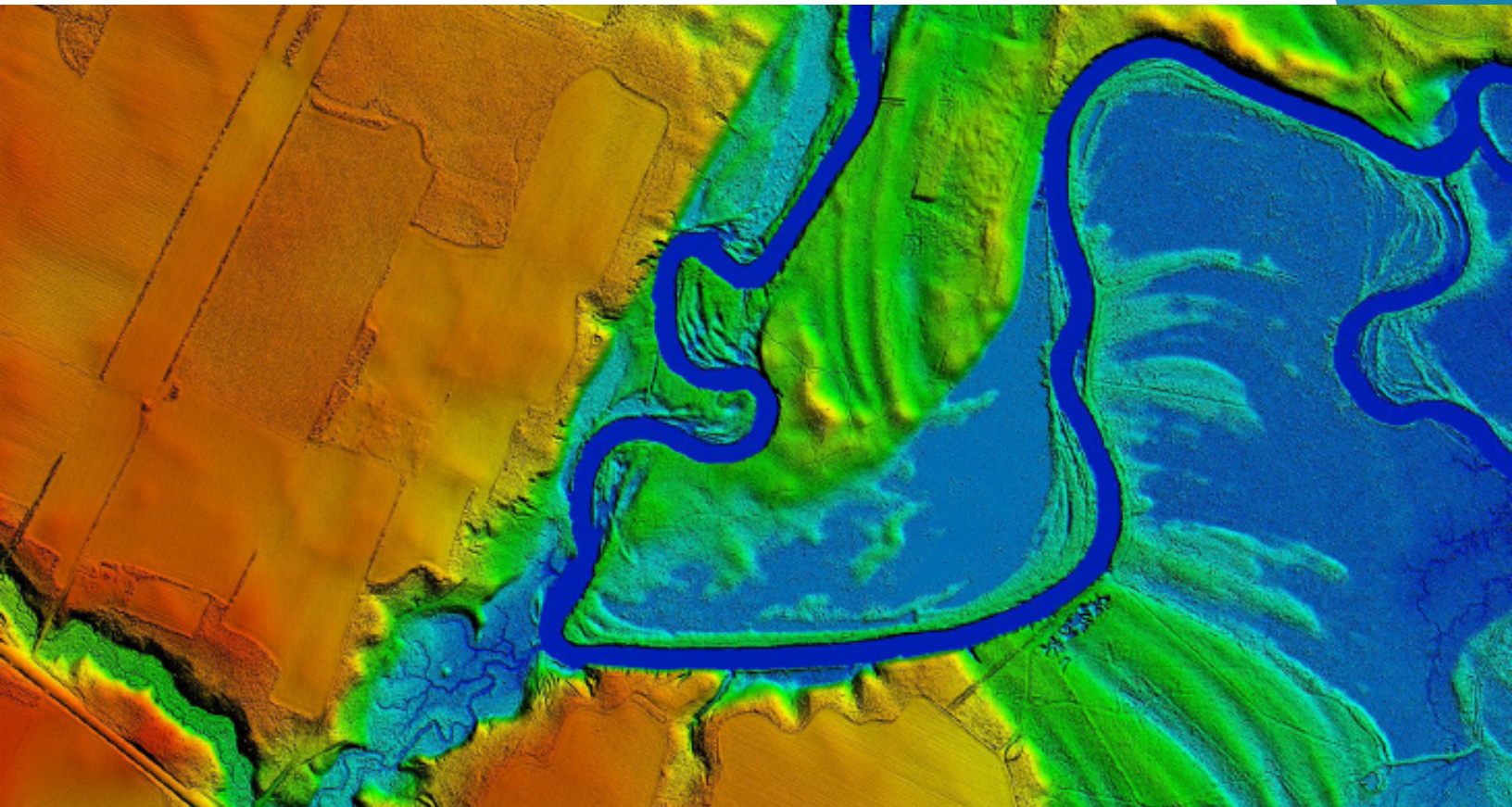


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NC HURRICANE FLORENCE 2020 D20 LIDAR PROJECT REPORT

Work Package ID: 186591

Work Unit ID: 218544

2020

Submitted: May 27, 2021

Prepared for:



1400 Independence Drive
Rolla, MO 65401

573.308.3500

Prepared by:



GEOSPATIAL

powered by QUANTUM SPATIAL

523 Wellington Way, Suite 375
Lexington, KY 40503

859.277.8700

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1. Summary / Scope

1.1. Summary

This report contains a summary of the NC Hurricane Florence 2020 D20, Work Unit 218544 lidar acquisition task order, issued by USGS under their Contract G16PC00016 on December 10, 2019. The task order yielded a project area covering approximately 1,181 square miles over North Carolina. 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	1400 m	58.5°	20%	≤ 10 cm

1.3. Coverage

The work unit boundary covers approximately 1,181 square miles over North Carolina. 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 December 16, 2019 to February 23, 2020 in 13 total lifts. See “Section: 2.4. Time Period” for more details.

1.5. Issues

There were no major issues to report for this project.

NC Hurricane Florence Work Unit 218544 Projected Coordinate System: UTM Zone 17N Horizontal Datum: NAD1983 (2011) Vertical Datum: NAVD88 (GEOID 18) Units: Meters	
Lidar Point Cloud	Classified Point Cloud in .LAS 1.4 format
Rasters	<ul style="list-style-type: none"> • 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) <ul style="list-style-type: none"> • Deliverable Swath • Lidar Tile Index Geodatabase (*.gdb) <ul style="list-style-type: none"> • Continuous Hydro-flattened Breaklines
Reports	Reports in PDF format <ul style="list-style-type: none"> • Focus on Delivery • Project Report
Metadata	XML Files (*.xml) <ul style="list-style-type: none"> • Breaklines • Classified Point Cloud • DEM • Intensity Imagery

NC Hurricane Florence Work Unit 218544 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), serial numbers 3069 and 3546, and a Riegl VQ1560ii, serial number 4046. 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.

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.

