Poster Proposal for 2012 3D Digital Documentation Summit, Presidio, San Francisco, California

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Laser Scanning America's Cultural Landscapes
The Historic American Landscapes Survey (HALS)
Documentation to the Secretary of the Interior Standards,
Assessing the Value of Laser Scan Data

The Heritage Documentation Programs proposes to present five posters that speak to our proposed oral presentation. The posters will describe the steps from data acquisition at the site to the various post-processing methods employed to generate models in CAD. Our data collection efforts are guided by our need to unearth not only dimensional data, but also interpretive data that reflect history, significance, and patterns of use and construction. In examining various projects from each of our three programs, (the Historic American Buildings Survey, the Historic American Engineering Record, and the Historic American Landscapes Survey), we intend to show several different approaches to incorporating laser scan data into the creation of an archival record that meets the Secretary of the Interior's Standards. These workflows vary based on the type and scale of historic resource being documented. In these processes it is often necessary to supplement point clouds with other data--some collected by hand and some derived from other resources and independent research. The post-processing of point clouds presents its own challenges. Software used may excel at certain tasks, while falling short at others. Sometimes this can be remedied by hardware upgrades, but often times the sheer size of the datasets (point clouds) is just too burdensome for the software itself. Educated choices must be made in both the collection and processing of laser scan data when producing documentation to the Secretary's standards.

The Historic American Landscapes Survey (HALS) mission is to record historic landscapes in the United States and its territories through measured drawings and interpretive drawings, written histories, and large-format black and white photographs 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).

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 and 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.

Back in the office, skilled architects then process the scan data 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.

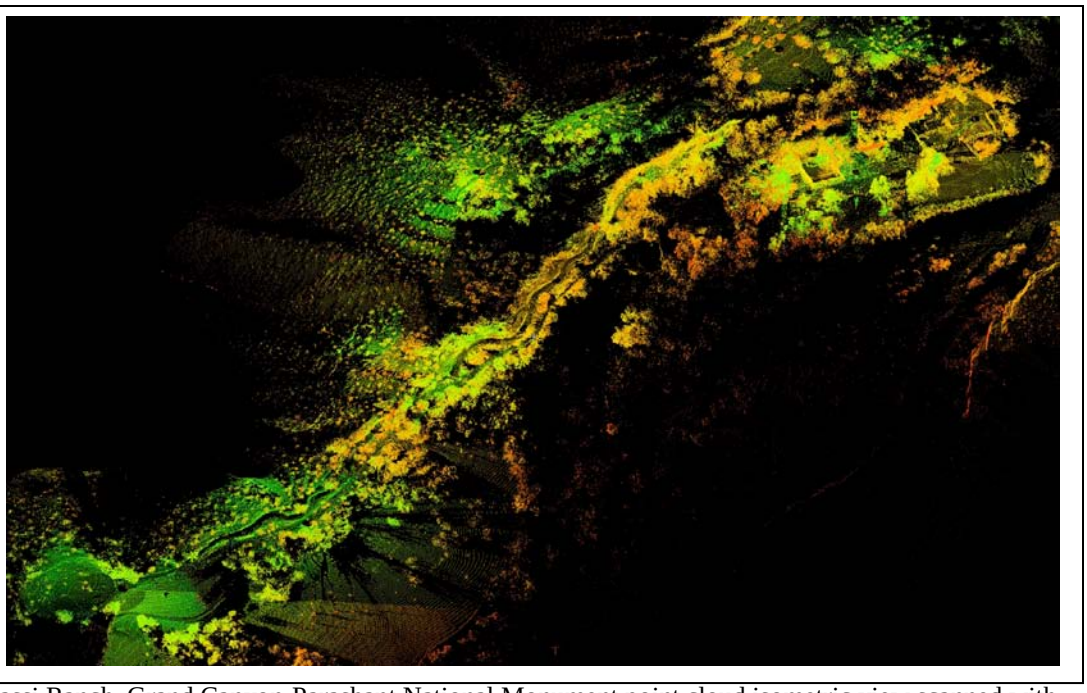
For many landscapes, the ideal documentation strategy is a combination of laser scanning for detail rich areas such as the cores of historic western cattle ranches in Grand Canyon-Parashant National Monument, Arizona and GPS for outlying landscape features such as miles of barbed wire fence lines and ranch roads. HALS documented Tassi Ranch, Waring Ranch, and Pine Ranch from 2009-2010. These desert ranches have subtle grade manipulations for either crop irrigation or for cattle watering "tanks." The only existing topographic source for the area is USGS maps, which typically only depicts one or two 25' contour lines for each ranch core. HALS teams were able to slice the point clouds to generate 1 foot contour lines to depict these vital cultural resources that allowed settlement in the arid Mojave Desert.

