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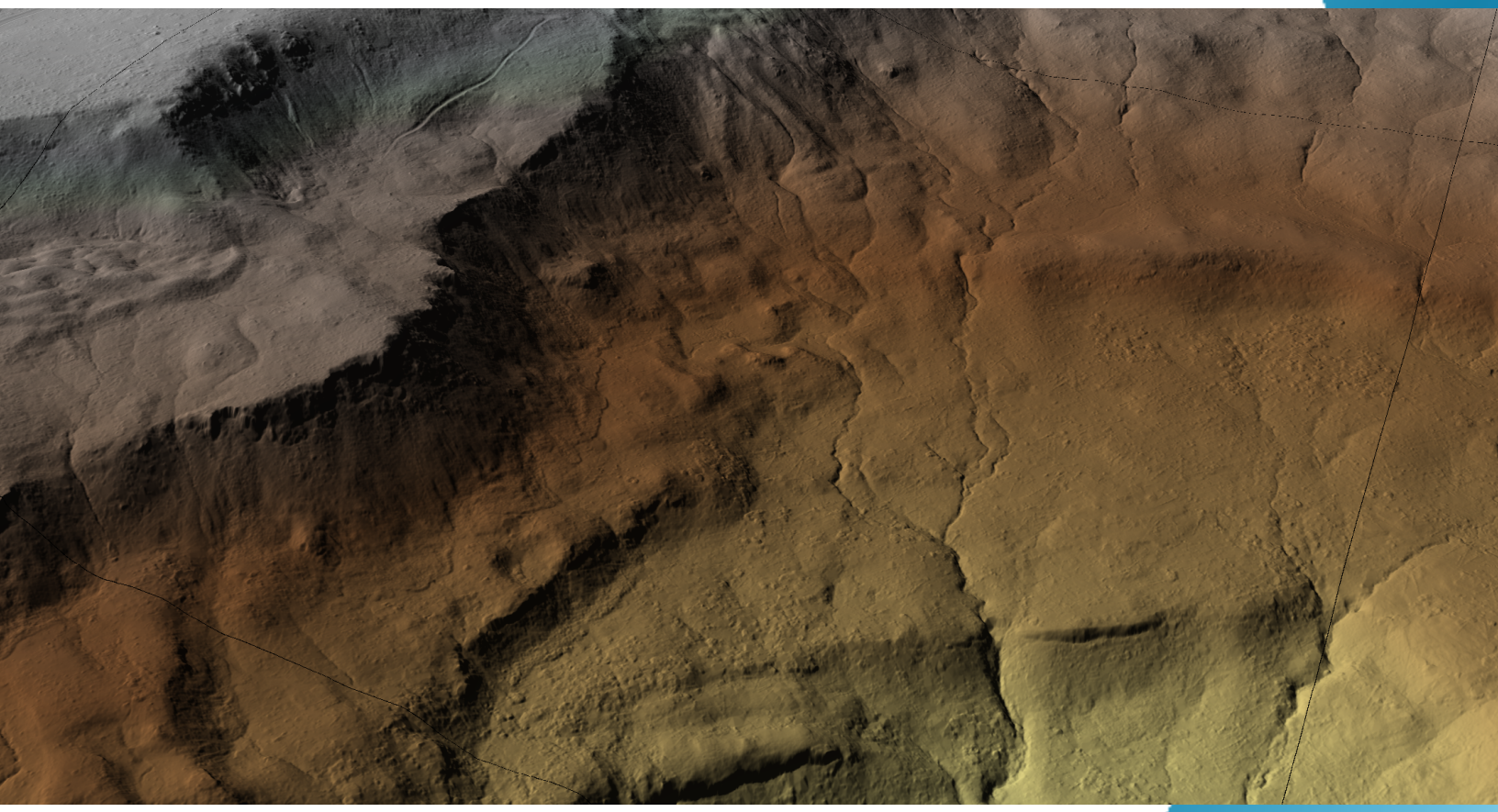

WA_EASTERNCASCADES_2019_B19 LIDAR PROCESSING REPORT

2021

Work Package: 182977
Work Unit: 216329

Submitted: November 1, 2021

Prepared for:

USGS
science for a changing world

Prepared by:

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1. Summary / Scope

1.1. Summary

This report contains a summary of the WA_EasternCascades_2019_B19, Work Unit 216329 lidar acquisition task order, issued by USGS under their Contract G16PC00016 on September 16, 2019. The task order yielded a project area covering approximately 1,491 square miles over Washington. 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	RMSEz
8 pts / m^2	2000-2085 m	58°	55%	≤ 10 cm

1.3. Coverage

The project boundary covers approximately 1,491 square miles over Washington. Project extents are shown in Figure 1.

1.4. Duration

LiDAR data was acquired from October 14, 2019 to April 7, 2020 in 26 total lifts. See "Section: 2.4. Time Period" for more details.

1.5. Issues

There were no major issues to report for this project.

WA_EasternCascades_2019_B19 Work Unit 216329 Projected Coordinate System: UTM Zone 10N Horizontal Datum: NAD1983 (2011) Vertical Datum: NAVD88 (GEOID 12b) Units: Meters	
Lidar Point Cloud	Classified Point Cloud in .LAS 1.4 format
Rasters	• 0.5-meter Hydro-flattened Bare Earth Digital Elevation Model (DEM) in GeoTIFF format • 0.5-meter Intensity images in GeoTIFF format
Vectors	Shapefiles (*.shp) • Project Boundary • LiDAR Tile Index • Calibration and QC Checkpoints (NVA/VVA) Geodatabase (*.gdb) • Continuous Hydro-flattened Breaklines
Reports	Reports in PDF format • Focus on Delivery • Processing Report
Metadata	XML Files (*.xml) • Breaklines • Classified Point Cloud • DEM • Intensity Imagery

WA_EasternCascades_2019_B19
Work Unit 216329 Boundary

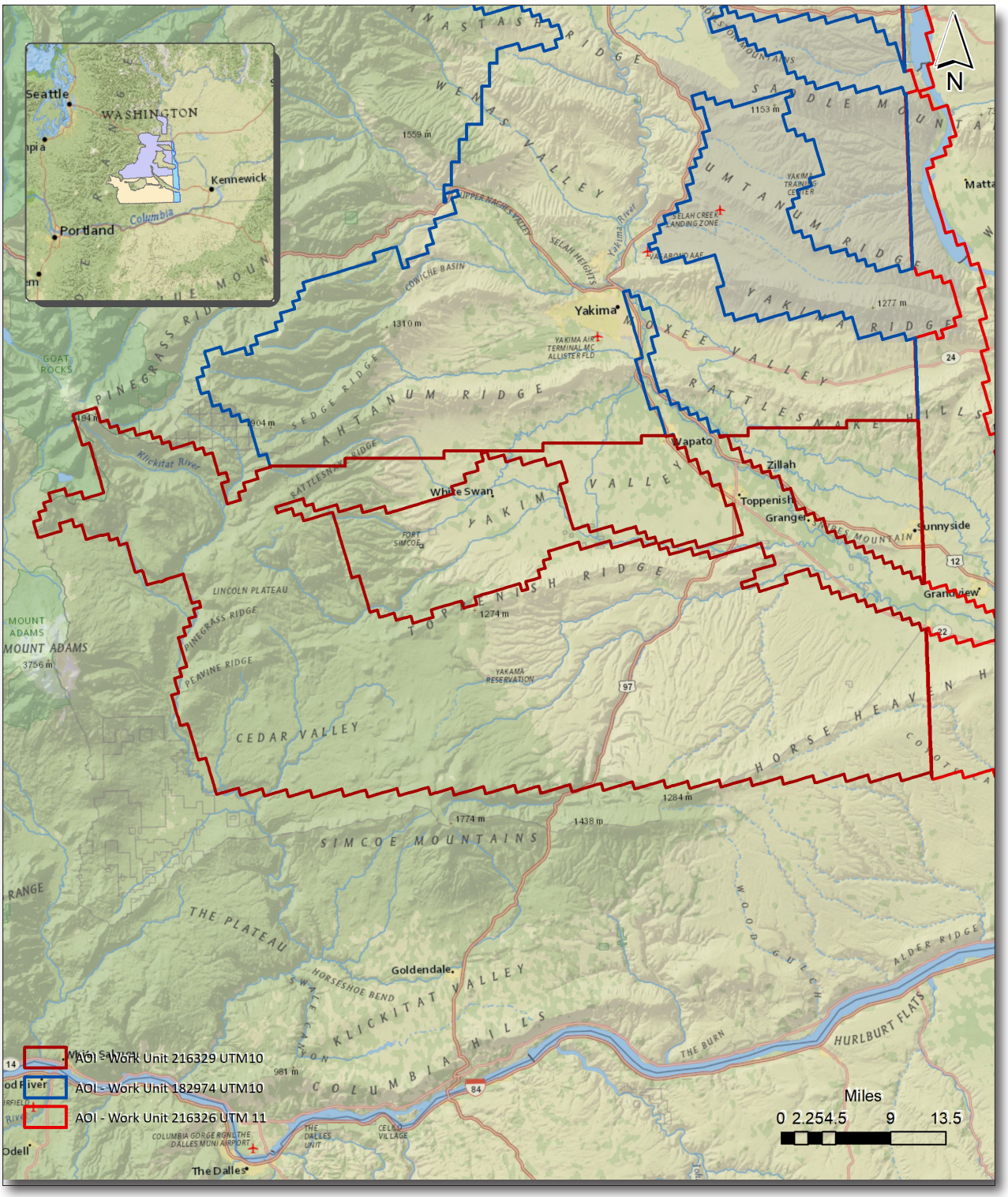


Figure 1. Work Unit Boundary

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. Planned flight lines are shown in Figure 2.

2.2. LiDAR Sensor

Quantum Spatial utilized a Riegl VQ1560i lidar sensor (Figure 3), sensor numbers 2738 and 3546 for data acquisition.

The Riegl 1560i system has a laser pulse repetition rate of up to 2 MHz resulting in more than 1.3 million measurements per second. The system utilizes a Multi-Pulse in the Air option (MPIA). The sensor is also equipped with the ability to measure up to an unlimited number of targets per pulse from the laser.

