



Airborne Topographic Lidar Report

Wisconsin WROC - 3DEP
Columbia County Lidar 2020

Prime Contractor: Ayres

Airborne Lidar Acquisition:
Quantum Spatial, an Nv5 Company

Ingenuity, Integrity, and Intelligence.

www.AyresAssociates.com





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1. Summary / Scope

1.1 Summary

This report contains a summary of the WROC 2020 Columbia County lidar acquisition task order, issued by Ayres Associates Inc. under Task Order 54 that was executed on January 21, 2020. The task order yielded a project area covering approximately 836 square miles over Columbia County in Wisconsin. The intent of this document is only to provide specific validation information for the data acquisition/collection, processing, and production of deliverables completed as specified in the task order.

1.2 Scope

Aerial topographic lidar was acquired using state-of-the-art technology, along with the necessary surveyed ground control points (GCPs) and airborne GPS and inertial navigation systems. The aerial data collection was designed with the following specifications listed in Table 1 below.

Table 1. Originally Planned Lidar Specifications

AVERAGE POINT DENSITY	FLIGHT ALTITUDE (AGL)	FIELD OF VIEW	MINIMUM SIDE OVERLAP
2 pts / m ²	2300 m	58.5°	30%

1.3 Coverage

The project boundary covers approximately 836 square miles over Wisconsin. Project extents are shown in Figure 1.

1.4 Duration

Lidar data was acquired from April 11, 2020, to April 18, 2020, in two lifts. See "Section: 2.4. Time Period" for more details.

