

NH_COASTAL_2019_B19 LIDAR PROCESSING REPORT

> Work Package: 183374 Work Unit: 183371

2020

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1. Summary / Scope

1.1. Summary

This report contains a summary of the NH_COASTAL_2019_B19, Work Unit 183371 lidar acquisition task order, issued by USGS under their Contract G16PC00016 on September 19, 2019. This work unit yielded a project area covering approximately 1,311 square miles over New Hampshire. 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	1100 m	31°	25%	≤10 cm

1.3. Coverage

The project boundary covers approximately 1,311 square miles over coastal New Hampshire. 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 23, 2019 to April 23, 2020 in thirty total lifts. See "Section: 2.4. Time Period" for more details.

1.5. Issues

There were no major issues to report for this project.



NH_COASTAL_2019_B19 Work Unit 183371

Projected Coordinate System: State Plane New Hampshire FIPS 2800
Horizontal Datum: NAD 1983 2011
Vertical Datum: NAVD88 (GEOID 12b)

Units: Feet

Lidar Point Cloud	Classified Point Cloud in .LAS 1.4 format
Rasters	 1.25-foot Hydro-flattened Bare Earth Digital Elevation Model (DEM) in GeoTIFF format 1.25-foot Intensity images in GeoTIFF format 1.25-foot Swath Separation images in GeoTIFF format
Vectors	Shapefiles (*.shp) • Project Boundary • LiDAR Tile Index Geodatabase (*.gdb) • Continuous Hydro-flattened Breaklines
Reports	Reports in PDF format • Focus on Delivery • Processing Report • Flight Logs (appended to Processing Report)
Metadata	XML Files (*.xml) • Breaklines • Classified Point Cloud • DEM • Intensity Imagery



NH_COASTAL_2019_B19 Work Unit 183371 Boundary

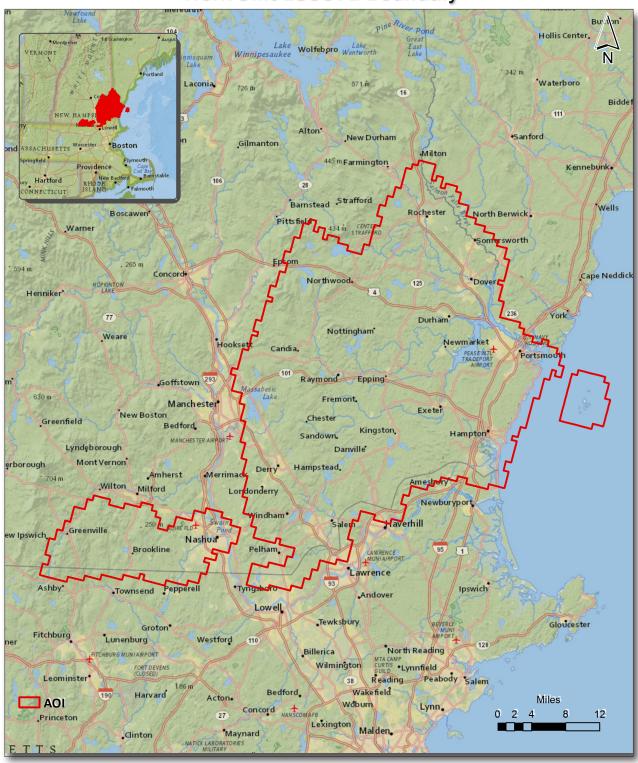


Figure 1. Work Unit Boundary



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 FMS Planner planning software. Planned flight lines are shown in Figure 2.

2.2. LiDAR Sensor

Quantum Spatial utilized Optech T-1000 LiDAR sensors (Figure 3), serial numbers 354 and 391 for lidar data collection.

The Optech Galaxy T1000 is a lidar sensor capable of wide-area mapping. It features a continuous operating envelope, a dynamic field of view, real-time sensor protocol, and a high-performace galvanometric scanner. This sensor has 1-MHz "on ground" collection rates and is capable of 8 returns per emitted pulse.

