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LiDAR Surface Topography of Kane County, Illinois

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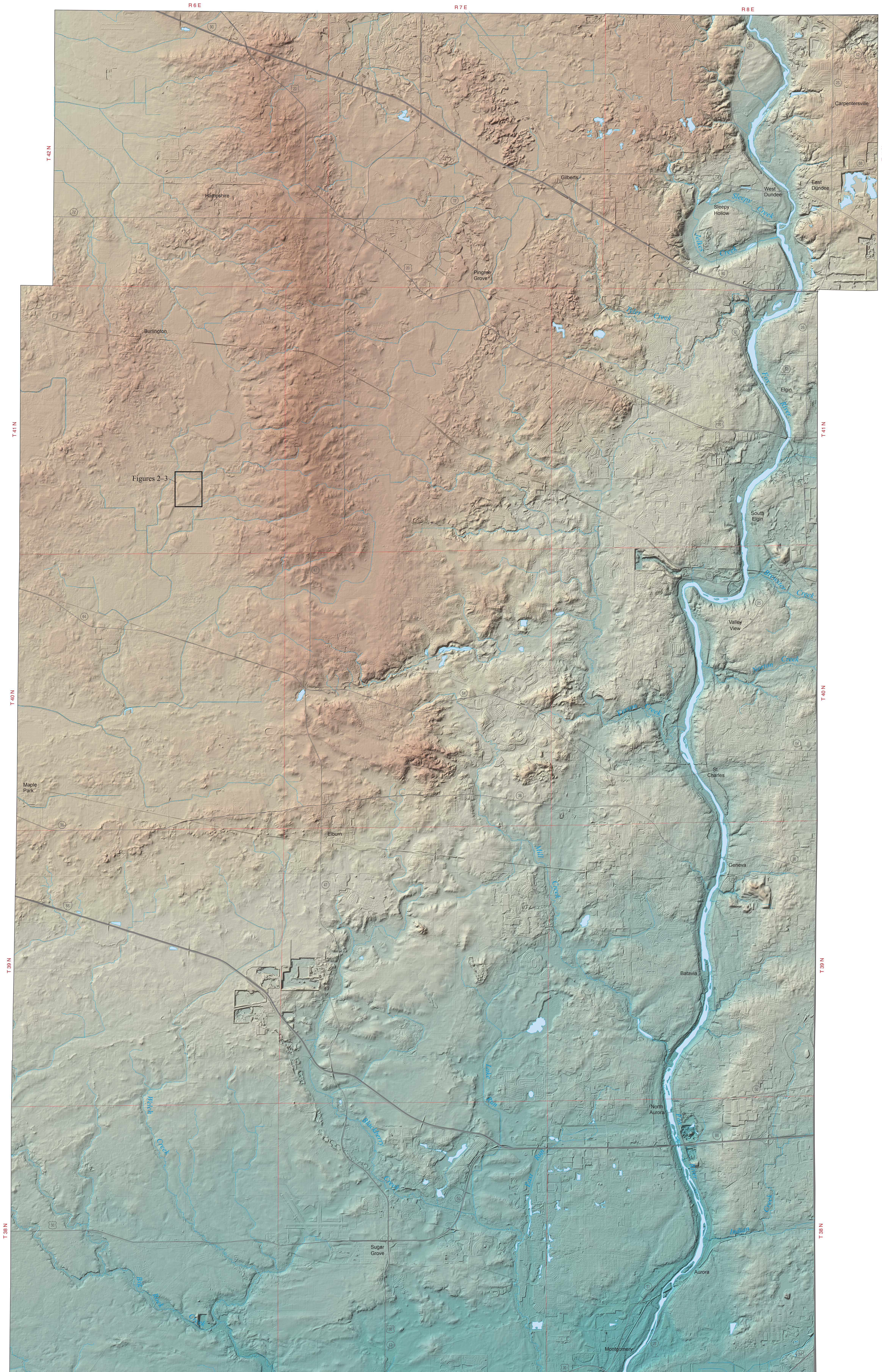
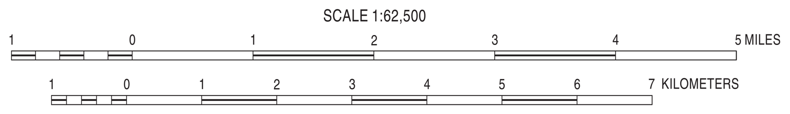
2014



