Spar Best Practice Leadership Case™

Information current as of December 19, 2003

Open-pit mine survey:
Realignment of Alberta Highway 627

Key participants

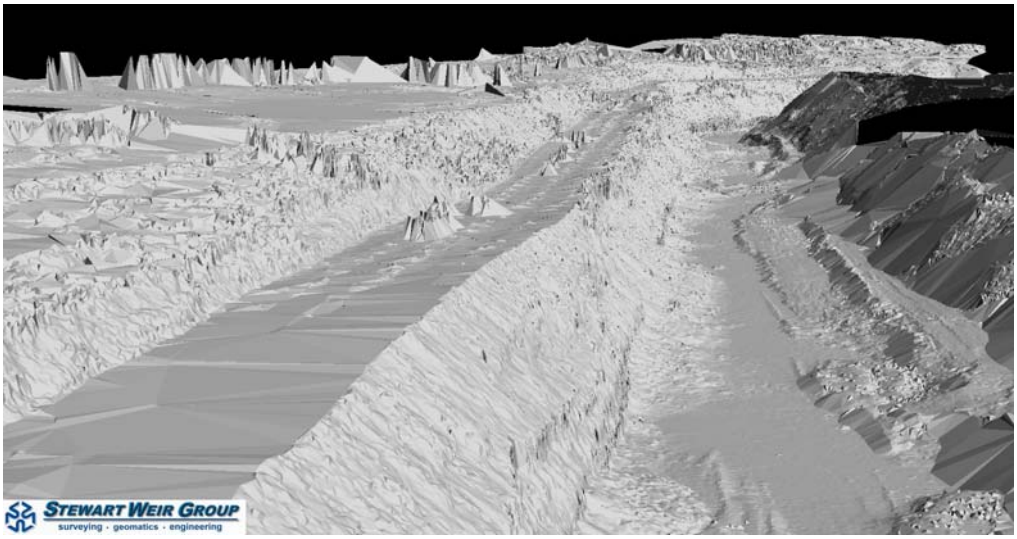
Owner Alberta Transportation

Contractor Stewart, Weir & Co. Ltd.

Scanning service provider Stewart, Weir & Co. Ltd.

Scanning system ILRIS-3D from Optech Incorporated

Point-cloud management software PolyWorks from InnovMetric Software Inc.



Laser scan image of Highvale Coal Mine
Courtesy Stewart Weir & Co. Ltd.

Business need

In the summer of 2002, Stewart, Weir & Co. Ltd. (Edmonton, AB) was retained by Alberta Transportation to provide engineering and surveying services for the realignment of a portion

Spar Point Research LLC
Tel. 978.774.1102
Fax 978.336.4667
www.sparllc.com

Spar Best Practice
Leadership Case™

Information current as of December 19, 2003

Open-pit mine survey:
Realignment of Alberta Highway 627 cont.

of Highway 627. The highway runs through the site of the Highvale Coal Mine, an open-pit mine owned and operated by TransAlta Energy Corporation. The mine supplies coal to the Sundance and Keephills power generating stations located on Lake Wabamun about an hour's drive west of Edmonton.

According to Garry Bondarevich, manager of 3D laser scanning with Stewart, Weir, the need for his firm's services arose because the highway had been built over a rich bed of coal, and was hampering mining operations. To remedy this, the project was undertaken to realign the east-west highway to the north in an area that had been previously mined, in order to allow expansion of the mine to the south and to enable mining of the coal under the existing highway right-of-way.

Photograph of Highvale Coal Mine
Courtesy Stewart Weir & Co. Ltd.

In the area of the mine planned for the new highway alignment, the coal had been removed, and a large ditch had been left behind when mining operations were terminated. During mining operations, the overburden is removed to expose the coal seam which, depending on location, can be buried at a considerable depth. In this case, mining operations had created a

Open-pit mine survey:
Realignment of Alberta Highway 627 cont.

ditch that was more than 40 meters deep, and consisted of cliffs and steep slopes of loose native material.

To perform a detailed engineering design of the highway realignment and calculate earthwork quantities, a survey was required after loose material was removed from the site and prior to the start of construction.

"The problem that was facing our firm," Bondarevich reports, "was how to safely and accurately survey a large ditch that was over 1.3 kilometers in length, is close to 150 meters in width, and contains severe terrain restrictions." Both technical and safety considerations made traditional surveying methods unattractive. "To perform the survey manually would require personnel trained in the proper use of climbing equipment to rappel down the cliffs with ropes and perform the survey of the ditch," according to Bondarevich. "Reflectorless total stations were considered, but due to the available equipment setup locations, the large scale of the project, and construction activities, it was not considered safe or feasible."

