ILLINOIS GROUNDWATER ASSOCIATION

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2010 Fall Meeting

Agenda and Abstracts

NIU – Hoffman Estates Campus, Hoffman Estates, IL
September 24, 2010

Agenda
Illinois Groundwater Association
2010 Fall Meeting

September 24, 2010
NIU-Hoffman Estates Campus, Hoffman Estates, Illinois

8:45 – 9:15 Registration

9:15 – 9:30 Opening Remarks, **Steve Kroll**, IGA Chair

9:30 – 10:00 **Yi-Chen E. Yang and Yu-Feng F. Lin,** *Illinois State Water Survey,* Managing Water Resources Using WebGIS: Development and Application of an ArcGIS Explorer Toolkit for McHenry County

10:00 – 10:30 **Jack Wittman**, *Wittman Hydro Planning Associates,* Managing the Risks of Irrigated Agriculture near Public Water Supplies: A Case Study near Lawrenceville, Illinois

10:30 – 10:45 Break

10:45 – 11:15 **Karel Waska,** *Northern Illinois University*, Hyper-Alkaline Aquifers of Calumet Wetlands (South Chicago, IL): Biodiversity and Remediation Study

11:15 – 12:00 **Michael Chrzastowski,** *Illinois State Geological Survey,* CHICAGOLAND – A Metropolis Site Determined by Glacial and Coastal Processes

12:00 – 1:00 Lunch & IGA Executive Committee Meeting

1:00 – 1:30 **Philip Carpenter**, *Northern Illinois University,* Non-Invasive Monitoring of Leachate Movement and Gas Migration within a Bioreactor Landfill Cell

1:30 – 2:00 **Hridaya Bastola**, *Illinois State University,* The Use of Tracer Test in Determining Hyporheic Flow Paths as an Aid in Streambed Thermal Modeling

2:00 – 2:15 Break

2:15 – 2:45 **Rick Cobb***, Illinois Environmental Protection Agency,* Summary of Ongoing Challenges on Public Water Supply Safety: Results of Implementing the Groundwater Rule, SB 3070 MCL Prevention Law and Right-to-Know Law

2:45 – 3:15 **George Gaffke,** *Illinois Water Well Licensing Board,* Geothermal Heating Systems Installation and Groundwater

3:15 – 3:30 Open for Comments / Announcements & Closing Remarks, **Steve Kroll**, IGA Chair

4:00 – 7:00 Social Event - Happy Hour and Dinner at Claim Jumpers Restaurant
2610 N. Sutton Road, Hoffman Estates, IL 60192 (847.645.6400)

Saturday, September 25th – IGA/AIPG One-Day Field Trip - "Geology and the Making of a Metropolis"
Hosted by Michael Chrzastowski, ISGS
**Motor coach to depart at 8:00 a.m. at the NIU Hoffman Estates Campus and to return at 5:30 p.m.*

ABSTRACTS

(In order of presentation)

Managing Water Resources Using WebGIS: Development and Application of an ArcGIS Explorer Toolkit for McHenry County

Yi-Chen E. Yang and Yu-Feng F. Lin
Illinois State Water Survey
Institute of Natural Resources Sustainability
University of Illinois

Integration of GIS with decision support systems (DSS) for environmental resources management has been a popular issue for more than a decade. A GIS-based DSS permits visualization of considerations pertinent to the decision-making process and allows informed participation by the non-technical decision maker. However, the information and knowledge contained in GIS datasets cannot be fairly and efficiently shared until all interested parties have access to GIS software. This problem has been addressed with the recent release by the Environmental Systems Research Institute, Inc. (ESRI) of a free, lightweight GIS browser, ArcGIS Explorer, a development with significant promise for community participation in planning via a GIS-based DSS.

The ubiquitous WebGIS Analysis Toolkit for Extensive Resources (uWATER) is an ArcGIS Explorer plug-in package developed by the Illinois State Water Survey for visualizing and analyzing decision support variables such as groundwater modeling results. The uWATER package was coded in Microsoft Visual Basic and designed to utilize the computing capacity of a single laptop computer. This presentation will demonstrate an application using uWATER for groundwater resource management in McHenry County including: 1) visualizing heads computed by a numerical model; 2) computing drawdown; 3) identifying hydrologic assets (such as fish habitats, streams, and wetlands) threatened by pumping. uWATER is free and can be downloaded from http://www.sws.uiuc.edu/gws/sware/uwater/. The download package includes the plug-in program, user's guide, and sample files.

