LA GRANGE WETLAND MITIGATION BANK: LEVEL II HYDROGEOLOGIC CHARACTERIZATION REPORT

La Grange, Brown County, Illinois

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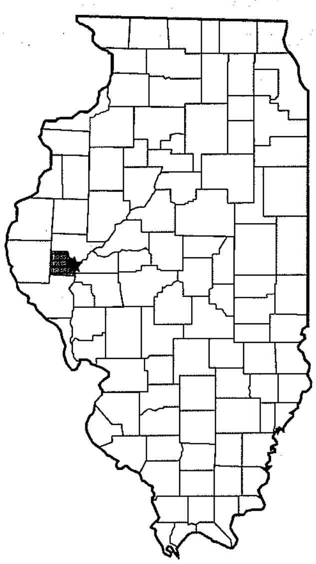

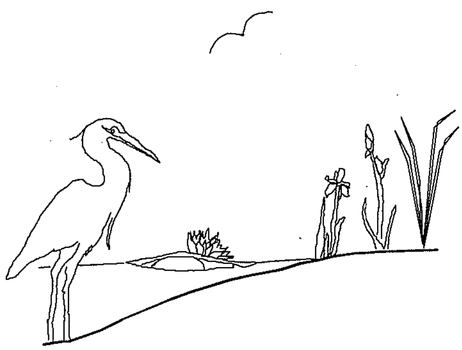

EXECUTIVE SUMMARY

In February 2000, the Illinois Department of Transportation tasked the Wetlands Geology Section of the Illinois State Geological Survey to conduct a hydrogeologic characterization of the La Grange Wetland Mitigation Bank site near La Grange in Brown County, Illinois. The purpose of this report is to identify the hydrogeologic conditions of the wetland mitigation bank site and to recommend wetland restoration strategies. The Illinois State Geological Survey began collecting data at the site in May 2000. Data presented in this report include, descriptions of geologic materials, on-site precipitation, and water-level measurements from monitoring wells, staff gauges, and data loggers.

Factors that indicate favorable conditions for wetland restoration include: hydric soils mapped over most of the site, extensive reversible hydrologic alterations, multiple potential water sources, and prior-converted (drained) wetlands mapped over approximately 50% of the site. Also, significant portions of the site conclusively satisfied jurisdictional wetland hydrology criteria in 2001, 2002, 2003, and 2004. The area that conclusively satisfied wetland hydrology criteria ranged from 200 ha (493 ac.) in 2001 to 624 ha (1543 ac.) in 2002.

The most significant potential water source for restoring wetlands at this site is the Illinois River. Flood-frequency analysis shows that floods from the Illinois River would inundate up to 527 ha (1303 ac.) once annually on average during the growing season, and up to 443 ha (1095 ac.) of the site would be inundated for durations sufficient to satisfy jurisdictional wetland hydrology criteria if a direct connection between the site and the river were reestablished. Input from small streams, runoff, and direct precipitation also contribute significantly to site hydrology. Ground-water discharge contributes minor, localized input.

Recommended actions for restoring wetlands include reestablishing connections between the site and the Illinois and La Moine rivers, discontinuing pumping, filling or blocking ditches, removing field tiles and culverts, and leveling berms. Reestablishing the connection of the site to the rivers could be achieved by actively dismantling the levees or allowing their continued degradation thus promoting more frequent flooding at the site. Discontinuation of pumping and disabling ditch and tile systems would slow drainage and promote retention of flood water, stream flow, runoff, and precipitation on site, thus prolonging ponding and soil saturation in areas that do not currently flood or do not flood long enough to satisfy wetland hydrology criteria.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This report was prepared by the Illinois State Geological Survey (ISGS) to provide the Illinois Department of Transportation (IDOT) with observations regarding the hydrogeologic conditions at the La Grange Wetland Mitigation Bank site (portions of Sections 9, 16, 17, 19, 20, and 21, T1S, R1W) Brown County, Illinois (Figure 1). The property, which covers approximately 666 ha (1645 ac.), has largely been drained for agricultural use although areas of wetland and open water remain.

The purpose of this report is to provide IDOT with hydrogeologic data and recommendations regarding restoration and/or creation of wetlands at the wetland compensation site. Therefore, this report presents conclusions and design recommendations first, followed by a discussion of the methods and supporting data. ISGS data presented in this report were collected between May 2000 and August 2004. The supporting data include ground-water and surface-water levels and precipitation measurements collected from on-site instruments (Figure 2), descriptions of geologic materials sampled from soil and well borings, and river-stage data from off-site gauging stations on the Illinois and La Moine rivers.

Data collection at the site is ongoing and will continue until no longer required by IDOT. The data currently being collected will be used to compare the pre- and post-restoration hydrology of the site, to determine the impact of hydrologic alterations, and to estimate the duration and extent of jurisdictional wetland hydrology.

SUMMARY

The following factors suggest that this site has a high potential for wetland restoration.

- The site lies on the Illinois River floodplain at the confluence of the Illinois and La Moine rivers. Analysis of 62 years of Illinois River stage records at the La Grange Lock and Dam (U.S. Army Corps of Engineers 2004) shows that, if levees had not been in place, floods that lasted for 12.5% of the growing season would have inundated areas below 131.7 m (432.1 ft.) and covered 281 ha (696 ac.) in 5 of 10 years on average. Floods that lasted for 5% of the growing season would have inundated areas below 132.5 m (434.7 ft.) and covered 443 ha (1095 ac.) in 5 of 10 years on average.

- Large areas of preexisting wetland and drained wetland have been mapped at the site. In 1988, NWI-mapped wetlands covered 43% of the site. In 2000, the INHS mapped 242.5 ha (599.2 ac.) of wetlands at the site, and the NRCS determined that 51% of the site is prior-converted (drained) wetlands.

- Several reversible hydrologic alterations exist on site. Alterations such as levees, ditches, field tile, berms, culverts, and pumping limit the area of wetland hydrology (Figure 3). Ditches and field tile expedite drainage and promote agricultural use. Prior to the flood in Summer 2002,

levees prevented direct flooding from adjacent rivers. The levees were damaged as a result of the 2002 flood, and currently the Illinois River floods the site when stage is above approximately 131.7 m (432.1 ft.).

- Multiple potential water sources exist at the site. Floods from the Illinois and La Moine rivers, flow from small ephemeral streams, and runoff could be used to expand wetland areas. Localized ground-water discharge could also contribute to wetland restoration in areas along the break in slope between the lake plain and the terrace if ditches are filled and field tile systems are disabled.

- Areas of the site have already satisfied jurisdictional wetland hydrology criteria. The estimated area that conclusively satisfied wetland hydrology criteria was 200 ha (493 ac.) in 2001, 624 ha (1543 ac.) in 2002, 304 ha (752 ac.) in 2003, and 355 ha (876 ac.) in 2004. The range of estimated wetland hydrology area is attributable to several factors including differences in the overall drainage management from year to year, variation in precipitation and evapotranspiration patterns, and site flooding.

- Hydric soils are mapped over most of the site. They include: Wagner silt loam, Beaucoup silty clay loam (frequently flooded), Darwin silty clay (ponded), and Titus silty clay loam (wet). Each of these soils is on both the state and county lists of hydric soils (USDA 1991, USDA 1995). The Wagner, Titus, Beaucoup and Darwin soils have slow to moderately slow permeability rates that facilitate ponding and saturation.

WETLAND COMPENSATION RECOMMENDATIONS

The wetland compensation recommendations outlined below are based on ISGS analysis of hydrogeologic data and are in accordance with guidelines from Admiraal et al. (1997). While various options exist for levee configuration, IDOT intends to allow continued levee degradation (Illinois Department of Transportation 2003). Therefore, the recommendations below do not address construction or repair of levees. However, a brief discussion of levee configuration options is given later in this report.

The cumulative effect of reversing specific hydrologic alterations cannot be determined at this time. Therefore we suggest that each stage of wetland restoration be followed by an evaluation period to determine the effects. Restoration through reversing hydrologic alterations in the lowest portions of the site will likely maximize initial efforts to restore wetland hydrology while maintaining site access. Disabling drainage tiles, filling ditches and removing berms in the lake plain surrounding Big Lake are recommended prior to restoring higher areas of the site (see Illinois Department of Transportation 2003).

1. The most significant potential water source for this site is flooding from the Illinois and La Moine rivers. We recommend that the wetland restoration strategy rely primarily on the flood hydrology of these rivers either by direct connection to the rivers, or by managed

flooding through a flood-control structure if it is deemed necessary to repair the levees. A direct connection to the river could be established by actively dismantling the levees or by allowing their continued degradation.

2. The gravity drain was formerly operated to keep floods out of the site and to allow drainage at low river stages. We recommend permanently opening the gravity drain, which would allow water into the site when the Illinois River stage is above approximately 131.1 m (430.1 ft.). Permanently opening the drain would also allow the lake plain to dry seasonally, which would promote stabilization of fine sediment and establishment of vegetation, thus decreasing turbidity in Big Lake and other open water areas. We suggest retaining the option to permanently remove the gravity drain at a later date. The gravity drain may be utilized as part of an adaptive management strategy if ongoing monitoring indicates that the wetland mitigation goals and objectives are not being met.

3. A mobile pumping station was in operation at the site during and prior to 2002. It was used to facilitate site drainage when river stages exceeded the elevation of the gravity drain outlet. Permanently discontinuing pumping will promote higher water levels on site during wet periods and thus make conditions more conducive to expanding the extent of jurisdictional wetland hydrology.

4. The ditches and field tiles currently expedite drainage of the site. Though much of the site would conclusively satisfy jurisdictional wetland hydrology criteria due to flooding if opened to the river, we recommend filling or blocking ditches and removing field tile. Disabling these drainage systems would promote retention of flood water, stream flow, runoff, ground-water, and precipitation on site, thus prolonging ponding and soil saturation in areas that do not flood or do not flood long enough to satisfy wetland hydrology criteria. Prolonging ponding and saturation would also make conditions more conductive to desired wetland plant species. While many of the ditches do not operate efficiently under the current situation, they may become functional should the levee degrade more than expected. Therefore, filling or blocking ditches and removing or disabling field tile may prevent future drainage as well.

5. Several culverts at the site facilitate drainage beneath access roads. We recommend removing these culverts to disable segments of the ditch system. Removing culverts may be especially effective for wetland restoration in fields 2, 5, and 11 (Figure 3).

6. Berms are located along ditches and in Horseshoe Lake (Figure 3). Berms partition Horseshoe Lake and hinder hydrologic connection on the lake plain especially among fields 1, 7, 8, and, 9. We recommend using material from these berms to block or fill ditches. Removing berms in Horseshoe Lake may also aid wetland restoration in field 2.

7. We recommend that IDOT or other co-operating party acquire the Reese property inholding (see Figure 3). Ditches at the wetland bank extend into this parcel. Filling ditches or

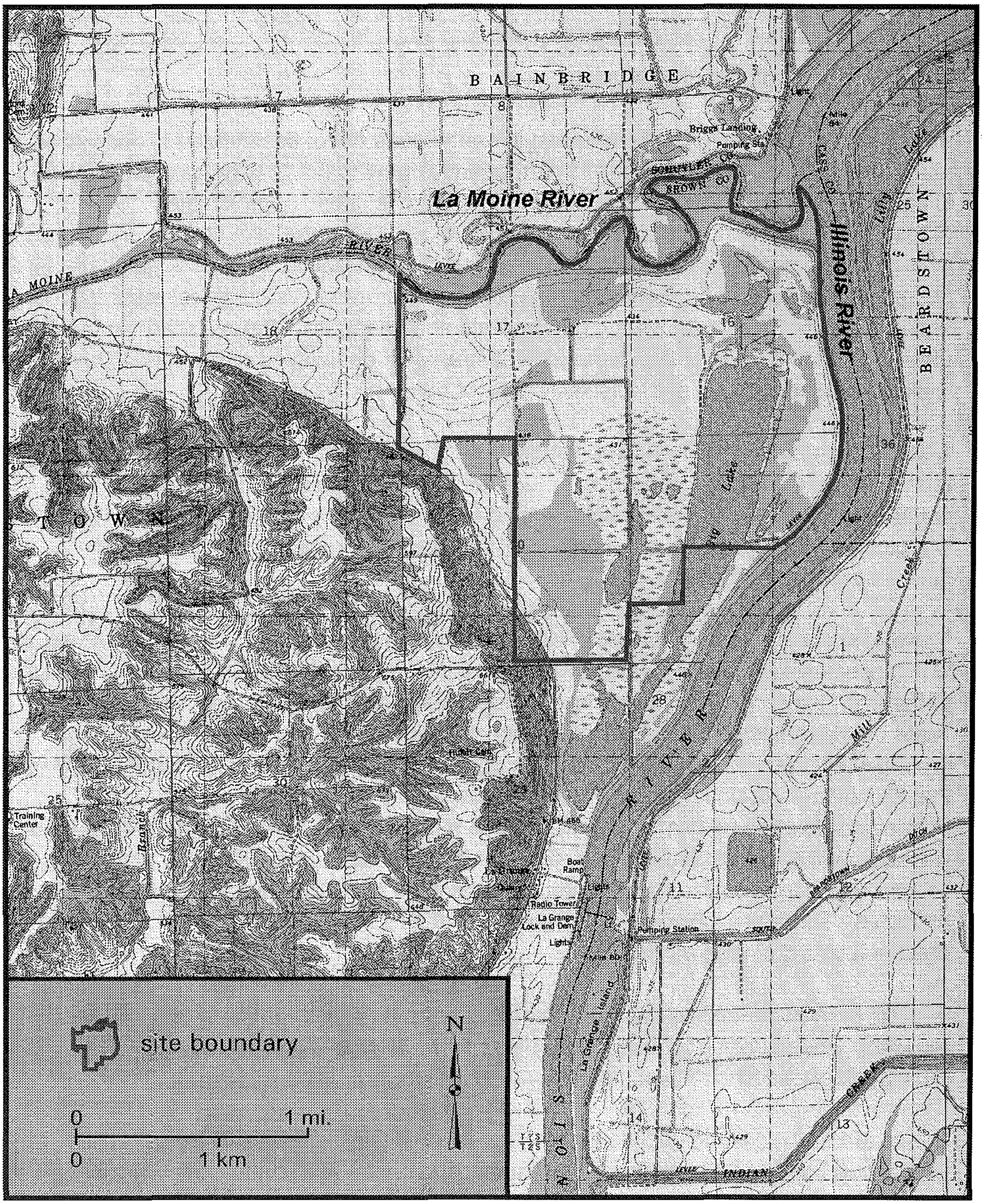

Figure 1. General study area and vicinty. Map of the La Grange Wetland Bank, Brown County, Illinois. Adapted from the USGS Topographic Series, Cooperstown,IL 7.5-minute Quadrangle (USGS 1980). Contour interval is 10 feet.

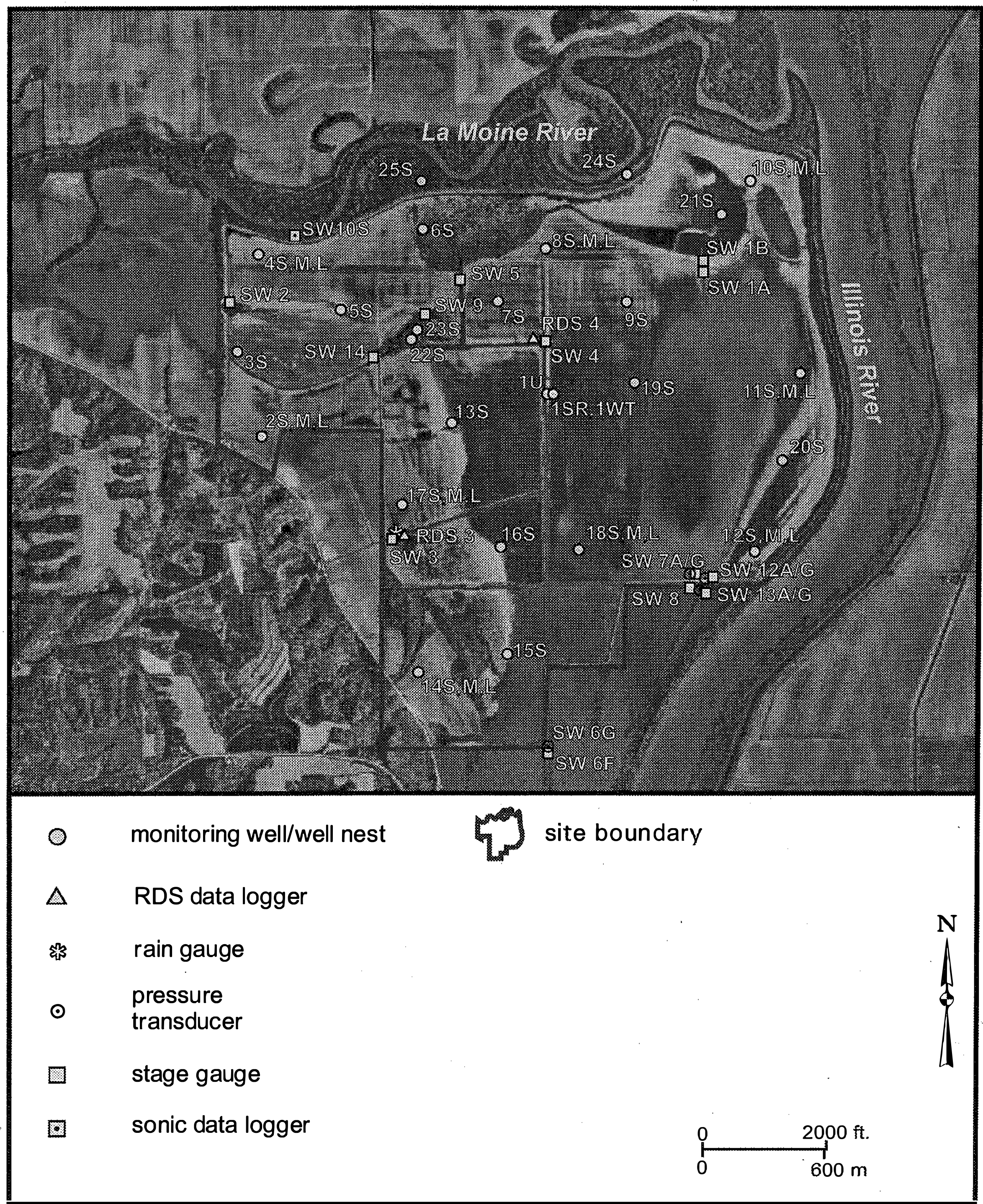

Figure 2. Instrument locations. Map of the water-level monitoring network at the La Grange Wetland Mitigation Bank, Brown County, Illinois. Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

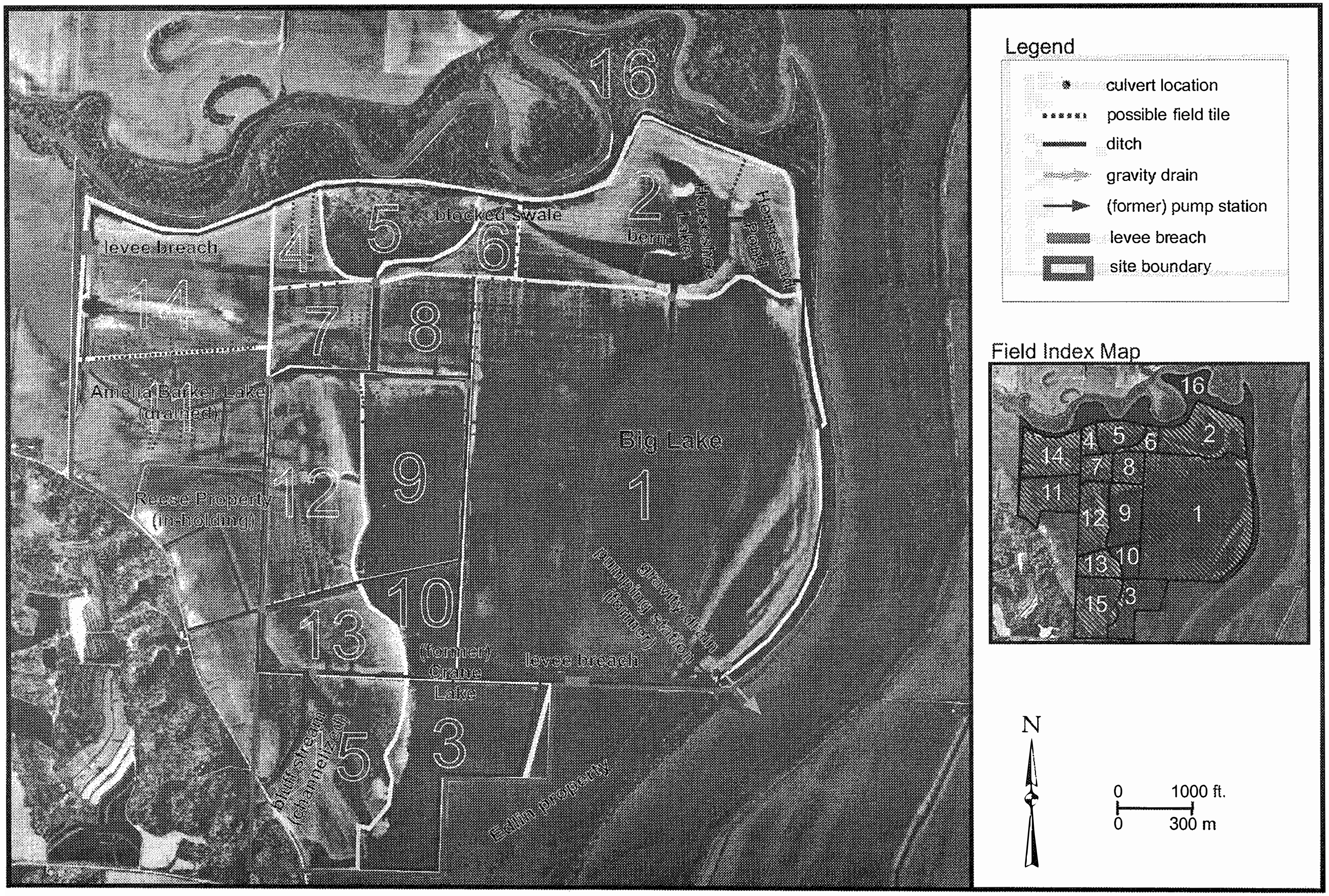

Figure 3. Hydrologic alterations. Map of various hydrologic alterations at the La Grange Wetland Mitigation Bank. A field index map is provided at the right to aid identification of various locations at the site. Maps are based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

disabling field tile that extend into this parcel could prevent adequate drainage. If the Reese property cannot be acquired, wetland restoration design should accommodate the current rate of drainage from the parcel. Instead of filling or blocking ditches in this part of the wetland bank, we suggest re-routing the ditches to promote wetland restoration without adversely affecting the adjacent parcel.

METHODS

The hydrogeology of the La Grange Wetland Mitigation Bank was characterized with focus on identifying potential water sources suitable for wetland restoration and mapping the extent of jurisdictional wetland hydrology (Fucciolo et al. 2000, 2001, 2002, 2003, and 2004). Methods included describing geologic samples from borings made during monitoring well installation, monitoring water levels in wells and surface water features, determining flood frequency, and recording precipitation at the site.

The ISGS installed 44 monitoring wells (Appendix A) at 25 locations (Figure 2) to evaluate hydraulic gradients and monitor saturated conditions near land surface. Borings for the intermediate depth wells (M-wells) and deeper wells (L-wells) were made using a CME 850 ATV drilling rig. Borings for shallow wells (S-wells and WT-well) were made with a hand auger. The geology of the site was characterized from sample descriptions made during well installation. The deepest well borings (for L-wells) were sampled at 2-ft. intervals using a split-spoon sampler. Each sample was examined in the field and properties such as texture, structure, Munsell Color (2000), and moisture were noted. Geologic descriptions of these samples are given in Appendix B.

S-wells and WT-wells were used to monitor saturated conditions near land surface. M-wells and L-wells were used to monitor deeper ground-water levels. M-wells and L-wells were developed by first surging the wells using a surge block and then by pumping them until dry or until water ran clear. For S-wells, development involved pumping only. Depths to water in the wells were measured on a biweekly basis in April, May, and June and monthly during the remainder of the monitoring period (Appendix C). Ground-water level elevations were calculated by subtracting the distance to water from the surveyed elevation of the measuring point of the wells.

Seven electronic data loggers and 13 staff gauges (SW1A, SW1B, SW2, SW3, SW4, SW5, SW6F, SW7A, SW8, SW9, SW12G, SW13G, and SW14) were installed at 11 locations across the site (Figure 2) to evaluate the duration of inundation, identify potential water sources that might be suitable for wetland restoration, and help map the extent of jurisdictional wetland hydrology. The data logger sensor types include: sonic (SW10), pressure transducer (SW6G, SW7G, SW12G and SW13G) and capacitor (RDS3 and RDS4). Depths of surface water at staff gauges were read manually on a biweekly basis in April, May, and June and monthly during the remainder of the monitoring period (Appendix C). The sonic device and the pressure transducers recorded data at 1-hour intervals and the capacitors recorded at 3-hour intervals.

The water-surface elevations for staff gauges were calculated by adding the depth of water to the elevation of the zero point on the staff gauge. For the pressure transducers, water-surface elevation was determined by adding the height of the water column above the pressure sensor to the elevation of the sensor. For the capacitors, water-surface elevation was determined by subtracting the distance to the water surface from the elevation of the measuring point for the capacitor. For sonic data loggers, water surface elevation was determined by subtracting the distance to the water surface from the elevation of sonic sensor height.

River-stage data from the La Grange Lock and Dam (U.S Army Corps of Engineers 2004) were analyzed using partial-duration series methodology. The method included tallying each flood event during each growing season for 1942-2003 and determining the duration that each event remained above specified elevations. The elevations for analysis were chosen to reflect the probability of jurisdictional wetland hydrology and annual and biennial flooding events at the site.

On-site precipitation data were recorded with a tipping-bucket rain gauge and data logger. The on-site data were supplemented with precipitation data recorded at the nearby Beardstown climate station (Station# 110492). These data were obtained from the National Water and Climate Center (NWCC) of the Natural Resources Conservation Service (NRCS) and from the Midwestern Climate Center (MCC) at the Illinois State Water Survey (ISWS).

Temperature data for Rushville, IL were also obtained from the NWCC in order to determine the length of the growing season for the region. The growing season is defined as the period between the last occurrence of 28°F temperatures in the spring and their first occurrence in the fall (Environmental Laboratory 1987). At Rushville, the median length of the growing season in 5 of 10 years for the period 1971-2000 is 207 days and it begins on April 5; 12.5% of the growing season is 26 days and 5% of the growing season is 10 days (National Water and Climate Center 2004).

Instrument and land-surface elevations were measured relative a benchmark established on site by the ISGS. The elevation of the benchmark was measured relative to the North American Vertical Datum of 1988 by IDOT. The elevations of measuring points on monitoring equipment were determined annually by ISGS using either a total station or auto-level equipment. In addition, the positions of the staff gauges, data loggers, and monitoring wells were obtained using a GPS and differentially corrected.

SITE CHARACTERIZATION

Regional Setting

The La Grange Wetland Mitigation Bank is located along the west bank of the Illinois River at the confluence of the La Moine and Illinois rivers (Figure 1). The property extends from the bluff on the west to the Illinois River on the east and from the La Moine River on the north to the levee that bisects Big Lake on the south. Since 1889, when the La Grange Lock and Dam was constructed approximately 2 mi. downstream of the site, the U.S. Army Corps of Engineers has controlled water levels to facilitate commercial navigation in the Illinois River. Like many other floodplain areas along the lower Illinois River, this site has been levee-protected and drained for agriculture. Systematic conversion of the floodplain to crop land at the site began with the establishment of the Big Prairie Levee and Drainage District in 1916 (Thompson 2002). The Big Prairie Levee and Drainage District has since been dissolved and currently drainage control on the site is at the discretion of the property owner.

Geomorphology and Geology

Natural landforms mapped at the site by Hajic (2000) include alluvial fans, river terraces in the southwest portion of the site along the flanks of the bluff, and paleochannels, natural levees, floodplain lakes and floodplain across the rest of the site. Several of these landscape units are mapped as having post-settlement overbank deposits, which suggest past frequent flooding and sedimentation at the site. Few natural drainage features currently exist at the site due to extensive hydrologic alteration.

The site overlies the western flank of the Illinois River bedrock valley (Herzog et al. 1994). Bedrock consists of the lower part of the Mississippian-age Valmeyeran Series (Willman et al. 1967, Willman et al. 1975). The lower Valmeyeran Series rocks consist of interbedded cherty limestones, siltstones, and shales. Bedrock in the vicinity is overlain by 15 to 30 m (50 to 100 ft.) of Quaternary deposits (Piskin and Bergstrom 1975). Cahokia Formation alluvial deposits are mapped over most of the site (Hansel and Johnson 1996, Lineback 1979, and Willman 1973). Cahokia Formation deposits are reported as being greater than 6.0 m (19.7 ft.) thick and overlie more than 6.0 m (19.7 ft.) of outwash sand and gravel of the Henry Formation (Berg and Kempton 1988).

Forty-four geologic borings at 25 locations were drilled. Most borings intersected interbedded materials ranging in texture from silty clay to sand and gravel (Figure 4). Wells were installed in each boring, however some deeper wells could not be installed to the boring completion depth due to collapse of saturated sediments into the hole (e.g. Figure 4, 17L). Shallower borings revealed fine-grained materials to a depth of at least 3.9 m (13.0 ft.). Deeper borings were terminated in saturated fine sand or sand and gravel at depths between 4.3 and 11.0 m (14.0 and 36.0 ft.) below land surface. Generally, materials observed became coarser with increasing depth and proximity to the bluff. Finer materials were encountered nearer to land surface and closer to the Illinois River. Appendix B contains detailed descriptions and graphic logs for each boring. Textural differences are attributable to differing depostional processes in various locations. Coarser texture materials along the flanks of the bluff and in northwest portions of the site suggest hillslope processes and recent higher-energy fluvial deposition. Coarser materials at depth reflect past glaciofluvial depositional processes. Finer surface materials along the La Moine and Illinois rivers suggest sediment deposition during floods in

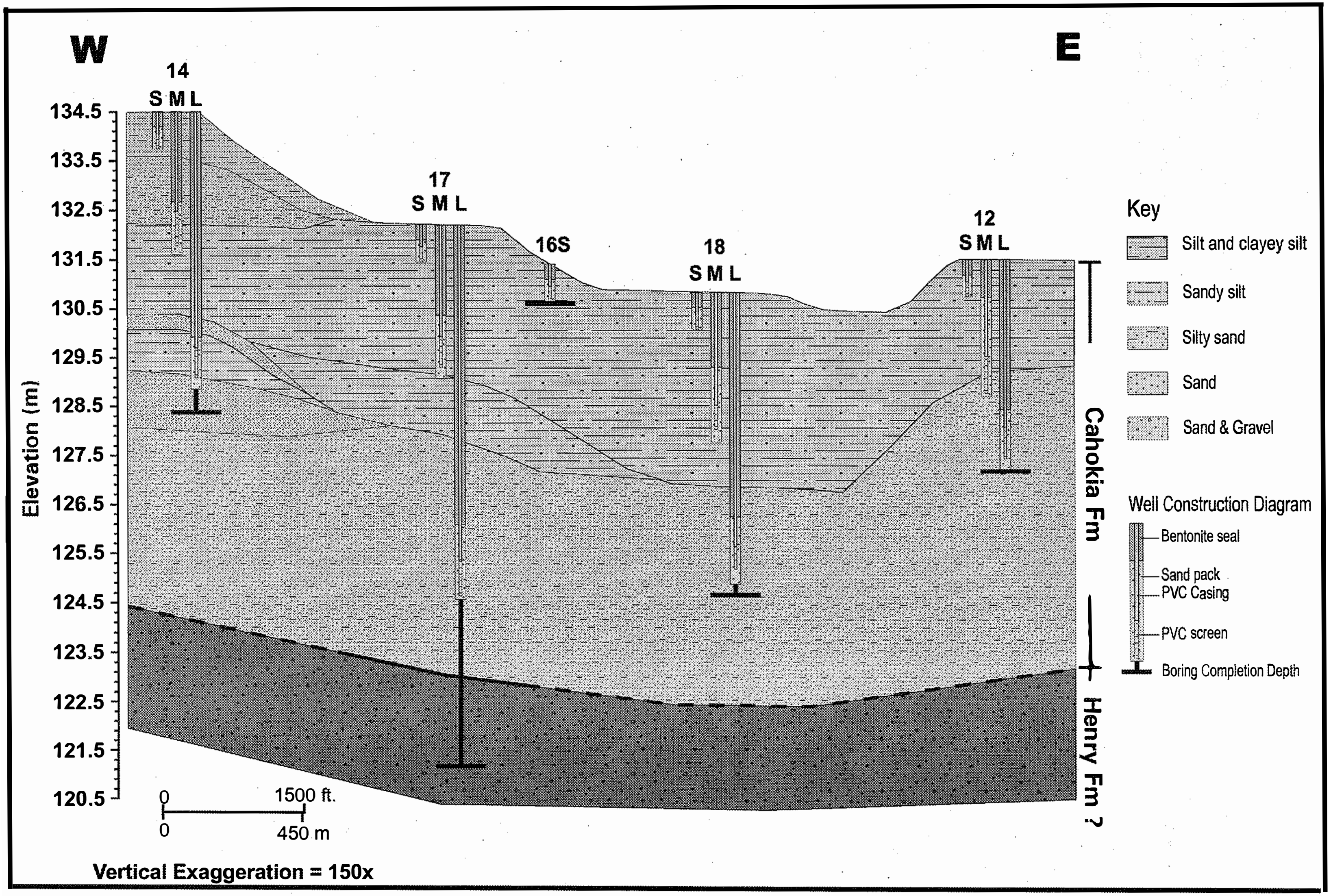

Figure 4: Geologic cross-section. Profile shows deposits encountered during well installation at the La Grange Wetland Mitigation Bank. Collapse of saturated sediments into the bore hole prevented installation of some wells to the boring completion depth.

