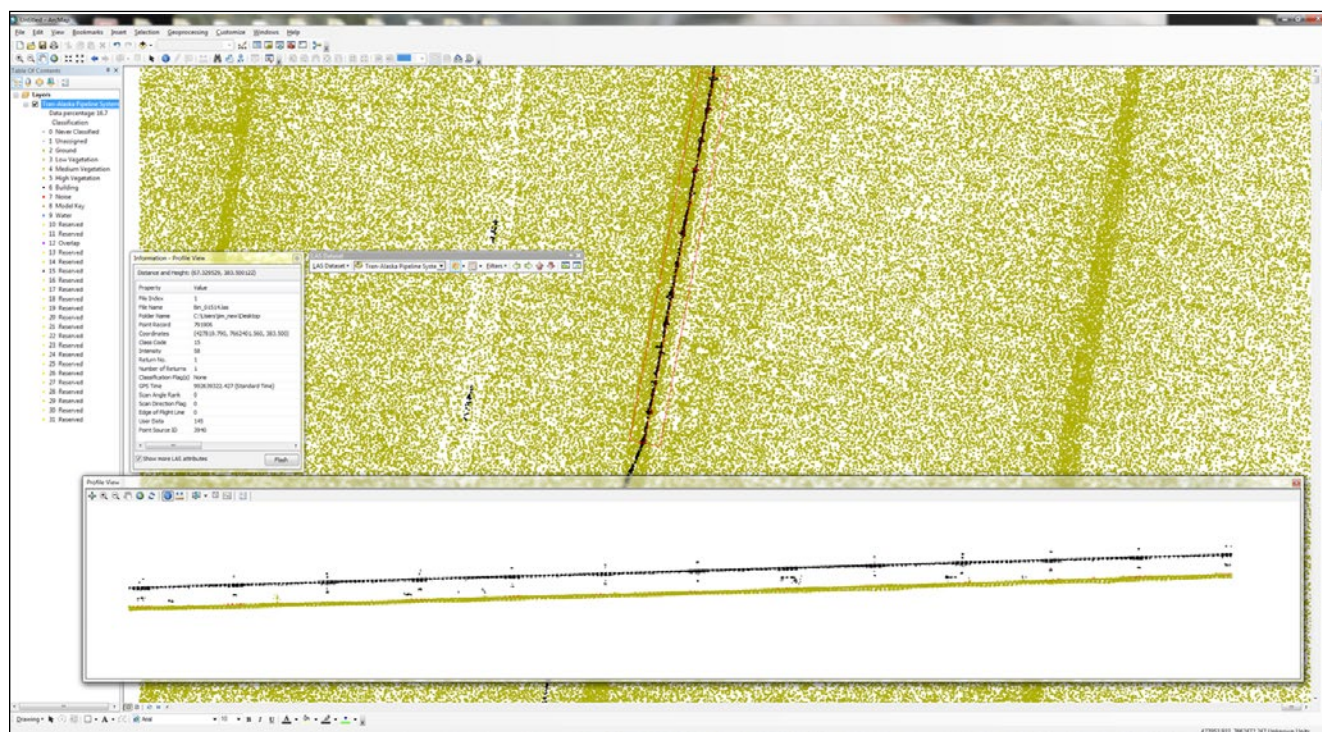




Viewing the LAS dataset along the Trans-Alaska Pipeline System (TAPS) in ArcGIS.

Ensuring Data Quality for Alaska's North Slope

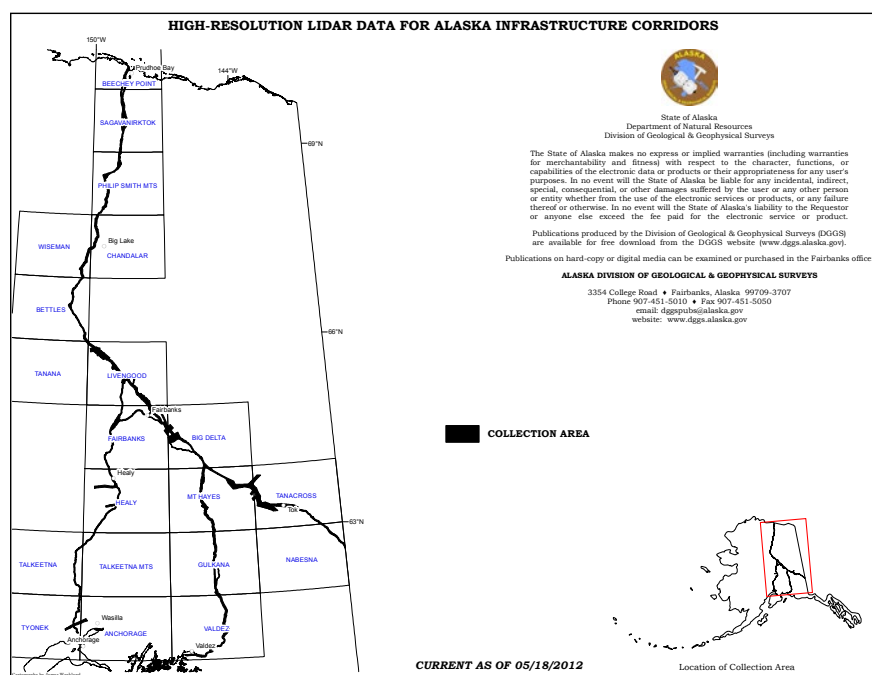
Alaska Division of Geological & Geophysical Surveys uses ArcGIS to evaluate 3,000 square miles of LiDAR data for proposed natural gas pipeline routes

The Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys (DGGS) collected high-resolution LiDAR topographic data for swaths of land that would likely be used if new natural gas pipelines were constructed in Alaska. The pipelines would be designed to deliver Alaska North Slope natural gas to out-of-state and Alaska customers. Collection of LiDAR data was supported by the State of Alaska Gas Pipeline

Project Office, the Office of the Federal Coordinator, and the Alaska Gasline Development Corporation.

The data—covering approximately 3,000 square miles along the proposed pipeline routes—were acquired to facilitate analysis during the design, permitting, and construction of the pipelines, including evaluation of active faulting, slope instability, thaw settlement, erosion, and other engineering constraints along the proposed pipeline routes. The data

BY JAMES **WEAKLAND**



Alaska DGGS collected LiDAR topographic data covering approximately 3,000 square miles of proposed natural gas pipeline corridor.

will also provide an Esri ArcGIS base layer for the state–federal GIS database and will be used to evaluate permit applications and construction plans.

LiDAR was chosen as the preferred data format because it has proven to be one of the most useful forms of remotely sensed data for identification and characterization of potentially active faults and many other surficial-geologic landforms and hazards, especially in areas of heavy vegetation where access may be difficult and other forms of remotely sensed data are ineffective.

Acquiring LiDAR data

LiDAR data were acquired and processed by Watershed Sciences, Inc. (WSI), based in Corvallis, Oregon. The data consist of continuous 1-mile-wide minimum coverage of existing infrastructure along the entire length of the proposed natural gas pipeline corridors

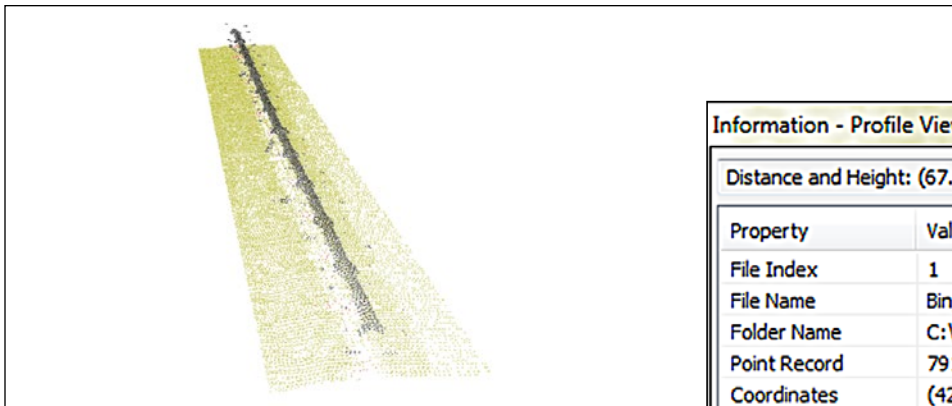
from Prudhoe Bay, Alaska, to the Canada border along the Trans-Alaska Pipeline System (TAPS) and Alaska Highway; Delta Junction to Valdez, Alaska along the TAPS corridor, and Livengood to Point McKenzie, Alaska along the George Parks Highway. LiDAR data were collected between September 21 and October 1, 2010, for an area that included portions of the Alaska Highway east of Johnson River to Robertson River, and included 117,357 acres within the requested area. This area was expanded to include a 100-meter buffer to make sure coverage was complete and there were adequate point densities around survey boundaries, resulting in 121,746 acres of delivered data.

