# Surveying to NEW HEIGHTS

BY ELISE LATHAM

## LiDAR technology expands opportunities for a Montana-based surveying firm.

Land surveyors, not surprisingly, have a particular affinity for the land. They like to walk it, touch it, see it and physically control the survey instruments used to measure it. That's why the trusted survey tools for many are hands-on instruments like total stations and GPS receivers. Indeed, these tools have long been the core hardware for Sands Surveying Inc. (SSI), a 25-year-veteran of land surveying services. In fact, for many years, surveyors at the Kalispell, Mont.-based company felt they "had it made" with their "dream team" of total stations, GPS units, laser plotter, fast PCs and supporting software that enabled them to efficiently serve clients with high-end map and elevation products.

That is, until four years ago. That's when a traditional client required a data set that challenged the confines of traditional land survey techniques. Rather than the average 15-acre topographic survey, this client needed a topographic survey for 2,500 acres of mountainous terrain at 1-foot contours–a project scope that rendered ground surveys and standard aerial photography nearly impossible.

"Aerial photography–provided you have good weather–is a great mapping tool, but it is plagued by shadows and does not capture steep terrain very well," says Tom Sands, PLS, SSI's president. "And tasking a ground crew to survey 2,500 acres of rough terrain with total stations and real-time GPS would take months–it's just not economically or technically feasible."

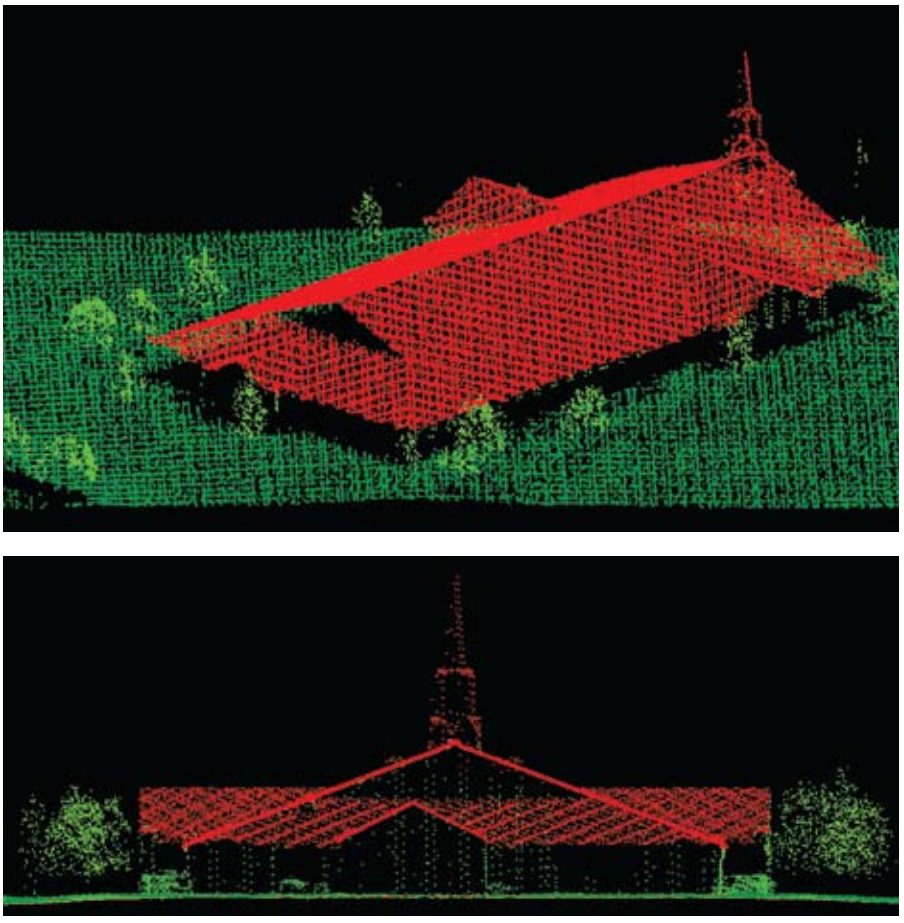
The client also recognized that traditional survey methods would not be possible for this project, so the company specifically asked Sands Surveying to acquire the survey with LiDAR technology. Pooling other customers' large-project needs together, SSI contracted a LiDAR vendor to fly 14,000 acres in northwest Montana. The entire survey was flown in a day and a half, and the 1-foot contour map was delivered to SSI 30 days later–all at a cost comparable to aerial photography. Field crews who were dispatched to conduct quality control tests with GPS and total stations reported that the LiDAR contours were within 0.3 to 0.9 foot vertically.

