Part 510 – Planning

510.3 Engineering Data to Support Plans

D. Use of Illinois LiDAR for Engineering Practices

(1) Background

(i) LiDAR (Light Detection and Ranging) is a technique used to obtain elevation data over large areas. Data quality can be affected by tree canopy, vegetation, type of data collection, and time of data collection.

(ii) In the past, LiDAR data have been collected sporadically across the state by various levels of government and by private firms. Due to this sporadic collection, the quality, accuracy, and type of data available vary greatly.

(2) Limitations of LiDAR

(i) Site Changes – LiDAR data represent a snapshot of the elevation at the exact time the data were collected. Changes occurring after collection, such as erosion or construction activities, are not reflected in the data.

(ii) Grade Breaks – LiDAR data are typically collected in a grid, not necessarily at observed grade changes as with a typical field survey. Features such as ditch bottoms may not be accurately represented.

(iii) Vegetation – Vegetation at the time of data collection may cause an inaccurate LiDAR representation of the ground elevation. For example, tree canopy or heavy vegetal cover may provide a reduced density of ground points collected, therefore reducing the accuracy of the data.

(iv) Site Specific Features – Some landscape features that should be identified for engineering design purposes but usually are not well defined by the LiDAR data include:

- Tile intakes and outlets
- Fences
- Wells
- Utilities
- Property lines
- Culvert inlets and outlets
- Buildings
- Locations below water level

(v) Accuracy – Most LiDAR data that have been collected in Illinois are adequate to support mapping of topographic contours at a 2 foot interval (Quality Level 3). Some engineering planning and design applications require accuracy to 1 foot or even 0.5 foot contours or better. The following table (Figure IL510-1) contains specifications for each Quality Level.

Figure IL510-1

Elevation Quality Level	Horizontal Resolution Terms		Vertical Accuracy Terms	
	Point Density, Pts / m^2	*Nominal Pulse Spacing, m*	**RMSEz in Open Terrain, cm*	*Equivalent Contour Accuracy, ft*
QL 1	8	.35	9.25	1**
QL 2	2	.7	9.25	1
QL 3	1 – 0.25	1 – 2	≤18.5	2

**RMSEz = Root Mean Square Error in the vertical direction*
***QL1 is needed to obtain accuracy for sites with heavy canopy or vegetative cover.*

(3) Use of LiDAR

(i) Planning – Use of LiDAR data is very well suited for planning purposes for all conservation engineering practices. Data may be in the form of triangulated irregular network (TIN), digital elevation model (DEM) surface, or contour lines.

(ii) Final Design – For design of engineering practices, the following table (Figure IL510-2) presents allowable Design Uses of LiDAR data for Illinois NRCS.

Figure IL510-2

Design Use*	Applicable Practice Type(s)	Accuracy Requirements
Stage storage computations	Ponds or flood routed dry dams with at least 6 feet of stage storage	2-ft contour interval or better
Stage storage computations	Waste storage facilities, wetland impoundments, grade stabilization structures and ponds with less than 6 feet of stage, terraces, wascobs	1-ft contour interval or better
Tile hydraulics	Grassed waterways, terraces, wascobs	1-ft contour interval or better
Waterway channel hydraulics	Grassed waterways steeper than 2.5% with less than 30 acres drainage area	2-ft contour interval or better
Drainage water management	DWM plans, structure for water control implementation of DWM plans	0.5 ft (6 inch) contour interval

* When employing LiDAR data for the above Design Uses, field verification of the data is required prior to design checking and approval. To do the field verification:

- Establish temporary benchmarks and control points on site.
- Perform a survey of at least 3 locations outside of any areas of active erosion, measuring elevations and distances, using the site benchmark(s). Make sure to check places with significant vegetative cover as well as places with bare ground, to determine if any inaccuracies due to vegetation exist in the LiDAR data.
- Check to ensure that the LiDAR data accurately represent the site and that the actual project location has been correctly identified. If there is a discrepancy which cannot be reconciled, discontinue use of LiDAR data for that site.
- Survey all critical locations near the site, including property boundaries, roads, visually evident utilities, fences, wells and other infrastructure.

- Gather site specific survey data where the proposed practice begins and ends (such as ditch bank configuration for tile or pipe outlets, tile or pipe inlet elevations, stable waterway outlet configurations, etc. Use this site specific information for the design, rather than the LiDAR data.
- Gather survey data as needed for any portions of the site that are under water, and for any portions of the site that are actively eroding (gullies or headcuts). Use this site specific information for the design, rather than the LiDAR data.
- Set flags or other markings to lay out the proposed practice for construction.

(iii) Note that the allowable use of LiDAR data does not alleviate designer of the responsibility to collect other necessary data using traditional survey and investigation techniques as needed to complete the practice design.