ILLINOIS GROUNDWATER ASSOCIATION

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Spring Meeting - April 14, 2023

In-person at ISU and Online via Zoom

Program Speakers/Topics:

8:00 AM — *Check-in*

8:05 AM — **Joe Krienert (IGA Chair)** — *Opening Remarks*

8:15 AM — **Okiemute Commander** – *Assessment of spatial and temporal variations in chloride concentration in an agricultural tile-drained area in central Illinois.*

8:45 AM — **Cecilia Cullen, M.S. & Fereshteh Ghiami Shomami, PhD** – *Exploring Variability and Seasonality in Groundwater Chloride at Community Wells with Weekly Data*

9:45 AM — *Break*

10:00 AM — **Wes Cattoor, P.E., CFM** – *Illinois State Water Plan and Its Next Steps*

11:00 AM — **Daniel Abrams, PhD & Fereshteh Ghiami Shomami, PhD** – *Sustainable Supply and Demand Assessments in Illinois*

12:00 PM — *Optional Virtual Lunch and Discussion*

1:00 PM — **Chris Stohr, PhD, PG, CEG** – *Review of Recent Activities Regarding Protection of the Sole-Source Mahomet Aquifer, East-Central Illinois*

2:00 PM — **Thomas M. Johnson, PG** – *"Do You Swear…?" - The Role of the Groundwater Scientist in Environmental Litigation*

3:00 PM — **Eric Peterson, PhD** — *Effectiveness of saturated buffer zones: A case study in central Illinois*

3:30 PM — **Megan R.M. Brown, PhD (IGA Vice-Chair)** - *Closing Discussion*

3:45 PM — *Meeting Adjourned and Optional Field Starts*

4:45 PM — *Field Trip Adjourned*

Assessment of spatial and temporal variations in chloride concentration in an agricultural tile-drained area in central Illinois.

Okiemute Commander[1] (ocomman@ilstu.edu), Dr Eric Peterson[1], Dr Catherine O'Reilly[1], Dr Jonathan Thayn[1], Dr Bill Perry[2] and Rick Twait[3]

[1]Department of Geography, Geology and the Environment, Illinois State University

[2]School of Biological Sciences, Illinois State University

[3]City of Bloomington Water Department (Retired)

Abstract

Long-term increase in chloride (Cl^-) concentration in surface water and groundwater from anthropogenic sources, including deicing salts, agriculture, septic effluents, and wastewater treatment plants is a growing cause for concern all over the world. In rural Midwestern US with predominant agricultural land usage and less impervious surface cover, agriculture may serve as a potential source for Cl^- in surface and groundwater systems. A saturated riparian buffer (SRB) installed adjacent to a central Illinois stream (tributary of Lake Evergreen) to reduce nutrient losses was used to identify groups of Cl^-, substantiate agricultural influence, and to identify spatial and temporal Cl^- variations within the SRB. 2297 water samples collected from 35 wells, a diversion box and stream over a 7-year period within the SRB were analyzed for major anions, with major cations analyzed for 155 samples from six sampling runs.

Based upon well depth and locations within the SRB, well groups were delineated into diamicton groundwater, downgradient shallow groundwater, upgradient shallow groundwater, diversion box, and stream. Seasons were divided to correspond with agricultural practices: spring/planting, summer/growing, fall/harvest, and winter/fallow. A cumulative probability plot indicated three populations of Cl^-, and two-way ANOVA results identified three distinct groups: 1) stream, 2) upgradient shallow groundwater, and 3) diversion box, downgradient shallow groundwater, and diamicton groundwater. Background chloride concentration in shallow groundwater (5.08 mg/L) and anthropogenic influence (potentially KCl fertilizer) from tile-drained waters were identified from thresholds in the cumulative probability plot. The ANOVA indicated seasonal differences in the waters of the stream and diversion box. Principal component analysis (PCA) of the water chemistry data indicated that water-rock interaction explained 41.8% of the variance while surface processes explained 17.6% of the variation.