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



NH_COASTAL_2019_B19 Work Unit 183371 Planned Flight Lines

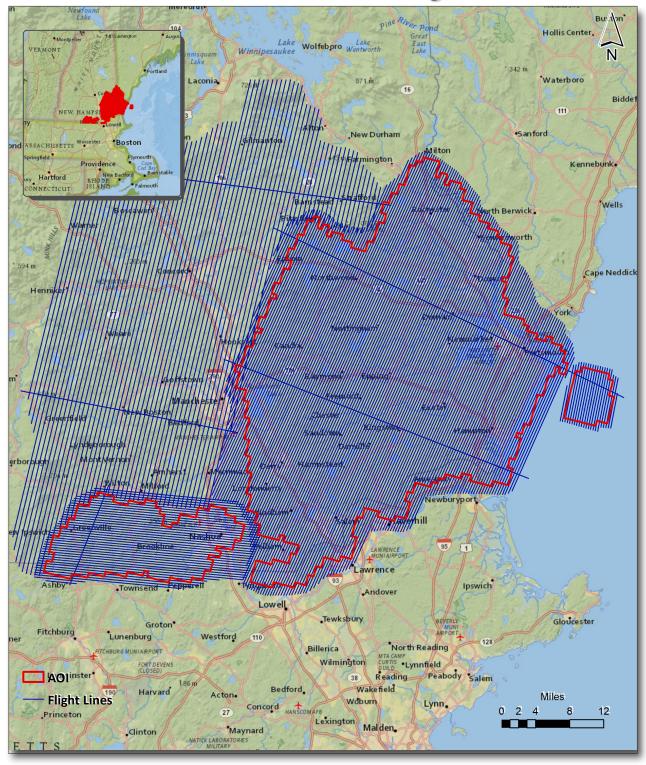


Figure 2. Planned Flight Lines



Table 2. LiDAR System Specifications

		Optech T-1000
Terrain and	Flying Height	1100 m
Aircraft Scanner	Recommended Ground Speed	160 kts
Common	Field of View	31°
Scanner	Scan Rate Setting Used	116 Hz
Laser	Laser Pulse Rate Used	600 kHz
Laser	Multi Pulse in Air Mode	4
Сомонала	Full Swath Width	610 m
Coverage	Line Spacing	457.59 m
Point Spacing	Average Point Spacing	0.35 m
and Density	Average Point Density	8 pts / m²

Figure 3. Optech T-1000 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

- 2015 BEECHCRAFT CORP B300, Tail Number: N50385
- Cessna 310 (twin-piston), Tail Number: N98869
- Cessna Executive Skynight (twin-piston), Tail Numbers: N4181T

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 Optech T-1000 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 November 23, 2019 and April 23, 2020. Thirty aircraft lifts were completed. Accomplished lifts are listed below.

- 11232019A1 (SN0354,N4281T)
- 11232019A3 (SN0354,N4281T)
- 11232019B (SN0354,N4281T)
- 11252019A (SN0354,N4281T)
- 11252019B (SN0354,N4281T)
- 11262019A (SN0354,N4281T)
- 11262019B1 (SN0354,N4281T)
- 11262019B2 (SN0354,N4281T)
- 11262019B3 (SN0354,N4281T)
- 11272019A (SN0354,N4281T)
- 11292019A (SN0354,N4281T)
- 11292019B (SN0354,N4281T)
- 11302019A1 (SN0354,N4281T)
- 11302019A2 (SN0354,N4281T)
- 11302019B1 (SN0354,N4281T)
- 11302019B2 (SN0354,N4281T)
- 04112020A (SN391,N50385)
- 04112020B (SN391,N50385)
- 04122020A (SN391,N50385)
- 04122020B (SN391,N50385)
- 04142020A (SN391,N50385)
- 04142020B (SN391,N50385)
- 04142020C (SN391,N50385)
- 04152020A (SN391,N50385)

- 04152020B (SN391,N50385)
- 04152020C (SN391,N50385)
- 04162020A (SN391,N50385)
- 04162020B (SN391,N50385)
- 04232020A1 (SN354,N98869)
- 04232020A2 (SN354,N98869)



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 Optech LMS 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	8.4
Optech LMS	4.4
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:

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

Table 3. LAS Classifications

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 hydrobreaklines 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 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 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 1.25-foot 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 1.25-foot were then provided as the deliverable for this dataset requirement.

3.8. Height Separation Raster Processing

Swath Separation images are rasters that represent the interswath alignment between flight lines and provide a qualitative evaluation of the positional quality of the point cloud. Proprietary software was used to create 1.25-foot raster images in GeoTIFF format.



