October 30, 2017

FEMA Topographic Data
Aerial LiDAR Data Collection & Processing
Waushara County, WI
Project Plan (Pre-flight)

Purpose

The Strategic Alliance for Risk Reduction (STARR II) has been tasked to provide the Federal Emergency Management Agency (FEMA) with topographic data for Waushara County, Wisconsin. For this effort, Continental Mapping Consultants (Continental) will collect, process, and classify high accuracy LiDAR data.

The area of interest (AOI) covers approximately six hundred thirty seven (637) square miles and is located in central Wisconsin.

Planned Schedule

Data Acquisition - November 7th-8th, 2017
Data Processing - December, 2018 – April 29, 2018
Data Delivery - April 30, 2018

Project Personnel

Project Manager- Benjamin Leonard
Continental Mapping Consultants, Inc.
121 South Bristol Street
Sun Prairie, WI 53590
Phone #- 888.815.3327
Email- bleonard@continentalmapping.com

Survey Crew- Philipp Hummel
Compass Data, Inc.
7074 South Revere Pkwy
Centennial, CO 80112
Phone#-303.627.4058
Email- phummel@compassdatainc.com

Prior to the survey or aerial lidar acquisition, Continental will contact the STARR II POC of the specific dates in which staff and/or aircraft will be on site.

Aircraft & Sensor Information

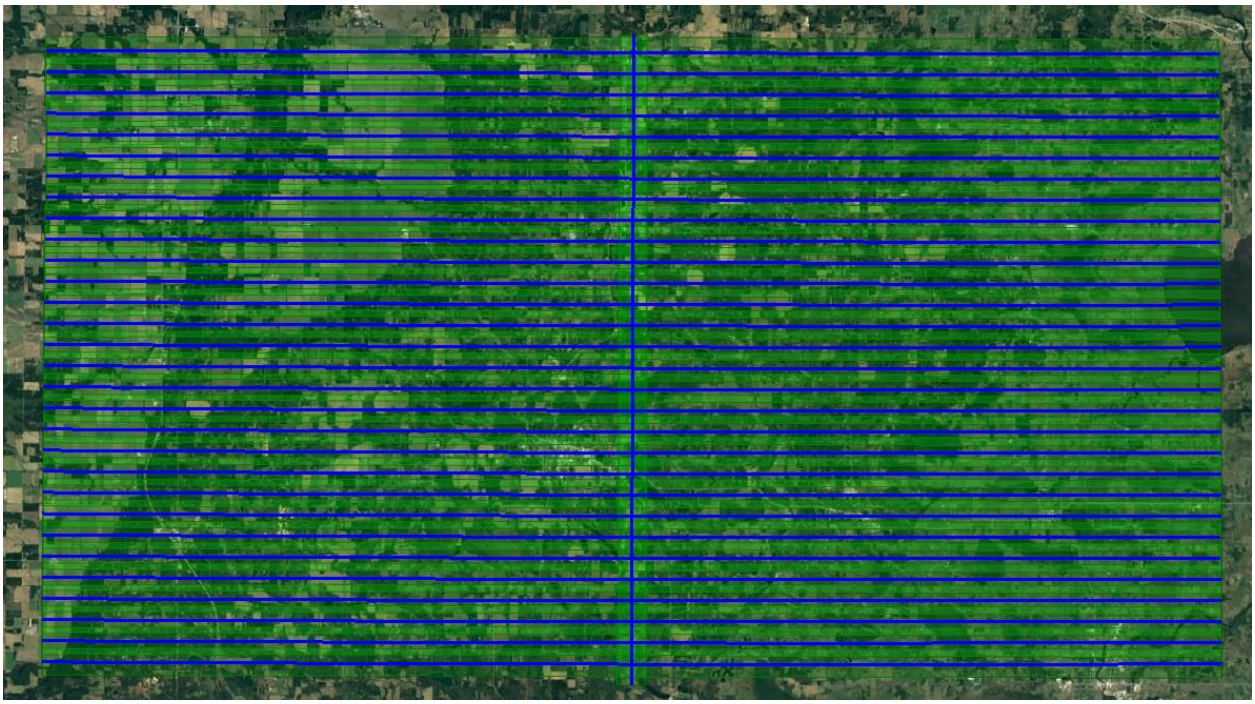
Aircraft-> Piper Navajo Chieftain
Sensor ->Leica ALS70 Planning
Software-> Leica's AeroPlan

Acquisition Parameters

Description	Computed	Target	Unit
Sensor ID	ALS70_SN7232_HP		
Terrain and Aircraft			
Reference Height	183 - 367		m
Flying Height AGL	1858 - 2042	2042	m
Altitude AMSL	2225 / 7300		m/ft
Recommended Ground Speed (GS)	150	150	kts
Scanner			
Field of View (FOV)	38.0	38.0	degrees
Maximum Scan Rate	54.7		Hz
Scan Rate Setting used (SR)	49.0		Hz
Aircraft Speed Sensitivity	2.88		kts
Delta Scan	46.35 - 53.88		# scans
Automatic scan delta optimization	not possible	enabled	
Laser			
Maximum Laser Pulse Rate	267800		Hz
Laser Pulse Rate used	135300		Hz
Multi Pulse in Air Mode	2	2	
Fixed Gain	255		
Range Intensity mode	7		
Nominal Maximum Slant Range	2217.83		m
Minimum Range Gate	1319.46		m
Maximum Range Gate	2217.94		m
Range Gate size	898.48		m
Range margin above hills	538.54		m
Range margin below valleys	55.11		m
Recommended Laser Power	100		%
Coverage			
Full Swath Width	1406.23		m
Coverage Rate (No line optimization)	322.71		km^2/h
Recommended Line Spacing (No DTM)	1161.65		m
Minimum Sidelap (No DTM,	17.39		%

lower)			
Minimum Sidelap (upper)	9.21		%
Point Spacing and Density			
Maximum Point Spacing Across Track	1.25		m
Maximum Point Spacing Along Track (in phase)	1.57		m
Optimal Point Spacing Along Track (out of phase)	0.79		m
Across Track/Along Track Ratio	0.79	0.72	
Average Point Density	2.47	1.00	pts / m^2
Average Point Spacing	0.64		m
Worst case Point Density	2.03		pts / m^2
Reflectivity and SNR			
Illuminated Footprint Diameter	0.22		m, 1/e^2
Terrain Reflectivity	0.10		
Estimated SNR for diffuse targets	13.98 - 12.97		
Line/Rail Cross Section	10.00		mm
Line/Rail Reflectivity	0.30		
Best Case Wire SNR	1.19 - 0.00		
Average SNR	13.47	25.00	
Accuracy			
Estimated Across Track Accuracy	0.20 - 0.22		m
Estimated Along Track Accuracy	0.19 - 0.22		m
Estimated Height Accuracy	0.08 - 0.11		m
Eye safety			
Eye Safety Shutoff Distance (Binoculars)	1062		m
Eye Safety Shutoff Distance (naked eye)	165		m
WFD Configuration			
Waveform configuration set	False		

