# LIDAR: A HIGHLY REVEALING TECHNOLOGY

Steven Winkley | Source Water Protection Specialist

Recently, I had the opportunity to utilize highly detailed ground surface elevation data for a wellhead protection planning project in Jefferson County. This elevation data is many times more precise and accurate than the elevation data that is found on topographic maps that many of you may be familiar with. Using the higher resolution elevation data, I was able to identify very subtle ground features that are characteristic of limestone bedrock (Figure 1). These features include small circular depressions known as sinkholes and a low ridge of shallow buried bedrock (Figure 1). The technology that created the high-resolution elevation data depicted in Figure 1 is known as LiDAR (Light Detection and Ranging).

The way LiDAR typically works is through the use of intense, focused beams of light that are emitted from laser instruments aboard an aircraft (Figure 2). The light beams bounce off features on the earth and sensors aboard the plane collect these light reflections or echoes. By measuring the time it takes for the reflections to be detected, and knowing the exact location of the sensors using GPS and other means, the distance and hence the elevation can be calculated.

The onboard sensors collect data on several reflections that occur from the same light pulse. For example, for a given light beam, there may be multiple echoes from the tree canopy and finally from the ground (see Figure 2). Thousands of laser light pulses are emitted every second, with corresponding reflections being recorded. The result is a huge dataset of geo-referenced elevation points known as a point cloud. Software is then used to manipulate the point cloud and filter out vegetation reflections and produce a so-called "bare-earth" that can be with or without buildings.

LiDAR can even be used underwater. Using sensors that operate in a different frequency range, bathymetric LiDAR systems can be used to measure the depth to the bottom of water bodies. In relatively clear water, airborne LiDAR can determine bottom depths to around 200 feet.

The vertical accuracy of LiDAR-derived ground elevations can be on the order of 4 to 12 inches. In comparison, the accuracy of conventional topographic