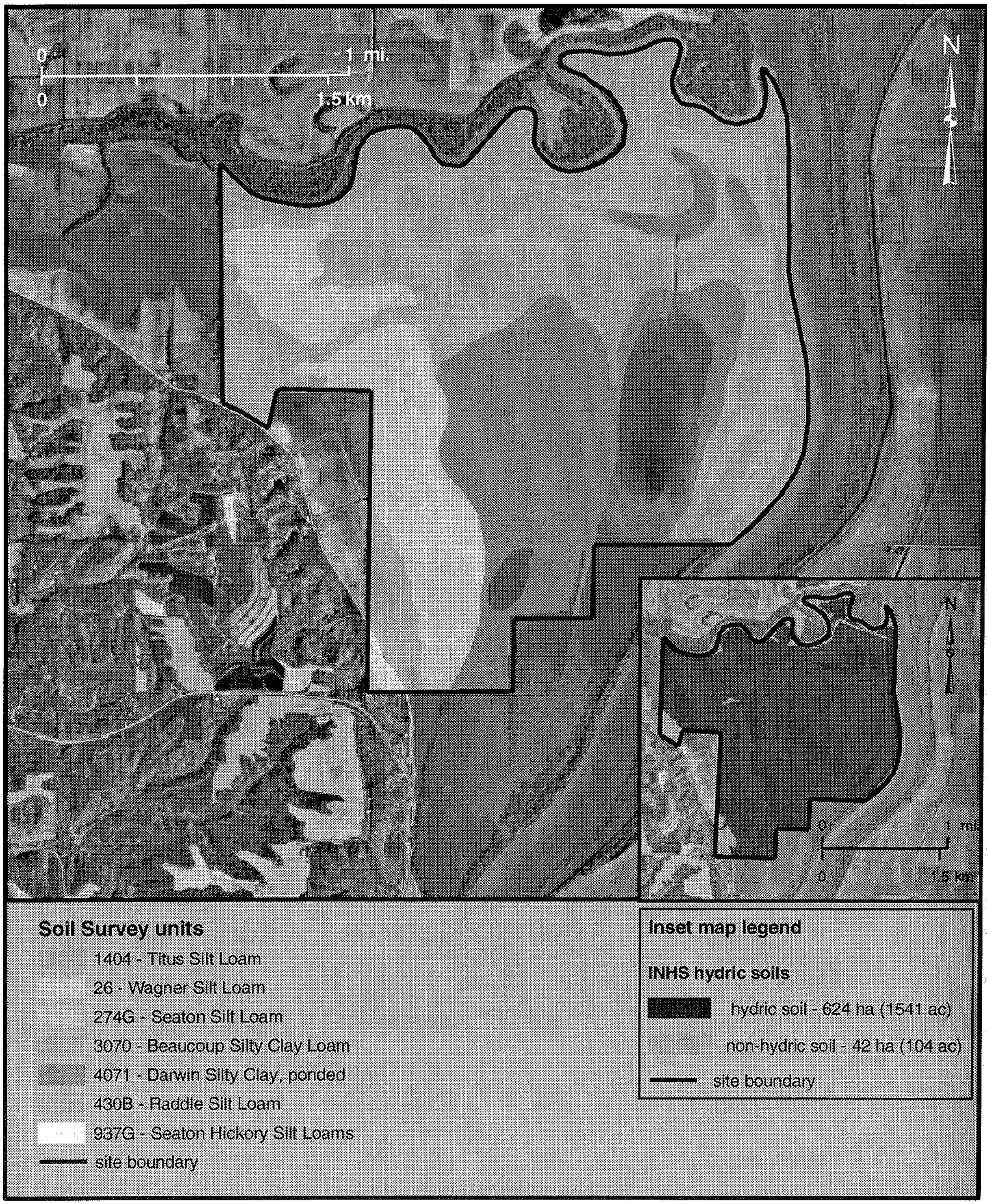

Figure 5. Soils map. The large map shows soils mapped by the Soil Survey (U.S. Department of Agriculture 1988). The inset map shows hydric soils mapped by the Illinois Natural History Survey (Busemeyer et al. 2001). Maps are based on USGS digital aerial photograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

northern and eastern portions of the site. Modern sediment deposits resulting from flooding were observed in these locations during this study.

Soils

The soils at the site are primarily in the Darwin-Titus-Beaucoup Association. Hydric soils are mapped over 581 ha (1435 ac.) of the parcel (Figure 5 and Table 1). They include Wagner silt loam, Titus silty clay loam, wet, Beaucoup silty clay loam, frequently flooded, and Darwin silty clay, ponded (U.S. Department of Agriculture 1988). These soils are on both the state and county lists of hydric soils (U.S. Department of Agriculture 1991, U.S. Department of Agriculture 1995) and have slow to moderately slow permeability rates that facilitate ponding and saturation. The Raddle silt loam is mapped on alluvial slopes near the bluff, has a moderate permeability rate, and is not on either the state or county hydric soils list.

Samples from well borings revealed that soil colors at this site range from very dark gray (10YR3/1) to light brown-gray (2.5Y6/2). In lower portions of the site where hydric soils were mapped, soil borings revealed redoximorphic features including mottling and iron/manganese nodules were common within the upper 30 cm (1 ft.) of the soil. Soil structure is generally subangular blocky (Appendix D) and a plow zone 15 to 30 cm (0.5 to 1.0 ft.) in depth was commonly observed.

Table 1: Hydrologic properties of on-site soil types (U.S. Department of Agriculture 1988).

Soil Name (code)	State Hydric	County Hydric	Permeability (in./hr)	Flooding (frequency, duration)	Depth to Seasonal High Water Table
Wagner silt loam (26)	yes	yes	0-8 in.: 0.2-0.6 8-16 in.: 0.2-0.6 16-60 in.: <0.06	occasional, brief	0.0 to 2.0 ft.
Raddle silt loam (430B)	no	no	0-17 in.: 0.6-2.0 17-60 in.: 0.6-2.0	rare	>6.0 ft.
Titus silty clay loam, wet (1404)	yes	yes	0-12 in.: 0.06-0.2 12-60 in.: 0.06-0.2	frequent, brief	+0.5 ft. to 2.0 ft.
Beaucoup silty clay loam, frequently flooded (3070)	yes	yes	0-11 in.: 0.2-0.6 11-60 in.: 0.2-0.6	frequent, brief	+0.5 ft. to 2.0 ft.
Darwin silty clay, ponded (4071)	yes	yes	0-20 in.: <0.06 20-60 in.: <0.06	frequent, long	1.0 ft. to 2.0 ft.

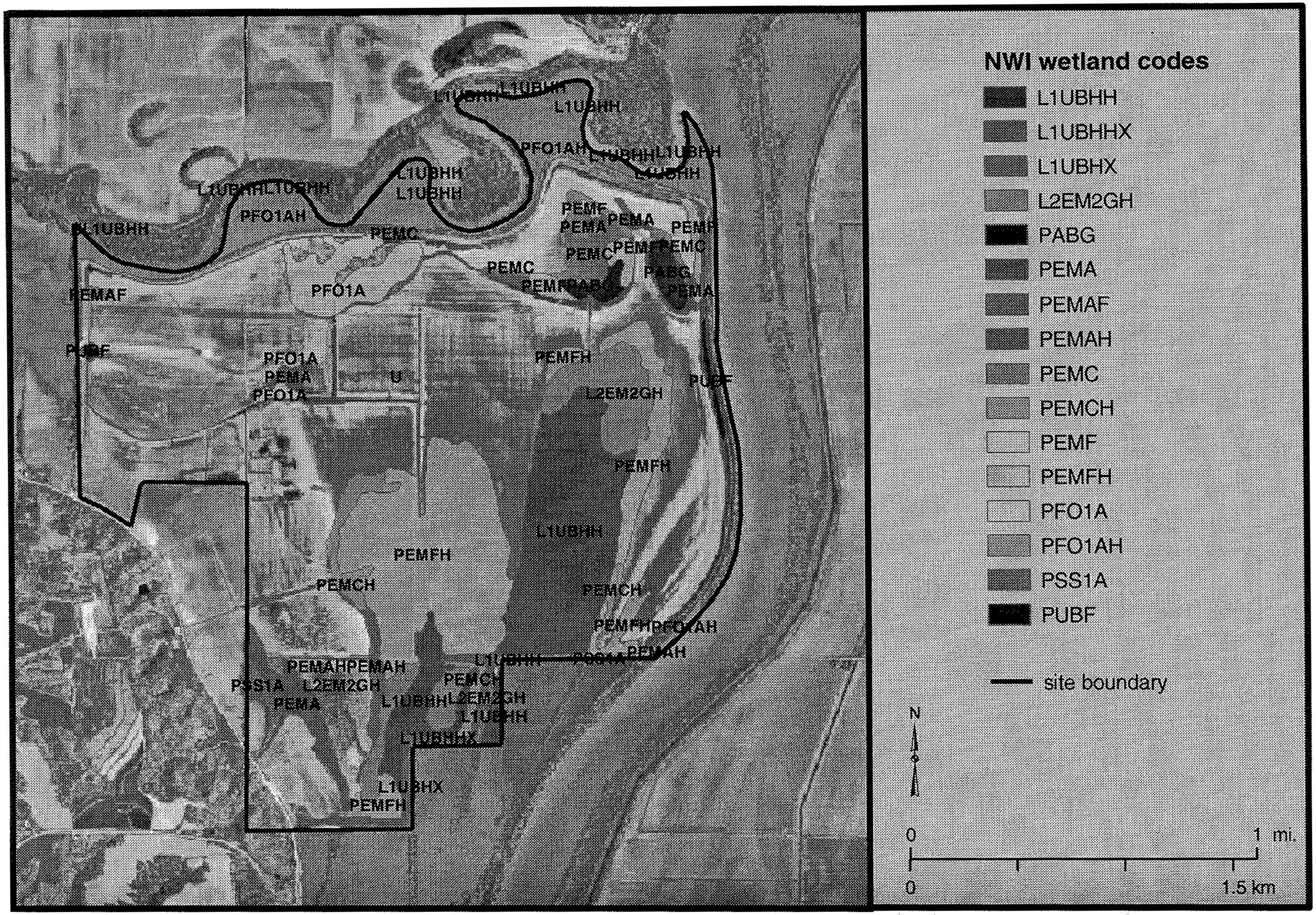

Figure 6. NWI wetlands. Figure shows wetlands mapped by the National Wetlands Inventory at the La Grange Wetland Mitigation Bank (U.S. Fish and Wildlife Service 2004). Explanation of NWI codes is given in Appendix E. Map based on USGS digital aerial photograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

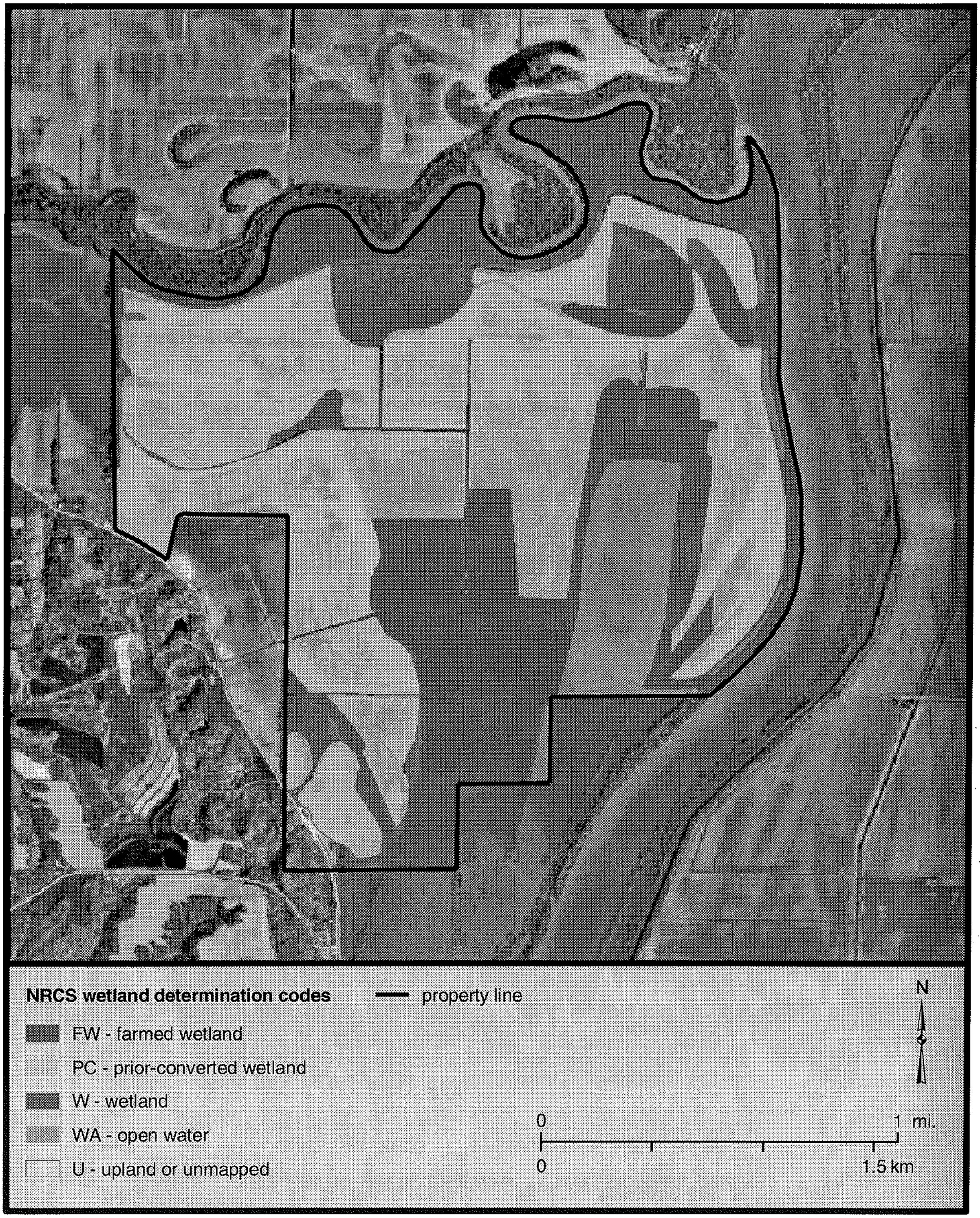

Figure 7. NRCS wetland determinations. Map showing wetland status as determined by the Natural Resources Conservation Service at the La Grange Wetland Mitigation Bank (U.S. Department of Agriculture 2001). Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

Mapped Wetlands

Large areas of wetland and drained wetland have been mapped at the site. Large portions of the site were historically mapped as marsh or swamp (Figure 1). The NWI mapped 17 wetland classes, including farmed and diked/impounded wetlands, covering 281.5 ha (695.6 ac.) or 42.3% of the site (Figure 6 and Appendix E). In 2000, the INHS (Busemeyer et al. 2001) delineated 242.5 ha (599.2 ac.) of wetland at the site (Appendix F) and the NRCS (U.S. Department of Agriculture 2001) determined that 51% of the site is prior-converted wetlands (Figure 7 and Table 2). The large area of designated prior-converted wetland suggests that if drainage of converted crop land (i.e. drained wetlands) is reversed, then these areas may revert to wetlands.

Table 2: NRCS wetland determinations and corresponding area and percent coverage at the La Grange Wetland Mitigation Bank (U.S. Department of Agriculture 2001).

Code	Description	Area	% of site
PC	prior-converted wetland	342.4 ha (846.1 ac.)	51.4
FW	farmed wetland	142.0 ha (351.0 ac.)	21.3
W	wetland	114.3 ha (282.4 ac.)	17.2
WA	water	47.7 ha (117.9 ac.)	7.2
U	upland or unmapped	19.0 ha (46.9 ac.)	2.9

Hydrology

Surface-water, ground-water, and precipitation data were collected to evaluate the influence of water sources on site hydrology, identify water sources that might be suitable for wetland restoration, and map the extent of wetland hydrology. The Illinois River is the predominant influence on site hydrology. Contributions from the La Moine River, channelized streams, and runoff from adjacent uplands are secondary but significant influences on site hydrology.

Climate

Based on the data collected from the MCC weather station at Beardstown (Midwest Regional Climate Center 2004), average annual precipitation is 35.79 in. On average, April through November are typically wetter months, with greater than 3.00 in. of precipitation (Appendix G). Averages for January February, March, and December are less than 3.00 in., indicating that a dry pattern is typical of late fall and winter. Most annual precipitation falls between April and August with peak monthly precipitation occurring in May.

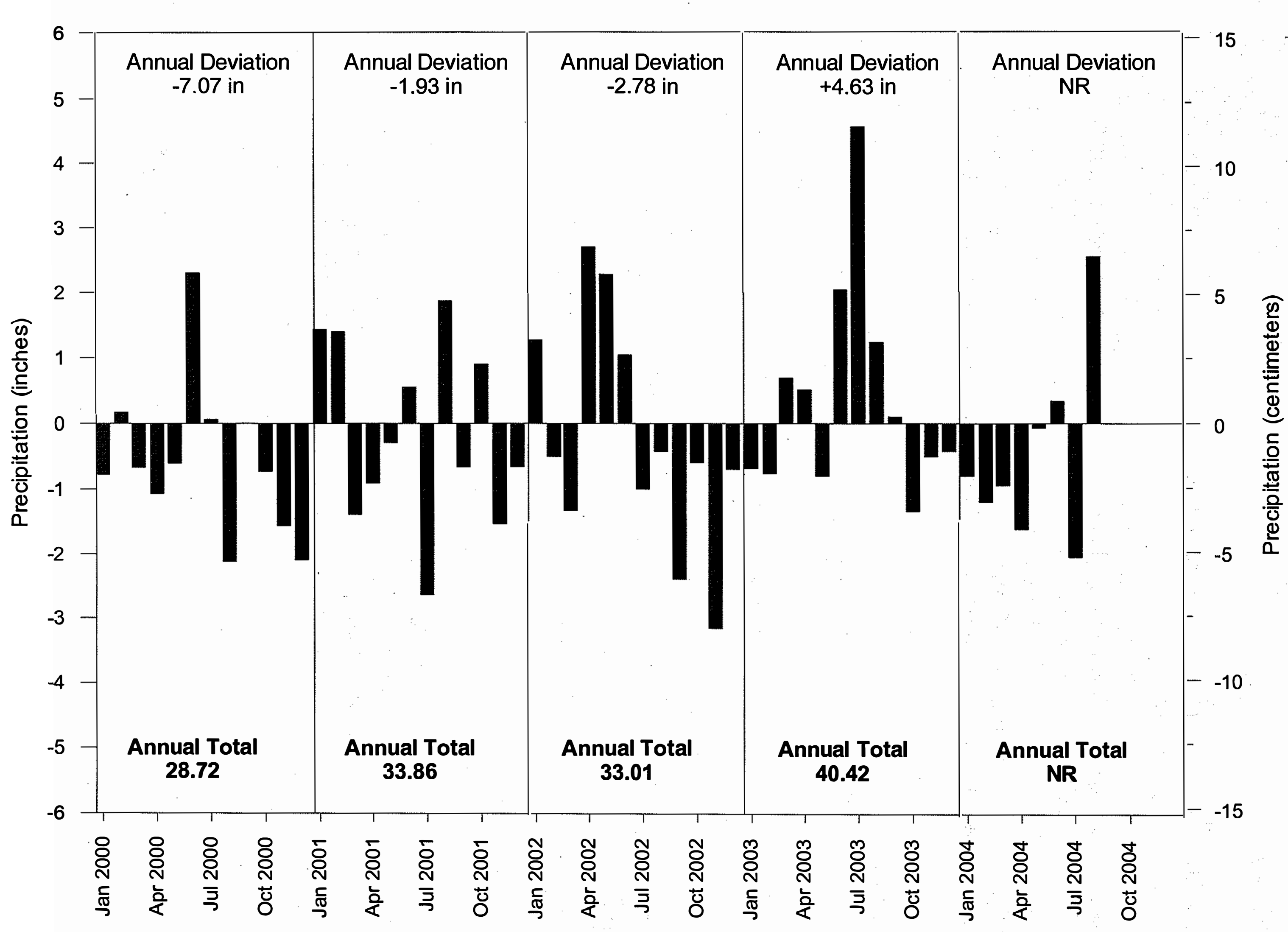

Figure 8. Deviation of observed monthly precipitation from the 30-year average. Graphed values are from the period January 2000 through August 2004 (Midwestern Regional Climate Center 2004). Annual total precipitation is shown in bold black type. Deviation of annual total precipitation from the 30-year average of 35.79 in. (90.91 cm) is shown in blue type. 'NR' indicates that the annual total was not reported because only partial data for the year was provided.

Drier than average conditions prevailed during this study. Annual precipitation totals for 2000, 2001 and 2002 were below the 30-year average although total annual precipitation for 2003 exceeded the 30-year average (Figure 8). The driest year was 2000 with annual precipitation totaling 30.12 in., or 5.67 in. less than normal. The wettest year was 2003 when observed precipitation totaled 40.42 in., or 4.63 in. greater than normal. During the period January 2000 through August 2004, observed monthly precipitation was below average in 34 of 56 months, and exceeded average values in successive months only 5 times during this study. The most sustained wetter-than-average period occurred during May through August 2003. Sustained drier-than-average periods occurred during July 2002 through February 2003, and October 2003 through May 2004 (Figure 8).

Surface Water

The most significant potential water source at this site is flooding from the Illinois River. Analysis of 62 years of Illinois River stage records at the La Grange Lock and Dam (U.S. Army Corps of Engineers 2004) shows that, if levees had not been in place, floods that lasted for 12.5% of the growing season would have inundated areas below 131.7 m (432.1 ft.) and covered 281 ha (696 ac.) in 5 of 10 years on average. Floods that lasted for 5% of the growing season would have inundated areas below 132.5 m (434.7 ft.) and covered 443 ha (1095 ac., Figure 9) in 5 of 10 years on average (Table 3).

Table 3: Results of a partial-duration series analysis of pool stage at the La Grange Lock and Dam for the period of record 1942-2003 (U.S. Army Corps of Engineers 2004). These results only address areas inundated and do not reflect soil saturation after floods recede.

River stage exceeded (NAVD,1988)	Number of events	Recurrence interval (years)	Exceedance probability (%)	% of site inundated	*Potential Area Inundated
133.6 m (438.3 ft.)	32	2.0	47.6	84.7	564 ha (1394 ac.)
132.9 m (436.0 ft.)	63	1.0	100.0	72.2	481 ha (1189 ac.)
132.5 (434.7 ft.)**	78	0.8	168.0	66.6	443 ha (1095 ac.)
131.7 (432.1 ft.)***	105	0.6	124.5	32.4	281 ha (696 ac.)

* area inside of the levee only

** elevation inundated for 5% of the growing season in at least 5 of 10 years on average

*** elevation inundated for 12.5% of the growing season in at least 5 of 10 years on average

Flood frequency during the growing season at the site is shown in Figure 10. The elevation of the statistical annual flood during the growing season for the period or record 1942-2003 (U.S. Army Corp of Engineers 2004) was 132.9 m (436.0 ft.) and was exceeded 4 times (in 3 of 5 years) during this study. Due to the presence of levees or levee remnants, the site was inundated only twice by direct flooding: when the levees were breached in 2002, and

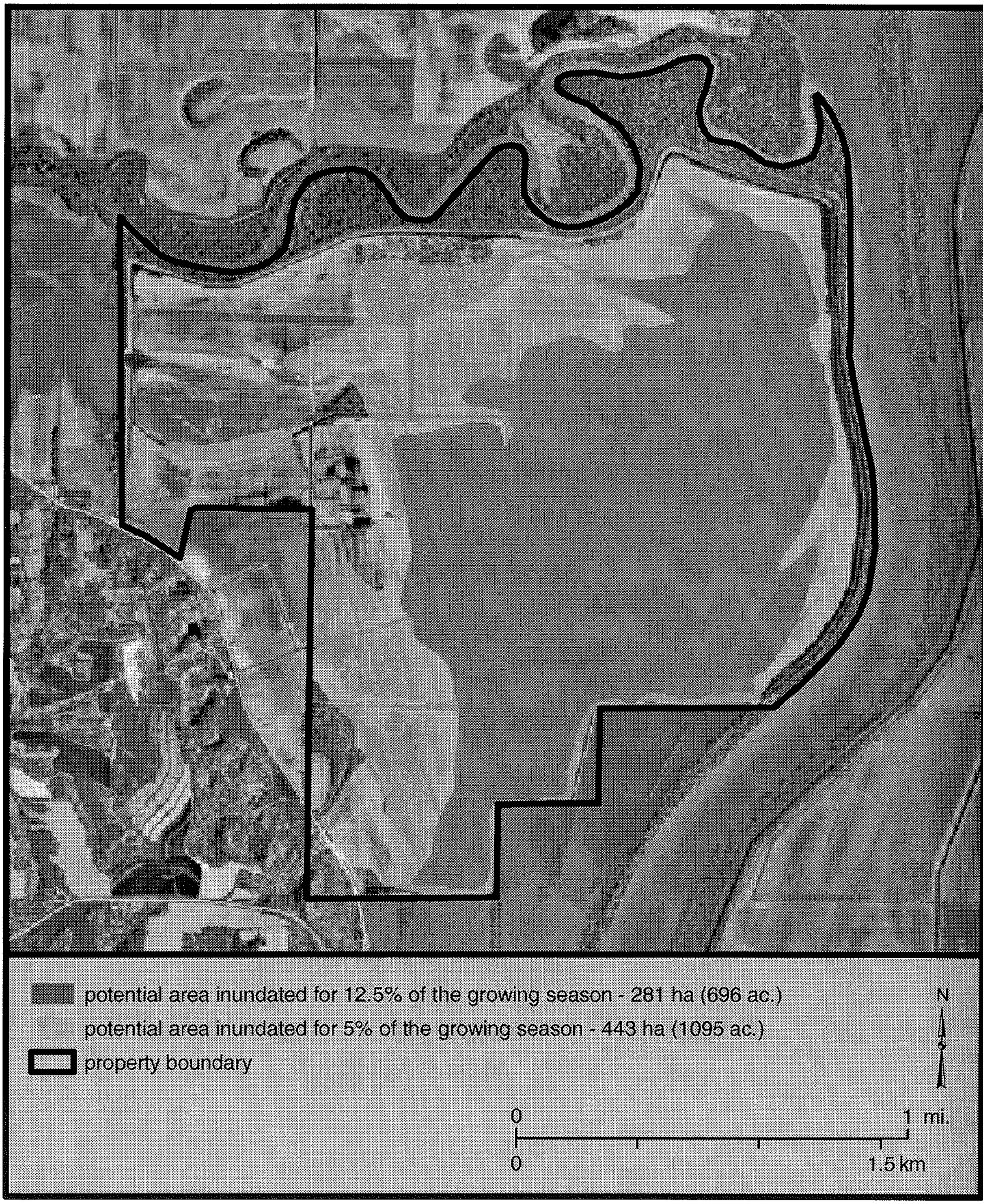

Figure 9. Long-term wetland hydrology potential from Illinois River flooding. Respectively, light green and dark green colors represent the area that would have flooded for greater than 5% and 12.5% of the growing season in 5 of 10 years on average during 1942-2003 if levees had not been present. Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

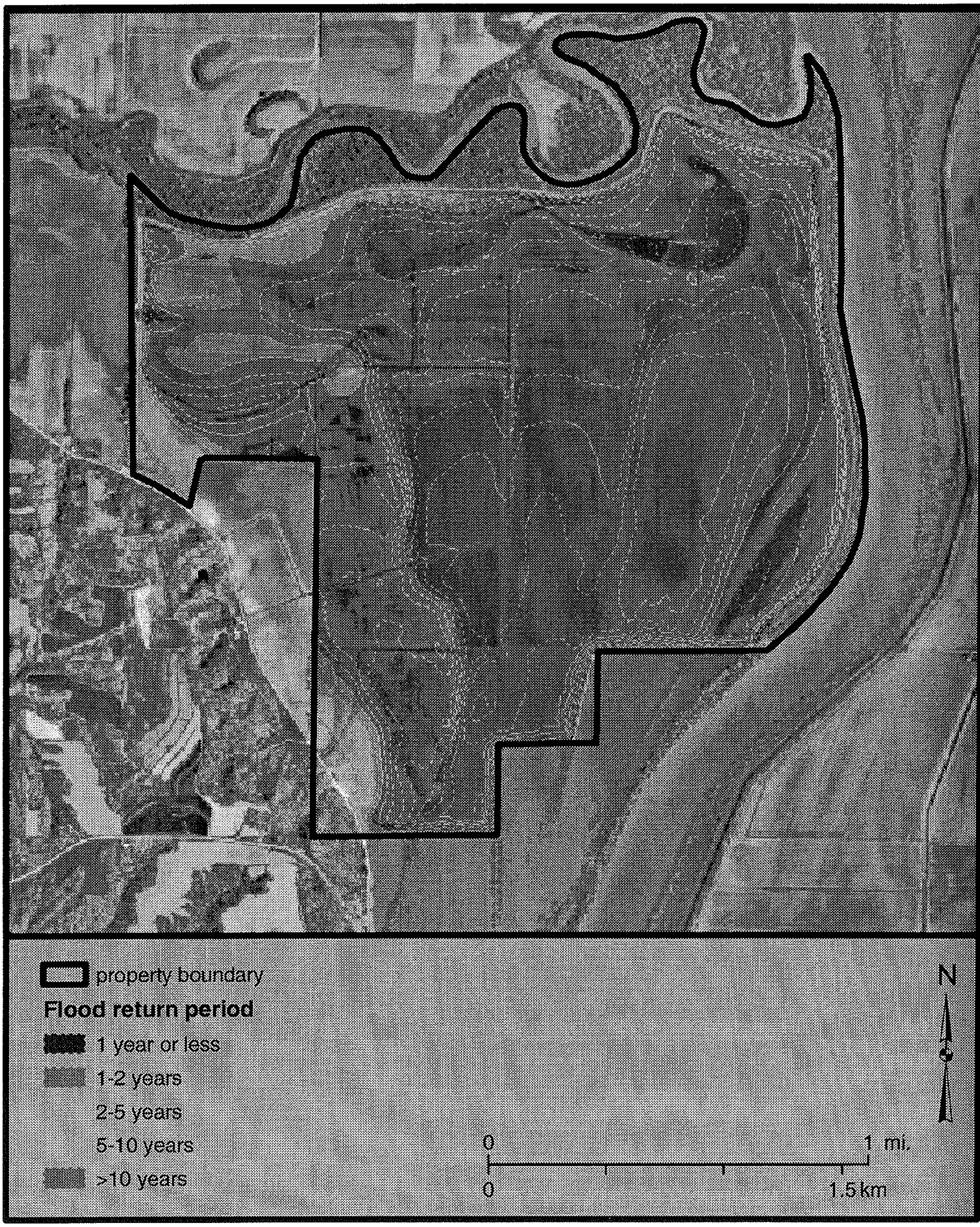

Figure 10. Illinois River flood frequency during the growing season. Color shading represents the average return interval of flooding during the growing season if levees were not present. Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

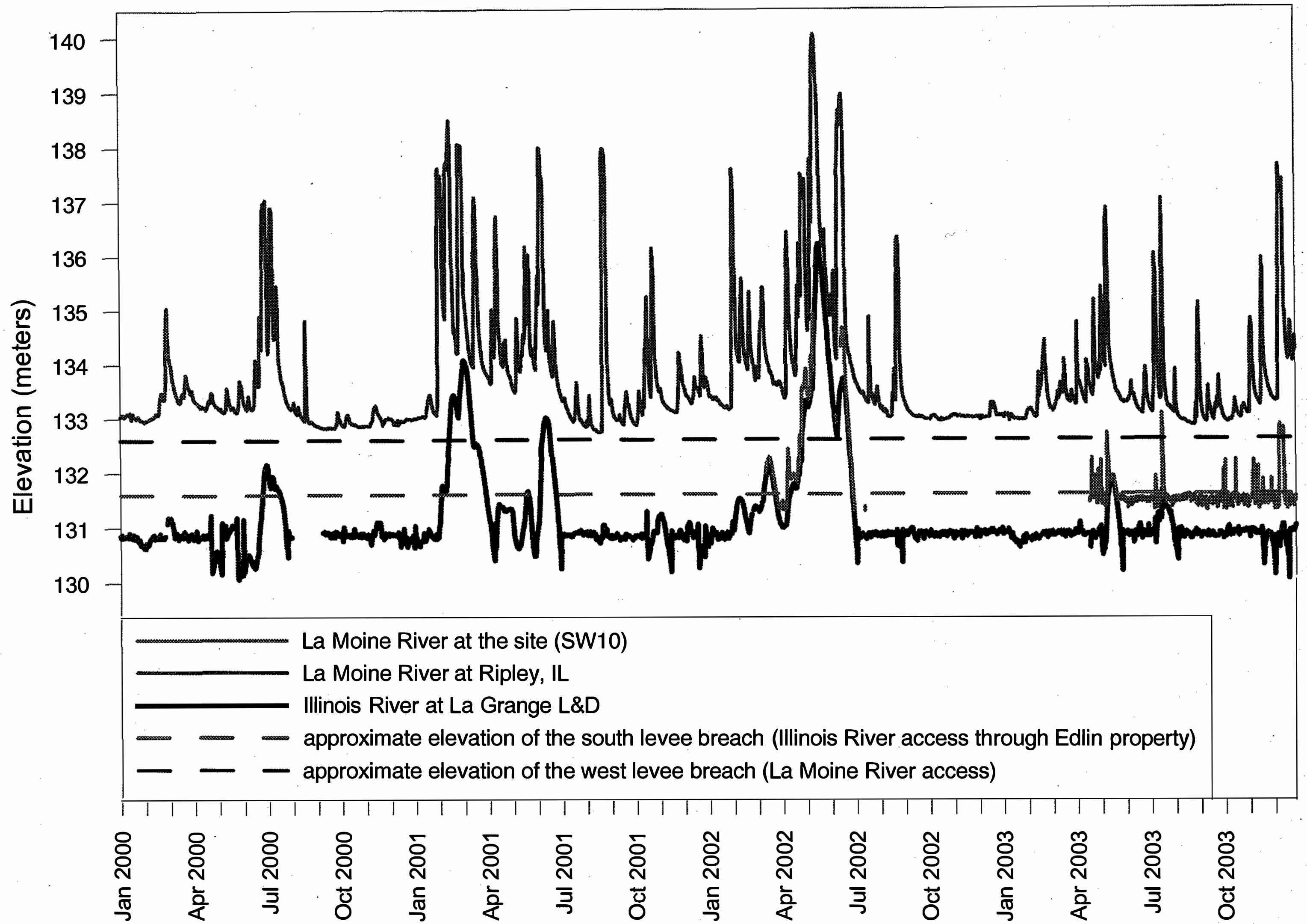

Figure 11. La Moine River stage. Data from on-site and upstream at Ripley, IL (U.S. Geological Survey 2004) relative to Illinois River stage (U.S. Army Corps of Engineers 2004) and the elevations of the levee breaches.

in 2004, when the Illinois River entered the site through the levee breach at the south end of the site.

