



LASER SCANNING AMERICA'S CULTURAL LANDSCAPES

The Historic American Landscapes Survey (HALS)

The Historic American Landscapes Survey (HALS) mission is to record historic landscapes in the United States and its territories through measured and interpretive drawings, written histories, and large-format black and white and color photographs. The National Park Service oversees the daily operation of HALS and formulates policies, sets standards, and drafts procedural guidelines in consultation with the American Society of Landscape Architects (ASLA). The Prints & Photographs Division of the Library of Congress preserves the documentation for posterity and makes it available to the general public [www.loc.gov/pictures/collection/hh/].

THE FIELD SURVEY

Laser scanning has proven to be a useful tool in documenting cultural landscapes for HALS, along with supplemental GPS data, LIDAR data if available, traditional civil surveying and hand measuring, large format photography, aerial/orthophotography, USGS maps, and historic research. For remote, difficult to reach landscapes, laser scanning can be the most efficient way to capture field measurements in great detail in terms of time and cost. Documenting landscapes comes with many challenges, and with each project and site visit, we must assess whether laser scanning will be possible and time effective. Full HALS documentation includes topography, vegetation, water, land patterns, circulation, views and vistas, buildings and structures, small scale elements, and archaeological sites. Many sites include dense vegetation that block the laser from reaching the terrain and other landscape characteristics and features. In addition, landscapes are typically measured in miles and acres rather than feet and inches, and thus would require numerous scan stations. LIDAR and GPS are more appropriate digital techniques for documenting at this large scale.

HALS landscape architects typically set up closed or open traverse surveys around and through a site using foresights and backsights. Selecting the location and number scanning stations is critical as laser scanners cannot scan what they do not "see." Our program owns a Leica Scan Station 2, a unit that is accurate over long distances, but slower than some short range models. The capabilities of the laser scanner as well as weather conditions used also influence the selection of scan stations. The HALS field team also records the geospatial coordinates for each scan station using a handheld GPS unit.

PROCESSING THE POINT CLOUD

Back in the office, the scan data is processed to produce archival plan, section, elevation, and isometric drawings for the Prints & Photographs Division of the Library of Congress. The Library preserves the documentation for posterity and makes it available to the general public. For our drawings to best interpret cultural landscapes for the public, our team has to first interpret our laser scans collected in the field. Human skill is required to accurately delineate the lines and edges in the point cloud and to decide how best to rotate, slice, and draw over the point cloud to clearly present the landscape characteristics and features in the most educational way. Our team uses much supplemental gathered measurements and data as described above to fill in the gaps that the laser scanner could not capture and flesh out the final drawings.

TASSI RANCH, GRAND CANYON-PARASHANT NATIONAL MONUMENT, ARIZONA

For many landscapes, the ideal documentation strategy is a combination of laser scanning for detail rich areas such as the cores of remote historic western cattle ranches in Grand Canyon-Parashant National Monument, Arizona and GPS for outlying landscape features such as miles of barbed wire fence lines and ranch roads. HALS documented Tassi Ranch in 2009-2010. This Mojave Desert ranch tapped uphill springs with holding ponds and a series of gravity fed irrigation ditches. Dense vegetation near the springs complicated the laser scanning, but the scanner recorded subtle, disappearing irrigation ditches in the outlying fields.

MOUNT CALVARY CEMETERY, HARRISBURG, PENNSYLVANIA

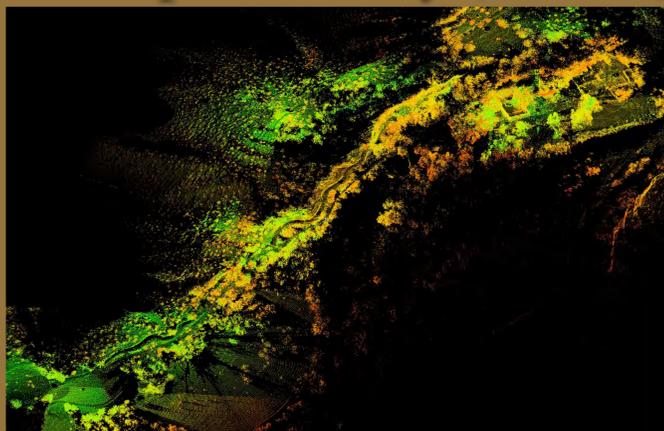
In 2011, HALS has also used the laser scanner to scan Mount Calvary Cemetery in Harrisburg, Pennsylvania working with our companion program, Cultural Resources Geographic Information Systems Facility (CRGIS), who conducted a GPS survey of the cemetery. Staff of both programs are now working together to combine the data in the office to explore the potential of assigning coordinates to all the points of the point cloud in AutoCAD Civil 3D. This technique should be beneficial to drawing, interpreting, and managing historic cemeteries.

PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE, HAWAII

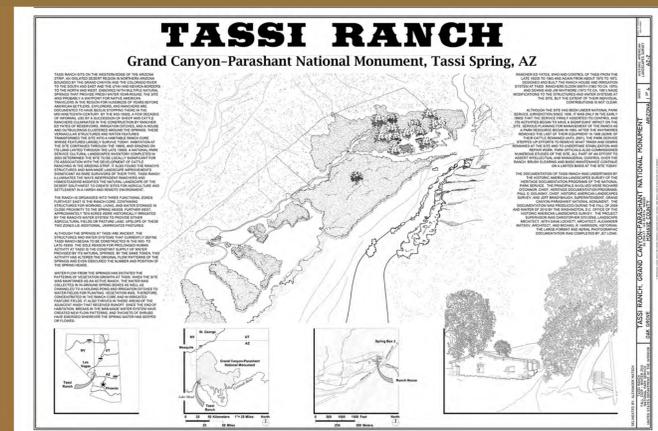
From 2009-2011, HALS documented two ceremonial platforms called heiaus in Pu'ukohola Heiau National Historic Site on the Island of Hawaii. The structures, constructed of dry-laid lava rock, had partially collapsed due to a 2006 earthquake. Laser scanning allowed the HALS team to quickly measure a very large site with curvilinear elements that would normally be very difficult to measure by hand and capture minute detail of the thousands of rocks comprising the structures. 2D drawings were extracted from the point clouds using Leica CloudWorx to convey the shape and context of the heiaus in their landscape.

CAMP CURRY, YOSEMITE NATIONAL PARK, CALIFORNIA

HALS staff is currently working on documenting the portion of historic Camp Curry at Yosemite National Park, California that falls within a dangerous rock fall zone and will be removed in 2012. Many of the camp's buildings were laser scanned by a private contractor who in turn produced drawings for the park. The HALS field team discovered many mistakes and omissions with these drawings using traditional hand measuring techniques and are now correcting them. The team is also using a current civil survey and aerial LIDAR data to generate 3D topographic drawings in AutoCAD Civil 3D to depict the scale, majestic beauty, and threat posed to the village by rock fall from Glacier Point. The data collected from these modern technologies and traditional techniques is enabling HALS to produce a rich set of mitigation drawings that document this threatened resource and will be publicly available forever through the Library of Congress.



