ILLINOIS STATE GEOLOGICAL SURVEY
PRAIRIE RESEARCH INSTITUTE

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Prairie Research Institute
Illinois State Geological Survey
615 East Peabody Drive
Champaign, Illinois 61820-6964
(217) 244-2414
http://www.isgs.illinois.edu

LIDAR SURFACE TOPOGRAPHY OF HENRY COUNTY, ILLINOIS

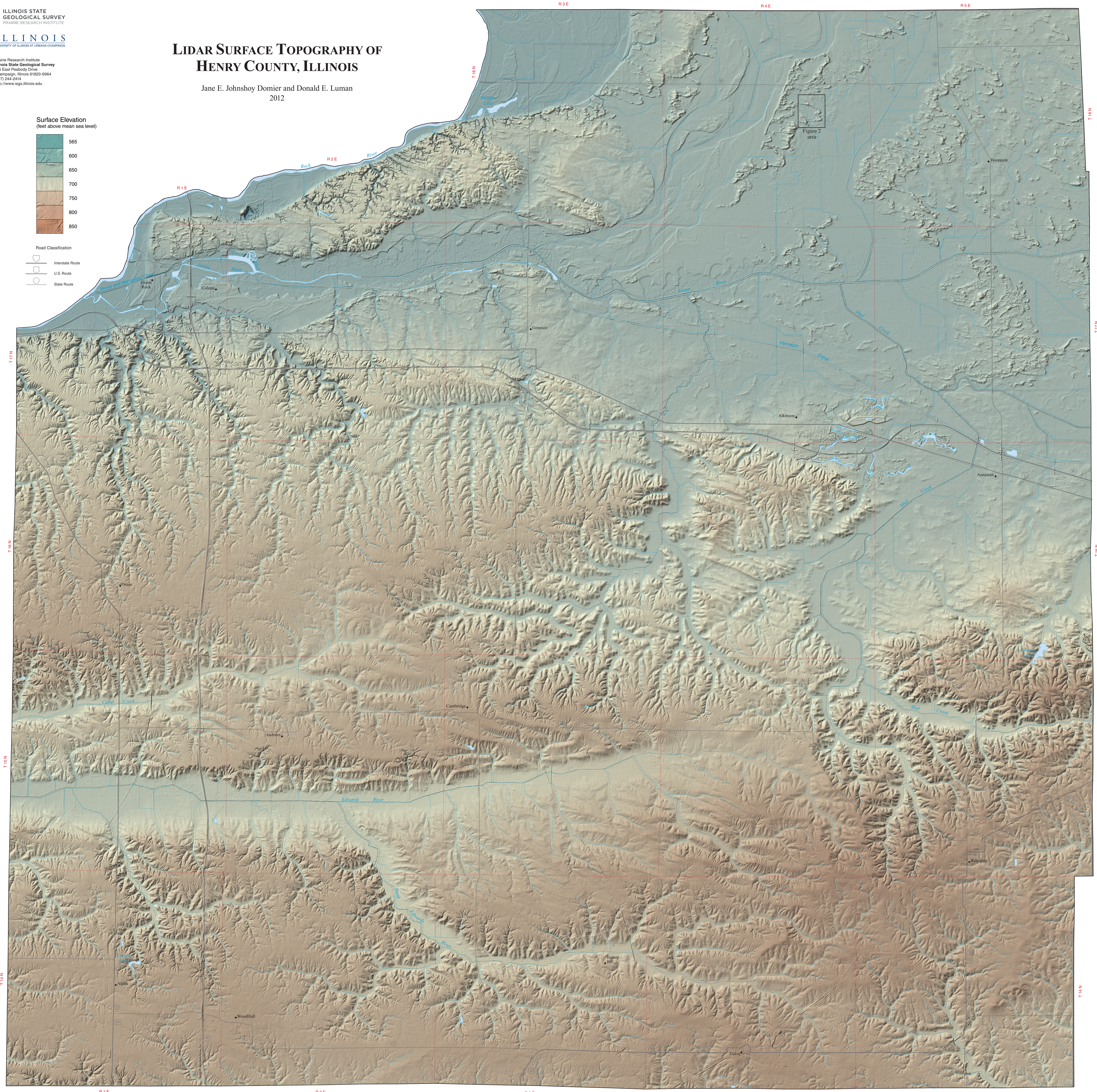
Jane E. Johnshoy Domier and Donald E. Luman
2012

Surface Elevation
(feet above mean sea level)

565
600
650
700
750
800
850

Road Classification

Interstate Route
U.S. Route
State Route



SCALE 1:62,500

1 0 1 2 3 4 5 MILES

1 0 1 2 3 4 5 6 7 KILOMETERS

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 such as vegetation. When a laser pulse encounters a soft target, for example 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 represents the ground surface and is 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 will likely reach the surface and produce ground returns.

