GREEN CREEK POTENTIAL WETLAND COMPENSATION SITE: LEVEL II HYDROGEOLOGIC CHARACTERIZATION REPORT

Effingham County, Illinois
(IL 32/33 City of Effingham, Sequence Number 12505)

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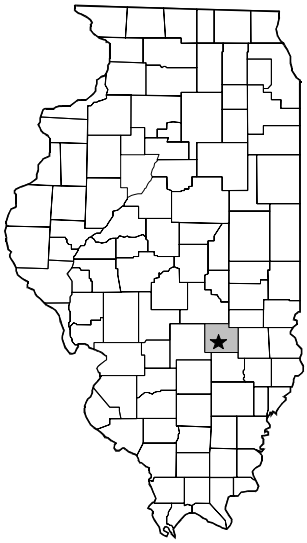

EXECUTIVE SUMMARY

In September 2005, the Illinois Department of Transportation (IDOT) tasked the Wetlands Geology Section of the Illinois State Geological Survey (ISGS) to conduct a hydrogeologic characterization of the Green Creek property, a potential wetland compensation site near Effingham in Effingham County, Illinois. Results from one season of monitoring indicate a minimum of 1.30 ha (3.2 ac.) of the site already satisfies the criteria for jurisdictional wetland hydrology - 0.06 ha (0.1ac.) in a low-lying area west of the main north-south ditch and 1.24 ha (3.1 ac.) east of the ditch. This includes 0.93 ha (2.3 ac.) east of the ditch that has already been mapped as jurisdictional wetland by the Illinois Natural History Survey. The area satisfying wetland hydrology on the eastern portion of the site could potentially be increased by 0.62 ha (1.5 ac.) with the following alterations. The height of the berm along either side of the main north-south ditch should be raised to an elevation of 160.78 m (527.5 ft.). The tributary ditch (Ditch A) should be filled and a rock-reinforced spillway with an elevation of 160.63 m (527.0 ft.) should be installed at the berm. Ground-surface elevations in the area selected for wetland creation should be reduced to 160.63 m (527.0 ft.). Potential for wetland creation west of the ditch is limited. However, maintaining a berm near the southeast corner of that area at the same elevation as the east side of the ditch [160.78 m (527.5 ft.)] has the potential to trap floodwater from Green Creek and the Little Wabash River and yield small areas of wetland hydrology. Without a berm to trap the floodwater, the area west of the ditch would only be eligible as a buffer area. The existing right of way and proposed alignment make the areas along the southern and far western perimeter of the site unavailable for mitigation. A 0.36 ha (0.9 ac.) area in the southeast corner of the site is also unsuitable for mitigation, but could be eligible for credit as a buffer area.

These recommendations were prepared using limited monitoring data. Additional monitoring is recommended to confirm the observed hydrologic conditions.

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INTRODUCTION

This report was prepared by the Illinois State Geological Survey (ISGS) to provide the Illinois Department of Transportation (IDOT) with observations regarding the hydrogeologic conditions of the Green Creek property, a 4.05 ha (10.0 ac.) potential wetland compensation site located north of Effingham in Effingham County (NW 1/4, NW 1/4 Section 18, T8N, R6E). The site is bounded by the raised roadbed of Illinois State Route 32/33 to the south, 1200th Street to the west, a farm field and forest to the north, and bluff and earthen dam to the east (Figure 1).

The purpose of this report is to provide IDOT with recommendations regarding the suitability of the site for wetland compensation. Therefore, wetland compensation recommendations are presented first, followed by a discussion of the methods and the supporting data. The supporting data include ground- and surface-water levels, and precipitation data collected from December 2005 to June 2006, and observations made during the initial site evaluation in Summer 2005 (Plankell et al. 2005). Soils information in this report is from published reports and maps, and is presented for hydrogeologic purposes. All soil mapping or classification has been verified by a qualified soil scientist at the Illinois Natural History Survey (INHS) (Illinois Natural History Survey 2005a, 2005b).

Data collection at the site is ongoing and will continue until terminated by IDOT. The data currently being collected will be used to compare the pre- and post-construction hydrology of the site, to determine the impact of hydrologic alterations on the area, and to measure the duration of wetland hydrology (Environmental Laboratory 1987).

SUMMARY

The following factors indicate that the potential for wetland preservation and creation at this compensation site is **moderate**:

- Hydrologic monitoring and visual observations in Spring 2006 determined that a minimum of 1.30 ha (3.2 ac.) of the site satisfied the criteria for jurisdictional wetland hydrology (Figure 2). Five of the seven wells indicated an area of 1.24 ha (3.1 ac.) east of the main ditch satisfied wetland hydrology criteria, while observations of continuous surface-water ponding west of the main ditch for a period greater than 11 days suggests a minimum of 0.06 ha (0.1 ac.) satisfies wetland hydrology criteria there.

- At present, roughly 0.93 ha (2.3 ac.) of the site satisfies all three criteria for jurisdictional wetland in two areas on the east side of the ditch (Figure 3). The largest area is located in the northeast corner of the site, with a smaller area along the south end under the power line right of way. These areas were previously identified by the INHS (Illinois Natural History Survey 2005a, 2005b).

- The major alteration onsite is the north-south ditch running through the center of the site. Since the primary function of this feature is to drain water from neighboring properties, it should not be reversed. Other alterations include two small east-west tributary ditches on the east side of the site; Ditch A running through the center of the area is reversible while Ditch B at the north end of the site is a primary outlet for overflow from Lake Pauline and should not be altered.

- Two distinct hydrological inputs were observed on the site. Overland runoff and groundwater discharge from the adjacent Lake Pauline reservoir dominates the hydrologic regime of the area east of the ditch. West of the ditch, floodwater from Green Creek and the

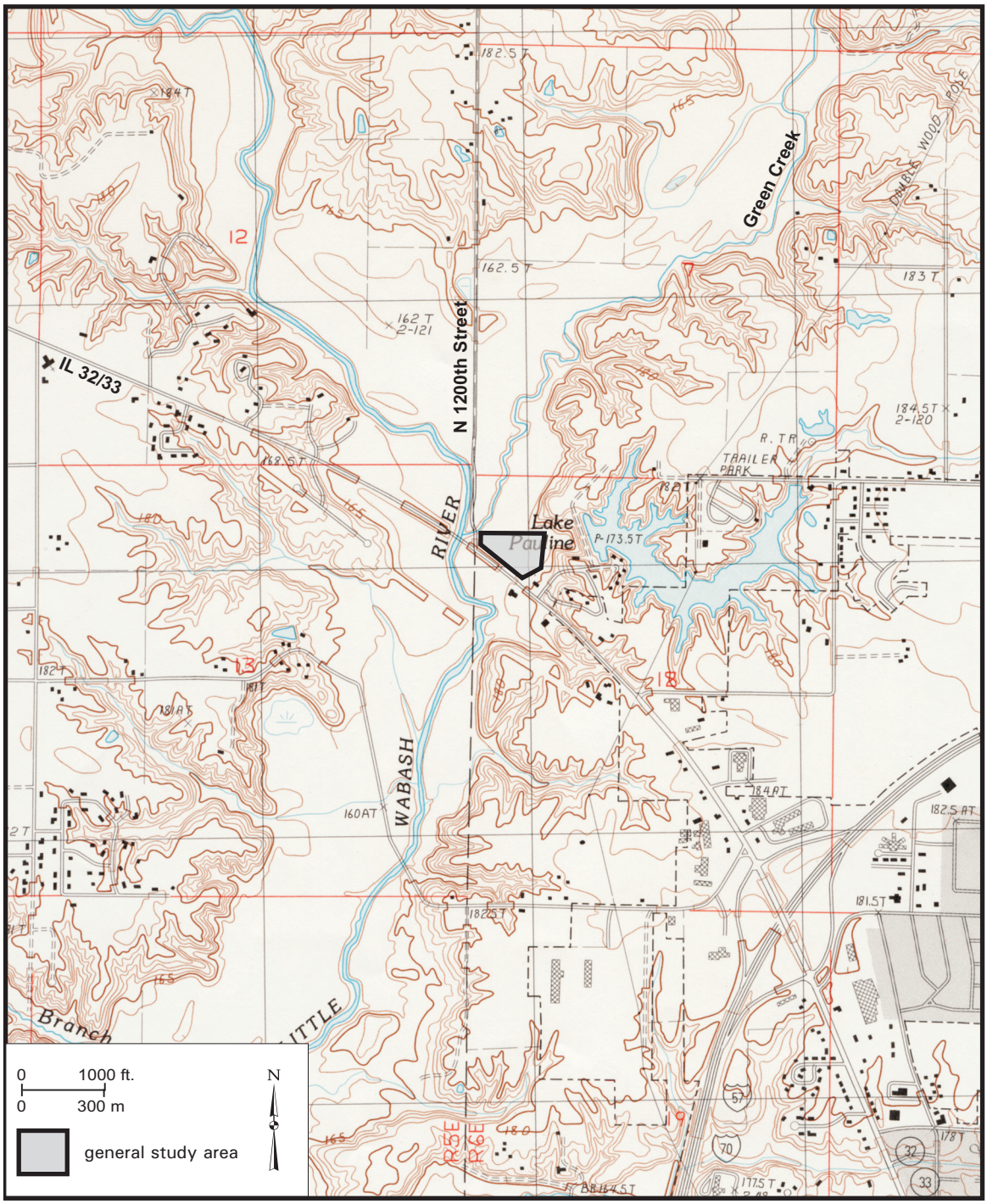

Figure 1. Location of the wetland compensation site (shaded grey) on the Effingham North, IL 7.5-minute quadrangle map (U.S. Geological Survey 1985). Contour interval is 3 m (10 ft.) with supplemental 1.5 m (5 ft.) contours.

