CARTHAGE POTENTIAL WETLAND COMPENSATION SITE: LEVEL II HYDROGEOLOGIC CHARACTERIZATION REPORT

Hancock County, Illinois
SE 1/4, SW 1/4, Section 18, T5N, R5W
(Federal Aid Project 315)

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Submitted Under Contract No. IDOT SW WIP FY05 ANTIC to
Illinois Department of Transportation
Bureau of Design and Environment, Wetlands Unit
2300 South Dirksen Parkway
Springfield, IL 62764

August 10, 2004

Illinois State Geological Survey
Open File Series 2004-13

Executive Summary

The proposed wetland compensation site is located in Hancock Co., IL. The site, which contains about 17.6 ha (43.5 ac), is located along U.S. 136 in the valley of the La Moine River, about 8.0 km (4.9 mi) east of the town of Carthage, IL in the SE ¼, SW ¼, Section 18, T5N, R5W.

The results of our investigation reveal that about 5.5 ha (13.6 ac) of the site satisfy the criteria for jurisdictional wetland hydrology in at least three out of six years. However, estimates reveal that the area can annually fluctuate by more than 50%. For example, the area was estimated to be about 10.0 ha (24.8 ac) in 2002, but it was estimated to be only about 3.8 ha (9.3 ac) in 2003. This fluctuation is likely caused by variations in precipitation.

In addition to providing monitoring data, this report also provides a review of a construction plan for this site that was prepared for IDOT by a private consultant. The proposed wetland construction plan includes filling a drainage ditch and lowering the elevation of portions of the site by excavation, thereby creating/restoring about 15.9 ha (39.4 ac) of wetland. However, the results of our investigation indicate that the proposed construction plan may only result in the creation/restoration of only about 5.6 ha (13.8 ac) of wetland for a total of 11.1 ha (27.4 ac), because 5.5 ha (13.6 ac) of the acreage designated for restoration/creation may already be wetland.

The construction plan calls for filling only a portion of the drainage ditch. However, this would leave a focus for runoff that would likely result in the erosion of the fill and the re-opening of the ditch. Therefore, the ISGS recommends that the entire ditch be filled. The ISGS also recommends that the elevation of the access road for the farm field north of the site be increased, because the alterations proposed in the construction plan may result in the inundation of the road. Raising the road would also help to retain precipitation and runoff on the site, further increasing the area of jurisdictional wetland hydrology.

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Introduction

This report was prepared by the Illinois State Geological Survey (ISGS) to provide the Illinois Department of Transportation (IDOT) with final conclusions regarding the hydrogeologic conditions of a proposed wetland compensation site in Hancock Co., IL. The study site, which contains about 17.6 ha (43.5 ac), is located along U.S. 136 (Figure 1) in the valley of the La Moine River, about 8.0 km (5.0 mi) east of the town of Carthage, IL in the SE ¼, SW ¼, Section 18, T5N, R5W.

The purpose of this report is to provide IDOT with data regarding the hydrogeologic conditions of the study site and to make recommendations regarding restoration and/or creation of wetlands. Therefore, the report presents conclusions and design recommendations first, followed by a discussion of the methods and supporting data. The supporting data include ground- and surface-water level data and precipitation data collected from February 1998 to December 2003, and geologic data collected during the installation of monitoring wells. This report also provides a review of a construction plan for this site that was prepared for IDOT by a private consultant.

Data collection at the site is ongoing and will continue until terminated by IDOT. The data currently being collected will be used to compare the pre- and post-construction hydrology of the site, and to determine the impact of hydrologic alterations on the area and the duration of wetland hydrology.

Summary

- Surface- and/or ground-water levels on approximately 5.5 ha (13.6 ac), or 27% of the site (Figure 2), conclusively satisfied the criteria for jurisdictional wetland hydrology (Environmental Laboratories 1987) in at least three out of six years during the monitoring period. This area is generally encompassed by the approximately 6.8 ha (16.8 ac) of wetland (USFWS 1988) mapped on the site (Figure 1), and the approximately 8.6 ha (21.2 ac) of hydric soil (USDA 1991, 1995a, 2001) mapped on the site (Figure 3).

- The only hydrologic alterations appear to be three drainage ditches (Figure 2): #1 in the western portion of the site that captures runoff from the upland, #2 in the eastern portion of the site that discharges into the La Moine River, and #3 parallel to U.S. 136 that captures runoff from the road and discharges into the La Moine River (Figure 2). The site does not appear to have been excavated or filled, there is no levee along the river, and no drainage tile have been found on the site.

- The wetland construction plan calls for the creation/restoration of 15.9 ha (39.4 ac) of wetland. However, the results of our investigation reveals that 5.2 ha (12.8 ac) of the area designated for restoration/creation currently satisfies the criteria for jurisdictional wetland hydrology, leaving about 10.7 ha (26.4 ac) available for wetland restoration/creation. Therefore, we recommend a wetland delineation of the site in order to make a specific determination of the available acreage.

- Our review of the wetland construction plan prepared by Christopher Burke suggests that it will be successful, but that the area of wetland created will likely be limited to those portions of the site designated for excavation (Figure 4). It is likely that no more than 5.6 ha (13.8 ac) of wetland will be produced in excess of the area that currently satisfies wetland hydrology criteria. The portion of the site east of the access road (Figure 4) will likely also be affected by the alterations proposed in the construction plan and by the ISGS, but the impact is uncertain.

Wetland Restoration/Creation

The proposed wetland construction plan (Christopher B. Burke Engineering Ltd. [CBBEL] 2001a)

includes preserving 1.1 ha (2.8 ac) of sedge meadow, and creating/restoring 5.6 ha (13.9 ac) of wet meadow and emergent wetland, and 9.2 ha (22.7 ac) of forested wetland (Figure 4). In order to accomplish this, the plan includes filling a portion of drainage ditch #2 (Figure 4) to an elevation of 165.5 m (543.0 ft), and lowering about 5.6 ha (13.8 ac) of the site (Figure 4) by excavation to elevations ranging from 165.5 m to 165.8 m (544.0 ft).

The results of our investigation reveal that 5.5 ha (13.6 ac) of the site currently satisfies the criteria for jurisdictional wetland hydrology, and includes the areas slated for wetland restoration/creation, designated as NRCS wetland, naturalized sedge meadow, and wet meadow/emergent wetland on the wetland construction plan. Therefore, the area available for wetland restoration/creation may be limited to those areas of the site designated forested wetland on the construction plan, a total of 9.2 ha (22.7 ac).

The alterations proposed in the plan will likely have the most effect on the portion of the site west of the farm access road (Figure 4). The topographic map of the site (CBBEL 2001a) reveals that this portion of the site is a bowl-shaped depression. Surface water in this area flows into ditch #2 via a swale between well clusters 14 and 6. Figure 5 shows that, except for a few extreme storm peaks, surface-water elevations in this area generally range from 165.5 m to 165.8 m. Filling ditch #2 will likely increase current surface-water elevations and result in the inundation of the proposed areas of excavation. The proposed area of excavation is 5.6 ha (13.8 ac). Therefore, the area of wetland would likely increase to 11.1 ha (27.4 ac), that is, the 5.5 ha (13.6 ac) that already satisfies the criteria in most years plus the 5.6 ha (13.8 ac) to be excavated.

In the portion of the site east of the access road, the effect of filling the ditch is not clear. Filling the drainage ditch would likely not affect the hydrology north of the drainage ditch. The topographic map (CBBEL 2001a) reveals that land surface in this area generally slopes toward the La Moine River, which indicates that surface-water runoff would tend to flow into the river rather than into the drainage ditch. South of the ditch, the topographic map shows that land surface is generally at an elevation of 165.5 m (543.0 ft). Three monitoring wells in this area (13S, 17S, and 18S) conclusively satisfied the criteria for jurisdictional wetland hydrology in 2002, and the depth-to-water data (Appendix B) indicate that inundation also occurred. This suggests that filling the ditch to an elevation of 165.5 m (543.0 ft) would likely trap runoff in the area. However, there are insufficient water level data to determine if filling the ditch would have a significant impact on the hydrology.

In addition to the alterations proposed in the construction plan, we also recommend the following alterations:

- Fill all of ditch #2 (Figure 4) rather than only a portion of the ditch. On-site observations reveal that surface-water flows into the ditch from the western portion of the site via a swale between wells clusters 14 and 6 (Figure 2). Therefore, leaving the western portion of the ditch open would allow water to continue to flow down the ditch and possibly result in the erosion of the fill.

- Increase the elevation of the access road where it crosses the swale (Figure 2) to at least the elevation of the fill (165.5 m) in the drainage ditch. Filling the drainage ditch would likely result in more frequent, and longer inundation of the access road, which would limit access to the farm field north of the site. The topographic map of the site (CBBEL 2001a) shows that the lowest elevation of the access road is below 165.2 m (542.0 ft). Figure 5 shows that surface-water elevations at RDS2, which was closest to the swale (Figure 2), were likely high enough to flow over the access road on at least four occasions in 2002, and on at least two occasions in 2003. Raising the elevation of the access road would have the added benefit of creating another barrier to surface-water runoff, thereby further increasing surface-water elevation in the western portion of the site.

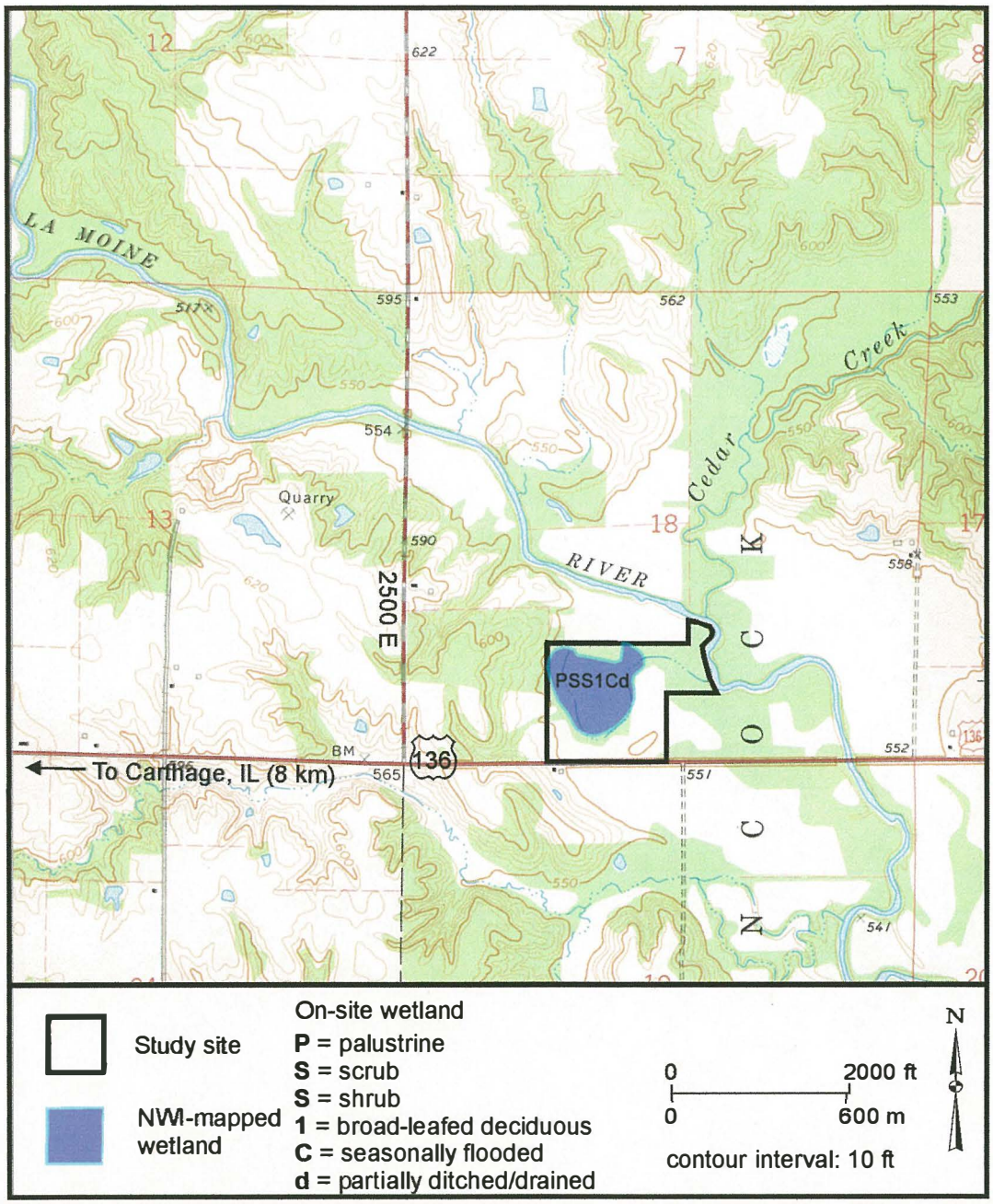

Figure 1: Site location and NWI-mapped wetlands (US Geological Survey 1974, USFish and Wildlife Service 1988)

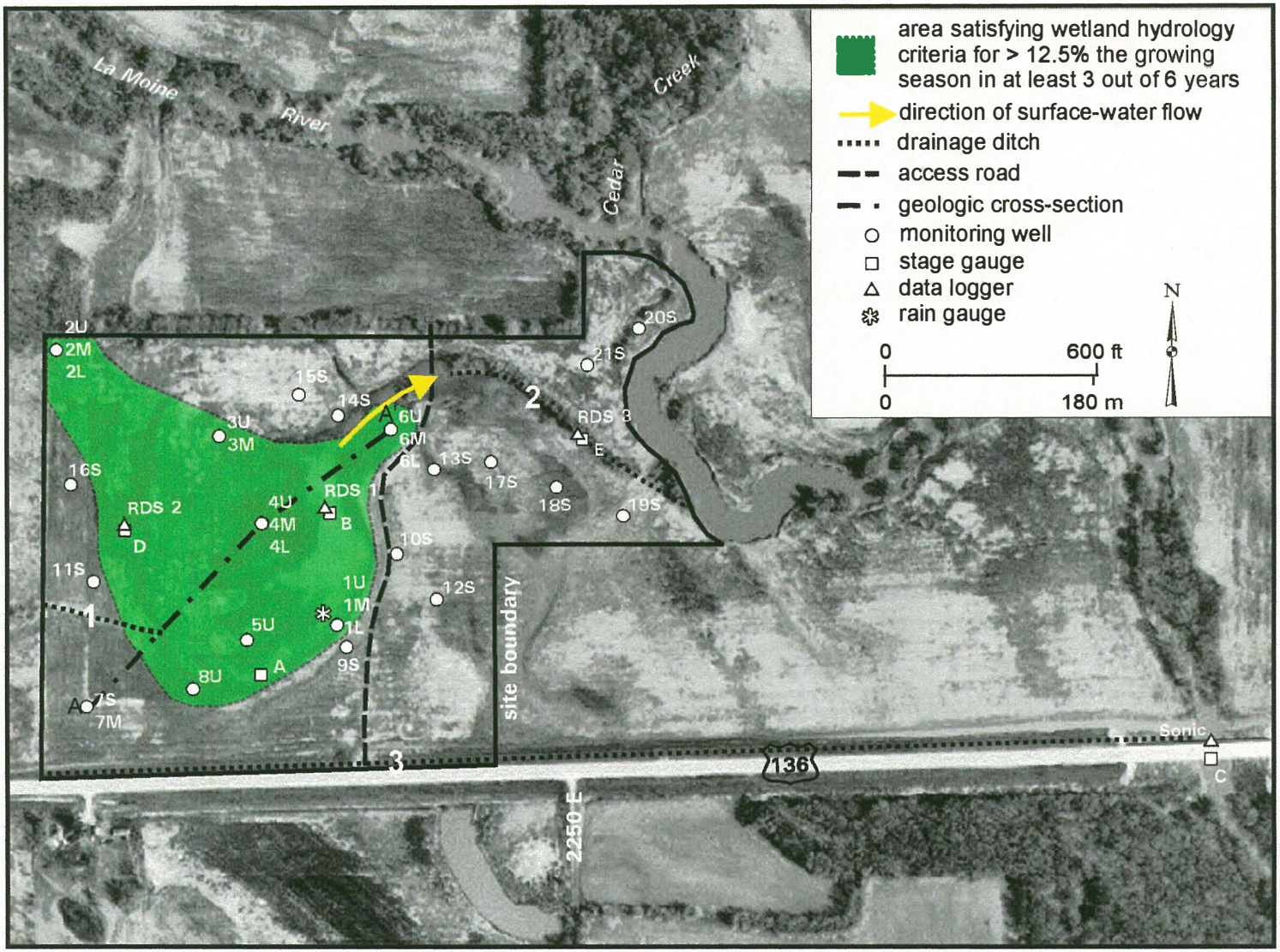

Figure 2: Monitoring network and average area of jurisdictional wetland hydrology (US Geological Survey 1998)

