

NEW VIEW OF AN ALASKAN ICON

VISUAL AND EMPIRICAL DATA PROVIDED COMPREHENSIVE DOCUMENTATION OF AN IMPORTANT HISTORIC SITE IN THE US. JOHN STENMARK REPORTS

When the last trainload of copper pulled out of Kennecott, Alaska, in the US in 1938, it left behind a community that had supported one of the most productive copper mines in the world. During its heyday in the early 20th century, the mine at Kennecott epitomised America's industrial boom and rapid growth. But when its rich ore deposits were depleted, Kennecott was no longer profitable. The once-bustling mill town was abandoned and left to decay.

Carved out of wilderness in the early 1900s, Kennecott operated for nearly 30 years before falling victim to the boom-and-bust cycle experienced by many other Alaskan communities. Over its lifecycle, the mine and supporting facilities employed thousands of workers and produced some 600,000 tons of copper from a difficult, remote location. The Kennecott site was declared a US National Historic Landmark in 1987.

In 1998, the US National Park Service (NPS) bought much of the site and its industrial buildings. The NPS is charged with preservation, stabilisation and restoration of the historic facilities, including the power plant and massive mill.

Located near the town of McCarthy in Wrangell-St Elias National Park and Preserve, Kennecott is a popular place. Due to its setting at the park gateway, Kennecott's spectacular landscape and buildings are seen and photographed by many of the park's roughly 75,000 annual visitors.

After NPS acquired Kennecott, it began the lengthy effort to preserve the site and determine which buildings should be stabilised or rehabilitated. Nearly 80 years of neglect and Alaska weather had taken its toll, and NPS historical architects and archaeologists needed accurate information on the structures that

remained. Shortly after the acquisition, NPS prepared Historic American Building Survey (HABS) and Historic American Engineering Record (HAER) drawings of the entire mill building and the equipment inside.

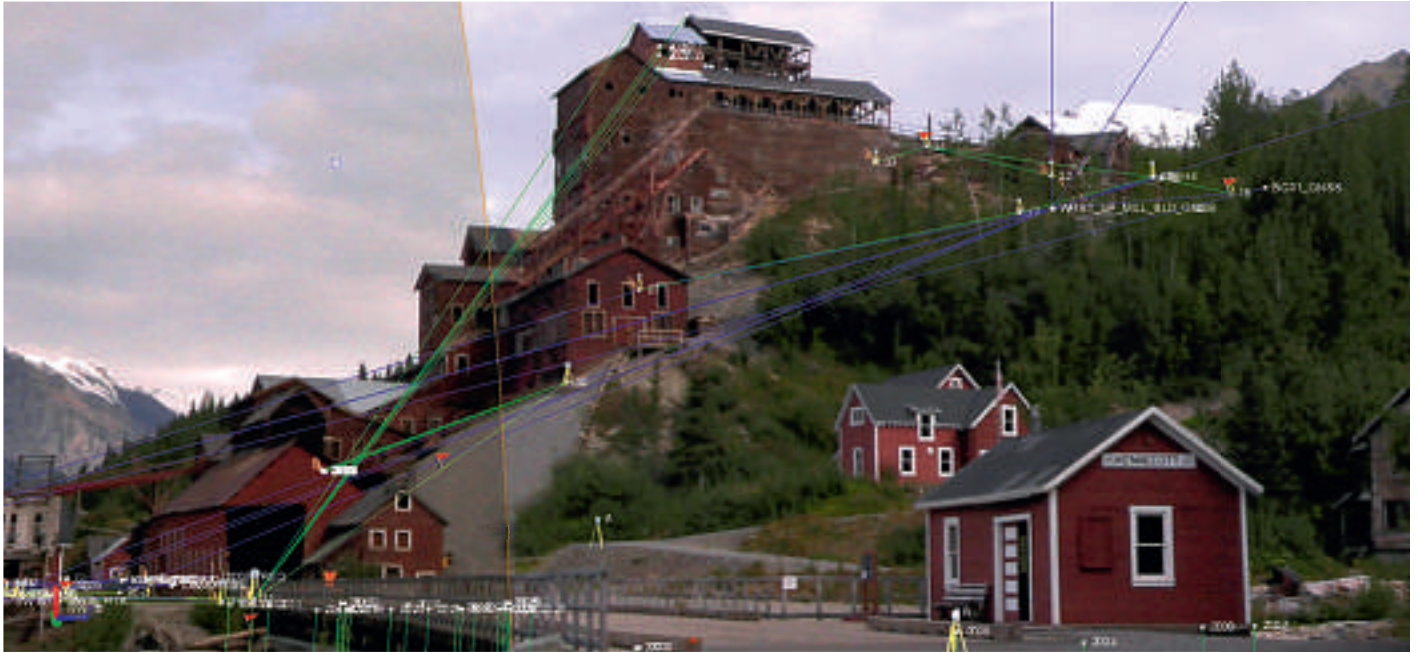
According to Greg Biddle, cultural resources management specialist for Wrangell-St Elias National Park and Preserve, NPS specialists worked to map the site in 1999 and 2000. The resulting sketches, CAD drawings and photographs with details on the structures have been instrumental in supporting NPS efforts to date.