Flooding from the La Moine River is also a potential water source for restoring wetland hydrology, though less significant than Illinois River flooding. During this study, the La Moine River stage was recorded at gauge SW10 (Figure 2), approximately 2 miles upstream from the confluence with the Illinois River. Comparison of La Moine River stage and Illinois River stage shows close correspondence when Illinois River stage is above 131.6 m (431.8 ft.) indicating back flooding of the Illinois River into the La Moine River channel (Figure 11). However, flooding from the La Moine River could also contribute water to the site independently of the Illinois River during local precipitation events within the La Moine Basin. The flood frequency of the La Moine River at the site could not be determined from the limited record, although the hydrograph from station SW10 shows that La Moine River floods briefly exceeded the average site elevation at 132.0 m (433.1 ft.) several times during 2002-2003. Comparison of on-site data to the corresponding La Moine River data from the U.S. Geological Survey gauging station at Ripley, IL, approximately 9 miles upstream, suggests that floods of this magnitude have occurred at least once annually since 1993. Given the short duration of the La Moine River floods, it is unlikely they could fully inundate the site, but they could provide sporadic water input.

Small intermittent streams convey runoff from adjacent uplands to the site. Water from these streams flows through the on-site ditch system to Big Lake. Water-level data collected in ditches (stations SW3 and SW4) and Big Lake show that the ditches contribute to water-level rise in Big Lake independently of the adjacent rivers following intense local precipitation events (Figure 12). Also, water levels in the ditches follow a seasonal pattern similar to water levels in wells. Generally, water levels in the ditches rise during the fall season as evapotranspiration decreases, remain steady or gradually increase from fall through spring, and then decrease through summer as evapotranspiration increases. The similarity of water-level trends in the ditches and nearby wells suggests that the ditches intersect the local water table.

The relative influence of the various water sources described above is illustrated by the hydrographs in Figure 12. Comparison of graphs A, B, and C shows that direct flooding of the site leads to sustained inundation and greater area of jurisdictional wetland hydrology, whereas precipitation, on-site ditches, and indirect flooding through the gravity drain provide enough water to promote wetland hydrology to a lesser extent. Graph A shows that the levee and existing gravity drain, even when opened, significantly attenuate the influence of Illinois River flooding that remains below the threshold of the levee breach. Although the Illinois River reached 131.8 m (432.4 ft.) on May 18, 2003, the water-level in Big Lake peaked at only 131.4 m (431.1 ft.) 6 days later. Approximately 121 ha (300 ac.) more of the site would have been inundated if the Illinois River could have flooded the site unimpeded by the levee remnants. Graph B shows abrupt water-level rise in response to heavy rainfall. On July 18, 2003, 5.25 in. of rain fell, causing water-levels in ditches to rise 0.8 m (2.6 ft.) in 3 hours. Subsequently, the water level in Big Lake rose 0.3 m (1.0 ft.) within 7 hours. While

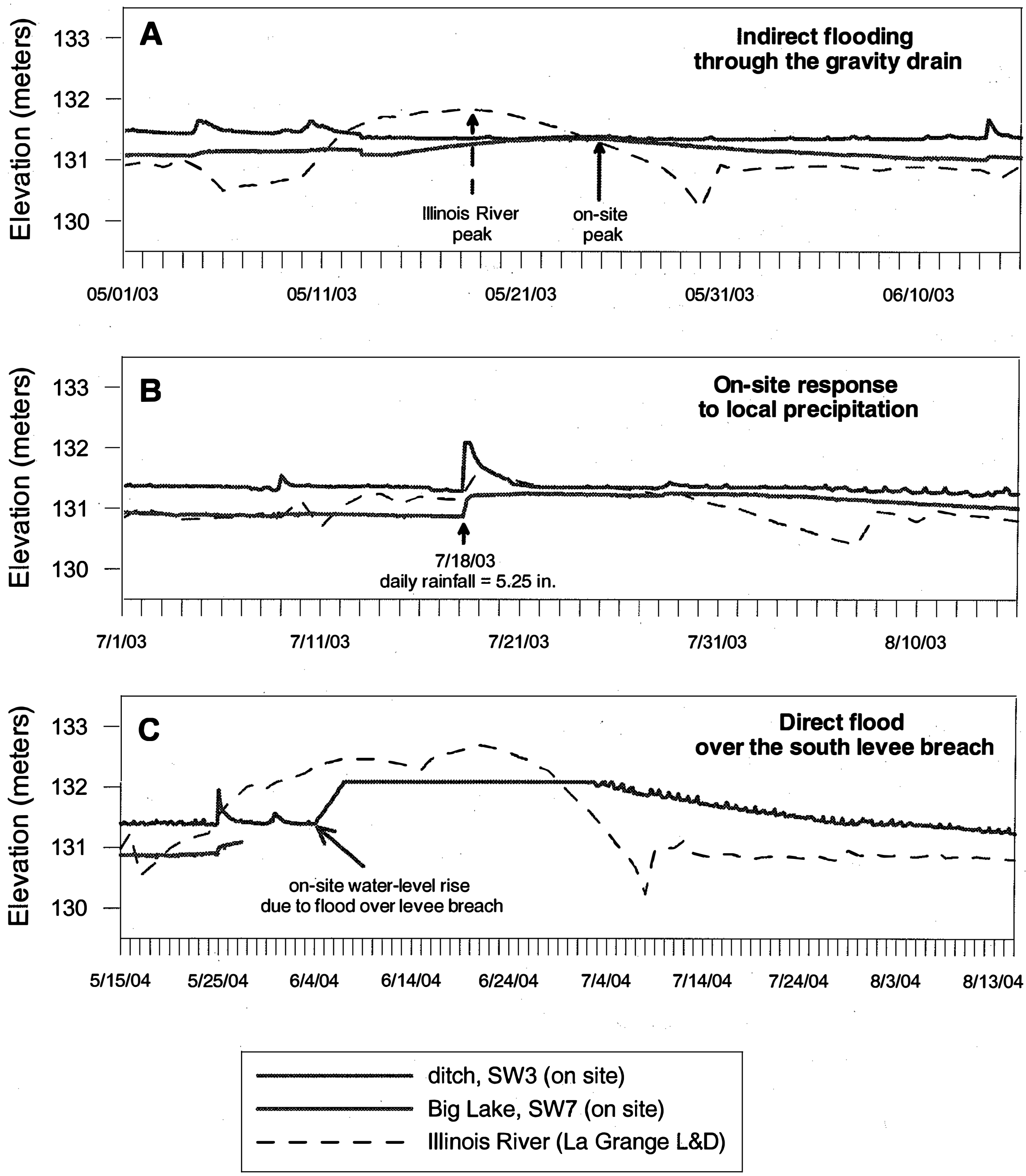

Figure 12. On-site surface-water response. Graphs show A) backup of an Illinois River flood through the gravity drain, B) an intense on-site precipitation event in excess of 5 inches, and C) direct flooding from the Illinois River.

surface water levels rose abruptly, heavy precipitation did not lead to widespread, long-term inundation. Water level in Big Lake rose sharply and remained steady while water levels in ditches fell quickly suggesting that the ditches are effective at draining higher areas. This suggests that focusing part of the wetland restoration strategy on filling or blocking the ditches will promote inundation and retention of water in higher areas of the site. Graph C shows the result of direct flooding at the site. The site began to flood on May 26, 2004 after Illinois River stage surpassed the threshold elevation of the south levee breach at 131.7 m (432.1 ft.). The water level on site rose gradually until it equalized with the Illinois River approximately 14 days later. Direct flooding led to inundation of approximately 443 ha (1095 ac.).

Ground Water

Ground-water levels in wells were measured to describe seasonal trends, identify hydraulic gradients, estimate flow directions, and detect soil saturation. The objective of the ground-water data collection was to assess water sources supplying current wetlands and to identify potential water sources for wetland restoration areas. Generally, downward hydraulic gradient and the close correspondence of shallow ground-water levels with precipitation and flood events suggests that the potential for ground-water input to restored wetlands is low relative to surface-water sources.

Seasonal water-level trends in wells were similar across the site. The maximum observed water levels generally occurred during spring, followed by a period of drawdown through late summer or early fall, when water in wells reached minimum levels. From late fall through early winter, water levels again gradually increased. More pronounced water-level rises during late winter and early spring months corresponded to stage rise in the Illinois and La Moine rivers. Gradual water-level rise corresponding to low monthly potential evapotranspiration rates beginning in fall and continuing through winter months may indicate ground-water recharge (Hensel 1992, Appendix G), but could also indicate increased hydrostatic pressure due to various processes including increased moisture content in the soil, rise in surface-water levels, and precipitation effects.

A downward hydraulic gradient, which typically indicates recharging conditions, generally characterizes ground-water hydrology at the site. Water levels measured in nested wells generally showed weak downward to near neutral hydraulic gradients during this study (Appendices C and D, Figures 13 and 14). Wells screened at higher elevations generally showed higher water levels. L-wells were screened in coarse-grained materials composed mostly of sand, except 4L and 2L which were screened in fine-grained deposits (Figure 4 and Appendix B). At most nests, M- and S-wells were screened in fine-grained deposits composed mostly of silt. In each of the L-wells, water levels remained within the unit in which they were screened through the duration of the study. However, water levels in L-wells at each nest were generally lower in elevation or near the same level as water levels in intermediate-depth (M) and shallow (S, WT) wells. Water levels in M- and S- and WT-wells were very similar at several well nests (e.g. nests 8, 10, 11 and 12) indicating neutral hydraulic gradient within the

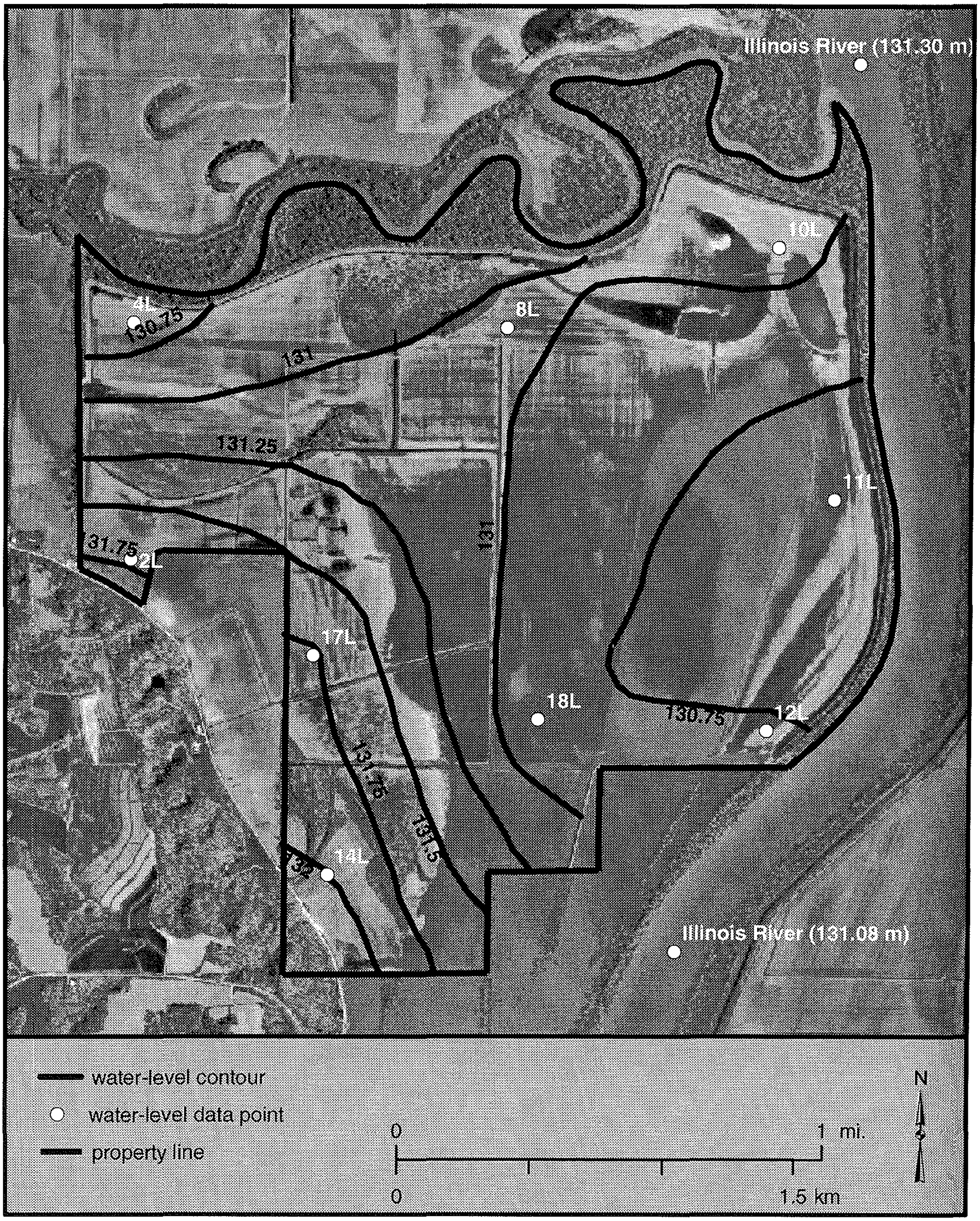

Figure 13. Water-level contours (deep wells). Water-level contours were drawn from water levels measured in deep wells at the La Grange Wetland Mitigation Bank on 4/8/2003. Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002). Contour interval is 0.25 m.

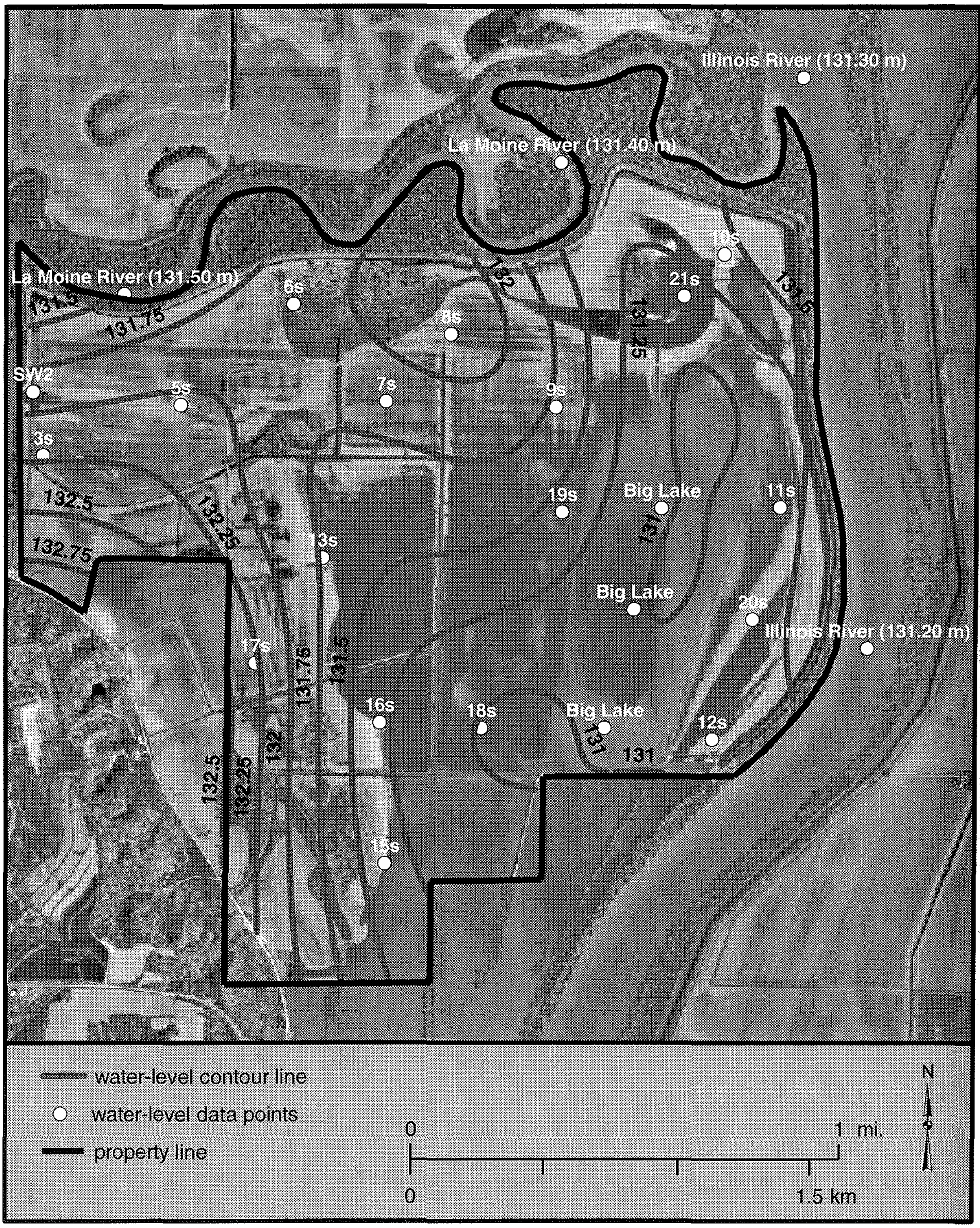

Figure 14. Water-level contours (shallow wells). Water-level contours were drawn from water levels measured in shallow wells at the La Grange Wetland Mitigation Bank on 4/8/2003. Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002). Contour interval is 0.25 m.

fine-grained geologic materials in those locations. Water levels at other well nests (e.g. 2, 14, and 17) suggest downward hydraulic gradients through the fine-grained deposits. Data did not clearly indicate upward hydraulic gradients or groundwater discharge during this study, although land-surface saturation observations and aerial photography suggest that ground-water discharge may be occurring in the vicinity of wells 13S, 15S, and 16S which are each located at a break in slope. Determination of localized ground-water discharge would require installation and monitoring of additional wells in these locations.

Ground-water flow direction was inferred from water levels measured in S- and L- wells on April 8, 2003 (Figures 13 and 14). Water-level data recorded on this date were used because they provide an example of high overall water levels during the early growing season with minimal influence from seasonal flooding. Data suggest that shallow and deep ground-water flow lines generally radiate northward and eastward from the bluff toward the La Moine and Illinois rivers. Comparison of water levels in shallow and deep wells showed no upward hydraulic gradients. Ground-water levels in lower areas and in deeper wells generally correlate with seasonal trends in river stage while ground-water levels in higher areas correlate with seasonal precipitation and evapotranspiration trends.

A cross-section illustrating shallow ground-water levels relative to surface-water features and land-surface profile is given in Figure 15. Water-level data from April 8, 2003 were used in this cross-section for reasons discussed above. The cross-section transect runs from the bluff west of the site to the Illinois River and includes wells 14S, 17S, 16S, 18S, and 12S. Each of these wells are screened in silty deposits within the Cahokia Formation (see Figure 4). Water levels in these shallow wells generally converge with land surface as distance from the bluff increases. Water levels in wells 12S and 18S approximate the water levels in Big Lake and the Illinois River, while wells at higher elevations (16S and 17S) show saturation near land surface. No indication of upward hydraulic gradient or groundwater discharge was observed during this study, however Figure 15 infers that the water table intersects land surface at the break in slope between wells 16S and 18S. This inference coupled with periodic observations of surface saturation just east of well 16S suggest that ground water may discharge at the base of the break in slope.

Data from S-wells were used primarily to determine if the soils were saturated long enough to satisfy jurisdictional wetland hydrology criteria (see Wetland Hydrology on page 28), however these data were also used to assess the potential for ground-water input for wetland restoration. Water levels in shallow wells were generally highest during the spring and rose following floods and precipitation events. Elevation does not explain the duration of soil saturation at the site, as might be expected. For example, well 17S showed shallow saturation more consistently than several wells screened in similar materials at lower elevations (e.g. 10S, 11S and 12S). Saturation at higher elevations may be due to a perched water table or localized ground-water input into the soil-zone. Also, the relative efficiency of hydrologic alterations, namely field tile and drainage ditches, likely influences the duration of shallow saturation.

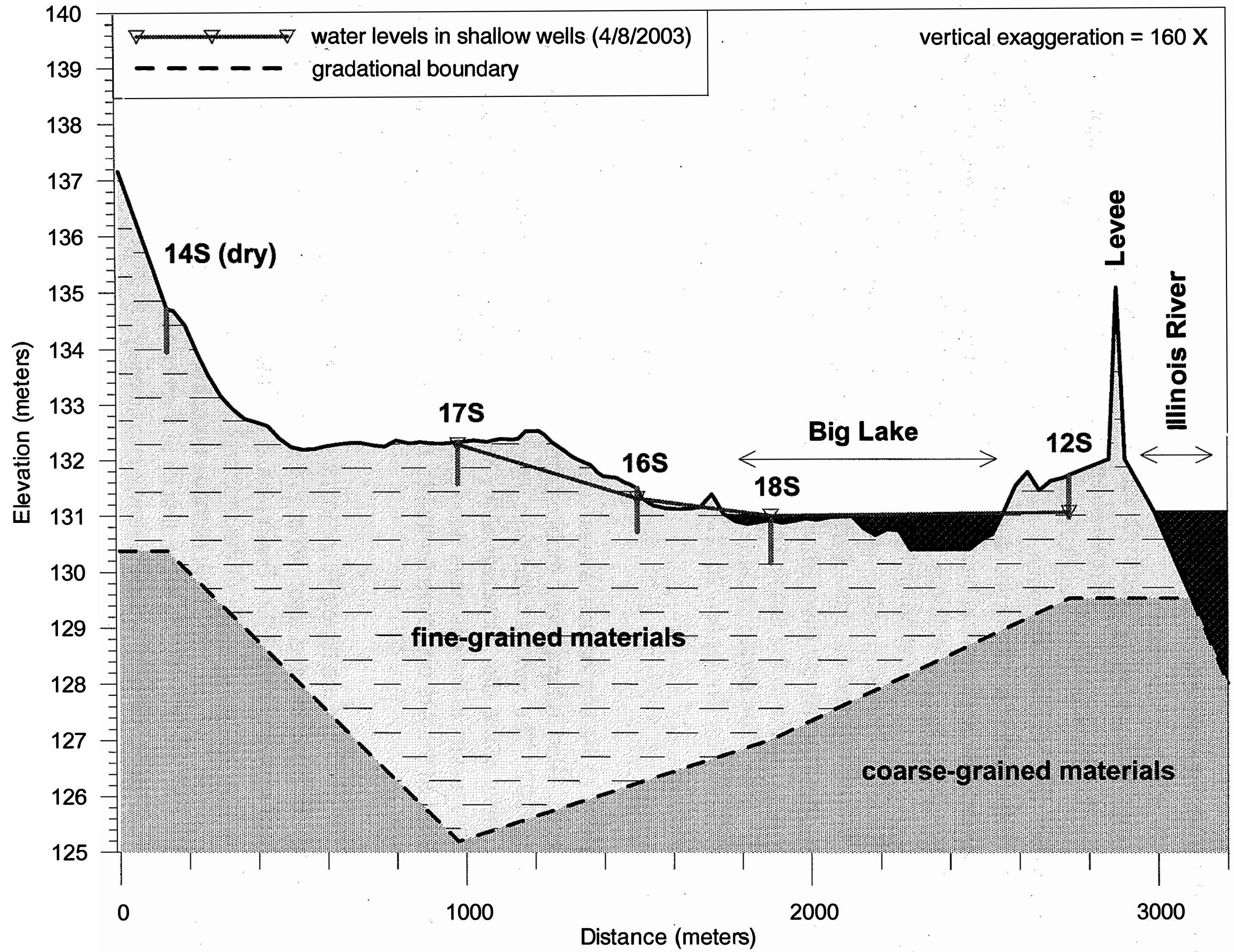

Figure 15. Water-level profile (shallow wells). Idealized cross-section showing water-levels in shallow wells relative to land surface and surface-water features at the La Grange Wetland Mitigation Bank on 4/8/2003.

Hydrologic Alterations

Regional and historical alterations

The hydrology of the Illinois River has been manipulated for over a century. Since construction of the La Grange Lock and Dam (2 miles downstream) in 1889, the U.S. Army Corps of Engineers has controlled river stage to facilitate commercial navigation in the river. Modifications to the river channel, floodplain, and watershed have, increased the elevation of flood peaks, increased flood frequency, increased sedimentation in unprotected areas of the floodplain, and contributed to increased baseflow (Demissie et al. 2003, Koel and Sparks 2002). Significant alterations include connection of Lake Michigan to the Illinois River via the Chicago Sanitary & Ship Canal and construction of the lock and dam system, which raised baseflow in the Illinois River, extensive leveeing of the floodplain along the Illinois River valley, which prevented floods from accessing the natural floodplain, and agricultural drainage and development throughout the Illinois River Basin, which increased the rate of delivery of water and sediment from the upland to the Illinois River. Systematic drainage of the floodplain to promote agriculture at this site began as early as 1916 with the establishment of the Big Prairie Levee and Drainage District (Thompson 2002).

Site alterations

Hydrologic alterations at the site include levees, a gravity drain/valve, ditches, field tile, culverts, and berms (Figure 3). Also, a temporary, mobile pumping station was in operation at the site during and prior to 2002. The various hydrologic alterations and drainage practices have made it possible to farm most of the site. However, since this study began, pumping has been discontinued and the levees at the site have been breached by floods. Currently, the remaining hydrologic alterations at the site are levee remnants, the gravity drain/valve, ditches, field tile, culverts, and berms.

Levees separate the site from the Illinois River to the east, the La Moine River to the north, and adjacent properties to the south and west. Prior to 2002, levees protected the site from floods below approximately 134.7 m (442.0 ft.). During 2002, an extreme flood breached the levees in two locations, near the northwest corner of the property and along the south boundary of the property at the south end of Big Lake. Both of these breaches are located along boundaries with adjacent properties; they do not connect directly to the river channels. The remaining levee currently prevents flooding for stages below approximately 131.7 m (432.1 ft.).

A gravity drain is located at the southeast corner of the property. The gravity drain consists of a 36-inch culvert equipped with a gate valve on the river side of the levee. The culvert runs through the levee, sloped slightly towards the river. This control structure has been used to prevent flooding from the Illinois River and to drain the site when the river is at low stage. Prior to March 2003, the gate valve was opened only to drain the site when the river was at low stage, otherwise the valve was generally kept closed to prevent the Illinois River from backflooding the site. After March 2003, the gate valve was generally kept open so that the effects of an open connection to the Illinois River could be assessed. The open gate valve allowed backflooding of the site when Illinois River stage rose above 131.1 m (430.1 ft.). Backflooding through the open gate valve allows river water onto the parcel and hinders flow in drainage ditches, which likely promotes inundation and prolonged duration of saturation over a larger area than if the gate valve remains closed.

A temporary, mobile pumping station was in operation at the site during and prior to 2002. It was used to facilitate site drainage when river stage exceeded the elevation of the gravity drain outlet. The apparatus extracted water from the ditch system at the southeast corner of the site, pumped it over the levee, and discharged into the Illinois River.

A system of drainage ditches and channelized streams exists at the site. The main ditch runs north to south and bisects the site. Three tributary ditches drain into the main ditch from the west. Ditch flow drains south to former Crane Lake, then east into Big Lake. When the Illinois River is at low stage, Big Lake discharges through the gravity drain into the Illinois River. Ditches convey runoff and likely serve as outlets for field tile systems. Blocking or filling ditches at specific locations would promote retention of runoff and stream flow, and prolong inundation and saturation of northern and western portions of the site.

Field tile have been observed at the site and are evident from aerial photography. Aerial photo interpretation suggests that the field tile network is extensive and currently functioning. The tile appear to be concentrated in north and central portions of the site just northwest of Big Lake. Disabling the field-tile system will likely prolong soil saturation across the site. Blocking or destroying the tile in fields where they are currently functioning would likely prolong saturation in those areas and increase the likelihood of saturated condition in adjacent fields.

Functioning culverts exist at several locations at the site and generally facilitate drainage beneath access roads. Segments of the ditch system could be disabled by removing or blocking these culverts. Removing culverts may be especially effective for restoration in fields 2, 5, and 11 (Figure 3).

Berms are located along ditches in field 6 and in Horseshoe Lake (Figure 3). Berms along ditches are discontinuous and may influence hydrology locally. Material from these berms may be used to block or fill ditches as part of a larger wetland restoration strategy. Berms also partition Horseshoe Lake and may prevent floods from filling portions of this lake. Removing these berms may be effective for wetland restoration in field 2 (Figure 3).

