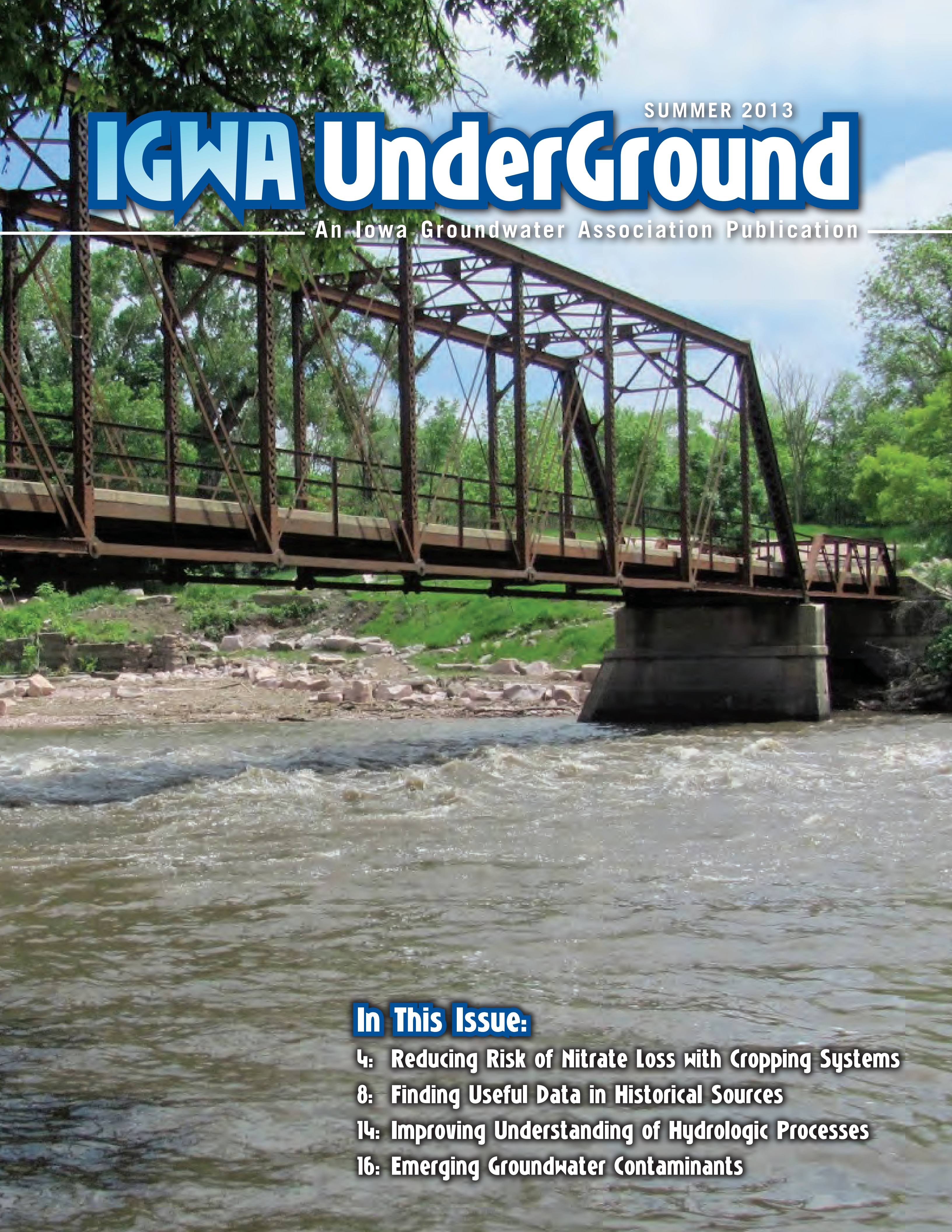
SUMMER 2013

IGWA UnderGround

An Iowa Groundwater Association Publication



In This Issue:

SAVE THE DATE!!

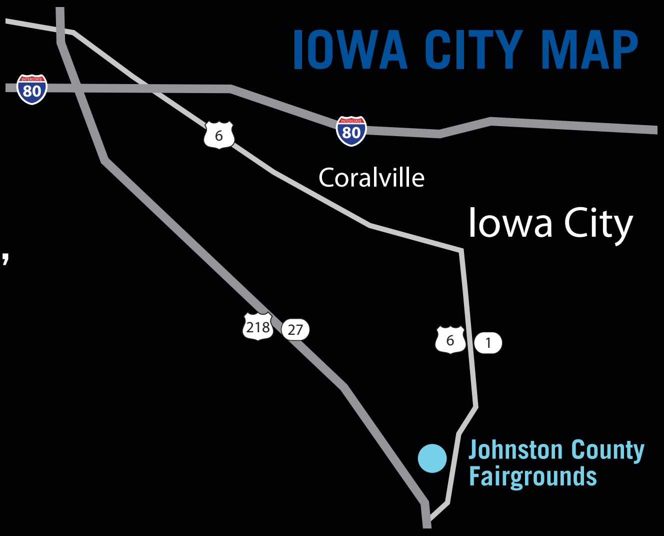
WHO: Attention all groundwater professionals, well drillers, water operators and interested persons in geology and groundwater.

WHAT: Iowa Groundwater Association Fall Meeting

WHEN: Wednesday, October 31, 2013

WHERE: Iowa State University Extension Building,
Johnston County Fairgrounds
4265 Oak Crest Hill Rd SE
Iowa City, Iowa

HOW: To register, go to our website at www.igwa.org



Continuing education units will be available for Well Contractors, Groundwater Professionals, and Water Operators.

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An Iowa Groundwater Association Publication

2013 IGWA Board Members

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COVER PHOTO: Big Sioux River, site of the former Klondike Dam in Lyon County

Objectives

- Promote education and research on Iowa groundwater issues.
- Foster cooperation and information exchange throughout its membership.
- Improve communication among state regulatory officials, professionals, and technicians working with groundwater.
- Cooperate with the activities of various state and national associations organized in the interest of groundwater use, conservation, management, and protection.

IOWA GROUNDWATER ASSOCIATION
COMMUNICATION • EDUCATION • RESEARCH

We are a not for profit organization.

Iowa Groundwater Association
PO Box 5602 • Coralville, IA 52241-0602
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the President's *message*

Cara Matteson – President, Iowa Ground Water Association

I am very proud to be a part of Iowa Groundwater Association! I moved back to Iowa four years ago after living in California for a stint. It's great to be back in my home state and be involved with this organization. I have had a variety of job experiences that includes being a private consultant, state regulator, grant writer, and watershed coordinator. My most challenging current work is at home raising my two small boys!

Since moving back to Iowa I have been working part-time for the Delaware County Soil & Water Conservation District. Living in Iowa, I have seen agriculture in my surroundings my whole life but just recently have started learning about conservation measures. I have been doing watershed conservation efforts for the past three years with Delaware SWCD. All my professional experience to this point has focused on groundwater and subsurface activity. It's nice to be able to see a different aspect of water quality. One of my watershed projects tied the groundwater and surface water levels together (even though the wells were deep bedrock). More education is needed to tie the surface water-groundwater loop. Most watershed projects solely focus on soil erosion and surface water. I am learning that more and more public water systems are having issues with elevated nitrates in their groundwater and are in need of options. It would make sense to try coupling watershed projects in areas where there is needed groundwater protection as well.

Sharing knowledge is a critical component in teaching and making improvements in our world. Two years ago I thought it was a great time to get involved with IGWA and help progress environmental awareness. IGWA has taken initiative to begin bringing issues that our members feel should get more attention to the legislators. This year's focus was reinstating the groundwater monitoring network. IGWA had members go to the lobby day and presented information. IGWA was well received and it looks like funding has been allocated for the monitoring network. Another initiative we want to tackle is the nitrate in groundwater and how public water systems are being affected financially.

There are some changes brewing with Iowa's Comprehensive Nutrient Management Plan being submitted. It is a great time to speak up and voice concerns. The time for change is coming and groundwater professionals should have a large stake in laying the groundwork!

IGWA: GETTING OUT THERE

UPDATE ON LEGISLATIVE INITIATIVE: Establishing a Water Level Monitoring Network in Iowa

Keith Schilling and Bob Drustrup

In the Summer 2012 issue of IGWA Underground, results from a membership survey indicated support for IGWA becoming more involved advocating groundwater issues to the Iowa state legislature. In the fall of 2012, a committee was convened to begin advocating for development of a groundwater level monitoring network in Iowa. Promotional materials were developed by the committee including a brochure and poster. These materials are available for viewing and downloading from the IGWA website (www.igwa.org). Near the start of the session, all legislators were provided an introductory letter from IGWA along with a copy of the brochure and the 2012 IGWA Underground magazine.

The argument presented to the legislature is actually very simple - there is very little water level monitoring being done in any of Iowa's major aquifers **(FIGURE 1)**. Compare the groundwater monitoring network in 2007 to current conditions and note the paucity of monitoring sites today. Sites that are currently being monitored are mainly focused in areas where regional groundwater models have been developed and do not necessarily represent a commitment to long term monitoring. The lack of systematic water level monitoring in Iowa is particularly troublesome since 80% of Iowans use groundwater for daily life. It is difficult to plan for sustainable water resource development when current conditions are so poorly documented.

On February 26, the Iowa Groundwater Association joined others from Iowa's conservation community to urge lawmakers to support funding for programs that protect our land, water and natural resources. IGWA representatives Keith Schilling and Ken Choquette manned a booth highlighting the need for a groundwater level monitoring network in Iowa **(FIGURE 2)**. Ken Choquette and Bob Drustrup attended a similar event at the Capitol ("Waters Day") on March 18th. Discussions at both events were held with several legislators and staff members, many of whom expressed support for the initiative. The low cost of the program was highlighted to the legislators (estimated <$50,000 a year), since existing wells appear more than capable for providing access to aquifers across the state.

For much of the 2013 legislative session, a bill supporting groundwater level monitoring was alive and it appeared to have support for funding. Unfortunately, the bill did not survive the final cut and funds were not appropriated. However, the legislative initiative was a great learning process for everyone involved and efforts are underway to make another run at it next year. Members are encouraged to review the poster and pamphlet and contact your legislators about the importance of funding groundwater level monitoring in the State of Iowa.

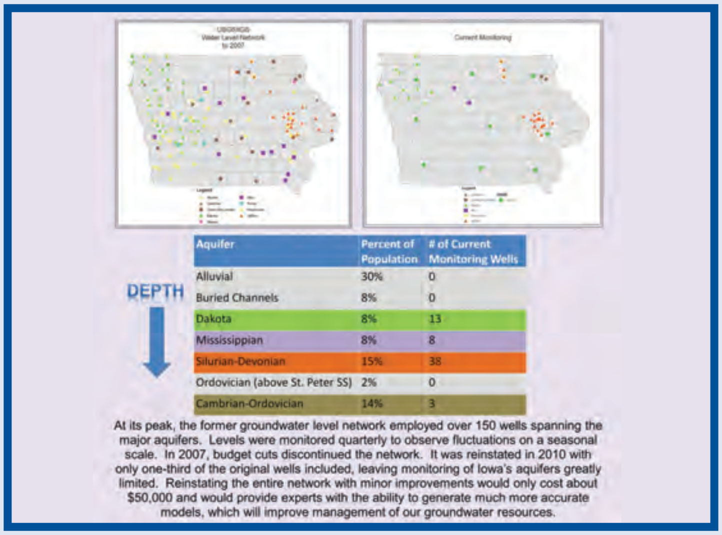

FIGURE 1. **Groundwater monitoring network well locations and associated groundwater source.**

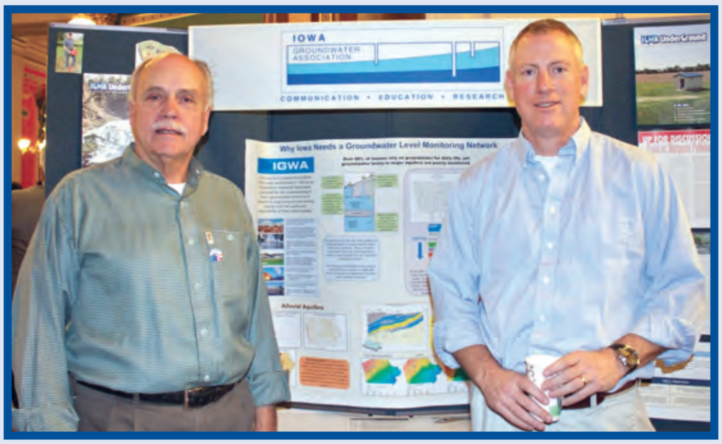

FIGURE 2. **Ken Choquette and Keith Schillling at the Iowa Capital lobbying for support for a water level monitoring network.**

Nitrogen Fertilizer, Cropping Systems, and Iowa Groundwater

Robert De Haan, Ph.D., Professor of Environmental Studies and Biology / Dordt College, Sioux Center, Iowa
Fellow Researchers: Matthew Schuiteman, B.S. in Agronomy, AJS Farms, Ronald Vos, Ph.D., Professor of Agriculture, Dordt College

INTRODUCTION

Sioux Center, a growing town of 7,048 in Northwest Iowa, obtains more than 50% of its drinking water from an alluvial aquifer tapped by wells that are 30 to 42 feet deep (Fuhrmann, 2008). These shallow wells have the potential to be strongly influenced by land management practices in the immediate vicinity, as well as in the surrounding watershed. In recent years, several of Sioux Center's twelve shallow wells have yielded water with nitrate nitrogen concentrations of more than 12 mg/L (Fuhrmann, 2008). This is not a localized occurrence. According to Rebecca Ohrtman (2008), the Source Water Protection Coordinator for the Iowa DNR, "more than 200 community water supplies in Iowa are susceptible to high nitrates potentially derived from non-point sources".

