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Geological and hydrogeological models of the 'Yonge Street' aquifer, south-central Ontario.

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ABSTRACT

In the Aurora, Newmarket and Queensville areas of the Greater Toronto Area, south-central Ontario, municipal water supply is obtained from the 'Yonge Street aquifer' (YSA), an informal name long used to describe relatively deep sand and gravel deposits. These deposits were previously described as discontinuous, perhaps channelized and possibly associated with buried bedrock valleys, largely interpreted from data at a few municipal well fields. Despite much historical and recent geological and hydrogeological work, including numerical groundwater flow modelling, the fundamental geological and hydrogeological framework (i.e. conceptual model) for the YSA has not been clearly developed and documented.

Based on high-quality geophysical and geological data (seismic profiles, continuously–cored, sedimentologically-logged boreholes, downhole geophysics, geological mapping and 3-D modeling) revised conceptual geological and hydrogeological models of the area are presented. The data reveal a sedimentary succession (e.g., ~140 m thickness at Aurora) that is truncated by a number of erosional unconformities characterized by deeply incised channels, locally extending to bedrock, with a ~NS to NE-SW orientation, both beneath and above the regional Newmarket Till stratigraphic marker. Channels may occur stratigraphically stacked and nested with Newmarket Till locally filling depressions. Core and seismic data permit identification of channelized Thorncliffe Fm. eroded into older sand and mud Scarborough Fm. equivalents. The Thorncliffe Fm. consists of fining upward transitions from coarse gravel, to sand, to rhythmically bedded mud interpreted to be deposited within a channel-esker-subaqueous fan complex. The YSA aquifer is one component of a system of similar deposits recognized across the region beneath drumlinized Newmarket Till.

The accompanying hydrogeological model benefits from a strong conceptual understanding of vertical and lateral facies changes (and connection to older aquifers) in the Thorncliffe Fm. depositional model. The subaqueous fan gravel-sand-mud, fining-upward facies succession provides a capping aquitard to YSA, in addition to the overlying Newmarket Till aquitard. Lateral coarse to fine facies transitions are very rapid perpendicular to paleoflow and explain relatively low-yield wells drilled near YSA municipal wells. Facies transitions are much longer along paleoflow, as supported by pumping tests in a similar aquifer system north of Markham which have high-yield hydraulic connections of ~1-10 kms.

The conceptual models documented in this paper are critical to guiding groundwater exploration and management. Paramount to improved knowledge is collection of high-quality subsurface data (including hydraulic data) that aids in developing a geological framework that represents the sedimentary system of the basin and its internal flow system.