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

NC Hurricane Florence Work Unit 218544 Planned Flight Lines

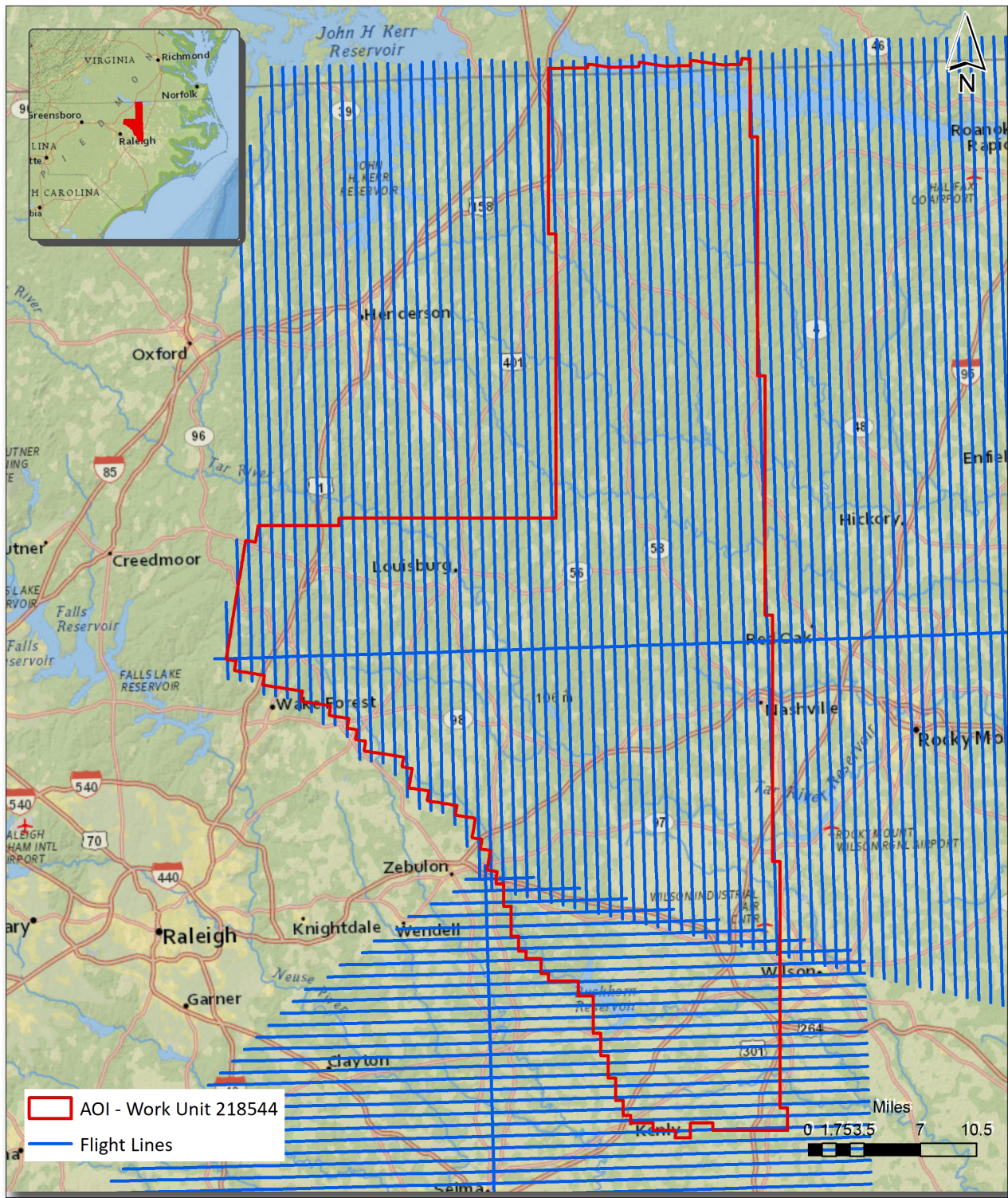


Figure 2. Planned Flight Lines

Table 2. Lidar System Specifications

		Riegl VQ1560i (3069)	Riegl VQ1560ii (4046)	Riegl VQ1560i (3546)
Terrain and Aircraft Scanner	Flying Height	1400 m	1400 m	1400 m
	Recommended Ground Speed	120 kts	160 kts	160 kts
Scanner	Field of View	58°	58.5°	58.5°
	Scan Rate Setting Used	135.33 Hz	180 Hz	160 Hz
Laser	Laser Pulse Rate Used	700 kHz	1000 kHz	2000 kHz
	Multi Pulse in Air Mode	yes	yes	yes
Coverage	Full Swath Width	1552 m	1568 m	1568 m
	Line Spacing	1241.6 m	1254 m	1254 m
Point Spacing and Density	Average Point Spacing	.35 m	.35 m	.35 m
	Average Point Density	8 pts / m ²	8 pts / m ²	8 pts / m ²

Figure 3. Riegl VQ1560i and VQ1560ii 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 T206 Turbo Stationair (piston-single), Tail Number: N27GP
- Cessna Caravan (single-turboprop), Tail Numbers: N704MD
- Piper Navajo (twin-piston), Tail Numbers: N22GE

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 VQ1560i lidar system. Some of Quantum Spatial's operating aircraft can be seen in Figure 4 below.

Figure 4. Some of Quantum Spatial's Planes



2.4. Time Period

Project specific flights were conducted between December 16, 2019 and February 23, 2020. Thirteen aircraft lifts were completed. Accomplished lifts are listed below.

- 12162019A (SN4046,NN22GE)
- 12162019B (SN4046,NN22GE)
- 01012020A (SN3069,N27GP)
- 01022020A (SN3069,N27GP)
- 01022020A (SN3546,NN704MD)
- 01052020A (SN3069,N27GP)
- 01062020A (SN3069,N27GP)
- 01102020B (SN3546,NN704MD)
- 01302020A (SN3069,N27GP)
- 01312020A (SN3069,N27GP)
- 02022020A (SN3069,N27GP)
- 02162020A (SN3069,N27GP)
- 02232020A (SN3069,N27GP)

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). See Appendix A for more information.

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 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
Applanix + POSPac	8.6
RiPROCESS	1.8.6
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 2.1 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.

All overlap data was processed through automated functionality provided by TerraScan to classify the overlapping flight line data to approved classes by USGS. The overlap data was identified using the Overlap Flag, per LAS 1.4 specifications.

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 streams and rivers 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 1 meter 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 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 overlap classes 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.