To meet this challenge, the Sioux Center Source Water Protection community planning team was formed in 2007. The team has developed an action plan with two main components. The first component involves regular water testing to determine the nitrate concentration in the water from each well, and from the streams that flow through the well field. Based on this initial sampling information a ground water assessment study was conducted by the Contaminated Sites Section of the IDNR in the summer of 2008.

The second component of the community planning team's action strategy is to reduce potential non-point source contamination of the well field by examining and perhaps changing land use practices in areas above and adjacent to the well field. The owners of land adjacent to the city's well field have been encouraged to enroll their land in the well head protection (also referred to as Source Water Protection) Conservation Reserve Program, but have so far declined. Since the inception of the SWP Conservation Reserve Program, statewide, less than 3% of land eligible for this practice has been enrolled, indicating that this may not be a viable land use solution for decreasing nitrate-N risk to community water supplies (Ohrtman, 2008). An alternative to enrolling land in the Conservation Reserve Program may be the implementation of cropping systems that manage soil nitrate-N very efficiently and thus result in little movement of nitrate through the soil profile and into shallow ground water aquifers like Sioux Center's east well field. If these cropping systems generate economic returns that are comparable to the returns from standard farming practices (higher than current Conservation Reserve Program payments) and can be shown to be practical on a field scale, then owners/operators of this land may be more willing to make positive land use changes. The Leopold Center for Sustainable Agriculture provided grant funding (2009 – 2013) to allow us to investigate these possibilities.

OBJECTIVES

The objective of this research is to assess cropping systems with the potential to produce a reasonable financial return for landowners/operators while simultaneously reducing the risk of nitrate-N movement into shallow municipal aquifers.

STRATEGIES

Selecting appropriate cropping systems to evaluate is of primary importance if we are to meet our objective. We considered several factors when making this decision. Dinnes et. al. (2002) and Oquist et. al. (2007) reviewed current literature addressing the impact of farming practices on nutrient losses, particularly nitrate N, from agricultural fields and made the following observations. In general, studies have shown that as nitrogen application rates increase above crop needs, nitrate N loss increases. Research also indicates that fall applied nitrogen is more likely to be affected by mineralization and nitrification than spring applied nitrogen, increasing the amount of nitrate N available for leaching in the spring before crop uptake begins. Many studies have shown that nitrate N losses are lower from fields planted to perennial crops than those planted to annual crops like corn or soybeans, and that nitrate N losses may be reduced by the incorporation of cover crops in the crop rotation.

CROPPING SYSTEMS EVALUATED:

1) **Continuous Corn.** Corn was be planted in the spring and harvested in early October. Winter rye was seeded in the corn stubble immediately after corn harvest using a no-till drill. Rye was killed in the spring when the corn was planted.

(continued on page 6)

FIGURE 1. Extracting 6 ft. deep soil samples.

FIGURE 2. Samples ready to be divided into 1 ft. segments.

(continued from page 4)

2) **Grass Hay.** We used a forage mix composed of smooth brome grass and orchard grass. No nitrogen fertilizer was applied to these plots.

3) **Oat – Alfalfa – Corn.** Oat underseeded with alfalfa, then a year of alfalfa, followed by a year of corn with a fall cover crop of oat. No N fertilizer was applied in this cropping system.

4) **Soybean – Winter Wheat – Corn.** Soybean, then winter wheat followed by a red clover cover crop, then corn with a fall cover crop of winter rye.

Cropping system 1), continuous corn, was included primarily for comparison purposes. Significant nitrate N losses have been documented with continuous corn cropping systems (Randall et. al., 1997), even when following best management practices.

Cropping system 2) is commonly used around municipal well fields and is expected to reduce the nitrate N content of soils and minimize the potential for nitrate leaching (Huggins et. al., 2001). This perennial grass system functions as yard stick to which we can compare the performance of the remaining cropping systems.

Cropping system 3) incorporates alfalfa into the rotation. Alfalfa can remove large quantities of nitrate N from agricultural soils. It has deep rooting potential, a large N requirement, long periods of N and water uptake, and a perennial growth habit, and as a result N removal rates are often two to four times higher with alfalfa than with annual crops like corn (Russelle et. al., 2001).

Cropping system 4) utilizes a soybean, winter wheat, corn rotation along with red clover and winter rye cover crops. Winter rye following corn has been shown to effectively reduce soil nitrate N concentrations (Villamil et. al., 2006). Winter wheat is capable of mineralizing N during late fall and early spring, and has been economically attractive in recent years.

EXPERIMENTAL DESIGN AND PLOT LAYOUT:

The experimental design is a randomized complete block with four replications. In order to accommodate conventional farm equipment, each plot is 60' wide and 625' long (0.86 acres). The total experimental area is approximately 36 acres.

MANAGING SOIL FERTILITY:

Randall and Mulla, (2001) state that applying the correct rate of N at the optimum time has been shown to have a substantial effect on nitrate N losses. With this in mind, corn received 21 lbs. N per acre as starter fertilizer at planting with the balance being side-dressed at the rate indicated by the late spring nitrate test (Blackmer et. al., 1997). Soil nutrient levels other than nitrate were monitored via annual soil tests and adjusted as necessary for optimum crop growth.

DATA COLLECTION PROCEDURES:

In late October or early November of each year six foot deep soil samples were taken from each plot and divided into one foot segments for analysis of nitrate N concentrations **(FIGURES 1 AND 2)**. These deep soil samples enabled us to construct nitrate N profiles for each plot and track nitrate N movement over time (Bundy el. al. 1999; Huggins et. al., 2001).

RESULTS

As expected, continuous corn plots contained high levels of residual nitrate N in the fall **(FIGURE 3)**. Even though we used the best management practices available, we still had an average of 137 lbs. per acre of residual nitrate N in the top 6' of soil at the end of the growing season. This N was concentrated in the top 2 feet of the soil profile, with some accumulation at the 5 to 6 foot depths as well.

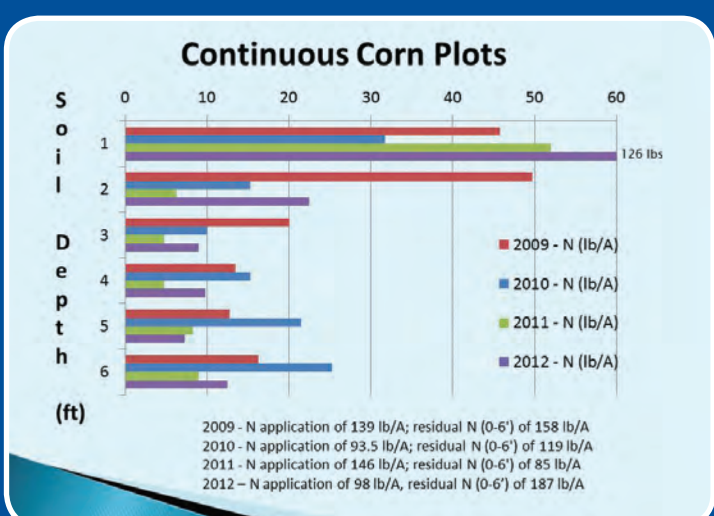

FIGURE 3. Residual Nitrogen N vs. Soil Depth: Continuous Corn Plots

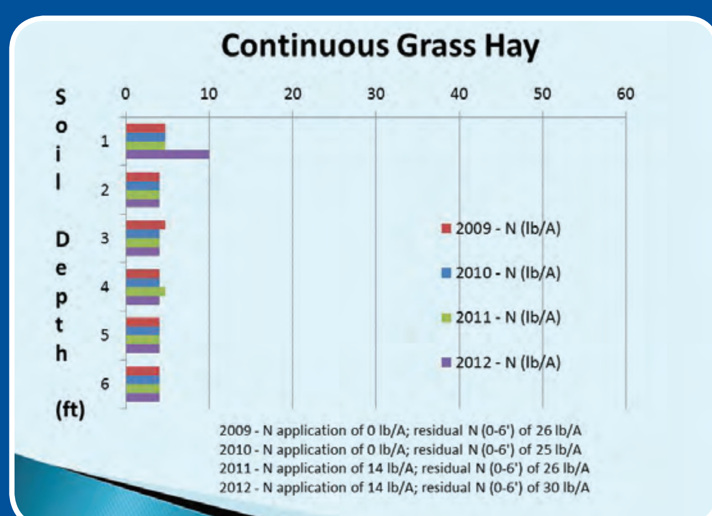

FIGURE 4. Residual Nitrogen N vs. Soil Depth: Continuous Grass Hay

In contrast, the continuous grass plots had an average of just 27 lbs. per acre of residual nitrate N in the 6' profile at the end of the growing season **(FIGURE 4)**. Compared to continuous corn, this is more than a five-fold reduction in N that could potentially migrate to groundwater.

The corn–oat–alfalfa rotation reduced average residual nitrate N levels over the three year period dramatically **(FIGURE 5)**. The corn plots still had high residual levels (an average of 170 lbs./A) but the oat and alfalfa years of the rotation averaged just 32 lbs./A of residual N.

Using a corn-soybean-wheat rotation also reduced residual nitrate N levels in the soil profile **(FIGURE 6)**, but not as much as the corn-oat-alfalfa rotation. In this case, the residual level in the corn plots averaged 175 lbs./A, while the soybean and wheat plots averaged 66 lbs./A.

CONCLUSIONS

Residual levels of nitrate N are clearly higher after a corn crop, even when managed for maximum nitrogen use efficiency, than any other crop we evaluated. Adding a tap-rooted legume such as red clover or alfalfa to the rotation dropped residual nitrate N levels throughout the 6' deep soil profile dramatically, but a continuous grass cropping system is still the most effective way to reduce the likelihood of nitrate N escaping from agricultural systems and entering groundwater. Ultimately, N movement through the landscape is a societal issue; it reflects our culture and values, and to make real progress we will need to account for this reality.

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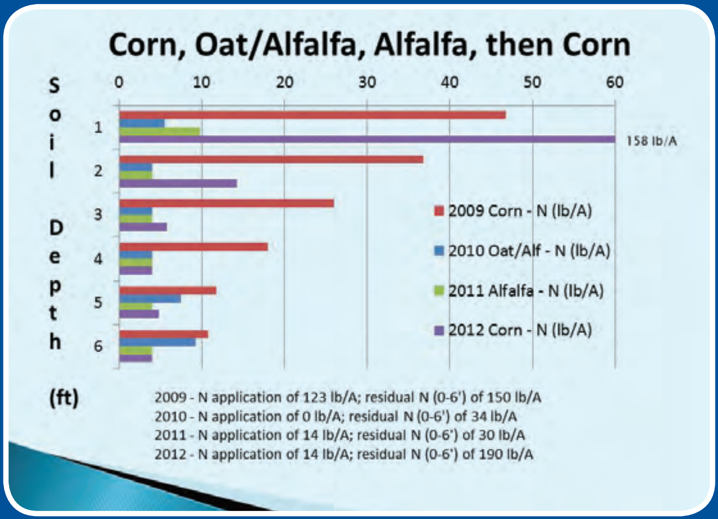

FIGURE 5. **Residual Nitrogen N vs. Soil Depth: Corn, Oat/Alfalfa, Alfalfa, then Corn**

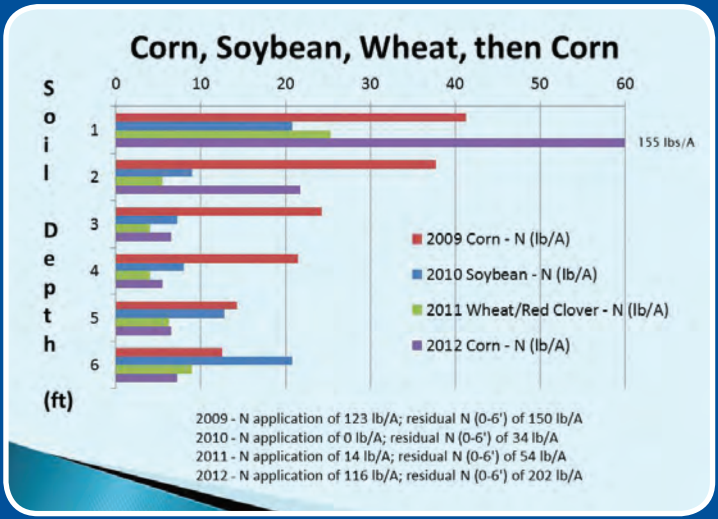

FIGURE 6. **Residual Nitrogen N vs. Soil Depth: Corn, Soybean, Wheat, then Corn**

THE VALUE OF HISTORIC AND UNPUBLISHED WORK IN UNDERSTANDING THE HYDROGEOLOGY OF DRY RUN CREEK, BLACKHAWK COUNTY, IOWA

Brian Gedlinske

Historic records and unpublished findings have potential to bring considerable value to contemporary watershed, groundwater, urban planning and resource management work. Unfortunately, it's easy to pass over this literature in favor of recently published work, yet these information sources may provide unique and forgotten insight on a watershed's land-use practices, land cover, hydrology-hydrogeology, water quality issues, and stream inhabitants. The following briefly describes some historical and unpublished work that contributes to a more holistic understanding of the Dry Run Creek (DRC) watershed in Blackhawk County.

