Revised Agenda and Abstracts

Illinois Groundwater Association
2003 Spring Meeting

Thursday, April 10, 2003
Fermi National Laboratory
Batavia, Illinois

REVISED AGENDA

ILLINOIS GROUNDWATER ASSOCIATION
2003 SPRING MEETING

THURSDAY, APRIL 10, 2003
FERMI NATIONAL LABORATORY, BATAVIA, ILLINOIS

8:15-9:20	Registration, Coffee & Doughnuts/Muffins/Bagels
9:20-9:30	Opening Remarks: Ed Mehnert, IGA Chair

Session 1 - Groundwater Planning, Management and Assessment

9:30-9:50	**Martin Jaffe**, College of Urban Planning and Public Affairs, University of Illinois at Chicago (specific topic may vary), *Managing the Chicago Metropolitan Region's Water Supply*
9:50-10:10	**Kelly Warner**, U.S. Geological Survey *Regional Framework for Assessing Water Quality in Glacial Deposit Aquifers*
10:10-10:30	**Paul Schuch**, Kane County Water Resources Department *Kane County's 2020 Land Resource Management Plan and Water Resource Planning*
10:30-10:50	Break
10:50-11:20	**Bill Dey, Randy Locke, and Doug Walker**, Illinois State Geological and Water Surveys *An Overview of the Kane County Water Resources Investigation*
11:20-11:40	**Brandon Curry**, Illinois State Geological Survey *Hydrogeologic Characteristics of Nelson Lake, Kane County, Illinois*
11:40-11:55	Awards Presentation
11:55-1:00	Lunch

Session 2 - Groundwater Planning, Management and Assessment

1:00-1:20	**Sarah Nerenberg**, Northeastern Illinois Planning Commission *Better Site Design for Water Resource Protection*
1:20-1:40	**Beau Harp**, Patrick Engineering, Inc. *Mining and Groundwater Resources near Bartlett, Illinois*
1:40-2:00	Business meeting and open mic for announcements to the Association
2:00-2:10	Break
2:10-2:30	**Paul Kesich**, Fermi National Accelerator Laboratory *FNAL Groundwater Monitoring Program*
2:30-2:50	**Mike Nellinger** and Philip Carpenter, Dept. of Geology and Environmental Geosciences, Northern Illinois University, *Geophysical Identification of Karst Recharge Features and Conduits in East-Central Illinois*
2:50	Adjourn

Presenters names are in bold type

Managing the Chicago Metropolitan Region's Water Supply

Martin Jaffe

Associate Professor, University of Illinois at Chicago, College of Urban Planning & Public Affairs, 412 S. Peoria Street, 215 ALHS (M/C 348), Chicago, IL 60607-7067, 312-996-2178, mjaffe@uic.edu

The Chicago metro area is projected to grow by 1.8 million by the year 2020 but there are concerns that there may be water supply resources to meet projected demand. Lake Michigan is the region's largest surface-water resource, since the need to maintain stream baseflows precludes the extensive use of other surface waters, but it also remains legally constrained as a water supply resource. Since the deep Elmhurst-Mt. Simon aquifer has poor ambient water quality and pumpage from the Cambrian-Ordovician aquifer exceeds the resource's estimated sustainable yield, the region's shallow aquifers remain the metro area's most feasible future water supply resource.

Management of Lake Michigan water is undertaken pursuant to U.S. Supreme Court decrees and federal and state laws. Other water resources are regulated by various state agencies under diverse state laws addressing water quality, but not quantity. One option is to increase the scope and stringency of the State's water resources management programs. This includes mapping and studying the region's shallow aquifers, expanding state regulatory authority to manage water supply withdrawals, and authorizing conjunctive use. Alternatively, water pricing strategies can also be considered, no longer treating water as a free good but instead letting the market determine its true value and allocational utility, subject to price contraints to ensure equity. Finally, market-based economic instruments can be considered, perhaps modeled on "cap and trade" air pollution control strategies. Transferable state water allocation permits can be created, allowing water rights to be bought and sold within the region to encourage conservation and conjunctive resource use.