Dangerous work

But the effort to capture images and dimensions was difficult and sometimes dangerous. People often needed to climb ladders to reach features high above the ground or to enter areas and structures of questionable stability. Teams needed an entire summer just to document

View of Kennicott Glacier from the top of the mill. Long range scanning can help monitor the shrinking glacier.





A georeferenced Trimble VISION photo mosaic of the Kennecott mill from the valley floor. Blue lines show GNSS measurements, green are from SX10 traverse and direct reflex data.

the site's iconic mill. The 14-storey structure received raw ore delivered by aerial trams from mine entrances in the mountainside above and delivered processed copper to railcars that passed through the mill's lowest level.

"The archaeologists mapped everything," Biddle says. "The mapping techniques they used worked, but they couldn't capture the important small details needed for engineering and planning."

He and his colleague, GIS specialist Joel Cusick, knew that 3D laser scanning combined with on-site imagery could provide the needed precision. But while NPS had previously used scanning, it had never tackled such a large site with dozens of complex, sometimes crumbling structures.



Capturing the Kennecott data

As part of ongoing work at Kennecott, NPS is planning to stabilise the upper seven storeys of the mill, which remains one of the largest wooden structures in North America. The effort will require replacing deteriorated structural beams and columns, many of which are out of plumb or lack structural integrity. Engineering and construction teams need accurate data on these and other components.

To gather additional information, NPS worked with Trimble and Anchorage-based Frontier Precision. Neil Robicheau, a surveyor and geospatial specialist with Frontier, explained that the team developed a plan to blend multiple geospatial solutions to produce comprehensive data and imagery of Kennecott's mill. The team allocated a full week for fieldwork and processing.

In addition to creating an accurate 3D dataset, Cusick needed to connect the data to existing survey control and property boundaries. Working directly on the existing survey grid would make it easy to bring the

scanning data and images into a GIS or other earth-based reference frame.

"There are a number of private inholdings remaining around the mine," he says. "We needed to be sure we weren't scanning someone else's property."

Upon arriving at Kennecott, the surveyors used GNSS to set control points tied to existing geodetic control markers on the site. They then used a Trimble SX10 scanning total station and Trimble TX8 scanner for the bulk of the work. In addition to handling the 3D scanning, the SX10 could tie to existing control points and use traverse or resection functions to establish georeferenced positions on each setup point.

The SX10 collected scanning measurements and images from more than 20 locations around the mill. From setup points on steep hillsides the SX10 could capture top-

down views and data on inaccessible features. Technicians used the instrument's panoramic and telephoto cameras to collect 'big picture' photos as well as high-resolution images of critical details.

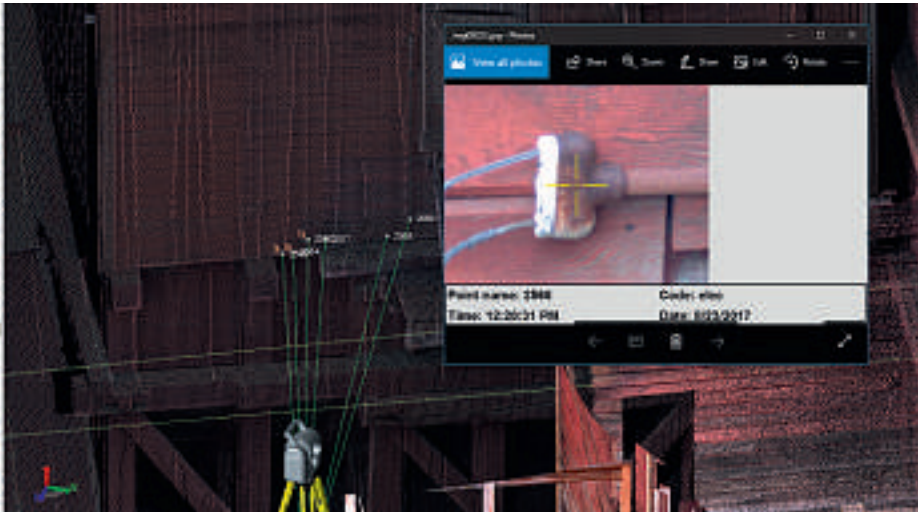
The instrument also captured 3D points and images of overhead tram cables running into the mill as well as complex, often inaccessible structural components.