Wetland Hydrology

Surface-water data collected from gauges and data loggers and shallow ground-water data collected from S-wells were used to estimate the area that satisfied jurisdictional wetland hydrology criteria in each year of this study (Environmental Laboratory 1987). Monitoring

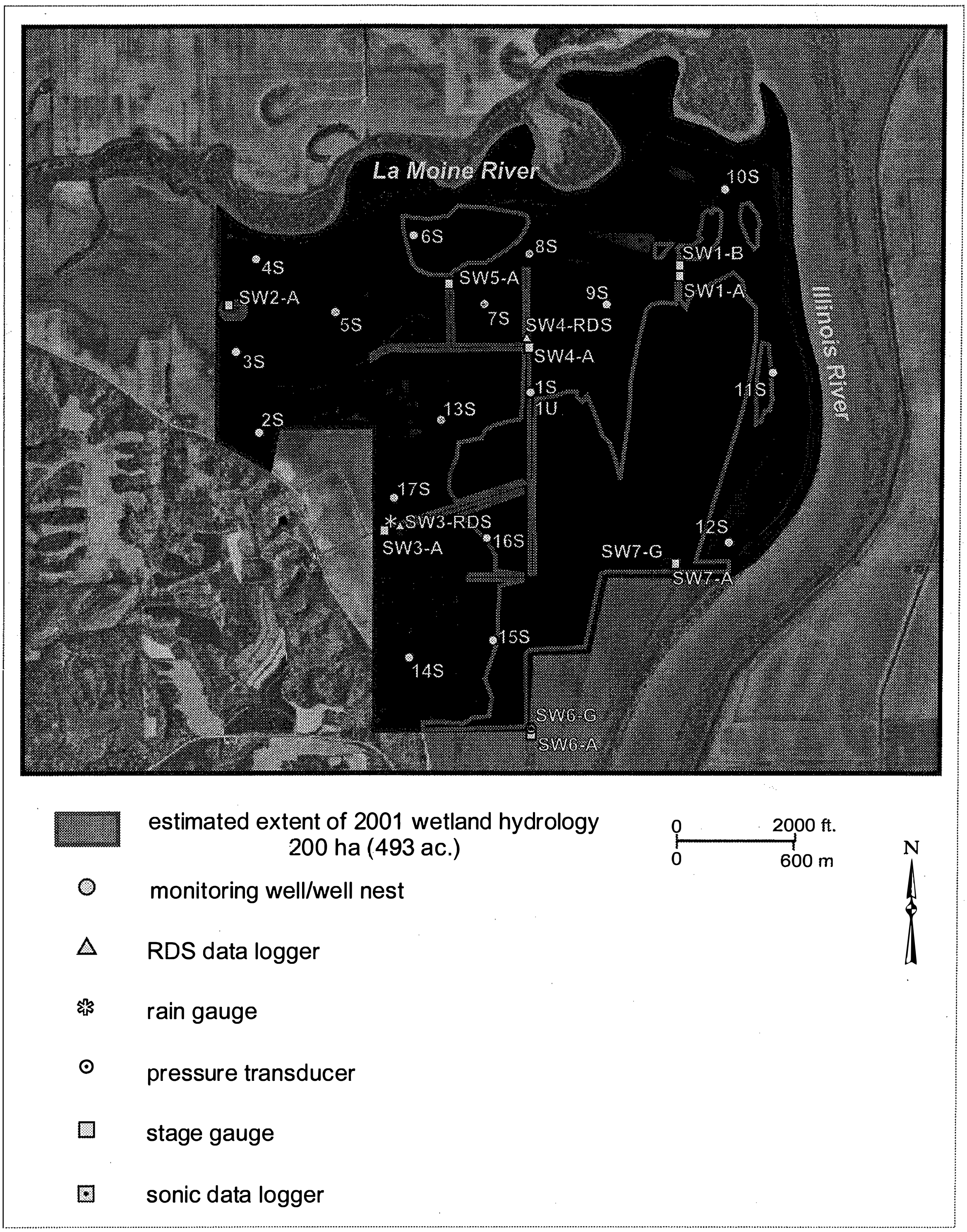

Figure 16. Area that satisfied jurisditional wetland hydrology (2001). Map showing the estimated extent of jurisdictional wetland hydrology during the 2001 growing season at the La Grange Wetland Mitigation Bank (Fucciolo et al. 2001). Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

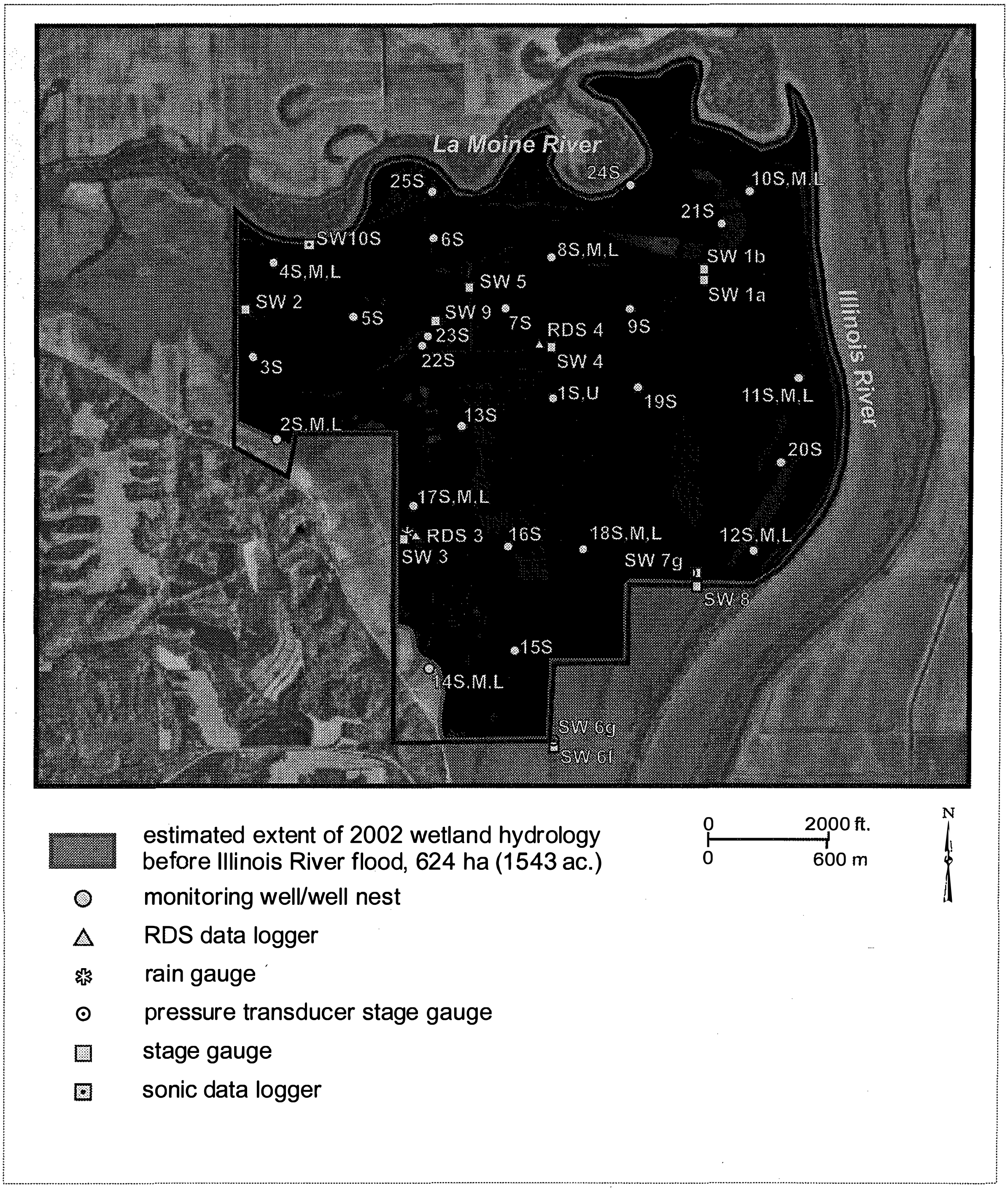

Figure 17. Area that satisfied jurisdictional wetland hydrology (2002). Map showing the estimated extent of jurisdictional wetland hydrology during the 2002 growing season at the La Grange Wetland Mitigation Bank (Fucciolo et al. 2002). Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

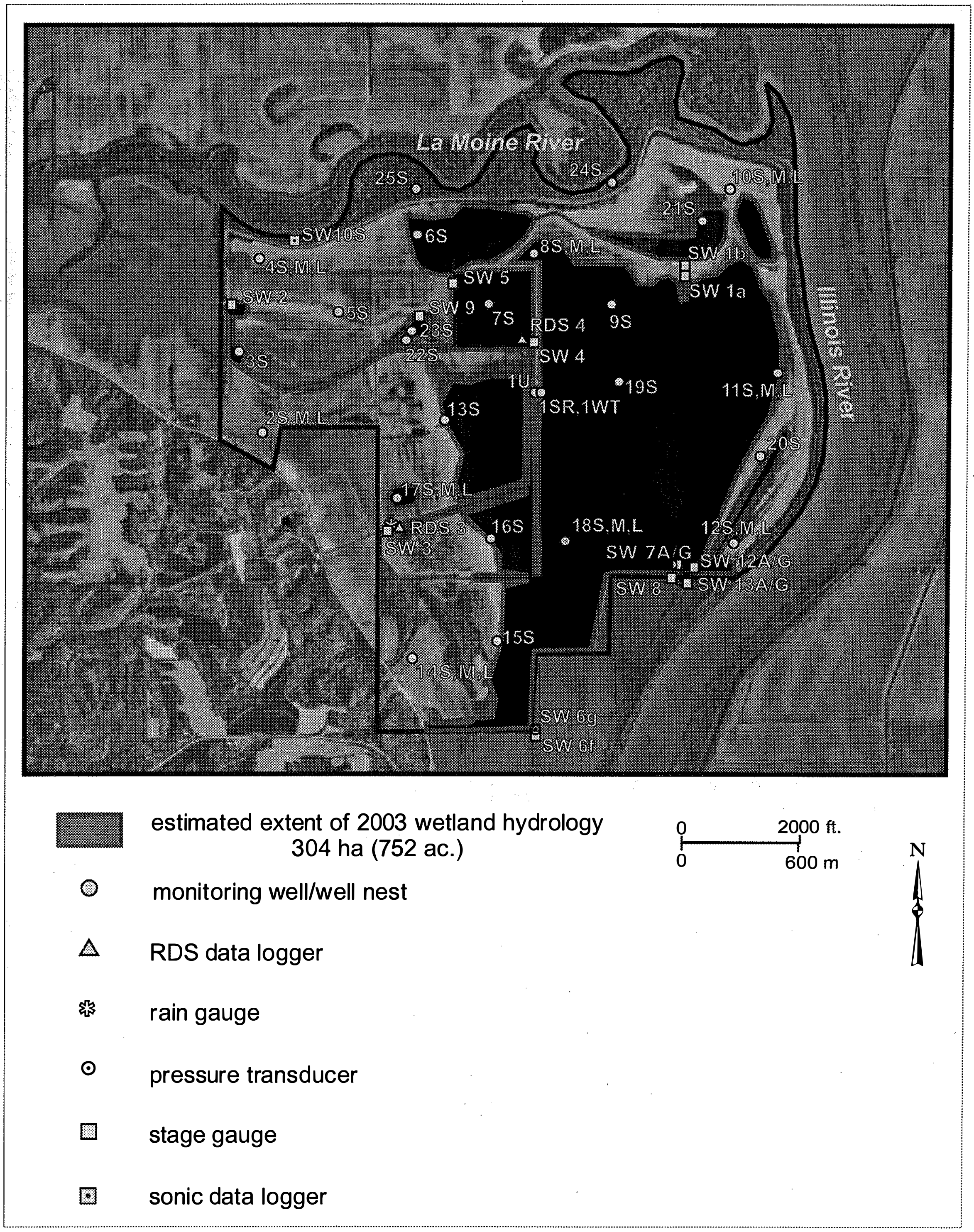

Figure 18. Area that satisfied jurisdictional wetland hydrology (2003). Map showing the estimated extent of jurisdictional wetland hydrology during the 2003 growing season at the La Grange Wetland Mitigation Bank (Fucciolo et al. 2003). Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

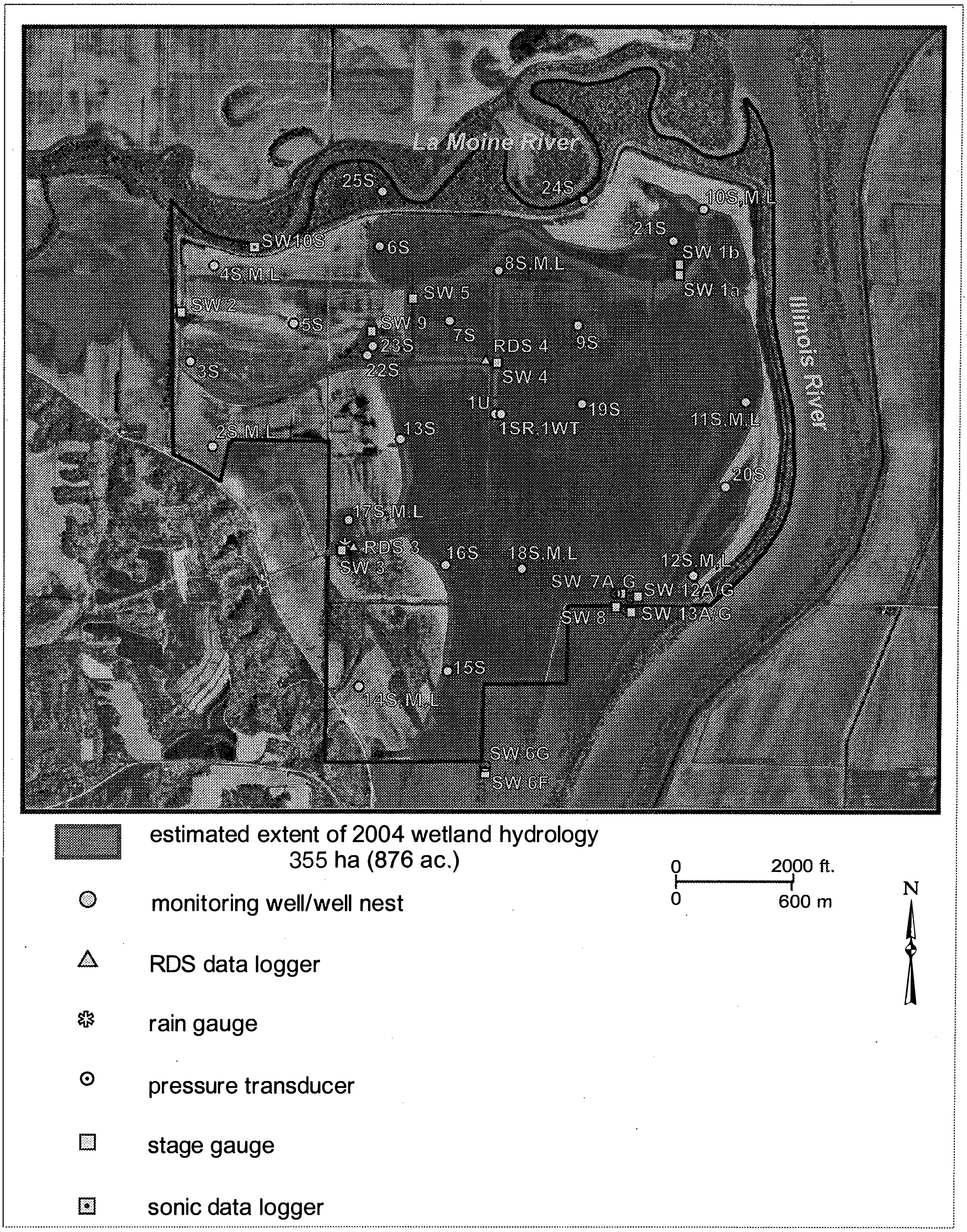

Figure 19. Area that satisfied jurisdictional wetland hydrology (2004). Map showing the estimated extent of jurisdictional wetland hydrology during the 2004 growing season at the La Grange Wetland Mitigation Bank (Fucciolo et al. 2004). Map based on USGS digital orthophotograph Cooperstown, NE quarter quadrangle produced from 4/14/98 aerial photography (ISGS 2002).

stations that indicated saturation or inundation for 26 consecutive days (12.5%) during the growing season were used in the estimate.

The annual estimates of area that conclusively satisfied jurisdictional wetland hydrology criteria were 309 ha (764 ac.) in 2001, 624 ha (1543 ac.) in 2002, 328 ha (810 ac.) in 2003, and 406 ha (1004 ac.) in 2004 (Figures 16, 17, 18, and 19; Table 4). The smallest area that satisfied jurisdictional wetland hydrology criteria was reported in 2001. Though precipitation was above normal for the preceding winter, the area of jurisdictional wetland hydrology was comparatively small and probably because of active pumping of the ditch system to the river and drier than normal conditions during March, April, and May. The 2002 jurisdictional wetland hydrology estimate was the largest due to a major flood that overwhelmed the levees and inundated the entire site. The 2003 jurisdictional wetland hydrology estimate was intermediate between the estimates for 2001 and 2002. Among the factors influencing jurisdictional wetland hydrology in 2003 were the open gravity drain that allowed backflooding from the Illinois River during May, and near normal precipitation from March through June. During 2004, a relatively minor flood inundated the site, leading to a jurisdictional wetland hydrology estimate of 354 ha (876 ac.).

Table 4: Jurisdictional wetland hydrology area estimates 2001-2004. Jurisdictional wetland hydrology area is reported for 5% and 12.5% of the growing season. Associated drainage/flooding regime is also reported for each year during the study.

Year	Wetland Hydrology Area		Drainage/Flood Regime
	> 5% of the growing season	> 12.5% of the growing season	
2001	309 ha (764 ac.)	200 ha (493 ac.)	- pumping - levees intact - gate valve control - no direct flood
2002	654 ha (1615 ac.)	624 ha (1543 ac.)	- no pumping - levees breached - gate valve control - direct flood (extreme event)
2003	328 ha (810 ac.)	304 ha (752 ac.)	- no pumping - levee remnants - gate valve open - no direct flood
2004	406 ha (1004 ac.)	355 ha (876 ac.)	- no pumping - levee remnants - gate valve open - direct flood (annual flood event)

Information given in Table 4 suggests that the estimated areal extent of jurisdictional hydrology is mainly dependent on drainage management and flood regime. Prior to 2002, wetland hydrology acreage was limited by pumping water off the site and flood control by the gravity drain valve. If the site had been allowed to flood directly in 2001, approximately 443 ha (1095 ac.) would have been inundated for greater than 5% of the growing season, which is 134 ha (331 ac) more than the actual greater-than-5% estimate for 2001. Since the May 2002 flood when the levees were breached, pumping has ceased and the gate valve on the gravity drain has generally been left open to the river. Under these conditions, the area that conclusively met jurisdictional wetland hydrology criteria has been no less than 304 ha (752 ac.).

CONCLUSIONS

The most significant potential water source for this site is the Illinois River. Historical stage data suggest that if the Illinois River is allowed to flood the site unimpeded by levees, it would inundate up to 282 ha (696 ac.) of the site for 12.5% of the growing season and 443 ha (1095 ac.) for greater than 5% of the growing season in 5 of 10 years. Without levees, floods from the La Moine River could also directly contribute to site hydrology independent of Illinois River stage, although widespread site flooding seems unlikely from this source alone. Contributions from channelized streams, run-off and direct precipitation are relatively minor compared to the potential contribution from the adjacent rivers. The potential of ground-water contribution for increasing wetland acreage at the site is also relatively minor, but may be locally significant.

The following factors suggest that this site has a high potential for wetland restoration.

- The site lies on the Illinois River floodplain at the confluence of the Illinois and La Moine rivers. Analysis of 62 years of Illinois River stage records at the La Grange Lock and Dam (U.S. Army Corps of Engineers 2004) shows that, if levees had not been in place, floods that lasted for 12.5% of the growing season would have inundated areas below 131.7 m (432.1 ft.) and covered 281 ha (696 ac.) in 5 of 10 years on average. Floods that lasted for 5% of the growing season would have inundated areas below 132.5 m (434.7 ft.) and covered 443 ha (1095 ac.) in 5 of 10 years on average.

- Large areas of preexisting wetland and drained wetland have been mapped at the site. In 1988, NWI-mapped wetlands covered 43% of the site. In 2000, the INHS mapped 242.5 ha (599.2 ac.) of wetlands at the site, and the NRCS determined that 51% of the site is prior-converted (drained) wetlands.

- Several reversible hydrologic alterations exist on site. Alterations such as levees, ditches, field tile, berms, culverts, and pumping limit the area of wetland hydrology (Figure 3). Ditches and field tile expedite drainage and promote agricultural use. Prior to the flood in Summer 2002, levees prevented direct flooding from adjacent rivers. The levees were damaged as a result of the 2002 flood, and currently the Illinois River floods the site when stage is above approximately 131.7 m (432.1 ft.).

- Multiple potential water sources exist at the site. Floods from the Illinois and La Moine rivers, flow from small ephemeral streams, and runoff could be used to expand wetland areas. Localized ground-water discharge could also contribute to wetland restoration in areas along the break in slope between the lake plain and the terrace if ditches are filled and field tile systems are disabled.

- Areas of the site have already satisfied jurisdictional wetland hydrology criteria. The estimated area that conclusively satisfied wetland hydrology criteria was 200 ha (493 ac.) in 2001, 624 ha (1543 ac.) in 2002, 304 ha (752 ac.) in 2003, and 355 ha (876 ac.) in 2004. The range of estimated wetland hydrology area is attributable to several factors including differences in the overall drainage management from year to year, variation in precipitation and evapotranspiration patterns, and site flooding.

- Hydric soils are mapped over most of the site. They include: Wagner silt loam, Beaucoup silty clay loam (frequently flooded), Darwin silty clay (ponded), and Titus silty clay loam (wet). Each of these soils is on both the state and county lists of hydric soils (USDA 1991, USDA 1995). The Wagner, Titus, Beaucoup and Darwin soils have slow to moderately slow permeability rates that facilitate ponding and saturation.

Wetland Compensation Recommendations

The wetland compensation recommendations outlined below are based on ISGS analysis of hydrogeologic data and are in accordance with guidelines from Admiraal et al. (1997).

1. The most significant potential water source for this site is flooding from the Illinois and La Moine rivers. We recommend that the wetland restoration strategy rely primarily on the flood hydrology of these rivers either by direct connection to the rivers, or by managed flooding through a flood-control structure if it is deemed necessary to repair the levees. A direct connection to the river could be established by actively dismantling the levees or by allowing their continued degradation.

2. The gravity drain was formerly operated to keep floods out of the site and to allow drainage at low river stages. We recommend permanently opening the gravity drain, which would allow water into the site when the Illinois River stage is above approximately 131.1 m (430.1 ft.). Permanently opening the drain would also allow the lake plain to dry seasonally, which would promote stabilization of fine sediment and establishment of vegetation, thus decreasing turbidity in Big Lake and other open water areas. We suggest retaining the option to permanently remove the gravity drain at a later date. The gravity drain may be utilized as part of an adaptive management strategy if ongoing monitoring indicates that the wetland mitigation goals and objectives are not being met.

3. A mobile pumping station was in operation at the site during and prior to 2002. It was used to facilitate site drainage when river stages exceeded the elevation of the gravity drain outlet. Permanently discontinuing pumping will promote higher water levels on site during wet periods and thus make conditions more conducive to expanding the extent of jurisdictional wetland hydrology.

4. The ditches and field tiles currently expedite drainage of the site. Though much of the site would conclusively satisfy jurisdictional wetland hydrology criteria due to flooding if opened to the river, we recommend filling or blocking ditches and removing field tile. Disabling these drainage systems would promote retention of flood water, stream flow, runoff, ground-water, and precipitation on site, thus prolonging ponding and soil saturation in areas that do not flood or do not flood long enough to satisfy wetland hydrology criteria. Prolonging ponding and saturation would also make conditions more conductive to desired wetland plant species. While many of the ditches do not operate efficiently under the current situation, they may become functional should the levee degrade more than expected. Therefore, filling or blocking ditches and removing or disabling field tile may prevent future drainage as well.

5. Several culverts at the site facilitate drainage beneath access roads. We recommend removing these culverts to disable segments of the ditch system. Removing culverts may be especially effective for wetland restoration in fields 2, 5, and 11 (Figure 3).

6. Berms are located along ditches and in Horseshoe Lake (Figure 3). Berms partition Horseshoe Lake and hinder hydrologic connection on the lake plain especially among fields 1, 7, 8, and, 9. We recommend using material from these berms to block or fill ditches. Removing berms in Horseshoe Lake may also aid wetland restoration in field 2.

7. We recommend that IDOT or other co-operating party acquire the Reese property inholding (see Figure 3). Ditches at the wetland bank extend into this parcel. Filling ditches or disabling field tile that extend into this parcel could prevent adequate drainage. If the Reese property cannot be acquired, wetland restoration design should accommodate the current rate of drainage from the parcel. Instead of filling or blocking ditches in this part of the wetland bank, we suggest re-routing the ditches to promote wetland restoration without adversely affecting the adjacent parcel.

Levee Options

As stated in the Wetland Banking Instrument for the La Grange Site (Illinois Department of Transportation 2003), IDOT intends to allow continued degradation of the levees without repair or maintenance. However, IDOT may deem it necessary to repair and stabilize or reconfigure levees if the goals and objectives of the wetland mitigation bank are not met. Therefore we briefly discuss levee configuration options below to assess potential effects on wetland restoration at the site.

The levees that formerly prevented direct flooding of the site from the Illinois and La Moine rivers were breached by a flood during May and June 2002. The breaches are located along the south boundary at Big Lake and near the northwestern corner of the site (Figure 3). Currently, the site is exposed to floods over approximately 131.7 m (432.1 ft.). After floods recede, water that is retained on site by the levee remnants gradually drains to the river through the gravity drain. Without repair or other maintenance measures, the existing levee breaches will continue to erode with subsequent floods. As the levees degrade, the frequency of flooding at the site would increase, but the duration of inundation would decrease. Without levees, approximately 443 ha (1095 ac.) would be inundated for durations long enough to satisfy jurisdictional wetland hydrology criteria in 5 of 10 years on average. If the site is allowed to flood directly, frequent floods may cause localized erosion and sedimentation.

Options for levee configuration include: 1) maintaining the current situation by stabilizing the thresholds of the levee breaches. 2) re-establishing a complete connection to the rivers either by actively dismantling all or portions of the levees, 3) stabilizing levees in their current configuration by lowering and broadening them to capture floods and optimize wetland hydrology acreage, and 4) repairing the levee breaches and stabilizing the current configuration to prevent all direct flooding of the site.

- Option 1: Maintain the current situation by stabilizing the threshold of the levee breaches. This strategy would allow indirect flooding through the gravity drain between river stage elevations of 131.1 m (430.0 ft.) and the elevation of the lowest levee breach at 131.7 m (438.3 ft.), and direct flooding if river stage exceeded 131.7 m (438.3 ft.). For example, during 2004, a relatively minor flood event (<1-year recurrence) inundated the site and resulted in 406 ha (1004 ac.) of jurisdictional wetland hydrology area.

- Option 2: Re-establish complete connection to the rivers by actively removing all or portions of the remaining levees. This strategy would immediately establish free exchange of water between the site and the adjacent rivers at an elevation of approximately 131.1 m (430.0 ft.). Based on flood-frequency analysis, the area of jurisdictional wetland hydrology in this scenario would be 443 ha (1095 ac.) in 5 of 10 years on average.

- Option 3: Lowering and broadening levees in their current configuration may optimize wetland hydrology area. This strategy would allow indirect flooding through the gravity drain between river stage elevations of 131.1 m (430.0 ft.) and the 2-year flood elevation of 133.6 m (438.3 ft.) and direct flooding if river stage exceeded 133.6 m (438.3 ft.). This mode of flooding would buffer the site from frequent flows and would serve to store floods during and after the 2-year flood event. Based on flood-frequency analysis, the 2-year flood event would inundate 85% of the site. The resulting duration of inundation is difficult to estimate, but water control structures could be installed to optimize flood water retention. However, retention of floods exceeding 133.6 m (438.3 ft.) would inundate much of the site to depths in excess of 2 m (6.6 ft.) and could be detrimental to other wetland mitigation goals.

- Option 4: Repair the levee breaches and stabilize the levees in the current configuration, and install control structures. This strategy would prevent all direct flooding of the site and would allow flood management at the site thus, reducing the potential for sedimentation and damage to tree plantings by floods. According to the historic stage records, to prevent direct flooding of the site the levee would have to be built up to an elevation of at least 136.4 m (447.5 ft.). Completely preventing flooding of the site may maximize protection from disturbance due to erosion, sedimentation and inundation. However, wetland hydrology area would likely be minimized as the primary potential water source for restoring wetlands, the Illinois River, would be excluded from the restoration. According to water-levels observed in Big Lake (SW7) during this study, the maximum extent of Big Lake without direct flooding from the Illinois and La Moine rivers was approximately 215 ha (532 ac.). This area represents the maximum area that can be expected to be inundated by surface water if the Illinois River is prevented from directly flooding the site. The potential for wetland hydrology area for in this scenario is difficult to estimate. However the wetland hydrology area of 197 ha (493 ac.) in 2001 serves as a conservative estimate as floods were kept out of the site by the gate valve and the levees were fully intact.

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APPENDIX A Well Construction Information

Well Construction Information	1S	1U	1WT	2S	2M	2L	3S	4S	4SR
Total length of well (m)	1.91	4.07	3.17	1.88	3.86	8.23	1.89	1.91	1.95
Screen length (m)	0.31	1.30	1.52	0.27	0.63	0.61	0.27	0.28	0.33
Depth of borehole (m) *	0.78	3.09	2.58	0.76	3.05	7.32	0.80	0.76	0.80
Bentonite seal - top (m) *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand pack - top (m) *	0.30	1.50	0.43	0.29	1.83	4.57	0.28	0.28	0.30
Sand pack - bottom (m) *	0.78	3.09	2.58	0.76	3.05	4.57	0.80	0.76	0.80
Depth to top of screen (m) *	0.43	1.65	1.04	0.44	2.16	6.37	0.48	0.44	0.42
Depth to bottom of screen (m) *	0.74	2.95	2.56	0.71	2.79	6.98	0.75	0.71	0.75

* referenced to land surface

Well Construction Information	4M	4L	5S	6S	7S	8S	8M	8L	9S
Total length of well (m)	3.96	8.27	1.89	1.89	1.89	1.89	3.96	8.19	1.90
Screen length (m)	0.62	0.62	0.28	0.28	0.28	0.28	0.64	0.60	0.27
Depth of borehole (m) *	2.87	7.22	0.79	0.78	0.77	0.75	3.05	7.34	0.77
Bentonite seal - top (m) *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand pack - top (m) *	1.63	5.61	0.30	0.25	0.30	0.30	1.83	5.79	0.30
Sand pack - bottom (m) *	2.87	7.22	0.79	0.78	0.72	0.72	3.00	73.44	0.77
Depth to top of screen (m) *	2.02	6.35	0.47	0.46	0.40	0.40	2.11	6.52	0.45
Depth to bottom of screen (m) *	2.64	6.97	0.75	0.73	0.68	0.68	2.75	7.12	0.72

* referenced to land surface

Well Construction Information	10S	10M	10L	11S	11M	11L	12S	12M	12L
Total length of well (m)	1.90	3.94	6.39	1.91	4.01	5.89	1.90	2.77	5.07
Screen length (m)	0.27	0.64	0.62	0.27	0.64	0.64	0.28	0.75	0.62
Depth of borehole (m) *	0.78	3.09	5.83	0.76	3.05	5.49	0.81	2.25	4.46
Bentonite seal - top (m) *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand pack - top (m) *	0.30	1.83	4.27	0.30	1.83	3.35	0.30	0.76	3.05
Sand pack - bottom (m) *	0.78	3.09	5.83	0.76	3.05	5.49	0.81	2.25	4.46
Depth to top of screen (m) *	0.46	2.20	4.98	0.45	2.16	4.24	0.49	1.44	3.61
Depth to bottom of screen (m) *	0.74	2.84	5.60	0.72	2.79	4.87	0.77	2.19	4.23

* referenced to land surface

Well Construction Information	13S	14S	14M	14L	15S	16S	17S	17M	17L
Total length of well (m)	1.91	1.90	3.94	6.45	1.90	1.90	1.90	3.91	8.47
Screen length (m)	0.27	0.27	0.66	0.61	0.27	0.27	0.27	0.64	0.72
Depth of borehole (m) *	0.77	0.78	2.93	5.81	0.81	0.77	0.76	3.15	7.68
Bentonite seal - top (m) *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sand pack - top (m) *	0.30	0.30	1.83	4.57	0.30	0.30	0.30	1.83	6.10
Sand pack - bottom (m) *	0.77	0.78	2.93	5.81	0.81	0.77	0.76	3.15	7.68
Depth to top of screen (m) *	0.45	0.46	2.04	4.97	0.50	0.45	0.31	2.14	6.89
Depth to bottom of screen (m) *	0.73	0.74	2.70	5.58	0.77	0.72	0.58	2.77	7.61

* referenced to land surface

APPENDIX A Well Construction Information

Well Construction Information	18S	18M	18L	19S	20S
Total length of well (m)	1.87	3.80	6.81	1.87	1.87
Screen length (m)	0.25	0.50	0.46	0.25	0.25
Depth of borehole (m) *	0.80	3.05	5.94	0.75	0.78
Bentonite seal - top (m) *	0.00	0.00	0.00	0.00	0.00
Sand pack - top (m) *	0.30	1.52	4.57	0.30	0.30
Sand pack - bottom (m) *	0.80	3.05	5.94	0.75	0.78
Depth to top of screen (m) *	0.37	2.17	5.21	0.43	0.49
Depth to bottom of screen (m) *	0.61	2.67	5.66	0.68	0.73

* referenced to land surface

Well Construction Information	21S	22S	23S	24S	25S
Total length of well (m)	1.87	1.90	1.87	1.92	1.89
Screen length (m)	0.24	0.26	0.27	0.30	0.28
Depth of borehole (m) *	0.76	0.76	0.79	0.76	0.76
Bentonite seal - top (m) *	0.00	0.00	0.00	0.00	0.00
Sand pack - top (m) *	0.30	0.30	0.30	0.30	0.30
Sand pack - bottom (m) *	0.76	0.76	0.79	0.76	0.76
Depth to top of screen (m) *	0.48	0.47	0.49	0.40	0.45
Depth to bottom of screen (m) *	0.72	0.73	0.75	0.70	0.72