NH_COASTAL_2019_B19 Work Unit 183371 Tile Layout

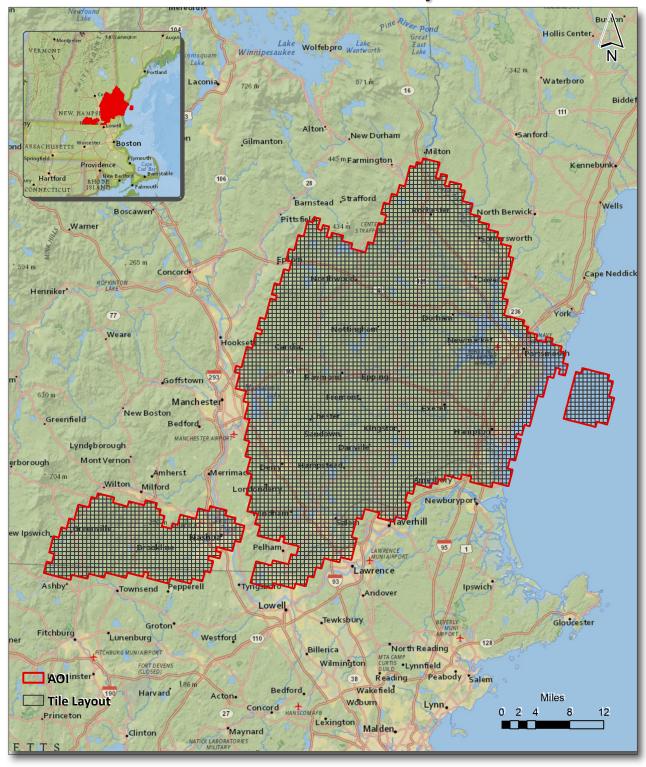


Figure 5. Lidar Tile Layout



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.



NH_COASTAL_2019_B19 Work Unit 183371 Lidar Coverage

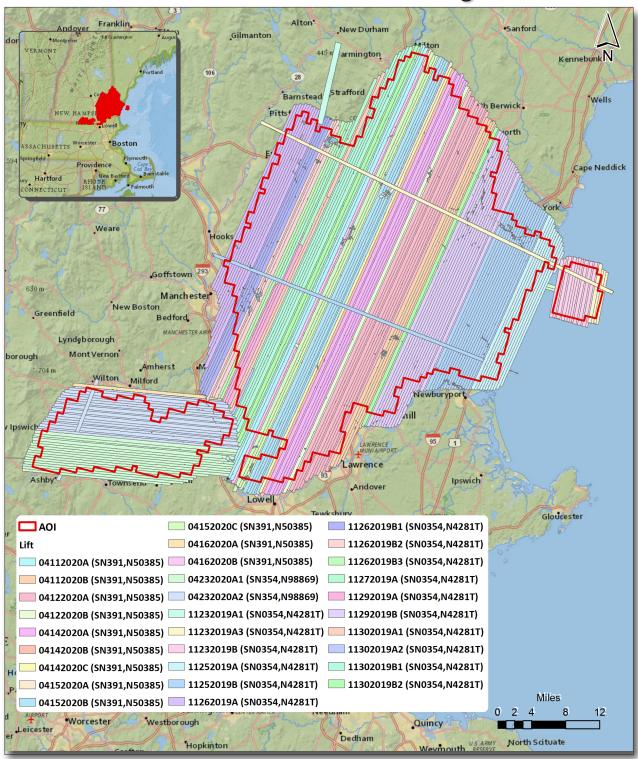


Figure 6. Lidar Coverage



Project Report Appendices

The following section contains the appendices as listed in the NH_Coastal_B19_2019 Lidar Processing Report.



Appendix A

Flight Logs

POS/AV Filename: 20 11116_81T_2
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Aircraft: N4181T
Sensor: 5060354
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Operator: 70
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BASE STATION			Engine Start (24HR LCL): 12 : 41	LCU): 12,41	ı I
POINT ID		LOCATION	Engine Stop (24HR LCL): (4:42	LCD: 16:42	ر آلہ
POSITION TYPE	KNOWN / AUTONOMOUS	TIME ON (UTC)	Depart: Kici Amve: Kici	Amve: KLCL	ı
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24HR UTC):	(C): (S): (43	
LATITUDE		PD0P	Ferry Stop (24HR UTC):	•	0
LONGITUDE		SAS	Depart: KFS M Arrive: K LCI	Arrive: KLCI	ı
					ı