Proposed Flight Lines



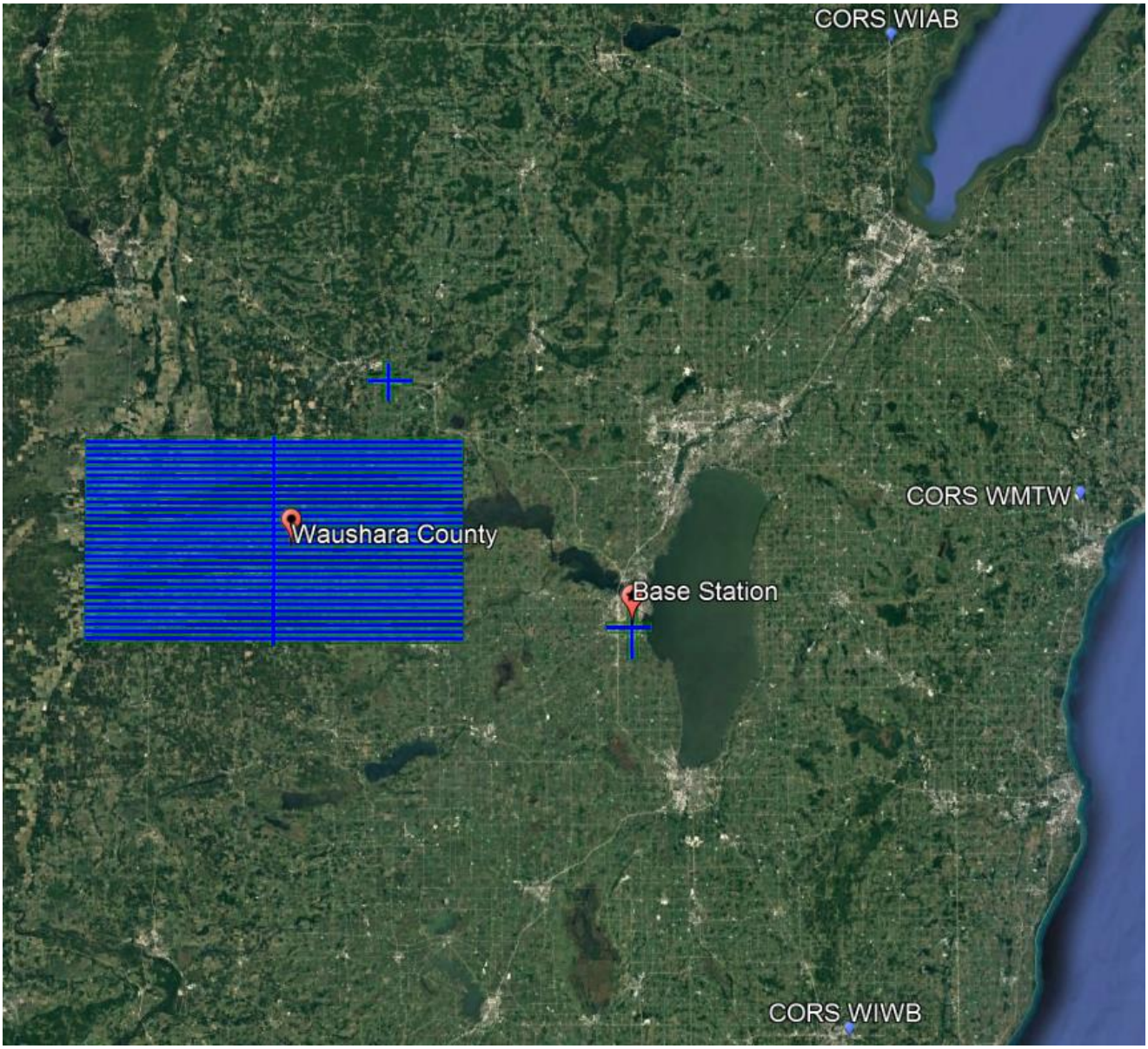
Waushara County, WI Proposed Flight Lines.

Aerial LiDAR Base Stations

Base stations determine where LiDAR data can be collected with the highest confidence of accuracy by measuring between satellites and the base station, itself.

Proposed base station:

- Set at Wittman Regional Airport, Oshkosh, WI



Waushara County, WI project, proposed base stations.

Risk

In the occurrence that an issue arises with the primary aircraft or sensor, Continental has access to a Leica ALS 80, which will be utilized. If re-flights are determined to be necessary, re-flights will occur as soon as weather permits.

Calibration Processing /Testing Methodology

The team will utilize a number of software packages to complete the calibration process. Below are the individual tasks and software packages.

The Continental team will utilize Leica's CloudPro to initially process the data and convert into LAS format. TerraMatch will be used to refine the calibration of the LiDAR dataset. The trajectory files and point cloud swaths will then be imported into GeoCue to perform project setup. The project set up phase sets the project parameters, and tiling scheme, and is the platform for initial macro runs. After the LiDAR boresight calibration is checked, the flight lines will be adjusted to each other for relative accuracy, using a z-bump method. Control values are run against the point cloud to verify the accuracy of the data prior to classification. Flight line separation images are created to confirm the LiDAR dataset is within project specifications for relative accuracy. A final overall z adjustment is performed to the ground control.

Internal Verification Quality Control

Continental will utilize various software packages and techniques to verify the accuracy of the data. Utilizing QCoherent's LP360, Continental will run a survey-to-las check, followed by seamline analysis. The survey-to-las check will calculate the deviation between the survey point elevation and the point cloud elevation and export a Non-Vegetated Vertical Accuracy (NVA) report. The second check will check the seamlines of the point cloud swaths. The third check, the Vegetated Vertical Accuracy (VVA) testing, will occur after the ground classification has been completed. Other software like Terra Solid and Global Mapper will be utilized to verify the results of the accuracy, as reported by LP360. Once all of the deliverables have been produced and verified, the data will move to the Quality office for final review. The Quality office will test the data, verify that the correct procedures were followed, and verify that all of the deliverables in the SOW are finished.

