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Well installation has begun for study of contamination gradient around irrigation wells

For more than two decades, irrigation wells have routinely been used to sample groundwater for nitrate contamination. However, the method is far from an exact science and typically underestimates the actual levels of contamination. But a research team from the University of Nebraska-Lincoln has started work this spring to change that.

The team, made up of hydrogeologists Jerry Ayers, David Gosselin and You-Kuan Zhang, all with the Conservation and Survey Division, and UNL graduate student Doug Haney, has begun well installation for a study that will use multi-level sampling and computer modeling to determine the flow of contaminants within an irrigation well's zone of influence.

Actual pumping and sampling will begin when the irrigation season starts, Ayers said. Eight

multi-level monitoring wells have been constructed around the irrigation well after extensive study of the hydrogeological characteristics of the aquifer near Shelton in Buffalo County.

At least one pumping test will be performed, more if irrigation schedules and weather permit, Ayers said. If all goes well, further testing will take place this fall and during spring and fall of 1994, he added.

Sampling of irrigation wells is quick, easy and relatively cheap, but the results may not be representative of the actual level of contamination because nitrate contamination isn't uniformly distributed in an aquifer, according to the team's proposal. Nitrate concentrations tend to be highest near the water table and diminish with depth.

(See Well installation continued on page 2)

Computer control base makes soils mapping more accurate

Soil surveys are nothing new; they've been done in Nebraska for decades. But the way the soils are being mapped is new, according to a University of Nebraska-Lincoln computer cartographer.

Margaret Warner of the Conservation and Survey Division said that a soil survey currently being done in Saunders County is the first in the state to be mapped on a computerized control base.

The "control base" is a U.S. Geological Survey (USGS) "orthophotoquad," an aerial photograph that has been registered to a USGS 7.5-minute map

quadrangle. The soil lines are drawn on the orthophotoquad and then digitized (entered into a computer). These lines can then be easily plotted.

After the control base is entered, the soil map can be digitally plotted over it. Using a control base to map soils is an improvement over the old method, where often the only markers used were county lines, Warner said.

"You can join these up with the real world," she said. "There was nothing to tie the old ones to the real world."

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Report on Midcontinent Rift System outlines the potential for minerals

As far as earth-shaking activity goes, most people would probably suppose that Nebraska is deathly quiet compared to, say, California. But it hasn't always been that way.

About a billion years ago--1.1 billion, to be exact--incredible forces within the earth's crust began splitting the North American continent apart. A 30-mile-wide rift was torn across the face of the continent, a precursor of what would have become a new ocean, separating a divided North America. And then, for reasons unknown, the tectonic forces (structural forces affecting the earth's crust) subsided and rifting ceased. The rift valley, which filled with lava and then sediment, underwent structural reversal, creating a high central block of volcanic rocks along the former path of the rift. Reactivation occurred 300 million years ago when South

America collided with North America. Several other minor periods of structural movement have affected the geologically-young sediments, and several earthquakes in southeastern Nebraska indicate that stresses remain in the system.

The remnants of all this tectonic activity, dubbed the Midcontinent Rift System, lie in a band of rocks stretching from Kansas to the Great Lakes. The Rift System intersects the southeastern corner of Nebraska and has been studied extensively in this state by Marvin P. Carlson, a research geologist with the UNL Conservation and Survey Division (CSD).

Recently, Carlson completed a contract report for the U.S. Geological Survey that pulls together most of the data gathered over the years on the

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Institute of Agriculture and Natural Resources/University of Nebraska-Lincoln

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Thus, water sampled from a well that pumps from the bottom of an aquifer would show less contamination than actually existed.

By using multi-level sampling--wells that screen various levels of the aquifer--the researchers will track the actual flow rate of nitrates to an irrigation well during pumping. Using this data, they can then determine the relationship between pumping time and contamination in the aquifer. This information will help validate a computer model of contaminant flow in the aquifer.

During 2-hour testing periods, samples will be taken from the pumping irrigation well at 1-minute intervals for the first 20 minutes, 5-minute intervals for the next 30

Soils mapping *continued from page 1*

The maps done on a control base can be cross-referenced to a variety of geological and human-made features, she added. For instance, a map of Nebraska roads and highways or one showing section lines can be overlain on the soil map, Warner said. By cross-referencing in this way, soil maps will be more accurate and more useful, she said.

The new maps are also being done on a scale of 1:12,000, whereas the old ones were done at 1:20,000. The smaller scale will also improve the accuracy of the maps, Warner said.

Because the new soil maps should be more accurate and are so easy to cross-reference, they will be useful for a variety of things. By overlaying the appropriate data on the soil map and control base, the maps can be used to study

minutes, and then at 15-minute intervals for the remaining time. Five samples will be taken from each monitoring well before, during and after the experiment. Each experiment will yield up to 66 samples, which will be analyzed at UNL labs for nitrate concentrations.