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.

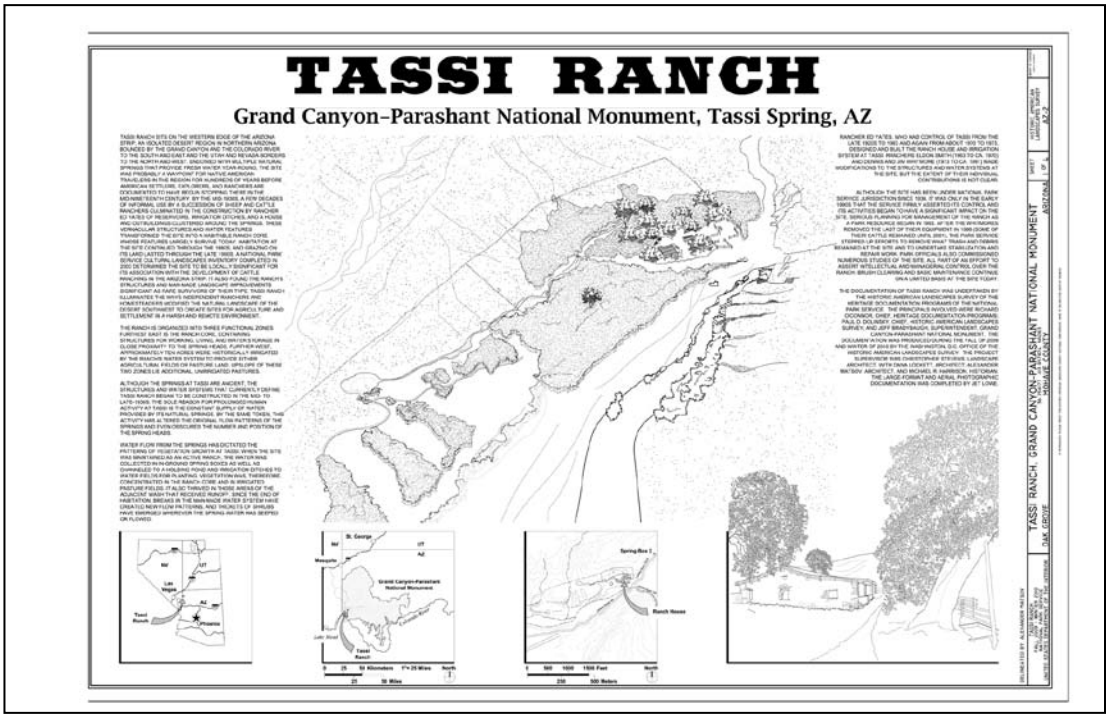
In 2009, HALS documented two ceremonial platforms called heiaus on the Island of Hawaii constructed of dry-laid lava rock. The structures had partially collapsed due to an earthquake during 2006. It was determined right away that laser scanning would be an ideal tool to use due to the organic nature of the site with curved and battered walls built of round and jagged rocks. After the initial visit and documentation, the park (PUHE) began reconstruction of the collapsed

heiaus to a state thought to be even closer to original design than in previous restoration efforts. In 2011 HALS returned to measure the site again with laser scanning allowing the park to compare two separate conditions of the site. 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.