Laser scan image of Highvale Coal Mine
Courtesy Stewart Weir & Co. Ltd.

How a solution was selected and implemented

The solution chosen by Stewart, Weir was to use the ILRIS-3D laser scanner from Optech Incorporated to collect point-cloud information on the entire survey area. Due to the logistics of the project, a two-man crew was used for targeting and operation of the laser scanner as it was positioned at prime locations along the ditch and overlapping scans were obtained.

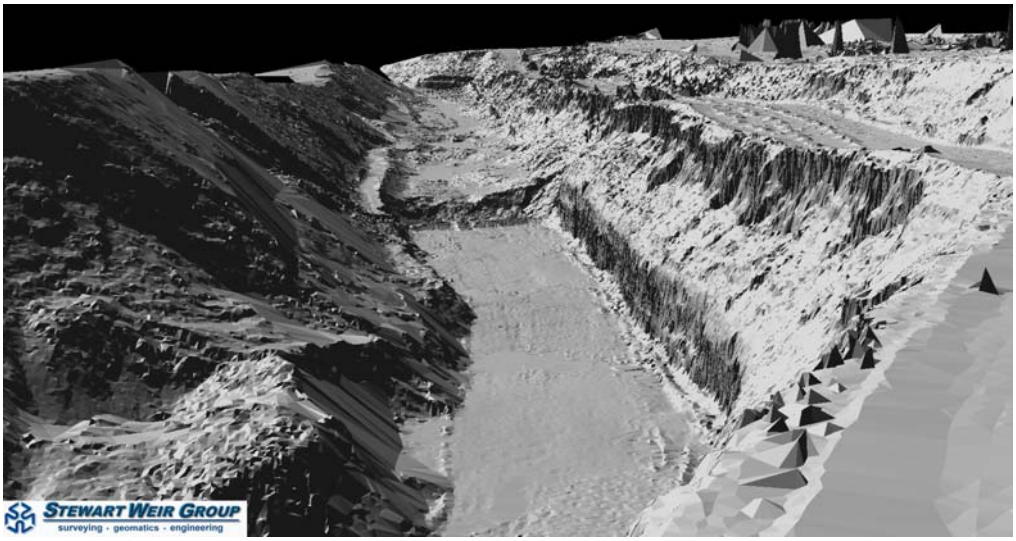
Spar Point Research LLC
Tel. 978.774.1102
Fax 978.336.4667
www.sparllc.com

Spar Best Practice
Leadership Case™
Information current as of December 19, 2003

Open-pit mine survey:
Realignment of Alberta Highway 627 cont.

Survey control coordinates were supplied by GPS and total station equipment, which was operated by a survey crew that was on site for the overall construction of the highway. In just one day, Stewart, Weir reports, the laser scanning survey crew was able to execute an accurate and complete topographic survey of the area without endangering personnel.

After the survey was complete, scan information was processed using the PolyWorks software from InnovMetric Software Inc. to align (register) multiple scans into one overall dataset, and to georeference the survey information to the project coordinate system. Once this was complete, a grid that accurately represented the surface of the ground was generated from the complete laser scan dataset.



Laser scan image of Highvale Coal Mine
Courtesy Stewart Weir & Co. Ltd.