SCALE 1:62,500



LiDAR Elevation Data

This surface topography map was created from enhanced elevation data acquired using airborne LiDAR (light detection and ranging) technology. This active remote sensing technique uses a pulsating laser sensor to scan the Earth's surface, and the intended application determines the sensitivity of the laser sensor used for data acquisition. For terrestrial applications such as topographic mapping, the principal wavelength selected for most airborne laser sensors is 1,064 nm, which is within the near-infrared band of the electromagnetic spectrum.

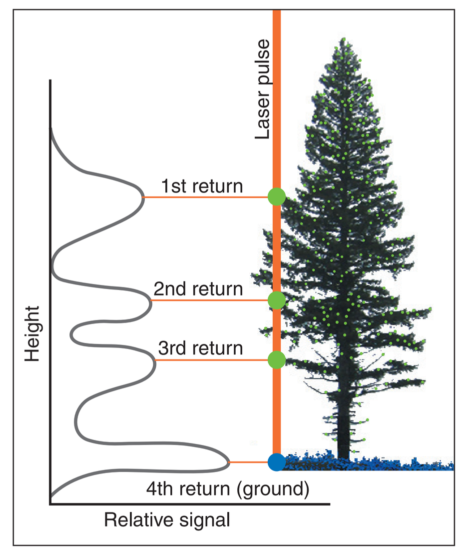


Figure 1 Simplified illustration of a single laser pulse interacting with a soft target. Four returns are generally the maximum from each pulse, and current airborne systems can emit more than 150,000 pulses per second. The waveform data collected from the target are processed into a LiDAR point cloud (colored dots), which is used to generate a three-dimen sional representation of the target (revised from Mangold and Van Sickle 2008).

The first object contacted by a laser pulse and reflected back to the sensor is designated as a "first return," which may be a hard target, such as a building rooftop or the ground surface, or a soft target such as vegetation. When a laser pulse encounters a soft target, e.g., a tree, a portion of the laser beam continues downward and reflects from the underlying branches and trunk, providing additional returns recorded by the laser sensor (Fig. 1). The reflected light pulses are detected by instruments that record the accurate location of each return pulse in three dimensions—(x) and (y) horizontal coordinates and (z) elevation values. The processed returns, which number in the billions for a typical county area, are termed a "point cloud."

A portion of the processed returns represent the ground surface and are referred to as the "bare-earth" point cloud. To maximize the probability of acquiring sufficient ground returns in vegetated terrain, LiDAR is collected in the Midwest during the leaf-off portion of the year when deciduous tree canopies are barren, crops are absent, and other vegetation types are dormant. However, wherever filtered daylight can pass through vegetated canopy, a portion of the laser pulses reach the surface and produce ground returns.

The bare-earth point cloud, comprising only ground returns, was processed to create a digital terrain model (DTM), which was used to produce the *LiDAR Surface Topography of Kane County, Illinois*. The extraordinary feature detail contained in the DTM is illustrated in the 1:6,000-scale enlargement of the glacial ice-walled lake plain feature in Figure 2. In contrast, processing all of the returns in the LiDAR point cloud produces a digital surface model (DSM) that characterizes the remaining landscape features for the same area (Fig. 3). Wooded areas, buildings, and other structures associated with the farmsteads are all apparent on the DSM. The returns representing these aboveground features are filtered from the all-returns point cloud to create a DTM. The airborne LiDAR data collected for Kane County and the surrounding counties (Fig. 4) average at least one return for each square meter of land surface. This point density, coupled with the exceptional vertical accuracy of LiDAR enhanced elevation data, meets the National Standard for Spatial Data Accuracy for the creation of 2-foot contours (Fig. 2).