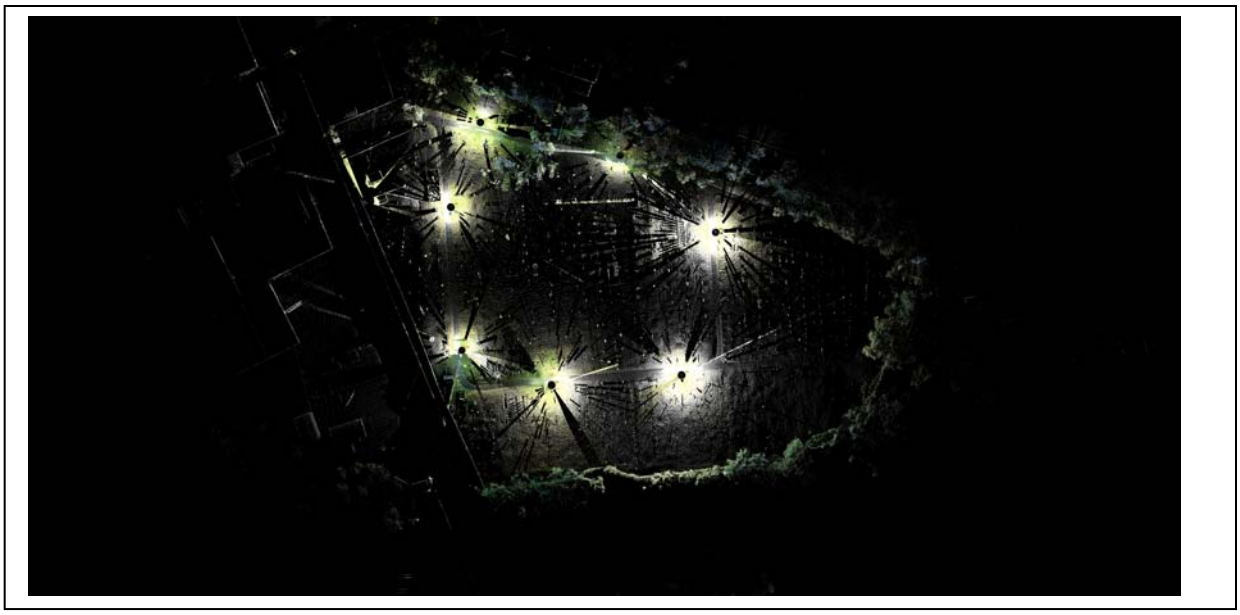
HALS staff is currently working on documenting the portion of historic Curry Village at Yosemite National Park, California that falls within a dangerous rock fall zone and will be removed in the spring of 2012. Many of the village's buildings were laser scanned by a private contractor who in turn produced 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 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.



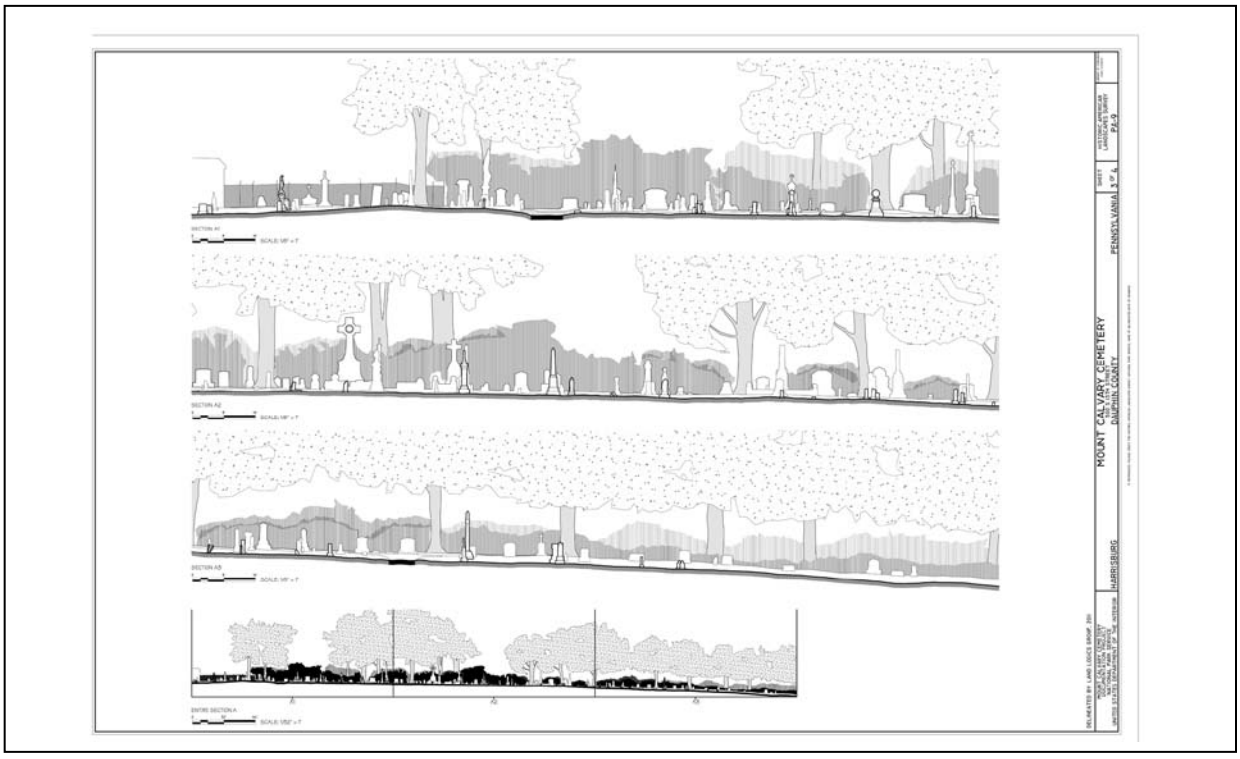
Tassi Ranch, Grand Canyon-Parashant National Monument point cloud isometric view scanned with a traverse survey using a Leica Scan Station 2.