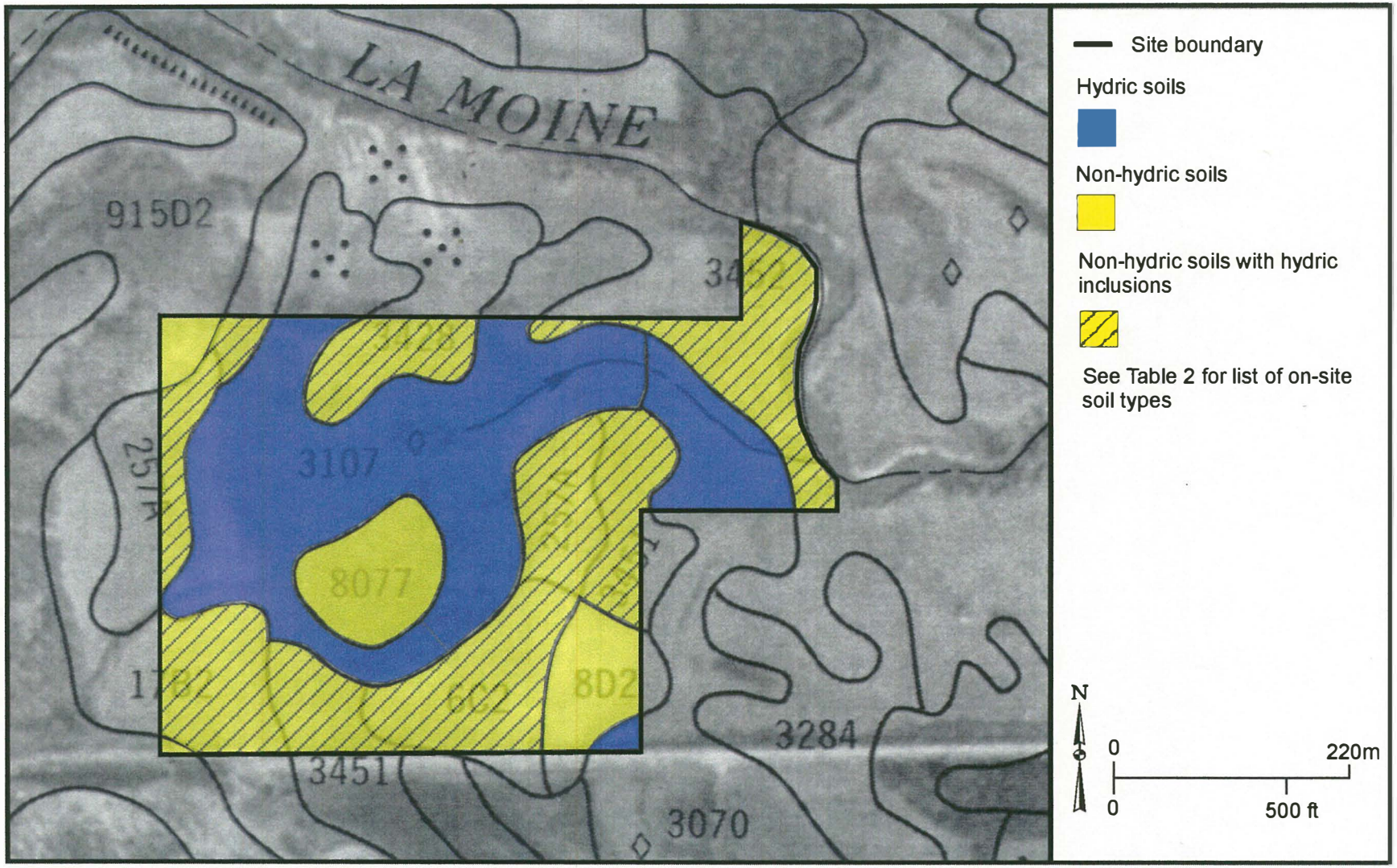

Figure 3: Soils (US Department of Agriculture 2001)

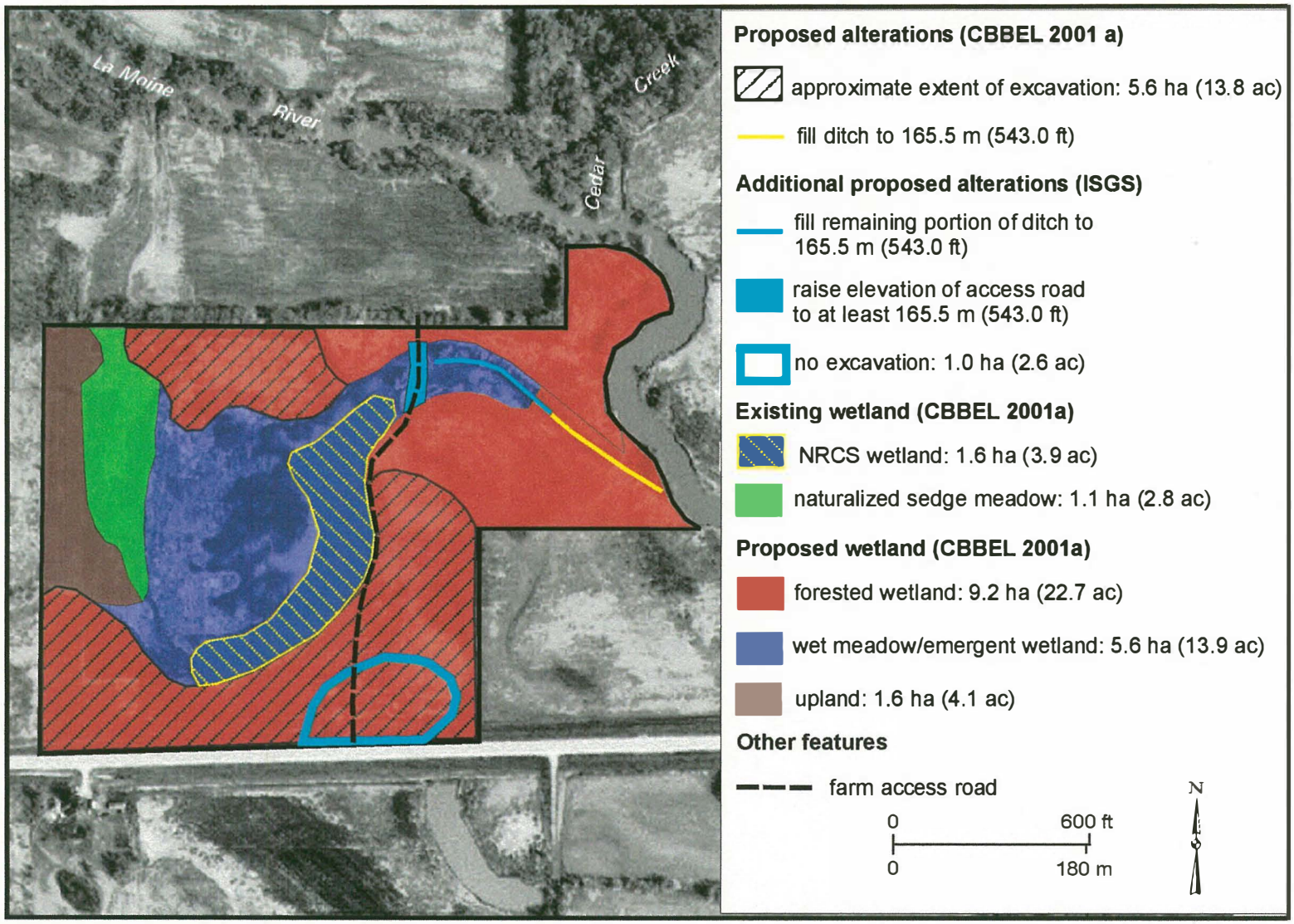

Figure 4: Proposed alterations and other site features

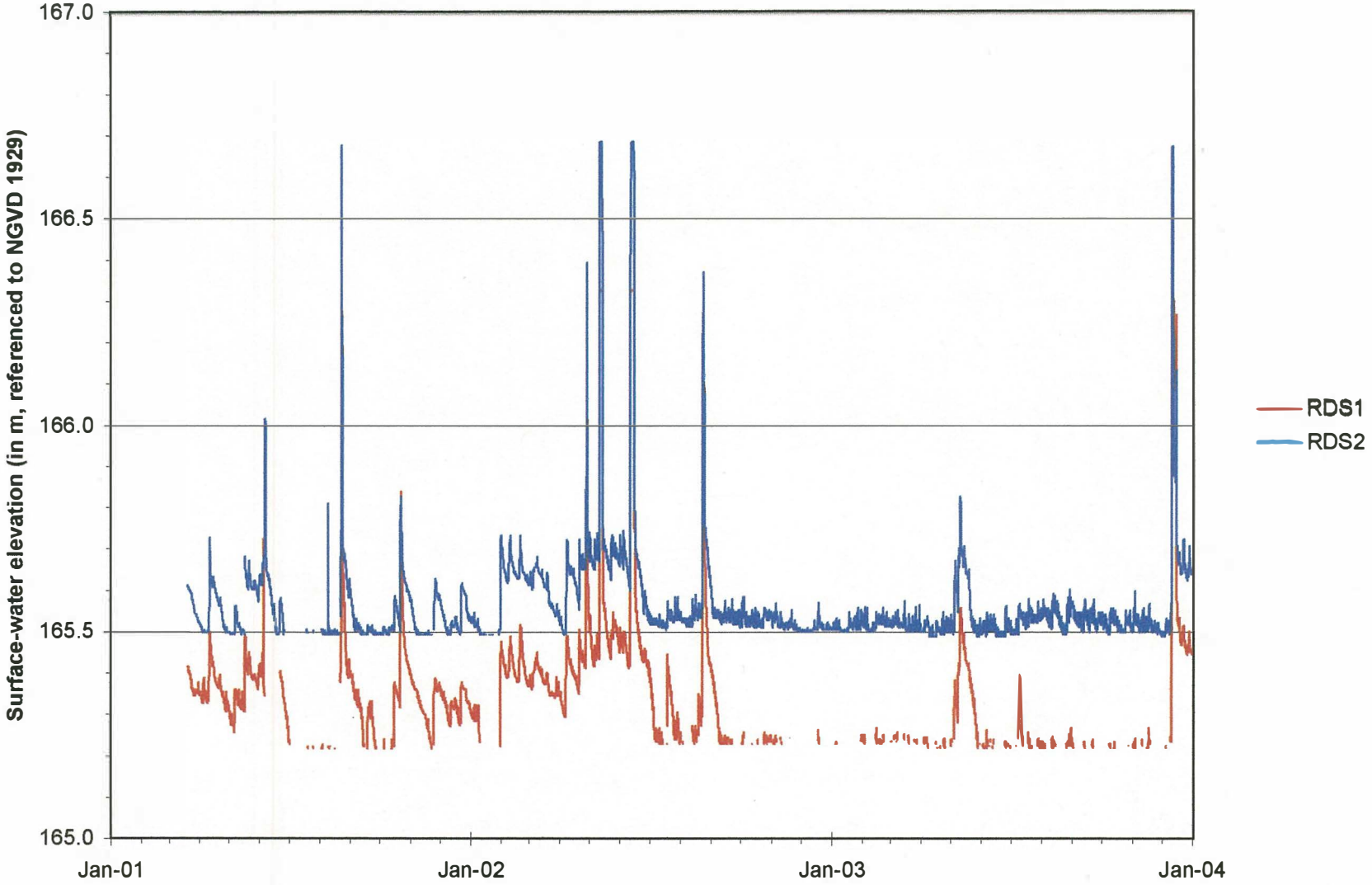

Figure 5: Surface-water elevations (March 2001 to January 2004)

- A portion of the area proposed for excavation (Figure 4) rises to an elevation of 168.6 m (553.0 ft). Lowering it to an elevation of 165.8 m (544.0 ft) would require removing up to 2.8 m (9.2 ft) of sediment. Therefore, we don't recommend excavation in this area.

- We recommend that a wetland delineation of the site be performed. The areas designated wet meadow/emergent wetland, NRCS wetland, and naturalized sedge meadow (Figure 4) already satisfy the criteria for jurisdictional wetland hydrology in most years. A wetland delineation would determine if these areas also satisfy the criteria for hydrophytic vegetation and hydric soil, and would determine how much acreage is available for wetland mitigation.

Methods

A total of 30 monitoring wells were installed at 20 locations on the site (Figure 2). Details of well construction can be found in Appendix A. The shallow (S) wells and most of the upper (U) wells are screened within 1.0 m (3.2 ft) of land surface. It is assumed that ground water this close to land-surface is unconfined due to the presence of secondary porosity, such as, fissures, fractures, and roots. Therefore, these wells show the position of the water-table and were used to determine saturation level in the soil zone. Pairs of middle (M) and lower (L) wells were used to determine if there were vertical hydraulic gradients, which would indicate the potential for ground-water discharge.

Depth-to-water in the monitoring wells was measured biweekly in the spring (April, May, June), and monthly throughout the rest of the year (Appendix B). Ground-water elevations (Appendix C) were calculated by subtracting the depth to water measured from the top of the well casing from the elevation of the top of the well casing.

In addition to the monitoring wells, four staff gauges (A, B, D, and E) and three data loggers (RDS1, RDS2, and RDS3) were installed on the site to monitor surface water. A staff gauge (C) and a data logger (Sonic) were also installed on the U.S. Rt. 136 bridge in order to monitor the level of the La Moine River (Figure 2). The staff gauges were read on the same schedule as the monitoring wells. The Sonic logger was installed in September 1999. Initially, it was programmed to record the surface-water elevation of the river in ½-hour intervals, but the interval was increased to 1 hour in January 2000. RDS1 was installed in March 2000, RDS2 in March 2001, and RDS3 in April 2002. All three data loggers were programmed to record water depth in 3-hour intervals. The water depth was then converted to surface-water elevation by subtracting the depth from the elevation of the logger.

Precipitation data recorded at Bentley, IL (Station# 110598), which is located about 7 miles southwest of the site, were obtained from the Midwestern Climate Center (MCC 2004) at the Illinois State Water Survey (ISWS). The data were used to show the effect of monthly, seasonal precipitation, and precipitation trends on surface- and ground-water levels and wetland hydrology. Data were also recorded by a tipping-bucket rain gauge equipped with a data logger installed at the site in Spring 1999. Precipitation was generally recorded from March to December. These data were used to check the accuracy of the data recorded at Bentley, IL.

Temperature data for Bentley, IL were obtained from the National Water and Climate Center (NWCC). These data were used to determine the length of the growing season for the site, and the number of days of inundation/saturation needed to satisfy the criteria for jurisdictional wetland hydrology (Environmental Laboratory 1987). The growing season is the period between the last occurrence of 28°F temperatures in the spring and the first occurrence in the fall. According to the data, the median length (5 out of 10 years) of the growing season for the site is 201 days, with the median starting date on April 3 and the median ending date on October 21 (NWCC 2004). In order to conclusively satisfy the criteria for jurisdictional wetland hydrology, inundation/saturation must last for at least 12.5% of the growing season, which for this site is about 25 days.

The elevations of the staff gauges, monitoring wells, and data loggers were measured from a benchmark that was established on site by the ISGS relative to the North American Vertical Datum of 1988. A Sokkia B-1 automatic level and a fiberglass extending rod were used to measure elevations on the site.

Site Characterization

Setting

The study site lies within the watershed of the La Moine River, a tributary of the Illinois River. The La Moine River is about 157.0 km (97.0 mi) long and drains an area of about 350,000 ha (865,000 ac) in McDonough, Schuyler, Adams, Brown, and Hancock counties (IEPA 1995).

The study site is near the confluence of La Moine River and Cedar Creek (figure 1), and is located in a shallow depression at the base of the west bluff of the river valley. Total relief on the site is about 3 m (CBBEL 2001b), ranging from 167.7 m (550.0 ft) along the western and southern boundaries to 164.9 m (541.0 ft) near the river. The entire site, except for a narrow fringe along the western boundary, is in the 100-year floodplain of the La Moine River (Federal Emergency Management Agency 1981).

Climate

Total precipitation during the monitoring period (January 1998 to December 2003) was 609.8 cm (240.1 in), which was 109% of average. Annual precipitation was above normal, that is, above the 30-year (1971–2000) average, in 1998, 2001, and 2002, near normal in 2003, and below normal in 1999 and 2000 (Table 1, Figure 7). Seasonal precipitation (Table 1) in 1998, 2001, and 2002, was, except for Fall 2002, near or above normal, while in 1999, 2000, and 2003, it was near or below normal, except for Summer and Fall 2003.

Figure 6 shows monthly precipitation during the monitoring period. The longest period of above normal precipitation was January to June 1998, and the longest period of below normal precipitation was September 2002 to January 2003. Other extended periods of above normal precipitation include September 1998 to January 1999, and April 2002 to August 2002, while other extended period of below normal precipitation include May to August 1999, and September to December 2000.

