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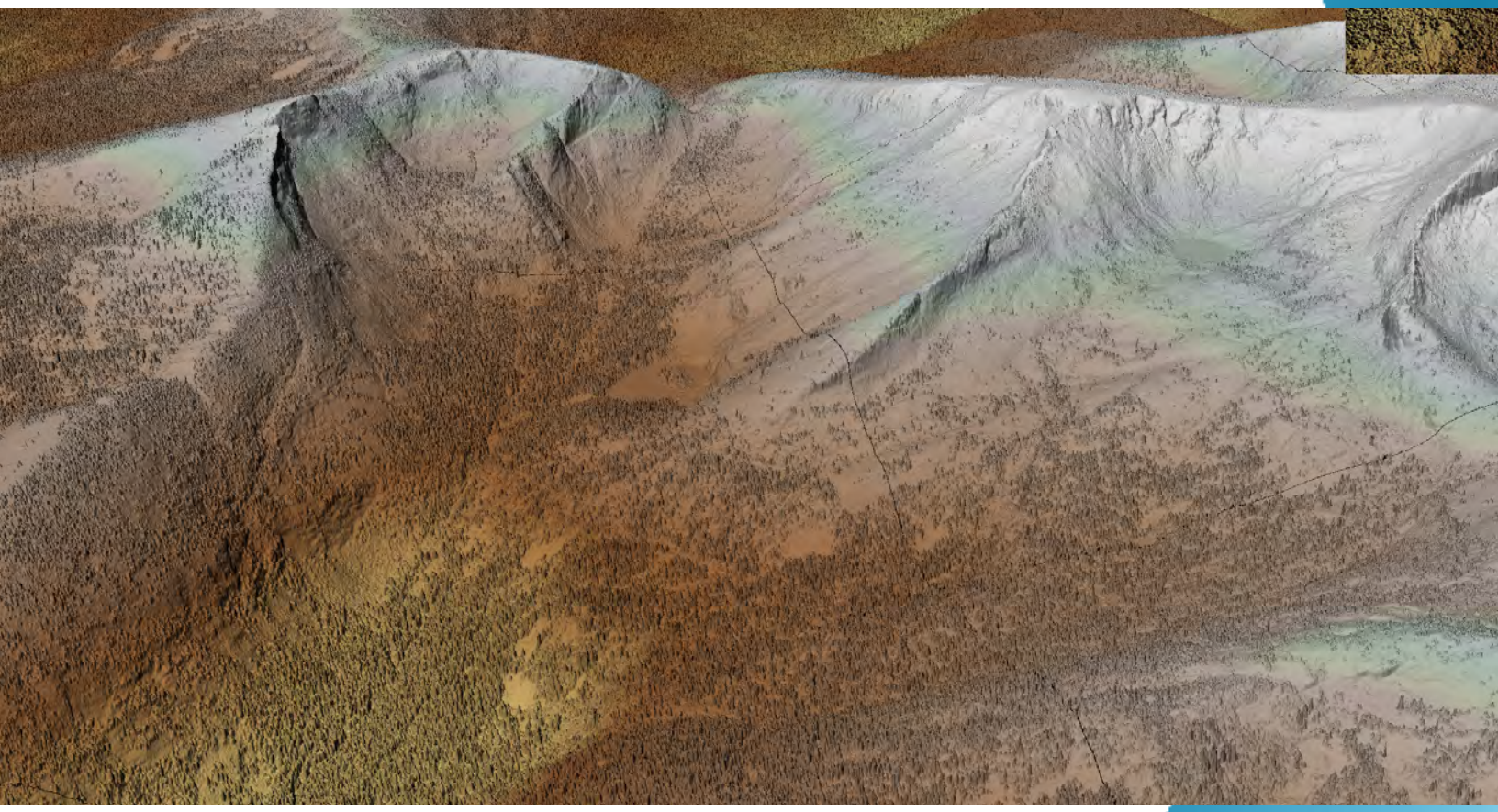

ID_NORTHERNID_2_2019 LIDAR PROCESSING REPORT

Project ID: 183391
Work Unit: 222491

2021

Submitted: February 15, 2022

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 ID_NorthernID_2_2019, Work Unit 222491 Lidar acquisition task order, issued by USGS under their Contract G16PC00016, Task Order 140G0219F0340, on September 19, 2019. This work unit yielded an area covering approximately 2,091 square miles over Idaho. 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	2085 m	58.5°	55%	≤ 10 cm

1.3. Coverage

The work unit boundary covers approximately 2,091 square miles over Northern Idaho. A buffer of 100 meters was created to meet task order specifications. Project extents are shown in Figure 1.

1.4. Duration

Lidar data was acquired from November 9, 2019 to October 2, 2020 in 43 total lifts. See “Section: 2.4. Time Period” for more details.

1.5. Issues

Tile 11TNP05385311 is located in a hydro area and contains no deliverable points. Because of this, there is one fewer LAS than the 3,130 that appear in the tile index. The DEMs were not impacted by this tile.

ID_NorthernID_2_2019 Work Unit 222491 Projected Coordinate System: UTM Zone 11N 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 • 0.5-meter First-return Raster Digital Surface Model (DSM) in GeoTIFF format (BLM QL1 AOI only)
Vectors	Shapefiles (*.shp) • Project Boundary • Lidar Tile Index 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