Direct reflex

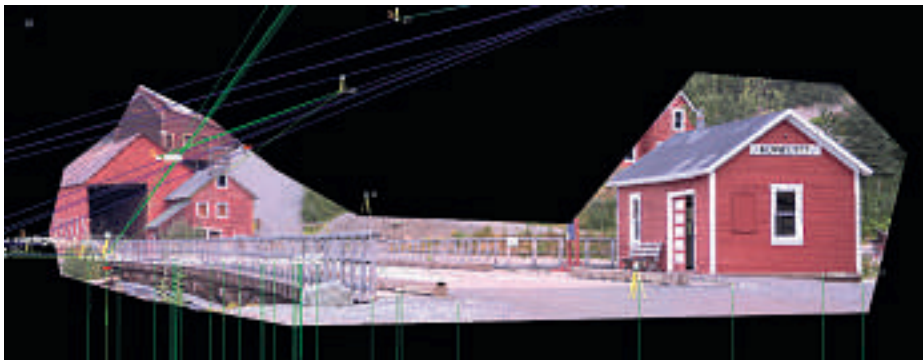
In addition to scanning and photography, the teams used direct reflex (DR) measurements to capture individual points on the building. These points could identify key features and then be compared to the point cloud and photos for quality assurance. In one instance, they used DR measurements to a window more than 100m above the instrument. In addition to saving time,

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3D VISUALISATION



View of scan data, survey points and detail photograph of an electrical connection in Trimble Business Center. The data enables inspection and measurement of inaccessible locations.



WE CAN USE 3D SCANNING TO PROVIDE VIRTUAL ACCESS AND WALKTHROUGHS FOR PEOPLE WITH VISUAL OR ACCESS LIMITATIONS

the DR and scanning provided an important margin of safety for working on the difficult site. "The ability to keep our feet on the ground and safely measure remote objects is an important by-product of the technology," Cusick says.

The team also collected long-range scanning data on the Kennecott Glacier, which lies adjacent to the mine site. They measured to points on the glacier and conducted additional scans from setups on the glacial surface. They hope to combine the 3D data and images with

historic photos to study the glacier's shrinkage over recent decades.

"In the 1930s you couldn't see across the valley because the glacier was so tall," Biddle says.

While the SX10 team focused on the mill, Robicheau used the Trimble TX8 scanner to collect high-resolution data on the power plant interior. The interior scans could be tied to control points outside the buildings, enabling the team to produce on-grid coordinates throughout the structures.



The technicians used Trimble Business Center software (TBC) to combine the traverse and GNSS results with scanning data and images from the SX10. They used Trimble RealWorks software to process the TX8 scan data onto the project coordinate system and transferred the finished point clouds to TBC.

As the scans were tightly georeferenced in the field, registration and processing moved rapidly. Multiple scans could be merged and the teams created colourised point clouds for visualisation and checking at the end of each workday.

High-value visuals

Data produced for the project will be used for more than stabilising and rehabilitating the buildings. For example, for safety reasons the NPS has plans to drop the sagging tram cables to the ground. The imaging data allows them to see the conditions directly beneath the cables, which are roughly 9m above the surface.

Georeferenced imaging will also help site managers assess deterioration of the buildings. By capturing detailed photos at various points in time, it's possible to produce empirical information on the scope and rate of change to a structure.

Cusick noted that geospatial technology improves the overall quality of the visual data. "It's not unusual for engineers or archaeologists to capture data using cloth tapes and cellphone cameras," he says. "The images from the SX10 match the quality of high-resolution, tripod mounted cameras and exceed the capabilities of most cameras and photographers."

The geospatial approach also solves a nagging issue in managing large quantities of photos. Rather than working with high volumes of files (often indexed with an arcane naming system), photos can be linked to a specific setup or location. A simple click on a map can retrieve the desired images.

The survey results can be shared with NPS cultural resources teams to improve visitor access to and understanding of Kennecott's important sites. Visualisation and 3D modelling can be used to increase public awareness and appreciation of historic sites while mitigating challenges associated with heavy visitation. To illustrate this, the technicians created a rough, street-level flythrough of the site immediately after the fieldwork. Cusick says the animation illustrates the capability to create a more refined virtual 'tour' of the site.

"The interpretive staff is very interested in this," Biddle says. "We can use 3D scanning to provide virtual access and walkthroughs for people with visual or access limitations. Scanning and the associated software is helping NPS preserve our national heritage in both the natural and cultural environments."

John Stenmark is a writer and consultant working in the geospatial, AEC and associated industries

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