Tassi Ranch, Grand Canyon-Parashant National Monument drawing HALS AZ-2, Sheet 1 of 4. www.loc.gov/pictures/item/az0599/

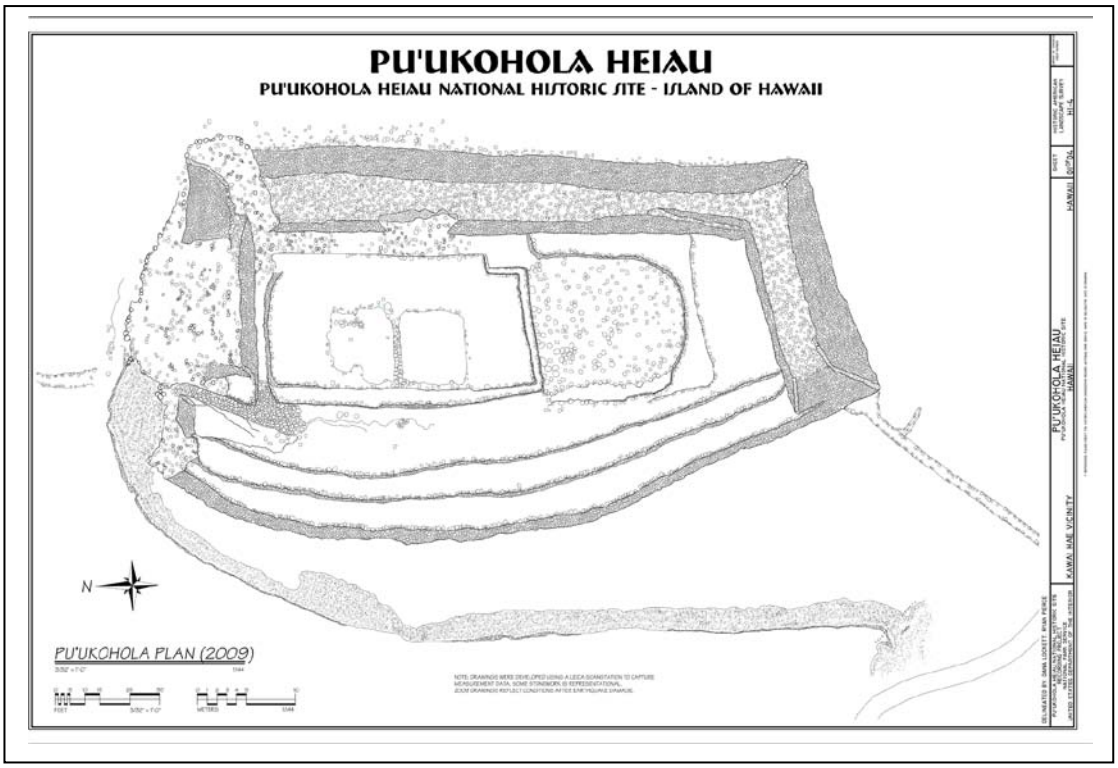


Mount Calvary Cemetery, Harrisburg, Pennsylvania point cloud plan view point cloud scanned with a traverse survey using a Leica Scan Station 2.