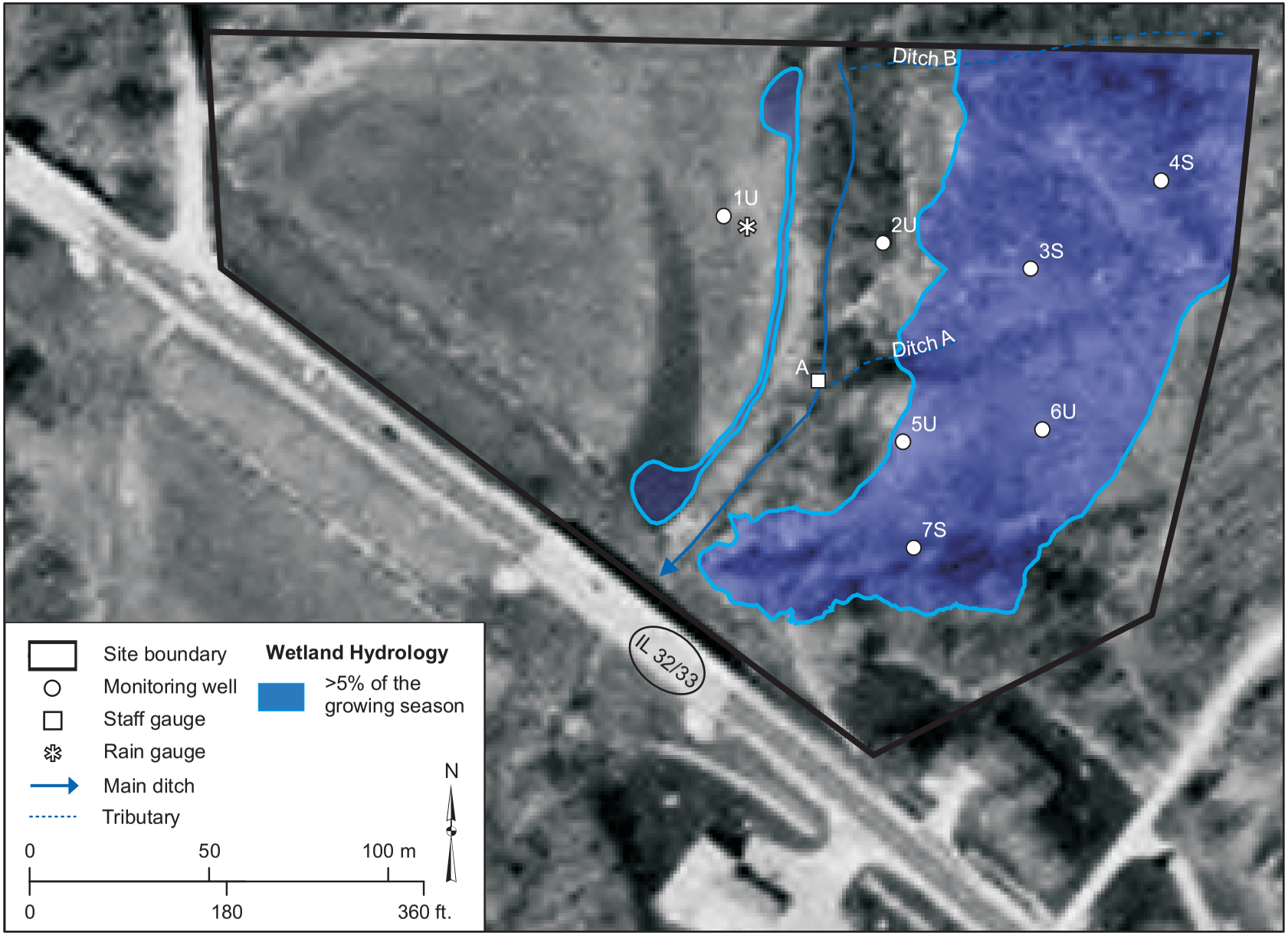

Figure 2. Areas exhibiting wetland hydrology in 2006 (map based on Illinois State Geological Survey 2001).

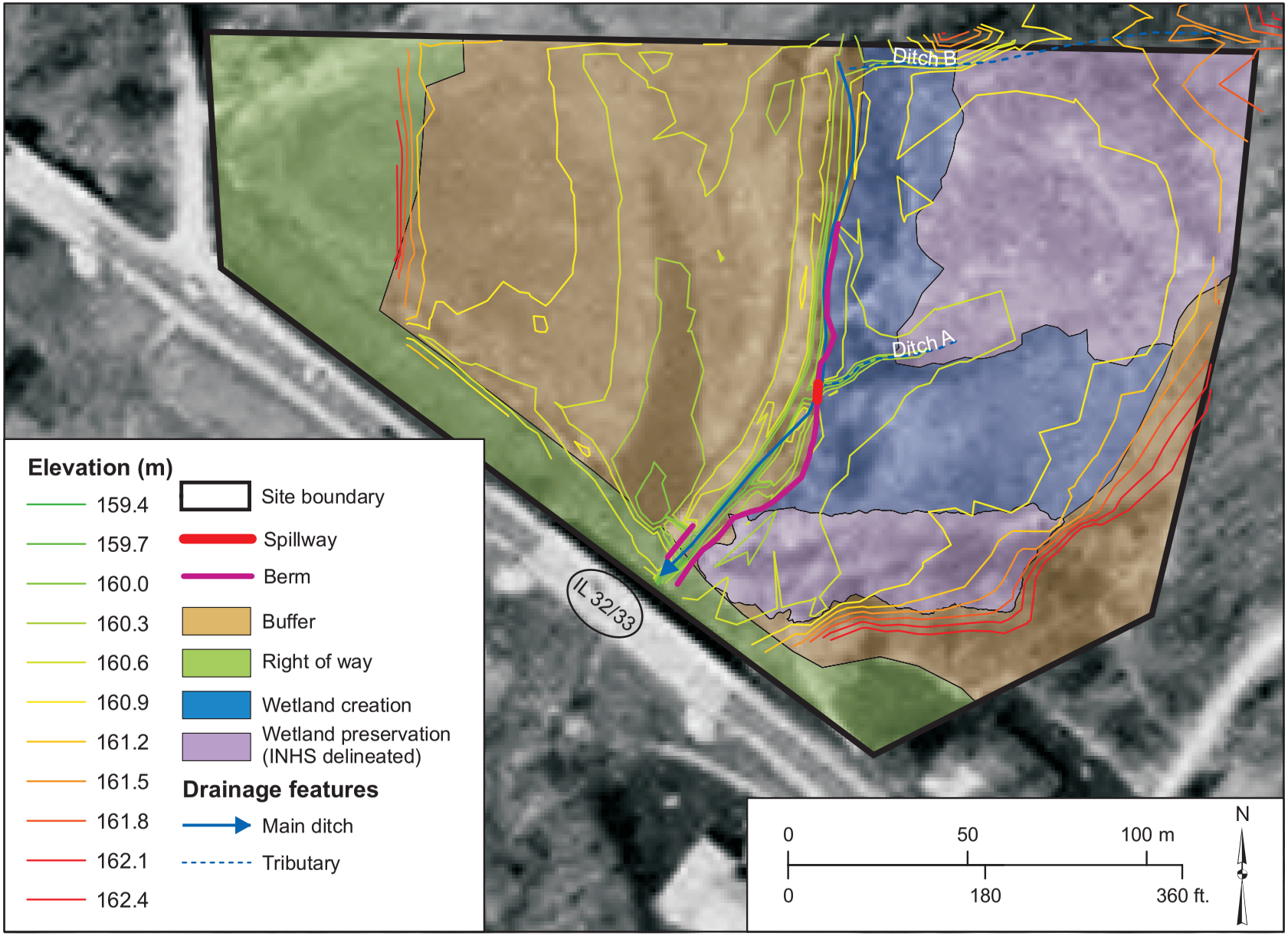

Figure 3. Proposed hydrologic alterations and compensation areas (map based on Illinois State Geological Survey 2001).

Little Wabash River can be significant when flooding occurs.

WETLAND CREATION AND SITE DESIGN

The following considerations and recommendations can be made regarding wetland compensation at this site (Figure 3). These were determined from nine months of monitoring, so additional monitoring is recommended to confirm long-term conditions and refine recommended elevations. The proposed design of the site involves wetland restoration/creation in the nonwetland areas, preservation or enhancement of the current wetland areas east of the main ditch, and creation of buffer in the remaining areas. These suggestions have been outlined in previous correspondence with IDOT (Robinson 2006).

- A threefold approach is proposed in order to establish wetland hydrology in the 0.62 ha (1.5 ac.) area east of the ditch identified as wetland creation in Figure 3. First a berm with an elevation of 160.78 m (527.5 ft.) should be built along the eastern edge of the main north-south ditch. Second, Ditch A should be filled and a rock-reinforced spillway with an elevation of 160.63 m (527.0 ft.) should be installed in the aforementioned berm. Third, ground-surface elevations in the areas identified as suitable for wetland creation in Figure 3 should be reduced to 160.63 m (527.0 ft.).

- The lack of reversible alterations and a consistent water source in the 1.39 ha (3.4 ac.) west of the ditch limits the potential for wetland creation there. At present, an access road built in the course of the construction on IL 32/33 has been acting as a dam, resulting in limited surface-water ponding caused by trapping floodwater from Green Creek and the Little Wabash River. A small amount of wetland creation acreage may be generated if a portion of the road is maintained as a berm once construction is complete (Figure 3). If this berm is removed, this area only has potential for credit as a buffer zone.

- The existing right of way and proposed alignment take up 0.76 ha (1.9 ac.) of the site, making it unavailable for mitigation. A 0.36 ha (0.9 ac.) area located in the southeast corner of the site is similarly unsuitable for mitigation due to steep slopes, but is potentially eligible as a buffer area.

METHODS

Instrumentation

A variety of instruments were installed at the site in order to monitor precipitation and water-level fluctuations, and map the extent of wetland hydrology.

A total of 7 monitoring wells were installed at 7 locations throughout the compensation site to monitor ground-water levels (Figure 4). The data were used to map the extent of wetland hydrology and identify water sources and locations that might be suitable for wetland compensation activities.