Classifications from the PCA helped in differentiating water sources identified in the cumulative probability plot. Although the shallow downgradient wells and the diamicton groundwater wells had statistically similar Cl^- concentrations, their water sources differed. Understanding agricultural contributions to Cl^- in the shallow groundwater zone and temporal variations within the SRB will help in reducing Cl^- loading into the stream and further downstream into Lake Evergreen (City of Bloomington water reservoir).

Exploring Variability and Seasonality in Groundwater Chloride at Community Wells with Weekly Data

Cecilia Cullen M.S., Fereshteh Ghiami Shomami PhD

Illinois State Water Survey Groundwater Section

Abstract

In the shallow aquifers of northeast Illinois, chloride contamination has been a long documented and growing concern. The Environmental Protection Agency (EPA) has set a Secondary Standard of chloride for 250 mg/L. High chloride contaminations are detrimental to aquatic species, increase corrosivity in water, and increase the water treatment costs for municipalities. Past studies at the Illinois State Water Survey (ISWS) found increased chloride concentrations in urbanized areas with the shallow aquifer near surface.

While timeseries of long term (over decades) chloride accumulation at wells are available and useful, a recurring comment of studies in the area is on the need for high-frequency data to document shorter term (over months) trends in the groundwater chloride concentrations. This study benefits from a dataset collected by water operators at a community in northeast Illinois. The ISWS has used this dataset of weekly chloride measurements at six wells in Will County to analyze variations in chloride concentration at different time scales. Concentrations at these wells are elevated and several exceed the EPA secondary standard. This presentation will also examine the possible relationships between land use, well depth, stormwater infrastructure, and chloride concentration in this urbanized area.

Illinois State Water Plan and Its Next Steps

Wes Cattoor, P.E., CFM,
Section Chief, Engineering Studies, IDNR - Office of Water Resources

Abstract

The Illinois State Water Plan, which serves as a blueprint for addressing key water-related challenges in the state over the next decade, has been updated for the first time since 1984 and is available to help guide state and local leaders in setting priorities for water resources. The updated Illinois State Water Plan spotlights 13 key water issues and focuses on improving the resiliency, sustainability, public safety, stewardship, economic development, and understanding of the water resources of Illinois to improve the lives of the people of the state while integrating social and environmental justice.

The State Water Plan presents an opportunity for all water related state agencies and stakeholders to work together to adjust state programs and policies in water resources by recommending necessary changes and new ideas to elected officials and key leaders in the state of Illinois. The updated State Water Plan provides a seven-year-focus strategic plan containing 147 actionable and measurable recommendations for future inclusive and equitable state water resources development in Illinois.

The next phase is implementing the plan by working closely with the General Assembly and stakeholders. The plan is dynamic and subject to change by the State Water Plan Task Force based on stakeholder collaboration to address these changes in Illinois for the good of its inhabitants.

Sustainable Supply and Demand Assessments in Illinois

Daniel Abrams (dbabrams@illinois.edu), Fereshteh Ghiami-Shomami, Vlad Iordache
Illinois State Water Survey, Champaign, Illinois

The Illinois State Water Survey, in coordination with IDNR, has developed an initial assessment of sustainable supply for every county in the state of Illinois. In this presentation, we will compare these sustainable supply estimates with county total demands for groundwater users. Assumptions for the development of sustainable supply will also be detailed, exploring the methodologies for calculating supply in the shallow aquifers of Illinois as opposed to the deep Cambrian-Ordovician sandstone aquifers. Each methodology has limitations, and we will discuss how those limitations can impact the estimates of supply as well as future work to improve these estimates to meet stakeholder needs. Furthermore, the ISWS will highlight the difference between county-level sustainability assessments of water supply and the drivers that can lead to very localized risk to an aquifer (which may not be represented in county scale assessments). Finally, we will reveal an online application that contains information related to supply and local scale risks facing communities.