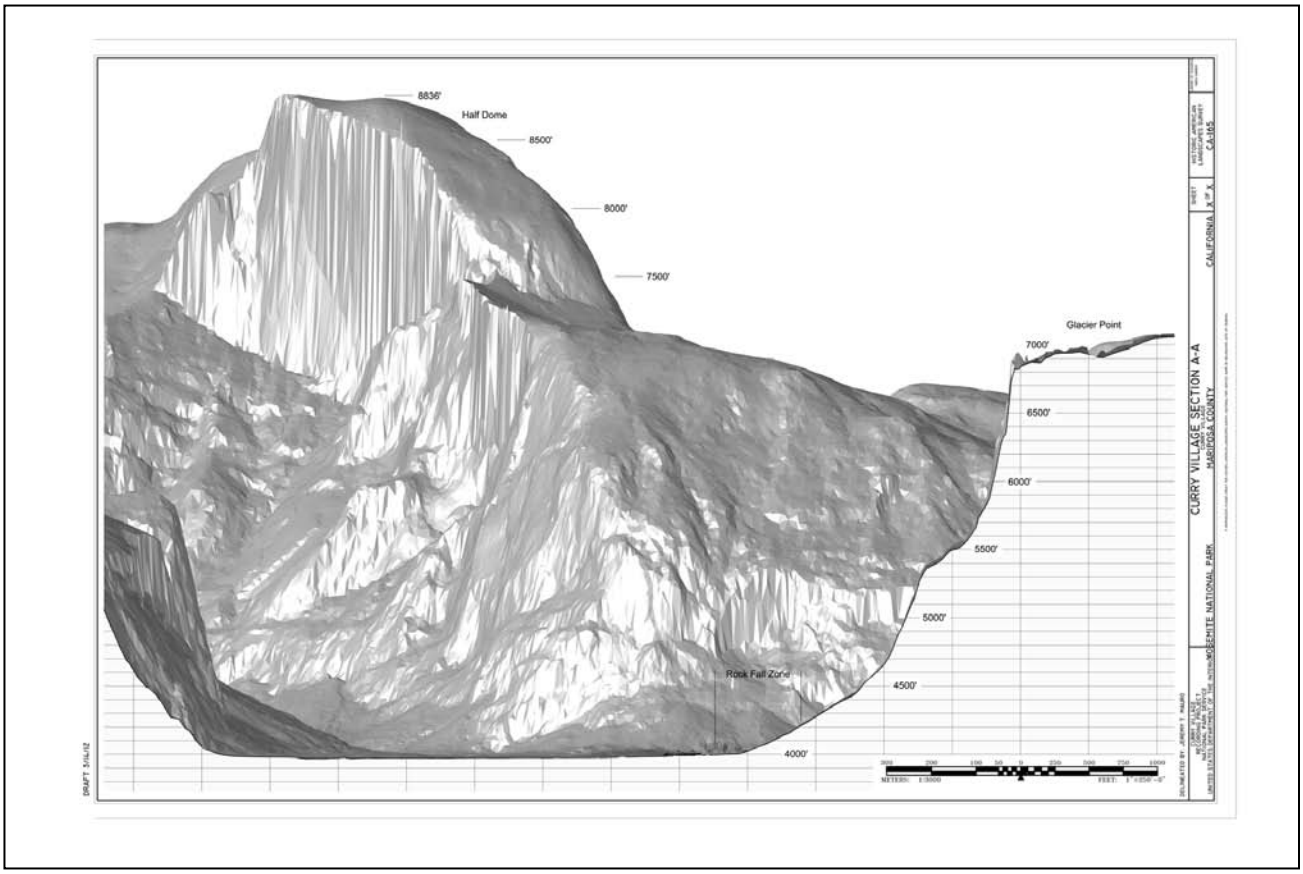


Mount Calvary Cemetery, Harrisburg, Pennsylvania east-west section drawing. HALS PA-9, Sheet 3 of 4.

Pu'Ukohola Heiau point cloud isometric view scanned with a traverse survey using a Leica Scan Station 2.



Pu'Ukohola Heiau plan drawing, HALS HI-4.



Curry Village, Yosemite National Park section elevation drawing. HALS CA-65. LIDAR and laser scan data plus civil survey combined in AutoCAD Civil 3D to demonstrate the threat of rock fall from Glacier Point to the cultural resources of Curry Village, tiny in comparison.