

Project Summary

Title	Hydrostratigraphy of West-Central Wisconsin: A new approach to groundwater management
Project I.D.	05-HDG-02
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Period of Contract	July 1, 2004 through June 30, 2005
Background/ Need	The bedrock that provides the primary water supply for west-central Wisconsin is both lithologically and hydraulically diverse, forming a complex sequence of aquifers and confining units, variably interconnected, and each of unique hydrogeologic character. Though this heterogeneity is an accepted fact, documented in studies in neighboring areas, there has been no significant work to develop a hydrogeologic framework specific to the bedrock of the region. A detailed hydrostratigraphic model – giving the sequence and properties of bedrock based on distinct hydrogeologic character – is sorely needed. Such a model will be a synthesis of a wide assortment of data, ideally incorporating all parameters affecting groundwater occurrence and flow for each distinct interval in the bedrock section. At the commencement of this project, it was unclear what useful hydrostratigraphic data might already exist, and hence where additional study was most needed.
Objectives	This project takes the first step toward a comprehensive hydrostratigraphic model of west-central Wisconsin. The objectives were as follows: <ul style="list-style-type: none">• Identify and compile all of the relevant hydrostratigraphic data that exist;• Review these available data resources with respect to relevance and data quality;• Synthesize, to the degree feasible, the data that do exist; and• Identify major data gaps remaining.
Methods	The project focused on the Cambrian-Ordovician strata within Pierce, St. Croix and Dunn Counties. We identified types of data that were needed for a hydrostratigraphic model, determined the most likely sources of those data and then sought to acquire them – generally from state agencies, and municipalities. Whenever feasible, we have compiled these data sources as scanned files on a data CD, available from the WGNHS. Limited data reduction, mostly of digital well log data and hydrogeologic parameters, was completed using standard electronic spreadsheet, database and GIS tools. Hydraulic conductivity values were estimated from specific capacity tests for more than 8000 well logs using a new spreadsheet version of TGuess (Bradbury and Rothschild, 1985), developed for this project. The updated TGuess program is included on the data CD.
Results and Discussion	Of a great many contaminated site investigations completed in the region, 16 were found that contain useful hydrostratigraphic data (e.g., hydraulic tests and other

studies of bedrock hydrogeology). These investigations are geographically skewed toward populated areas, and generally focus on only the uppermost intervals of bedrock. Forty-five geotechnical reports by the Wisconsin and Minnesota departments of transportation provide some additional detail on bedrock lithology, but generally have little or no data of a hydraulic nature. Municipal water authorities have some of the only data for the deeper aquifers – most private and environmental test wells are comparatively shallow. A limited dataset of downhole geophysics and video logs are available for town water-supply wells.

Three statewide electronic databases of completed wells (maintained by the WDNR and WGNHS) are the most comprehensive data resource, with greater than 14,000 wells in the study area. The utility of these data is, however, limited by their frequent lack of detail and poor data quality. The well logs' specific capacity test data does permit a rough estimation of hydraulic conductivity, albeit subject to large uncertainties about data quality.

Evidence of karst in the region's carbonate rocks (particularly the Ordovician Prairie du Chien Group dolomite) is widespread but mostly observational. Various spring and sinkhole studies have been completed, but no data exist that provide a coherent model of modern karst processes. The WGNHS now maintains a karst features inventory, but the dataset is largely incomplete.

Conclusions and Recommendations The data that currently exist are inadequate to develop a fully coherent hydrostratigraphic conceptual model. Sufficient data exist to suggest parallels with the better-constrained hydrostratigraphy of eastern Minnesota (Runkel et al, 2003), but not to independently verify it. The sequence, thickness, and lithologic character of the bedrock is the best constrained element of the hydrostratigraphy at this time. The intrinsic hydraulic properties of the rock are less well known. Hydraulic conductivity values (from consulting reports, municipal well tests, and specific capacity test analyses) exist for several broadly defined intervals, but are not adequately depth-precise and continuous to allow differentiation of aquifers and confining units. There is also a complete lack of vertical hydraulic conductivity values. The relative importance of intergranular porosity, fractures, and karst conduits is completely unknown. No porosity data exist, and only limited well video and downhole geophysical logs constrain the degree of fracturing. The function of karst in the carbonate units is especially uncertain. There are numerous examples of sinkholes, caves and solution-enlarged cavities, but no work has been done to identify integrated karst systems, patterns of karst development, or to describe the effect of karst on groundwater flow patterns.

Related Publications Pending release as a WGNHS Open-File report.: Hydrostratigraphic Data Resources for West-Central Wisconsin, Open-File Report 2005-04.

Key Words Hydrostratigraphy, west-central Wisconsin, Pierce County, St. Croix County, Dunn County, specific capacity tests, TGuess, well-constructor reports.

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