cost/Some Effort Required:

- Install drip irrigation for flowers, fruit and vegetables (50-70*).
- Install a “smart irrigation controller” that shuts the irrigation system down when it rains (60-100*).
- Replace a portion of your lawn with drought tolerant perennials and groundcovers. (30-50*).

Higher Cost/Some Time Required:

- Replace toilet with low-flush model @ ____ flushes per week (2 gallons per flush*).
- Replace washing machine with water-saving model @ ____ loads per week (20 gallons per load*).
- Replace dishwasher with water-saving model @ ____ loads per week (7 gallons per load*).

*Amounts saved are estimates based on national averages. Actual savings will vary with household size, equipment efficiency, etc. For more information on how to save water, visit water.unl.edu/drinkingwater and water.unl.edu/landscapewater

Water efficiency is important whether your water comes from a public water source or a private well. Our public water supply infrastructure is aging. The same is true for the public wastewater infrastructure by which used water is carried away, treated, and returned to the environment.

In addition, many private well and onsite wastewater treatment systems are aging, and some might not be in compliance with current standards designed to protect human health and the environment. Water efficiency can reduce the stress on public and private water and wastewater treatment systems.

In some cases, large-scale efficiency might increase the life of public water or wastewater infrastructure, and reduce the need for additional or new infrastructure.
Aurora Students Get Intense Day of UNL Water Lessons and Tours

By Steve Ress, UNL Water Center

It was all about taking a day to become immersed in all things water.

More than 70 Aurora Public School students, ranging from fifth grade to high school seniors, got a cram-course on water quantity and quality issues and exposure to a variety of University of Nebraska, state and Natural Resources District water experts on March 3.

The daylong event, sponsored by the University of Nebraska–Lincoln's School of Natural Resources and Water Center, was part of the students' research into water quality issues that could have an impact on future water supplies.

State Senator Annette Dubas, whose district includes Aurora, greeted students and challenged them to become involved in their community's issues. From there, they jumped into an overview of Nebraska's surface and groundwater resources by UNL Water Center and Water for Food education and outreach specialist Rachael Herpel and a lesson on how Nebraska's water quality is carefully guarded and monitored by John Bender of the Nebraska Department of Environmental Quality.

Gwendolyn Ryskamp, a research assistant in the University of Nebraska, Omaha's aquatic toxicology laboratory and UNL hydrogeologist and hydrochemist Dave Gosselin continued the theme of water quality with respective presentations on “Water Quality and Biology” and “Naturally-occurring Contaminants,” with Gosselin stressing to the students that not all contaminants found in our water are things introduced into it by humans…. that some of them occur naturally.

There had to be a “Pop quiz” somewhere along the way and Sara Cooper, program coordinator for UNL's School of Natural Resources' Environmental Studies program and Environmental Resource Center, provided that, quizzing students on what they knew, and what they didn't, on water quality and what affects it. No grades were given, but perfect scores were rewarded with a T-shirt.

Scott Snell of the Upper Big Blue Natural Resources District in York next told students how the NRD, which covers Aurora and surrounding territory, helps work with producers and irrigators to find common-sense solutions to water use and water quality concerns.

Changing directions, UNL environmental engineer and interim UNL Water Center director Bruce Dvorak and UNL
Analytical equipment and facilities of the UNL Water Sciences Laboratory, where researchers go to have organic contaminants in water measured to the very minutest of quantities, were presented by laboratory services manager and hydrochemist Dan Snow.

UNL environmental engineer Wayne Woldt and Danielle Moore, of the Department of Biological Systems Engineering, next demonstrated Woldt’s “Water Machine” a model designed to show how groundwater flows and how it can become contaminated from a variety of sources.

Extension water quality educator Sharon Skipton teamed to talk about subjects the students had asked in advance to hear more about….dealing with water supply and water concerns in the wake of natural or man-made disasters or devastations to water supply infrastructure.

After lunch, there was time for touring UNL East Campus facilities and hands-on activities. These included learning about water turbidity, or how suspended particles in water gives it that cloudy or hazy appearance and a tour of Hardin Hall’s water laboratory where students were able to work with microscopes to study algae and examine aquatic invertebrates from a nearby stream.

Ryskamp and Jamie Oltman of The Groundwater Foundation gave the turbidity activity. Karla Jarecke worked with students in the Hardin Hall water lab.

Oltman ended the day with a talk on additional approaches to improving overall water quality, including participation in The Groundwater Foundation’s Groundwater Guardian and Groundwater Guardian Green Sites programs.
Power II: Mobilizing the Citizen Scientist

By Alan S. Kolok, Ph.D., Aquatic Toxicologist, Department of Biology, UNO; Department of Environmental, Agricultural and Occupational Health, UNMC

In the last Water Current I wrote about power, and how the word can have multiple meanings. At the end of that article I suggested that groups of citizen scientists could wield collective power to produce data sets that were simultaneously statistically powerful, personally empowering and scientifically robust.

In this issue allow me to give you two examples where citizen scientists are collecting these data.

The first example is the Mississippi River Nutrient Study, a large program spearheaded by the Open Source Science Project (http://www.theopensourcescienceproject.com). Project rationale stems from evidence suggesting excess nutrients released into the Mississippi River are responsible for a ‘dead zone’ found within the Gulf of Mexico. The dead zone is an area within the Gulf where levels of dissolved oxygen are so low fish cannot survive prolonged exposures to them.

One project goal is to identify hot spots where nutrients may be entering the river in particularly high concentrations. Samples will be collected from the Missouri and Mississippi Rivers, then analyzed for nitrogen and phosphorus four times over the next year. The project has some lofty goals, in that water samples are to be taken in the river every 5 miles from the mouth of the Mississippi to its headwaters in Lake Itasca, as well as up the Missouri River to Sioux City, all on the same day within the same hour!

How can a small group of highly trained scientists be deployed in so many places all at the same time? They can’t.

Now here’s the interesting part: to collect water samples across such a vast landscape organizers are using teams of citizen scientists. Sample bottles will be delivered to the teams ahead of time then they will collect water and send it to one sampling laboratory that will do all of the analysis. Now that’s putting the citizen science force to work.

The second project is closer to home in the Elkhorn River watershed. On April 23 (two weeks after I wrote this, but a few weeks before you get to read it) large numbers of citizen scientists will fan out across this 10,000 square kilometer watershed and take a simple atrazine measurement. Atrazine is a common herbicide used in Nebraska and was the focus of my Spring 2010 Water Current article. It is a presumptive endocrine disrupting compound turning male frogs female.

Citizen scientists involved in this project will then be able to take a GPS measurement (or use the Google map on our interactive website) to download the exact coordinates where they sampled and there will be a dialog box where they can mark whether or not they received an atrazine ‘hit’.

Using the combined and equally sophisticated techniques of the atrazine strips, along with information technology to catalog and process the data, these citizen scientists will collect over 150 samples from the watershed in a single day.

Admittedly, as I write this, I am a little anxious about the experiment’s outcome. A number of disappointing things can happen: return of the ‘survey’ data may be very low possibly because participants find the strips harder to read than anticipated, or the website more difficult to navigate. All of the collected data may be positive, or it may all be negative, or it may be so confusing as to be incomprehensible.

Even after the data are collected (in either study) the naysayers may pooh-pooh the utility of citizen scientists, even as it relates to the identification of hot spots or points of interest within certain watersheds.

Despite these real and potential drawbacks, I also keep in mind the positive attributes that both these experiments share. Both use tools that are sophisticated and powerful in their own way. Both hold the prospect of being statistically powerful, if not for the sake of the tool employed then certainly due to the vast number of samples collected more or less simultaneously, and both directly engage citizen scientists to collect ecologically relevant data. The level of personal empowerment that emanates from participation, and the appreciation for the importance of scientific inquiry in a modern society, may be the most important result that emerges from these two ‘power’ projects.
A drilling crew and staff from the South Platte Natural Resources District (SPNRD), University of Nebraska–Lincoln’s Conservation Survey Division and United States Geological Survey (USGS) recently completed work in Kimball County, the first phase of a project to expand the NRD’s groundwater monitoring well network.

SPNRD, at Sydney, currently has 64 dedicated monitoring wells at 58 sites. Three have become dry over time. That, combined with the need for additional information in portions of the NRD, spurred the expansion project.

Thirty-nine additional wells will be drilled in the NRD, with locations chosen according to needs determined by the NRD and USGS. Due to size and location of the NRD and amount of wells needed to be drilled to obtain the most precise data, the current drilling work is part of a three-year, $759,000 effort, financed in part with a $529,000 grant from the Nebraska Environmental Trust.

The expansion, along with other efforts such as Helicopter Aerial Geophysical Surveys, which take electromagnetic readings of area geology, are parts of current work being undertaken to form a greater understanding of area aquifers.

Information from the monitoring network helps verify HEM data by “ground truthing,” or providing a comparison of known information. To provide that information, geologists from UNL and USGS collect geologic samples during the drilling process and log the data for later use.

The combination of electronic and physical information goes into developing groundwater models, which can be used to analyze data for management purposes.

Examples of water management issues facing the NRD include, but are not limited to, surface water supply, groundwater supply and transfers, pooling agreements, drought management and groundwater quality.

By improving understanding of how water flows through the groundwater system, the NRD can be more effective in evaluating water quality and quantity problems and management decisions.

The NRD, in conjunction with the Nebraska Department of Natural Resources, implemented an Integrated Management Plan in 2008, setting goals and methods to manage current water supplies, as well as protecting those for the future.

NRD officials feel the monitoring well network expansion will help them manage a safe, sufficient water supply for present and future generations. It will also help maintain, enhance and protect regional agriculture, municipal systems and promote economic growth while avoiding adverse environmental impacts.
Growing Crops with Less Water; West Central REC Assembles Team to Address Factors Related to Farming With Less Water

By Daniel R. Moser, Educational Media, Department of Agricultural Leadership, Education and Communications

The business of farming is increasingly complex, with multiple factors that interact and affect the quality, yield and value of the crop. So, scientists are adopting interdisciplinary approaches to tackle those challenges.

At the Institute of Agriculture and Natural Resources’ West Central Research and Extension Center at North Platte, for example, a team of physical and social scientists has been assembled in the last couple of years to address the challenges of growing crops with limited water. While their research is just getting under way, it builds on decades of water science in the region.

“There’s so much interaction, the way we manage things is not isolated anymore,” said Steve Young, weed ecologist. “We have to look at everything – plants, soil, air, water. All these things are interacting, and that’s why there’s so much interest in forming these interdisciplinary teams.”

Another member of the team, agricultural economist Matt Stockton, said some of the most significant research grants now go to multidisciplinary teams like West Central’s.

“The integrated research is really where the synergy comes,” Stockton said.

Growing crops with limited water, in both irrigated and nonirrigated systems, is one of two key focus research and extension areas at West Central, the other being beef systems, said Don Adams, director of the center.