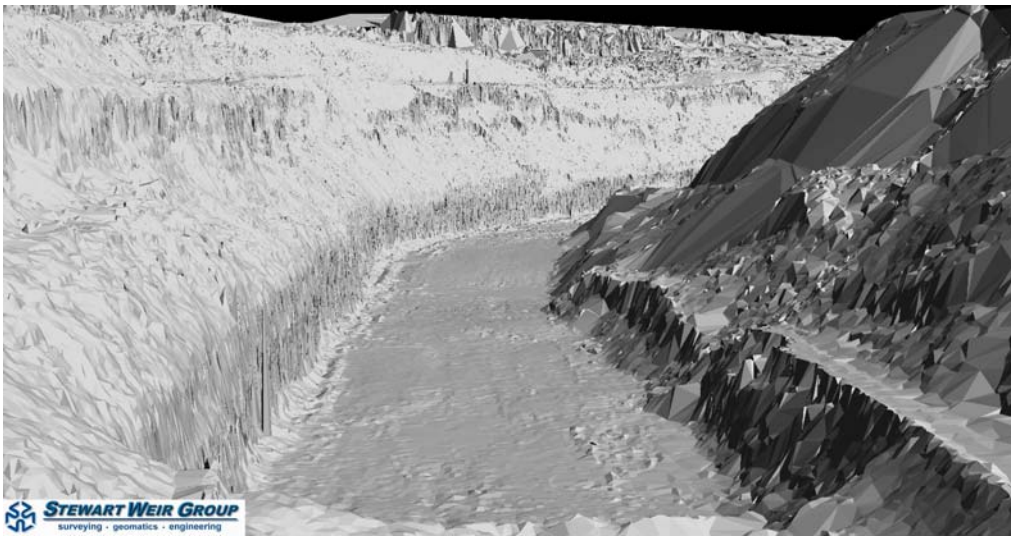
Work process issues

A critical issue in projects of this kind is survey control, according to Bondarevich. “You have to make sure you have good survey control, so the information you collect on the ground is accurate.” To ensure that all scan setups are correct, he reports, “Proper survey practices are crucial. Use of proper survey discipline in the field is important, even with laser scanning.”

Another work process issue is the need to consider the project’s requirements in advance of scanning, “and plan your survey accordingly.” In particular, Bondarevich advises, the data captured in scanning “has to be something that has the accuracy and level of detail you need.” How the data will be used has to be “thought out in advance. Proper planning of the survey is essential to getting the required results.”

Open-pit mine survey:
Realignment of Alberta Highway 627 cont.

After scanning is complete, processing the data can also pose some challenges. "If the scene includes bushes or other features that you don't want to capture, they have to be stripped out in the data processing phase," Bondarevich notes. "We were fortunate in this case not to have vegetation, but in some jobs we had to remove it." However, in this job, he notes, "there were vehicles in the way, which we removed during processing." This was done prior to the process of creating the digital terrain model of the site. "You can have the DTM application span across those open areas, by setting criteria in the DTM software appropriately," he explains. Alternately, "you can fill in the gaps using PolyWorks."



Laser scan image of Highvale Coal Mine
Courtesy Stewart Weir & Co. Ltd.

Integration with existing information technologies

Laser scan data was aligned (registered) and then georeferenced to the project coordinate system using the PolyWorks point-cloud processing software from InnovMetric Software Inc., which Optech offers with the ILRIS-3D scanner.

Next, PolyWorks was used to generate a grid representation of the ground surface from the scan data. Stewart, Weir explains that this is done to reduce the number of data points to a size acceptable and manageable by downstream engineering software, while maintaining the required level of detail in the ground surface data.

The grid representation was exported from PolyWorks to an ASCII file containing xyz coordinates. The resulting file was then imported into CAiCE, from the CAiCE Transportation Group of Autodesk, Inc., to do the earthworks calculations.

Spar Point Research LLC
Tel. 978.774.1102
Fax 978.336.4667
www.sparllc.com

Spar Best Practice Leadership Case™

Information current as of December 19, 2003

Open-pit mine survey:
Realignment of Alberta Highway 627 cont.

Contribution of solution providers

According to Bondarevich, "The ILRIS-3D laser scanner from Optech Incorporated has the range and accuracy required for large-scale engineering projects," and "has proven to be a rugged and reliable piece of equipment." As a company, Optech is "responsive to our requests," he reports. "They look out for our needs." Another plus for Stewart, Weir is that "they don't compete with us -- they don't provide scanning services."

Stewart, Weir also likes the partnership between Optech and InnovMetric, and InnovMetric's responsiveness. "We are submitting requests to Optech about what we want in PolyWorks, and those requests are getting through to InnovMetric," Bondarevich reports. "They listen to what you have to say. In new beta releases, we see things that we've asked for."

Business value created

Completeness and accuracy of the data generated in laser scanning were key business values for Stewart, Weir. "The results were outstanding," Bondarevich reports, "and provided our highway engineering department with complete and reliable survey data for their engineering computations."

An equally important benefit for the firm is safety. In Bondarevich's view, the project "has also shown others in the industry that the correct application of laser scanning technology on even the most difficult projects can obtain survey information quickly, accurately, and above all, safely."

Best-practice key learnings

One technique that Stewart, Weir has found to be important in projects of this kind addresses the challenge of maintaining accuracy when reducing the cliff-face scan data to a grid representation. In processing this area of the point cloud in PolyWorks, "you have to look at the data from various angles," Bondarevich reports. "If you look straight down the slope, you won't get an accurate grid of the cliff face."

Reprint courtesy
InnovMetric Software Inc.
2014 Jean-Talon Blvd. North
Suite 310
St. Foy, QC G1N 4N6
Canada
Tel. +1 (418) 688-2061
www.innovmetric.com