Airborne Topographic Lidar Report

Wisconsin WROC - 3DEP
Eau Claire County Lidar 2020

Prime Contractor: Ayres

Airborne Lidar Acquisition:
Quantum Spatial, an Nv5 Company

Ingenuity, Integrity, and Intelligence.

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1. Summary / Scope

1.1 Summary

This report contains a summary of the WROC 2020 Eau Claire 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 674 square miles over Eau Claire 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 674 square miles over Wisconsin. Project extents are shown in Figure 1.

1.4 Duration

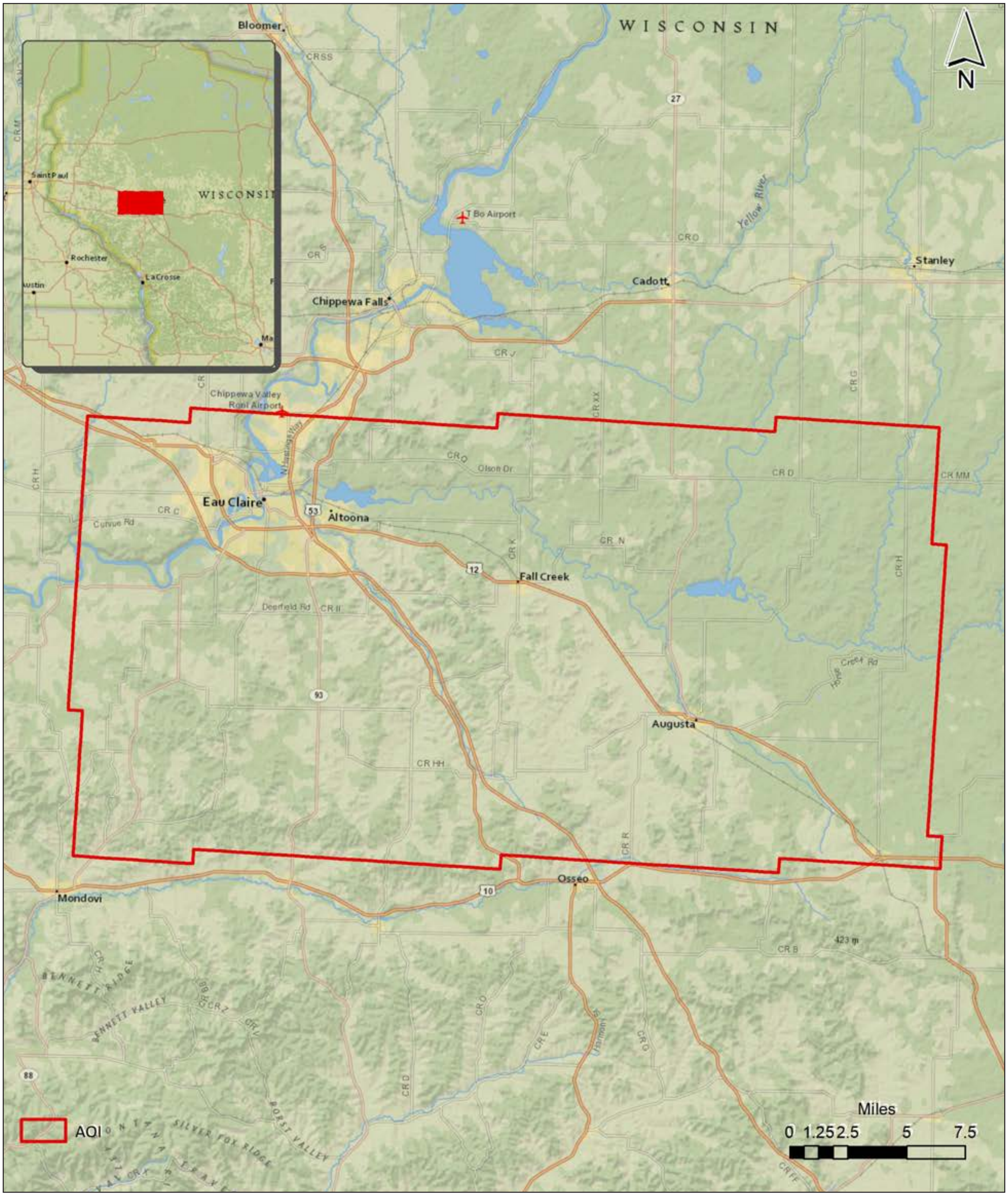
Lidar data was acquired from April 30, 2020, to May 7, 2020, in four lifts. See “Section: 2.4. Time Period” for more details.

