Abstracts

Thursday, May 1

Session K2: Characterization of Regional Groundwater Systems

10:00 – 11:30 am | Room 262

Measuring Hydrostratigraphy in Two Minnesota Bedrock Wells; a Case Study of Methods for Better Understanding Ground-Water/Surface-Water Interaction, Water Quality, and Well Productivity

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Abstract
The use of continuously-logging instruments in open wells provides valuable insights into local hydrogeology which may not be apparent from driller's logs or water samples collected from pumping wells. Borehole data loggers record changes with depth in physicochemical water properties such as temperature, pH, specific conductance, redox and dissolved oxygen. Video cameras record changes in the rock formation, the presence of fractures and caverns, and the movement of particles indicating water flow. Combining these data with results from calipers, gamma and drill logs, supports the selection of depth intervals to be targeted for discrete-depth water sampling. The Minnesota Department of Health, along with the Minnesota Geological Survey, conducts studies of this kind to better understand local hydrogeologic conditions relative to issues of water quality and quantity, as well as basic aquifer characterization for source water protection efforts. We discuss examples from two different bedrock aquifer systems; the Prairie du Chien-Jordan (Ordovician-Cambrian carbonate and sandstone) and the Biwabik Iron Formation (Early Proterozoic chemical sediment). In both cases, borehole logging and discrete-depth water sampling detected stratification of the water column, related to either distinct hydrostratigraphic horizons or fractures. At one of these sites, we gleaned important information about surface-water/ground water interaction, which is important for the protection of drinking water quality and quantity.

Factors Affecting Public-Supply-Well Vulnerability to Contamination: Understanding Observed Water Quality and Anticipating Future Water Quality

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Abstract
As part of the U.S. Geological Survey National Water-Quality Assessment (NAWQA) Program, a national study was conducted from 2001 to 2011 to shed light on factors that affect the vulnerability of water from public-supply wells to contamination. The study was designed as a follow-up to earlier NAWQA studies that found mixtures of contaminants at low concentrations in groundwater near the water table in urban areas across the Nation and, less frequently, in deeper groundwater typically used for public supply.

The vulnerability of the water from public-supply wells to contamination is a function of contaminant input within the area that contributes water to a well, the mobility and persistence of a contaminant once released to the groundwater, and the ease of groundwater and contaminant movement from the point of recharge to the open interval of a well. The following measures, which are described in newly released USGS Circular 1385, are particularly useful for indicating which contaminants in an aquifer might reach an individual public-supply well and when, how, and at what concentration they might arrive:

- Sources of recharge – Information on the sources of recharge for a well provides insight into contaminants that might enter the aquifer with the recharge water and potentially reach the well.

• Geochemical conditions – Information on the geochemical conditions encountered by groundwater traveling to a well provides insight into contaminants that might persist in the water all the way to the well.

• Groundwater-age mixtures – Information on the ages of the different waters that mix in a well provides insight into the time lag between contaminant input at the water table and contaminant arrival at the well. It also provides insight into the potential for in-well dilution of contaminated water by unaffected groundwater of a different age that simultaneously enters the well.

Preferential flow pathways-pathways that provide little resistance to flow-can influence how all other factors affect public-supply-well vulnerability to contamination. Methods for recognizing the influence of preferential flow pathways on the quality of water from a public-supply well are presented in the Circular and will be discussed.

The Kentucky Interagency Groundwater Monitoring Network: Expanded Monitoring Programs

Robert Blair[1] and Bart Davidson[2]
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Abstract
Systematic groundwater monitoring in Kentucky was initiated through a consortium of academic and government agencies in the mid-1990s. This body eventually became the Interagency Technical Advisory Committee (ITAC) on Groundwater and established the Interagency Groundwater Monitoring Network ("the Network") in Kentucky.

ITAC made several recommendations for the Network's design, including representation of Kentucky's aquifer types and physiographic regions, spatial distribution of sites and parameters to be analyzed. Following the recommendations, the Network was established with the Kentucky Division of Water (KDOW) collecting samples at approximately 60 sites on a quarterly basis. Although the parameters, aquifer types and physiographic regions have been represented as designed, the spatial distribution and site density are only a fraction of what was proposed – due to resource constraints. To fill these data gaps, one-time sampling sites were selected based on proximity to permanent sites and requests by groundwater users. Additionally, after several years the sampling frequency at some sites was decreased once they were considered to be well-characterized so that new sites could be added to the Network. Finally, expanded monitoring has been conducted through various programs and grants, which have allowed for regional and watershed-based groundwater projects led by KDOW and the Kentucky Geological Survey (KGS).

Expanded groundwater monitoring projects by KDOW and KGS were initially conducted within the individual boundaries of major river basins, or Basin Management Units (BMUs). These studies covered large areas and, similar to the Network, focused on characterizing ambient groundwater quality throughout the BMU. Follow up studies then focused on smaller watersheds within various BMUs where surface streams had been assessed and deemed impaired. The goal with these projects was to determine the influence of groundwater on surface water quality. Additionally, some follow up studies focused on regions previously not assessed, or under represented by monitoring efforts to date. Recent monitoring projects in karst regions have utilized an approach to integrate surface water assessment protocols to better define the relationship of these conjunctive systems.

This presentation will highlight field activities, expanded groundwater monitoring programs and interagency coordination utilized for the success of the Network.

Assessing the Quality of Groundwater Used for Public Supply in Principal Aquifers of the Western United States

Laura Bexfield
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Abstract
In 2013, the National Water-Quality Assessment (NAWQA) Program of the U.S. Geological Survey began a 10-year assessment of the quality of groundwater used for public supply in principal aquifers across the United States. Public-supply wells are being selected for sampling in a subset of principal aquifers under a nationally consistent design that uses equal-area grids to achieve a spatially unbiased dataset. The wells are being sampled for a

comprehensive suite of analytes to characterize the occurrence of contaminants of concern for human health and to improve understanding of groundwater processes that are important to management of water resources. Analytes include nutrients, volatile organic compounds, pharmaceuticals, hormones, pesticides, major elements, trace elements, radionuclides, microbial indicators, and tracers of groundwater age. Among principal aquifers in the western United States, the first NAWQA sampling effort of this type was conducted in 2013 in the Basin and Range basin-fill aquifers; future sampling efforts are planned for the Rio Grande aquifer system, the High Plains aquifer, and the Columbia Plateau basaltic-rock and valley-fill aquifers.

The Basin and Range basin-fill aquifers extend through large areas of Arizona, California, Nevada, and Utah. They consist primarily of unconsolidated to semi-consolidated gravel, sand, silt, and clay deposits in alluvial basins bounded by mountain ranges. The 1,010 million gallons of groundwater withdrawn for public supply across the Basin and Range basin-fill aquifers in 2000 ranked fourth among all principal aquifers in the nation; however, little or no groundwater is withdrawn for public supply in several alluvial basins. To focus the water-quality assessment on the extent of the groundwater resource actually used for public supply, the NAWQA study area was defined based on 20-kilometer buffers placed around each known public-supply well. Eighty public-supply wells were selected for sampling using equal-area grids within the targeted study area. Preliminary results for groundwater samples collected from these wells will be presented.