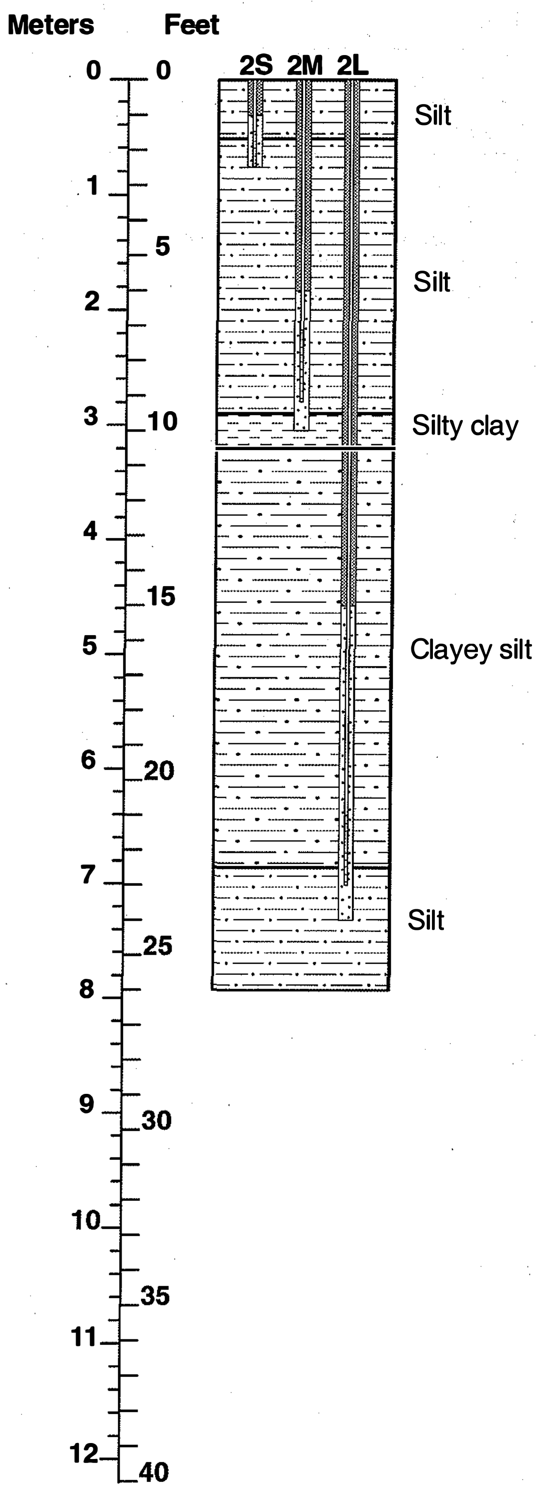
* referenced to land surface

APPENDIX B Geologic logs

Boring:	2L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 1.67' (0 m – 0.51 m)	*Notes*: fine silt, 10YR 3/2, crumby, dry to slightly moist @ base, 10-20% organic material
1.67' – 9.5' (0.51 m – 2.90 m)	*Notes*: silt with trace sand and clay, 10YR 4/3 to 10YR 4/4, crumbly, slightly moist down to saturation zone @ 7.5'-8.5', grades to clayey silt @ 5' where quartz and feldspar rock fragments are present (<5%); <10% organic materials and <10% small Fe/Mn redox concentrations (7.5YR 4/6) are also present
9.5' – 10.5' (2.90 m – 3.20 m)	*Notes*: silty clay, 10YR 5/3, med. stiff, slightly moist to dry
10.5' – 22.5' (3.20 m – 6.86 m)	*Notes*: clayey silt, 10YR 6/2 to 10YR 5/2 common, distinct redox concentrations (10YR 5/8 to 10YR 4/6), med. stiff, slightly moist to saturated, contains alternating layers of silty clay and clayey silt with varied moisture content
22.5' – 26' (6.86 m – 7.92 m)	*Notes*: silt, 5Y 4/1 soft, saturated @ 22.5' (other portions slightly moist), common organic fragments (20%+), some finely laminated zones, sharp upper contact

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	2-1-3-3	15
2-4'	2-4-5-5	20
4-6'	3-3-2-2	20
6-8'	1-2-3-3	23
8-10'	2-2-2-4	24
10-12'	1-2-2-3	24
12-14'	0-1-2-2	24
14-16'	0-0-0-2	24
16-18'	1-2-3-3	24
18-20'	1-2-2-3	22
20-22'	0-1-2-2	24
22-24'	1-2-2-2	24
24-26'	1-2-2-3	24

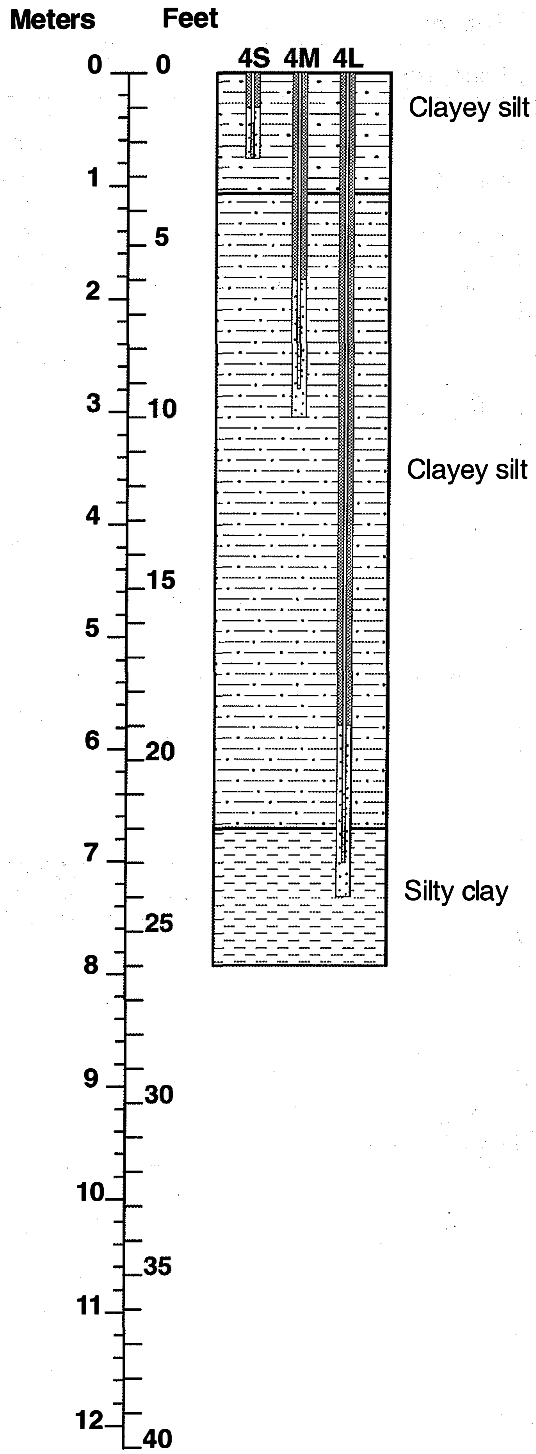


APPENDIX B Geologic logs

Boring:	4L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 3.5' (0 m – 1.07 m)	*Notes*: clayey silt, 10YR 3/2, slightly moist, crumbly, 10-15% visible organic matter
3.5' – 22' (0 m – 6.71 m)	*Notes*: clayey silt, 10YR 3/2 to 10YR 4/1, dry to slightly moist, silt/clay ratio varies with depth, faint to distinct (10YR 3/6) redox concentrations and Mn nodules (10YR 3/1) increase in number and prominence below 10'
22' – 26' (6.71 m – 7.92 m)	*Notes*: silty clay, 5Y 4/1 to 5Y 5/1, SATURATED, visible organics (10-15%)

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	2-4-5-7	22
2-4'	4-5-7-8	18
4-6'	5-6-8-9	24
6-8'	4-4-6-7	24
8-10'	4-4-6-6	24
10-12'	4-4-6-8	24
12-14'	2-3-4-5	24
14-16'	5-5-6-8	24
16-18'	2-3-4-5	24
18-20'	2-3-5-5	22
20-22'	3-4-5-9	24
22-24'	3-4-5-5	24
24-26'	0-3-3-2	24

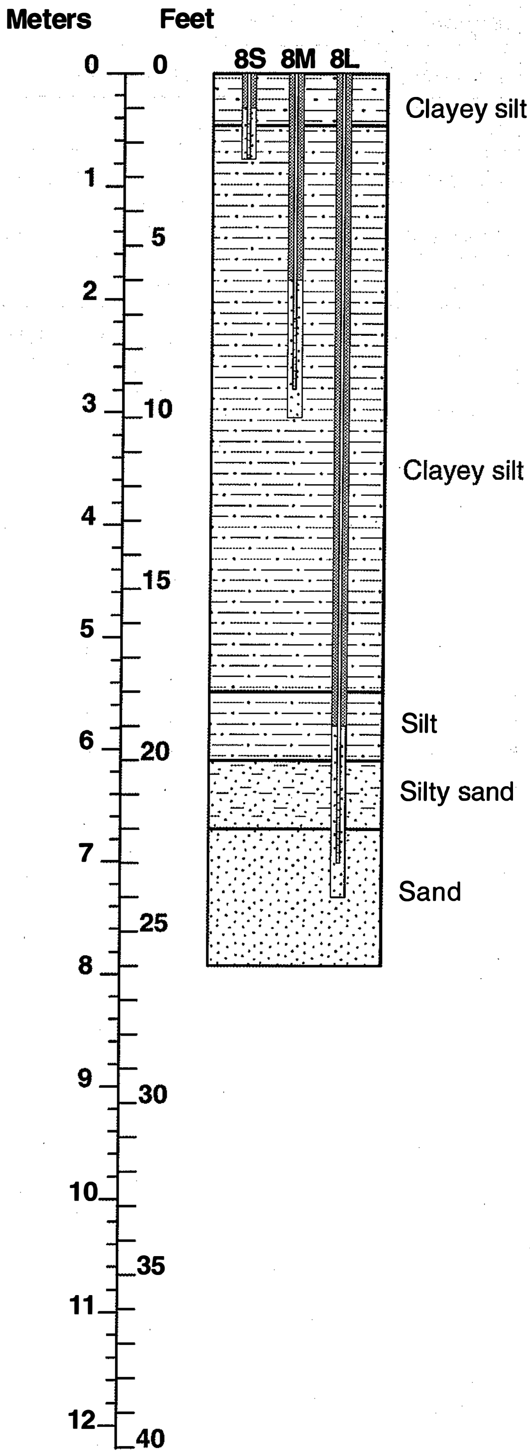


APPENDIX B Geologic logs

Boring:	8L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 1.5' (0 m – 0.46 m)	*Notes*: clayey silt, 10.5YR 3/2, med. stiff, slightly moist, visible roots and other organic material (~5%), faint (10.5YR 3/6) redox concentrations (~5%)
1.5' – 18' (0.46 m – 5.49 m)	*Notes*: clayey silt, 10YR 4/1 to 10.5YR 4/2, slightly moist, med. stiff, few to many, faint to distinct (10.5 YR 3/6 to 10YR 4/6) redox concentrations, number and prominence of redox concentrations increases with depth, reduced root channels (G1 5/10Y) and dark Mn nodules present below 10'
18' – 20' (5.49 m – 6.10 m)	*Notes*: silt, trace clay and trace fine sand, 10YR 5/2 to 10YR 4/6, v. moist to saturated in spots
20' – 22' (6.10 m – 6.71 m)	*Notes*: fine silty sand with sandy lenses, 5Y 4/2, 15-20% redox concentrations (10YR 3.6) with reduced (5/5 GY) root channels visible
22' – 26' (6.71 m – 7.92 m)	*Notes*: fine silty sand, Grading from above into G1 4-3/10Y, SATURATED

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	3-3-4-4	17
2-4'	2-3-5-6	21
4-6'	4-4-6-7	24
6-8'	4-4-6-7	24
8-10'	3-3-4-6	24
10-12'	3-4-5-6	24
12-14'	2-4-4-7	24
14-16'	2-4-4-5	24
16-18'	2-3-3-4	24
18-20'	2-2-3-3	13
20-22'	1-1-2-2	24
22-24'	1-1-2-2	24
24-26'	0-0-0-0	24

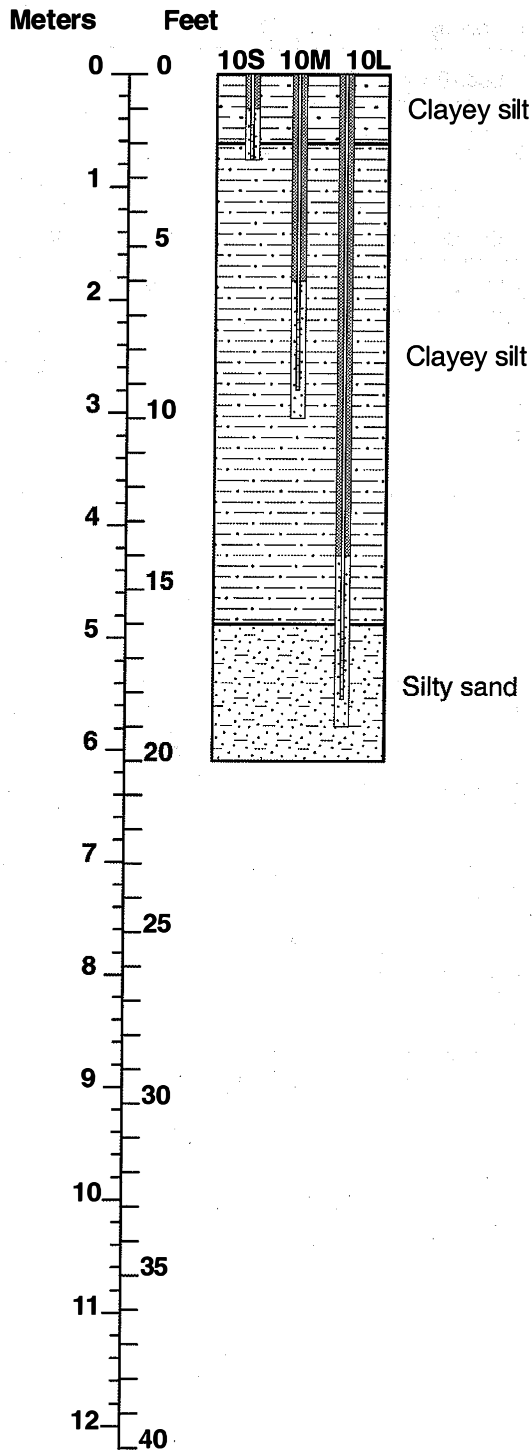


APPENDIX B Geologic logs

Boring:	10L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 2' (0 m – 0.61 m)	*Notes*: clayey silt, 10YR 3/2, med. stiff, crumbly, slightly moist, up to 10% fine redox concentrations (10YR 3/6), up to 10% root fragments and visible organic materials
2' – 16' (0.61 m – 4.88 m)	*Notes*: clayey silt, 10YR 4/1, soft, common (10-60%) fine redox concentrations (10YR 3/6), slightly moist throughout with some wet pore linings at ~5', silt/clay ratio and abundance of redox concentrations variable throughout, saturated silt lens present at 8.5', trace sand starting at 8'-9' and continuing to base of unit, matrix color varies to GY 4-N at greater depth and redox coloration varies to 7.5YR 4/6 at greater depth, 12'-14' sample wet upon removal
16' – 20' (4.88 m – 6.10 m)	*Notes*: silty fine sand, 5Y 4/2 SATURATED, soft with few (5%) distinct (10YR 4/6) redox concentrations

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	1-3-4-5	15
2-4'	2-3-3-4	21
4-6'	3-3-4-6	23
6-8'	2-2-4-6	24
8-10'	3-3-4-4	24
10-12'	1-1-2-2	24
12-14'	1-1-1-1	24
14-16'	0-0-1-1	12
16-18'	0-0-1-2	18
18-20'	0-0-0-0	18

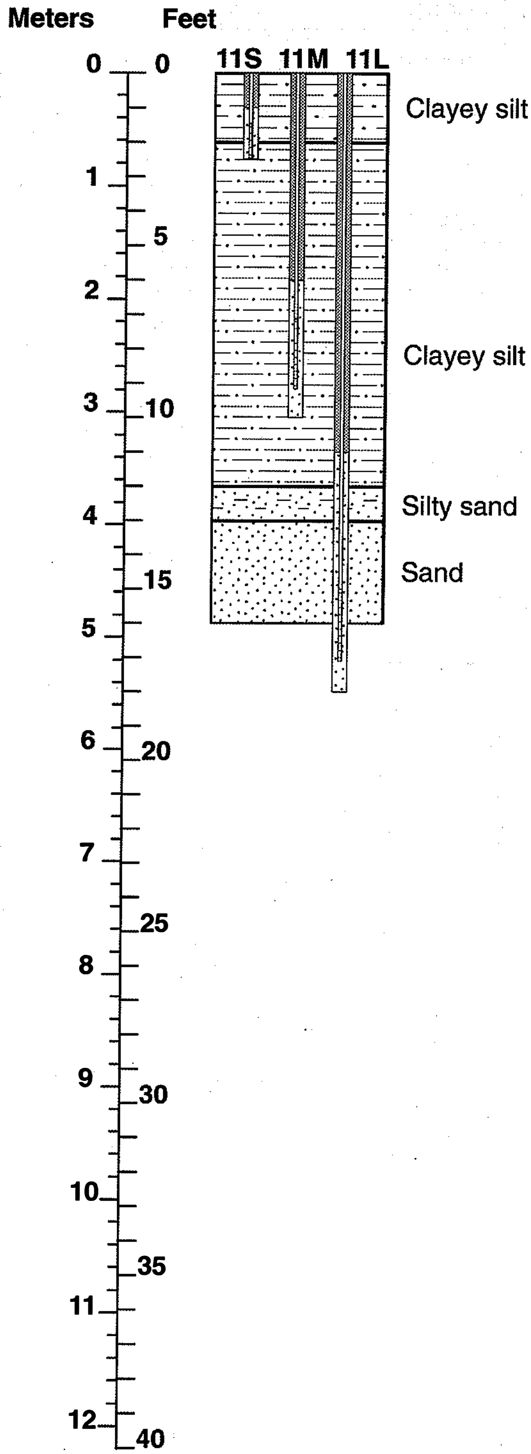


APPENDIX B Geologic logs

Boring:	11L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 2' (0 m – 0.61 m)	*Notes:* clayey silt, 10YR 4/1, crumbly, slightly moist, 20-30% 5YR 4/6 redox concentrations, visible root channels with depleted color on rims
2' – 12' (0.61 m – 3.66 m)	*Notes:* clayey silt, 10YR 5/1, soft, slightly moist, 30-50% 5YR 4/6 redox concentrations, Fe/Mn nodules and pore water noted at ~4'-6' depth, silt content increases with depth at 9'-10'
12' – 13' (3.66 m – 3.96 m)	*Notes:* fine silty sand, 5Y 4/1, SATURATED, transition zone from above unit into unit below
13' – 16' (3.96 m – 4.88 m)	*Notes:* sand with trace silt, 5YR 3/1, SATURATED, small 100% silt bodies also present

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	4-3-5-5	18
2-4'	1-2-3-3	22
4-6'	2-2-3-3	24
6-8'	0-0-2-3	20
8-10'	1-1-2-3	24
10-12'	2-2-1-2	15
12-14'	0-1-1-2	16
14-16'	0-0-1-1	24

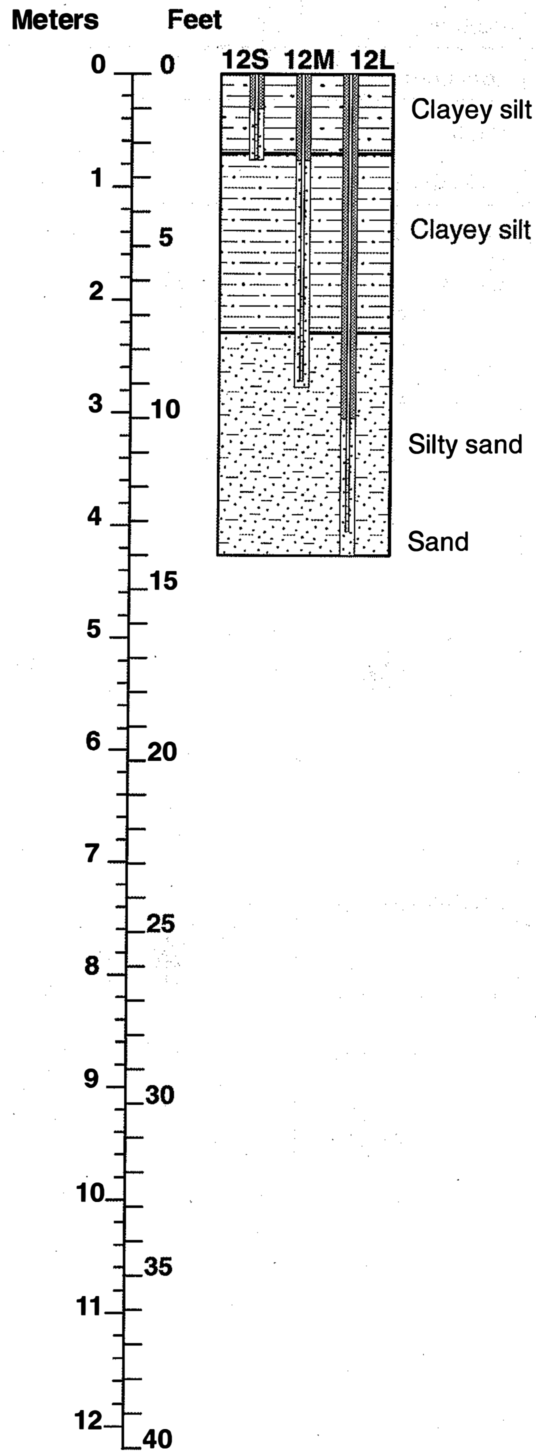


APPENDIX B Geologic logs

Boring:	12L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 2.3' (0 m – 0.70 m)	*Notes*: clayey silt, 10YR 3/1 to 10YR 3/2, few faint (7.5YR 4/6) redox concentrations, med. stiff, crumbly, slightly moist
2.3' – 7.5' (0.70 m – 2.29 m)	*Notes*: clayey silt, 10YR 4/1 soft, moist to SATURATED at 5', distinct (7.5 YR 4/6) redox concentrations, unit grades into fine silty sand at base
7.5' – 14' (2.29 m – 4.27 m)	*Notes*: silty sand, 5Y 4/1 layer of clean sand near base, SATURATED

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	3-5-5-5	22
2-4'	2-4-4-5	24
4-6'	2-2-2-2	22
6-8'	0-0-0-1	22
8-10'	0-0-0-1	21
10-12'	0-0-0-0	22
12-14'	0-1-1-1	14

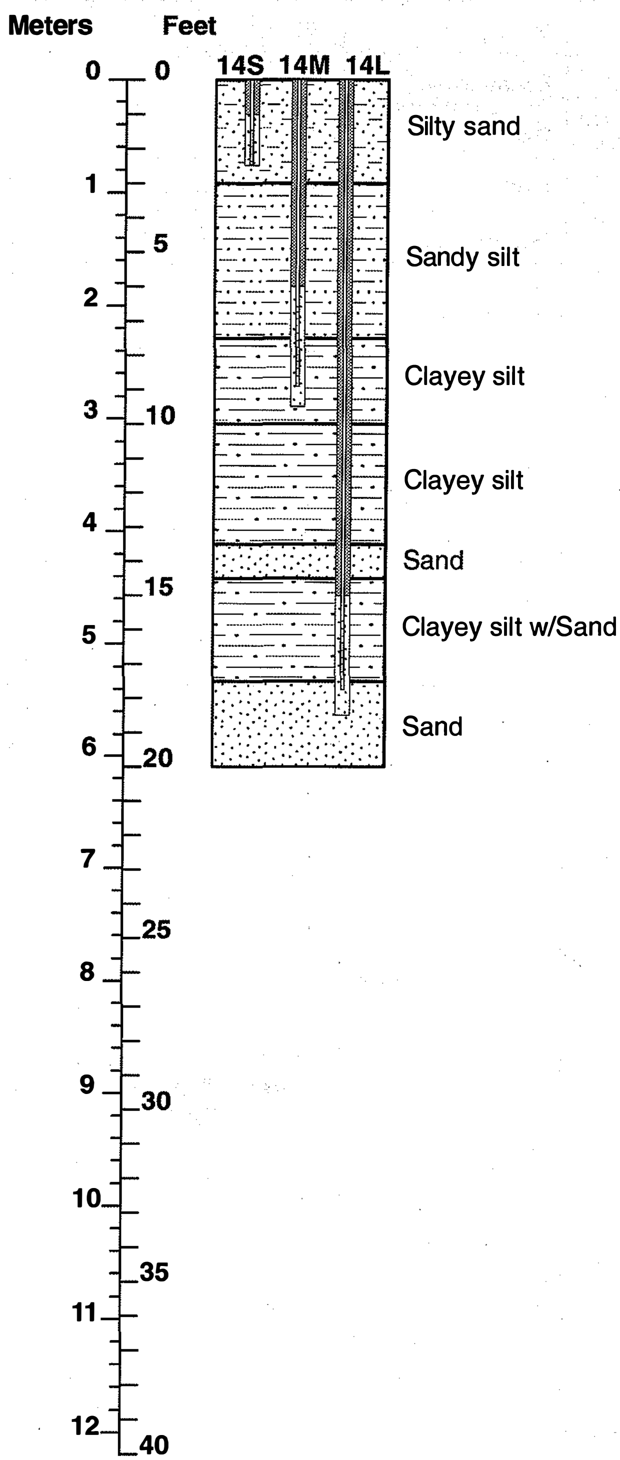


APPENDIX B Geologic logs

Boring:	14L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 3' (0 m – 0.91 m)	*Notes*: sandy silt and fine silty sand, 10YR 4/4 with 7.5YR 2.5/1 sandy silt bodies, moist, loose to crumbly, visible organic fragments and roots
3' – 7.5' (0.91 m – 2.29 m)	*Notes*: fine sandy silt, 10YR 2/2 to 10YR 2/1, slightly moist, crumbly, soft
7.5' – 10' (2.29 m – 3.05 m)	*Notes*: clayey silt with trace sand, 10YR 4/1, many (15-20%) distinct (10YR 4/6 and 10YR 5/3) redox concentrations, moist, soft, a layer resembling the above unit is present at 9'
10' – 13.5' (3.05 m – 4.11 m)	*Notes*: clayey silt , 2.5Y 5/2, with common (10%) distinct (10YR 5/6 and 5YR 2.5/1) redox concentrations and Fe/Mn nodules, moist, med. stiff, SATURATED pore linings visible at 10-12'
13.5' – 14.5' (4.11 m – 4.42 m)	*Notes*: fine sand with trace silt, 10YR 5/3, common (15-20%) distinct (7.5YR 5/8) redox concentrations, loose, SATURATED, coarsens downward from unit above
14.5' – 17.5' (4.42 m – 5.33 m)	*Notes*: Interlayered combination of above two units, layers 6" to 1' thick
17.5' – 20' (5.33 m – 6.10 m)	*Notes*: med. coarse sand with trace silt, 10YR 5/8, WET, loose, Fe-rich zone at ~19' (7.5YR 4/6)

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	3-4-4-4	24
2-4'	3-2-3-3	24
4-6'	2-3-4-5	24
6-8'	1-3-3-4	21
8-10'	2-2-2-2	24
10-12'	1-3-4-4	24
12-14'	0-2-2-3	24
14-16'	0-1-1-1	24
16-18'	1-4-5-6	24
18-20'	0-1-3-2	24

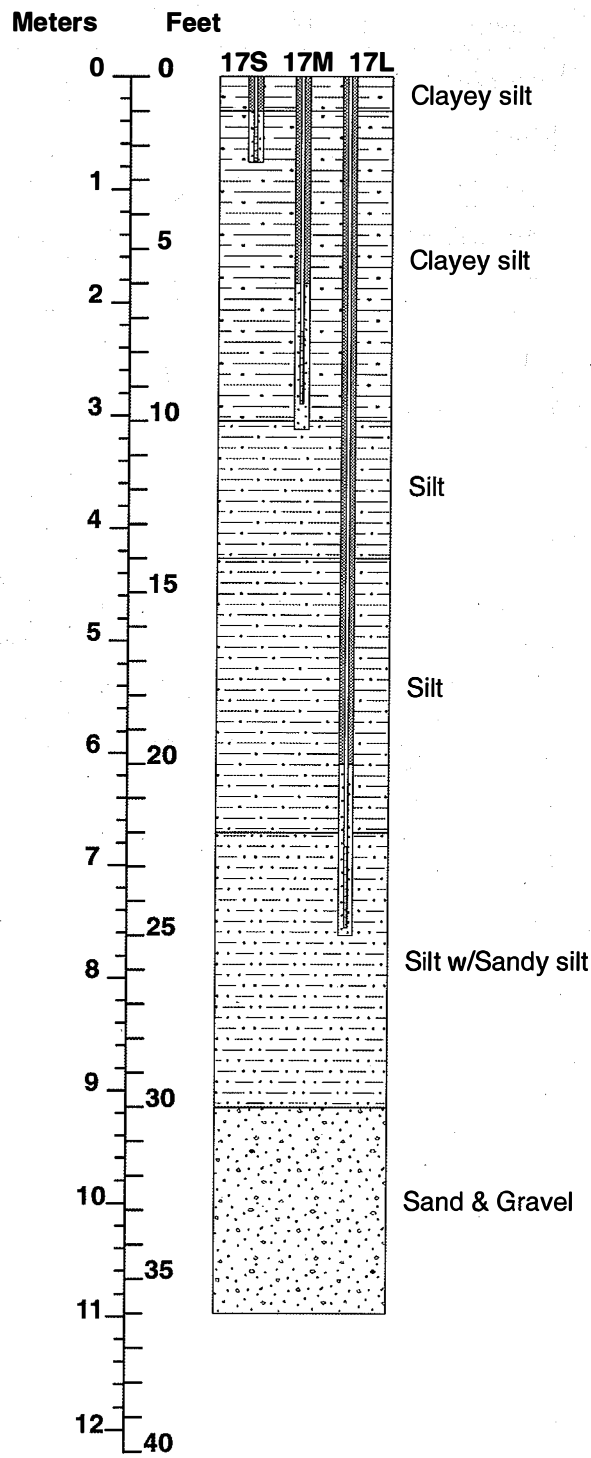


APPENDIX B Geologic logs

Boring:	17L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 1' (0 m – 0.30 m)	*Notes:* clayey silt , 10YR 3/2, few (5%) faint (10YR 4/6) redox concentrations, moist to SATURATED, soft to med. stiff, visible root materials
1' – 10' (0.30 m – 3.05 m)	*Notes:* clayey silt, 10YR 4/1, many (10-40%) distinct (10YR 4/6) redox concentrations, med. stiff, blocky structure, Fe/Mn nodules present below 2', roots common to 8' depth, silt/clay ratio varies with depth though silt content increases overall, trace quartz sand grains visible, WET pore linings below 5'
10' – 14' (3.05 m – 4.27 m)	*Notes:* silt with trace clay, 2.5Y 6/2, Mn specks (1-2%) common, few (5-10%) distinct (7.5YR 5/8) redox concentrations, moist, med. stiff
14' – 22' (4.27 m – 6.71 m)	*Notes:* silt , 5Y 4/1, trace (<5%) faint (10YR 5/8) Fe redox concentrations, fine lamination structure at 16' alternates between light and dark coloration, 5-10% organic material visible, moist throughout to SATURATED at 17'
22' – 30 (6.71 m – 9.14 m)	*Notes:* silt and silty sand with trace clay, 5Y 4/1, SATURATED, loose and crumbly, soft, interlayered with sandy lenses (5Y 5/2)
30' – 36' (9.14 m – 10.97 m)	*Notes:* sand and gravel, 10YR 5/1 to 10YR 4/2, SATURATED, loose, many rock fragments (white/pink quartz and feldspar) and granitic rock fragments also visible

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	2-4-5-5	20
2-4'	2-4-5-6	23
4-6'	2-3-4-5	24
6-8'	1-2-3-4	24
8-10'	2-2-3-4	24
10-12'	0-2-3-4	24
12-14'	2-3-3-4	24
14-16'	1-1-2-2	20
16-18'	0-1-1-2	24
18-20'	0-1-1-2	24
20-22'	0-1-1-2	24
22-24'	1-2-2-3	20
24-26'	0-1-2-1	24
26-28'	0-0-2-2	18
28-30'	0-1-1-3	14
30-32'	2-2-2-2	24
32-34'	3-5-5-5	24
34-36'	3-6-7-9	24