Year	1998	1999	2000	2001	2002	2003
	percent of normal					
Winter	208	87	100	146	94	65
Spring	169	91	109	127	163	94
Summer	98	77	81	123	99	128
Fall	133	50	60	112	57	113
Annual	145	77	89	126	110	104

Table 1: Annual and seasonal precipitation (Midwest Climate Center 2004)

Geology

The uppermost bedrock units in the area are mapped as undifferentiated Mississippian limestone, sandstone, and shale of the Lower and Middle Valmeyeran Series (Willman et al. 1975). The bedrock surface (Herzog et al. 1994) slopes toward the southwest into a bedrock valley underlying Bear Creek

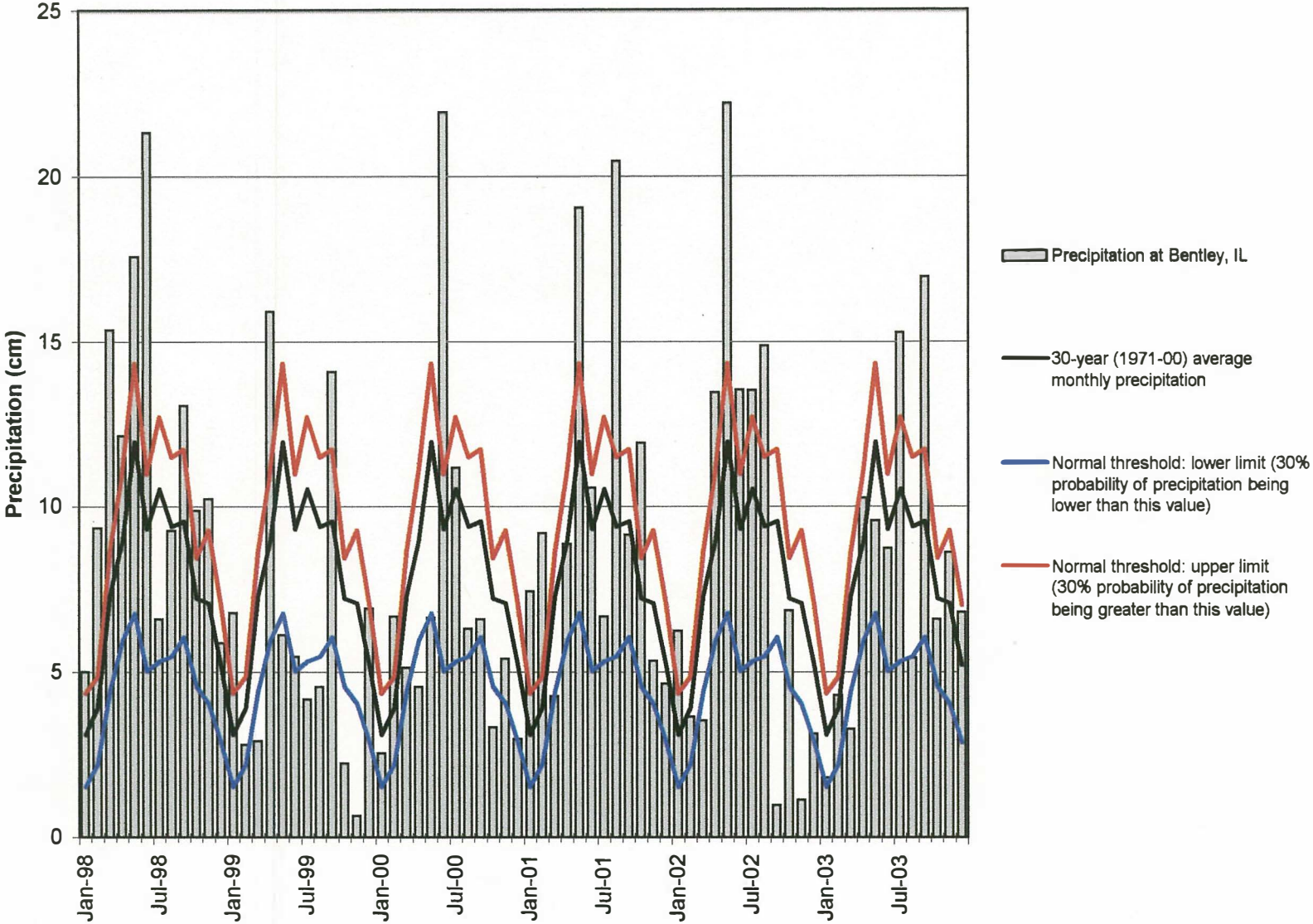

Figure 6: Monthly precipitation (Midwest Climate Center 2004)

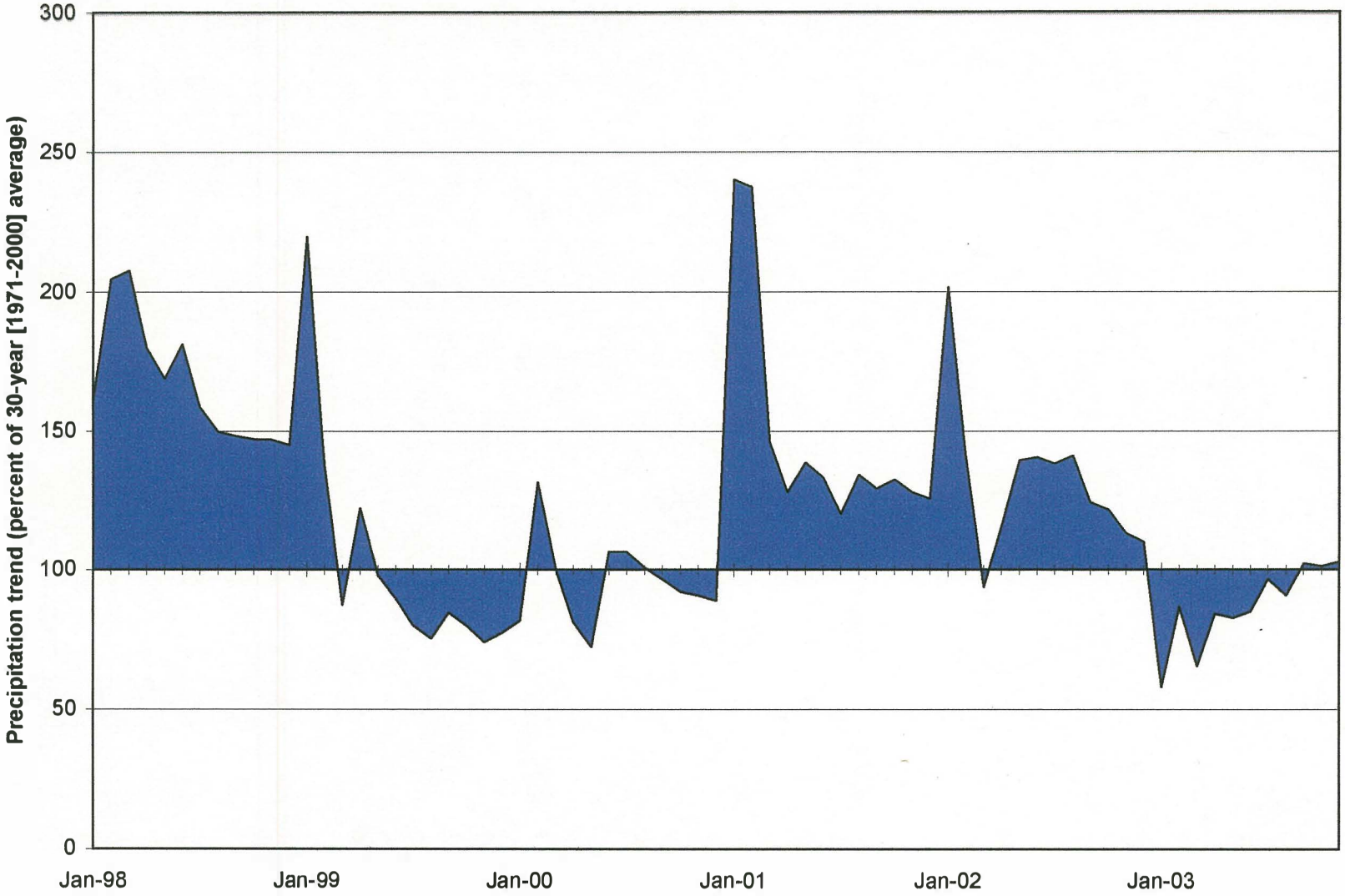

Figure 7: Precipitation trend (Midwest Climate Center 2004)

in western Hancock Co., IL. This bedrock valley trends toward the southwest and eventually merges with the bedrock valley underlying the Mississippi River.

The thickness of Quaternary sediments in the area ranges from < 7.6 m (25.0 ft) to about 30.5 m (100.0 ft) (Piskin and Bergstrom 1975). The sediments consist of the Kellerville Member of the Glasford Formation forming the river bluffs, and alluvium of the Cahokia Formation underlying the river valley (Lineback 1979, Willman and Frye 1970, Berg and Kempton 1988). The materials described in the borehole logs (Appendix D) generally support this mapping (Figure 8). In addition, the upper part of the sediments found along the slope of the bluff (boreholes 7S and 7M, [Figure 8], and borehole 2, [Appendix D]) are interpreted as colluvium derived from the Glasford Fm., while sand found in the lower portions of boreholes 4L, 6L (Figure 6), and borehole 1 (Appendix D) is interpreted as an undifferentiated fluvial deposit, possibly belonging to the Henry Fm. or a fluvial facies of the Cahokia Fm.

Soils

Eleven soil types are mapped on the site (Figure 3). Two of them, the Beaucoup and Sawmill, are on both the state (USDA 1991) and county (USDA 1995a) hydric soils lists. These soils cover about 8.5 ha (21.0 ac) or about 48% of the site. The other soil types are non-hydric, though the Clarksdale, Coffeen, Lawson, and Riley soils can have inclusions (USDA 1995b) of the hydric Virden, Beaucoup, Sawmill, and Ambraw soils, respectively. This suggests that, where these inclusions are present, the soil may support wetlands.

The hydraulic properties of the soils (Table 2) reveal that the Beaucoup and the Sawmill will likely support wetlands, while the Coffeen, Lawson, and Riley have the potential to support wetlands. All of these soils are subject to frequent flooding for brief durations from November to June or July, and during the growing season the highest apparent water table is within (Beaucoup and Sawmill), or close to (Coffeen, Lawson, Riley), the depth (≤0.30 m) for wetland hydrology. The remaining soils are generally not subject to flooding, and the apparent high water table is too deep to support wetlands.

Soil type	Hydric	Permeability (cm/hr)	Flood regime	Water table
Beaucoup silty clay loam (3070)	Yes	0.5-1.5	Frequent, brief, Nov-Jun	+0.1-0.3 m, apparent, Mar-Jun
Sawmill silty clay loam (3107)	Yes	1.5-5.1	Frequent, brief, Nov-Jun	0.0-0.6 m, apparent, Nov-Jul
Coffeen silt loam (3428)	No	1.5-15.2	Frequent, brief, Nov-Jul	0.3-0.9 m, apparent, Nov-Jul
Lawson silt loam (3451)	No	1.5-5.1	Frequent, brief, Nov-Jul	0.3-0.9, apparent, Nov-Jul
Riley loam (3452)	No	1.5-50.8	Frequent, brief, Nov-Jun	0.4-0.9 m, apparent, Nov-Jul
Fishhook silt loam (6C2)	No	0.5-1.5	None	0.4-0.9 m, perched, Dec-Jun
Keomah silt loam (17B2)	No	1.5-5.1	None	0.6-1.2 m, apparent, Mar-Jun
Clarksdale silt loam (257A)	No	0.5-5.1	None	0.3-0.9 m, apparent, Mar-Jun
Elco-Ursa Complex (915D2)	No	1.5-5.1	None	0.7-1.4 m, perched, Dec-Jul
Huntsville silt loam (8077)	No	1.5-5.1	None	>1.8 m

Table 2: Hydraulic properties of on-site soil types (USDA 2001)

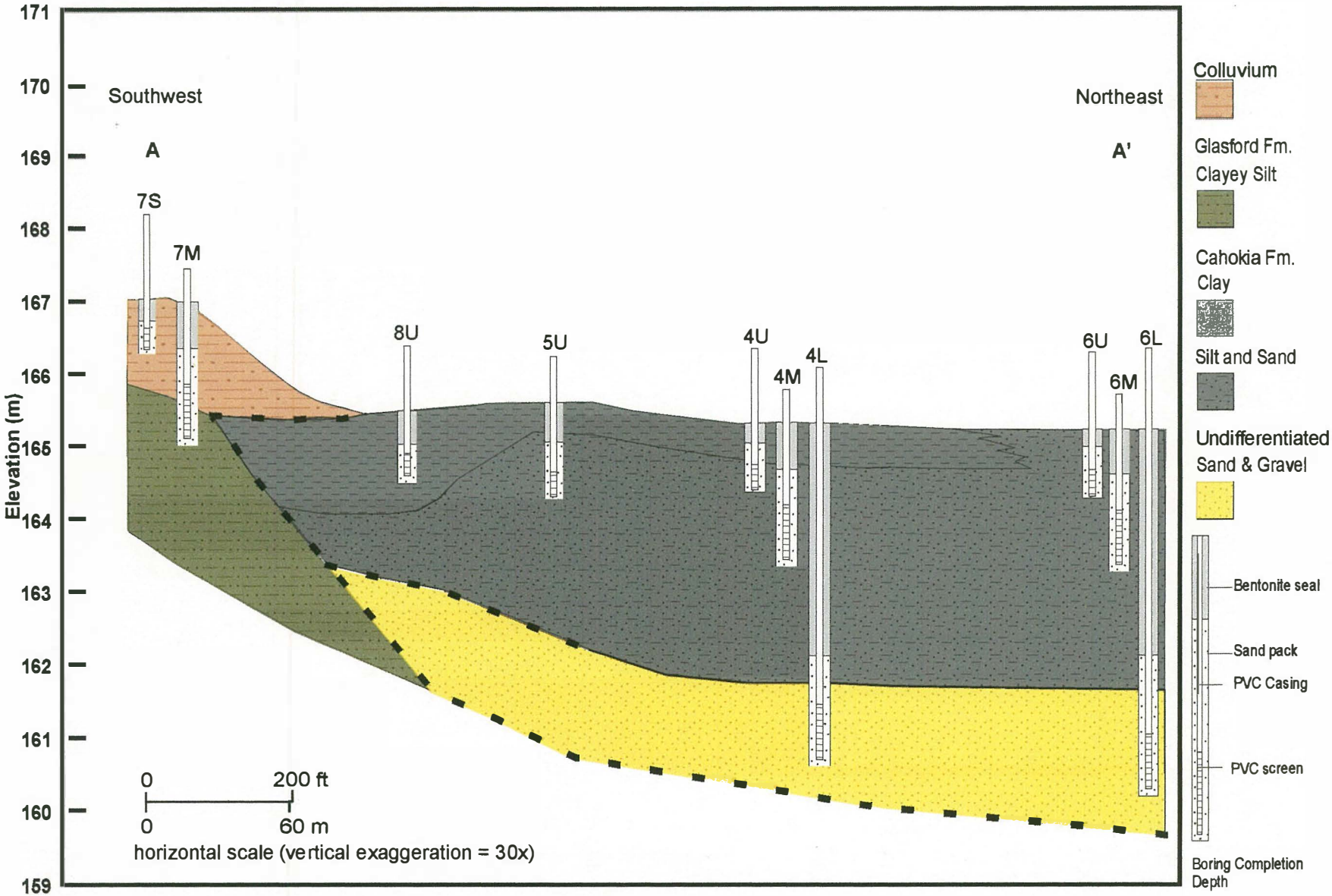

Figure 8: Geologic cross-section (line of cross-section shown on Figure 2)

Hydrology

Figure 9 shows ground-water elevations in three of the U wells, and Figure 10 shows ground-water elevations in six of the M and L wells. These wells are representative of ground-water elevations in the other monitoring wells, and were chosen because they have the most complete records. The figures show that there is an annual ground-water fluctuation in both the shallow ground water (Figure 9), and in the deeper ground water (Figure 10). The highest ground-water elevations occur in the spring, and the lowest in the fall and/or winter. Figure 10 also shows that there are generally no vertical hydraulic gradients, which indicate that upward ground-water flow is unlikely.

Figure 5 shows surface-water elevations recorded by RDS1 and RDS2. Except for brief peaks that correspond to precipitation events, surface-water elevations on the site generally ranged from 165.2 m (541.8 ft) to 165.5 m (542.8 ft) at RDS1 and 165.5 m to 165.8 m (543.8 ft) at RDS2. The figure also shows that the duration of inundation in 2001 and 2002 was longer than in 2003.

Figure 11 shows surface-water elevations recorded in the La Moine River (Sonic) and in drainage ditch #2 (RDS3), and the ground-surface elevations at RDS2 and RDS3. The figure shows that the river got high enough to flood the site on only a few occasions, and then for only brief periods. This indicates that the river is not a reliable source of water for wetlands.

Figure 12 and Figure 13 show shallow ground-water elevations, the direction of ground-water flow, and the approximate extent of inundation on April 29, 2002 and April 29, 2003, respectively. The pattern of ground-water flow shown on Figure 12 is typical of periods when shallow ground-water is at its highest elevation and the area inundation is at its greatest extent. These conditions generally occur in the spring (Appendix B). The pattern of ground-water flow shown on Figure 13 is typical of periods when shallow ground-water elevations are at their lowest, and when there is either no inundation, or the area of inundation is small. These conditions generally occur during periods of below normal precipitation, such as occurred in Spring 2003, and during the summer and fall (Appendix B).

Annual estimates of the area of jurisdictional wetland hydrology (Table 3) reveal that the area fluctuates by as much as 50%. This fluctuation is caused by variations in seasonal and annual precipitation (Table 1), and whether the trend was for above or below average precipitation (Figure 7). In 2001 and 2002, when the area was > 9.0 ha (22.2 ac), precipitation was, except for Fall 2002, near or above average, and the trend was for above average precipitation. In 2000 and 2003, when the area was <4.0 ha (9.9 ac), precipitation was, except for Summer and Fall 2003, near or below average, and the trend was for below average precipitation.