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

WA_EasternCascades_2019_B19
Work Unit 216329 Planned Flight Lines

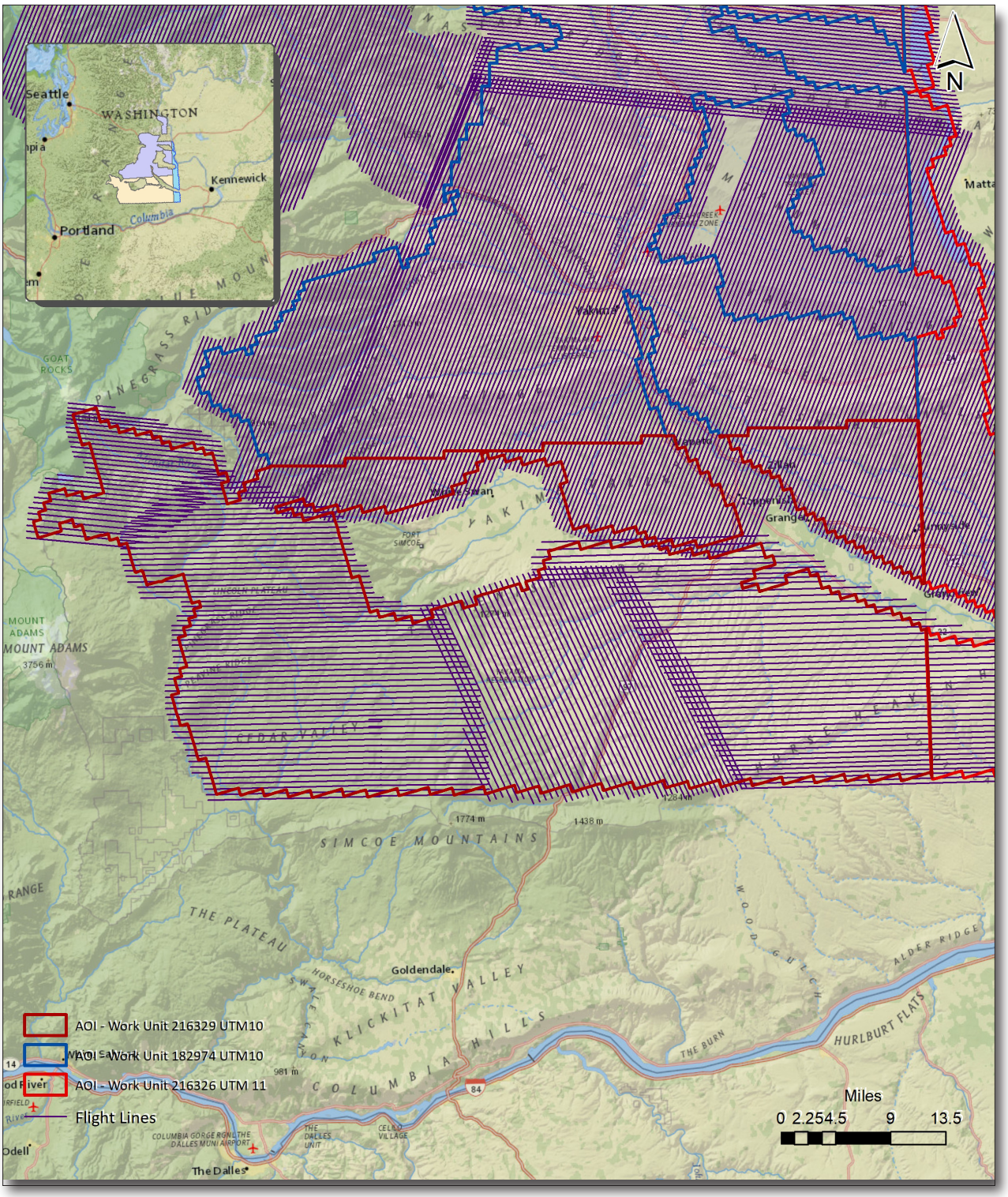


Figure 2. Planned Flight Lines

Table 2. LiDAR System Specifications

		Riegl VQ1560i (3546)	Riegl VQ1560i (2738)
Terrain and Aircraft Scanner	Flying Height	2085 m	2000 m
	Recommended Ground Speed	115 kts	160 kts
Scanner	Field of View	58°	58°
	Scan Rate Setting Used	81 lines per second	109 lines per second
Laser	Laser Pulse Rate Used	2 x 500 kHz	2 x 500 kHz
	Multi Pulse in Air Mode	yes	yes
Coverage	Full Swath Width	2330 m	2044 m
	Line Spacing	1048 m	695 m
Point Spacing and Density	Aggregate Pulse Spacing	0.32 m	0.35 m
	Average Point Density	2 x 4.84 pts / m^2	2 x 4 pts / m^2

Figure 3. Riegl V1560i Lidar Sensor

2.3. Aircraft

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

LiDAR Collection Planes

- Cessna Caravan (single-turboprop), Tail Number: N22TE
- Cessna Caravan (single-turboprop), Tail Number: N704MD
- Piper Navajo, Tail Number: C-FVZM

These aircraft provided an ideal, stable aerial base for lidar acquisition. These aerial platforms have 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 lidar systems. 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 between October 14, 2019 and April 7, 2020. Twenty-six aircraft lifts were completed. Accomplished lifts are listed below.

- 04062020A (SN3546,N704MD)
- 04072020A (SN3546,N704MD)
- 10142019A (SN3546,N22TE)
- 10142019B (SN3546,N22TE)
- 10152019A (SN3546,N22TE)
- 10182019A (SN3546,N22TE)
- 10222019A (SN3546,N22TE)
- 10252019A (SN3546,N22TE)
- 10262019A (SN3546,N22TE)
- 10272019A (SN3546,N22TE)
- 10282019A (SN3546,N22TE)
- 10292019A (SN3546,N22TE)
- 10302019A (SN3546,N22TE)
- 10312019A (SN3546,N22TE)
- 11012019A (SN3546,N22TE)
- 11032019A (SN2738,C-FVZM)
- 11042019A (SN2738,C-FVZM)
- 11052019A (SN2738,C-FVZM)
- 11082019A (SN2738,C-FVZM)
- 11102019A (SN2738,C-FVZM)
- 11182019A (SN2738,C-FVZM)
- 11202019A (SN2738,C-FVZM)
- 11222019A (SN2738,C-FVZM)
- 11242019A (SN2738,C-FVZM)
- 11292019A (SN2738,C-FVZM)
- 11302019A (SN2738,C-FVZM)

3. Processing Summary

3.1. Flight Logs

Flight logs were completed by LIDAR sensor technicians for each mission during acquisition. These logs depict a variety of information, including:

- Job / Project #
- Flight Date / Lift Number
- FOV (Field of View)
- Scan Rate (HZ)
- Pulse Rate Frequency (Hz)
- Ground Speed
- Altitude
- Base Station
- PDOP avoidance times
- Flight Line #
- Flight Line Start and Stop Times
- Flight Line Altitude (AMSL)
- Heading
- Speed
- Returns
- Crab

Notes: (Visibility, winds, ride, weather, temperature, dew point, pressure, etc).

3.2. 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. TerraScan and TerraModeler software packages are then used for automated data classification and manual cleanup. The data are manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler.

DEMs and Intensity Images are then generated using proprietary software. In the bare earth surface model, above-ground features are excluded from the data set. Global Mapper is used as a final check of the bare earth dataset.

Finally, proprietary software is used to perform statistical analysis of the LAS files.

Software	Version
RiPROCESS	1.8.6
Applanix + POSPac	8.4
GeoCue	2017.1.14.1
Global Mapper	19.1;20.1
TerraModeler	20.004
TerraScan	20.011
TerraMatch	20.004

3.3. LAS Classification Scheme

The classification classes are determined by the USGS Version 1.3 specifications and are an industry standard for the classification of LIDAR point clouds. All data starts the process as Class 1 (Unclassified), and then through automated classification routines, the classifications are determined using TerraScan macro processing.

The classes used in the dataset are as follows and have the following descriptions:

Table 3. LAS Classifications

	Classification Name	Description
1	Processed, but Unclassified	Laser returns that are not included in the ground class, or any other project classification
2	Bare earth	Laser returns that are determined to be ground using automated and manual cleaning algorithms
7	Low Noise	Laser returns that are often associated with scattering from reflective surfaces, or artificial points below the ground surface
9	Water	Laser returns that are found inside of hydro features
17	Bridge Deck	Laser returns falling on bridge decks
18	High Noise	Laser returns that are often associated with birds or artificial points above the ground surface
20	Ignored Ground	Ground points that fall within the given threshold of a collected hydro feature.

3.4. Classified LAS Processing

The bare earth surface is then manually reviewed to ensure correct classification on the Class 2 (Ground) points. After the bare- earth surface is finalized; it is then used to generate all hydro-breaklines through heads-up digitization.

All ground (ASPRS Class 2) LiDAR data inside of the Lake Pond and Double Line Drain hydro flattening breaklines were then classified to water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 3 feet was also used around each hydro flattened feature to classify these ground (ASPRS Class 2) points to Ignored ground (ASPRS Class 20). All Lake Pond Island and Double Line Drain Island features were checked to ensure that the ground (ASPRS Class 2) points were reclassified to the correct classification after the automated classification was completed.

Any noise that was identified either through manual review or automated routines was classified to the appropriate class (ASPRS Class 7 and/or ASPRS Class 18) followed by flagging with the withheld bit.

All data was manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper is used as a final check of the bare earth dataset. GeoCue was then used to create the deliverable industry-standard LAS files for all point cloud data. Quantum Spatial's proprietary software was used to perform final statistical analysis of the classes in the LAS files, on a per tile level to verify final classification metrics and full LAS header information.

3.5. Hydro-Flattened Breakline Processing

Class 2 LiDAR was used to create a bare earth surface model. The surface model was then used to heads-up digitize 2D breaklines of Inland Streams and Rivers with a 100 foot nominal width and Inland Ponds and Lakes of 2 acres or greater surface area.

Elevation values were assigned to all Inland Ponds and Lakes, Inland Pond and Lake Islands, Inland Streams and Rivers and Inland Stream and River Islands using Quantum Spatial's proprietary software.

All ground (ASPRS Class 2) lidar data inside of the collected inland breaklines were then classified to water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 3 feet was also used around each hydro flattened feature. These points were moved from ground (ASPRS Class 2) to Ignored Ground (ASPRS Class 20).

The breakline files were then translated to Esri file geodatabase format using Esri conversion tools.

Breaklines are reviewed against lidar intensity imagery to verify completeness of capture. All breaklines are then compared to TINs (triangular irregular networks) created from ground only points prior to water classification. The horizontal placement of breaklines is compared to terrain features and the breakline elevations are compared to lidar elevations to ensure all breaklines match the lidar within acceptable tolerances. Some deviation is expected between breakline and lidar elevations due to monotonicity, connectivity, and flattening rules that are enforced on the breaklines. Once completeness, horizontal placement, and vertical variance is reviewed, all breaklines are reviewed for topological consistency and data integrity using a combination of Esri Data Reviewer tools and proprietary tools.

3.6. Hydro-Flattened Raster DEM Processing

Class 2 LiDAR in conjunction with the hydro breaklines were used to create a 0.5-meter Raster DEM. Using automated scripting routines within proprietary software, a GeoTIFF file was created for each tile. Each surface is reviewed using Global Mapper to check for any surface anomalies or incorrect elevations found within the surface.

