Data/Case Study 2008-01

Development of an Observation Well Network in the Mahomet Aquifer of East-Central Illinois

by
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Illinois State Water Survey
A division of the Illinois Department of Natural Resources
and an affiliated agency of the University of Illinois

2008

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March 2008

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Abstract

An observation well network was built in east-central Illinois for the purpose of monitoring groundwater levels in the Mahomet aquifer. The aquifer is an unconsolidated sand deposit that lies in a buried bedrock valley and is as much as 150 feet thick. Groundwater in the aquifer occurs under confined conditions; therefore, groundwater levels rise above the top of the Mahomet aquifer. The top of the sand comprising the Mahomet aquifer occurs at depths of 175-225 feet below the land surface.

More than 1,300 observations of depth-to-water were collected from 25 2-inch diameter observation wells between 1994 and 1998. As a result, an expectation of the depth-to-water has been established for each well, and seasonal variations have been documented.

The observations were converted to elevations, plotted on a map, and contoured. The result is a potentiometric map for the Mahomet aquifer in east-central Illinois. Interpretation of the map indicates that flow in the aquifer is away from a groundwater divide located near Paxton, Illinois. The highest groundwater elevations in the Mahomet aquifer have been recorded along this divide, which also coincides with the surface water divide between the Mississippi and Ohio River basins. Pumpage in the Champaign-Urbana area has caused groundwater levels (potentiometric heads) to be reduced by almost 50 feet since the 1950s, and the cone of depression has caused groundwater flow to the west of Champaign to be reversed from west to east.

Groundwater samples were collected from the observation wells in 1996. Total Dissolved Solids (TDS) averaged 396 milligrams per liter (mg/L) for much of the Mahomet aquifer, although much higher values are known to exist in Iroquois and Vermilion Counties. Calcium in the Champaign and Ford County samples averaged 66 mg/L, while magnesium and sodium averaged 30 and 31 mg/L, respectively. These values are comparable to those reported by the public water supplies in Rantoul, Champaign, and Mahomet. Bicarbonate, the dominant anion, averaged 381 mg/L in the Mahomet aquifer samples.

Introduction

The Illinois State Water Survey (ISWS) initiated a test drilling project that included the construction of 25 2-inch diameter observation wells at sites in east-central Illinois in 1994. The project concentrated on the deepest part of a buried bedrock valley in Champaign, Ford, Iroquois, and Vermilion Counties, but spread broadly across the width of the buried valley. The purpose of the project was to develop observation wells that could be used to collect data about the potentiometric surface of the Mahomet aquifer. Exploration of the sites primarily focused on the Mahomet aquifer. The main areas of interest were near and along the Illiana moraine at Paxton and near the water-supply wellfield northwest of Champaign, Illinois.

Historical Background

The bedrock surface of Illinois, upon which the glacial deposits rest, has its own uplands and valleys. Horberg (1945, 1950) identified and named many of the outstanding features on the bedrock surface, including one that traverses much of central Illinois (Figure 1). That feature, a broad buried bedrock valley, varies in width from 4 to 14 miles across and is 200-300 feet deep (Visocky and Schicht, 1969). The bedrock valley, named the Mahomet by Horberg in 1945, is important primarily because of the sand-and-gravel deposits it contains. These glacial and perhaps pre-glacial granular deposits serve as an aquifer and supply large quantities of groundwater to many communities and commercial users in east-central Illinois.

Horberg studied the subsurface deposits in bedrock valleys and focused much attention on the sequences observed in the Mahomet bedrock valley and in the ancestral Mississippi River valley near Peoria. In 1953, he formally defined the principal outwash in the Mahomet bedrock valley and named it the Mahomet sand for the village of Mahomet in Champaign County (Kempton et al., 1991). According to Horberg (1953), the sand-and-gravel deposit is continuous along the valley, but thickest over the deepest parts of the valley, and the top of the Mahomet sand ranges from 465 to 530 feet, with most elevations near 500 feet. Kempton et al. (1991) refined this observation and restated that the uppermost surface of the Mahomet sand attains its highest elevation (540-560 feet) in the vicinity of Hoopeston and slopes down the valley to perhaps 530-550 feet near Paxton, and 510-540 feet at Champaign.

The Mahomet sand is overlain by glacial till, less extensive deposits of fine sand, and other Quaternary deposits. Consequently, the sand comprising the Mahomet aquifer is buried 175-225 feet below the land surface at most locations in east-central Illinois.

Visocky and Schicht (1969) studied and summarized groundwater resources within the Mahomet sand. They focused on the principal hydraulic properties of the aquifer, its confining beds, well construction features, pumpage between 1890 and 1965, and groundwater levels since 1947. Visocky and Schicht referred to the Mahomet sand as the “deep aquifer” in their description of aquifers in the Champaign-Urbana area and noted that it was commonly encountered at depths greater than 200 feet.

Visocky and Schicht noted that high-capacity wells into the Mahomet aquifer often yielded 1,500-2,000 gallons per minute (gpm) and reported a maximum pumpage of 3,000 gpm. Kempton et al. (1991) reported maximum hydraulic conductivy of 4,780 gallons per day per square foot (gpd/ft^2), with storage coefficients ranging from $2x10^{-5}$ to $2x10^{-3}$. According to Kempton et al. (1991), the median hydraulic conductivity was 2,920 gpd/ft^2 in the area between Monticello and Champaign.

Although Visocky and Schicht (1969) knew groundwater levels in the Mahomet aquifer were responding to pumpage, no one attempted to construct even the simplest potentiometric map in east-central Illinois until Sanderson and Zewde (1976). That map, based on static water levels recorded on well construction reports by drillers over many decades, only covered Champaign County and illustrated that groundwater elevations sloped from slightly over 700 feet near Ludlow to less than 625 feet inside the Champaign well field. They understood that the general pattern of groundwater flow was from an area of high potentiometric head near Ludlow and Paxton to areas of lower head at Champaign.

Using available well logs, Kempton et al. (p. 121, 1991) showed the "probable direction of groundwater flow" and stated that "a precise potentiometric surface map could not be constructed." Although they could not locate the groundwater divide and erroneously suggested that there was flow into west central Indiana, Kempton et al. (1991) provided the first regional map of groundwater flow in the Mahomet aquifer from Indiana to southern Tazewell County.

Acknowledgments

The author acknowledges the professional manner and cooperative spirit that characterized the rotary drilling services provided by Jet Hall, Albrecht Drilling Company, Ohio, Illinois. Sims Drilling provided drilling services for shallower wells in 1998, primarily in Iroquois County.

David R. Larson, Illinois State Geological Survey (ISGS), sampled and characterized drill cuttings at many sites and provided frequent assistance with the construction of many of the observation wells. Appreciation also is extended to Timothy C. Young for operating the ISGS' downhole geophysical logger and thereby documenting natural gamma variations in the subsurface.

Loretta Skowron, Daniel L. Webb, Sofia Lazovsky, Lauren F. Sievers, Kaye Surratt, and Susan R. Bachman provided chemical analyses of water samples collected at the well sites. Joseph Karny helped collect groundwater samples from the observation wells. Peer reviewers of this report were Mark Anliker and Kenneth J. Hlinka. Additional review comments by H. Allen Wehrmann, Director of the Center for Groundwater Science, were also incorporated into the text. Eva Kingston provided editorial review, Linda Hascall provided graphical support, and Pamela Lovett and Patti Hill did the final word processing and report layout.

The views expressed in this report are those of the author and do not necessarily reflect the views of the Illinois State Water Survey.

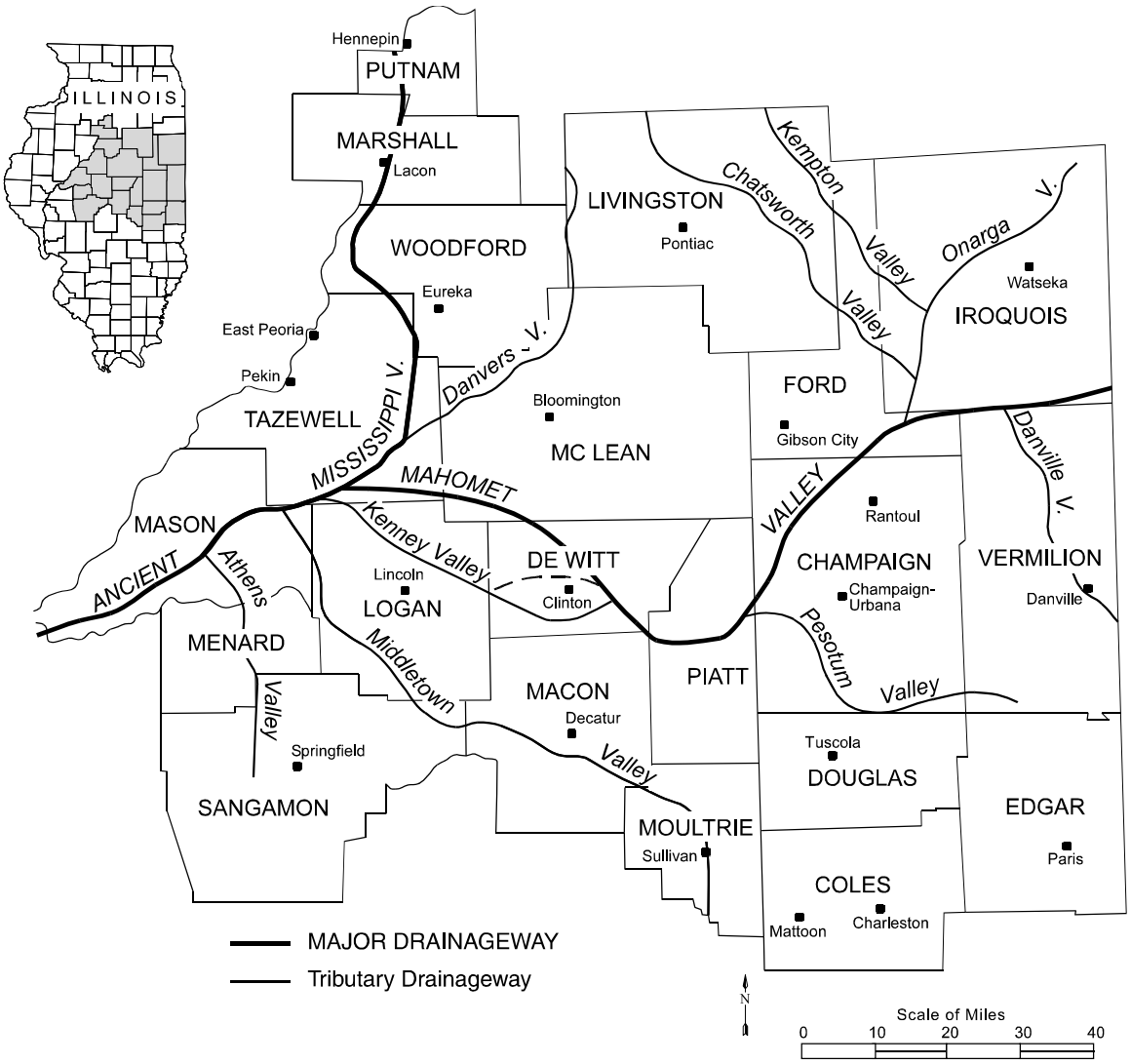

Figure 1. Trace of the Mahomet bedrock valley in central Illinois (after Selkregg and Kempton, 1958)

Observation Well Network

Although the Mahomet aquifer is widely known in east-central Illinois, no regional observation well network existed until 50 years after the aquifer was identified as an important resource for public water supplies. As Visocky and Schicht (1969) reported, systematic groundwater-level measurements were collected only in the vicinity of pumping centers and usually by individual municipalities. The ISWS encouraged them to make periodic measurements and to report them monthly. Prior to this project, there were only six observation wells in the Mahomet aquifer, and they were concentrated in two Champaign County townships: T19N, R8E and T19N, R9E.

Consequently, in 1994, the Aquifer Assessment program at the ISWS set out to build a Mahomet aquifer observation well network that stretched 60 miles from the Illinois-Indiana border west and southwest to the Champaign-Piatt County line. The effort continued in 1995, 1996, and was completed in 1998. The result was the establishment of a widespread observation well network (Figure 2) dedicated to the monitoring of groundwater levels in the Mahomet aquifer.

Test Drilling and Observation Well Construction

Drill Site Selection

Test drilling and the construction of observation wells involved determining where to drill, the depth to the bottom of the Mahomet aquifer, and executing the necessary logistics. This process began with the selection of potential sites by tracing the 500 and 550 feet bedrock contour lines onto road maps for Champaign, Vermilion, Ford, and Iroquois Counties. These contour lines approximate the boundary of the deposit. Logs of private wells on file at the ISWS were studied to develop a stratigraphic sense of the depths to the top of the Mahomet aquifer.

A field reconnaissance of the area was conducted in spring 1994 to find locations suitable for observation wells. Basically, the process involved driving on township roads looking for potential drill sites with wide, flat places in the right-of-way where a drill rig could set up without interference from overhead power lines or underground utilities (typically telephone cables and natural gas pipelines).

Six sites were selected for construction of observation wells: (1) on a moraine (possibly the Gifford moraine) west of Ludlow; (2) on a moraine east of Paxton (possibly the Ellis moraine); (3) between Rankin and East Lynn along the deepest part of the bedrock valley; (4) one mile north of Hoopeston; (5) on the Illinois-Indiana border in southeastern Iroquois County; and (6) at an undeveloped rest area along Route 9, southeast of East Lynn. Holes were drilled to bedrock at five sites, and observation wells in the Mahomet aquifer were built (CHM-94A, FRD-94A, VER-94A, VER-94D, and IRO-94A). The sixth site also resulted in a Mahomet observation well (CHM-94C), although the drill hole did not reach bedrock. Separate holes were drilled into the overlying Glasford aquifer (CHM-94B, FRD-94B, VER-94B, and IRO-94B) at

four of the six sites, and wells were completed so that water-level differences could be observed between the Glasford and the Mahomet aquifers.

In 1995, the focus shifted to Champaign County and to building wells only into the Mahomet aquifer because the previously drilled observation wells showed little groundwater-level difference exists at the Ludlow, Paxton, and Rankin area well sites. The savings realized by not constructing Glasford wells made it possible to construct four Mahomet observation wells (CHM-95A, CHM-95B, CHM-95C, and CHM-95D) into the deepest parts of the Mahomet buried bedrock valley. One additional Mahomet aquifer well (IRO-95A) was constructed in the Gilman bedrock valley, about 2 miles northeast of Loda (Ford County).

In 1996 three more observation wells (CHM-96A, CHM-96B, and CHM-96C) were drilled in Champaign County. These holes were typically about 330 feet deep and deliberately sought the lowest parts of the Mahomet bedrock valley. A Mahomet aquifer well situated over the shallower Gilman bedrock valley also was drilled, southeast of Thawville in Iroquois County (IRO-96A).

The Mahomet aquifer observation well network was extended into Iroquois County during 1998. The basis for this extension was that these sites might be used to document the flow of groundwater northward and away from the main axis of the Mahomet bedrock valley. Consequently, five holes were drilled at sites in Iroquois County. Three of these sites resulted in Mahomet aquifer observation wells (IRO-98B, IRO-98C, and IRO-98D). These holes were shallower and typically encountered bedrock at about 190 feet. One hole did not encounter the Mahomet aquifer although it was cased (IRO-98A). Another hole, drilled at the eastern margin of the bedrock valley, did not encounter enough aquifer to warrant construction of an observation well.

With the completion of the northern extension of the network, a final effort was made to expand network coverage over a wider area. Consequently, at the end of the 1998 drilling effort, an additional site was developed in extreme northwestern Champaign County near the village of Lotus (CHM-98A). It, too, encountered the Mahomet aquifer and provides a useful data point for constructing water-level maps.

As a result of this multi-year effort, observation wells were constructed in the Mahomet aquifer at 20 sites in east-central Illinois (Figure 2). At four of these sites a shallower observation well was also completed in the overlying Glasford aquifer. A fifth site failed to encounter the Mahomet aquifer. Consequently, a single observation well in the Glasford aquifer was completed at that location. More than 1,300 observations of groundwater levels (potentiometric heads) have been collected from these wells and the information obtained from them is central to understanding groundwater flow in the Mahomet aquifer.

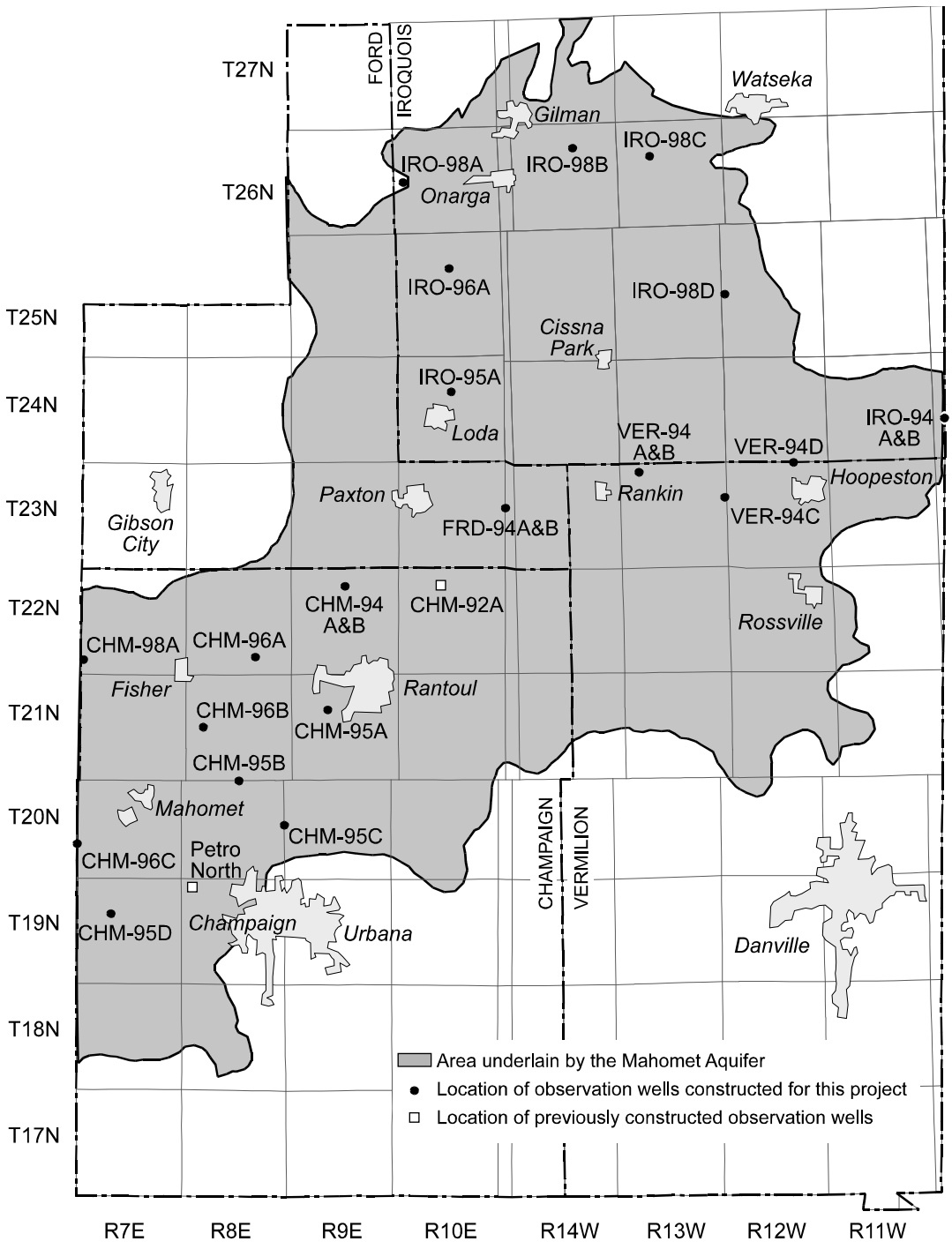

Figure 2. Locations of observation wells in the project area.

Drilling Method

A hydraulic mud-rotary rig was used to drill into the Mahomet aquifer. The contractors used 6-inch diameter, tri-cone bits at each hole to reach the desired depth (or until bedrock was encountered). Water needed for drilling, perhaps 1,500 gallons per hole, was obtained from nearby public water supplies.

At most locations, samples washed up to the surface were collected at 5-foot depth intervals and were described, bagged, and archived by Illinois State Geological Survey (ISGS) staff. Additional samples were collected at selected depths for grain-size analysis, to observe perceived changes in texture, and to help decide the appropriate placement of the well screen. Table 1 presents the Wentworth classification scheme used to describe the sand samples. Lithologic logs of the borings and well construction details are shown as Appendix A.

Geophysical Logging

The ISGS ran natural gamma logs, which record the relative emission of gamma rays versus depth below land surface at all drill sites. These downhole geophysical logs depict changes in strata by using the changes in natural radiation (measured in counts per second) commonly associated with differences in formation materials. Clay and shale usually contain more radioactive elements than limestone, sandstone, or sand. When paired with the driller's log, the natural gamma log is very effective in documenting the stratigraphic relationships of aquifers and less permeable layers. Readers interested in the original logs are directed to the ISGS.

A hydrogeologist with experience in a locale, especially if he examined the drill cuttings as they washed to the surface, can recognize signatures on the natural gamma log that correlate with particular lithostratigraphic units. The lithology cannot be read directly from such geophysical logs, but the signal strengths reflect the lithologies passed by while traveling through the subsurface. Geologists, in fact, often add lithologic information from the drill cuttings to geophysical logs, rather than the geophysical log dictating the lithology. The correlation often is based more on the observed drilling action, penetration rate, and cuttings rather than on the strength of the radioactive emission.

Table 1. Scale for Classifying Grain Size

Type of sand	*Range of grain size (mm)*
Very Coarse	1 - 2
Coarse	0.5 - 1
Medium	0.25 - 0.50
Fine	0.125 - 0.25
Very Fine	0.0625 - 0.125

Consequently, it has been observed during exploration of glacial deposits in Illinois that sand and/or gravel has a lower radiation rate than does glacial till. The usual sensitivity range in such terrains is 0-100 counts per second (cps). It has been observed that the clay matrix of till correlates with higher emission rates, and helps to delineate the Mahomet aquifer. Figure 3 illustrates the natural gamma log recorded for observation well CHM-95D (near Seymour, IL). Several notable correlations are visible in the illustration. The low natural gamma count, on the order of 25-30 cps below a depth of about 175 feet, corresponds with the sand of the Mahomet aquifer. Above this deposit, a homogeneous clay till unit of 45-55 cps was observed. An interbedded sequence of clay and sand occurs between depths of 90 and 135 feet. Correspondingly, the natural gamma counts vary in a 25-45 cps range. At the bottom of the hole, bedrock was encountered and it is denoted on the log by the strong increase ("kick") in signal strength.

Observation Well Construction

Observation wells were constructed in 25 of the 26 holes drilled for this study. The observation wells are used to monitor groundwater levels and also for collection of water samples for chemical analyses. The wells were completed at depths of 190-340 feet and were constructed of 2-inch diameter, flush-jointed PVC casing with 5-foot lengths of PVC well screen. Each well was backflushed with 400-500 gallons of potable water to purge the borehole of drilling fluids, and the annulus then was filled with ⅜-inch gravel. Layers of bentonite chips were interspersed in the annulus to inhibit vertical movement of groundwater within the borehole; and the annulus was sealed with bentonite near the surface. Each well is protected at the surface with a lockable, square steel cover.

Within a week or two of construction, each well was developed with compressed air for about an hour to remove sediment, drilling mud, and fine sands from the screened portion of the well. The land surface around the wells was generally restored to near original condition.

Surveying

Elevations of casing tops are critical to any groundwater investigation because depth-to-water measurements in a well normally are taken with reference to the top of the well casing. Measuring-point elevations of most of the observation wells have been calculated relative to the National Geodetic Vertical Datum (NGVD) with Global Positioning System (GPS) equipment owned by the ISWS. Table 2 summarizes measuring-point elevations and locations of the observation wells.

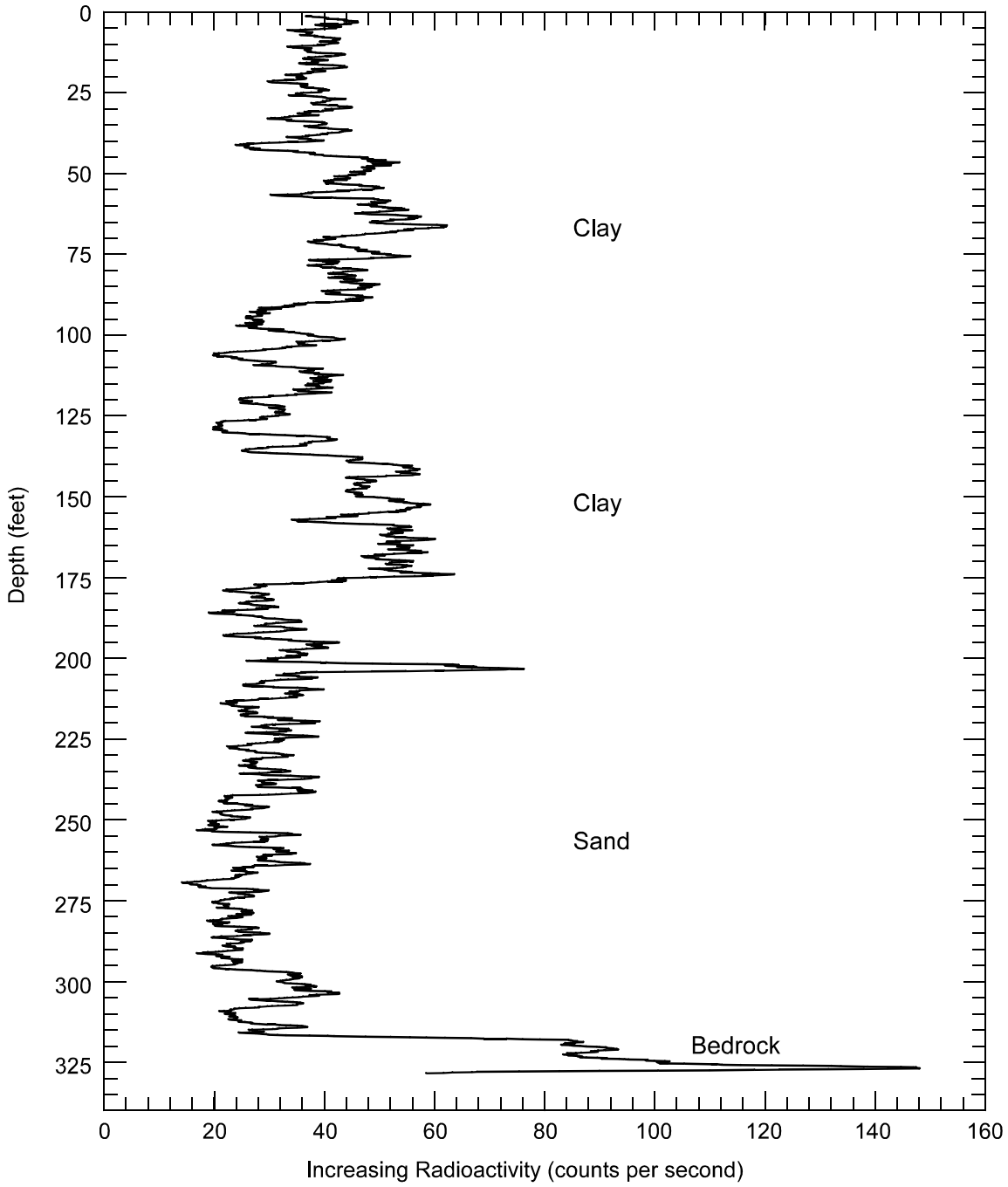

Figure 3. Natural gamma log showing difference between sand, clay, and bedrock.