Year	1999	2000	2001	2002	2003
Hectares	12.0	3.4	9.3	10.0	3.8
Acres	29.6	8.5	23.0	24.8	9.3

Table 3: Annual estimated area of jurisdictional wetland hydrology (Fucciolo et al. 1999, 2000, 2001, 2002, 2003)

The largest estimated area of jurisdictional wetland hydrology was 12.0 ha (Table 3). However, table 1 shows that 1999 was the driest year during the monitoring period. This suggests that the size of the area was overestimated, likely due to a monitoring network that was less dense than in subsequent years (Appendix B). Therefore, it is likely that the area of jurisdictional wetland hydrology in 1999 was comparable to, or smaller than, the area in 2000 and 2003.

The fluctuation in the area of jurisdictional wetland hydrology at this site makes it difficult to determine what the area would be in a normal year. In addition to seasonal and annual precipitation, the hydrology

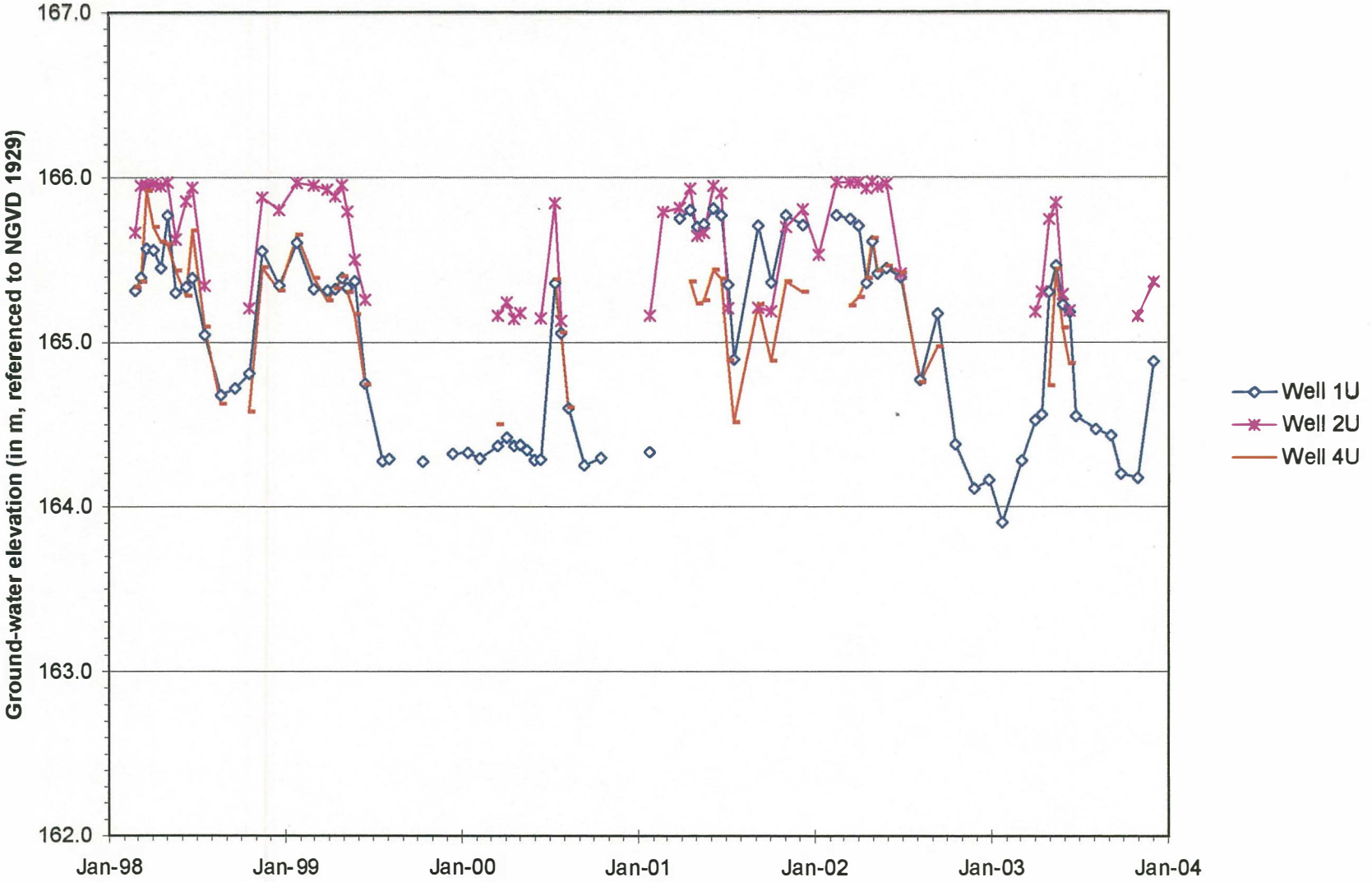

Figure 9: Ground-water elevations in selected U wells

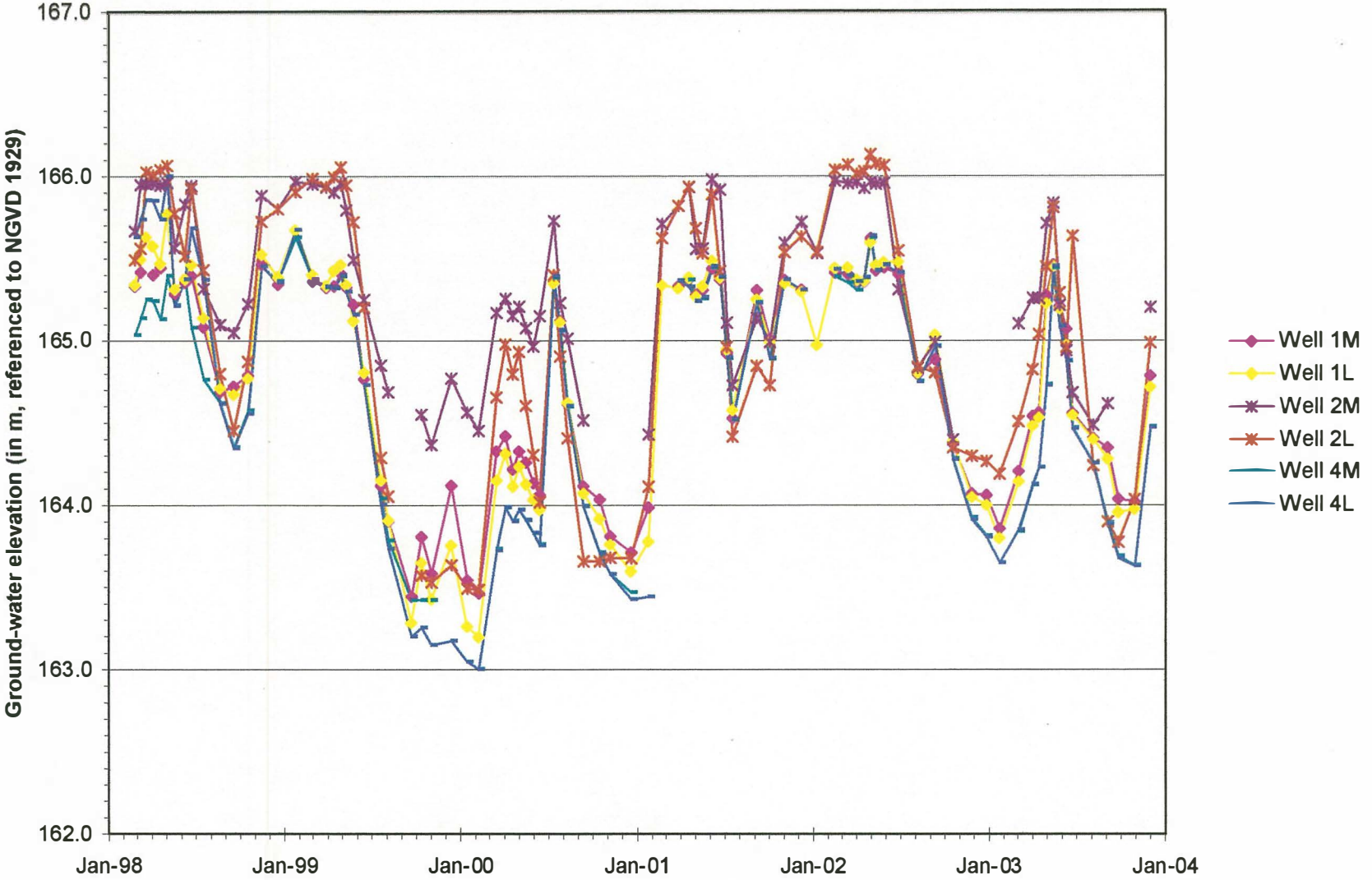

Figure 10: Ground-water elevations in selected M and L wells

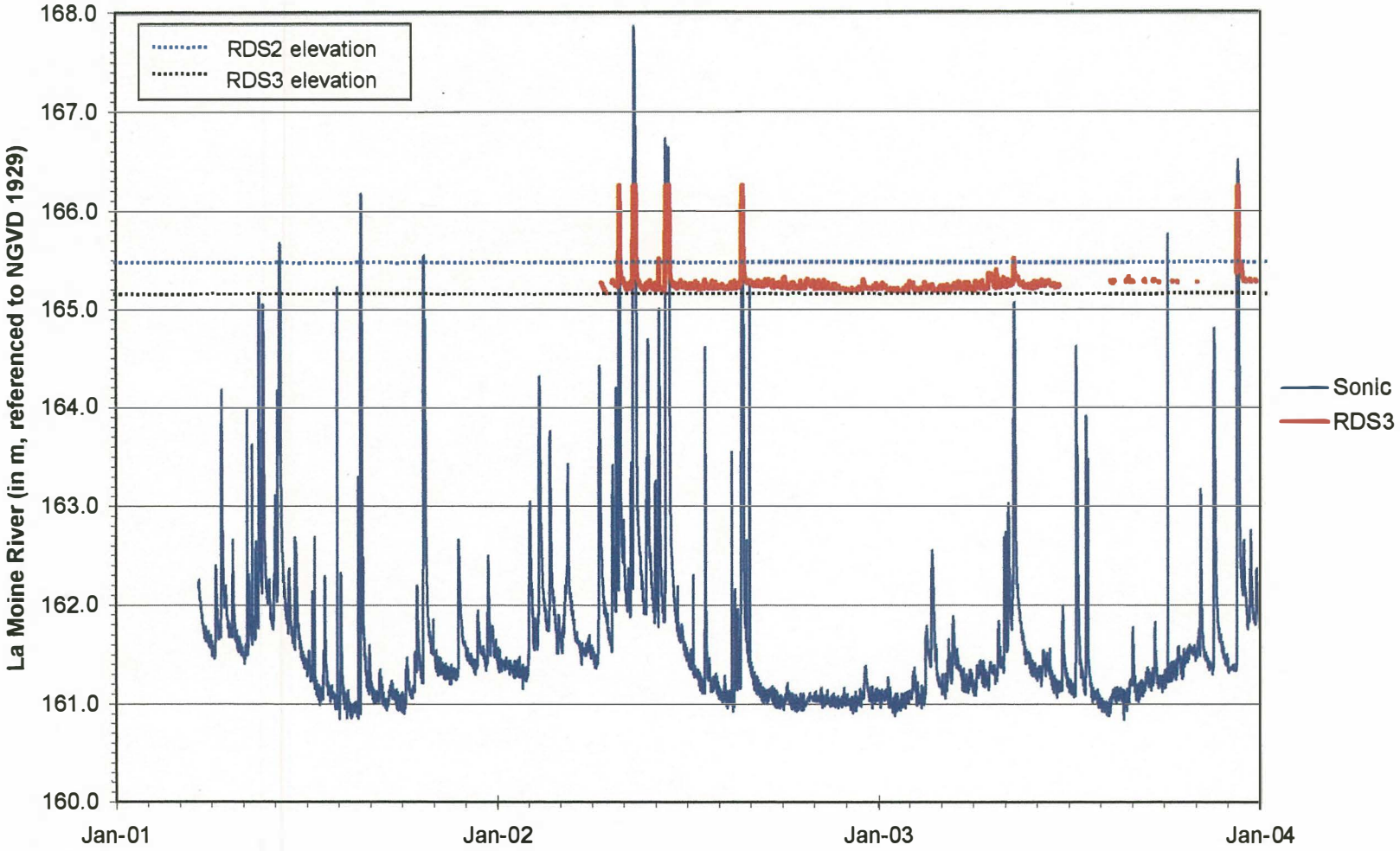

Figure 11: La Moine River hydrograph (in m, referenced to NGVD 1929)

