ILLINOIS GROUNDWATER ASSOCIATION

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2011 Spring Meeting

Agenda and Abstracts

Dickson Mounds Museum, Lewistown, IL
April 6, 2011

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Illinois Groundwater Association
2011 Spring Meeting

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Dickson Mounds Museum, Lewistown, Illinois

8:30 – 9:00	Registration
9:00 – 9:15	Opening Remarks, Danielle Wallin, IGA Chair
9:15 – 9:45	**Amy Gahala**, *Northern Illinois University*, Impact of Tourism on the Groundwater of the Riviera Maya, Quintana Roo, Mexico
9:45 – 10:15	**Jim Mueller**, *The Adventus Group*, InSitu Chemical Reduction Technologies – Differentiators and Technology Implementation
10:15 – 10:45	Break
10:45 – 11:15	**Shae Birkey**, *AECOM Environment,* TBA
11:15 – 11:45	**Jessie Ackerman**, *Illinois State University*, Quantifying Nutrient from Groundwater Seepage Out of a Constructed Wetland Receiving Wastewater Effluent
11:45 – 1:00	Lunch & IGA Executive Committee Meeting
1:00 – 1:30	**Mark O'Brien,** *JFNew,* Specifying and Procuring Native Plant Material for Alternative Stormwater Management
1:30 – 2:00	**Jonathan W. Love**, *Illinois State University*, Using Natural N Isotopes to Identify Nitrate Removal Mechanisms in Constructed Wetlands Receiving Agricultural Tile Drainage
2:00 – 2:15	Break
2:15 – 2:45	**Steve Wilson**, *Illinois State Water Survey*, The Effects of Irrigation and Pumpage on the Groundwater System in Mason and Tazewell Counties, Illinois
2:45 – 3:15	**Allen Wehrmann**, *Illinois State Water Survey*, Assessment of Groundwater Conditions at the Emiquon Project Area Prior to Flooding
3:15 – 5:00	Field Trip to Emiquon Wetland Restoration—Deanna Zercher, *The Nature Conservancy*

ABSTRACTS

(In order of presentation)

Illinois Groundwater Association – *Spring Meeting*
Wednesday April 6, 2011 - Dixon Mounds, Illinois

Impact of Tourism on the Groundwater of the Riviera Maya, Quintana Roo, Mexico

Amy Gahala, *Northern Illinois University*

The Yucatan Peninsula (YP) is exceptionally vulnerable to pollutants due to the karst geology and the lack of surficial soil. The northeast coast of the YP is a popular tourism destination commonly known as the Riviera Maya. Tourists may be impacting the groundwater along the Riviera Maya due to the corresponding increase in garbage and wastewater. This study sampled several popular sinkholes (locally known as cenotes) frequented by tourists, two waste water treatment plants (WWTP), and four drinking water wells during the low tourism season and again in the high tourism season along the Riviera Maya. A variety of methods were applied to create profiles for each sampling site. Profiles for each sampling site are based on microbial communities, total and fecal coliform, pharmaceuticals, personal care products, antibiotic resistance analysis and geochemical data. The data from the low season and the high season show distinct differences in microbial communities, along with increases in total and fecal coliform and antibiotic resistance. Caffeine, norfloxacin and erythromycin have been found in the drinking water of Tulum and in the effluent of a major municipal WWTP. The results of all the methods applied show evidence of tourists impacting the local groundwater.

In Situ Chemical Reduction Technologies –Differentiators and Technology Implementation

Jim Mueller, *The Adventus Group – Freeport, IL*

In situ chemical reduction (ISCR) as defined herein describes the combined effect of stimulated biological oxygen consumption (via fermentation of an organic carbon source), direct chemical reduction with zero-valent iron (ZVI) or other reduced metals, and the corresponding enhanced thermodynamic decomposition reactions that are realized at the lowered redox (Eh) conditions. A number of enhanced reductive dehalogenation (ERD) and other accelerated anaerobic bioremediation technologies exist (*e.g.*, emulsified oils, oils, carbon-based hydrogen release compounds) that purportedly offer similar responses. However, the original ISCR substrates are unique in their ability to provide ZVI thereby yielding Eh values as low as -600 mV under field conditions. Accordingly, the use of ISCR technologies has recognized potential for managing soil and groundwater environments impacted by chlorinated solvents, pesticides, heavy metals and other constituents of interest (COI). A number of factors have been identified as important variables in remedial design and ISCR technology selection. The potential benefits of ISCR include:

1. No reliance on physical, short-term sequestration of targeted compounds as a primary removal mechanism (as is common with [emulsified] oils);
2. No accumulation of dead-end catabolic intermediates as a function of substrate addition (as is common with [emulsified] oils and sources of carbon only);
3. No physical displacement of COIs via substrate addition and water flushing (as is common with [emulsified] oils);
4. No problems associated with aquifer acidification (as is common with [emulsified] oils and sources of carbon only);
5. Will not mobilize arsenic or other heavy metals yielding secondary contaminants (as is common with [emulsified] oils and sources of carbon only);
6. Has been easily applied globally in many lithologies using conventional construction equipment;
7. Environmental longevity (>5 years);
8. Green and sustainable;
9. Applicability to source areas, hot-spot treatment or permeable reactive barriers;
10. Ability to immobilize heavy metals present as co-contaminants;
11. Cost effective at $2.50/lb (volume discounts apply) and made within the USA;
12. Technology end users and their clients are fully protected from all Patent and other legal issues

With a particular focus on the application of various ISCR technologies under various site settings, the significance of these factors will be discussed and case studies will be presented summarizing various installation techniques/performance/cost.

Practical Wetland Restoration and Lessons Learned

Shae Birkey, *AECOM Environment*

Wetland restoration is a science that has come a long way, with some successes and many more failures to show for it. This presentation is meant to explain the basics of wetland restoration and also describe some of the lessons learned from the viewpoint of two companies who have seen a good number of both failures and successes over time. We hope that by the end of this presentation you will have a better understanding of why wetland restoration is important and how it's done, using lessons learned and adaptive management along the way.

Quantifying Nutrient from Groundwater Seepage Out of a Constructed Wetland Receiving Wastewater Effluent

Jessie Ackerman, *Illinois State University*

The goal of this study is to quantify the removal of nutrients from water that seeps out of a constructed wetland receiving treated wastewater effluent. The Bloomington-Normal Wastewater Reclamation District's treatment facility south of Bloomington, Illinois is currently using constructed wetlands as a final treatment for nutrients by putting a fraction of their treated wastewater effluent in the wetlands before being released into a stream. Shallow and deep wells have been installed around and beneath the wetland. Samples from these wells, the effluent channel and outlet are being analyzed for nitrate, phosphate and chloride. These data will be used to determine the quantity of nutrients being removed from the seepage compared to the total amount of water flowing through the wetland, through groundwater modeling. After sampling it appears that a majority of the nitrate and phosphate seeping out of the wetlands is being removed by groundwater processes. Effluent-groundwater mixing calculations were completed using an effluent chloride concentration end member from the day samples were collected and a groundwater chloride concentration end member from wells located up-gradient of the wetland. The calculations show that a majority of the water sampled from the wells is effluent rich (50-100%), although 3 wells on the berm closest to the wetland are showing low effluent concentrations (<1-40%) possibly due to surface recharge. Data collected when the facility first started shows that there is a lag time of 26 days between when the effluent is released from the plant and when it reaches the groundwater wells between the wetland and stream. From cross-sections constructed using boring logs, seismic data, a pumping test and geochemical data; a numerical model will be constructed using MODFLOW to quantify the amount of water flowing out of the wetland as seepage. The amount of nutrients being removed from the groundwater will be calculated using the modeled seepage and the reduction in nutrient concentrations between effluent and groundwater.

Specifying and Procuring Native Plant Material for Alternative Stormwater Management

Mark O'Brien, *JFNew*

Reviewing new techniques and the native material options associated with establishing alternative stormwater management systems. Raingardens, vegetated swales, buffer strips for streams, ditch banks and detention basins will be highlighted. What material options work best, (plants, seed, live stakes, fascines, coir logs, rooted mats), and what to expect from each. When is this material available and what you need to know when ordering or specifying.

BULLET POINTS OF PRESENTATION HIGHLIGHTS:

- Common challenges with native projects
- Aesthetics vs. functionality
- Cost saving tips
- Critical maintenance requirements

Using Natural N Isotopes to Identify Nitrate Removal Mechanisms in Constructed Wetlands Receiving Agricultural Tile Drainage

