Title: **Variation of Hydraulic Conductivity in Sandy Glacial Till: Site Variation Versus Methodology**

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Background/Need: The sandy till of the Green Bay Lobe is mapped as the Horicon Formation, a lithostratigraphic term that implies that certain properties of the sediment can be recognized everywhere it occurs. A compilation of hydrogeological studies of the Horicon Formation in a six-county area from consulting reports show that there is a wide variation of hydrogeologic properties in material mapped as till of the Horicon Formation. The till is not fractured and large inclusions of coarse sediments are not observed. Based on field observations and laboratory testing, there is little variation in texture. Thus, the till appears to be lithologically and texturally homogeneous, but hydrogeologically heterogeneous. This study addresses the need to understand this apparent heterogeneity in a uniform medium and evaluates different methods for determining hydraulic conductivity. This information is important for the Wisconsin Department of Natural Resources and other regulatory agencies that require that hydraulic conductivity tests be made as part of any site investigation. This would allow these agencies to establish realistic and consistent requirements for initial site reports and feasibility studies.

Objectives: 1) To determine if apparent variability of hydraulic conductivity in Horicon Formation till from a compilation of consulting reports is real or a result of different testing methods at different scales. 2) To examine the effectiveness of different methods of determining hydraulic conductivity in such materials.

Methods: Two field sites in till of the Horicon Formation were instrumented with piezometers. Each site is located in an area of thick, uniform till, away from drumlins and moraines. At Site 1, the aquifer is unconfined, with a saturated thickness of 8 m. At Site 2, the till aquifer is confined by locally occurring lake silt and clay. The saturated thickness at Site 2 is also about 8 m. The sites are instrumented with 26 and 27 piezometers, respectively. Each piezometer is 2 inches in diameter and has a screen length of 30 cm. The piezometer array is roughly square, with dimensions of about 10 m by 10 m. Hydraulic conductivity was determined at each site by the following methods: (1) slug tests, (2) bail tests, (3) bore-hole dilution tests, and (4) pumping tests.

Results: The results of tests performed at the sites showed that hydraulic conductivity varies over nearly two orders of magnitude, from about $4x10^{-5}$ to about $2x10^{-3}$ cm/sec. In general, larger-scale tests yield larger values of hydraulic conductivity. Repeated tests of individual piezometers gave consistent values of hydraulic conductivity. Textural analyses of samples of the till from the screened intervals showed little variability, and there was no correlation between simple textural characteristics and hydraulic conductivity.

Implications/

Recommendations: Most of the reported variability (from DNR files) of field-measured values of hydraulic conductivity in till of the Horicon Formation is due to different testing methods (e.g. slug tests versus pumping tests), different scales of the same testing method (e.g. different slug sizes) that test different volumes of aquifer, or misidentification of the material. The till can be considered homogeneous at a site scale (15 m x 15 m). There is no spatial correlation of hydraulic conductivity at the smallest sampling interval (2 m) when determined by a slug test. Genetic classification of glacial sediment is difficult for consultants. However, if unfractured basal till is identified based on its highly uniform textural properties, then fewer tests of the hydraulic conductivity of the till should be required than in mixed sediments. This is due to the apparent homogeneity of the till within a field-scale study.

Key Words: Hydraulic conductivity, sandy till, slug test, Horicon Formation

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Final Report: A final report containing more detailed information on this project is available for loan from Wisconsin's Water Library, University of Wisconsin - Madison, 1975 Willow Drive, Madison, Wisconsin 53706 (608) 262-3069.