

REGIONAL GROUNDWATER FLOW MODELING IN THE OAK RIDGES MORaine AREA: BUILDING ON THE 3D GEOLOGIC MODEL

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With more powerful computers and better software for data visualization, management, and analysis, it has become possible to build detailed 3D geologic models and then incorporate all the complexity and spatial variability in stratigraphy and hydraulic properties within high-resolution numerical models. This became a primary objective in developing a regional model for the Oak Ridges Moraine area in southern Ontario. Including the local variation in stratigraphy and aquifer properties along with better characterization of the surface water system led to a model that was much more representative of the flow system.

Extensive data were compiled, analyzed and synthesized to create a regional-scale model covering the entire Oak Ridges Moraine (ORM) area. The model built on a conceptual understanding of the geologic framework and depositional history of the ORM (Sharpe et al., 2002). Further refinement was done to subdivide the "Lower Deposits" defined by Sharpe et al. into aquifer and aquitard units. Refinement was a time-consuming task, requiring the analysis of individual well logs. The refined hydrostratigraphic model became the basis of the sub-regional-scale "Core Model" covering a 55-km wide area between Lake Simcoe and Lake Ontario. Methods were developed to use lithologic data from the large volume of water well records to supplement aquifer testing data and develop maps of hydraulic conductivity. The hydraulic conductivity distribution obtained conformed well to our understanding of depositional processes in the ORM. It also correlated well with variation in hydraulic gradients. Limits in the data and in our knowledge of the depositional processes, however, make it difficult to see clear trends in the spatial distribution of properties in the lower units.

Spatial variation in groundwater recharge was estimated using climate, surficial geology, topography, and land use data. Better mapping of properties within the shallow system could lead to improved representation of recharge, runoff and ET. Streambed properties were estimated based on surficial geology and stratigraphy. It is suspected that more data on the local-scale stratigraphy within the stream valleys would help improve the match between simulated and measured spatial distributions in flow.

The refined geologic model, with 100-m cell size, has now been extended to the east and west. New conceptual models were developed to handle the transition from a bedrock flow system of the Niagara Escarpment in the west to the overburden aquifer dominated flow system to the east. The conceptual models will be tested as the numerical model is developed for these areas.

The process of model construction helped us focus on the gaps and biases in the available data. Much effort was invested in using our conceptual understanding of depositional and erosional processes to bridge these gaps and guide the construction of the hydrostratigraphic and numerical models. The continued success of the project is attributed to four guiding principles: 1) a focus on data; 2) incorporation of geological interpretation, along with other data sources, into the geological analyses; 3) a strong emphasis on understanding the link between the groundwater and surface water systems; and 4) an effective blending of a regional-scale approach with sufficient resolution and detail for local-scale analyses.

REFERENCES

Sharpe, D. R., Hinton, M. J., Russell, H. A. J., and Desbarats, A. J., 2002, The need for basin analysis in regional hydrogeological studies: Oak Ridges Moraine, Southern Ontario: *Geoscience Canada*, v. 29, no. 1, p. 3-20.