DRC is a small sub-basin (roughly 24 mi2) of the Cedar River watershed with approximately 35% of the basin situated in an urban environment (Cedar Falls). The outer portion of the DRC watershed is primarily agricultural land used for row crops. The watershed lies within the Iowan Surface ecoregion, with typical geology consisting of several meters of loamy Wisconsin sediments (primarily loess) overlying approximately 15 to 30 meters of pre-Illinoian till.

DRC has received considerable attention since being listed in 2002 as an impaired water body due to diminished aquatic life, and in 2008, listed again for high coliform bacteria. As a result of its impaired status and proximity to the University of Northern Iowa (UNI), it's seen more than its fair share of water quality studies. Despite all this attention, significant hydrogeological characteristics of the basin have been overlooked or forgotten with time.

While recent work on DRC may give the impression that the streambed is situated on a confining layer of till, effectively separating it from the underlying and heavily utilized Devonian aquifer, one can readily observe the streambed cutting directly into the highly fractured carbonate bedrock of the Devonian aquifer, especially in the Southwest Branch (SWB) sub-basin **(FIGURE 1)**. Only by reviewing historical literature dating back to the late 1800s - early 1900s and unpublished work does one find a more revealing portrayal of the area's hydrogeology and its connection to DRC surface water.

SOME LESSER-KNOWN DRC PUBLICATIONS

Some early work that addressed the DRC was written by Melvin F. Arey, a professor of Natural Sciences at Iowa Normal School / Iowa State Teachers College (now UNI). In his 1905 review on the geology of Black Hawk County, he describes the presence of several quarries and natural bedrock exposures within the Cedar Falls area along DRC. He also noted the extensive jointing, weathering, and karst characteristics associated with the limestone bedrock and its ability to completely intercept SWB surface flow except during times of heavy precipitation. Other sources of information on quarries once located along DRC include an 1875 map of Black Hawk County (Andreas, 1875), memoirs by Lantz (1975), and descriptions of the J. Nielson Quarry, a relatively well-known quarry location due to its role in the origin of Viking Pump.

Information on the area's hydrogeology, highlighting the aquifer's susceptibility to contamination, is also found in a 1912 study by Dr. A. L. Grover. Grover determined the city's water source, then referred to as the "springs" (now known as Pfeiffer Springs), was the common factor in a 1911 typhoid fever outbreak in Cedar Falls. The water collection system at the "springs" consisted of a roofed brick enclosure that collected water from the springs and routed it through wooden and iron conduits to a cistern where it was pumped into city mains. As noted by Grover, this collection and distribution system provided ample opportunity for contaminated surface water to reach the water supply, especially during times of flooding.

The outbreak also spiked a great deal of interest in the hydrogeology of the area. In a cooperative effort, Grover and the USGS identified the limestone aquifer feeding the "springs" as being another potential outbreak source because of its shallow depth, exposure along the DRC streambed, pervasive secondary porosity, and the permeable alluvial sands-gravels often found overlying the aquifer. Roily water was often observed from the "springs," wells, and quarries after heavy rainfall or during flooding, indicating a strong hydraulic tie between the aquifer and surface waters. Additionally, abandoned shallow bedrock wells were occasionally found to be used as privies or cesspools (a practice later prohibited).

Although bedrock crevices intercepting DRC surface flow were often filled-in whenever found, bedrock outcrops and quarries were

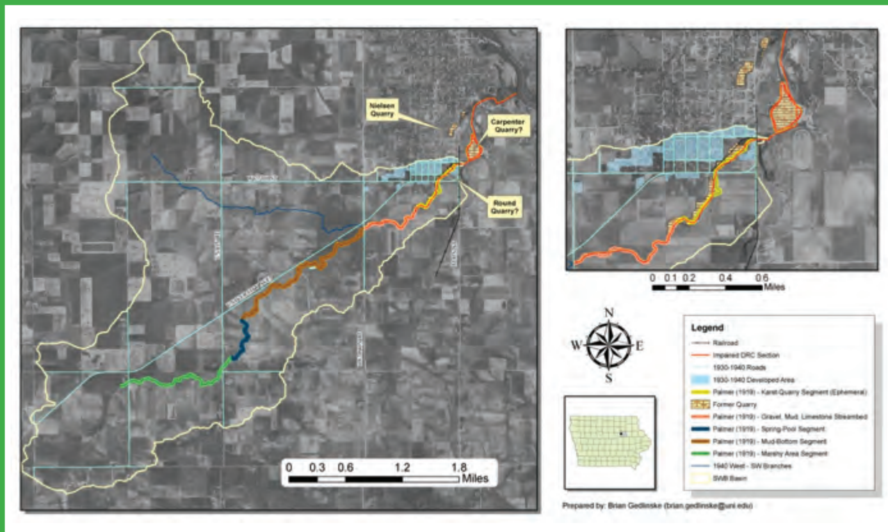

FIGURE 2. Historical reconstruction of the Southwest branch of the Dry Run Creek watershed.

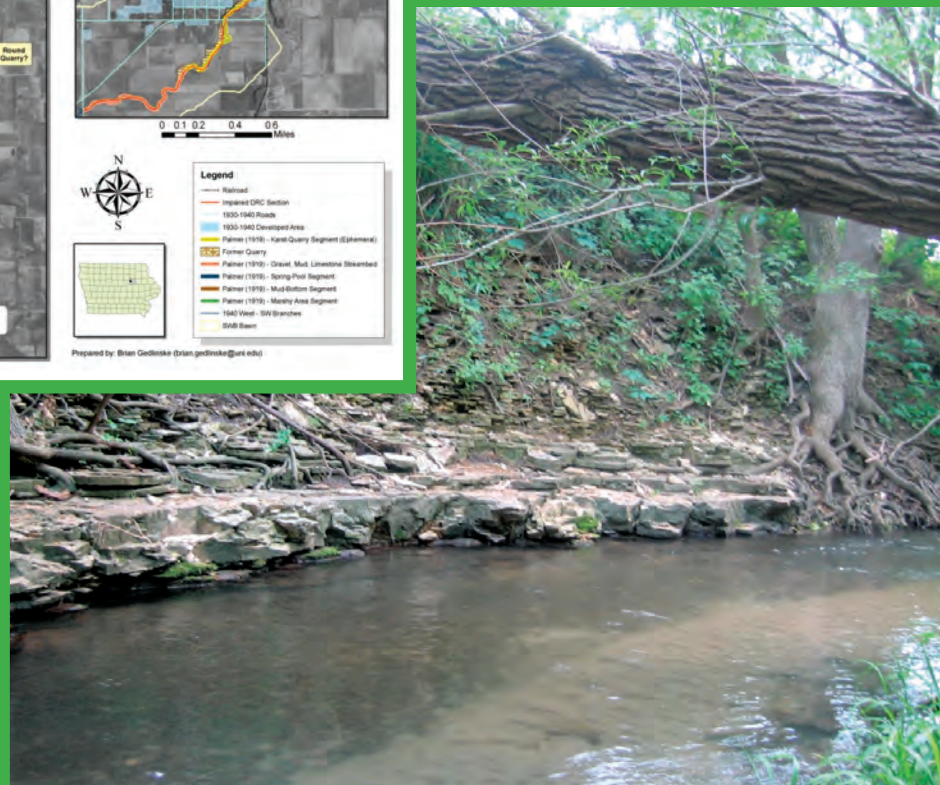

FIGURE 1. A view of bedrock exposures along Dry Run Creek.

so commonplace upstream of the "springs" that efforts to seal-off these subsurface pathways were considered futile. Grover and the USGS speculated on the possibility of disappearing DRC surface flow resurfacing at the "springs." Attempts to introduce fluorescein dye upstream within the DRC's dry limestone streambed, however, were inconclusive as winter conditions and a lack of surface flow prevented the dye from being flushed into the ground. Ultimately, efforts to identify a sole contaminant source were unsuccessful. Recent river flooding, floodwater entering bedrock crevices along DRC, or seepage into the city's water collection-distribution system were all viewed as potential causes. At the recommendation of Grover and the USGS, use of the "springs" as a water supply was abandoned in 1912 after constructing deep groundwater wells.

With respect to early SWB sub-basin characteristics, the most telling historical resource was a 1919 study by E.L. Palmer, a botanist at Iowa State Teachers College. Although his two-year ecological survey of the SWB (referred to as the west branch of DRC in his work) focused on the type and distribution of fish species found within the watershed, Palmer also detailed a number of the SWB's physical attributes. Palmer commented on several springs emanating from the streambed, suggesting these provided baseflow.

In an area now recognized as UNI's Biological Preserve, Palmer describes the streambed transitioning to limestone bedrock **(FIGURE 2)**. This apparently represents the region where DRC began to live up to its name. As documented by Palmer, the SWB became ephemeral in this region as swallow-holes effectively intercepted all surface flow. During baseflow conditions, an upstream swallow-hole with a circular opening of approximately five feet was reportedly capable of diverting all surface flow underground. Palmer commented one could hear water cascading underground at this location. A short distance downstream, Palmer described a long, shallow basin filled with fragmented limestone. Although surface flow could surpass the upstream swallow-hole following a storm event, travel beyond this basin was rare. Only during extended wet periods or heavy rains would the SWB flow past this point. Except during times of heavy spring flooding, a quarry downstream of the basin typically marked the furthest extent of SWB surface flow.

Finally, a particularly interesting but unpublished 1985 study on DRC was performed by Michael J. Brandt, a former graduate student at UNI. The focus of Brandt's work was on the occurrence and distribution of fish species within DRC (similar to Palmer's work conducted 68 years earlier). Brandt also collected chemical water-quality data for DRC and recorded a number of physical parameters of DRC. Ironically, with respect to the DRC's impaired status from diminished aquatic life, Brandt noted that fish diversity within DRC had actually increased from six to 17 species since Palmer's 1919 study. Brandt suggested water discharged

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from UNI's once-through cooling-water system may have contributed to this increase by transforming the SWB to a perennial stream. In 2012 UNI withdrew 2.5 billion gallons of groundwater for its once-through campus-building cooling needs (operated roughly six months of the year). Most of this water ultimately ends up in DRC and likely forms a significant amount of its baseflow during warmer months.

DRC - Past and Present

All sources discussed above as well as others were used to develop a composite historical map **(FIGURE 2)**. It largely reflects geospatial locations of features and areas observed, described, and mapped within the SWB drainage basin during the late 1800s to early 1900s. The imagery used in Figure 2, however, was from the late 1930s - early 1940s. Key features included in Figure 2 include Palmer's five distinct SWB stream segments and estimated locations of quarries that once lined DRC. For reference and comparison, the 2002-2008 impaired section of DRC is also shown. As illustrated, a good portion of today's impaired DRC segment is located in a region where SWB surface flow was rare or nonexistent.

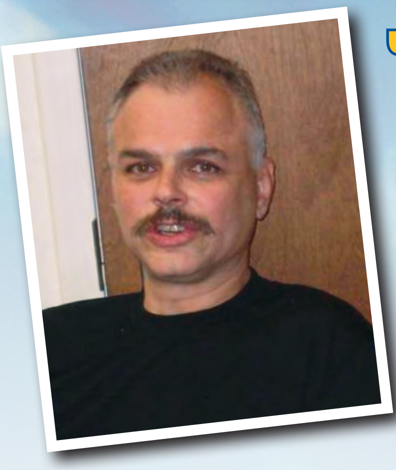
Since the early 1900's, the most pronounced change in the SWB, however, has been its transformation from an ephemeral to a perennial stream. A combination of factors including urbanization, land-use change, ag-drainage tiling, UNI's cooling-water discharge, and landscape modification likely contributed to this transformation. Additionally, the well-documented swallow-holes and quarries once found within the region near the UNI Biological Preserve are no longer present or barely perceptible. As projected by Grover, the swallow-holes and some quarry areas were undoubtedly filled-in. Siltation from upstream soil erosion may have also contributed to their fate.

Although agriculture remains the dominant land use within the watershed, the SWB is also experiencing a growing degree of water-quality issues associated with urbanization. Data collected by IDNR and UNI researchers indicate contaminants such as organics, chlorine, chloride, bacteria, and residential pesticides have been detected in DRC surface waters. In the end, information gathered from a variety of sources, including underutilized historic and unpublished sources, can often yield important information about a watershed's history and shed light on current issues and water quality concerns. This additional information will provide a stronger foundation for targeted watershed improvement work, effective source water protection, and informed decision making.

