ROLE OF CONSULTANT
Merrick & Company’s (Merrick) role was to plan, manage and perform the airborne acquisition of LiDAR to support the remote sensing objectives of the Southern Nevada Water Authority (SNWA), and its funding partners. Merrick used its Optech Galaxy LiDAR sensor to collect high-resolution elevations (point cloud) that met United States Geological Survey (USGS) Quality Level 1 and 2 (QL1 and QL2) specifications. Merrick processed the LiDAR point cloud to facilitate SNWA’s remote sensing vegetation analysis.

ROLE OF OTHER CONSULTANTS IN THE PROJECT
Merrick completed the project using its LiDAR sensor and production capacity from the corporate headquarters in Greenwood Village, Colorado. Merrick holds a long-term aircraft operating lease with a Woman Business Enterprise (WBE) firm named Aero Systems, Inc. of Erie, Colorado. Aero Systems provides Merrick aviation logistics, dedicated Cessna 402C aircraft, and certified pilots. Because some of the funding came from a USGS 3-Dimensional Elevation Program (3DEP) grant, the USGS also provided administrative and quality acceptance support.

ROLE OF THE CLIENT
In addition to administering Merrick’s contract, the SNWA performed the task of surveying LiDAR checkpoints and remote sensing analysis. The checkpoints were spatially distributed across the project areas. Standards outlined in USGS National Geospatial Program LiDAR Base Specification, Techniques and Methods, and ASPRS Positional Accuracy Standards for Digital Geospatial data were required for the project. SNWA surveyed a total of 265 checkpoints consisting of 61 Non-vegetated Vertical Accuracy (NVA) checkpoints, and 204 Vegetated Vertical Accuracy (VVA) checkpoints. In addition to surveying the LiDAR checkpoints, the SNWA performed a rigid quality assessment of all Merrick’s deliverables. Merrick and SNWA worked very well together to coordinate the surveying and data validation tasks.

PROJECT INTRODUCTION
The SNWA was formed in 1991 by a cooperative agreement among seven local water and wastewater agencies. Collectively, the SNWA member agencies serve more than 2.1 million residents in the cities of Boulder City, Henderson, Las Vegas, North Las Vegas, Laughlin and areas of unincorporated Clark County. As the wholesale water provider, the SNWA is responsible for water treatment and delivery, as well as acquiring and managing long-term water resources for Southern Nevada in a region that averages less than 4
inches of rain per year. The adjacent map illustrates the geographic extent of the SNWA purveyor service area.

Today, the SNWA provides world-class water service in a sustainable, adaptive and responsible manner to its customers through reliable, cost effective systems in the driest region of the United States. As drought conditions in Colorado River Basin persist, the SNWA manages a robust Water Resource Plan and comprehensive water conservation program, which includes the SNWA’s Water Smart Landscapes Rebate Program (WSL) that pays property owners to replace water-thirsty grass landscaping with drought-tolerant landscaping. Managing existing and future water supplies, constructing and operating regional water facilities, and promoting conservation are part of the complex solutions in a region that is known for its beautiful desert landscape, growing residential communities, government and military facilities, and of course, the Entertainment Capital of the World’s famed Las Vegas Strip.

Southern Nevada residents account for 60 percent of the region’s overall water use, making it the largest water-use sector in the desert community. By comparison, hotels and casinos account for about 7 percent. Furthermore, Southern Nevada reclaims and recycles nearly all water used indoors. The high-quality effluent is returned to Lake Mead where it can be used again. Through this community-wide water reuse program, about 40 percent of Southern Nevada’s water supply is returned back to Lake Mead in a sustainable manner. The remaining 60 percent of Southern Nevada’s overall water use is consumed outdoors for landscape irrigation and evaporative cooling. Water use outdoors cannot be reclaimed or recycled; therefore, the community’s water conservation efforts have focused on reducing consumptive, outdoor water use. To support the region’s conservation initiatives, the SNWA developed geospatial solutions. With the effective use of a variety of mapping and remote sensing technologies, the SNWA regularly invests in spatial technologies to support scientific initiatives, advocacy and public education efforts to promote a wide-array of conservation approaches.

The SNWA is well known for its innovative use of satellite imagery, aerial photography and remote sensing to identify large grass and vegetation areas that may qualify for its Water Smart Landscape (WSL) program. Since being initiated in 1999, more than 185 million square feet of grass have been converted to water smart landscaping under the WSL program, reducing outdoor water use and saving more than 119 billion gallons of water. Wanting to improve its ability to identify the large consumers of water such as residential turf and vegetation, LiDAR was integrated into the SNWA’s remote sensing analysis.