Table 2. Observation Well Locations and Measuring-Point Elevations

Well name	*Location (section, township, and range)*	*Depth (ft)*	*Elevation (ft)*
CHM-94A	NE¼, NE¼, NE¼, NE¼ of Sec. 09, T22N, R9E	385	819.51
CHM-94B	NE¼, NE¼, NE¼, NE¼ of Sec. 09, T22N, R9E	265	819.90
CHM-95A	NW¼, NW¼, NW¼, NW¼ of Sec. 16, T21N, R9E	265	--
CHM-95B	NE¼, NE¼, NE¼, ¼ of Sec. 03, T20N, R8E	280	784.21
CHM-95C	NW¼, SW¼, SW¼, SW¼ of Sec. 18, T20N, R9E	317	732.82
CHM-95D	NW¼, NW¼, NW¼, NW¼ of Sec. 16, T19N, R7E	290	700.11
CHM-96A	SE¼, SE¼, SE¼, SE¼ of Sec. 27, T22N, R8E	351	--
CHM-96B	SE¼, SE¼, SE¼, SE¼ of Sec. 18, T21N, R8E	341	707.34
CHM-96C	NW¼, NW¼, NW¼, NW¼ of Sec. 30, T20N, R7E	340	699.85
CHM-98A	NW¼, NW¼, NW¼, NW¼ of Sec. 31, T22N, R7E	245	--
FRD-94A	NW¼, SW¼ of Sec. 13, T23N, R11E	375	799.11
FRD-94B	NW¼, SW¼ of Sec. 13, T23N, R11E	200	798.87
IRO-94A	SE¼, NE¼, SE¼ of Sec. 19, T24N, R10W	305	761.14
IRO-94B	SE¼, NE¼, SE¼ of Sec. 19, T24N, R10W	200	761.06
IRO-95A	NE¼, NE¼, NE¼, NE¼ of Sec. 16, T24N, R10E	235	739.15
IRO-96A	NE¼, NE¼, NE¼, NE¼ of Sec. 09, T25N, R10E	210	678.82
IRO-98A	NW¼, NW¼, NW¼, NE¼ of Sec. 20, T26N, R10E	185	679.24
IRO-98B	NW¼, SW¼, SW¼, NE¼ of Sec. 10, T26N, R14W	187	660.72
IRO-98C	NE¼, NW¼, NE¼, NE¼ of Sec. 17, T26N, R13W	172	661.02
IRO-98D	SW¼, NW¼, SW¼, NW¼ of Sec. 18, T25N, R12W	232	--
VER-94A	SW¼, NW¼, NW¼, SW¼ of Sec. 05, T23N, R13W	255	697.47
VER-94B	SW¼, NW¼, NW¼, SW¼ of Sec. 05, T23N, R13W	135	697.30
VER-94C	NW¼, NE¼, NE¼, NE¼ of Sec. 13, T23N, R13W	240	706.95
VER-94D	NW¼, NW¼, NW¼, NW¼ of Sec. 02, T23N, R12W	320	717.44

Groundwater Levels

The level to which groundwater rises in a well is a direct response to pressure within an aquifer. By measuring the depth-to-water in a well and comparing that observation with the depth to the top of the aquifer being utilized by the well, one can determine whether groundwater in the aquifer occurs under confined conditions (synonymous with artesian) or unconfined conditions (water table).

If the aquifer is overlain (confined) by an impermeable layer, groundwater often rises to some level above the top of the aquifer. The difference in height to which groundwater rises above the top of a confined aquifer is termed artesian head. Figure 4 is a schematic illustrating the physical relationship of depth-to-water, artesian head and saturated aquifer thickness. The illustration also shows how the value of artesian head is calculated.

The Mahomet aquifer occurs under confined conditions throughout the study area. As shown in Figure 5, the amount of artesian head present in the Mahomet aquifer varies from 80 to 205 feet (roughly equivalent to 35 to 88 pounds per square inch). These values, observed in Spring 2002, show measurements of more than 130-140 feet of artesian head are common throughout the aquifer in east-central Illinois.

Potentiometric Surface Map

When groundwater level measurements are converted to elevations and plotted on a map, they can be contoured. Such a map represents an imaginary surface, called the potentiometric surface, and illustrates the elevation to which groundwater would rise in a well constructed at that location.

Elevations calculated from groundwater level measurements at each Mahomet aquifer observation well during 1999 (May to July) were plotted to produce the potentiometric surface map presented as Figure 6. Because groundwater moves from areas of high to low potentiometric elevation, it is inferred from Figure 6 that groundwater flow in the eastern portion of the Mahomet aquifer is multi-directional. The direction of flow is largely dependent upon your location within the four counties of east-central Illinois: Champaign, Ford, Iroquois, or Vermilion County.

A groundwater divide exists near Paxton, Illinois, and extends southeast across the buried bedrock valley. The highest groundwater elevations in the Mahomet aquifer have been recorded along this divide. Two observation wells (CHM-94A and FRD-94A) have been used to document groundwater elevations of 694 and 692 feet, respectively, roughly coinciding with the trace of the Gifford Moraine. The location of this Woodfordian Moraine, shown by Willman and Frye (1970), also coincides with the surface water divide between the Mississippi and Ohio River basins.

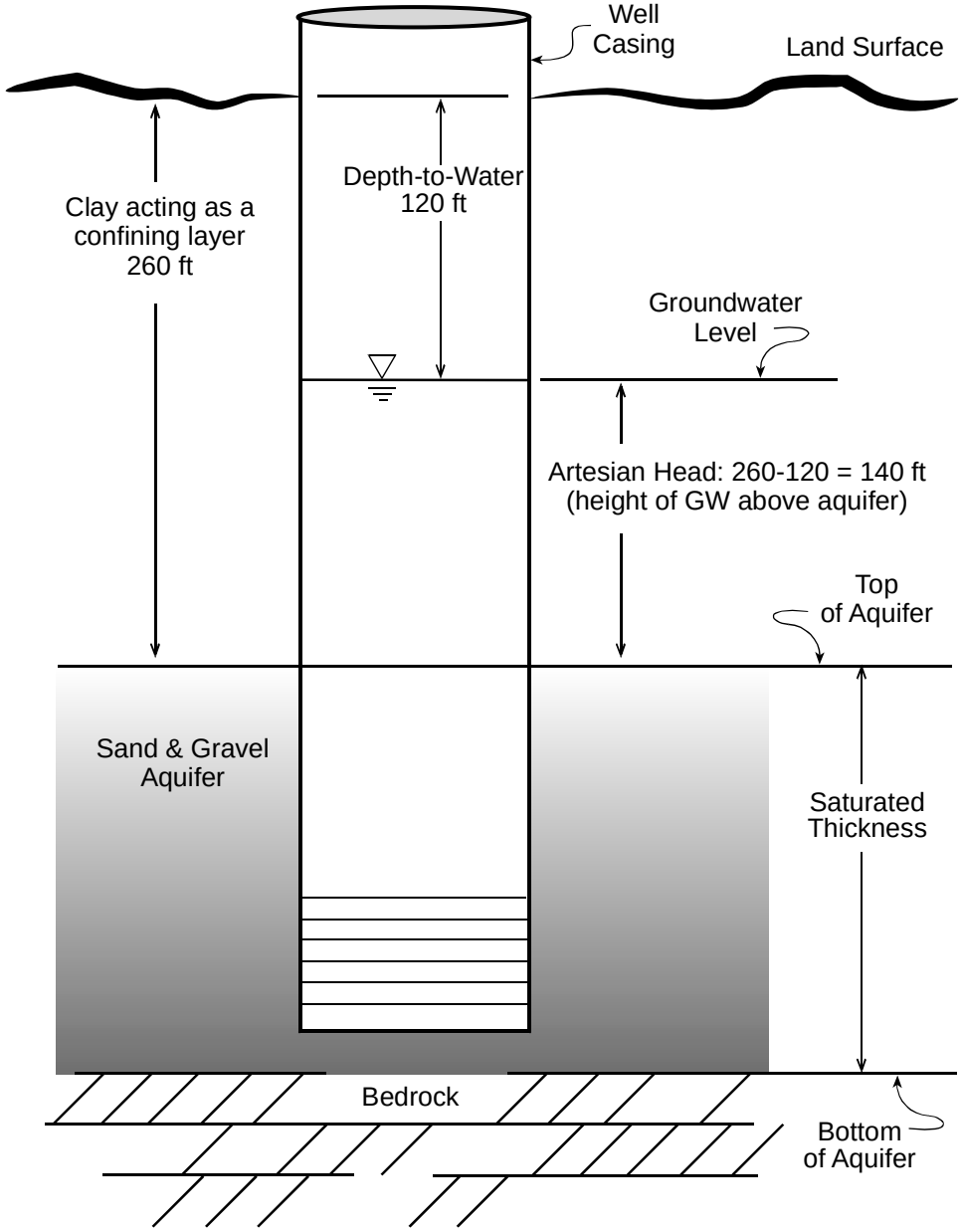

Figure 4. Illustration of artesian head and how it is calculated.

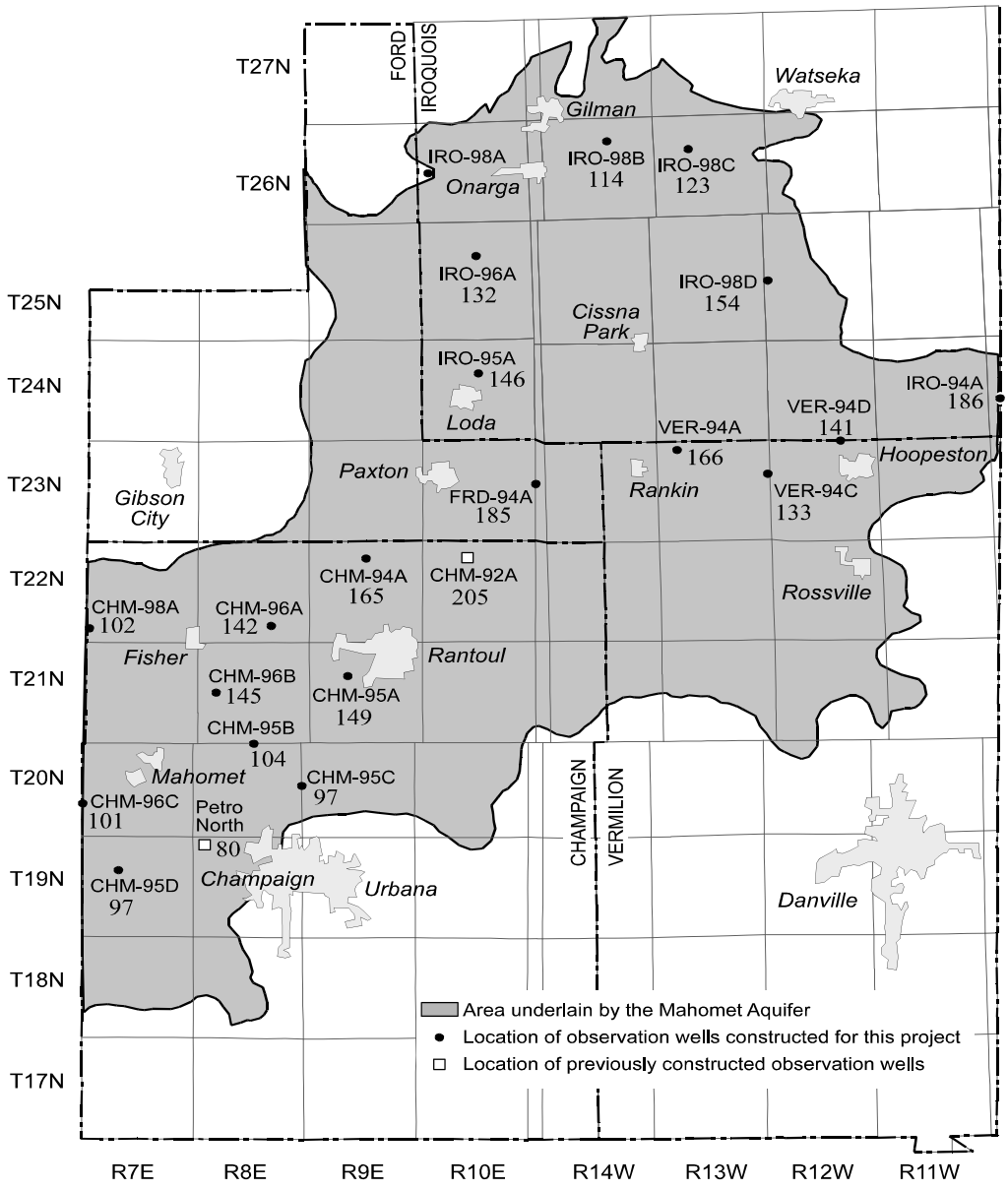

Figure 5. Values of artesian head (feet) at observation wells in the Mahomet aquifer.

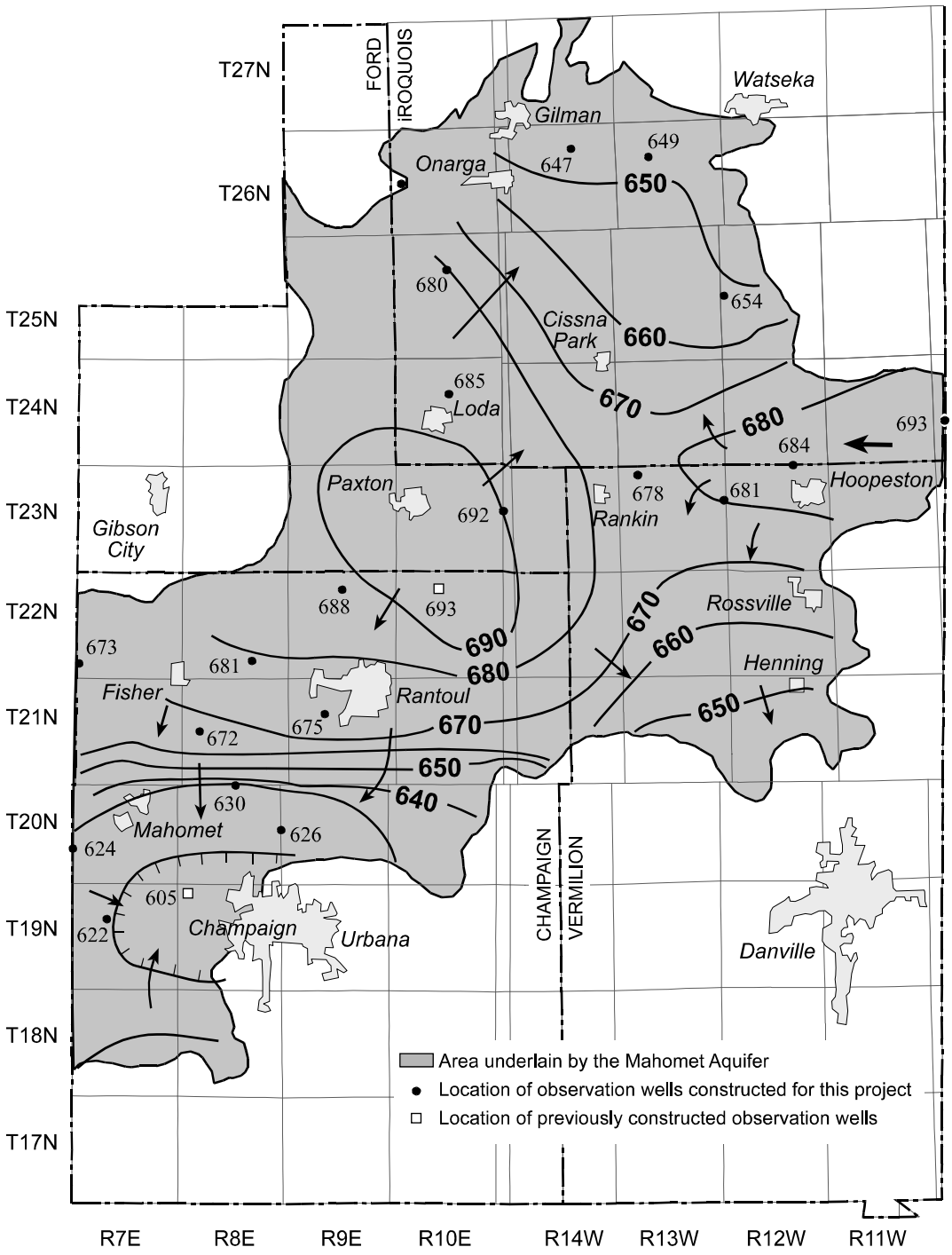

Figure 6. Groundwater elevations (potentiometric surface) in the Mahomet aquifer, May-July 1999.

From this area of high groundwater elevations, flow is to the east and west. The eastward flow follows the hydraulic gradient toward Rankin where it splits both northward and southward. The groundwater flowing northward actually is migrating up a buried bedrock valley tributary. This, in addition to the tight overlying lake clays and relatively flat topography, contributes to the existence of numerous flowing artesian wells in southern Iroquois County. The groundwater flowing southward moves toward the small community of Henning (Vermilion County).

The potentiometric surface map also shows that groundwater enters Illinois from Indiana, contrary to speculation by Kempton et al. (1991). The groundwater elevation at the stateline is 692 feet and slopes west past Hoopeston and also toward the Rankin area. Again, the horizontal hydraulic gradient splits both northward and southward. Groundwater elevations in VER-94A and VER-94B are nearly identical, signifying essentially no vertical gradient between the Mahomet and the overlying Glasford aquifer. Water quality samples taken from observation wells VER-94A and VER-94B are also more mineralized than elsewhere in the Mahomet aquifer, further suggesting a stagnant area where groundwater quality has been affected by longer residence times.

The potentiometric surface can be impacted greatly by groundwater withdrawals (pumpage). Removal of groundwater by wells will reduce the potentiometric pressure in the aquifer, causing a depressed surface to occur around the wells. If the pumpage is short-lived and ceases, the potentiometric surface often recovers quickly. However, if steady pumpage continues for years or decades, a regional cone of depression can form particularly around a water-well field.

The most notable depression on the potentiometric surface is located near Champaign. Visocky and Schicht (1969) noted that groundwater levels in Mahomet aquifer wells declined 35 feet between 1948 and 1963. Since then, pumpage at Champaign has increased from about 13 million gallons per day (mgd) in 1965 to about 19 mgd in 2000. Consequently, the cone of depression has expanded and deepened accordingly so that now much of the flow moving down the bedrock valley from the northeast is captured. Groundwater levels near Champaign frequently drop below the 600-foot elevation, although the aquifer remains under confined conditions even while being pumped. The impact is so extensive that Anliker and Sanderson (1995) observed another divide in the aquifer just beyond the western boundary of the study area (near White Heath in Piatt County). From this small divide where the groundwater elevation is about 625 feet, some groundwater flows back toward Champaign despite the buried valley's regional slope toward Illinois River valley.

The potentiometric surface map (Figure 6) also illustrates that the hydraulic gradient west of the divide near Paxton suggests groundwater is moving steadily down the Mahomet valley past Rantoul and into the regional depression created by the well field northwest of Champaign, as also documented by Sanderson and Zewde (1976). The potentiometric surface map shown in this report, however, reveals a steepening of the hydraulic gradient between Rantoul and Champaign, an anomaly not previously observed. It is likely that this increase in hydraulic gradient reflects a reduction in aquifer thickness or hydraulic conductivity (permeability) or both. Beyond this anomaly the pattern indicates that flow is into the regional depression of the potentiometric surface. This cone is caused mainly by the highly-developed water supply well field northwest of Champaign.

Hydrographs

Hydrographs are visual representations of water levels over time. Depths-to-water or groundwater elevations plotted over time are particularly useful for showing fluctuations about a typical value and trend. Some wells constructed at the beginning of this project have been observed more than 50 times between 1994 and 2002. Consequently, some confidence in a typical value and seasonal variation exists for each well. Hydrographs and water-level data (depths-to-water and as elevations) for each observation well are shown in Appendix B.

The hydrograph for observation well CHM-95D, located near Seymour, is shown as Figure 7. It provides an excellent example of seasonal fluctuations during the 1995-1999 period followed by a reduction in groundwater elevation in midsummer 1999 as the result of renewed pumpage by a nearby industrial user. Subsequent fluctuations about a "new" equilibrium show that groundwater elevations are lowest in the summer and then rise during the fall and winter, and peak in late spring.

The magnitude of the seasonal variation is dependent upon how close the observation well is to a pumping, high-capacity well. Household use has little effect on the groundwater observations because of the Mahomet aquifer's great volume and water transmitting capability. In this confined part of the aquifer, changes in barometric pressure probably have more impact on groundwater elevations than do farm wells. Nevertheless, it has been observed that groundwater elevations fluctuate seasonally in the eastern Mahomet aquifer by 3-5 feet.

Longer periods of record provide trend information. The "Petro North" well constructed for the ISWS in 1953 (T19N-R08E-Sec. 06) is 235 feet deep (hole drilled to 255 feet) and pre-dates the current project. The 50-year long hydrograph (Figure 8) of groundwater elevations in this well reveals a decline of 47 feet between 1953 and April 2002. However, even though the groundwater head has decreased by almost 50 feet, the aquifer is still completely saturated because only a portion of the artesian head has been removed. About 80 feet of artesian head still remains at that location.

People concerned about the 50-year decline often fail to correlate this water-level decline with the historic increase in pumpage from the aquifer. While the artesian head decline is important, it must be put into context with the quantity of water being removed from the aquifer. As long as head declines are proportional to pumpage increases, recharge is not being exceeded because the cone of depression, as reflected in the head decline, must expand to meet withdrawals.

Often it is postulated that leakage from the overlying Glasford aquifer may occur in response to the decline in Mahomet aquifer artesian head. Visocky and Schicht (1969, p.42) state that the decline in artesian head near the Champaign wells also would lower groundwater levels (head) in the overlying Glasford aquifer: "…leakage through the confining beds [would] vary from place to place, and [be] primarily controlled by vertical permeabilities and thicknesses of confining beds and by differences between the heads…" of the Mahomet aquifer and overlying Glasford aquifer. An analysis of the relationship between head decline in the Mahomet and Glasford aquifers was beyond the scope of this project.

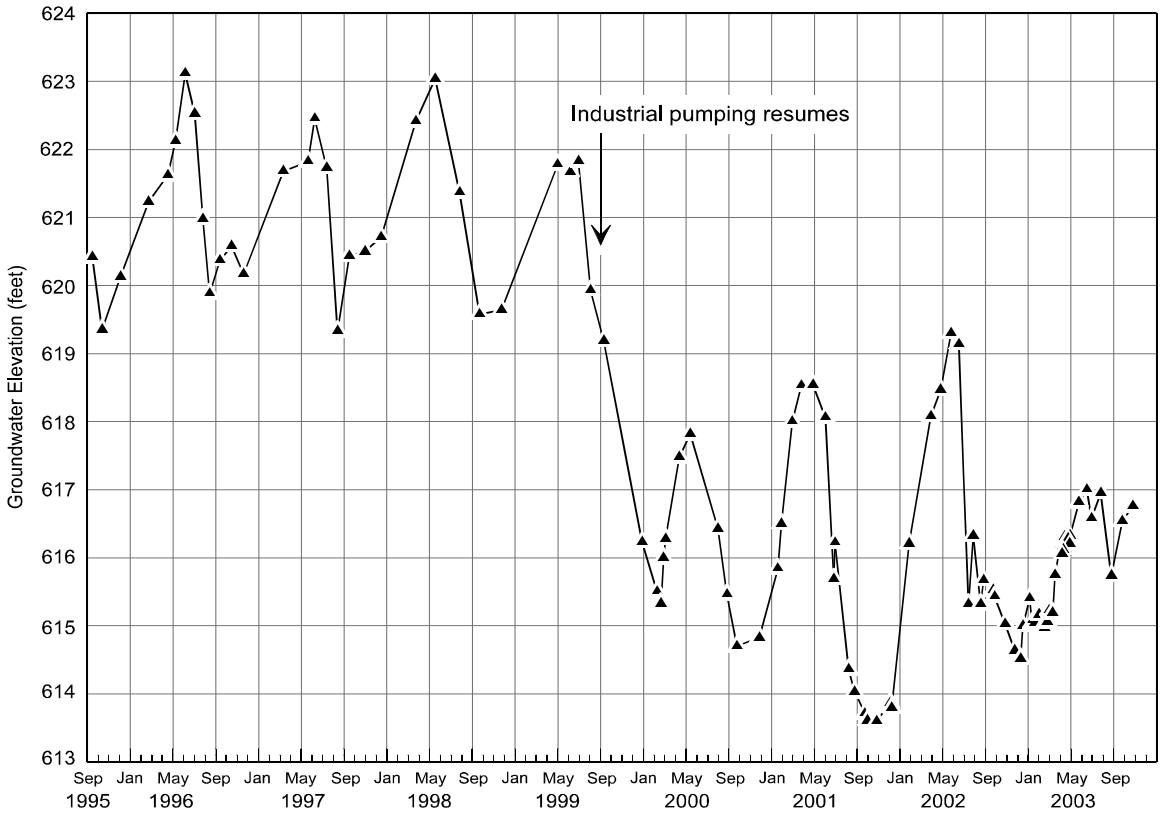

Figure 7. The CHM-95D hydrograph illustrates annual oscillation about a new equilibrium of groundwater elevations.