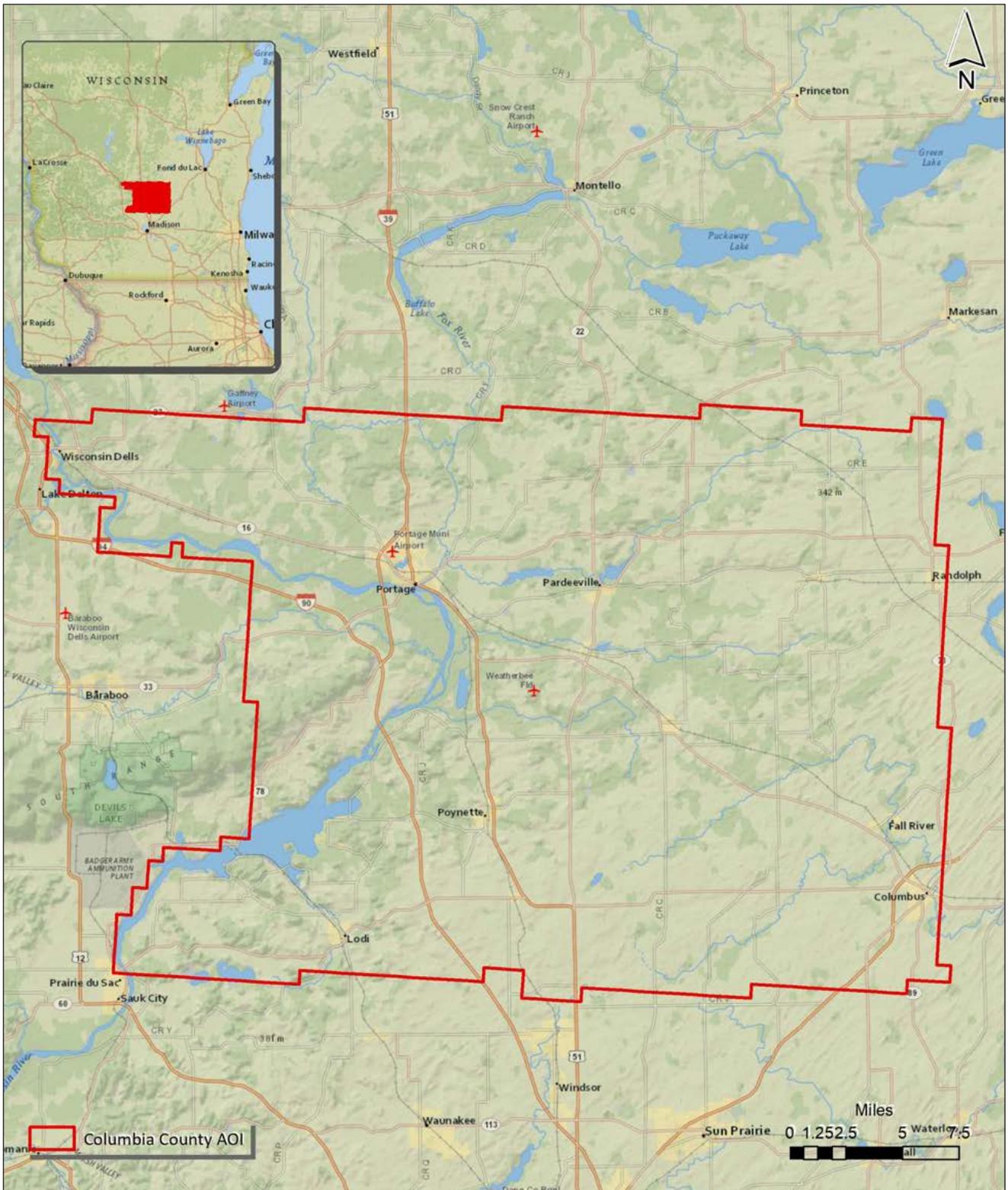
1.5 Issues

There were no major issues to report for this project.

WROC 2020 COLUMBIA COUNTY – DELIVERABLES
PROJECTED COORDINATE SYSTEM: WISCRS COLUMBIA COUNTY
HORIZONTAL DATUM: NAD83 (2011)
VERTICAL DATUM: NAVD88 (GEOID 12B)
UNITS: U.S. SURVEY FEET

- One copy of lidar tiled point cloud data in LAS format on external hard drive
- All flight mission parameters appropriate for inclusion in FGDC/USGS compliant metadata

Figure 1. Columbia County Project Boundary



2. Planning / Equipment

2.1 Flight Planning

Flight planning was based on the unique project requirements and characteristics of the project site. The basis of planning included: required accuracies, type of development, amount/type of vegetation within project area, required data posting, and potential altitude restrictions for flights in project vicinity.

Detailed project flight planning calculations were performed for the project using RiPARAMETER planning software. The entire target area was comprised of 67 planned flight lines (Figure 2).

2.2 Lidar Sensor

Quantum Spatial used a Riegl LMS-Q1560 lidar sensor (Figure 3), serial number 1264, for lidar collection.

The Riegl LMS-Q1560 system has a laser pulse repetition rate of up to 800 kHz. This sensor has forward/backward looking capability and a wide field of view for ultra wide area mapping. There is a two channel scanner that uses MTA processing, echo digitization, and waveform analysis.

A brief summary of the aerial acquisition parameters for the project are shown in the Lidar System Specifications in Table 2.

