INTRODUCTION

Project Background

Nitrate contamination has long been known to be a problem in Wisconsin's sandy aquifers with shallow depth to groundwater (Jackson and others, 1987). Recent data suggest that 10-20 percent of domestic wells in agricultural counties across the state exceed the drinking water standard of 10 mg/l NO_3-N (Kraft, 1994); in Dane County 24 percent of rural wells exceed this standard (Bridson and others, 1994). Shallow, sandy aquifers are especially vulnerable to nitrate contamination due to rapid infiltration and the limited attenuation capability of these coarse-textured soils. In areas where sandy soils are used for crop production, nitrate contamination is common. For example, 34 percent of wells in the Lower Wisconsin River Valley exceed the 10 mg/l NO_3-N standard (Cates and Madison, 1992). Management of agricultural nitrogen inputs is becoming a growing concern; the Wisconsin Department of Agriculture, Trade, and Consumer Protection (DATCP) is considering new regulations aimed at managing nitrogen applications. In order to determine how various agricultural management practices impact groundwater, we first need to identify the temporal variability in nitrate concentrations reaching the saturated zone. Most groundwater monitoring projects assume that monthly or quarterly samples are adequate to characterize nitrate concentrations in groundwater, yet this assumption has not been tested.

Purpose and Scope

The objectives of this project were 1) to determine the temporal variability in nitrate concentrations in shallow, sandy aquifers, 2) to define the relationship between recharge and

groundwater nitrate concentrations, and 3) to develop recommendations concerning monitoring frequency for such aquifers. Specifically we hoped to examine the distsribution of nitrate and cloride across hydrographs generated by rainfall or other climatic events

FIELD SETTING AND METHODS

An existing research site, in the Lower Wisconsin River Valley, provided a controlled setting where we could explore the temporal variability of nitrate loading in shallow sandy aquifers. The site was established to investigate the effects of ridge tillage on the movement of agrichemicals in the unsaturated zone under corn and soybeans (Lowery and McSweeney, 1992; Fermanich, 1995) and was ideally suited for monitoring of nitrate in the saturated zone.

Geologic Setting

The research site, located north of Arena, Wisconsin, in eastern Iowa County, is within the "Driftless" or unglaciated portion of the Lower Wisconsin River Basin (figure 1). The bedrock geology of the basin consists of Precambrian crystalline rock overlain by a thick sequence of relatively-flat-lying Cambrian sandstone, shale, and Ordovician dolomite. These sedimentary strata dip and thicken to the southwest (Hindall and Borman, 1974). During Late Pleistocene time, meltwater streams cut deeply into Paleozoic bedrock and deposited a nearly 200 ft thick sequence of sand and gravel in the Wisconsin River Valley; lake sediments were deposited in many of the tributary valleys. A thin loess cover blankets the bedrock uplands.