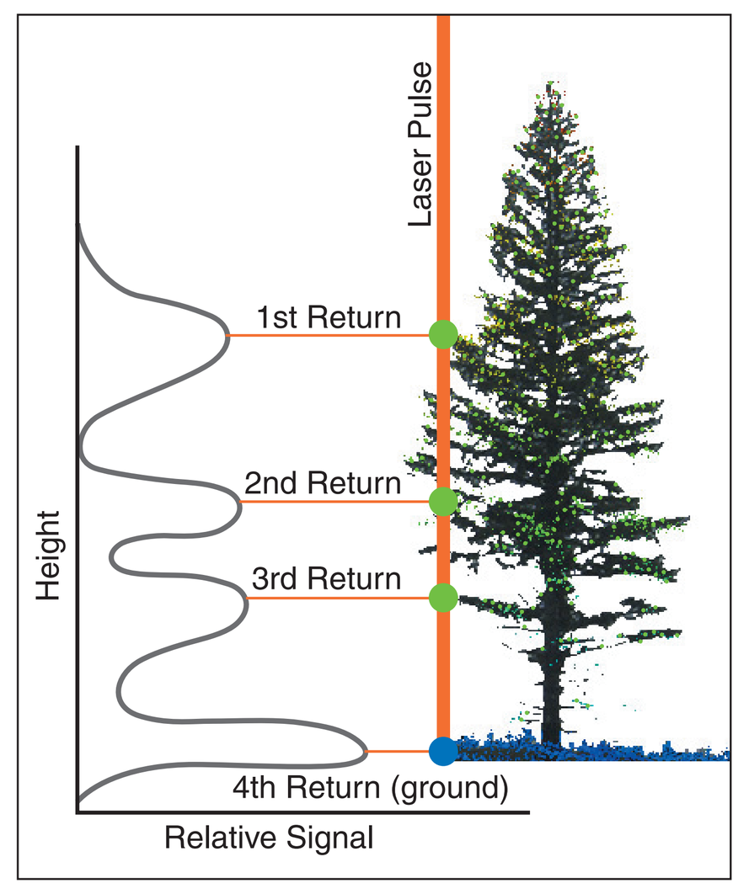


Figure 1 Simplified illustration of a single laser pulse interacting with a soft target. Four returns are generally the maximum from each pulse, and current airborne systems can emit over 150,000 pulses per second. The waveform data collected from the target are processed into a LiDAR point cloud (colored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

Figure 2 Sand dunes are a prominent landform feature within the Green River Lowland of Illinois, and several dune fields are evident in northern Henry County. Formed by wind action approximately 17,000 to 18,000 years ago, most of these relict dunes are parabolic or compound parabolic in form. Standing 30 feet in height and measuring nearly 1.5 miles in length, this dune's exceptional feature detail is revealed using LiDAR technology. Scale 1:6,000.

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 Henry County, Illinois* map. The extraordinary feature detail contained in the DTM is illustrated in the 1:6,000-scale enlargement of sand dunes in northeastern Henry County (fig. 2). In contrast, processing all the returns in the LiDAR point cloud produces a digital surface model (DSM) that characterizes the remaining landscape features (fig. 3). Wooded areas situated on the dune are now apparent, as well as buildings and other structures associated with the farmstead at the bottom of the image. The returns representing these aboveground features are filtered from the all returns point cloud to create a DTM. The airborne LiDAR data collected for Henry County and the surrounding area (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 creation of 2-foot contours (fig. 3).

Figure 3 Digital surface model (DSM) produced for a portion of figure 2. Compare the landscape features observable on the digital terrain model (DTM) with the features visible on this DSM. Scale 1:6,000.

References

Mangold, R. and J. Van Sickle, 2008, Points of Light: *in* Point of Beginning, February 1, 2008, http://www.pobonline.com/Articles/Article_Rotation/BNP_GUID_9-5-2006_A_10000000000000242390. (Accessed May 27, 2012.).

U.S. Geological Survey, 2012, National Elevation Dataset: http://ned.usgs.gov/. (Accessed May 27, 2012.).