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Page [

55.0 - th 180

4.02

 POS/AV Filename: 20191121.817.5

 Date: 11/21/14

 Project: 14 PA-719

 Aircraft: N41877

 Sensor: 5040354

 Pilot: 70P

 Operator: 7L

 HD: (A) B

Flight Man Info	Į.	Weather Info	Q.
Roll Comp	0n	Gnd Pressure (inHg)	3003
Scan Frequency	وو	Ground Temp (°C)	8
Scan Half Angle	20	Air Temp (°C)	. h
Laser PRF	220	Dew Point (°C)	* *\bar{2}
Desired Range	1500	Turbulence	114
Planned Ground Speed	170	Wind Speed/Gusts (kts.)	Calm
System Power	HIGH	Visibility (Miles)	ţŌ

		Г		_	г —	T T	_					 _		_			_	$\overline{}$
FLIGHT NOTES	litesnow Northernansalomites				GDS Midniant - @ production	11 Snow Marking House I'res	LIPSYMONIAN MAN CANES			^				999999				
SV	110	91	٩	ી		18	1	5	٩	ľ	ŁĮ				·			
PDOP	0.92	580	0.93	450		56'0	1.02	1.15	0.97	16.0	6840							
SPEED	169	t &)	109	18		173	83	109	181	(73	1621					ï		
RANGE	पिपव	1584	1458	1602		1356	1489	1400	lous	1210-2	1095							
HEADING	193,4	13.4	193,4	13.4		193.4	13.4	193.4	13.4	193.4	280.9							
GNB	23:01	23:19	23:38	23:20		60:23	O6:40	00:10	01:17	01:33	01:45							
START	22.46	23:04	23:22 23:38	23:41 23:56		00:07	00:20	OC: 44	01:02	01:21	01:30 01:45							
LINE	1810	182	187	30		182	181	8	타	178	727							
STRIPID	43	ከከ	ЧS	و †	7	1	84	49	50	<u>N</u>	1652							

BASE STATION			Engine Start (24HR LCL): 17:21 2 77	
POINT (D		LOCATION	Engline Srop (24HK LCU): 2 1:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0 + 0:0	•
POSITION TYPE	POSITION TYPE KNOWN / AUTOMOMOUS	TIME ON (UTC)	Depair: KLCI Anne: IN SIM	
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24HR UTC):	
LATITUDE		P00P	Femy Stop (24HR UTC):	
LONGITUDE	•	SAS	Depart: Arrive: Page	ЭE

Page 1 of

POS/AV Filename: 2C(91123_817_6

Date: 1122 119

Project: 19 PA - 719

Aircraft: N41817

Sensor: 50(eh354

Pilot: 30P

HD: A/ B

Flight Plan Info	ıfo	Weather Info	۰
Roll Comp	u0	Gnd Pressure (inHg)	29.87
Scan Frequency	ماها	Ground Temp (°C)	'n
Scan Half Angle	200	Air Temp (°C)	c
LaserPRF	255	Dew Point (°C)	,21-
Desired Range	S	Turbulence	12
Planned Ground Speed	130	Wind Speed/Gusts (kts.)	14/23
System Power	HIGH	Visibility (Miles)	ţ

KEYSTONE AERIAL SURVEYS	
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E31		[3:40
PDOP @ 13,20 ES		A-PILOT DISPIALL
Notes:	SAS	Gestar
ite	14 [23	<u>+</u> 0

