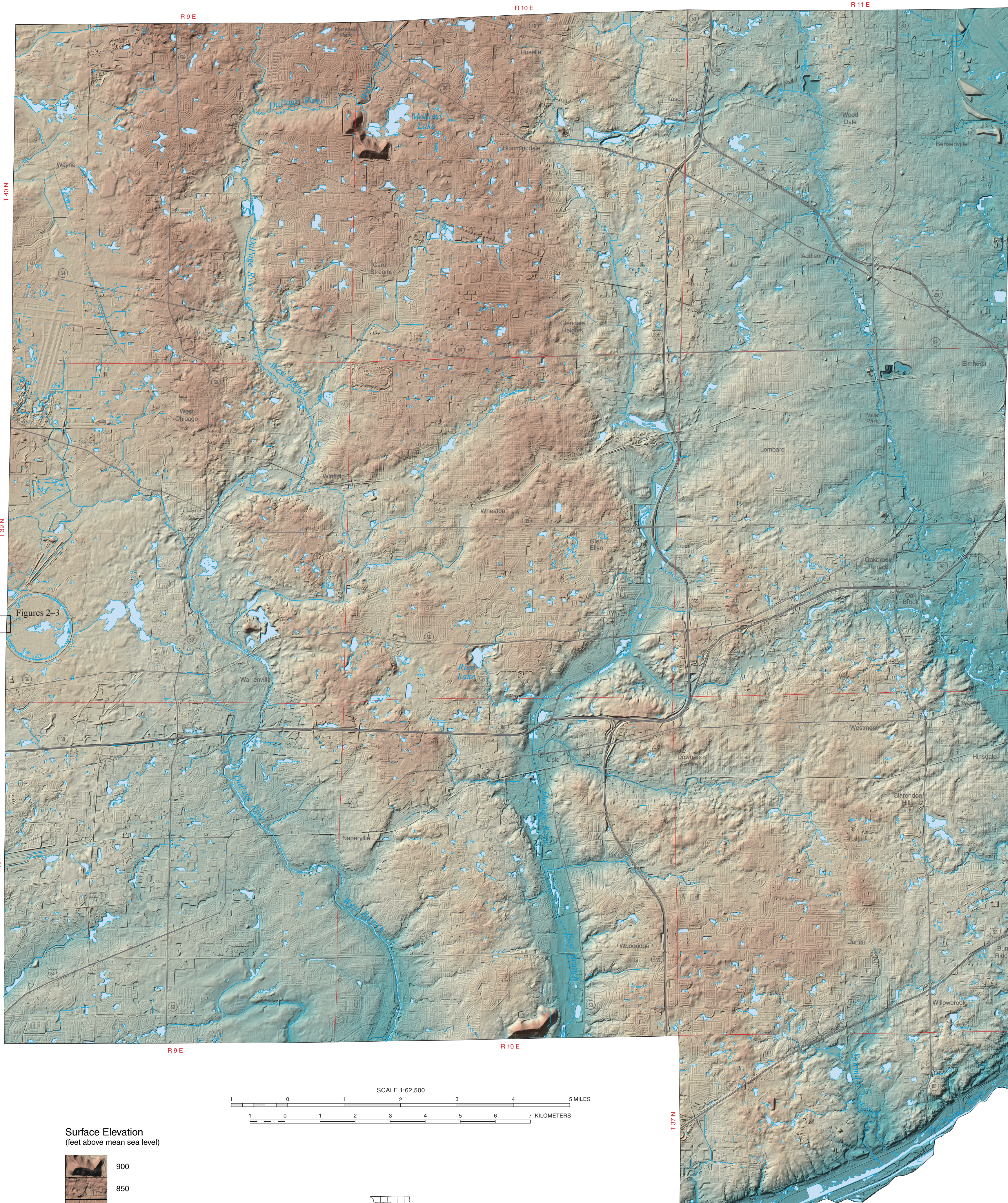


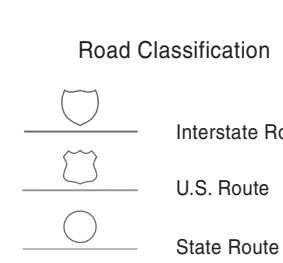
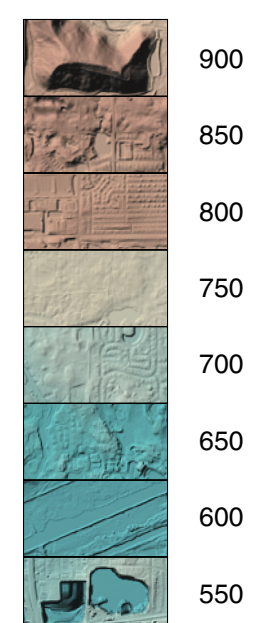
LIDAR SURFACE TOPOGRAPHY OF DUPAGE COUNTY, ILLINOIS

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 2014

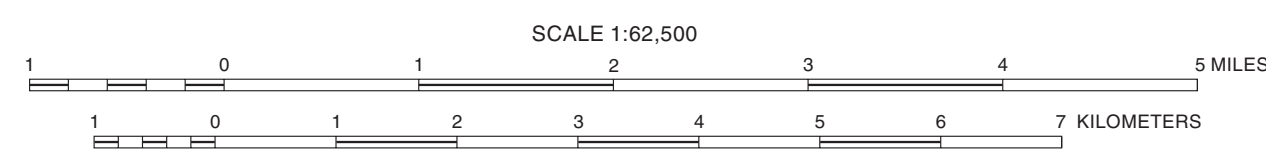
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Surface Elevation
 (feet above mean sea level)



11 1/2°
 APPROXIMATE MEAN
 DECLINATION, 2014



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.