Matching information collected from the pumping tests against a model predicting contaminant movement near a partially penetrating well, the researchers should be able to identify the main factors influencing water-quality variations in samples taken from high-capacity wells. They then hope to develop a better methodology for sampling irrigation wells, Ayers said.

pollution, water quality and erosion potential, to determine land suitability for construction projects, to assess taxes and many other things, Warner said. The new soil surveys will even be compared with old ones, to see how the landscape and mapping methods have changed over the years, she said.

The current soil survey in Saunders County should be completed this summer, Warner said. Once the field work is completed, it will probably take an additional 6 to 8 months to finish digitizing the soil maps, assuming funding is available, she said. The digitizing process for soil survey maps should become standard if enough funds are available, she said.

Logo by Wahoo man chosen for centennial celebration of Nebraska Geological Survey

A winner has been chosen in the centennial logo contest announced in the 1991-1992 edition of Resource Notes, the annual report of the Conservation and Survey Division (CSD). The division held the contest to find an emblem for the 100th anniversary of the Nebraska Geological Survey, the predecessor of CSD.

Theodore L. Huscher of Wahoo was awarded the \$100 cash prize in the contest sponsored by the Centennial Celebration Committee, headed by Duane Eversoll, associate director of CSD. Huscher is a project geologist for Coranco Inc., an environmental contracting firm.

The final version of the logo, pictured here, is a combination of various elements from the designs Huscher

submitted, rendered by Jerry Leach, chief cartographer of the CSD.

The logo will be used on promotional material and publications.

The centennial celebration kicks off in September with a weekly seminar series and culminates in a week of activities from September 20-24, including a luncheon, an open house with many displays and some key demonstrations for invited guests. More information about the celebration will be included in upcoming editions of Resource News.



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Resource News is a bimonthly publication of the Conservation and Survey Division, 113 Nebraska Hall. Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln, 68588-0517. It is distributed free to all interested in earth science in the state. To receive it, write to the address above. In addition, the Resource News audience will receive Resource Notes, the annual report of the division. The Conservation and Survey Division is the agency designated by statute to investigate and interpret the geologically related natural resources of the state, to make available to the public results of these investigations and assist in the development and conservation of these resources. The Conservation and Survey Division provides information and educational programs to all people without regard to race, color, national origin, sex or handicap. Background of nameplate on page one depicts the layered rock column from the Geologic Bedrock Map of Nebraska. Layers shown are (from the bottom) Precambrian, Cambrian, Ordovician, Silurian and Devonian rocks.

Ongoing state soil survey threatened with budget cut

After being funded by the Nebraska Legislature continuously since 1976, the Nebraska Soil Survey Fund is in danger of losing its appropriations for the 1993-1994 and 1994-1995 fiscal years.

The legislature's Appropriations Committee has proposed no funding for the program, which amounted to \$155,738 in fiscal year 1992-1993 in the appropriations budget. Loss of funding would mean the loss of seven soil survey personnel with more than 90 years of combined experience, said Mark Kuzila, head soil scientist of the Conservation and Survey Division (CSD) soils program.

These seven people, working out of Chadron, Valentine, Grand Island, Wahoo, Lincoln and Omaha, are paid jointly through the Soil Survey Fund, local natural resources districts and county governments. Without the Soil Survey Fund, it's unlikely that these local cooperators could continue to take part in the program, Kuzila said.

The soils program provides up-to-date information on a variety of important matters, including: soil suitability for agricultural, residential and industrial use; fair appraisal and

tax equalization of land; and soil, groundwater and solid-waste management, Kuzila said. Many counties, including Cherry, Sioux, Saunders, Washington and Hall, need their soil surveys to be updated or completed, he said.

In a state where the economy is dependent on agriculture and agriculture is dependent on soils, a \$156,000 appropriation is "a pittance when we talk about a state budget of about \$1.6 billion," Kuzila said.

"What it comes down to is: our agriculture is dependent on our soils, and we have some of the best soils in the world. Is Nebraska worth a minimal annual investment in the Soil Survey Fund?" he said.

The issue will likely be decided when the appropriations bill goes to a vote in the legislature. Despite the Appropriations Committee's resistance to funding the Soil Survey, Kuzila said he remains optimistic. The program has survived cuts in the past as a result of interest shown by Natural Resources Districts, county assessors, and other clientele, he said.

Grant allows for first work on southeastern Nebraska coal field

The Conservation and Survey Division (CSD) of the University of Nebraska-Lincoln has received a \$12,500 grant from the U.S. Geological Survey (USGS) to do a preliminary study of the Nebraska section of the Forest City Basin coal field, said Ray Burchett, a geologist for the division.

The Forest City field underlies parts of Otoe, Nemaha and Richardson counties in Nebraska, as well as portions of Iowa, Kansas, and Missouri. It is believed that the field may have the potential for producing methane generated from coal beds.