FLIGHTNOTES	Deficient Teline (line 201 severe)	+30 001 4 1	<u> </u>	OF FLIGHT																		
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PDOP	0.88	96.0	0.93	26.0	0.93	0.91	26.0	88.0	1.00	1.02	1.03	6.97	0.96	0.8<	0.88	0.90	0.89	0.88	0.89	C.92	6.92	
SPEED	150	1+1	آو	14	ار و او	75	ဝ၅	1.79	165	611	169	181	167	183	المحا	179	153		159	187	<u> </u>	
RANGE	1490	1501	1557	12.19	2251	1534	1513	1555	1518	1497	1546	1450	558	1478	1211	439	1480	1482	125	1539	1215	
HEADING	288	193.4	13,4	193.4			13.4	193.4	13.4	193.4	13.4	43,4	13.4	193,4	13,4	193.4	13,4	193,4	13.4	14.84	3,4	
END	13:58	14.04	14:11	ापः।	14.27	14:32	14:43	14:51	14:57	15:03	15:10	15:15	15:22	15:28	15.34	15.40 M	15:46	15:52	15:28	10:04		
START	13:56	14.0Z	14:09	14:15	72:41	18:71	14:39	14:47	14:54	30.5)	15:07	15:13	15:19	15:25	15:31	15:37	15:43	5:49	15:55	10:01	16.67	[
LINE	201 🖈	203	202	201	177	176	175	174	173	7 5	<u>_</u>	176	14,9	168	16.7	ماها	ر دعا	するこ	163	162	وَ _	
STRIPID	1底53	ħS	55	A Ja	5. 1.	rs C	50	٥	ا ما	257	C 3	119	ر ا	مام	۴۹	دي و د	69	4	1+	72	L 6)	

	TIME ON UTC. 13 24 13: 49	KIN ON UTC: 13:35	KIN OFF UTC:	TIME OFF UTC:	
-	135.44		_	 I	

BASE STATION			Engine Start (24HR LCL): <u>08,255,1,</u> 35	St. 15
POINT ID		LOCATION	Engine Stop (24HR LCL): [3:1	; , .
POSITION TYPE	POSITION TYPE KNOWN / AUTONOMOUS	TIME ON (UTC)	Depart: K F SAA Amve: K DSM	اء
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24HR UTC):	X
LATITUDE		PDOP	Ferry Stop (24HR UTC):	,
LONGITUDE		SAS	Depart: Arrive:	- Paga
				ĺ

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Page 1

POS/AV Filename: 2019.1123_817_6

Date: 1\(1\z \aligned 119\)

Project: 19\(\beta \cdot - 719\)

Aircraft: \(\text{NULST} \aligned 17\)

Sensor: \(\subseteq 0 \

Flight Plan Info	0 0	Weather Info	7 958 0
1	و	Ground Temp (°C)	, v
	70	Air Temp (°C)	2°
	250	Dew Point (°C)	-150
	1500	Turbulence	4:1
	170	Wind Speed/Gusts (kts.)	
	HIGH	Visibility (Miles)	101

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Engine start (24HK LCL):					<i>III</i>	DASE STATION	 		AIAAV
					,,,,,	DACE CTATI	_		ARCDS
	2	38,0	150	562	~	b0:4-	الو جال	226	Tie 78
0	7.	9.0	179	Isso	193,4	16.52	15:01	125	tt
Rostavi - Pilot Displan force 16.45					7			1-:-1	
0	†1	760	1+1	1517	13,4	16:36	16:34	158	و ۲
Bostach - Dist Display Froze 18:28					.,				. N
	ما	±8:0	احماا	1535	13,4	25:01	+1:قا	159	<u>դ</u>
	اد	16.0	187	583	43.4	16.14	lte: 12	0ما ا	74
FLIGHTNOTES	λS	PDOP	SPEED	RANGE	HEADING	END	START	LINE	STRIPID

					Page 2 of
Engine Start (24HR LCL): US:25	Engine slop (24HK LCL): 15/10	Depair: Krant Ame. Trysin	Ferry Start (24HR UTC):	Ferry Stop (24HR UTC):	Depart: Arrive:
	LOCATION	TIME ON (UTC)	TIME OFF (UTC)	PDOP	S.A.S
		KNOWN / AUTONOMOUS	METERS		
NOLLY STATION	OILL ID	POSITION TYPE KNOWN	ANTENNA HEIGHT	SOUTURE	LONGITUDE
	54:45	<u>-</u>	<u> </u>		
ABGPS	TIME ON UTC: (3:49/14:28 [14:45]	KIN ON UTC:	KIN OFF UTC:	TIME OFF UTC.	