Adams said several of the scientists are recent hires, with one vacancy, for a plant pathologist, remaining. “We brought each one in to fill what we consider a key component.”

A key to the research, Adams said, is the new West Central Water Resource Field Laboratory in Brule, purchased by UNL in 2007 to research, demonstrate and teach water conservation methods in cropping and livestock systems in western Nebraska.

Scientists on the team and their roles in the research include:

– Young is studying invasive plant species such as Phragmites australis, a non-native common reed, and salt cedar, which can impede stream flows, as well as management of agronomic weeds. One focus is new weed-control technology that uses sensors and guidance systems to distinguish between weeds and crops in the field.

– Simon Van Donk, irrigation management scientist, is studying issues related to scheduling irrigation, including subsurface drip and sprinkler approaches. He’s also researching crop residue impacts on evaporation, soil water and crop production.

– Greg Kruger, cropping systems specialist, is focused on cropping rotations and weed control as water conservation tools.

– Tim Shaver, soil scientist, is studying soil nutrient management under limited irrigation, including how varying irrigation amounts impacts nitrogen and phosphorous requirements. He’s also looking into tillage practices’ impact.

– Aaron Stalker, animal scientist, is working with several other scientists on how to incorporate cattle grazing on corn residue into the system.

– Stockton, agricultural economist, is charged with exploring both short-term, simple cost considerations and longer-term economics of changes in cropping approaches. “Research is grand and glorious, but there are some interesting questions that are both practical and systemic that need to be answered from an economic point of view,” he said.

“One of the true measures of impact is profitability and sustainability,” Adams said.

Much of the team’s research is focused on tying cropping and livestock systems together, a whole-systems approach, Stalker said.

At the Brule site, for example, scientists are experimenting with how leaving different levels of crop residue in the field over the winter affects crop production in the following growing season.

Van Donk and Stalker are key scientists in this research, but the entire team ultimately will be involved in research that’s likely to last a decade or so.

“This is very complex. When a producer makes this decision, he’s not just thinking about next year’s crop production. He’s also got to think about getting cows through the winter,” Stalker said. “There are tradeoffs. Ultimately, what it comes down to is the economic impacts. A lot of biological processes are going on here. That’s why it’s so important to have this multidisciplinary team.”

The research is funded by IANR’s Agricultural Research Division.
The U.S. Environmental Protection Agency (EPA) is proposing for public comment standards to protect billions of fish and other aquatic organisms drawn each year into cooling water systems at large power plants and factories.

The proposal, based on Section 316(b) of the Clean Water Act, would establish a common sense framework, putting a premium on public input and flexibility.

“This proposal establishes a strong baseline level of protection and then allows additional safeguards for aquatic life to be developed through a rigorous site-specific analysis, an approach that ensures the most up to date technology available is being used. It puts implementation analysis in the hands of the permit writers, where requirements can be tailored to the particular facility,” said Nancy Stoner, acting assistant administrator for EPA’s Office of Water.

“The input we receive will make certain that we end up with a flexible and effective rule to protect the health of our waters and ecosystems.”

Safeguards against impingement will be required for all facilities above a minimum size; closed-cycle cooling systems may also be required on a case by case basis when, based on thorough site-specific analysis by permitting authorities, such requirements are determined to be appropriate. EPA is proposing this regulation as a result of a settlement agreement with Riverkeeper, Inc. and other environmental groups.

Flexible Technology Standards:

**Fish Impingement** (Being pinned against screens or other parts of a cooling water intake structure): Existing facilities that withdraw at least 25 percent of their water exclusively for cooling purposes and have a design intake flow of greater than 2 million gallons per day (MGD) would be required to reduce fish impingement under the proposed regulations. To ensure flexibility, the owner or operator of the facility will be able to choose one of two options for meeting best technology available requirements for reducing impingement. They may conduct monitoring to show the specified performance standards for impingement mortality of fish and shellfish have been met, or they may demonstrate to the permitting authority that the intake velocity meets the specified design criteria. EPA estimates that more than half of the facilities that could be impacted by this proposed rule already employ readily available technologies that are likely to put them into compliance with the proposed standard.

**Fish Entrainment** (Being drawn into cooling water systems and affected by heat, chemicals or physical stress): EPA is proposing a site-specific determination to be made based on local concerns and on the unique circumstances of each facility.

This proposed rule establishes requirements for the facility owner to conduct comprehensive studies and develop other information as part of the permit application, and then establishes a public process, with

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**EPA proposes third UCMR**

The U.S. Environmental Protection Agency has proposed a rule to require an expanded group of water utilities to test for 30 unregulated contaminants.

As proposed in the March 3 Federal Register, the third Unregulated Contaminant Monitoring Regulation (UCMR3) for public water systems would expand the pool of systems affected by UCMR3 to include systems serving more than 10,000 people that rely solely on purchased water for List 1 monitoring.

Systems serving more than 10,000 persons would conduct UCMR monitoring and analysis at their own cost, while USEPA would cover sample shipping and analysis costs for a statistically derived sample of smaller systems.

The 28 proposed List 1 contaminants include seven hormones and pharmaceuticals 1,4-dioxane nine volatile organic compounds four metals (cobalt, molybdenum, strontium, vanadium) chlorate perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and four other perfluorinated chemicals.

In addition, two viruses (enterovirus, norovirus) are proposed for List 3 pre-screen testing.

The Federal Register notice also requests comments on whether hexavalent chromium (chromium-6) should be included as one of the 30 contaminants for UCMR 3 monitoring and which contaminant should be removed from the proposed list to make room for chromium 6 if it were added to the list.

The rule will be finalized in 2012, and monitoring will occur from 2013 to 2015.

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*continued on page 18*
Here’s something to ponder: The United States uses 79.6 billion gallons of fresh groundwater per day for public supply, private supply, irrigation, livestock, manufacturing, mining, thermoelectric power and other purposes, according to the National Ground Water Association.

With that in mind The Groundwater Foundation (TGF) celebrated National Groundwater Awareness Week (March 6-12, 2011), continuing to educate and inspire everyone to ensure groundwater is available for future generations.

Groundwater is the water that fills the cracks and crevices of rocks and sands beneath the Earth’s surface and supplies a majority of us with our drinking water. One of the ways TGF works to ensure it is available into the future is through “Let’s Keep It Clean!”

The awareness program works within Nebraska, directly in communities. In the past year TGF has worked with Crete, Wayne and Minden and are now setting their sights on working with Fairbury, St. Paul, Auburn and others.

The goal is to make residents aware of groundwater and how they impact it daily. They may receive that information in many different forms from reading an article in the local paper, or hearing a spot on the radio or television, or attending an event at the local library or a community-wide activity.

But there are many things that everyone can do to ensure this clean supply of water will be there into the distant future. Take action by:

- Taking short showers instead of baths
- Running full loads of dishes and laundry
- Decreasing or eliminating fertilizer and pesticide usage
- Watering outside only when necessary
- Checking for leaky faucets and repairing them
- Disposing of chemicals properly by taking them to recycling centers
- Teaching others about ways to protect and preserve water

For more information about The Groundwater Foundation, how to become a member, or any of its programs, call 1-800-858-4844 or visit www.groundwater.org. The “Let’s Keep It Clean!” program is sponsored by the Nebraska Department of Environmental Quality and the Nebraska Environmental Trust.

**WEFTEC 2011**

Registration and housing is open for WEFTEC 2011, the Water Environment Federation’s 84th annual technical exhibition and conference. This year’s event is Oct. 15-19, Los Angeles Convention Center, Los Angeles, Calif.

If it’s about water, it will be at WEFTEC. As the largest annual water quality conference and exhibition in the world, WEFTEC continues to offer the best educational, business and networking opportunities in the water profession today.

This year features 115 technical sessions, 27 workshops and eight local facility tours. A wide range of topics and focus areas allow attendees to design their own, unique learning experience with the opportunity to earn continuing education credits.

Focus areas include facility operations and wastewater treatment; nutrients; collection systems; residuals and biosolids; utility management; water reuse and management; stormwater and green infrastructure; sustainability and energy management; industrial wastewater; watershed management; and more. An exhibition will provide access to over 1,000 companies showing the latest developments, research, solutions, and cutting-edge technologies in the field.

For conference details go to www.weftec.org.

**Stormwater Newsletter**

Water Environment Federation (WEF) has premiered a new publication to keep water quality professionals informed about activities and developments related to stormwater — a subject of expanding interest.

The Stormwater Report includes the latest in innovative programs and resources and publishes as a free monthly. It covers advanced practices, cutting-edge research, policy updates, and current events related to stormwater. For example, readers will be kept abreast of the many stormwater-related sessions, workshops, and meetings planned for WEFTEC 2011, which will, for the first time ever, feature continuous stormwater programming during each day of the conference.

“Stormwater represents one of the most important challenges facing water quality professionals,” said WEF Executive Director Jeff Eger.

To support WEF’s goal of be the go-to resource for stormwater professionals, WEF has a number of publications coming down the pipe with committee activities now coordinated with its newly formed Stormwater Coordinating Council. In addition to other publications
such as the upcoming Manual of Practice 23, *Urban Runoff Quality Management*, WEF stormwater highlights include a free “Meeting the Public Education Requirements of the Municipal Stormwater Permit” webcast and a June 15 webcast update on green infrastructure costs and regulatory updates, among others.

If you are interested in stormwater, subscribe online, or check it out on Access Water Knowledge. Be sure to look for The Stormwater Report on the first Thursday of each month. Go to www.wef.org

**GW Foundation Grant Funding**

The Groundwater Foundation will receive $70,811 from the Nebraska Environmental Trust for the Growing Groundwater Awareness in Nebraska program.

This is the second year of the award. The project is one of 94 receiving $15,412,788 in grant awards from the Nebraska Environmental Trust this year.

The goal of the program is to empower Nebraskans to play a key part in protecting their groundwater. The main objectives are to create awareness and provide tools for communities to take proactive steps to ensure a safe, lasting supply. The work centers around the slogan, “Let’s Keep it Clean!” The Groundwater Foundation has worked in Crete, Wayne and Minden and is currently working in St. Paul, Auburn and Fairbury. More details are available by clicking the Let’s Keep It Clean! button at www.groundwater.org.

**Keep Stormwater from Polluting**

As spring showers get going, whatever doesn’t soak into the ground runs off roofs and yards, down streets, into storm drains, and then directly into rivers, lakes, creeks, and other local water bodies.

If that runoff is polluted, it’s most likely because of little things people commonly do (or not) every day that add up to big water pollution in their communities – and ultimately around the world. The Water Environment Federation suggests five things everyone can do to help keep stormwater from polluting our water resources all year long:

- Don’t dump anything down storm drains, including leaves, trash, and grass clippings. Storm drains are for rain only!
- Pick up after your pet. Don’t let harmful bacteria contaminate local water.
- Reduce fertilizer use. Use natural fertilizers according to directions.
- Recycle Motor Oil. Also, fix cars and lawn equipment that leak oil.
- Recycle Household Waste. Follow directions on household products for proper use, disposal, or recycling.