Regional Design for Monitoring Ground-Water Quality in the Glacial-Deposit Aquifer System of the United States

Kelly L. Warner

Hydrologist, U.S. Geological Survey, 221 N. Broadway Avenue, Urbana, IL 61801, 217-344-0037

The glacial-deposit aquifer system covers approximately 660,000 square miles of the conterminous United States. The glacial-deposit aquifer system includes ground water in all glacial material. Ground-water withdrawals for drinking-water supply in 1990 from this aquifer system is larger than from any other aquifer system in the U.S., accounting for about 13 percent of all ground-water withdrawals for drinking-water supply. The unconsolidated and generally unconfined nature of this aquifer system, plus the relatively high recharge rates compared to other systems, make the aquifer system susceptible to anthropogenic sources of contamination. Long-term monitoring of ground-water quality in these areas is, therefore, an important aspect of a ground-water-protection strategy for the glacial-deposit aquifer system.

The challenge in designing a ground-water-quality monitoring program for the glacial-deposit aquifer system is how to provide a high-quality assessment given limited monitoring resources. The approach used by the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program to design a regional water-quality monitoring network was to classify and map the aquifer system on the basis of 3 variables: (1) the hydrogeomorphic environment; (2) aquifer susceptibility, and; (3) aquifer vulnerability. Once classified, historical and ongoing monitoring, as well as information gaps in each aquifer class within the system, will be identified. In order to select the most critical areas for both new and continued water-quality monitoring, these areas were prioritized on the basis of relative amount of withdrawals for drinking-water supply and likelihood of anthropogenic contamination. This approach also provides a framework for linking NAWQA studies to State and local monitoring programs.

Kane County's 2020 Land Resource Management Plan and Water Resource Planning

Paul M. Schuch, P.E.

Director, Kane County Water Resources Department, 719 Batavia Avenue, Geneva, Illinois 60134, 630-232-3497, schuchpaul@co.kane.il.us

Most of Kane County's municipalities are planning, managing and making decisions for their potable water supplies independent of other communities in the County and in the Region. The NIPC Draft Strategic Plan for Water Resource Management (September 2001) predicts potential water shortages by the year 2020 in four (4) county townships (Rutland, Geneva, St. Charles and Dundee) if current population growth trends do not change and if additional sources of water are not found. Townships and municipal boundaries overlap aquifer and watershed boundaries. How can the County provide guidance and assistance to water managers and policy makers throughout the County in planning, managing and making sound water supply decisions for the future?

Protecting and planning for the sustainable water supply of Kane County is called for in the County's 2020 Land Resource Management Plan. The Plan's goal for Natural Resources (page 10) states that "All development decisions should consider the conservation and wise use of the soil, air, **water resources,** [emphasis added] and the natural environment of Kane County". The Plan is intended to be a shared community vision for future growth throughout the whole County. The Plan designates eight (8) Planning Partnership areas within the County for the orderly implementation of the Plan's goals.

The Planning Issues section identifies certain Water Resource objectives (page 47) including recognition of the interaction between land and water resources, protection and enhancement of the quantity and quality of ground and surface waters for drinking water supplies, reduction of pollutants that may affect water supplies, and encourages watershed planning that fosters understanding of the finite and irreplaceable water resources.

The Planning Policies section identifies certain Water Resource policies (page 58) that include the protection of groundwater, the principal source of potable water in Kane County; the encouragement of water conservation programs; the development of a Countywide Stormwater Management Plan; the development of a comprehensive set of Countywide water resource management regulations to preserve and protect watersheds, stream banks, floodplains, wetlands and groundwater recharge areas; and, while there is insufficient regulatory data available at the present time, the requirement that new developments study and report proposed sources of potable water supply and the impacts to existing wells.

The County has contracted with the ISWS and ISGS to gather and study existing and new geologic and hydrogeologic data for both the shallow and deep aquifer systems underlying the County and enter the data into a Geographic Information System database. The ISWS and ISGS will then create both geologic and hydrogeologic models to assist in future planning for the County under a new 2030 Land Resource Management Plan now being written. In the future, possible water regulatory measures using the data and models from the ISWS and ISGS study as the scientific basis, may need to be enacted within the County to ensure a long-term, sustainable water supply.