Figure 2. Columbia County Planned Flight Lines

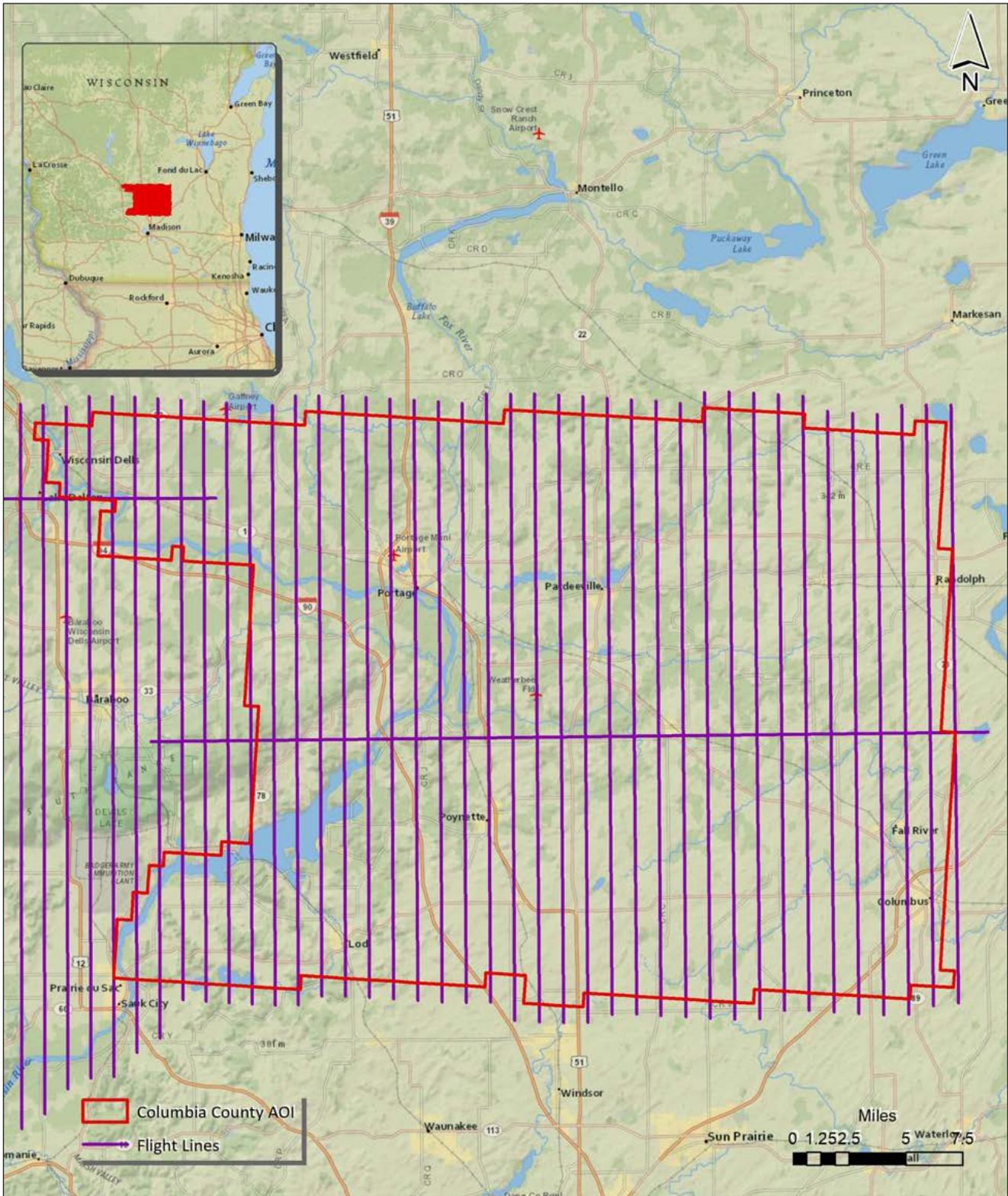


Table 2. Lidar System Specifications

		RIEGL LMS Q1560
Terrain and Aircraft Scanner	Flying Height	2300 m
	Recommended Ground Speed	150 kts
Scanner	Field of View	58.5°
	Scan Rate Setting Used	2 x 80 lps
Laser	Laser Pulse Rate Used	2 x 350 kHz
	Multi Pulse in Air Mode	1
Coverage	Full Swath Width	2576 m
	Line Spacing	2249.4 m
Point Spacing and Density	Average Point Spacing	0.907 m
	Average Point Density	2 x 2.43 pts/m ²

Figure 3. Riegl LMS Q1560 Lidar Sensor



2.3 Aircraft

All flights for the project were accomplished through the use of a customized plane. The plane type and tail number are listed below.