Remember, if you don’t want it in the water, keep it out of the storm drain!

**UNL Hydrogeology Program Among Top 100**

In January the National Ground Water Association (NGWA), the largest groundwater association in the world, picked the University of Nebraska–Lincoln’s hydrogeology program as one of its top 100 in North America.

More than 400 programs were considered for the NGWA honor, including many international programs. In selecting top programs, NGWA’s goal is to give prospective groundwater students a list of strong options and a jumping-off point for their searches.

Selection factors center on the length and strength of the program, as well as its faculty.

Within the 100 selected top programs, none are ranked against one another. The selected programs are listed on the NGWA web site at http://www.ngwa.org/students/hydrogeology-programs.aspx. The information can also be found in the latest Newsletter of the U.S. National Chapter of International Association of Hydrogeologists (the unranked alphabetical listing still uses “Geosciences” as a part of the department name.)

Hydrogeology specialization in the Department of Earth and Atmospheric Sciences at UNL was approved by UNL Graduate Council in 1998 and includes Vitaly Zlotnik, Advisory Committee Chair, J.B. Gates, and D.T. Pederson.
the phenology and growth of wetland plants. By exploring effects of altered climate and habitat conditions on wetland-dependent birds using a holistic approach that incorporates both top-down and bottom-up constraints, we will better predict changes in wetland ecosystems and responses of migratory birds to those changes. This research will assist managers and conservation professionals within federal, state, and nongovernmental organizations concerned with protecting migratory bird species and managing critical wetland habitats.

Understanding landscape constraints on local management decisions: Throughout the Great Plains the structure and function of grassland and farmland wildlife communities are increasingly threatened by urbanization and the intensification of agricultural production. Even in areas managed exclusively for wildlife, responses to habitat enhancement is often less than predicted and less than desired by managers and the public. Given the incredible costs of wildlife enhancement projects, understanding why populations and communities fail to respond to apparently suitable habitat improvements is imperative to not only sustaining wildlife populations, but ensuring public support for wildlife programs. Traditionally, assessment of wildlife population responses to habitat improvements are focused on local habitat attributes; however, as habitats are increasingly isolated it is becoming obvious that factors beyond local vegetation and resource distribution may play a role in where species are located or the productivity of local populations. We are working to examine how the availability of suitable habitat across a landscape constrains or facilitates local population responses to grassland bird habitat enhancement programs. To this end we are developing models that relate the distribution and abundance of grassland birds to the availability and suitability of habitats across various spatial scales. By understanding how multi-scalar landscape parameters influence local populations we can better understand how to successfully manage species and appropriate research, monitoring and management efforts. This research will assist managers and conservation professionals within federal, state, and nongovernmental organizations concerned with the management of grassland communities and protecting grassland bird species.

Examples of Past Research/Extension Programs:
1) Neotropical migrant bird habitat decision
2) Impacts of dewatering on riparian community ecology
3) Impacts of climate change variation on migratory species
4) Song expression
5) Influence of nest predation on reproductive strategies in birds
6) Influence of nest predation on habitat selection by breeding birds

Teaching:

As a member of the Coop. Unit our primary responsibility is graduate student education. As such I primarily teach graduate class-es, but I am periodically asked by fellow professors in SNR to teach a lecture in their classes. Currently I am teaching a graduate course on Adaptive Natural Resource Management.

Fall 2010: Adaptive Natural Resource Management: From cultural taboos to the current socio-ecological framework, the art and science of natural resource management has and continues to evolve. The primary focus of this course is to introduce students to the concepts of structured decision making and adaptive management, but in doing so the course will explore the history of natural resource management and the various management paradigms that have and continue to dominate resource management. At the completion of this course students will have an understanding of the theory and practice of adaptive management as well as an understanding of why we continue to move toward a more transparent and scientific methodology of natural resource management.

Selected Publications:

Web addresses:
http://sites.google.com/site/fontainejoseph/
http://snr.unl.edu/necoopunit/
http://snr.unl.edu/aboutus/who/people/faculty-member.sp?pid=1017
“During the course of the tour, participants will be exposed to project features and activities supported by three Irrigation Districts and two Natural Resources Districts.

“Some of the features in the tour area will include the Niobrara Valley Preserve, UNL’s Barta Brothers Ranch, Merritt Reservoir, Niobrara National Scenic River and Snake River Falls,” said tour co-organizer and host Michael Jess.

“There will also be an opportunity for canoeing the Niobrara River,” he remarked.

Issues key to the tour focus on the use and controversies surrounding surface and groundwater resources in the region. The area sits atop the Ogallala (or High Plains) Aquifer, which is one of the largest aquifers in the world, covering an area of about 174,000 square miles in parts of eight states, and is relied upon heavily for irrigated agriculture, drinking water and other uses.

It is key to many conservation, recreation and agriculture issues in central and north-central Nebraska.

The tour departs Kearney’s Ramada Inn July 12 and makes morning stops at Davis Creek Lake in the Twin Loups Irrigation District and Lower Loups Natural Resources District, then to NRD offices in Ord for discussions of water and natural resources management in the lower Loup River watershed.

Afternoon discussions will focus on rebuilding infrastructure and irrigation canal diversion works following extensive flooding on the Loup Rivers in June 2010.

The tour then heads to UNL’s Barta Brothers Ranch research and extension facility near Rose and then to Sandhill Implement Co. in Bassett before overnight in Ainsworth.

Wednesday morning the tour explores the Niobrara Valley Preserve near Johnstown and Fort Niobrara National Wildlife Refuge near Valentine. Discussions there will be about the challenges of managing the Scenic Niobrara River. In the afternoon, tour attendees can opt to raft the Niobrara River before a western cookout at the Diamond Lazy J Ranch near Nenzel, where vineyard and ranch tours will also be available.

Overnight is at Valentine’s Niobrara Lodge.

On Thursday, discussions shift to current plans by the Nebraska Game and Parks Commission to purchase historic and scenic Snake River Falls from its current owners and then a look at nearby Merritt Reservoir before traveling to Broken Bow for lunch and a tour of Sargent Irrigation Co.’s manufacturing plant there. The tour then returns to Kearney.

Space is limited and registrations are first-come, first-served. Cost is $500 per person single occupancy or $400 per person double occupancy. Registration includes all meals, motel, transportation and activities. To register, or obtain a registration brochure, contact Jennie Nollette at the Kearney Area Chamber of Commerce at (308) 237-3168 or email jnollette@kearneycoc.org. More information is online at watercenter.unl.edu.

Tour cosponsors are Central Nebraska Public Power and Irrigation District, Kearney Area Chamber of Commerce, Nebraska Public Power District, UNL Water Center and School of Natural Resources, Northern Plains Supply, Inc., Perfect Valley Irrigation, Inc., Sandhill Implement, Inc. and the Lower Loup Natural Resources District.
two feet and areas south of the Platte River in west-central Nebraska and north of the Platte River in central Nebraska experienced rises of more than a foot, but generally less than five feet.

Some of the biggest recorded one-year gains were near the Missouri River and its major tributaries in northeastern and southeastern Nebraska, where groundwater levels rose by more than five feet, Burbach said.

Declines of more than a foot were relatively few and widely scattered across the state. The largest of these areas was in Clay and Fillmore Counties, where declines were from two to five feet.

Despite the gains, or at least slowing of declines, in groundwater levels over much of the state in the last three years, levels remain below Spring 2000 levels over most of Nebraska due to widespread drought from 2000 to 2007.

Gains or slowing declines since 2007 also don’t erase the fact that large areas of groundwater level decline since predevelopment of irrigation remain in the south central, southwest and Panhandle, Korus said.

Predevelopment water levels are estimated, but generally occurred before the early to mid-1950’s depending on when intensive groundwater irrigation began.

In areas of the state showing the longest long-term groundwater decline, “Many are in areas of intense groundwater irrigation, but in a few areas wells are not particularly dense.”

“Other factors such as aquifer characteristics, rates of recharge and irrigation scheduling could be contributing to the declines,” Burbach said.

Average daily streamflows across Nebraska were highly variable over 2009.

In central and parts of northeast Nebraska, flows were above average due to above-average precipitation, but in parts of western, southern and southeastern Nebraska flows were below the long-term average due to near or below average precipitation.

“The low flows in some streams in the Panhandle and southwest are part of a regional trend in the High Plains aquifer of long term reductions in baseflow to streams due to lowering of the regional water table,” Burbach said.

Groundwater level change maps included in the report can be downloaded free at the School of Natural Resources web site at http://snr.unl.edu/information/GroundwaterMaps.asp. Maps from previous years are also archived there, dating to 1954.

Data for the maps, graphs and reports is based on recorded measurements from more than 6,000 observation wells taken by 27 organizations, including each of Nebraska’s 23 Natural Resources Districts, U.S. Geological Survey, Central Nebraska Public Power and Irrigation District, U.S. Bureau of Reclamation, and UNL’s Conservation and Survey Division.

Groundwater level change maps rely on well readings recorded as close to April 1 as possible, before the start of the irrigation season.

The full, published report, “Nebraska Statewide Groundwater-Level Monitoring Report 2010,” (Nebraska Water Survey Paper Number 77) which explains and amplifies data presented on the maps, as well as other materials, can be purchased for $15 online at snrsales@unl.edu or at the Nebraska Maps and More store, first floor Hardin Hall, UNL East Campus, N. 33rd and Holdrege Sts., Lincoln. Korus, Burbach, geologist Matt Joeckel and cartographer Les Howard, all part of UNL’s Conservation and Survey Division, coauthored the report.

EPA Opens Public Comment

opportunity for public input, by which the appropriate technology to reduce entrainment mortality would be implemented at each facility after considering site-specific factors.

Because new units can incorporate the most efficient, best-performing technology directly into the design stage of the project, thus lowering costs and avoiding constraints associated with technology that has already been locked in, the proposed rule would require closed-cycle cooling (cooling towers) for new units at existing facilities, as is already required for new facilities.

EPA will conduct a 90-day public comment period and will carefully consider those comments before taking final action on the proposal. The administrator must take final action by July 27, 2012.

More information, go online to http://water.epa.gov/lawsregs/lawsguidance/cwa/316b/
Nebraska’s Water Situation

Nebraska is unique because of the large groundwater supply provided by the Ogallala Aquifer, Dvorak said. “And that groundwater is of really high quality, so we’re fortunate. A very large amount of our water is from groundwater sources; in Nebraska, over 80 percent of our citizenry gets their drinking water from groundwater.” Also unusual, he said, is that almost half of Nebraskans are drinking groundwater supplies that have little or no treatment because the quality is so high. Dvorak said the aquifer provides some extra treatment and means many of the issues of national concern – such as various contaminants – are less of a problem in Nebraska’s public water and domestic water supplies.