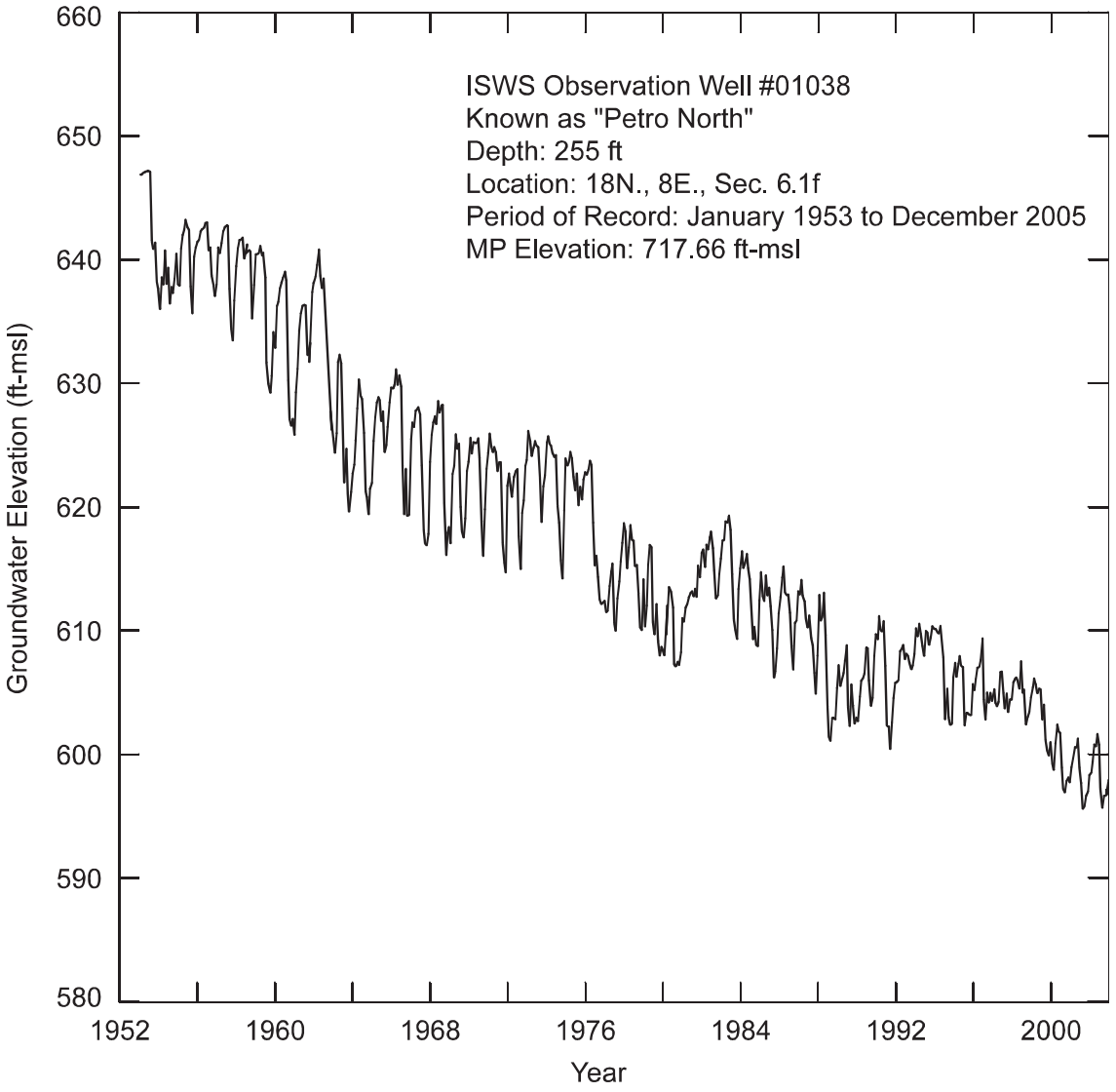

Figure 8. Hydrograph of “Petro North” groundwater elevations illustrates 50 years of decline in response to increasing well field pumpage.

Groundwater Quality

The chemical quality of raw groundwater is an important part of resource characterization. Consequently, groundwater samples from the observation wells are important to both private and public interests. Since the wells were constructed, they have also been sampled by other researchers at the ISGS and Illinois State University (ISU). Therefore, the network provides access to the Mahomet aquifer not possible prior to its existence.

Sampling Plan and Procedure

Groundwater samples were collected by ISWS staff from the observation wells in August and September 1996. The purpose of the sampling was the determination of major dissolved constituents and metals found in groundwater from the Mahomet and, to a lesser extent, the Glasford aquifers. Samples were collected at each of the 19 ISWS observation wells constructed between 1994 and 1996. An additional sample was collected from a pre-existing observation well constructed for an ISGS project (sample MVE-12 from observation well CHM-92A). Three blank (MVE-1) or duplicates (MVE-6 and MVE-22) were submitted during the course of sampling for quality control. All samples were kept on ice in a cooler during transport. Care was taken to drain cooler meltwater and to store the samples in an upright position to avoid cross-contamination of the samples. The five wells subsequently constructed in 1998 (mostly in Iroquois County) have not yet been sampled.

The wells were pumped for several minutes with a 1.8-inch diameter submersible pump (Grundfos®, Bjerringbro, Denmark) until the groundwater temperature and pH stabilized. During this time the sample bottles were labeled and cross referenced to an individual log sheet for each site that also included location (township, range, and section), observation well name, date and time, and any notes describing the visit.

Samples from each observation well were collected in four containers. Two bottles of 500- and 250-milliliter (mL) capacity were filled with water that had passed through a 0.45-micron QED or GeoTek filter with cellulose nitrate membranes. The 500-mL sample was used to determine total dissolved solids (TDS), sulfate, nitrate, chloride, and phosphate. The sample collected in the 250-mL bottle was preserved with 0.5 percent nitric acid (HNO_3) and was used for the metals analysis.

The other two samples were unfiltered and collected in smaller, 60-mL, wide-mouth polyethylene bottles and were used to determine alkalinity and ammonia. Attempts were made to ensure that the filled bottles contained no air bubbles because the carbon dioxide in the air can alter alkalinity. After many tries, it became apparent that the bottles could not be filled without some air (headspace) remaining. Because alkalinity was not critical to the study, these alkalinity samples were determined to be satisfactory. The ammonia sample was preserved with a 0.2 percent sulfuric acid (H_2SO_4) concentration.

Laboratory Determinations

Laboratory determinations were performed at the ISWS facilities in Champaign. The laboratory follows strict quality control and quality assurance procedures. Most determinations were made using an inductively coupled plasma (ICP) argon instrument. Ion chromatographs were made for chloride, nitrate, phosphate, and sulfate.

Results

This section briefly describes the major and secondary constituents found in a subset of the groundwater samples collected from some of the Mahomet aquifer observation wells in the study area. Specific details about trace constituents which are not shown in this report, such as barium, phosphate, and strontium, are available from the ISWS offices in Champaign, Illinois.

Table 3 lists the determinations from 13 observation wells deemed representative of the Mahomet aquifer. Most of these samples are from Champaign County although the list includes two samples from Vermilion County (near Hoopeston), one sample from Ford County, and one sample from Iroquois County (on the Illinois border with Indiana).

Table 4 lists three determinations from observation wells in the Glasford aquifer. Table 5 lists the remaining four samples not deemed representative of either the Mahomet or Glasford aquifers. Samples from these wells are shown separately because the wells are either finished in the overlying Glasford aquifer, or the samples are so mineralized as to have a distinct character that may be indicative of a different flow regime.

Major Constituents

The major constituents found in groundwater are calcium, magnesium, sodium, bicarbonate, sulfate, and chloride. Some of these constituents are among the most abundant minerals in the Earth's crust. Likewise, the most abundant constituents in seawater are chloride, sodium, sulfate, magnesium, calcium, and bicarbonate so it is not surprising to find “Earth products” as dissolved constituents in groundwater.

An ionic balance is maintained between positively charged and negatively charged constituents. Positively charged ions are called cations, and negatively charged ions are called anions. Calcium, magnesium, and sodium are the most significant cations in groundwater. Sulfate, chloride, and bicarbonate are the dominant anions. Together, these constituents are TDS, a frequent measurement for quickly characterizing groundwater quality. The average TDS value calculated was 396 mg/L, although much higher values are known to exist in Iroquois County.

Calcium in the Champaign and Ford County samples averaged 66 mg/L, while magnesium and sodium averaged 30 and 31 mg/L, respectively. These values are comparable to values reported by the public water supplies in Rantoul, Champaign, and Mahomet. The dominant anion in the groundwater samples from the Mahomet aquifer is bicarbonate, which averaged 381 mg/L in the corresponding samples. Sulfate, the second most common anion,

Table 3. Chemical Determinations for Mahomet Aquifer Samples

	Observation Well Name and Sample Number					
	CHM-95D	*CHM-96C*	*CHM-96B*	*CHM-96A*	*CHM-95B*	*CHM-95C*
Parameter (mg/L)	*2*	*3*	*4*	*5*	*7*	*8*
Major Constituents						
Calcium	60.6	75.7	70.7	71.7	63.4	58.6
Magnesium	30.3	36.7	27.8	28.2	32.0	31.5
Sodium	32.8	24.0	34.2	27.8	32.2	19.5
NO_3-N	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sulfate	<0.9	7.95	52.6	43.2	4.57	15.8
Chloride	3.0	3.2	2.0	1.3	1.9	10.6
Alkalinity	398	458	367	370	404	332
TDS @ 180°C	386	436	432	416	385	355
Secondary Constituents						
Iron	1.45	0.967	0.725	0.590	0.699	0.985
Manganese	0.049	0.264	0.052	0.064	0.055	0.054
Potassium	1.45	2.25	2.02	1.82	1.86	2.16
Fluoride	0.1	0.2	0.1	0.1	0.2	0.2
NH_4-N	0.808	4.775	0.714	0.629	1.173	0.582
Boron	0.43	0.20	0.59	0.76	0.45	0.23

	CHM-95A	*CHM-94A*	*CHM-92A*	*IRO-94A*	*VER-94D*	*VER-94C*	*FRD-94A*
Parameter (mg/L)	*9*	*11*	*12*	*14*	*15*	*16*	*18*
Major Constituents							
Calcium	69.0	65.4	52.1	64.1	66.2	67.7	75.0
Magnesium	27.6	25.4	24.5	25.8	27.3	29.8	41.0
Sodium	28.9	43.8	28.4	39.0	32.1	28.5	30.3
NO_3-N	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Sulfate	43.6	7.50	2.39	23.2	13.9	22.2	90.4
Chloride	1.5	1.5	3.2	1.6	1.9	1.8	3.1
Alkalinity	395	399	341	375	378	374	366
TDS @ 180°C	395	402	333	390	377	377	463
Secondary Constituents							
Iron	0.748	1.29	0.604	0.776	0.711	1.26	0.288
Manganese	0.095	0.072	0.184	0.250	0.125	0.042	0.516
Potassium	2.32	2.34	3.30	2.19	2.22	1.97	2.12
Fluoride	0.1	0.1	0.6	0.4	0.1	0.1	<0.1
NH_4-N	1.033	0.932	0.978	0.916	0.621	0.676	0.676
Boron	0.61	1.33	0.12	0.86	0.60	0.50	0.71

Table 4. Chemical Determinations for Glasford Aquifer Samples

	Observation Well Name and Sample Number		
	CHM-94B	*IRO-94B*	*FRD-94B*
Parameter (mg/L)	*10*	*13*	*17*
Major Constituents			
Calcium	72.8	68.8	79.0
Magnesium	29.9	27.5	33.1
Sodium	40.6	41.3	4.12
NO_3-N	<0.02	<0.02	<0.02
Sulfate	55.4	6.52	<0.9
Chloride	0.6	1.6	1.5
Alkalinity	388	420	383
TDS @ 180°C	449	402	353
Secondary Constituents			
Iron	1.21	0.950	0.982
Manganese	0.177	0.058	0.110
Potassium	1.67	1.75	1.34
Fluoride	0.6	0.2	<0.1
NH_4-N	0.458	1.405	0.233
Boron	1.03	0.86	<0.15

Table 5. Chemical Determinations for Anomalous Samples

	Observation Well Name and Sample Number			
	VER-94A	*VER-94B*	*IRO-95A*	*IRO-96A*
Parameter (mg/L)	*19*	*20*	*21*	*23*
Major Constituents				
Calcium	146.6	243.9	114.5	146.0
Magnesium	57.5	91.2	46.6	56.3
Sodium	68.6	94.6	49.3	67.6
NO_3-N	<0.02	<0.02	<0.02	<0.02
Sulfate	403	1054	134	406
Chloride	8.7	3.8	3.7	5.6
Alkalinity	345	241	438	343
TDS @ 180°C	993	1783	604	990
Secondary Constituents				
Iron	1.28	0.02	1.11	1.52
Manganese	0.143	1.146	0.071	0.047
Potassium	1.62	2.36	1.56	2.23
Fluoride	<0.1	<0.1	<0.1	0.1
NH_4-N	1.320	0.567	1.452	1.499
Boron	0.76	1.71	0.73	1.11

averaged 29 mg/L, although the determinations vary widely. Chloride averaged only 3 mg/L in the Champaign and Ford County samples.

Secondary Constituents

Groundwater also contains elements that occur in concentrations much smaller than those of the major constituents. These secondary constituents normally are found in concentrations less than 10 mg/L. For purposes of this study, iron, manganese, potassium, fluoride, ammonia, and boron were defined as secondary constituents. Iron and manganese are two constituents of particular interest because they stain laundry and plumbing fixtures of many private well-owners.

Both iron and manganese are found in groundwater samples from the Mahomet aquifer. Iron concentrations averaged 0.85 mg/L, and manganese concentrations averaged 0.14 mg/L. More prevalent than iron and manganese was ammonia (NH_4-N), which averaged 1.12 mg/L. The presence of nitrogen in the form of ammonia was interesting because nitrate sample concentrations were low, always less than 0.02 mg/L. Also present in the groundwater samples was boron, which averaged 0.6 mg/L in the Champaign and Ford County samples.

Summary and Conclusions

In 1994, the ISWS Aquifer Assessment program set out to build an observation well network dedicated to monitoring groundwater levels in the eastern portion of the Mahomet aquifer. The effort continued in 1995 and 1996, and was completed in 1998. The result was the establishment of a widespread observation well network that stretches 60 miles from the Illinois-Indiana border west and southwest to the Champaign-Piatt County line.

The Mahomet aquifer, a Quaternary sand deposit, lies in a buried bedrock valley and is as much as 150 feet thick. The aquifer is overlain by glacial till and less extensive deposits of fine sand, also of Quaternary age. Consequently, the top of the sand comprising the Mahomet aquifer is buried 175-225 feet below the land surface at most locations in east-central Illinois.

As a result of this multi-year effort, 25 observation wells were constructed in east-central Illinois. More than 1,300 observations of groundwater levels have been collected from these wells, and this information lies at the core of our understanding of the Mahomet aquifer. As a result, an expectation of the depth-to-water (in feet) has been established for each well, and seasonal variations have been observed. When these depths are converted to elevations and plotted on a map, they can be contoured. The result is a regional map of the potentiometric surface of the Mahomet aquifer.

This potentiometric surface map illustrates that groundwater flow in this portion of the Mahomet aquifer is multi-directional. The prevailing direction of flow is largely dependent upon where you are located within the four counties of east-central Illinois. Prior to the establishment of the network, it was assumed that flow was simply down the bedrock valley, i.e., from the Hoopeston area to Champaign, but the pattern is now known to be more complex.

A groundwater divide has been observed near Paxton, Illinois, and it extends southeast across the buried bedrock valley. The highest groundwater elevations in the Mahomet aquifer have been recorded along this divide. Two observation wells (CHM-92A and FRD-94A) have been used to document groundwater elevations of 694 and 692 feet, respectively; and their locations have been observed to roughly coincide with the trace of the Gifford Moraine. The location of this groundwater divide also coincides with that of the surface water divide between the Mississippi and Ohio River basins. Pumpage in the Champaign-Urbana area has caused groundwater heads to be reduced by almost 50 feet since the 1950s, and the resulting cone of depression has caused groundwater flow to the west of Champaign to be reversed from west to east. Although heads have decreased, the aquifer is still completely saturated because only a portion of the artesian head has been removed.

Determining the chemical quality of raw groundwater is an important part of a resource characterization. Consequently, ISWS staff collected a set of groundwater samples from the observation wells in August and September 1996. Sampling involved purging the well casing and taking field measurements of pH, temperature, and electrical conductivity until these

parameters stabilized. A sample then was collected at each of the 19 existing observation wells in the network and at another site developed for an unrelated ISGS project (CHM-92A).

Total Dissolved Solids (TDS), a frequent measurement for quickly characterizing groundwater quality, averaged 396 mg/L in the 13 Mahomet aquifer samples. A few much higher values (~1,000 mg/L) were found to exist in Vermilion and Iroquois counties (Table 5). These values are either from wells into the Mahomet aquifer (VER-94B) or are deemed beyond the Mahomet bedrock valley (i.e., the Onarga bedrock valley and its tributaries).

Calcium in the Champaign and Ford County samples averaged 66 mg/L while magnesium and sodium averaged 30 and 31 mg/L, respectively. These values are comparable to values reported by the public water supplies in Rantoul, Champaign, and Mahomet. Bicarbonate, the dominant anion in the groundwater samples from the Mahomet aquifer, averaged 381 mg/L. Sulfate, the second most common anion, averaged 29 mg/L, although the determinations vary widely. Chloride determinations averaged only 3 mg/L in Champaign and Ford Counties.

Both iron and manganese are found in groundwater samples from the Mahomet aquifer, and these concentrations averaged 0.85 mg/L and 0.14 mg/L, respectively. More prevalent than iron and manganese was ammonia (NH_4-N), which averaged 1.12 mg/L. Nitrogen in the samples occurred in the form of ammonia, rather than as nitrate, which was always less than 0.02 mg/L.

Drilling information collected during the construction of the observation wells provides reliable information about the subsurface. Consequently, observation well construction details and geologists' logs are provided as Appendix A of this report. Groundwater levels are provided graphically and in tabular form as Appendix B. The natural gamma (geophysical) logs are kept on file at the ISGS.

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Appendix A. Illinois State Water Survey Test Hole and Observation Well Records

The following format is used to report drilling done for this study. The information listed at the top of each log refers to drilling location and date, a formal name for the observation well if constructed at the site, key personnel, and a geographic description name of the location. The logs are compilations of all available information for a particular site: the driller's log, the log kept by the ISGS, the geophysical log, and the author's log. Logs are arranged alphabetically by county and then sequentially by observation well names.

The description of materials first lists the rock or soil type followed by descriptive terms. The purpose of this format is to emphasize the material in each interval of depth (in feet) rather than its particular color, texture, or other features. Note that hyphens are used between words combined to form unit modifiers that immediately follow the principal term and that are not ordinarily hyphened. A question mark is used to express uncertainty.

Total depth (T.D.) of the hole, in feet, and other well construction details and additional notes are listed after the lithologic description. Additional notes about subsequent visits to the site may also be listed after the well construction details.

Appendix A. Illinois State Water Survey Test Hole and Observation Well Records

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-94A
(South well of two)

Location: NE¼, NE¼, NE¼, NE¼ of Sec. 09, T22N, R9E
County: Champaign
Casing Top Elevation: 819.51 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 16-17, 1994

Drilling Contractor: Albrecht Drilling
Method: Rotary, 5-inch
Driller: Jet Hall
Drilling Fluid: Natural

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way, 2 miles west of Ludlow at intersection of County Roads 1500E and 3500N. South well of two. (Test hole #1A)

Depth (feet)	*Description of materials*
0 - 1	Topsoil
1 - 13	Clay, yellow-brown to olive-brown, silty, sandy (till)
13 - 66	Clay, medium dark gray, moderately silty, with mostly very fine to medium sand; some black and gray shale fragments (till)
66 - 80	Clay, medium dark gray, gravelly, silty (till)
80 - 113	Clay, medium dark gray, silty, slightly sandy and pebbly; faintly pink, poor sample recovery, hard drilling (till)
113 - 122	Sand, gray, coarse to very coarse, poorly sorted; angular medium gray shale fragments mixed in with reddish granitic-type fragments too
122 - 138	Clay, pinkish-gray; sandy, gravelly (till)
138 - 141	Clay, yellow-brown, moderately to very silty; moderately calcareous, oxidized
141 - 148	Sand, yellow-brown, fine to medium; trace of medium gravel
148 - 151	Clay, yellowish-brown?
151 - 159	Sand, brown, medium to very coarse; with gray shale fragments, not taking much water, cobbles at 153 feet
159 - 171	Clay, olive-gray to medium dark gray, moderately silty and sandy, firm; gravel-sized fragments of shale (till)
171 - 199	Sand, clayey; some gravel present, very little water loss observed

Appendix A. (continued)

Observation Well Name: CHM-94A (concluded)

Depth (feet)	*Description of materials*
199 - 238	Sand, very fine; some gravel, slightly clayey, may be silty or very fine, did not look promising
238 - 280	Sand, gray, very fine to fine, moderately well sorted; quartz-rich deposit contains some red grains and is mixed with traces of coarse sand, gray shale fragments, and/or limestone fragments. Overall texture is coarser between 255- and 274-foot depths.
280 - 285	Clay, brownish-gray, very soft, sticky
285 - 295	Clay, reddish-gray, moderately silty, slightly sandy, very calcareous; with granules of gray shale
295 - 317	Sand, gray, very fine to medium, well sorted; mostly rounded quartz, poor recovery, most went through our sieves
317 - 327	Sand, gray, very coarse to very fine gravel; occurs with angular multi-colored rock fragments; black, gray, tan, and green shale; and fine-grained quartz
327 - 340	Sand, gray, coarse; commonly includes very fine sand, trace of medium gravel, and light-gray subrounded limestone/dolomite fragments
340 - 375	Sand, gray, medium to coarse; poorer sample recovery
375 - 390	Sand, gray, coarse to very coarse; multi-colored and green sand grains increasingly common along with large proportion of angular shale and limestone fragments. Rate of penetration slowed near top of this interval, then went more quickly.
390 - 414	Sand, gray, fine; drills easily but too fine for most sieves, seems to be cleaner, possibly fewer shale fragments and has "Sankoty-like" appearance because of texture and presence of red and black grains
414 - 415	Claystone; very firm drilling (bedrock)
415 - 420	Dolomite?; lost circulation, had difficulties pulling back drill tools, used four bags of bentonite and 1,500 gallons of water attempting to regain circulation, may be creviced (Silurian?)

T.D. = 420 feet

Well Construction Details:
Installed 380 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.020-inch slot size) at the bottom of the casing. Filled open hole below the well with pea gravel (⅜ inch) before backflushing well. Resumed backfilling annulus with 3,500 lb of pea gravel interspersed with 150 lb of bentonite chips.

Set and padlocked a 4-inch-square well protector over well. Developed well with compressed air on August 18, 1994, for more than one hour.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-94B
(North well of two)

Location: NE¼, NE¼, NE¼, NE¼ of Sec. 09, T22N, R9E
County: Champaign
Casing Top Elevation: 819.90 feet
Casing Stickup above Land: 2.5 feet
Date Drilled: August 18, 1994

Drilling Contractor: Albrecht Drilling
Method: Rotary, 5 inch
Driller: Jet Hall
Drilling Fluid: Natural

Hydrogeologist: Burch
Geophysical Logs: None

Located in right-of-way, 2 miles west of Ludlow at intersection of County Roads 1500E and 3500N. North well of two. (Test hole #1B)

Depth (feet)	*Description of materials*
0 - 1	Topsoil
1 - 13	Clay, yellow-brown to olive-brown, silty, sandy (till)
13 - 66	Clay, medium dark gray, moderately silty, with mostly very fine to medium sand; some black and gray shale fragments (till)
66 - 80	Clay, medium dark gray, gravelly, silty (till)
80 - 113	Clay, medium dark gray, silty, slightly sandy and pebbly; faintly pink, poor sample recovery, hard drilling (till)
113 - 122	Sand, gray, coarse to very coarse, poorly sorted; angular medium gray shale fragments mixed in with reddish granitic-type fragments too
122 - 138	Clay, pinkish-gray; sandy, gravelly (till)
138 - 141	Clay, yellow-brown, moderately to very silty; moderately calcareous, oxidized
141 - 148	Sand, yellow-brown, fine to medium; trace of medium gravel
148 - 151	Clay, yellowish-brown?
151 - 159	Sand, brown, medium to very coarse; with gray shale fragments, not taking much water, cobbles at 153 feet
159 - 171	Clay, olive-gray to medium dark gray, moderately silty and sandy, firm; gravel-sized fragments of shale (till)
171 - 199	Sand, clayey; some gravel present, very little water loss observed

Appendix A. (continued)

Observation Well Name: CHM-94B (concluded)

Depth (feet)	*Description of materials*
199 - 238	Sand, very fine; some gravel, slightly clayey, may be silty or very fine, did not look promising
238 - 263	Sand, gray, very fine to fine, moderately well sorted; quartz-rich deposit contains some red grains and is mixed with traces of coarse sand, gray shale fragments, and/or limestone fragments. Overall texture is coarser below 255-foot depth.

T.D. = 263 feet

Well Construction Details:
Installed 260 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.020-inch slot size) at the bottom of the casing. Backflushed well with clear water and then backfilled annulus with 10 gallons of pea gravel. Added 25 lb of bentonite chips to isolate well screen, before continuing to backfill annulus with gravel. Interspersed layers of bentonite chips in the annulus as it was filled. Set 4-inch-square steel protector over well and padlocked.

Developed well with compressed air on August 18, 1995, for 45 minutes. Pumped slowly and with very fine sand.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-95A

Location: NW¼, NW¼, NW¼, NW¼ of Sec. 16, T21N, R9E County: Champaign
Casing Top Elevation: 748 feet (est.)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 3, 1995

Drilling Contractor: Albrecht Drilling Method: Rotary, 6-inch
Driller: Jet Hall Drilling Fluid: Bentonite

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way, 2 miles southwest of Rantoul, at intersection of County Roads 1400E and 2800N. (Test hole #7)

Depth (feet)	*Description of materials*
0 - 2	Clay, black, silty (topsoil)
2 - 14	Clay, yellow-brown
14 - 58	Clay, medium dark gray, silty, sandy (till)
58 - 59	Sand, gray, fine to medium
59 - 88	Clay, medium dark gray (till)
88 - 99	Clay, yellow-brown, increasingly sandy
99 - 130	Sand, olive-gray, very fine to very coarse; subrounded, very coarse grains are composed of limestone, shale, and chert
130 - 135	Clay; (based on geophysical log)
135 - 139	Sand; (based on geophysical log)
139 - 195	Clay, medium dark gray, sandy; uniform drilling, noted cuttings seemed more gravelly at the top of the interval, observed faintly olive cast at 145-foot depth and then rate of penetration slowed considerably (till)
195 - 210	Sand, gray, very fine to medium; rocks and/or gravel streaks from 201- to 203-foot depth
210 - 220	Clay, medium gray, lots of gravel (shale and limestone fragments about ⅛-inch size; faintly purple-colored at first (till)
220 - 229	Sand, olive to olive-gray, very coarse sand; and shale fragments
229 - 255	Sand, gray, very fine quartz to very coarse shale grains; some fine gravel streaks

Observation Well Name: CHM-95A (concluded)

Depth (feet)	*Description of materials*
255 - 265	Sand, gray, medium to coarse; quartz-rich rounded grains are moderately well sorted
265 - 287	Sand, gray, fine to medium; moderately well sorted quartz-rich sand has red (jasper) grains scattered throughout and a trace of very coarse sand, rock at 286 feet; color darkens below 286 feet
287 - 317	Clay, medium dark gray, gravelly, sandy (till)
317 - 322	Limestone, light gray; effervescent
322 - 328	Shale, light gray

T.D. = 328 feet

Well Construction Details:
Installed 260 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) at the bottom of the casing. Filled open hole below 270 feet with pea gravel and placed a bentonite seal midway in that fill. When well was sitting on filled material, casing was backflushed to clean out the annulus. Then sandpacked screened interval before resuming backfill of annulus with pea gravel and intermittent layers of bentonite chips. Set a 4-inch-square steel protector over well and padlocked.