Author profile: Brian Gedlinske is an Environmental Specialist at the University of Northern Iowa's - Iowa Waste Reduction Center.

IN MEMORIAM

JOOST KORPEL

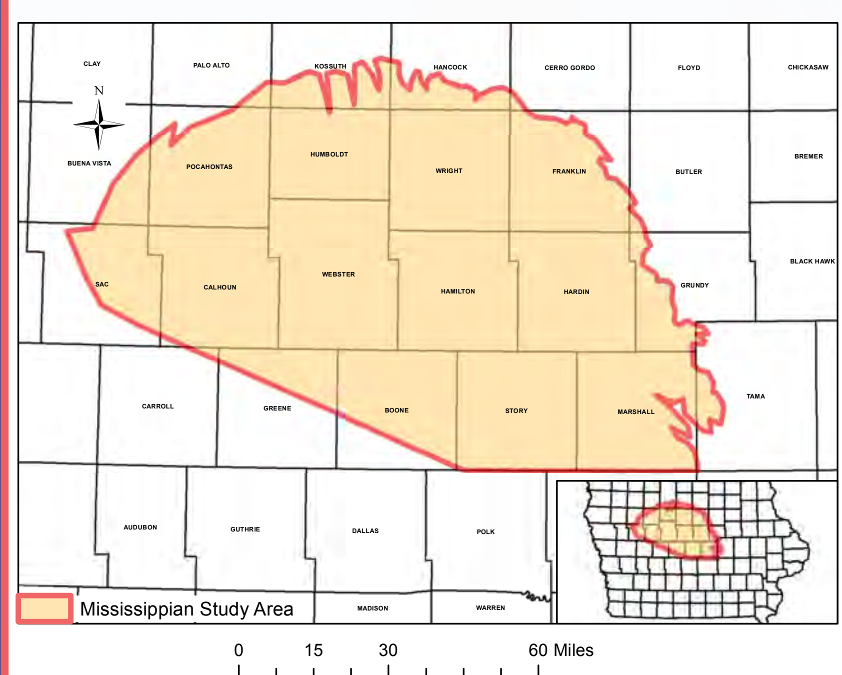


IGWA lost a valued colleague and friend when Joost Korpel passed away on January 16, 2013 in Iowa City. Joost provided expertise in both geology, IT, and network administration data management at the Iowa Geological and Water Survey and the Iowa Department of Natural Resources.

He helped to develop the primary Geographic Information Database for the State of Iowa and other natural resource databases and internet applications for the public access, including the popular GEOSAM web application. Joost is survived by his wife of 30 years, Margaret, his father, Adrian, and his two children, Hannah and Ian. He will be greatly missed.

NEW GROUNDWATER FLOW MODEL OF THE MISSISSIPPIAN AQUIFER

The Iowa Geological and Water Survey released a new report and groundwater flow model of the Mississippian aquifer in north-central Iowa. The study included investigation of the hydrogeology of the aquifer and involved the construction of a three-dimensional groundwater flow model using the MODFLOW code. Modeling results indicate that an additional 1 billion gallons per year (bgy) of groundwater could be withdrawn from the Mississippian aquifer in north central Iowa using precipitation recharge alone. A greater withdrawal rate is possible considering the relatively large volume of groundwater (10.6 bgy) that is being discharged into the major river systems from the aquifer. While not all of this water could be withdrawn from the aquifer without potentially impacting river baseflow, a conservative estimate of 50% of the river recharge might be available for future water use, which when combined with precipitation recharge, suggests that an additional 6.3 bgy of groundwater may available for development and beneficial use in the region. A complete report and downloadable MODFLOW files can be found on our web site http://www.igsb.uiowa.edu/GroundwaterResources/WaterResourcesManagement/Mississippian/Mississippian.htm .

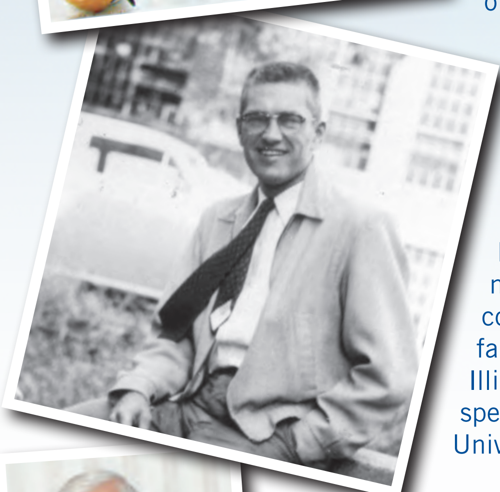


IN MEMORIAM

PAUL HORICK

For those of you who have been working in the groundwater industry in Iowa, the Midwest, even all around the country for more than 21 years, please join me in bidding a fond farewell to IGWA's founding father, Paul J. Horick, who passed away on Wednesday, January 30th (Horick Obituary). Paul had recently celebrated his 90th birthday at a jam-packed Zion Lutheran Church in Iowa City. I had seen Paul a few months before at a local restaurant. While certainly looking frail, Paul had his wits about him.

It's not easy to summarize a man's life or what he meant to his family, friends, acquaintances, and colleagues ("Groundwater Hero" IGWA Underground, Summer 2012, p. 19). Paul grew up and spent his youth in the small towns on the west side of Chicago: LaGrange, Riverside, Western Springs, Hinsdale, Downers Grove, Lisle, Naperville, and Aurora all connected by the CB&QRR and Highway 6. More or less flat terrain and rolling farmland enticed Paul and his father to walk through wooded areas along the Des Plaines River and Salt Creek. Paul attended grammar school and secondary school in Brookfield and Riverside. Times were hard for many people; this was during the Great Depression.



In 1933, at age 11, Paul was stricken by meningitis that left him with total hearing loss and partial blindness. Despite the severe handicaps, Paul attended normal public schools and planned on attending college, but where and at what cost? Paul's father found employment in the Rock Island business community so the family moved there. They inquired at Augustana College and learned that the state of Illinois would pay Paul's tuition for both his undergraduate and graduate degrees in a special rehab program. There he encountered geology and received an invitation to the University of Iowa graduate program.

Beginning in the fall of 1945, Paul worked part time at the Iowa Geological Survey (IGS). Upon completion of his Masters degree, he was hired full time in August 1948. Paul's first assignment was to prepare drill-cutting samples for study. As he gained expertise in bedrock geology, he was given more responsibility to write reports for municipalities, engineering consultants, industries, other state agencies, water well contractors, recreational organizations, farmers, and home-owners on groundwater quantity and quality at specific locations. Ultimately, this attention to detail and site-specific conditions would earn him the unofficial sobriquet, "Iowa's Water Well Forecaster" (Jean C. Prior, Iowa's Water – Well Forecaster, Iowa Geology number 7, 1982, p. 12-13).

Detailed well forecasting led Paul into more extensive research on Iowa's aquifers. Publication of both the major statewide aquifers as well as regional compilations brought considerable respect to both Paul and the Survey. He authored or co-authored several landmark publications including the three major statewide bedrock aquifers (Mississippian, Silurian-Devonian, and Jordan), Water Atlas No. 8, and the "Water Resources of Iowa" (available from the Iowa Academy of Science). This publication was the culmination of the first-of-its-kind symposium from the Iowa Academy of science, "The Water Resources of Iowa," which Paul organized.

Not all of his publications were on groundwater: Bibliography of the geology of Iowa (1960 – 1964) and — one of the more popular IGS publications — The Minerals of Iowa.

Paul became active in national groundwater affairs, mostly under the direction of the National Ground Water Association (NGWA). He assisted in organizing several national conventions in various locales: Las Vegas, Baltimore, Kansas City, and

Minneapolis where he received a recognition plaque for his dedication in promoting the role of regulatory officials and the groundwater community.

In 1984, the timing seemed to be right, so after contacting numerous key engineers and hydrologists, Paul founded the Iowa Groundwater Association, whose stated purpose was communication, education, and research. Paul started a quarterly newsletter immediately after forming the association and was its editor for the next eight years. The newsletter became the Iowa Groundwater Quarterly in 1990. The Quarterly was well received and even won plaudits from the publishing community. In addition to the Quarterly, Paul compiled Iowa's Principal Aquifers, A Review of Geology and Hydrogeologic Units, a compilation of reprints formerly in the Quarterly. Naturally, Paul authored or co-authored five of the seven chapters.

His greatest contribution may have been the hundreds, if not thousands, of individual well forecast letters he wrote which provided site-specific information on the availability and sustainability of groundwater resources. Paul also maintained a technical file of non-groundwater subjects of interest from agriculture to earthquakes to energy to fuels to minerals and more.

Paul stepped aside as Editor when he retired from the Survey in 1992 ("Paul Horick Retires" Iowa Groundwater Quarterly, vol. 3, no. 6. June 1992, p. 1, 3-5). Paul could only be replaced by a team of dedicated IGWA members IGWA has been a boon to the state and has fostered changes in state law and regulations governing groundwater.

With Paul's leadership, IGWA routinely hosts two educational events per year and has co-hosted events with the Iowa Water Well Association, Iowa Department of Public Health, Iowa Environmental Health Association, Illinois Ground Water Association, and the Midwest Ground Water Conference. Paul's rapport with the Iowa Water Well Association earned him the Ber Zander award in 1987 as the individual who had done the most for the industry and the people of Iowa. In 1986 the Water Well Journal did a story on Paul's life and contributions to the industry.

Paul enjoyed a unique relationship with water well contractors, pump installers, engineers, regulators, and his colleagues at the survey. Because he was totally deaf, Paul developed the remarkable skill of reading lips. He did have some difficulty with mustaches, however, and in meetings, he'd often write messages to colleagues. He also relied on his office mate to take notes for him. The only frustrating thing was that if Paul didn't want to talk or "hear" what you had to say, he'd simply look away from your mouth. End of discussion! Once a colleague was attempting to help Paul have a phone conversation, whereby his colleague would talk on the phone, Paul and his colleague would write messages to be relayed to the other party. Paul got so frustrated that he took the phone receiver and proceeded to deliver a strongly worded, several minutes long monologue over the phone before handing back the receiver.

Paul worked full time at the Survey until age 70. He worked for 47 years under the leadership of five state geologists: A.C. Trowbridge, Garland Hershey, Sam Tuthill, Stan Grant, and Don Koch. IGS has been blessed with a strong staff of researchers, such as Paul, whose investigations have greatly benefitted the state.

Paul's other interests included: Kiwanis, traveling the U.S. and Europe, volunteering at the Shelter House, photography, writing poetry, and participating in Zion Lutheran Church activities. God bless you Paul for all you accomplished.

Rest in Peace, Paul.

HIGH-RESOLUTION WATER TABLE MONITORING

Improves Understanding of Basic Hydrologic Processes

Keith Schilling – Iowa DNR Geological and Water Survey

Groundwater recharge (R), discharge to rivers or stream as baseflow (BF), and discharge to the atmosphere as evapotranspiration (ET) are major hydrological processes in the basin-scale water cycle. For an aquifer system with no well pumping, these processes can be related by a simple water balance equation:

$$R - ET - BF - D = \triangle S \qquad (1)$$

where $\triangle S$ is the change in groundwater storage, and D is groundwater discharge to deeper subsurface strata. Precipitation that infiltrates into the ground can enter the aquifer as recharge, and exit the aquifer by evaporation and plant transpiration (ET), discharge to a stream as baseflow, or discharge to deeper strata. Residual water left from the water balance equation ($\triangle S$) is essentially the amount of water stored in the unsaturated zone profile as the water table moves up and down and can be thought of as variations in soil moisture content. The residual water includes the capillary fringe that extends upward from the water table. In a shallow aquifer underlain by low permeable material, the amount of water discharged to deeper strata is minimal and equation (1) can be simplified to:

$$R - ET - BF = \triangle S \qquad (2)$$

Unfortunately, gathering information about each of these processes with specific measurements is often difficult since these processes are hidden from view. Unlike precipitation and streamflow that can be measured directly on the land surface with routine monitoring devices, measuring R, ET and BF typically requires special equipment or procedures. For example, measuring ET directly typically involves accessing sap flow in an individual plants or estimating indirectly using expensive meteorological procedures (eddy covariance or flux tower). Recharge to an aquifer is difficult to measure directly because it is complicated by other processes that affect how much water enters the water table, including soil moisture conditions and capillary rise. Furthermore, variations in recharge are known to occur across the hydrologic landscape with recharge rates controlled by topography, geology, climate and vegetation (Scanlon et al., 2002). Even BF is not measured directly in watershed studies but estimated using hydrograph separation techniques or chemical tracers. However, since BF estimation involves measured surface water discharge, estimation procedures are, at a minimum, anchored to a known baseline condition.