The deepest wells on site (U-wells) were installed at 4 of the 7 locations at depths between 1.00 and 2.55 m (3.3 and 8.4 ft.) below land surface, and have a screen length of roughly 0.30 m (1.0 ft.). Soil-zone wells (S-wells) were installed at the remaining 3 locations. These wells are generally 0.75 m (2.5 ft.) deep with screens 0.30 m (1.0 ft.) in length. The S-wells are designed to monitor saturation in the near-surface sediments and delineate areas of wetland hydrology.

All the wells were constructed with threaded 2.54-cm (1-in.) PVC casing and 0.25-mm (0.01-in.)

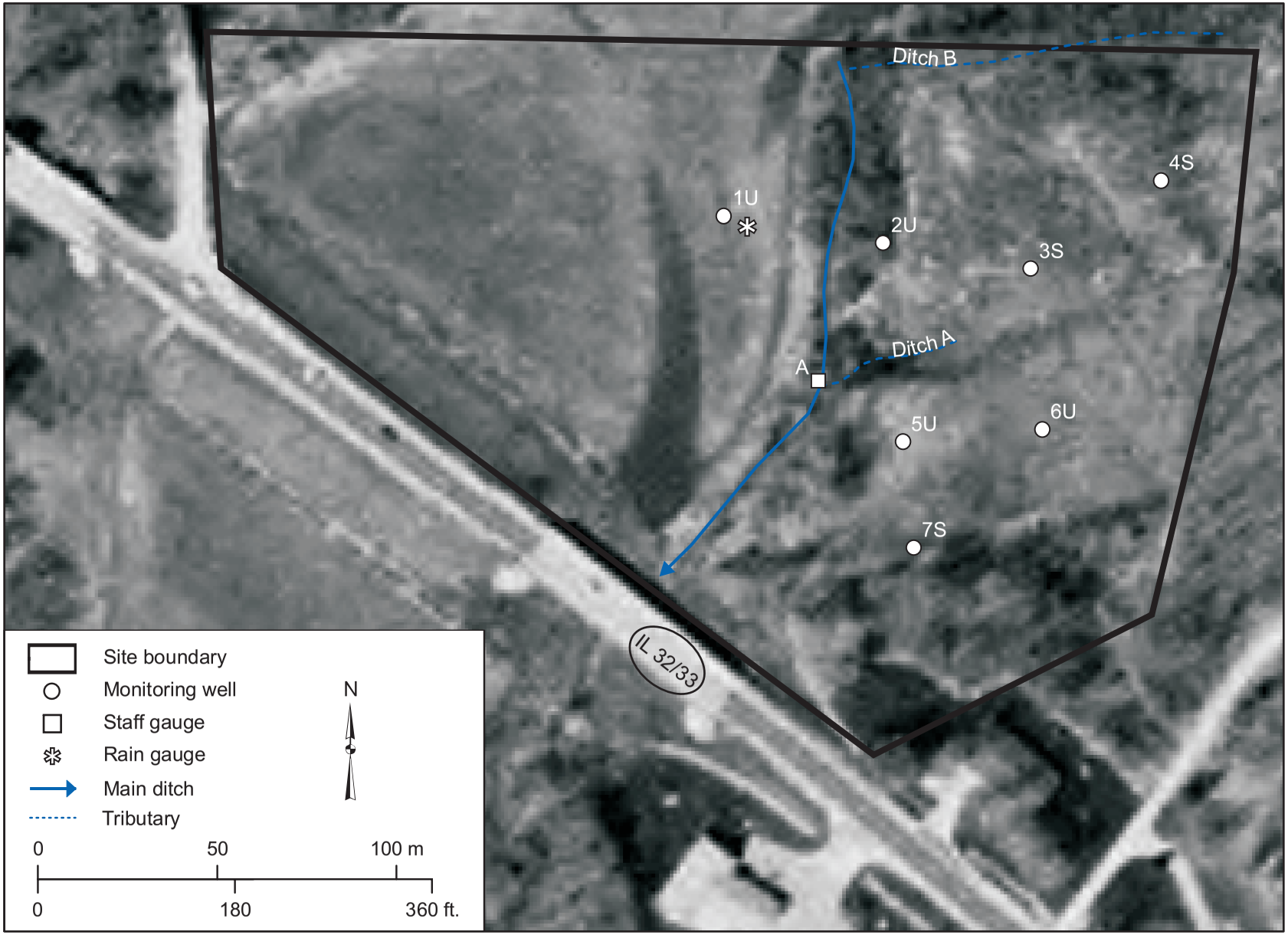

Figure 4. Locations of ISGS monitoring instruments (map based on Illinois State Geological Survey 2001).

manufactured PVC screens. All screens have a bottom cap with a single drainage hole. Well screens were packed with quartz sand with a grain size of 0.9 mm (0.038 in.), typically #5 Global silica filter pack or equivalent. The annulus was then back-filled to land surface with medium bentonite chips. Well-construction details are provided in Appendix A.

A staff gauge (Gauge A) was installed in the main north-south ditch that cuts through the center of the site (Figure 4). Although no instruments will be installed to monitor the water levels in Green Creek or the Little Wabash River until road construction is completed, water levels recorded at USGS gauging station #03378635, located 6.8 km (4.3 mi.) downstream, were used to infer flood status at the site.

Onsite precipitation was measured with a tipping-bucket rain gauge equipped with a datalogger that was installed in March 2006. This supplemented the precipitation data recorded at Effingham, Illinois (Station #112687) (Midwestern Regional Climate Center 2006). These data were obtained from the Midwestern Regional Climate Center (MRCC) at the Illinois State Water Survey (ISWS). The precipitation data were used to determine the effect of monthly and seasonal precipitation trends on surface- and ground-water levels.

Site Monitoring and Surveying

The wells, data loggers, and staff gauges were monitored twice per month during the spring (April to June) and monthly thereafter. The complete record of ground- and surface-water elevations and depths to water in wells are reported in Appendix B.

Temperature data from the station at Effingham, Illinois (Station #112687) were used to determine the length of the growing season for the region. The growing season is defined as the period between the last occurrence of -2.2°C (28°F) temperatures in the spring and the first occurrence in the fall (Environmental Laboratory 1987) . The median length (5 out of 10 years) of the growing season for the region is 210 days, with the median starting date on April 6 and the median ending date on November 2 (National Water and Climate Center 2006).

The elevations of the monitoring wells and staff gauges were surveyed in December 2005 and March 2006 with a Sokkia B1 Automatic Level from an IDOT benchmark located on the IL32/33 bridge adjacent to the site using the NGVD 1929 datum plane. In December 2005, instrument locations were surveyed using a Trimble Pathfinder ProXR GPS unit. To increase position accuracy, these locations were differentially corrected using Trimble Pathfinder software.

RESULTS

Setting

The compensation site is located within the 100-yr floodplain of the Little Wabash River (U.S. Department of Housing and Urban Development 1977). Both the Little Wabash River and Green Creek are deeply incised, likely due to the agricultural development of the region over the last century. Although a berm or pile of dredge spoil exists along the east bank of Green Creek, the low, discontinuous nature of this feature allows unrestricted flow from Green Creek to enter and leave the site when it floods.

Historic photos and maps indicate that an unnamed tributary of Green Creek formerly flowed across the site from the east. In the 1950's, construction of the Lake Pauline dam across this tributary cut off most of the water that originally entered the site from the east. In the 1980's, a north-south

drainage ditch was excavated through the center of the site to drain water from the fields to the north and west of the site. To expedite removal of water from the eastern half of the site, water that flows from the overflow channel of Lake Pauline was included. Water captured by the north-south drainage ditch exits the site at the southern property boundary, and flows under the bridge on IL 32/33 (Figure 3).

The area east of the ditch is forested and is in a slightly higher landscape position compared to the area west of the ditch, which is a fallow field. The far western portion of the site has been slated for the new alignment of 1200th Street, and construction has already begun. Since being tasked to monitor the site, numerous changes have occurred at the site as a result of this construction. The western reaches of the site have been entirely cleared and construction of the road has commenced. The farm road that previously ran along the north perimeter of the site has been removed, as well as the two large culverts that conveyed drainage from the field to the north. An access road has been constructed along the southern perimeter of the site, paralleling IL 32/33 along the west portion and then turning south under the bridge. This road has effectively blocked any overland drainage from the western portion of the site into the north-south ditch.

Geology

The uppermost bedrock unit in the project area is the Pennsylvanian-age Mattoon Formation (Kolata 2005). The Mattoon Formation is described as a complex unit of thin limestones, coals, shales, and sandstones (Willman et al. 1975). Depth to bedrock in the project area is mapped as less than 7.6 m (25 ft.), and the site is situated along the SE wall of a NNE/SSW-trending bedrock valley with an elevation between 137 to 152 m (450 and 500 ft.) (Herzog et al. 1994).

Surficial materials in the project area are mapped as less than 7.6 m (25 ft.) thick (Piskin and Bergstrom 1975). Immediately adjacent to Green Creek, surficial materials are mapped as less than 6 m (20 ft.) of the recent Cahokia Formation alluvium overlying less than 6 m (20 ft.) of the Illinoian age Glasford Formation. Over the remainder of the site, surficial materials are mapped as greater than 6 m (20 ft.) of Glasford Formation (Vandalia Till Member) (Hansel and Johnson 1996). The Cahokia Formation consists primarily of poorly-sorted sand, silt, or clay with local lenses of sand and gravel, and the Glasford Formation consists primarily of glacial tills and intercalated outwash deposits of silt, sand, and gravel (Willman et al. 1975).

On-site boring for this and previous investigations (Plankell et al. 2005) revealed that the site is generally underlain by silt, although the character of the silt varies by location and depth. The silt is more clay rich at land surface along the eastern portion of the site, and becomes more sandy to the west and at depth.