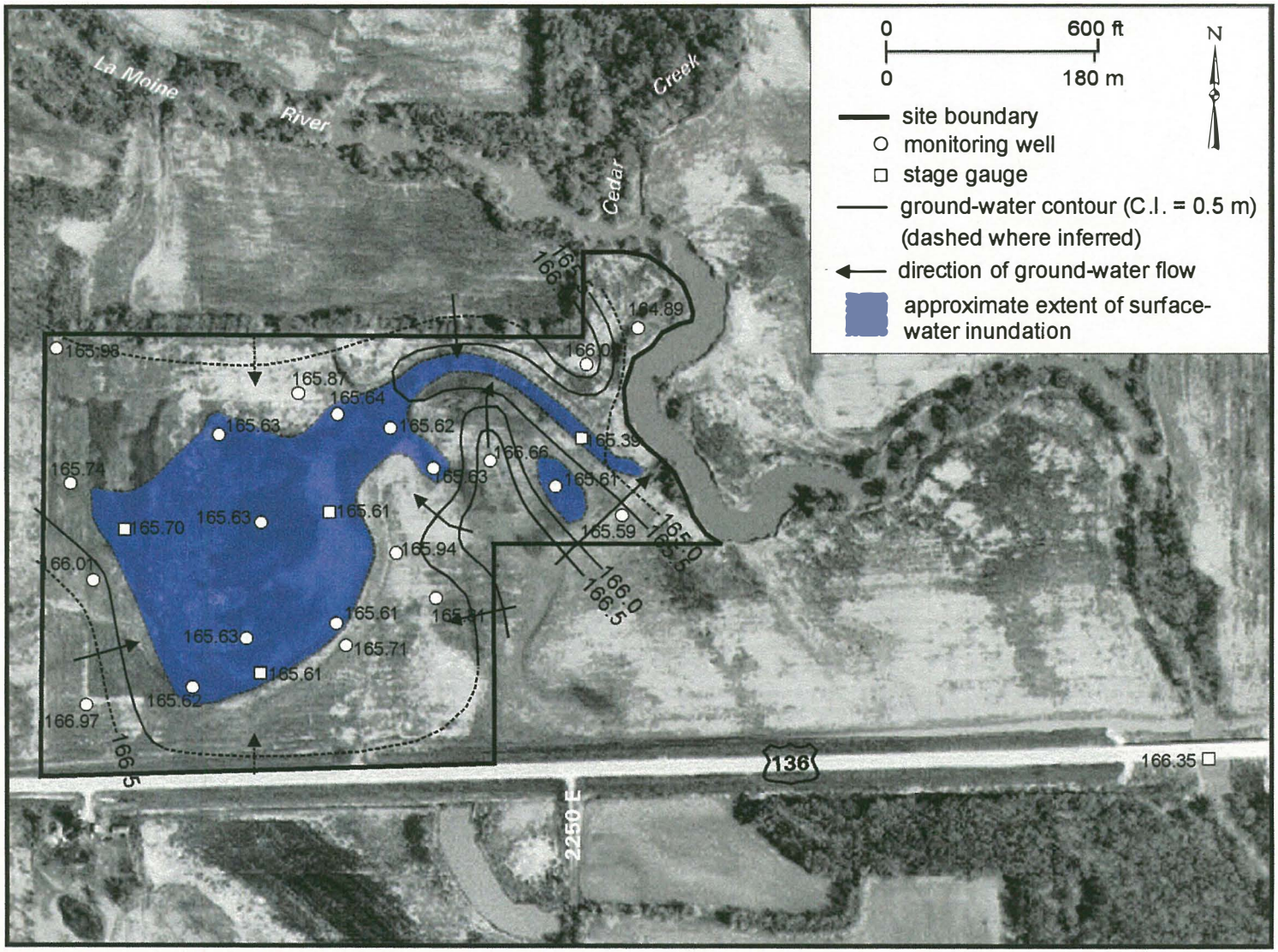

Figure 12: Ground-water flow during wet periods and in the spring

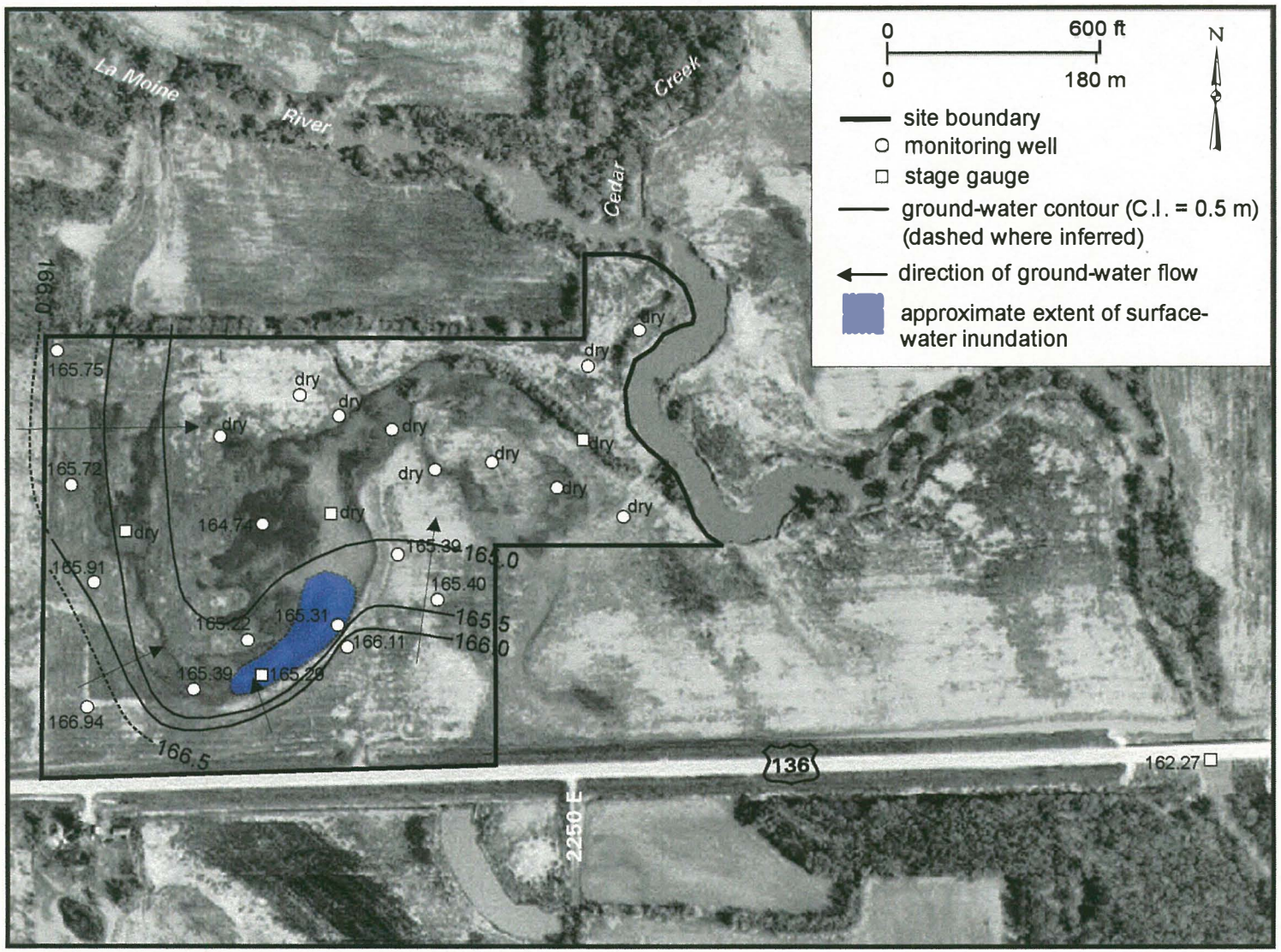

Figure 13: Ground-water flow during dry periods and in the summer and fall

of the site is likely also affected by longer term precipitation trends (Wendland 2001), and variations in evaporation and evapotranspiration. Therefore, instead of determining the area of jurisdictional wetland hydrology in an average year, depth-to-ground-water data were analyzed in order to determine which monitoring wells satisfied the jurisdictional criteria for at least half of the monitoring period (Table 4).

Well#	Number of years		
	> 12.5%	5% - 12.5%	< 5%
1U	5	1	0
2U	4	1	1
3U	4	0	2
4U	4	2	0
5U	4	1	1
6U	4	0	2
7S	1	1	3
8U	3	2	1
9S	0	0	5
10S	2	0	3
11S	1	3	1

Table 4: Number of years water levels measured in the wells conclusively (> 12.5%), may have (5%-12.5%), and did not (< 5%) satisfy the criteria for jurisdictional wetland hydrology

Table 4 shows the number of years that water levels in each monitoring well conclusively satisfied (> 12.5%), may have satisfied (5% - 12.5%), and did not satisfy (< 5%) the criteria for jurisdictional wetland hydrology during the growing season. The eleven wells shown have at least five years worth of data. Eight of them (1U, 2U, 3U, 4U, 5U, 6U, 8U) conclusively satisfied the criteria for at least half the period of record, one (11S) may have satisfied the criteria, and three (7S, 9S, and 10S) did not satisfy the criteria for at least half the period of record. Plotting the results (Figure 2) reveals that about 5.5 ha (13.6 ac) of the site has jurisdictional wetland hydrology for at least half of the monitoring period.

In addition to the wells shown above, five monitoring wells (12S, 13S, 14S, 15S, and 16S) had three years worth of data. One well (12S) conclusively satisfied the criteria in 2 out of 3 year, one (16S) may have satisfied the criteria in 2 out of 3 years, and the remainder did not either conclusively, or possibly, satisfy the criteria in more than 1 year out of 3. The remaining monitoring wells (17S, 18S, 19S, 20S, and 21S) had two years worth of data. Two (17S and 18S) conclusively satisfied the criteria in one year, and the rest never satisfied the criteria. These wells were not used to determine the area of the site that satisfied the criteria for more than half the monitoring period because their periods of record are too short to discern a trend.

Conclusions

The results of the investigation reveals the following:

- Analysis of depth-to-water data reveals that about 5.5 ha (13.6 ac) of the site conclusively

satisfies the criteria for jurisdictional wetland hydrology for at least half the monitoring period. This area (Figure 2) generally is encompassed by the area mapped as wetland (Figure 1), and the area of state and county listed hydric soil (Figure 3).

- The area that satisfies the criteria includes areas designated on the wetland construction plan as naturalized sedge meadow, wet meadow/emergent wetland, and NRCS wetland (Figure 4). Therefore, these areas are likely already wetland, and may not be available for wetland mitigation credit. The areas designated forested wetland on the construction plan do not satisfy the criteria. Therefore, it is likely that these areas are not wetland.

- West of the access road, the alterations proposed in the construction plan would likely increase the current area of jurisdictional wetland hydrology by 5.5 ha (13.6 ac), resulting in the creation of wetland in the areas designated forested wetland. East of the access road, the proposed alterations would likely affect the hydrology south of the drainage ditch, though it cannot be stated what affect this will have on wetland hydrology. North of the drainage ditch, the alterations would likely have little effect on hydrology.

- The ISGS suggests that additional alterations, including filling the entire drainage ditch and raising the elevation of the farm access road, are needed in order to prevent the erosion of the fill in the drainage ditch and to insure access to the farm field north of the site.

- ISGS also recommends that a wetland delineation be performed in order to determine the total area available for wetland mitigation credit.

Acknowledgments

Many people have contributed to the success of this study, including former project managers Nancy Rorick and Blaine Watson, and the field staff of the Wetlands Geology Section. Funding for this study was provided by the Illinois Department of Transportation (IDOT) under contract# IDOT SW WIP FY04. Publication is authorized by the Chief, Illinois State Geological Survey.

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Appendix A: Well construction details

Well#	1U	1M	1L	2U	2M	2L
Depth to bottom (cm)	113.0	206.0	630.0	96.0	168.0	460.0
Diameter (cm)						
Screened interval (cm)	73.0-110.0	121.0-196.0	545.8-620.8	58.5-92.5	82.0-158.0	375.0-450.0
Sand pack (cm)	15.0-113.0	61.0-206.0	61.0-630.0	37.0-96.0	37.0-168.0	317.0-460.0
Well seal (cm)	0.0-15.0	0.0-61.0	0.0-61.0	0.0-37.0	0.0-37.0	0.0-317.0
Well length (cm)	159.0	238.0	709.0	199.0	243.0	547.0
Screen length (cm)	37.0	75.0	75.0	34.0	76.0	75.0
Top of casing elevation (m)	165.77	165.63	166.10	166.95	166.67	166.79
Ground elevation (m)	165.31	165.31	165.31	165.92	165.92	165.92

Well#	3U	3M	4U	4M	4L	5U
Depth to bottom (cm)	90.0	191.0	95.0	198.0	471.0	133.0
Diameter (cm)						
Screened interval (cm)	51.0-87.0	105.5-180.5	56.6-91.6	113.0-188.0	386.0-462.0	95.8-129.8
Sand pack (cm)	27.0-90.0	61.0-191.0	27.0-95.0	64.0-198.0	320.0-471.0	55.0-133.0
Well seal (cm)	0.0-27.0	0.0-61.0	0.0-27.0	0.0-64.0	0.0-320.0	0.0-55.0
Well length (cm)	194.0	242.0	200.0	249.0	547.0	195.0
Screen length (cm)	36.0	75.0	35.0	75.0	76.0	34.0
Top of casing elevation (m)	166.57	165.86	166.40	165.86	166.11	166.21
Ground elevation (m)	165.53	165.35	165.35	165.35	165.35	165.59

Well#	6U	6M	6L	7S	7M	8U
Depth to bottom (cm)	95.0	196.0	504.0	72.8	220.0	102.0
Diameter (cm)				2.5		
Screened interval (cm)	55.0-92.0	111.0-186.0	418.5-493.5	40.0-69.4	135.5-211.5	60.0-99.0
Sand pack (cm)	24.0-95.0	61.0-196.0	310.9-504.0	30.0-72.8	91.0-220.0	46.0-102.0
Well seal (cm)	0.0-24.0	0.0-61.0	0.0-310.9	15.0-30.0	0.0-91.0	0.0-46.0
Well length (cm)	196.0	244.0	619.0	186.8	297.0	191.0
Screen length (cm)	37.0	75.0	75.0	29.4	76.0	39.0
Top of casing elevation (m)	166.26	165.70	166.30	168.13	167.76	166.31
Ground elevation (m)	165.25	165.22	165.22	166.99	166.99	165.42

Top of casing and ground elevations measured in April 2003.

Appendix A: continued

Well#	9S	10S	11S	12S	13S	14S
Depth to bottom (cm)	75.0	77.0	74.5	78.0	75.0	76.0
Diameter (cm)	2.5	2.5	2.5	2.5	2.5	2.5
Screened interval (cm)	42.2-71.4	43.7-73.2	41.1-70.9	47.6-73.0	42.5-67.8	46.7-72.7
Sand pack (cm)	30.0-75.0	30.0-76.7	30.0-74.5	29.0-78.0	30.0-75.0	30.0-76.0
Well seal (cm)	0.0-30.0	0.0-30.0	0.0-30.0	0.0-29.0	0.0-30.0	0.0-30.0
Well length (cm)	190.0	186.0	190.5	186.0	187.0	186.0
Screen length (cm)	29.2	29.5	29.8	25.4	25.3	26.0
Top of casing elevation (m)	167.37	167.04	167.13	166.85	166.63	166.60
Ground elevation (m)	166.22	165.95	165.97	165.77	165.51	165.50

Well#	15S	16S	17S	18S	19S	20S	21S
Depth to bottom (cm)	75.0	78.0	75.5	74.5	76.0	74.5	75.0
Diameter (cm)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Screened interval (cm)	44.1-69.4	46.3-71.7	47.3-73.8	43.1-69.2	46.8-73.3	43.3-70.0	41.0-72.2
Sand pack (cm)	29.0-75.0	30.0-78.0	30.0-75.0	29.5-74.5	30.0-76.0	29.0-74.5	30.5-75.0
Well seal (cm)	0.0-29.0	0.0-30.0	0.0-30.0	0.0-29.5	2.0-30.0	3.0-29.0	5.0-30.5
Well length (cm)	186.0	183.0	189.5	190.5	188.0	191.5	192.0
Screen length (cm)	25.3	25.4	26.5	26.1	26.5	26.7	31.2
Top of casing elevation (m)	167.04	166.76	167.79	166.59	166.81	166.13	167.38
Ground elevation (m)	165.93	165.71	166.65	165.43	165.69	164.96	166.21

Top of casing and ground elevations measured in April 2003.

Appendix B: Depth to ground water

Well	2/24/98	3/8/98	3/20/98	4/3/98	4/18/98	5/2/98	5/18/98	6/9/98	6/22/98	7/17/98	8/20/98
1U	***-0.06***	***-0.14***	***-0.32***	***-0.31***	***-0.20***	***-0.52***	***-0.05***	***-0.09***	***-0.14***	***0.20***	0.57
1M	***-0.01***	***-0.09***	flooded	***-0.08***	***-0.12***	flooded	***0.04***	***-0.03***	***-0.07***	***0.24***	0.64
1L	***0.01***	***-0.14***	***-0.28***	***-0.22***	***-0.12***	***-0.42***	***0.04***	***-0.02***	***-0.11***	***0.21***	0.64
2U	***0.26***	***-0.03***	***-0.04***	***-0.04***	***-0.03***	***-0.05***	***0.30***	***0.07***	***-0.02***	0.58	dry
2M	***0.25***	***-0.04***	***-0.04***	***-0.04***	***-0.03***	***-0.05***	0.35	***0.09***	***-0.03***	0.60	0.82
2L	0.41	0.34	***-0.13***	***-0.11***	***-0.14***	***-0.16***	***0.13***	0.39	***-0.03***	0.47	1.11
3U	***0.21***	***-0.02***	***-0.08***	***-0.10***	***0.02***	***-0.22***	***-0.73***	***-0.52***	***-0.01***	0.44	0.74
3M	***0.19***	***-0.05***	***-0.04***	***-0.04***	***0.00***	***-0.30***	***0.27***	0.58	***-0.03***	***-0.16***	0.98
4U	***0.04***	***0.00***	***-0.55***	***-0.33***	***-0.24***	***-0.22***	***-0.07***	***0.09***	***-0.31***	***0.27***	0.74
4M	0.32	***0.21***	***0.10***	***0.11***	***0.22***	***-0.05***	***0.13***	***-0.02***	***0.27***	0.59	0.73
4L	***-0.29***	***-0.40***	***-0.52***	***-0.51***	***-0.40***	***-0.66***	***0.13***	***-0.03***	***-0.35***	***-0.03***	0.73
5U	***0.22***	***0.08***	***0.04***	***0.02***	***0.14***	***-0.12***	0.35	***0.21***	***0.20***	0.55	0.85
6U	***0.00***	***-0.11***	***-0.56***	***-0.48***	***-0.23***	***-0.70***	***-0.46***	***-0.35***	***-0.39***	***-0.05***	dry
6M	***-0.03***	***-0.23***	flooded	***-0.18***	***-0.22***	flooded	***0.08***	***-0.12***	***-0.18***	***0.29***	***
6L	***0.05***	***-0.23***	flooded	***-0.16***	***-0.19***	flooded	***0.11***	***-0.10***	***-0.17***	0.31	***
7S	*	*	*	*	*	*	*	*	*	*	*
7M	0.38	0.34	***0.26***	0.33	0.49	***0.26***	0.94	1.13	0.37	1.14	1.72
8U	***0.01***	***-0.12***	***-0.16***	***-0.15***	***-0.03***	***-0.29***	***0.25***	***0.00***	***-0.01***	0.45	0.72
9S	*	*	*	*	*	*	*	*	*	*	*
10S	*	*	*	*	*	*	*	*	*	*	*
11S	*	*	*	*	*	*	*	*	*	*	*
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
\- indicates water above land surface
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well
bold depth values ≤ 0.304 m

Appendix B: continued

Well	9/18/98	10/17/98	11/14/98	12/18/98	1/24/99	2/28/99	3/28/99	4/14/99	4/28/99	5/9/99	5/24/99
1U	0.53	0.44	***-0.30***	***-0.10***	***-0.36***	***-0.07***	***-0.02***	***-0.03***	***-0.10***	***-0.04***	***-0.08***
1M	0.60	0.54	***-0.14***	***-0.02***	flooded	***-0.04***	***-0.03***	***-0.04***	***-0.11***	***-0.03***	***0.08***
1L	0.68	0.58	***-0.17***	***-0.03***	***-0.32***	***-0.05***	***0.00***	***-0.09***	***-0.12***	***0.00***	***0.22***
2U	dry	0.72	***0.04***	***0.12***	***-0.05***	***-0.03***	***-0.01***	***0.04***	***-0.03***	***0.13***	0.42
2M	0.87	0.69	***0.03***	***0.11***	***-0.06***	***-0.04***	***-0.02***	***0.01***	***-0.05***	***0.12***	0.42
2L	1.45	1.03	***0.18***	***0.10***	***0.00***	***-0.08***	***-0.03***	***-0.09***	***-0.15***	***-0.04***	***0.19***
3U	0.77	0.80	***-0.01***	***0.15***	***-0.12***	***0.10***	***0.24***	***0.22***	***-0.06***	***0.26***	0.40
3M	1.38	1.15	***-0.03***	***0.13***	***-0.13***	***0.08***	***0.24***	***0.22***	***-0.02***	***0.25***	0.40
4U	dry	0.79	***-0.09***	***0.06***	***-0.28***	***-0.02***	***0.09***	***0.01***	***-0.06***	***0.04***	***0.17***
4M	1.00	0.78	***-0.10***	***-0.01***	***-0.28***	***-0.02***	***0.00***	***0.01***	***-0.06***	***0.03***	***0.17***
4L	1.00	0.79	***-0.11***	***-0.02***	***-0.33***	***-0.04***	***-0.02***	***-0.01***	***-0.09***	***0.01***	***0.15***
5U	**	0.78	***0.12***	***0.22***	***-0.05***	***0.21***	***0.22***	***0.24***	***0.15***	***0.28***	0.39
6U	dry	dry	***-0.20***	***0.01***	***-0.30***	***-0.07***	***0.16***	***0.10***	***-0.16***	***0.08***	0.35
6M	***	***	***	***	***	***	***	***	***	***	***
6L	***	***	***	***	***	***	***0.16***	***0.09***	***-0.24***	***0.07***	0.35
7S	*	*	*	*	*	*	0.42	0.45	***0.06***	0.59	dry
7M	2.08	1.63	0.81	0.88	0.80	0.51	0.83	0.63	0.32	0.80	1.02
8U	0.67	0.53	***-0.07***	***0.03***	***-0.25***	***-0.02***	***0.05***	***0.04***	***-0.04***	dry	***0.30***
9S	*	*	*	*	*	*	*	*	*	*	*
10S	*	*	*	*	*	*	*	*	*	*	*
11S	*	*	*	*	*	*	*	*	*	*	*
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
\- indicates water above land surface
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well
bold depth values ≤ 0.304 m