"That absolutely amazed me," Sands recalls. "To collect millions of data points from the air in a little more than a day and be that accurate on the ground completely defies belief. And it really heightened–literally–the limitations of conventional techniques. With air photography's shadow and exposure challenges, we've found that at times our vertical accuracy was off by 30 feet. So at a cost value, dollar for dollar, the LiDAR provided a far superior product in far less time."

### The LiDAR Leap

That experience not only pushed Sands to see land surveying from a new perspective–it left him with the LiDAR bug. However, although he was sold on the capabilities of the technology, he, like many other land surveyors, was not sure his small company could afford the capital investment. "Initially, I viewed LiDAR as a risky return on investment," Sands says.

**Above: Viewing the LiDAR data points by their reflectivity and using that information to create an image that is in the same coordinate system as the source data makes viewing planimetric features simple.**



**These images demonstrate the true 3D nature of LiDAR data. No ground scanning was performed to create these graphics—only aerial LiDAR data.**

"But then I really looked at the business and noted that we were not only experiencing a strong trend in large topographic mapping, I recognized that the technology could be a great business development tool and bring us new revenue–all of which would pay for the system."

In addition, SSI has four registered land surveyors who are both professional surveyors and geomatics specialists. That means they can readily understand clients' survey and end-product needs and explain how LiDAR will help them achieve their goals.

In late 2007, SSI purchased the Leica Geosystems ALS Corridor Mapper (CM), a LiDAR system that allows users to capture ground point densities of about eight points per square meter at pulse rates up to 150 kHz at an accuracy range of 3 to 6 centimeters. By the spring of 2008, SSI had the Leica ALS-CM in the air capturing topographic surveys for a number of clients with varying coverage needs.

Before each flight, SSI personnel use Leica Flight Planning and Evaluation Software to create the most efficient flight plan and then upload the plan directly into their Leica ALS sensor. During flights, two Leica GPS units are set up on site to collect location data for post processing. Usually during that time, the crew will take a shot about every 40 acres using RTK GPS to "ground truth" the project and ensure the accuracy of the end product. Staff then transform the multimillion points of data into customized topographic maps, CAD drawings or land use classifications–deliverables that typically can be provided within one week of the flight.

Although the company has regularly been using its LiDAR technology to collect raw data for topographic mapping, gravel pits and landfill measurements and quantities, base maps for 3D models, and flood plain studies, Sands says the system has been particularly beneficial for projects that are thick with diverse features such as railroad tracks, buildings, power lines, rivers and mountainsides. "Acquiring large swaths of varied topographic elements with traditional surveying can be very time consuming and challenging," Sands says. "For railroads, you have to maintain a certain distance from the tracks and acquire special clearances. With power lines, it's difficult to obtain accurate height measurements. And mountainsides pose significant safety risks. It can be months of dedicated work. With LiDAR, those features are captured to within 6 centimeters in one hour."

## "Magical" Capabilities

Though the technology was initially targeted for surveys of more than 40 acres, Sands says LiDAR also offers a competitive alternative on smaller-acreage projects. "One of the biggest misconceptions about LiDAR is that it is too expensive," Sands says. "We've shot acreage as small as 15 acres more cheaply with LiDAR than [we could have] conventionally because of the rolling terrain and tree cover. What one crew can do in a week, we can achieve in a few hours with an airplane. That is all savings for the client. And it frees us up to take on more work." Enough work, in fact, that the firm anticipates meeting its targeted five-year payoff on the equipment despite the economic recession.

Although SSI has already completed a multitude of LiDAR surveys, Sands still finds himself impressed with LiDAR's capabilities.

"With the ALS, we collect eight points per square meter," he says. "Depending on the project, that can be more than 100 million data points. You could never achieve that with a total station. If you take a topographic survey with traditional RTK GPS, you'll take a shot every 50 meters. So the data density and detail (the point cloud looks like a photograph) with LiDAR is absolutely phenomenal. Combine that with its data collection speed and it's magic."

*Elise Latham is a freelance writer specializing in geospatial technology. For more information about Sands Surveying, e-mail tom@sandssurveying.com or visit www.mtlidar.com. More information about Leica's ALS technology can be found at www.leica-geosystems.us.*