Soils

The site was mapped by the NRCS as containing two map units: Camden silt loam in the southeast corner, and Holton silt loam over the rest of the site (U.S. Department of Agriculture 1991). Investigations by the INHS found the boundary between these soils in approximately the location as mapped, but also found two areas of Birds silt loam in the eastern portion of the site (Figure 5) (Illinois Natural History Survey 2005a, 2005b).

Camden silt loam is a well-drained soil that is not flooded and has a water table greater than 1.8 m (6 ft.) below land surface, while Holton silt loam is a somewhat poorly drained soil that is frequently flooded for brief periods between January and June with an apparent high water table that lies between 0.3 and 0.9 m (1 and 3 ft.) below land surface between November and June. Neither of

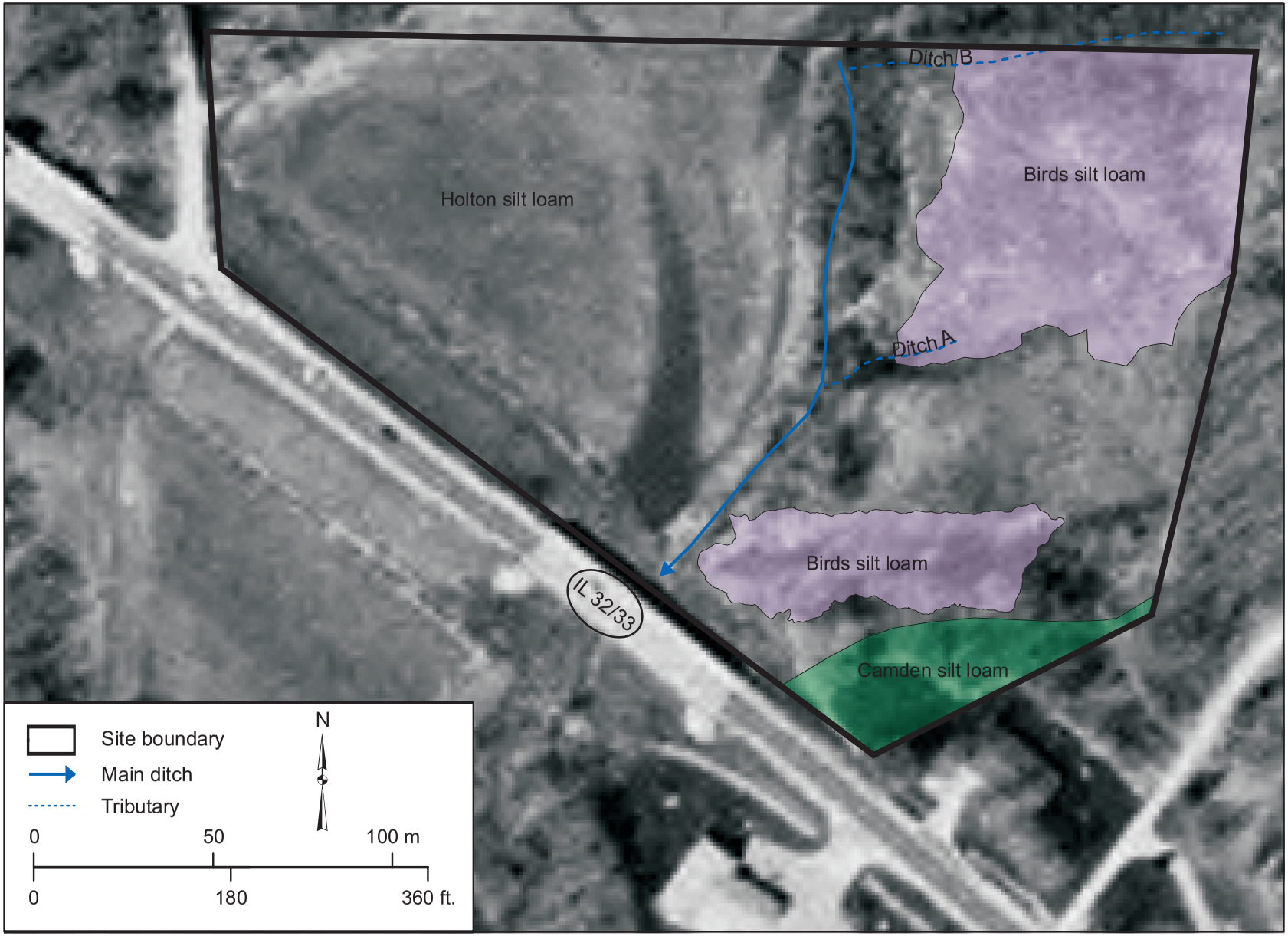

Figure 5. Soil types mapped by the USDA and INHS (map based on U.S. Department of Agriculture 1991, Illinois State Geological Survey 2001, Illinois Natural History Survey 2005a, 2005b).

these soils are classified as hydric (U.S. Department of Agriculture 1995a, 1995b, 1995c).

Although Birds silt loam is not mapped in Effingham County by the NRCS, it is described in the soil survey of adjacent Clay County (U.S. Department of Agriculture 1998) where it is classified as hydric. Birds silt loam is a poorly drained soil that is frequently flooded for brief periods between December and June with an apparent high water table that lies between 0.0 and 0.3 m (0 and 1 ft.) during the period January to June. In addition, Birds silt loam is described as an inclusion of Holton in the Clay County Soil Survey (U.S. Department of Agriculture 1998).

Precipitation

The average annual precipitation at the nearby Effingham station is 101.73 cm (40.1 in.) (Midwestern Regional Climate Center 2006). Precipitation is typically greatest between March and July, peaking in June. Total precipitation at Effingham from December 2005 through August 2006 was 69.90 cm (27.5 in.), which is 90% of the average, with 5 out of the 9 months reporting above average values (Figure 6). The wettest month was March 2006 (136% of the March average), while the driest month was December (35% of the December average).

Hydrology

Ground-water Hydrology

Figures 7 and 8 show the shallow ground-water levels measured in one season of monitoring. Water levels in each well followed similar trends in response to precipitation. Rising water levels reported in early February and April were preceded by months with above average precipitation. Below average precipitation in April resulted in a slight drop in water levels before rebounding in late May due to slightly above average precipitation. Water levels then began to drop in June with the onset of higher summer evapotranspiration rates.

The difference in water levels between the wells was substantial [up to 2.1 m (7.0 ft.)]. The highest elevations were at either well 4S or 6U, while the lowest was always at well 1U. These wells are located in the highest and lowest elevations respectively, suggesting that the potentiometric surface in the shallow ground-water mimics the topography, and the groundwater generally flows westward towards Green Creek and the Little Wabash River. These patterns can be observed in Appendix C, which shows the direction of ground-water flow on selected dates when water was recorded in all the wells onsite.

Surface-water Hydrology

While instrumentation to monitor surface-water levels is limited to the staff gauge in the main north-south ditch, visual observations of surface water were made during site visits throughout the spring.

Surface water was observed from April 5 to May 16 throughout the 0.69 ha (1.7 ac.) that has previously been mapped as wetland in the northeast corner. Despite a lack of channelization, the water in this area was flowing generally to the southwest, along the topographic gradient towards Ditch A and the main ditch. The path of flow suggests that the source of this water is from Lake Pauline in the northeast.

West of the ditch, an area of inundation of at least 0.06 ha (0.1 ac.) was observed (Figure 9). Secondary indicators such as debris lines and water stains suggest that Green Creek and/or the Little Wabash River flooded the site at least once between the dates of April 6 and April 20, leading

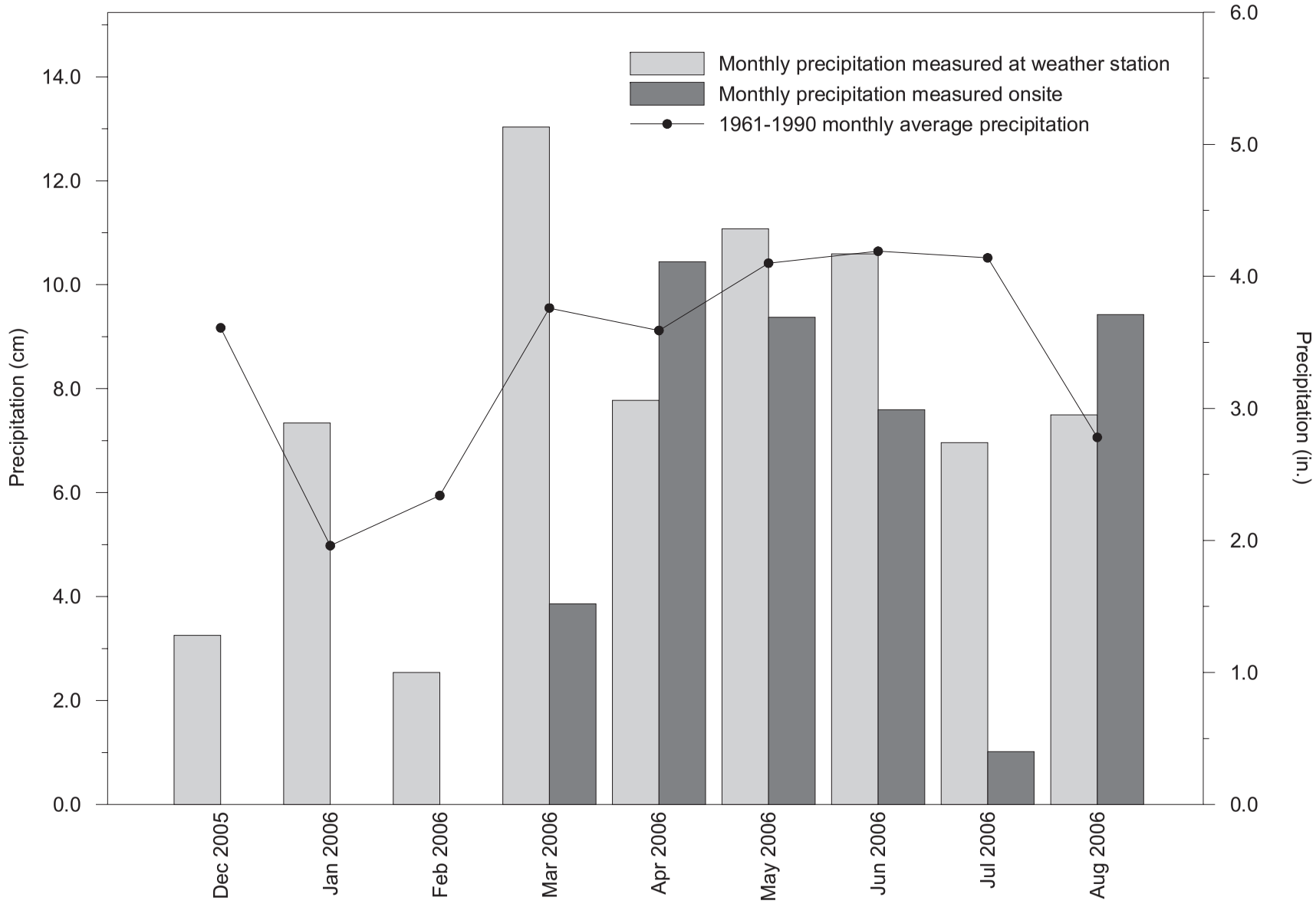

Figure 6. Total monthly precipitation recorded onsite and at the Effingham, Illinois weather station (Midwestern Regional Climate Center 2006, National Water and Climate Center 2006).