Considering the challenges involved with directly measuring major hydrological processes R, ET and $\triangle S$ that affect the basin-scale water cycle, it is important to develop methods that can be used to assess these processes on an indirect basis. In shallow aquifer systems, these processes commingle with one another at the water table surface **(FIGURE 1)**. Recharge occurs when water from the unsaturated zone moves downward to the saturated zone across the water table. When vegetation roots tap the water table,

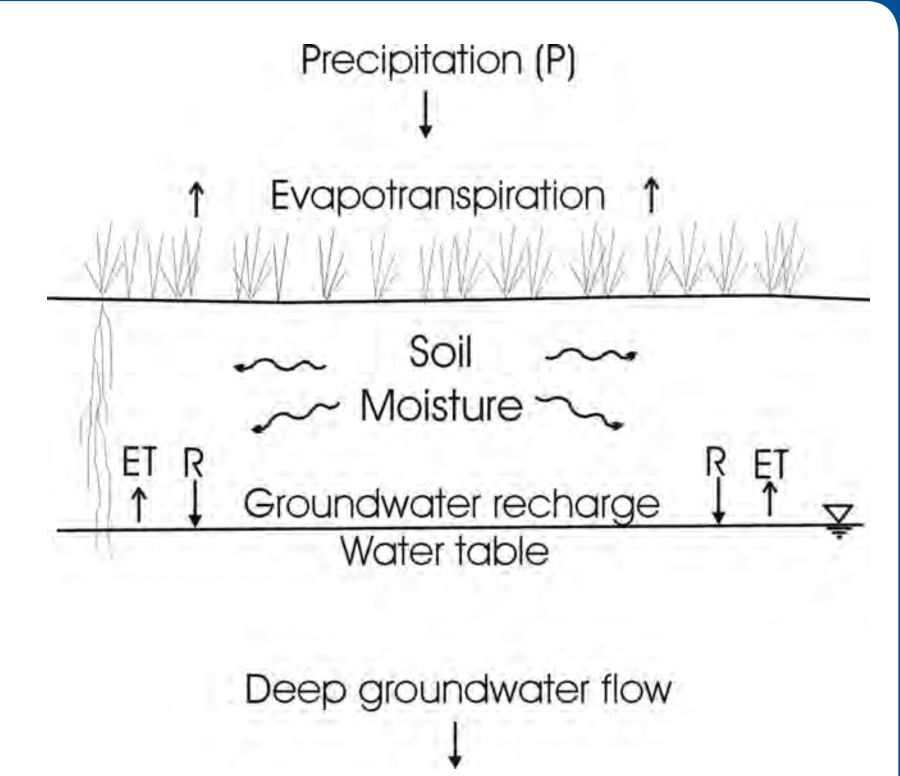


FIGURE 1. Hydrologic processes occurring at the water table surface.

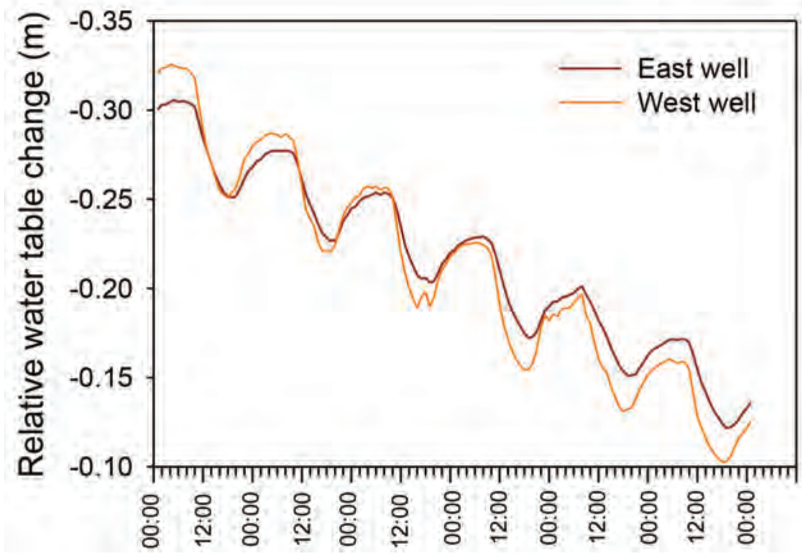


FIGURE 2. Diurnal pattern of water table fluctuations measured in east and west monitoring wells during a six day period in July 2005 at a floodplain site under savanna vegetation (Schilling and Jacobson, 2008). Note how the water table declines during the day and recovers at night. This diurnal pattern can be used to estimate evapotranspiration.

the water table surface may fluctuate in response to daily plant water uptake. Diurnal water table fluctuations have been used to estimate ET **(FIGURE 2)**. The rate of water table rise (WTR) in response to precipitation can provide clues regarding soil moisture conditions in the unsaturated zone of an aquifer. The amount of WTR measured after a rainfall event provides an estimate of the amount of open pore space available in the unsaturated zone (i.e., specific yield). Loheide et al. (2005) recommended that the rainfall / WTR method apply to sites with a shallow water table and high soil water content, conditions often found along floodplains or other poorly drained areas. Thus, monitoring water table behavior offers promise for indirect measurement of main hydrological processes of R, ET and $\triangle$S in a watershed

While water table monitoring is routinely conducted at sites to measure hydrologic conditions affecting groundwater flow and contaminant transport (e.g., hydraulic heads, gradients, hydraulic conductivity), most of these studies include monitoring of water table behavior on a periodic frequency, with manual measurements taken on a weekly or monthly basis. While this measurement resolution is sufficient in most cases to estimate groundwater flow directions and gradients, this measurement scale is not sufficient to estimate R, ET and $\triangle$S with much certainty. High resolution water table monitoring, (i.e., hourly measurement) is less frequently done. Researchers have used high resolution water table monitoring to evaluate the degree of surface and groundwater interaction in riparian systems (Schilling et al., 2006) and wetlands (e.g., Gerla, 1992). However, more studies are needed to investigate how high resolution water table monitoring can be used to evaluate hydrologic processes at a watershed scale.

Improved understanding of water table behavior is important because studies have shown that water table dynamics play an important role in biogeochemical cycling of many pollutants, including nitrate-nitrogen (nitrate). For example, studies have shown that water table depth plays a critical role controlling nitrate removal processes in groundwater. High water tables in fine-grained, organic-rich alluvium typically encourage denitrification and vegetative assimilation processes and seasonal patterns of denitrification activity have been linked to water table fluctuations in riparian zones. Hefting et al. (2004) showed that specific nitrogen cycling processes (ammonification, denitrification and nitrification) are related to average water table depths in the floodplain. A better understanding of riparian water table behavior can also improve the success of vegetation restorations. Recent hydroecological modeling suggests that plant functional types are strongly influenced by groundwater hydrology (Booth and Loheide, 2012).

Overall, detailed monitoring of water table dynamics can: 1) improve our understanding of hydrological processes of R, ET and $\triangle$S; and 2) provide important information related to biogeochemical cycling of nutrients and restoration ecology.

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WHAT ELSE IS IN OUR GROUNDWATER?

A STATEWIDE LOOK AT VIRUSES AND PHARMACEUTICALS IN IOWA'S AQUIFERS

Dana Kolpin, Robert Libra, Chad Fields, Claire Hruby

While this spring's rains generally ended the drought and Iowa's immediate groundwater quantity problems, our groundwater quality issues continue. Such concerns include natural contaminants, such as ammonia and arsenic, and those derived from human activities. Given Iowa's agricultural history, nitrate and pesticides have been a public concern since the 1950s, and several decades of monitoring work has been done to understand their occurrence and trends. Recently, as new sampling and analytical methods have been developed, questions about less familiar contaminants have arisen. These contaminants of emerging concern (CECs) include pathogens, hormones, and human and veterinary pharmaceuticals. Studies have shown that while some CECs are attenuated by various processes (e.g. sorption, degradation) along subsurface pathways, others appear to defy conventional wisdom by reaching aquifers assumed to be naturally protected by confining layers.

Viruses are one type of such "unconventional" contaminants. At a recent Iowa Groundwater Association (IGWA) meeting, Dr. Mark Borchardt (U.S. Department of Agriculture (USDA)-Agricultural Research Service) presented research on viruses in Wisconsin groundwater. His team discovered several human viruses, such as adenovirus 41 and echovirus 3, in public supply wells. They also found viruses to be more common during wet, recharge periods. Surprisingly, they even found viruses in relatively deep (700-900 feet) bedrock wells supplying Madison, wells cased through what is regarded as an effective shale confining bed. The water produced by these wells contained no bacterial species, and only trace amounts of tritium, suggesting decades-old water. So where did the viruses come from and how did they get there?

The Wisconsin research found correlations between the assemblage of viruses in wastewater treatment plant sewage and those in the wells one or two weeks later, indicating that leaking sewer lines were the most likely source of the viruses to the aquifer. Viruses are considerably smaller than bacteria, and therefore may be able to migrate through microscopic fractures in an aquitard or well grout that would not transmit larger pathogens because they are not binding to particulates. In addition, viruses occur in such high concentrations in raw sewage that even a small amount may be detectable in groundwater, even when other indicators of modern water, such as tritium, suggest that human-derived contaminants should not be present. In a study of communities without disinfection, the group found increased risk of gastrointestinal illness in residents from viruses entering drinking-water via wells and distribution systems.

This Wisconsin research raised the question of what is happening here in Iowa. To find out, a multidisciplinary team of scientists put together a plan to conduct a statewide assessment of major aquifers in Iowa. The team included staff from the Department of Natural Resources' Geological and Water Survey, Drinking Water, and Source Water Protection programs, the U.S. Geological Survey (Iowa Water Science Center and the Toxics Substances Hydrology Program), the State Hygienic Lab (SHL), the Center for the Health Effects of Environmental Contamination (CHEEC), and the USDA–Agricultural Research Service (Marshfield, Wisconsin).

The team laid out a plan to sample the source water from 66 public supply wells from all major aquifer types in Iowa (Figure 1). The selected wells were from a variety of hydrogeologic settings with a range of vulnerability to surficial contamination from shallow, unconfined alluvial and bedrock aquifers to deep, confined artesian sources like the Jordan aquifer. The method of assessing aquifer vulnerability by confining layer thickness developed by the Iowa Geological and Water Survey in the 1980s has worked well for several conventional water soluble contaminants, but does it also accurately describe unconventional contaminants such as viruses and pharmaceuticals? To facilitate our understanding, the team strategically selected wells with a range of pumping rates and construction ages, allowing scientists to assess the role of these variables on contaminant transport. Wells were also chosen with an eye towards primary land use surrounding their location. For example, some wells were located in the middle of town where sewer lines

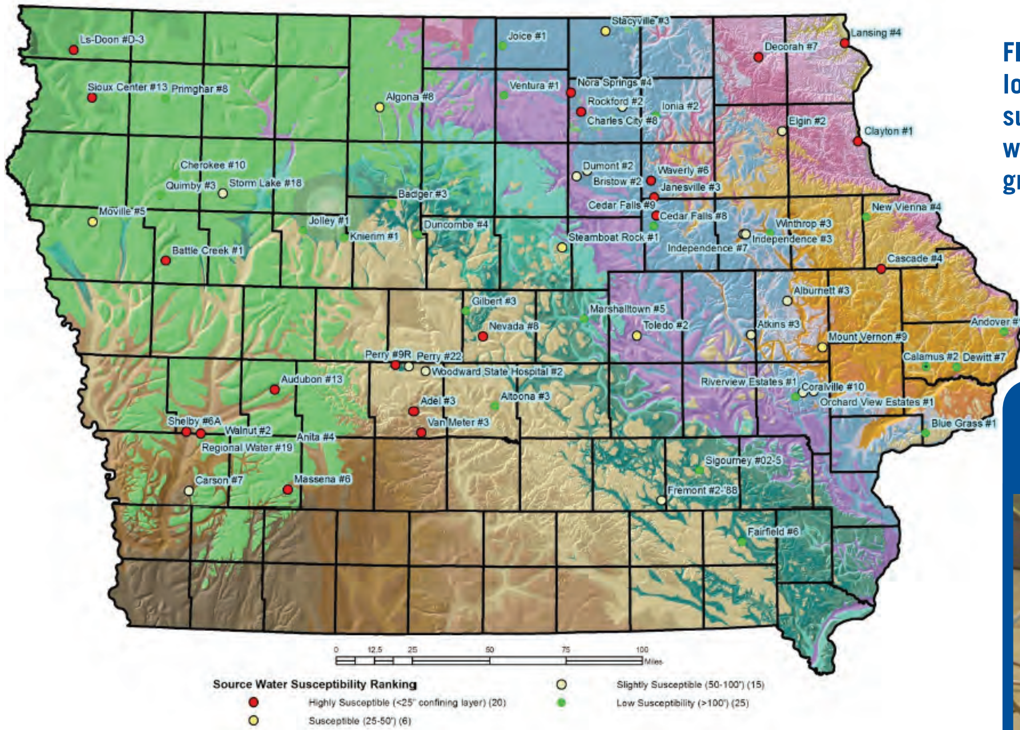


FIGURE 1. Map of the location, geology, and susceptibility of the 66 wells sampled for the groundwater study.

FIGURE 2. Typical sampling setup utilized for the groundwater study.

are more densely spaced, while others were located at the edge of town or adjacent areas where sewer lines are less of a factor.