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, 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 most 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.

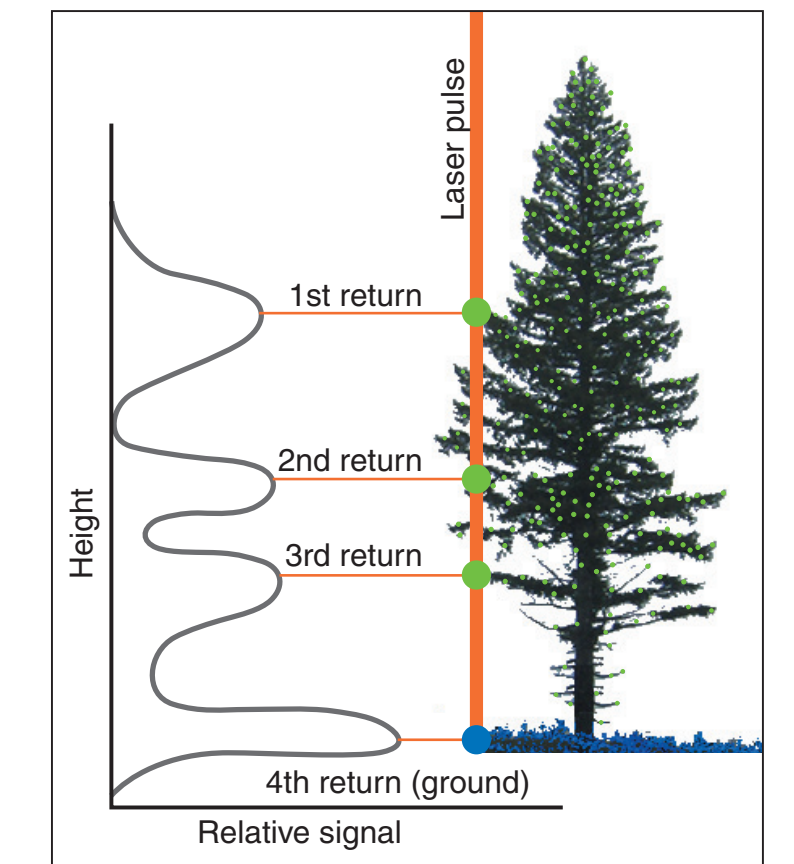


Figure 1 Simplified illustration of a single laser pulse interacting with a soft target (the tree). A maximum of four returns are possible from each pulse, and current airborne systems can emit more than 150,000 pulses per second. The waveform data collected from the target are processed into a LIDAR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