NC Hurricane Florence Work Unit 218544 Tile Layout

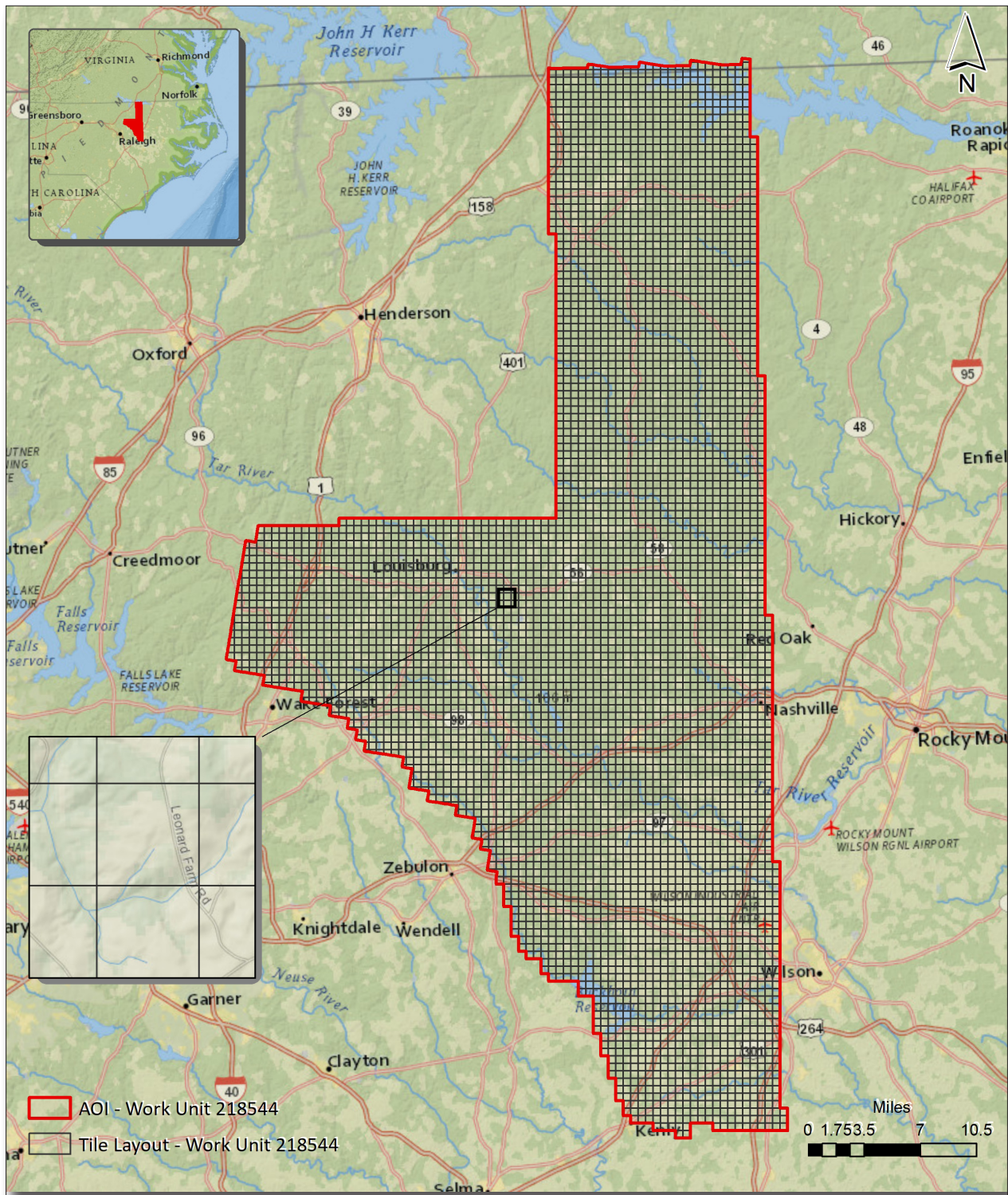


Figure 5. Lidar Tile Layout

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.

NC Hurricane Florence Work Unit 218544 Lidar Coverage

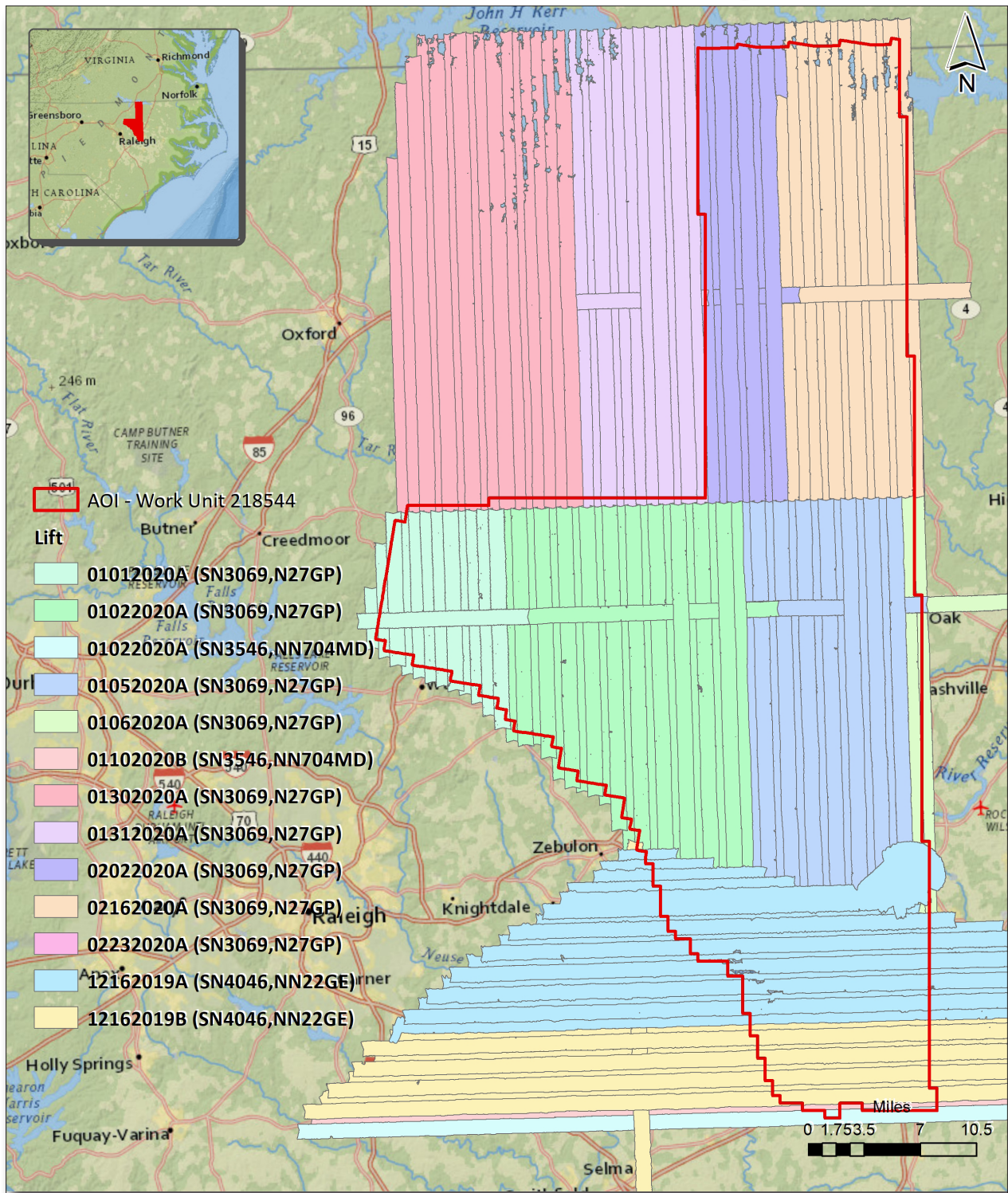


Figure 6. Lidar Coverage

Appendix A

Flight Logs

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



(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 1/1/20
Pg. 1 of 1

Project: QSI Hurricane Florence Proj #: 19143.135 Flight Mgmt File: _____

Aircraft: 276P Begin Hobbs: 7878.8 End Hobbs: 7882.3 Total: 2.5 Pilot: CS Co-Pilot: _____ Tech: AB