Limited Water, New Laws

However, the amount of available water is limited. If we’re not careful, Dvorak said, we’ll start seeing more rivers and wells going dry, so that vision of the future has led to competition and concern. From a law standpoint, regulations are being developed to address competing interests, he said, balancing agricultural water use with other uses. “Many of our laws are based on outdated science. Many laws were developed 60 to 90 years ago when we did not understand the hydrology and the water cycle the way we understand today,” he said. “Now, we understand an awful lot more about the science, and we’re experiencing some climate variability,” he added. Better knowledge of science has changed the way land is used and that has changed water usage. Conservation techniques such as no-till agriculture and efforts to protect the soil by reducing nonpoint source pollution have resulted in reduced river flow in some areas of the state, affecting contractual obligations to provide water to other states.

Sustainability, Pollution, Climate Variability … and Us

Above all, Dvorak believes a definition for “sustainable” will help to determine the future of water policy and law as scientists obtain a better understanding of science related to climate variability, drought and potentially, climate change. He expects there will be more discussion about both rural and urban nonpoint source nutrient pollution that will be particularly focused on the eastern third of Nebraska. He also expects more discussion related to micro-contaminants, including more scientific information on potential risks, adding that as a society, we are becoming more concerned about smaller and smaller risks. “I anticipate there’ll probably be discussion related to that, both research and policy and public discussion about what level of risk we’re willing to accept,” he said.

The future will emphasize working with the state’s economic systems to try to reduce water use without affecting production, he said, citing a recent UNL research project that has been shown to save two inches of water in each field to produce the same number of bushels per acre.

But Dvorak believes one of the biggest challenges in the next decade will be convincing people to put the science into use. “We have all this good science, we have great technologies, but the next challenge is what I call the human dimension,” he said, including having public policy and economic incentives in place as well as understanding the sociology of the way people use water.

“Nationally, internationally it is well understood that although there’s a need for more science and technology research, there’s also a real need to understand the human interactions with that science and technology so we can actually have it applied,” he said.

(Editor’s Note: This article was written by Mary Garbacz, lecturer and coordinator of Strategic Discussions for Nebraska in the UNL College of Journalism and Mass Communications. It was published in Opportunities for Nebraska, August 2010).
UNL Water Center Addresses Quality, Quantity, Sustainability Issues

“Nebraska is unusual because we’re number one in the nation in the amount of irrigation that comes from groundwater sources,” said Bruce Dvorak, interim director of the University of Nebraska–Lincoln Water Center. Yet, when Nebraskans talk about water, residents of the central and western part of the state often look at the whole spectrum of water issues, while many residents of the eastern part of the state mainly consider water used at home. “I think a lot of people in the eastern part of the state take water for granted,” Dvorak said. In Nebraska, only about three percent of water is used by public water supplies and domestic wells; the rest is used in irrigation and by industry.

A UNL professor of civil engineering, Dvorak has a special interest in drinking water and sustainability issues and in the research and extension efforts related to those issues.

“Obviously, water is very important throughout the country. We all need to drink water, but it’s also very important for the economy here in Nebraska,” Dvorak said. Nebraska relies on irrigation to produce agricultural crops and for urban horticulture; industry relies on water as a cooling source; and water is used to generate hydroelectric power. Additionally, water is necessary in streams for fish, birds and other wildlife, he said.

“There are a lot of reasons water is important and a lot of reasons water research is important to help support those various uses and help improve both quantity and quality,” Dvorak said.

The Water Center serves a broad mission and addresses the science and engineering of the quantity and quality of water, as well as the management and laws and policies related to water. The Water Center is one of 54 centers established by federal mandate more than 45 years ago. Dvorak said the centers were established in each U.S. state and territory for three main purposes: 1) to provide a place for competent research to expand the understanding of water and to address water problems; 2) to aid the entry of new water scientists, engineers and managers into the field of water study; and 3) to communicate results of the research to water managers and to the public.

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May Water for Food Conference; Water Tour, Symposium and Water Law Conference All Coming Up

The third annual Global Water for Food conference, May 1-4 here in Lincoln, was an unqualified success no matter how you measure it. There were more than 450 participants representing more than two dozen countries and a very full slate of internationally recognized speakers on all topics related to the conference. It was very energizing to listen to many different perspectives on water availability, cropping practices, irrigation practices, and international cooperation to feed a fast growing global population. It was simply a fantastic conference and wonderful opportunity to interact with colleagues from around the globe.

At that conference, the University of Nebraska Medical Center (UNMC) in Omaha and the Water Center organized a Water Quality Interest Group meeting of NU faculty. Special thanks to Rachael Herpel and Ann Bleed for helping develop and run this session. During the meeting, faculty explored how water quality issues may be addressed as part of the Water for Food Institutes’ programming. The faculty participants discussed the following topical areas:

- How can wastewater be reused and/or impaired waters be used safely for food production?
- How can the role of ecosystem services be identified, modeled, and measured in agriculture dominated ecosystems?
- How can we develop a systems approach, incorporating various models, to understanding the trade-offs and constraints on decisions that protect water quality in an agriculture dominated landscape?
- How can water quality be protected for multiple uses (e.g., domestic use, food processing, industrial use, ecosystem services) in an agricultural environment?

This may include education leading to new practices based on behavioral change, new technologies or management practices, and new monitoring approaches.

- What design, legal, economic, political and cultural frameworks are necessary to protect water quality as agriculture expands?

It is anticipated that further sessions will be held to further develop topical areas, and that some elements of these topics will be used to develop future Water for Food Conference sessions.

I want to recognize several individuals and groups for assistance to the Water Center and Nebraska water community on special projects. Rachael Herpel has been doing double duty since mid-fall, in working at the Water Center and assisting the nascent Water for Food Institute with conference preparations and developing its expertise database. She has done a great job and as one can imagine, is especially relieved that this year’s Water for Food Conference is now completed.

Dr. Xun-Hong Chen in UNL’s School of Natural Resources graciously agreed to prepare a specialized workshop in May on the use of MODFLOW, a groundwater model, for continued on page 6
MEET THE FACULTY

Joseph J. Fontaine, Ph.D.

Joseph (TJ) Fontaine is assistant unit leader in the U.S. Geological Survey (USGS) Nebraska Cooperative Fish and Wildlife Research Unit and assistant professor in the University of Nebraska–Lincoln’s School of Natural Resources, a position he has held since January 2009.

Education:

Ph.D., Fish and Wildlife Biology, 2006, The University of Montana
B.S. with Honors, Wildlife Biology – 1997, The University of Montana

Examples of Current Research/Extension Programs:

Migratory shorebird habitat decisions across spatial scales: Wetland ecosystems function as important stopover habitats for migratory birds and add significantly to local and regional biodiversity. These ecosystems are increasingly threatened by climate change and the potential synergistic effects of increasing demand for water and invasion by exotic species. We are working to examine the effects of climate and land use change on bird populations and their wetland habitats in the Prairie Pothole Region (PPR) of North America by examining the linkages between climate, hydrology, and the biological factors that influence riparian and wetland ecosystem resilience and migratory bird communities. To this end we are developing multi-spatial models that relate habitat decisions of migratory shorebirds to annual and seasonal changes in water resources, and

Tapan Pathak, Ph.D. continued from page 3

Examples of Current Research/Extension Programs:

Examples of Past Research/Extension Programs:

Prior to joining UNL, from 2005 to 2010, I was a research assistant at University of Florida. My dissertation was on forecasting cotton yield in the southeastern United States using climate forecasts and other climate information as a way to adapt to a variable climate. I used climate indices as an early indicator of crop yield and a crop simulation model for in-season updates of cotton yield forecasts. From 2002 to 2004, I worked on my M.S. research at Utah State University, which focused on validating existing potato yield models and various agricultural assessments using airborne multispectral remote sensing imagery.

Examples of Outreach Programs:

Newsletters and scholarly articles on climate, water, and agriculture related topics.

Selected Publications:

Royce, F., G.A. Baigorria, H. Hu, C. Fraisse, and T.B. Pathak. 2008. ENSO classification and summer crop yields in the Southeastern USA. Workshop on climate change impacts and adaptation to agriculture, forestry and fisheries at the national and regional levels. WMO/South East Climate Consortium. Orlando, FL.

Web address:

http://snr.unl.edu/aboutus/who/people/faculty-member.asp?pid=1279

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Statewide groundwater monitoring by the University of Nebraska–Lincoln paints a picture that can be interpreted many ways. If you look only at the last year to three years, the news is generally good as groundwater levels under most of Nebraska continued to gain, or at least slow their declines.

Overall, groundwater levels under most of Nebraska changed less than a foot from spring 2009 to spring 2010, but when you look at the data from the past 10 or more years the picture isn’t quite as rosy.

“We’ve had a few years of average to above-average precipitation, which have helped groundwater levels over much of the state, but if you look at the longer term, our groundwater levels are continuing to decline,” said UNL School of Natural Resources groundwater geologist Jesse Korus.

“Nebraska Statewide Groundwater-Level Monitoring Report 2010,” which Korus co-authored with other UNL groundwater experts, says “Long term groundwater level changes in Nebraska primarily reflect aquifer depletion in areas of dense irrigation development and increases in (groundwater) storage due to seepage from canals and reservoirs.”

This and much more information is contained in the 19-page illustrated report that details and maps changes in Nebraska groundwater levels from Spring 2009 to Spring 2010, over the past 10 years, from predevelopment of irrigation to Spring 2010, as well as average daily streamflows in 2009 and other related information.

“Increases in precipitation over most of the state since 2007, which also helped reduce demands for irrigation, have meant generally good news for Nebraska groundwater levels, but the long term trend is still that groundwater levels continue to decline from the period of predevelopment of irrigation to the present,” report co-author and assistant geoscientist Mark Burbach echoed.

Looking just at the past year, the news is better.

From 2009 to 2010, groundwater levels under most of Nebraska generally changed less than a foot. There were rises in scattered locations, but there were also a few places showing declines.

“Some, but not all of these trends are reflective of statewide precipitation patterns in 2009, compared to the long-term norms,” Korus said.

Groundwater level rises of more than two feet occurred around Lake McConaughy, Keith and Perkins Counties and under most of the southern Panhandle. Much of the western and northern Sandhills experienced rises of one to two feet.
The Lincoln-based Groundwater Foundation is currently seeking abstracts from potential presenters and exhibitors for its national conference, Oct. 4-6, in Omaha.

Conference theme is “Let’s Keep It Clean: Exploring a Collaborative Approach to Groundwater Protection” and will focus on the knowledge, technology and practices to assist communities in local groundwater protection.