Review of Recent Activities Regarding Protection of the Sole-Source Mahomet Aquifer, East-Central Illinois

Chris Stohr PhD, PG, CEG (cstohr@illinois.edu)
Standing Member, Champaign County Board and Mahomet Aquifer Council, Illinois

Abstract
The Mahomet Aquifer is East-Central Illinois' only regional potable water resource, serving more than 500,000 people in 15 Illinois counties, provides an estimated 220 million gallons of water per day to communities, agriculture, industry, and rural wells. Several organizations have advocated for the Mahomet Aquifer, in response to an event or circumstance, but also becoming dormant following resolution of the impetus. Nevertheless, developments continue - including:

- 2012-2015: Several counties, municipalities, Univ. of IL, and the IL American Water company were granted a petition by the U.S. Environmental Protection Agency (EPA), seeking a "sole source aquifer" designation for the Mahomet Aquifer pursuant to Section 1424(e) of the Safe Drinking Water Act 1974.
- 2012: Local and state agencies filed a complaint with the Illinois Pollution Control Board (IPCB) against Clinton Landfill, Inc. alleging that the company was illegally accepting waste containing polychlorinated biphenyls (PCBs), a substance regulated under the federal Toxic Substances Control Act.
- 2017-2018: The IL governor signed into law Public Act 100-0403, legislation creating the Mahomet Aquifer Protection Task Force [MAPTF] and initial goals.
    - Provide funds for Helicopter-borne Transient Electromagnetic (HTEM) geophysics [$19.8 million].
    - Developing a state plan to maintain/monitor the groundwater supply of the Mahomet Aquifer [$2.3 million annually].
- 2019-2021: Repairs underway for a leak detected from Peoples Gas Light and Coke company's underground storage at Manlove Gas Field. This has contaminated private water wells in northern Champaign County, and forced residents to rely on bottled water until water can be supplied by Sangamon Valley Public Water District.
- 2020: Champaign County Board allocates $500,000 from American Rescue Plan Act funds for HTEM and related studies work over the portion of the Mahomet Aquifer in the county to protect groundwater resources.
- 2022: The Omnibus Appropriations Act allocated $1 million to Univ. of IL to map the underground geology of Mahomet Aquifer.
- In 2022, a 25-member Mahomet Aquifer Council was appointed with agricultural, industrial, commercial, and political stakeholders [SB2515 Enrolled]. The Council is charged to "review, evaluate, and make recommendations regarding State laws, regulations, and procedures… and … current and potential contamination threats to the water quality of the Mahomet Aquifer.

“Do You Swear…?”
The Role of the Groundwater Scientist in Environmental Litigation

Thomas M. Johnson, PG (thomasjohnsonassociates@gmail.com)
Thomas Johnson Associates Middleton, WI / San Francisco Bay Area, CA

Abstract

Environmental litigation often involves technical issues that require the assistance of geoscientists, including hydrogeologists and hydrologists in civil and criminal courts and dispute resolution hearings. Expert witnesses provide testimony to assist the parties, the jury, and the court in understanding complex technical issues. These experts are often assisted by a team of scientists and staff from varying backgrounds. Additionally, geoscientists not serving as expert witnesses are often called to present testimony regarding work that was done. It is likely that most environmental geoscientists will receive a subpoena to testify in a litigation sometime during their career. This presentation discusses the role of the geoscientist in court using actual case examples, and provides guidance for those considering this as a career or encountering this aspect of the legal system.

Effectiveness of saturated buffer zones: A case study in central Illinois.

Eric Peterson, PhD (ewpeter@isu.edu)
Department of Geography, Geology and the Environment, Illinois State University