Dep Apt: KRDU Dep Time (Lcl): 10:25Z Arr Apt: KRDU Arr Time (Local): 12:44 (Z: 17:49) Tot Time Aloft: 2:24

CORS: Q1N Sta 1: WCRD Sta 2: KCRD Flyovers: Q1N If Y, times: Sta1) 15:37 Sta2) 17:33

GPS Unit: Y (N) Sta 1: _____ Sta 2: _____ Flyovers: Y | N If Y, times: Sta1) _____ Sta2) _____

Gd Temp beg: 8.3 °C End: 10.6 °C OAT beg: 30.5 °C End: 1.6 °C Altimeter begin: 29.97 end: 29.93

LIDAR	Type	Serial #	Alt	Max	Avg Pt	Mag	Storage
	FOV	Scan Freq	Mp/A In Air	Gddpd Power	Spdng PSM	GS Tot	Name/ID
	15601	2223069	4500	120	824/12		

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	ROOF/Start	GPS Altitude	Cab	Turn
90	9	1547	1549	100	1.1/23	5100	10	0
91	139	1553	1556	115	1.1/22	5100	-7	0
92	9	1559	1603	102	1.1/22	4900	10	0
93	139	1606	1610	116	1.1/22	5000	-7	0
94	9	1613	1618	92	1.1/21	4900	11	0
95	189	1620	1625	111	1.1/21	5000	-9	0
96	9	1628	1634	102	1.2/20	4900	11	0
97	189	1636	1640	111	1.1/21	5000	-7	0
98	9	1643	1648	106	1.1/21	4900	11	0
99	189	1651	1656	117	1.1/21	5000	-5	0
100	9	1659	1704	114	1/22	4900	8	0
101	189	1707	1713	106	1/21	4900	-6	0
101	279	1718	1724	101	1/22	4900	-1	0

Possible Cloud in Scan North end

Cross line

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



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

Date: 1/2/20

Project: ASZ Hurricane Florence Prof #: 1814313 Flight Mgmt File: Ltr: A B C D E Pg 1 of 3

Aircraft: 276P Begin Hobbs: 7882.3 End Hobbs: 7887.5 Total: 5.2 Pilot: SS Co-Pilot: — Tech: AS

Dep Airt: KRDU Dep Time (Ldt): 8:20Z: 14:20 Arr Airt: KRDU Arr Time (Local): 14:42Z: 19:42 Tot Time Aloft: 1923

CORS: 01N Sta 1: NCRD Sta 2: NENA Flyovers: 01N If Y, times: Sta1) 14:28 Sta2) 1923

GPS Unit: Y/N Sta 1: Sta 2: Flyovers: Y/N If Y, times: Sta1) Sta2)

Gd Temp beg: 8.3 °C End: 8.5 °C OAT beg: 7.2 °C End: 5.5 °C Altimeter begin: 30.05 end: 30.01

LIDAR Type: 1560i Serial #: 5223069 Alt AGL: 4500 Alt AMSL: 5000 Avg Terr: 500 Max Gdepd: 120 Avg Pt Spacing: 0.89pts/ft

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POF/s	GPS Altitude	Crab	Turb	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
102	9	1438	1444	115	1/26	5000	11	0	Clear
103	189	1447	1455	100	.96/27	4900	-10	0	
104	9	1457	1504	120	.88/29	4900	11	0	
105	189	1507	1515	97	.98/28	4800	-11	0	
106	9	1518	1525	119	.81/31	4900	10	0	
107	189	1529	1538	95	.81/31	4800	-12	0	
108	9	1541	1549	115	.98/29	4800	12	0	
109	189	1553	1602	97	.55/29	4800	-11	0	
110	9	1605	1613	117	.93/28	4800	13	0	
111	189	1617	1628	94	.88/28	4800	-14	0	
112	9	1631	1641	115	.93/27	4800	15	0	
113	189	1644	1656	95	.91/28	4800	-16	0	
114	9	1658	1708	117	.92/27	4800	17	0	
115	189	1711	1723	99	.95/27	4800	-16	0	
116	9	1726	1737	112	.91/28	4800	16	0	
117	189	1739	1752	93	.81/28	4800	-19	0	
118	9	1754	1805	115	.81/27	4800	16	0	
119	189	1808	1821	95	.95/26	4800	-17	0	

Total Proj Lines: 91 Lines Flown: 22 Lines Remain: 58 Online Time: 4:40 Mob Time: 18:24 Notes: (42)



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

(email log daily to flight-log-distribution_list@quantumspatial.com)

Date: 1/2/20

Lift: A B C D E

Pg 2 of 2

Project: OST Hurricane Florence Proj #: 1814313 Flight Mgmt File:

Aircraft: Z16R Begin Hobbs: 7882.3 End Hobbs: 7887.5 Total: 5.2 Pilot: SS Co-Pilot: — Tech: AS

Dep Apt: KEDU Dep Time (Lcl): 9:20 (Z) Arr Apt: KEDU Arr Time (Local): (Z) Tot Time Aloft:

CORS: Ø1N Sta 1: UICRP Sta 2: NCNA Flyovers: Ø1N If Y, times: Sta1) 14:28 Sta2) 19:23

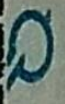
GPS Unit: Y1Ø Sta 1: Sta 2: Flyovers: Y1N If Y, times: Sta1) Sta2)

Gd Temp beg: 8.3 °C End: 12.8 °C OAT^Ø Beg: 7.2 °C End: 5.5 °C Altimeter begin: 30.05 end: 30.01

Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Hr	Max Gdspd	Avg Pt Spacing	Storage Name/ø
LIDAR	15601	4500	5000	500	170	Ø9pts/ft ²	Beg 546.9L End 547.67 ØB 385.14 Tot 384.67 ØB 157.8L Tot 158.9L

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POOF/s	GPS Altitude	Crab	Turb (0..+)	FLIGHT LINE NOTES - Visibility, clouds, smoke, partial, etc
120	9	1823	1834	111	.99/25	4800	16	0	Clear
121	189	1836	1848	104	.99/25	4900	-15	0	
122	9	1851	1902	109	.98/25	4800	19	0	↓
181	29	1908	1918	79	1.1/24	4700	1	0	Cross line

Total Proj Lines: 91 Lines Flown: 22 Lines Remain: 58 Online Time: 4:40 Mob Time: 42 Notes:



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

Date: 1/5/20

Project: Hurricane Florence Proj #: 1814313 Flight Mgmt File: _____

Aircraft: 276P Begin Hobbs: 7887.5 End Hobbs: 7892.3 Total: 4.8 Pilot: SS Co-pilot: _____ Tech: 413

Dep Apr: KRDV Dep Time (Ldt): 9:27Z: 14:27 Arr Apr: KRDV Arr Time (Local): 2:25Z: 19:25 Tot Time Aloft: _____

CORS: B1N Sta 1: NAVA Sta 2: UCRD Flyovers: B1N If Y, times: Sta1) 14:50 Sta2) 19:14