ID_NorthernID_2_2019
Work Unit 222491 Boundary

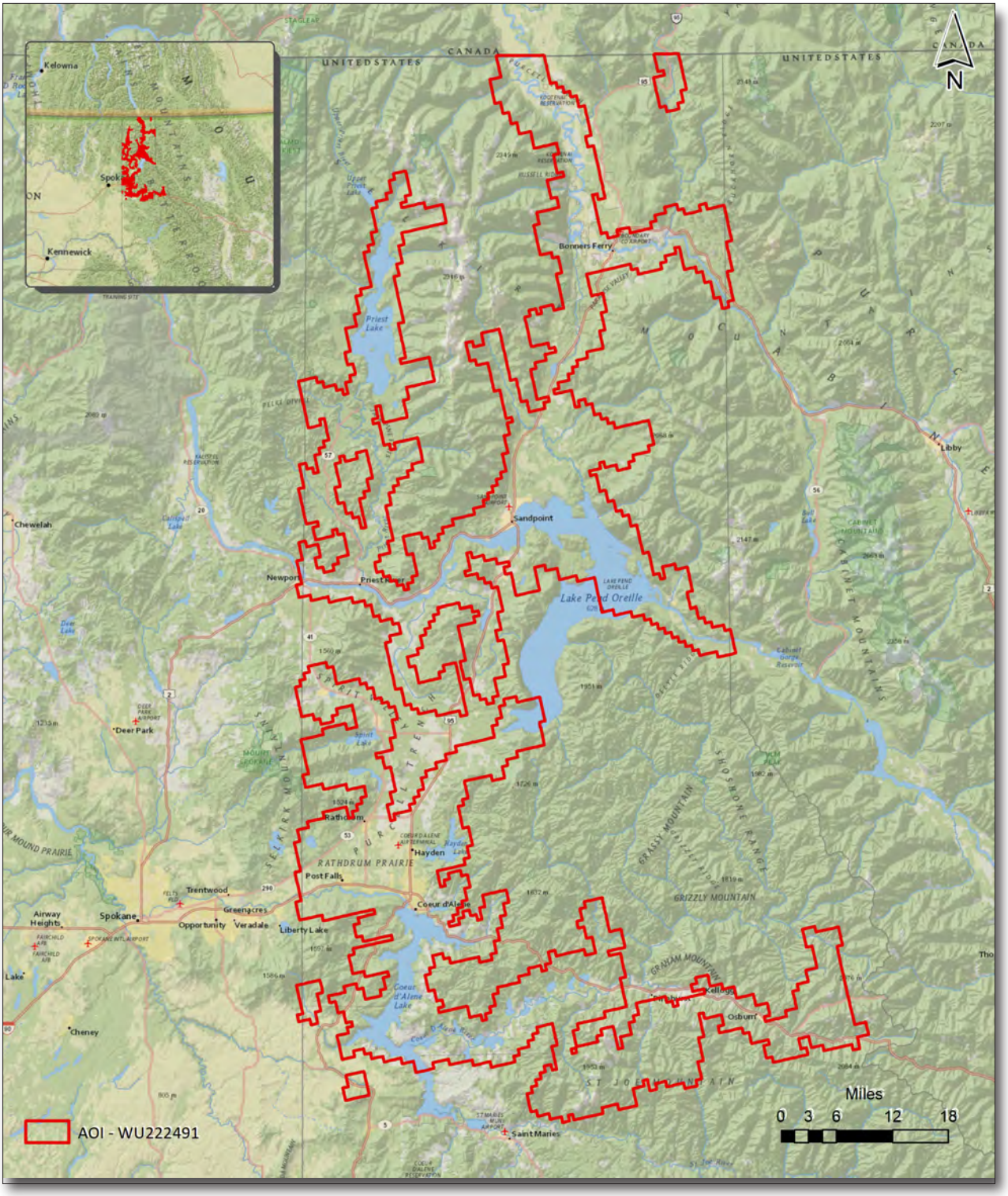


Figure 1. Work Unit Boundary

ID_NorthernID_2_2019
BLM QL1 AOI

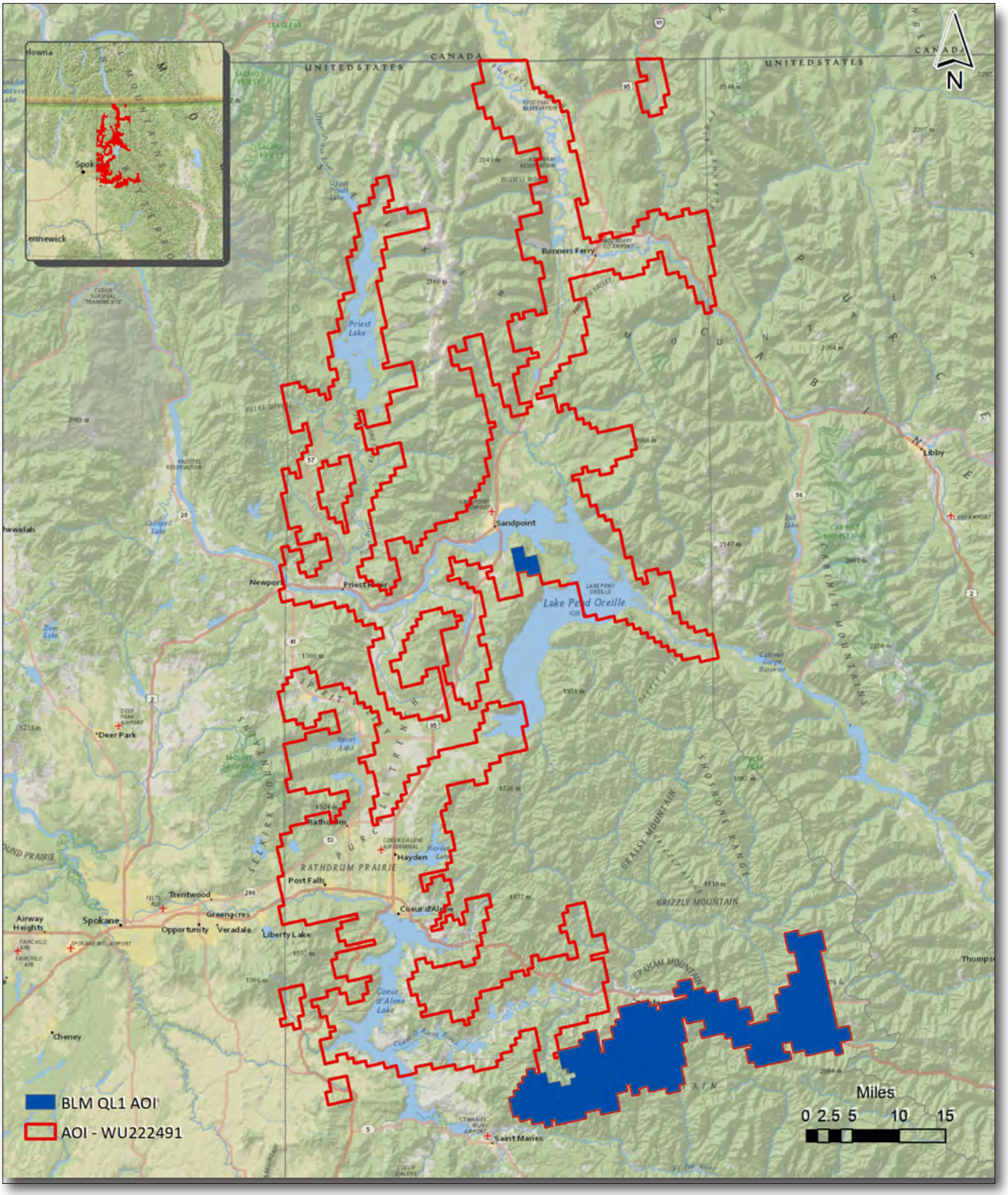


Figure 2. BLM QL1 AOI

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 and FMS Planner planning software.

2.2. Lidar Sensor

NV5 Geospatial utilized the following lidar sensors (Figure 3) for data acquisition:

Riegl VQ1560i: 3546
Riegl VQ1560ii: 4040, 4046
Optech Galaxy: 0427

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.

The Riegl 1560II system is a dual channel waveform processing airborne scanning system. It has a laser pulse repetition rate of up to 4 MHz resulting in up to 2.66 million measurements per second. The system utilizes a Multi-Pulse in the Air option (MPIA) and an integrated IMU/GNSS unit.

The Optech Galaxy Prime is capable of collecting data at a maximum frequency of 550 kHz. These systems utilize a Multi-Pulse in the Air option (MPIA). These sensors are also equipped with the ability to measure up to 8 returns per outgoing pulse

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

Table 2. Lidar System Specifications

		Riegl VQ1560i (3546)	Riegl VQ1560ii (4046)	Riegl VQ1560ii (4040)	Optech Galaxy (0427)
Terrain and Aircraft Scanner	Flying Height	2085 m	2085 m	2305 m	2000 m
	Recommended Ground Speed	115 kts	115 kts	140 kts	130 kts
Scanner	Field of View	58.5°	58.5°	58.5°	38°
	Scan Rate Setting Used	80.6 x 2 Hz	80.6 x 2 Hz	71.9 x 2 Hz	69 Hz
Laser	Laser Pulse Rate Used	500 x 2 kHz	500 x 2 kHz	350 x 2 kHz	500 kHz
	Multi Pulse in Air Mode	Continuous MTA	Continuous MTA	Continuous MTA	Yes
Coverage	Full Swath Width	2336 m	2336 m	2583 m	1377 m
	Line Spacing	1051 m	1051 m	2066 m	550 m
Point Spacing and Density	Average Point Spacing	0.315 m	0.315 m	0.69 m	0.35 m
	Average Point Density	10.08 pts / m^2	10.08 pts / m^2	2.51 pts / m^2	8 pts / m^2

Figure 3. Riegl VQ1560i, Riegl VQ1560ii, and Optech Galaxy Prime Lidar Sensors

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, Tail Numbers: N704MD, N604MD, N208NR
- Piper Navajo, Tail Number: N22GE
- PAC P-750 XSTOL, Tail Number: N750VX

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 state-of-the-art Riegl and Optech Lidar systems. Some of NV5 Geospatial's operating aircraft can be seen in Figure 4 below.

Figure 4. Some of NV5 Geospatial's Planes

2.4. Time Period

Project specific flights were conducted between November 9, 2019 and October 2, 2020. Forty-three aircraft lifts were completed. Accomplished lifts are listed below.

Lift	Start UTC	End UTC
11092019A (SN0427,750ZX)	11/09/2019 7:19:45 PM	11/09/2019 8:45:33 PM
11102019A (SN0427,750ZX)	11/10/2019 9:59:26 PM	11/10/2019 10:37:47 PM
11142019A (SN0427,750ZX)	11/14/2019 9:08:33 PM	11/15/2019 1:18:38 AM
11202019A (SN0427,750ZX)	11/20/2019 5:41:15 PM	11/20/2019 8:26:10 PM
11212019A (SN0427,750ZX)	11/21/2019 7:40:19 PM	11/21/2019 11:52:44 PM
11222019A (SN0427,750ZX)	11/22/2019 11:09:00 PM	11/22/2019 11:57:32 PM
11282019A (SN0427,750ZX)	11/28/2019 8:08:24 PM	11/29/2019 12:07:34 AM
11292019A (SN0427,750ZX)	11/29/2019 6:12:06 PM	11/29/2019 10:10:45 PM
11302019A (SN0427,750ZX)	11/30/2019 6:18:15 PM	11/30/2019 8:40:40 PM
06032020A (SN3546,N704MD)	6/03/2020 3:45:08 PM	6/03/2020 9:10:31 PM
06042020A (SN3546,N704MD)	6/04/2020 3:39:46 PM	6/04/2020 5:48:25 PM
06112020A (SN3546,N704MD)	6/11/2020 5:47:23 PM	6/12/2020 12:03:10 AM
06122020A (SN3546,N704MD)	6/12/2020 4:34:10 PM	6/12/2020 5:28:07 PM
06122020B (SN3546,N704MD)	6/12/2020 5:45:15 PM	6/12/2020 9:35:08 PM
06192020A (SN3546,N704MD)	6/19/2020 4:51:58 PM	6/19/2020 7:01:18 PM
06202020A (SN3546,N704MD)	6/20/2020 7:25:57 PM	6/20/2020 8:55:36 PM
06222020A (SN3546,N704MD)	6/22/2020 2:49:28 PM	6/22/2020 4:24:46 PM
06222020B (SN3546,N704MD)	6/22/2020 4:40:54 PM	6/22/2020 8:12:20 PM
06232020A (SN3546,N704MD)	6/23/2020 2:58:04 PM	6/23/2020 5:22:04 PM
06232020B (SN3546,N704MD)	6/23/2020 5:29:50 PM	6/23/2020 8:35:23 PM
06242020A (SN3546,N704MD)	6/24/2020 5:30:18 PM	6/24/2020 9:34:40 PM
06262020A (SN3546,N704MD)	6/26/2020 4:44:58 PM	6/26/2020 7:14:51 PM
06272020A (SN3546,N704MD)	6/27/2020 3:50:57 PM	6/27/2020 6:08:51 PM

