Title: **Spatial Attributes of the Soil Landscape Groundwater System of the Lower Wisconsin River Valley**

Project I.D.: DNR Project No. 88

Investigators: K. McSweeney, Professor, UW-Madison, Dept. of Soil Science
F. Madison, Professor, UW-Madison, Dept.of Soil Science
J. Attig, Associate Professor, WGNHS, UWEX
M. Bohn, Information Manager, WGNHS, UWEX
P. Falk, Research Assistant, UW-Madison, Dept. of Soil Science

Period of Contract: July 1, 1991 through June 30, 1993.

Objectives: This study was conducted to determine if differences in the stratigraphy exist which affect water flow through the sediments found on the lower terraces of the Wisconsin River. This area has recently been the scene of groundwater contamination by agrichemicals. The goal was to locate sites which appear to be more or less susceptible to groundwater contamination. This data could then be used at some future time to predict where groundwater contamination will occur or to devise land use schemes that will prevent its development.

Methods: Geomorphic and soils layers were developed for the study area to be used in a Geographic Information System at the Wisconsin Natural History and Geological Survey. Well logs were analyzed and saturated conductivity calculated from information included in the well logs. Drilling was conducted on each of the terrace surfaces to obtain samples of the sediments for analysis. Trenching of an area of patterned ground and an area of surface silt deposits was undertaken. Data on water well contamination in the study area were consulted. Samples from soils representative of the various landforms and terraces in the Lower Wisconsin River Valley (LWRV) were collected and analyzed.

The study area stretches from Arena to Blue River, Wisconsin. The geomorphic and soils coverage also include parts of Dane County. Three of the drilling sites are also located in Dane County. The information gleaned from upstream locations in Dane County added insight into processes which were occurring downstream. The time period covered by this study was January 1991 through June 1993.

Results and Discussion: Analysis of the particle size distribution of the drilling samples indicated the presence of four different terrace deposits: a late Pleistocene high terrace sequence; a late Pleistocene intermediate terrace sequence; a late Pleistocene low terrace sequence; and a Holocene terrace sequence. Patterned ground is the result of permafrost conditions prevalent during the late Pleistocene in the LWRV and occurs on all three late Pleistocene terrace surfaces. All of the terrace sequences are probably within 1000-1500 years in age of each other, with the exception of the Holocene terrace sequence. Except for the small area of silty soils found on the intermediate terrace, the soils are very similar on all three terrace surfaces. This is to be expected since they are all relatively the same age. This similarity in age creates a problem in that comparisons of soil properties with respect to differences in development over time between terraces is not possible. Another problem is that sandy textured soils do not preserve differences in development well. Saturated conductivity of the sediments does not follow any set pattern. Saturated conductivity values tend to be higher near

the river, but there are several exceptions. Comparison with well contamination data shows that in the majority of cases the wells where K_{sat} was calculated are not the wells which have been tested for contamination.

Conclusions: The stratigraphy of the sediments of the lower terraces of the LWRV are highly variable. There does not appear to be any significant differences between each individual terrace deposit that would affect groundwater flow, so the deposits can all be treated as one unit. The silt and clay rich surficial deposits or soils high in organic matter are probably more significant in predicting susceptibility of a site to groundwater contamination.

Implications/ Recommendations: For further research, to provide a more complete picture of groundwater and contaminant flow, a more systematic coverage of the LWRV is needed. No data or only minimal data exist for large regions of the study area. Drilling of wells and water sampling to augment the existing data would improve saturated conductivity estimates, detection of contaminant sites, and provide a clearer picture of the stratigraphy of the valley.

Related Publications:

Fermanich, K.J., B. Lowery, K. McSweeney, and S. Grant. 1991. Atrazine leaching at a field site in the Lower Wisconsin River Valley. Proc. 1991 Fertilizer, Aglime and Pest Mgmt. Conf. 30:129-137, Madison, WI.

Hart, G.L., B. Lowery, K.J. Fermanich, and K. McSweeney. 199_. *In-situ* characterization of hydrologic properties of Sparta sand: Relation to solute movement. Geoderma (in press).

Wang, D., J.M. Norman, B. Lowery, and K. McSweeney. 1994. Nondestructive determination of hydrogeometrical characteristics of soil macropores. Soil Sci. Am. J. 58:294-303.

Wang, D., K. McSweeney, J.M. Norman, and B. Lowery. 1991. Preferential flow in soils with ant burrows. p. 183-191. *In* T.J. Gish and A. Shirmohammadi (ed.) Preferential flow. Proc. Natl. Symp., Chicago, IL. 1617 Dec. 1991. Am. Soc. Agric. Engr., St. Joseph, MI.

Key Words: fluvial geomorphology, Lower Wisconsin River Valley, stratigraphy

Funding: DNR

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.