Appendix B: continued

Well	6/15/99	7/20/99	8/04/99	9/21/99	10/12/99	11/1/99	12/13/99	1/14/00	2/7/00	3/15/00	4/3/00
1U	0.54	1.02	1.00	dry	1.02	dry	0.97	0.97	1.00	0.92	0.87
1M	0.53	1.18	1.39	1.85	1.49	1.71	1.18	1.75	1.83	0.97	0.88
1L	0.53	1.18	1.43	2.05	1.69	1.91	1.58	2.08	2.14	1.19	0.99
2U	0.67	dry	dry	dry	dry	dry	dry	dry	dry	0.76	0.71
2M	0.67	1.07	1.23	dry	1.36	1.55	1.15	1.35	1.47	0.75	0.67
2L	0.71	1.62	1.86	**	2.34	2.38	2.27	2.42	2.42	1.25	0.94
3U	0.75	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
3M	0.86	1.45	1.71	**	1.85	1.85	dry	dry	dry	1.82	1.85
4U	0.60	dry	dry	dry	dry	dry	dry	dry	dry	0.84	dry
4M	0.60	1.29	1.54	1.91	1.91	1.91	dry	dry	dry	1.59	1.33
4L	0.58	1.31	1.58	2.11	2.06	2.16	2.14	2.27	2.31	1.59	1.34
5U	0.77	dry	dry	dry	dry	dry	dry	dry	dry	1.30	1.16
6U	dry	dry	dry	dry	0.94	dry	dry	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	0.89	1.65	1.90	2.48	2.52	2.60	2.67	2.72	2.76	2.30	2.14
7S	dry	dry	dry	dry	0.69	dry	0.44	0.51	dry	0.47	0.52
7M	1.65	2.06	2.10	2.12	1.89	2.10	2.10	2.02	2.09	1.31	1.15
8U	dry	dry	dry	dry	dry	dry	dry	dry	dry	1.03	0.86
9S	0.55	dry	dry	dry	0.59	0.69	0.44	0.59	0.65	dry	dry
10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
11S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
\- indicates water above land surface
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well
bold depth values ≤ 0.304 m

Appendix B: continued

Well	4/18/00	5/1/00	5/15/00	5/30/00	6/12/00	7/12/00	7/25/00	8/9/00	9/11/00	10/15/00	11/5/00
1U	0.92	0.92	0.95	1.01	1.01	***-0.07***	***0.24***	0.69	1.04	1.00	dry
1M	1.08	0.97	1.04	1.16	1.23	***-0.07***	***0.18***	0.68	1.18	1.26	1.49
1L	1.19	1.07	1.18	1.27	1.33	***-0.04***	***0.19***	0.68	1.23	1.39	1.54
2U	0.80	0.77	dry	dry	0.80	***0.10***	0.82	dry	dry	dry	dry
2M	0.77	0.72	0.85	0.96	0.77	***0.19***	0.69	0.91	1.41	dry	dry
2L	1.12	0.98	1.31	1.61	1.90	0.52	1.01	1.51	2.26	2.26	2.24
3U	dry	dry	dry	dry	dry	***0.06***	0.52	dry	dry	dry	dry
3M	1.83	1.80	1.81	1.84	1.84	***0.10***	0.53	0.99	1.58	1.84	1.85
4U	dry	dry	dry	dry	dry	***-0.02***	***0.30***	0.76	dry	dry	dry
4M	1.41	1.34	1.41	1.49	1.55	***-0.06***	***0.26***	0.72	1.33	1.61	1.74
4L	1.43	1.36	1.42	1.50	1.58	***-0.06***	***0.27***	0.73	1.34	1.63	1.75
5U	dry	dry	dry	dry	dry	***0.18***	0.53	0.95	dry	dry	dry
6U	dry	dry	dry	dry	dry	***-0.09***	0.58	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	2.14	2.10	2.13	2.18	2.26	***-0.12***	0.57	1.19	1.88	2.22	2.33
7S	0.58	0.57	dry	dry	0.59	0.55	dry	0.58	dry	0.51	dry
7M	1.48	1.18	1.51	1.73	1.91	0.81	1.22	1.51	1.93	2.08	2.09
8U	dry	dry	dry	dry	dry	***0.02***	0.46	0.82	dry	dry	dry
9S	dry	dry	dry	dry	0.35	0.65	dry	dry	dry	0.52	0.61
10S	dry	dry	dry	dry	0.68	0.41	dry	dry	dry	dry	dry
11S	dry	dry	dry	dry	dry	***0.21***	dry	dry	dry	dry	dry
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
\- indicates water above land surface
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well
bold depth values ≤ 0.304 m

Appendix B: continued

Well	12/19/00	1/24/01	2/21/01	3/27/01	4/18/01	5/2/01	5/16/01	6/5/01	6/21/01	7/5/01	7/17/01
1U	dry	0.96	frozen	***-0.46***	***-0.51***	***-0.41***	***-0.43***	***-0.52***	***-0.48***	***-0.06***	0.40
1M	1.58	1.31	frozen	***-0.02***	***-0.06***	***0.03***	***0.00***	***-0.13***	***-0.06***	0.39	0.78
1L	1.71	1.53	***-0.03***	***0.00***	***-0.07***	***0.05***	***-0.01***	***-0.17***	***-0.07***	0.37	0.74
2U	dry	0.78	***0.16***	***0.14***	***0.02***	0.31	***0.29***	***0.00***	***0.05***	0.75	dry
2M	dry	1.50	***0.22***	***0.11***	***-0.01***	0.37	0.37	***-0.06***	***0.01***	0.82	1.20
2L	2.24	1.81	***0.29***	***0.08***	***-0.03***	***0.22***	0.38	***0.01***	0.48	0.94	1.49
3U	dry	dry	frozen	***0.14***	***0.12***	0.35	0.36	***-0.02***	***0.05***	0.68	dry
3M	1.85	dry	frozen	***0.12***	***0.10***	0.33	0.35	***-0.04***	***0.05***	0.66	1.02
4U	dry	dry	frozen	frozen	***-0.03***	***0.10***	***0.08***	***-0.10***	***-0.05***	0.45	0.82
4M	1.85	dry	frozen	***-0.03***	***-0.03***	***0.10***	***0.08***	***-0.11***	***-0.05***	0.44	0.82
4L	1.91	1.89	frozen	***-0.03***	***0.01***	***0.09***	***0.07***	***-0.12***	***-0.05***	0.44	0.81
5U	dry	dry	***0.22***	***0.22***	***0.22***	0.34	0.32	***0.14***	***0.19***	0.69	1.06
6U	dry	dry	frozen	***-0.06***	***-0.10***	***0.26***	0.35	***-0.21***	***-0.11***	0.65	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	2.47	2.45	***-0.13***	***-0.06***	***-0.10***	***0.30***	0.41	***-0.24***	***-0.11***	0.68	1.15
7S	0.64	0.42	***0.30***	0.35	0.35	0.50	0.35	***0.02***	0.63	0.52	dry
7M	dry	1.33	1.05	0.83	0.81	0.83	0.81	0.62	0.95	1.10	1.23
8U	dry	dry	frozen	***0.06***	***0.03***	***0.18***	***0.07***	***-0.04***	***0.01***	0.60	0.90
9S	dry	dry	dry	dry	dry	dry	0.59	0.65	***0.11***	0.59	dry
10S	dry	dry	***0.30***	0.33	***0.27***	0.41	***0.30***	***0.01***	***0.19***	dry	dry
11S	dry	dry	0.31	***0.30***	***0.26***	0.44	0.31	***0.01***	***0.11***	dry	dry
12S	*	*	*	***0.29***	***0.14***	0.31	***0.15***	***-0.01***	***0.04***	dry	dry
13S	*	*	*	***0.28***	***0.23***	0.55	0.63	***-0.04***	***0.02***	dry	dry
14S	*	*	*	***0.18***	***0.17***	0.33	0.33	***0.01***	***0.15***	dry	dry
15S	*	*	*	0.63	0.62	dry	dry	***0.18***	0.53	dry	dry
16S	*	*	*	***0.09***	***0.08***	0.40	0.32	***-0.04***	***0.00***	dry	dry
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
\- indicates water above land surface
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well
bold depth values ≤ 0.304 m

Appendix B: continued

Well	9/5/01	10/2/01	11/2/01	12/7/01	1/8/02	2/14/02	3/14/02	4/1/02	4/17/02	4/29/02	5/10/02
1U	***-0.42***	***-0.07***	***-0.48***	***-0.42***	frozen	***-0.48***	***-0.46***	***-0.41***	***-0.08***	***-0.33***	***-0.14***
1M	***0.00***	***0.30***	***-0.06***	***0.00***	frozen	***-0.10***	***-0.09***	***-0.05***	***-0.11***	***-0.37***	***-0.17***
1L	***0.07***	0.33	***-0.03***	***0.02***	0.34	***-0.12***	***-0.13***	***-0.05***	***-0.03***	***-0.27***	***-0.13***
2U	0.74	0.77	***0.26***	***0.14***	0.43	***-0.02***	***-0.02***	***-0.02***	***0.00***	***-0.04***	-0.01
2M	0.79	0.93	0.33	***0.21***	0.40	***-0.05***	***-0.03***	***-0.04***	***-0.02***	***-0.05***	***-0.04***
2L	1.06	1.18	0.37	***0.27***	0.37	***-0.13***	***-0.17***	***-0.11***	***-0.12***	***-0.22***	***-0.17***
3U	0.40	0.75	***0.19***	0.34	0.59	frozen	***0.04***	***0.21***	***0.17***	***-0.08***	***0.01***
3M	0.39	0.73	***0.17***	0.32	0.60	***0.01***	***0.04***	***0.20***	***0.15***	***-0.10***	***-0.02***
4U	***0.11***	0.45	***-0.03***	***0.03***	frozen	frozen	***0.11***	***0.06***	***-0.02***	***-0.26***	***-0.06***
4M	***0.10***	0.45	***-0.04***	***0.03***	frozen	***-0.05***	***-0.02***	***0.03***	***-0.05***	***-0.30***	***-0.10***
4L	***0.11***	0.44	***-0.04***	***0.03***	frozen	***-0.10***	***-0.06***	***-0.02***	***-0.05***	***-0.30***	***-0.09***
5U	0.36	0.59	***0.23***	***0.26***	0.59	***0.16***	***0.19***	***0.22***	***0.25***	***-0.01***	***0.20***
6U	***0.16***	0.85	***-0.12***	0.36	0.74	***-0.12***	***-0.10***	***0.18***	***-0.03***	***-0.38***	***-0.16***
6M	***	***	***	***	***	***	***	***	***	***	***
6L	***0.19***	0.97	***-0.10***	0.42	0.74	***-0.15***	***-0.13***	***0.22***	***-0.01***	***-0.41***	***-0.18***
7S	0.60	0.65	0.60	***0.13***	0.60	***0.03***	***0.05***	***0.10***	***0.27***	***0.01***	***0.11***
7M	1.23	1.28	1.00	0.93	1.15	0.70	0.42	0.58	0.55	0.46	0.38
8U	***0.28***	0.45	***0.05***	***0.07***	0.49	frozen	***0.04***	***0.09***	***0.00***	***-0.21***	***-0.04***
9S	0.54	0.51	0.54	0.46	0.57	***0.30***	***0.27***	0.50	0.45	0.51	0.48
10S	0.67	dry	0.45	0.47	dry	***0.06***	***0.10***	0.43	0.39	***-0.01***	***0.15***
11S	0.65	dry	0.36	***0.26***	0.63	***0.04***	***0.09***	***0.16***	***0.24***	***0.00***	***0.12***
12S	0.58	dry	0.40	0.56	dry	***0.01***	***0.01***	0.41	0.39	***-0.03***	***0.03***
13S	0.62	dry	***0.30***	dry	dry	frozen	***0.14***	0.55	0.36	***-0.13***	***-0.03***
14S	***0.28***	dry	***0.19***	0.33	dry	***0.15***	***0.16***	***0.27***	***0.22***	***-0.10***	***0.12***
15S	dry	dry	0.66	dry	dry	0.56	0.53	dry	dry	***0.03***	0.39
16S	0.50	dry	***0.18***	***0.13***	0.65	***-0.04***	***0.00***	***0.01***	***0.04***	***-0.03***	***-0.01***
17S	*	*	*	*	*	*	*	*	dry	***0.03***	***0.25***
18S	*	*	*	*	*	*	*	*	dry	***-0.16***	***0.23***
19S	*	*	*	*	*	*	*	*	dry	***0.10***	0.67
20S	*	*	*	*	*	*	*	*	dry	***0.08***	dry
21S	*	*	*	*	*	*	*	*	dry	***0.15***	dry

*	not yet installed
**	not measured
***	destroyed
-	indicates water above land surface
U	indicates upper monitoring well
M	indicates middle monitoring well
L	indicates lower monitoring well
S	indicates soil-zone monitoring well
bold	depth values ≤ 0.304 m

Appendix B: continued

Well	5/28/02	6/26/02	8/6/02	9/11/02	10/17/02	11/26/02	12/26/02	1/22/03	3/3/03	4/1/03	4/14/03
1U	***-0.17***	***-0.11***	0.51	***0.10***	0.90	1.17	1.12	1.38	1.00	0.75	0.75
1M	***-0.19***	***-0.15***	0.46	0.37	0.88	1.18	1.19	1.39	1.05	0.71	0.75
1L	***-0.14***	***-0.15***	0.53	***0.30***	0.94	1.28	1.33	1.53	1.19	0.85	0.78
2U	***-0.03***	0.52	dry	dry	dry	dry	dry	dry	dry	0.75	0.61
2M	***-0.05***	0.60	1.08	0.92	1.52	dry	dry	dry	0.81	0.65	0.66
2L	***-0.16***	0.37	1.07	1.11	1.56	1.62	1.65	1.72	1.40	1.09	0.88
3U	***-0.01***	***0.11***	dry	0.67	dry	dry	dry	dry	dry	dry	dry
3M	***-0.03***	***0.09***	0.88	0.65	1.35	1.69	1.80	dry	1.81	1.58	1.54
4U	***-0.09***	***-0.05***	0.61	0.40	dry	dry	dry	dry	dry	dry	dry
4M	***-0.13***	***-0.08***	0.58	0.36	1.05	1.40	1.52	dry	1.49	1.21	1.12
4L	***-0.12***	***-0.07***	0.59	0.37	1.06	1.42	1.53	1.69	1.49	1.21	1.12
5U	***0.16***	***0.19***	0.76	0.64	1.22	dry	dry	dry	dry	1.12	1.04
6U	***-0.21***	***-0.12***	dry	0.65	dry	dry	dry	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	***-0.23***	***-0.12***	1.09	0.67	1.56	1.93	2.08	2.23	2.05	1.94	1.87
7S	***0.04***	0.59	0.61	dry	dry	dry	0.50	dry	dry	0.41	0.47
7M	0.32	0.54	1.30	1.22	1.56	1.98	2.07	dry	dry	dry	1.82
8U	***-0.05***	***-0.02***	0.56	0.53	dry	dry	dry	dry	dry	0.79	0.77
9S	0.43	***0.30***	0.51	**	dry	dry	0.52	0.51	0.58	***0.29***	0.52
10S	***0.05***	0.42	dry	dry	dry	dry	dry	dry	dry	dry	dry
11S	***0.02***	0.46	dry	dry	dry	dry	dry	dry	dry	dry	dry
12S	***0.00***	0.40	0.71	0.67	dry	dry	dry	dry	dry	dry	dry
13S	***-0.04***	***0.19***	dry	dry	dry	dry	dry	dry	dry	dry	dry
14S	***0.08***	***0.16***	dry	dry	dry	dry	dry	dry	dry	dry	dry
15S	0.36	0.56	dry	**	dry	dry	dry	dry	dry	dry	dry
16S	***-0.02***	***0.11***	dry	dry	dry	dry	dry	dry	dry	dry	dry
17S	***0.22***	0.60	dry	dry	dry	dry	dry	dry	dry	dry	dry
18S	***0.23***	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
19S	0.66	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
21S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** not measured
*** destroyed
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bold depth values ≤ 0.304 m