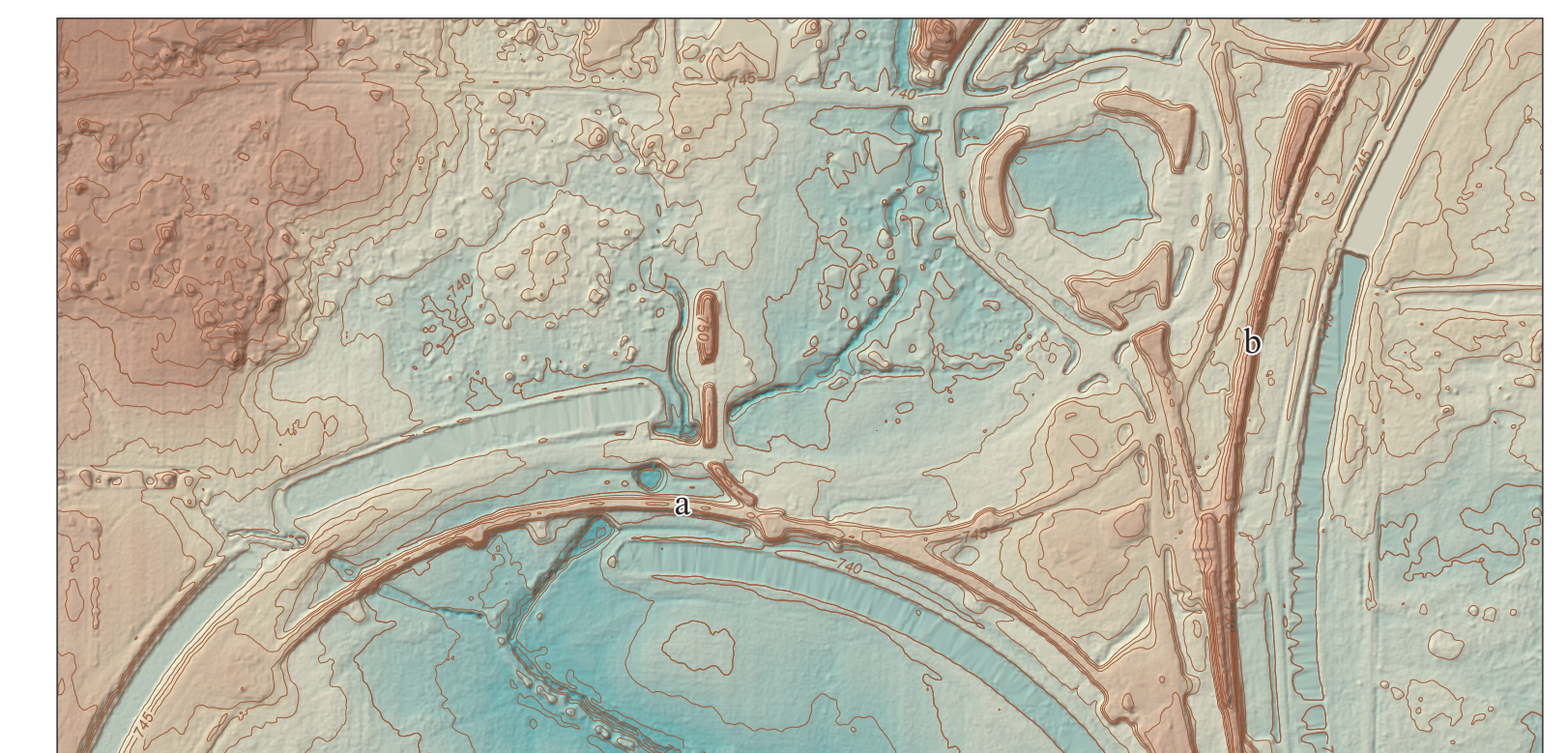


Figure 2 LIDAR digital terrain model (DTM) of the Fermi National Accelerator Laboratory site (T39N, R9E), showing portions of the two principal circular structures, the smaller Main Injector (a) and larger Tevatron (b). A DTM represents only the ground surface and is extracted from airborne LIDAR data using automated filtering methods to produce what is commonly referred to as a "bare-earth" point cloud. Contours are shown at 2- and 5-foot intervals. Scale is 1:6,000 (1 in. = 500 ft).