References

Curry, B. B., 2008, Surficial geology of Hampshire Quadrangle, DeKalb and Kane Counties, Illinois: Illinois State Geological Survey, Illinois Geologic Quadrangle Map, IGQ Hampshire-SG, 2 sheets, 1:24,000, report, 13 p.

Mangold, R. and J. Van Sickle, 2008, Points of light, *in* Point of beginning, February 1, 2008, http://www.pobonline.com/articles/91662-points-of-light (accessed March 30, 2014).

U.S. Geological Survey, 2014, The National Map Viewer and Download Platform, http://viewer.nationalmap.gov/viewer/ (accessed March 30, 2014).

Surface Elevation
(feet above mean sea level)

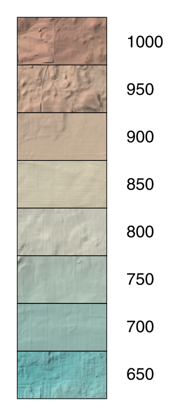


Figure 2 The surface topography of Kane County has largely resulted from the action of continental glaciers and glacial meltwaters during the Wisconsin Episode, and it is estimated that glacial ice first reached this area in northeastern Illinois approximately 24,000 years ago. The heart-shaped feature shown on this LiDAR digital terrain model (DTM; T41N, R6E) is an ice-walled lake plain that formed on the glacier surface in this region about 17,250 to 15,150 ^{14}C yr BP (radiocarbon years before the present; Curry 2008). Measuring approximately 0.5 × 0.6 miles, this particular ice-walled lake plain exhibits a noticeable raised outer rim (a) that stands 19 feet above the surrounding land surface. Although ice-walled lake plains are subtle landforms when viewed at the ground level, LiDAR DTMs have shown them to be conspicuous landscape features in Kane County, and many other such features can be seen on the main map. Contours are shown at 2- and 5-foot intervals. Scale is 1:6,000 (1 in. = 500 ft).