3.7. Intensity Image Processing

GeoCue software was used to create the deliverable intensity images. All withheld points were

ignored during this process. This helps to ensure a more aesthetically pleasing image. The GeoCue software was then used to verify full project coverage as well. GeoTIFF files with a cell size of 0.5-meter were then provided as the deliverable for this dataset requirement.

WA_EasternCascades_2019_B19
Work Unit 216329 Tile Layout

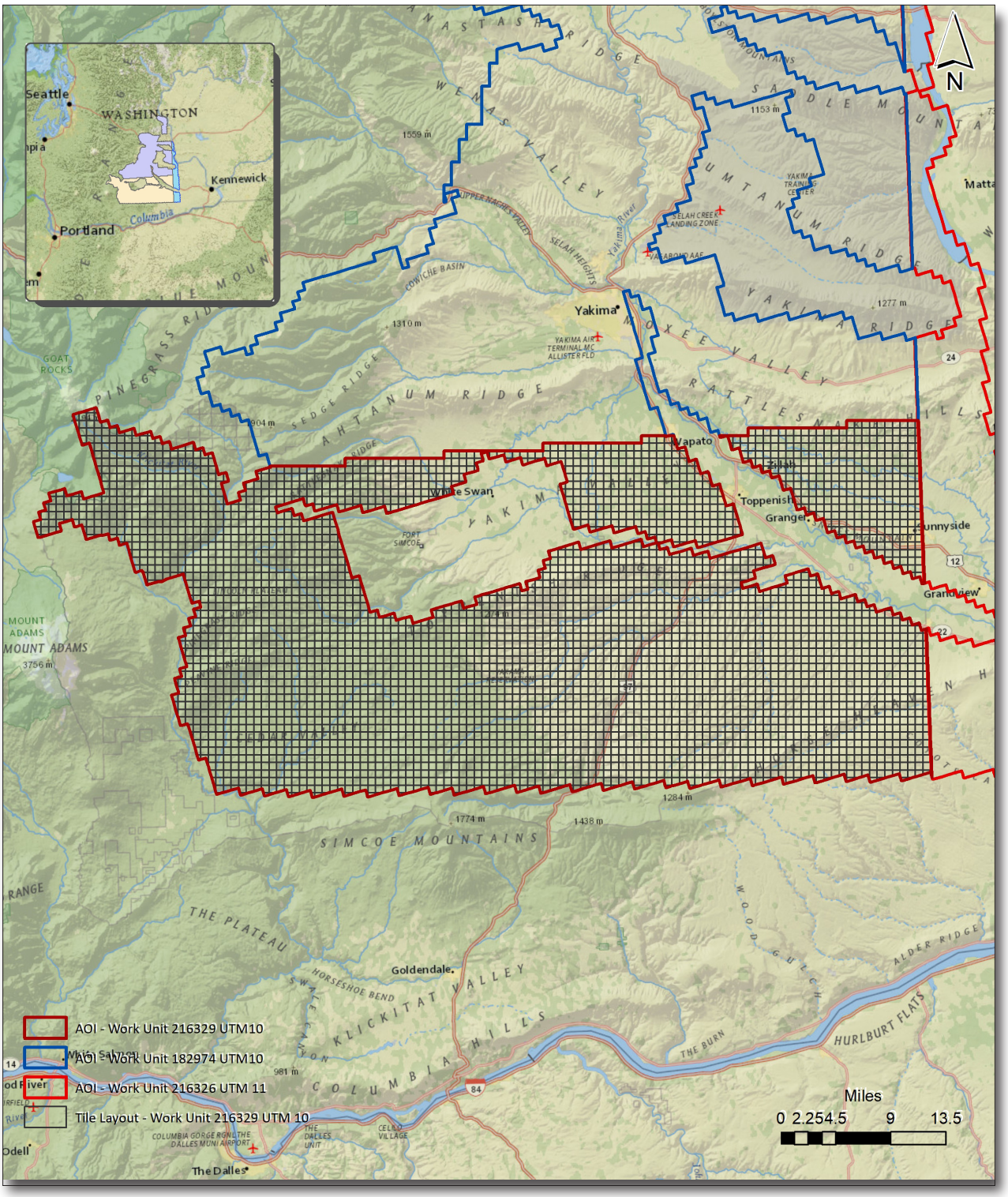


Figure 5. Lidar Tile Layout

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.

WA_EasternCascades_2019_B19
Work Unit 216329 Lidar Coverage

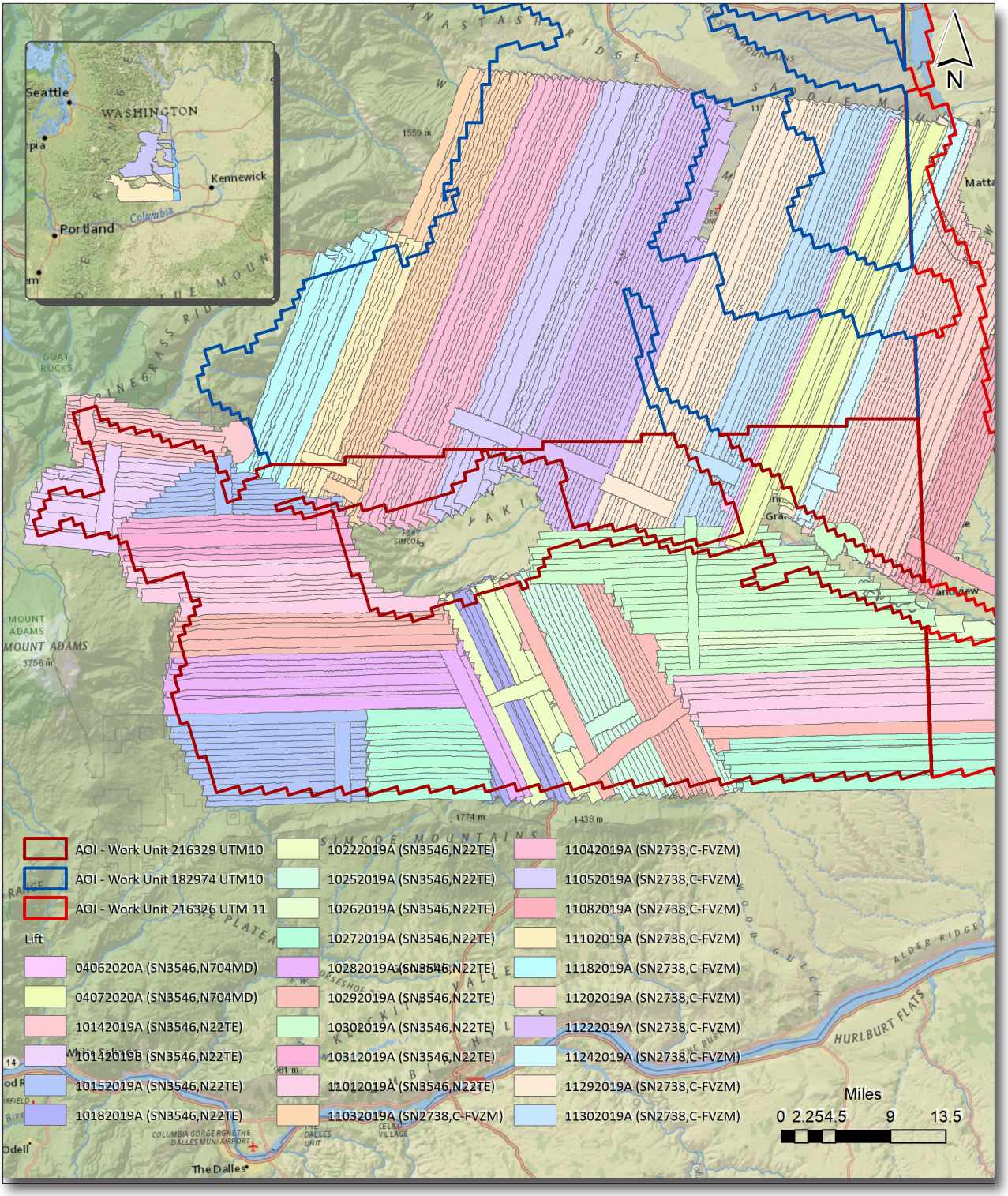


Figure 6. Lidar Coverage

5. Geometric Accuracy

5.1. Horizontal Accuracy

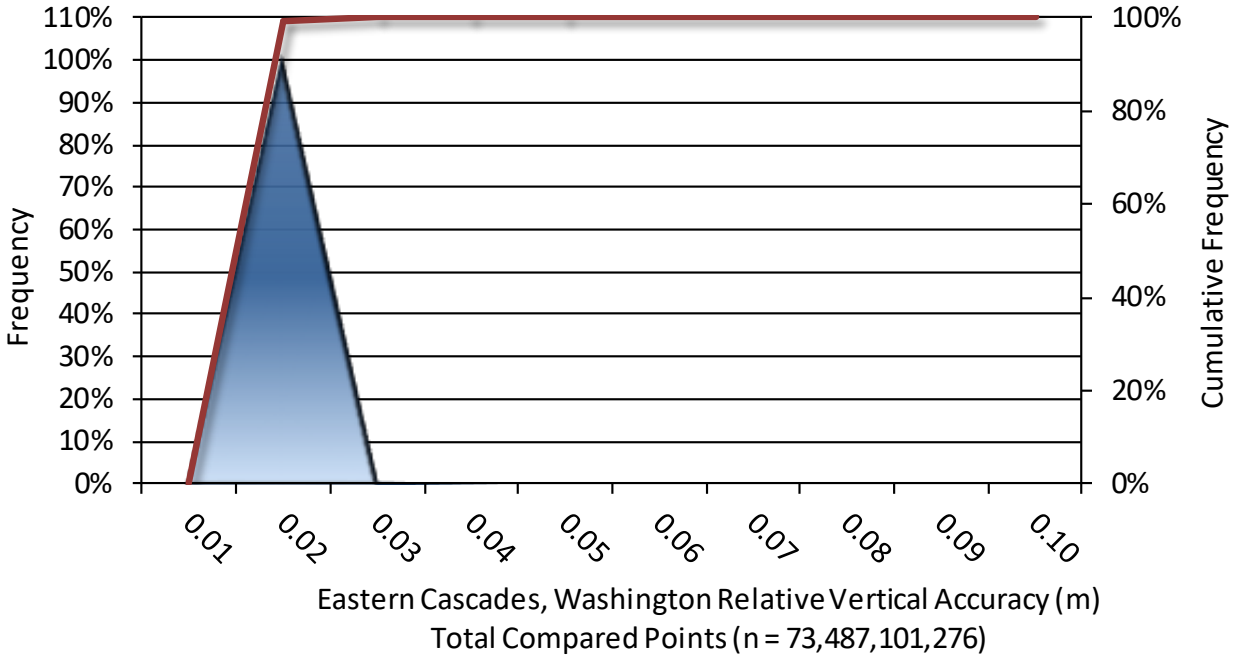
Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained $RMSE_r$ value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial Data Accuracy (NSSDA) reporting standard where a theoretical point will fall within the obtained radius 95% of the time. Based on a flying altitude of 2085 meters, an IMU error of 0.002 decimal degrees, and a GNSS positional error of 0.015 meters, this project was compiled to meet 0.23 meter horizontal accuracy at the 95% confidence level. A summary is shown below.