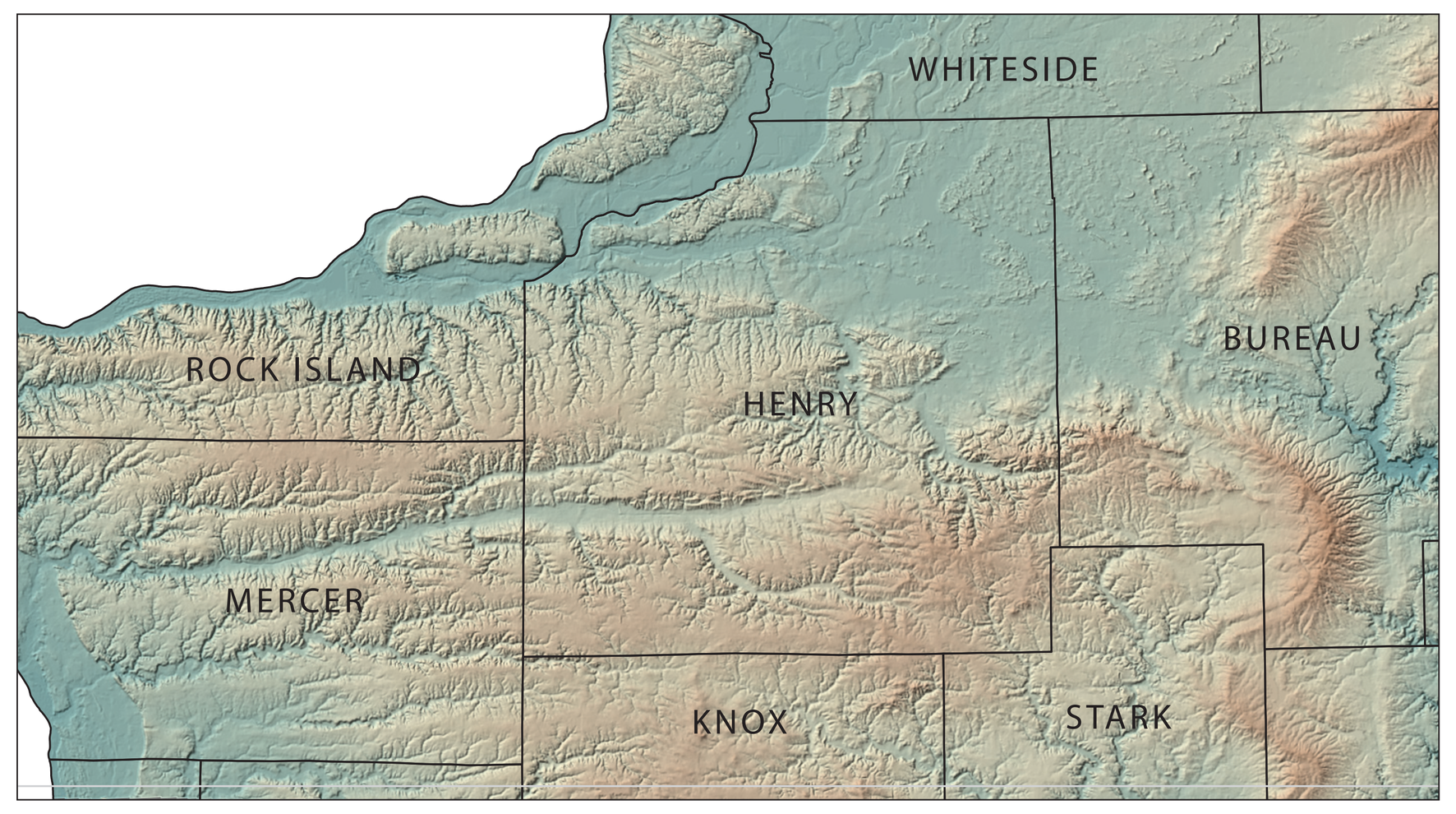
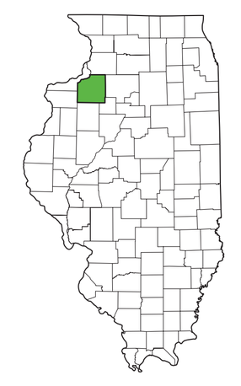


Figure 4 Generalized surface topography for a portion of northwestern Illinois produced from the U.S. Geological Survey National Elevation Dataset (U.S. Geological Survey 2012).



1½°
TRUE NORTH
MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2012

2009 LiDAR data for Henry County, Illinois made available through the Illinois Department of Transportation and the Illinois Height Modernization Program http://www.isgs.illinois.edu/nsdihome/webdocs/ilhmp/. Illinois State Plane Coordinate System, west zone. North American Datum of 1983 (NSRS2007), North American Vertical Datum of 1988. Vector base data from 2009 TIGER/Line Shapefiles provided by the United States Census Bureau.

Recommended citation:
Domier, J.E.J., and D.E. Luman, 2012, LiDAR Surface Topography of Henry County, Illinois: Illinois State Geological Survey, Illinois County Geologic Map, ICGM Henry-ST, 1:62,500.