The conference will be more than lectures in a hotel conference room. It will include field-based tours showcasing innovative solutions and programs that have been developed and implemented in Nebraska.

Groundwater plays a vital role in our lives – we rely on it and it relies on us working together to protect and use it wisely so that it will be available for future generations.

What are communities doing to create a collaborative approach to groundwater protection? What needs to be done on a community-wide basis to safeguard groundwater? When do we need to act and who will do so? Answers to these questions and more will provide conference participants with the knowledge and tools needed to build a far-reaching, collaborative groundwater protection strategy. One that when implemented truly makes a difference in protecting groundwater for future generations.

Conference sponsors are Nebraska Department of Environmental Quality, Senninger Irrigation, Valmont Industries and the Water Research Foundation.

To learn more or submit an abstract go to www.groundwater.org/pe/conference.html, email info@groundwater.org or call 1-800-858-4844 to request the call for presentation brochure.

Tenth Annual Sand Hills Discovery Conference in Ainsworth

The tenth annual Sand Hills Discovery Conference is Thursday, July 14 in Ainsworth.

At the conference, participants can learn more about sand hills lakes, rivers and creeks as well as other topics and learn more about the unique area that is the Sand hills of Nebraska.

Area tours are being offered the day before and the day after the conference that will include fossil digs, a Dutch oven workshop, hands-on science workshop and a driving tour through the sand hills.

One hour of undergraduate or graduate college credit is available from Wayne State College. For more information on the conference, go online to www.sandhillsdiscovery.org or phone (866) 387-2740 or (402) 387-2740.

Fall Events continued from page 1

Law, will focus on current Nebraska water law. It is designed to benefit practicing attorneys, but is open to anyone and can benefit water professionals and managers in many other professional venues.

Law conference registration will be available about Aug. 1. More information on the day’s agenda, topics and speakers will be posted online, as available, at watercenter.unl.edu

CLE credit for practicing attorneys will be applied for, Benson said.

At the same location the following day, focus shifts to Great Plains climate, water and ecosystems in a symposium showcasing “Natural, physical and social sciences research and innovative programming that includes effects of climate change.”

According to Benson, “The geographic focus will be the Great Plains, including research or programming that’s transferrable to the Great Plains.”

Invitations to present at the symposium are now open and will remain so through June 13.

Requested oral presentations are for approximately 10-15 minutes, including two to five minutes for questions. Abstracts should be no more than 300 words and contain all pertinent information on presenters, contact information and topic. More than one abstract may be submitted.

Posters are also being solicited through June 13.

The one-day event is being co-hosted by the U.S. Geological Survey Nebraska Water Science Center.

For more information, check online at watercenter.unl.edu, or call Benson at (402) 472-7372.

Registration details for both events will be posted online about August 1.
From the Director  continued from page 2

about 16 attendees. This training was previously unavailable in our region. As with many things Dr. Chen does here at UNL, this workshop will be an invaluable and well-received service to our state and regional stakeholders.

A faculty panel has been assisting the Water Center and Water Sciences Laboratory (WSL) as the WSL evolves to address its success in developing many new analytical methods and in receiving a record number of samples for the past year. I thank Drs. Alan Kolok, Ed Harvey, Steve Comfort, John Gates, and Noah Clayton of the UNL Office of Research for serving on this panel. The lab’s success has created new challenges in providing rapid sample turnaround times and in setting priorities.

Based on their input, the lab now has additional explicit policies and operating procedures to increase sample turnaround times, and additional procedures for gathering data that will be used in the future to continue to improve its services to the Nebraska water community.

In concluding, let me highlight several coming Water Center events. The first is our July 12-14 water and natural resources tour of north central Nebraska and the Niobrara and Loup River basins. Highlights of this tour will be hearing the challenges and opportunities of the Niobrara Scenic River designation and developments on the Snake River near Merritt Reservoir on a possible change of ownership of the historic and scenic Snake River Falls. Part of a day canoeing the Niobrara should be fun, as well and I am very excited to be participating in part of the tour for the first time as interim director of the Water Center. I want to thank our primary cosponsors… Central Nebraska Public Power and Irrigation District, the Kearney Area Chamber of Commerce and Nebraska Public Power District….for their tremendous help and involvement in keeping these annual tours going.

Preparations are well in hand for our Fall Research Symposium on October 13th. Theme is “Climate, Water and Ecosystems-Shaping the Great Plains.” This event will showcase natural, physical, and social sciences research and innovative programming that includes effects of climate change or variability in the Great Plains regions. Research or programming that’s transferable to the Great Plains will be part of the program. It will also include a session related tools which can be used to help manage watersheds.

There is still time to submit abstracts for platform presentations or posters. This can be done by going to watercenter.unl.edu and submitting by June 14. This is another event that wouldn’t be possible without co-sponsors and this case we thank the U.S. Geological Survey Nebraska Water Science Center and the Robert B. Daugherty Water for Food Institute for their gracious involvement.

The day before the symposium, on Oct. 12, we hold our annual Water Law Conference in partnership with the University of Nebraska College of Law, focusing. The conference will touch on a broad range of water law issues, including Clean Water Act requirements and enforcement, transactions involving water rights, and due process rights associated with water rights. The primary audience is the practicing bar, but this conference will be useful to anyone interested in water quality or quantity, especially water professionals and managers.
The 100-Gallon Challenge

By John C. Fech, UNL Extension Educator

Wow, that’s a catchy title, isn’t it? The Hundred-Gallon Challenge.

But what exactly is it? Fair question. Simply put, it’s a group of common sense best management practices that will A.) Reduce stormwater runoff, B.) Soften peak demand of water systems while meeting the needs of plant and domestic water consuming activities, and C.) Reduce the volume of water needed to grow turf grass and landscape plants and carry on the daily routines of our lives.

Fellow University of Nebraska–Lincoln Extension Educator Sharon Skipton and I are touting this challenge…..the100 Gallon Challenge…..a program we adapted from the San Diego Water Department…to encourage adoption of sound management principles by homeowners and service professionals like lawn care providers and housing developers.

The good news is that these principles can be implemented as part of an overall goal of “going green.”

The challenge contains practices set in the model of changes to everyday behavior. Ten practices have been chosen for outside/landscape use and ten for inside/domestic use. They are divided into “easy to do/low cost”, “low cost/some time required” and “moderate to high cost/some time required” - a sort of low, medium and high set of options.

The numbers that follow each option represent the number of gallons per week that will be saved by implementation.

No Cost/Easy to Do:

• Water only between 4 a.m. and 8 a.m. to reduce evaporation and interference from wind. (40-70*).
• Adjust irrigation sprinklers to prevent spraying the street, sidewalk and other non-pervious surfaces. (30-50*).
• Reduce each lawn irrigation cycle by 2 minutes (50-90*).
• Use a bucket of soapy water to wash your car, using a hose only for rinsing. Use a self-closing nozzle to make it easier. (30-70*).
• Use a broom instead of a hose to clean driveway and sidewalks. (20-40*).

Low or No Cost/Easy to Do:

• Do not use the toilet as a wastebasket; use trash cans for waste other than sanitary waste. @ ____ times per week (1.6 gallons per time*).
• Install aerator on faucet @ ____ faucets (35 gallons per faucet per week*).
• Turn off water while brushing teeth @ ____ brushings per week (4 gallons per brush*).
• Do not rinse dishes before putting them in the dishwasher @ ____ loads per week (5 gallons per load*).

Low Cost/Some Time Required:

• Repair leaks in hoses, valves and sprinkler heads. (10-50*).
• Repair or replace leaking outdoor hose bibs. (90-100*).

Medium Cost/Some Time Required:

• Replace showerhead with water-saving model @ ____ 4-minute showers per week (12 gallons per shower*).
• Fix leaking toilet valve @ ____ # toilets (154 gallons per toilet per week*).

Moderate Cost/Some Effort Required:

• Install drip irrigation for flowers, fruit and vegetables (50-70*).
• Install a “smart irrigation controller” that shuts the irrigation system down when it rains (60-100*).
• Replace a portion of your lawn with drought tolerant perennials and groundcovers. (30-50*).

Higher Cost/Some Time Required:

• Replace toilet with low-flush model @ ____ flushes per week (2 gallons per flush*).
• Replace washing machine with water-saving model @ ____ loads per week (20 gallons per load*).
• Replace dishwasher with water-saving model @ ____ loads per week (7 gallons per load*).

*Amounts saved are estimates based on national averages. Actual savings will vary with household size, equipment efficiency, etc. For more information on how to save water, visit water.unl.edu/drinkingwater and water.unl.edu/landscapewater

Water efficiency is important whether your water comes from a public water source or a private well. Our public water supply infrastructure is aging. The same is true for the public wastewater infrastructure by which used water is carried away, treated, and returned to the environment.

In addition, many private well and onsite wastewater treatment systems are aging, and some might not be in compliance with current standards designed to protect human health and the environment. Water efficiency can reduce the stress on public and private water and wastewater treatment systems.

In some cases, large-scale efficiency might increase the life of public water or wastewater infrastructure, and reduce the need for additional or new infrastructure.
It was all about taking a day to become immersed in all things water.

More than 70 Aurora Public School students, ranging from fifth grade to high school seniors, got a cram-course on water quantity and quality issues and exposure to a variety of University of Nebraska, state and Natural Resources District water experts on March 3.

The daylong event, sponsored by the University of Nebraska–Lincoln’s School of Natural Resources and Water Center, was part of the students’ research into water quality issues that could have an impact on future water supplies.

State Senator Annette Dubas, whose district includes Aurora, greeted students and challenged them to become involved in their community’s issues. From there, they jumped into an overview of Nebraska’s surface and groundwater resources by UNL Water Center and Water for Food education and outreach specialist Rachael Herpel and a lesson on how Nebraska’s water quality is carefully guarded and monitored by John Bender of the Nebraska Department of Environmental Quality.

Gwendolyn Ryskamp, a research assistant in the University of Nebraska, Omaha’s aquatic toxicology laboratory and UNL hydrogeologist and hydrochemist Dave Gosselin continued the theme of water quality with respective presentations on “Water Quality and Biology” and “Naturally-occurring Contaminants,” with Gosselin stressing to the students that not all contaminants found in our water are things introduced into it by humans…. that some of them occur naturally.

There had to be a “Pop quiz” somewhere along the way and Sara Cooper, program coordinator for UNL’s School of Natural Resources’ Environmental Studies program and Environmental Resource Center, provided that, quizzing students on what they knew, and what they didn’t, on water quality and what affects it. No grades were given, but perfect scores were rewarded with a T-shirt.

Scott Snell of the Upper Big Blue Natural Resources District in York next told students how the NRD, which covers Aurora and surrounding territory, helps work with producers and irrigators to find common-sense solutions to water use and water quality concerns.