Horizontal Accuracy	
$RMSE_r$	0.43 ft
	0.13 m
ACC_r	0.74 ft
	0.23 m

5.2. Relative Vertical Accuracy

Relative vertical accuracy refers to the internal consistency of the data set as a whole: the ability to place an object in the same location given multiple flight lines, GPS conditions, and aircraft attitudes. When the lidar system is well calibrated, the swath-to-swath vertical divergence is low (<0.10 meters). The relative vertical accuracy was computed by comparing the ground surface model of each individual flight line with its neighbors in overlapping regions. The average (mean) line to line relative vertical accuracy for the Project Name Lidar project was 0.042 feet (0.013 meters). A summary is shown below.

Relative Vertical Accuracy	
Sample	149 flight line surfaces
Average	0.042 ft
	0.013 m
Median	0.042 ft
	0.013 m
RMSE	0.045 ft
	0.014 m
Standard Deviation (1σ)	0.006 ft
	0.002 m
1.96σ	0.011 ft
	0.003 m



Project Report Appendices

The following section contains the appendices as listed in the WA_EasternCascades_2019_B19 LiDAR Project Report.

Appendix A

Flight Logs

Julian Day	307	Flt	A

LIDAR Flight Log

Date	November 3 2019	Aircraft	C-FVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	J. Grayson
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	4
Scanner 2 Drive	5

Additional Notes

Aircraft Block Time					
Engine On	17:19	Ramp Out		Takeoff	17:38
Engine Off	23:13	Ramp In		Landing	23:02
Total	5.9 **hrs**	Total	**hrs**	Total	5.4 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:23	17:28
Post Mission	23:06	23:11

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
00	-		17:56	18:01			-	Figure 8
4001	3819307_01	9°	18:06	18:19			191103_180605	
4002	02	189°	18:23	18:35			182322	
4003	03	9°	18:40	18:54			184023	
4004	04	189°	18:58	19:10			185813	
4005	05	9°	19:15	19:28			191502	
4006	06	189°	19:33	19:45			193308	
4007	07	9°	19:50	20:03			195018	
4008	08	189°	20:07	20:20			200748	
4009	09	9°	20:25	20:40			202515	
4010	10	189°	20:44	20:57			204421	
4011	11	9°	21:01	21:15			210139	
4012	12	189°	21:18	21:31			211845	
4013	13	9°	21:35	21:49			213544	
4014	14	189°	21:54	22:06			215357	

Julian Day	307	Flt	A

LIDAR Flight Log

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Date	November 3 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCountie	Pilot	N. Emson
Location	Redding, CA	Operator	J. Grayson
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	4
Scanner 2 Drive	5

Additional Notes

Aircraft Block Time					
Engine On	17:19	Ramp Out		Takeoff	17:38
Engine Off	23:13	Ramp In		Landing	23:02
Total	5.9 **hrs**	Total	**hrs**	Total	5.4 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:23	17:28
Post Mission	23:06	23:11

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4015	15	9°	22:11	22:24			221113	
4016	16	189°	22:28	22:41			222833	
X-tie	17	279°	22:44	22:47			224421	
00	-		22:47	22:52			-	Figure 8

Julian Day	308	Flt	A

LIDAR Flight Log

Date	November 4 2019	Aircraft	C-FVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	J. Grayson
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:30	Ramp Out		Takeoff	16:47
Engine Off	22:24	Ramp In		Landing	22:13
Total	5.9 **hrs**	Total	**hrs**	Total	5.4 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:40	16:45
Post Mission	22:16	22:21

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
00	-		17:03	17:07			-	Figure 8
4017	3819308_01	9°	17:10	17:23			191104_171047	
4018	02	189°	17:28	17:42			172849	
4019	03	9°	17:46	17:59			174639	
4020	04	189°	18:04	18:17			180420	
4021	05	9°	18:21	18:34			182150	
4022	06	189°	18:38	18:52			183838	
4023	07	9°	18:56	19:10			185650	
4024	08	189°	19:15	19:28			191524	
4025	09	9°	19:33	19:46			193315	
4026	10	189°	19:51	20:04			195135	
4027	11	9°	20:08	20:21			200840	
4028	12	189°	20:26	20:39			202610	
4029	13	9°	20:43	20:56			204330	
4030	14	189°	21:00	21:13			210000	

Julian Day	308	Flt	A

LIDAR Flight Log

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Date	November 4 2019	Aircraft	C-FVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	J. Grayson
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:30	Ramp Out		Takeoff	16:47
Engine Off	22:24	Ramp In		Landing	22:13
Total	5.9 **hrs**	Total	**hrs**	Total	5.4 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:40	16:45
Post Mission	22:16	22:21

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4031	15	9°	21:17	21:31			211755	
4032	16	189°	21:36	21:49			213613	
X-tie	17	279°	21:55	21:58			215547	
00	-		22:58	22:03			-	Figure 8

Julian Day	309	Flt	A

LIDAR Flight Log

Date	November 5 2019	Aircraft	C-FVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:50	Ramp Out		Takeoff	17:14
Engine Off	22:51	Ramp In		Landing	22:41
Total	6.0 **hrs**	Total	**hrs**	Total	5.5 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:01	17:06
Post Mission	22:44	22:49

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		17:30	17:35			-	Figure 8
4033	3819309_01	189°	17:37	17:49			191105_173716	
4034	02	9°	17:54	18:08			175404	
4035	03	189°	18:12	18:25			181232	
4036	04	9°	18:29	18:43			182920	
4037	05	189°	18:47	19:00			184741	
4038	06	9°	19:05	19:19			190536	
4039	07	189°	19:24	19:37			192439	
4040	08	9°	19:41	19:54			194141	
4041	09	189°	19:59	20:11			195933	
4042	10	9°	20:16	20:28			201608	
4043	11	189°	20:32	20:44			203254	
4044	12	9°	20:48	21:00			204848	
4045	13	189°	21:05	21:16			210501	
4046	14	9°	21:21	21:32			212104	

Julian Day	309	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 5 2019	Aircraft	C-FVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:50	Ramp Out		Takeoff	17:14
Engine Off	22:51	Ramp In		Landing	22:41
Total	6.0 **hrs**	Total	**hrs**	Total	5.5 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:01	17:06
Post Mission	22:44	22:49

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4047	15	189°	21:38	21:50			213828	
4048	16	9°	21:55	22:07			215514	
4049	17	189°	22:11	22:23			221123	
X-TIE	18	179°	22:25	22:29			222552	
PPP-8	-		22:30	22:34			-	Figure 8

Julian Day	310	Flt	A

LIDAR Flight Log

Date	November 6 2019	Aircraft	C-FVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:56	Ramp Out		Takeoff	17:14
Engine Off	22:56	Ramp In		Landing	22:46
Total	6.0 **hrs**	Total	**hrs**	Total	5.5 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:06	17:11
Post Mission	22:49	22:54

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8			17:41	17:45				Figure 8
5001	3819310_01	83°	17:47	17:51			191106_174753	
5002	02	263°	17:55	17:59			175528	
5003	03	83°	18:03	18:10			180346	
5004	04	263°	18:15	18:23			181525	
5005	05	83°	18:27	18:35			182724	
5006	06	263°	18:39	18:47			183900	
5007	07	83°	18:51	19:00			185135	
5008	08	263°	19:03	19:12			190342	
5009	09	83°	19:15	19:24			191558	
5010	10	263°	19:29	19:38			192957	
5011	11	83°	19:43	19:51			194329	
5012	12	263°	19:56	20:05			195606	
5013	13	83°	20:08	20:17			200821	
5014	14	263°	20:20	20:29			202048	

Julian Day	310	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 6 2019	Aircraft	C-FVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:56	Ramp Out		Takeoff	17:14
Engine Off	22:56	Ramp In		Landing	22:46
Total	6.0 **hrs**	Total	**hrs**	Total	5.5 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:06	17:11
Post Mission	22:49	22:54

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
5015	15	83°	20:34	20:42			203411	
5016	16	263°	20:47	20:56			204736	
5017	17	83°	21:00	21:08			210012	
5018	18	263°	21:16	21:29			211609	
5019	19	83°	21:32	21:46			213258	
5020	20	263°	21:49	22:03			214954	
X-TIE	21	353°	22:07	22:10			220709	
PPP-8	-		22:11	22:15			-	Figure 8

Julian Day	311	Flt	A

LIDAR Flight Log

Date	November 7, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:45	Ramp Out		Takeoff	17:07
Engine Off	23:22	Ramp In		Landing	23:11
Total	6.6 **hrs**	Total	**hrs**	Total	6.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:55	17:00
Post Mission	23:15	23:20

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		17:32	17:37			-	Figure 8
5021	3819311_01	263°	17:40	17:54			191107_174030	
5022	02	83°	17:58	18:11			175829	
5023	03	263°	18:15	18:30			181531	
5024	04	83°	18:33	18:46			183339	
5025	05	263°	18:51	19:05			185101	
5026	06	83°	19:09	19:22			190917	
5027	07	263°	19:26	19:41			192639	
5028	08	83°	19:44	19:58			194457	
5029	09	263°	20:01	20:16			200151	
5030	10	83°	20:19	20:32			201945	
5031	11	263°	20:37	20:52			203725	
5032	12	83°	20:55	21:08			205554	
5033	13	263°	21:13	21:27			211316	
5034	14	83°	21:31	21:44			213133	

Julian Day	311	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 7, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:45	Ramp Out		Takeoff	17:07
Engine Off	23:22	Ramp In		Landing	23:11
Total	6.6 **hrs**	Total	**hrs**	Total	6.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:55	17:00
Post Mission	23:15	23:20

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
5035	15	263°	21:48	22:02			214832	
5036	16	83°	22:06	22:19			220646	
5037	17	263°	22:23	22:40			222355	
X-TIE	18	353°	22:41	22:44			224152	

Julian Day	312	Flt	A

LIDAR Flight Log

Date	November 8, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:55	Ramp Out		Takeoff	17:12
Engine Off	23:04	Ramp In		Landing	22:55
Total	6.2 **hrs**	Total	**hrs**	Total	5.7 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:04	17:09
Post Mission	22:57	23:02