LIDAR REPORT

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

AERIAL LIDAR DATA COLLECTION & PROCESSING

WAUSHARA COUNTY, WISCONSIN

DATA CREATED BY THE STRATEGIC ALLIANCE FOR RISK REDUCTION (STARR II)

CONTINENTAL MAPPING CONSULTANTS, INC.

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Overview

1.1 Vendor Contact Information:

Continental Mapping Consultants, Inc.
121 South Bristol Street
Sun Prairie, WI 53590
(888) 815-3327

Contact: Benjamin Leonard
Telephone: 888.815.3327
Email: bleonard@continentalmapping.com

1.2 Purpose

The Strategic Alliance for Risk Reduction (STARR II) has been tasked to provide the Federal Emergency Management Agency (FEMA) with topographic data for Waushara County, Wisconsin. For this effort, Continental Mapping Consultants (Continental Mapping) collected, processed, and classified high accuracy LiDAR data.

The completed area of interest (AOI) covers approximately six hundred forty seven (647) square miles and is located in central Wisconsin. The AOI and specific project boundary are shown in Figure 1.3.

Project Specifications/Accuracy Requirements

The specifications of this project were designed to conform to all applicable FEMA Standards, USGS LIDAR Base Specification v1.2 (2014), ASPRS LAS Specification Version 1.4-R13 (2013), and ASPRS Positional Accuracy Standards for Digital Geospatial Data v1.0 (2014).

LIDAR will be collected considering the following requirements:

- Atmospheric conditions will be cloud and fog free between the aircraft and the ground
- Ground conditions will be snow free without extensive flooding or other inundation

The county boundary was downloaded from the State of Wisconsin website, and buffered by 100 meters. All LIDAR point cloud data, breaklines, and DEMs were developed to the extent of the buffered project area.

The classification codes followed the USGS LIDAR Base Specification v1.2 (2014) classes utilizing the following:

- Class 1 – Processed, but unclassified
- Class 2 – Bare earth
- Class 7 – Low noise
- Class 9 – Water
- Class 10 – Ignored ground (near a breakline)
- Class 17 – Bridge decks
- Class 18 – High noise

Class 1 will be used for feature points that are not in Classes 2, 7, 9, 10, 17 and 18.
Class 2 will be used for feature points that represent the bare-earth.
Class 7 will be used for feature points that represent low noise.
Class 9 will be used for feature points that represent water.
Class 10 will be used for feature points that represent ignored ground near breaklines.
Class 17 will be used for feature points that represent bridge decks.
Class 18 will be used for feature points that represent high noise.

Resolution of LIDAR – To comply with the USGS Lidar Base Specification QL2, the project was flown at an altitude to produce ANPS less than 0.71 ppm.

Quality Level (QL)	Aggregate nominal pulse spacing (ANPS) (m)	Aggregate nominal pulse density (ANPD) (pls/m^2)
QL0	≤0.35	≥8.0
QL1	≤0.35	≥8.0
QL2	≤0.71	≥2.0
QL3	≤1.41	≥0.5

Figure 1.1 Nominal Pulse Spacing Requirements

Absolute Vertical Accuracy Requirement
The USGS Lidar Base Specification QL2 non-vegetated RMSE accuracy requirement for the raw point cloud data is 10cm RMSE.

Quality Level (QL)	RMSE$_z$ (nonvegetated) (cm)	NVA at 95-percent confidence level (cm)
QL0	≤5.0	≤9.8
QL1	≤10.0	≤19.6
QL2	≤10.0	≤19.6
QL3	≤20.0	≤39.2

Figure 1.2 Project Accuracy Requirements

Deliverables:

- Certification of Compliance
- Flight Logs
- Raw LIDAR point cloud swaths in LAS v 1.4
    - Including associated swath index in shapefile format
- Tiled/classified LIDAR point clouds in LAS v1.4
    - Including associated tile index in shapefile format
    - The tile scheme shall be 5,000 X 5,000 feet
- 3D breakline shapefiles
    - Including associated breakline tile index in shapefile format
- File Geodatabase
    - Including 3D hydro breakline feature class data in shapefile format
    - Including topology report
- Hydro-Flattened DEMS in ERDAS Imagine .IMG 32-bit floating point format
    - Including associated DEM tile index in shape format
- Acquisition Spatial Data
- Metadata
- Ancillary Information

Figure 1.3: Waushara County, Wisconsin

Project Constraints:

- Leaf off conditions
- Snow
- Water level
- Cloud Ceiling

2.0 Acquisition

2.1 Project Planning

Planning was based on project requirements, constraints and industry best practices. The project area was defined based on the required accuracies, geometry of the project area, the amount and type of vegetation and the required data post spacing. A brief summary of the aerial acquisition parameters for this project are shown in Table 2.1. To meet the accuracies required, a control layout including checkpoints was developed, presented to the STARR II for review and surveyed by Compass Data, Inc., along with the required validation points.

Table 2.1: Planned LiDAR System Specifications

Parameters	10 cm RMSEz (non-vegetated)
Flying Height	2200 m AGL
Aircraft Ground Speed (knots)	160
Pulse Rate (Hz)	135300
Scan Rate (Hz)	49.2
Full Field of View (degrees)	38
Multi-Pulse	Yes
Full Swath Width (meters)	1300.00
Swath Overlap (percentage)	20%
Max. Point Spacing Across Track (meters)	1.25
Max. Point Spacing Along Track (meters)	1.57
Average point density (pts/mˆ2)	2.47
Lowest point density (pts/mˆ2)	1.96