Changing directions, UNL environmental engineer and interim UNL Water Center director Bruce Dvorak and UNL...
Analytical equipment and facilities of the UNL Water Sciences Laboratory, where researchers go to have organic contaminants in water measured to the very minutest of quantities, were presented by laboratory services manager and hydrochemist Dan Snow.

UNL environmental engineer Wayne Woldt and Danielle Moore, of the Department of Biological Systems Engineering, next demonstrated Woldt’s “Water Machine” a model designed to show how groundwater flows and how it can become contaminated from a variety of sources.

Extension water quality educator Sharon Skipton teamed to talk about subjects the students had asked in advance to hear more about….dealing with water supply and water concerns in the wake of natural or man-made disasters or devastations to water supply infrastructure.

After lunch, there was time for touring UNL East Campus facilities and hands-on activities. These included learning about water turbidity, or how suspended particles in water gives it that cloudy or hazy appearance and a tour of Hardin Hall’s water laboratory where students were able to work with microscopes to study algae and examine aquatic invertebrates from a nearby stream.

Ryskamp and Jamie Oltman of The Groundwater Foundation gave the turbidity activity. Karla Jarecke worked with students in the Hardin Hall water lab.

Oltman ended the day with a talk on additional approaches to improving overall water quality, including participation in The Groundwater Foundation’s Groundwater Guardian and Groundwater Guardian Green Sites programs.

Aurora students study a Nebraska Water map as part of their day of water education at UNL (Steve Ress photo).
In the last Water Current I wrote about power, and how the word can have multiple meanings. At the end of that article I suggested that groups of citizen scientists could wield collective power to produce data sets that were simultaneously statistically powerful, personally empowering and scientifically robust.

In this issue allow me to give you two examples where citizen scientists are collecting these data.

The first example is the Mississippi River Nutrient Study, a large program spearheaded by the Open Source Science Project (http://www.theopensourceScienceproject.com). Project rationale stems from evidence suggesting excess nutrients released into the Mississippi River are responsible for a ‘dead zone’ found within the Gulf of Mexico. The dead zone is an area within the Gulf where levels of dissolved oxygen are so low fish cannot survive prolonged exposures to them.

One project goal is to identify hot spots where nutrients may be entering the river in particularly high concentrations. Samples will be collected from the Missouri and Mississippi Rivers, then analyzed for nitrogen and phosphorus four times over the next year. The project has some lofty goals, in that water samples are to be taken in the river every 5 miles from the mouth of the Mississippi to its headwaters in Lake Itasca, as well as up the Missouri River to Sioux City, all on the same day within the same hour!

How can a small group of highly trained scientists be deployed in so many places all at the same time?

They can’t.

Now here’s the interesting part: to collect water samples across such a vast landscape organizers are using teams of citizen scientists. Sample bottles will be delivered to the teams ahead of time then they will collect water and send it to one sampling laboratory that will do all of the analysis. Now that’s putting the citizen science force to work.

The second project is closer to home in the Elkhorn River watershed. On April 23 (two weeks after I wrote this, but a few weeks before you get to read it) large numbers of citizen scientists will fan-out across this 10,000 square kilometer watershed and take a simple atrazine measurement. Atrazine is a common herbicide used in Nebraska and was the focus of my Spring 2010 Water Current article. It is a presumptive endocrine disrupting compound turning male frogs female.

Citizen scientists involved in this project will be able to determine whether or not the water that they sample contains atrazine exceeding the U.S. Environmental Protection Agency’s safe drinking water standard of 3 parts per billion (ppb). The assay involves the use of a test strip (similar to many pregnancy test kits). Two pronounced bands on the exposed strip will confirm the presence of atrazine in the water sample.

Citizen scientists will then be able to take a GPS measurement (or use the Google map on our interactive website) to download the exact coordinates where they sampled and there will be a dialog box where they can mark whether or not they received an atrazine ‘hit’.

Using the combined and equally sophisticated techniques of the atrazine strips, along with information technology to catalog and process the data, these citizen scientists will collect over 150 samples from the watershed in a single day.

Admittedly, as I write this, I am a little anxious about the experiment’s outcome. A number of disappointing things can happen: return of the ‘survey’ data may be very low possibly because participants find the strips harder to read than anticipated, or the website more difficult to navigate. All of the collected data may be positive, or it may all be negative, or it may be so confusing as to be incomprehensible.

Even after the data are collected (in either study) the naysayers may pooh-pooh the utility of citizen scientists, even as it relates to the identification of hot spots or points of interest within certain watersheds.

Despite these real and potential drawbacks, I also keep in mind the positive attributes that both these experiments share. Both use tools that are sophisticated and powerful in their own way. Both hold the prospect of being statistically powerful, if not for the sake of the tool employed then certainly due to the vast number of samples collected more or less simultaneously, and both directly engage citizen scientists to collect ecologically relevant data. The level of personal empowerment that emanates from participation, and the appreciation for the importance of scientific inquiry in a modern society, may be the most important result that emerges from these two ‘power’ projects.
A drilling crew and staff from the South Platte Natural Resources District (SPNRD), University of Nebraska–Lincoln’s Conservation Survey Division and United States Geological Survey (USGS) recently completed work in Kimball County, the first phase of a project to expand the NRD’s groundwater monitoring well network.

SPNRD, at Sydney, currently has 64 dedicated monitoring wells at 58 sites. Three have become dry over time. That, combined with the need for additional information in portions of the NRD, spurred the expansion project.

Thirty-nine additional wells will be drilled in the NRD, with locations chosen according to needs determined by the NRD and USGS. Due to size and location of the NRD and amount of wells needed to be drilled to obtain the most precise data, the current drilling work is part of a three-year, $759,000 effort, financed in part with a $529,000 grant from the Nebraska Environmental Trust.

The expansion, along with other efforts such as Helicopter Aerial Geophysical Surveys, which take electromagnetic readings of area geology, are parts of current work being undertaken to form a greater understanding of area aquifers.

Information from the monitoring network helps verify HEM data by “ground truthing,” or providing a comparison of known information. To provide that information, geologists from UNL and USGS collect geologic samples during the drilling process and log the data for later use.

The combination of electronic and physical information goes into developing groundwater models, which can be used to analyze data for management purposes.

Examples of water management issues facing the NRD include, but are not limited to, surface water supply, groundwater supply and transfers, pooling agreements, drought management and groundwater quality.

By improving understanding of how water flows through the groundwater system, the NRD can be more effective in evaluating water quality and quantity problems and management decisions.

The NRD, in conjunction with the Nebraska Department of Natural Resources, implemented an Integrated Management Plan in 2008, setting goals and methods to manage current water supplies, as well as protecting those for the future.

NRD officials feel the monitoring well network expansion will help them manage a safe, sufficient water supply for present and future generations. It will also help maintain, enhance and protect regional agriculture, municipal systems and promote economic growth while avoiding adverse environmental impacts.
The business of farming is increasingly complex, with multiple factors that interact and affect the quality, yield and value of the crop. So, scientists are adopting interdisciplinary approaches to tackle those challenges.

At the Institute of Agriculture and Natural Resources’ West Central Research and Extension Center at North Platte, for example, a team of physical and social scientists has been assembled in the last couple of years to address the challenges of growing crops with limited water. While their research is just getting under way, it builds on decades of water science in the region.

“There’s so much interaction, the way we manage things is not isolated anymore,” said Steve Young, weed ecologist. “We have to look at everything—plants, soil, air, water. All these things are interacting, and that’s why there’s so much interest in forming these interdisciplinary teams.”

Another member of the team, agricultural economist Matt Stockton, said some of the most significant research grants now go to multidisciplinary teams like West Central’s.

“The integrated research is really where the synergy comes,” Stockton said.

Growing crops with limited water, in both irrigated and nonirrigated systems, is one of two key focus research and extension areas at West Central, the other being beef systems, said Don Adams, director of the center.

Adams said several of the scientists are recent hires, with one vacancy, for a plant pathologist, remaining. “We brought each one in to fill what we consider a key component.”

A key to the research, Adams said, is the new West Central Water Resource Field Laboratory in Brule, purchased by UNL in 2007 to research, demonstrate and teach water conservation methods in cropping and livestock systems in western Nebraska.

Scientists on the team and their roles in the research include:

– Young is studying invasive plant species such as Phragmites australis, a non-native common reed, and salt cedar, which can impede stream flows, as well as management of agronomic weeds. One focus is new weed-control technology that uses sensors and guidance systems to distinguish between weeds and crops in the field.

– Simon Van Donk, irrigation management scientist, is studying issues related to scheduling irrigation, including subsurface drip and sprinkler approaches. He’s also researching crop residue impacts on evaporation, soil water and crop production.

– Greg Kruger, cropping systems specialist, is focused on cropping rotations and weed control as water conservation tools.

– Tim Shaver, soil scientist, is studying soil nutrient management under limited irrigation, including how varying irrigation amounts impacts nitrogen and phosphorous requirements. He’s also looking into tillage practices’ impact.

– Aaron Stalker, animal scientist, is working with several other scientists on how to incorporate cattle grazing on corn residue into the system.

– Stockton, agricultural economist, is charged with exploring both short-term, simple cost considerations and longer-term economics of changes in cropping approaches. “Research is grand and glorious, but there are some interesting questions that are both practical and systemic that need to be answered from an economic point of view,” he said.

“One of the true measures of impact is profitability and sustainability,” Adams said.

Much of the team’s research is focused on tying cropping and livestock systems together, a whole-systems approach, Stalker said. At the Brule site, for example, scientists are experimenting with how leaving different levels of crop residue in the field over the winter affects crop production in the following growing season.

Van Donk and Stalker are key scientists in this research, but the entire team ultimately will be involved in research that’s likely to last a decade or so.

“This is very complex. When a producer makes this decision, he’s not just thinking about next year’s crop production. He’s also got to think about getting cows through the winter,” Stalker said. “There are tradeoffs. Ultimately, what it comes down to is the economic impacts. A lot of biological processes are going on here. That’s why it’s so important to have this multidisciplinary team.”

The research is funded by IANR’s Agricultural Research Division.
The U.S. Environmental Protection Agency (EPA) is proposing for public comment standards to protect billions of fish and other aquatic organisms drawn each year into cooling water systems at large power plants and factories.

The proposal, based on Section 316(b) of the Clean Water Act, would establish a common sense framework, putting a premium on public input and flexibility.

“This proposal establishes a strong baseline level of protection and then allows additional safeguards for aquatic life to be developed through a rigorous site-specific analysis, an approach that ensures the most up to date technology available is being used. It puts implementation analysis in the hands of the permit writers, where requirements can be tailored to the particular facility,” said Nancy Stoner, acting assistant administrator for EPA’s Office of Water.

“The input we receive will make certain that we end up with a flexible and effective rule to protect the health of our waters and ecosystems.”