Burchett said the \$12,500 grant will be used to prepare a preliminary report on the possible occurrence of methane gas and production from the field, mainly in Nemaha and Richardson counties. The Iowa, Kansas and Missouri geological surveys received identical grants and will apply them similarly, he said.

These reports will be presented to Congress when the four states and the USGS apply for a multi-million grant to conduct a 4-year study into the methane-producing potential of the field, Burchett said.

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Nebraska segment of the rift. Entitled "Characterization of the Midcontinent Rift System in Nebraska," the report relates the history and structure of the Rift System and its influence on the current subsurface of Nebraska.

Carlson said the Rift System is of interest for more than just scientific reasons. The brief reactivation 300 million years ago created stratigraphic traps--folds, faults and other layers that hold oil and natural gas.

In addition, the Rift System could also hold metallic deposits, he said. Large copper deposits are located in part of the Rift System near Lake Superior.

Thus far, no large mineral deposits have been discovered in the Rift System in Nebraska or surrounding areas, but the potential is certainly there, Carlson said.

Another feature related to the Rift System that is potentially of economic interest is the Elk Creek Carbonatite, said Ray Burchett, another CSD research geologist.

The carbonatite, a large chunk of intrusive carbonate rock located in a break in the Rift System in southeastern Pawnee and Johnson counties, contains so-called "rare-

earth" elements that could be exploited, Burchett said.

Burchett said these elements, especially columbium and niobium, are used in making steel, phosphors (phosphorescent and fluorescent materials), various filtration devices, and are used in catalytic converters for automobiles. However, at present the "rare earths" can be obtained more cheaply from two surface mines in Nevada and South America than they can from the Elk Creek Carbonatite, which lies about 620 feet below the surface, he said.

If the demand for columbium and niobium should go up, however, it would probably be profitable to mine the carbonatite, Burchett said.

The carbonatite, four to six miles across the top and at least 950 feet deep, is one of the largest in the world. It was formed when carbonate rocks were pushed up into overlying rock layers by magma and then crystallized. Burchett said this process could have been related to the tectonic activity associated with the Rift System.

New publications on Nebraska geology, geography and water

Available from the Conservation and Survey Division

--Cedar County Test-Hole Log Book: R.R. Burchett and F.A. Smith, CSD; 110 p.; (THR-14) \$7.00

--Pierce County Test-Hole Log Book: R.R. Burchett, Susan Olafsen Lackey, and F.A. Smith, CSD; 64 p.; (THR-70) \$5.00

--Crow Butte Uranium Deposits, Nebraska Geonotes, 1993 revision: R.R. Burchett, CSD; 4 p.; 50 cents

Please use order numbers (in parentheses) and add \$1.50 for shipping and handling. Nebraska residents should also add city and state sales tax.

Open File Reports

--Geological Field Guide to the Cedar Point Biological Station, Keith County, Nebraska: R.F. Diffendal Jr. and Roger Pabian, CSD; 25 p.; (OFR-22a) 1979 (revised Feb. 1993)

Open File Reports are available for study or copying at the CSD.

Available from CSD c/o James Merchant

--Nebraska GIS Update (new newsletter intended to disseminate up-to-date information about geographical information systems to interested parties)

Available from the U.S. Geological Survey

--Water-level changes in the High Plains Aquifer; predevelopment to 1990: by J.T. Dugan and D.E. Schild; 55 p. (WRI 91-4165) microfiche \$4; paper copy \$25.75

To order, contact the Nebraska district office of the USGS at 100 Centennial Mall, Lincoln, Neb. 68508 (402) 437-5082

Available from the U.S. Department of the Interior Bureau of Mines or from Conservation and Survey Division

--The Mineral Industry of Nebraska Annual Report: Burchett, Raymond R., CSD, and Karl E. Starch; 7 p., Sept. 1992.

Coming up: National, state and regional meetings and workshops

--Lincoln Gem and Mineral Show, Pershing Auditorium, March 27-28, Lincoln

--Geological Society of America, North Central Section, March 29-30, Rolla, Mo.

--Nebraska Academy of Sciences, annual meeting, April 16-17, Nebraska Wesleyan University, Lincoln

--Center for Advanced Land Management Information Technologies (CALMIT) University of Nebraska-Lincoln training courses:

Introduction to Remote Sensing, April 19

Digital Image Processing, April 20-23

--Nebraska GIS Forum, April 21, University of Nebraska-Lincoln East Campus Union

--American Association of Petroleum Geologists, annual meeting, April 25-28, New Orleans

--Science Fair, Cathedral of the Risen Christ School, April 28, Lincoln

--1993 National Earthquake Conference, May 2-5, Peabody Hotel, Memphis, Tenn.

--American Geophysical Union, spring meeting, May 24-28, Baltimore, Md.

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