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		17:30	17:34			-	Figure 8
4171	3819312_01	190°	17:39	17:40			191108_173900	
4170	02	10°	17:44	17:46			174441	
4169	03	190°	17:50	17:52			175023	
4168	04	10°	17:56	17:58			175632	
4167	05	190°	18:02	18:05			180256	
4166	06	10°	18:09	18:11			180920	
4165	07	190°	18:16	18:19			181616	
4164	08	10°	18:23	18:26			182337	
4163	09	190°	18:31	18:34			183107	
4162	10	10°	18:37	18:41			183732	
4161	11	190°	18:45	18:49			184502	
4160	12	10°	18:53	18:57			185330	
4159	13	190°	19:01	19:06			190127	
4158	14	10°	19:10	19:14			191016	

Julian Day	312	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 8, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:55	Ramp Out		Takeoff	17:12
Engine Off	23:04	Ramp In		Landing	22:55
Total	6.2 **hrs**	Total	**hrs**	Total	5.7 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:04	17:09
Post Mission	22:57	23:02

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4157	15	190°	19:19	19:25			191909	
4156	16	10°	19:29	19:34			192916	
4155	17	190°	19:38	19:45			193855	
4154	18	10°	19:49	19:54			194927	
4153	19	190°	19:59	20:04			195904	
4152	20	10°	20:09	20:14			200919	
4151	21	190°	20:19	20:25			201912	
4150	22	10°	20:29	20:35			202941	
4149	23	190°	20:39	20:46			203909	
4148	24	10°	20:49	20:55			204919	
4147	25	190°	21:00	21:08			210029	
4146	26	10°	21:11	21:19			211140	
4145	27	190°	21:23	21:31			212307	
4144	28	10°	21:34	21:42			213443	
4143	29	190°	21:45	21:54			214552	

Julian Day	312	Flt	A

LIDAR Flight Log

Date	November 8, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:55	Ramp Out		Takeoff	17:12
Engine Off	23:04	Ramp In		Landing	22:55
Total	6.2 **hrs**	Total	**hrs**	Total	5.7 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:04	17:09
Post Mission	22:57	23:02

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4142	30	10°	21:58	22:06			215817	
4141	31	190°	22:11	22:20			221127	
X-TIE	32	100°	22:23	22:27			222301	
PPP-8	-		22:27	22:32			-	Figure 8

Julian Day	314	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 10, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	15:49	Ramp Out		Takeoff	16:05
Engine Off	19:17	Ramp In		Landing	19:08
Total	3.5 **hrs**	Total	**hrs**	Total	3.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	15:58	16:03
Post Mission	19:10	19:15

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		16:20	16:26			-	Figure 8
4140	3819314_01	10°	16:29		16:38		191110_162956	Fog on the North end of lines
PPP-8	-		17:02	17:07			-	Figure 8
3040	02	9°	17:10	17:19			171027	
3039	03	189°	17:22	17:30			172224	
3038	04	9°	17:34	17:43			173431	
3037	05	189°	17:46	17:55			174653	
3036	06	9°	17:59	18:08			175936	
3035	07	189°	18:12	18:21			181251	
3034	08	9°	18:25	18:33			182512	
3033	09	189°	18:38	18:46			183840	clouds developing in the area
X-TIE	10	99°	18:51	18:54			185129	
PPP-8	-		18:54	18:58			-	Figure 8

Julian Day	322	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 18, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	J. Mathieson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:29	Ramp Out		Takeoff	16:48
Engine Off	21:04	Ramp In		Landing	20:54
Total	4.6 **hrs**	Total	**hrs**	Total	4.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:35	16:40
Post Mission	20:57	21:02

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		16:57	17:03			-	Figure 8
3032	3819322_01	189°	17:05	17:14			191118_170540	
3031	02	9°	17:17	17:25			171722	
3030	03	189°	17:28	17:37			172848	
3029	04	9°	17:40	17:48			174025	
3028	05	189°	17:52	18:01			175224	
3027	06	9°	18:04	18:11			180401	
3026	07	189°	18:15	18:22			181502	
3025	08	9°	18:26	18:33			182619	
3024	09	189°	18:37	18:44			183701	
3023	10	9°	18:47	18:54			184759	
3022	11	189°	18:58	19:06			185843	
3021	12	9°	19:09	19:16			190914	areas of snow in to the west
X-TIE	13	99°	19:19	19:21			191929	

Julian Day	322	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 18, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	J. Mathieson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:29	Ramp Out		Takeoff	16:48
Engine Off	21:04	Ramp In		Landing	20:54
Total	4.6 **hrs**	Total	**hrs**	Total	4.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:35	16:40
Post Mission	20:57	21:02

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
2111	14	9°	19:27	19:32			192737	Switched to 2300m block and
2110	15	189°	19:36	19:41			193612	changed scanner settings
2109	16	9°	19:44	19:49			194437	
2108	17	189°	19:53	19:59			195326	
2107	18	9°	20:02	20:06			200201	
2106	19	189°	20:10	20:16			201039	
2105	20	9°	20:19	20:24			201925	
2104	21	189°	20:27	20:33			202757	Cloud on south end of line, refly
X-TIE	22	9°	20:37	20:39			203724	
PPP-8	-		20:39	20:45			-	Figure 8

Julian Day	324	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 20, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	17:03	Ramp Out		Takeoff	17:22
Engine Off	23:32	Ramp In		Landing	23:21
Total	6.5 **hrs**	Total	**hrs**	Total	6.0 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:06	17:11
Post Mission	23:25	23:30

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		17:35	17:40			-	Figure 8
4140	3819324_01	10°	17:42	17:52			191120_174244	
4139	02	190°	17:55	18:04			175518	
4138	03	10°	18:07	18:17			180730	
4137	04	190°	18:20	18:29			182033	
4136	05	10°	18:33	18:44			183356	
4135	06	190°	18:47	18:56			184731	
4134	07	10°	19:00	19:10			190007	
4133	08	190°	19:13	19:22			191324	
4132	09	10°	19:26	19:37			192635	
4131	10	190°	19:40	19:49			194018	
4130	11	10°	19:53	20:04			195305	
4129	12	190°	20:07	20:17			200735	
4128	13	10°	20:20	20:32			202058	
4127	14	190°	20:34	20:43			203454	

Julian Day	324	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 20, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	17:03	Ramp Out		Takeoff	17:22
Engine Off	23:32	Ramp In		Landing	23:21
Total	6.5 **hrs**	Total	**hrs**	Total	6.0 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:06	17:11
Post Mission	23:25	23:30

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4126	15	10°	20:47	20:58			204744	
4125	16	190°	21:01	21:11			210159	
4124	17	10°	21:14	21:25			211449	
4123	18	190°	21:28	21:38			212850	
4122	19	10°	21:42	21:53			214252	
4121	20	190°	21:56	22:06			215651	
4120	21	10°	22:10	22:21			221007	
4119	22	190°	22:26	22:37			222603	
4118	23	10°	22:41	22:54			224150	
X-TIE	24	280°	23:03	23:06			230302	
PPP-8	-		23:06	23:11			-	Figure 8

Julian Day	325	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 21 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:35	Ramp Out		Takeoff	16:52
Engine Off	23:09	Ramp In		Landing	22:59
Total	6.6 **hrs**	Total	**hrs**	Total	6.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:39	16:44
Post Mission	23:02	23:07

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		17:03	17:08			-	Figure 8
5038	3819325_01	82°	17:10	17:24			191121_171045	
5039	02	262°	17:27	17:40			172701	
5040	03	82°	17:43	17:56			174345	
5041	04	262°	17:59	18:12			175955	
5042	05	82°	18:15	18:29			181547	
5043	06	262°	18:32	18:45			183244	
5044	07	82°	18:48	19:01			184852	
5045	08	262°	19:05	19:18			190520	
5046	09	82°	19:21	19:34			192139	
5047	10	262°	19:37	19:50			193743	
5048	11	82°	19:53	20:06			195356	
5049	12	262°	20:09	20:22			200941	
5050	13	82°	20:26	20:39			202605	
5051	14	262°	20:41	20:55			204154	

Julian Day	325	Flt	A

LIDAR Flight Log

Date	November 21 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	N. Emson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

AIRBORNE IMAGING INC

Aircraft Block Time					
Engine On	16:35	Ramp Out		Takeoff	16:52
Engine Off	23:09	Ramp In		Landing	22:59
Total	6.6 **hrs**	Total	**hrs**	Total	6.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:39	16:44
Post Mission	23:02	23:07

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
5052	15	82°	20:58	21:11			205829	
5053	16	262°	21:14	21:27			211430	
5054	17	82°	21:32	21:45			213207	
5055	18	262°	21:48	22:01			214833	
5056	19	82°	22:04	22:17			220431	
5057	20	262°	22:21	22:35			222101	
X-TIE	21	352°	22:37	22:40			223714	
PPP-8	-		22:43	22:48			-	Figure 8

Julian Day	326	Flt	A

LIDAR Flight Log

Date	November 22, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	J. Mathieson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:56	Ramp Out		Takeoff	17:12
Engine Off	23:13	Ramp In		Landing	23:04
Total	6.3 **hrs**	Total	**hrs**	Total	5.9 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:00	17:05
Post Mission	23:06	23:11

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		17:23	17:28			-	Figure 8
5058	3819326_01	82°	17:31		17:39		191122_173138	Clouds on east end of line, refly
4050	02	189°	17:44	17:55			174402	
4051	03	9°	17:58	18:10			175845	
4052	04	189°	18:13	18:25			181336	
4053	05	9°	18:29	18:40			182900	
4054	06	189°	18:43	18:55			184356	
4055	07	9°	18:58	19:10			185851	
4056	08	189°	19:13	19:25			191346	
4057	09	9°	19:28	19:40			192841	
4058	10	189°	19:43	19:55			194335	
4059	11	9°	19:59	20:11			195912	
4060	12	189°	20:14	20:27			201455	
4061	13	9°	20:30	20:43			203029	
4062	14	189°	20:46	20:58			204616	

Julian Day	326	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 22, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	J. Mathieson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:56	Ramp Out		Takeoff	17:12
Engine Off	23:13	Ramp In		Landing	23:04
Total	6.3 **hrs**	Total	**hrs**	Total	5.9 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	500 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:00	17:05
Post Mission	23:06	23:11

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4063	15	9°	21:01	21:14			210137	
4064	16	189°	21:17	21:29			211745	
4065	17	9°	21:32	21:42			213244	
4066	18	189°	21:47	21:55			214702	
4067	19	9°	21:59	22:07			215915	
4068	20	189°	22:11	22:20			221112	
4069	21	9°	22:24	22:32			222408	
4070	22	189°	22:35	22:44			223553	
X-TIE	23	279°	22:48	22:52			224834	
PPP-8	-		22:52	22:57			-	Figure 8

