Illinois Groundwater Association

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2008 Spring Meeting

Par-A-Dice Hotel, East Peoria, IL
April 8, 2008

Agenda and Abstracts

AGENDA

Illinois Groundwater Association

2008 Spring Meeting

April 8, 2008

Par-A-Dice Casino, East Peoria, Illinois

8:30–9:15 Registration
9:15–9:45 Opening Remarks, Presentation of Awards: **Dan Horvath**, IGA Chair

Morning Session

9:45- 10:15 **Bill White**, *Illinois State Water Survey,* Framework for Project Identification and Restoration of Watersheds in the Illinois River Basin: Senachwine Creek Case Study

10:15-10:45 **John Keller**, *Southern Illinois University*, Creation of a Highly Accurate Axisymmetric Numerical Model for the Analysis of Aquifer Tests

10:45-11:15 **BREAK**

11:15-11:45 **Rick Twait,** *City of Bloomington*, Water Supply Planning for Bloomington, Illinois: Adaptations to the Regional Vision

11:45-12:15 **Dominic Strezo**, *Illinois State University*, Quantifying the effects of beaver dams on hyporheic nitrogen cycling

12:15-1:45 **Lunch**

1:45-2:00 Update from **Jerry Dalsin** on IDPH and regulations

Afternoon Session

2:00-2:30 **Samantha Lax,** *Illinois State University*, Creating a model to estimate stream chloride concentrations as a function of land use change for two small watersheds in central Illinois

2:30-3:00 **Greg Dunn**, *Illinois Environmental Protection Agency*, Indoor Inhalation Update

3:00-3:30 **Walt Kelly,** *Illinois State Water Survey*, Increasing Chloride Concentrations in Shallow Groundwater and Surface Water in the Chicago Region

3:30-4:00 Closing Remarks: **Dan Horvath**, IGA Chair, OPEN MIKE

Public Evening Session

4:00-5:00 Public Meeting: Water Resources Planning for the Peoria Area

Part 1: Water Resources in Central Illinois

Part 2: Water Use in the Region

Part 3: Current Water Management Planning Process

ABSTRACTS

(In order of presentation)

Framework for Project Identification and Restoration of Watersheds in the Illinois River Basin: Senachwine Creek Case Study

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Erosion and sediment deposition has been recognized as a main environmental problem in the Illinois River Basin. Project identification in watersheds and streams and implementation of restoration is necessary to reverse the effect of past disturbances and the continued trend toward further ecological and infrastructure degradation. Watershed assessments which identify on-the-ground natural resource restoration targets are well received by the public and by public institutions in charge of funding ecosystem restoration efforts.

The Scientific Surveys from the State of Illinois are performing assessment and evaluation of specific watersheds in the Illinois River Basin in order to facilitate implementation of the larger goals of the Illinois River Basin Ecosystem Restoration Plan. Watershed assessments include use of existing data and collection of new data. The assessments includes analysis of existing Geographic Information System (GIS) data, collection of digital aerial imagery of specific sub-basins selected for survey using consensus driven criteria, and field data collection and analysis of geomorphological and biological indicators. Data is being used specifically to locate, characterize, and prioritize multi-objective restoration projects that reduce erosion, restore habitat, and protect overall ecosystem health. Assessment using a low level aerial camera attached to a helicopter with a synchronized Global Positioning System allows for relatively rapid identification of the location and general nature of targets such as critical erosion areas, potential wetland restoration sites, and channel re-meandering opportunities. More thorough biological and geomorphological field assessments are then performed to understand local reach scale erosion issues and systemic causative factors. Senachwine Creek, a direct tributary to Peoria Lakes in the central part of Illinois is used to illustrate the assessment approach. The IGA discussion will briefly describe the framework and criteria for selecting sub-basins, watersheds, and sub-watersheds for the aerial assessment and field data collection efforts and utilize the Senachwine Creek watershed as a case study of specific data interpretation efforts.