Jonathan W. Love, *Illinois State University*

Constructed wetlands can be effective in removing nitrate from agricultural tile drainage. However, there is little research that identifies or quantifies removal mechanisms (primarily denitrification and uptake). We are conducting an investigation on the Gully wetland at the Franklin Demonstration Farm in Lexington, IL that is operated by The Nature Conservancy. The Gully wetlands consists of 3 sequential cells, with the area of each cell representing 3% of the tile drainage area. The natural N isotopic composition of nitrate, macrophytes, and sediments was analyzed in order to calculate nitrification, denitrification, and uptake rates using a N isotopic mass balance equation. The N isotopic composition was shown to be higher in the plants (duckweed and algae: 2.4-9.5‰, cattails: 4.6-7.9‰, arrowheads: 7.1-8.1‰) than the sediments (2.3-7.2‰). The N isotopic composition of N found in nitrate is ranged between 2.0-14.8‰ and progressively increase through each cell. Data collected from four rounds over a 1 year period indicate that denitrification is the dominant mechanism for removing nitrate, because the N isotopic ratios increase as nitrate concentrations decrease through the three cells according a Rayleigh fractionation model. The wetlands remain at least partially effective in removing nitrate by denitrification even in winter when ice covers the surface of the wetlands as indicated decreasing nitrate concentrations and increase N isotopic composition in samples collected in February. The isotopic data also show evidence of dilution by groundwater input and nitrification within the wetlands. Dilution can be seen in the data collected from cell three where groundwater with low nitrate causes a decrease in nitrate concentration without a change in the N isotopic composition. Nitrification can be seen in samples that fall to the right of a Rayleigh curve indicating an increase in the nitrate concentration with little change in the N isotopic composition. The nitrate added by nitrification is not expected to change the overall N isotopic composition because plant matter and sediment are similar in isotopic composition to dissolved nitrate.

The Effects of Irrigation and Pumpage on the Groundwater System in Mason and Tazewell Counties, Illinois

Steve Wilson, *Illinois State Water Survey*

The Havana Lowlands area of Mason and Tazewell Counties in Illinois is known as the Imperial Valley of the Midwest. The area overlies the confluence of the ancient Mississippi and the Mahomet-Teays bedrock valleys. The sandy soils and rolling dunes of this region stand in stark contrast to the typically flat silt loam soils throughout much of the rest of central Illinois. The sand-and-gravel deposits, which make up the surficial unconfined aquifer associated with these two valleys, contain an abundant groundwater resource. The area is used primarily for row and specialty crops, and it is extensively irrigated.

The Illinois State Water Survey (ISWS), under contract to the Imperial Valley Water Authority (IVWA), has operated a network of 20 rain gauges in Mason and Tazewell Counties since August 1992 and a network of 13 observation wells since 1994. The purpose of the rain gauge and observation well networks is to collect long-term data to help determine the impact of groundwater withdrawals, principally for irrigation,, and to evaluate the groundwater system dynamics under varying conditions.

In the last few years, pressure transducers have been placed in the observation wells, allowing for a much more detailed view of how rainfall and pumpage affect recharge. There are nearly 2,000 center pivot irrigation systems in the Imperial Valley and summer irrigation pumpage has been as high 72 billion gallons (590 MGD average over the 4 month irrigation season). Interestingly, groundwater levels in wells remain nearly the same as they were in the 1960’s, when center pivot irrigation was a new technology.

Assessment of Groundwater Conditions at the Emiquon Project Area Prior to Flooding

Allen Wehrmann, *Illinois State Water Survey*

The land surface of the Emiquon area lies at elevations commonly below that of the Illinois River stage and for decades was kept arable by the levee, a dewatering system of drainage tiles and canals, and a pumping station that discharged the tile drainage and canal water to the river. Observation wells were drilled for this project at 15 sites, each about 0.5 to 1 mile apart. Drilling revealed a 15 to 20 ft thick clay layer overlying a fine- to medium-grained, quartz-rich sand deposit. Groundwater elevations were determined in each well, mapped, and contoured. The resulting potentiometric map revealed that the groundwater in the sand deposit is confined, and that heads in the sand have been lowered 5 to 7 feet, principally in the vicinity of the major north-south canal that traverses the Emiquon project area. The groundwater potentiometric surface is believed to reflect the effects of a system of drainage canals and pumping of drained water to the Illinois River by high capacity pumps located at the Thompson Lake pumping station. The configuration of the potentiometric surface along the major north-south canal suggests the confined groundwater, under pressure higher than land surface, is leaking up to the surface through connections created when the canals were cut. Investigations to determine where such groundwater - surface water connections occur, or where such connections contribute most of the water, were conducted with limited success. Methods employed included probing of ditches to examine bottom texture/composition, electrical earth resistivity geophysical surveys, and monitoring of ditch water levels after pumping of ditch sections.

When pumping is suspended, as currently operated, it is expected that groundwater levels will seek to return to the higher elevation through these surface connections, potentially flooding portions of Emiquon permanently. Based on these investigations, the rate of groundwater leakage into Emiquon remains highly uncertain, but is likely much less than contributions from normal precipitation and runoff captured within the Emiquon drainage area. Groundwater contributions could provide a water source during low precipitation cycles. Continuing water management options are likely to be necessary to return historical natural water level fluctuations to the Emiquon.