Safeguards against impingement will be required for all facilities above a minimum size; closed-cycle cooling systems may also be required on a case by case basis when, based on thorough site-specific analysis by permitting authorities, such requirements are determined to be appropriate. EPA is proposing this regulation as a result of a settlement agreement with Riverkeeper, Inc. and other environmental groups.

**Flexible Technology Standards:**

**Fish Impingement** (Being pinned against screens or other parts of a cooling water intake structure): Existing facilities that withdraw at least 25 percent of their water exclusively for cooling purposes and have a design intake flow of greater than 2 million gallons per day (MGD) would be required to reduce fish impingement under the proposed regulations. To ensure flexibility, the owner or operator of the facility will be able to choose one of two options for meeting best technology available requirements for reducing impingement. They may conduct monitoring to show the specified performance standards for impingement mortality of fish and shellfish have been met, or they may demonstrate to the permitting authority that the intake velocity meets the specified design criteria. EPA estimates that more than half of the facilities that could be impacted by this proposed rule already employ readily available technologies that are likely to put them into compliance with the proposed standard.

**Fish Entrainment** (Being drawn into cooling water systems and affected by heat, chemicals or physical stress): EPA is proposing a site-specific determination to be made based on local concerns and on the unique circumstances of each facility.

This proposed rule establishes requirements for the facility owner to conduct comprehensive studies and develop other information as part of the permit application, and then establishes a public process, with

The U.S. Environmental Protection Agency has proposed a rule to require an expanded group of water utilities to test for 30 unregulated contaminants.

As proposed in the March 3 Federal Register, the third Unregulated Contaminant Monitoring Regulation (UCMR3) for public water systems would expand the pool of systems affected by UCMR3 to include systems serving more than 10,000 people that rely solely on purchased water for List 1 monitoring.

Systems serving more than 10,000 persons would conduct UCMR monitoring and analysis at their own cost, while USEPA would cover sample shipping and analysis costs for a statistically derived sample of smaller systems.

The 28 proposed List 1 contaminants include seven hormones and pharmaceuticals, 1,4-dioxane, nine volatile organic compounds, four metals (cobalt, molybdenum, strontium, vanadium), chlorate perfluorooctane sulfonate (PFOS), perfluorooctanoic acid (PFOA) and four other perfluorinated chemicals.

In addition, two viruses (enterovirus, norovirus) are proposed for List 3 pre-screen testing.

The Federal Register notice also requests comments on whether hexavalent chromium (chromium-6) should be included as one of the 30 contaminants for UCMR 3 monitoring and which contaminant should be removed from the proposed list to make room for chromium 6 if it were added to the list.

The rule will be finalized in 2012, and monitoring will occur from 2013 to 2015.
Here’s something to ponder: The United States uses 79.6 billion gallons of fresh groundwater per day for public supply, private supply, irrigation, livestock, manufacturing, mining, thermoelectric power and other purposes, according to the National Ground Water Association.

With that in mind The Groundwater Foundation (TGF) celebrated National Groundwater Awareness Week (March 6-12, 2011), continuing to educate and inspire everyone to ensure groundwater is available for future generations.

Groundwater is the water that fills the cracks and crevices of rocks and sands beneath the Earth’s surface and supplies a majority of us with our drinking water. One of the ways TGF works to ensure it is available into the future is through “Let’s Keep It Clean!”

The awareness program works within Nebraska, directly in communities. In the past year TGF has worked with Crete, Wayne and Minden and are now setting their sights on working with Fairbury, St. Paul, Auburn and others.

The goal is to make residents aware of groundwater and how they impact it daily. They may receive that information in many different forms from reading an article in the local paper, or hearing a spot on the radio or television, or attending an event at the local library or a community-wide activity.

But there are many things that everyone can do to ensure this clean supply of water will be there into the distant future. Take action by:

• Taking short showers instead of baths
• Running full loads of dishes and laundry
• Decreasing or eliminating fertilizer and pesticide usage
• Watering outside only when necessary
• Checking for leaky faucets and repairing them
• Disposing of chemicals properly by taking them to recycling centers
• Teaching others about ways to protect and preserve water

For more information about The Groundwater Foundation, how to become a member, or any of its programs, call 1-800-858-4844 or visit www.groundwater.org. The “Let’s Keep It Clean!” program is sponsored by the Nebraska Department of Environmental Quality and the Nebraska Environmental Trust.

WEFTEC 2011

Registration and housing is open for WEFTEC 2011, the Water Environment Federation’s 84th annual technical exhibition and conference. This year’s event is Oct. 15-19, Los Angeles Convention Center, Los Angeles, Calif.

If it’s about water, it will be at WEFTEC. As the largest annual water quality conference and exhibition in the world, WEFTEC continues to offer the best educational, business and networking opportunities in the water profession today.

This year features 115 technical sessions, 27 workshops and eight local facility tours. A wide range of topics and focus areas allow attendees to design their own, unique learning experience with the opportunity to earn continuing education credits.

Focus areas include facility operations and wastewater treatment; nutrients; collection systems; residuals and biosolids; utility management; water reuse and management; stormwater and green infrastructure; sustainability and energy management; industrial wastewater; watershed management; and more. An exhibition will provide access to over 1,000 companies showing the latest developments, research, solutions, and cutting-edge technologies in the field.

For conference details go to www.weftec.org.

Stormwater Newsletter

Water Environment Federation (WEF) has premiered a new publication to keep water quality professionals informed about activities and developments related to stormwater — a subject of expanding interest.

The Stormwater Report includes the latest in innovative programs and resources and publishes as a free monthly. It covers advanced practices, cutting-edge research, policy updates, and current events related to stormwater. For example, readers will be kept abreast of the many stormwater-related sessions, workshops, and meetings planned for WEFTEC 2011, which will, for the first time ever, feature continuous stormwater programming during each day of the conference.

“Stormwater represents one of the most important challenges facing water quality professionals,” said WEF Executive Director Jeff Eger.

To support WEF’s goal of be the go-to resource for stormwater professionals, WEF has a number of publications coming down the pipe with committee activities now coordinated with its newly formed Stormwater Coordinating Council. In addition to other publications
such as the upcoming Manual of Practice 23, *Urban Runoff Quality Management*, WEF stormwater highlights include a free “Meeting the Public Education Requirements of the Municipal Stormwater Permit” webcast and a June 15 webcast update on green infrastructure costs and regulatory updates, among others.

If you are interested in stormwater, subscribe online, or check it out on Access Water Knowledge. Be sure to look for The Stormwater Report on the first Thursday of each month. Go to www.wef.org

**GW Foundation Grant Funding**

The Groundwater Foundation will receive $70,811 from the Nebraska Environmental Trust for the Growing Groundwater Awareness in Nebraska program.

This is the second year of the award. The project is one of 94 receiving $15,412,788 in grant awards from the Nebraska Environmental Trust this year.

The goal of the program is to empower Nebraskans to play a key part in protecting their groundwater. The main objectives are to create awareness and provide tools for communities to take proactive steps to ensure a safe, lasting supply. The work centers around the slogan, “Let’s Keep it Clean!” The Groundwater Foundation has worked in Crete, Wayne and Minden and is currently working in St. Paul, Auburn and Fairbury. More details are available by clicking the Let’s Keep It Clean! button at www.groundwater.org.

**Keep Stormwater from Polluting**

As spring showers get going, whatever doesn’t soak into the ground runs off roofs and yards, down streets, into storm drains, and then directly into rivers, lakes, creeks, and other local water bodies.

If that runoff is polluted, it’s most likely because of little things people commonly do (or not) every day that add up to big water pollution in their communities – and ultimately around the world. The Water Environment Federation suggests five things everyone can do to help keep stormwater from polluting our water resources all year long:

- Don’t dump anything down storm drains, including leaves, trash, and grass clippings. Storm drains are for rain only!

- Pick up after your pet. Don’t let harmful bacteria contaminate local water.

- Reduce fertilizer use. Use natural fertilizers according to directions.

- Recycle Motor Oil. Also, fix cars and lawn equipment that leak oil.

- Recycle Household Waste. Follow directions on household products for proper use, disposal, or recycling.

Remember, if you don’t want it in the water, keep it out of the storm drain!

**UNL Hydrogeology Program Among Top 100**

In January the National Ground Water Association (NGWA), the largest groundwater association in the world, picked the University of Nebraska–Lincoln’s hydrogeology program as one of its top 100 in North America.

More than 400 programs were considered for the NGWA honor, including many international programs. In selecting top programs, NGWA’s goal is to give prospective groundwater students a list of strong options and a jumping-off point for their searches.

Selection factors center on the length and strength of the program, as well as its faculty.

Within the 100 selected top programs, none are ranked against one another. The selected programs are listed on the NGWA web site at http://www.ngwa.org/students/hydrogeology-programs.aspx. The information can also be found in the latest Newsletter of the U.S. National Chapter of International Association of Hydrogeologists (the unranked alphabetical listing still uses “Geosciences” as a part of the department name.)

Hydrogeology specialization in the Department of Earth and Atmospheric Sciences at UNL was approved by UNL Graduate Council in 1998 and includes Vitaly Zlotnik, Advisory Committee Chair, J.B. Gates, and D.T. Pederson.
the phenology and growth of wetland plants. By exploring effects of altered climate and habitat conditions on wetland-dependent birds using a holistic approach that incorporates both top-down and bottom-up constraints, we will better predict changes in wetland ecosystems and responses of migratory birds to those changes. This research will assist managers and conservation professionals within federal, state, and nongovernmental organizations concerned with protecting migratory bird species and managing critical wetland habitats.

Understanding landscape constraints on local management decisions: Throughout the Great Plains the structure and function of grassland and farmland wildlife communities are increasingly threatened by urbanization and the intensification of agricultural production. Even in areas managed exclusively for wildlife, responses to habitat enhancement is often less than predicted and less than desired by managers and the public. Given the incredible costs of wildlife enhancement projects, understanding why populations and communities fail to respond to apparently suitable habitat improvements is imperative to not only sustaining wildlife populations, but ensuring public support for wildlife programs. Traditionally, assessment of wildlife population responses to habitat improvements are focused on local habitat attributes; however, as habitats are increasingly isolated it is becoming obvious that factors beyond local vegetation and resource distribution may play a role in where species are located or the productivity of local populations. We are working to examine how the availability of suitable habitat across a landscape constrains or facilitates local population responses to grassland bird habitat enhancement programs. To this end we are developing models that relate the distribution and abundance of grassland birds to the availability and suitability of habitats across various spatial scales. By understanding how multi-scalar landscape parameters influence local populations we can better understand how to successfully manage species and appropriate research, monitoring and management efforts. This research will assist managers and conservation professionals within federal, state, and nongovernmental organizations concerned with the management of grassland communities and protecting grassland bird species.