Appendix B: continued

Well	4/29/03	5/13/03	5/27/03	6/10/03	6/23/03	8/4/03	9/4/03	9/25/03	10/29/03	12/1/03
1U	***0.01***	***-0.15***	***0.08***	***0.13***	0.76	0.84	0.88	1.11	1.14	0.43
1M	***0.03***	***-0.15***	***0.10***	***0.24***	0.75	0.90	0.96	1.27	1.29	0.52
1L	***0.08***	***-0.14***	***0.12***	0.34	0.76	0.91	1.03	1.36	1.33	0.59
2U	***0.17***	***0.07***	0.63	0.73	dry	dry	dry	dry	0.76	0.55
2M	***0.21***	***0.08***	0.71	0.98	1.24	1.43	1.30	dry	dry	0.72
2L	0.47	***0.11***	0.63	0.96	***0.28***	1.68	2.02	2.14	1.88	0.93
3U	dry	***0.06***	0.54	**	**	dry	dry	dry	dry	dry
3M	1.20	***0.06***	0.54	**	**	1.40	1.71	1.81	1.82	1.32
4U	0.62	***-0.09***	***0.26***	0.48	dry	dry	dry	dry	dry	dry
4M	0.62	***-0.09***	***0.27***	0.48	0.88	1.10	1.46	1.66	1.72	0.88
4L	0.62	***-0.10***	***0.26***	0.47	0.89	1.10	1.46	1.67	1.72	0.88
5U	0.36	***0.15***	0.50	0.57	1.04	1.16	dry	dry	dry	0.78
6U	dry	***-0.17***	0.48	dry	dry	dry	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***
6L	1.59	***-0.18***	0.51	1.04	1.38	1.71	2.13	2.29	2.36	1.73
7S	***0.05***	***0.06***	0.53	0.50	0.59	0.57	0.51	dry	***0.18***	***0.18***
7M	0.97	0.76	0.96	1.24	1.33	1.20	1.30	1.53	0.97	0.90
8U	***0.03***	***-0.03***	0.42	0.41	0.86	0.95	dry	dry	dry	0.49
9S	***0.11***	0.31	0.49	***0.03***	0.47	0.48	0.31	***0.17***	***0.18***	***0.30***
10S	0.56	***0.18***	dry	dry	dry	dry	dry	dry	dry	dry
11S	***0.06***	***0.17***	dry	dry	dry	dry	dry	dry	dry	0.53
12S	0.37	***0.05***	0.62	***0.28***	dry	dry	dry	dry	dry	0.61
13S	dry	***0.23***	dry	dry	dry	dry	dry	dry	dry	dry
14S	dry	***0.08***	0.53	dry	dry	dry	dry	dry	dry	dry
15S	dry	0.64	dry	0.66	dry	dry	dry	dry	dry	dry
16S	***-0.01***	***0.01***	0.64	dry	dry	dry	dry	dry	dry	dry
17S	dry	0.56	dry	dry	dry	dry	dry	dry	dry	dry
18S	dry	0.60	dry	dry	dry	dry	dry	dry	dry	dry
19S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
21S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** not measured
*** destroyed
\- indicates water above land surface
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well
bold depth values ≤ 0.304 m

Appendix C: Ground-water and surface-water elevations

Well	2/24/98	3/8/98	3/20/98	4/3/98	4/18/98	5/2/98	5/18/98	6/9/98	6/22/98	7/17/98	8/20/98
1U	165.32	165.40	165.57	165.56	165.45	165.77	165.30	165.34	165.39	165.05	164.68
1M	165.34	165.42	flooded	165.41	165.45	flooded	165.29	165.36	165.40	165.09	164.69
1L	165.34	165.50	165.63	165.58	165.47	165.77	165.32	165.38	165.46	165.14	164.71
2U	165.67	165.96	165.96	165.97	165.95	165.98	165.63	165.86	165.95	165.35	dry
2M	165.67	165.96	165.96	165.96	165.95	165.97	165.57	165.83	165.95	165.32	165.10
2L	165.50	165.57	166.04	166.02	166.05	166.07	165.78	165.52	165.93	165.44	164.80
3U	165.33	165.55	165.62	165.64	165.52	165.76	166.26	166.06	165.55	165.10	164.80
3M	165.34	165.57	165.56	165.56	165.52	165.82	165.25	164.94	165.55	165.68	164.54
4U	165.34	165.37	165.92	165.70	165.61	165.60	165.44	165.28	165.68	165.10	164.63
4M	165.04	165.14	165.25	165.24	165.13	165.40	165.22	165.38	165.08	164.77	164.62
4L	165.63	165.74	165.86	165.86	165.74	166.01	165.22	165.38	165.69	165.38	164.62
5U	165.36	165.50	165.55	165.57	165.44	165.70	165.23	165.37	165.38	165.04	164.74
6U	165.24	165.36	165.80	165.73	165.48	165.95	165.71	165.60	165.64	165.29	dry
6M	165.25	165.45	flooded	165.40	165.44	flooded	165.14	165.34	165.40	164.93	***
6L	165.18	165.46	flooded	165.39	165.42	flooded	165.12	165.33	165.40	164.92	***
7S	*	*	*	*	*	*	*	*	*	*	*
7M	166.63	166.67	166.75	166.68	166.52	166.75	166.07	165.88	166.64	165.87	165.28
8U	165.39	165.52	165.56	165.55	165.44	165.69	165.15	165.40	165.41	164.96	164.68
9S	*	*	*	*	*	*	*	*	*	*	*
10S	*	*	*	*	*	*	*	*	*	*	*
11S	*	*	*	*	*	*	*	*	*	*	*
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*
A	165.23	165.38	165.55	165.55	165.43	165.69	165.27	165.33	165.37	dry	dry
B	165.23	165.37	165.55	165.54	165.43	165.70	165.28	165.32	165.37	165.21	dry
C	*	*	*	*	*	*	*	*	*	*	*
D	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well

Appendix C: continued

Well	9/18/98	10/17/98	11/14/98	12/18/98	1/24/99	2/28/99	3/28/99	4/14/99	4/28/99	5/9/99	5/24/99
1U	164.72	164.81	165.56	165.35	165.61	165.33	165.32	165.33	165.39	165.33	165.38
1M	164.73	164.79	165.47	165.35	flooded	165.36	165.33	165.34	165.41	165.33	165.22
1L	164.68	164.77	165.53	165.39	165.67	165.40	165.34	165.43	165.46	165.34	165.12
2U	dry	165.21	165.89	165.81	165.97	165.96	165.93	165.89	165.96	165.80	165.51
2M	165.05	165.23	165.89	165.81	165.98	165.96	165.94	165.91	165.97	165.80	165.49
2L	164.46	164.88	165.73	165.81	165.91	165.99	165.94	166.00	166.07	165.95	165.72
3U	164.77	164.74	165.54	165.39	165.65	165.44	165.28	165.31	165.58	165.27	165.12
3M	164.14	164.37	165.55	165.39	165.65	165.44	165.28	165.30	165.54	165.27	165.12
4U	dry	164.58	165.46	165.32	165.66	165.39	165.26	165.33	165.40	165.31	165.17
4M	164.35	164.57	165.45	165.36	165.63	165.38	165.33	165.32	165.39	165.30	165.16
4L	164.34	164.56	165.45	165.36	165.68	165.38	165.33	165.33	165.40	165.30	165.16
5U	**	164.81	165.46	165.36	165.64	165.37	165.36	165.34	165.43	165.30	165.19
6U	dry	dry	165.45	165.23	165.55	165.31	165.07	165.13	165.39	165.14	164.88
6M	***	***	***	***	***	***	***	***	***	***	***
6L	***	***	***	***	***	***	165.03	165.10	165.42	165.12	164.84
7S	*	*	*	*	*	*	166.59	166.55	166.94	166.41	dry
7M	164.93	165.38	166.20	166.12	166.21	166.50	166.19	166.38	166.70	166.21	166.00
8U	164.74	164.87	165.47	165.37	165.65	165.43	165.36	165.37	165.45	dry	165.12
9S	*	*	*	*	*	*	dry	dry	165.64	165.64	165.60
10S	*	*	*	*	*	*	165.33	165.47	165.91	165.39	165.28
11S	*	*	*	*	*	*	165.78	165.72	165.99	165.59	165.40
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*
A	dry	dry	165.45	165.33	165.63	165.42	165.36	165.32	165.40	165.32	165.26
B	dry	dry	165.45	165.33	165.65	165.32	165.25	165.31	165.39	165.31	165.26
C	*	*	*	*	*	*	**	**	164.26	161.66	161.60
D	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well

Appendix C: continued

Well	6/15/99	7/20/99	8/04/99	9/21/99	10/12/99	11/1/99	12/13/99	1/14/00	2/7/00	3/15/00	4/3/00
1U	164.75	164.28	164.29	dry	164.28	dry	164.32	164.33	164.29	164.37	164.42
1M	164.77	164.12	163.91	163.45	163.81	163.59	164.12	163.55	163.47	164.33	164.42
1L	164.81	164.15	163.91	163.28	163.65	163.43	163.76	163.26	163.20	164.15	164.31
2U	165.26	dry	dry	dry	dry	dry	dry	dry	dry	165.17	165.25
2M	165.25	164.85	164.69	dry	164.55	164.37	164.77	164.57	164.45	165.17	165.26
2L	165.21	164.29	164.06	**	163.58	163.54	163.64	163.50	163.49	164.66	164.98
3U	164.77	dry	dry	**	dry	dry	dry	dry	dry	dry	dry
3M	164.66	164.07	163.82	**	163.67	163.67	dry	dry	dry	163.70	163.72
4U	164.74	dry	dry	dry	dry	dry	dry	dry	dry	164.50	dry
4M	164.73	164.04	163.79	163.42	163.42	163.42	dry	dry	dry	163.74	163.99
4L	164.73	164.01	163.74	163.20	163.26	163.15	163.18	163.05	163.00	163.72	163.99
5U	164.81	dry	dry	dry	dry	dry	dry	dry	dry	164.28	164.41
6U	dry	dry	dry	dry	164.29	dry	dry	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	164.29	163.54	163.29	162.71	162.67	162.59	162.52	162.47	162.43	162.89	163.09
7S	dry	dry	dry	dry	166.32	dry	166.57	166.49	dry	166.53	166.49
7M	165.37	164.96	164.92	164.90	165.12	164.92	164.92	165.00	164.92	165.71	165.86
8U	dry	dry	dry	dry	dry	dry	dry	dry	dry	164.38	164.56
9S	165.68	dry	dry	dry	165.65	165.54	165.79	165.65	165.58	dry	dry
10S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
11S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*
A	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
B	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
C	161.67	161.51	161.12	160.89	161.07	161.00	161.23	161.11	frozen	161.34	161.32
D	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well

Appendix C: continued

Well	4/18/00	5/1/00	5/15/00	5/30/00	6/12/00	7/12/00	7/25/00	8/9/00	9/11/00	10/15/00	11/5/00
1U	164.37	164.38	164.34	164.29	164.29	165.36	165.06	164.60	164.25	164.30	dry
1M	164.22	164.33	164.26	164.14	164.07	165.37	165.12	164.62	164.12	164.04	163.81
1L	164.12	164.24	164.13	164.04	163.97	165.35	165.12	164.62	164.07	163.92	163.76
2U	165.15	165.18	dry	dry	165.15	165.85	165.13	dry	dry	dry	dry
2M	165.15	165.21	165.08	164.97	165.15	165.73	165.23	165.02	164.52	dry	dry
2L	164.80	164.94	164.61	164.31	164.02	165.40	164.91	164.41	163.66	163.66	163.68
3U	dry	dry	dry	dry	dry	165.48	165.02	dry	dry	dry	dry
3M	163.74	163.76	163.75	163.72	163.72	165.47	165.03	164.57	163.98	163.72	163.72
4U	dry	dry	dry	dry	dry	165.38	165.06	164.60	dry	dry	dry
4M	163.91	163.97	163.91	163.83	163.77	165.38	165.06	164.60	163.99	163.71	163.58
4L	163.90	163.97	163.91	163.83	163.76	165.39	165.07	164.60	164.00	163.71	163.58
5U	dry	dry	dry	dry	dry	165.39	165.05	164.63	dry	dry	dry
6U	dry	dry	dry	dry	dry	165.34	164.68	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	163.09	163.13	163.10	163.05	162.97	165.34	164.66	164.04	163.35	163.01	162.90
7S	166.43	166.43	dry	dry	166.42	166.45	dry	166.43	dry	166.50	dry
7M	165.53	165.83	165.50	165.28	165.10	166.20	165.79	165.50	165.08	164.93	164.92
8U	dry	dry	dry	dry	dry	165.40	164.96	164.60	dry	dry	dry
9S	dry	dry	dry	dry	165.90	165.60	dry	dry	dry	165.72	165.64
10S	dry	dry	dry	dry	165.27	165.54	dry	dry	dry	dry	dry
11S	dry	dry	dry	dry	dry	165.82	dry	dry	dry	dry	dry
12S	*	*	*	*	*	*	*	*	*	*	*
13S	*	*	*	*	*	*	*	*	*	*	*
14S	*	*	*	*	*	*	*	*	*	*	*
15S	*	*	*	*	*	*	*	*	*	*	*
16S	*	*	*	*	*	*	*	*	*	*	*
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*
A	dry	dry	dry	dry	dry	165.35	dry	dry	dry	dry	dry
B	dry	dry	dry	dry	dry	165.35	165.18	dry	dry	dry	dry
C	161.27	161.23	161.35	161.31	161.29	162.34	161.31	161.15	160.90	161.00	161.00
D	*	*	*	*	*	*	*	*	*	*	*
E	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well

Appendix C: continued

Well	12/19/00	1/24/01	2/21/01	3/27/01	4/18/01	5/2/01	5/16/01	6/5/01	6/21/01	7/5/01	7/17/01
1U	dry	164.34	frozen	165.76	165.80	165.70	165.72	165.82	165.77	165.35	164.90
1M	163.72	163.99	frozen	165.34	165.38	165.28	165.31	165.44	165.38	164.92	164.53
1L	163.60	163.78	165.34	165.32	165.38	165.27	165.33	165.49	165.39	164.95	164.58
2U	dry	165.17	165.80	165.82	165.94	165.65	165.67	165.95	165.91	165.21	dry
2M	dry	164.43	165.71	165.82	165.94	165.56	165.56	165.99	165.92	165.11	164.73
2L	163.68	164.11	165.63	165.83	165.94	165.69	165.53	165.90	165.43	164.97	164.42
3U	dry	dry	frozen	165.40	165.43	165.19	165.18	165.56	165.50	164.87	dry
3M	163.72	dry	frozen	165.41	165.43	165.19	165.18	165.57	165.47	164.87	164.50
4U	dry	dry	frozen	frozen	165.37	165.24	165.26	165.44	165.39	164.89	164.51
4M	163.47	dry	frozen	165.37	165.37	165.24	165.26	165.44	165.39	164.89	164.52
4L	163.43	163.44	frozen	165.37	165.33	165.24	165.26	165.45	165.39	164.90	164.52
5U	dry	dry	165.36	165.38	165.38	165.26	165.28	165.46	165.41	164.91	164.54
6U	dry	dry	frozen	165.29	165.34	164.97	164.88	165.44	165.34	164.58	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	162.76	162.78	165.36	165.27	165.32	164.92	164.81	165.46	165.33	164.54	164.07
7S	166.37	166.59	166.71	166.67	166.67	166.52	166.67	167.00	166.39	166.50	dry
7M	dry	165.68	165.96	166.20	166.21	166.20	166.22	166.41	166.07	165.93	165.80
8U	dry	dry	frozen	165.36	165.39	165.25	165.36	165.47	165.42	164.83	164.52
9S	dry	dry	dry	dry	dry	dry	165.65	165.60	166.13	165.66	dry
10S	dry	dry	165.65	165.62	165.68	165.54	165.65	165.94	165.76	dry	dry
11S	dry	dry	165.72	165.72	165.76	165.58	165.71	166.01	165.91	dry	dry
12S	*	*	*	165.48	165.63	165.46	165.63	165.78	165.73	dry	dry
13S	*	*	*	165.25	165.29	164.97	164.90	165.56	165.51	dry	dry
14S	*	*	*	165.34	165.35	165.19	165.19	165.51	165.37	dry	dry
15S	*	*	*	165.31	165.32	dry	dry	165.76	165.40	dry	dry
16S	*	*	*	165.62	165.63	165.31	165.39	165.75	165.71	dry	dry
17S	*	*	*	*	*	*	*	*	*	*	*
18S	*	*	*	*	*	*	*	*	*	*	*
19S	*	*	*	*	*	*	*	*	*	*	*
20S	*	*	*	*	*	*	*	*	*	*	*
21S	*	*	*	*	*	*	*	*	*	*	*
A	dry	dry	frozen	165.34	165.36	165.29	165.32	165.44	165.37	dry	dry
B	dry	dry	frozen	165.33	165.35	165.27	165.28	165.44	165.37	dry	dry
C	frozen	frozen	frozen	161.67	161.69	161.47	161.84	163.52	162.56	161.29	160.99
D	*	*	*	165.57	165.60	dry	165.52	165.68	165.58	dry	dry
E	*	*	*	*	*	*	*	*	*	*	*