1.5 Issues

There were no major issues to report for this project.

WROC 2020 EAU CLAIRE COUNTY – DELIVERABLES PROJECTED COORDINATE SYSTEM: WISCRS EAU CLAIRE 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. Eau Claire 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 37 planned flight lines (Figure 2).

2.2 Lidar Sensor

Quantum Spatial used a Riegl LMS-Q1560 lidar sensor (Figure 3), serial numbers 754 and 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. Eau Claire County Planned Flight Lines

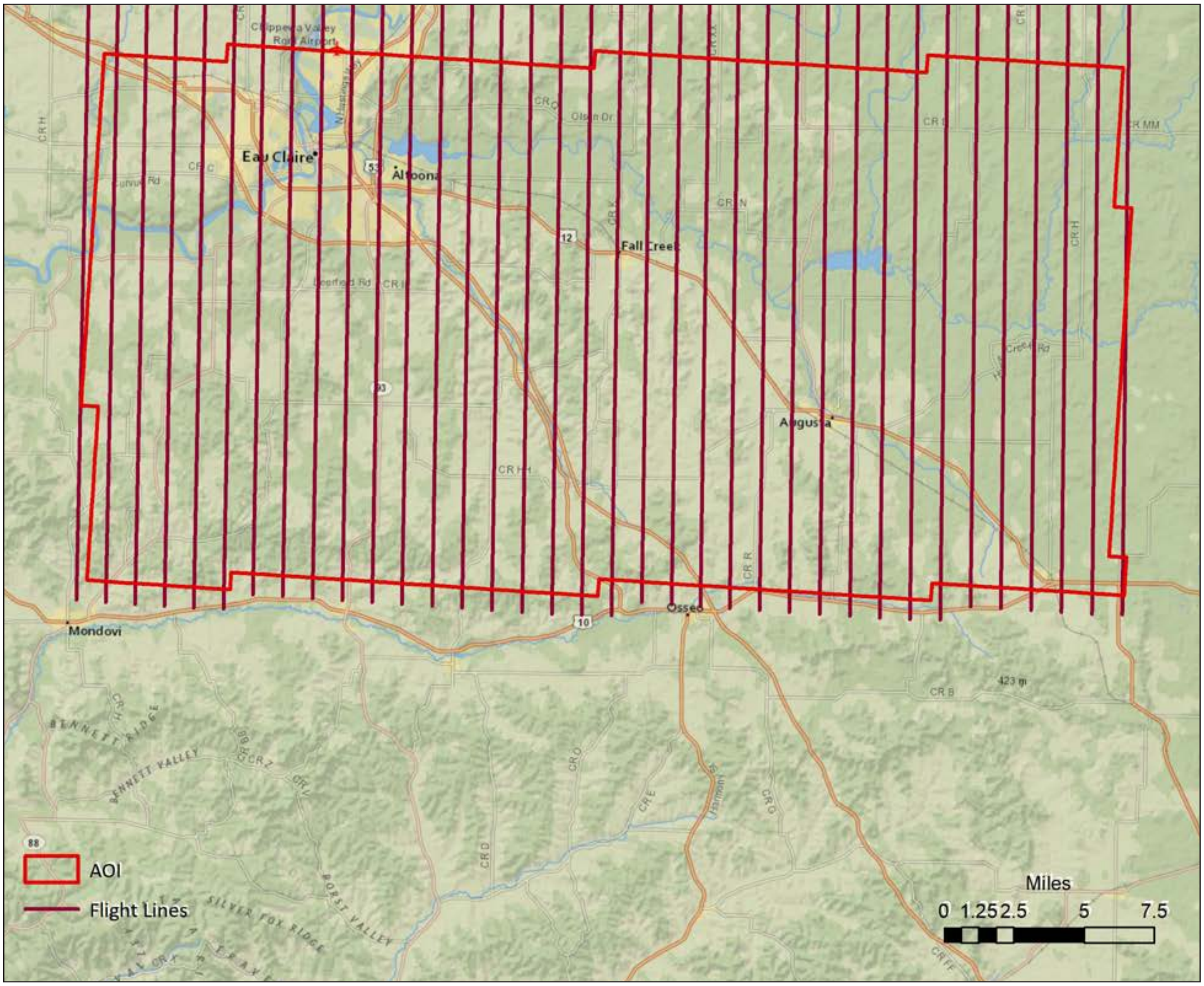


Table 2. Lidar System Specifications

		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	2168.80 m
Point Spacing and Density	Average Point Spacing	0.907 m
	Average Point Density	2 x 2.43 pts/m²

Figure 3. Riegl LMS Q1560 Lidar Sensor

2.3 Aircraft

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

Lidar Collection Planes

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

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 and May of 2020. Four aircraft lifts were completed. The accomplished lifts are listed below.