Creation of a Highly Accurate Axisymmetric Numerical Model for the Analysis of Aquifer Tests

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The spatial determination of hydraulic conductivity (K) is perhaps the most crucial component of any groundwater investigation. Single well tests (slug tests) or multiple well tests (pump tests) on monitoring wells have historically been employed to estimate aquifer properties such as hydraulic conductivity. Generally, various analytical curve-matching techniques are utilized in the analysis of field data. However, most analytical methods cannot handle real-world heterogeneity. Numerical methods have been developed to overcome the limitations behind analytical solutions. Some of the existing numerical methods; however, have drawbacks such as coarse cylinder spacing directly adjacent to the well and coarse time steps, which adversely affect the accuracy of the model. We developed a new flexible radial model that can reproduce well hydraulics with a high degree of accuracy.

Our numerical model incorporates small cylinder spacing and time steps and applies the Crank Nicolson method, an average between fully implicit and explicit conditions, to improve accuracy. Also unlike existing numerical models, it can simulate both slug and pump tests and employs a user-friendly interface that prints the results directly to an Excel spreadsheet. The computer code can reproduce established analytical solutions including Theis (1935; 1940), Hantush and Jacob (1954), and Cooper-Bredehoeft-Papadopulos (1967). Data points generated from the numerical model fall directly on top of curves from all three analytical solutions.

The numerical model may have application to tests conducted with the Direct Push Permeameter (DPP), a new methodology developed by the Kansas Geological Survey (KGS). This new field technique was developed to overcome the presence of a zone of disturbance typically created in the installation of monitoring wells. Disturbed materials near the borehole can lead to underestimation of hydraulic conductivity. The DPP technology has the potential to determine K on a much finer spatial scale than current methods while also improving the vertical resolution. Further research will attempt to match DPP field data to data simulated with the cylindrical finite-difference model.

Water Supply Planning for Bloomington, Illinois: Adaptations to the Regional Vision

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Like any municipality, the City of Bloomington has the responsibility of ensuring a safe and reliable water supply for the citizens it serves. Adequate supply is determined by many factors in addition to source water quantity, such as water quality, treatment and distribution capacity, consumption patterns, rates, and response to drought and other shortages. This talk will describe Bloomington's efforts to address those factors in order to meet long term and interim water demands. The current efforts will also be related to the regional water supply concept that originated from the problems encountered during the 1988-1989 drought.

Quantifying the Effects of Beaver Dams on Hyporheic Nitrogen Cycling

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This research has been designed to quantify the role that a beaver dam plays on hyporheic nitrogen cycling. The placement of a dam increases hyporheic flux by increasing the downward hydraulic gradient across the dam. The subsurface flow path length may also increase, thus lengthening the residence time within the geochemically active hyporheic zone. Quantifying the role of beaver dams could be valuable in evaluating the merit of using natural or artificial dams as a viable management strategy to reduce the amount of nitrogen in streams. Nested hyporheic samplers and drive point wells have been strategically placed within the study site to provide both model calibration and water chemistry data. A bromide tracer test was performed under dammed conditions to provide extensive calibration data. Two numerical models, created using the MODFLOW software, were used to quantify the flux of water entering and leaving the stream under both dammed and partially dammed conditions. Once calibrated, the dammed model simulated 0.033 m^3/s of water from the stream into the aquifer and 0.222 m^3/s of water back into the stream. The partially dammed conditions produced a flux 0.007 m^3/s into the aquifer and 0.067 m^3/s reentering the stream. These flux values were then combined with monthly water chemistry data to perform nitrogen mass flux calculations. The net N flux to the stream was 188.4 mg/s under dammed conditions and 49.2 mg/s under partially dammed conditions. These mass flux calculations indicate that under these modeled conditions the hyporheic zone is acting as a net N source under both conditions, with the N flux is greater in the dammed simulations. If the desired result is the removal of stream nitrogen then the building of a dam would not be a viable strategy as the dam is increasing the total amount of nitrogen to the stream..

