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# Field Testing Land Management Technology Tools Utilizing Lidar Data

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**ABSTRACT**

*Light Detection and Ranging collects a vast amount of data regarding the earth's surface. Utilizing this data to produce accurate field maps for a specific purpose was a goal for the Natural Resource Conservation Service. Field testing of the software tools designed to utilize LIDAR data was completed by the researchers. The results of the field test created land maps revealing the concentrated water flow areas and a contour map. The utilization of LIDAR data created maps of extreme accuracy without the traditional on-site field data collection process. The researchers concluded that the software was a major time saving process that could replace in the field surveying and data collection. The most limiting factor in the software mapping process is the user's learning curve to learn the new software intricacies.*

**Keywords:** *LIDAR, land mapping, water flow,*

## INTRODUCTION

LIDAR stands for Light Detection and Ranging, (LIDAR). People not familiar with LIDAR may assume it is a new technology. LIDAR technology was developed over 40 years ago and was initially used for mapping particles in the atmosphere. During the 1980s, the further development and availability of GPS technology opened up the applications to moving sensors (airborne LIDAR). Bathymetric LIDAR was actually one of the first uses of airborne LIDAR. The surface of the water provided a "reference" that de-emphasized the absolute location of the airplane. . Some of the earlier non-bathymetric airborne applications were in the measurement of glaciers and how they were changing, (NOAA, 2012). The early 1990s saw the improvement of the inertial measurement unit, (IMU) and the ability to begin achieving decimeter accuracies.

LIDAR can help determine where to apply costly fertilizer, (USDA 2010). It can create a topographical map of the fields and reveal slopes and sun exposure of the farm land. Researchers at the Agricultural Research Service used this topographical data with the farmland yield results from previous years, to categorize land into zones of high, medium, or low yield. LIDAR is an opportunity to take advantage of an extremely accurate and consistent base layer that will benefit agency business as well as the general public. Some applications include:

- Hydrologic modeling
- Engineering surveys and planning
- Floodplain delineations
- Terrain visualization
- Determination of slope gradient, aspect, and complexity
- Fast and accurate stream cross-section acquisition and geomorphology mapping
- Watershed evaluations
- Wildfire planning, fire behavior modeling, and rehab
- Oil and gas and mining rehab [1]

For the Commonwealth of Kentucky, elevation data are critical for agriculture and precision farming, natural resources conservation, flood risk management, infrastructure and construction management, forest resources management, geologic resource assessment and hazards mitigation, and other business uses. Today, high-density light detection and ranging (LIDAR) data are the primary sources for deriving elevation models and other datasets. Federal, State, Tribal, and local agencies work in partnership to (1) replace data that are older and of lower quality and (2) provide coverage where publicly accessible data do not exist. A joint goal of State and Federal partners is to

acquire consistent, statewide coverage to support existing and emerging applications enabled by LIDAR data. "Kentucky from Above," the Kentucky Aerial Photography and Elevation Data Program (http://kygeonet.ky.gov/kyfromabove/), provides statewide LIDAR coordination with local, Commonwealth, and national groups in support of 3DEP for the Commonwealth, (Carswell 2014). The state of Kentucky has been documented with the exception of the Appalachian region, (Figure 1). The Appalachian region of eastern Kentucky is covered by the Daniel Boone National Forest. Foliage from the trees provides interference between the beams and the ground. GIS specialists hope that all of Kentucky will have LIDAR coverage by January of 2019.

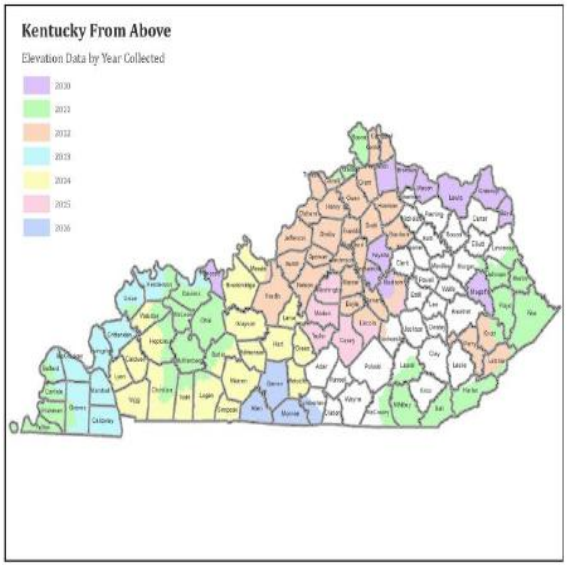


**Figure.1** *LIDAR coverage of Kentucky*

The mission of the Natural Resource Conservation Service (NRCS) is to provide national leadership in the conservation of soil, water, and related natural resources. The NRCS provides balanced technical assistance and cooperative conservation programs to landowners and land managers throughout the United States as part of the U.S. Department of Agriculture (USDA). [2]. The main way NRCS assists landowners is through the Environmental Quality Incentives Program. The program provides cost share on the implementation of conservation practices.

Many of the conservationist practices require in the field land surveying of the area to adequately evaluate the design elements of the conservation structure to be installed. The NRCS, like numerous other governmental agencies, has reduced the number of employees available to handle the increasing workload. Trends in federal employment suggest that the federal workforce may already be under strain from cost-cutting measures and that further reductions could impede the government's ability to fulfill parts of its mission.[3]NRCS field technicians and engineers are required to do more with less, the utilization of LIDAR technology is necessary to fill the reduced man-hours void. The NRCS had a staffed office in every county and during those times it was not very difficult to drive to the farm and survey/assess the land management issue. The technology tools developed for NRCS staff utilizing LIDAR data makes it possible to accurately deal with land management issues without several trips to the specific site and doing hours of "in the field" data collection.