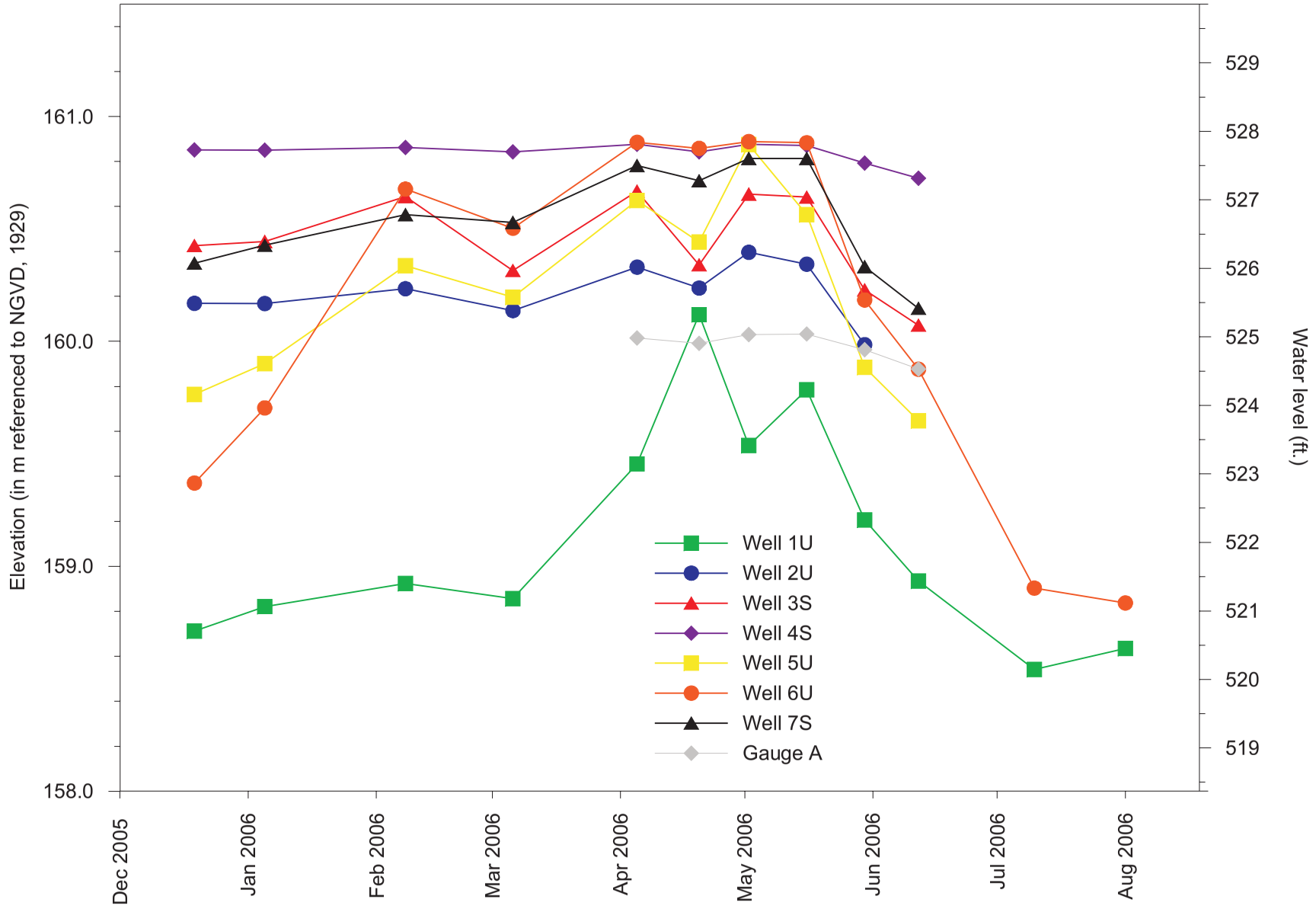

Figure 7. Water-level elevations onsite.

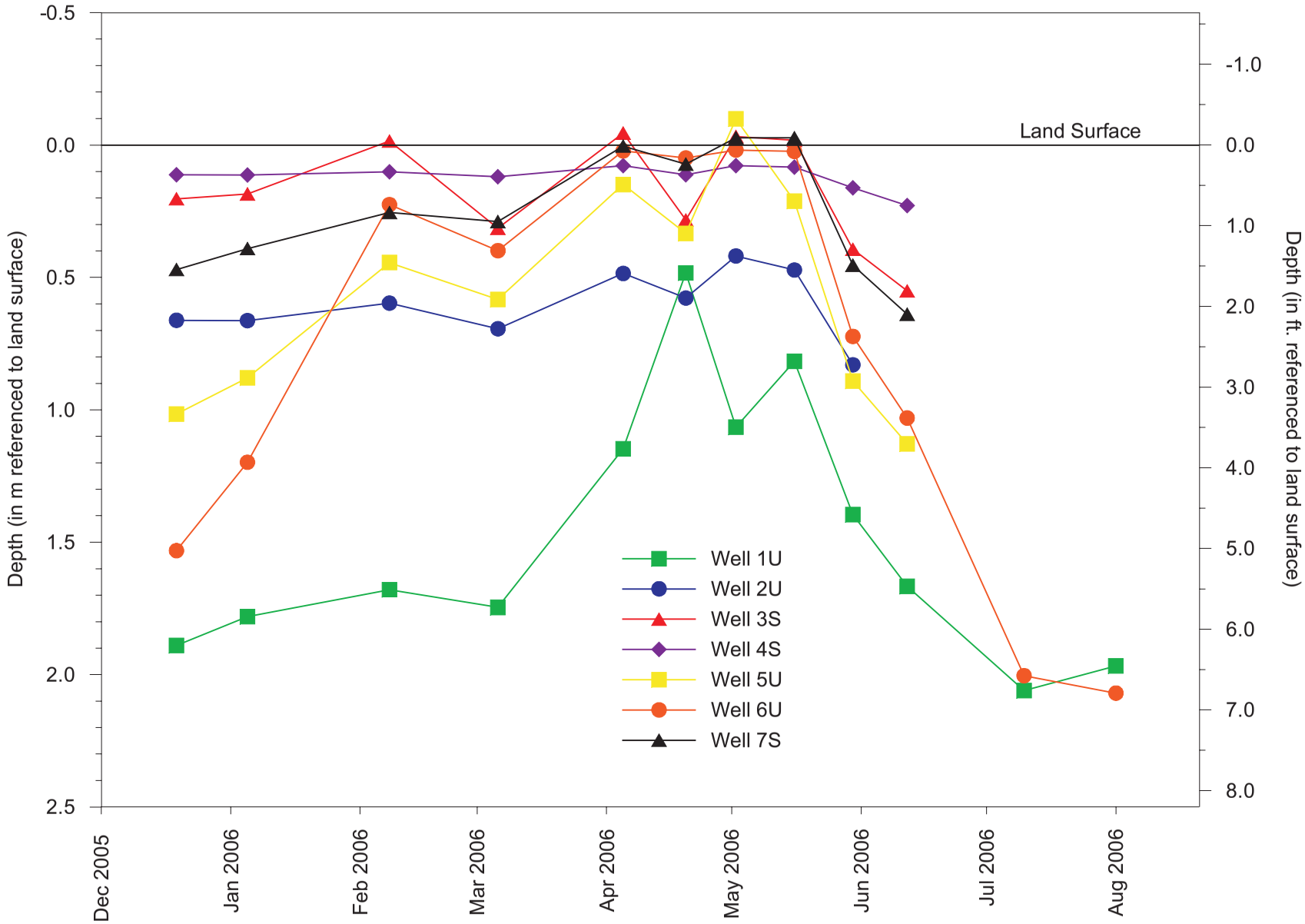

Figure 8. Depth to water in all wells onsite.

Figure 9. Inundation west of the main ditch, looking south (May 2, 2006).

to standing water for a period of at least 25 days. This is supported by data from the USGS gauging station 6.8 km (4.3 mi.) downstream; daily mean gauge height indicates that the Little Wabash River was above a flood stage of 157.58 m (517.0 ft.) on April 7, 2006 (Figure 10). Furthermore, over the entire course of record of the gauge, the Little Wabash River has exceeded its banks on 25 separate occasions, 13 of which occurred during the growing season (U.S. Geological Survey 2006, LaTour 2006).

Figure 8 shows little variation in water levels in the main north-south ditch when water is observed. The maximum water level observed in the ditch was 160.03 m (525.03 ft.). This is below the current bank elevation of 160.30 m (525.92 ft.) shown in Figure 3, suggesting that water from the north-south ditch did not flood any portions of the site.