Lift	Start UTC	End UTC
06292020A (SN3546,N704MD)	6/29/2020 6:11:01 PM	6/29/2020 7:19:34 PM
07062020A (SN3546,N704MD)	7/06/2020 4:02:11 PM	7/06/2020 8:03:33 PM
07112020A (SN3546,N704MD)	7/11/2020 4:05:17 PM	7/11/2020 9:54:59 PM
07122020A (SN3546,N704MD)	7/12/2020 4:04:40 PM	7/12/2020 5:15:01 PM
07132020A (SN3546,N704MD)	7/13/2020 4:03:10 PM	7/13/2020 6:52:10 PM
07142020A (SN3546,N704MD)	7/14/2020 2:55:24 PM	7/14/2020 7:42:00 PM
07152020A (SN3546,N704MD)	7/15/2020 2:40:05 PM	7/15/2020 7:58:25 PM
07162020A (SN3546,N704MD)	7/16/2020 2:46:03 PM	7/16/2020 7:48:10 PM
07172020A (SN3546,N704MD)	7/17/2020 2:42:11 PM	7/17/2020 6:36:12 PM
07192020A (SN3546,N704MD)	7/19/2020 6:40:38 PM	7/19/2020 7:43:13 PM
07202020A (SN3546,N704MD)	7/20/2020 2:37:48 PM	7/20/2020 5:34:59 PM
07212020A (SN3546,N704MD)	7/21/2020 2:28:47 PM	7/21/2020 8:08:13 PM
07222020A (SN3546,N704MD)	7/22/2020 2:33:44 PM	7/22/2020 4:58:16 PM
07222020B (SN3546,N704MD)	7/22/2020 5:49:34 PM	7/22/2020 7:22:42 PM
07232020A (SN3546,N704MD)	7/23/2020 5:09:07 PM	7/23/2020 9:26:07 PM
07242020A (SN3546,N704MD)	7/24/2020 4:42:57 PM	7/24/2020 10:34:35 PM
08232020A (SN4046,N604MD)	8/23/2020 4:29:29 PM	8/23/2020 10:21:44 PM
08242020A (SN4046,N604MD)	8/24/2020 5:15:52 PM	8/24/2020 9:26:47 PM
09062020A (SN4040,N22GE)	9/06/2020 3:57:07 PM	9/06/2020 5:10:12 PM
10022020B (SN3546,N208NR)	10/02/2020 8:34:57 PM	10/02/2020 9:45:29 PM

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). Project specific flight logs for each sortie are available in Appendix A.

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 Optech LMS and 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	8.6
Optech LMS	4.4
GeoCue	2020.1.22.1
Global Mapper	19.1;20.1
TerraModeler	21.008
TerraScan	21.016
TerraMatch	21.007

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. NV5 Geospatial'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 streams and rivers using NV5 Geospatial'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 0.5 meters 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.

3.8. First Return Raster DSM Processing

For the BLM QL1 AOI, first-return lidar points were used to create a 0.5-meter first-return raster DSM. Using automated scripting routines within proprietary software, GeoTIFF files were created for each tile. Each surface is reviewed using Global Mapper to check for any surface anomalies or incorrect elevations found within the surface.

ID_NorthernID_2_2019
Work Unit 222491 Tile Layout

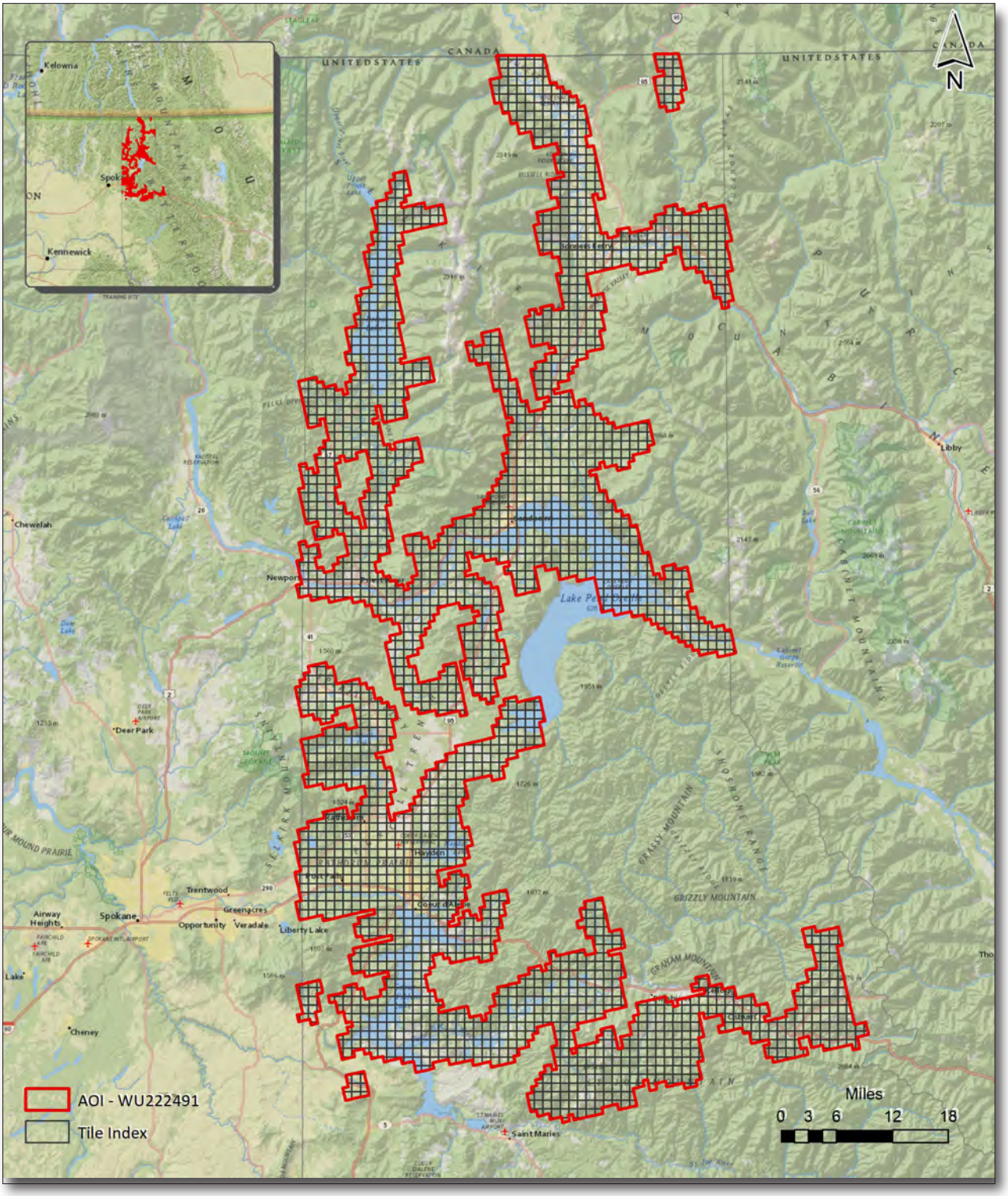


Figure 5. Lidar Tile Layout

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.