Not only were viruses investigated, but the wells were also sampled for a comprehensive suite of 110 human pharmaceuticals, making this the first study of its kind in the nation. Studies by the USGS and others have shown that such chemicals commonly occur in the nation's surface waters (including Iowa's). Evidence also suggests these chemicals are mobile and persistent enough to reach groundwater, but this is the first study to systematically evaluate Iowa's groundwater for these contaminants. If sewer-line leakage has the potential to deliver viruses to source aquifers of public supply wells, testing this same set of wells for pharmaceuticals was a logical and complimentary addition to this unique study.

Rounding out the lab work, the well samples are being analyzed for their basic chemistry (e.g. common ions, metals, etc.), tritium (to provide a general water age), and many of the contaminants that we typically deal with including bacteria, pesticides, and nutrients. This will provide a context for the results of the virus analyses, and could even supply the team with a potential indicator for virus occurrence. The virus analyses themselves are relatively expensive, and the sampling is quite time- and labor-intensive. It typically takes four hours to filter the 1,000 liters of water necessary for obtaining a virus sample (Figure 2). Thus, an inexpensive indicator (surrogate) of viral contamination, combined with the well and site factors, would be a valuable outcome.

The sampling for this statewide study was done by staff from SHL and the USGS in March and April of this year, and the team anticipates receiving all the results (from four different state and federal labs) by mid-summer 2013. Data compilation and analysis of this rich dataset (the total analyte list exceeds 200 constituents!) will quickly follow. The plan is to share results and interpretations with IGWA and others once this stage has been completed.

Protection of our groundwater, particularly that used for drinking water, requires forward thinking to consider contaminants that may be "in the pipeline," whether the pipeline is the geologic plumbing system of supply wells, or the evaluation pipeline that leads to regulation of such supplies. Many of the compounds and pathogens the team is analyzing are currently unregulated, but some of the viruses, heavy metals, and pharmaceuticals the scientists are monitoring are being considered for future regulation by the U.S. Environmental Protection Agency. Knowing which of these are present in our raw source groundwater provides water suppliers and groundwater scientists time to appraise risks to drinking water and plan source water protection actions to head off potential problems before they arise.

This work is supported in large part by funds from the DNR Drinking Water program, with additional support from CHEEC, the USGS Cooperative Water Program, and appropriations to the DNR's Geological and Water Survey.

Project Team Principals

DNR-IGWS: Bob Libra, Chad Fields, Claire Hruby

USGS: Dana Kolpin, Laura Hubbard

SHL: Nancy Hall, Mike Schueller, Mike Wichman

USDA-ARS: Mark Borchardt

update on

Perchlorate Contamination, Hills, IA

Hylton Jackson – Iowa Department of Natural Resources, Contaminated Sites Section

In 2003, the EPA began supplying bottled water to 16 affected residences and one business. In 2005, EPA installed point-of-use reverse osmosis (RO) systems in the affected residences.

On November 6, 2012, the voters in the City of Hills, Iowa (a community of approximately 300 households located just south of Iowa City) approved a bond issue for a community water supply. With this vote, the commitment to construct a community water supply resolves an issue that first came to light in 2001. It was then that the Environmental Protection Agency (EPA) Region VII began conducting screening assessments at 40 former U.S. Department of Agriculture grain-storage sites in Iowa, which included a facility located in the northwest part of Hills, Iowa. The purpose of the screening assessments was to determine if there was any impact from grain fumigants on soil and groundwater.

On June 13, 2001, five soil-gas samples, two soil samples and six groundwater samples were collected by EPA. The soil gas and soil samples were collected using a direct-push sampling rig and the groundwater samples were collected from shallow sand-point residential/commercial wells. Two wells were located onsite and four wells were offsite. All samples were submitted for laboratory analysis of volatile organic compounds, with the water samples also being analyzed for the common grain fumigants; 1,2-ethylene dibromide (EDB), 1,2-dibromo-3-chloropropane (DMCP). EPA also sampled groundwater for nitrate-nitrite and perchlorate.

In the mid to late 1990s, perchlorate-contaminated groundwater had become an issue in some areas of the U.S. (most usually associated with defense related activities). EPA viewed these grain-storage screening assessments as an opportunity to examine just how widespread the issue may be. Perchlorate was detected in one of the offsite wells in Hills at a concentration of 29.7 ug/L. Although no MCL exists for perchlorate, EPA has established an action level of 18 ug/L.

EPA then conducted an Integrated Site Assessment (ISA) that included additional soil and groundwater sampling in and around Hills. The sampling was conducted in two phases in the spring and fall of 2003. An estimated 260 water supply wells are located within a half-mile of the area. Groundwater samples were obtained from 191 private and public wells and 14 temporary Geoprobe wells. Public water supply wells provide water to places other than single-family homes like; churches, community centers, assisted living villages, parks, businesses, fire stations, etc. Twenty-one of the wells tested were categorized as public water supply wells.

Perchlorate was detected in water from 148 of these 191 wells at concentrations ranging from 0.45ug/L to 66.0 ug/L. Perchlorate was detected in one of the Geoprobe locations at 90.9 ug/L. In February and March of 2004, additional groundwater samples were obtained from 65 private and public wells. Perchlorate was detected in water from 27 of these 65 wells at concentrations ranging from 4.10 ug/L to 18.5 ug/L. A limited number of agricultural pesticides were detected in groundwater at concentrations below their applicable MCLs.

In 2003, the EPA began supplying bottled water to 16 affected residences and one business. In 2005, EPA installed point-of-use reverse osmosis (RO) systems in the affected residences. While the source of the perchlorate contamination was originally unknown, additional groundwater sampling conducted by both EPA and IDNR eventually determined the source to be the area of the City's annual fireworks display held at a city park on the southwest side of town.

In August of 2006, EPA transferred the responsibility of maintaining the existing RO systems and installing new units (on any active water supply well testing higher that 18 ug/L of perchlorate) to the City of Hills. Regulatory oversight was also transferred to the IDNR at this time. The number of affected wells with RO units now numbers 26 and an additional 5 residences are being provided bottled water. The perchlorate groundwater plume continues to move east, from the southwest corner of town **(FIGURES 1 & 2)**.

Many of the affected wells were sand points installed to a maximum depth of 30 feet and finished in a shallow, unconfined sand aquifer. Several of these wells have also shown nitrate impacts.

With the passage of the bond issue for the new community water supply, Hills will be provided with water from two deep wells (one finished at depth of 151 feet and the other at 189 feet). These wells will draw water from a lower sand and gravel aquifer which is isolated from the shallow, contaminated aquifer by two separate clay aquitards. The plans for the new community water supply include a reverse osmosis system intended to address modest levels of ammonia (approximately 3 mg/L) detected in the deep wells.

The new, reliable community water supply planned for the City is already being promoted to attract new business and development. A $4.63 million state revolving fund loan has been acquired that will cover the project. If all goes as scheduled, the new water supply should be delivering water to the residents of Hills by the fall of 2015.

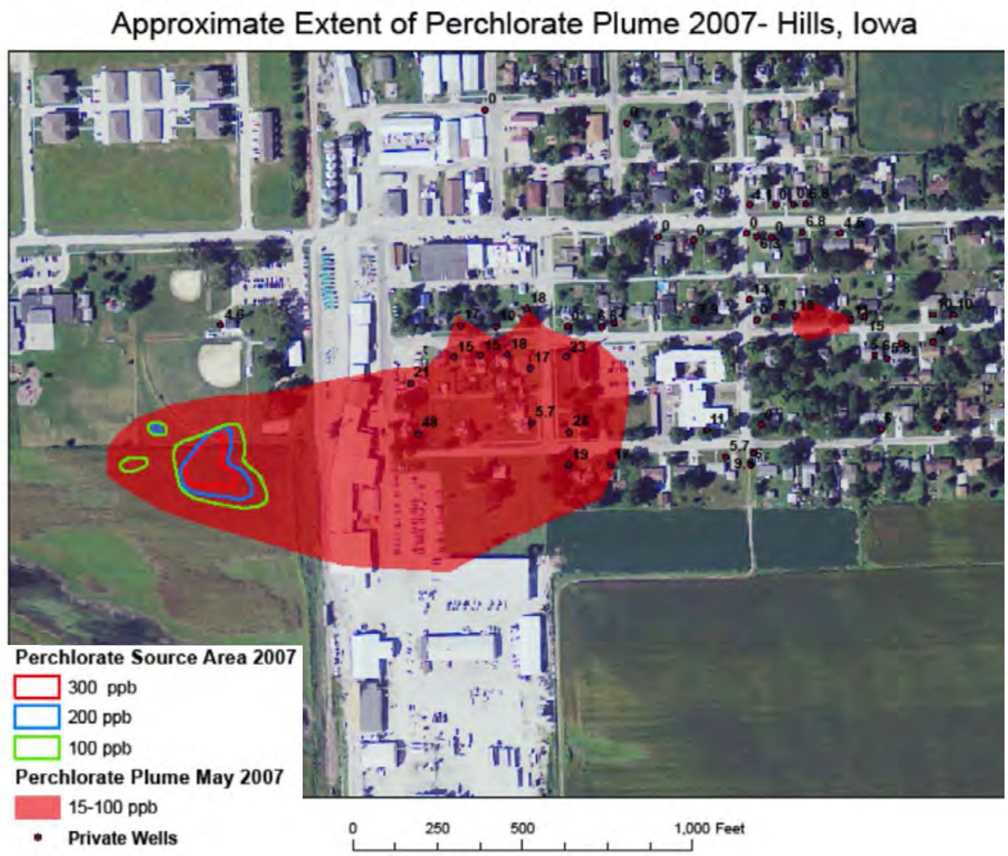


FIGURE 1. **Extent of Perchlorate Plume 2007 – Hills, Iowa**

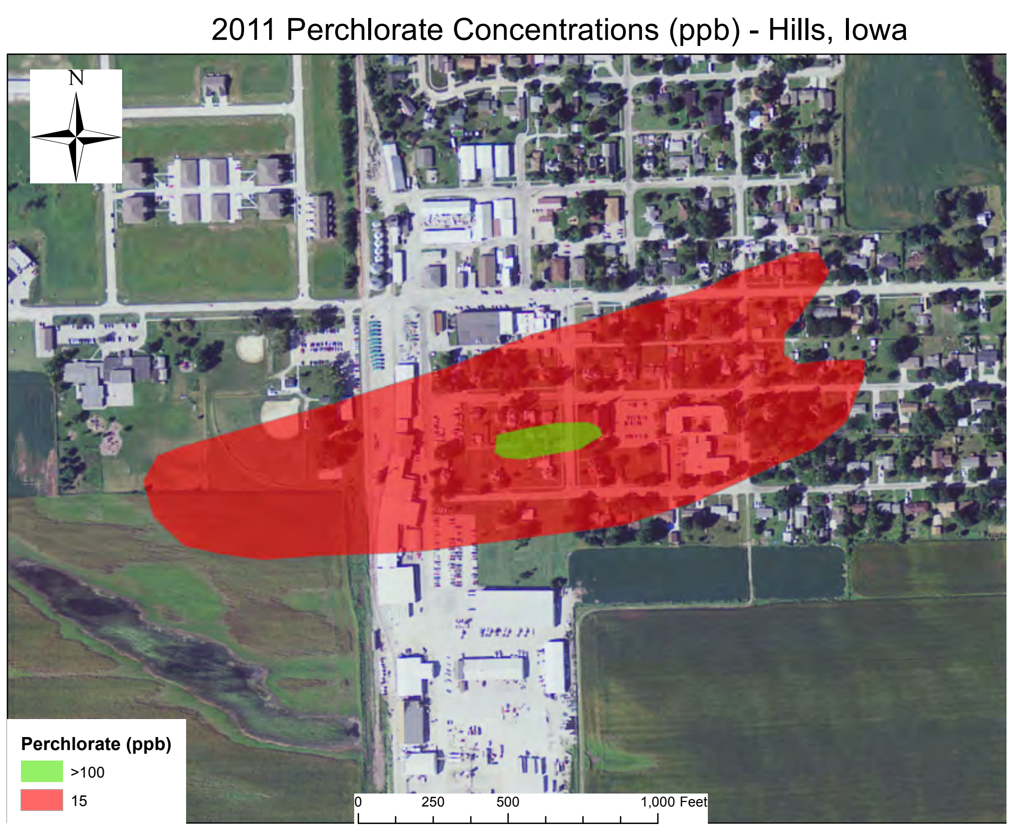
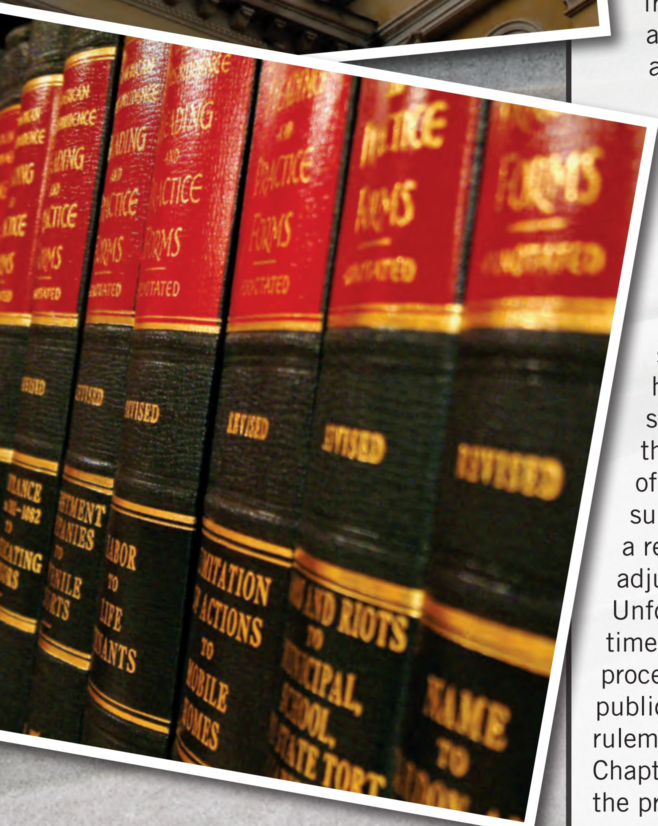


FIGURE 2. **Extent of Perchlorate Plume 2011 – Hills, Iowa**

Legislative Review: Geothermal Heat Exchange (GHEX) System Rules Update

Russell Tell – Iowa DNR



The business of installing geothermal heating and cooling systems in Iowa continues to be strong. Approximately one-third of the 2616 private well construction permits issued in our state during the last calendar year were for GHEX borehole and GHEX well installations.