Managing the Risks of Irrigated Agriculture near Public Water Supplies: a case study near Lawrenceville, Illinois

Jack Wittman, PhD
Director of Layne GeoScience
Bloomington, IN

Agriculture has, to some extent, already affected groundwater quality in the outwash aquifer used by the City of Lawrenceville. In recent years, concerns have grown because there has been a continuous increase in the maximum nitrate (NO3) levels in drinking water wells. The wells are constructed in the floodplain of the Wabash River and a low concentration of nitrate is a natural component in this shallow groundwater system. That background nitrate is a product of the oxidation of ammonia in soils and of other nitrogen-containing compounds that result from decaying organic matter. Because nitrogen is a critical nutrient for plant growth and modern agricultural practices include applications of some fertilizers, water supplies in much of the Midwestern United States have experienced increases in nitrate when the source is a shallow aquifer.

Since 1982, the concentrations of nitrate in water samples at Lawrenceville have increased steadily, although in recent years the concentration has become more variable. More importantly, since 1998 samples of water from the Lawrenceville wells have had nitrate concentrations that exceed the MCL. Increasing levels of nitrate in water wells may often be the result of increased fertilizer application, increasing use of irrigation, or both. The old Lawrenceville wells were all developed several decades ago, and their screens were all set at shallow depths in the aquifer, which could contribute to the problem. In order to reduce the frequency of nitrate contamination above the MCL and improve the long-term water quality in Lawrenceville, a new well field has been constructed southeast of the original well field. The wellhead protection program that was developed for the City of Lawrenceville included measures to ensure the safety of their new wells. The new wells were constructed deeper than the current well field to avoid water with the highest nitrate concentrations. The new well field along with a new ordinance protecting the area around the wells from additional contamination should help agriculture and water supply coexist in this area.

CHICAGOLAND –
A Metropolis Site Determined by Glacial and Coastal Process

Michael J. Chrzastowski, Ph.D., P.G
Senior Coastal Geologist
Illinois State Geological Survey
Champaign, IL 61820-6964

The glacial processes that shaped the Great Lakes Region had similar impacts across most of the region, removing pre-existing unconsolidated materials down to bedrock, scouring the bedrock surface, depositing till in ground and end moraines, and establishing a new topography and new drainage patterns. However, at the southern end of the Lake Michigan basin, in the area of present-day Chicago, a unique glacial shaping of the landscape occurred. End moraines were formed that could act as a dam to hold glacial lake water at an elevation about 60 feet (18 m) higher than the historical mean, and glacial-fluvial erosion breaching this morainal dam allowed glacial and post-glacial lake water to drain to the Mississippi River system. As lake level declined to the modern level and as the Chicagoland river system developed, a natural waterway passage formed in the Chicago area between the Great Lakes and Mississippi River watersheds. A critical factor in this waterway connection was coastal erosion that established the location of the mouth of the Chicago River. The site of Chicago was thus destined by glacial and coastal processes to be the most significant waterway transportation center in the mid-continent, but major geo-engineering would be needed for urban growth. The Chicago River mouth needed straightening and protection from shoaling, the land of the central business district needed to be raised for improved drainage, and ultimately the flow direction of the Chicago River needed to be reversed to redirect sewage and protect the water quality of Lake Michigan. All of this geologic and human-induced landscape shaping is now a backdrop to ongoing considerations for future geo-engineering to modify or terminate this Mississippi River to Great Lakes watershed connection. That connection, interestingly, is the very reason for the founding and growth of Chicago.

Non-invasive Monitoring of Leachate Movement and Gas Migration Within a Bioreactor Landfill Cell

Philip J. Carpenter, Dept. of Geology and Environmental Geosciences
Northern Illinois University, DeKalb, IL USA

Solenne Grellier, Veolia Environmental Services Research Center, Limay, France

Krishna R. Reddy, Dept. of Civil and Materials Engineering
University of Illinois at Chicago, Chicago, IL USA