ID_NorthernID_2_2019
Work Unit 222491 Lidar Coverage

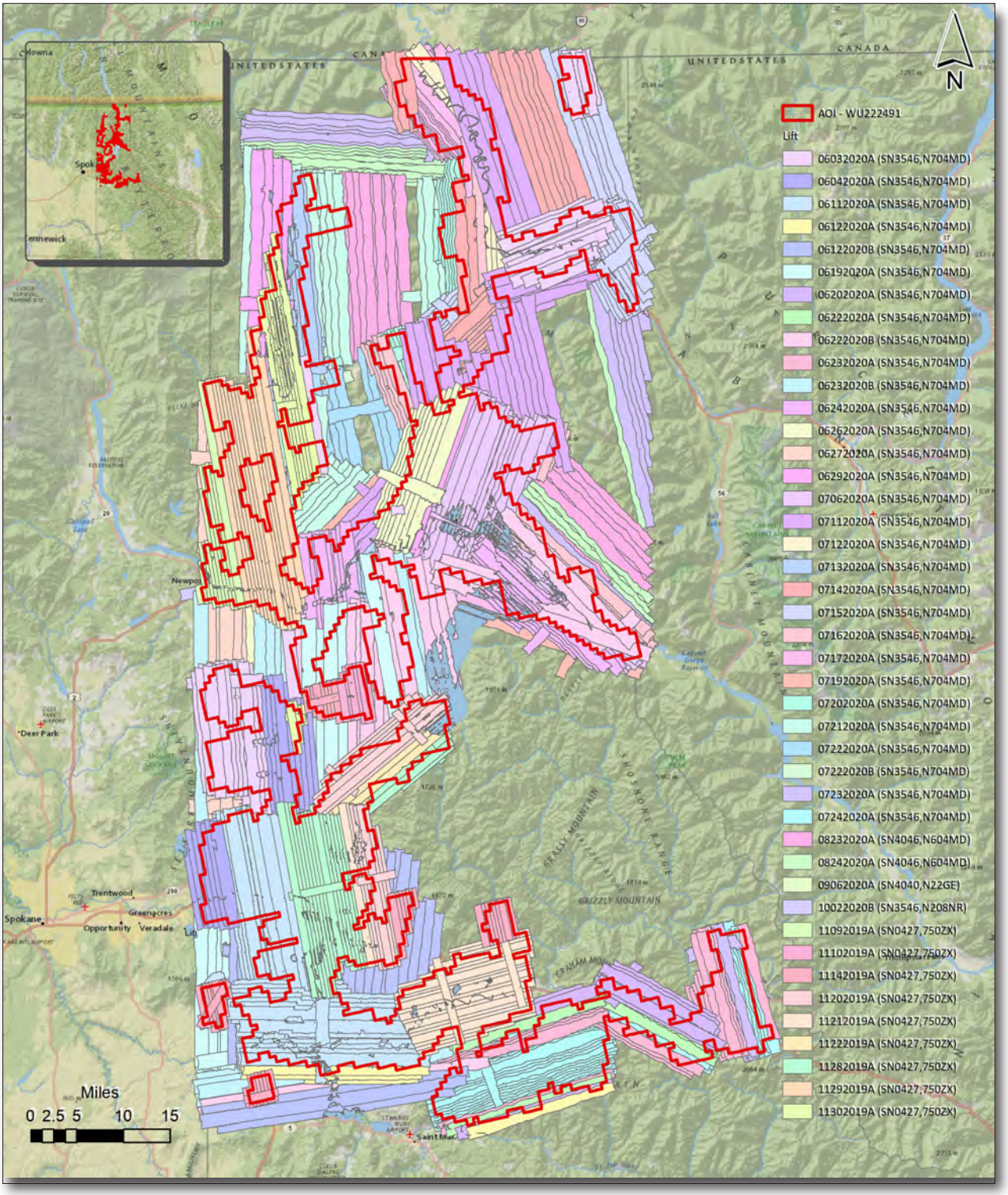


Figure 6. Lidar Coverage

5. Geometric Accuracy

5.1. Horizontal Accuracy

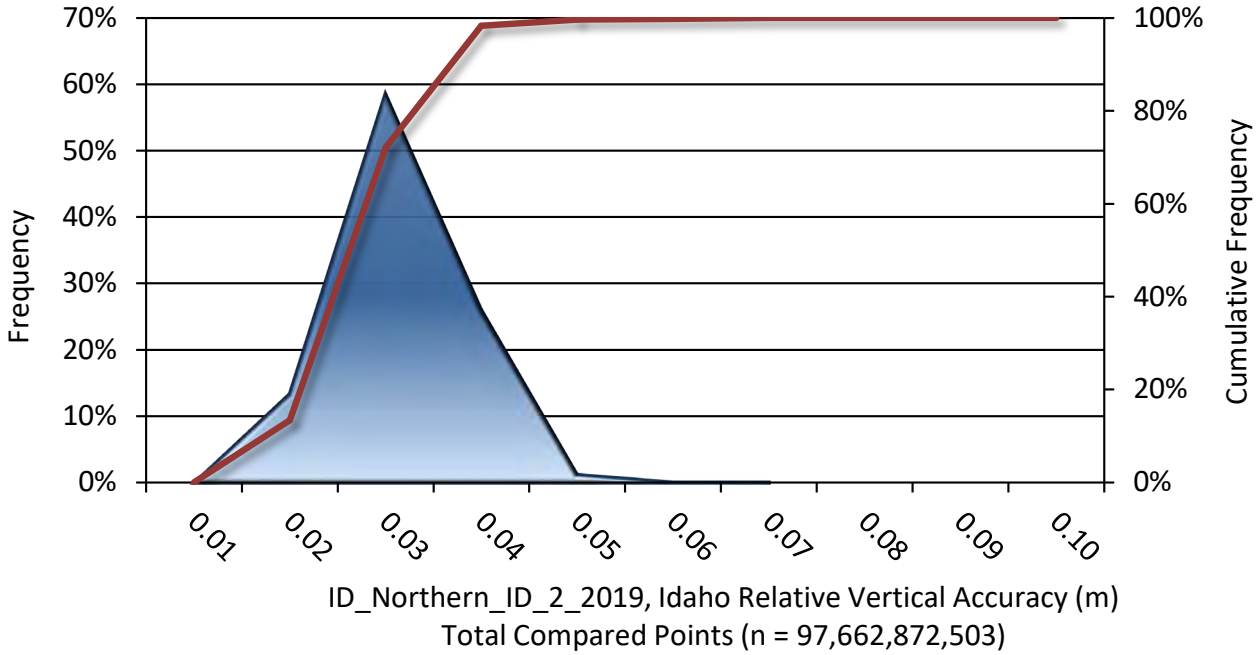
Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained $RMSE_r$ value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial 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	
$RMSE_r$	0.13 m
	0.43 ft
ACC_r	0.23 m
	0.74 ft

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 ID_NorthernID_2_2019, Work Unit 222491, was 0.080 feet (0.024 meters). A summary is shown below.

Relative Vertical Accuracy	
Sample	1116 flight line surfaces
Average	0.080 ft
	0.024 m
Median	0.083 ft
	0.025 m
RMSE	0.089 ft
	0.027 m
Standard Deviation (1σ)	0.021 ft
	0.006 m
1.96σ	0.041 ft
	0.013 m



6. Ground Control and Check Point Collection

Quantum Spatial completed a field survey of 124 ground control (calibration) points along with 108 NVA and 80 VVA blind QA points. These points were used as an independent test of the accuracy of this project.

A combination of precise GPS surveying methods, including static and RTK observations were used to establish the 3D position of ground calibration points and QA points for the point classes above. GPS was not an appropriate methodology for surveying in the forested areas during the leaf-on conditions for the actual field survey (which was accomplished after the LiDAR acquisition). Therefore the 3D positions for the forested points were acquired using a GPS-derived offset point located out in the open near the forested area, and using precise offset surveying techniques to derive the 3D position of the forested point from the open control point. The explicit goal for these surveys was to develop 3D positions that were three times greater than the accuracy requirement for the elevation surface. In this case of the blind QA points the goal was a positional accuracy of 5 cm in terms of the RMSE.

The required accuracy testing was performed on the LiDAR dataset (both the LiDAR point cloud and derived DEM's) according to the USGS LiDAR Base Specification Version 1.3.

6.1. Calibration Control Point Testing

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

6.2. Point Cloud Testing

The project specifications require that only Non-Vegetated Vertical Accuracy (NVA) be computed for raw lidar point cloud swath files. The required accuracy (ACCz) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the "bare earth" and "urban" land cover classes. The NVA was tested with 108 checkpoints located in bare earth and urban (non-vegetated) areas. These check points were not used in the calibration or post processing of the lidar point cloud data. The checkpoints were distributed throughout the project area and were surveyed using GPS techniques. See survey report for additional survey methodologies.

Elevations from the unclassified lidar surface were measured for the x,y location of each check point. Elevations interpolated from the lidar surface were then compared to the elevation values of the surveyed control points. AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using RMSE(z) x 1.9600 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines.

6.3. Digital Elevation Model (DEM) Testing

The project specifications require the accuracy (ACCz) of the derived DEM be calculated and reported in two ways:

1. The required NVA is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSE of 10 cm in the "bare earth" and "urban" land cover classes. This is a required accuracy. The NVA was tested with 108 checkpoints located in bare earth and urban (non-vegetated) areas. See Figure 8.

2. Vegetated Vertical Accuracy (VVA): VVA shall be reported for "brushlands/low trees" and "tall weeds/crops" land cover classes. The target VVA is: 29.4 cm at the 95th percentile, derived according to ASPRS Guidelines, Vertical Accuracy Reporting for Lidar Data, i.e., based on the 95th percentile error in all vegetated land cover classes combined. This is a target accuracy. The VVA was tested with 80 checkpoints located in tall weeds/crops and brushlands/low trees (vegetated) areas. The checkpoints were distributed throughout the project area and were surveyed using GPS techniques. See Figure 9.

AccuracyZ has been tested to meet 19.6 cm or better Non-Vegetated Vertical Accuracy at 95% confidence level using RMSE(z) x 1.9600 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ ASRPS Guidelines.

A brief summary of results are listed below.

	Target	Measured	Point Count
Raw NVA	0.196 m	.0701 m	108
NVA	0.196 m	.0685 m	108
VVA	0.294 m	.02151 m	80

