Shallow Ground-Water Flow and Mass Flux of Nitrogen and Phosphorus in the Big Ditch Watershed

Project Description
The objective is to estimate the amount of nitrogen (N) and phosphorus (P) contributed to Big Ditch, a tributary of the Sangamon River, by ground water. The surficial geology of the watershed was characterized by studying available literature and analyzing soil cores collected for the project. Monitoring wells were designed to sample shallow ground water near the top of the water table and ground water from deeper sand layers. Water levels in the wells are measured periodically and a ground-water flow model is being developed. Ground-water samples are being collected periodically and analyzed for N species and total P. The fluxes of N and P will be estimated by multiplying flow rates by N and P concentrations.

METHODS
Twenty monitoring wells have been installed at eleven sites across the watershed, including 11 shallow wells to monitor the water table (~12 feet below surface), and 9 wells to monitor the ground water of deeper sand and gravel layers (up to 50 feet). Water levels are measured at regular intervals, at least once every 2 weeks. Continuous water-level measurements are monitored in at least one shallow well near the top of the water table and a ground-water flow model is being developed. Ground-water samples are collected from these wells and analyzed for nitrate, ammonia, total Kjeldahl nitrogen, total phosphorus, and nonvolatile organic carbon. Temperature, pH, baseflow separation calculations and by field experiments such as determining hydraulic gradients with a potentiometer. A ground-water flow model is being developed.

Geochemical Setting of the Big Ditch Watershed
• Watershed is predominantly intermorainal landscape, but includes portions of the Rantoul moraine to the S-SE and the Illiana morainic system to the NE.
• The intermorainal area of the watershed ranges in elevation between 212 and 223 meters MSL. The crest of the Rantoul moraine is typically between 235 and 240 meters MSL. In the northern-most end of the watershed, the land surface elevation peaks at nearly 250 meters MSL. The crest of the Rantoul moraine is typically between 235 and 240 meters MSL.
• The intermorainal area of the watershed ranges in elevation between 212 and 223 meters MSL. The Illiana morainic system within the watershed is typically about 235 meters MSL. In the northern-most end of the watershed, the land surface elevation peaks at nearly 250 meters MSL. The crest of the Illiana morainic system is typically between 235 and 240 meters MSL.
• Four different glacial tills were identified in the shallow subsurface. Jointing and fracturing of the tills was commonly observed and will likely have a large impact on ground-water flow and chemical transport.
• There are sand layers (yellow) which we believe conduct most of the ground water at the site. Two wells were installed at this site to monitor the water levels and sample water from these sand layers.

Soil borings from a location northeast of Site 8. The numbers in parentheses indicate layer thickness (m). There are sand layers (yellow) which we believe conduct most of the ground water at the site. Two wells were installed at this site to monitor the water levels and sample water from these sand layers.

Shallow well, Site 3

Organic N and \( \text{NH}_4^+ \) were the main N species in the deep wells. Nitrate was sometimes found at low concentrations. Well 3S is shown as an example.

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Plains for Further Work
• Continue monitoring water levels and water chemistry
• Continue to develop the ground-water flow model

Acknowledgement
This research was sponsored by the Illinois Council on Food and Agricultural Research through the Water Quality Strategic Research Initiative (WQ-SRI). The goal of the WQ-SRI is to characterize the mass balance of nutrients (N and P) in the watershed. The Illinois State Water Survey (ISWS) and Illinois State Geological Survey are determining component of the mass balance for the shallow groundwater. Researchers from the ISWS and UI College of Agriculture, Consumer and Environmental Sciences are determining the other components (tile drainage, atmospheric deposition, fertilizer application, surface water flow...).