* not yet installed
** not measured
*** destroyed
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
S indicates soil-zone monitoring well

Appendix C: continued

Well	9/5/01	10/2/01	11/2/01	12/7/01	1/8/02	2/14/02	3/14/02	4/1/02	4/17/02	4/29/02	5/10/02
1U	165.71	165.36	165.77	165.71	frozen	165.77	165.75	165.71	165.36	165.61	165.42
1M	165.31	165.01	165.37	165.31	frozen	165.42	165.41	165.36	165.36	165.63	165.43
1L	165.25	164.99	165.35	165.30	164.98	165.44	165.45	165.37	165.37	165.60	165.46
2U	165.21	165.19	165.70	165.81	165.53	165.98	165.97	165.97	165.94	165.98	165.95
2M	165.14	165.00	165.60	165.72	165.53	165.98	165.96	165.97	165.93	165.97	165.96
2L	164.85	164.73	165.54	165.64	165.54	166.04	166.08	166.02	166.04	166.14	166.08
3U	165.14	164.79	165.35	165.21	164.96	frozen	165.50	165.33	165.38	165.63	165.55
3M	165.14	164.80	165.35	165.20	164.93	165.51	165.49	165.33	165.38	165.63	165.56
4U	165.23	164.89	165.37	165.31	frozen	frozen	165.22	165.27	165.39	165.63	165.43
4M	165.23	164.89	165.37	165.31	frozen	165.39	165.35	165.31	165.38	165.63	165.43
4L	165.23	164.89	165.37	165.31	frozen	165.43	165.40	165.36	165.39	165.64	165.43
5U	165.24	165.01	165.37	165.34	165.01	165.44	165.41	165.38	165.37	165.63	165.42
6U	165.07	164.38	165.35	164.88	164.49	165.35	165.33	165.05	165.27	165.62	165.40
6M	***	***	***	***	***	***	***	***	***	***	***
6L	165.03	164.25	165.32	164.80	164.47	165.37	165.35	165.00	165.22	165.62	165.39
7S	166.42	166.37	166.42	166.89	166.42	166.99	166.97	166.92	166.72	166.97	166.88
7M	165.80	165.75	166.03	166.10	165.87	166.33	166.60	166.45	166.46	166.54	166.62
8U	165.15	164.97	165.37	165.36	164.94	frozen	165.39	165.33	165.41	165.62	165.45
9S	165.70	165.73	165.70	165.79	165.67	165.94	165.98	165.74	165.77	165.71	165.74
10S	165.28	dry	165.50	165.48	dry	165.88	165.85	165.52	165.54	165.94	165.78
11S	165.37	dry	165.66	165.76	165.39	165.98	165.93	165.86	165.77	166.01	165.89
12S	165.19	dry	165.37	165.21	dry	165.76	165.76	165.36	165.39	165.81	165.74
13S	164.91	dry	165.22	dry	dry	frozen	165.39	164.97	165.15	165.63	165.53
14S	165.24	dry	165.33	165.19	dry	165.37	165.36	165.25	165.32	165.64	165.42
15S	dry	dry	165.28	dry	dry	165.37	165.40	dry	dry	165.87	165.52
16S	165.21	dry	165.54	165.58	165.06	165.75	165.71	165.70	165.67	165.74	165.72
17S	*	*	*	*	*	*	*	*	dry	166.66	166.43
18S	*	*	*	*	*	*	*	*	dry	165.61	165.21
19S	*	*	*	*	*	*	*	*	dry	165.59	165.02
20S	*	*	*	*	*	*	*	*	dry	164.89	dry
21S	*	*	*	*	*	*	*	*	dry	166.05	dry
A	165.29	dry	165.36	165.32	frozen	165.40	165.39	165.35	165.35	165.61	165.42
B	165.29	dry	165.36	165.44	frozen	165.38	165.36	165.32	165.35	165.61	165.41
C	161.01	160.95	161.38	161.37	161.36	161.97	161.80	161.48	161.70	166.35	162.29
D	dry	dry	165.56	dry	frozen	165.64	165.63	165.52	165.61	165.70	165.66
E	*	*	*	*	*	*	*	*	dry	165.39	165.18

* not yet installed
** not measured
*** destroyed
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S indicates soil-zone monitoring well

Appendix C: continued

Well	5/28/02	6/26/02	8/6/02	9/11/02	10/17/02	11/26/02	12/26/02	1/22/03	3/3/03	4/1/03	4/14/03
1U	165.45	165.40	164.77	165.18	164.38	164.11	164.16	163.91	164.28	164.53	164.56
1M	165.45	165.41	164.80	164.89	164.38	164.08	164.06	163.86	164.21	164.54	164.57
1L	165.48	165.48	164.81	165.03	164.39	164.05	164.00	163.80	164.15	164.48	164.53
2U	165.97	165.42	dry	dry	dry	dry	dry	dry	dry	165.19	165.31
2M	165.97	165.31	164.84	165.00	164.40	dry	dry	dry	165.10	165.26	165.26
2L	166.08	165.55	164.84	164.81	164.35	164.30	164.27	164.19	164.51	164.83	165.04
3U	165.56	165.44	dry	164.88	dry	dry	dry	dry	dry	dry	dry
3M	165.56	165.44	164.65	164.88	164.19	163.84	163.73	dry	163.72	163.96	164.00
4U	165.46	165.42	164.76	164.97	dry	dry	dry	dry	dry	dry	dry
4M	165.46	165.42	164.76	164.97	164.28	163.93	163.81	dry	163.84	164.12	164.23
4L	165.46	165.41	164.75	164.97	164.28	163.92	163.81	163.65	163.85	164.13	164.23
5U	165.46	165.43	164.86	164.98	164.40	dry	dry	dry	dry	164.50	164.55
6U	165.45	165.37	dry	164.60	dry	dry	dry	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***	***
6L	165.44	165.33	164.13	164.54	163.65	163.28	163.13	162.98	163.16	163.28	163.36
7S	166.95	166.40	166.37	dry	dry	dry	166.49	dry	dry	166.58	166.52
7M	166.69	166.46	165.71	165.79	165.44	165.02	164.93	dry	dry	dry	165.17
8U	165.46	165.43	164.85	164.89	dry	dry	dry	dry	dry	164.62	164.65
9S	165.78	165.92	165.70	**	dry	dry	165.69	165.71	165.64	165.92	165.70
10S	165.88	165.51	dry	dry	dry	dry	dry	dry	dry	dry	dry
11S	165.98	165.55	dry	dry	dry	dry	dry	dry	dry	dry	dry
12S	165.78	165.38	165.07	165.11	dry	dry	dry	dry	dry	dry	dry
13S	165.55	165.31	dry	dry	dry	dry	dry	dry	dry	dry	dry
14S	165.46	165.38	dry	dry	dry	dry	dry	dry	dry	dry	dry
15S	165.54	165.34	dry	**	dry	dry	dry	dry	dry	dry	dry
16S	165.73	165.60	dry	dry	dry	dry	dry	dry	dry	dry	dry
17S	166.46	166.09	dry	dry	dry	dry	dry	dry	dry	dry	dry
18S	165.22	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
19S	165.03	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
20S	dry	dry	**	dry	dry	dry	dry	dry	dry	dry	dry
21S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
A	165.45	165.38	dry	dry	dry	dry	dry	dry	dry	dry	dry
B	165.45	165.39	dry	dry	dry	dry	dry	dry	dry	dry	dry
C	162.26	161.69	161.01	161.08	160.97	161.01	frozen	frozen	161.18	161.18	161.19
D	165.66	165.56	dry	dry	dry	dry	dry	dry	dry	dry	dry
E	165.16	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** not measured
*** destroyed
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Appendix C: continued

Well	4/29/03	5/13/03	5/27/03	6/10/03	6/23/03	8/4/03	9/4/03	9/25/03	10/29/03	12/1/03
1U	165.31	165.47	165.23	165.19	164.55	164.47	164.44	164.20	164.18	164.88
1M	165.28	165.46	165.21	165.07	164.56	164.41	164.35	164.04	164.03	164.79
1L	165.23	165.46	165.19	164.98	164.55	164.40	164.28	163.96	163.98	164.72
2U	165.75	165.85	165.29	165.20	dry	dry	dry	dry	165.16	165.37
2M	165.72	165.84	165.22	164.94	164.69	164.49	164.62	dry	dry	165.20
2L	165.45	165.81	165.29	164.96	165.64	164.24	163.90	163.78	164.04	164.99
3U	dry	165.48	164.99	**	**	dry	dry	dry	dry	dry
3M	164.33	165.47	165.00	**	**	164.13	163.83	163.72	163.71	164.22
4U	164.74	165.44	165.09	164.87	dry	dry	dry	dry	dry	dry
4M	164.73	165.44	165.09	164.87	164.47	164.25	163.90	163.69	163.64	164.48
4L	164.73	165.45	165.09	164.88	164.47	164.25	163.89	163.68	163.63	164.47
5U	165.22	165.44	165.09	165.01	164.55	164.43	dry	dry	dry	164.81
6U	dry	165.43	164.77	dry	dry	dry	dry	dry	dry	dry
6M	***	***	***	***	***	***	***	***	***	***
6L	163.63	165.40	164.71	164.19	163.85	163.52	163.10	162.94	162.86	163.49
7S	166.94	166.93	166.46	166.49	166.40	166.42	166.48	dry	166.81	166.81
7M	166.02	166.22	166.03	165.75	165.66	165.78	165.69	165.46	166.02	166.09
8U	165.39	165.45	165.00	165.01	164.56	164.47	dry	dry	dry	164.94
9S	166.11	165.90	165.73	166.19	165.74	165.73	165.90	166.04	166.04	165.92
10S	165.39	165.77	dry	dry	dry	dry	dry	dry	dry	dry
11S	165.91	165.80	dry	dry	dry	dry	dry	dry	dry	165.44
12S	165.40	165.72	165.14	165.49	dry	dry	dry	dry	dry	165.15
13S	dry	165.29	dry	dry	dry	dry	dry	dry	dry	dry
14S	dry	165.41	164.97	dry	dry	dry	dry	dry	dry	dry
15S	dry	165.29	dry	165.27	dry	dry	dry	dry	dry	dry
16S	165.72	165.70	165.07	dry	dry	dry	dry	dry	dry	dry
17S	dry	166.10	dry	dry	dry	dry	dry	dry	dry	dry
18S	dry	164.83	dry	dry	dry	dry	dry	dry	dry	dry
19S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
20S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
21S	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
A	165.29	165.43	dry	dry	dry	dry	dry	dry	dry	dry
B	dry	165.44	165.21	dry	dry	dry	dry	dry	dry	dry
C	161.40	162.27	161.35	161.31	dry	160.94	161.09	161.19	161.47	161.28
D	dry	165.64	dry	dry	dry	dry	dry	dry	dry	dry
E	dry	165.22	dry	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** not measured
*** destroyed
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Appendix D: Geologic logs

Borehole: 1
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	Description
0.00-0.13	Sandy silt, very dark gray (10YR3/1); few, fine, distinct, dark yellowish brown (10YR4/6) mottles; massive; firm; plastic; slightly sticky; < 1 % root traces; clear lower boundary
0.13-0.65	Sandy silt, very dark grayish brown (10YR3/2); common, fine, distinct, dark brown (7.5 YR3/4) mottles; massive; thickly bedded with 50-mm thick light brownish gray (10YR6/2) laminae; firm; slightly plastic and sticky; abrupt lower boundary.
0.65-1.34	Sandy silt, very dark gray (10YR3/1); no mottles; fine, weak, subangular blocky structure; friable; plastic; sticky; < 1 % wood fragments; clear lower boundary.
1.34-1.72	Clayey silt, very dark gray (10YR3/1); no mottles; massive; firm; plastic; sticky; < 1 % wood fragments; gradual lower boundary.
1.72-5.45	Clayey silt, very dark gray (10YR3/1); no mottles; massive; firm; plastic; sticky; < 1 % wood fragments; gradual lower boundary.
5.45-5.57	Sand, dark gray (10YR4/1) grading to brown (10YR5/3); no mottles; medium, rounded, well-sorted; 1 % chert and other minerals

Borehole: 2
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	Description
0.00-0.29	Sandy silt, dark gray (10YR4/1); no mottles; very fine, weak, subangular blocky structure; firm; plastic; sticky; no clay films; abrupt lower boundary.
0.29-0.66	Sandy silt, dark gray (10YR4/1); common, fine, distinct, dark yellowish brown (10YR4/4) mottles; fine, moderate, subangular blocky structure; firm; plastic; sticky; no clay films; abrupt lower boundary.
0.66-1.62	Sandy silt, dark gray (10YR4/1); few, fine, faint, dark yellowish brown (10YR4/6) mottles; very fine, weak, subangular blocky structure; firm; slightly plastic and sticky; gradual lower boundary.
1.62-4.88	Diamicton, light brownish gray (10YR6/2); common, fine, distinct, yellowish brown (10YR5/6) mottles; very fine, massive structure; very firm; plastic; sticky; very fine gravel containing 1-2 % chert and other minerals.

Appendix D: continued

Borehole: 3
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	**Description**
0.00-0.21	Sandy silt, very dark brown (10YR2/2), few, fine, faint, dark red (2.5YR4/6) mottles; fine, weak, granular structure; firm; slightly plastic and sticky; 1 % root traces; abrupt lower boundary.
0.21-0.33	Sandy silt, very dark gray (10YR3/1); common, fine, distinct, dark reddish brown (5YR3/4) mottles; fine, strong, subangular blocky structure; firm; slightly plastic and sticky; no clay films; root traces; clear lower boundary.
0.33-0.70	Sandy silt, very dark gray (10YR3/1); few, fine, faint, dark red (2.5YR3/6) mottles along root traces; fine, weak, subangular blocky structure; very thinly bedded (~ 1 cm) with very fine sand laminae; firm; slightly plastic and sticky; root traces; gradual lower boundary.
0.70-1.83	Sandy silt, very dark grayish brown (10YR3/2); no mottles; massive; firm; slightly plastic and sticky.

Borehole: 4
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	**Description**
0.00-0.51	Silty clay, very dark gray (10YR3/1); no mottles; fine, moderate, subangular blocky structure from 0.14 to 0.21 m, otherwise massive; firm; plastic; sticky; clear lower boundary.
0.51-2.44	Sandy silt, black (10YR2/1); no mottles; massive; firm; slightly plastic and sticky
2.44-3.56	Silty sand, brown (10YR4/3); no mottles; very friable; very fine, sub-rounded quartz sand containing shell fragments; abrupt lower boundary.
3.56-4.71	Sand, brown (10YR4/3) sub-rounded, well-sorted quartz sand containing 1% chert and other minerals.

Appendix D: continued

Borehole: **5**
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	Description
0.00-0.42	Clayey silt, very dark gray (10YR3/1); no mottles; fine, weak, subangular blocky structure from 0.20 to 0.26 m, otherwise massive; firm; slightly plastic and sticky.
0.42-0.60	Silty sand, dark grayish brown (10YR4/2); no mottles; massive; gritty; slightly plastic and sticky.
0.60-1.22	Silty sand, very dark grayish brown (10YR3/2); no mottles; massive; moderately-sorted, sub-rounded quartz sand containing 2 % other minerals.

Borehole: **6**
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	Description
0.00-0.55	Sandy silt, very dark grayish brown (10YR3/2); very fine, dark yellowish brown (10YR4/6) oxidized rhizospheres along root traces; massive; firm; slightly plastic and sticky; gradual lower boundary.
0.55-1.22	Sandy silt, dark grayish brown (10YR4/2); many, medium, faint, brown (10YR4/3) mottles; massive; faint bedding; slightly plastic and sticky.
1.22-3.55	Silty sand, dark grayish brown (10YR4/2); very friable; sub-rounded, moderately-sorted, quartz sand containing 1% other minerals; organic material from 2.84 to 2.92 m and from 3.13 to 3.20 m.
3.55-4.88	Sand, brown (10YR4/3) with interbedded silty sand layers; fine to medium, sub-rounded, moderately-sorted, quartz sand containing 2% chert and other minerals.

Borehole: **7**
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	Description
0.00-0.30	Sandy silt, grayish brown (10YR5/2); few, fine, faint, yellowish brown (10YR5/8) mottles; friable; slightly plastic and sticky; very fine, rounded sand, clear lower boundary.
0.30-0.73	Sandy silt, light brownish gray (10YR6/2); common, fine, distinct, brown (10YR4/3) mottles; slightly plastic and sticky, gradual lower boundary.
0.73-1.33	Clayey silt, brown (10YR5/3); common, fine, distinct, strong brown (7.5YR5/8) mottles; massive; firm; plastic; sticky.
1.33-2.20	Sandy silt, grayish brown (10YR5/2); common, fine, prominent, yellowish brown (10YR5/8) mottles; massive; firm; slightly plastic and sticky.

Appendix D: continued

Borehole: 8
Location: **SE ¼, SW ¼ Section 18, T5N, R5W, Hancock Twp., Hancock Co., IL**

Depth (m)	**Description**
0.00-1.02	Clayey silt, dark grayish brown (10YR4/2); few, fine, faint, brownish yellow (10YR6/6) mottles; firm; plastic; sticky.