ID_NorthernID_2019_D19
Calibration Points

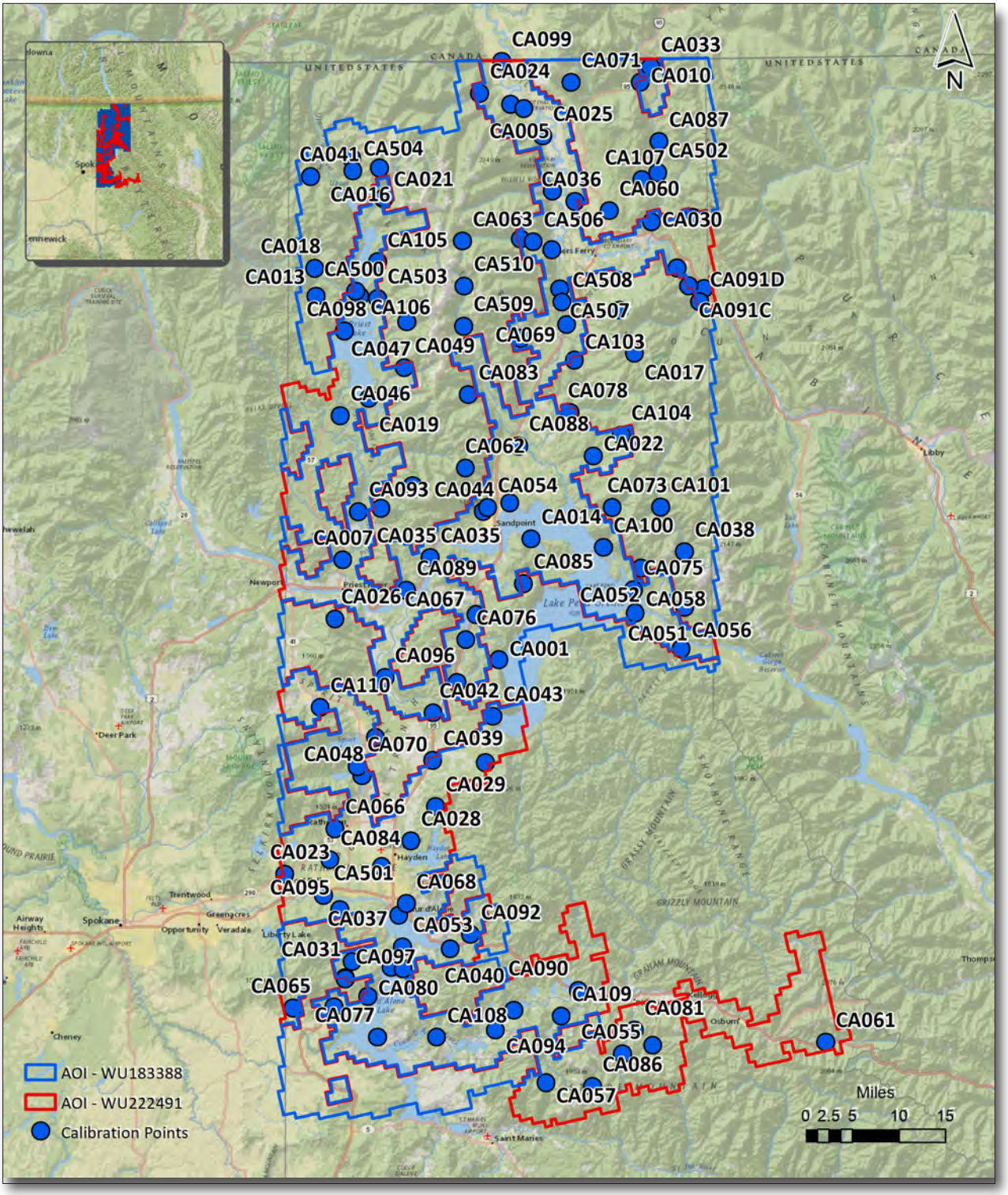


Figure 7. Calibration Control Point Locations

ID_NorthernID_2019_D19
NVA Points

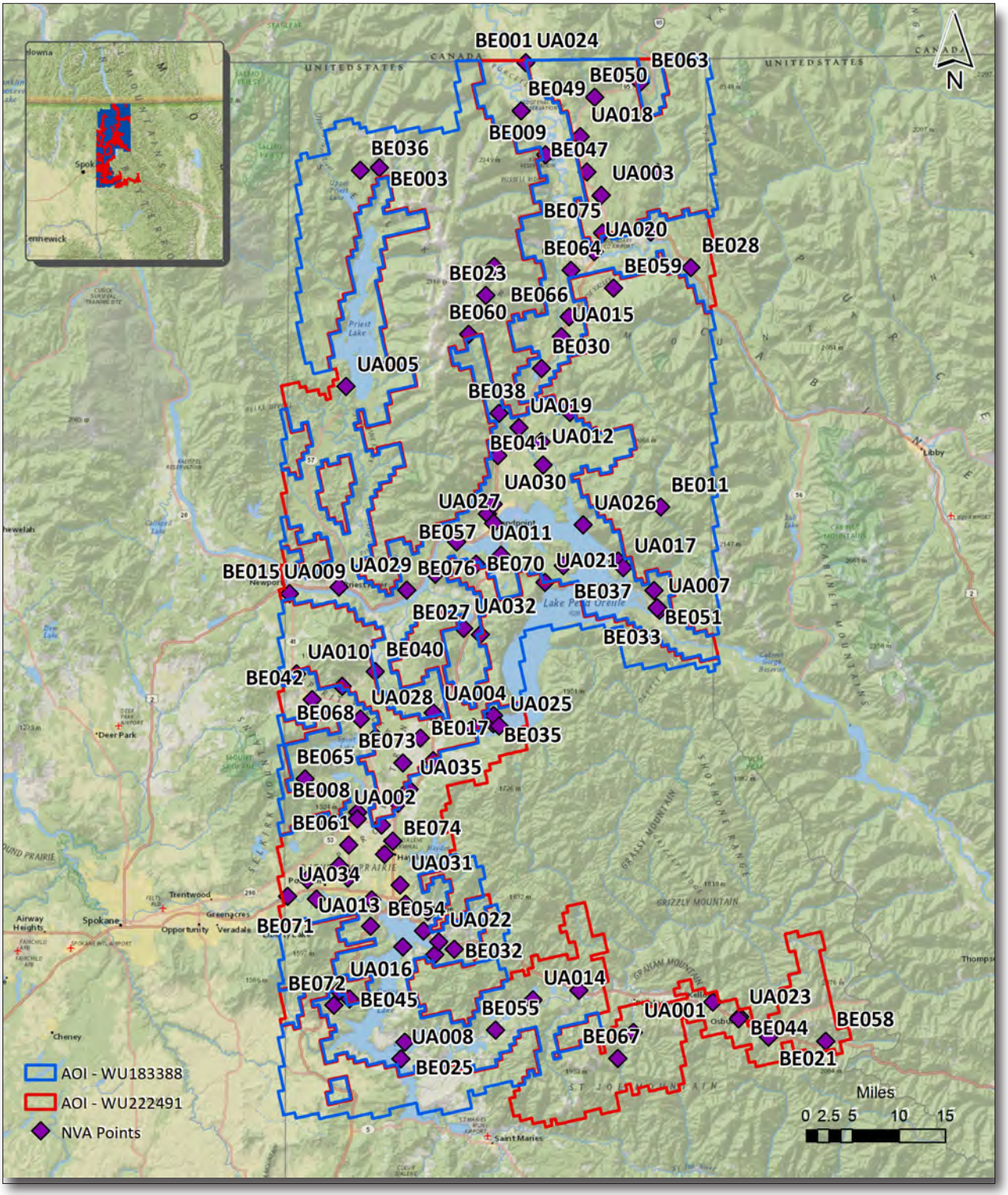


Figure 8. QC Checkpoint Locations - NVA

ID_NorthernID_2019_D19
VVA Points

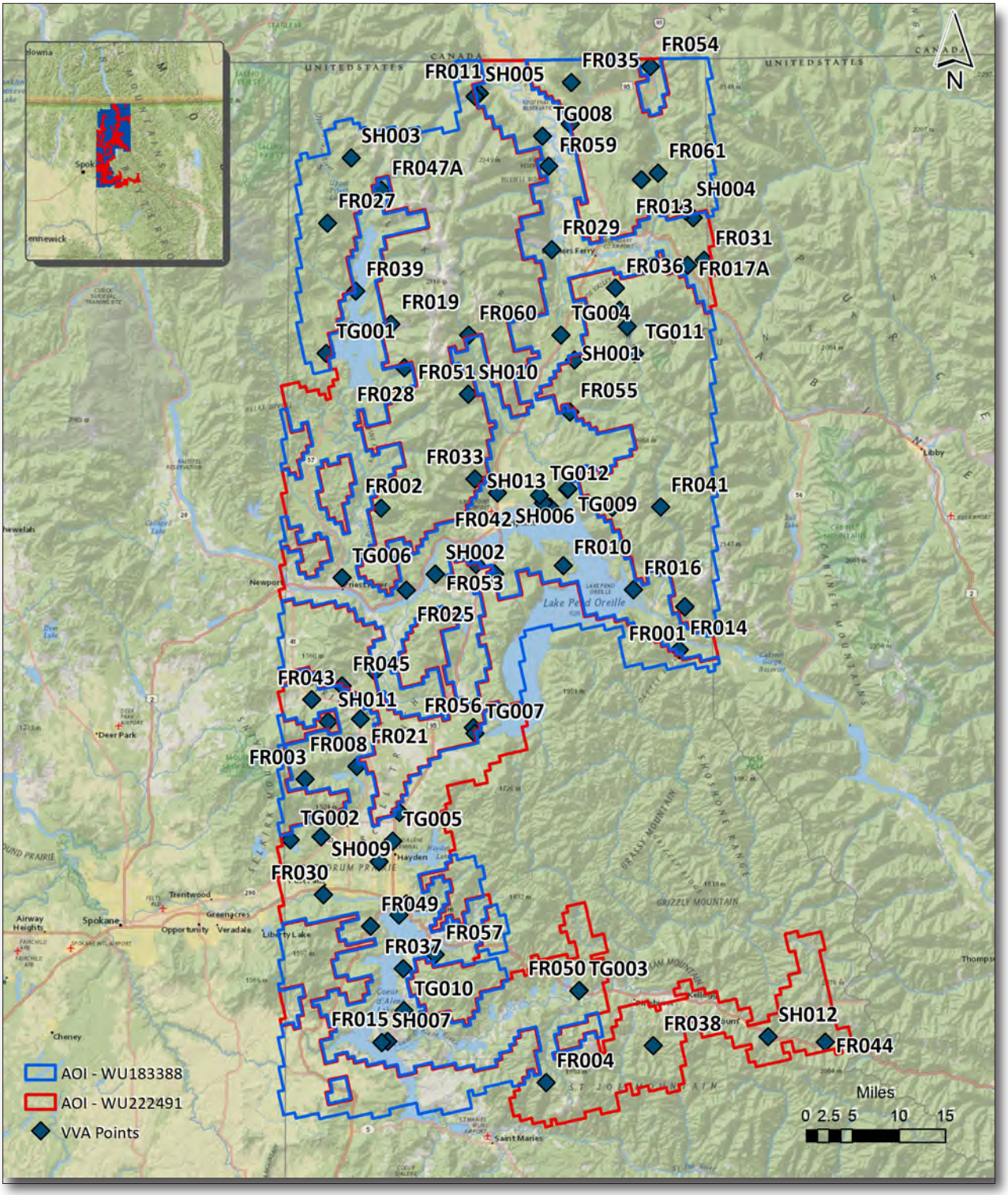


Figure 9. QC Checkpoint Locations - VVA

Project Report Appendices

The following section contains the appendices as listed in the ID_NorthernID_2_2019 Lidar Project Report.