- 04302020A (SN754, C-GKSX)
- 05012020A (SN1264, C-FKMA)
- 05032020A (SN754, C-GKSX)
- 05072020A (SN754, C-GKSX)

3. Processing Summary

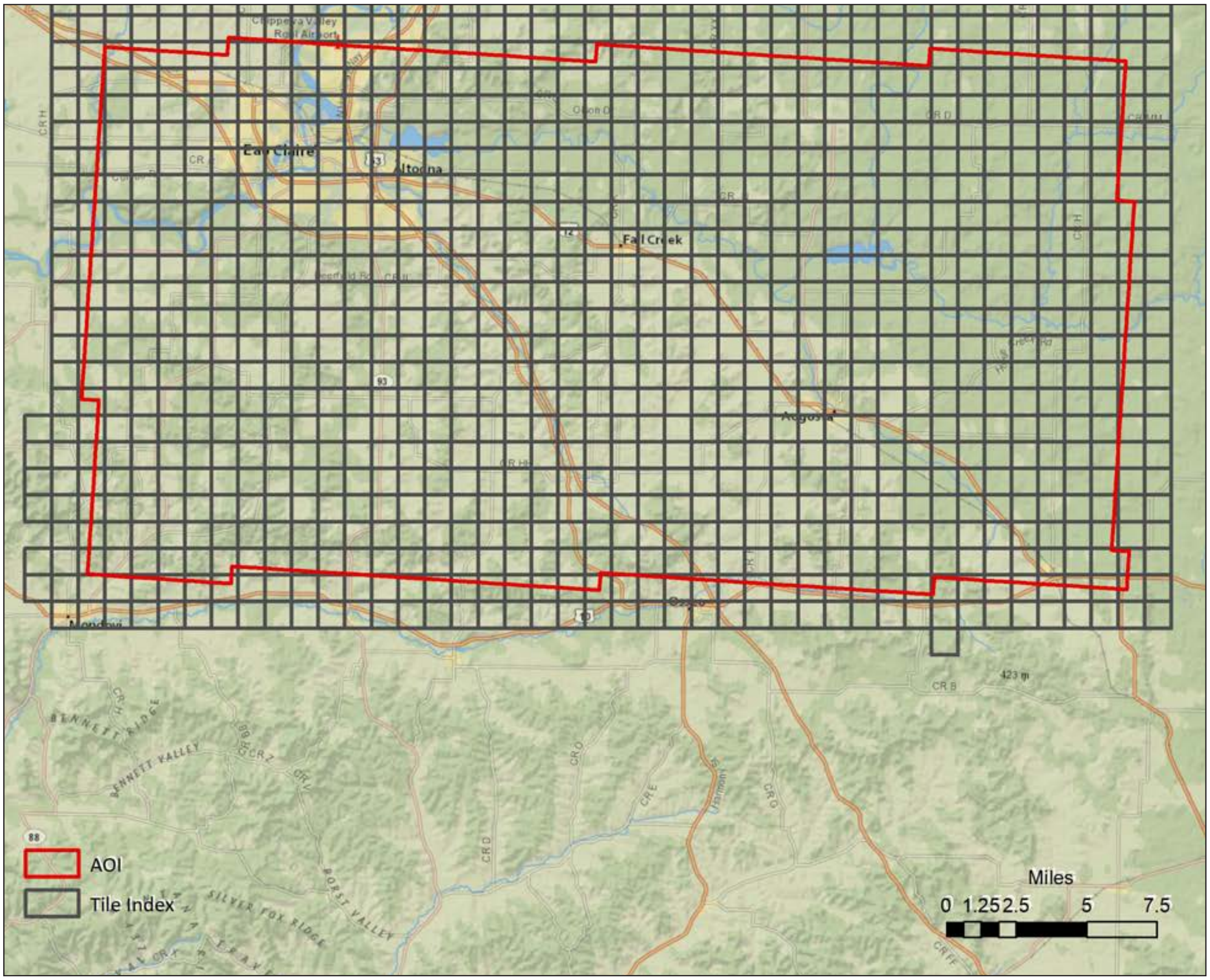
3.1 Lidar Processing

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.