In 2016, the SNWA retained Merrick to collect LiDAR (elevation point clouds) over an approximate 1,162 square mile area of the Las Vegas Valley. The SNWA Project Map illustrates the LiDAR project area. LiDAR uses a beam of light rapidly projected from a sensor in an aircraft to the surface of the earth to create highly accurate elevation information of natural landforms and man-made objects. After a rigid and unique post-process, the LiDAR derived digital elevation models and hydro-enforced breaklines were integrated by the SNWA into its analysis to identify the mass/volume of various types of vegetation. SNWA refined the LiDAR model to further classify vegetation and trees by height categories including: Class 5: High – 7+ feet, Class 4: Medium – 2 ft – 7ft, and Class 3: Low – 0.3 - 2 ft.
COMPLEXITY

Due to the wide variations in natural and urban characteristics, Merrick needed to be careful post-processing the point cloud elevation data. Because Las Vegas has very unique man-made features within its many themed hotels and resorts (Sphynx, roller-coasters, Eiffel Tower, pyramid, etc.), special attention was needed during the filtering process that classifies elevation points into the USGS LAS attribute levels.

Merrick’s MARS® software was used following the classification process to create breaklines which helped identify discrete geometric characteristics of man-made objects like the Sphynx, and important hydraulic drainage features found in a wash or arroyos that influence storm water runoff. Accurately mapping both types of features were important to correctly represent hydraulic drainage patterns. Moreover, correctly-drawn and hydro-enforced breaklines of these features enable engineers and planners to more accurately model water flow and volume computations, as well as plan water-related infrastructure improvements. The example to the left illustrates a colorized point cloud in the USGS QL1 area where each color represents specific changes in pre-defined elevation ranges.

ORIGINAL AND INNOVATIVE TECHNIQUES

Due to the drought conditions in the western United States, Lake Mead, the area’s primary water source has steadily diminished over the past 15 years. The adjacent picture illustrates the dramatic change in the water level of Lake Mead due to drought conditions. Through its proactive conservation measures, the SNWA utilizes innovative geospatial solutions to help manage the water resources. Integrating LiDAR into the process to identify and quantify residential irrigation consumers allows the SNWA to detect large turf-grass areas for targeting conservation outreach efforts.

The Optech Galaxy LiDAR sensor used by Merrick was one of the first of its kind at the time the project was planned and flown. The Galaxy is a wide-area LiDAR sensor with best-of-class point density performance and collection efficiency. With a collection pulse rate capable of 550kHz (550,000 pulses per second), the Galaxy is the highest-performance sensor on the market. Merrick worked very closely with Optech to assure this innovative technology performed to the intended SNWA and 3DEP specifications.

FUTURE VALUE TO THE GEOSPATIAL PROFESSION

The LiDAR data will enhance ongoing vegetation analysis over 1,100 square miles by classifying and identifying various trees and plants by height, which can’t be done with aerial imagery alone, stated Craig Hale, SNWA Spatial Technologies Project Manager. Specifically, adding LiDAR to the SNWA remote sensing analysis will increase the accuracy of identifying vegetation from approximately 89% to 96%. These improved results will help identify areas where outdoor water use efficiencies can be improved, so that precious water can be saved then used for more critical purposes.

Combining the many benefits of LiDAR data with the advantage of multiple agencies sharing costs and using the USGS 3DEP LiDAR specifications, project stakeholders will see many improvements with the new point cloud data. Moreover, many local and federal users will be analyzing exactly the same data, which could increase collaborative decision making, reduce duplication and provide higher value to citizens in southern Nevada. Also, the Return on Investment (ROI) of this project dramatically increases because the point cloud has multiple uses.

Examples of this “map it once, use it many times” strategy include: 1) new LiDAR data greatly improving existing/outdated digital elevation models; 2) providing a framework for infrastructure engineering/planning of flood control channels and hydraulic modeling; and, 3) enhancing geologic mapping by partnering agencies of known hazards that exist throughout the Las Vegas Metro area.

CLIENT SATISFACTION

A clear indication that Merrick’s LiDAR acquisition and production processes met the USGS 3DEP specifications came after the USGS National Geospatial Technical Operations Center (NGTOC), completed their Quality Acceptance Testing. Following this rigorous testing the USGS approved the SNWA LiDAR products for inclusion in the National Elevation Dataset.

Moreover, following the successful completion of the 2016 LiDAR project, the SNWA once again contracted with Merrick to expand its use of LiDAR data for other water-related applications.