Appendix A

Flight Logs

atlantic
2223 S Drake Ave, Suite 200
Huntsville, AL 35805
PH. (256) 971-9991
FX. (256) 971-1154

Project #:	19085	Tail Number:	750VX
Flight plan name:	19085_North	Flight Date:	20191109
Location:	Idaho	Sensor SN	0427
Pilot:	Courtney	Weather	clear
Operator:	Jun		
Sensor:	Galaxy		
Hobbs Time Start:	4383.3		
Hobbs Time Stop:	4386.5		
Pre-Static:	17:41~17:46		
Post-Static:	21:06~21:11		
Fwd Lap:			
Side Lap			

Lever Arm			
	X	Y	Z
GPS	-0.13	-0.011	-1.522
IMU	#N/A	#N/A	#N/A

Base Station		ARP	Start	Stop
	0.000	0.000	0	0
	0.000	0.000		
	0.000	0.000		

Line/DIR		Start	End	Air Speed	Alt(ft)	# Exp	Light Values	Total Time	Comments or errors while online:
84	350	11:19	11:20	138	8701			0:01	Strip 001 SA 6
83	170	11:22	11:23	128	8677			0:01	Strip 002
82	350	11:26	11:28	132	8606			0:02	Strip 003
81	170	11:31	11:34	134	8842			0:03	Strip 004
80	350	11:36	11:39	130	8855			0:03	Strip 005
79	170	11:42	11:45	130	8883			0:03	Strip 006
78	350	11:47	11:53	126	9366			0:06	Strip 007
77	170	11:56	12:02	128	9251			0:06	Strip 008
76	350	12:05	12:11	130	9186			0:06	Strip 009
75	170	12:14	12:20	130	9088			0:06	Strip 010
74	350	12:23	12:30	124	9114			0:07	Strip 011
73	170	12:35	12:45	128	9228			0:10	Strip 012 clouds in line

atlantic
2223 S Drake Ave, Suite 200
Huntsville, AL 35805
PH. (256) 971-9991
FX. (256) 971-1154

Project #:	19085	Tail Number:	750VX			Lever Arm			
Flight plan name:	19085_north	Flight Date:	20191110				X	Y	Z
Location:	COE Idaho	Sensor SN	0427			GPS	-0.13	-0.011	-1.522
Pilot:	Courtney	Weather	overcast			IMU	#N/A	#N/A	#N/A
Operator:	Jun			Base Station			ARP	Start	Stop
Sensor:	Galaxy					0.000	0.000	0	0
Hobbs Time Start:						0.000	0.000		
Hobbs Time Stop:						0.000	0.000		
Pre-Static:	21:33~21:38								
Post-Static:	22:48~22:53								
Fwd Lap:									
Side Lap									

Line/DIR		Start	End	Air Speed	Alt(ft)	# Exp	Light Values	Total Time	Comments or errors while online:
65	351	13:59	14:01	117	9000			0:02	Strip 001 SA 10
66	171	14:04	14:06	136	9042			0:02	Strip 002
67	351	14:10	14:12	115	9036			0:02	Strip 003
68	171	14:15	14:17	132	9020			0:02	Strip 004
69	351	14:20	14:23	113	9022			0:03	Strip 005
70	171	14:25	14:27	122	9021			0:02	Strip 006
71	351	14:30	14:33	119	9015			0:03	Strip 007
72	171	14:35	14:37	130	8963			0:02	Strip 008 clouds in line

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(email log daily to flight_log_distribution_list@quantumspatial.com)

Date:20191114

Lift: A B C D E

Project:19085		Proj #:19085		Flight Mgmt File:		
Aircraft:750VX	Begin Hobbs:4393	End Hobbs:4397.8	Total:4.8	Pilot: Courtney	Co-Pilot:	Tech: Jun
Dep Apt:	Dep Time (Lcl):	(Z):	Arr Apt:	Arr Time (Local):	(Z):	Tot Time Aloft:
CORS: Y / N	Sta **1**:	Sta 2:	Flyovers: Y / N	If Y, times: Sta**1**)	Sta2)	
GPS Unit: Y / N	Sta **1**:	Sta 2:	Flyovers: Y / N	If Y, times: Sta**1**)	Sta2)	

Gd Temp beg: °c	End: °c	OAT beg: °c	End: °c	Altimeter begin:	end:		
LiDAR	Type Galaxy	Serial # 0427	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM

Beg GB	Storage Name/#
End GB	
Tot GB	

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
72	351	13:08	13:10	126		8979			Flight plan:19085_North SA 10 Refly from 20191111 Cloud in line
45	76	13:16	13:18	115		8980			Crossline
10	168	13:33	13:34	132		10084			Flight plan changed to 19085_South SA2
11	348	13:36	13:37	128		9482			
12	168	13:39	13:40	138		9407			
13	348	13:44	13:46	136		9254			
14	168	13:48	13:50	136		9235			
15	348	13:53	13:55	130		9234			
16	168	13:57	13:59	134		9194			
17	348	14:02	14:04	132		9365			
18	168	14:06	14:08	136		9418			
19	348	14:10	14:11	128		9392			
19	32	14:15	14:17	132		9387			Crossline
8	168	14:24	14:25	130		9374			SA 8
7	348	14:27	14:28	126		9472			
6	168	14:30	14:32	128		9392			
5	348	14:34	14:36	128		9442			
4	168	14:38	14:40	130		9490			

3	348	14:42	14:44	128		9441			
2	168	14:46	14:48	136		9481			
1	348	14:51	14:53	130		9411			
9	256	14:55	14:57	121		9472			Crossline
376	78	15:08	15:09	132		9307			Flight plan changed to 19085_North SA 59 Crossline
365	168	15:13	15:15	138		9840			
366	348	15:18	15:19	132		9537			
367	168	15:22	15:24	132		9148			
368	348	15:26	15:28	136		8876			
369	168	15:30	15:32	132		9079			
370	348	15:34	15:36	130		9197			
371	168	15:38	15:40	130		9195			
372	348	15:42	15:44	130		9213			
373	168	15:46	15:48	130		9265			
374	348	15:51	15:52	134		9417			
375	168	15:55	15:56	134		9573			
402	350	16:01	16:02	130		9573			Flight plan changed to 19085_South SA 21
403	170	16:04	16:05	126		9458			
404	350	16:07	16:08	132		9527			
405	170	16:11	16:12	134		9422			
406	350	16:15	16:16	132		9315			
407	170	16:19	16:21	130		9120			
408	350	16:24	16:26	124		9262			
72	351	16:34	16:35	130		9015			Flight plan changed to 19085_North SA 10 Refly
73	171	16:37	16:39	130		8967			
74	351	16:41	16:43	132		8970			
75	171	16:45	16:47	132		8983			
76	351	16:49	16:51	130		8941			
77	171	16:53	16:55	134		8949			
78	351	16:57	16:58	132		8939			

79	171	17:01	17:02	134		8850			
80	351	17:05	17:06	134		8815			
81	171	17:08	17:09	132		8913			
82	351	17:11	17:12	132		8954			
45	76	17:16	17:18	126		8941			Crossline

Total Proj Lines:	Lines Flown: 53	Lines Remain:	Online Time: 4.8	Mob Time:	Notes:

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(email log daily to flight_log_distribution_list@quantumspatial.com)

Date:20191120

Lift: A B C D E

Project:19085 | Proj #:19085 | Flight Mgmt File:

Aircraft:750VX | Begin Hobbs:4397.8 | End Hobbs: | Total:4.8 | Pilot: Courtney | Co-Pilot: | Tech: Jun

Dep Apt: | Dep Time (Lcl): 09:29 | (Z): | Arr Apt: | Arr Time (Local): 12:36 | (Z): | Tot Time Aloft: 3.1

CORS: Y / N | Sta **1**: | Sta 2: | Flyovers: Y / N | If Y, times: Sta**1**) | Sta2)

GPS Unit: Y / N | Sta **1**: | Sta 2: | Flyovers: Y / N | If Y, times: Sta**1**) | Sta2)

Gd Temp beg: 0 °c | End: 6 °c | OAT beg: °c | End: °c | Altimeter begin: | end:

LiDAR	Type Galaxy	Serial # 0427	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM

Beg GB	Storage Name/#
End GB	
Tot GB	

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
409	170	0940	0946	130		9572			Fire in line. SA 21
410	350	0949	0955	119		9610			
411	170	0958	1005	132		9478			Possible clouds in line
412	350	1008	1015	124		9433			
413	170	1018	1026	122		9339			Possible clouds in line
414	350	1029	1037	119		9244			
337	51	1041	1047	117		9036			SA 19
338	231	1049	1050	134		9247			
339	51	1053	1054	113		9317			
336	231	1057	11:02	132		8951			
335	51	1105	1111	113		9110			
334	231	1114	1120	126		9070			
333	51	1123	1131	117		9041			
332	231	1134	1141	136		8981			
331	51	1143	1151	119		8998			
330	231	1154	1200	138		9066			
148	131	1206	1209	121		9369			Crossline for SA 19
147	317	1214	1216	121		9765			Crossline for SA 19

219	258	1224	1225	140		9147			Crossline for SA 21

Total Proj Lines:	Lines Flown:	Lines Remain:	Online Time:	Mob Time:	Notes:

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date:20191121

Lift: A B C D E **Pg 1 of __**

Project:19085 Proj #:19085 Flight Mgmt File: 0427_20191121_1

Aircraft:750VX Begin Hobbs:4400.9 End Hobbs: Total: Pilot: Courtney Co-Pilot: Tech: Jun