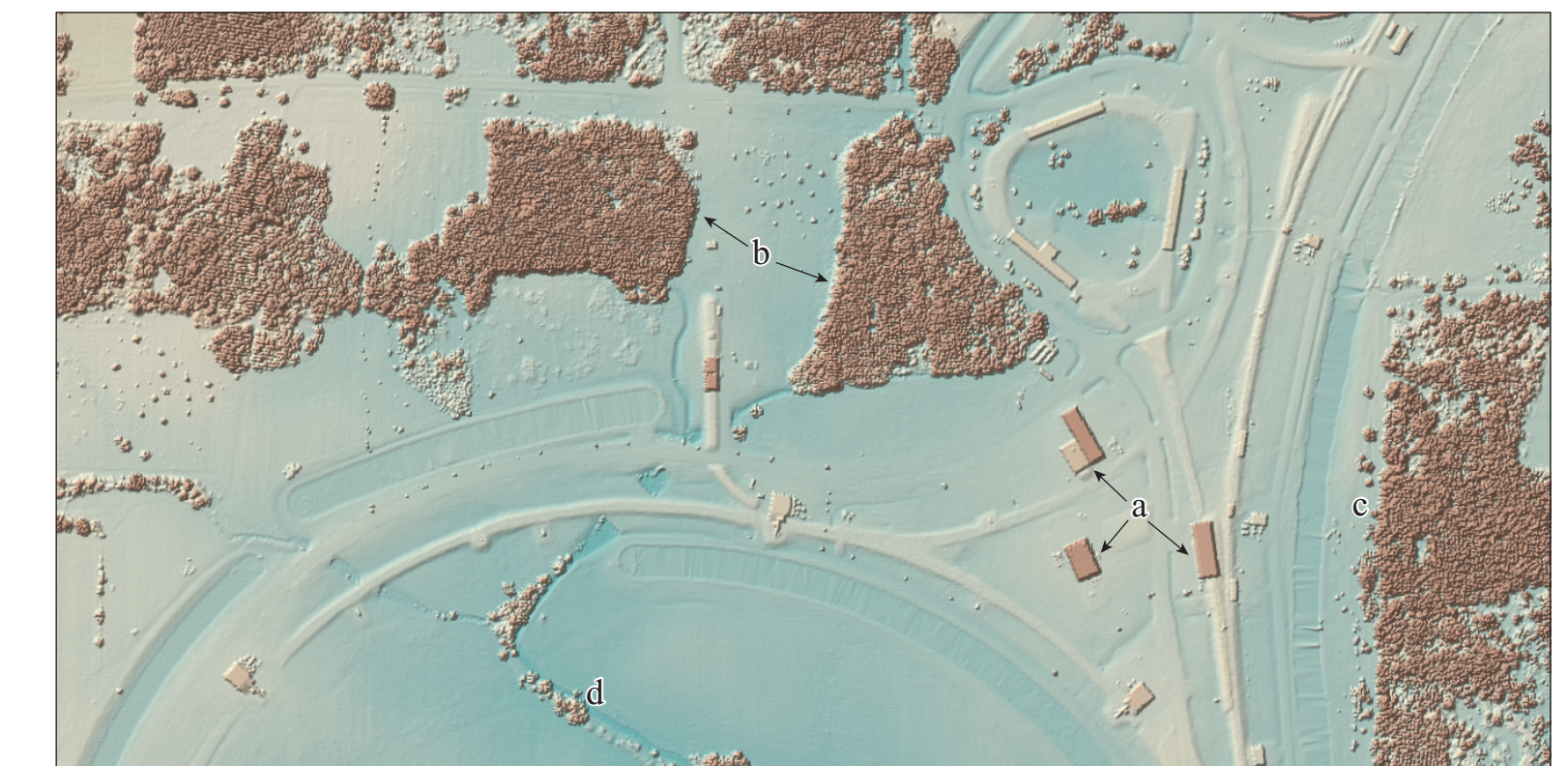


Figure 3 LIDAR digital surface model (DSM) of the same area shown in Figure 2. In contrast to a DTM, a DSM portrays all aboveground features. For example, note how the building structures, which are easily discernible on the DSM (a), have been removed on the DTM. Woodland areas visible on the DSM north of the Main Injector (b), inside the Tevatron (c), and along Indian Creek (d), have also been eliminated on the DTM, revealing the detail of the underlying topographic surface. Scale is 1:6,000 (1 in. = 500 ft).

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 DuPage County, Illinois*. The extraordinary feature detail contained in the DTM is illustrated in the 1:6,000-scale enlargement of the Fermi National Accelerator Laboratory example in Figure 2. In contrast, processing all 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 Fermilab site 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 DuPage 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