The current construction standards for both GHEX boreholes and GHEX water supply wells fall under the water well rules found in 567 Iowa Administrative Code Chapter 49. The standards for GHEX boreholes contained in this chapter of rules are very basic and have a number of gaps that must be managed through local guidance and procedural requirements. Since 2004, there has been interest from GHEX stakeholder groups and the department to develop a dedicated set of GHEX loop borehole rules.

Starting in 2005, a stakeholder committee started work on a set of draft GHEX loop borehole rules known as Chapter 48. The final rule making process started in late 2010 and public hearings were held around the state in early 2011. During the public hearings, a number of concerned well contractors submitted comments that created a reasonable need to make some adjustments to the draft rules. Unfortunately, there was not enough time left in the 180 day rule making process to draft the changes, hold public hearings again, and finish the rulemaking. At this time, the draft Chapter 48 rules were withdrawn from the process so that they could be revised and introduced at a later date. In general, most of the public hearing comments originated from our state's most challenging drilling environment – the eastern third of Iowa. This part of our state includes large areas of Karst topography and the shallow bedrock water quality problems associated with this geologic feature, and multiple bedrock aquifers that are part of our drinking water resources. The comments generated in public hearings ranged from requesting minor revisions in specific text in areas the contractors viewed as lacking detail or direction, to a number of major issues that require a shift in the philosophy within the draft rules.

The major issues include setbacks from various point sources of contamination, commercial loop field language and requirements, when additional site assessment is required and details of site assessments, details that should or should not be part of guidance documents and forms, interconnections between multiple aquifers, enforcement criteria and the issues of quality control and oversight of projects by engineering firms and state and local environmental departments.

During the time since the original public hearings, additional requirements were put in place by the executive branch of our government to further justify all rulemaking initiated by the departments of state government. This extra step in the rulemaking process is intended to help ensure that the proposed rules were both necessary and within a scope that accomplished the goals without undue burden placed on the regulated public.

I am pleased announce that we have been approved to move forward with the Chapter 48 rules once again. This renews the effort to work with specific stakeholder groups and revise the original draft document. In the near future our office will contact the original stakeholder committee, along with additional stakeholders in the water well industry, the GHEX loop borehole industry, and engineers who design GHEX systems. Our plan is to work with each group - first individually and then as a greater committee of all stakeholder groups - to look at each of the issues and develop language that provides for the environmental protection needs of loop borehole installations and allows for reasonable access to the resources.

The timeline that we have set to accomplish the work needed to reach a Chapter 48 effective date in Iowa Administrative Code is approximately 14 months. Our hope is to have the final rules effective near the end of August, 2014.

In closing, it is important that we all remember that our state's groundwater resources serve over 90 percent of the population. These resources are contained within complex geological environments that require specific protections, before, during and after drilling operations. The balance of retaining the right to access the resources while ensuring the protection of our drinking water aquifers can only happen with increasing construction standards. Additional standards and the resultant protections will require commitments from landowners, engineers, general contractors and drilling contractors, state and county environmental staff, and the professionals who are studied in our state's geologic features and aquifers. These commitments need to focus on what protections are needed at each location and then how to work together – as vested partners – to solve any issues that are specific to each borehole field location. This will require that all parties take an active role before any drilling takes place, during the course of drilling projects and after the installations are completed. Working as vested partners to solve current and future GHEX borehole problems will help ensure the longevity of the GHEX industry in Iowa and minimize any potential negative interaction with our groundwater resources.

If you would like to participate in the renewed rule making process as a stakeholder, I ask that you submit your request to me via United States Postal Service or by email at Russell.tell@dnr.iowa.gov.

For question, comments or concerns about GHEX installations, current or future rule language, or to discuss water supply wells, please contact me at 515.725.0462 or by email, or you can contact Deb Williams at 515.725.0290 or by email at Deborah.Williams@dnr.iowa.gov.

Legislative Review:

Update: Proposed Revisions to Chapter 133

Bob Drustrup – Iowa DNR Contaminated Sites Section

In last year's IGWA Underground I reported on efforts underway to revise Chapter 133 of the Iowa Department of Natural Resources' (DNR's) rules. Chapter 133 currently addresses only groundwater-related contamination. The changes being considered would increase the scope of the chapter to include contamination of soils, vapors, and surface water. The goal is to establish rules that include practical criteria for determining problematic contamination, identify parties responsible for contamination, and prescribe actions by responsible parties to resolve contamination concerns.

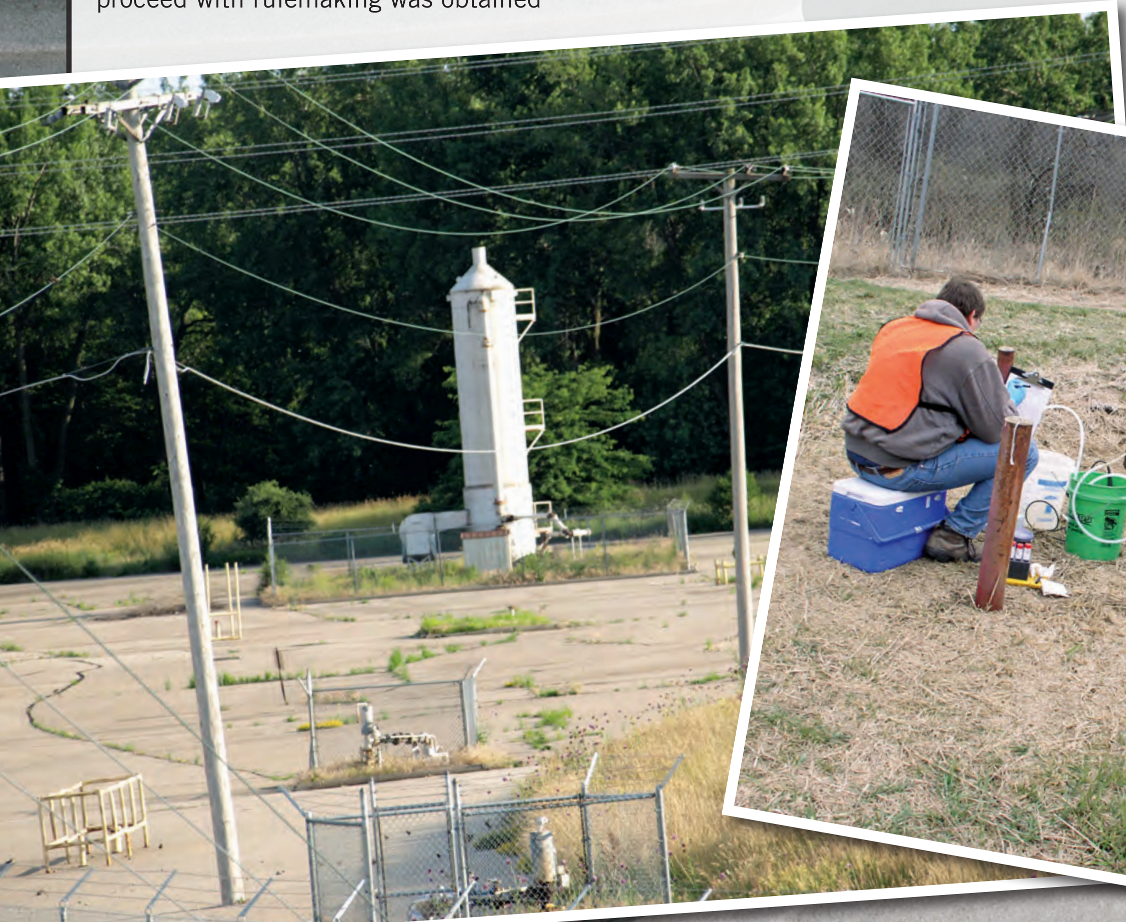
A draft re-write of Chapter 133 was released in August of 2012. Shortly thereafter a new executive order from the Governor's office came out regarding rulemaking. Approval to proceed with rulemaking was obtained early in 2013. Over 70 potential stakeholder representing a variety of interests including legal, business, environmental, banking, real estate, and consulting were contacted.

On April 30th an initial stakeholder meeting was held in Des Moines. Over 30 individuals from the public attended this meeting. The group decided to establish three subgroups: policy, technical, and overall consistency. The policy and technical subgroups met in Ankeny on May 24th.

Major issues coming out of the stakeholder involvement so far include:

- ❖ the scope of the rules
- ❖ reporting requirements
- ❖ DNR's discretionary authority
- ❖ institutional controls
- ❖ gross contamination (e.g., non-aqueous phase liquids)
- ❖ laboratory practical quantification limits

The DNR is maintaining a web site about the Chapter 133 rulemaking effort. This web site includes the most recent draft of the rules, summaries of stakeholder involvement, and a large amount of supporting information. For more information, including opportunities for input, please visit the Chapter 133 rulemaking web site: www.iowadnr.gov/InsideDNR/RegulatoryLand/ContaminatedSites/Ch133Rulemaking.aspx



Legislative Review: Rule Changes to Chapter 135

Elaine Duskey – IDNR Underground Storage Tank Section

The Environmental Protection Commission (EPC) authorized the Department to begin procedures to amend Iowa Administrative Code 567-Chapter 135 "Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks." The Notice of Intended Action, which addresses leak detection requirements at unstaffed facilities, was approved by the EPC at their June 18, 2013 meeting.

Background:

Paragraph 135.5(1)"e" specifically addresses leak detection requirements for pressurized piping used at underground storage tank (UST) facilities that operate without on-site personnel.

Concerns expressed in 2012 by industry representatives over the costs and potential hardship of complying with the current rule's upgrade requirements prompted the Department to reconsider alternative leak detection methods at unstaffed facilities. Stakeholder meetings were held in the spring to discuss alternative leak detection and notification methods that are both cost effective to the owners, and environmentally protective. Participants included representatives from the petroleum marketer industry, UST insurance industry, owners of staffed and unstaffed facilities, UST installers, the Iowa Environmental Council, and the Department.

Proposed Rule Change:

The Department is proposing new standards for leak detection at unstaffed UST facilities based on extensive stakeholder input. In summary the new rule requires automatic line leak detectors be in place that do one or more of the following:

- ❖ Shut down the submersible pump when a leak is detected
- ❖ Restrict the flow of product when a leak is detected
- ❖ Trigger an audible or visual alarm when a leak is detected

For the latter two choices the rule further outlines requirements for implementation, including the options of 1) conducting on-site visits to confirm the status of the leak detection equipment; 2) notification to facility operators by immediate electronic communication; or 3) providing signage with an emergency phone number by which customers may immediately contact operators in the event of an alarm or notice of restricted flow.