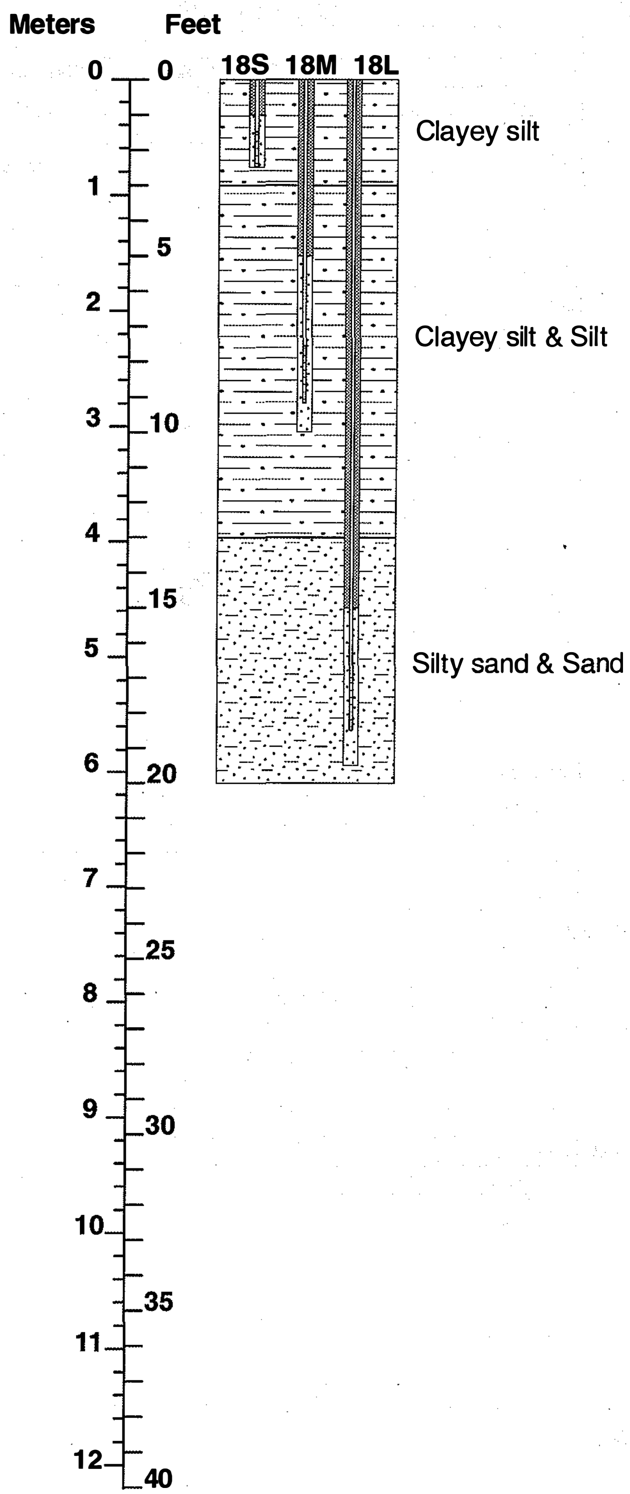


APPENDIX B Geologic logs

Boring:	18L
Location:	
Date:	
Field Crew:	Keith Carr, Bonnie Robinson, Paula Sabatini, Blaine Watson, Kelli Weaver
Equipment:	ATV rig, CME 850, 6-inch solid stem auger, continuous 2-ft split spoon samples
Depth	**Unit Descriptions**
0' – 3' (0 m – 0.91 m)	*Notes*: clayey silt ,10YR 3/1, common (15-20%) distinct (10YR 3/6) redox concentrations, moist, soft, visible root fragments
3' – 13' (0.91 m – 3.96 m)	*Notes*: clayey silt ,10YR 4/1, common (20-50%) distinct (10YR 4/6) redox concentrations, moist, soft to med. stiff, root fragments with visible depletion zones around, redox concentrations/depletions are evenly mixed below ~8' with Fe/Mn nodules common, unit grades downward into clayey silt with up to 5% sand
13' – 20' (3.96 m – 6.10 m)	*Notes*: 2.5Y 5/1 fine silty sand to med. sand, SATURATED at 13', common (30+%) distinct (2.5Y 5/4) redox concentrations, loose, no obvious structure

APPENDIX B Geologic logs

Depth (feet)	Blow Counts (per 6" driven)	Recovery (inches)
0-2'	1-2-3-3	15
2-4'	2-3-3-4	24
4-6'	2-3-3-5	24
6-8'	1-2-4-5	22
8-10'	2-3-4-5	24
10-12'	1-2-3-3	24
12-14'	0-1-2-3	24
14-16'	0-1-2-3	24
16-18'	0-2-1-2	24
18-20'	0-1-2-5	16



APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	05/30/00	06/26/00	06/27/00	07/14/00	08/14/00	09/11/00	10/16/00
Well 1S	*	**	dry	dry	dry	dry	dry
Well 1WT	*	*	*	*	*	*	*
Well 1U	**	**	130.82	130.87	130.73	130.47	dry
Well 2S	*	*	*	*	*	*	*
Well 2M	*	*	*	*	*	*	*
Well 2L	*	*	*	*	*	*	*
Well 3S	*	*	*	*	*	*	*
Well 4S	*	*	*	*	*	*	*
Well 4M	*	*	*	*	*	*	*
Well 4L	*	*	*	*	*	*	*
Well 5S	*	*	*	*	*	*	*
Well 6S	*	*	*	*	*	*	*
Well 7S	*	*	*	*	*	*	*
Well 8S	*	*	*	*	*	*	*
Well 8M	*	*	*	*	*	*	*
Well 8L	*	*	*	*	*	*	*
Well 9S	*	*	*	*	*	*	*
Well 10S	*	*	*	*	*	*	*
Well 10M	*	*	*	*	*	*	*
Well 10L	*	*	*	*	*	*	*
Well 11S	*	*	*	*	*	*	*
Well 11M	*	*	*	*	*	*	*
Well 11L	*	*	*	*	*	*	*
Well 12S	*	*	*	*	*	*	*
Well 12M	*	*	*	*	*	*	*
Well 12L	*	*	*	*	*	*	*
Well 13S	*	*	*	*	*	*	*
Well 14S	*	*	*	*	*	*	*
Well 14M	*	*	*	*	*	*	*
Well 14L	*	*	*	*	*	*	*
Well 15S	*	*	*	*	*	*	*
Well 16S	*	*	*	*	*	*	*
Well 17S	*	*	*	*	*	*	*
Well 17M	*	*	*	*	*	*	*
Well 17L	*	*	*	*	*	*	*
Well 18S	*	*	*	*	*	*	*
Well 18M	*	*	*	*	*	*	*
Well 18L	*	*	*	*	*	*	*
Well 19S	*	*	*	*	*	*	*
Well 20S	*	*	*	*	*	*	*
Well 21S	*	*	*	*	*	*	*
Well 22S	*	*	*	*	*	*	*
Well 23S	*	*	*	*	*	*	*
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	10/25/00	11/15/00	12/28/00	01/18/01	02/22/01	03/28/01	04/11/01
Well 1S	dry	dry	dry	dry	131.24	131.55	131.38
Well 1WT	*	*	*	*	*	*	*
Well 1U	130.64	130.70	130.69	130.83	131.25	131.55	131.39
Well 2S	*	*	*	*	*	*	*
Well 2M	*	*	*	*	*	*	*
Well 2L	*	*	*	*	*	*	*
Well 3S	*	*	*	*	*	*	*
Well 4S	*	*	*	*	*	*	*
Well 4M	*	*	*	*	*	*	*
Well 4L	*	*	*	*	*	*	*
Well 5S	*	*	*	*	*	*	*
Well 6S	*	*	*	*	*	*	*
Well 7S	*	*	*	*	*	*	*
Well 8S	*	*	*	*	*	*	*
Well 8M	*	*	*	*	*	*	*
Well 8L	*	*	*	*	*	*	*
Well 9S	*	*	*	*	*	*	*
Well 10S	*	*	*	*	*	*	*
Well 10M	*	*	*	*	*	*	*
Well 10L	*	*	*	*	*	*	*
Well 11S	*	*	*	*	*	*	*
Well 11M	*	*	*	*	*	*	*
Well 11L	*	*	*	*	*	*	*
Well 12S	*	*	*	*	*	*	*
Well 12M	*	*	*	*	*	*	*
Well 12L	*	*	*	*	*	*	*
Well 13S	*	*	*	*	*	*	*
Well 14S	*	*	*	*	*	*	*
Well 14M	*	*	*	*	*	*	*
Well 14L	*	*	*	*	*	*	*
Well 15S	*	*	*	*	*	*	*
Well 16S	*	*	*	*	*	*	*
Well 17S	*	*	*	*	*	*	*
Well 17M	*	*	*	*	*	*	*
Well 17L	*	*	*	*	*	*	*
Well 18S	*	*	*	*	*	*	*
Well 18M	*	*	*	*	*	*	*
Well 18L	*	*	*	*	*	*	*
Well 19S	*	*	*	*	*	*	*
Well 20S	*	*	*	*	*	*	*
Well 21S	*	*	*	*	*	*	*
Well 22S	*	*	*	*	*	*	*
Well 23S	*	*	*	*	*	*	*
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	04/24/01	04/25/01	05/09/01	05/24/01	06/12/01	06/26/01	07/23/01
Well 1S	131.32	**	131.10	dry	131.14	dry	dry
Well 1WT	*	*	*	*	*	*	*
Well 1U	131.32	**	131.10	130.95	131.14	130.97	130.68
Well 2S	dry	**	dry	dry	dry	dry	dry
Well 2M	*	*	*	*	*	*	*
Well 2L	*	*	*	*	*	*	*
Well 3S	131.79	**	dry	dry	131.84	131.63	dry
Well 4S	dry	**	dry	dry	132.08	dry	dry
Well 4M	*	*	*	*	*	*	*
Well 4L	*	*	*	*	*	*	*
Well 5S	131.76	**	dry	dry	131.98	131.82	131.59
Well 6S	131.84	**	131.68	131.65	131.76	131.45	dry
Well 7S	131.63	**	131.25	131.22	131.63	131.31	dry
Well 8S	131.96	**	131.63	131.60	131.91	131.71	dry
Well 8M	*	*	*	*	*	*	*
Well 8L	*	*	*	*	*	*	*
Well 9S	131.52	**	131.14	131.13	131.47	131.20	dry
Well 10S	131.40	**	131.18	dry	131.30	dry	dry
Well 10M	*	*	*	*	*	*	*
Well 10L	*	*	*	*	*	*	*
Well 11S	131.26	**	130.86	130.90	131.18	130.97	dry
Well 11M	*	*	*	*	*	*	*
Well 11L	*	*	*	*	*	*	*
Well 12S	131.26	**	dry	dry	131.41	131.13	dry
Well 12M	*	*	*	*	*	*	*
Well 12L	*	*	*	*	*	*	*
Well 13S	**	131.78	131.40	131.47	131.98	131.79	dry
Well 14S	**	dry	dry	dry	dry	dry	dry
Well 14M	*	*	*	*	*	*	*
Well 14L	*	*	*	*	*	*	*
Well 15S	**	131.39	131.12	130.97	131.17	dry	dry
Well 16S	**	131.32	131.17	131.05	131.21	130.96	dry
Well 17S	**	132.15	131.71	131.77	132.14	131.79	dry
Well 17M	*	*	*	*	*	*	*
Well 17L	*	*	*	*	*	*	*
Well 18S	*	*	*	*	*	*	*
Well 18M	*	*	*	*	*	*	*
Well 18L	*	*	*	*	*	*	*
Well 19S	*	*	*	*	*	*	*
Well 20S	*	*	*	*	*	*	*
Well 21S	*	*	*	*	*	*	*
Well 22S	*	*	*	*	*	*	*
Well 23S	*	*	*	*	*	*	*
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	09/12/01	10/24/01	12/12/01	01/02/02	01/25/02	03/01/02	03/19/02
Well 1S	dry	dry	**	dry	dry	131.07	131.12
Well 1WT	*	*	*	*	*	*	*
Well 1U	130.57	130.77	**	130.79	130.77	131.07	131.12
Well 2S	dry	dry	dry	dry	dry	dry	dry
Well 2M	*	*	dry	132.34	132.47	133.19	133.27
Well 2L	*	*	131.89	132.40	132.45	133.13	133.18
Well 3S	dry	131.75	dry	dry	dry	131.97	132.01
Well 4S	dry	dry	dry	dry	dry	dry	dry
Well 4M	*	*	dry	dry	130.19	130.44	130.57
Well 4L	*	*	130.80	131.47	131.29	132.04	132.13
Well 5S	dry	dry	dry	dry	dry	131.95	132.07
Well 6S	dry	dry	131.33	131.45	131.35	131.79	131.84
Well 7S	dry	131.70	**	131.36	131.56	131.77	131.89
Well 8S	dry	132.09	**	131.61	131.52	131.82	131.80
Well 8M	*	*	**	131.10	131.20	131.78	131.58
Well 8L	*	*	**	130.74	130.69	131.16	131.81
Well 9S	dry	131.57	**	131.20	131.15	**	131.45
Well 10S	dry	dry	**	dry	dry	dry	131.26
Well 10M	*	*	**	130.97	130.86	131.19	131.25
Well 10L	*	*	**	130.83	130.79	131.15	131.25
Well 11S	dry	130.71	**	dry	dry	130.92	131.03
Well 11M	*	*	**	130.65	130.44	130.91	131.02
Well 11L	*	*	**	130.21	130.18	130.65	131.00
Well 12S	dry	dry	**	dry	dry	dry	131.13
Well 12M	*	*	**	130.57	130.51	130.99	131.11
Well 12L	*	*	**	130.53	130.44	130.99	131.17
Well 13S	dry	131.27	**	dry	dry	131.68	131.86
Well 14S	dry	dry	dry	dry	dry	dry	dry
Well 14M	*	*	dry	131.97	132.11	132.67	132.75
Well 14L	*	*	131.68	131.73	131.71	131.97	131.83
Well 15S	dry	130.99	**	dry	130.91	131.12	131.17
Well 16S	dry	131.07	**	130.92	131.02	131.21	131.23
Well 17S	dry	132.25	**	131.82	132.03	132.28	132.25
Well 17M	*	*	**	131.64	131.85	132.03	132.16
Well 17L	*	*	**	131.35	131.34	131.77	131.97
Well 18S	*	*	**	130.59	130.82	frozen	131.14
Well 18M	*	*	**	130.07	130.68	131.05	131.12
Well 18L	*	*	**	130.36	130.42	130.84	131.14
Well 19S	*	*	**	130.93	130.99	131.15	131.10
Well 20S	*	*	**	dry	dry	130.94	131.08
Well 21S	*	*	**	130.90	130.92	131.12	131.16
Well 22S	*	*	*	*	*	dry	dry
Well 23S	*	*	*	*	*	131.87	132.00
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	04/11/02	04/23/02	05/07/02	05/13/02	08/01/02	09/10/02	10/16/02
Well 1S	131.14	131.14	131.39	flooded	131.51	131.14	dry
Well 1WT	*	*	*	*	*	*	*
Well 1U	131.15	131.15	131.40	flooded	131.48	131.12	130.85
Well 2S	dry	dry	dry	**	dry	dry	dry
Well 2M	133.23	133.31	flooded	**	133.07	132.58	dry
Well 2L	133.12	133.19	133.70	**	133.17	132.52	131.54
Well 3S	132.34	132.27	flooded	flooded	dry	dry	dry
Well 4S	dry	dry	inaccessible	flooded	damaged	dry	dry
Well 4M	130.72	130.82	inaccessible	flooded	133.21	132.54	131.60
Well 4L	132.09	132.18	inaccessible	flooded	131.76	131.20	130.61
Well 5S	132.25	132.23	132.56	**	dry	dry	dry
Well 6S	131.88	131.88	inundated	flooded	131.75	dry	dry
Well 7S	131.88	131.84	inaccessible	**	**	dry	dry
Well 8S	132.06	131.99	132.13	**	131.58	dry	dry
Well 8M	131.78	131.82	131.91	**	131.71	131.35	131.00
Well 8L	131.39	131.51	132.18	**	130.90	130.63	130.00
Well 9S	131.64	131.60	saturated	131.70	131.14	dry	dry
Well 10S	131.46	131.46	inaccessible	131.79	131.44	dry	dry
Well 10M	131.45	131.45	inaccessible	131.81	131.43	131.11	130.79
Well 10L	131.21	131.30	inaccessible	131.79	131.43	131.15	130.78
Well 11S	131.32	131.32	inundated	flooded	131.51	130.82	dry
Well 11M	131.31	131.31	inundated	flooded	131.50	130.82	130.34
Well 11L	130.83	131.00	inundated	flooded	130.53	130.37	130.15
Well 12S	131.20	131.21	inaccessible	131.65	131.35	dry	dry
Well 12M	131.11	131.20	inaccessible	131.59	131.51	130.91	130.48
Well 12L	131.07	131.19	inaccessible	131.95	131.37	130.74	130.40
Well 13S	131.90	131.91	inaccessible	**	131.28	dry	dry
Well 14S	dry	dry	134.02	**	dry	dry	dry
Well 14M	132.58	132.67	133.44	**	132.45	131.93	131.85
Well 14L	132.08	132.11	132.60	**	131.64	131.12	130.85
Well 15S	131.34	131.26	inaccessible	flooded	131.36	130.98	dry
Well 16S	131.30	131.30	131.47	flooded	131.48	131.00	dry
Well 17S	132.25	132.23	132.39	**	dry	dry	dry
Well 17M	132.18	132.16	132.27	**	131.61	130.91	130.64
Well 17L	131.98	131.99	132.29	**	131.45	130.89	130.63
Well 18S	inundated	inundated	inundated	131.65	inundated	inundated	dry
Well 18M	inundated	inundated	inundated	131.41	inundated	inundated	130.57
Well 18L	inundated	inundated	inundated	131.90	inundated	inundated	130.31
Well 19S	131.37	131.34	inundated	inundated	inundated	130.81	dry
Well 20S	131.28	131.28	inundated	inundated	131.46	130.85	dry
Well 21S	131.21	131.22	inaccessible	inundated	131.52	131.10	dry
Well 22S	132.16	132.14	132.60	**	dry	dry	dry
Well 23S	132.05	132.04	132.23	**	131.49	dry	dry
Well 24S	*	*	*	*	*	dry	dry
Well 25S	*	*	*	*	*	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	11/13/02	12/17/02	01/13/03	02/05/03	03/06/03	04/08/03	04/22/03
Well 1S	dry	dry	dry	dry	dry	dry	burned
Well 1WT	*	*	*	*	*	*	131.02
Well 1U	130.88	130.83	130.90	130.91	130.88	131.03	130.96
Well 2S	dry	dry	dry	dry	**	134.41	dry
Well 2M	132.23	132.23	132.23	132.22	**	133.27	133.29
Well 2L	131.74	131.64	131.81	131.90	**	131.74	132.84
Well 3S	dry	dry	dry	dry	**	132.22	132.36
Well 4S	dry	dry	dry	dry	**	dry	dry
Well 4M	131.66	131.38	131.28	131.23	**	130.51	130.63
Well 4L	130.92	130.83	131.18	131.29	**	130.62	131.71
Well 5S	dry	dry	dry	dry	**	132.04	dry
Well 6S	dry	dry	131.30	131.33	**	131.88	131.86
Well 7S	dry	dry	131.39	131.51	**	131.85	131.85
Well 8S	dry	dry	131.68	131.82	frozen	132.13	132.04
Well 8M	130.89	130.79	131.84	131.72	131.96	132.08	132.07
Well 8L	130.35	130.39	130.76	130.86	130.92	131.03	130.96
Well 9S	dry	dry	dry	131.13	**	131.70	131.60
Well 10S	dry	dry	dry	dry	**	131.42	131.29
Well 10M	130.93	130.71	131.11	131.07	**	131.47	131.28
Well 10L	130.86	130.69	131.06	130.91	**	131.08	130.89
Well 11S	dry	dry	130.78	130.79	130.72	131.17	130.99
Well 11M	130.50	130.28	130.77	130.88	130.71	131.27	130.98
Well 11L	130.17	130.14	130.26	130.29	130.27	130.51	130.38
Well 12S	dry	dry	dry	dry	dry	131.06	dry
Well 12M	130.55	130.45	130.73	130.66	130.67	131.06	130.90
Well 12L	130.46	130.40	130.58	130.59	130.55	130.77	130.68
Well 13S	dry	dry	dry	dry	dry	131.73	131.58
Well 14S	dry	dry	dry	dry	dry	dry	dry
Well 14M	131.86	131.86	131.85	131.85	132.09	132.23	132.78
Well 14L	131.17	131.28	131.59	131.80	131.78	132.01	132.05
Well 15S	dry	dry	dry	131.05	131.02	131.37	131.27
Well 16S	dry	dry	130.98	131.08	131.18	131.31	131.26
Well 17S	dry	dry	131.86	131.98	132.24	132.28	132.26
Well 17M	130.55	130.48	131.59	131.72	131.97	132.18	132.16
Well 17L	130.59	130.55	131.15	131.17	131.41	131.76	131.80
Well 18S	130.66	130.60	130.60	130.73	**	130.99	130.70
Well 18M	130.77	130.54	130.83	130.60	**	130.89	130.85
Well 18L	130.44	130.35	130.44	130.48	**	130.77	130.62
Well 19S	dry	dry	dry	131.09	**	131.42	131.15
Well 20S	dry	dry	dry	dry	dry	131.15	131.02
Well 21S	130.78	dry	130.95	131.01	**	131.15	131.08
Well 22S	dry	dry	dry	dry	**	dry	dry
Well 23S	dry	dry	dry	dry	**	131.95	131.83
Well 24S	dry	dry	dry	dry	**	dry	dry
Well 25S	dry	dry	dry	dry	**	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
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M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	05/06/03	05/20/03	06/03/03	06/17/03	07/15/03	08/12/03	09/03/03
Well 1S	burned	burned	burned	burned	burned	burned	burned
Well 1WT	131.07	131.27	131.16	130.82	130.35	130.47	131.10
Well 1U	131.13	131.29	131.13	130.98	130.83	130.98	131.05
Well 2S	dry	dry	dry	dry	dry	dry	dry
Well 2M	133.87	133.60	133.33	133.50	133.08	132.72	132.58
Well 2L	133.34	133.57	133.35	133.31	133.09	132.80	132.38
Well 3S	132.42	131.91	dry	132.16	131.92	dry	132.31
Well 4S	132.41	132.06	dry	dry	dry	dry	132.04
Well 4M	130.76	130.97	131.15	131.28	131.44	131.65	131.59
Well 4L	132.14	132.09	131.74	131.94	131.65	131.63	131.52
Well 5S	132.29	132.00	dry	131.93	dry	dry	132.13
Well 6S	131.90	131.67	131.49	131.62	dry	dry	131.72
Well 7S	131.86	131.42	131.22	131.65	131.27	dry	131.78
Well 8S	132.07	131.51	131.48	131.82	131.51	dry	131.98
Well 8M	132.09	131.57	131.46	131.80	131.71	131.57	131.37
Well 8L	131.09	131.26	130.79	130.94	130.94	130.72	130.91
Well 9S	131.65	131.15	dry	131.40	131.08	dry	131.51
Well 10S	131.58	131.24	131.18	131.29	dry	dry	131.25
Well 10M	131.57	131.23	131.17	131.28	130.95	130.95	131.25
Well 10L	131.08	131.17	131.01	131.05	130.88	130.86	130.78
Well 11S	131.27	131.19	131.17	131.04	130.81	dry	131.18
Well 11M	131.26	131.24	131.19	131.02	130.80	130.59	131.18
Well 11L	130.47	130.92	130.43	130.44	130.52	130.33	130.49
Well 12S	131.19	131.06	dry	131.03	dry	dry	131.18
Well 12M	131.20	131.05	130.91	131.03	130.67	130.68	131.18
Well 12L	130.82	131.05	130.68	130.80	130.64	130.56	130.91
Well 13S	131.90	131.76	131.38	131.60	131.30	dry	131.52
Well 14S	dry	133.80	dry	dry	dry	dry	dry
Well 14M	133.11	133.15	132.73	132.67	132.37	131.74	131.96
Well 14L	132.31	132.04	131.78	131.91	131.47	131.93	131.73
Well 15S	131.48	131.25	131.23	131.02	dry	dry	131.11
Well 16S	131.40	131.29	131.22	131.13	130.84	130.83	131.16
Well 17S	132.27	131.85	131.70	132.13	131.84	dry	132.23
Well 17M	132.23	131.89	131.64	132.07	131.82	131.49	132.03
Well 17L	132.01	131.82	131.46	131.80	131.54	131.26	131.68
Well 18S	131.10	**	**	131.02	130.49	131.03	131.07
Well 18M	130.97	**	**	131.11	130.70	131.06	130.73
Well 18L	130.82	**	**	130.73	130.52	130.66	130.76
Well 19S	131.37	130.87	dry	130.88	dry	dry	130.93
Well 20S	131.31	131.04	130.91	131.12	130.80	dry	131.20
Well 21S	131.23	131.28	131.21	131.02	130.58	130.95	131.18
Well 22S	132.23	dry	dry	dry	dry	dry	dry
Well 23S	132.07	131.85	131.46	131.66	dry	dry	131.86
Well 24S	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
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L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	10/01/03	11/14/03	12/15/03	01/22/04	03/09/04	04/06/04	04/15/04
Well 1S	burned	burned	burned	burned	burned	burned	burned
Well 1WT	130.76	130.96	131.11	130.75	131.00	130.82	130.74
Well 1U	130.87	130.87	131.05	130.84	130.90	131.05	131.05
Well 2S	dry	dry	134.38	dry	dry	dry	dry
Well 2M	132.33	132.63	133.21	133.07	133.21	133.09	133.06
Well 2L	132.26	132.40	132.89	133.03	132.90	133.07	133.03
Well 3S	dry	132.15	132.45	dry	132.28	131.94	dry
Well 4S	dry	dry	132.17	dry	132.01	dry	dry
Well 4M	131.50	131.40	131.57	131.69	131.58	131.65	131.65
Well 4L	131.18	131.63	131.95	131.73	131.75	131.75	131.70
Well 5S	dry	dry	132.24	dry	131.93	dry	dry
Well 6S	131.16	131.69	131.84	131.66	131.81	131.76	131.61
Well 7S	dry	131.77	frozen	131.30	131.53	131.28	131.21
Well 8S	131.50	131.98	132.08	131.62	131.94	131.60	131.50
Well 8M	131.44	131.78	131.94	131.83	131.98	131.70	131.56
Well 8L	130.68	130.89	131.24	130.82	131.07	131.18	130.88
Well 9S	dry	dry	131.63	131.23	131.45	131.25	131.15
Well 10S	dry	dry	131.37	dry	131.26	131.19	dry
Well 10M	130.90	131.10	131.36	131.06	131.25	131.18	131.13
Well 10L	130.76	130.92	131.10	130.92	131.07	131.07	131.03
Well 11S	dry	130.81	131.32	130.74	130.94	130.90	130.83
Well 11M	130.15	130.80	131.31	130.75	130.94	130.90	130.84
Well 11L	130.25	130.42	130.50	130.30	130.46	130.76	130.32
Well 12S	dry	dry	131.18	dry	dry	dry	dry
Well 12M	130.52	130.69	131.16	130.69	130.91	130.92	130.81
Well 12L	130.42	130.78	130.97	131.10	130.76	130.91	130.65
Well 13S	dry	131.31	131.86	131.29	131.65	131.57	131.33
Well 14S	dry	dry	dry	dry	dry	dry	dry
Well 14M	132.01	132.19	132.89	132.66	132.79	132.77	132.69
Well 14L	131.45	131.74	132.09	131.95	132.10	131.97	131.84
Well 15S	dry	131.00	131.31	130.94	131.24	131.09	131.07
Well 16S	dry	131.08	131.25	131.03	131.18	131.12	131.05
Well 17S	131.70	132.24	132.27	frozen	132.15	131.74	dry
Well 17M	131.55	132.07	132.16	131.94	132.09	131.78	131.65
Well 17L	131.21	131.64	131.94	131.53	131.79	131.64	131.46
Well 18S	130.78	130.84	frozen	130.58	130.91	131.01	131.01
Well 18M	130.81	130.85	130.95	130.83	130.86	130.92	130.99
Well 18L	130.52	130.58	130.86	130.50	130.71	130.90	130.71
Well 19S	130.75	**	131.38	130.91	131.29	131.17	130.93
Well 20S	dry	130.70	131.26	dry	130.91	130.89	130.82
Well 21S	130.77	dry	131.25	131.05	131.19	131.14	131.06
Well 22S	dry	dry	dry	dry	dry	dry	dry
Well 23S	dry	dry	132.03	131.47	131.83	131.62	131.45
Well 24S	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
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M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations			
Date	04/30/04	05/14/04	05/27/04	06/09/04
Well 1S	burned	burned	burned	burned
Well 1WT	130.80	130.64	131.09	**
Well 1U	130.92	130.85	131.05	**
Well 2S	dry	dry	dry	dry
Well 2M	133.02	132.88	133.03	132.93
Well 2L	132.94	132.85	132.80	132.91
Well 3S	131.96	dry	132.40	131.93
Well 4S	dry	dry	132.16	132.06
Well 4M	131.65	131.62	131.63	131.72
Well 4L	131.61	131.43	130.99	131.98
Well 5S	dry	dry	132.26	132.05
Well 6S	131.72	131.62	131.78	flooded
Well 7S	131.35	131.26	131.74	**
Well 8S	131.63	131.79	132.00	**
Well 8M	131.70	131.52	131.92	**
Well 8L	130.88	130.81	131.50	**
Well 9S	131.23	dry	131.47	**
Well 10S	131.19	dry	131.46	**
Well 10M	131.18	131.13	131.45	**
Well 10L	131.04	130.91	131.04	**
Well 11S	130.87	130.68	131.31	**
Well 11M	130.87	130.68	131.30	**
Well 11L	130.36	130.28	131.02	**
Well 12S	dry	dry	131.12	**
Well 12M	130.82	130.59	131.12	**
Well 12L	130.67	130.53	131.12	**
Well 13S	131.37	dry	131.91	132.39
Well 14S	dry	dry	dry	dry
Well 14M	132.54	132.41	132.28	132.27
Well 14L	131.82	131.65	131.84	132.23
Well 15S	131.08	130.93	131.18	**
Well 16S	131.11	131.11	131.31	**
Well 17S	131.79	131.90	132.15	132.32
Well 17M	131.79	131.63	132.15	132.28
Well 17L	131.54	131.26	131.99	132.11
Well 18S	130.70	130.82	131.02	**
Well 18M	130.96	130.77	130.76	**
Well 18L	130.58	130.43	131.01	**
Well 19S	131.17	131.31	131.36	**
Well 20S	130.86	dry	131.18	**
Well 21S	131.02	131.04	131.20	**
Well 22S	dry	dry	dry	dry
Well 23S	131.44	dry	131.94	132.41
Well 24S	dry	dry	dry	**
Well 25S	dry	dry	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C1 Water-Level Elevations in Monitoring Wells (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations			
Date	06/23/04	07/13/04	07/14/04	08/17/04
Well 1S	burned	burned	burned	burned
Well 1WT	flooded	**	**	130.57
Well 1U	flooded	131.63	**	130.98
Well 2S	dry	dry	**	dry
Well 2M	132.91	132.73	**	132.21
Well 2L	132.89	132.74	**	132.21
Well 3S	132.56	**	132.01	dry
Well 4S	132.41	**	dry	dry
Well 4M	131.83	**	131.94	131.70
Well 4L	132.19	**	131.97	131.09
Well 5S	132.53	**	dry	dry
Well 6S	flooded	**	131.78	dry
Well 7S	132.50	**	131.47	dry
Well 8S	132.55	131.77	**	dry
Well 8M	132.55	131.92	**	131.01
Well 8L	132.14	131.12	**	130.51
Well 9S	flooded	**	131.43	dry
Well 10S	132.59	131.65	**	dry
Well 10M	132.57	131.64	**	130.92
Well 10L	flooded	131.54	**	130.85
Well 11S	flooded	131.68	**	130.65
Well 11M	flooded	131.68	**	130.64
Well 11L	flooded	130.69	**	130.19
Well 12S	flooded	131.64	**	dry
Well 12M	flooded	131.65	**	130.63
Well 12L	flooded	131.29	**	130.52
Well 13S	**	**	131.44	dry
Well 14S	dry	**	dry	dry
Well 14M	132.38	**	132.44	131.92
Well 14L	132.47	**	131.84	131.02
Well 15S	**	**	131.62	dry
Well 16S	**	**	131.63	130.79
Well 17S	132.44	**	131.96	dry
Well 17M	132.49	**	132.00	130.95
Well 17L	132.35	**	131.70	130.84
Well 18S	flooded	flooded	**	131.03
Well 18M	flooded	flooded	**	131.25
Well 18L	flooded	flooded	**	130.60
Well 19S	flooded	**	flooded	dry
Well 20S	flooded	131.65	**	dry
Well 21S	flooded	131.66	**	130.93
Well 22S	132.30	**	dry	dry
Well 23S	132.56	**	131.60	dry
Well 24S	132.66	dry	**	dry
Well 25S	132.79	**	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