Wetland Hydrology

Inundation and/or saturation to land surface must occur for at least 5 percent of the growing season (11 days in Effingham County) to satisfy wetland hydrology criteria as outlined in the 1987 Corps of Engineers Wetland Delineation Manual (Environmental Laboratory 1987). Water levels within 30 cm (1 ft.) of land surface in wells are interpreted to show saturation to land surface due to the presence of a capillary fringe, as suggested by informal Corps guidance. Interpolation and/or extrapolation were performed to determine the duration of saturation for wells and staff gauges where manual water-level measurements were collected, and visual observations were used to document extent and duration of inundation.

Neither the National Wetland Inventory (NWI), nor the NRCS identified any wetlands onsite (U.S. Fish and Wildlife Service 1987, Illinois Natural History Survey 2005a, 2005b). However, the INHS determined there were two areas of jurisdictional wetland comprising a total 0.93 ha (2.3 ac.) east of the main ditch (Figure 3) (Illinois Natural History Survey 2005a, 2005b).

Hydrologic monitoring and visual observations from one season of monitoring determined that a minimum of 1.30 ha (3.2 ac.) of the site satisfied the criteria for jurisdictional wetland hydrology (Figure 2). This includes, but is not limited to, the entire area already mapped as jurisdictional wetland by the INHS.

Water-level data collected indicate that five of the six wells east of the ditch (3S, 4S, 5U, 6U and 7S), defining a total minimum area of 1.24 ha (3.1 ac.), showed water levels within 30 cm (1 ft.) of land surface for greater than 5 percent of the growing season (Figure 8). Included in this area is the 0.69 ha (1.7 ac.) in the northeast corner that was previously mapped as wetland where actively flowing water was also observed. Wetland hydrology is present in this area despite the fact that it is the highest onsite and the water is actively flowing away from it. However, once the water reaches the ditches and is channelized, wetland hydrology is no longer observed.

Immediately west of the ditch, an area of inundation of at least 0.06 ha (0.1 ac.) was observed for greater than 5% of the growing season (Figure 9). It appears that the access road created during the construction acted as a dam along the south edge of the site, trapping floodwater from Green Creek and the Little Wabash River onsite and resulting in wetland hydrology of a small, low area.

CONCLUSIONS AND RECOMMENDATIONS

Following one season of monitoring, the ISGS determined that a minimum of 1.30 ha (3.2 ac.) of the site satisfied the criteria for jurisdictional wetland hydrology. This includes the 0.93 ha (2.3 ac.) that also meets vegetation and soils criteria and has been identified as jurisdictional wetland by the

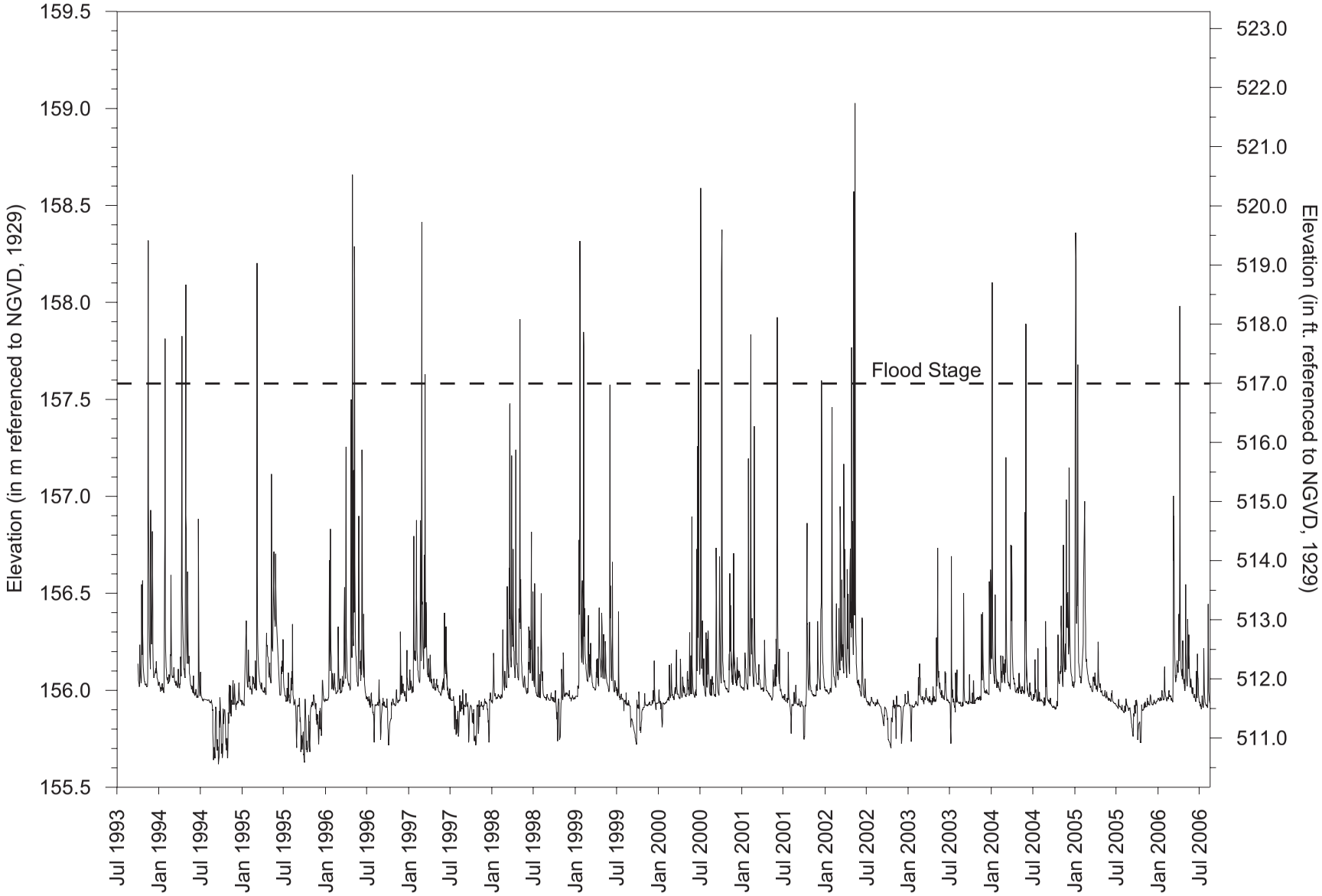

Figure 10. Mean daily water-level elevation in the Little Wabash River measured at the USGS gauging station 6.8 km (4.3 mi) downstream of the site (U.S. Geological Survey 2006, LaTour 2006).

INHS (Illinois Natural History 2005a, 2005b). Additional monitoring is needed to confirm these initial observations.

The dominant water source for the area east of the ditch is the overland runoff and groundwater leakage from the adjacent Lake Pauline, while floodwater from Green Creek and the Little Wabash River is the main water source for the west side of the site. Therefore, strategies to maximize the amount of wetland hydrology onsite differ for the areas on either side of the ditch.

East of the Ditch

In order to ensure the entire area identified as suitable for wetland creation (Figure 3) meets the criteria for wetland hydrology regularly, as well as maximizing the area of wetland hydrology east of the ditch, the ISGS recommends the following.

1) A berm with an elevation of 160.78 m (527.5 ft.) should be built along the eastern edge of the north-south ditch to retain runoff and groundwater discharge east of the ditch.

2) Ditch A should be filled. At the current outlet of this ditch, a rock-reinforced spillway should be installed in the newly created berm with an elevation of 160.63 m (527.0 ft.).

3) Ground-surface elevations should be reduced to 160.63 m (527.0 ft.) in areas identified as wetland creation (Figure 3). No excavation should be done within the limits of the existing mapped wetland, and the INHS suggests a buffer zone of at least 6.1 m (20 ft.) around wetland areas. To limit potential erosion and deposition within the existing wetland, it is also suggested that adequate erosion control be installed according to IDOT policies.

It is expected that construction of the berm will restrict the volume of water currently draining from the proposed area of wetland creation, while the lower elevation at the ditch check will enable some drainage to limit the extent of surface ponding. Coupled with excavation/lowering of the ground surface, ground-water levels are expected to be within 0.3-0.6 m (1-2 ft.) of land surface for most of the year, with standing water less than 0.15 m (0.5 ft.) deep for several months.

West of the Ditch

The occurrence of 0.06 ha (0.1 ac.) of wetland hydrology on the west side of the site was the result of unintentional damming of floodwater behind a temporary access road. This suggests that the presence of a berm at the southeast corner as outlined in earlier correspondence with IDOT would be successful in retaining floodwater from Green Creek and the Little Wabash River onsite for a period long enough to satisfy the criteria for wetland hydrology. Given the frequenct flooding of the Little Wabash River (Figure 10), maintaining a berm at the southeast corner of the area west of the ditch, at the same elevation as on the east side of the ditch [160.78 m (527.5 ft.)], after construction has been completed has the potential to yield small areas of wetland hydrology.

ACKNOWLEDGMENTS

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REFERENCES

Environmental Laboratory, 1987, Corps of Engineers Wetlands Delineation Manual: U. S. Army Corps of Engineers Technical Report Y-87-1, Washington, D.C., 100 p. Available online at http://www.saj.usace.army.mil/permit/documents/87manual.pdf.

Hansel, A. and W.H. Johnson, 1996, Wedron and Mason Groups: Lithostratigraphic Reclassification of Deposits of the Wisconsin Episode, Lake Michigan Lobe Area: Illinois State Geological Survey Bulletin 104, Champaign, Illinois, 116 p.

Herzog, B., B. Stiff, C. Chenoweth, K. Warner, J. Sieverling, and C. Avery, 1994, Buried Bedrock Surface of Illinois: Illinois State Geological Survey, Illinois Map 5, Champaign, Illinois, map scale 1:500,000, 1 sheet.