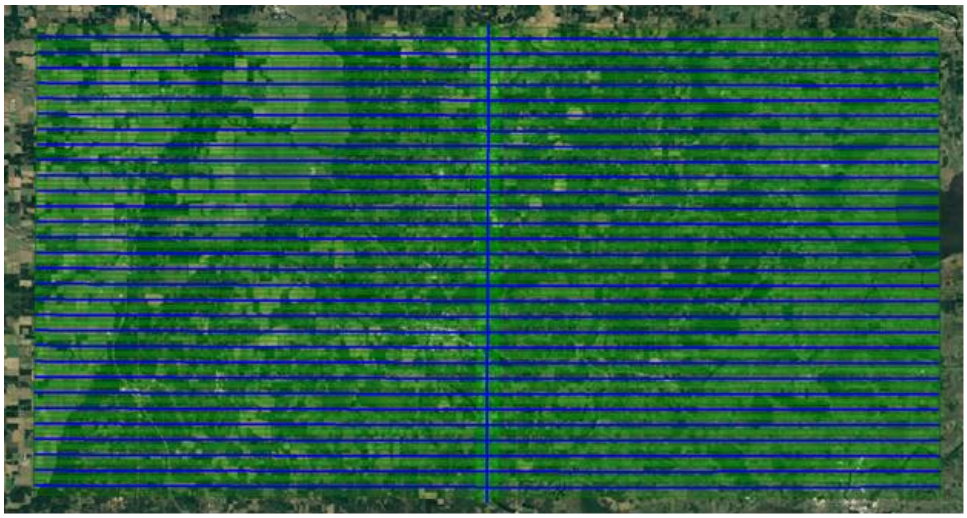

Figure 2.1: Planned Flight Lines

2.2 Ground Survey

All survey responsibilities were performed by Compass Data, Inc.

Datum
Coordinate Reference System: Wisconsin State Plane South, 4803
Horizontal Datum: NAD83 (2011), Epoch 2010.00
X, Y Linear Units: US Survey Feet
Vertical Datum: NAVD88, Geoid 12B
Units: US Survey Feet

2.3 Aerial LiDAR

Aerial LiDAR Base Station
Base stations determine where LIDAR data can be collected with the highest confidence of accuracy by measuring between satellites and the base station, itself.

Base station location:

- Set at Wittman Regional Airport, Oshkosh, WI (see figure 2.2)

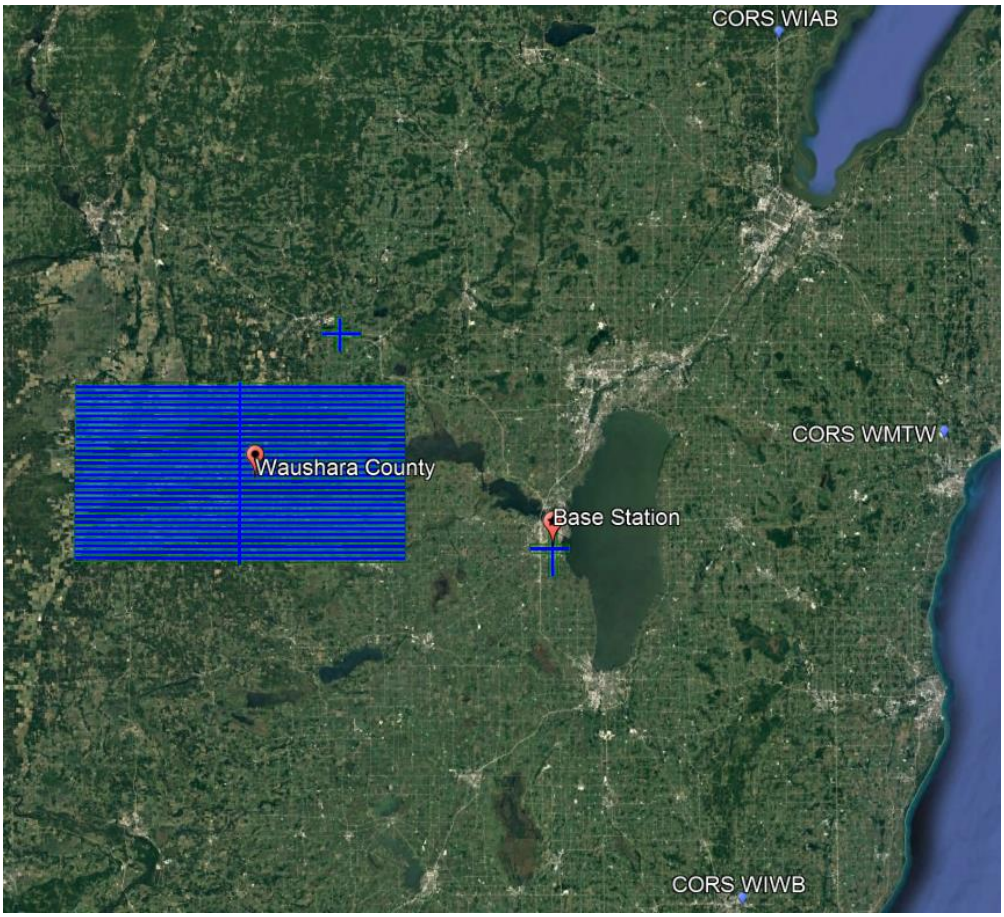

Figure 2.2: Location of base station and boresight locations in relation to project area

Aerial LIDAR Boresight Procedures

The purpose of boresighting is to determine the offset values for the IMU used in the LIDAR sensor. To determine the boresight offset values, the LIDAR sensor has to be flown in a certain configuration over a well-controlled site. The boresighting is done both prior to the flight of the project area and after. This ensures that the quality of the LIDAR was maintained throughout the process. Boresighting was performed at Wittman Regional Airport, Oshkosh, WI and Waupaca Municipal Airport, Waupaca, WI.

Aerial LIDAR Acquisition

The aerial survey teams were deployed at the first opportunity based on acceptable weather conditions. Leica's AeroPlan software was utilized to conduct the final flight planning. The sensor used was a Leica ALS70. There were 30 project flight lines, and 1 cross flight collected. Re-flights were needed on Strip 21, due to an error message reported by the data logger, and portions of Strips 22, 19, and 11 to compensate for initial off-line collection. On the date of the flight the weather was clear & smooth with low winds and low turbulence. High, scattered clouds were present but cleared throughout the day and did not significantly interfere with data collection.