Dep Apt: Dep Time (Lcl): 11:27 (Z): Arr Apt: Arr Time (Local): (Z): Tot Time Aloft: 3.1

CORS: Y / N Sta **1**: Sta 2: Flyovers: Y / N If Y, times: Sta**1**) Sta2)

GPS Unit: Y / N Sta **1**: Sta 2: Flyovers: Y / N If Y, times: Sta**1**) Sta2)

Gd Temp beg: 4 °c End: 6 °c OAT beg: °c End: 5 °c Altimeter begin: end:

LiDAR	Type Galaxy	Serial # 0427	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM

Beg GB	Storage Name/#
End GB	
Tot GB	

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
515	75	1139	1143	128		9622			SA 23
514	255	1146	1149	124		9444			
513	75	1152	1156	130		9421			
512	255	1159	1204	122		9490			
511	75	1206	1211	142		9479			
510	255	1214	1219	128		9493			
509	75	1221	1227	134		9417			
508	255	1230	1236	130		9326			
507	75	1238	1244	134		9342			
506	255	1247	1253	128		9243			
505	75	1256	1302	136		9137			
504	255	1304	1310	130		9048			
503	75	1313	1319	130		8915			
502	255	1322	1328	122		8801			
501	75	1331	1336	128		8807			
500	255	1339	1345	130		8860			
499	75	1348	1353	130		9060			
498	255	1356	1401	124		9286			

497	75	1404	1409	128		9211			
496	255	1412	1418	130		9295			
495	75	1421	1426	132		9376			
494	255	1429	1435	124		9542			Possible fire in line, smoke in line
493	75	1437	1442	142		9722			Possible fire in line, smoke in line
492	255	1446	1450	136		9908			Possible fire in line, smoke in line
491	75	1453	1456	134		10068			Possible fire in line, smoke in line
490	255	1500	1501	136		10065			Possible fire in line, smoke in line
517	345	1507	1511	138		9903			Crossline
516	164	1516	1519	124		9983			Crossline Possible fire in line, smoke in line
415	350	1526	1533	136		9200			SA 21
416	170	1535	1542	136		9167			
417	350	1545	1552	124		9213			

Total Proj Lines:	Lines Flown:	Lines Remain:	Online Time:	Mob Time:	Notes:

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date:20191122

Lift: A B C D E

Project:19085 Proj #:19085 Flight Mgmt File: 0427_20191122_1

Aircraft:750DV Begin Hobbs: End Hobbs: Total: Pilot: Aiden Co-Pilot: Tech: Jun

Dep Apt: Dep Time (Lcl): 14:58 (Z): Arr Apt: Arr Time (Local): 16:07 (Z): Tot Time Aloft: 1.1

CORS: Y / N Sta **1**: Sta 2: Flyovers: Y / N If Y, times: Sta**1**) Sta2)

GPS Unit: Y / N Sta **1**: Sta 2: Flyovers: Y / N If Y, times: Sta**1**) Sta2)

Gd Temp beg: °c End: °c OAT beg: °c End: °c Altimeter begin: end:

LiDAR							
Type Galaxy	Serial # 0427	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing	
FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM	

Beg GB	Storage Name/#
End GB	
Tot GB	

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
329	51	1508	1515	132		9236			SA 19 light fog in line
328	231	1519	1526	124		9422			Light fog in line
327	51	1529	1535	128		9520			Light fog in line
147	317	1541	1542	119		9655			Crossline
326	231	1545	1552	128		9693			Light fog in line
148	311	1556	1557	121		9345			Crossline light fog in line

Total Proj Lines:	Lines Flown:	Lines Remain:	Online Time:	Mob Time:	Notes:

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date:20191128

Lift: A B C D E

Project:19085 Proj #:19085 Flight Mgmt File: 0427_20191128_1

Aircraft:750DV Begin Hobbs: End Hobbs: Total: Pilot: Aiden Co-Pilot: Tech: Jun

Dep Apt: Dep Time (Lcl): 11:57 (Z): Arr Apt: Arr Time (Local): 16:14 (Z): Tot Time Aloft: 1.1

CORS: Y / N Sta **1**: Sta 2: Flyovers: Y / N If Y, times: Sta**1**) Sta2)

GPS Unit: Y / N Sta **1**: Sta 2: Flyovers: Y / N If Y, times: Sta**1**) Sta2)

Gd Temp beg: °c End: °c OAT beg: °c End: °c Altimeter begin: end:

LiDAR							
	Type Galaxy	Serial # 0427	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM

Beg GB	Storage Name/#
End GB	
Tot GB	

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
325	51	1208	1213	132		9956			SA 19
324	271	1216	1222	128		10008			
323	51	1225	1230	126		10037			
322	271	1233	1238	128		10154			
148	311	1241	1242	126		9361			Crossline
147	137	1247	1248	132		9653			Crossline
321	271	1251	1254	126		10755			
418									Strip 008- Strip 009 disregard. Pilot came on line crooked. SA 21
418	170	1303	1310	130		9162			Strip 010
419	350	1313	1320	132		9172			
420	170	1323	1330	126		9157			
421	350	1333	1340	128		9178			
422	170	1344	1351	128		9193			
423	350	1354	1401	130		9022			
424	170	1404	1411	130		8912			
425	350	1414	1420	132		8972			
426	170	1423	1430	128		8913			
427	350	1433	1440	130		8835			

428	170	1443	1451	132		8872			
429	350	1453	1501	132		8875			
430	170	1504	1512	128		8872			
431	350	1515	1523	132		8833			
432	170	1526	1534	132		8830			
433	350	1537	1546	132		8744			
434	170	1549	1557	130		8954			
219	78	1603	1607	138		9074			Crossline

Total Proj Lines:	Lines Flown:	Lines Remain:	Online Time:	Mob Time:	Notes:

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date:20191130

Lift: A B C D E

Pg 1 of __

Project:19085		Proj #:19085		Flight Mgmt File: 0427_20191128_1			
Aircraft:750DV	Begin Hobbs:7113.6	End Hobbs:7116.4	Total: 2.8	Pilot: Aiden	Co-Pilot:	Tech: Jun	
Dep Apt:	Dep Time (Lcl): 1002	(Z):	Arr Apt:	Arr Time (Local): 1247	(Z):	Tot Time Aloft: 2.8	
CORS: Y / N	Sta **1**:	Sta 2:	Flyovers: Y / N	If Y, times: Sta**1**)	Sta2)		
GPS Unit: Y / N	Sta **1**:	Sta 2:	Flyovers: Y / N	If Y, times: Sta**1**)	Sta2)		
Gd Temp beg: °c	End: °c	OAT beg: °c	End: °c	Altimeter begin:	end:		

LiDAR	Type Galaxy	Serial # 0427	Alt AGL	Alt AMSL	Avg Terr Ht	Max Gdspd	Avg Pt Spacing
	FOV	Scan Freq	MpiA Y / N	Pulses In Air	Pulse Rate	Power	PPSM

Beg GB	Storage Name/#
End GB	
Tot GB	

Line #	Hdg	Start (UTC):	End (UTC):	Gd Spd	PDOP/#Sats	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc.
52	350	1017	1027	132		8964			SA 6 Flight plan 19085_North
51	170	1030	1038	130		8966			
50	350	1041	1050	128		8940			
49	170	1053	1102	130		8923			
48	350	1105	1115	132		9049			
47	170	1118	1128	130		9093			
46	350	1131	1141	134		9072			
36	80	1144	1145	116		9220			Crossline
45	170	1150	1200	130		9035			
35	262	1207	1209	136		9162			Crossline
357	170	1221	1222	126		9114			Flight plan changed to 19085_South SA 20
358	350	1225	1226	132		9202			
359	170	1229	1230	128		9173			
360	350	1233	1236	130		9124			
180	273	1239	1240	130		9302			Crossline Turning back due to scattered clouds rolling in to survey areas.

Total Proj Lines:	Lines Flown:	Lines Remain:	Online Time:	Mob Time:	Notes:

Project Name **ID Northern ID**

Date	Mission ID	Sensor	Aircraft Make/Model	Aircraft Tail Number	Project Name	Flight Plan	Lines Flown/Dead End Stopped at	Flight 1 Wheels Up (MDT)	Flight 1 Wheels Down (MDT)	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
6/3/2020	20200603_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	NorthernID_QL1	26-31, 128-141, 213, 214, 298-311	8:58:00 AM	2:20:00 PM	14533.6	14540.0	6.4	James Douglas	Nathan Sharp	KCOE	Headed from Kalispell to Idaho. Started at north end of Idaho QL1, worked south towards Coeur d'Alene as clouds pushed us out of most of the northern lines. Snow line throughout AOI is between 5500 and 6500 depending on sun exposure.	Monitor weather, acquire where weather is best
6/4/2020	20200604_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	1-7, 312-321	8:24:00 AM	11:13:00 AM	14540.0	14542.8	2.8	James Douglas	Nathan Sharp	KCOE	Acquired on lines near Coeur d'Alene. Clouds present in all northern lines and popped up quick in the south as well. Wind was supposed to blow clouds out of the area but once outside air temps warmed up there were puffies everywhere. Abandoned acquisition after giving a brief scout of the SE corner of the AOI.	Monitor weather, fly where optimal
6/11/2020	20200611_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1 8-22, 85-101	10:30:00 AM	5:12:00 PM	4542.8	4549.5	6.7	Miranda Geller	Brian Butler	KCOE	Great day of flying, got lots done	Wx may roll in tomorrow, otherwise we will continue on blocks to the east
6/12/2020	20200612_SN3546A &	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1 66, 102-105; QL2 8-23, 185-192	9:15:00 AM	2:48:00 PM	4549.5	4555.1	5.6	Miranda Geller	Brian Butler	KCOE	Had to duck around to various QL1 and QL2 blocks to avoid snowfields and precip, but otherwise a productive day	Not likely to get a lift due to wx
6/19/2020	20200619_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL2 1, 36-38, 181-184	9:34:00 AM	12:27:00 PM	4555.6	4558.5	2.9	Miranda Geller	Brian Butler	KCOE	After some troubleshooting with the sensor, it started working correctly and with no error. We hopped around trying to avoid clouds/snow but they were only growing. Landed and watched wx to see if clouds lifted enough for a second lift.	Will get a lift if wx permits
6/20/2020	20200620_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	32, 33, 65, 67-73	12:10:00 PM	2:31:00 PM	4558.5	4560.8	2.3	Miranda Geller	Brian Butler	KCOE	Managed to get some acq before the clouds and rain closed in	Get a lift if wx allows
6/22/2020	20200622_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1 34-36, 74-77; QL2 7, 8, 35, 40-45, 148-149, 163-165, 173-174, 177-180	7:35:00 AM	1:30:00 PM	4560.8	4566.7	5.9	Miranda Geller	Brian Butler	KCOE	Wx was gorgeous and sunny, but we dodged clouds the whole time.	Get a lift if wx permits
6/23/2020	20200623_SN3546A &	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1 40-42, 84-82, 276, 285, 297; QL2 2-6, 24, 31-35, 145, 156	7:42:00 AM	1:50:00 PM	4566.7	4572.8	6.1	Miranda Geller	Brian Butler	KCOE	Great day for flying, didn't get chased around by clouds too much. Some peaks still have quite a bit of snow on them.	Will get a lift if wx cooperates
6/24/2020	20200624_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1 163-178, 337-348	10:19:00 AM	2:50:00 PM	4572.8	4577.4	4.6	Miranda Geller	Brian Butler	KCOE	managed to get a good window of wx, but lightning storms started up in area	NE will rotate in
6/26/2020	20200626_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1: 349-358, QL2: 7, 30, 165	9:28:00 AM	12:32:00 PM	14577.4	14580.5	3.1	Noah Edelson	Chris Gattman	KCOE	Finished our two reflies and then flew lines over Sandpoint until we were clouded out.	Get an earlier start and hopefully acquire for longer before being clouded out.
6/27/2020	20200627_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL2 25-29, 46-52	8:32:00 AM	11:23:00 AM	14580.5	14583.8	3.3	Noah Edelson	Chris Gattman	KCOE	Managed to fly on two blocks that were mostly cloud free, had to do a little bit of cloud dodging, had three noticeable dropouts in lines 46-52, manually flew two lines under the clouds to cover those 3 spots. Had a few close calls with clouds in data on lines 25-29 but did not see any dropouts in scan data.	Check weather and fly if conditions allow.
6/29/2020	20200629_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1 359, QL2 88-91	10:55:00 AM	12:49:00 AM	14583.3	14585.2	1.9	Noah Edelson	Chris Gattman	KCOE	Squeezed in a short lift between bands of weather, the cloud ceiling was at or below our flight altitude in most places, called it a day when the clouds were quickly increasing in size above us and were worried about conditions deteriorating.	Check weather, fly if conditions allow
7/6/2020	20200706_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	ID NorthernID R035827	QL1 333-336, 360-378	8:48:00 AM	1:14:00 PM	14597.0	14601.4	4.4	Noah Edelson	Chris Gattman	KSZT	The clouds for the most part stayed over the mountains, so we were able to acquire until we hit our fuel minimum.	Get another early start to hopefully get in some acquisition before clouds build in the late morning
7/11/2020	20200711_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL2	59-63, 217-237, 252-258, 144-147	8:45:00 AM	3:00:00 PM	14604.3	14610.6	6.3	Justen Maxey	Chris Griffin	KSZT	Decent flight today. Had to move around due to some clouds and patchy snow.	N ID
7/12/2020	20200712_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1	122-123, 158-162	8:45:00 AM	11:00:00 AM	14610.6	14612.6	2.0	Justen Maxey	Chris Griffin	KSZT	Dodged some clouds to get some lines. We got forced out due to clouds and high winds.	N ID
7/13/2020	20200713_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1	179-183, 251-258	8:40:00 AM	12:05:00 PM	0.0	0.0	0.0	Justen Maxey	Chris Griffin	KSZT	Fog this am so we had to wait a bit. Got up and had to bounce around due to clouds.	Try an earlier departure in hopes there is no fog and we can get a few more flight hours.

7/14/2020	20200714_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL2 QL1	QL1 64-71, 119-120, 193-199 QL2 198-211	7:10:00 AM	1:00:00 PM	14616.0	14621.7	5.7	Justen Maxey	Chris Griffin	KSZT	Windy all day. We got blown around quite a bit	N ID
7/15/2020	20200715_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1 QL2	QL1- 234-250, 191-198. QL2 72-82, 238-239	7:25:00 AM	1:11:00 PM	14621.7	14627.5	5.8	Justen Maxey	Chris Griffin	KSZT	Good flight, no issues	N ID
7/16/2020	20200716_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1	156-157, 184-190, 263-268, 325-332, 379-382	7:30:00 AM	1:05:00 PM	14627.5	14633.1	5.6	Justen Maxey	Chris Griffin	KSZT	Good flight. Hit some heavy turbulence in the last hour or so.	N ID
7/17/2020	20200717_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1	106-121, 124-127, 23-25, 154-155	7:20:00 AM	1:55:00 PM	14633.1	14637.6	4.5	Justen Maxey	Chris Griffin	KSZT	We managed to sneak under the clouds and get a decent flight in before the clouds lowered forcing us out	mx
7/19/2020	20200719_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL2	143, 166-171	10:50:00 AM	12:55:00 PM	14637.6	14639.7	2.1	Justen Maxey	Chris Griffin	KSZT	MX finished up around 0800. Had some sensor issues which delayed us for a while. We got up and got a handful of lines before getting clouded out.	N ID
7/20/2020	20200720_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1	142-153, 269-275	7:25:00 AM	11:00:00 AM	14639.7	14643.3	3.6	Justen Maxey	Chris Griffin	KSZT	Got a few hours in before getting clouded out.	N ID
7/21/2020	20200721_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL2	53-58, 83-87, 92-100, 111-118, 135-142	7:15:00 AM	1:30:00 PM	14643.3	14649.5	6.2	Justen Maxey	Chris Griffin	KSZT	Great day. We had smooth skies and cleaned up blocks to the snow line.	N ID
7/22/2020	20200722_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1 QL2	QL1: 215-223, 259-262. QL2: 121-134	7:10:00 AM	12:40:00 PM	14649.5	14655.0	5.5	Justen Maxey	Chris Griffin	KSZT	Good flight. We wrapped up the snow free lines on the west side.	Pick away at snow free lines in the east and to the south.
7/23/2020	20200723_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1 & QL2	QL1 286-288: QL2 150-152, 200-205, 245-251	9:16:00 AM	2:56:00 PM	7655.0	7660.5	5.5	Ben Miller	Dan Luckett	KSZT	Launched for N ID and had laser problem right away, it turned off swath was lost and wouldnt reconnect. Rebooted and was fine. Had another scanner connectivity issue on MOB back after getting rained out.	N ID
7/24/2020	20200724_SN3546A	Riegl VQ-1560i SN3546	Cessna Caravan 208B	704MD	ID NorthernID R035827	QL1	37-39, 43-61, 78-81, 290-296	9:13:00 AM	4:05:00 PM	7660.5	7667.3	6.8	Ben Miller	Dan Luckett	KSZT	Launched for remaining snow free lines on QL1, there were a couple instances of the tiniest amount of snow on north slope, no sensor issues.	Adams CTY, MT
8/23/2020	20200823_SN4046A	Riegl VQ-1560ii SN4046	Cessna Caravan 208B	604MD	ID NorthernID R035827	NorthernID_QL1, NorthernID_QL2	QL1	9:36:00 AM	3:38:00 PM	4939.4	4945.7	6.3	Scott White	Jamon Neilson	KSZT	Clear skies and full lift.	Should be able to finish up Northern ID if wx allows.
8/24/2020	20200824_SN4046A	Riegl VQ-1560ii SN4046	Cessna Caravan 208B	604MD	ID NorthernID R035827	NorthernID_1560i_QL2	153-156, 206-216, 240-244	10:01:00 AM	2:37:00 PM	4945.7	4950.2	4.5	Scott White	Jamon Neilson	KSZT	We got up and finished the project pending QC Had to battle some pretty good turbulence specifically on a ridge-line on our northern most block, but at least it was isolated to that one spot.	MOB to Missoula to try to finish Base.
9/6/2020A	20200906_SN4040A	SN4040	Piper Navajo	22GE	ID NorthernID R035827	QL2 N ID Reflies	1-14	8:30:00 AM	1:00:00 PM	10825.6	10829.8	4.2	Jonathon Swan	Jamon Neilson	KMSO	We were able to wrap up the QL2 reflies	
10/2/2020	20201002_SN3546B	SN3546	Cessna Caravan 208B	208NR	ID NorthernID R035827	QL1 Reflies	2, 4-7, 9	8:48:00 AM	11:34:00 AM	7726.4	7729.2	2.8	Erin Guillory	Bob Cale	KMYL	Went up this morning and completed North Fork Payette. Smoky but returns were good. Then mob'd up to Sandpoint to collect the Northern Idaho Reflies. Conditions were great.	