Lidar Collection Planes

- Piper Navajo (twin-piston), Tail Number: C-FKMA

This aircraft provided an ideal, stable aerial base for lidar acquisition. This aerial platform has relatively fast cruise speeds, which are beneficial for project mobilization/demobilization while maintaining relatively slow stall speeds, proving ideal for collection of high-density, consistent data posting using a state-of-the-art Riegl LMS-Q1560 lidar system. Some of Quantum Spatial's operating aircraft can be seen in Figure 4 below.

Figure 4. Some of Quantum Spatial's Planes



2.4 Time Period

Project-specific flights were conducted in April 2020. Two aircraft lifts were completed. The accomplished lifts are listed below.

- O4112020A (SN1264, C-FKMA)
- O4182020A (SN1264, C-FKMA)

3. Processing Summary

3.1 Lidar Processing

Applanix + POSPac software was used for post-processing of airborne GPS and inertial data (IMU), which is critical to the positioning and orientation of the lidar sensor during all flights. Applanix POSPac combines aircraft raw trajectory data with stationary GPS base station data yielding a “Smoothed Best Estimate Trajectory” (SBET) necessary for additional post processing software to develop the resulting geo-referenced point cloud from the lidar missions.

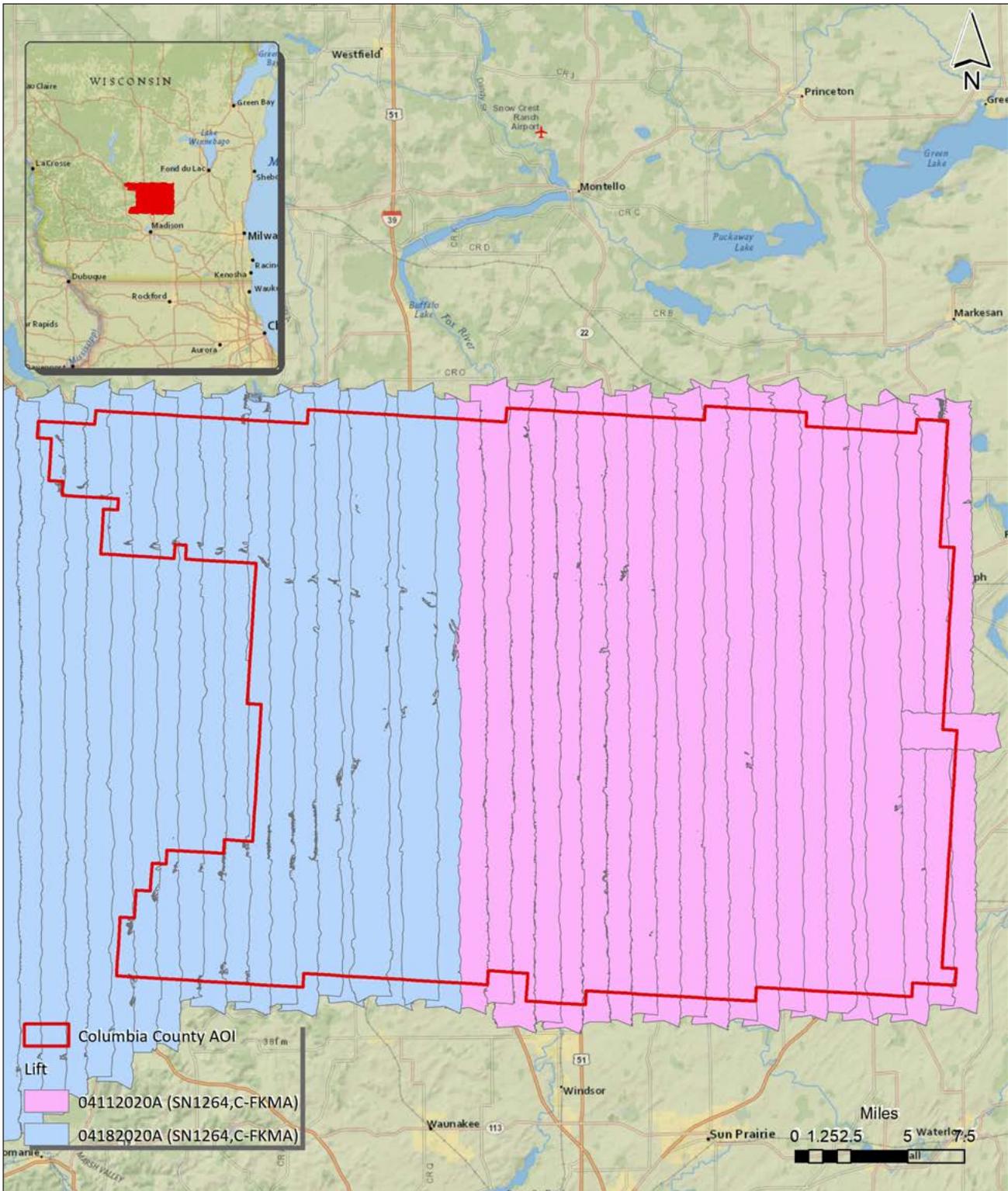
During the sensor trajectory processing (combining GPS & IMU datasets), certain statistical graphs and tables are generated within the Applanix + POSPac processing environment, which are commonly used as indicators of processing stability and accuracy. This data for analysis include: Max horizontal/vertical GPS variance, separation plot, altitude plot, PDOP plot, base station baseline length, processing mode, number of satellite vehicles, and mission trajectory.