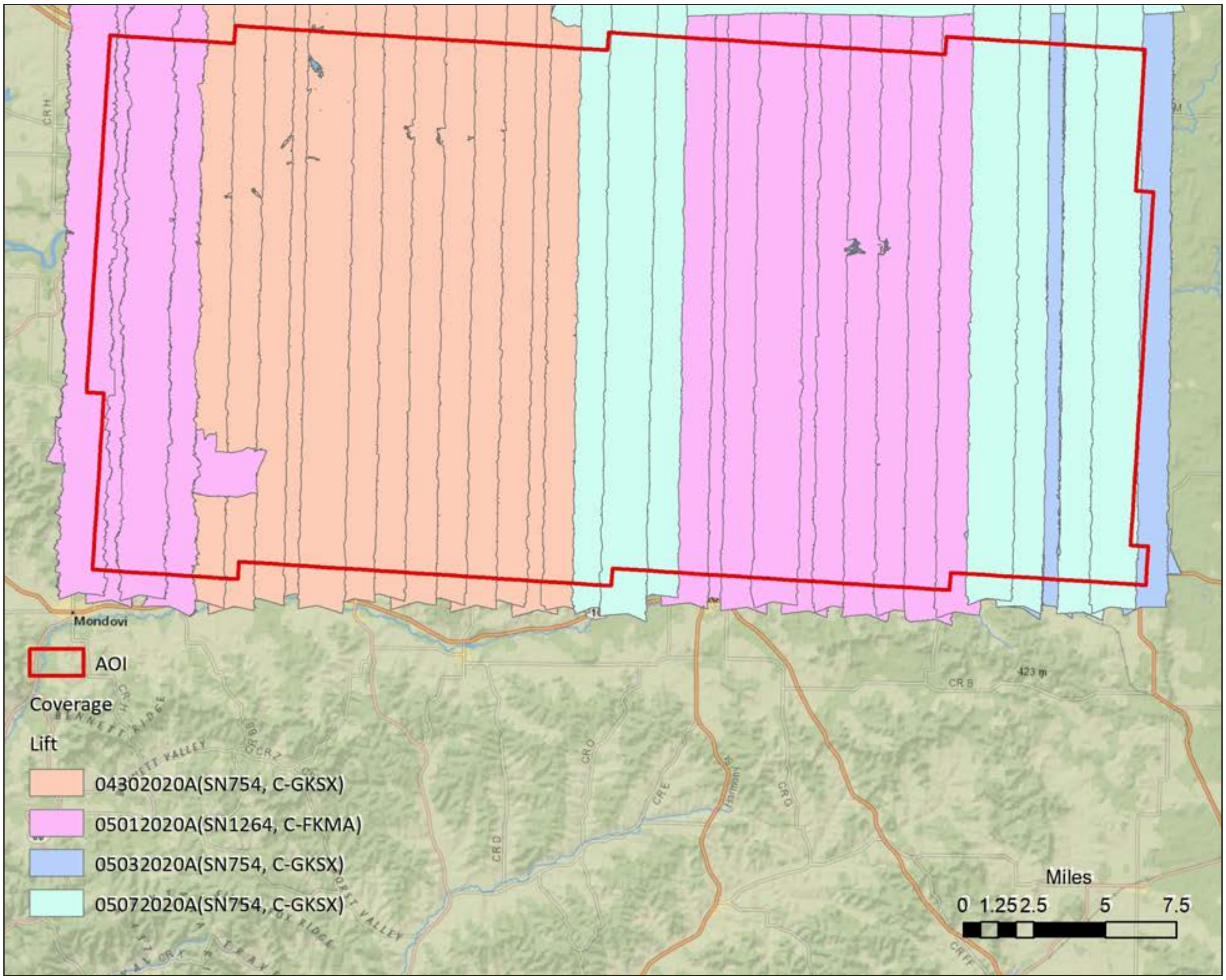
Figure 5. Lidar Tile Layout



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 24 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