Developed well with compressed air on September 11, 1995.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-95B

Location: NE¼, NE¼, NE¼, ¼ of Sec. 03, T20N, R8E
County: Champaign
Casing Top Elevation: 784.21 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 7-8, 1995

Drilling Contractor: Albrecht Drilling
Method: Rotary, 6-inch
Driller: Jet Hall
Drilling Fluid: Bentonite

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way, at curve on the "Fisher-Dewey Blacktop," at intersection of County Roads 900E and 2400N. (Test hole #8)

Depth (feet)	*Description of materials*
0 - 3	Clay, black (topsoil)
3 - 14	Clay, yellow-brown to yellowish gray, sandy, pebbly (till)
14 - 23	Clay, medium dark gray
23 - 35	Clay, olive-gray to gray, sandy (till)
35 - 37	Clay, gray (lacustrine?)
37 - 45	Clay, olive-gray to gray, sandy (till)
45 - 55	Clay, medium dark gray, sandy, pebbly (till)
55 - 62	Clay, medium dark gray, sandy, pebbly; harder drilling than overlying interval (till)
62 - 89	Clay, medium dark gray, sandy; easy penetration (till)
89 - 97	Sand and gravel, gray; over 50 percent dark gray shale fragments which range from very coarse sand grain size to ¼-inch, angular, and flat-sided gravel; also included are some tan limestone fragments that are very coarse sand-sized granules
97 - 99	Clay, gray, sandy, gravelly; faintly pink (till)
99 - 121	Clay, medium dark gray, gravelly, sandy (till)
121 - 123	Silt, very dark brown (Robein?)
123 - 138	Clay, medium dark gray
138 - 149	Sand, gray, medium; soft drilling, with trace of granule-sized particles
149 - 153	Clay, gray; (based on geophysical log)

Appendix A. (continued)

Observation Well Name: CHM-95B (concluded)

Depth (feet)	*Description of materials*
153 - 170	Sand, gray; soft interbedded lenses may be occurring
170 - 246	Clay, medium dark gray, calcareous; contains very coarse sand to granule sized particles, hard drilling slowed rate of penetration considerably (till)
246 - 261	Clay, dark gray to medium dark gray; softer drilling, this may be a transition zone to sand
261 - 288	Sand, gray, medium, quartz-rich, moderately well sorted; includes some slightly coarser, white grains (limestone?); uniform drilling
288 - 304	Shale, light gray changing to medium gray

T.D. = 304 feet

Well Construction Details:
Installed 275 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) at the bottom of the casing. Encountered obstructions near 90 to 100-foot depth and at bottom of hole while logging. Ran drill tools to bottom the next morning and washed out prior to second attempt to geophysically log the hole. Set casing immediately after logging and although hole seemed bridged, the well backflushed easily.

Backfilled annulus with pea gravel and placed bentonite layers intermittently. Set a 4-inch-square steel protector over well and padlocked.

Developed well with compressed air on September 11, 1995.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-95C

Location: NW¼, SW¼, SW¼, SW¼ of Sec. 18, T20N, R9E — County: Champaign
Casing Top Elevation: 732.82 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 4, 1995

Drilling Contractor: Albrecht Drilling — Method: Rotary, 6-inch
Driller: Jet Hall — Drilling Fluid: Bentonite

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located within grounds of the State's "Leverett Garage" along I-57, near intersection of County Roads 1150E and 2100N. (Test hole #9)

Depth (feet)	*Description of materials*
0 - 4	Fill
4 - 5	Clay, yellow
5 - 6	Sand; some gravel
6 - 16	Clay, yellow
16 - 33	Clay, gray
33 - 36	Sand and gravel
36 - 53	Clay, olive-colored
53 - 95	Clay, medium dark gray; very hard
95 - 104	Sand
104 - 123	Clay, medium dark gray
123 - 156	Sand, gray, fine to medium, quartz-rich; minor amounts of very coarse sand to granule sized particles
156 - 169	Sand and gravel, gray; mostly coarse sand with 1/8 to 3/16-inch gravel
169 - 199	Clay, medium dark gray, silty; minor amount of sand present (till)
199 - 207	Clay, medium dark gray, increasingly sandy; silty? (till)
207 - 243	Sand, gray, fine to coarse; cuttings include very coarse sand-sized grains of white limestone and very dark gray shale
243 - 251	Sand, gray, coarse; with very coarse sand and very fine-to-fine gravel common
251 - 276	Clay, medium dark gray; firm at top of interval
276 - 278	Sand

Observation Well Name: CHM-95C (concluded)

Depth (feet)	*Description of materials*
278 - 318	Clay, medium to dark gray, gravelly; lots of angular shale and limestone fragments result in decidedly darker appearance
318 - 323	Shale, medium gray

T.D. = 323 feet

Well Construction Details:
Installed 312½ feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size). The geophysical logger was not available at end of drilling, so the screen is located 75 feet above the bottom of the casing (consequently, the screened interval is from 235- to 240-foot depth). Well was constructed by first dumping 20 gallons of pea gravel into the annulus and then bentonite chips in an effort to isolate the bedrock from the well. More buckets of gravel backfill were added to the annulus. The well was backflushed with clear water before sandpack was dumped into the annulus (it is not likely to be adjacent to the well screen). Resumed backfilling the annulus with pea gravel and intermittently with 100 lb of bentonite chips. Set a 4-inch-square steel protector over well and padlocked.

Developed well with compressed air on September 8, 1995.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-95D

Location: NW¼, NW¼, NW¼, NW¼ of Sec. 16, T19N, R7E
County: Champaign
Casing Top Elevation: 700.11 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 8-9, 1995

Drilling Contractor: Albrecht Drilling
Driller: Jet Hall
Method: Rotary, 7¾-inch (0-45 ft), 6-inch (45-80 ft), and 5-inch (80-330 ft)
Hydrogeologist: Burch, D. Larson (ISGS)
Drilling Fluid: Bentonite
Geophysical Logs: Natural Gamma

Located in right-of-way, ½-mile north of Seymour, at intersection of County Roads 200E and 1600N. (Test hole #11)

Depth (feet)	*Description of materials*
0 - 4	Clay, black (topsoil)
4 - 6	Clay, brown
6 - 8	Sand, brown, poorly sorted; with clay
8 - 13	Clay, brown, silty, pebbly (till)
13 - 40	Clay, gray, silty, pebbly (till)
40 - 43	Sand, dark gray, coarse; poorly sorted material includes very fine sand to gravel; this sand interval continued "caving-in" and brought about the use of 45 feet of temporary casing so the hole could be completed.
43 - 55	Clay, gray, silty
55 - 57	Silt, dark brown, clayey
57 - 69	Clay, medium gray; with sand from overlying units? (till)
69 - 91	Clay, medium dark gray, slightly sandy; minor amount of granules (till)
91 - 101	Sand, dark gray, medium to very coarse with very fine-to-fine gravel; coarser materials typically comprised of dark gray shale or light gray, angular fragments of limestone/dolomite
101 - 104	Clay (lithologic interpretation based on geophysical log)
104 - 110	Sand (lithologic interpretation based on geophysical log)
110 - 118	Clay, gray; hard drilling results in slow penetration rate and poor sample recovery
118 - 131	Sand; scattered wood shreds (lithologic interpretation based on geophysical log)

Appendix A. (continued)

Observation Well Name: CHM-95D (concluded)

Depth (feet)	*Description of materials*
131 - 134	Clay, gray; hard
134 - 137	Sand
137 - 176	Clay, medium dark gray, silty; even harder drilling than at 131 feet, minor amount of sand present (till)
176 - 195	Sand, brownish-gray, very fine to medium, moderately well sorted quartz-rich material
195 - 205	Sand, brownish-gray, medium to coarse, moderately well sorted quartz-rich material; very little, very coarse sand and less than 5 percent of grains are granule- sized
205 - 222	Sand, gray, medium, very well sorted, quartz-rich; no granules are present, but secondary amounts of coarse sand is present in cuttings
222 - 272	Sand, gray, medium to very coarse, with very fine gravel; coarser fraction of cuttings tend to be comprised of light gray limestone or dark gray shale fragments
272 - 287	Sand, gray, medium to coarse, quartz-rich
287 - 316	Sand, gray, medium to very coarse, with very fine-to-fine gravel; overall color darkens with depth, black shale fragments present in cuttings, rig "chatters" through layers at 301 and 307 feet
316 - 323	Shale, medium gray
323 - 327	Shale, black
327 - 330	Shale? (lithologic interpretation based on field notes and geophysical log)

T.D. = 330 feet

Well Construction Details:
Installed 285 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) 5 feet above the bottom of the casing (consequently, the screen interval is from about 278-283 feet in depth). Backfilled below well with pea gravel, then backflushed the well with clear water. Dumped 4 bags of sandpack in annulus to cover well screen. Resumed backfilling annulus with pea gravel. Sealed several intervals, including at 175- and 75-foot depths, with 100 lb of bentonite chips. Set a 4-inch-square steel protector over well and padlocked.

Developed well with compressed air on September 12, 1995.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-96A

Location: SE¼, SE¼, SE¼, SE¼ of Sec. 27, T22N, R8E
County: Champaign
Casing Top Elevation: 723 feet (est.)
Casing Stickup above Land: 2.2 feet
Date Drilled: June 21, 1996

Drilling Contractor: Albrecht Drilling
Method: Rotary, 6-inch
Driller: Jet Hall
Drilling Fluid: Bentonite

Hydrogeologist: Burch, R. Vaiden (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way, 0.7 miles northeast of Dewey, at intersection of County Roads 1000E and 3100N. (Test hole #13)

Depth (feet)	*Description of materials*
0 - 6	Soil, black, clayey
6 - 11	Clay, yellow; hard
11 - 16	Clay, gray
16 - 21	Clay, gray, increasingly sandy; with gravel?
21 - 25	Rocks, gravel
25 - 29	Clay, gray
29 - 41	Clay, gray; streak of sand at 36 feet, pebbly
41 - 63	Clay, medium dark gray, sandy, hard (till)
63 - 124	Clay, medium dark gray, some sand, but less than overlying interval, pebbly (till)
124 - 126	Sand, medium to coarse
126 - 138	Clay, medium gray, sand, pebbles (till)
138 - 155	Clay, medium gray but faintly pink-colored, sandy, very hard drilling. Noted a very thin dark brown silt (clay?) layer at top of this interval, but couldn't recover much of the brown cuttings. Decidedly pinkish-gray in 140- to 145- foot interval.
155 - 160	Clay, grayish medium dark brown, sandy as before and still hard drilling (till)
160 - 165	Clay, medium gray, sandy, hard drilling. Most of the clay goes into the mud with only the sand fraction being caught in the sampling sieve (till).
165 - 173	Clay, dark gray, sandy with lots of wood fragments mixed in with the cuttings. Wood fragments were so prevalent they were plugging the drill rods.
173 - 178	Sand; poor sample recovery and poor circulation.
178 - 182	Clay

Appendix A. (continued)

Observation Well Name: CHM-96A (concluded)

Depth (feet)	*Description of materials*
182 - 195	Sand, gray, fine overall with some ranging up to coarse sand grain size. Cuttings are very clayey ("dirty") and wood fragments still circulate. Larger grain sizes tend to be black to dark blue in color. Pulled drill rods out of the hole and changed drill bits at 185-foot depth.
195 - 213	Sand, gray, fine to medium. Grain size ranges up to coarse and very coarse sand with approximately 10 percent of larger fraction being white. The fines and very fines are quartz grains.
213 - 233	Sand, dark gray, fine
233 - 280	Sand, gray, medium texture overall but grain size ranges from very fine sand to very coarse sand. White grains are plainly visible; minor amount of cuttings are very coarse grain size while coarse sand is more common.
280 - 305	Sand, brownish-gray, fine to medium, well sorted and has an overall texture that is finer grained than the overlying interval. The majority of the samples from below the 280-foot depth are fine sand grains comprised of quartz.
305 - 323	Sand, brownish-gray, medium; sorting is moderate and cuttings contain more coarse sand than did the 280- to 305-foot interval. Natural gamma log hints that a clayey sand may occur at depth from 306-309 feet, although it was not observed. A pink clay and then dark gray clay was observed briefly at the 320- to 323-foot depth. Perhaps this observation corresponds with the natural gamma log and that travel time to the surface delayed its arrival.
323 - 327	Sand, brownish-gray, medium to coarse, moderately well sorted
327 - 338	Sand, brownish-gray, very fine to fine, well sorted
338 - 339	Sand; rocky? Drill rig banged past obstructions
339 - 350	Shale; observed a mixture of dark brown clay, medium gray clay, and sand. Penetration rate of drill was slow. The dark brown cuttings seem predominant, but the gray cuttings have a waxy, sticky feel.

T.D. = 350 feet

Well Construction Details:
Installed 346 feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) located 40 feet above the bottom of the casing (consequently, the screen interval is from about 306-311 feet in depth). Backfilled below well screen with pea gravel, then backflushed the well with approximately 100 gallons of clear water. Dumped 4 bags of sandpack in annulus to cover well screen. Resumed backfilling annulus with 3,300 lb of pea gravel and sealing annulus intermittently with 100 lb of bentonite chips. The annulus was still not filled, so returned next day with another 2,200 lb of pea gravel and 50 lb of bentonite chips. Set a 4-inch-square steel protector over well and padlocked. Developed well with compressed air on July 25, 1996 at 5-6 gallons per minute.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-96B

Location: SE¼, SE¼, SE¼, SE¼ of Sec. 18, T21N, R8E
County: Champaign
Casing Top Elevation: 700.11 feet (est.)
Casing Stickup above Land: 2.4 feet
Date Drilled: June 24, 1996

Drilling Contractor: Albrecht Drilling
Method: Rotary, 6-inch
Driller: Jet Hall
Drilling Fluid: Bentonite

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located northwest of northwest corner of bridge over Big Ditch, and about 3 miles south of Fisher near intersection of County Roads 700E and 2700N. (Test hole #14)

Depth (feet)	*Description of materials*
0 - 4	Clay, black to very dark brown, very silty to clayey silt, very soft
4 - 10	Clay, reddish-brown, moderately to very silty; streak of gravel at 10-feet (till)
10 - 13	Clay, gray, moderately silty, moderately sandy (till)
13 - 16	Clay, gray, very sandy and pebbly
16 - 24	Clay, gray, moderately silty, moderately sandy (till)
24 - 42	Sand, brown, very fine to very coarse, however mostly very fine to medium, sparse fine gravel
42 - 56	Clay, olive-gray, moderately silty, only slightly sandy; soft, smooth (till)
56 - 72	Clay, medium gray, moderately sandy (till)
72 - 107	Clay, dark gray, slightly silty and sandy; uniformly hard drilling (till)
107 - 130	Clay, olive-gray, silty, sandy, and slightly pebbly
130 - 140	Clay, olive-gray, moderately silty, slightly sandy with very fine to fine sand; smooth, soft (till)
140 - 143	Clay, olive, moderately silty, slightly sandy; smooth, soft (till)
143 - 148	Clay, dark greenish-gray, moderately silty, slightly sandy with very fine to fine sand; smooth, firmer than overlying interval (till)
148 - 160	Sand, with fine gravel; natural gamma log suggests possibly clayey
160 - 178	Sand, fine to coarse, with some very fine sand and fine gravel; fines are mostly subrounded quartz

Observation Well Name: CHM-96B (concluded)

Depth (feet)	*Description of materials*
178 - 180	Clay, gray olive-brown, moderately to very silty
180 - 200	Sand, olive-gray, fine, well sorted, quartz-rich; texture ranges up to very coarse sand with larger grain sizes being mostly carbonates and shale
200 - 228	Sand, olive-gray, fine to medium; frequent white grains appear
228 - 266	Sand, gray, medium, well sorted; rig "chattered" through several potentially "gravelly" intervals most notably at 250-foot depth
266 - 307	Sand, gray, fine, well sorted; overall texture is finer than overlying interval with grain sizes ranging from very fine to medium
307 - 320	Sand, gray, medium to very fine gravel; small rock at 320-foot depth
320 - 330	Gravel, brown to gray, with sand, poorly sorted; noticed water loss to the formation, observed abundant dark colors (black, red, brown, and bronze)
330 - 332	Shale, medium gray to grayish-brown; stiff drilling, cuttings are smooth and have sticky feel, natural gamma log suggests lithology may be a limestone (weathered?)
332 - 339	Limestone, grayish-brown, with light gray, calcareous shale partings

T.D. = 339 feet

Well Construction Details:
Installed 336 feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) located 40-45 feet above the bottom of the casing. Bottom of well is capped. Backfilled annulus with 47 gallons of pea gravel prior to backflushing the well with clear water. Resumed backfilling with an additional 4,500 lb of pea gravel and sealing annulus with 100 lb of bentonite chips placed intermittently as a series of layers within the backfill. Set a 4-inch-square steel protector over the well and padlocked.

Developed well with compressed air on July 25, 1996, at about 5 gallons per minute.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-96C

Location: NW¼, NW¼, NW¼, NW¼ of Sec. 30, T20N, R7E County: Champaign
Casing Top Elevation: 699.8 feet (GPS)
Casing Stickup above Land: 2.4 feet
Date Drilled: June 25, 1996

Drilling Contractor: Albrecht Drilling Method: Rotary, 6-inch
Driller: Jet Hall Drilling Fluid: Bentonite

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way ditch, about 2 miles west of Mahomet at intersection of County Roads 000E and 2000N. (Test hole #15)

Depth (feet)	*Description of materials*
0 - 2	Clay, very dark brown, very silty, only slightly sandy (topsoil)
2 - 8	Silt, dark yellowish-brown, possibly clayey; soft, noncalcareous (loess?)
8 - 13	Clay, yellowish-brown, very silty, slightly sandy, very slightly pebbly (till)
13 - 20	Clay, gray to dark gray, slightly silty, some sand (till)
20 - 32	Clay, dark gray, slightly silty, but softer drilling than overlying interval (till)
32 - 37	Clay, black, moderately silty to very silty; very soft, smooth
37 - 45	Clay, dark grayish-brown, moderately silty, slightly sandy, slightly pebbly; driller noted a streak of greenish-colored gravel at 42- to 44-foot depth (till)
45 - 55	Clay, dark gray, moderately silty, moderately sandy, with pebbles; harder drilling (till)
55 - 59	Sand and gravel, gray, poorly sorted; grain size ranges from very fine sand to medium gravel, but is mostly coarse to very coarse sand
59 - 71	Clay, medium gray, sandy (till)
71 - 74	Sand and gravel; driller noted dark color of the cuttings
74 - 114	Clay, gray, moderately to very silty, increasingly sandy with depth, pebbly (till)
114 - 143	Clay, dark gray to gray, moderately silty, moderately sandy, slightly pebbly; driller noted this interval as hard pinkish-gray clay
143 - 146	Clay, gray, very sandy (till)
146 - 173	Clay, gray, moderately silty, moderately sandy; hard drilling (till)
173 - 177	Clay, dark reddish-gray, moderately silty, sandy, and pebbly; faint pink coloration

Observation Well Name: CHM-96C (concluded)

Depth (feet)	*Description of materials*
177 - 190	Sand, olive-gray, very fine to fine; natural gamma log suggests clay streaks too
190 - 232	Sand, olive-gray, very fine to fine, moderate sorting; some medium to coarse sand occurs and comprises perhaps 20-30 percent of the cuttings, overall impression of uniform texture
232 - 235	Sand, olive-gray, fine to medium, moderately well sorted with some coarse to very coarse sand
235 - 297	Sand, olive-gray, very fine to fine, moderately well sorted; noted slightly coarser and "whiter" below depth of 260 feet when more subangular very coarse sand starts to appear in cuttings; rocks at 277-278 feet, slow penetration rate
297 - 302	Sand, olive-gray, coarse; grain sizes range from very fine sand to fine gravel, drill rig hammers loudly on even coarser materials not reaching the surface
302 - 322	Sand, olive-brown to olive-gray, very coarse; quieter drilling than 298- to 302-foot interval, abundant oblate grains of shale and perhaps 30 percent of very coarse sand is brown (chert?), trace amounts of fine quartz sand
322 - 323	Clay, medium dark gray to dark gray; tacky feel, driller noted color as brown
323 - 334	Sand; mixed with green and brown gravel
334 - 340	Shale, black, very firm to hard; much slower penetration rate

T.D. = 340 feet

Well Construction Details:
Installed 335 feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) located 45-50 feet above the bottom of the casing. Bottom of well is capped. Backfilled annulus with 35 gallons of pea gravel prior to backflushing the well with clear water. Resumed backfilling with an additional 5,000 lb of pea gravel and sealing annulus with bentonite chips placed intermittently as a series of layers within the backfill. Set a 4-inch-square steel protector over the well and padlocked.

Developed well with compressed air for 30 minutes on July 25, 1996, at rate of 5-6 gallons per minute.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: CHM-98A

Location: NW¼, NW¼, NW¼, NW¼ of Sec. 31, T22N, R7E County: Champaign
Casing Top Elevation: 738 feet (est.)
Casing Stickup above Land: 2.0 feet
Date Drilled: June 4-5, 1998

Drilling Contractor: Sims Drilling Method: Rotary, 6-inch
Driller: Mike McCarty Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma (run on 5-22-2002)

Located along abandoned section line, in right-of-way ½-mile north of Lotus, near intersection of County Roads 00E and 3100N. (Test hole #21)

Depth (feet)	*Description of materials*
0 - 2	Topsoil, very dark brown to black; clayey, silty
2 - 11	Clay, yellow-brown, sandy, silty (till)
11 - 19	Clay, medium dark gray (till)
19 - 22	Clay, medium dark gray, sandy (till)
22 - 40	Clay, medium dark gray (till)
45 - 52	Clay, greenish-gray, sandy, silty (till)
52 - 67	Clay, medium dark gray (till)
67 - 125	Clay, medium dark gray, sandy, silty; uniform drilling (till)
125 - 134	Clay, pinkish-gray (till)
134 - 167	Clay, gray; poor sample recovery (till)
167 - 175	Sand, brownish-gray, slightly clayey or silty?
175 - 228	Sand, brownish-gray, fine to coarse, predominant grain size is medium sand
228 - 248	Clay, light olive to medium gray; poor sample recovery and circulation problems below 245 feet

T.D. = 248 feet

Observation Well Name: CHM-98A (concluded)

Well Construction Details:
Installed 240 feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) located 20 feet above the bottom of the casing. Capped bottom of casing. Backflushed well casing with clear water. Dumped 150 lb of sandpack in annulus to cover well screen. Backfilled remainder of the annulus with 2,600 lb of pea gravel and sealed intermittently with 75 lb of bentonite chips in distinct layers.

Set a 6-inch-square steel protector over well and padlocked.

Finished filling annulus with pea gravel and securing well protector on September 30, 1999.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: FRD-94A
(North well of two)

Location: NW¼, SW¼ of Sec. 13, T23N, R11E
County: Ford
Casing Top Elevation: 799.11 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date drilled: August 22-23, 1994

Driller Contractor: Albrecht Drilling
Method: Rotary, 5-inch
Driller: Jet Hall
Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located in right-of-way, about 4 miles east of Paxton, along County Road 2400E and about ¾ mile south on Illinois Route 9. North well of two. (Test hole #2A)

Depth (feet)	*Description of materials*
0 - 12	Clay, yellow-brown, silty, sandy (till)
12 - 40	Clay, medium dark gray, slightly sandy (till)
40 - 82	Clay, medium dark gray; with high clay content, cuttings readily form into balls and "ribbons" (lacustrine?)
82 - 83	Clay, medium dark gray, sandy; characterized by orangish-brown rock fragments ranging from coarse to very coarse sand size
83 - 105	Sand, orangish-brown, coarse to very coarse is dominant, but fine to medium sand is present. Angular chert and other rock fragments are abundant, but not much quartz.
105 - 153	Sand and gravel; orangish-brown; coarse to very coarse sand with ¼-inch gravel
153 - 175	Sand, yellow-brown, medium to coarse
175 - 202	Sand, gray, medium to coarse; with white specks
202 - 207	Clay, gray, sandy (till?)
207 - 209	Sand, gray, very coarse
209 - 238	Clay, medium dark gray, sandy; interbedded with sand? (till)
238 - 248	Clay, gray; soft, with sand, gravel, and wood fragments
248 - 266	Clay, medium dark gray; hard
266 - 287	Sand, grayish-brown, fine

Observation Well Name: FRD-94A (concluded)

Depth (feet)	*Description of materials*
287 - 291	Clay, olive-gray
291 - 330	Sand, olive-gray, fine to medium; very well sorted and quartz rich
330 - 365	Sand, gray, medium; with a small amount of rounded, very-coarse sand to granule sized grains
365 - 390	Sand, gray, medium; lesser amount of coarser materials than preceding interval
390 - 414	Sand, dark gray, very coarse; with angular black granules. Drill rig rattles through this interval. Not reacting to acid. Dark yellow-brown and red rock fragments are also present.
414 - 418	Shale
418 - 423	Limestone, light gray; highly effervescent, very hard penetrating this interval

T.D. = 423 feet

Well Construction Details:
Set 370 feet of 2-inch diameter, flush-joint PVC casing and a 5-foot PVC screen (0.020-inch slot size) at the bottom of the casing. Bottom of hole was filled with pea gravel (⅜ inch) and well materials on top of that fill. Casing and screen were backflushed with clear water before three bags of sandpack was poured down the annulus. Then annulus was sealed with 15 lb of bentonite chips immediately above the sandpack. Remainder of annulus was backfilled with pea gravel and layers of bentonite chips (100 lb). Developed well with compressed air until clear. Well pumped slowly. Completed construction with bentonite seal at surface and set padlocked, 4-inch-square steel well protector over well.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: FRD-94B
(South well of two)

Location: NW¼, SW¼ of Sec. 13, T23N, R11E
County: Ford
Casing Top Elevation: 798.87 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date drilled: August 22-23, 1994

Driller Contractor: Albrecht Drilling
Method: Rotary, 5-inch
Driller: Jet Hall
Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: None

Located in right-of-way, about 4 miles east of Paxton, along County Road 2400E and about ¾ mile south on Illinois Route 9. South well of two. (Test hole #2B)

Depth (feet)	*Description of materials*
0 - 12	Clay, yellow-brown, silty, sandy (till)
12 - 40	Clay, medium dark gray, slightly sandy (till)
40 - 82	Clay, medium dark gray; with high clay content, cuttings readily form into balls and "ribbons" (lacustrine?)
82 - 83	Clay, medium dark gray, sandy; characterized by orangish-brown rock fragments ranging from coarse to very coarse sand size
83 - 105	Sand, orangish-brown, coarse to very coarse is dominant, but fine to medium sand is present. Angular chert and other rock fragments are abundant, but not much quartz.
105 - 153	Sand and gravel; orangish-brown; coarse to very coarse sand with ¼-inch gravel
153 - 175	Sand, yellow-brown, medium to coarse
175 - 197	Sand, gray, medium to coarse; with white specks

T.D. = 197 feet

Observation Well Name: FRD-94B (concluded)

Well Construction Details:
Set 195 feet of 2-inch diameter, flush-joint PVC casing and a 5-foot PVC screen (0.020-inch slot size) at the bottom of the casing. Casing and screen were backflushed with clear water before three bags of sandpack was poured down the annulus. Then annulus was sealed with 15 lb of bentonite chips immediately above the sandpack. Remainder of annulus was backfilled with pea gravel and layers of bentonite chips (50 lb) near the surface.