Written comments on the proposed amendments may be submitted on or before August 13, 2013, to: Director Chuck Gipp, c/o Paul Nelson, Department of Natural Resource, Wallace State Office Building, 502 East 9th Street, Des Moines Iowa 50319; fax: (515)281-8895; or email: paul.nelson@dnr.iowa.gov. A public hearing is scheduled for August 13, 2013, at 1:00 pm in Conference Room 5W at the Wallace State Office Building, at which people may present their views.

designing a field and numerical EXPERIMENT TO EVALUATE THE RESILIENCE OF VEGETATION COMMUNITIES TO CLIMATE CHANGE AT THE CIHA FEN (JOHNSON COUNTY, IA, USA)

Matthew J. Even, Depart. of Earth & Environmental Sciences, University of Iowa

The distribution of water availability and soil properties at a site creates a suite of hydrological niches occupied by different vegetation communities. Water availability is a primary determinant of vegetation pattering, and is itself a function of soil properties, landscape position, climate, and other factors. Here, we take the Ciha Fen (Johnson County, IA, USA) as a case study in the resilience of current vegetation communities to potential future climate scenarios (see photograph). My research will assess three vegetation communities (wetland, transitional, upland) occupying at least three unique soil types at the Ciha Fen. Field monitoring including a meteorological data, soil moisture measurements, and observation of groundwater levels will be completed during the 2013 growing season. These data will support the calibration of a 1-D numerical model to predict water availability as a function of future climate, using changes in precipitation and evapotranspiration to drive the model. The research design will ultimately predict the magnitude of hydrological change required for vegetation patterning to change on the landscape. For example, how dry would the climate need to be until the transitional community overtakes the wetland community? How wet to cause expansion of the transitional community uphill? Results of this study will support ongoing management of the Ciha Fen Preserve.

student bio

I am currently a M.S. candidate in the Department of Earth and Environmental Sciences at the University of Iowa working under the supervision of Dr. Adam Ward and Dr. E. Arthur Bettis, III. I was born in Gilbertville, IA and graduated from the University of Northern Iowa in 2007 with a B.S. in Geology and B.A. in Physics and Earth Science. My research interests are interactions between hydrology, soils, and vegetation, particularly as related to wetlands and environmental restoration projects.

impact of climate change on SPRING PERSISTENCE AND BLACK RHINOCEROS (DICEROS BICORNIS) HABITAT AVAILABILITY IN THE NAMIB DESERT

Robert Logan, Grinnell College

The Namib Desert in Namibia is home to the last populations of many desert-adapted animals including the critically endangered black rhinoceros (Diceros bicornis). Recent conservation efforts aimed at helping the black rhino have addressed the immediate threat of poaching but generally ignored the potential long-term issue of climate change. In this hyper-arid region with no perennial rivers or large bodies of water, animals must rely on a series of groundwater-fed springs that dot the landscape for water. However, many climate models have predicted the region is likely to get warmer and drier in the coming decades.

In this study, I have been working with Dr. Peter Jacobson (Grinnell College) and Dr. Keith Schilling (Iowa DNR and Univ. of Iowa) with funding from Grinnell College and the University of Iowa's Center for Global and Regional Environment Research to assess the impact of climate change on Namib Desert springs and the subsequent impacts this will have on animal populations throughout the region. The study area is focused on the springs within or adjacent to the Etendeka Plateau in north-western Namibia, a region of volcanic rock (basalt) covering some 78, 000 km2. The rocks of the plateau are correlated with volcanic rocks of the Parana Basin of Brazil, together with which they formed a major igneous province in western Gondwanaland just before continental breakup some ~135 Mya.

Water samples collected from ~40-50 springs during a wet period in 2012 and a dry period in 2013 have been analyzed for major anion and elemental concentrations as well as isotopic analysis for deuterium, tritium, and oxygen-18. Historical spring persistence data was obtained from the Save the Rhino Trust (SRT), a Namibian-based NGO dedicated to rhino conservation and anti-poaching efforts. The dataset consists of a total of 169 springs and includes attributes about which springs the SRT considers most critical to rhinos. The database also identified which springs dried up during a severe and protracted drought in the early 1980s allowing us to correlate geochemistry with drought susceptibility.

Preliminary results from geochemical analysis show promise for elucidating patterns of groundwater residence time and recharge rates. Initial clustering of elemental and anion data of 2012 samples revealed definite patterns of geochemical similarity among springs corresponding to geography and salinity levels. Analysis of data collected in 2013 is ongoing to tease out differences among the various spring water sources. Spatial modeling of springs using a geographic information system (GIS) suggests that drought conditions result in higher levels of habitat fragmentation, a 35% reduction in the most desirable habitat, and a 50% increase in the mean distance required for black rhinos to walk between springs. Results from our study are showing how spatial analysis and geochemical tools can be used together to provide more predictive modeling of animal habitat that will allow conservationists to better manage animal populations in the near future.

student bio

Robert is a New Orleans native who just graduated from Grinnell College with a major in biology. He will be spending next year providing training and outreach support for the Gobabeb Research & Training Centre in Namibia through a one-year fellowship with Grinnell College and plans to eventually enter into a graduate program that will allow him to combine his interests in analytical chemistry, climate science, biogeochemistry, and field work.

Re-injection well for the Department of Corrections.

SANITARIAN'S CORNER

Over the last few years there have been a lot of interesting situations involving well drilling in Black Hawk County. Most of them involved private wells. But with the plentiful aquifers, and government subsidies, there is a large market for geothermal well construction. Some of these systems are horizontal closed-loop systems, some are closed-loop vertical systems, and there are a few open-loop types that consist of a "pump and dump" well. Fortunately (or unfortunately-depending upon your perspective) the pump and dump types of geothermal systems are now being replaced by pump and re-inject systems. The main reason for this change is the pump and dump wells have discharge permitting requirements through NPDES and municipal storm-water regulations.

The storm-water systems are not always able to handle the extra load of these high capacity wells so engineering companies are now looking at pump and re-injection as an alternative. For example, one of these open-loop systems in Waterloo is designed for a peak discharge of over 4000 gallons per minute (GPM). That is a lot of water being withdrawn from the aquifer and where to discharge that water after it flows through the heat exchangers is sometimes a problem. Many of the new schools in Waterloo and Cedar Falls have been designed for pump and re-inject well systems that operate between 600-1000 GPM. The University of Northern Iowa uses approximately 30 wells mainly for cooling purposes and is allocated to withdraw up to 4.7 billion gallons per year.

Construction permits for geothermal wells are issued at the county level. Unfortunately, some of these well systems being proposed are located near contaminated sites. This makes determining whether to permit the well very difficult. We no longer are looking at standard separation distances like 50 feet from a septic tank or 100 feet from an absorption field. Now we have to consider things like whether the well is placed upstream or downstream from a contamination plume, will the drawdown from the geothermal well affect plume movement, what is the proximity of the geothermal wells to municipal wells, and whether the geothermal well will negatively affect the contaminated site.

One recent example of permitting wells near a hazardous waste site involved a dewatering well permit request near the Waterloo Coal Gasification Plant Superfund site. The dewatering wells are located down-gradient from the plume and approximately 800 feet away. The

One of the dewatering wells recently installed.

contaminated site was a coal gasification plant that went through rigorous cleanup in the 1990's, but there is still a contamination plume. The Black Hawk County Health Department issued a restrictive covenant letter to prevent the installation of water wells within 1000 feet of the contaminated site per EPA's request in 2006. This restriction allows management of any circumstances that may directly affect the site. As a result of the restrictive covenant, the Health Department contacted the EPA for further assessment. The wells were permitted under specific conditions to use monitoring wells already onsite to determine if dewatering is having an effect on the contaminant plume. The owners of the property were required to install transducers in monitoring wells near the site and provide the data to DNR, EPA, and the county. If there is any influence, the owners are required to inform the EPA and explore other avenues for dewatering. Unfortunately this situation may create additional project costs. Hopefully monitoring results will show little to no influence on the contamination plume. A few years ago a pump and re-inject geothermal system was permitted up-gradient from this site. Once the wells were drilled, pump testing and monitoring of wells nearby concluded there would be minimal effect on the plume.

These situations are the type that county sanitarians are running into and thankfully we have the help from EPA, DNR, private engineering companies, and well contractors to help properly evaluate well locations.

GROUNDWATER'S ROLE IN AMERICA'S ECONOMIC VITALITY

ESTIMATED ANNUAL ECONOMIC VALUE OF:

- **Pumped water1/total $20.09 bil.**
- **Pumped water/public supply $12.91 bil.**
- **Pumped water/individual household $3.3 bil.**
- **Pumped water/irrigation $1.07 bil.**
- **Pumped water/livestock/aquaculture $64.0 mil.**
- **Pumped water/industrial, self-supplied (fresh) $2.71 bil.**
- **Pumped water/mining (fresh) $20.4 mil.**
- **Pumped water/thermoelectric (fresh) $10.2 mil.**
- **Installed well/pump infrastructure/ public supply $3.73 bil.**
- **Installed well/pump infrastructure/ individual household $64.31 bil.**
- **Installed well/pump infrastructure/ irrigation $6.0 bil.**

AMERICAN GROUNDWATER-RELATED BUSINESSES:

- **Environmental consulting11 – estimated sales $6.5 bil.**
- **Remediation services12 – estimated sales $6.6 bil.**
- **Well construction and related services13 – estimated sales $2.73 bil.**

AMERICAN GROUNDWATER-RELATED MANUFACTURING:

- **Drilling machines shipped by manufacturers (2010)14 115**
- **Value of drilling machines shipped (2010) $91.2 mil.**
- **Pumps shipped by manufacturers (2010)15 1,483,354**
- **Value of pumps shipped (2010) $261.8 mil.**

(information provided by National Groundwater Association. http://www.ngwa.org/Fundamentals/Pages/default.aspx)

IGWA Member News

MEMBERSHIP RECOGNITION

New Members
- Sushil Tuladhar

5-Year Members
- Caley Parrish • Tim Wilson

10-Year Members
- Danial Ries

15-Year Members
- Mark Wiseman • Sherman Lundy
- Doug Groux • Richard Heller
- James Traen

20-Year Members
- Jeff White • Valerie Chambers
- Jon Martens • Michael Leat

Corporate Members
- IDNR Geological and Water Survey
- Apex Companies LLC
- Downhole Well Services, LLC
- Terracon
- Stanley Consultants Inc.
- HR Green Inc.

DID YOU KNOW

that IGWA is now accepting government groups, such as Iowa DNR sections or county public health departments, as corporate members?

Contact an IGWA Board member for details.

IOWA GROUNDWATER ASSOCIATION

COMMUNICATION • EDUCATION • RESEARCH

Upcoming Events

IRWA Fall Conferences Okoboji September 10-11, 2013 & Dubuque October 8-9, 2013
www.iowaruralwater.org/events_fall_conference.html

2013 AWWA - IAWEA Fall Short Course September 10-11, 2013
Des Moines Area Community College, FFA Enrichment Center – 1055 SW Prairie Trail Parkway, Ankeny IA
www.ia-awwa.org/conferencesandtraining/shortcourse.html

Illionois Groundwater Association September 13, 2013
Best Western Clocktower Inn, Rockford IL | *www.illinoisgroundwater.org/meetings/meetings.html*

2013 National Association of Abandoned Mine Land Programs (NAAMLP) September 22-25, 2013
Daniels WV | *http://naamlp.net/*

IAMU Water Distribution & Leak Detection Workshop September 4-5, 2013
IAMU Conservation Planning & Water Loss Training October 29 & 30, November 5 & 6, 2013
IAMU Water / Wastewater Annual Conference November 19-20, 2013
http://www.iamu.org/en/events/events_calendar/

58th Annual Midwest Groundwater Conference September 23-25, 2013
Ramkota Hotel, Bismarck ND | http://www.mwgwc.org/

Aquifer Testing for Improved Hydrogeologic Site Characterization September 23-24, 2013
In-Situ, Inc Headquarters, Ft Collins CO | *www.midwestgeo.com/courses/aquifer2013-ftcollins.php*

2013 NEHA/Joint Education Conference (Fall Regional Environmental Health Conference) September 25-26, 2013
Radisson Conference Center, LaCrosse WI | www.weha.net/professionaldevelopment.php

Iowa Environmental Council Annual Conference October 11, 2013
Drake University, Des Moines IA | *http://iaenvironment.org/conference/2013/index.php*

2013 Iowa Section AWWA Annual Conference October 15-16, 2013
Double Tree, Cedar Rapids Convention Complex, Cedar Rapids IA
www.ia-awwa.org/conferencesandtraining/annualconference.html

2013 Iowa Science Teachers Fall Conference October 22-23, 2013
Scheman Building, ISU Campus, Ames IA | *www.ictm-ists-conference.org/*

Iowa Groundwater Association Fall Meeting October 31, 2013
ISU Extension Building, Johnson Co Fairgrounds, 4265 Oak Crest Hill Rd SE, Iowa City IA | *www.igwa.org*

Minnesota Ground Water Associaton Fall Conference November 13, 2013
Univ. of MN St Paul Continuing Education and Conference Center, St Paul MN | *www.mgwa.org/meetings_2013_fall.php*

2013 EPI Fall Symposium November 18-19, 2013
Stoney Creek, Johnston IA | *www.epiowa.org*

2013 NGWA Ground Water Expo and Annual Meeting December 3-6, 2013
Register on or before November 9 to save on registration! | *http://groundwaterexpo.com/*

IWWA 85th Annual Convention & Trade Show January 30-31, 2014
Coralville Marriott Hotel & Conference Center, Coralville IA | *www.iwwa.org*

2014 Annual Nebraska Water Industries Convention February 18-20, 2014
Kearney NE | *www.nebraskawelldrillers.org/content.asp?contentid=30*

Iowa Water Conference March 3-4, 2014
Scheman Bldg Iowa State University, Ames IA | *www.water.iastate.edu/content/iowa-water-center-events*

IOWA GROUNDWATER ASSOCIATION

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