Illinois Natural History Survey, 2005a, Mitigation Site Assessment, IL 32/33, unpublished contract report presented to the Illinois Department of Transportation, Illinois Natural History Survey, Champaign, Illinois, 13 p.

Illinois Natural History Survey, 2005b, Mitigation Site Assessment, IL 32/33 - supplement to original report, unpublished contract report presented to the Illinois Department of Transportation, Illinois Natural History Survey, Champaign, Illinois, 8 p.

Illinois State Geological Survey, 2001, Illinois Natural Resources Geospatial Data Clearinghouse, Effingham North SW Digital Orthophoto Quarter Quadrangle, 1998 Data: Illinois State Geological Survey, Champaign, Illinois, available for download on line at http://www.isgs.uiuc.edu/nsdihome/webdocs/doqs/.

Kolata, D.R., 2005, Bedrock Geology of Illinois: Illinois State Geological Survey, Illinois Map 14, Champaign, Illinois, map scale 1:500,000, 1 sheet.

LaTour, John K., August 25th 2006, Supervisory Hydrologist, Illinois Water Science Center, U.S. Geological Survey, email correspondence.

Midwestern Regional Climate Center, July 2006, Midwestern Climate Information System: Illinois State Water Survey, Champaign, Illinois, available online at http://mcc.sws.uiuc.edu/.

National Water and Climate Center, July 2006, National Resource Conservation Service, Climate Analysis for Wetlands by County, available online at http://www.wcc.nrcs.usda.gov/climate/wetlands.html.

Piskin, K., and R. Bergstrom, 1975, Thickness of Glacial Drift in Illinois: Illinois State Geological Survey Circular 490, Champaign, Illinois, 34 p.

Plankell, E.T., G.A. Shofner, K.W. Carr, G.E. Pociask, and C.S. Fucciolo 2005, Initial Site Evaluation, Proposed Wetland Compensation Site, BDE Sequence No. 12505 (IL 32/33, Effingham County, Illinois: Illinois State Geological Survey unpublished contract report to the Illinois Department of Transportation, Champaign, Illinois, 32 p.

Robinson, B.J. March 21st 2006, correspondence to IDOT outlining conceptual site design plan.

U.S. Department of Agriculture, 1991, Soil Survey of Effingham County, Illinois, Soil Conservation Service, Washington D.C., 111 p.

U.S. Department of Agriculture, 1995a, Hydric Soils of Illinois (revised December 15, 1995), Hydric Soils of the United States, National Resources Conservation Service, National Soil Data Access Facility, available online at http://soils.usda.gov/use/hydric/.

U.S. Department of Agriculture, 1995b, County List of Hydric Soils in Illinois, National Resources Conservation Service.

U.S. Department of Agriculture, 1995c, County List of Soils with Hydric Inclusions in Illinois, National Resources Conservation Service.

U.S. Department of Agriculture, 1998, Soil Survey of Clay County, Illinois, Natural Resources Conservation Service, Washington D.C., 181 p.

U.S. Department of Housing and Urban Development, 1977, Flood Hazard Boundary Map, Effingham County, Illinois (unincorporated areas), Community-Panel Number 170227 0002A, page 2 of 6.

U.S. Fish and Wildlife Service, 1987, National Wetlands Inventory Map, Effingham North Quadrangle, Illinois, map scale 1:24,000, 1 sheet, available for download online at http://www.isgs.uiuc.edu/nsdihome/.

U.S. Geological Survey, 1985, Effingham North, Illinois, 7.5-Minute Series (Topographic): U.S. Department of the Interior, Geological Survey, Reston, Virginia, map scale 1:24,000. 1 sheet, available for download online at http://www.isgs.uiuc.edu/nsdihome/.

U.S. Geological Survey, August 2006, mean gauge height at Little Wabash River near Effingham, IL (USGS 03378635), National Water Information System, available online at http://waterdata.usgs.gov/nwis/.

Willman, H.B., E. Atherton, T.C. Buschbach, C. Collinson, J.C. Frye, M.E. Hopkins, J.A. Lineback, and J.A. Simon, 1975, Handbook of Illinois Stratigraphy: Illinois State Geological Survey Bulletin 95, Urbana, Illinois, 261 p.

Appendix A: Well Construction Information

Well Number	Elevation of well top (m)	Land surface elevation (m)	Bottom of well **	Well seal - top **	Well seal - bottom **	Sand pack - top **	Sand pack - bottom **	Top of screen**	Bottom of screen **
1U	161.417	160.602	2.550	0.000	1.860	1.860	2.550	2.258	2.508
2U	161.750	160.815	1.027	0.000	0.580	0.580	1.027	0.666	0.983
3S	161.781	160.623	0.786	0.000	0.300	0.300	0.786	0.435	0.743
4S	162.002	160.954	0.808	0.000	0.300	0.300	0.808	0.517	0.763
5U	161.890	160.776	1.539	0.000	1.030	1.030	1.539	1.180	1.495
6U	162.116	160.907	2.218	0.000	1.570	1.570	2.218	1.862	2.172
7S	161.816	160.786	0.828	0.000	0.300	0.300	0.828	0.536	0.783
* NGVD 29									
** reported in m below land surface									

Appendix B: Water-Level Data

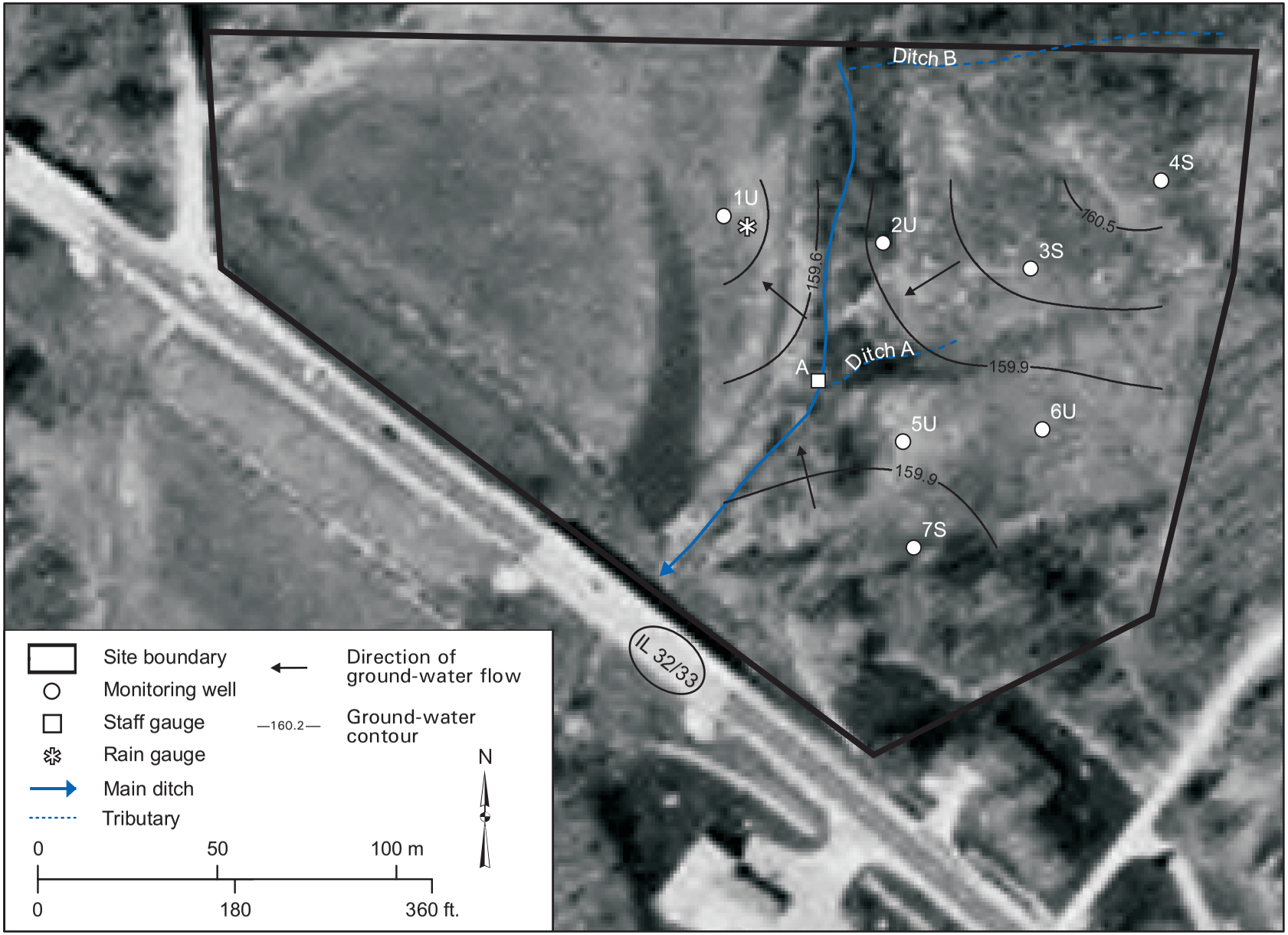
Green Creek Potential Wetland Compensation Site
2005 to 2006

	Water-Level Elevations (in m referenced to NGVD, 1929)											
Date	12/19/2005	1/5/2006	2/8/2006	3/6/2006	4/5/2006	4/20/2006	5/2/2006	5/16/2006	5/30/2006	6/12/2006	7/10/2006	8/1/2006
Well 1U	158.712	158.821	158.923	158.856	159.455	160.119	159.537	159.785	159.206	158.935	158.542	158.635
Well 2U	160.169	160.168	160.234	160.137	160.330	160.237	160.396	160.343	159.985	dry	dry	dry
Well 3S	160.426	160.444	160.644	160.315	160.668	160.340	160.655	160.641	160.229	160.072	dry	dry
Well 4S	160.851	160.850	160.862	160.843	160.876	160.842	160.876	160.870	160.792	160.725	dry	dry
Well 5U	159.764	159.901	160.336	160.197	160.627	160.442	160.875	160.564	159.885	159.647	dry	dry
Well 6U	159.370	159.704	160.677	160.503	160.885	160.858	160.888	160.883	160.184	159.876	158.903	158.837
Well 7S	160.348	160.427	160.563	160.529	160.782	160.714	160.813	160.813	160.332	160.147	dry	dry
Gauge A	**	**	**	**	160.015	159.990	160.030	160.033	159.963	159.878	dry	dry