APPENDIX C Water Levels and Depths to Water

Table C2 Water-Level Elevations on Stage Gauges (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	05/30/00	06/26/00	06/27/00	07/14/00	08/14/00	09/11/00	10/16/00
Gauge SW1-A	130.63	**	130.70	130.81	130.71	130.46	**
Gauge SW1-B	130.88	**	130.95	130.95	dry	dry	**
Gauge SW2-A	131.12	131.63	**	flooded	131.42	130.95	131.08
Gauge SW3-A	*	*	*	*	*	*	*
Gauge SW4-A	*	*	*	*	*	*	*
Gauge SW5-A	130.89	**	130.94	130.94	130.83	130.67	**
Gauge SW6-A	*	*	*	*	*	*	131.37
Gauge SW7-A	*	*	*	*	*	*	*
Gauge SW8-A	*	*	*	*	*	*	*
Gauge SW9-A	*	*	*	*	*	*	*
Gauge SW12-A	*	*	*	*	*	*	*
Gauge SW13-A	*	*	*	*	*	*	*
Gauge SW14-A	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued

	Water-Level Elevations						
Date	10/25/00	11/15/00	12/28/00	01/18/01	02/22/01	03/28/01	04/11/01
Gauge SW1-A	130.57	130.65	frozen	frozen	131.20	131.43	131.34
Gauge SW1-B	dry	130.71	frozen	frozen	131.31	131.68	131.49
Gauge SW2-A	**	131.28	frozen	frozen	flooded	131.70	131.78
Gauge SW3-A	131.32	131.34	frozen	frozen	131.46	131.60	131.49
Gauge SW4-A	130.66	130.70	frozen	frozen	131.26	flooded	131.40
Gauge SW5-A	130.87	130.91	frozen	frozen	frozen	131.53	131.37
Gauge SW6-A	**	131.36	frozen	frozen	flooded	131.73	131.60
Gauge SW7-A	130.66	130.66	frozen	frozen	131.24	**	**
Gauge SW8-A	*	*	*	*	*	*	*
Gauge SW9-A	*	*	*	*	*	*	*
Gauge SW12-A	*	*	*	*	*	*	*
Gauge SW13-A	*	*	*	*	*	*	*
Gauge SW14-A	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued

APPENDIX C Water Levels and Depths to Water

Table C2 Water-Level Elevations on Stage Gauges (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	04/24/01	04/25/01	05/09/01	05/24/01	06/12/01	06/26/01	07/23/01
Gauge SW1-A	131.30	**	131.07	130.92	131.10	130.95	130.59
Gauge SW1-B	131.41	**	131.18	131.02	131.22	131.05	dry
Gauge SW2-A	flooded	**	131.61	131.45	flooded	flooded	131.44
Gauge SW3-A	**	131.45	131.42	131.41	131.44	131.41	131.17
Gauge SW4-A	131.32	**	131.12	130.96	131.17	130.99	130.74
Gauge SW5-A	131.31	**	131.10	130.94	131.13	130.98	130.75
Gauge SW6-A	**	131.58	131.51	131.48	inaccessible	131.63	131.42
Gauge SW7-A	131.31	**	131.09	130.94	131.13	130.97	130.71
Gauge SW8-A	*	*	*	*	*	*	*
Gauge SW9-A	*	*	*	*	*	*	*
Gauge SW12-A	*	*	*	*	*	*	*
Gauge SW13-A	*	*	*	*	*	*	*
Gauge SW14-A	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued

	Water-Level Elevations						
Date	09/12/01	10/24/01	12/12/01	01/02/02	01/25/02	03/01/02	03/19/02
Gauge SW1-A	130.57	130.78	**	frozen	130.79	frozen	131.11
Gauge SW1-B	dry	131.01	**	frozen	130.96	frozen	131.13
Gauge SW2-A	131.05	131.18	131.34	frozen	131.29	flooded	flooded
Gauge SW3-A	131.21	131.41	**	frozen	131.36	131.40	131.40
Gauge SW4-A	130.61	130.76	**	130.74	130.74	131.05	131.10
Gauge SW5-A	130.75	130.88	**	frozen	130.93	131.08	131.13
Gauge SW6-A	131.21	131.23	131.23	frozen	131.25	131.33	flooded
Gauge SW7-A	130.64	130.72	**	130.77	130.76	frozen	131.11
Gauge SW8-A	*	*	*	*	*	131.32	131.75
Gauge SW9-A	*	*	*	*	*	**	132.06
Gauge SW12-A	*	*	*	*	*	*	*
Gauge SW13-A	*	*	*	*	*	*	*
Gauge SW14-A	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued

APPENDIX C Water Levels and Depths to Water

Table C2 Water-Level Elevations on Stage Gauges (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	04/11/02	04/23/02	05/07/02	05/13/02	08/01/02	09/10/02	10/16/02
Gauge SW1-A	131.13	131.13	131.38	flooded	131.50	131.16	130.82
Gauge SW1-B	131.17	131.16	131.41	flooded	131.51	131.17	130.74
Gauge SW2-A	flooded	flooded	flooded	**	132.21	131.46	dry
Gauge SW3-A	131.45	131.44	131.90	**	131.51	131.28	dry
Gauge SW4-A	131.13	131.13	131.41	submerged	submerged	131.13	130.87
Gauge SW5-A	131.16	131.16	131.44	**	131.51	131.16	130.89
Gauge SW6-A	131.47	131.87	submerged	submerged	131.41	131.26	131.26
Gauge SW7-A	131.12	131.13	131.43	submerged	submerged	131.16	130.89
Gauge SW8-A	131.45	131.84	submerged	submerged	131.40	131.23	**
Gauge SW9-A	132.09	132.11	132.15	**	dry	dry	dry
Gauge SW12-A	*	*	*	*	*	*	*
Gauge SW13-A	*	*	*	*	*	*	*
Gauge SW14-A	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued

	Water-Level Elevations						
Date	11/13/02	12/17/02	01/13/03	02/05/03	03/06/03	04/08/03	04/22/03
Gauge SW1-A	130.90	130.77	frozen	frozen	frozen	131.07	131.01
Gauge SW1-B	130.87	dry	frozen	frozen	frozen	131.14	131.10
Gauge SW2-A	dry	dry	dry	frozen	**	131.88	**
Gauge SW3-A	dry	dry	frozen	frozen	frozen	131.44	131.41
Gauge SW4-A	130.88	130.85	frozen	frozen	frozen	131.09	131.04
Gauge SW5-A	130.91	**	130.91	frozen	**	130.99	130.93
Gauge SW6-A	131.36	131.29	frozen	frozen	frozen	131.34	131.30
Gauge SW7-A	130.89	130.84	frozen	frozen	130.90	131.05	131.01
Gauge SW8-A	131.34	131.26	frozen	131.36	131.35	131.32	dry
Gauge SW9-A	dry	dry	dry	dry	**	132.05	131.95
Gauge SW12-A	*	*	*	*	*	*	*
Gauge SW13-A	*	*	*	*	*	*	*
Gauge SW14-A	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued

APPENDIX C Water Levels and Depths to Water

Table C2 Water-Level Elevations on Stage Gauges (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations						
Date	05/06/03	05/20/03	06/03/03	06/17/03	07/15/03	08/12/03	09/03/03
Gauge SW1-A	131.21	131.34	131.17	131.02	130.89	131.03	131.08
Gauge SW1-B	131.27	131.30	131.17	131.03	130.87	131.03	131.10
Gauge SW2-A	submerged	**	**	**	***	***	***
Gauge SW3-A	131.44	131.31	131.31	131.31	131.26	131.17	131.37
Gauge SW4-A	131.21	submerged	131.15	131.00	130.87	131.02	131.05
Gauge SW5-A	131.10	131.32	131.15	131.01	130.87	131.02	131.07
Gauge SW6-A	131.36	131.27	131.26	131.26	131.29	130.93	***
Gauge SW7-A	**	**	**	**	130.89	***	***
Gauge SW8-A	dry	***	**	dry	***	***	***
Gauge SW9-A	132.14	131.99	dry	dry	dry	dry	132.03
Gauge SW12-A	*	131.34	131.14	131.01	130.88	131.02	131.06
Gauge SW13-A	*	131.32	131.20	dry	dry	dry	131.05
Gauge SW14-A	*	132.02	131.89	132.00	131.89	131.81	131.99

* not yet installed
** no measurement
*** discontinued

	Water-Level Elevations						
Date	10/01/03	11/03/03	12/15/03	01/22/04	03/09/04	04/06/04	04/15/04
Gauge SW1-A	130.91	130.93	131.09	frozen	130.93	131.14	131.16
Gauge SW1-B	130.90	130.92	131.11	frozen	131.30	131.26	131.22
Gauge SW2-A	***	***	***	***	***	***	***
Gauge SW3-A	131.29	131.33	131.37	frozen	131.38	131.36	131.35
Gauge SW4-A	130.89	130.88	frozen	frozen	131.01	131.18	131.19
Gauge SW5-A	130.90	130.93	131.07	frozen	130.93	131.03	131.05
Gauge SW6-A	***	***	***	***	***	***	***
Gauge SW7-A	***	***	frozen	**	131.01	131.15	131.14
Gauge SW8-A	***	***	***	***	***	***	***
Gauge SW9-A	dry	dry	132.06	dry	131.88	dry	dry
Gauge SW12-A	130.89	130.89	frozen	frozen	130.89	131.05	131.05
Gauge SW13-A	131.19	131.32	frozen	frozen	131.33	131.32	131.27
Gauge SW14-A	131.78	131.85	frozen	frozen	131.94	131.97	131.90

* not yet installed
** no measurement
*** discontinued

APPENDIX C Water Levels and Depths to Water

Table C2 Water-Level Elevations on Stage Gauges (in m referenced to North American Vertical Datum, 1988)

	Water-Level Elevations			
Date	04/30/04	05/14/04	05/27/04	06/09/04
Gauge SW1-A	130.98	130.91	131.12	**
Gauge SW1-B	131.06	131.03	131.21	**
Gauge SW2-A	***	***	***	***
Gauge SW3-A	131.35	131.38	131.38	**
Gauge SW4-A	131.05	130.98	131.19	**
Gauge SW5-A	130.94	130.94	131.07	**
Gauge SW6-A	***	***	***	***
Gauge SW7-A	131.02	130.94	131.15	**
Gauge SW8-A	***	***	***	***
Gauge SW9-A	dry	dry	131.93	132.37
Gauge SW12-A	130.91	130.85	131.06	**
Gauge SW13-A	131.21	131.14	131.30	**
Gauge SW14-A	131.87	131.88	132.04	132.37

* not yet installed
** no measurement
*** discontinued

	Water-Level Elevations			
Date	06/23/04	07/13/04	07/14/04	08/17/04
Gauge SW1-A	flooded	flooded	**	131.04
Gauge SW1-B	flooded	flooded	**	131.04
Gauge SW2-A	***	***	***	***
Gauge SW3-A	flooded	**	131.67	dry
Gauge SW4-A	flooded	flooded	**	131.02
Gauge SW5-A	flooded	flooded	**	131.03
Gauge SW6-A	***	***	***	***
Gauge SW7-A	flooded	flooded	**	131.03
Gauge SW8-A	***	***	***	***
Gauge SW9-A	132.82	**	dry	dry
Gauge SW12-A	flooded	131.64	**	131.01
Gauge SW13-A	flooded	131.63	**	131.27
Gauge SW14-A	132.56	132.03	**	dry

* not yet installed
** no measurement
*** discontinued

APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	05/30/00	06/26/00	06/27/00	07/14/00	08/14/00	09/11/00	10/16/00
Well 1S	*	**	dry	dry	dry	dry	dry
Well 1WT	*	*	*	*	*	*	*
Well 1U	**	**	0.92	0.87	1.01	1.27	dry
Well 2S	*	*	*	*	*	*	*
Well 2M	*	*	*	*	*	*	*
Well 2L	*	*	*	*	*	*	*
Well 3S	*	*	*	*	*	*	*
Well 4S	*	*	*	*	*	*	*
Well 4M	*	*	*	*	*	*	*
Well 4L	*	*	*	*	*	*	*
Well 5S	*	*	*	*	*	*	*
Well 6S	*	*	*	*	*	*	*
Well 7S	*	*	*	*	*	*	*
Well 8S	*	*	*	*	*	*	*
Well 8M	*	*	*	*	*	*	*
Well 8L	*	*	*	*	*	*	*
Well 9S	*	*	*	*	*	*	*
Well 10S	*	*	*	*	*	*	*
Well 10M	*	*	*	*	*	*	*
Well 10L	*	*	*	*	*	*	*
Well 11S	*	*	*	*	*	*	*
Well 11M	*	*	*	*	*	*	*
Well 11L	*	*	*	*	*	*	*
Well 12S	*	*	*	*	*	*	*
Well 12M	*	*	*	*	*	*	*
Well 12L	*	*	*	*	*	*	*
Well 13S	*	*	*	*	*	*	*
Well 14S	*	*	*	*	*	*	*
Well 14M	*	*	*	*	*	*	*
Well 14L	*	*	*	*	*	*	*
Well 15S	*	*	*	*	*	*	*
Well 16S	*	*	*	*	*	*	*
Well 17S	*	*	*	*	*	*	*
Well 17M	*	*	*	*	*	*	*
Well 17L	*	*	*	*	*	*	*
Well 18S	*	*	*	*	*	*	*
Well 18M	*	*	*	*	*	*	*
Well 18L	*	*	*	*	*	*	*
Well 19S	*	*	*	*	*	*	*
Well 20S	*	*	*	*	*	*	*
Well 21S	*	*	*	*	*	*	*
Well 22S	*	*	*	*	*	*	*
Well 23S	*	*	*	*	*	*	*
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

- indicates water above land surface
bold depth values less than or equal to 0.304 m

APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	10/25/00	11/15/00	12/28/00	01/18/01	02/22/01	03/28/01	04/11/01
Well 1S	dry	dry	dry	dry	0.52	**0.21**	0.38
Well 1WT	*	*	*	*	*	*	*
Well 1U	1.10	1.04	1.05	0.90	0.49	**0.19**	0.35
Well 2S	*	*	*	*	*	*	*
Well 2M	*	*	*	*	*	*	*
Well 2L	*	*	*	*	*	*	*
Well 3S	*	*	*	*	*	*	*
Well 4S	*	*	*	*	*	*	*
Well 4M	*	*	*	*	*	*	*
Well 4L	*	*	*	*	*	*	*
Well 5S	*	*	*	*	*	*	*
Well 6S	*	*	*	*	*	*	*
Well 7S	*	*	*	*	*	*	*
Well 8S	*	*	*	*	*	*	*
Well 8M	*	*	*	*	*	*	*
Well 8L	*	*	*	*	*	*	*
Well 9S	*	*	*	*	*	*	*
Well 10S	*	*	*	*	*	*	*
Well 10M	*	*	*	*	*	*	*
Well 10L	*	*	*	*	*	*	*
Well 11S	*	*	*	*	*	*	*
Well 11M	*	*	*	*	*	*	*
Well 11L	*	*	*	*	*	*	*
Well 12S	*	*	*	*	*	*	*
Well 12M	*	*	*	*	*	*	*
Well 12L	*	*	*	*	*	*	*
Well 13S	*	*	*	*	*	*	*
Well 14S	*	*	*	*	*	*	*
Well 14M	*	*	*	*	*	*	*
Well 14L	*	*	*	*	*	*	*
Well 15S	*	*	*	*	*	*	*
Well 16S	*	*	*	*	*	*	*
Well 17S	*	*	*	*	*	*	*
Well 17M	*	*	*	*	*	*	*
Well 17L	*	*	*	*	*	*	*
Well 18S	*	*	*	*	*	*	*
Well 18M	*	*	*	*	*	*	*
Well 18L	*	*	*	*	*	*	*
Well 19S	*	*	*	*	*	*	*
Well 20S	*	*	*	*	*	*	*
Well 21S	*	*	*	*	*	*	*
Well 22S	*	*	*	*	*	*	*
Well 23S	*	*	*	*	*	*	*
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

\- indicates water above land surface
bold depth values less than or equal to 0.304 m

APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	04/24/01	04/25/01	05/09/01	05/24/01	06/12/01	06/26/01	07/23/01
Well 1S	0.44	**	0.66	dry	0.62	dry	dry
Well 1WT	*	*	*	*	*	*	*
Well 1U	0.42	**	0.64	0.79	0.60	0.77	1.05
Well 2S	dry	**	dry	dry	dry	dry	dry
Well 2M	*	*	*	*	*	*	*
Well 2L	*	*	*	*	*	*	*
Well 3S	0.45	**	dry	dry	0.40	0.61	dry
Well 4S	dry	**	dry	dry	0.57	dry	dry
Well 4M	*	*	*	*	*	*	*
Well 4L	*	*	*	*	*	*	*
Well 5S	0.51	**	dry	dry	0.29	0.45	0.68
Well 6S	0.01	**	0.17	0.20	0.09	0.40	dry
Well 7S	0.17	**	0.55	0.58	0.17	0.49	dry
Well 8S	0.18	**	0.51	0.54	0.23	0.43	dry
Well 8M	*	*	*	*	*	*	*
Well 8L	*	*	*	*	*	*	*
Well 9S	0.12	**	0.50	0.51	0.18	0.44	dry
Well 10S	0.45	**	0.67	dry	0.55	dry	dry
Well 10M	*	*	*	*	*	*	*
Well 10L	*	*	*	*	*	*	*
Well 11S	0.05	**	0.45	0.42	0.13	0.34	dry
Well 11M	*	*	*	*	*	*	*
Well 11L	*	*	*	*	*	*	*
Well 12S	0.40	**	dry	dry	0.25	0.53	dry
Well 12M	*	*	*	*	*	*	*
Well 12L	*	*	*	*	*	*	*
Well 13S	**	0.10	0.48	0.41	-0.10	0.09	dry
Well 14S	**	dry	dry	dry	dry	dry	dry
Well 14M	*	*	*	*	*	*	*
Well 14L	*	*	*	*	*	*	*
Well 15S	**	0.25	0.52	0.66	0.47	dry	dry
Well 16S	**	0.10	0.26	0.38	0.21	0.46	dry
Well 17S	**	0.08	0.52	0.45	0.09	0.44	dry
Well 17M	*	*	*	*	*	*	*
Well 17L	*	*	*	*	*	*	*
Well 18S	*	*	*	*	*	*	*
Well 18M	*	*	*	*	*	*	*
Well 18L	*	*	*	*	*	*	*
Well 19S	*	*	*	*	*	*	*
Well 20S	*	*	*	*	*	*	*
Well 21S	*	*	*	*	*	*	*
Well 22S	*	*	*	*	*	*	*
Well 23S	*	*	*	*	*	*	*
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

\- indicates water above land surface
bold depth values less than or equal to 0.304 m

APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	09/12/01	10/24/01	12/12/01	01/02/02	01/25/02	03/01/02	03/19/02
Well 1S	dry	dry	**	dry	dry	0.69	0.64
Well 1WT	*	*	*	*	*	*	*
Well 1U	1.17	0.97	**	0.97	0.99	0.70	0.64
Well 2S	dry	dry	dry	dry	dry	dry	dry
Well 2M	*	*	dry	2.82	2.69	1.97	1.89
Well 2L	*	*	3.26	2.75	2.71	2.03	1.98
Well 3S	dry	0.49	dry	dry	dry	0.64	0.60
Well 4S	dry	dry	dry	dry	dry	dry	dry
Well 4M	*	*	dry	dry	2.58	2.34	2.20
Well 4L	*	*	1.98	1.30	1.48	0.73	0.64
Well 5S	dry	dry	dry	dry	dry	0.67	0.55
Well 6S	dry	dry	0.55	0.43	0.53	**0.10**	**0.05**
Well 7S	dry	**0.10**	**	0.48	**0.27**	**0.07**	**-0.05**
Well 8S	dry	**0.05**	**	0.48	0.58	**0.28**	**0.29**
Well 8M	*	*	**	0.98	0.87	**0.29**	0.50
Well 8L	*	*	**	1.33	1.39	0.91	**0.26**
Well 9S	dry	**0.08**	**	0.55	0.60	**	**0.30**
Well 10S	dry	dry	**	dry	dry	dry	0.69
Well 10M	*	*	**	1.00	1.11	0.78	0.72
Well 10L	*	*	**	1.14	1.18	0.82	0.72
Well 11S	dry	0.61	**	dry	dry	0.47	0.35
Well 11M	*	*	**	0.73	0.95	0.48	0.37
Well 11L	*	*	**	1.17	1.21	0.74	0.39
Well 12S	dry	dry	**	dry	dry	dry	0.57
Well 12M	*	*	**	1.13	1.18	0.71	0.59
Well 12L	*	*	**	1.17	1.26	0.71	0.53
Well 13S	dry	0.61	**	dry	dry	**0.23**	**0.05**
Well 14S	dry	dry	dry	dry	dry	dry	dry
Well 14M	*	*	dry	2.61	2.48	1.92	1.84
Well 14L	*	*	2.91	2.86	2.88	2.62	2.76
Well 15S	dry	0.65	**	dry	0.74	0.52	0.48
Well 16S	dry	0.36	**	0.57	0.46	**0.27**	**0.25**
Well 17S	dry	**-0.02**	**	0.47	**0.26**	**0.01**	**0.04**
Well 17M	*	*	**	0.69	0.48	**0.30**	**0.17**
Well 17L	*	*	**	0.98	0.99	0.56	0.36
Well 18S	*	*	**	0.39	**0.16**	frozen	**-0.16**
Well 18M	*	*	**	0.91	**0.29**	**-0.07**	**-0.14**
Well 18L	*	*	**	0.62	0.56	**0.14**	**-0.17**
Well 19S	*	*	**	0.52	0.47	0.31	0.36
Well 20S	*	*	**	dry	dry	0.49	0.36
Well 21S	*	*	**	0.39	0.36	**0.16**	**0.13**
Well 22S	*	*	*	*	*	dry	dry
Well 23S	*	*	*	*	*	**0.30**	**0.17**
Well 24S	*	*	*	*	*	*	*
Well 25S	*	*	*	*	*	*	*

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

\- indicates water above land surface
bold depth values less than or equal to 0.304 m

APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	04/11/02	04/23/02	05/07/02	05/13/02	08/01/02	09/10/02	10/16/02
Well 1 S	0.62	0.62	0.37	flooded	**0.26**	0.62	dry
Well 1WT	*	*	*	*	*	*	*
Well 1U	0.61	0.61	0.36	flooded	**0.29**	0.64	0.92
Well 2S	dry	dry	dry	**	dry	dry	dry
Well 2M	1.93	1.84	flooded	**	2.08	2.58	dry
Well 2L	2.04	1.97	1.46	**	1.99	2.64	3.62
Well 3S	**0.28**	0.35	flooded	flooded	dry	dry	dry
Well 4S	dry	dry	inaccessible	flooded	damaged	dry	dry
Well 4M	2.06	1.95	inaccessible	flooded	**-0.43**	**0.23**	1.17
Well 4L	0.68	0.60	inaccessible	flooded	1.02	1.57	2.16
Well 5S	0.37	0.39	**0.06**	**	dry	dry	dry
Well 6S	**0.01**	**0.00**	inundated	flooded	**0.13**	dry	dry
Well 7S	**-0.05**	**0.00**	inaccessible	**	**	dry	dry
Well 8S	**0.03**	**0.11**	**-0.03**	**	0.51	dry	dry
Well 8M	**0.29**	**0.26**	**0.16**	**	0.37	0.73	1.08
Well 8L	0.68	0.57	**-0.11**	**	1.17	1.45	2.08
Well 9S	**0.11**	**0.15**	saturated	**0.05**	0.61	dry	dry
Well 10S	0.49	0.49	inaccessible	**0.15**	0.50	dry	dry
Well 10M	0.52	0.52	inaccessible	**0.16**	0.54	0.86	1.18
Well 10L	0.76	0.67	inaccessible	**0.18**	0.55	0.82	1.19
Well 11S	**0.06**	**0.06**	inundated	flooded	**-0.12**	0.57	dry
Well 11M	**0.07**	**0.08**	inundated	flooded	**-0.11**	0.56	1.04
Well 11L	0.55	0.38	inundated	flooded	0.86	1.02	1.24
Well 12S	0.50	0.49	inaccessible	**0.05**	0.34	dry	dry
Well 12M	0.59	0.49	inaccessible	**0.10**	**0.19**	0.78	1.22
Well 12L	0.63	0.50	inaccessible	**-0.25**	0.33	0.96	1.30
Well 13S	**0.01**	**0.00**	inaccessible	**	0.62	dry	dry
Well 14S	dry	dry	0.57	**	dry	dry	dry
Well 14M	2.01	1.92	1.15	**	2.14	2.65	2.73
Well 14L	2.51	2.48	1.99	**	2.95	3.47	3.74
Well 15S	**0.30**	0.39	inaccessible	flooded	**0.29**	0.67	dry
Well 16S	**0.19**	**0.18**	**0.02**	flooded	**0.00**	0.49	dry
Well 17S	**0.04**	**0.06**	**-0.10**	**	dry	dry	dry
Well 17M	**0.15**	**0.17**	**0.06**	**	0.72	1.42	1.69
Well 17L	0.35	0.34	**0.04**	**	0.88	1.44	1.70
Well 18S	inundated	inundated	inundated	**-0.67**	inundated	inundated	dry
Well 18M	inundated	inundated	inundated	**-0.44**	inundated	inundated	0.41
Well 18L	inundated	inundated	inundated	**-0.92**	inundated	inundated	0.67
Well 19S	**0.08**	**0.11**	inundated	inundated	inundated	0.64	dry
Well 20S	**0.16**	**0.15**	inundated	inundated	**-0.02**	0.59	dry
Well 21S	**0.08**	**0.07**	inaccessible	inundated	**-0.24**	**0.19**	dry
Well 22S	0.64	0.66	**0.20**	**	dry	dry	dry
Well 23S	**0.12**	**0.13**	**-0.06**	**	0.68	dry	dry
Well 24S	*	*	*	*	*	dry	dry
Well 25S	*	*	*	*	*	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

\- indicates water above land surface
bold depth values less than or equal to 0.304 m

APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	11/13/02	12/17/02	01/13/03	02/05/03	03/06/03	04/08/03	04/22/03
Well 1S	dry	dry	dry	dry	dry	dry	burned
Well 1WT	*	*	*	*	*	*	**0.23**
Well 1U	0.88	0.93	0.86	0.85	0.89	0.74	0.80
Well 2S	dry	dry	dry	dry	**	0.68	dry
Well 2M	2.92	2.93	2.93	2.94	**	1.89	1.87
Well 2L	3.42	3.52	3.35	3.26	**	3.42	2.32
Well 3S	dry	dry	dry	dry	**	0.39	**0.26**
Well 4S	dry	dry	dry	dry	**	dry	dry
Well 4M	1.11	1.39	1.49	1.54	**	2.26	2.14
Well 4L	1.85	1.94	1.59	1.49	**	2.15	1.06
Well 5S	dry	dry	dry	dry	**	0.58	dry
Well 6S	dry	dry	0.59	0.55	**	**0.01**	**0.02**
Well 7S	dry	dry	0.45	0.33	**	**-0.02**	**-0.01**
Well 8S	dry	dry	0.41	**0.28**	frozen	**-0.04**	**0.06**
Well 8M	1.19	1.28	**0.23**	0.35	**0.11**	**0.00**	**0.01**
Well 8L	1.72	1.68	1.31	1.21	1.15	1.05	1.11
Well 9S	dry	dry	dry	0.62	**	**0.05**	**0.15**
Well 10S	dry	dry	dry	dry	**	0.53	0.65
Well 10M	1.04	1.26	0.86	0.90	**	0.50	0.69
Well 10L	1.11	1.29	0.92	1.07	**	0.89	1.08
Well 11S	dry	dry	0.61	0.60	0.67	**0.22**	0.39
Well 11M	0.89	1.10	0.62	0.51	0.68	**0.11**	0.40
Well 11L	1.21	1.25	1.12	1.09	1.11	0.88	1.01
Well 12S	dry	dry	dry	dry	dry	0.64	dry
Well 12M	1.14	1.25	0.97	1.04	1.03	0.64	0.80
Well 12L	1.24	1.30	1.11	1.11	1.14	0.93	1.01
Well 13S	dry	dry	dry	dry	dry	**0.18**	0.32
Well 14S	dry	dry	dry	dry	dry	dry	dry
Well 14M	2.73	2.73	2.74	2.74	2.50	2.36	1.80
Well 14L	3.42	3.31	3.00	2.79	2.81	2.58	2.53
Well 15S	dry	dry	dry	0.60	0.63	**0.28**	0.38
Well 16S	dry	dry	0.51	0.41	**0.30**	**0.18**	**0.23**
Well 17S	dry	dry	0.43	0.31	**0.05**	**0.01**	**0.03**
Well 17M	1.78	1.85	0.74	0.61	0.36	**0.15**	**0.17**
Well 17L	1.74	1.78	1.18	1.16	0.92	0.57	0.53
Well 18S	0.31	0.38	0.37	**0.24**	**	**-0.02**	**0.27**
Well 18M	**0.21**	0.44	**0.16**	0.38	**	**0.09**	**0.13**
Well 18L	0.54	0.62	0.53	0.50	**	**0.20**	0.36
Well 19S	dry	dry	dry	0.37	**	**0.04**	**0.30**
Well 20S	dry	dry	dry	dry	dry	**0.28**	0.42
Well 21S	0.51	dry	0.33	**0.28**	**	**0.14**	**0.20**
Well 22S	dry	dry	dry	dry	**	dry	dry
Well 23S	dry	dry	dry	dry	**	**0.22**	0.34
Well 24S	dry	dry	dry	dry	**	dry	dry
Well 25S	dry	dry	dry	dry	**	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
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\- indicates water above land surface
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APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	05/06/03	05/20/03	06/03/03	06/17/03	07/15/03	08/12/03	09/03/03
Well 1S	burned	burned	burned	burned	burned	burned	burned
Well 1WT	0.18	-0.02	0.09	0.43	0.90	0.78	0.15
Well 1U	0.63	0.36	0.51	0.67	0.82	0.66	0.60
Well 2S	dry	dry	dry	dry	dry	dry	dry
Well 2M	1.29	1.55	1.83	1.65	2.07	2.44	2.58
Well 2L	1.82	1.53	1.75	1.79	2.01	2.30	2.71
Well 3S	0.19	0.68	dry	0.43	0.68	dry	0.29
Well 4S	0.49	0.78	dry	dry	dry	dry	0.80
Well 4M	2.01	1.81	1.63	1.50	1.34	1.13	1.18
Well 4L	0.63	0.66	1.01	0.81	1.11	1.13	1.23
Well 5S	0.33	0.57	dry	0.64	dry	dry	0.44
Well 6S	-0.01	0.17	0.35	0.22	dry	dry	0.12
Well 7S	-0.02	0.36	0.56	0.12	0.50	dry	-0.01
Well 8S	0.03	0.57	0.60	0.25	0.56	dry	0.10
Well 8M	-0.01	0.52	0.63	0.29	0.38	0.52	0.72
Well 8L	0.98	0.84	1.31	1.17	1.17	1.39	1.19
Well 9S	0.10	0.53	dry	0.27	0.60	dry	0.17
Well 10S	0.37	0.64	0.69	0.58	dry	dry	0.62
Well 10M	0.40	0.69	0.74	0.63	0.97	0.97	0.67
Well 10L	0.89	0.72	0.88	0.85	1.01	1.03	1.11
Well 11S	0.11	0.13	0.15	0.28	0.51	dry	0.14
Well 11M	0.12	0.08	0.13	0.30	0.51	0.72	0.14
Well 11L	0.92	0.40	0.88	0.87	0.80	0.99	0.82
Well 12S	0.51	0.60	dry	0.63	dry	dry	0.48
Well 12M	0.50	0.60	0.74	0.61	0.98	0.97	0.46
Well 12L	0.88	0.61	0.98	0.87	1.03	1.10	0.76
Well 13S	0.01	0.11	0.48	0.27	0.57	dry	0.35
Well 14S	dry	0.69	dry	dry	dry	dry	dry
Well 14M	1.48	1.46	1.88	1.95	2.25	2.88	2.65
Well 14L	2.27	2.55	2.81	2.68	3.13	2.66	2.86
Well 15S	0.16	0.34	0.36	0.57	dry	dry	0.48
Well 16S	0.08	0.14	0.21	0.30	0.59	0.60	0.27
Well 17S	0.02	0.36	0.52	0.08	0.38	dry	-0.02
Well 17M	0.10	0.41	0.66	0.23	0.48	0.81	0.28
Well 17L	0.32	0.49	0.84	0.50	0.76	1.04	0.62
Well 18S	-0.12	**	**	-0.03	0.49	-0.04	-0.08
Well 18M	0.00	**	**	-0.17	0.23	-0.12	0.21
Well 18L	0.16	**	**	0.23	0.44	0.29	0.20
Well 19S	0.08	0.51	dry	0.50	dry	dry	0.45
Well 20S	0.13	0.35	0.47	0.26	0.58	dry	0.18
Well 21S	0.06	-0.04	0.03	0.22	0.67	0.29	0.06
Well 22S	0.57	dry	dry	dry	dry	dry	dry
Well 23S	0.10	0.28	0.67	0.47	dry	dry	0.27
Well 24S	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** discontinued
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APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water						
Date	10/01/03	11/14/03	12/15/03	01/22/04	03/09/04	04/06/04	04/15/04
Well 1S	burned	burned	burned	burned	burned	burned	burned
Well 1WT	0.49	**0.29**	**0.14**	0.50	**0.25**	0.43	0.51
Well 1U	0.77	0.78	0.60	0.80	0.75	0.60	0.60
Well 2S	dry	dry	0.66	dry	dry	dry	dry
Well 2M	2.83	2.52	1.94	2.09	1.94	2.06	2.09
Well 2L	2.84	2.70	2.21	2.07	2.20	2.02	2.07
Well 3S	dry	0.45	**0.15**	dry	0.32	0.65	dry
Well 4S	dry	dry	0.67	dry	0.82	dry	dry
Well 4M	1.27	1.38	1.21	1.09	1.19	1.13	1.13
Well 4L	1.58	1.13	0.80	1.02	1.01	1.00	1.05
Well 5S	dry	dry	0.33	dry	0.64	dry	dry
Well 6S	0.67	**0.15**	**0.00**	**0.18**	**0.03**	**0.08**	**0.22**
Well 7S	dry	**0.01**	frozen	0.48	**0.25**	0.49	0.57
Well 8S	0.58	**0.10**	**0.00**	0.46	**0.14**	0.48	0.58
Well 8M	0.65	**0.30**	**0.15**	**0.26**	**0.11**	0.39	0.53
Well 8L	1.42	1.22	0.87	1.28	1.03	0.93	1.23
Well 9S	dry	dry	**0.05**	0.44	**0.23**	0.42	0.53
Well 10S	dry	dry	0.50	dry	0.62	0.69	dry
Well 10M	1.02	0.82	0.56	0.85	0.67	0.73	0.79
Well 10L	1.13	0.97	0.79	0.97	0.82	0.82	0.86
Well 11S	dry	0.51	**0.00**	0.57	0.38	0.42	0.48
Well 11M	1.17	0.51	**0.01**	0.57	0.38	0.42	0.48
Well 11L	1.06	0.89	0.82	1.01	0.86	0.56	1.00
Well 12S	dry	dry	0.48	dry	dry	dry	dry
Well 12M	1.13	0.96	0.49	0.96	0.73	0.72	0.84
Well 12L	1.25	0.89	0.69	0.57	0.91	0.75	1.02
Well 13S	dry	0.56	**0.01**	0.57	**0.21**	**0.30**	0.54
Well 14S	dry	dry	dry	dry	dry	dry	dry
Well 14M	2.61	2.43	1.72	1.95	1.82	1.85	1.93
Well 14L	3.14	2.85	2.50	2.65	2.50	2.62	2.75
Well 15S	dry	0.59	**0.29**	0.65	0.36	0.50	0.52
Well 16S	dry	0.36	**0.18**	0.40	**0.25**	0.31	0.38
Well 17S	0.51	**-0.03**	**-0.05**	frozen	**0.06**	0.47	dry
Well 17M	0.76	**0.24**	**0.15**	0.36	**0.22**	0.52	0.65
Well 17L	1.09	0.66	0.36	0.78	0.51	0.66	0.84
Well 18S	**0.21**	**0.15**	frozen	0.41	**0.07**	**-0.02**	**-0.02**
Well 18M	**0.13**	**0.08**	**-0.01**	**0.11**	**0.07**	**0.02**	**-0.05**
Well 18L	0.43	0.37	**0.10**	0.45	**0.25**	**0.05**	**0.24**
Well 19S	0.63	**	**0.00**	0.47	**0.09**	**0.21**	0.45
Well 20S	dry	0.68	**0.12**	dry	0.47	0.49	0.56
Well 21S	0.47	dry	**-0.01**	**0.19**	**0.05**	**0.10**	**0.18**
Well 22S	dry	dry	dry	dry	dry	dry	dry
Well 23S	dry	dry	**0.10**	0.66	0.30	0.52	0.68
Well 24S	dry	dry	dry	dry	dry	dry	dry
Well 25S	dry	dry	dry	dry	dry	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
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bold depth values less than or equal to 0.304 m