Julian Day	327	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 23, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	J. Mathieson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:25	Ramp Out		Takeoff	16:42
Engine Off	20:59	Ramp In		Landing	20:49
Total	4.6 **hrs**	Total	**hrs**	Total	4.1 **hrs**

Mission Plan			
AGL Height	2300 **m**	Pulse Rep Rate	700 **kHz**
Ground Speed	160 **kts**	Scan Rate	168 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:29	16:34
Post Mission	20:52	20:57

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		16:52	16:57			-	Figure 8
5058	3819327_01	82°	16:59		17:11		191123_165959	Clouds on east end of line, refly
4071	02	190°	17:16		17:25		171635	Clouds on south end of line, refly
2104	03	9°	17:37		17:40		173753	used scan settings for 2000m block
2104	04	9°	17:53	17:58			175315	changed settings for 2300m block
2103	05	189°	18:01	18:06			180144	
2102	06	9°	18:11	18:16			181107	
2101	07	189°	18:20	18:25			182024	
2100	08	9°	18:28	18:33			182835	
2099	09	189°	18:36	18:41			183631	
2098	10	9°	18:44	18:48			184421	
2097	11	189°	18:52	18:57			185227	
2096	12	9°	19:00	19:04			190012	

Julian Day	327	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 23, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounti	Pilot	J. Mathieson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:25	Ramp Out		Takeoff	16:42
Engine Off	20:59	Ramp In		Landing	20:49
Total	4.6 **hrs**	Total	**hrs**	Total	4.1 **hrs**

Mission Plan			
AGL Height	2300 **m**	Pulse Rep Rate	700 **kHz**
Ground Speed	160 **kts**	Scan Rate	168 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:29	16:34
Post Mission	20:52	20:57

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
2095	13	189°	19:08	19:12			190808	
2094	14	9°	19:15	19:20			191531	
2093	15	189°	19:23	19:27			192300	
2092	16	9°	19:30	19:34			193017	
2091	17	189°	19:38	19:42			193808	
2090	18	9°	19:44	19:49			194458	
2089	19	189°	19:52	19:56			195219	
2088	20	9°	19:59	20:04			195957	
2087	21	189°	20:07	20:12			200750	
2086	22	9°	20:15	20:19			201531	
2085	23	189°	20:23	20:28			202321	Patches of snow to the west
X-TIE	24	99°	20:31	20:35			203136	
PPP-8	-		20:35	20:40			-	Figure 8

Julian Day	328	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 24, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	J. Mathieson
Location	Yakima, WA	Operator	B. Eisenbart
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	1
Scanner 2 Drive	2

Additional Notes

Aircraft Block Time					
Engine On	16:10	Ramp Out		Takeoff	16:26
Engine Off	20:11	Ramp In		Landing	20:02
Total	4.0 **hrs**	Total	**hrs**	Total	3.6 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	1000 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	16:13	16:18
Post Mission	20:04	20:09

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		16:38	16:43			-	Figure 8
5058	3819328_01	83°	16:47	17:00			191124_164712	
5059	02	263°	17:05	17:21			170503	
5060	03	83°	17:24	17:38			172434	
5061	04	263°	17:42	17:58			174218	
5062	05	83°	18:01	18:14			180120	
X-TIE	06	353°	18:17	18:19			181754	
4117	07	190°	18:23	18:35			182320	
4116	08	10°	18:38	18:51			183856	
4115	09	190°	18:54	19:06			185445	
4114	10	10°	19:10	19:23			191006	
4113	11	190°	19:26	19:37			192616	Clouds nearby on the south end
X-TIE	12	100°	19:41	19:42			194111	
PPP-8	-		19:43	19:48			-	Figure 8

Julian Day	333	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 29, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	J. Mathieson
Location	Yakima, WA	Operator	J. Grayson
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	3
Scanner 2 Drive	1

Additional Notes

Aircraft Block Time					
Engine On	17:00	Ramp Out		Takeoff	17:20
Engine Off	23:35	Ramp In		Landing	23:25
Total	6.6 **hrs**	Total	**hrs**	Total	6.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	1000 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:08	17:13
Post Mission	23:28	23:33

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		17:37	17:42			-	Figure 8
4112	3819333_01	190°	17:45	17:56			191129_174520	light snow, moving to west side
4071	02	10°	18:04	18:17			180409	Potential light snow on all lines
4072	03	190°	18:20	18:33			182044	
4073	04	10°	18:37	18:51			183712	
4074	05	190°	18:54	19:07			185456	
4075	06	10°	19:11	19:25			191117	
4076	07	190°	19:29	19:41			192909	
4077	08	10°	19:45	19:59			194521	
4078	09	190°	20:03	20:15			200304	
4079	10	10°	20:19	20:33			201900	
4080	11	190°	20:36	20:49			203629	
4081	12	10°	20:53	21:07			205317	
4082	13	190°	21:10	21:23			211057	
4083	14	10°	21:27	21:41			212732	

Julian Day	333	Flt	A

LIDAR Flight Log

AIRBORNE IMAGING INC

Date	November 29, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCountie:	Pilot	J. Mathieson
Location	Yakima, WA	Operator	J. Grayson
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	3
Scanner 2 Drive	1

Additional Notes

Aircraft Block Time					
Engine On	17:00	Ramp Out		Takeoff	17:20
Engine Off	23:35	Ramp In		Landing	23:25
Total	6.6 **hrs**	Total	**hrs**	Total	6.1 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	1000 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:08	17:13
Post Mission	23:28	23:33

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
4084	15	190°	21:45	21:57			214503	
4085	16	10°	22:01	22:15			220105	
4086	17	190°	22:18	22:31			221834	
4087	18	10°	22:35	22:49			223505	
4088	19	190°	22:52	23:05			225231	
X-tie	20	280°	23:08	23:11			230820	
PPP-8	-		23:11	23:16			-	Figure 8

Julian Day	334	Flt	A

LIDAR Flight Log

Date	November 30, 2019	Aircraft	CFVZM
Project	3183_QSI_CascadeCounties	Pilot	J. Mathieson
Location	Yakima, WA	Operator	J. Grayson
Mission Objective			

System	1560i
Unit	38
IMU	**Applanix AP50**
GPS Rx	**Trimble**
Scanner 1 Drive	5
Scanner 2 Drive	4

Additional Notes

Aircraft Block Time					
Engine On	17:51	Ramp Out		Takeoff	18:07
Engine Off	22:15	Ramp In		Landing	22:04
Total	4.4 **hrs**	Total	**hrs**	Total	4.0 **hrs**

Mission Plan			
AGL Height	2000 **m**	Pulse Rep Rate	1000 **kHz**
Ground Speed	160 **kts**	Scan Rate	214 **Hz**
Laser Current	100 **%**	FOV	60 **Deg's**

Static Alignment	GPS Time	
	Start	End
Pre Mission	17:55	18:00
Post Mission	22:07	22:13

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Ln Aborted	Date Stamp	ALS Time Stamp	Comments
			Start	End	Time			
PPP-8	-		18:17	18:22			-	Figure 8
4089	3819334_01	10°	18:25	18:38			191130_182551	
4090	02	190°	18:42	18:56			184231	
4091	03	10°	18:59	19:12			185954	
4092	04	190°	19:16	19:29			191617	
4093	05	10°	19:33	19:46			193341	
4094	06	190°	19:50	20:03			195018	
4095	07	10°	20:07	20:20			200727	
4096	08	190°	20:23	20:37			202348	
4097	09	10°	20:40	20:53			204059	
4098	10	190°	20:57	21:10			205715	
4099	11	10°	21:14	21:26			211400	
4100	12	190°	21:30	21:43			213008	
X-tie	13	280°	21:47	21:49			214733	
PPP-8	-		21:49	21:55			-	Figure 8

Julian Day	207	Flight	B

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 25, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl Q 1560 II
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	18:16	**Takeoff**	18:36	
Engine Off	21:39	**Landing**	21:30	
Total	0.0 hrs	**Total**	⅞,101.1 hrs	

Mission Plan					
AGL Height	2000	m	**Pulse Rate**	1000 khz	
Target Speed	160	kts	**Scan Rate**	218 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	18:19	18:24
Post Mission	21:32	21:37

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200725	Comments
			Start	End	Time	nmi to End		
PPP-8		-	18:50	18:55			-	figure 8
3001	512020715	189	18:56	1857			185559	
3002	512020716	009	19:00	19:02			190034	
3003	512020717	189	19:05	19:07			190521	
3004	512020718	009	19:10	19:11			191003	
3005	512020719	189	19:16	19:18			191614	
3006	512020720	009	19:20	19:23			192058	
3007	512020721	189	19:26	19:28			192612	
3008	512020722	009	19:31	19:34			193141	
3009	512020723	189	19:37	19:40			193759	
3010	512020724	009	19:43	19:46			194323	
3011	512020725	189	19:49	19:52			194921	
3012	512020726	009	19:55	19:59			195553	
3013	512020727	189	20:01	20:05			200145	
3014	512020728	009	20:08	20:12			200803	

Julian Day	207	Flight	B

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 25, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl Q 1560 II
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	18:16	**Takeoff**	18:36	
Engine Off	21:39	**Landing**	21:30	
Total	0.0 hrs	**Total**	6,101.1 hrs	

Mission Plan					
AGL Height	2000	m	**Pulse Rate**	1000	khz
Target Speed	160	kts	**Scan Rate**	218	lps
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	18:19	18:24
Post Mission	21:32	21:37

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200725	Comments
			Start	End	Time	nmi to End		
3015	512020729	189	20:15	20:19			201526	
3016	512020730	009	20:22	20:28			202259	
3017	512020731	189	20:30	20:35			203019	
3018	512020732	009	20:38	20:43			203804	
3019	512020733	189	20:46	20:51			204624	
3020	512020734	009	20:55	21:02			205514	
X-TIE	512020735	279	21:07	21:10			210718	
PPP-8		-	21:10	21:15			-	figure 8

Julian Day	208	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 26, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl Q 1560 II
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:55	**Takeoff**	15:13	
Engine Off	21:13	**Landing**	21:03	
Total	0.0 hrs	**Total**	⅞,101.1hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	15:01	15:06
Post Mission	21:06	21:11

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200726	Comments
			Start	End	Time	nmi to End		
PPP-8		-	15:25	15:30			-	figure 8
2084	512020801	009	15:34	15:39			153454	
2083	512020802	189	15:43	15:47			154309	
2082	512020803	009	15:53	16:01			155330	
2081	51202084	189	16:06	16:18			160629	
2080	512020805	009	16:20	16:33			162054	
2079	512020806	189	16:34	16:47			163443	
2078	512020807	009	16:49	17:01			164923	
2077	512020808	189	17:04	17:16			170422	
2076	512020809	009	17:19	17:31			171903	
2075	512020810	189	17:33	17:45			173311	
2074	512020811	009	17:47	18:00			174755	
2073	512020812	189	18:01	18:14			180149	
2072	512020813	009	18:16	18:28			181607	
2071	512020814	189	18:30	18:42			183032	