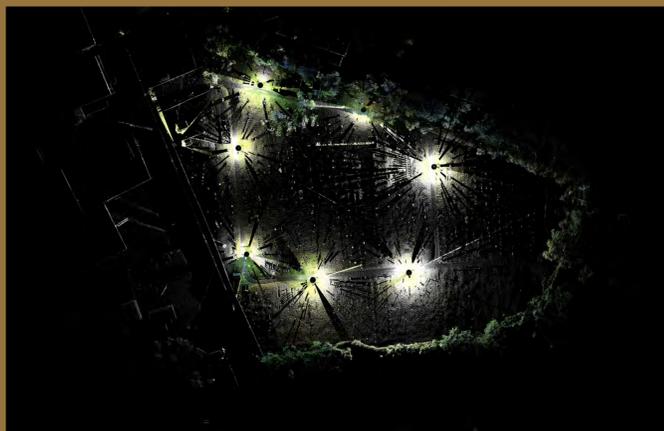
TASSI RANCH, GRAND CANYON-PARASHANT N.M., ARIZONA - TRAVERSE SURVEY



BIRDSEYE DRAWING GENERATED FROM POINT CLOUD AND GPS DATA



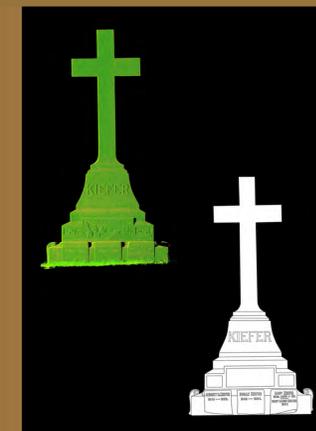
REMOTE VERNACULAR RANCH



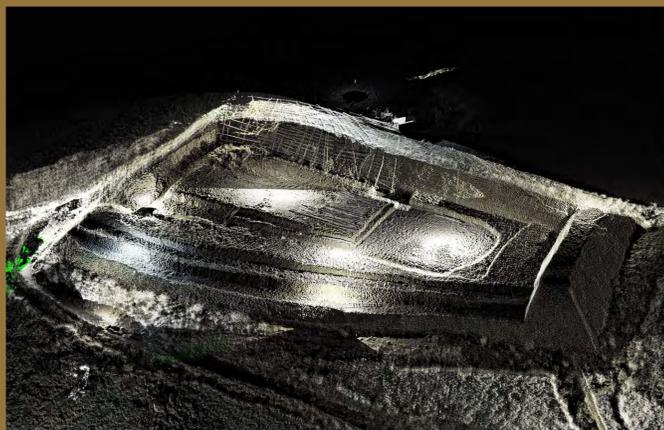
MOUNT CALVARY CEMETERY, HARRISBURG, PENNSYLVANIA - TRAVERSE SURVEY



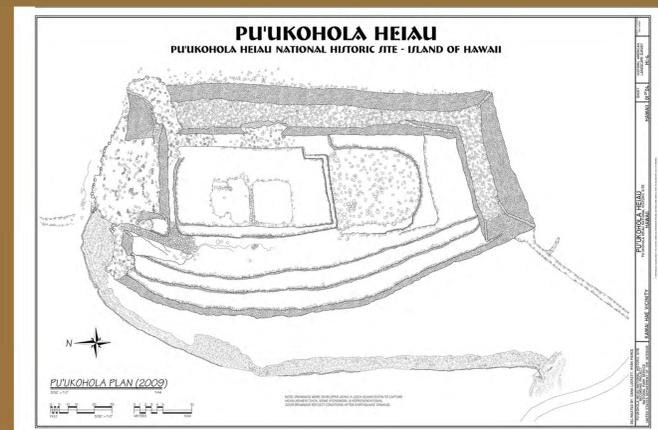
SECTION DRAWING GENERATED FROM POINT CLOUD



RURAL CEMETERY



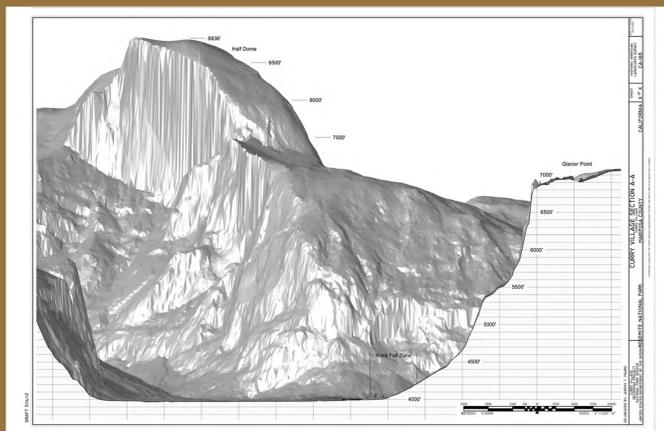
PU'UKOHOLA HEIAU NATIONAL HISTORIC SITE, HAWAII - TRAVERSE SURVEY



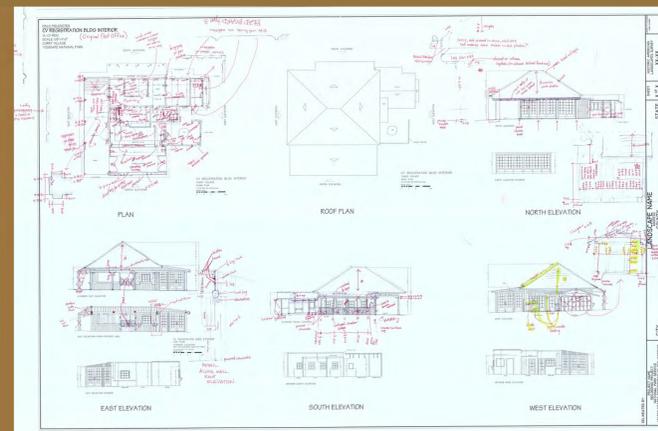
PLAN DRAWING GENERATED FROM POINT CLOUD



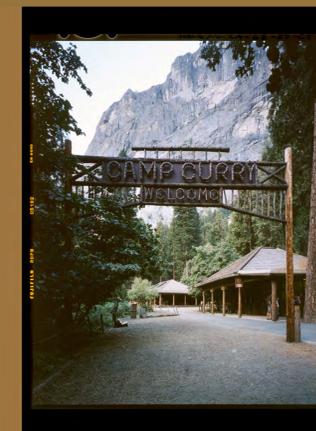
CEREMONIAL LANDFORM



CAMP CURRY, YOSEMITE NATIONAL PARK, CALIFORNIA - AERIAL LIDAR



PLAN & ELEVATION DRAWINGS GENERATED FROM POINT CLOUD & CORRECTED WITH HAND MEASUREMENTS (REDLINES)



CABIN CAMP