Table 2.2 Flight Specifications

Parameters	10 cm RMSEz (non-vegetated)
Altitude AMSL (ft)	8200
Aircraft Ground Speed (knots)	1600
Pulse Rate (Hz)	135300
Scan Rate (Hz)	49.2
Full Field of View (degrees)	38.0
Multi-Pulse	Yes
Full Swath Width (ft)	4265.00
Swath Overlap (percentage)	20%
Max Point Spacing Across Track (meters)	1.25
Max Point Spacing Along Track (meters)	1.57
Average point density (pts/ sq. meter)	2.25
Lowest point density (pts/ sq. meter)	1.96

Flight Plan Line	TRJ NAME	Flight Date
1	211	11/08/17
2	208	11/08/17
3	207	11/08/17
4	206	11/08/17
5	205	11/08/17
6	204	11/08/17
7	203	11/08/17
8	202	11/08/17
9	114	11/07/17A
10	113	11/07/17A
11	112/311	11/07/17A,11/08/17
12	111	11/07/17A
13	307	11/08/17
14	306	11/08/17
15	305	11/08/17
16	304	11/08/17
17	303	11/08/17
18	313	11/08/17
19	214/308	11/07/17B,11/08/17
20	213	11/07/17B
21	110/212	11/07/17A/B
22	109/211	11/07/17A/B
23	108	11/07/17A
24	107	11/07/17A
25	106	11/07/17A
26	105	11/07/17A
27	104	11/07/17A
28	103	11/07/17A
29	102	11/07/17A
30	117	11/07/17A
31	210	11/07/17A

Table 2.3: Flight lines as they relate to mission trajectories

Position Dilution of Precision Report (PDOP)