Julian Day	208	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 26, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl Q 1560 II
Unit	51
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:55	**Takeoff**	15:13	
Engine Off	21:13	**Landing**	21:03	
Total	0.0 hrs	**Total**	⅞,101.1 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	15:01	15:06
Post Mission	21:06	21:11

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200726	Comments
			Start	End	Time	nmi to End		
2070	512020815	009	18:45	1857			184533	
2069	512020816	189	1859	19:12			185943	
2068	512020817	009	19:14	19:25			191421	
2067	512020818	189	19:28	19:40			192812	
2066	512020819	009	19:42	19:54			194224	
2065	512020820	189	19:56	20:07			195611	
2064	512020821	009	20:09	20:21			200938	
2063	512020822	189	20:23	20:35			202309	
X-TIE	512020823	099	20:41	20:45			204126	
PPP-8		-	20:45	20:50			-	figure 8

Julian Day	209	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 27, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl Q 1560 II
Unit	51
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:42	**Takeoff**	14:59	
Engine Off	20:19	**Landing**	20:09	
Total	0.0 hrs	**Total**	⅞,101.1 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:47	14:52
Post Mission	20:12	20:17

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200727	Comments
			Start	End	Time	nmi to End		
PPP-8		-	15:14	15:19			-	figure 8
2062	512020901	009	15:20	15:31			152010	
2061	512020902	189	15:34	15:46			153436	
2060	512020903	009	15:49	16:00			154905	
2059	512020904	189	16:02	16:14			160249	
2058	512020905	009	16:16	16:27			161647	
2057	512020906	189	16:30	16:42			163025	
2056	512020907	009	16:44	16:56			164441	
2055	512020908	189	16:58	17:09			165826	snow in peaks to the north
2044	512020909	009	17:13	17:25			171340	
2043	512020910	189	17:28	17:41			172828	
2042	512020911	009	17:42	17:54			174251	
2041	512020912	189	17:58	18:11			175801	
2040	512020913	009	18:13	18:25			181310	
2039	512020914	189	18:28	18:41			182819	

Julian Day 209	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 27, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl Q 1560 II
Unit	51
IMU	Applanix AP50
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:42	**Takeoff**	14:59	
Engine Off	20:19	**Landing**	20:09	
Total	0.0 hrs	**Total**	6,101.1 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:47	14:52
Post Mission	20:12	20:17

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200727	Comments
			Start	End	Time	nmi to End		
2038	512020915	009	18:43	18:56			184346	
2037	512020916	189	18:59	19:12			185931	
2036	512020917	009	19:15	19:27			191519	moderate turbulence
2035	512020918	189	19:30	19:43			193038	moderate turbulence
X-TIE	512020919	99	19:49	19:53			194933	moderate turbulence
PPP-8		-	19:53	19:58			-	figure 8

Julian Day	211	Flight	A

LIDAR Flight Log

Date	July 29, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

high winds, turbulence in the mountains

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:51	**Takeoff**	15:10	
Engine Off	18:59	**Landing**	18:50	
Total	0.0 hrs	**Total**	⅞,101.1hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:55	15:00
Post Mission	18:52	18:57

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200729	Comments
			Start	End	Time	nmi to End		
PPP-8		-	15:36	15:41			-	figure 8
6001	512021101	330	15:41	15:43			154147	
6002	512021102	150	15:46	15:47			154600	
6003	512021103	330	15:50	15:52			155015	
6004	512021104	150	15:52	15:57			155221	
6005	512021105	330	16:01	16:03			160113	
6006	512021106	150	16:06	16:08			160641	
6007	512021107	330	16:11	16:14			161147	
6008	512021108	150	16:17	16:20			161737	
6009	512021109	330	16:23	16:25			162305	
6010	512021110	150	16:29	16:32			162903	
6011	512021111	330	16:35	16:37			163517	
6012	512021112	150	16:41	16:44			164129	
X-TIE	512021113	60	16:48	16:50			164843	Snow in the peaks to the east
6061	512021114	150	17:02	17:11			170243	snow patches on line

Julian Day 211	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 29, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

high winds, turbulence in the mountains

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:51	**Takeoff**	15:10	
Engine Off	18:59	**Landing**	18:50	
Total	0.0 hrs	**Total**	6,101.1 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:55	15:00
Post Mission	18:52	18:57

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200729	Comments
			Start	End	Time	nmi to End		
6060	512021115	330	17:13	17:20			171316	moderate turbulence
6059	512021116	150	17:23	17:32			172356	moderate turbulence
6058	512021117	330	17:35	17:42			173502	moderate turbulence
X-TIE	512021118	60	17:47	17:48			174703	Snow in the peaks to the west
6121	512021119	330	18:01	18:08			180140	strong winds, moderate turbulence
PPP-8		-	18:11	18:16			-	figure 8

Julian Day	212	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 30, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:48	**Takeoff**	15:04	
Engine Off	19:14	**Landing**	19:04	
Total	4.4 hrs	**Total**	4.0 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:52	14:57
Post Mission	19:07	19:12

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200730	Comments
			Start	End	Time	nmi to End		
PPP-8		-	15:27	15:32			-	figure 8
6121	512021201	330	15:32	15:39			153209	
6120	512021202	150	15:45	15:53			154524	
6119	512021203	330	15:56	16:03			155646	
6118	512021204	150	16:08	16:16			160839	
6117	512021205	330	16:19	16:27			161951	
6116	512021206	150	16:31	16:40			163154	
6115	512021207	330	16:44	16:52			164441	
6114	512021208	150	16:55	17:04			165547	
6113	512021209	330	17:07	17:15			170722	
6112	512021210	150	17:19	17:28			171924	
6111	512021211	330	17:32	17:40			173245	
6110	512021212	150	17:45	17:54			174508	
6109	512021213	330	17:58	18:06			175831	
X-TIE	512021214	240	18:12	18:14			181240	Snow in the peaks to the West

Julian Day 212	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	July 30, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:48	**Takeoff**	15:04	
Engine Off	19:14	**Landing**	19:04	
Total	4.4 hrs	**Total**	4.0 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:52	14:57
Post Mission	19:07	19:12

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200730	Comments
			Start	End	Time	nmi to End		
PPP-8		-	18:14	18:19			-	figure 8

Julian Day 214	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	Aug 1, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Strong turbulent winds developed in the mountains

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:51	**Takeoff**	15:09	
Engine Off	20:53	**Landing**	20:43	
Total	6.0 hrs	**Total**	5.6 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:55	15:00
Post Mission	20:46	20:51

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200801	Comments
			Start	End	Time	nmi to End		
PPP-8		-	15:26	15:30			-	Figure 8
2054	512021401	009	15:53	15:41			153118	
2053	512021402	189	15:44	15:55			154428	
2052	512021403	009	15:58	16:08			155848	
2051	512021404	189	16:11	16:22			161141	
2050	512021405	009	16:25	16:35			162538	
2049	512021406	189	16:39	16:50			163918	
2048	512021407	009	16:53	17:03			165329	
2047	512021408	189	17:06	17:16			170606	
2046	512021409	009	17:19	17:30			171950	
2045	512021410	189	17:34	17:47			173408	
X-TIE	512021411	009	17:56	17:58			175616	clouds nearby to the west
6108	512021412	330	18:18	18:26			181817	
6107	512021413	150	18:29	18:38			182912	
6106	512021414	330	18:42	18:50			184203	

Julian Day 214	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	Aug 1, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Strong turbulent winds developed in the mountains

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:51	**Takeoff**	15:09	
Engine Off	20:53	**Landing**	20:43	
Total	6.0 hrs	**Total**	5.6 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:55	15:00
Post Mission	20:46	20:51

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200801	Comments
			Start	End	Time	nmi to End		
6105	512021415	330	18:53	19:02			185333	
6104	512021416	150	19:06	19:14			190610	
6103	512021417	330	1917	19:26			191716	
6102	512021418	150	19:03	19:38			190329	winds in the peaks increasing
X-TIE	512021419	330	19:42	19:43			194214	
6062	512021420	150	19:50	19:55	19:55		195059	turbulence, aborted line
Test Strip		-	20:00	20:00			200022	
PPP-8		-	20:04	20:07			-	figure 8

Julian Day 218	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	August 05, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Low clouds on the west end of the project

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:47	**Takeoff**	15:05	
Engine Off	19:24	**Landing**	19:12	
Total	4.6 hrs	**Total**	4.1 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:51	14:56
Post Mission	19:17	19:22

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200805	Comments
			Start	End	Time	nmi to End		
PPP-8		-	15:37	15:42			-	figure 8
6101	512021801	330	15:45	15:53			154500	
6100	512021802	150	15:56	16:06			155641	
6099	512021803	330	16:09	16:18			160934	
6098	512021804	150	16:21	16:30			162113	
6097	512021805	330	16:35	16:43			163506	
6096	512021806	150	16:46	16:56			164648	
6095	512021807	330	16:59	17:08			165957	
6094	512021808	150	17:11	17:21			171127	turbulence in the peaks
6082	512021809	330	17:23	17:31			172333	
6083	512021810	150	17:35	17:45			173548	
6084	512021811	330	17:49	17:58			174953	
6081	512021812	150	18:01	18:10			180119	
6080	512021813	330	18:13	18:21			181323	
6079	512021814	150	18:24	18:33			182430	

Julian Day	218	Flight	A

LIDAR Flight Log

Date	August 05, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Low clouds on the west end of the project

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time					
Engine On	14:47	**Takeoff**	15:05		
Engine Off	19:24	**Landing**	19:12		
Total	4.6 hrs	**Total**	4.1 hrs		

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:51	14:56
Post Mission	19:17	19:22

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200805	Comments
			Start	End	Time	nmi to End		
X-TIE	512021815	240	18:37	18:40			183744	clouds forming over AOI
PPP-8		-	18:41	18:46			-	figure 8

Julian Day 223	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	August 10, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:47	**Takeoff**	15:02	
Engine Off	20:30	**Landing**	20:18	
Total	5.7 hrs	**Total**	5.3 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:51	14:56
Post Mission	20:23	20:28