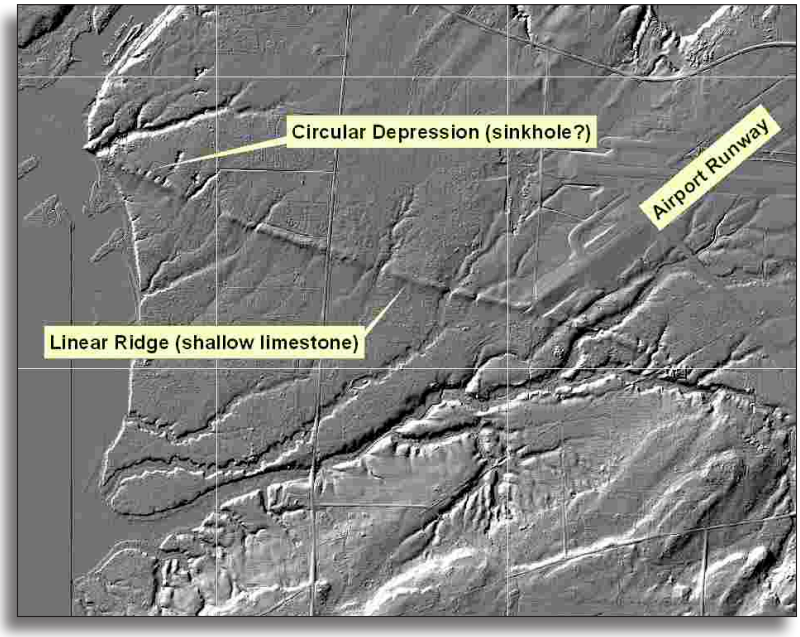


**Figure 1. Hill Shading Map Derived From LiDAR Elevation Data**

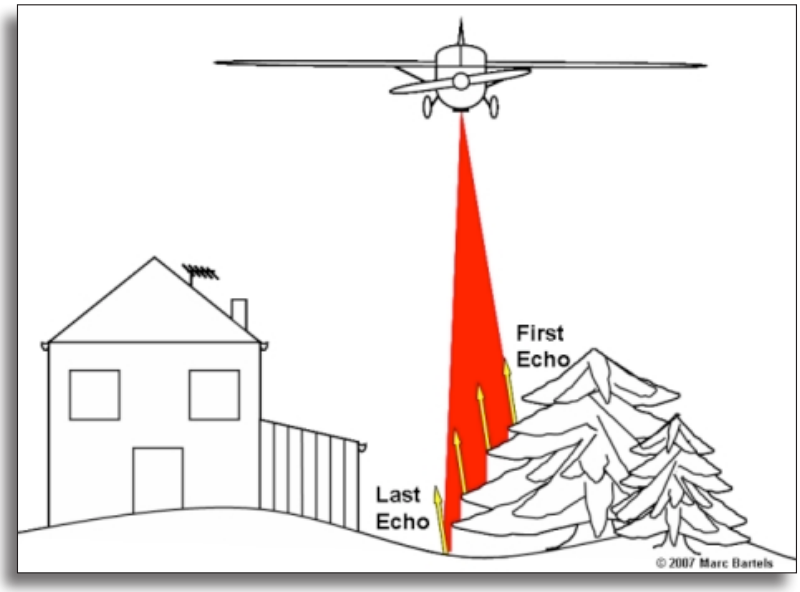


**Figure 2. LiDAR Reflections**

quadrangles is approximately 8 feet. With that type of accuracy, LiDAR has many, many applications. These include 3-D modeling of man-made and/or landscapes, floodplain mapping and planning, disaster management, geologic mapping, forestry, land use mapping and planning, coastal >>>

erosion and nautical charting, and utility mapping and planning.

For the aquifer and watershed mapping that I am involved with, I have found that LiDAR-derived elevation data is invaluable. Are there other applications for LiDAR-derived elevation data for the water/wastewater industry? For example, could we use LiDAR to map the position of remote, water transmission mains for example?

There are communities with miles of poorly-located water transmission mains in heavily forested, remote areas. Could LiDAR identify subtle elevation changes that mark the position of the water main? Collecting LiDAR data is not cheap, but fortunately there area areas of the New York State where data is available. Figure 3 is a map that shows where LiDAR data is available for free from the New York State GIS Clearinghouse.

If your community falls within an area of LiDAR data coverage, I would be interested in piloting a project to see if such data could be used to locate a remote water or sewer pipeline. Feel free to contact me at 1-888-NYRURAL, ext. 17 or winkley@nyruralwater.org if you are interested or would simply like to learn more. 💧💧💧

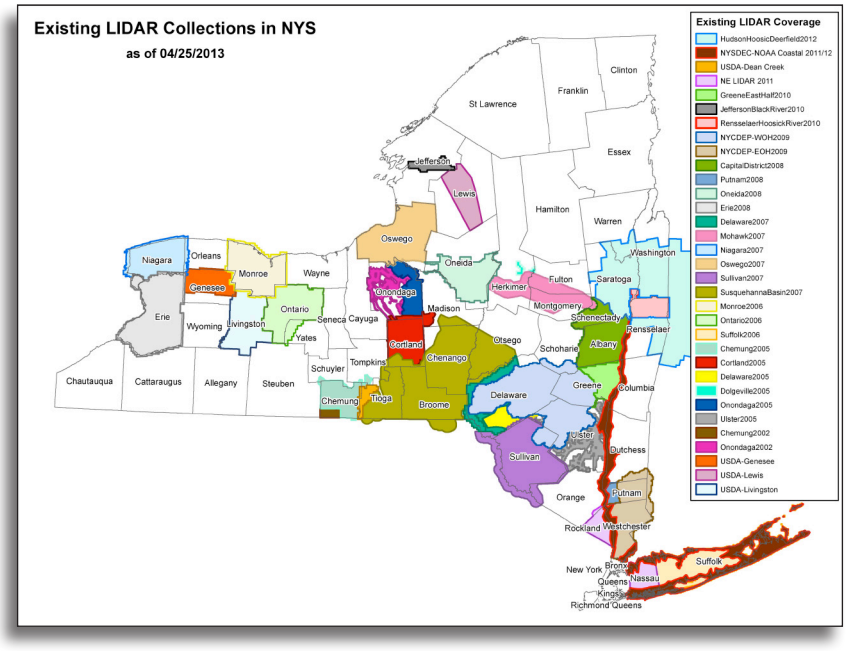


**Figure 3. Publicly Available LiDAR Data in New York**