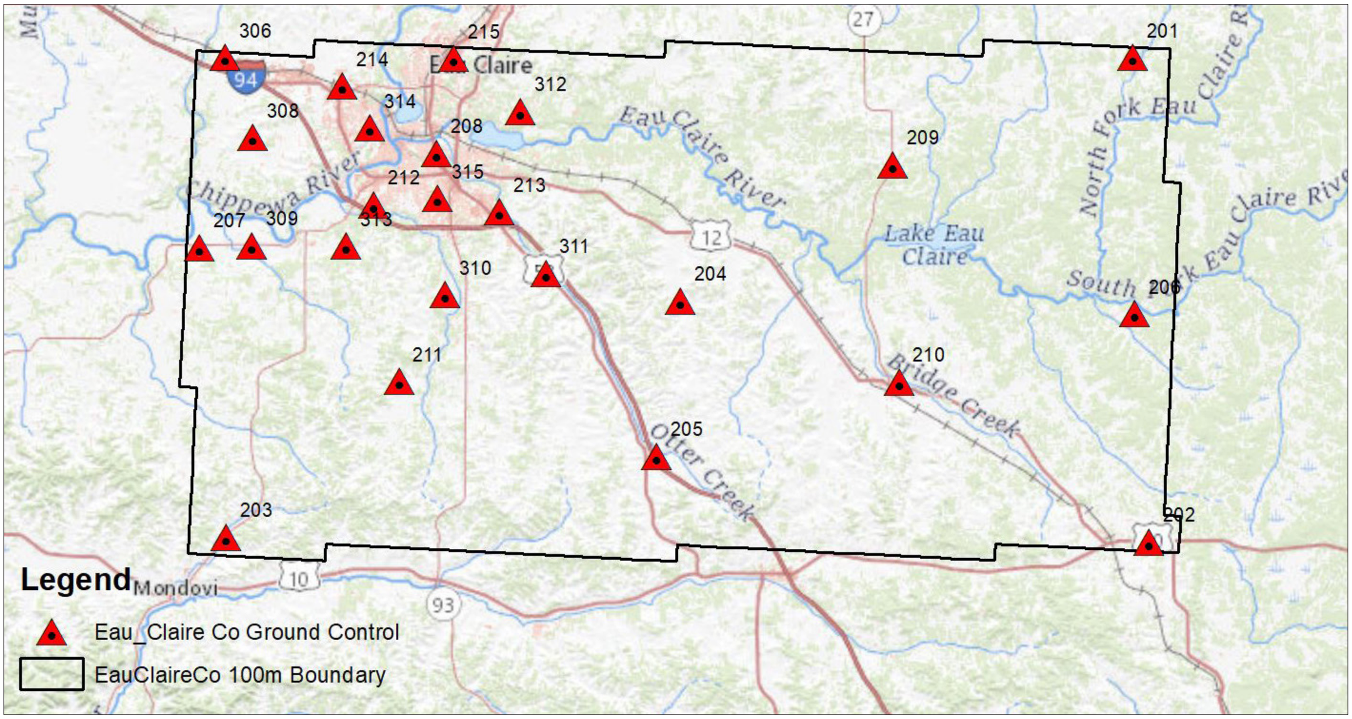


Table 3. Calibration Control Point Report
Units = U.S. survey feet

NUMBER	EASTING	NORTHING	KNOWN Z	LASER Z	DZ
201	483794.407	295643.918	1057.694	1057.620	-0.074
202	486915.892	200422.873	1083.846	1083.850	0.004
203	305439.104	201270.005	858.347	858.420	0.073
204	394766.373	247812.624	961.244	961.230	-0.014
205	390062.039	217217.186	987.738	987.810	0.072
206	484241.859	245215.305	995.011	995.070	0.059
207	300210.807	258241.756	760.258	760.190	-0.068
208	346748.707	276858.344	880.847	880.900	0.053
209	436565.612	274571.479	1083.920	1084.060	0.140
210	437797.049	231813.364	965.278	965.340	0.062
211	339446.449	231993.876	955.690	955.830	0.140
212	334450.163	266690.744	868.474	868.500	0.026
213	359283.469	265334.714	895.362	895.530	0.168
214	328238.635	290061.535	912.632	912.790	0.158
215	350282.676	295435.806	891.010	891.140	0.130
306	305255.828	295617.776	893.831	893.970	0.139
308	310750.024	279911.127	892.594	892.690	0.096
309	310464.126	258673.940	774.112	774.140	0.028
310	348561.736	249035.625	903.270	903.300	0.030
311	368295.339	253248.489	917.852	917.810	-0.042
312	363302.759	285043.530	900.953	900.980	0.027
313	329062.148	258509.207	864.890	864.900	0.010
314	333788.926	281803.608	866.602	866.700	0.098
315	346964.767	267956.009	906.843	906.830	-0.013

Average Dz	0.054
Minimum Dz	-0.074
Maximum Dz	0.168
Average Magnitude	0.072
Root Mean Square	0.087
Std Deviation	0.070