The LiDAR survey data were collected with Leica ALS60 sensors in a Cessna Caravan 208B and Partenavia P-68 aircraft. The Leica systems were set to acquire 200,000 laser pulses

per second and flown at 900 or 1,300 meters above ground level, depending on cloud ceiling and terrain, capturing a scan angle of plus/minus 14 degrees from nadir. The system achieved a minimum survey density of 8 pulses per square meter and up to four returns per pulse. The data included minimum 1-mile-wide corridors covering gas-pipeline routes being considered by applicants, and half-mile-wide coverage of existing primary pipeline-support roads outside the main corridor. Other expanded coverage included areas where data are needed for evaluation of active faults, slope instability, and other geologic hazards.

To facilitate processing and product delivery, WSI grouped the data into delivery areas (subsets of the entire data collection region) in the order in which they were collected and processed. Files for each delivery area were organized by 1:63,360-scale quadrangle. Next, WSI sent the data for each delivery area to the State of Oregon Department of Geology and Mineral Industries (DOGAMI) for independent quality-control analysis under separate contract with DGGS. DOGAMI is a proven leader in the collection and use of LiDAR data, with vast experience in these types of analyses.

After correcting any errors identified by DOGAMI, WSI sent the revised data set to DGGS along with a delivery report describing details about LiDAR acquisition, accuracy, and quality for the delivery area. DOGAMI also provided a separate report for each delivery area, summarizing their methodologies and the results of quality control checks.



Oblique view of the Trans-Alaska Pipeline System.

LiDAR points were classified as ground, low and medium vegetation, buildings or manmade structures, noise/error points, water, snow, and pipeline. Contour lines were derived at 1 meter intervals from ground-classified LiDAR point data using TerraSolid processing software and Microstation. For the derived DEMs, lakes and other closed water bodies with surface areas of greater than 150 square meters were flattened to a consistent water level using a hydroflattening procedure to ensure stream channels break at culvert locations and the sinks and pits in the data are removed.

Ensuring quality using ArcGIS

Bare-earth and highest-hit grids were delivered in ArcGIS grid format with 1 meter cell size. LiDAR point data were delivered in LAS binary format for ground classified returns as well as the entire LiDAR point cloud. Georeferenced intensity images of 1 meter cell size were supplied in geoTIF format. Supplementary data include 1-meter-cell-size vegetation rasters displaying canopy and other vegetation metrics. Real-time kinematic ground survey data that are used for absolute vertical adjustment were supplied in shapefile format.

All data associated with the delivery were loaded and viewed to ensure completeness. Raster imagery such as elevation grids and intensity geoTIFFs were viewed in ArcGIS and cross referenced with the delivery area. These grids were loaded into ArcGIS software for visual analysis. Data were examined through slope and hillshade models of bare earth returns. Hillshades of the highest-hit models were used to identify areas of missing ground. Both bare-earth and highest-hit models were examined for calibration offsets, tiling artifacts, seam-line offsets, pits, and birds (both real and anomalous).

Errors noted during visual analysis were digitized for spatial reference and stored in Esri shapefile format. Each feature was assigned an ID value and commented to describe the nature of the observed error. The shapefile was delivered to WSI for locating and fixing apparent errors. Upon receiving the observed error locations, the vendor

Information - Profile View	
Distance and Height: (67.329529, 383.500122)	
Property	Value
File Index	1
File Name	Bin_01514.las
Folder Name	C:\Users\jim_new\Desktop
Point Record	791906
Coordinates	(427819.790, 7662401.560, 383.500)
Class Code	15
Intensity	58
Return No.	1
Number of Returns	1
Classification Flag(s)	None
GPS Time	992639322.427 (Standard Time)
Scan Angle Rank	0
Scan Direction Flag	0
Edge of Flight Line	0
User Data	145
Point Source ID	3940
☒ Show more LAS attributes <button>Flash</button>	

ArcGIS pop-up window identifying a LAS point in the profile view.

performed an analysis to conclude whether the error was valid, and reprocessed if necessary.

Delivering the goods

DGGS has made this LiDAR data available free to the public at its website (www.dggs.alaska.gov/pubs/id/22722). The data are arranged by U.S. Geological Survey (USGS) quadrangle in the order that delivery areas were received from WSI. A single data delivery from WSI typically covered portions of several 1:250,000-scale quadrangles. Individual delivery reports from WSI were combined into a comprehensive report organized by delivery area. Section 1 of

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Tanacross	Mt. Hayes		Mt. Hayes		Nabesna	Tanacross		Fairbanks	Big Delta	Big Delta		Bettles	Tyonek	Talkeetna	
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