APPENDIX C Water Levels and Depths to Water

Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water			
Date	04/30/04	05/14/04	05/27/04	06/09/04
Well 1S	burned	burned	burned	burned
Well 1WT	0.45	0.61	0.16	**
Well 1U	0.73	0.79	0.59	**
Well 2S	dry	dry	dry	dry
Well 2M	2.14	2.27	2.13	2.23
Well 2L	2.16	2.25	2.30	2.19
Well 3S	0.64	dry	0.20	0.66
Well 4S	dry	dry	0.67	0.77
Well 4M	1.13	1.16	1.15	1.05
Well 4L	1.14	1.32	1.76	0.77
Well 5S	dry	dry	0.31	0.52
Well 6S	0.12	0.22	0.06	flooded
Well 7S	0.43	0.52	0.03	**
Well 8S	0.45	0.29	0.08	**
Well 8M	0.39	0.56	0.17	**
Well 8L	1.23	1.29	0.61	**
Well 9S	0.44	dry	0.21	**
Well 10S	0.68	dry	0.41	**
Well 10M	0.73	0.79	0.47	**
Well 10L	0.85	0.98	0.85	**
Well 11S	0.44	0.64	0.01	**
Well 11M	0.45	0.63	0.02	**
Well 11L	0.96	1.04	0.30	**
Well 12S	dry	dry	0.54	**
Well 12M	0.83	1.05	0.52	**
Well 12L	0.99	1.14	0.55	**
Well 13S	0.50	dry	-0.05	-0.52
Well 14S	dry	dry	dry	dry
Well 14M	2.08	2.21	2.34	2.35
Well 14L	2.77	2.94	2.75	2.36
Well 15S	0.51	0.66	0.41	**
Well 16S	0.32	0.32	0.12	**
Well 17S	0.42	0.31	0.06	-0.10
Well 17M	0.51	0.68	0.16	0.03
Well 17L	0.76	1.04	0.31	0.19
Well 18S	0.29	0.16	-0.04	**
Well 18M	-0.02	0.16	0.18	**
Well 18L	0.37	0.52	-0.06	**
Well 19S	0.21	0.07	0.02	**
Well 20S	0.52	dry	0.20	**
Well 21S	0.22	0.20	0.04	**
Well 22S	dry	dry	dry	dry
Well 23S	0.69	dry	0.19	-0.28
Well 24S	dry	dry	dry	**
Well 25S	dry	dry	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
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bold depth values less than or equal to 0.304 m

APPENDIX C Water Levels and Depths to Water
Table C3 Depths to Water in Monitoring Wells (in m referenced to land surface)

	Depths to Water			
Date	06/23/04	07/13/04	07/14/04	08/17/04
Well 1S	burned	burned	burned	burned
Well 1WT	flooded	**	**	0.69
Well 1U	flooded	0.02	**	0.70
Well 2S	dry	dry	**	dry
Well 2M	2.24	2.43	**	2.95
Well 2L	2.20	2.36	**	2.94
Well 3S	0.04	**	0.59	dry
Well 4S	0.43	**	dry	dry
Well 4M	0.94	**	0.83	1.06
Well 4L	0.56	**	0.78	1.63
Well 5S	0.04	**	dry	dry
Well 6S	flooded	**	0.05	dry
Well 7S	-0.72	**	0.30	dry
Well 8S	-0.47	0.30	**	dry
Well 8M	-0.47	0.16	**	1.10
Well 8L	-0.03	0.99	**	1.61
Well 9S	flooded	**	0.24	dry
Well 10S	-0.72	0.22	**	dry
Well 10M	-0.66	0.27	**	1.04
Well 10L	flooded	0.35	**	1.08
Well 11S	flooded	-0.36	**	0.66
Well 11M	flooded	-0.36	**	0.71
Well 11L	flooded	0.62	**	1.16
Well 12S	flooded	0.02	**	dry
Well 12M	flooded	0.00	**	1.00
Well 12L	flooded	0.38	**	1.12
Well 13S	**	**	0.43	dry
Well 14S	dry	**	dry	dry
Well 14M	2.23	**	2.17	2.71
Well 14L	2.12	**	2.75	3.61
Well 15S	**	**	-0.03	dry
Well 16S	**	**	-0.20	0.65
Well 17S	-0.23	**	0.26	dry
Well 17M	-0.18	**	0.30	1.30
Well 17L	-0.05	**	0.60	1.41
Well 18S	flooded	flooded	**	-0.08
Well 18M	flooded	flooded	**	-0.30
Well 18L	flooded	flooded	**	0.35
Well 19S	flooded	**	flooded	dry
Well 20S	flooded	-0.27	**	dry
Well 21S	flooded	-0.41	**	0.33
Well 22S	0.46	**	dry	dry
Well 23S	-0.42	**	0.54	dry
Well 24S	0.14	dry	**	dry
Well 25S	0.73	**	dry	dry

* not yet installed
** no measurement
*** discontinued
S indicates soil-zone monitoring well
U indicates upper monitoring well
M indicates middle monitoring well
L indicates lower monitoring well
WT indicates water-table monitoring well

\- indicates water above land surface
bold depth values less than or equal to 0.304 m

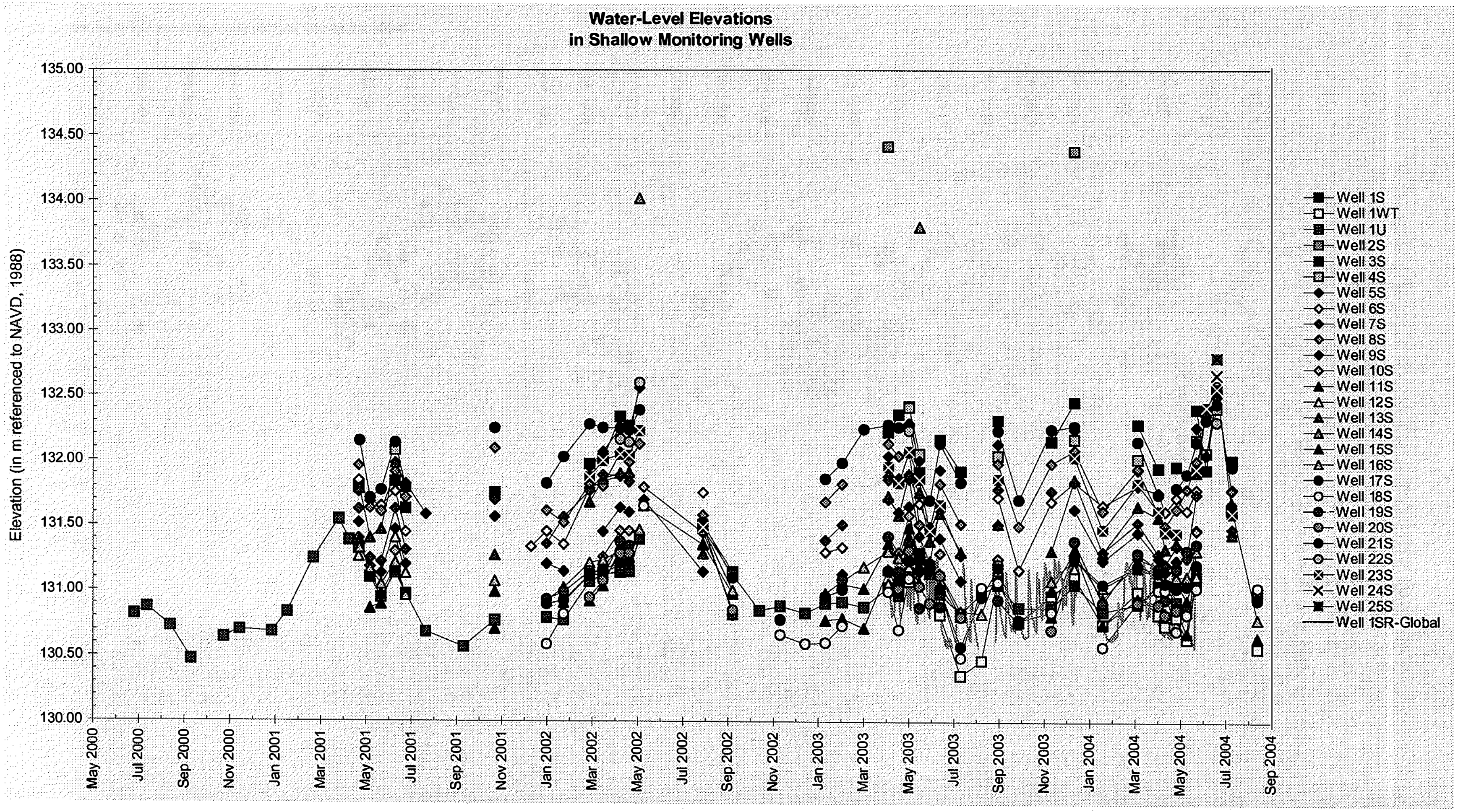

Figure D1 Water-level elevations in shallow wells.

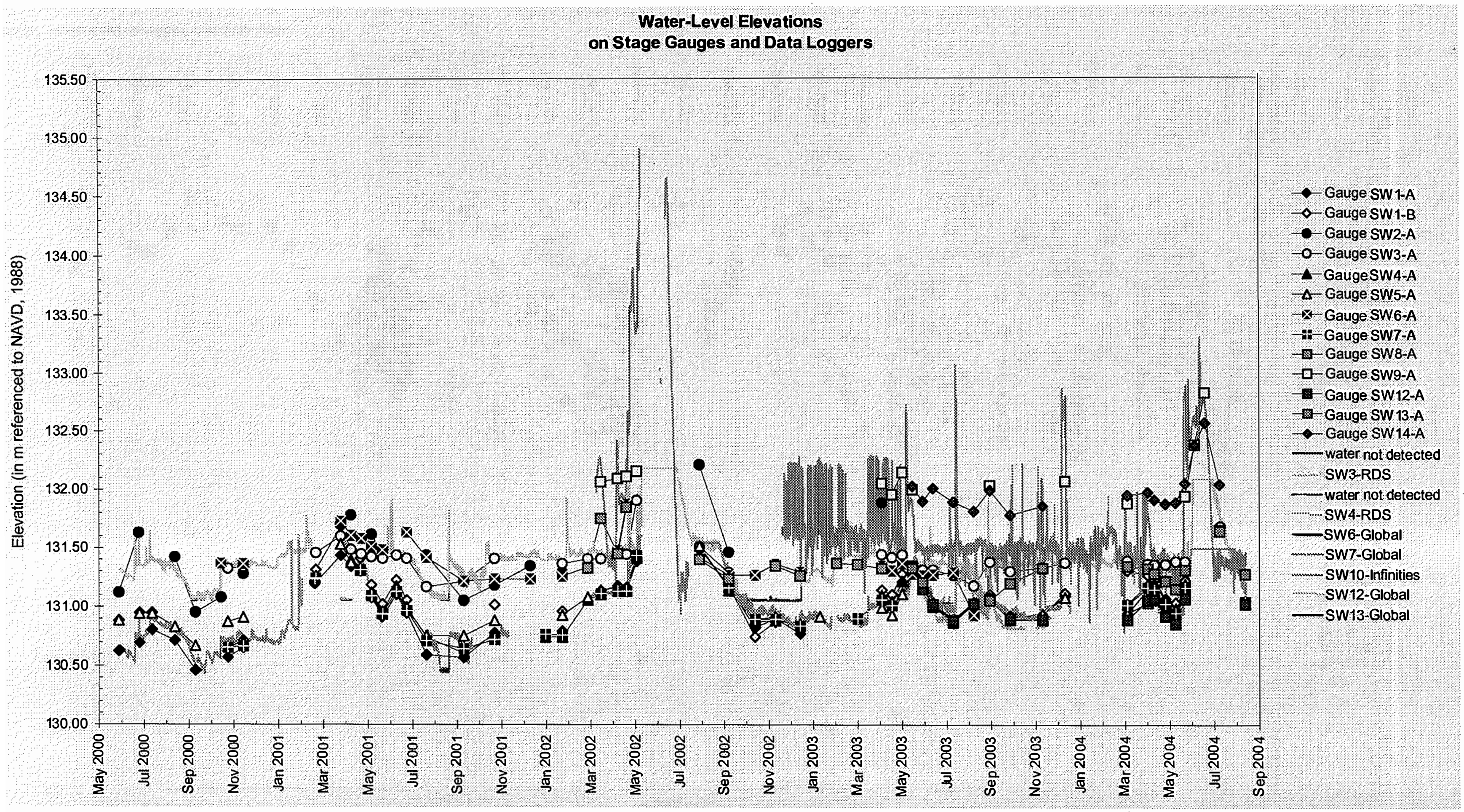

Figure D2 Water-level elevations on stage gauges and data loggers.

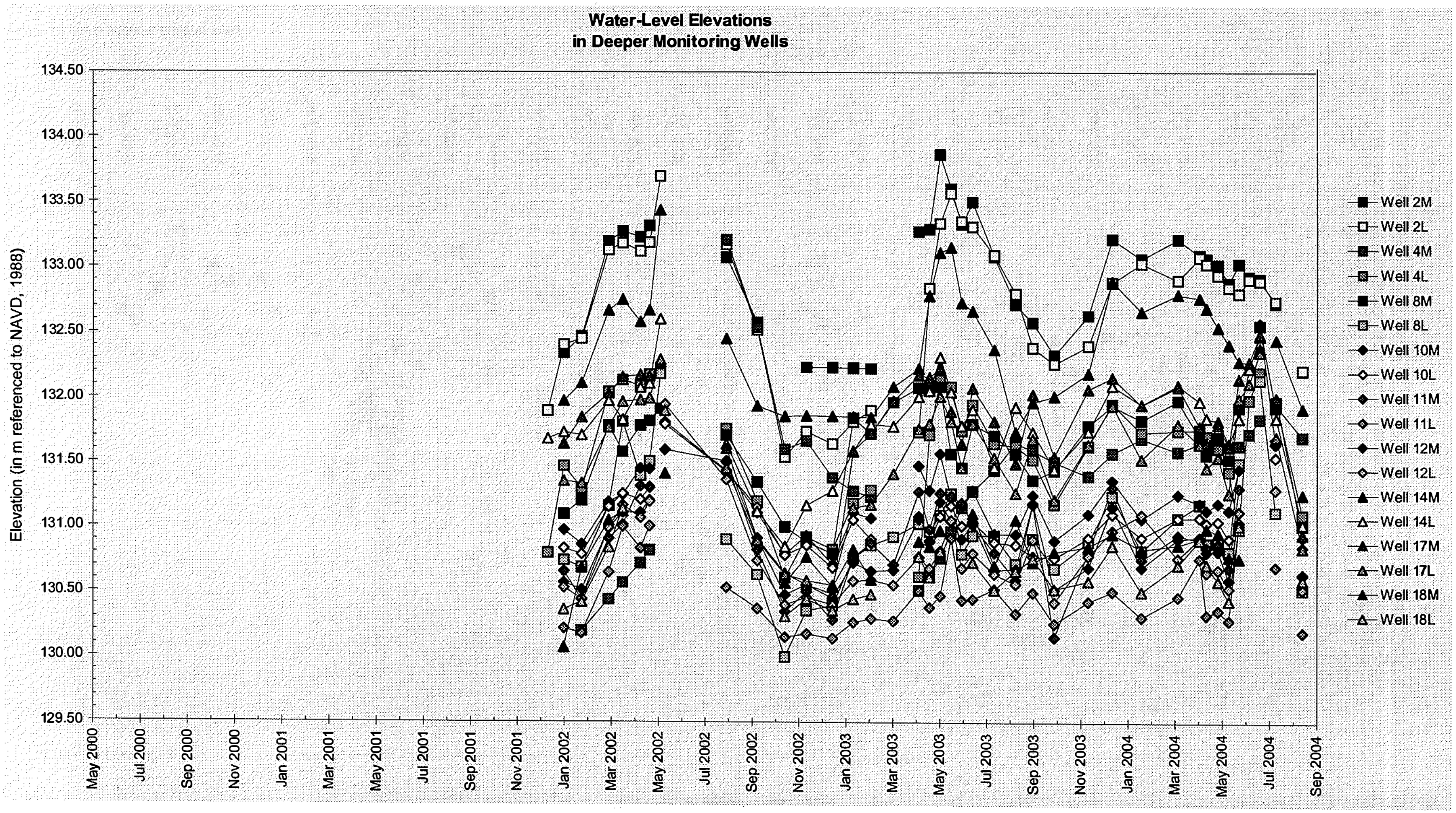

Figure D3 Water-level elevations in deeper wells.

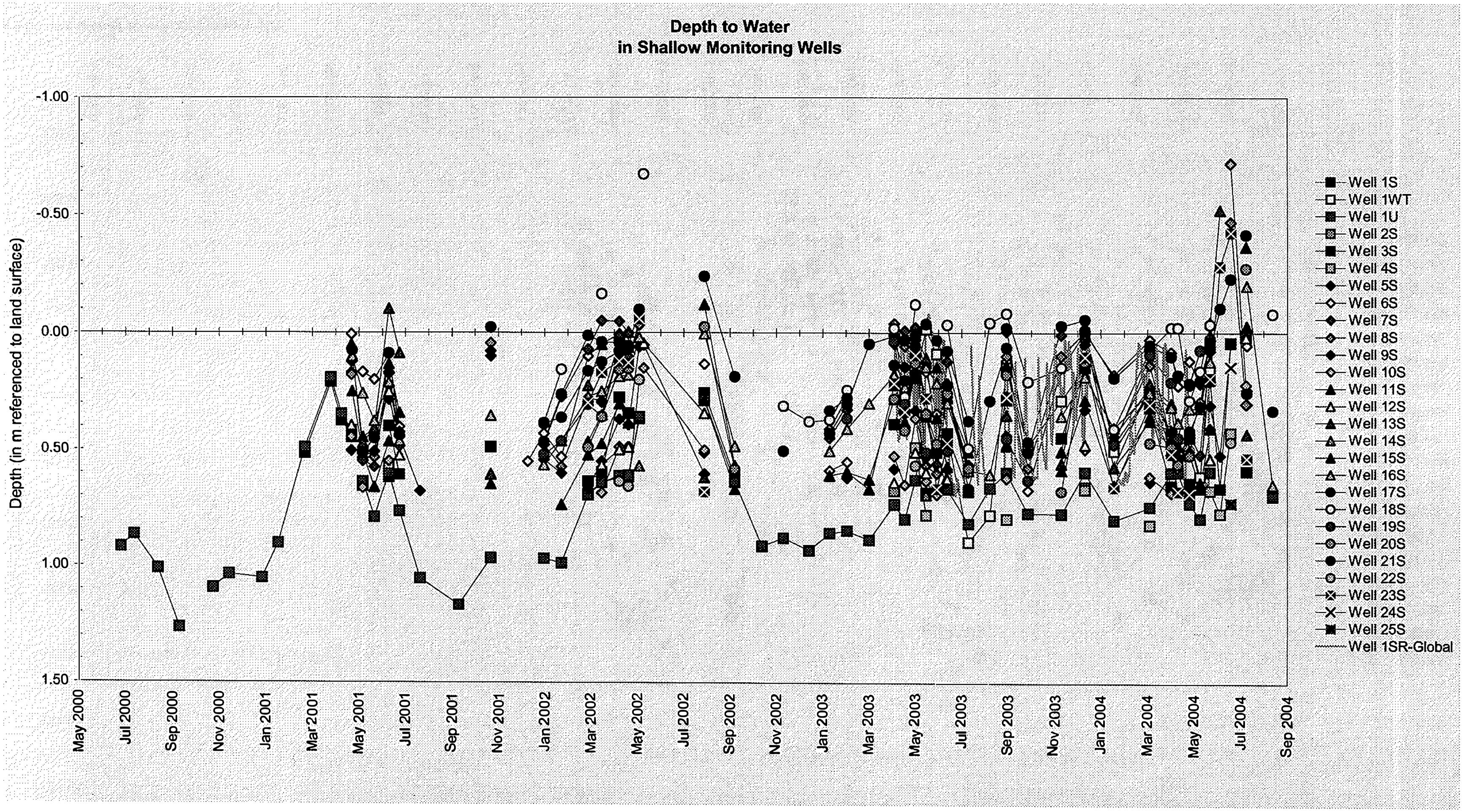

Figure D4 Depth to water in shallow wells.

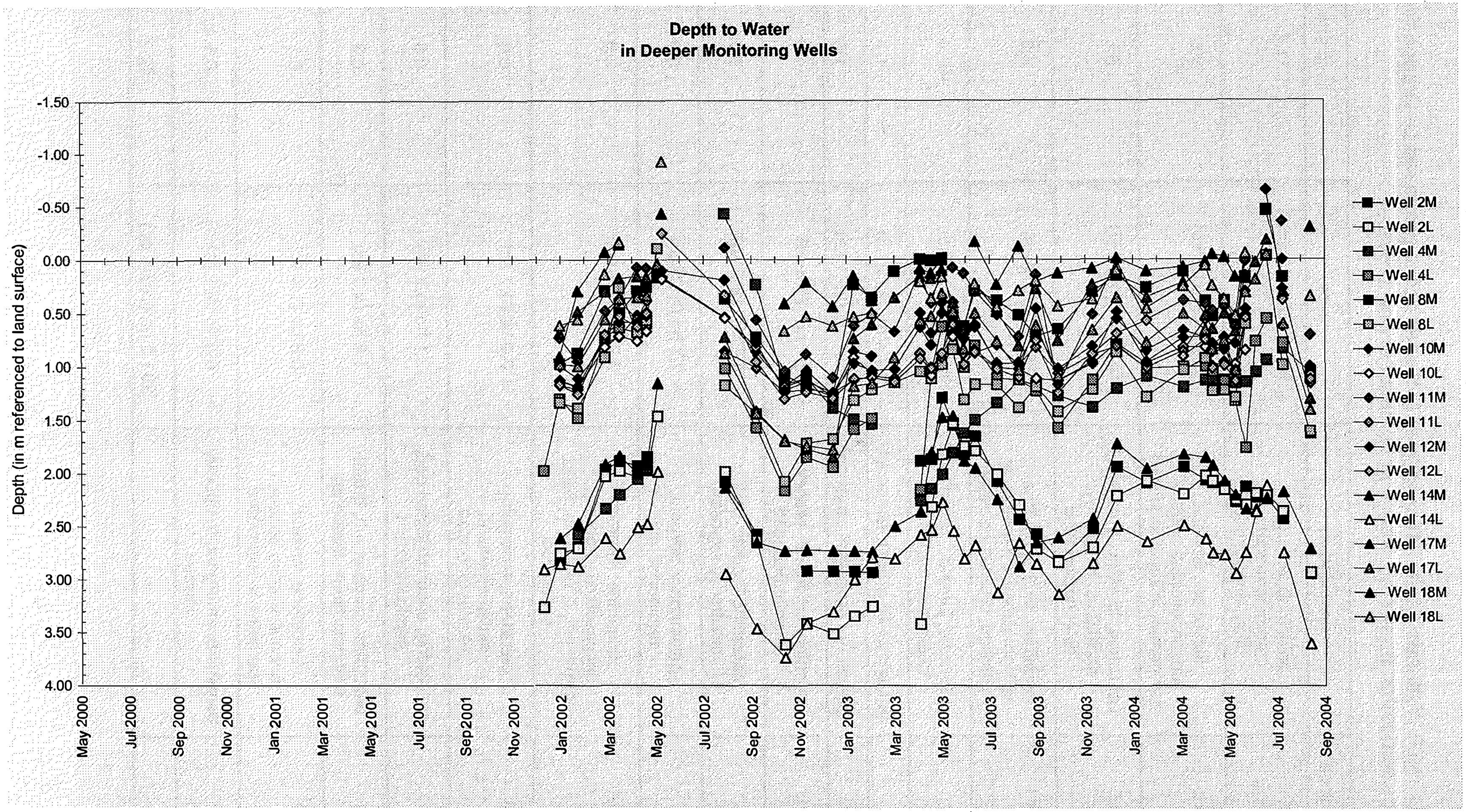

Figure D5 Depth to water in deeper wells.

APPENDIX E NWI Wetlands Table. NWI-mapped wetlands at the proposed La Grange Wetland Mitigation Bank (U.S. Fish and Wildlife Service 1988).

NWI class code	description	area	% of site
PEMFH	palustrine, emergent, semipermanent, diked/impounded	77.8 ha (192.4 ac)	11.7
L1UBHH	lacustrine, limnetic, unconsolidated bottom, permanent, diked/impounded	63.9 ha (157.9 ac)	9.6
PFO1AH	palustrine, forested, broad-leaf deciduous, temporary, diked/impounded	44.2 ha (109.3 ac)	6.6
L2EM2GH	lacustrine, littoral, emergent, non-persistent, intermittently exposed, diked/impounded	22.2 ha (54.8 ac)	3.3
PFO1A	palustrine, forested, broad leaf deciduous, temporary	16.2 ha (40.0 ac)	2.4
PEMA	palustrine, emergent, temporary	11.4 ha (28.2 ac)	1.7
PEMC	palustrine, emergent, seasonal	10.1 ha (25.1 ac)	1.5
PEMCH	palustrine, emergent, seasonal, diked/impounded	8.7 ha (21.4 ac)	1.3
PABG	palustrine, aquatic bed, intermittently exposed	6.7 ha (16.5 ac)	1.0
PEMF	palustrine, emergent, semipermanent	5.7 ha (14.2 ac)	0.9
L1UBHHX	lacustrine, limnetic, unconsolidated bottom, permanent, diked/impounded, excavated	5.7ha (14.1 ac)	0.9
PEMAH	palustrine, emergent, semipermanent, diked/impounded	3.9 ha (9.7 ac)	0.6
PUBF	palustrine, unconsolidated bed, semipermanent	2.1 ha (5.2 ac)	0.3
PSS1A	palustrine, scrub-shrub, broad-leaf deciduous, temporary	1.8 ha (4.3 ac)	0.3
L1UBHX	lacustrine, limnetic, unconsolidated bottom, permanent, excavated	0.6 ha (1.4 ac)	0.1
PEMAF	palustrine, emergent, temporary, farmed	0.5 ha (1.1 ac)	0.1
Total	-	**281.5 ha (695.6 ac)**	**42.3**

APPENDIX F Vegetative Cover Table. Summary of cover type and dominant plant species during 2000 at the La Grange Wetland Mitigation Bank (Busemeyer et al. 2001).

Vegetative Cover Type	Area	Dominant Species		NRCS Designation (11/30/2000)
A. Floodplain forest (wetland)	42.05 ha (103.9 ac)	Overstory:	*Acer saccharinum*	W (wetland)
		Sapling layer:	*Acer negundo*	
		Shrub layer:	*Acer negundo*	
		Herbaceous layer:	*Ambrosia trifida, Aster simplex, Galium aparine, Phalaris arundinacea, Urtica dioica*	
B. Floodplain forest (non-wetland)	24.6 ha (60.8 ac)	Overstory:	*Acer saccharinum*	W (wetland)
		Sapling layer:	*Acer negundo*	
		Shrub layer:	*Acer negundo*	
		Herbaceous layer:	*Ambrosia trifida, Aster ontarionus, Aster simplex, Galium aparine, Phalaris arundinacea*	
C. Upland forest (non-wetland)	4.25 ha (10.5 ac)	Overstory:	*Quercus rubra, Fraxinus americana, Quercus macrocarpa*	U (unclassified)
		Shrub layer:	*Assimina triloba, Staphylea trifolia*	
		Herbaceous layer:	*Festuca obtusa, Geum canadense, Laportia Canadensis, Sanicula gregaria*	
D. Scrub-shrub (wetland)	3.1 ha (7.6 ac)	Shrub layer:	*Populus deltoides, Salix nigra*	W (wetland)
		Herbaceous layer:	*Xanthium strumarium*	
E. Meadow (wetland)	188.1 ha (464.9 ac)	Herbaceous layer:	*Amaranthus tuberculatus, Ambrosia trifida, Conyza canadensis, Polygonum amphibium, Polygonum pennsylvanicum, Xanthium strumarium*	W (wetland), FW (farmed wetland), and PC (prior converted)
F. Meadow (wetland)—Farmed when dry enough	2.8 ha (7.0 ac)	Herbaceous layer:	*Abutilon theophrasti, Ambrosia trifida, Conyza canadensis*	FW (farmed wetland)
G. Marsh (wetland)—Farmed when dry enough	6.39 ha (15.8 ac)	Herbaceous layer:	*Cyperus strigosus, Leersia oryzoides, Rorippa islandica, Typha latifolia*	FW (farmed wetland)
H. Lake or flooded ditch	68.84 ha (170.1 ac)	None	None	Wa (Water)
I. Pond	0.4 ha (1.1 ac)	None	None	FW (farmed wetland)
J. Cropland	314.4 ha (776.9 ac)	Herbaceous layer:	*Zea mays*	PC (prior converted)
K. Berm	10.0 ha (24.8 ac)	Herbaceous layer:	*Ambrosia trifida*	U (unclassified)

APPENDIX G Precipitation-Evapotranspiration Graph. Observed monthly precpitation at the La Grange Wetland Mitigation Bank, average precipitation at Beardstown, and total monthly potential evapotranspiration at Perry, IL (Midwest Regional Climate Center 2004, Water and Atomospheric Resources Monitoring Program 2004).