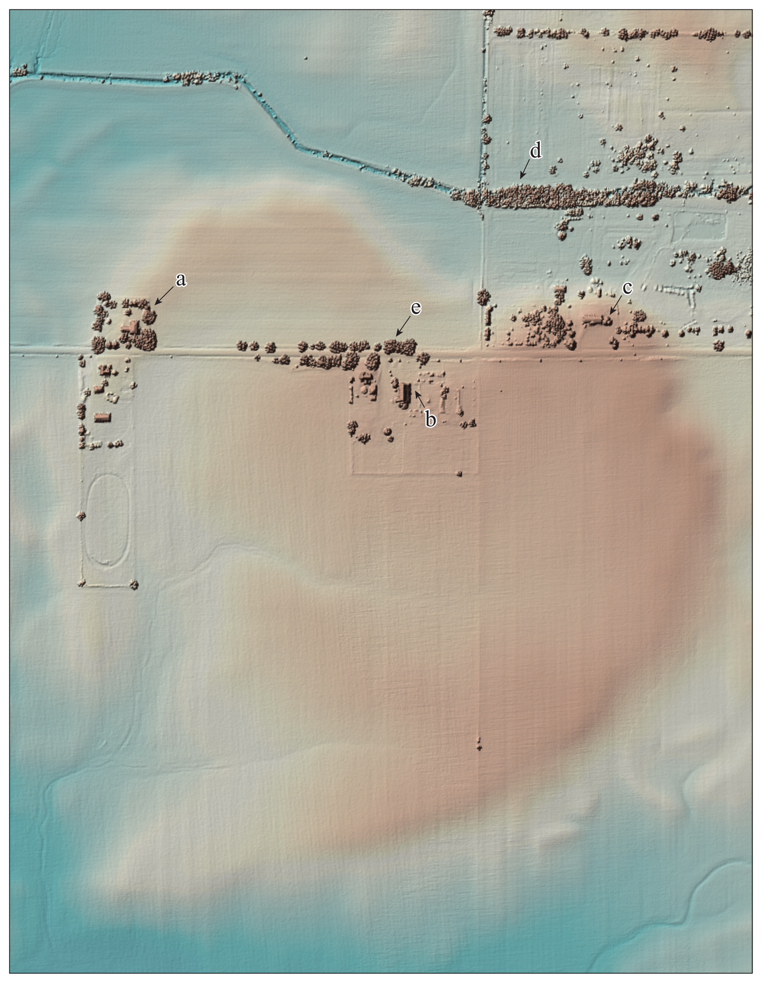


Figure 3 LiDAR digital surface model (DSM) of the same area shown in Figure 2. A DSM portrays all aboveground features. In contrast, a DTM represents only the ground surface and is extracted from airborne LiDAR data using automated filtering methods to produce what is commonly referred to as a "bare-earth" point cloud. Compare the landscape features observable on this DSM with the DTM in Figure 2. For example, note how woodland vegetation (a, c), houses, and other structures (b, c), which are easily discernible on this DSM, have been removed on the DTM in Figure 2. Scale is 1:6,000 (1 in. = 500 ft).

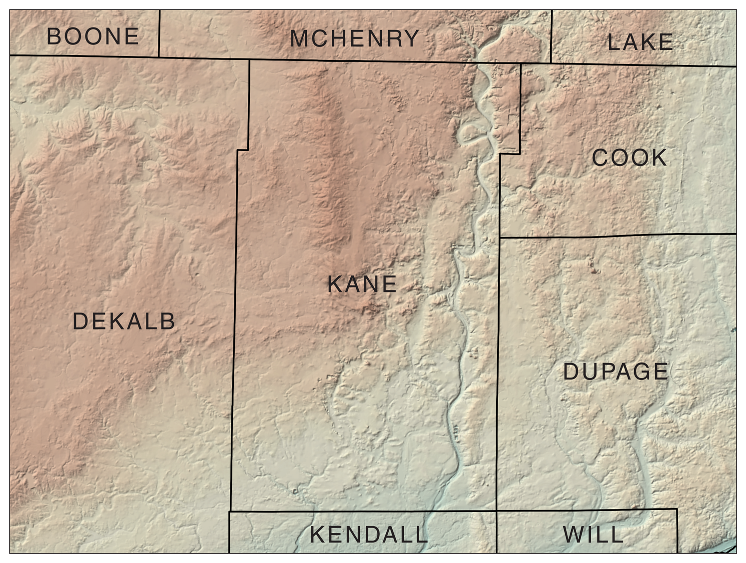
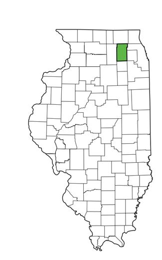
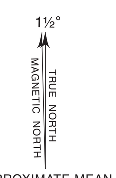


Figure 4 Generalized surface topography for a portion of northeastern Illinois produced from the U.S. Geological Survey National Elevation Dataset (U.S. Geological Survey 2014).

Road Classification

Interstate Route
U.S. Route
State Route





APPROXIMATE MEAN
DECLINATION, 2013

2008 LiDAR data for Lake County, Illinois, made available through the U.S. Geological Survey, the Kane County GIS Department, and the Illinois Height Modernization Program http://www.isgs.illinois.edu/nsdihome/webdocs/ilhmp/. Universal Transverse Mercator, zone 16. North American Datum of 1983 (NSRS2007), North American Vertical Datum of 1988. Vector base data from 2013 TIGER/Line Shapefiles provided by the United States Census Bureau.

Recommended citation:
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