Abstract

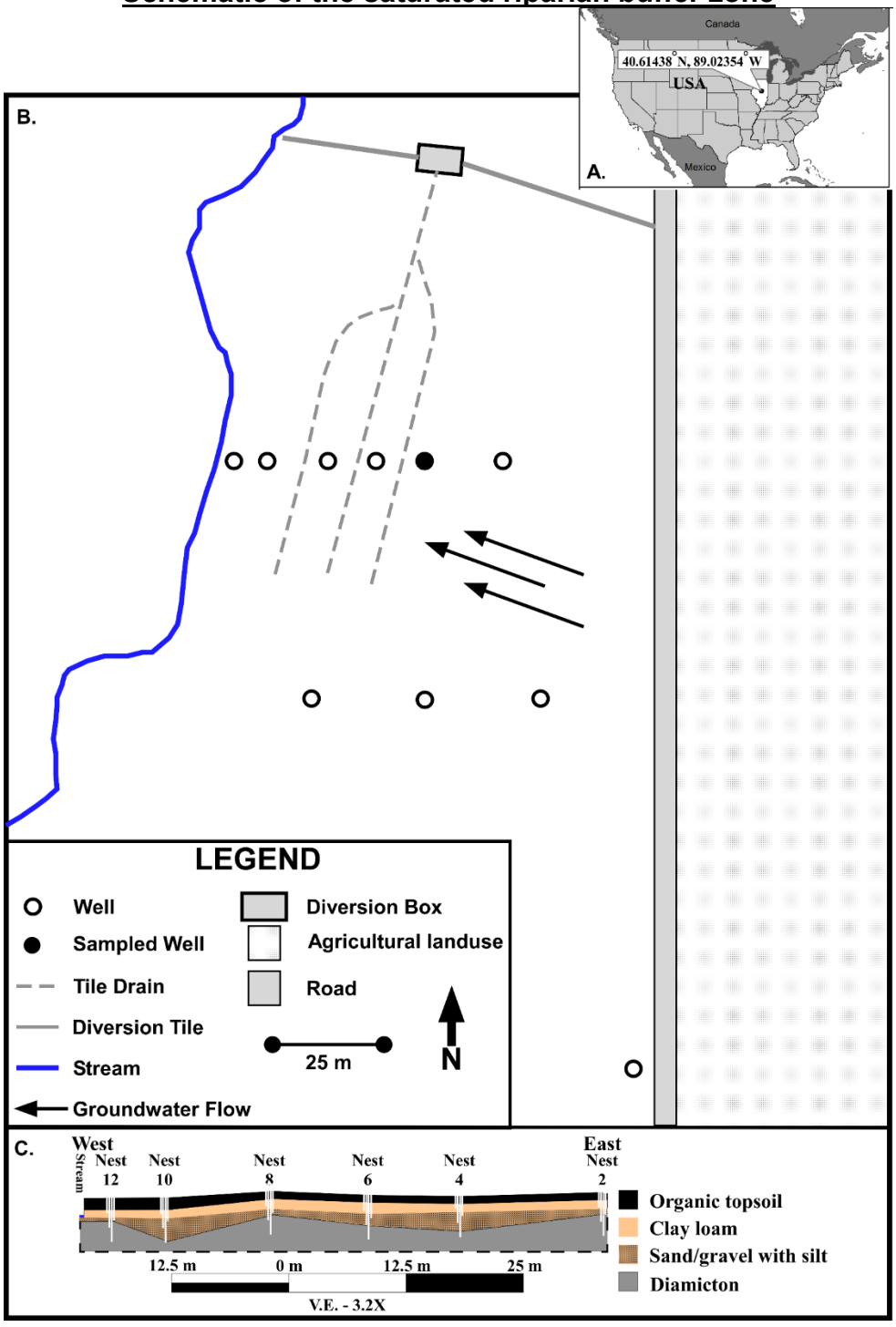
In the U.S. Midwest, agriculture is a principal use of the land. Successful cultivation of corn and soybean depends upon a balance of nutrients and water. However, the application of excess nitrogen (N) fertilizers coupled with tile-drainage systems contribute to eutrophication and hypoxic conditions in surface water. To abate these conditions, the U.S. EPA established a goal to decrease N loading by 45% in the Mississippi River by 2035. One proposed best-management practice is the implementation of a saturated riparian buffer (SRB). To assess their utility, an SRB was installed in a restored prairie, diverting the tile-water into the vadose zone rather than directly discharging into a stream. The tile-system drains an upgradient field that grows corn and soybeans.

This work summarizes nearly seven years of research and provides a conceptual model of the SRB shown in the attached schematic. As the water table rises in response to precipitation, the diversion system directs water to the soil beginning late winter (late-February) until late spring (early June). The tile-waters are rich in nitrate, greater than 10 mg/L nitrate as nitrogen (NO3-N), while NO3-N concentrations of background water are below 1 mg/L. Travel times from the diversion system to the stream are variable but are greater than 30 days. Along the flow paths, NO3-N concentrations decrease. While the mixing of tile-waters and groundwater will produce diluted water, a mixing-model indicates dilution is not the sole mechanism for the decrease in NO3-N concentration. The mixing model reveals losses of NO3-N exceeding 30%. Analysis of δ18O-NO3- and δ15N-NO3- highlight a denitrification signature among the waters traveling away from the diversion system. Measured rates of denitrification were low, less than 1.4 μg NO3-N/h/g.