Point clouds were created using the RiPROCESS software. The generated point cloud is the mathematical three-dimensional composite of all returns from all laser pulses as determined from the aerial mission. The point cloud is imported into GeoCue distributive processing software. Imported data is tiled and then calibrated using TerraMatch and proprietary software. Using TerraScan, the vertical accuracy of the surveyed ground control is tested, and any bias is removed from the data.

4. Project Coverage Verification

Coverage verification was performed by comparing coverage of processed .LAS files captured during project collection to generate project shape files depicting boundaries of specified project areas. Please refer to Figure 6.

Figure 6. Lidar Flight Line Coverage



5. Ground Control and Check Point Collection

Quantum Spatial used 16 ground control (calibration) points collected by Ayres.

5.1 Calibration Control Point Testing

Figure 7 shows the location of each bare earth calibration point for the project area. TerraScan was used to perform a quality assurance check using the lidar bare earth calibration points. The results of the surface calibration are not an independent assessment of the accuracy of these project deliverables, but the statistical results do provide additional feedback as to the overall quality of the elevation surface.

Figure 7. Calibration Control Point Locations

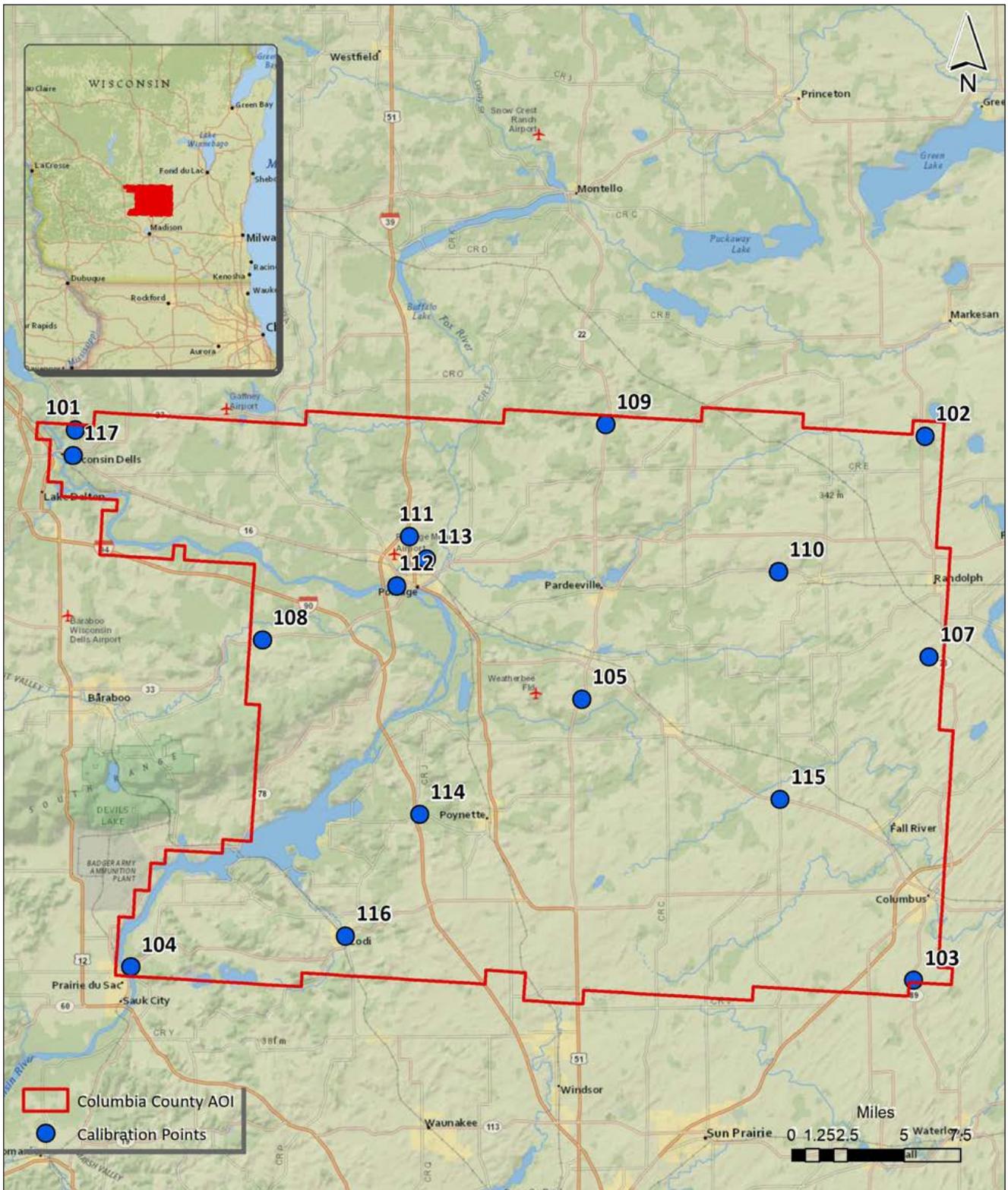


Table 3. Calibration Control Point Report
Units = U.S. survey feet

NUMBER	EASTING	NORTHING	KNOWN Z	LASER Z	DZ
101	2030949.193	598287.094	905.527	905.54	0.013
102	2229610.4	596761.612	965.845	965.82	-0.025
103	2226993.27	469431.807	905.239	905.29	0.051
104	2043948.447	472570.618	763.784	763.88	0.096
105	2149382.936	535288.223	931.543	931.66	0.117
107	2230584.123	545218.051	934	933.95	-0.05
108	2074700.013	549187.507	850.774	850.75	-0.024
109	2154985.378	599572.954	849.869	849.95	0.081
110	2195354.734	565013.289	844.691	844.75	0.059
111	2109083.149	573298.571	799.485	799.54	0.055
112	2106092.128	561796.74	835.1	835.1	0
113	2113080.57	568012.846	790.719	790.84	0.121
114	2111495.568	508337.723	810.853	810.86	0.007
115	2195747.713	511782.381	938.654	938.66	0.006
116	2094142.201	479834.366	813.471	813.31	-0.161
117	2030443.32	592219.377	910.563	910.62	0.057
Average Dz		0.025			
Minimum Dz		-0.161			
Maximum Dz		0.121			
Average Magnitude		0.058			
Root Mean Square		0.073			
Std Deviation		0.071			