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200810	Comments
			Start	End	Time	nmi to End		
PPP-8		-	15:25	15:29			-	figure 8
6057	512022301	330	15:32	15:40			153234	
6056	512022302	150	15:43	15:50			154304	
6055	512022303	330	15:53	16:01			155315	clouds popping up on line
X-TIE 6055-57	512022304	240	16:07	16:08			160741	
2008	512022305	189	16:14	16:25			161441	
2009	512022306	009	16:27	16:38			162759	
2010	512022307	189	16:41	16:52			164138	
2011	512022308	009	16:55	17:07			165559	
2012	512022309	189	17:09	17:20			170916	
2013	512022310	009	17:23	17:34			172342	
2014	512022311	189	17:37	17:49			173742	
2015	512022312	009	17:52	18:03			175221	
2016	512022313	189	18:07	18:19			180721	
2017	512022314	009	18:22	18:33			182211	

Julian Day 223	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	August 10, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:47	**Takeoff**	15:02	
Engine Off	20:30	**Landing**	20:18	
Total	5.7 hrs	**Total**	5.3 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:51	14:56
Post Mission	20:23	20:28

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200810	Comments
			Start	End	Time	nmi to End		
2018	512022315	189	18:37	18:48			183701	moderate turbulence
2019	512022316	009	18:51	19:03			185129	moderate turbulence
2020	512022317	189	19:06	19:19			190627	moderate turbulence
2021	512022318	009	19:22	19:34			192220	heavy turbulence
2034	512022319	189	19:37		19:46		193702	heavy turbulence - line aborted
X-TIE 2008-21	5120223	279	19:51	19:54			195121	
PPP-8		-	19:54	19:58			-	figure 8

Julian Day	224	Flight	A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	August 11, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:44	**Takeoff**	15:00	
Engine Off	20:35	**Landing**	20:24	
Total	5.9 hrs	**Total**	5.4 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:49	14:54
Post Mission	20:27	20:32

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200811	Comments
			Start	End	Time	nmi to End		
Test Strip		-	15:19	15:28			151949	
PPP-8		-	15:31	15:35			-	figure 8
6054	512022401	330	15:37	15:43			153704	
6053	512022402	150	16:45	15:51			154552	
6052	512022403	330	15:54	16:00			155423	
6051	512022404	150	16:03	16:10			160352	
6050	512022405	330	16:13	16:19			161329	
6049	512022406	150	16:22	16:27			162209	
6048	512022407	330	16:30	16:36			163029	
6047	512022408	150	16:39	16:45			163935	
6046	512022409	330	16:47	16:53			164734	
6045	512022410	150	16:56	17:01			165614	
6044	512022411	330	17:05	17:11			170535	
6043	512022412	150	17:14	17:19			171431	
6042	512022413	330	17:23	17:28			172303	

Julian Day 224	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	August 11, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:44	**Takeoff**	15:00	
Engine Off	20:35	**Landing**	20:24	
Total	5.9 hrs	**Total**	5.4 hrs	

Mission Plan			
AGL Height	2300 m	**Pulse Rate**	700 khz
Target Speed	160 kts	**Scan Rate**	170 lps
Laser Current	100 %	**FOV**	60 degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:49	14:54
Post Mission	20:27	20:32

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200811	Comments
			Start	End	Time	nmi to End		
6041	512022414	150	17:31	17:36			173132	
6040	512022415	330	17:40	17:45			174014	
6039	512022416	150	17:48	17:54			174832	
6038	512022417	330	17:57	18:02			175726	
6037	512022418	150	18:05	18:10			180534	
6036	512022419	330	18:13	18:18			181326	
6035	512022420	150	18:20	18:25			182053	
6034	512022421	330	18:28	18:33			182840	
6033	512022422	150	18:36	18:40			183610	
6032	512022423	330	18:43	18:48			184343	
6031	512022424	150	18:50	18:54			185040	
6030	512022425	330	18:57	19:01			185751	
6029	512022426	150	19:05	19:09			190508	
6028	512022427	330	19:11	19:15			191144	
6027	512022428	150	19:19	19::23			191904	

Julian Day 224	Flight A

LIDAR Flight Log

AIRBORNE IMAGING
A Clean Harbors Company

Date	August 11, 2020	**Aircraft**	C-GKSX
Project	3183 QSI Cascade	**Pilot**	A. Murray
Location	Yakima WA	**Operator**	B. Eisenbart
Mission Objective			

System	Reigl VQ 1560 II
Unit	S2224051
IMU	Applanix AP60
GPS Rx	Trimble GNSS17
Scanner 1 Drive	
Scanner 2 Drive	

Additional Notes

Time to next maintenance: _____ ◉ 50 hr ○ 100 hr

Aircraft Block Time				
Engine On	14:44	**Takeoff**	15:00	
Engine Off	20:35	**Landing**	20:24	
Total	5.9 hrs	**Total**	5.4 hrs	

Mission Plan					
AGL Height	2300	m	**Pulse Rate**	700 khz	
Target Speed	160	kts	**Scan Rate**	170 lps	
Laser Current	100	%	**FOV**	60	degs

Static Alignment	GPS Time	
	Start	**End**
Pre Mission	14:49	14:54
Post Mission	20:27	20:32

Flight Line	LiDAR File Name	Flight Direction	GPS Time		Line Aborted		Mission ID Time Stamp 200811	Comments
			Start	End	Time	nmi to End		
6026	512022429	330	19:25	19:30			192552	
6025	512022430	150	19:32	19:36			193233	
6024	512022431	330	19:39	19:43			193949	clouds to the west
X-TIE	512022432	060	19:47	19:51			194710	
2034		189	19:57		20:01		195744	clouds on line - refly
PPP-8		-	20:01	20:06			-	figure 8

Project Name: **Eastern Cascades USGS**

Date	Mission ID	Sensor	Aircraft Make/Model	Aircraft Tail Number	Flight Plan	Lines Flown/Dead End Stopped at	Flight 1 Wheels Up (PDT)	Flight 1 Wheels Down (PDT)	Flight 1 Begin Hobbs	Flight 1 End Hobbs	Flight 1 Total Hobbs	Operator 1	Pilot 1	Base of Operations (airport, KXXX)	Notes	Plan for Tomorrow	System Error(s)	Action Taken
10/14/2019	20191014_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	164-192	9:19:00 AM	3:30:00 PM	5185	5191.2	6.2	Stephanie Cohee	Bob Cale	KYKM	for frost conditions to get warmer in the morning. Hit the Eastern Cascades project for	Check weather conditions and prioritize from there.	2046: WARNING:APDFOV_CTRL_PI C_COMM_ERROR	cleared all errors in system.
10/15/2019	20191015_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	15-24, 75-60	8:55:00 AM	1:46:00 PM	5191.2	5196	4.8	Stephanie Cohee	Bob Cale	KYKM	We were able to get an early start today with out frost conditions. We targeted the NW/N side of Mt. Adams lines first, but due to turbulence we were pushed out and moved to	Check on weather and prioritize from there.		
10/18/2019	20191018_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	117-122, 125-130	9:06:00 AM	11:40:00 AM	5196.6	5199.1	2.5	Ben Miller	Chris Gattman	KYKM	around, pushed around until	Eastern Cascades	Pilot killed sensor power while on	reboot
10/22/2019	20191022_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	123-124, 130-135	8:55:00 AM	12:10:00 PM	5199.1	5202.1	3	Ben Miller	Chris Gattman	KYKM	Cascades, in high winds, 59+kts tailwinds at alt, flew	Eastern Cascades	Data recorder failed to format HD	Reboot reformat
10/25/2019	20191025_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	136-148, 156-161	8:55:00 AM	2:38:00 AM	5213.2	5218.7	5.5	Ben Miller	Chris Gattman	KYKM	Mobd to Eastern Cascades. Flew line 50 3/4s too turbulent, aborted line. Moved to line 136. Line 139 flew 130 kts 6nm from line end. Mod Turb	Eastern Cascades		
10/26/2019	20191026_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	89-92, 106-116	8:46:00 AM	12:58:00 PM	5218.7	5222.7	4	Ben Miller	Chris Gattman	KYKM	was cold, got there and clouds rain and ice kept us from AOI.	Eastern Cascades		
10/27/2019	20191027_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	1-14, 106-116	9:08:00 AM	2:30:00 PM	5222.7	5228.1	5.4	Ben Miller	Chris Gattman	KYKM	Mobd to Eastern Cascades. Started with refly of line 59 but aborted due to clouds at 11nm to line end. Moved to line 14, small amount of snow at 2.5nm to line end. Line 12	Eastern Cascades		
10/28/2019	20191028_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	50-59, 121, 122	12:54:00 PM	4:14:00 PM	5228.1	5231.4	3.3	Ben Miller		KYKM	to low level freezing and precipitation and mod turb. Conditions cleared by noon, Mob'd to East Cascades.	Eastern Cascades		
10/29/2019	20191029_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	42-49, 148-155, 104, 105	8:48:00 AM	2:13:00 PM	5231.4	5236.8	5.4	Ben Miller	Chris Gattman	KYKM	Mobd to line 49. Winds 26kts at tail. Started line, got "621:Error:SPF_REAR_BOTTOM_INTERFACE_CRC_ERROR". Rebooted system, refly line. light snow on ground for lines 42-49. High speed around 140 kts on w-e lines.	Eastern Cascades	Error 621 on first line flown line 49	Reboot stabilized system
10/30/2019	20191030_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	76-82, 83-88, 93-96, 162, 163	10:42:00 AM	4:00:00 AM	5236.8	5242	5.2	Ben Miller	Chris Gattman	KYKM	"14:warning:device_temp_is_low". Waited until up to temp. Mob'd to East Cascades. Started with line 76. Laser misfire after line 79. Aborted	Eastern Cascades	error "14:warning:device_temp_is_low " when booting system	waited a few minutes until interface said it was read
10/31/2019	20191031_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	26-32			5242	5247.6	5.6	Ben Miller	Chris Gattman	KYKM	Good Day of flying. No issues to report	Eastern Cascades	n/a	n/a
11/1/2019	20191101_SN3546	Riegl VQ1560i S2223546	Cessna Caravan 208B	N22TE	Eastern Cascades QL1	33-41, 97-103	10:22:00 AM	4:24:00 AM	5247.6	5253.7	6.1	John Neubert	Bob Cale	KYKM	lines 33-41, 97-103, refly line	Eastern Cascades	'Device temp high'	blocked vents to keep
4/6/2020	20200406_SN3546	Riegl VQ1560i S2223546	Beeachcraft King Air	N94S	Eastern Cascades QL1	1-4	10:02:00 AM	11:06:00 AM	N/A	N/A	N/A	Justen Maxey	Dynamic	KYKM	clouds pushed us out.	Eastern Cascades		
4/7/2020	20200407_SN3546	Riegl VQ1560i S2223546	Beeachcraft King Air	N94S	Eastern Cascades QL1	4-17	8:55:00 AM	12:37:00 PM	N/A	N/A	N/A	Justen Maxey	Dynamic	KYKM	restricted airspace today.	Mobilize off station		