The goal of the NRCS GIS specialist was to have all LIDAR data processed and available by January 1st, 2018. There are a variety of tools now available to NRCS employees. The tools were designed to be user friendly due to the fact many of the NRCS work force is less familiar with the relative new utilization of GIS, GPS, and LIDAR technology.

## Materials & Methods

This study conducted a field test of two of the NRCS developed LIDAR data based tools for land management practices. A field test was completed utilizing the Concentrated Flow Tool, (CFT), and the Contour tool. The researchers and the NRCS staff selected plots of land of which both parties were familiar with. A satellite image of the plot of land for the CFT field test is shown in figure 2. [4]

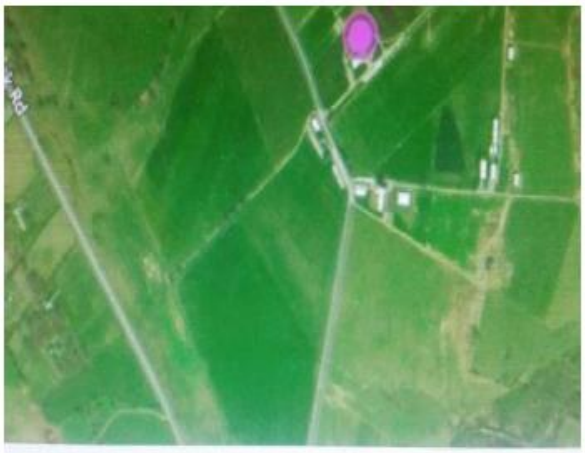

**Figure2.**

The image (Figure 3) is a demonstration of the CFT being used on a heavily cropped area that was selected. The dark lines indicate

concentrated water flow and/or areas that could become erosion problems in the future. The CFT tool allows the NRCS technician to utilize the precision LIDAR data that has been collected to produce an accurate depiction the land's water flow characteristics.

**Figure3.**

The contour tool is like a topographic map because it provides similar information. Figure 4 is a satellite image of the selected site where the LIDAR data was used for the contour tool test. [4]

**Figure4.**

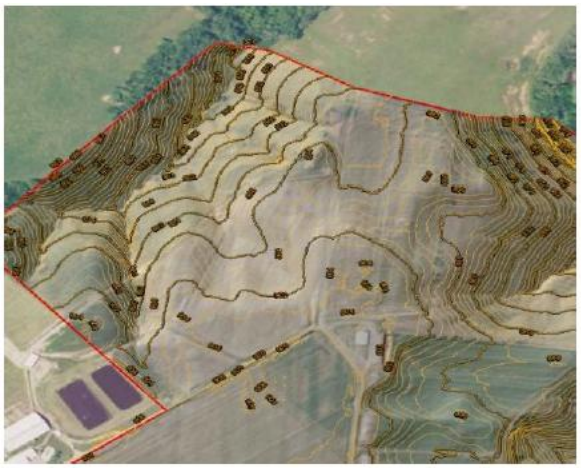

**Figure5.**

## DISCUSSION

The Concentrated Flow tool indicates areas of water flow. This tool can provide accurate topographical data to assist field staff with placement of the structures. If a technician needs to determine where to start a grassed waterway, they can utilize the CFT to help place the structure that can capture runoff in the most effective way.

In the reverse circumstance, some structures need to be placed away from concentrated water flow areas. During wet conditions, many farms need an area to stockpile manure until weather and field conditions improve enough to facilitate manure applications on nutrient deficient areas of the farm.

If manure storage areas were placed in a high water flow area, manure would be carried away into creeks or leached into ground water and other areas that would cause a negative environmental impact.

Placing land management practices in the best location will allow the landowner to see a longer useful life of the conservation practice making the marginal benefit greatly exceed the marginal cost of the investment. Many topographic maps are just not accurate enough to be used to plan and implement conservation practices.

Typical topographic maps may use 20 foot contour intervals. LIDAR provides accurate data and uses 2 foot contour intervals.

Another key feature of LIDAR data based tools is that the tools can be used simultaneously. This greatly reduces user time. The tool allows field office staff to better understand the field without taking the time to travel to and survey said field.

## CONCLUSIONS

The LIDAR data based software tools provided finished products that were accurate and descriptive of the test sites. The LIDAR data based software tools allow NRCS employees to

Understand a site with a significant reduction in man-hours to gather the same data provided by LIDAR. There is a learning curve to utilizing the tools which is directly dependent upon the user's computer technology prior experience and skill level.

## ACKNOWLEDGEMENTS

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## REFERENCES


[1] "ARS Study Helps Farmers Make Best Use of Fertilizers". USDA Agricultural Research Service. June 9, 2010.

[2] Carswell, W.J., Jr., 2014, The 3D Elevation Program—Summary for Kentucky: U.S. Geological Survey Fact Sheet 2014–3012.

[3] National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center. 2012. "LIDAR 101: An Introduction to LIDAR Technology, Data, and Applications." Revised. Charleston, SC: NOAA Coastal Services Center.

[4] https://gdg.sc.egov.usda.gov/Catalog/ProductDescription/LIDAR.html; LIDAR Elevation Dataset–Bare Earth Digital Elevation ...

[5] http://resources.ca.gov/wetlands/agencies/nrcs.html ; USDA 2018

[6] https://www.cbo.gov/budget-ptions/2016/52222 ; Reduce the Size of the Federal Workforce Through Attrition CBO 2016

[7] https://www.mapsatellite.net/us/sm/?url=http%3A%2F%2Fwww.MapSatellite.net&msclkid=cc4a5b4b71d411c07c0c075f67da08b5&gclid=CIi61_mXoN8CFe-JxQIdggQFFA&gclsrc=ds


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