Examples of Past Research/Extension Programs:

1) Neotropical migrant bird habitat decision
2) Impacts of dewatering on riparian community ecology
3) Impacts of climate change variation on migratory species
4) Song expression
5) Influence of nest predation on reproductive strategies in birds
6) Influence of nest predation on habitat selection by breeding birds

Teaching:

As a member of the Coop. Unit our primary responsibility is graduate student education. As such I primarily teach graduate class-
“During the course of the tour, participants will be exposed to project features and activities supported by three Irrigation Districts and two Natural Resources Districts.

“Some of the features in the tour area will include the Niobrara Valley Preserve, UNL’s Barta Brothers Ranch, Merritt Reservoir, Niobrara National Scenic River and Snake River Falls,” said tour co-organizer and host Michael Jess.

“There will also be an opportunity for canoeing the Niobrara River,” he remarked.

Issues key to the tour focus on the use and controversies surrounding surface and groundwater resources in the region. The area sits atop the Ogallala (or High Plains) Aquifer, which is one of the largest aquifers in the world, covering an area of about 174,000 square miles in parts of eight states, and is relied upon heavily for irrigated agriculture, drinking water and other uses.

It is key to many conservation, recreation and agriculture issues in central and north-central Nebraska.

The tour departs Kearney’s Ramada Inn July 12 and makes morning stops at Davis Creek Lake in the Twin Loups Irrigation District and Lower Loups Natural Resources District, then to NRD offices in Ord for discussions of water and natural resources management in the lower Loup River watershed.

Afternoon discussions will focus on rebuilding infrastructure and irrigation canal diversion works following extensive flooding on the Loup Rivers in June 2010.

The tour then heads to UNL’s Barta Brothers Ranch research and extension facility near Rose and then to Sandhill Implement Co. in Bassett before overnight in Ainsworth.

Wednesday morning the tour explores the Niobrara Valley Preserve near Johnstown and Fort Niobrara National Wildlife Refuge near Valentine. Discussions there will be about the challenges of managing the Scenic Niobrara River. In the afternoon, tour attendees can opt to raft the Niobrara River before a western cookout at the Diamond Lazy J Ranch near Nenzel, where vineyard and ranch tours will also be available.

Overnight is at Valentine’s Niobrara Lodge.

On Thursday, discussions shift to current plans by the Nebraska Game and Parks Commission to purchase historic and scenic Snake River Falls from its current owners and then a look at nearby Merritt Reservoir before traveling to Broken Bow for lunch and a tour of Sargent Irrigation Co.’s manufacturing plant there. The tour then returns to Kearney.

Space is limited and registrations are first-come, first-served. Cost is $500 per person single occupancy or $400 per person double occupancy. Registration includes all meals, motel, transportation and activities. To register, or obtain a registration brochure, contact Jennie Nollette at the Kearney Area Chamber of Commerce at (308) 237-3168 or email jnollette@kearneycoc.org. More information is online at watercenter.unl.edu.

Tour cosponsors are Central Nebraska Public Power and Irrigation District, Kearney Area Chamber of Commerce, Nebraska Public Power District, UNL Water Center and School of Natural Resources, Northern Plains Supply, Inc., Perfect Valley Irrigation, Inc., Sandhill Implement, Inc. and the Lower Loup Natural Resources District.
two feet and areas south of the Platte River in west-central Nebraska and north of the Platte River in central Nebraska experienced rises of more than a foot, but generally less than five feet.

Some of the biggest recorded one-year gains were near the Missouri River and its major tributaries in northeastern and southeastern Nebraska, where groundwater levels rose by more than five feet, Burbach said.

Declines of more than a foot were relatively few and widely scattered across the state. The largest of these areas was in Clay and Fillmore Counties, where declines were from two to five feet.

Despite the gains, or at least slowing of declines, in groundwater levels over much of the state in the last three years, levels remain below Spring 2000 levels over most of Nebraska due to widespread drought from 2000 to 2007.

Gains or slowing declines since 2007 also don’t erase the fact that large areas of groundwater level decline since predevelopment of irrigation remain in the south central, southwest and Panhandle, Korus said.

Predevelopment water levels are estimated, but generally occurred before the early to mid-1950’s depending on when intensive groundwater irrigation began.

In areas of the state showing the longest long-term groundwater decline, “Many are in areas of intense groundwater irrigation, but in a few areas wells are not particularly dense.

“Other factors such as aquifer characteristics, rates of recharge and irrigation scheduling could be contributing to the declines,” Burbach said.

Average daily streamflows across Nebraska were highly variable over 2009.

In central and parts of northeast Nebraska, flows were above average due to above-average precipitation, but in parts of western, southern and southeastern Nebraska flows were below the long-term average due to near or below average precipitation.

“The low flows in some streams in the Panhandle and southwest are part of a regional trend in the High Plains aquifer of long term reductions in baseflow to streams due to lowering of the regional water table,” Burbach said.

Groundwater level change maps included in the report can be downloaded free at the School of Natural Resources web site at http://snr.unl.edu/information/GroundwaterMaps.asp. Maps from previous years are also archived there, dating to 1954.

Data for the maps, graphs and reports is based on recorded measurements from more than 6,000 observation wells taken by 27 organizations, including each of Nebraska's 23 Natural Resources Districts, U.S. Geological Survey, Central Nebraska Public Power and Irrigation District, U.S. Bureau of Reclamation, and UNL's Conservation and Survey Division.

Groundwater level change maps rely on well readings recorded as close to April 1 as possible, before the start of the irrigation season.

The full, published report, “Nebraska Statewide Groundwater-Level Monitoring Report 2010,” (Nebraska Water Survey Paper Number 77) which explains and amplifies data presented on the maps, as well as other materials, can be purchased for $15 online at snrsales@unl.edu or at the Nebraska Maps and More store, first floor Hardin Hall, UNL East Campus, N. 33rd and Holdrege Sts., Lincoln. Korus, Burbach, geologist Matt Joeckel and cartographer Les Howard, all part of UNL's Conservation and Survey Division, coauthored the report.

opportunity for public input, by which the appropriate technology to reduce entrainment mortality would be implemented at each facility after considering site-specific factors.

Because new units can incorporate the most efficient, best-performing technology directly into the design stage of the project, thus lowering costs and avoiding constraints associated with technology that has already been locked in, the proposed rule would require closed-cycle cooling (cooling towers) for new units at existing facilities, as is already required for new facilities.

EPA will conduct a 90-day public comment period and will carefully consider those comments before taking final action on the proposal. The administrator must take final action by July 27, 2012.

More information, go online to http://water.epa.gov/lawsregs/lawguidance/cwa/316b/
Nebraska’s Water Situation

Nebraska is unique because of the large groundwater supply provided by the Ogallala Aquifer, Dvorak said. “And that groundwater is of really high quality, so we’re fortunate. A very large amount of our water is from groundwater sources; in Nebraska, over 80 percent of our citizenry gets their drinking water from groundwater.” Also unusual, he said, is that almost half of Nebraskans are drinking groundwater supplies that have little or no treatment because the quality is so high. Dvorak said the aquifer provides some extra treatment and means many of the issues of national concern – such as various contaminants – are less of a problem in Nebraska’s public water and domestic water supplies.

Limited Water, New Laws

However, the amount of available water is limited. If we’re not careful, Dvorak said, we’ll start seeing more rivers and wells going dry, so that vision of the future has led to competition and concern. From a law standpoint, regulations are being developed to address competing interests, he said, balancing agricultural water use with other uses. “Many of our laws are based on outdated science. Many laws were developed 60 to 90 years ago when we did not understand the hydrology and the water cycle the way we understand today,” he said. “Now, we understand an awful lot more about the science, and we’re experiencing some climate variability,” he added. Better knowledge of science has changed the way land is used and that has changed water usage. Conservation techniques such as no-till agriculture and efforts to protect the soil by reducing nonpoint source pollution have resulted in reduced river flow in some areas of the state, affecting contractual obligations to provide water to other states.

Sustainability, Pollution, Climate Variability … and Us

Above all, Dvorak believes a definition for “sustainable” will help to determine the future of water policy and law as scientists obtain a better understanding of science related to climate variability, drought and potentially, climate change. He expects there will be more discussion about both rural and urban nonpoint source nutrient pollution that will be particularly focused on the eastern third of Nebraska. He also expects more discussion related to micro-contaminants, including more scientific information on potential risks, adding that as a society, we are becoming more concerned about smaller and smaller risks. “I anticipate there’ll probably be discussion related to that, both research and policy and public discussion about what level of risk we’re willing to accept,” he said.

The future will emphasize working with the state’s economic systems to try to reduce water use without affecting production, he said, citing a recent UNL research project that has been shown to save two inches of water in each field to produce the same number of bushels per acre.

But Dvorak believes one of the biggest challenges in the next decade will be convincing people to put the science into use. “We have all this good science, we have great technologies, but the next challenge is what I call the human dimension,” he said, including having public policy and economic incentives in place as well as understanding the sociology of the way people use water.

“Nationally, internationally it is well understood that although there’s a need for more science and technology research, there’s also a real need to understand the human interactions with that science and technology so we can actually have it applied,” he said.

(Editor’s Note: This article was written by Mary Garbacz, lecturer and coordinator of Strategic Discussions for Nebraska in the UNL College of Journalism and Mass Communications. It was published in Opportunities for Nebraska, August 2010).
Nebraska is unusual because we’re number one in the nation in the amount of irrigation that comes from groundwater sources,” said Bruce Dvorak, interim director of the University of Nebraska–Lincoln Water Center. Yet, when Nebraskans talk about water, residents of the central and western part of the state often look at the whole spectrum of water issues, while many residents of the eastern part of the state mainly consider water used at home.

“I think a lot of people in the eastern part of the state take water for granted,” Dvorak said. In Nebraska, only about three percent of water is used by public water supplies and domestic wells; the rest is used in irrigation and by industry.

A UNL professor of civil engineering, Dvorak has a special interest in drinking water and sustainability issues and in the research and extension efforts related to those issues.

“Obviously, water is very important throughout the country. We all need to drink water, but it’s also very important for the economy here in Nebraska,” Dvorak said. Nebraska relies on irrigation to produce agricultural crops and for urban horticulture; industry relies on water as a cooling source; and water is used to generate hydroelectric power. Additionally, water is necessary in streams for fish, birds and other wildlife, he said.

“There are a lot of reasons water is important and a lot of reasons water research is important to help support those various uses and help improve both quantity and quality,” Dvorak said.

The Water Center serves a broad mission and addresses the science and engineering of the quantity and quality of water, as well as the management and laws and policies related to water. The Water Center is one of 54 centers established by federal mandate more than 45 years ago. Dvorak said the centers were established in each U.S. state and territory for three main purposes: 1) to provide a place for competent research to expand the understanding of water and to address water problems; 2) to aid the entry of new water scientists, engineers and managers into the field of water study; and 3) to communicate results of the research to water managers and to the public.