GPS Unit: Y / N Sta 1: _____ Sta 2: _____ Flyovers: Y / N If Y, times: Sta1) _____ Sta2) _____

Gd Temp beg: 5 °C End: _____ °C OAT beg: _____ °C End: _____ °C Altimeter begin: 30.15 end: 30.15

LIDAR	Type	Serial #	Alt	Alt	°C	Alt	Max	Avg Pt	Storage
	FOV	Scan Freq	AGL	AVSL	End	Gdspd	Spdchg	Spdchg	
	1560,	52223069	4500	7000		120	100	252.52	384.47
	58.52		MPIA Y / N	Pulses In Air		Power	PP3M	247.15	

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POOF/sms	GPS Altitude	Crab	Turb	Notes
123	189	1504	1515	118	1/29	4600	-6	0	Clear 40knt tailwind
124	9	1519	1535	86	1/29	4700	6	0	40 knt headwind
125	189	1537	1548	118	98/29	4800	-6	0	35 knt Tailwind
126	9	1552	1608	75	1/26	4700	6	0	36 knt headwind
127	189	1611	1622	115	1/25	4700	-6	0	26 knt Tailwind
128	9	1626	1642	81	53/26	4700	6	0	35 knt headwind
129	189	1644	1656	115	.85/26	4800	-7	0	23 knt Tailwind
130	9	1659	1714	82	.84/27	4700	5	0	33 knt headwind
131	189	1716	1728	118	.96/25	4800	-6	0	30 knt Tailwind
132	9	1731	1746	100	.95/25	4700	5	0	32 knt headwind
133	189	1748	1800	118	1/25	4800	-4	0	35 knt Tailwind
134	9	1803	1818	93	1/24	4600	4	0	35 knt headwind
135	189	1820	1832	118	1/24	4700	-4	0	35 knt Tailwind
136	9	1835	1850	107	.84/27	4600	5	0	70 knt headwind
181	279	1854	1900	105	.92/26	4700	-8	0	Cross line

Total Proj Lines: 91 Lines Flown: 14 Lines Remain: 44 Online Time: 3:56 Mob Time: 1:02 Notes: _____

37 25

2



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

Date: 1/6/20

(email log daily to flight_log_distribution_list@quantumspatial.com)

File: ABCDE

Page 1 of 1

Project: Hurricane Florence Proj #: 18143.13 Flight Mgmt File:

Aircraft: 2760 Begin Hobbs: End Hobbs: ~~7892.3~~ Total: 7892.3 Pilot: SS Co-Pilot: Tech: A03

Dep Apt: KRDU Dep Time (Ld): 9:15 (Z): 14:15 Arr Apt: LRDV Arr Time (Local): 2:28 (Z): 19:28 Tot Time Aloft: 5:13

CORS: N Sta 1: NCRD Sta 2: NCUA Flyovers: N IF Y, times: Sta1) 14:22 Sta2) 18:03

GPS Unit: Y / N Sta 1: Sta 2: Flyovers: Y / N IF Y, times: Sta1) Sta2)

Gd Temp beg: 3 °C End: 14 °C OAT beg: °C End: 8 °C Altimeter begin: 3013 end: 30.08

LIDAR	Type	Serial #	Alt AGL	Alt AVSL	Avg Terr Ht	Max Gdepd	Avg Pct Spanding	Storage GB
	FOV	Scan Freq	MPIA Y / N	Pulses In Air	Pulse Rate	Power	PPSM	End GB

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POOF/s	GPS Altitude	Cab	Turb
137	9	1436	1451	93	.85/31	4600	10	0
138	189	1454	1506	115	.83/31	4700	-12	0
139	9	1509	1524	95	.87/30	4600	7	0
140	189	1526	1538	115	1/28	4600	-13	0
141	9	1541	1557	96	.95/29	4600	8	0
142	189	1559	1612	112	.9/28	4700	-11	0
143	9	1614	1630	93	.55/27	4600	11	0
144	189	1632	1645	114	.9/26	4600	-10	0
145	9	1648	1703	98	.91/26	4600	7	0
146	189	1705	1718	115	.96/26	4600	-9	0
147	9	1721	1736	98	.53/25	4600	10	0
148	189	1738	1751	116	.9/25	4600	-10	0
149	9	1754	1810	97	1/23	4600	9	0
150	189	1812	1825	116	.87/26	4600	-9	0
151	9	1827	1843	97	.9/26	4600	10	0
152	189	1846	1849	114	1.03/29	4600	-8	0
181	280	1853	1900	99	1.1/24	4600	-5	0

Clear

Tach Time Start: 7892.3
Stop: 7897.4
Total: 5.1

Partial
Cross line

Total Proj Lines: 91 Lines Flown: 15 Lines Remain: 29 Online Time: 4:24 Mob Time: 49 Notes:

Screen Shot PDS Laser Arms Lidar SOCS 21 28



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

Date: 1/10/20

Project: Hurricane Florence

email log daily to flight_log_distribution_list@quantumspatial.com

Lift: A B C D E

Pg 1 of 1

Project: Hurricane Florence Proj #: 18143,13 Flight Mgmt File:

Aircraft: 276P Begin Hobbs: 7905 End Hobbs: 79097 Total: 4.7 Pilot: SS Co-Pilot: Tech: A93

Dep Apt: KRDU Dep Time (Ld): 9:00 (Z): 14:00 Arr Apt: KRDU Arr Time (Local): 2:05 (Z): 19:05 Tot Time Aloft: 5:05

CORS: D/N Sta 1: NCRD Sta 2: NUVA Flyovers: D/N If Y, times: Sta1) 14:14 Sta2) 18:34

GPS Unit: Y/N Sta 1: Sta 2: Flyovers: Y/N If Y, times: Sta1) Sta2)

Gd Temp beg: 7 °C End: 9 °C OAT beg: 6 °C End: 7 °C Altimeter begin: 3057 end: 3056

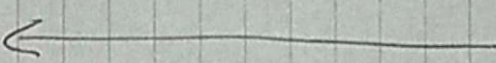
LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Pt
	FOV	Scan Freq	AGL	AVSL	Ht	Gdapt	Spacing
	58.52	52223069	4500	5800	500	120	PP3M
			MPIA Y/N	Pulses In Air	Pulse Rate	Power	

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	Profile-sars	GPS Altitude	Corb	Turb
152	9	1435	1449	116	1/26	4600	8	0
153	189	1451	1508	86	1/29	4600	-8	0
154	9	1510	1524	111	1/29	4600	8	0
155	40	1526	1542	90	1/28	4600	-8	0
156	10	1544	1557	116	1/27	4600	9	0
157	190	1559	1616	92	1/27	4600	-7	0
158	10	1617	1631	116	1/27	4600	5	0
159	190	1634	1650	160	1/25	4600	-4	0
160	10	1652	1706	118	1/26	4500	6	0
161	190	1709	1725	99	1/24	4500	-6	0
162	10	1727	1741	117	1/25	4500	8	0
163	190	1743	1800	97	1/24	4600	-6	0
164	10	1802	1816	117	1/24	4600	7	0
181	280	1821	1827	102	1/24	4600	11	0