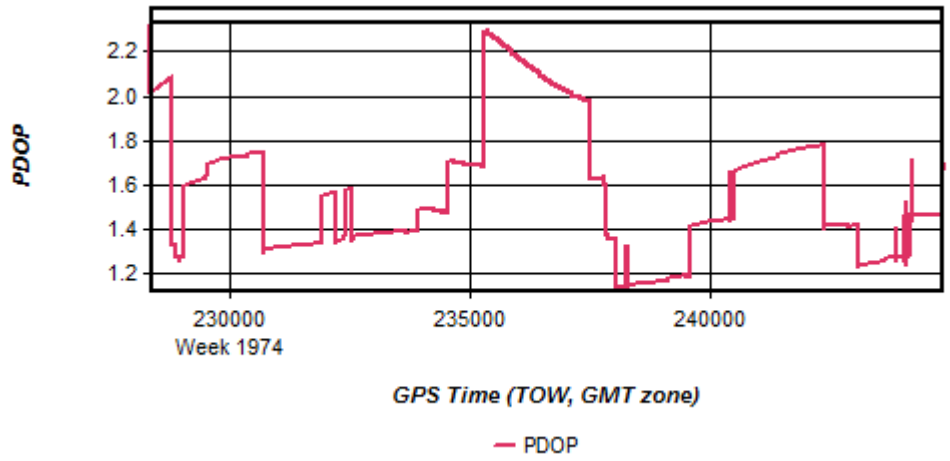

Figure 2.3: 11/07/17A_4102J_SN7232 [GNSS Combined] – PDOP Plot

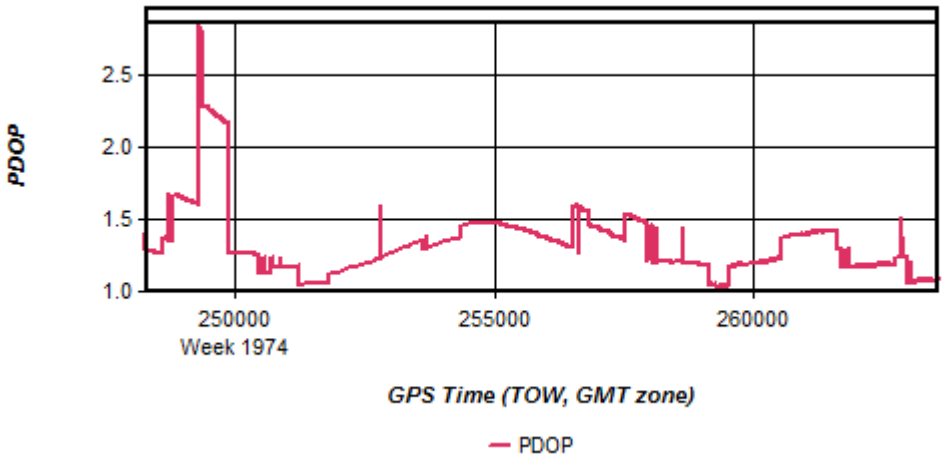

Figure 2.4: 11/07/17B_4102J_SN7232 [GNSS Combined] – PDOP Plot

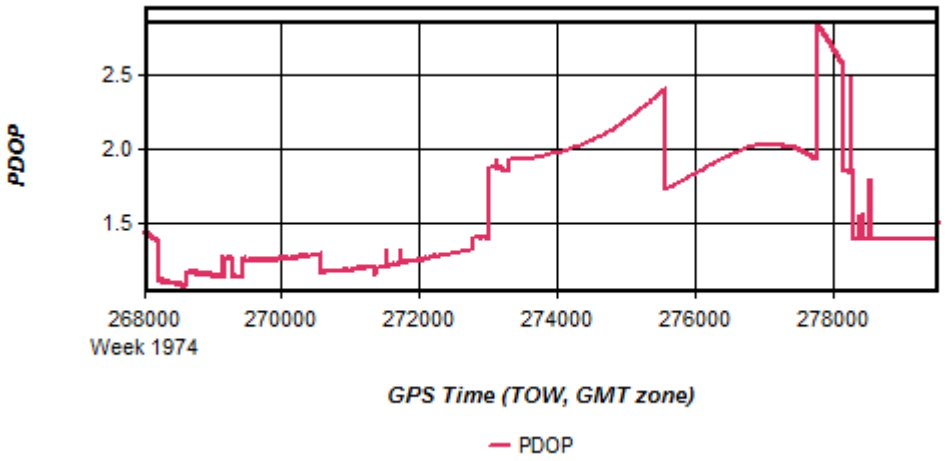

Figure 2.5: 11/08/17_4102J_SN7232 [GNSS Combined] – PDOP Plot

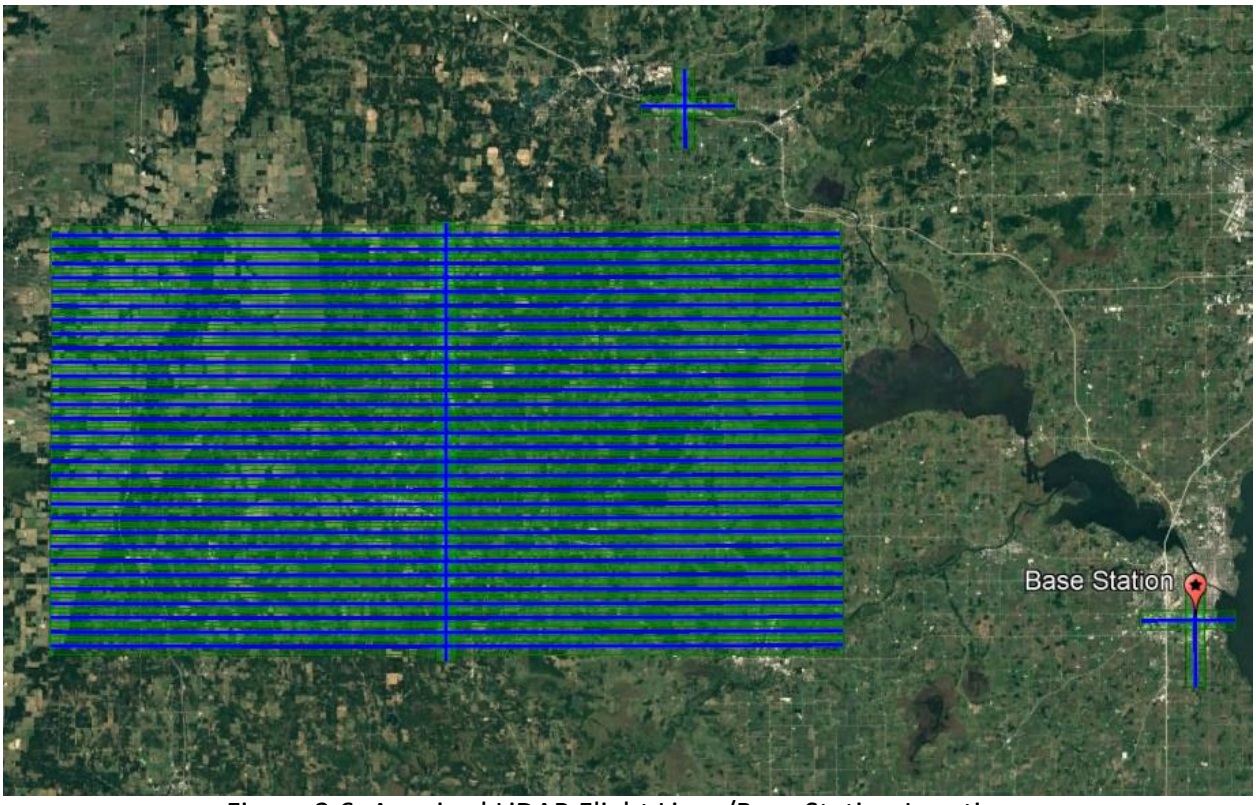

Figure 2.6: Acquired LiDAR Flight Lines/Base Station Locations

Project Site Definition	
Min/Max Ground Elevation	670-1300’
Flight Altitude AGL	2200 m
Geographic Location	Waushara County, WI
Distance Units	Survey Feet
Coordinate System	State Plane, Wisconsin South
Horizontal Datum	NAD83 (2011)
Vertical Datum	NAVD88, Geoid 12B
Leica ALS70 Settings (SN 7232)	
Scan FOV	38 degrees
Flying Altitude AMSL	8200 ft
Laser Pulse Rate (Hz)	135300
Scan Rate (Hz)	49.2
Laser Power (%)	100
Laser Pulse Width	1
Raw Laser Statistics	
Swath Width	1300.00m
Average Point Density	2.25 m
Average Point Spacing	.665 m

Flight Mission Data	
Aircraft	PA-31 Piper Navajo Chieftain
Date Flown	11/07/2017 – 11/08/2018
Number of Flight Lines	31
Total Flight Line Miles	1109
Flight Speed	~160
Data Processing	
New Boresight Calibration?	Yes
Min/Max Scan Angle Output	+/- 19 degrees
Actual Scan Angle Output	Full FOV
Tile Layout Used	Arbitrary, 5000'x5000' tiles
Data Formats Created	Las v1.4
Accuracy Testing	
Number of Control Points Used in Analysis	40 points, NVA 30 points, VVA
Number of Control Points Eliminated from Original Set	0 points
NVA of LAS Swaths @ 95% Confidence	0.094 m
NVA of DEM @ 95% Confidence	0.080 m
VVA of DEM @ 95th percentile	0.039 m

Table 2.4: Project Specifications

3.0 Processing Summary

The Continental Mapping team utilized Leica's CloudPro to initially process the data and convert it into LAS format. TerraMatch was then used to refine the LIDAR dataset's calibration. A RMSDz report was generated to provide additional numerical height difference data between swaths further indicating calibration was successful. The trajectory files and point cloud swaths were imported into GeoCue to perform project setup and calibration QC. This project set-up phase sets the project parameters, tiling scheme, and is the platform for initial macro runs. After import, checkpoints were run against the point cloud to verify the accuracy of the data prior to classification. The detailed description of this process is below in 4.0 Accuracy Assessment. After verifying the accuracy, the processing continues. A macro was then run through TerraScan to locate and set unusable noise points for withheld low and high classes, to find and set more standard low points, and to classify the ground. Due to differing terrain, this step may take multiple iterations after observing tested results and resetting macros to classify ground most efficiently per terrain type. Once the analyst has satisfactorily

verified the results of the ground macro, the ground classification QC begins. During the ground QC phase, analysts reclassify the point cloud in areas where the macro was unable to develop ground, or where points were misclassified. During this phase of production, analysts noted a number of non-vegetated areas with sparse point returns. A number of factors can produce the occurrence of sparse returns, including extremely dark, fresh, or wet pavement, prone to absorbing laser signals, and atmospheric haze, which has weakened the signal strength just enough to reduce the pulse returns below detection. Examples of this occurrence are shown in figure 3.1. and 3.2. Bridge points were also sought out by the LAS editors and classified to class 17. Following ground classification, a water macro was run on the dataset which utilized the hydro breaklines that were manually digitized to set LAS classification to water inside water polygons. These digitized breaklines were classified as ponds and rivers. After the hydro features were digitized, the ponds were flattened. This process calculated the lowest elevation of the feature, and used that elevation to populate the remaining vertices. This process ensures that all ponds are flat. The manually digitized river polygons were run against a monotonicity tool. This tool utilized the elevation of a centerline with the correct elevation and pushed that elevation out to the river polygon. This process not only maintains the monotonicity of the river, but also ensures that the river is flat from bank to bank. Rigorous quality steps were then performed for each classification level. The bare earth LIDAR points that fell within 3 feet of the water were classified to class 10 (Ignored ground) also using the water breaklines. After the analysts completed the QC process in TerraScan, raster files were produced as 32-bit floating GeoTiffs and Erdas Imagine IMG files using GeoCue Group's LP360. These files were created using only the ground class to sample elevation height. The 2-foot cell DEMs were run against proprietary tools to identify any remaining potential blunders. These automatic checks look for issues with the breaklines, as well as overall DEM deviations. Further, visual checks were completed in LP360 via colored terrain shading to objectively verify adjacent terrain such that hydro breaklines are placed at correct horizontal position and proper height adjustment relative to ground. Re-creation of DEM rasters were applied to tiles after ground or breakline fixes were made. After all LAS data completely passed QC and required no further edits, a macro was run to set overlap to the LAS.