* no measurement
** not yet installed
S indicates soil-zone monitoring well

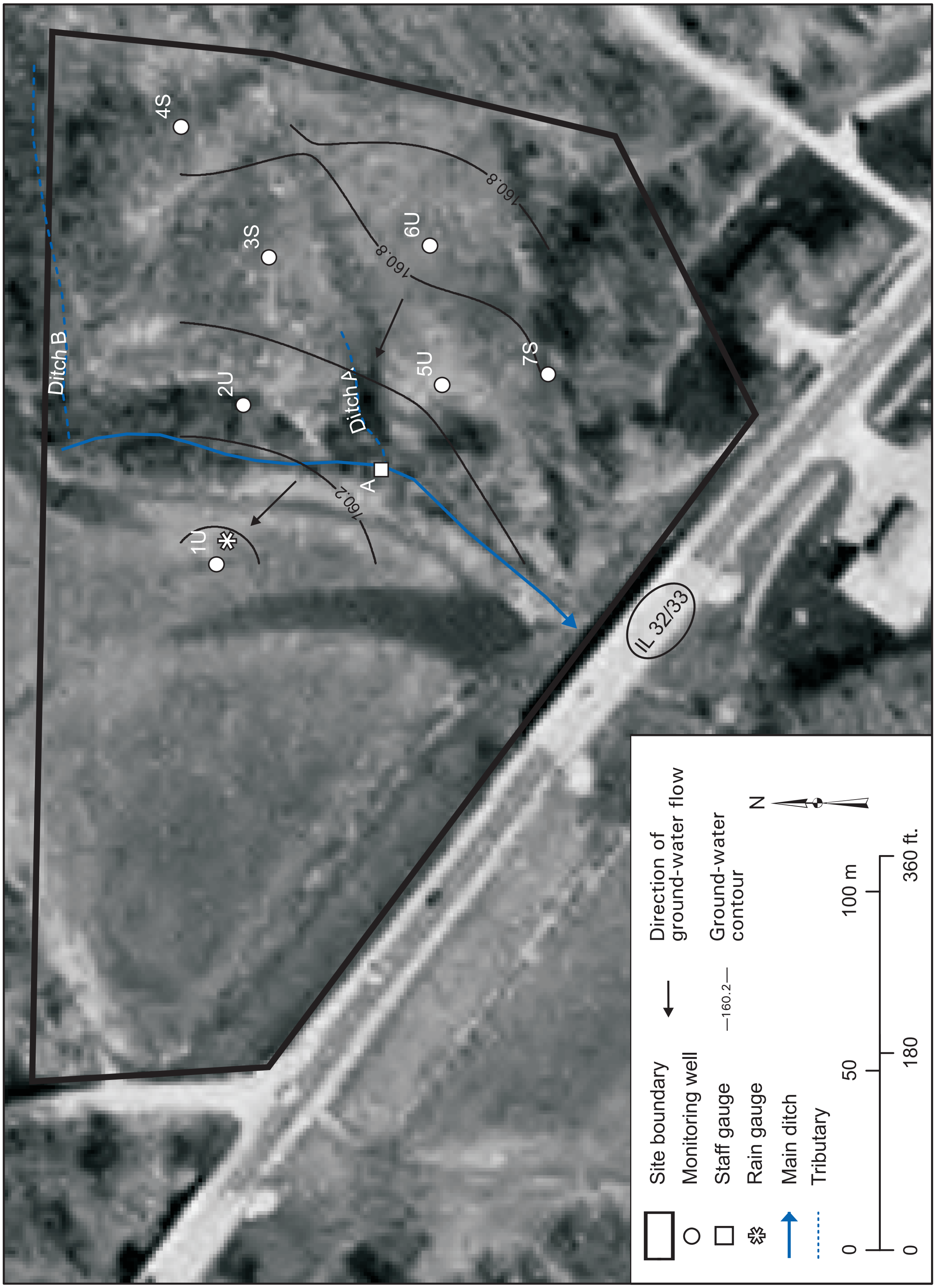
	Depth to Water (in m referenced to land surface)											
Date	12/19/2005	1/5/2006	2/8/2006	3/6/2006	4/5/2006	4/20/2006	5/2/2006	5/16/2006	5/30/2006	6/12/2006	7/10/2006	8/1/2006
Well 1U	1.890	1.781	1.679	1.746	1.147	0.483	1.065	0.817	1.396	1.667	2.060	1.967
Well 2U	0.662	0.663	0.597	0.694	0.485	0.578	0.419	0.472	0.830	dry	dry	dry
Well 3S	0.203	0.185	-0.015	0.314	-0.045	0.283	-0.032	-0.018	0.394	0.551	dry	dry
Well 4S	0.112	0.113	0.101	0.120	0.078	0.112	0.078	0.084	0.162	0.229	dry	dry
Well 5U	1.016	0.879	0.444	0.583	0.149	0.334	-0.099	0.212	0.891	1.129	dry	dry
Well 6U	1.532	1.198	0.225	0.399	0.022	0.049	0.019	0.024	0.723	1.031	2.004	2.070
Well 7S	0.470	0.391	0.255	0.289	0.004	0.072	-0.027	-0.027	0.454	0.639	dry	dry

\- indicates water above land surface
* no measurement
** not yet installed
bold depth values less than or equal to 0.304 m
S indicates soil-zone monitoring well



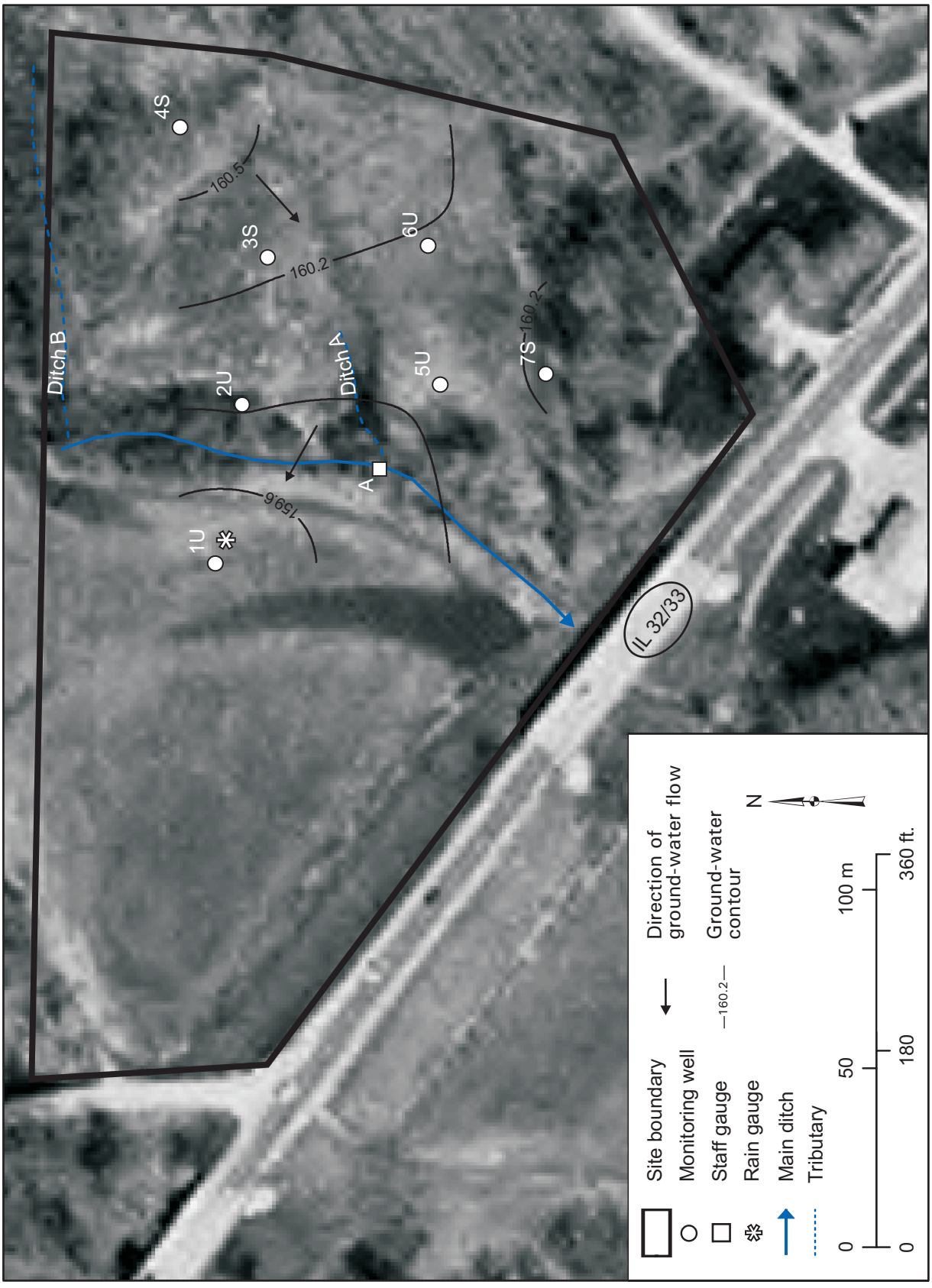
Shallow ground-water flow directions from water levels recorded on December 19, 2005 (map based on Illinois State Geological Survey 2001).

Appendix C: Shallow Ground-Water Flow Directions



Shallow ground-water flow directions from water levels recorded on May 16, 2006 (map based on Illinois State Geological Survey 2001).

Appendix C: Shallow Ground-Water Flow Directions



Shallow ground-water flow directions from water levels recorded on May 30, 2006 (map based on Illinois State Geological Survey 2001).