ESTIMATING STREAM CHLORIDE CONCENTRATIONS AS FUNCTION OF LAND USE CHANGE FOR TWO WATERSHEDS IN CENTRAL ILLINOIS

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This study focused on determining the relationship between land use and stream Cl- concentrations, which was used to create a model to estimate chloride (Cl-) concentration in streams as a function of land use change. The study area comprises two adjacent watersheds in Central Illinois, with similar geology and climate but different land uses (agricultural and urban). GIS technology was used to determine watershed land use profile and to calculate road surface areas. Stream water samples were collected and analyzed for anion composition for a full year. Results show increase in Cl- concentrations during winter months of more than 20 times for an urban stream (range between 1350 and 65 mgL-1) and around 3 times for an agricultural stream (between 60 and 20 mgL-1). Because sources of Cl- other than road salts contribute to total Cl- in the stream, Cl- and bromide ratios (Cl/Br) were used to identify potential sources of Cl-. The stream Cl- estimation model shows a non-linear relationship between stream average Cl- and total percent urbanization. With the increase in urbanization, the average Cl- in the streams reaches a maximum of approximately 145 mg/L.

Indoor Inhalation Update

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Over the last few years, indoor inhalation has been discussed at the State and Federal levels, at National Conferences, and among numerous committees. However, less than 30 states have some form of vapor intrusion/indoor inhalation guidance and at least 6 of those states defer to the USEPA's 2002 guidance. In response to the indoor inhalation issues, the Illinois Environmental Protection Agency has assembled an internal workgroup to develop regulations and an accompanying guidance document for the indoor inhalation pathway to the Tiered Approach to Corrective Action Objectives (TACO - 35 Illinois Administrative Code Part 742) regulations. The presentation will give an overview of the indoor inhalation pathway from an Illinois EPA perspective.

Increasing Chloride Concentrations in Shallow Groundwater and Surface Water in the Chicago Region

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Population and infrastructure are growing rapidly in the Chicago, Illinois, metropolitan area. Population is projected to increase from 8 million in 2005 to more than 10 million by 2030. Most of the growth is occurring in collar counties such as Kane, McHenry, and Will, where populations may double in that period. Demand for water is also increasing substantially. Shallow bedrock and overlying sand and gravel aquifers, which can be vulnerable to surface contaminants, are expected to be the main sources of water to meet the increased demand in the Chicago region.

A statistical study of historical water quality data for shallow aquifers (< 200 ft) has indicated that chloride (Cl^-) concentrations have been increasing since the 1960s, particularly in collar counties west and south of Chicago. The primary source of Cl^- is road salt runoff. About 43% of public supply wells in the collar counties have increases in Cl^- concentrations greater than 1 mg/L/yr and 15% have increases greater than 4 mg/L/yr. Approximately 24% of the samples collected from public supply wells in the Chicago area in the 1990s had Cl^- concentrations greater than 100 mg/L (35% in the collar counties); median values were less than 10 mg/L prior to 1960. The greater increase in Cl^- concentrations in the collar counties is likely due to both natural and anthropogenic factors, including the presence of more significant and shallower sand and gravel deposits and less curbing of major highways and streets.

Elevated levels of Cl^- have also been observed in the Illinois River waterway. In a recent study, samples were collected from the river and selected tributaries from Chicago to its confluence with the Mississippi River over a two-year period. Chloride concentrations in the Illinois River ranged from 40 to 488 mg/L and spiked during the late winter and early spring as a result of road salt runoff. A large component of Cl^- throughout the year was attributed to treated wastewater (TWW) from the Chicago area, and during periods of low flow, elevated Cl^- levels attributable to TWW were detected all the way to the confluence with the Mississippi River. Chloride concentrations in the Illinois River at Peoria have been increasing since the 1950s; the annual median increased from about 20 mg/L in 1946 to near 100 mg/L in 2005, approximately 1.0 mg/L/yr. The greatest concentrations and rates of increase occur between January and March, due to road salt runoff.