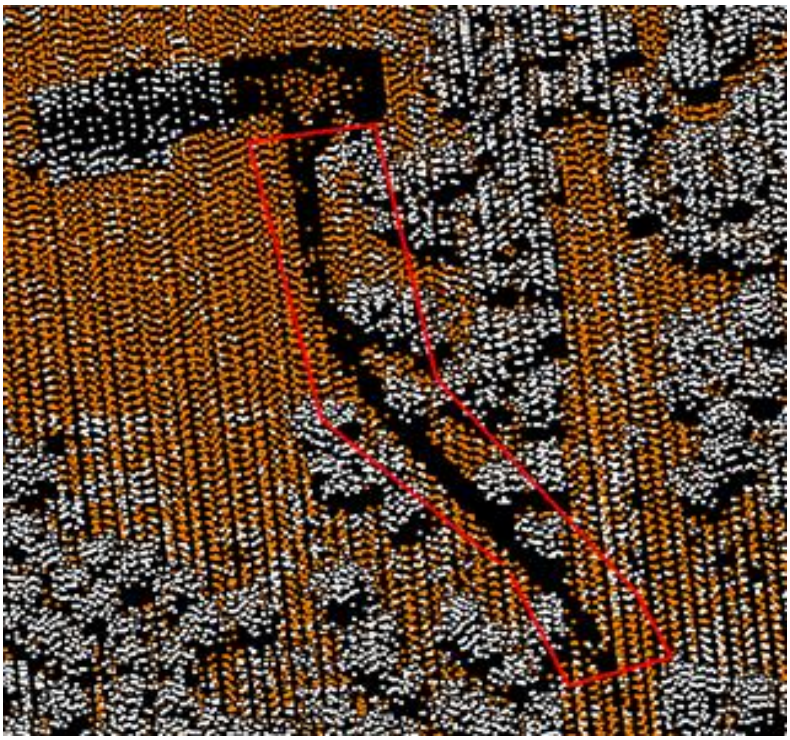

Figure 3.1: Heavy absorption of laser pulses on asphalt drive

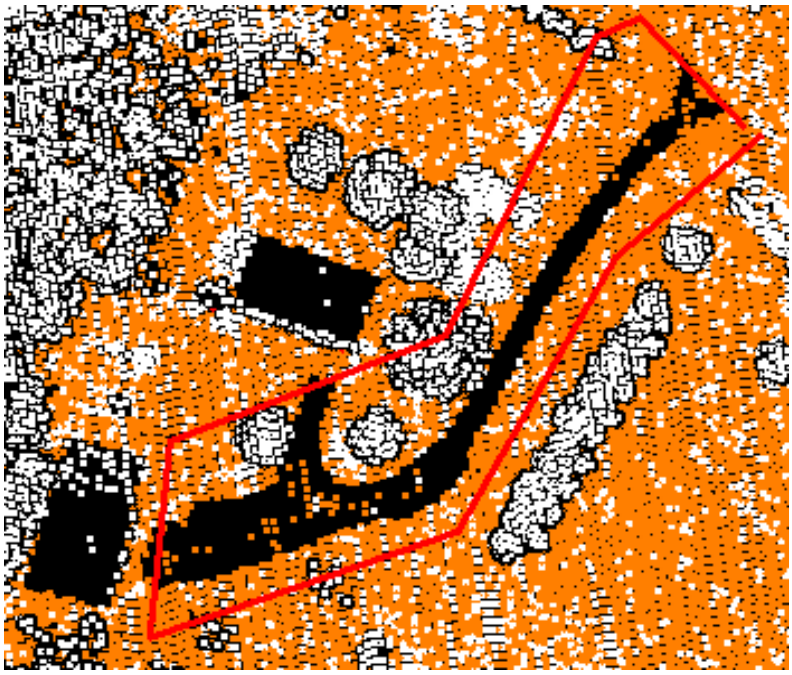

Figure 3.2: Heavy absorption of laser pulses on asphalt drive and roofing shingles

4.0 Accuracy Assessment

Continental Mapping utilized various software packages and techniques to verify the accuracy of the data. Utilizing GeoCue Group's LP360, Continental Mapping ran a survey-to-las check, followed by seamline analysis (swath to swath analysis) to verify the absolute and relative accuracy of the dataset. The survey-to-las check calculates the deviation between the survey point elevation and the point cloud elevation and exports an RMSE report. This check was performed by Continental Mapping as an internal check, utilizing the provided control, and formally by Compass Data Inc. utilizing the NVA points. (LAS NVA assessment results by Compass Data are below.) The second check calculates the deviation between the seamlines of the point cloud swaths. This check is performed in GeoCue Group's GeoCue software after classifying the initial ground. The output of the seam line analysis is represented visually on an intensity image with certain color shades representing discrete Z difference between like scenes in adjacent strips where patches of a particular color represent potentially problematic calibration errors, or conversely, excellent calibration. These images were delivered with the project deliverables. LP 360's planar statistics point cloud task for evaluating intraswath noise was also run in scattered locations throughout the project on flatter, uniform surfaces on the raw point cloud's 1st-return points with passing levels of noise. Below is the specification for these checks.