Overcast < haze

Cross line



Total Proj Lines: 9 Lines Flown: 13 Lines Remain: 6 Online Time: 3:52 Mob Time: 1:13 Notes: 35 78

5:1



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

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Date: 01/30/2020
Pg 1 of 1

Project: **HURRICANE FLORENCE** Proj #: **QSI 35630 NC** Flight Mgmt File:

Aircraft: **N27GP** Begin Hobbs: **7949.2** End Hobbs: **7954.2** Total: **5.0** Pilot: **S.SANTOS** Co-Pilot: **N/A** Tech: **G.A.DAAMS**

Dep Airt: **KRDU** Dep Time (Lcl): **9:26 (Z)** Arr Airt: **KRDU** Arr Time (Local): **14:46 (Z)** Tot Time Aloft: **5:20**

CORS: **0/N** Sta 1: **DURH** Sta 2: **NCRD** Flyovers: **0/N** If Y, times: Sta1) **9:32** Sta2) **19:27**

GPS Unit: **Y/N** Sta 1: Sta 2: Flyovers: **Y/N** If Y, times: Sta1) Sta2)

Gd Temp beg: **4 °C** End: **10 °C** OAT beg: **0 °C** End: **4 °C** Altimeter begin: **30.20** end:

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Pt	Pg	Storage
	FOV	Scan	AGL	AMSL	Ht	Gdepd	Spacing		
	58	52223069	4500	4800	500	120	PPSM		
		Freq	MPIA	In Air	Pulse Rate	Power			
		135.33	Y/N		700	100%			

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.

Line #	Hdg	Start (UTC)	End (UTC)	Gd spd	POOF/s	GPS Altitude	Crab	Turn
1	020	14:48	14:59	101	29	4900	0	0 CLR
2	180	15:03	15:15	114	28	4900	2	0 CLR
3	021	15:17	15:32	99	30	4900	-2	0 CLR
4	180	15:35	15:48	109	28	4800	2	0 CLR
5	020	15:51	16:06	105	27	4900	-3	0 CLR
6	180	16:07	16:21	108	26	4900	3	0 HIGH OVC (OVERCAST)
7	020	16:23	16:38	108	24	4900	-1	+
8	180	16:40	16:53	118	26	4900	2	+
9	020	16:55	17:09	110	25	4900	-1	+
10	180	17:11	17:24	119	24	4900	5	+
11	020	17:26	17:40	112	27	4900	-1	+
12	181	17:41	17:55	120	26	4900	2	+
13	020	17:56	18:10	115	26	4900	-1	+
14	180	18:11	18:25	114	28	4800	2	+
15	020	18:27	18:41	115	27	4900	-1	+
16	180	18:43	18:56	117	30	4900	-1	+
89	265	19:05	19:10	110	29	4900	-1	+

Total Proj Lines: 89 Lines Flown: 17 Lines Remain: 72 Online Time: 3:43 Mob Time: 0:38 Notes:



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

Date: 01/31/2020

Project: HURRICANE FLORENCE Proj #: 35630 NC Flight Mgmt File: Lift: A B C D E Pg. 1 of 1

Aircraft: N27GP Begin Hobbs: 7954.2 End Hobbs: 7958.0 Total: 3.8 Pilot: S. SANTOS Co-Pilot: N/A Tech: G. ADAMS

Dep Apt: KRDU Dep Time (Lcl): 9:24 (Z): 14:24 Arr Apt: KRDU Arr Time (Local): 13:28 (Z): 18:28 Tot Time Aloft: 4:04

CORS: O/N Sta 1: DURH Sta 2: NCRD Flyovers: Y/N If Y, times: Sta1) 9:36 (Lcl) Sta2) 18:07 (UTC)

GPS Unit: Y/N Sta 1: Sta 2: Flyovers: Y/N If Y, times: Sta1) Sta2)

Gd Temp beg: 2 °C End: 8 °C OAT beg: 1 °C End: 6 °C Altimeter begin: 30.30 end: 30.22

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Reg	Storage
	FOV	Scan Freq	MPIA Y/N	AMSL Pulses In Air	Ht Pulse Rate	Gdspd Power	End GB	Name/ #
	58	52223069	Y/N	4800	500	120		
					700	100%		

FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc

Line #	Hdg	Start (UTC)	End (UTC)	Gd spd	roof/sars	GPS Altitude	Crab	Turn
								(0, -, +)
17	010	14:50	15:05	110	28	4800	2	0
18	190	15:06	15:20	115	26	4900	-4	0
19	010	15:21	15:35	115	25	4900	1	0
20	190	15:36	15:50	119	21	4900	-2	0
21	010	15:51	16:05	117	28	4900	-1	0
22	190	16:06	16:20	118	26	4900	-2	0
23	010	16:21	16:35	116	25	4900	1	+
24	190	16:36	16:50	111	26	4900	-1	+
25	010	16:51	17:05	114	26	4900	-1	+
26	190	17:06	17:20	109	25	4900	2	+
27	010	17:21	17:35	112	27	4800	-1	+
89	260	17:44	17:48	118	27	4800	4	+

CROSS LINE

Total Proj Lines: 89 Lines Flown: 12 Lines Remain: 62 Online Time: 2:39 Mob Time: 0:55 Notes:



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

Date: 02/02/2020

Project: **HURRICANE FLORENCE** Prof #: **QSI 35630NC** Flight Mgmt File: _____

Aircraft: **N27GP** Begin Hobbs: **7958.0** End Hobbs: **7961.7** Total: **3.7** Pilot: **S. SANTOS** Co-Pilot: **N/A** Tech: **G. ADAMS**

Dep Apt: **KRDU** Dep Time (Lcl): **9:19** (Z): **14:19** Arr Apt: **KRDU** Arr Time (Local): **13:06** (Z): **18:06** Tot Time Aloft: **3:47**

CORS: **O/N** Sta 1: **NCMR** Sta 2: **NCRD** Flyovers: **O/N** If Y, times: Sta1) **14:43** Sta2) **17:52**

GPS Unit: **Y/N** Sta 1: _____ Sta 2: _____ Flyovers: **Y/N** If Y, times: Sta1) _____ Sta2) _____

Gd Temp beg: **6** °C End: **15** °C OAT beg: **4** °C End: **8** °C Altimeter begin: **29.89** end: **29.75**

Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Ft	Storage
VO-1560i	522223069	AGL	AMSL	Ht	Gaspd	Spacing	Name/#
FOV	58	Mp/A	In Air	Pulse Rate	Power	PPSM	
		Y/N		700	100%		