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 POS/AV Filename: 20141123 STT. 6

 Date: 1, 123 119

 Project: 19 P.A. - 71c1

 Aircraft: N4181T

 Sensor: 5000

 Pilot: 300

 Operator: 7L

 HD: (A) B

Right Plan Info	oJu	Weather Info	,o
Roll Comp	00	Gnd Pressure (inHg)	29/8/62
Scan Frequency	ماا	Ground Temp (°C)	50
Scan Half Angle	15.5	Air Temp (°C)	2.
Laser PRF	005	Dew Point (°C)	-17.
Desired Range	1100	Turbulence	Prod-lib
Planned Ground Speed	0	Wind Speed/Gusts (kts.)	=
System Power	エロス	Visibility (Miles)	†q
	þ		

KEYSTONE AERIAL SURVEYS

Notes: SA 192 135-156

	FLIGHTNOTES	Within his tide the Course govern																
	λS	Ē	હ	7	V	r	ħ1											
þ	PDOP	10.1	0.98	7.6.0	0.0 M	0.94	160		i	-								
	SPEED	50	150	Н	169	15%	17-1							_				
	RANGE	943	1116	10.08	ופעת	1036	1(3)	•										_
'	HEADING	110.4	191.9	(1.9	191.9	11.9	191.9				-							
	END	[7:31	17.36	17:41	17:46	17:51	17:50		i			İ						
	START	17,17	17:34	17:39	17:44	17:49	-			Ť		1						
	LINE	133	135	136	137	138	139							ļ				
	STRIPID	TE 79	B	18	82	83	84											i
_		250	29.				>		 1		 	I_	 !		 1	1	1	

_		E KON	Щ		
	POINT 10	POSITION TYPE	ANTENNA HEIGHT	LATITUDE	LONGITUDE
	_	<u>a</u>	AN		İ
	57.5		80.8	10:5	
	_	انخ	<u>``</u>	<u>دن</u> دن	
	TIME ON UTC:	KIN ON UTC:	KIN OFF UTC: 18:09	TIME OFF UTC: 18:07	
	Ħ	臺	2	1	

SESTATION			Engine S	Engine Start (24HR LCL): 08,25
POINT 10		LOCATION	Engines	Engine Stop (24HR LCL): 13:10
OSITION TYPE	USITION TYPE KNOWN / AUTONOMOUS	TIME ON (UTC)		Depair: Kraw Arrive: 14 PSW
TENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Sta	Ferry Start (24HR UTC):
LATITUDE		POOP	Ferry Sto	Ferry Stop (24HR UTC):
LONGITUDE		S.A.S	Depart	Arrive:

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POS/AV Flename: 20191123-811-7 11123/19 5000354 LISIN 30P Pilot: Operator: HD: (A) / B Sensor. Aircraft: Date: Project:

Hight Plan Info	oju	Weather Info	o,
Roll Comp	u0.	Gnd Pressure (inHg)	29.85
Scan Frequency	1160	Ground Temp (°C)	
Scan Half Angle	<u>ب</u> ۷	Air Temp (°C)	
Laser PRF	003	Dew Point (°C)	
Desired Range	8	Turbulence	lik-non-
Planned Ground Speed	200	Wind Speed/Gusts (kts.)	ь
System Power	11911	Visibility (Miles)	†QI

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KEYSTONE	AERIAL SURVEYS	Notes: SA2	FILM DISPINAL From Conforces

	FLIGHTNOTES																	7.801		
	SV	۷	2	7	<u>\</u>	ī	و	Ā	<u>r</u>	و	٩	و	٩	ŗ.	<u>r</u> +	<u>r</u> +	<u>7</u>	ĩ		
	PDOP	1.00	540	10.	1.01	1,03	15 O	1.02	101	0.95	0.45	6.94	260	C.8.7	6.83	0.82	560	Ø.9℃		
	SPEED	171	451	104	157	[s]	1.01	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	الوج	12)	الوج	169	1.0	1109	[6 7	163	ادوا	143		
	RANGE	1076	UAU	102.7	F F 01	1098	800	hS0/	(୧୩୦)	1024	1lot	1043	911	1116	1108	1057	USO	१० वर		
0.00	HEADING	191.9	11.9	19.191	(1.9	191.9	11.9	191.9	11.9	141.9	11.9	191.9	11.9	191.9	1.9	191.9	11.9	9:9		
	END	20:02	20:09	20: 14	20:19	70:24	20:29	20:35	20:40	20:4S	15:02	20:50	21:01	21:06	71:11	21:16	21:21	21.25		
10.410	SIAKI	20:01	20.0c	20:11	20:16	20122	20:27	20:32	20:38	20:43	20:48	20:53	20,59	21:04	21:09	21:14	21:19	21:23		
1911	LINE	9	141	14.2	143	144	145	الله الله	14.41	148	149	150	<u>V</u>	152	[५३	154	<u>7</u>	<u>√</u>		
CTBIBIB	SIRIFID	œ Ω	9 20	84	පිහි	500	S S	<u>-</u>	26	43	76	15	و	40	9	99	2	101		

*				
IME ON UTC.	19:35	19:पव	2	
KIN ON UTC:	19:39	3	چ	POS
ON OFF UTC.	23,31			ANTE
WE OFF UTC.	23:30			7
				U!