Quality Level (QL)	Smooth surface repeatability (cm)	Swath overlap difference, $RMSD_Z$ (cm)	Swath overlap difference, maximum (cm)
QL0	≤3	≤4	±8
QL1	≤6	≤8	±16
QL2	≤6	≤8	±16
QL3	≤12	≤16	±32

Table 4.1 Seamline analysis requirements

Flightline	Magnitude	Dz
102	0.0904	-0.0011
103	0.0901	-0.0005
104	0.0911	-0.0004
105	0.0922	0.002
106	0.0928	0.0015
107	0.093	-0.0019
108	0.0935	0.0038
109	0.0933	0.0034
110	0.093	-0.0056
111	0.0928	-0.0021
112	0.0931	0.0008
113	0.0945	-0.0033
114	0.0942	0.0026
117	0.0899	0.0058
203	0.0927	0.0019
204	0.0923	-0.0023
205	0.0924	0.0017
206	0.0913	-0.0016
207	0.0914	0.0007
208	0.0908	0.0004
209	0.0892	-0.0041
210	0.0929	0.0039
211	0.0926	0.0076
212	0.0927	-0.0027
213	0.0911	0.0068
214	0.0894	-0.0065
216	0.093	0.0026
303	0.0903	-0.0042
304	0.0902	-0.0035
305	0.0905	0.0029
306	0.0907	-0.0047
307	0.0914	0
308	0.0883	-0.006
311	0.093	0.0026
313	0.0914	0.0064

Avg. Magnitude: 0.09191 Svy Ft/2.80 cm

Table 4.2 Swath overlap difference results

Lift	Standard Deviation
110717A	5.84 cm
110717B	5.43 cm
110817	4.47 cm

Table 4.3 Smooth surface testing results

Quality Level (QL)	$RMSE_z$ (nonvegetated) (cm)	NVA at 95-percent confidence level (cm)	VVA at 95th percentile (cm)
QL0	≤5.0	≤9.8	≤14.7
QL1	≤10.0	≤19.6	≤29.4
QL2	≤10.0	≤19.6	≤29.4
QL3	≤20.0	≤39.2	≤58.8

Table 4.4 NVA and VVA accuracy requirements

The Vegetated Vertical Accuracy (VVA) testing occurred after the ground classification was completed. Known surveyed values were compared to vegetated locations testing the raster DEM data set. The VVA DEM testing was performed by Compass Data Inc.

Non-Vegetated Vertical Accuracy Assessment of LAS Swaths
There were 40 NVA points collected and tested in Waushara County. The NVA Test is at RMSE: 0.048 and * 1.96 = 0.094 Meters for 95% Confidence Level.

Non-Vegetated Vertical Accuracy Assessment of DEM
Test performed by CMC using NVA values vs DEM rasters. The NVA Test is at RMSE: 0.041 and * 1.96 = 0.080 Meters for 95% Confidence Level.

Vegetated Vertical Accuracy Assessment of DEM
There were 30 VVA points collected and tested in Waushara County. The VVA Test is at 95th percentile error, in Meters 0.039

Once all of the deliverables had been produced and verified, the data was moved to the Quality office for final review. The Quality office tested the data, determined that the correct procedures were followed, and verified that all of the deliverables in the SOW were finished.

APPENDIX A FLIGHT LOG

Note: This was a nighttime flight, which resulted in trajectory/lift dates that carried early into the following day.

LiDAR FLIGHT REPORT

	Pilot/Operator		Tail Number		Sky conditions, light conditions, horizon, shadowing, visibility/haze, cloud types, wind, turbulence, etc.
CREW	Nicol/Joe	AIRCRAFT	4102J	WEATHER	High scattered clouds – Clearing throughout the day to clear
	mm/dd/yy				
DATE	11/7/2017	8.11/8/2017			
	LIDAR S/N		GPS	Source: FWD Antenna	
Camera System	7232				
	fwd/aft				
(Hole)	FWD				

	Time	Location
Start-up	1525	KOSH
Shut-down	2000	KOSH

Calibration Certificate 29 Jan 2016

LiDAR STARTUP CHECKS	
Lens cleaned	
All ipds uploaded	
Pilot's screen functional	
Compact flash drive space	
SSDs have space	
Startup beeps & IPAS recording	
Initials:	JP

SSD	
Drive #	
SSD1	
Space Rem.	
392GB	

Job #	Location/ Site/Block	Line #	Flight	Crab Angle	Remarks
60844	Oshkosh	99	S		Start-up/Time: 1525
60844	Oshkosh	99	S		Calibration Line – Start
		98	W		Calibration Line
		30	W	3	
		29	E	5	
		28	W	5	
		27	E	6	
		26	W	5	
		25	E	3	
		24	W	4	
		23	E	3	
		22	W	3	About 20 miles in from the East there was a thin cloud, able to see through it
		21	E	4	Between 2 to 3 miles in from the West another thin cloud that I could see through pops up
		12	W	3	Skipped ahead to avoid small cloud coverage
		11	E	2	A little after 12.5 miles in there was a small cloud on the right side that I could not see through well
		10	W	4	
		9	E	3	
		99	S		Calibration Line – Finish
		98	E		Calibration Line
					Landed – Shut-down/Time: 2000
					Take off
60844	Oshkosh	99	S		Calibration Line – Start
		98	W		Calibration Line
		8	W	4	Shut-down and refueled picked up mission on this line – Start-up/Time: 2055 Location: KOSH Shut-down/Time: 0112 Location: KOSH
		7	E	5	
		6	W	3	
		5	E	5	
		4	W	3	
		3	E	5	
		2	W	4	
		1	E	5	
		31	S	10	
		22	W	4	Reflight – Started the line about 16 miles in from the East
		21	E	4	Reflight – whole line – 20 miles in from the West Error message popped up once, Data Logger not connected check cabling, it was still recording after it cleared
		20	W	4	
		19	E	6	
		99	S		Calibration Line – Finish
		98	W		Calibration Line
					Landed
					Take off
60844	Oshkosh	99	S		Calibration Line – Start
		98	W		Calibration Line
		18	W	3	Shut-down and refueled picked up mission on this line – Start-up/Time: 0227 Location: KOSH Shut-down/Time: 0538 Location: KOSH
		17	E	2	
		16	W	4	
		15	E	4	
		14	W	3	
		13	E	4	
		19	E	4	Reflight – Redid first 5 miles of the line to make up for being too far off line at the start earlier in the day
		11	E	4	Reflight – Started the line about 8 miles in from the West and ends at 15 miles in
		99	S		Calibration Line – Finish
		98	W		Calibration Line
					Landed