During the growing season, plant uptake by riparian vegetation results in the minimum NO3-N concentrations in groundwater occurring in the afternoon, and the maximum concentrations measured at night. Decomposition of the vegetation increases NO3-N concentrations and generates organic carbon within the vadose zone. The vegetation is interpreted as a seasonal sink for NO3-N. While a single system is not the basis of review, the reduction of NO3-N by greater than 30% indicates the use of SRBs may help to achieve the 45% reduction goal.

Please see the attached study area diagram, and driving map to reach the site for our meetings closing field trip.

Schematic of the saturated riparian buffer zone

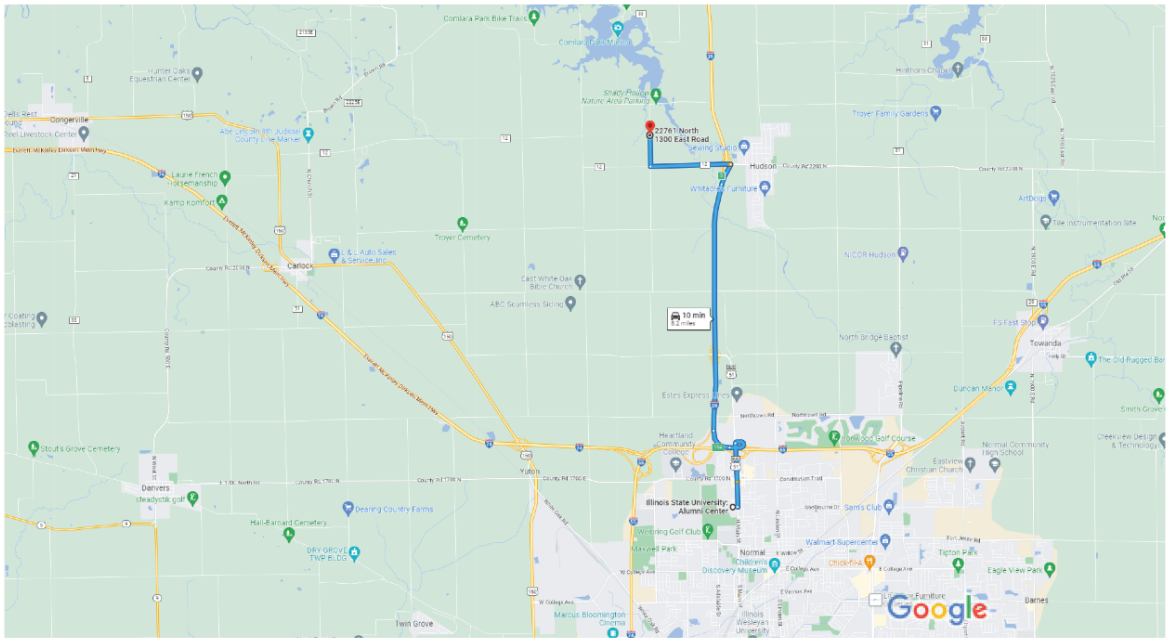


Directions to the saturated riparian buffer from the ISU Alumni Center

Google Maps

Illinois State University - Alumni Center, 1101 N Main St, Normal, IL 61761 to 22761 N 1300 East Rd, Hudson, IL 61748

Drive 8.2 miles, 10 min



Map data ©2023 1 mi

Illinois State University - Alumni Center
1101 N Main St, Normal, IL 61761

1. Head north on N Main St toward Orlando Ave — 1.1 mi
2. Use the right lane to take the I-55 S ramp to St Louis — 0.4 mi
3. Keep right at the fork to continue on Exit 164 — 0.4 mi
4. Continue onto I-39 N — 4.1 mi
5. Take exit 5 toward Hudson — 0.4 mi
6. Turn left onto County Rd 2200 N/W Franklin St — 1.3 mi
7. Turn right onto N 1300 East Rd
   Destination will be on the right — 0.5 mi