Michael Thompson, MDT Associates, Inc.
Bolingbrook, IL USA

Abstract

Bioreactor landfills enhance waste degradation through recirculation of leachate inside the waste mass. In this study frequency-domain electromagnetic (EM) conductivity was measured along several profile lines before, during and after leachate injection at a cell at the Orchard Hills landfill, 15 km south of Rockford, Illinois. Electrical resistivity tomography (ERT) measurements were also made before, during and after leachate recirculation. One profile line was located above and coincident with a leachate recirculation line (LRL). The other profiles were perpendicular to LRLs, which varied in depth from 5-15 m below the EM lines. Apparent conductivity increased along segments of the EM profile over the LRL during injection of 17.8 m^3 of leachate, when measured with a Geonics EM34 at 10 and 20 m vertical dipole separations. These zones also correspond to zones of decreased resistivity in the corresponding ERT sections. Leachate injection appears to be non-uniform along the LRL, with larger volumes entering the refuse at the beginning, middle and ends of the injection interval. EM and ERT values during a second experiment, however, in which a smaller leachate volume was injected, showed no change.

During the fall of 2007 three seismic lines were profiled at the Orchard Hills landfill. Two of these lines were over different parts of the bioreactor cell. An additional seismic line was deployed over new waste, to assess changes in seismic velocity over time due to waste degradation and compaction. A multi-channel, engineering seismograph was used with a 7.3 kg sledgehammer as the energy source. Both compressional (P) and horizontally-polarized shear (SH) waves were transmitted and recorded through the upper 7-to-10 m of the cell. Tomographic inversion of the P- and SH-wave data revealed a major boundary within the bioreactor cell waste at depths of 3-6 m. Both P- and SH-wave tomograms image this boundary, as do Vp/Vs plots and Poisson's ratio images. It cannot be due to saturation, since it far above the LRLs in this area. It probably represents a major physical property change in the biodegrading waste. A reduced P-wave velocity zone at elevation approximately 244 m, approximately 7-8 m below the surface, is situated beneath the highest point of the bioreactor cell. This zone could represent an accumulation of landfill gas, but needs to be imaged with more raypaths to see if it is an artifact of recording geometry or if it is a real feature.

The Use of Tracer Test in Determining Hyporheic Flowpaths as an Aid in Streambed Thermal Modeling

Hridaya Bastola
Illinois State University

The thermal profile of a streambed is affected by a number of factors including temperature of both stream water and ground water, hydraulic conductivity, thermal conductivity and heat capacity of the streambed, and the nature of hyporheic flowpaths. Seasonal changes in thermal profiles could therefore be documented in terms of seasonal changes in these parameters. In the study, temperature data were collected at depths of 30, 60, 90 and 150 cm at six hyporheic wells 5 meters apart along the thalweg of a third-order, low gradient stream. Thermal models of the streambed were built using VS2DHI to simulate the thermal profiles observed in the field. Deviations from observed temperature were calculated using mean absolute error (mae). Sensitivities of hydraulic and thermal parameters used in the model were identified and the more sensitive parameters were first corrected before adjusting for the less sensitive parameters. Models for a week long time period in April suggested a higher sensitivity of the model to saturated thermal conductivity, vertical flux and low sensitivity for porosity, dry heat capacity of the streambed, and vertical to horizontal hydraulic conductivity ratio. After adjusting parameter values the model improved to a mae of 0.29 °C. The spring model was not the best fit model when used for week long periods in summer and winter yielding mae of 1.34°C and 1.12°C respectively. Adjustments to the parameters resulted in mae of 0.94 and 1.06 °C for respective models. Comparison of the parameters showed significant differences in saturated thermal conductivity and porosity between the spring, winter and summer time periods. A steeper temperature gradient was observed in the shallow subsurface during the winter time period and a relatively gentle negative temperature for the summer time period. Also, study of hyporheic extent using chloride suggested a complicated regional hyporheic flow pattern. However a bromide tracer test done in the study area suggested a shallow local hyporheic extent that was mostly consistent with the homogeneous textural and upwelling conditions used in the models.

Summary of Ongoing Challenges on Public Water Supply Safety: Results of Implementing the Groundwater Rule, SB 3070 MCL Prevention Law and Right-to-Know Law

Rick Cobb
Deputy Manager, Division of Public Water Supplies
Illinois Environmental Protection Agency

Groundwater quality and quantity are linked. Based on population growth trends, the Illinois State Water Survey study found the State of Illinois may need up to 50 percent more water within 40 years. These combined factors make it imperative to reverse degradation trends, and to manage for potential diminishment of ground and surface water resources.