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POOF/s	GPS Altitude	Crab	Turb	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
28	200	14:54	15:01	120	26	4900	-19	+	40KNT WINDS COMING FROM THE NORTHWEST; CHANNEL ERROR
28	360	15:10	15:25	91	24	4900	18	+	
29	260	15:30	15:45	116	25	4900	-20	+	
30	360	15:48	16:04	95	24	4900	18	+	
31	200	16:06	16:20	116	23	4900	-19	+	
32	360	16:23	16:40	92	24	4900	19	+	
33	200	16:42	16:56	117	24	4900	-22	+	
34	360	16:58	17:15	96	23	4900	21	+	50 KNT WINDS
35	200	17:16	17:18	120	24	4900	-26	+	MOUNT AT MAX CRAB - ALT. HIGH
89	270	17:24	17:29	76	25	4900	-5	+	SPEED FLUCTUATED BETWEEN 60-77KNTS

Total Proj Lines: 89 Lines Flown: 9 Lines Remain: 54 Online Time: 2:02 Mob Time: 1:11 Notes:

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

Date: 2020.01.02

Project: NC-LIDAR, MLS Proj # 35130 Flight Mgmt File

Aircraft: 704 MD Begin Hobbs: 14190.6 End Hobbs: 14195.2 Total: 4.6 Pilot: C. Laposa Co-Pilot: TEG

Dep Apt: Dep Time (Lcl): 848 (Z): 1348 Arr Apt: Arr Time (Local): 1326 (Z): 1826 Tot Time Aloft: 4.63

CORS: Y (N) Sta 1: Sta 2: Flyovers: Y (N) If Y, times: Sta 1) Sta 2)

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

Gd Temp beg: °C End: °C OAT beg: °C End: °C Altimeter begin: 2992 end:

LIDAR	Type	Serial #	Alt AGL	Alt AMSL	Avg Terr Hr	Max Gapped	Avg Pt Spacing	TT
	PLCCL (500)	3546	1400	4593'	2000	100	PP3M	248.26
	FOV	2 x 161	MPIA Y / N	Pulses In Air	Rate	Power	PP3M	36.9, 73.2, 519.64, 124.65, 133.58

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	PDOP/sats	GPS Altitude	Crab	Turb	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
50 01	348 140815	140930	145	099/18				0	WINDS
50 02	348 141108	141230	140	108/16	1375	Y	0	S-N	
50 03	142 141455	141630	145	109/17	1386	Y	0	S-N	
50 04	350 141539	142025	140	1.1/16	1379			S-N	
50 05	140 142305	142515	145	1.1/16	1375			S-N	
50 06	351 142742	143055	150	1.1/16	1373			S-N	
50 07	140 143356	143730	141	0.99/15	1379			S-N	missive 143117
50 08	351 144000	1444	148	0.99/16	1363			S-N	
50 09	140 144709	1452	147	0.99/17	1371			S-N	
50 10	351 145523	150059	148	0.99/17	1365			S-N	
50 11	140 150504	151258	150	1.03/16	1373			S-N	
50 12	351 151450	152245	155	0.92/18	1375			S-N	light rain on line 4.1 min to line end
50 13	140 153457	1542	142	1.02/18	1352			S-N	REFLY? move to EAST END

Total Prod Lines: 90 Lines Flown: 13 Lines Remain: 77 Online Time: 1:30 Mob Time: 1:00 Notes



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

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Date: 12 16 19
Lift: A B C D E Pg. 1 of 1

Project:	NC LIDAR	Proj #:	35630	Flight Mgmt File:	20191216_NC-35630
Aircraft:	226F	Begin Hobbs:	10185.0	End Hobbs:	10189.4 Total: 1.4
Dep Apt:	RDU	Dep Time (Lcl):	849 (Z): 1349	Arr Apt:	RWI Arr Time (Local): 111 (Z): 1811
CORS:	Y (N)	Sta 1:		Sta 2:	
GPS Unit:	Y (N)	Sta 1:		Sta 2:	
Gd Temp beg:	°c	End:	°c	OAT beg:	°c
Altimeter begin:	°c	End:	°c	end: 30.19	
LIDAR Type:	1560i	Serial #:	4046	Alt AGL:	4593
FOV:	58	Scan Freq:	1000	MPIA Y/N:	Y/N
Avg Terr Ht:		Max Gdspd:		Pulse Rate:	
Avg Pt Spacing:		Power:	100	PPSM:	8
beg GB:		End GB:		Tot GB:	
Storage Name/P:					

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	PDOP # Sats	GPS Altitude	Crab	Turb (0, -1)	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.
3001	099	1406	1407	175	0.9/27	4675	0	1	S-TURN
3002	279	1412	1415	112	0.8/29	4668	0	2	
3003	099	1419	1422	158	0.9/29	4636	0	2	
3004	279	1427	1433	115	0.9/29	4623	0	1	
3005	099	1436	1442	157	0.9/29	4626	0	1	Scanner stayed on Thru Turn
3006	279	1446	1454	119	0.9/29	4616	0	1	
2007	099	1459	1507	166	1.0/27	4347	0	0	
3008	279	1511	1525	108	0.8/30	4462	0	1	
3009	099	1528	1538	157	0.9/27	4550	0	1	
3010	279	1541	1558	112	0.9/29	4550	0	1	
3011	099	1601	1612	149	0.9/20	4541	0	0	
3012	279	1616	1633	107	0.9/29	4541	0	1	
3013	099	1636	1647	159	0.9/30	4541	0	0	
3014	279	1651	1708	112	0.9/30	4544	0	0	
3015	099	1711	1724	145	0.9/27	4544	0	0	
3016	279	1726	1745	116	0.9/25	4484	0	0	
3017	099	1748	1802	151	0.9/25	4485	0	0	S-TURN

Total Proj Lines:	Lines Flown: 17	Lines Remain:	Online Time: 4.0	Job Time: 0.7	Notes:
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123.85 Wash



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

(email log daily to flight_log_distribution_list@quantumspatial.com)

Date: 12/6/19
Lift: A B C D E Pg 3 of 3

Project: NC LIDAR	Proj #: 35630	Flight Mgmt File: 20191218-NC-35630-2							
Aircraft: Z26E	Begin Hobbs: 10189.4	End Hobbs: 10192.8 Total: 3.4							
Dep Apt: RWI	Dep Time (Local): 224 (Z): 1924	Arr Apt: ADU Arr Time (Local): 553 (Z): 2253 Tot Time Aloft:							
CORS: Y10	Sta 1:	Sta 2:							
GPS Unit: Y10	Sta 1:	Sta 2:							
Gd Temp beg: °C End: °C OAT beg: °C End: °C		Altimeter begin: 30.11 end: 30.08							
LIDAR	Type: 1560	Serial #: 4046	Alt AGL: 4593	Alt AMSL:	Avg Terr Ht:	Max Gdepd: 110	Avg Pt Spacing:	Reg CB:	Storage Name/ID:
	FOV: 56	Scan Freq: 1000	MplA: Y1N	Pulse in Air:	Pulse Rate:	Power: 1000	PPSM: 8	End CB:	Tot CB:

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	PDOF/Sets	GPS Altitude	Crab	Turb (0, -, +)	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc.
3104	279	1944	1958	127	1.0/23	4550	-1	0	S-Turn - x Tie - planned
3018	099	2012	2025	158	0.9/24	4524	0	0	
3019	279	2029	2047	114	0.9/25	4534	0	0	
3020	099	2049	2103	146	0.9/25	4534	0	0	
3021	279	2107	2125	120	0.9/25	4511	0	0	
3022	099	2128	2142	145	0.9/28	4521	0	0	
3023	279	2146	2203	122	0.8/28	4521	0	0	
3024	099	2206	2221	144	0.9/28	4531	0	0	
3025	279	2224	2243	123	1.0/28	4524	0	0	S-Turn

Total Prod Lines: 105	Lines Flown: 9	Lines Remain:	Online Time: 3.0	Job Time: 0.4	Notes:
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Airborne LIDAR Data Collection Log Sheet :: Quantum Spatial, Inc

Date: 02/16/20

Ltr: A B C D E

Pg 1 of 1

(email log daily to flight_log_distribution_list@quantumspatial.com)

Project: HURRICANE FLORENCE

Project #: 35630 NC

Flight Mgmt File:

Altcraft: N276P

Begin Hobbs: 7976.7 End Hobbs: 7981.9 Total: S.2

Pilot: S. SANTOS

Co-Pilot: —

Tech: G. ADAMS

Dep Airt: KRDU

Dep Time (Lcl): 9:27 (Z): 14:27

Arr Airt: KRDU

Arr Time (Local): 14:55 (Z): 19:55

Tot Time Aloft: S: 28

CORS: Y / N

Sta 1: NCRWR

Flyovers: Y / N

If Y, times: Sta1) 14:58

GPS Unit: Y / N

Sta 2: NCRWR

Flyovers: Y / N

If Y, times: Sta1)

Sta2)

Gd Temp beg: 3 °C End: 12 °C OAT beg: 1 °C End: 8 °C Altimeter begin: 30.29 end: 30.14

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Pt	Bag	Storage
	FOV	Scan	AGL	MSL	Ht	Gdop	Spacing		
	58	S2223069	4500	4800	500	120		End	
		Freq 135.33	MplA Y / N	Pulses In Air	Rate 700	Power 100%	PPSM	Tot	

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	POF/s	GPS Altitude	Cab	Turb	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc	
35	185	15:06	15:20	117	24	4800	-3	0	CLEAR (CLR)	
36	020	15:21	15:35	110	23	4800	2	0	CLR	
37	185	15:37	15:50	115	24	4800	-1	0	CLR	
38	020	15:52	16:03	112	26	4700	1	0	CLR	
39	185	16:05	16:21	113	25	4800	-1	0	CLR	
40	020	16:22	16:35	119	26	4800	2	0	CLR	
41	185	16:37	16:52	161	26	4700	-1	0	CLR	
42	020	16:53	17:06	118	26	4700	5	0	CLR	
43	185	17:07	17:21	109	27	4700	-3	0	CLR	
44	020	17:22	17:36	118	28	4800	6	0	CLR	
45	185	17:37	17:52	107	30	4700	-1	0	CLR	
46	020	17:53	18:06	120	28	4700	8	0	CLR	
47	185	18:07	18:22	102	30	4700	-2	0	CLR	
48	020	18:24	18:37	119	30	4600	6	0	CLR	
49	185	18:38	18:53	107	30	4800	-2	0	CLR	
50	020	18:54	19:08	118	31	4600	11	0	CLR	
89	270	19:18	19:24	108	29	4700	4	0	CROSS LINE	

Total Proj Lines: 89 Lines Flown: 17 Lines Remain: 38 Online Time: 3:49 Mob Time: 0:59 Notes:



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

Date: 02/23/20

Lift: A B C D E

Pg. of

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Project: **HURRICANE FLORENCE** Proj #: **35630 NC** Flight Mgmt File: **---**

Aircraft: **N9481T** Begin Hobbs: **2317.8** End Hobbs: **2322.6** Total: **4.8** Pilot: **S. SANTOS** Co-Pilot: **---** Tech: **G. ADAMS**

Dep Airt: **KRPDU** Dep Time (Lcl): **9:14 (Z): 14:14** Arr Airt: **KRPDU** Arr Time (Local): **13:46 (Z): 18:46** Tot Time Aloft: **4:32**

CORS: **(Y)/N** Sta 1: **NCRD** Sta 2: **NCWR** Flyovers: **(Y)/N** If Y, times: **Sta1) 14:24 Sta2) 18:19**

GPS Unit: **Y/(N)** Sta 1: **---** Sta 2: **---** Flyovers: **Y/(N)** If Y, times: **Sta1) --- Sta2) ---**

Gd Temp beg: **3 °C** End: **17 °C** OAT beg: **1 °C** End: **15 °C** Altimeter begin: **30.30** end: **30.20**

LIDAR	Type	Serial #	Alt	Alt	Avg Terr	Max	Avg Pt	Bag	Storage
	FOV	Scan Freq	AgL	AVSL	Ht	Gasped	Spacing	GB	Name/#
	58	52223069	4500	4800	300	120	PPSM	End GB	
		135.33	MPIA Y/N	Pulses In Air	Pulse Rate	Power		Tot GB	
					700	100			

Line #	Hdg	Start (UTC)	End (UTC)	Gd Spd	PDR/#sars	GPS Altitude	Crab	Turb (0-+)	FLIGHT LINE NOTES - visibility, clouds, smoke, partial, etc
35	007	14:43	14:57	113	25	4800	2	0	CLR
36	190	14:58	15:12	110	25	4800	-3	0	CLR
37	007	15:13	15:27	114	25	4800	3	0	CLR
38	190	15:28	15:42	112	24	4800	-3	0	CLR
39	007	15:43	15:57	118	24	4700	4	0	CLR
40	190	15:58	16:13	107	24	4800	-4	0	CLR
41	007	16:14	16:28	115	25	4800	4	0	CLR
42	190	16:29	16:44	108	27	4800	-5	0	CLR
43	007	16:45	16:59	118	28	4700	5	0	CLR
44	190	17:00	17:15	103	31	4800	-4	+	MILD TURBULENCE STARTING
45	007	17:15	17:29	117	30	4700	5	+	CLR
46	190	17:30	17:46	105	29	4700	-5	+	CLR
47	007	17:46	18:00	119	30	4700	5	+	CLR; MODERATE TURBULENCE
48	190	18:00	18:15	106	28	4700	4	+	CLR
89	276	18:10	18:15	106	28	4700	4	+	CROSS LINE

Total Proj Lines: 89 Lines Flown: 14 Lines Remain: 29 Online Time: 3:12 Mob Time: 1:00 Notes: