IV. FIELD WORK

A. Preliminary Field Work

Field work for this project began in July of 1987. For two weeks attempts were made to obtain water table profiles in the Buena Vista Groundwater Basin, the area investigated by Stoertz (1985) and Faustini (1985). A 120 MHz antenna was used for this work. Poor results were obtained in this area, possibly because the water table here is too shallow to be resolved from the reflections of the ground surface. The water table is typically about five feet deep in the central portion of the basin and the wavelength of the radar signal in the sand above the water table is about four feet. Surveys with a 500 MHz antenna in the central portion of the basin and surveys with the 120 MHz antenna over the moraines in the eastern portion of the basin (where the water table is deeper) were also unsuccessful. In both these cases, it is possible that conductive road surface materials contributed to the poor quality of the results. Another possible explanation for the poor results is that the predominant soil types in the basin have surface layers of muck which obscure reflections from the water table. The influence of soil type on signal quality is discussed in detail in section C of this chapter.

At the end of this two week period, surveys were made in the area of the northern boundary of the Buena Vista Groundwater Basin, formed by a water table divide. North of this divide groundwater flows generally northward to the Wisconsin River. GPR surveys yielded fairly clear water table profiles throughout much of this area. Because of the success of these surveys and because of the abundance of existing piezometers in this area, it was chosen as the area of detailed study for this project. For a description of the field area, see Chapter II.

During October of 1987, an attempt was made to carry out detailed GPR surveys and collect water level measurements in the field area. However, rain and technical difficulties with the radar system allowed only patchy data to be collected during these two weeks. A detailed survey of road surface elevation around one block in the field area was performed during this time. This survey has been used to evaluate the uncertainty in road surface elevations obtained from interpolating between data points shown on topographic maps for the area.

B. Detailed Surveys in the Field Area

Systematic radar surveys along roads in the field area were obtained during the first week of November, 1987. Water levels in most of the piezometers in the field area were also measured during this week. Additional water level measurements were provided by Kraft (personal communication), who had made water level measurements throughout October.

Figure 6 shows the distribution of data points in the field area. Radar surveys were performed along roads in the study area by towing the antenna behind an automobile containing the control unit, tape recorder and graphic recorder. A vertical mark was printed on the radar record every twentieth of a mile, as estimated from the automobile odometer. Water table return times were later picked off the record at each of these marked points. Thus the GPR data points shown on Figure 6 are at intervals of one-twentieth of a mile. There are 280 GPR data points. Of course, the actual record is continuous, so a finer or coarser level of discretization could have been chosen. Examination of the radar records reveals that this level of discretization is fine enough to characterize any real variations in water table depth. Most of the variation at smaller scales than this is probably due to small-scale elevation changes of the road surface, rotations of the antenna as it rolls along the road and other apparently random effects. Two or more surveys were carried out along most of the roads, so that repeat observations were obtained at most of the GPR data points shown in Figure 6.

C. Influence of Soil Type

There appears to be a strong correlation between the quality of the radar signal and soil type in the field area. Otter and Fiala (1978) show two dominant soil types in the field area. A swath of Friendship loamy

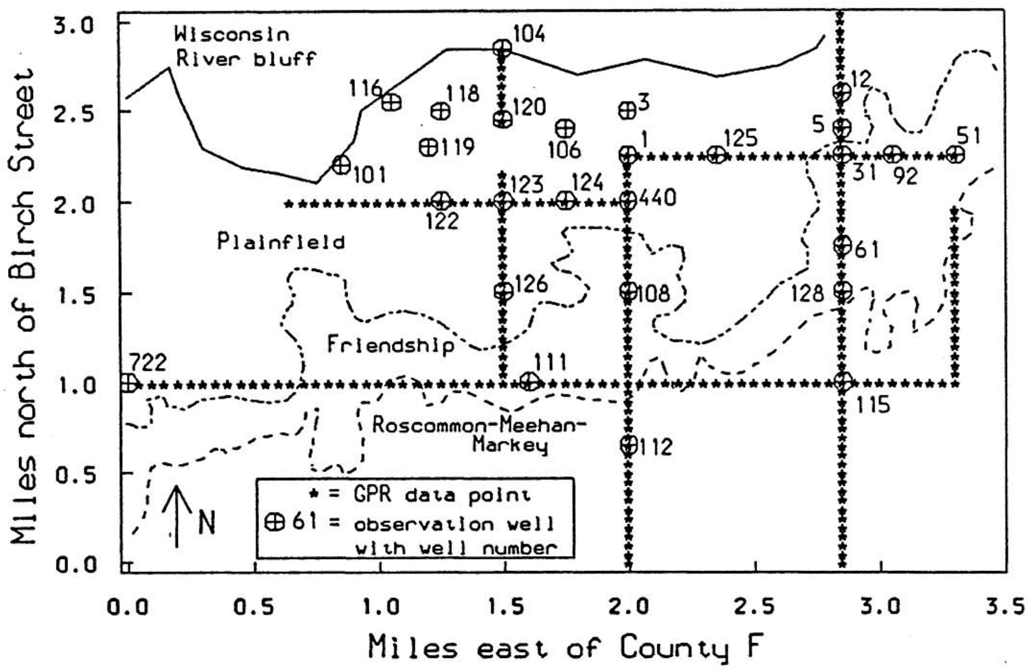

Figure 6. Distribution of data points in the field area with soil type boundaries shown by dashed lines. Birch Street and County Highway F are shown on Fig. 2.

sand runs approximately southwest-northeast, occupying perhaps a quarter of the field area. North of this swath, the Plainfield loamy sand predominates and south of it a complex intermingling of soils of the Roscommon-Meehan-Markey association occurs.

Figures 7 and 8 show radar records obtained over Plainfield loamy sand soils and Friendship loamy sand soils, respectively. The distinct difference in the clarity of the profile between these two soils is consistent throughout the field area, with changes in quality coinciding almost exactly with the soil boundaries shown in Otter and Fiala (1978). It is difficult to distinguish the water table in much of the record obtained over the Friendship soils. The descriptions of these soils in Otter and Fiala are almost identical, except that the upper loamy sand portion of the Friendship soils is slightly thicker than the upper loamy sand portion of the Plainfield soils. The Friendship soils are described as having an upper layer of loamy sand from 0 to 7 inches and a lower layer of loamy sand from 7 to 19 inches below the land surface. The Plainfield soils have an upper loamy layer from 0 to 5 inches and a light loamy sand from 5 to 14 inches below the land surface. It seems unlikely that such a slight variation should cause such a dramatic difference in signal quality, especially since the water table in this area is below these loamy sand horizons. However, the correlation between soil type and signal quality is quite strong. Perhaps some other subsurface variation, such as the occurrence

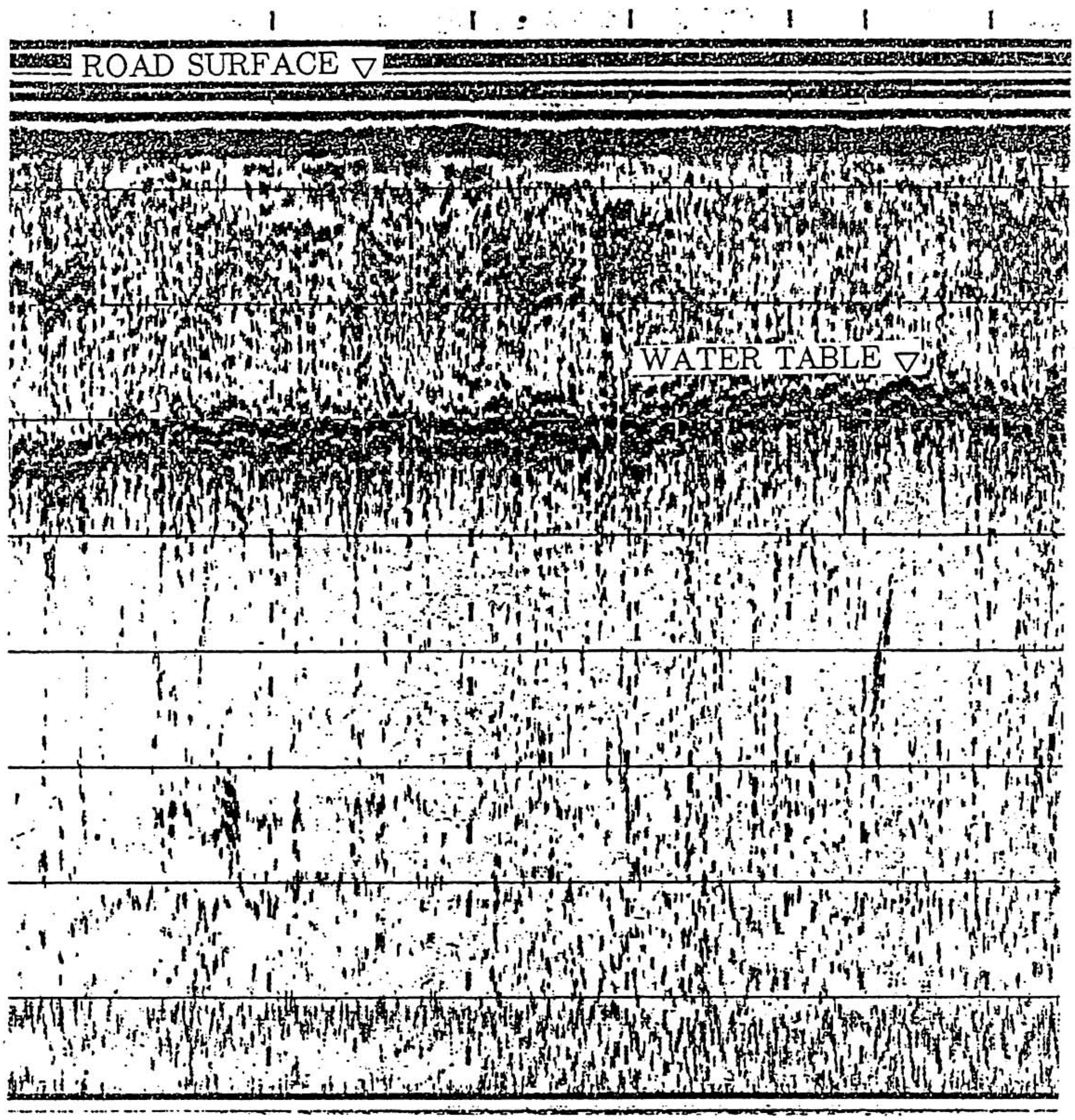

Figure 7. Typical radar record from a survey over Plainfield loamy sand soil. The vertical marks at the top of the record are at intervals of one-twentieth of a mile. The vertical scale is 17.2 ns/cm.

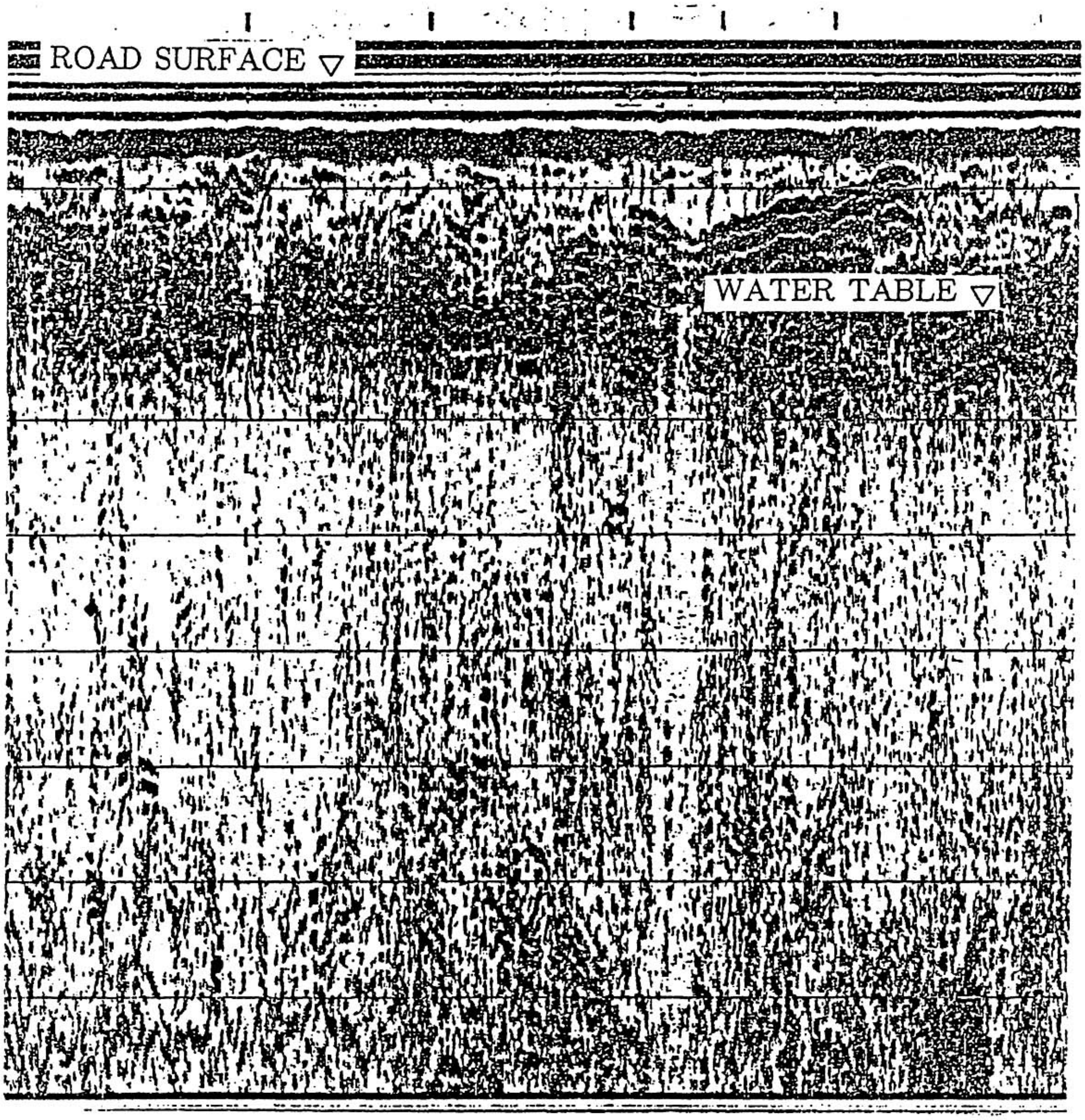

Figure 8. Typical radar record from a survey over Friendship loamy sand soil. The vertical marks at the top of the record are at intervals of one-twentieth of a mile. The vertical scale is 17.2 ns/cm.

of finer materials at depths of a few feet or more under areas of Friendship soils, not only influences the quality of the radar signal, but also influences the development of the overlying soils by causing variations in drainage conditions.

The radar profiles obtained in soils of the Roscommon-Meehan-Markey series contain adequately clear water table reflections, although they are not as clear as those from profiles over Plainfield soils. The Roscommon and Markey both have surface layers of muck, about nine inches thick in Roscommon soils and 16 to 51 inches thick in Markey soils (Otter and Fiala, 1978). One would not expect very good radar profiles in such soils. However, the Meehan loamy sand apparently underlies most of the surveyed roads in the southern half of the study area. The Roscommon and Markey soils predominate farther to the south, in the central portion of the Buena Vista Groundwater Basin. This is perhaps the best explanation for the fact that radar records from surveys in the basin were in general quite cluttered.