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).

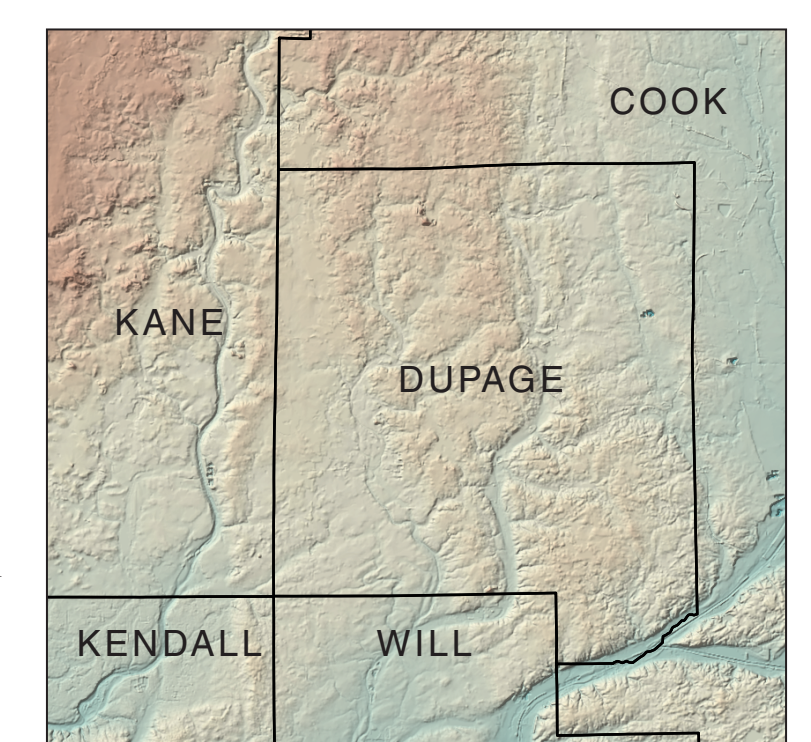


Figure 4 Generalized surface topography for a portion of northeastern Illinois produced from the U.S. Geological Survey, one-third arc second resolution National Elevation Dataset (U.S. Geological Survey 2014).

2008 LIDAR data for DuPage County, Illinois, made available through the DuPage County GIS Department, and the Illinois Height Modernization Program (<http://www.isgs.illinois.edu/nsd/home/webdocs/ihmp/>). Universal Transverse Mercator, zone 16, North American Datum of 1983 (NAD83), North American Vertical Datum of 1988. Vector base data from 2013 TIGER/Line Shapefiles provided by the United States Census Bureau.

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Recommended citation:

Domier, J.E.J., and D.E. Luman. 2014. LIDAR Surface Topography of DuPage County, Illinois: Illinois State Geological Survey, Illinois County Geologic Map, ICGM DuPage-ST, 1:62,500.