Completed construction the next morning with bentonite seal at surface and set padlocked, 4-inch-square steel well protector over well. Well was developed on September 2, 1994.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-94A
(South well of two)

Location: SE¼, NE¼, SE¼ of Section 19, T24N, R10W
County: Iroquois
Casing Top Elevation: 761.14 feet (GPS)
Casing Stickup above Land: 3.3 feet
Date Drilled: August 25, 1994

Drilling Contractor: Albrecht Drilling
Method: Rotary, 5-inch
Driller: Jet Hall
Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located in right-of-way, along Illinois-Indiana border. South well of two (Test hole #5A)

Depth (feet)	*Description of materials*
0 - 2	Clay, black, silty (colluvium)
2 - 13	Clay, yellow-brown, gravelly (till)
13 - 43	Clay, medium dark gray, silty, sandy; sticky, trace of granules
43 - 53	Clay, medium dark gray, silty, sandy; with granules of shale (till)
53 - 71	Clay, medium dark gray, sandy, pebbly (till)
71 - 87	Clay, olive-gray, sandy, soft drilling
87 - 100	Clay, medium dark gray; streaks of sand and/or very fine gravel
100 - 109	Clay, gray; many black grains included in clay matrix
109 - 115	Clay, greenish-gray, gravelly
115 - 118	Clay, pinkish-gray
118 - 167	Clay, medium dark gray, very little sand; hard uniform drilling
167 - 169	Clay, very sandy
169 - 180	Clay, gray; increasingly sandy with depth
180 - 201	Sand, gray, fine to very coarse; angular dark gray fragments are common
201 - 210	Clay, medium dark gray, sandy (till)
210 - 226	Sand, gray, fine to very coarse, poorly sorted; clay streak at 218 feet, hard drilling, increased number of medium brown rock fragments
226 - 235	Clay, grayish-brown; lots of wood shreds

Observation Well Name: IRO-94A (concluded)

Depth (feet)	*Description of materials*
235 - 241	Sand, gray, fine to very coarse, poorly sorted; clayey?
241 - 250	Clay, dark gray; with brown wood shreds
250 - 252	Sand, gray; cobble at 251 feet
252 - 265	Sand, grayish-brown, very fine to fine, moderately well sorted; not taking much water, many quartz grains, silty?
265 - 296	Sand, gray, fine to very coarse; multicolored grains mixed with black, light gray, red, and brown grains, "well drillers dream"
296 - 328	Sand, gray, fine to very coarse; with granules, "bumpier ride" as rig penetrates this interval may indicate basal gravels, also present are milky quartz, light gray chert, and grains of jasper, a few very dark gray rock fragments are present
328 - 328½	Limestone
328½ - 331	Shale, medium gray
331 - 338	Limestone, light bluish-gray to medium brown to medium gray; effervesces in acid

T.D. = 338 feet

Well Construction Details:
Installed 300 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.020-inch slot size) at the bottom of the casing. Backfilled beneath the well with pea gravel (⅜ inch). Backflushed well until clearer water reached the surface. Then added 120 lb of silica sandpack to cover screened interval. Filled next 25 feet of annulus with pea gravel, and then placed about 25 lb of bentonite chips in annulus to isolate the well screen. Resumed backfilling the annulus with 3,000 lb of pea gravel intermittently sealed with bentonite chips. Sealed upper three to four feet with bentonite (chips and crumbles). Set 4-inch-square steel protector over well and padlocked.

Returned on September 2, 1994, and developed well with compressed air.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-94B
(North well of two)

Location: SE¼, NE¼, SE¼ of Section 19, T24N, R10W
County: Iroquois
Casing Top Elevation: 761.06 feet (GPS)
Casing Stickup above Land: 3 feet
Date Drilled: August 26, 1994

Drilling Contractor: Albrecht Drilling
Method: Rotary, 5-inch
Driller: Jet Hall
Drilling Fluid: Natural

Hydrogeologist: Burch
Geophysical Logs: None

Located in right-of-way, along Illinois-Indiana border. North well of two (Test hole #5B)

Depth (feet)	*Description of materials*
0 - 2	Clay, black, silty (colluvium)
2 - 13	Clay, yellow-brown, gravelly (till)
13 - 43	Clay, medium dark gray, silty, sandy; sticky, trace of granules
43 - 53	Clay, medium dark gray, silty, sandy; with granules of shale (till)
53 - 71	Clay, medium dark gray, sandy, pebbly (till)
71 - 87	Clay, olive-gray, sandy, soft drilling
87 - 100	Clay, medium dark gray; streaks of sand and/or very fine gravel
100 - 109	Clay, gray; many black grains included in clay matrix
109 - 115	Clay, greenish-gray, gravelly
115 - 118	Clay, pinkish-gray
118 - 167	Clay, medium dark gray, very little sand; hard uniform drilling
167 - 169	Clay, very sandy
169 - 180	Clay, gray; increasingly sandy with depth
180 - 198	Sand, gray, fine to very coarse; angular dark gray fragments are common

T.D. = 198 feet

Appendix A. (continued)

Observation Well Name: IRO-94B (concluded)

Well Construction Details:
Installed 195 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.020-inch slot size) at the bottom of the casing. Backfilled beneath the well with pea gravel (⅜-inch). Backflushed well until clearer water reached the surface. Then added 120 lb of silica sandpack to cover screened interval. Filled next 20 feet of annulus with pea gravel, and then placed about 20 lb of bentonite chips in annulus to isolate the well screen. Resumed backfilling the annulus with pea gravel intermittently sealed with bentonite chips. Sealed upper three to four feet with bentonite (chips and crumbles). Set 4-inch-square steel protector over well and padlocked.

Developed well with compressed air on September 2, 1994.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-95A

Location: NE¼, NE¼, NE¼, NE¼ of Sec. 16, T24N, R10E — County: Iroquois
Casing Top Elevation: 739.15 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 10, 1995

Drilling Contractor: Albrecht Drilling — Method: Rotary, 5-inch
Driller: Jet Hall — Drilling Fluid: Bentonite

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way, 2 miles northeast of Loda at intersection of County Roads 300E and 400N. (Test hole #10)

Depth (feet)	*Description of materials*
0 - 4	Clay, black, very silty
4 - 20	Clay, pale brown (lacustrine)
20 - 25	Clay, grayish-brown, with very fine to medium sand (till)
25 - 45	Clay, bluish medium dark gray, sandy, silty (till)
45 - 63	Clay, light gray, smooth (lacustrine)
63 - 65	Gravel, gray, poorly sorted; with very fine sand to shale gravel
65 - 67	Sand, gray, silty, gravelly (lithologic interpretation based on field notes and geophysical log)
67 - 75	Sand, yellowish-brown, very fine to fine gravel
75 - 87	Sand, yellowish-brown; mostly very coarse
87 - 97	Clay, brownish-gray, silty, very sandy; lots of yellow-brown dolomite fragments present; noted yellow-gray streak of sand at top of interval
97 - 115	Clay, medium dark gray, sandy, silty; very hard drilling
115 - 126	Clay, gray, very gravelly; increasingly sandy with depth below 122 feet
126 - 141	Gravel, gray, fine; with lots of coarse and very coarse sand, poorly sorted with gray to dark gray, subrounded rock fragments up to ¼-inch in diameter
141 - 158	Clay, medium dark gray, silty; minor amounts of sand and granules
158 - 165	Sand and gravel; with clay lense at 162-foot depth
165 - 170	Clay
170 - 172	Silt, dark brownish-gray; "Robein?"

Observation Well Name: IRO-95A (concluded)

Depth (feet)	*Description of materials*
172 - 183	Sand, brownish-gray, medium, well sorted quartz-rich; possible clay lense at 174-176 feet
183 - 187	Clay (lithogic interpretation based solely on geophysical log)
187 - 196	Sand, gray to dark gray, very coarse; poorly sorted
196 - 199	Clay
199 - 218	Sand, gray, fine to medium, mostly quartz grains; trace of white, subangular coarse sand grains; slow penetration rate
218 - 224	Sand, gray, coarse; occurs with medium to very coarse sand
224 - 234	Shale, bluish-gray; waxy feel

T.D. = 234 feet

Well Construction Details:
Installed 230 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) 10 feet above the bottom of the casing. The geophysical log was run several days after the well was built. Some difficulty in getting well to backflush, but then did so successfully. Backfilled annulus with pea gravel and intermittently with bentonite chips. Set a 4-inch-square steel protector over well and padlocked.

Developed well with compressed air on September 8, 1995.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-96A

Location: NE¼, NE¼, NE¼, NE¼ of Sec. 09, T25N, R10E — County: Iroquois
Casing Top Elevation: 678.82 feet (GPS)
Casing Stickup above Land: 2.0 feet
Date Drilled: June 20, 1996

Drilling Contractor: Albrecht Drilling — Method: Rotary, 6-inch
Driller: Jet Hall — Drilling Fluid: Bentonite

Hydrogeologist: Burch, R. Vaiden (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way, 3 miles southeast of Thawville at intersection of County Roads 300E and 1100N. (Test hole #12)

Depth (feet)	*Description of materials*
0 - 4	Clay, greenish-gray to brown, silty
4 - 16	Clay, brownish-gray; sticky, smooth
16 - 66	Clay, medium gray; waxy feel, very little sand (lacustrine)
66 - 77	Clay, gray, silty, with sand (till)
77 - 79	Sand
79 - 83	Clay, dark brown to dark gray
83 - 86	Sand, medium to coarse, yellow-brown
86 - 124	Clay, medium gray, silty, sandy; hard drilling (till)
124 - 129	Sand, gray, coarse to very coarse; with some very fine gravel?
129 - 131	Clay, gray
131 - 165	Sand, brownish-gray, medium, very well sorted; subrounded quartz-rich grains with only a minor amount of fine sand, mostly medium size grains of sand
165 - 175	Sand, brownish-gray, medium, very well sorted with occasional granules; many more black or dark-colored grains present, reddish-brown grains are more frequent
175 - 197	Sand, brownish-gray, medium to coarse with minor amounts of very coarse sand; observed increasingly pink color from 195- to 197-foot depths, increased water loss
197 - 198	Rock; rig chattered loudly, rock chips in cuttings appear to light gray limestone

Observation Well Name: IRO-96A (concluded)

Depth (feet)	*Description of materials*
198 - 238	Gravel, fine; with very coarse sand, white limestone and brown dolomite fragments are abundant, olive-brown grains of very fine gravel present, texture becomes coarser below 215 feet, quite noisy at 230 feet perhaps indicating rocks and gravel, significant water loss
238 - 240	Dolomite, brownish-gray

T.D. = 240 feet

Well Construction Details:
Installed 205 feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) at the bottom of the casing. Casing is sitting on collapsed sand at bottom of borehole. Backflushed well casing with clear water from Onarga. Dumped 100 lb of sandpack in annulus to cover well screen. Backfilled annulus with pea gravel and sealed annulus with 100 lb of bentonite chips in four distinct layers.

Well flows! Static water level is about 10 inches above the top of the casing. A threaded cap on top of the well shuts in the water. Set a 4-inch-square steel protector over well and padlocked.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-98A

Location: NW¼, NW¼, NW¼, NE¼ of Sec. 20, T26N, R10E County: Iroquois
Casing Top Elevation: 679.24 feet (GPS)
Casing Stickup above Land: 2.0 feet
Date Drilled: May 26, 1998

Drilling Contractor: Sims Drilling Method: Rotary, 6-inch
Driller: Mike McCarty Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located in right-of-way, 4½ miles west of Onarga along County Road 1500N and ½-mile west of County Road 200N. (Test hole #16)

Depth (feet)	*Description of materials*
0 - 3	Sand, brown, fine to medium, well-sorted; silty, clayey?
3 - 11	Clay, brown, silty, sandy
11 - 30	Clay, gray; sticky
30 - 53	Clay, olive-gray grades to medium gray, harder than overlying interval; no sand, samples press into hard lumps (lacustrine)
53 - 69	Clay, medium gray, trace of sand; softer than overlying interval (till?)
69 - 77	Sand, brownish-gray, slightly clayey
77 - 128	Sand, brownish-gray, very fine to medium, uniform appearance; cuttings suspended in very thick mud
128 - 151	Clay, medium gray, sand, silt (till)
151 - 158	Clay, reddish-brown, sandy, silty; “oxidized” (till)
158 - 180	Clay, brownish-gray
180 - 185	Shale? Greenish clay on last sample

T.D. = 185 feet

Observation Well Name: IRO-98A (concluded)

Well Construction Details:
Installed 180-feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) 60 feet above the bottom of the casing. To enhance setting the casing, the well was not capped at bottom. Backflushed well casing with clear water. Backfilled annulus with 2,000 lb of pea gravel and sealed annulus with 40 lb of bentonite chips. Sealed again near the surface and then set a 6-inch-square steel protector over well and padlocked.

Attempted to develop the well with compressed air on June 25, 1998. Evacuated casing of water and chunks of mud. Well needs more pumping to be fully functional for use in monitoring ground-water levels. The screen is 122-127 feet below land surface.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-98B

Location: NW¼, SW¼, SW¼, NE¼ of Sec. 10, T26N, R14W County: Iroquois
Casing Top Elevation: 660.72 feet (GPS)
Casing Stickup above Land: 3.8 feet
Date Drilled: May 27-28, 1998

Drilling Contractor: Sims Drilling Method: Rotary, 6-inch
Driller: Mike McCarty Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located in right-of-way, 3 miles east of Gilman along County Road 1050E and almost ½-mile south of County Road 1700N. (Test hole #17)

Depth (feet)	*Description of materials*
0 - 3	Clay, yellow-brown, very sandy, silty
3 - 7	Sand, brown, fine to medium, silty
7 - 18	Clay, medium gray (lacustrine?)
18 - 36	Clay, medium dark-gray, trace of gravel; cuts into balls (till)
36 - 37	Sand, olive-gray, clayey
37 - 107	Clay, medium dark gray, sand, trace of gravel (till)
107 - 117	Clay, medium dark gray, very sandy; rig rattles through this interval
117 - 124	Clay, medium dark gray; harder drilling?
124 - 182	Sand and gravel, gray; common sizes range from very coarse sand to very fine gravel, although gravel ranges up to ⅜- and ½-inch diameters, rock fragments of shale, limestone, and dolomite predominate cuttings; not especially rich in quartz and differs from sand found in Banner Formation near Paxton and Hoopeston
182 - 198	Clay, brownish-gray, sandy, silty; observed one wood fragment (till)

T.D. = 198 feet

Observation Well Name: IRO-98B (concluded)

Well Construction Details:
Installed 182½ feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) 20 feet above the bottom of the casing. Casing is capped on bottom. Backflushed well casing with clear water. Backfilled annulus with more than 2,800 lb of pea gravel (⅜-inch diameter) and sealed annulus with 100 lb of bentonite chips in four distinct layers.

Set a 6-inch-square steel protector over well and padlocked.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-98C

Location: NE¼, NW¼, NE¼, NE¼ of Sec. 17, T26N, R13W County: Iroquois
Casing Top Elevation: 661.02 feet (GPS)
Casing Stickup above Land: 2.0 feet
Date Drilled: May 29 and June 1, 1998

Drilling Contractor: Sims Drilling Method: Rotary, 6-inch
Driller: Mike McCarty Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located in right-of-way, 2 miles south of Crescent City along County Road 1600N and ¾-mile east of County Road 1400E. (Test hole #18)

Depth (feet)	*Description of materials*
0 - 5	Sand, brown, fine to medium, silty
5 - 15	Clay, brown, sandy
15 - 17	Sand, gray
17 - 38	Clay, bluish medium gray, very sticky; no sand or gravel
38 - 102	Clay
102 - 107	Sand, gray, medium to very coarse
107 - 113	Clay, pinkish medium-dark gray, sandy, gravelly
113 - 129	Sand, gray, medium with some fine gravel
129 - 133	Clay; guess based on natural gamma log
133 - 161	Sand, gray; medium sand sized grains of quartz mixed with very coarse sand grains of rock fragments, might be mixture of Mahomet-like sand and local outwash
161 - 173	Clay; guess based on natural gamma log
173 - 176	Dolomite?; guess based on natural gamma log
176 - 182	Shale? no cuttings observed, but drills harder
182	Dolomite, black, gray, and brown fragments; no penetration by drag bit

T.D. = 182 feet

Observation Well Name: IRO-98C (concluded)

Well Construction Details:
Installed 167½ feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) at the bottom of the casing. Backflushed well casing with clear water. Dumped 150 lb of sandpack in annulus to cover well screen. Backfilled remainder of the annulus with 2,600 lb of pea gravel and sealed intermittently with 75 lb of bentonite chips in distinct layers.

Set a 6-inch-square steel protector over well and padlocked.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: IRO-98D

Location: SW¼, NW¼, SW¼, NW¼ of Sec. 18, T25N, R12W County: Iroquois
Casing Top Elevation: 684 feet (est.)
Casing Stickup above Land: 3.5 feet
Date Drilled: June 1-2, 1998

Drilling Contractor: Sims Drilling Method: Rotary, 6-inch
Driller: Mike McCarty Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located in right-of-way, 4 miles west of Milford along County Road 1900E and 0.3-mile south of County Road 1000N. (Test hole #19)

Depth (feet)	*Description of materials*
0 - 1	Clay, very dark brown (topsoil)
1 - 5	Clay, yellow-brown; not sandy, not sticky
5 - 16	Clay, medium dark gray to dark gray; not sandy
16 - 64	Clay, bluish medium-dark gray; not sandy but sticky with a waxy feel (lacustrine)
64 - 69	Clay; gamma log suggests possible gravelly till interval
69 - 84	Clay, medium dark gray (lacustrine?)
84 - 181	Clay, medium gray, sandy, gravelly, silty; not sticky, uniform drilling (till)
181 - 231	Sand, brownish-gray, fine to medium, moderately well sorted, quartz-rich, resembles the Mahomet sand, grain size increases to more coarse sand near bottom of this interval
231 - 233	Clay; Shale?

T.D. = 233 feet

Well Construction Details:
Installed 227½ feet of 2-inch diameter PVC casing (usually in 10-foot lengths) and a 5-foot length of PVC well screen (0.010-inch slot size) at the bottom of the casing. Backflushed well casing with clear water. Dumped 150 lb of sandpack in annulus to cover well screen. Backfilled remainder of the annulus with 2,600 lb of pea gravel and sealed intermittently with 75 lb of bentonite chips in distinct layers. Set a 6-inch-square steel protector over well and padlocked.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: VER-94A
(South well of two)

Location: SW¼, NW¼, NW¼, SW¼ of Sec. 05, T23N, R13W County: Vermilion
Casing Top Elevation: 697.47 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 18-19, 1994

Drilling Contractor: Albrecht Drilling Method: Rotary, 5-inch
Driller: Jet Hall Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located in right-of-way on east side of County Road 470E, just north of bridge over Whisky Creek. About 2 miles northeast of Rankin. South well of two. (Test hole #3A)

Depth (feet)	*Description of materials*
0 - 12	Clay, yellow-brown, silty, sandy (till)
12 - 16	Clay, medium dark gray, silty, sandy (till)
16 - 24	Gravel, gray
24 - 68	Clay, gray; gravel streak at 66-68 feet (till)
68 - 71	Clay, tan changing to light gray
71 - 87	Sand
87 - 98	Clay
98 - 113	Sand
113 - 121	Clay
121 - 137	Sand
137 - 151	Clay, pinkish-gray changing to medium dark gray; contains very dark gray pebbles (till)
151 - 167	Sand, olive, fine, well sorted; contains reddish and black grains
167 - 171	Clay, gray
171 - 177	Sand, gray
177 - 183	Clay, medium gray (till)
183 - 210	Sand, olive-gray, very fine to fine, very well sorted

Observation Well Name: VER-94A (concluded)

Depth (feet)	*Description of materials*
210 - 233	Sand, gray, fine to coarse, well sorted; rounded grains of fine sand alternate with rounded coarse sand
233 - 243	Sand, gray, fine to very coarse; fine sand reacts with acid, lots of very light gray grains present, minor amount of reddish colored sand grains observed
243 - 258	Sand, gray, very coarse; "bumpy" drilling action
258 - 275	Sand, gray, fine to medium, well sorted; poor sample recovery
275 - 287	Sand, gray, medium to coarse
287 - 289	Rock, red granitic
289 - 307	Gravel; ¼-inch diameter; abundant angular light gray chert and other noncalcareous bluish-green rock fragments occur with highly polished, oblate grains of jasper and milky quartz; losing water rapidly
307 - 313	Shale, light bluish-gray
313 - 314	Shale, very dark gray to black

T.D. = 314 feet

Well Construction Details:
Installed 250 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.020-inch slot size) at the bottom of the casing. Filled open hole below the well with pea gravel (⅜ inch), before backflushing well. Added gravel around screen and then bentonite chips. Resumed backfilling the annulus with gravel and intermittently with layers of bentonite chips (totalling 100 lb). Sealed near surface with bentonite and set a 4-inch-square steel protector over the well. Padlocked well protector.

Returned on August 22, 1994, and developed well with compressed air. Discharge cleared and yielded more than 10 gpm with no sand.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: VER-94B
(North well of two)

Location: SW¼, NW¼, NW¼, SW¼ of Sec. 05, T23N, R13W County: Vermilion
Casing Top Elevation: 697.30 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 22, 1994

Drilling Contractor: Albrecht Drilling Method: Rotary, 5-inch
Driller: Jet Hall Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: None

Located in right-of-way on east side of County Road 470E, just north of bridge over Whisky Creek. About 2 miles northeast of Rankin. North well of two. (Test hole #3B)

Depth (feet)	*Description of materials*
0 - 12	Clay, yellow-brown, silty, sandy (till)
12 - 16	Clay, medium dark gray, silty, sandy (till)
16 - 24	Gravel, gray
24 - 68	Clay, gray; gravel streak at 66-68 feet (till)
68 - 71	Clay, tan changing to light gray
71 - 87	Sand
87 - 98	Clay
98 - 113	Sand
113 - 121	Clay
121 - 135	Sand

T.D. = 135 feet

Appendix A. (continued)

Observation Well Name: VER-94B (concluded)

Well Construction Details:
Installed 130 feet of 2-inch diameter PVC casing (in 10-foot lengths) and a 5-foot length of PVC well screen (0.020-inch slot size) at the bottom of the casing. Backflushed well. Added 3 bags of washed sandpack around screen and then 35 lb of bentonite chips. Resumed backfilling the annulus with pea gravel (⅜ inch), but annulus seemed to bridge shut. Sealed upper 6 inches with bentonite and set a 4-inch-square steel protector over the well. Padlocked well protector. Developed well with compressed air for 45-60 minutes before leaving site.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: VER-94C

Location: NW¼, NE¼, NE¼, NE¼ of Sec. 13, T23N, R13W County: Vermilion
Casing Top Elevation: 706.95 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 29, 1995

Drilling Contractor: Albrecht Drilling Method: Rotary, 5-inch
Driller: Jet Hall Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located at northwest corner of undeveloped rest area along Illinois Route 9 about 2 miles east of East Lynn. (Test hole #6)

Depth (feet)	*Description of materials*
0 - 2	Clay, black, crumbly (topsoil)
2 - 8	Clay, yellow-brown, gravelly, silty (till)
8 - 16	Clay, yellow-brown, silty, sandy (till)
16 - 43	Clay, gray
43 - 62	Clay, medium dark gray, sandy; poor sample recovery (till)
62 - 68	Clay, sandy; softer drilling
68 - 69	Clay, dark gray; hard drilling
69 - 75	Clay, medium dark gray
75 - 77	Sand and Gravel, multicolored
77 - 100	Clay, medium gray (lighter than overlying clay unit); many pebbles
100 - 103	Sand, gray, medium to very coarse; with angular granules of gray limestone
103 - 140	Clay, medium dark gray, some sand; very hard drilling, very light bluish-gray gravel fragments, a few red sand grains, faintly overall olive color at 135 feet
140 - 155	Clay, medium dark gray, trace of sand; cuttings recovered in form of very clay balls
155 - 160	Sand, brownish-gray, very fine; well-sorted quartz-rich material
160 - 168	Sand, gray, fine to medium, well sorted
168 - 185	Sand, dark gray, medium to very coarse; with a few granules, grains have inclusions of black, green, and light gray minerals

Observation Well Name: VER-94C (concluded)

Depth (feet)	*Description of materials*
185 - 191	Sand, brownish-gray, fine to medium; moderately sorted, trace of very fine sand
191 - 197	Sand, gray, medium to very coarse
197 - 205	Sand, fine
205 - 215	Sand, medium to very coarse
215 - 223	Sand, fine
223 - 228	Sand and gravel; medium to very coarse sand grains with many granules
228 - 236	Sand, brownish-gray, fine to medium; with a small amount of very coarse sand to granule-sized grains

T.D. = 236 feet

Well Construction Details:
Installed 235 feet of 2-inch diameter PVC casing and a 5-foot length of PVC well screen (0.020-inch slot size). Backflushed well casing, then dumped sandpack down annulus to cover the screen interval. Backfilled annulus with pea gravel (⅜ inch) and bentonite chips. Sealed near surface with bentonite and set 4-inch-square steel protector over well. Padlocked well protector.