Status Report on Water-Resources Investigations for Kane County, Illinois

Randall A. Locke II[1], William S. Dey[2], and Douglas D. Walker[3]

[1] *Illinois State Water Survey, 2204 Griffith Drive, Champaign, IL 61820, 217-333-3866, rlocke@uiuc.edu*
[2] *Illinois State Geological Survey, 615 E. Peabody, Champaign, IL 61820, 217-244-2779, dey@isgs.uiuc.edu*
[3] *Illinois State Water Survey, 2204 Griffith Drive, Champaign, IL 61820, 217-333-1724, ddwalker@uiuc.edu*

Water-resources management in Kane County faces a challenging future. In addition to natural constraints on water availability, other factors like future population demands, impaired quality, and legal constraints will warrant consideration. The Illinois State Water Survey and Illinois State Geological Survey jointly proposed a series of hydrological and geological investigations to provide technical support for management and protection of water resources listed in the *Kane County 2020 Land Resource Management Plan*. The specific objectives of the investigations are to assist the County in:

- protecting groundwater quality;
- preserving groundwater availability;
- providing a basis for formulation of policy and management strategies for its water resources; and
- providing baseline data and a framework for future studies.

The Surveys plan to accomplish these objectives through geological and hydrological field studies, records searches, development and analysis of databases, and mapping and modeling of the geologic, groundwater, and surface water systems. The investigations began May 1, 2002 and will continue through April 30, 2007.

Nearly a year into the investigations, significant strides have been made in geologic mapping, groundwater mapping and numerical model development. Geologic mapping efforts have included the compilation of a database of 27,160 wells and boring records and 1400 seismic reflection data points. All records have been ranked for data quality and nearly 3400 well locations have been field verified.

Groundwater mapping efforts have focused on developing a network of public and private wells finished in shallow aquifers. Through March 28, 2003, an estimated 1500 well owners have been contacted and permission has been granted for use of 420 wells. These wells have been surveyed by GPS and well data including preliminary water level measurements have been compiled. This well "inventory" will continue through July 2003 and will be followed by a synoptic measurement of water levels in the fall of 2003.

Groundwater modeling activities have included assembling an interstate geological framework, building a database of water withdrawals, and assembling data for a regional model of the entire aquifer system. A series of databases and GIS files are being created for storage, retrieval, and processing of this data. A preliminary regional model has been assembled, and will begin yielding useful results in late 2003.

Investigation of the Geology, Geohydrology, and Paleoenvironment of Nelson Lake Marsh, Kane County, Illinois

B. Brandon Curry[1] and William S. Dey[2]

[1]*Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820, 217-244-5787, curry@isgs.uiuc.edu*
[2]*Illinois State Geological Survey, 615 E. Peabody, Champaign, IL 61820, 217-244-2779, dey@isgs.uiuc.edu*

Covering 110 acres, Nelson Lake is part of an Illinois Nature Preserve imbedded in the Kane County Forest Preserve's largest property. Part shallow lake, pristine calcareous fen, former peat mine, and restored prairie, the diversity of plants in the preserve is one of the greatest known in northeastern Illinois. It also is visited by migrating birds and used for nesting by endangered animals such as the sand hill crane. The objective of this investigation was to provide the Kane County Forest Preserve with baseline information on the geology and hydrogeology of the Nelson Lake watershed.

Nelson Lake occupies a kettle, a depression formed during the last glaciation. The surficial geology east of Nelson Lake is completely different from that on the west side. On the east side of the lake, the glacial drift is about 70 to 100 feet thick, and composed primarily of silty and clayey diamicton with relatively little sand and gravel. On the west side of the lake, the drift is as much as 150 feet thick and includes a thick succession of bouldery sand and gravel. The results of high-resolution electrical earth resistivity transects indicate a narrow zone where the two contrasting geologic successions merge. The transects also show that thick lake sediment, at least 60 feet thick, underlie the northern end of the Nelson Lake marsh, and that the basin is probably made up of several coalescing kettle depressions.

Our moisture balance study for the water year 2000 determined that moisture was redistributed to the basin and atmosphere in the following proportions: 78.0% - evapotranspiration; 12.6% - lake overflow; 4.7% - lake evaporation, 3.3% - increase in groundwater storage, and 1.4% - increase in lake storage or lake level. A detailed bathymetric survey reveals that Nelson Lake has an mean depth of less than 4 feet, a maximum known depth of 6.9 feet, and stores about 1.9 x 10 ft^3 of water. Considering the balance between the volume of water lost to overflow and evaporation, and the maintained lake level, the mean residence time of the water in year 2000 was no more than about 3 months.

An ion mass balance suggests that about 15% of the water in Nelson Lake is derived from groundwater inflow. The balance is based on the mass of dissolved ions found in the lake water lost to overflow vs. the mass of dissolved ions in groundwater needed to replenish the lost ions. The balance assumes negligible amounts of dissolved ions enter the lake via overland flow. The balance is hampered by the lack of any truly conservative ions (that is, ions which do not participate in any chemical or biochemical reactions once they enter the lake or are affected by anthropogenic additions). The most conservative ions in the balance were Ca^{++}, Mg^{++}, Sr^{++}, and HCO_3^-. Ions that would participate in the precipitation of calcite seem to work in the balance in part because the dissolved ion composition of Nelson Lake water is below the saturation index of calcite. Aquatic snails and ostracodes are abundant in Nelson Lake today, but shells that remain at the sediment/water interface eventually dissolve unless they are protected by sediment. Na^+ and Cl^- were clearly not conservative, and are probably added to the basin through septic effluent.

Better Site Design for Water Resource Protection

Sarah B. Nerenberg

Director of Natural Resources, Northeastern Illinois Planning Commission, 222 South Riverside Plaza, Suite 1800, Chicago, IL 60202, 312-454-0400, snerenberg@nipc.org

The Northeastern Illinois Planning Commission (NIPC) has been a regional leader for the past decade in promoting and educating developers and communities about the practices of better site design with an emphasis on water resource protection. Recently, NIPC completed a Conservation Design Resource Manual which provides background to communities and practitioners on site design practices and language to amend local ordinances. Many of the practices, compared to conventional development practices, result in reduced demand on water and better potential groundwater recharge. The main principles covered in this manual that will be presented are:

1. **Develop Flexible Lot Design Standards** (e.g., lot size, density, and suggested open space, arranging the development site, and building setbacks)
2. **Protect and Create Natural Landscapes and Drainage Systems** (e.g., natural area protection and conservation, natural landscape sensitivity, natural landscaping, and open space management)
3. **Reduce Impervious Surface Areas** (e.g., including roadway design, parking lot design, vegetated swales, walkways, driveway design, roof runoff management)
4. **Implement Sustainable Stormwater Management Techniques**

Mining and Groundwater Resources near Bartlett Illinois

Lawrence L. Holish, PE

Senior Project Manager, Patrick Engineering Inc., (630) 795-7357, lholish@patrickengineering.com

Probably the most important task of any site investigation is characterizing the natural geologic and hydro-geologic conditions. The characterization of geological heterogeneity is one of the most difficult problems we face. Understanding the hydro-geologic conditions can make the difference between success and failure in site characterization, since any anomalous conditions will often control the integrity of the soil and rock mass, ground water flow and contaminant transport.

To ensure that underground aggregate mining operations can co-exist within the near proximity of the Bluff Springs Fen (Fen) a regional groundwater study was undertaken. The Fen is a boggy irregularly defined area that is reportedly recharged by an artesian upper limestone (Niagaran Age Formation) bedrock aquifer. Groundwater from the upper limestone bedrock aquifer produces complex alkaline reactions altering water conditions in the Fen that in turn provides favorable biological and chemical environment for some rare flora. Proposed portal operations at the Mine will intersect and pass through the same bedrock aquifer that is purported to supply water to the Fen albeit distant and cross gradient. Previous groundwater flow characteristic assessments have indicated as much as 7% of the total water supply moving through the Fen will have originated from the south and proposed mine area

Anticipated groundwater flowing into mine limestone excavations will be pumped from the excavation potentially causing a hydraulic sink in the aquifer. The expected duration and the magnitude of the pumping from the bedrock aquifer will initiate a reduction in the hydraulic heads at the mine operations area. And, if the pumping is sustained and un-monitored interested parties have postulated a possibility to reduce water levels in the Fen, hypothesizing an effect on the bio-system.

The magnitude and the extent of adversity to the Fen bio-system would be initially projected to be small. However, the political and Scio-environmental consequences of an envisaged water supply reduction to the Fen will have a strong likelihood of delaying the mining project. In order to ensure that mining operations do not adversely affect the Fen, a two-tier system was recommended and will be implemented early within the project timeline to establish baseline (non-pumping) conditions. The first tier will consist of a strategically placed network of observation wells designed to accurately monitor chronological / seasonal changes of potentiometric elevations in the bedrock aquifer, and the ancillary shallow sand and gravel deposits that immediately underlie the Fen.

The second component of the recommendation is provision of monitoring data utilization in combination with characterization of theoretical groundwater level impacts considering probable dewatering / pumping scenarios. Through an understanding of the predictable impacts contingent upon the execution of alternative excavation dewatering methods, and as forecasted by a site groundwater management model decisions regarding mitigating measures may undertaken prior to an impact to the Fen eco-system. The management model which was developed and calibrated to the measured hydraulic regime while allowing reasonable, predictable, and cost effective mitigation when and where needed.

FNAL Groundwater Monitoring Program

Paul Kesich

Environmental Protection Group, Fermi National Accelerator Laboratory, 630-840-4495, pkesich@fnal.gov

Fermilab is a Department of Energy high energy physics research facility operated by Universities Research Association, Inc. The facility is located on 6,800 acres east of Batavia. Groundwater investigations center around four main issues at the laboratory: routine monitoring for stewardship management, permit related monitoring for the sites RCRA Facility Investigation Solid Waste Management Units, pre-operational design and special project impacts.

This presentation will cover aspects of all issues with major emphasis on the results of the NuMI project. The NuMI project at Fermilab required the construction of a roughly half mile long slightly angled tunnel located 100 to 350 feet below the surface. It will be used as the site of generation of a stream of subatomic particles called neutrinos for a unique physics experiment. The neutrino is a subatomic particle — but an odd one. It carries no charge and has little or no mass. Scientists believe that if they can determine that neutrinos do have mass, they will have answered a number of questions, including the identity of part of the "missing" or dark matter that possibly fills the universe. The 20-foot diameter mostly unlined tunnel was constructed in the upper bedrock formation, which supplies drinking water to not only Fermilab but also some of its neighbors, and the Maquoketa confining unit. The formations consist of Silurian-aged dolomite and Ordovician-aged shales and dolomites. Inflow during construction has averaged around 300 gallons per minute (gpm) with high flows up to 500 gpm. After the tunnel is completed it will continue to receive inflow of around 200 gpm. This inflow is collected and pumped to the surface. During construction water has been discharged to surface water under a NPDES permit for non-coal mines. During operation water will be pumped for use as industrial cooling water with a small additional discharge to surface water of 20 gpm that will be addressed within the sites combined NPDES permit.

Geophysical Identification of Karst Recharge Features and Conduits in East-Central Illinois

Michael L. Nellinger and Philip J. Carpenter

Dept. of Geology and Environmental Geosciences, 312 Davis Hall, Northern Illinois University, DeKalb, Illinois

A significant portion of the world's drinking water is contained in karst aquifers. These aquifers are generally highly susceptible to contamination, with numerous points of entry for contaminants through various types of karst recharge features such as sinkholes, swallow holes and soil pipes. These features are generally associated with the deeper hydraulically-active bedrock conduits of the karst aquifer. Such conduits may be extensive and complex: their identification could greatly enhance understanding of flow paths and be invaluable in pollution prevention and/or remediation efforts. To test the hypothesis that geophysical methods could be used to identify conduits and recharge features the western portion of Perry Farm Park, Bourbonnais Illinois, was examined using two-dimensional electrical resistivity imaging (2D-ERI) and ground penetrating radar (GPR). The tests were conducted in an area with 1 to 4 meters of loess and till overlying karstic Silurian dolomite. The 2D-ERI inverted sections suggest an undulating bedrock surface between 2.2 and 3.2 meters depth, several possible air-filled near-surface conduits (high resistivity anomalies) and several possible hydraulically-active conduits deeper in the bedrock. A bedrock conduit at 2.5 m depth and a paleocollapse feature were imaged by GPR in a location reasonably coincident with one of the high resistivity anomalies in the 2D-ERI sections. These results suggest 2D-ERI and GPR are viable tools for mapping conduits and recharge features in a thinly-mantled karst terrain.