Returned September 2, 1994, and developed well with compressed air.

Appendix A. (continued)

Illinois State Water Survey
Test Hole and Observation Well Record

Observation Well Name: VER-94D

Location: NW¼, NW¼, NW¼, NW¼ of Sec. 02, T23N, R12W County: Vermilion
Casing Top Elevation: 717.44 feet (GPS)
Casing Stickup above Land: 2.5 feet
Date Drilled: August 24, 1994

Drilling Contractor: Albrecht Drilling Method: Rotary, 5-inch
Driller: Jet Hall Drilling Fluid: Bentonite

Hydrogeologist: Burch, D. Larson (ISGS)
Geophysical Logs: Natural Gamma

Located in right-of-way, about a mile north of Hoopeston, at intersection of Illinois Route 1 and south side of County Road 4300N. (Test hole #4)

Depth (feet)	*Description of materials*
0 - 3	Clay, black, very silty to clayey silt, crumbly (topsoil)
3 - 9	Clay, yellow-brown to olive-brown, moderately silty; sticky
9 - 18	Clay, medium gray, slightly to moderately silty; stiff, cuts into "ribbons" (lacustrine?)
18 - 33	Clay, medium dark gray, faintly greenish cast; somewhat stiff, slightly sandy, slightly pebbly
33 - 39	Clay, gray, sandy (till)
39 - 56	Clay, medium dark gray, silty, stiff, very little sand; firm, smooth drilling
56 - 60	Clay, greenish-gray, moderately silty, very slightly sandy; with thin brown layers of clay at about 58 feet
60 - 65	Clay, brownish olive gray, gravelly
65 - 89	Clay, medium dark gray, sandy, pebbly (till)
89 - 99	Sand, olive-gray, medium to coarse; with many very fine and fine sand grains, abundant with white rock fragments (limestone?)
99 - 121	Clay, gray to pinkish-gray, moderately silty, sandy, pebbly (till)
121 - 123	Sand and gravel; mostly coarse sand
123 - 130	Clay, gray to pinkish-gray, moderately silty, sandy, pebbly
130 - 136	Sand
136 - 149	Clay, gray to pinkish-gray, moderately silty, sandy, pebbly

Appendix A. (continued)

Observation Well Name: VER-94D (concluded)

Depth (feet)	*Description of materials*
149 - 165	Sand, brownish-gray, medium to very coarse; with very fine to medium gravel, lots of black and gray rounded grains up to ⅜-inch in diameter
165 - 171	Clay, sandy
171 - 223	Sand, gray, medium to very coarse; with very fine to medium gravel and some very fine sand, poorly sorted; fines are mostly rounded shale, limestone and quartz
223 - 233	Sand, gray, fine to coarse; finer-grained than overlying interval and tends to be medium sand
233 - 245	Sand and Gravel, gray; increased percentage of fine gravel (¼-inch)
245 - 300	Sand and Gravel, gray, medium to very coarse sand with ⅜-inch gravel; abundant light gray grains with lesser amounts of white chert and medium brown dolomite fragments in samples
300 - 301	Rock; rig chatters loudly as it pushes aside obstruction
301 - 318	Sand and gravel; very fine sand to medium gravel, poorly sorted; red grains very common, finer grains typically rounded quartz while others are mostly shale and limestone
318 - 320	Shale, bluish- to greenish-gray, moderately silty, very calcareous; very hard drilling
320 - 323	Dolomite (?), bluish gray, noncalcareous; lithified, is likely fractured as drillstem dropped about 1 foot at 322 foot depth

T.D. =323 feet

Well Construction Details:
Installed 315 feet of 2-inch diameter PVC casing and a 5-foot length of PVC well screen (0.020-inch slot size). The screen is located 20 feet above the bottom of the well. A cap is attached to the bottom of the casing. Poured about 20 gallons of pea gravel (⅜ inch) into annulus before backflushing the well. Then added silica sandpack (about 120 lb) to cover screened interval. Resumed backfilling annulus with 3,000 lb of pea gravel and 100 lb of bentonite chips, placed intermittently as layers. Set 4-inch square, steel protector over well and sealed upper 4-5 feet with bentonite. Padlocked well protector.

Returned September 2, 1994, and developed the well with compressed air.

Appendix A. (continued)

Illinois State Water Survey
Test Hole

Test Hole Number 20

Location: SW¼, SW¼, SW¼, SE¼ of Sec. 03, T24N, R12W
County: Iroquois
Casing Top Elevation: 687 feet (est.)
Casing Stickup above Land: Not applicable
Date Drilled: June 3, 1998

Drilling Contractor: Sims Drilling
Method: Rotary, 6-inch
Driller: Mike McCarty
Drilling Fluid: Bentonite

Hydrogeologist: Burch
Geophysical Logs: Natural Gamma

Located south of Milford, in right-of-way at "T-Road" intersection of County Roads 2250E and 500N. (Test hole #20)

Depth (feet)	*Description of materials*
0 - 1	Topsoil, brownish-black
1 - 13	Clay, yellow-brown, sand, minor amount of silt (till)
13 - 20	Clay, medium dark gray, sand, minor amount of silt (till)
20 - 40	Clay, medium dark gray, sand (till)
40 - 52	Sand and gravel; grain sizes range from coarse sand to coarse gravel and include rock fragments up to ¾ inch in diameter
52 - 98	Clay, pinkish dark gray, sandy (till)
98 - 106	Sand, gray, medium to coarse with some fine to medium gravel; sand is often comprised of quartz grains with ¼-inch gravel of light to dark gray limestone fragments
106 - 120	Clay, medium dark gray, sandy, silty (till)
120 - 160	Clay, reddish-brown, sandy, silty; observed a subangular, ¾-inch fragment of red granite in sample from approximately 125 feet
160 - 163	Sand, brownish-gray; suspended in thick drilling mud, poor recovery
163 - 190	Shale, greenish-gray changes to bluish-gray; interbedded with harder seams (carbonate rock?)

T.D. = 190 feet

Appendix A. (concluded)

Test Hole Number 20 (concluded)

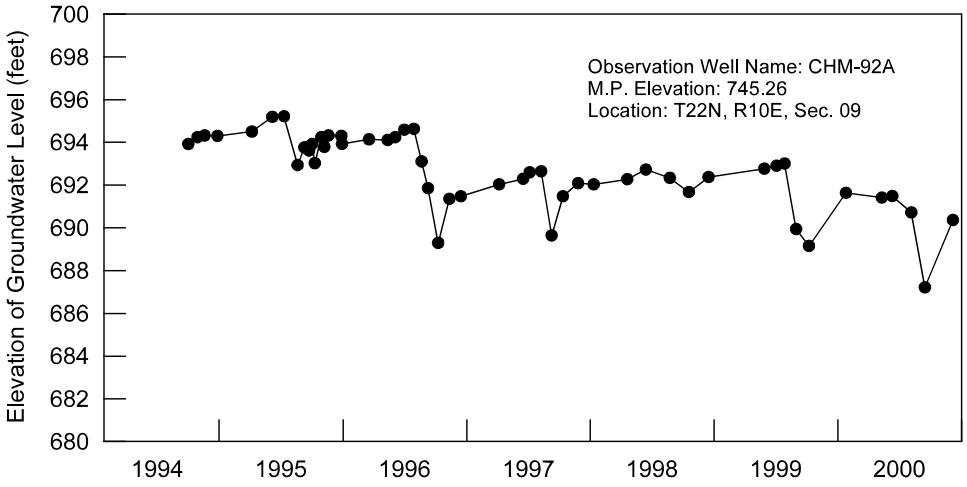
Note #1:
Temporarily set 190 feet of 2-inch diameter PVC casing so that natural gamma log could be run later. No screen or cap on bottom of casing. Attempted to backfill the annulus, but it was bridged after only about 1,000 lb of pea gravel was placed in the hole. Top of the casing is about 8 inches below land surface.

Note #2:
Poured approximately 50 lb of bentonite chips inside well casing on July 29, 1998. Finished backfilling annulus with pea gravel to near surface. Removed upper length of PVC casing and sealed hole with bentonite chips.

Appendix B. Observed Groundwater Levels and Elevations

Appendix B. Observed Groundwater Levels and Elevations

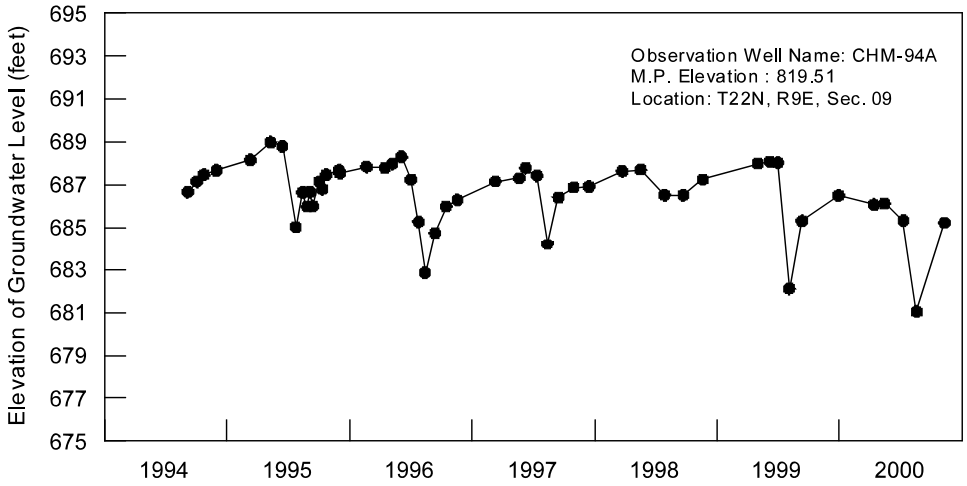
Observation Well: CHM-92A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	51.19	693.91	11/19/1996	53.79	691.47
10/4/1994	50.87	694.23	3/12/1997	53.23	692.03
10/25/1994	50.79	694.31	5/22/1997	52.97	692.29
12/2/1994	50.81	694.29	6/10/1997	52.67	692.59
3/13/1995	50.61	694.49	7/14/1997	52.62	692.64
5/12/1995	49.91	695.19	8/14/1997	55.62	689.64
6/16/1995	49.88	695.22	9/16/1997	53.79	691.47
7/26/1995	52.17	692.93	10/31/1997	53.18	692.08
8/15/1995	51.35	693.75	12/16/1997	53.23	692.03
8/29/1995	51.49	693.61	3/25/1998	52.99	692.27
9/7/1995	51.19	693.91	5/19/1998	52.54	692.72
9/15/1995	52.08	693.02	7/29/1998	52.93	692.33
10/4/1995	50.87	694.23	9/23/1998	53.59	691.67
10/13/1995	51.32	693.78	11/20/1998	52.89	692.37
10/25/1995	50.79	694.31	5/3/1999	52.50	692.76
12/2/1995	50.81	694.29	6/8/1999	52.36	692.90
12/4/1995	51.18	693.92	7/2/1999	52.26	693.00
2/22/1996	50.97	694.13	8/5/1999	55.32	689.94
4/17/1996	51.00	694.10	9/12/1999	56.11	689.15
5/9/1996	51.03	694.23	12/30/1999	53.63	691.63
6/5/1996	50.68	694.58	4/14/2000	53.85	691.41
7/3/1996	50.64	694.62	5/15/2000	53.78	691.48
7/26/1996	52.16	693.10	7/10/2000	54.55	690.71
8/14/1996	53.41	691.85	8/19/2000	58.05	687.21
9/13/1996	55.97	689.29	11/10/2000	54.90	690.36
10/16/1996	53.91	691.35			

Appendix B. (continued)

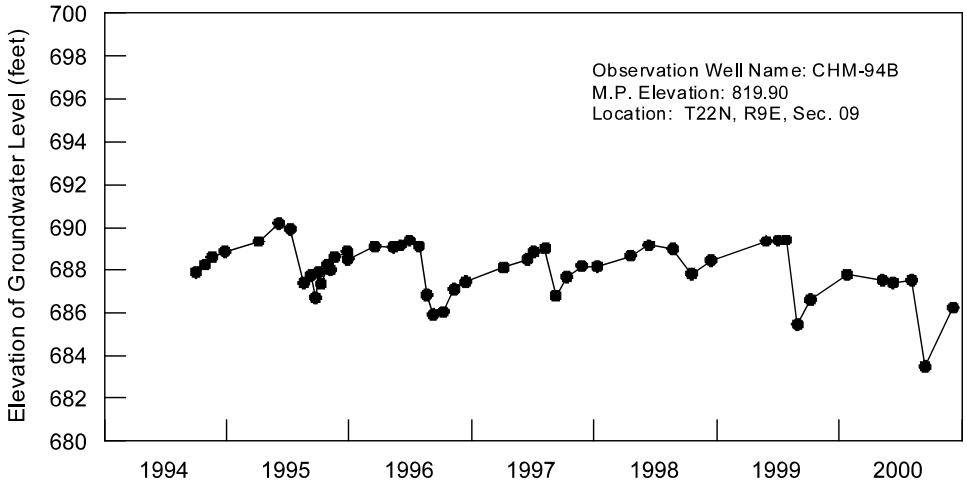
Observation Well: CHM-94A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	131.64	686.66	11/19/1996	133.23	686.28
10/4/1994	131.16	687.14	3/12/1997	132.36	687.15
10/25/1994	130.84	687.46	5/22/1997	132.21	687.30
12/2/1994	130.64	687.66	6/10/1997	131.74	687.77
3/13/1995	130.16	688.14	7/14/1997	132.09	687.42
5/12/1995	129.33	688.97	8/14/1997	135.32	684.19
6/16/1995	129.52	688.78	9/16/1997	133.11	686.40
7/26/1995	133.28	685.02	10/31/1997	132.64	686.87
8/15/1995	131.66	686.64	12/16/1997	132.61	686.90
8/29/1995	132.33	685.97	3/25/1998	131.89	687.62
9/7/1995	131.64	686.66	5/19/1998	131.81	687.70
9/15/1995	132.31	685.99	7/29/1998	133.00	686.51
10/4/1995	131.16	687.14	9/23/1998	133.00	686.51
10/13/1995	131.51	686.79	11/20/1998	132.28	687.23
10/25/1995	130.84	687.46	5/3/1999	131.53	687.98
12/2/1995	130.64	687.66	6/8/1999	131.45	688.06
12/4/1995	130.77	687.53	7/2/1999	131.49	688.02
2/22/1996	130.47	687.83	8/5/1999	137.41	682.10
4/17/1996	130.52	687.78	9/12/1999	134.21	685.30
5/9/1996	131.54	687.97	12/30/1999	133.02	686.49
6/5/1996	131.22	688.29	4/14/2000	133.45	686.06
7/3/1996	132.28	687.23	5/15/2000	133.39	686.12
7/26/1996	134.25	685.26	7/10/2000	134.19	685.32
8/14/1996	136.67	682.84	8/19/2000	138.48	681.03
9/13/1996	134.78	684.73	11/10/2000	134.29	685.22
10/16/1996	133.53	685.98			

Appendix B. (continued)

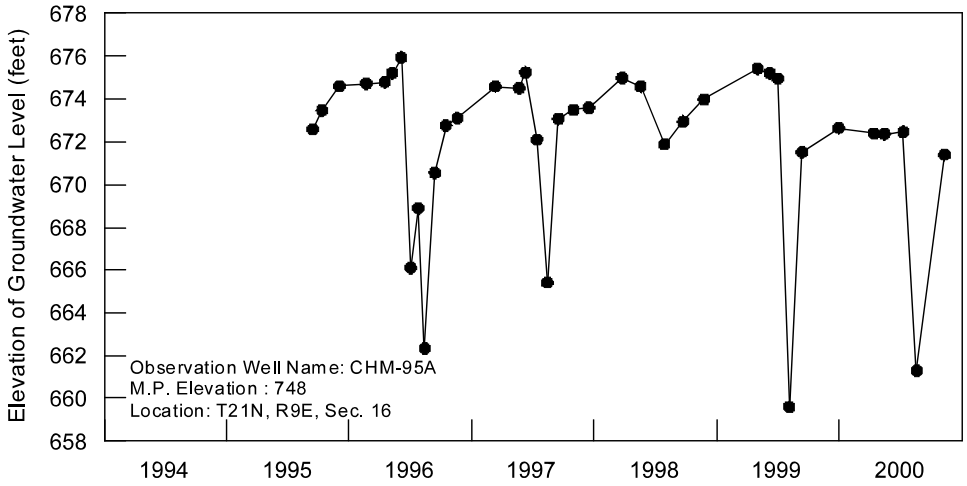
Observation Well: CHM-94B



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	130.83	687.86	11/19/1996	132.49	687.41
10/4/1994	130.48	688.21	3/12/1997	131.82	688.08
10/25/1994	130.13	688.56	5/22/1997	131.44	688.46
12/2/1994	129.87	688.82	6/10/1997	131.09	688.81
3/13/1995	129.37	689.32	7/14/1997	130.93	688.97
5/12/1995	128.50	690.19	8/14/1997	133.14	686.76
6/16/1995	128.76	689.93	9/16/1997	132.26	687.64
7/26/1995	131.32	687.37	10/31/1997	131.75	688.15
8/15/1995	130.98	687.71	12/16/1997	131.77	688.13
8/29/1995	132.02	686.67	3/25/1998	131.27	688.63
9/7/1995	130.83	687.86	5/19/1998	130.76	689.14
9/15/1995	131.37	687.32	7/29/1998	130.96	688.94
10/4/1995	130.48	688.21	9/23/1998	132.12	687.78
10/13/1995	130.72	687.97	11/20/1998	131.49	688.41
10/25/1995	130.13	688.56	5/3/1999	130.57	689.33
12/2/1995	129.87	688.82	6/8/1999	130.53	689.37
12/4/1995	130.23	688.46	7/2/1999	130.51	689.39
2/22/1996	129.64	689.05	8/5/1999	134.47	685.43
4/17/1996	129.66	689.03	9/12/1999	133.32	686.58
5/9/1996	130.76	689.14	12/30/1999	132.16	687.74
6/5/1996	130.53	689.37	4/14/2000	132.42	687.48
7/3/1996	130.82	689.08	5/15/2000	132.53	687.37
7/26/1996	133.10	686.8	7/10/2000	132.41	687.49
8/14/1996	134.02	685.88	8/19/2000	136.43	683.47
9/13/1996	133.89	686.01	11/10/2000	133.69	686.21
10/16/1996	132.84	687.06			

Appendix B. (continued)

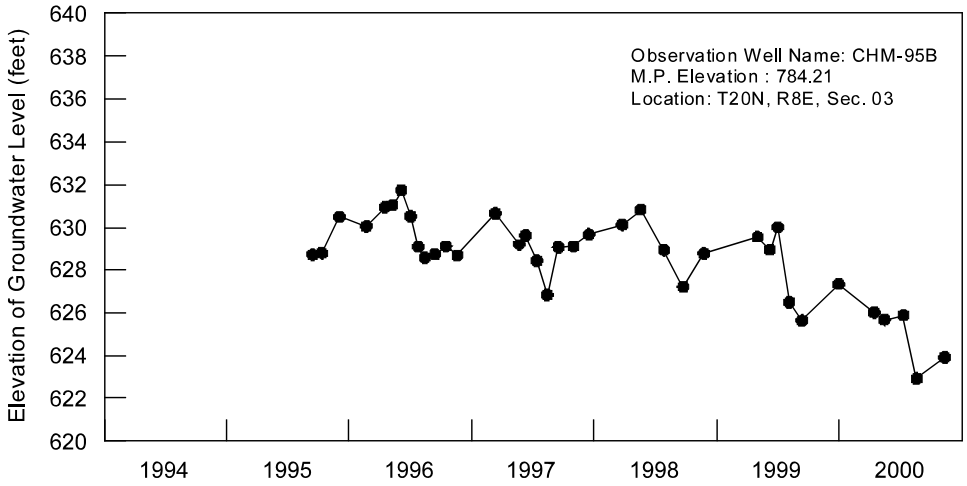
Observation Well: CHM-95A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/15/1995	74.22	673	10/31/1997	74.53	673
10/13/1995	74.39	673	12/16/1997	74.43	674
12/4/1995	73.26	675	3/25/1998	73.04	675
2/22/1996	73.14	675	5/19/1998	73.43	675
4/17/1996	73.07	675	7/29/1998	76.13	672
5/9/1996	72.82	675	9/23/1998	75.07	673
6/5/1996	72.09	676	11/24/1998	74.04	674
7/3/1996	81.94	666	5/3/1999	72.61	675
7/26/1996	79.10	669	6/8/1999	72.82	675
8/14/1996	85.69	662	7/2/1999	73.07	675
9/13/1996	77.45	671	8/5/1999	88.41	660
10/16/1996	75.25	673	9/12/1999	76.49	672
11/19/1996	74.92	673	12/30/1999	75.37	673
3/12/1997	73.43	675	4/14/2000	75.63	672
5/22/1997	73.51	674	5/15/2000	75.65	672
6/10/1997	72.79	675	7/10/2000	75.55	672
7/14/1997	75.91	672	8/19/2000	86.72	661
8/14/1997	82.62	665	11/10/2000	76.61	671
9/16/1997	74.95	673			

Appendix B. (continued)

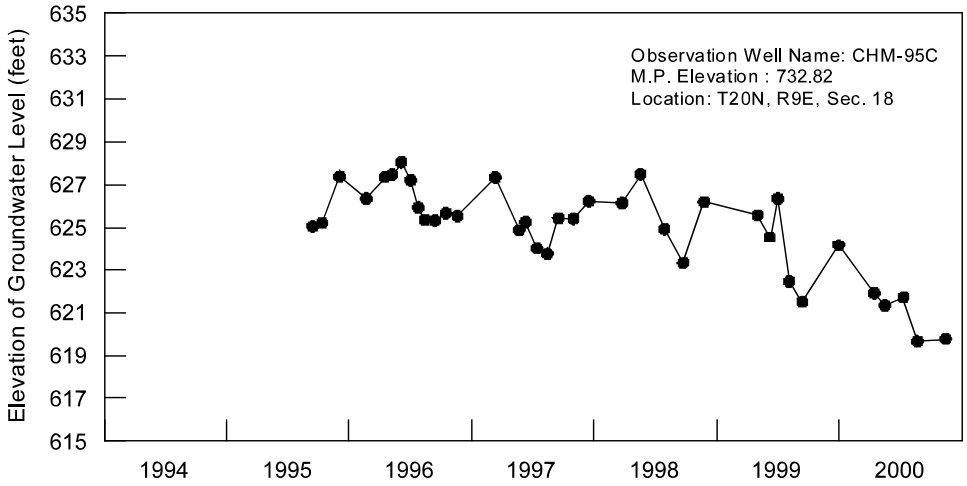
Observation Well: CHM-95B



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/15/1995	154.33	628.67	10/31/1997	155.15	629.06
10/13/1995	154.25	628.75	12/16/1997	154.53	629.68
12/4/1995	152.50	630.50	3/25/1998	154.07	630.14
2/22/1996	152.95	630.05	5/19/1998	153.38	630.83
4/17/1996	152.05	630.95	7/28/1998	155.32	628.89
5/9/1996	153.17	631.04	9/23/1998	157.03	627.18
6/5/1996	152.47	631.74	11/24/1998	155.49	628.72
7/3/1996	153.69	630.52	5/3/1999	154.66	629.55
7/26/1996	155.17	629.04	6/8/1999	155.31	628.90
8/14/1996	155.68	628.53	7/2/1999	154.19	630.02
9/13/1996	155.51	628.70	8/5/1999	157.75	626.46
10/16/1996	155.14	629.07	9/12/1999	158.60	625.61
11/19/1996	155.57	628.64	12/30/1999	156.90	627.31
3/12/1997	153.55	630.66	4/14/2000	158.22	625.99
5/22/1997	155.04	629.17	5/15/2000	158.56	625.65
6/10/1997	154.58	629.63	7/10/2000	158.35	625.86
7/14/1997	155.82	628.39	8/19/2000	161.30	622.91
8/14/1997	157.41	626.80	11/10/2000	160.32	623.89
9/16/1997	155.19	629.02			

Appendix B. (continued)

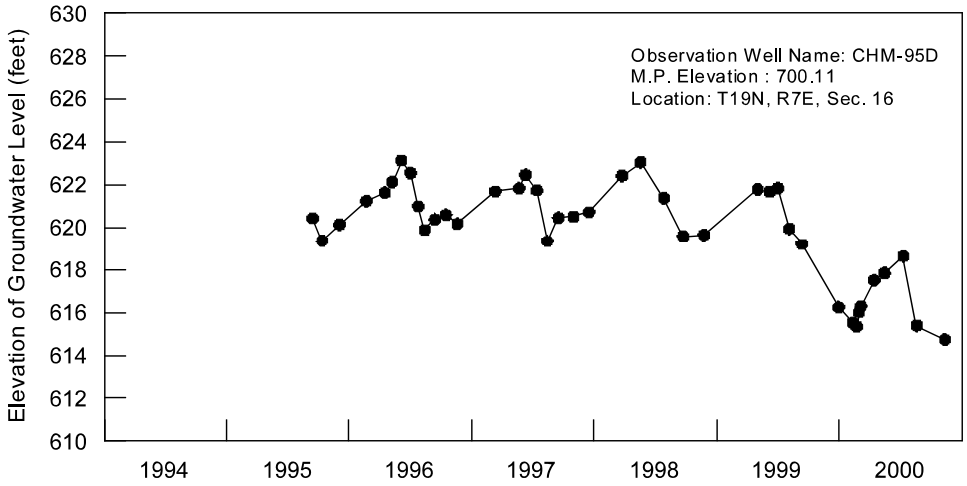
Observation Well: CHM-95C



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/15/1995	106.56	625.05	10/31/1997	107.41	625.41
10/13/1995	106.39	625.22	12/16/1997	106.59	626.23
12/4/1995	104.24	627.37	3/25/1998	106.68	626.14
2/22/1996	105.26	626.35	5/19/1998	105.34	627.48
4/17/1996	104.26	627.35	7/29/1998	107.89	624.93
5/9/1996	105.35	627.47	9/23/1998	109.53	623.29
6/5/1996	104.78	628.04	11/24/1998	106.63	626.19
7/3/1996	105.62	627.20	5/3/1999	107.25	625.57
7/26/1996	106.89	625.93	6/8/1999	108.29	624.53
8/14/1996	107.46	625.36	7/2/1999	106.47	626.35
9/13/1996	107.49	625.33	8/5/1999	110.39	622.43
10/16/1996	107.15	625.67	9/13/1999	111.34	621.48
11/19/1996	107.29	625.53	12/30/1999	108.68	624.14
3/12/1997	105.49	627.33	4/14/2000	110.93	621.89
5/22/1997	107.94	624.88	5/16/2000	111.51	621.31
6/10/1997	107.57	625.25	7/10/2000	111.13	621.69
7/14/1997	108.85	623.97	8/21/2000	113.18	619.64
8/14/1997	109.11	623.71	11/13/2000	113.06	619.76
9/16/1997	107.39	625.43			

Appendix B. (continued)

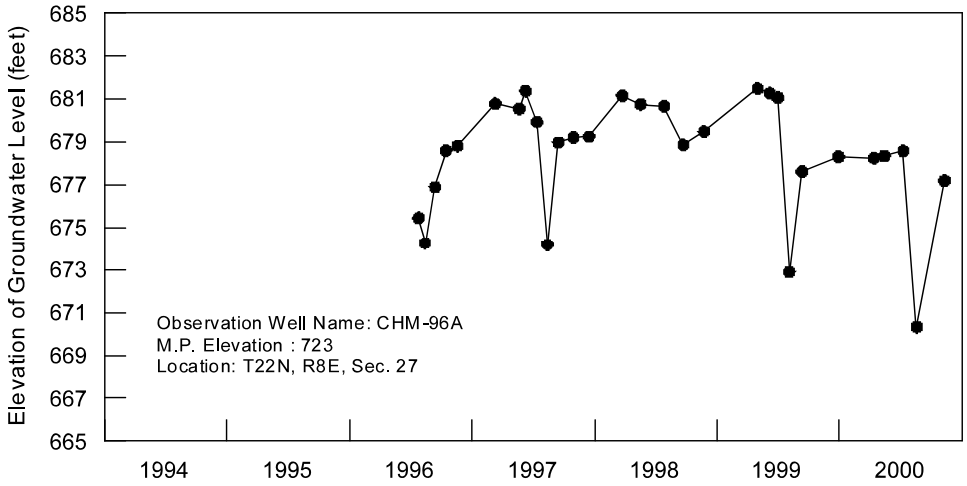
Observation Well: CHM-95D



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/15/1995	78.48	620.42	3/25/1998	77.70	622.41
10/13/1995	80.60	619.35	5/19/1998	77.07	623.04
12/4/1995	79.82	620.13	7/28/1998	78.74	621.37
2/22/1996	78.72	621.23	9/23/1998	80.53	619.58
4/17/1996	78.33	621.62	11/24/1998	80.47	619.64
5/9/1996	77.99	622.12	5/3/1999	78.33	621.78
6/5/1996	76.99	623.12	6/8/1999	78.44	621.67
7/3/1996	77.58	622.53	7/2/1999	78.28	621.83
7/26/1996	79.13	620.98	8/5/1999	80.18	619.93
8/14/1996	80.23	619.88	9/12/1999	80.92	619.19
9/13/1996	79.74	620.37	12/30/1999	83.88	616.23
10/16/1996	79.53	620.58	2/11/2000	84.61	615.50
11/19/1996	79.94	620.17	2/22/2000	84.78	615.33
3/12/1997	78.43	621.68	2/29/2000	84.11	616.00
5/22/1997	78.29	621.82	3/6/2000	83.83	616.28
6/10/1997	77.66	622.45	4/14/2000	82.63	617.48
7/14/1997	78.38	621.73	5/15/2000	82.29	617.82
8/14/1997	80.78	619.33	7/10/2000	81.49	618.62
9/16/1997	79.67	620.44	8/19/2000	84.74	615.37
10/31/1997	79.61	620.50	11/11/2000	85.39	614.72
12/16/1997	79.40	620.71			

Appendix B. (continued)

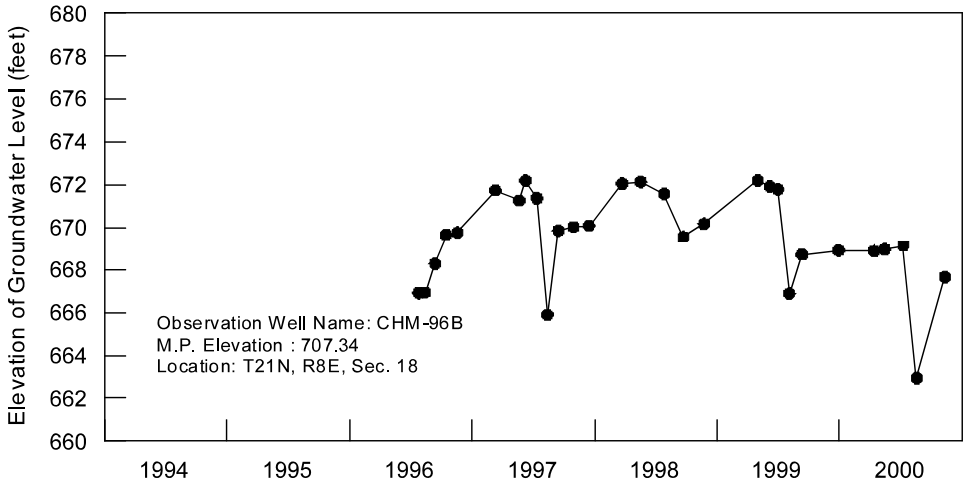
Observation Well: CHM-96A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
7/26/1996	47.56	675	7/28/1998	42.35	681
8/14/1996	48.76	674	9/23/1998	44.16	679
9/13/1996	46.12	677	11/24/1998	43.54	679
10/16/1996	44.43	679	5/3/1999	41.54	681
11/19/1996	44.20	679	6/8/1999	41.75	681
3/12/1997	42.24	681	7/2/1999	41.95	681
5/22/1997	42.48	681	8/5/1999	50.13	673
6/10/1997	41.64	681	9/12/1999	45.40	678
7/14/1997	43.09	680	12/30/1999	44.71	678
8/14/1997	48.83	674	4/14/2000	44.77	678
9/16/1997	44.04	679	5/15/2000	44.67	678
10/31/1997	43.81	679	7/10/2000	44.44	679
12/16/1997	43.77	679	8/19/2000	52.70	670
3/25/1998	41.87	681	11/10/2000	45.82	677
5/19/1998	42.27	681			

Appendix B. (continued)

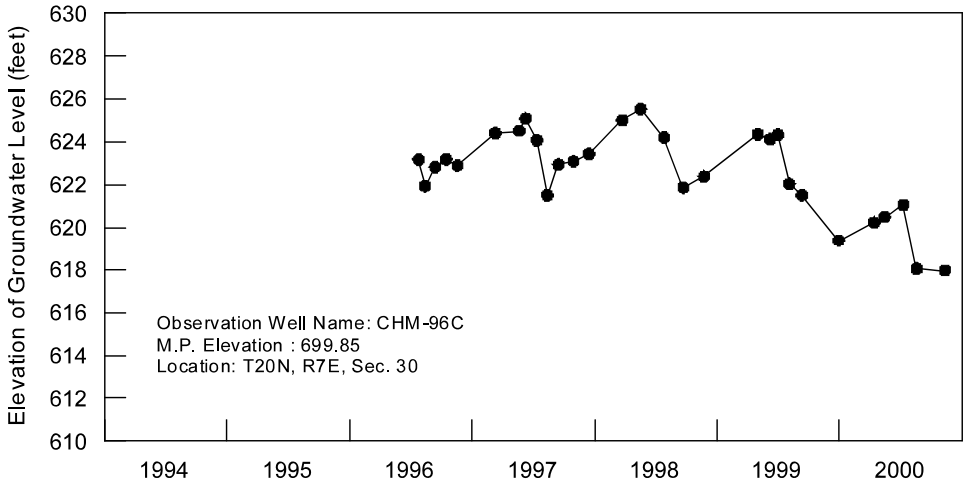
Observation Well: CHM-96B



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
7/26/1996	40.45	666.89	7/28/1998	35.77	671.57
8/14/1996	40.43	666.91	9/23/1998	37.80	669.54
9/13/1996	39.08	668.26	11/24/1998	37.17	670.17
10/16/1996	37.68	669.66	5/3/1999	35.15	672.19
11/19/1996	37.59	669.75	6/8/1999	35.43	671.91
3/12/1997	35.61	671.73	7/2/1999	35.57	671.77
5/22/1997	36.08	671.26	8/5/1999	40.48	666.86
6/10/1997	35.16	672.18	9/12/1999	38.65	668.69
7/14/1997	35.98	671.36	12/30/1999	38.46	668.88
8/14/1997	41.47	665.87	4/14/2000	38.49	668.85
9/16/1997	37.49	669.85	5/15/2000	38.41	668.93
10/31/1997	37.32	670.02	7/10/2000	38.23	669.11
12/16/1997	37.26	670.08	8/19/2000	44.41	662.93
3/25/1998	35.30	672.04	11/11/2000	39.70	667.64
5/19/1998	35.21	672.13			

Appendix B. (continued)

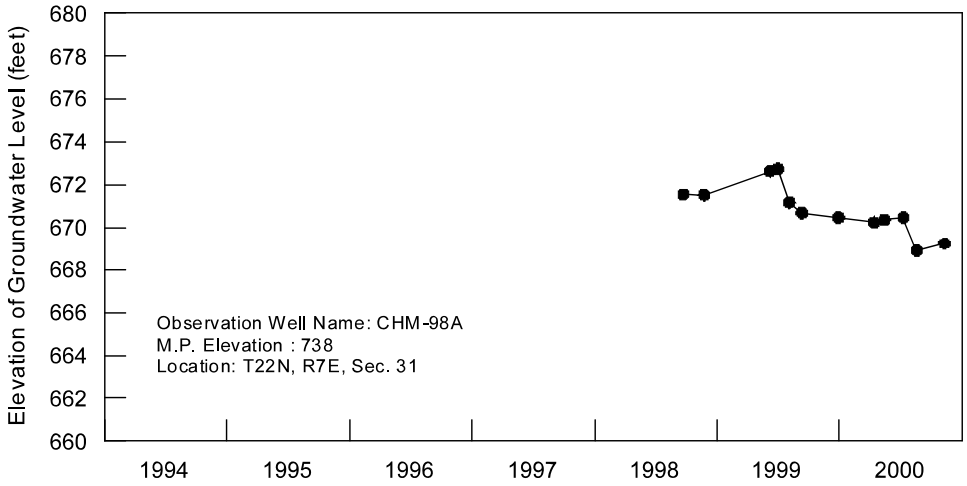
Observation Well: CHM-96C



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
7/26/1996	76.69	623.16	7/28/1998	75.66	624.19
8/14/1996	77.92	621.93	9/23/1998	77.99	621.86
9/13/1996	77.04	622.81	11/24/1998	77.48	622.37
10/16/1996	76.68	623.17	5/3/1999	75.51	624.34
11/19/1996	76.96	622.89	6/8/1999	75.74	624.11
3/12/1997	75.46	624.39	7/2/1999	75.53	624.32
5/22/1997	75.35	624.50	8/5/1999	77.82	622.03
6/10/1997	74.78	625.07	9/12/1999	78.34	621.51
7/14/1997	75.79	624.06	12/30/1999	80.48	619.37
8/14/1997	78.35	621.50	4/14/2000	79.62	620.23
9/16/1997	76.92	622.93	5/15/2000	79.36	620.49
10/31/1997	76.77	623.08	7/10/2000	78.80	621.05
12/16/1997	76.43	623.42	8/19/2000	81.82	618.03
3/25/1998	74.86	624.99	11/11/2000	81.91	617.94
5/19/1998	74.34	625.51			

Appendix B. (continued)

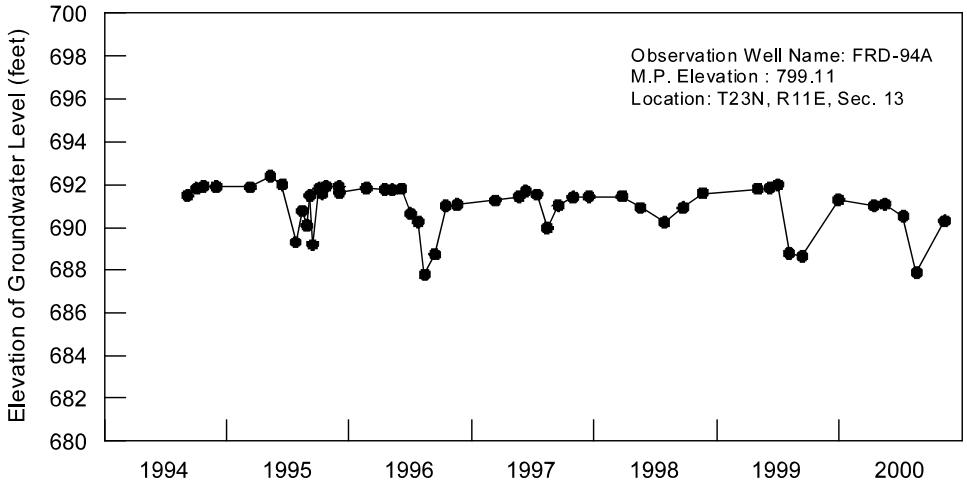
Observation Well: CHM-98A



Obs Date	*DTW (ft)*	*Elevation (ft)*
9/23/1998	66.46	672
11/24/1998	66.48	672
6/8/1999	65.37	673
7/2/1999	65.27	673
8/5/1999	66.83	671
9/12/1999	67.31	671
12/30/1999	67.54	670
4/14/2000	67.77	670
5/15/2000	67.64	670
7/10/2000	67.54	670
8/19/2000	69.13	669
11/10/2000	68.77	669

Appendix B. (continued)

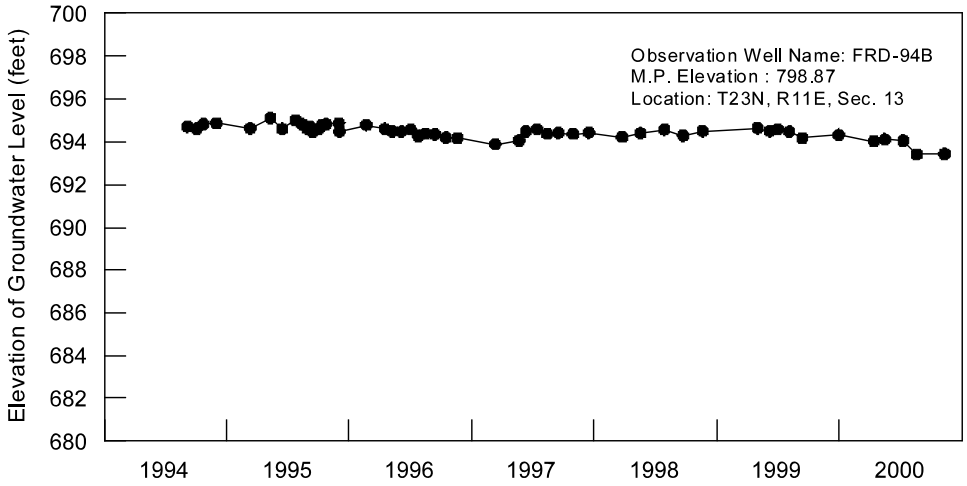
Observation Well: FRD-94A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	106.41	691.49	11/19/1996	108.04	691.07
10/4/1994	106.08	691.82	3/12/1997	107.85	691.26
10/25/1994	105.98	691.92	5/22/1997	107.67	691.44
12/2/1994	106.00	691.90	6/11/1997	107.41	691.70
3/13/1995	106.02	691.88	7/14/1997	107.57	691.54
5/12/1995	105.51	692.39	8/14/1997	109.13	689.98
6/16/1995	105.90	692.00	9/16/1997	108.08	691.03
7/26/1995	108.61	689.29	10/30/1997	107.70	691.41
8/15/1995	107.12	690.78	12/16/1997	107.66	691.45
8/29/1995	107.80	690.10	3/25/1998	107.65	691.46
9/7/1995	106.41	691.49	5/19/1998	108.19	690.92
9/15/1995	108.74	689.16	7/29/1998	108.87	690.24
10/4/1995	106.08	691.82	9/23/1998	108.18	690.93
10/13/1995	106.32	691.58	11/20/1998	107.51	691.60
10/25/1995	105.98	691.92	5/3/1999	107.31	691.80
12/2/1995	106.00	691.90	6/8/1999	107.26	691.85
12/4/1995	106.27	691.63	7/2/1999	107.12	691.99
2/22/1996	106.06	691.84	8/5/1999	110.38	688.73
4/17/1996	106.13	691.77	9/13/1999	110.52	688.59
5/9/1996	107.35	691.76	12/30/1999	107.82	691.29
6/5/1996	107.31	691.80	4/14/2000	108.09	691.02
7/3/1996	108.46	690.65	5/16/2000	108.02	691.09
7/26/1996	108.84	690.27	7/10/2000	108.58	690.53
8/14/1996	111.37	687.74	8/19/2000	111.27	687.84
9/13/1996	110.42	688.69	11/10/2000	108.81	690.30
10/16/1996	108.10	691.01			

Appendix B. (continued)

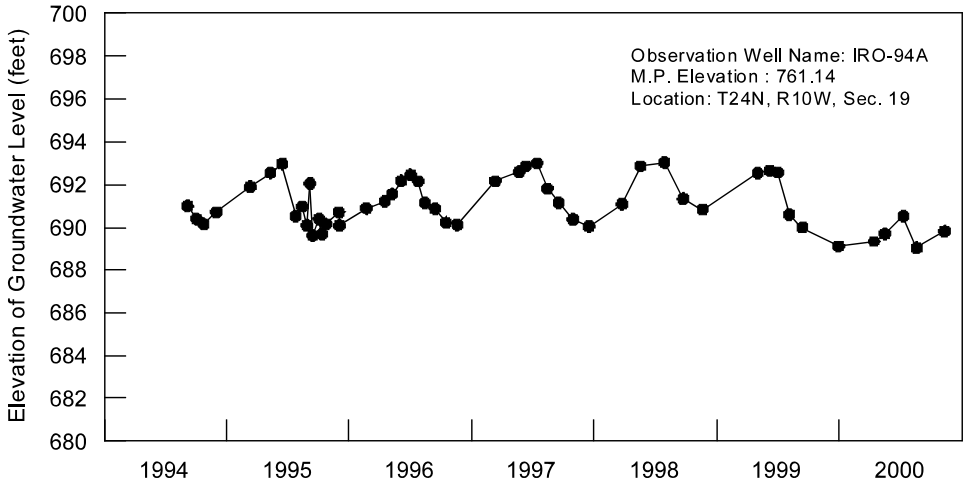
Observation Well: FRD-94B



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	102.96	694.70	11/19/1996	104.71	694.16
10/4/1994	103.06	694.60	3/12/1997	104.99	693.88
10/25/1994	102.85	694.81	5/22/1997	104.83	694.04
12/2/1994	102.81	694.85	6/11/1997	104.40	694.47
3/13/1995	103.05	694.61	7/14/1997	104.29	694.58
5/12/1995	102.56	695.10	8/14/1997	104.51	694.36
6/16/1995	103.07	694.59	9/16/1997	104.46	694.41
7/26/1995	102.67	694.99	10/30/1997	104.51	694.36
8/15/1995	102.86	694.80	12/16/1997	104.45	694.42
8/29/1995	103.05	694.61	3/25/1998	104.65	694.22
9/7/1995	102.96	694.70	5/19/1998	104.48	694.39
9/15/1995	103.21	694.45	7/29/1998	104.31	694.56
10/4/1995	103.06	694.60	9/23/1998	104.59	694.28
10/13/1995	102.88	694.78	11/20/1998	104.38	694.49
10/25/1995	102.85	694.81	5/3/1999	104.25	694.62
12/2/1995	102.81	694.85	6/8/1999	104.38	694.49
12/4/1995	103.19	694.47	7/2/1999	104.29	694.58
2/22/1996	102.89	694.77	8/5/1999	104.41	694.46
4/17/1996	103.07	694.59	9/13/1999	104.71	694.16
5/9/1996	104.39	694.48	12/30/1999	104.56	694.31
6/5/1996	104.41	694.46	4/14/2000	104.85	694.02
7/3/1996	104.30	694.57	5/16/2000	104.77	694.10
7/26/1996	104.62	694.25	7/10/2000	104.83	694.04
8/14/1996	104.51	694.36	8/19/2000	105.46	693.41
9/13/1996	104.53	694.34	11/10/2000	105.45	693.42
10/16/1996	104.69	694.18			

Appendix B. (continued)

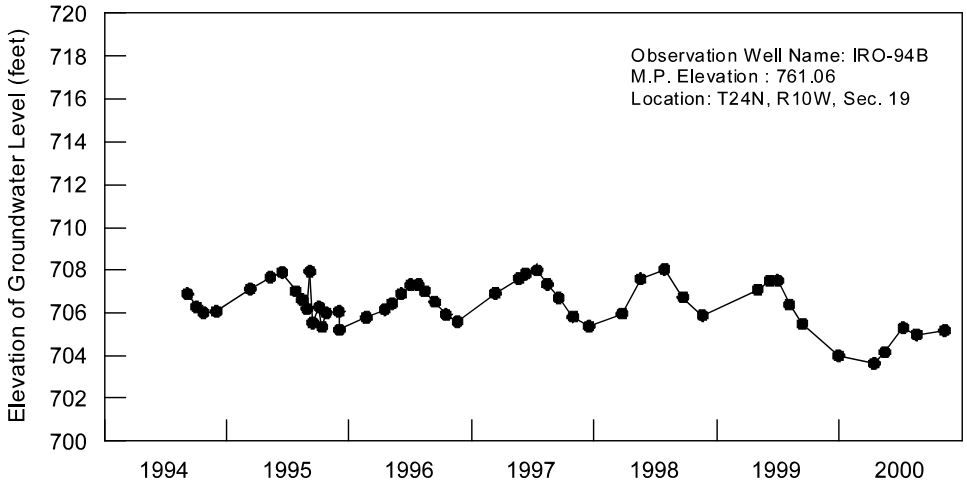
Observation Well: IRO-94A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	68.93	691.00	11/19/1996	71.01	690.13
10/4/1994	70.58	690.40	3/12/1997	68.98	692.16
10/25/1994	70.81	690.17	5/22/1997	68.55	692.59
12/2/1994	70.27	690.71	6/11/1997	68.29	692.85
3/13/1995	69.08	691.90	7/14/1997	68.15	692.99
5/12/1995	68.43	692.55	8/14/1997	69.33	691.81
6/16/1995	68.01	692.97	9/17/1997	69.99	691.15
7/26/1995	70.45	690.53	10/30/1997	70.76	690.38
8/15/1995	70.00	690.98	12/16/1997	71.08	690.06
8/29/1995	70.88	690.10	3/25/1998	70.04	691.10
9/7/1995	68.93	692.05	5/19/1998	68.29	692.85
9/15/1995	71.35	689.63	7/29/1998	68.11	693.03
10/4/1995	70.58	690.40	9/23/1998	69.80	691.34
10/13/1995	71.28	689.70	11/20/1998	70.30	690.84
10/25/1995	70.81	690.17	5/3/1999	68.61	692.53
12/2/1995	70.27	690.71	6/8/1999	68.49	692.65
12/4/1995	70.88	690.10	7/2/1999	68.58	692.56
2/22/1996	70.08	690.90	8/5/1999	70.54	690.60
4/17/1996	69.76	691.22	9/13/1999	71.13	690.01
5/9/1996	69.58	691.56	12/30/1999	72.07	689.07
6/5/1996	68.97	692.17	4/14/2000	71.82	689.32
7/3/1996	68.69	692.45	5/16/2000	71.43	689.71
7/26/1996	68.99	692.15	7/10/2000	70.61	690.53
8/14/1996	69.99	691.15	8/19/2000	72.15	688.99
9/13/1996	70.26	690.88	11/10/2000	71.32	689.82
10/16/1996	70.91	690.23			

Appendix B. (continued)

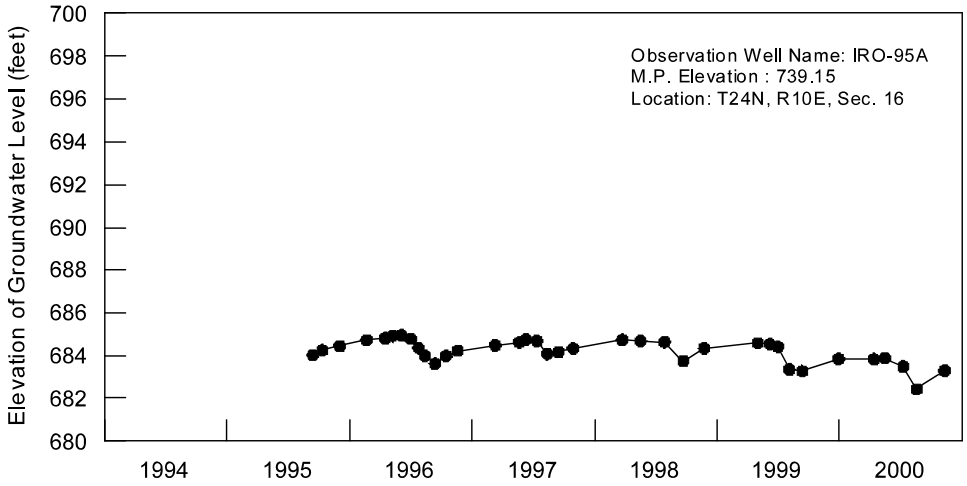
Observation Well: IRO-94B



Obs Date	*DTW (ft)*	*Elevation(ft)*	*Obs Date*	*DTW (ft)*	*Elevation(ft)*
9/7/1994	53.00	706.85	11/19/1996	55.51	705.55
10/4/1994	54.66	706.24	3/12/1997	54.18	706.88
10/25/1994	54.93	705.97	5/22/1997	53.50	707.56
12/2/1994	54.87	706.03	6/11/1997	53.28	707.78
3/13/1995	53.82	707.08	7/14/1997	53.11	707.95
5/12/1995	53.27	707.63	8/14/1997	53.76	707.3
6/16/1995	53.05	707.85	9/17/1997	54.40	706.66
7/26/1995	53.92	706.98	10/30/1997	55.27	705.79
8/15/1995	54.32	706.58	12/16/1997	55.72	705.34
8/29/1995	54.74	706.16	3/25/1998	55.13	705.93
9/7/1995	53.00	707.9	5/19/1998	53.52	707.54
9/15/1995	55.40	705.5	7/29/1998	53.07	707.99
10/4/1995	54.66	706.24	9/23/1998	54.37	706.69
10/13/1995	55.59	705.31	11/20/1998	55.21	705.85
10/25/1995	54.93	705.97	5/3/1999	54.02	707.04
12/2/1995	54.87	706.03	6/8/1999	53.60	707.46
12/4/1995	55.72	705.18	7/2/1999	53.59	707.47
2/22/1996	55.14	705.76	8/5/1999	54.71	706.35
4/17/1996	54.77	706.13	9/13/1999	55.61	705.45
5/9/1996	54.66	706.4	12/30/1999	57.09	703.97
6/5/1996	54.21	706.85	4/14/2000	57.45	703.61
7/3/1996	53.79	707.27	5/16/2000	56.92	704.14
7/26/1996	53.78	707.28	7/10/2000	55.79	705.27
8/14/1996	54.09	706.97	8/19/2000	56.11	704.95
9/13/1996	54.58	706.48	11/10/2000	55.91	705.15
10/16/1996	55.18	705.88			

Appendix B. (continued)

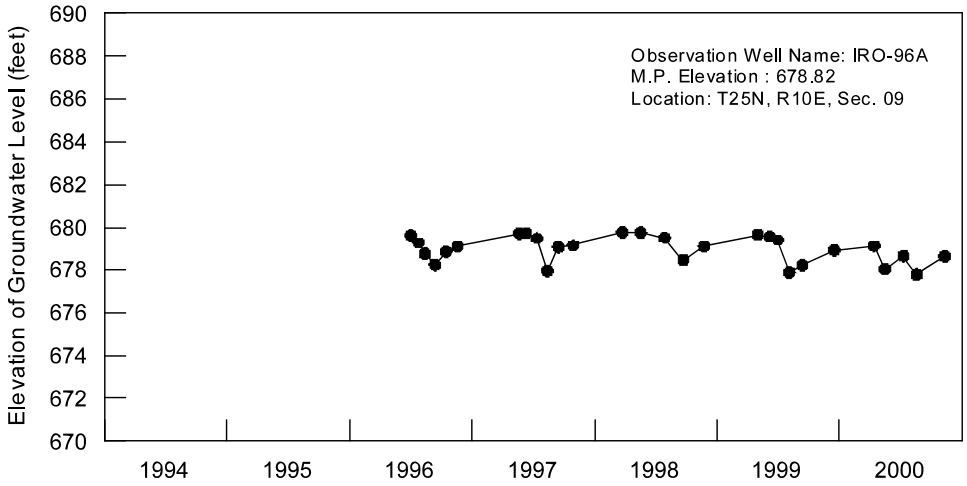
Observation Well: IRO-95A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/15/1995	54.99	684.00	9/16/1997	55.01	684.14
10/13/1995	54.77	684.22	10/30/1997	54.85	684.30
12/4/1995	54.57	684.42	3/25/1998	54.44	684.71
2/22/1996	54.29	684.70	5/19/1998	54.50	684.65
4/17/1996	54.21	684.78	7/29/1998	54.55	684.60
5/9/1996	54.26	684.89	9/23/1998	55.43	683.72
6/5/1996	54.23	684.92	11/24/1998	54.83	684.32
7/3/1996	54.40	684.75	5/3/1999	54.59	684.56
7/26/1996	54.82	684.33	6/8/1999	54.64	684.51
8/14/1996	55.19	683.96	7/2/1999	54.76	684.39
9/13/1996	55.55	683.60	8/5/1999	55.82	683.33
10/16/1996	55.19	683.96	9/13/1999	55.90	683.25
11/19/1996	54.95	684.20	12/30/1999	55.33	683.82
3/12/1997	54.70	684.45	4/14/2000	55.34	683.81
5/22/1997	54.56	684.59	5/16/2000	55.29	683.86
6/11/1997	54.42	684.73	7/10/2000	55.68	683.47
7/14/1997	54.49	684.66	8/19/2000	56.73	682.42
8/14/1997	55.09	684.06	11/10/2000	55.88	683.27

Appendix B. (continued)

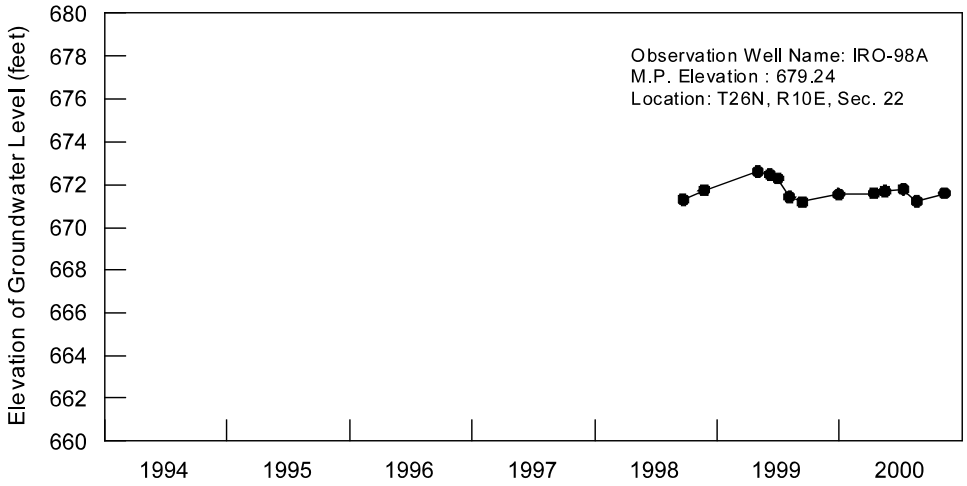
Observation Well: IRO-96A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
7/3/1996	-0.81	679.63	7/29/1998	-0.68	679.50
7/26/1996	-0.44	679.26	9/23/1998	0.40	678.42
8/14/1996	0.10	678.72	11/24/1998	-0.25	679.07
9/13/1996	0.62	678.20	5/3/1999	-0.85	679.67
10/16/1996	0.01	678.81	6/8/1999	-0.75	679.57
11/19/1996	-0.23	679.05	7/2/1999	-0.57	679.39
5/22/1997	-0.90	679.72	8/5/1999	0.98	677.84
6/11/1997	-0.91	679.73	9/13/1999	0.63	678.19
7/14/1997	-0.65	679.47	12/17/1999	-0.07	678.89
8/14/1997	0.91	677.91	4/14/2000	-0.28	679.10
9/16/1997	-0.21	679.03	5/16/2000	0.82	678.00
10/30/1997	-0.31	679.13	7/10/2000	0.20	678.62
3/25/1998	-0.95	679.77	8/19/2000	1.07	677.75
5/19/1998	-0.94	679.76	11/10/2000	0.22	678.60

Appendix B. (continued)

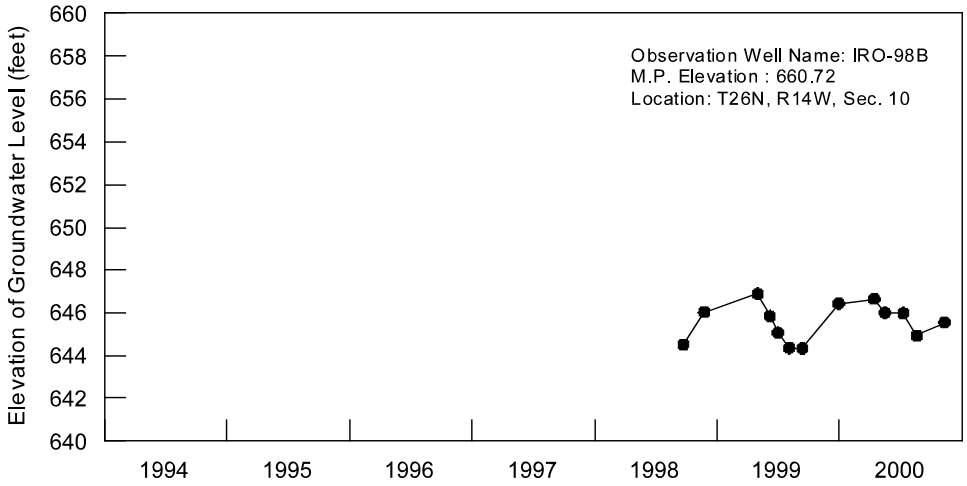
Observation Well: IRO-98A



Obs Date	*DTW (ft)*	*Elevation (ft)*
9/23/1998	7.94	671.30
11/24/1998	7.50	671.74
5/3/1999	6.63	672.61
6/8/1999	6.77	672.47
7/2/1999	6.95	672.29
8/5/1999	7.82	671.42
9/13/1999	8.05	671.19
12/30/1999	7.69	671.55
4/14/2000	7.64	671.60
5/16/2000	7.54	671.70
7/10/2000	7.45	671.79
8/19/2000	8.01	671.23
11/10/2000	7.64	671.60

Appendix B. (continued)

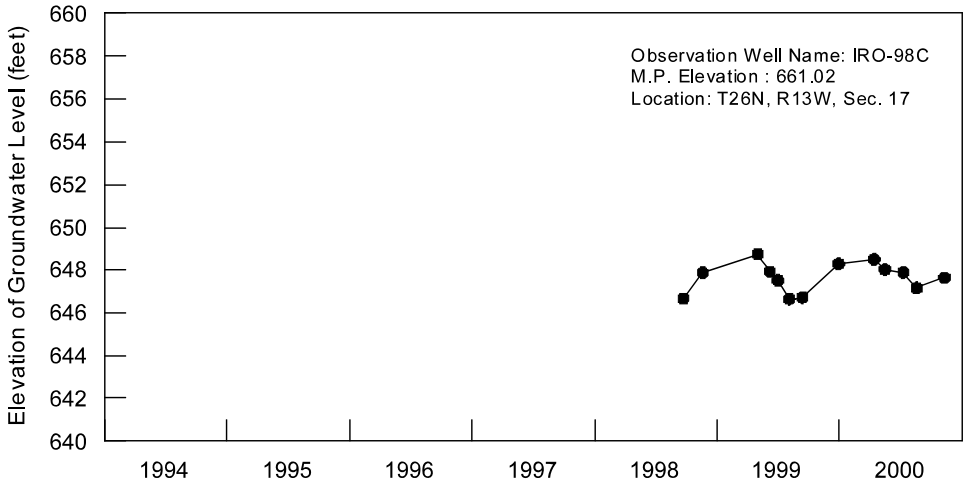
Observation Well: IRO-98B



Obs Date	*DTW (ft)*	*Elevation (ft)*
9/23/1998	16.24	644.48
11/24/1998	14.72	646.00
5/3/1999	13.87	646.85
6/8/1999	14.91	645.81
7/2/1999	15.67	645.05
8/5/1999	16.39	644.33
9/13/1999	16.41	644.31
12/30/1999	14.32	646.40
4/14/2000	14.10	646.62
5/16/2000	14.75	645.97
7/10/2000	14.77	645.95
8/19/2000	15.82	644.90
11/10/2000	15.20	645.52

Appendix B. (continued)

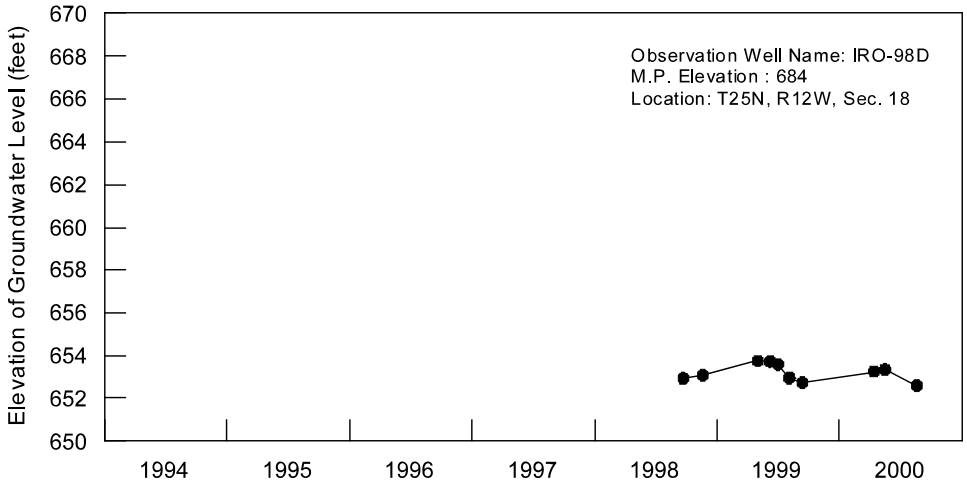
Observation Well: IRO-98C



Obs Date	*DTW (ft)*	*Elevation (ft)*
9/23/1998	14.39	646.63
11/20/1998	13.19	647.83
5/3/1999	12.32	648.70
6/8/1999	13.14	647.88
7/2/1999	13.54	647.48
8/5/1999	14.41	646.61
9/13/1999	14.34	646.68
12/30/1999	12.78	648.24
4/14/2000	12.57	648.45
5/16/2000	13.04	647.98
7/10/2000	13.17	647.85
8/19/2000	13.89	647.13
11/10/2000	13.42	647.60

Appendix B. (continued)

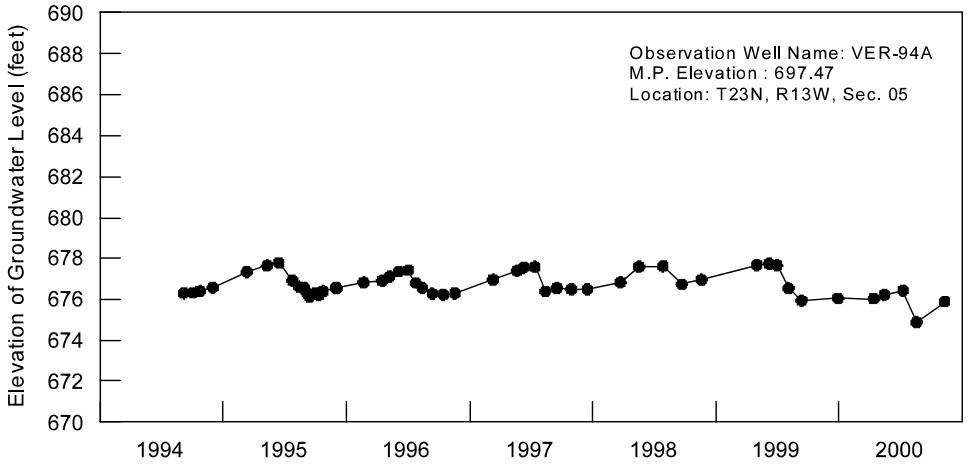
Observation Well: IRO-98D



Obs Date	*DTW (ft)*	*Elevation (ft)*
9/23/1998	31.08	653
11/20/1998	30.93	653
5/3/1999	30.27	654
6/8/1999	30.29	654
7/2/1999	30.43	654
8/5/1999	31.06	653
9/13/1999	31.28	653
4/14/2000	30.76	653
5/16/2000	30.67	653
8/19/2000	31.41	653

Appendix B. (continued)

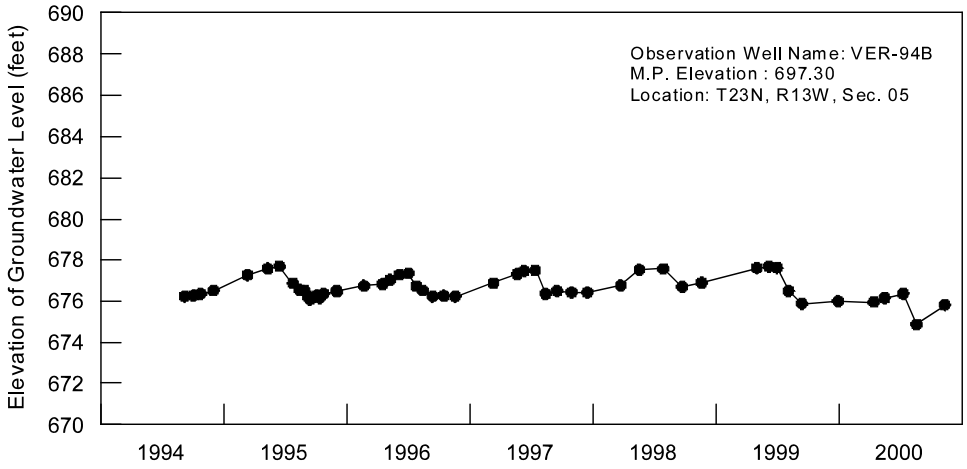
Observation Well: VER-94A



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	21.04	676.27	11/19/1996	21.21	676.26
10/4/1994	21.02	676.29	3/12/1997	20.55	676.92
10/25/1994	20.94	676.37	5/22/1997	20.12	677.35
12/2/1994	20.77	676.54	6/11/1997	19.96	677.51
3/13/1995	20.01	677.30	7/14/1997	19.93	677.54
5/12/1995	19.70	677.61	8/14/1997	21.11	676.36
6/16/1995	19.57	677.74	9/17/1997	20.95	676.52
7/26/1995	20.43	676.88	10/30/1997	21.02	676.45
8/15/1995	20.74	676.57	12/16/1997	21.02	676.45
8/29/1995	20.76	676.55	3/25/1998	20.68	676.79
9/7/1995	21.04	676.27	5/19/1998	19.92	677.55
9/15/1995	21.22	676.09	7/29/1998	19.89	677.58
10/4/1995	21.02	676.29	9/23/1998	20.77	676.70
10/13/1995	21.13	676.18	11/20/1998	20.55	676.92
10/25/1995	20.94	676.37	5/3/1999	19.83	677.64
12/2/1995	20.77	676.54	6/8/1999	19.77	677.70
12/4/1995	20.82	676.49	7/2/1999	19.85	677.62
2/22/1996	20.53	676.78	8/5/1999	20.97	676.50
4/17/1996	20.44	676.87	9/13/1999	21.56	675.91
5/9/1996	20.40	677.07	12/30/1999	21.46	676.01
6/5/1996	20.16	677.31	4/14/2000	21.47	676.00
7/3/1996	20.09	677.38	5/16/2000	21.28	676.19
7/26/1996	20.71	676.76	7/10/2000	21.07	676.40
8/14/1996	20.94	676.53	8/19/2000	22.61	674.86
9/13/1996	21.23	676.24	11/10/2000	21.61	675.86
10/16/1996	21.28	676.19			

Appendix B. (continued)

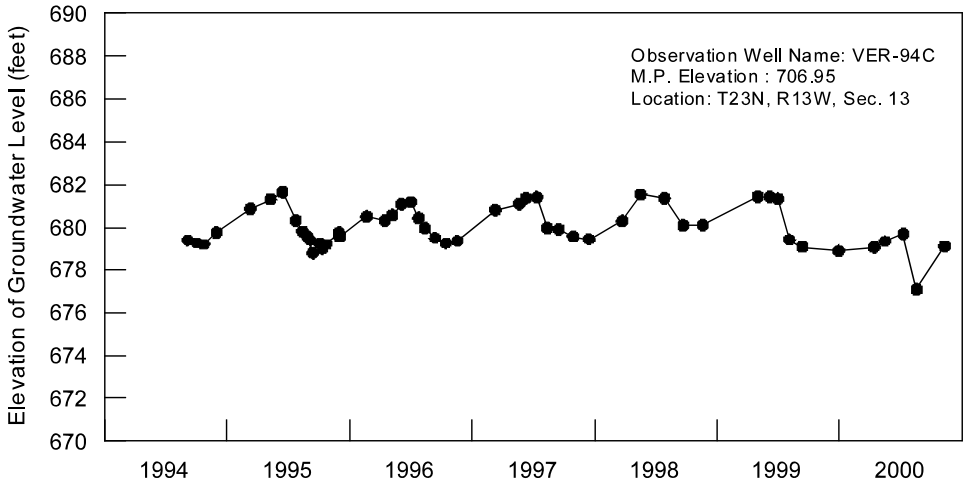
Observation Well: VER-94B



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	20.94	676.20	11/19/1996	21.10	676.20
10/4/1994	20.90	676.24	3/12/1997	20.46	676.84
10/25/1994	20.82	676.32	5/22/1997	20.02	677.28
12/2/1994	20.66	676.48	6/11/1997	19.87	677.43
3/13/1995	19.91	677.23	7/14/1997	19.84	677.46
5/12/1995	19.60	677.54	8/14/1997	20.98	676.32
6/16/1995	19.48	677.66	9/17/1997	20.84	676.46
7/26/1995	20.31	676.83	10/30/1997	20.91	676.39
8/15/1995	20.63	676.51	12/16/1997	20.91	676.39
8/29/1995	20.65	676.49	3/25/1998	20.58	676.72
9/7/1995	20.94	676.20	5/19/1998	19.82	677.48
9/15/1995	21.09	676.05	7/29/1998	19.77	677.53
10/4/1995	20.90	676.24	9/23/1998	20.64	676.66
10/13/1995	21.01	676.13	11/20/1998	20.44	676.86
10/25/1995	20.82	676.32	5/3/1999	19.73	677.57
12/2/1995	20.66	676.48	6/8/1999	19.66	677.64
12/4/1995	20.72	676.42	7/2/1999	19.72	677.58
2/22/1996	20.43	676.71	8/5/1999	20.84	676.46
4/17/1996	20.35	676.79	9/13/1999	21.45	675.85
5/9/1996	20.30	677.00	12/30/1999	21.34	675.96
6/5/1996	20.06	677.24	4/14/2000	21.37	675.93
7/3/1996	19.99	677.31	5/16/2000	21.18	676.12
7/26/1996	20.60	676.70	7/10/2000	20.97	676.33
8/14/1996	20.82	676.48	8/19/2000	22.46	674.84
9/13/1996	21.10	676.20	11/10/2000	21.51	675.79
10/16/1996	21.07	676.23			

Appendix B. (continued)

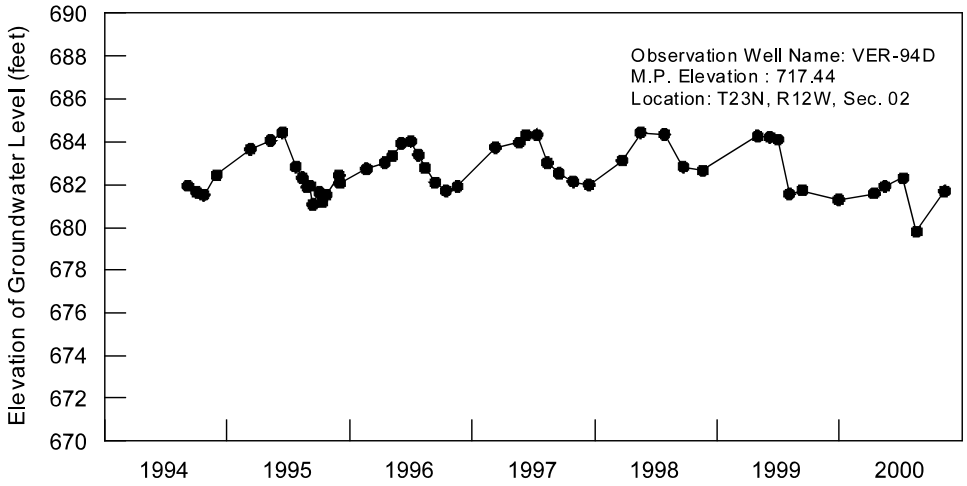
Observation Well: VER-94C



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	27.41	679.38	11/19/1996	27.61	679.34
10/4/1994	27.54	679.25	3/12/1997	26.14	680.81
10/25/1994	27.61	679.18	5/22/1997	25.85	681.10
12/2/1994	27.03	679.76	6/11/1997	25.58	681.37
3/13/1995	25.92	680.87	7/14/1997	25.54	681.41
5/12/1995	25.47	681.32	8/14/1997	26.98	679.97
6/16/1995	25.14	681.65	9/17/1997	27.04	679.91
7/26/1995	26.46	680.33	10/30/1997	27.38	679.57
8/15/1995	26.98	679.81	12/16/1997	27.52	679.43
8/29/1995	27.21	679.58	3/25/1998	26.65	680.30
9/7/1995	27.41	679.38	5/19/1998	25.41	681.54
9/15/1995	28.03	678.76	7/29/1998	25.59	681.36
10/4/1995	27.54	679.25	9/23/1998	26.85	680.10
10/13/1995	27.83	678.96	11/20/1998	26.84	680.11
10/25/1995	27.61	679.18	5/3/1999	25.51	681.44
12/2/1995	27.03	679.76	6/8/1999	25.52	681.43
12/4/1995	27.25	679.54	7/2/1999	25.61	681.34
2/22/1996	26.28	680.51	8/5/1999	27.54	679.41
4/17/1996	26.47	680.32	9/13/1999	27.91	679.04
5/9/1996	26.37	680.58	12/30/1999	28.10	678.85
6/5/1996	25.86	681.09	4/14/2000	27.92	679.03
7/3/1996	25.76	681.19	5/16/2000	27.62	679.33
7/26/1996	26.51	680.44	7/10/2000	27.25	679.70
8/14/1996	26.99	679.96	8/19/2000	29.89	677.06
9/13/1996	27.47	679.48	11/10/2000	27.88	679.07
10/16/1996	27.71	679.24			

Appendix B. (concluded)

Observation Well: VER-94D



Obs Date	*DTW (ft)*	*Elevation (ft)*	*Obs Date*	*DTW (ft)*	*Elevation (ft)*
9/7/1994	35.34	681.94	11/19/1996	35.53	681.91
10/4/1994	35.63	681.65	3/12/1997	33.71	683.73
10/25/1994	35.76	681.52	5/22/1997	33.48	683.96
12/2/1994	34.85	682.43	6/11/1997	33.14	684.30
3/13/1995	33.63	683.65	7/14/1997	33.13	684.31
5/12/1995	33.23	684.05	8/14/1997	34.43	683.01
6/16/1995	32.86	684.42	9/17/1997	34.92	682.52
7/26/1995	34.45	682.83	10/30/1997	35.30	682.14
8/15/1995	34.96	682.32	12/16/1997	35.45	681.99
8/29/1995	35.39	681.89	3/25/1998	34.32	683.12
9/7/1995	35.34	681.94	5/19/1998	33.02	684.42
9/15/1995	36.21	681.07	7/29/1998	33.11	684.33
10/4/1995	35.63	681.65	9/23/1998	34.61	682.83
10/13/1995	36.10	681.18	11/20/1998	34.79	682.65
10/25/1995	35.76	681.52	5/3/1999	33.19	684.25
12/2/1995	34.85	682.43	6/8/1999	33.23	684.21
12/4/1995	35.20	682.08	7/2/1999	33.34	684.10
2/22/1996	34.55	682.73	8/5/1999	35.88	681.56
4/17/1996	34.26	683.02	9/13/1999	35.70	681.74
5/9/1996	34.11	683.33	12/30/1999	36.14	681.30
6/5/1996	33.53	683.91	4/14/2000	35.85	681.59
7/3/1996	33.43	684.01	5/16/2000	35.52	681.92
7/26/1996	34.06	683.38	7/10/2000	35.14	682.30
8/14/1996	34.66	682.78	8/19/2000	37.63	679.81
9/13/1996	35.35	682.09	11/10/2000	35.75	681.69
10/16/1996	35.73	681.71			

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