BASE STATION			
OINT 10		LOCATION	Engine Stop (2
POSITION TYPE	KNOWN / AUTONOMOUS	TIME ON (UTC)	Nepart: 서년
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24H
301LILY1		dOdd	Ferry Stop (24H
LONGITUDE		SAS	Depart:

		Engine Start (24HR LCL): [4:32	14:32	
	LOCATION	Engine Stop (24HR LCL):	M. (2)	
TOMOMOUS	TIME ON (UTC)	Depart: KRSM Amve: KLSM	7733	
S	THANE OFF (UTC)	Ferry Start (24HR UTC):		
	PDOP	Ferry Stop (24HR UTC):		
	SAS	Depart: Arrive:	: :	Page

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POS/AV Filename: 20/9/123-817-7Date: |1|23/B|
Project: |9/04-7/9 5000354 180 Pilot: Operator: HD: (A) / B Sensor:

					Z	<u> </u>	<u>. </u>
	,	·					
•							
Weather Info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)
fo	u ₀	<i>)</i> 13)	20	250	(CE)	140	H-01H
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	Laser PRF	Desired Range	Planned Ground Speed	System Power

Notes:

_	_		_																	
FLIGHT NOTES			1000	C CERTAIN												25		1000		
	REFLIGHT POLSOF											Taract anale	0 0		-	PET INT THE LINE				
SV	<u>n</u>	15	<u> </u>	<u>√</u>	15	4	1+	亡	#	<u>+</u>	7*	110	1-1	<u> </u>	<u>+</u>	1				
PDOP	10.	0.99	0.98	0.91	O.S.B.	0.830	0.85	0.91	1400	345	0.95	0.088	0,0	70'	16,0	26.0			-	
SPEED	14	169	441	一十	14	1107	1.38	177	7.7	±±]	173	173	Pt.	14	133	lot				
RANGE	1452	1394	1	श्रीमा	1418	1223	1378	1341	07021	1310	142.1	1325	1381	1202	1376	1502				
HEADING	13,4	193,4	3.4	193,4	13.4	193.4	13.4	193,4	13,44	193.4	13.4	H261	13.4	193,4	13.4	102				
END	21:43	21:4	21:55	72:01	12:07	SI:22	22:19	Sz:22	18:22	12:37	22:43	22:49	12:54	123:61	4	23:15		-		
START	71.12	21:46 21:4	21:52	21:58		22:10		22:22	22:28	72.34	017:22	22:46	22:52	22:58		111:82				
LINE	178	120	2	8	18.2	183	tres)	185	relo	±81	188	<u>Z</u>	061	ы	192	226*				
STRIPID	162	103	101	<u>S</u>	old	1	<u></u> 20	109	110	11	721	113	111	ī.	116	TIE 117				

	ons: 19:50			\$ 23:30	
400FS	TIME ON UTC.	KIN ON UTC:	KIN OFF UTC:	TIME OFF UTC.	

BASESTATION			Engine	Engine Start (24HR LCL): 14:32	14:32	,
POINT ID	-	LOCATION	Engline	Stop (24HR LCL):	[8:33 8:33	į
POSITION TYPE	KNOWN / AUTONOMOUS	TIME ON (UTC)		Jepan: / Krswi Amve: Krswi	호 호	
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry S	Ferry Start (24HR UTC):		
LATITUDE		PDOP	Ferry S	Ferry Stop (24HR UTC):		
LONGITUDE		SAS	Depart:	T: Arrive:		Page
			1			ı

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Page 2

POS/AV Filename: 20191125_81T_8

Date: 11 25/19

Project: 19PA - 719

Aircaft: N4181T

Sensor: 50c0354

Pilot: 10P

	29,75	اه	-10	.7-	May-lik	09	10+	
Weather Info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)	
fo	00	91)	15.5	000	1100	160	H-PIH	
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	LaserPRF	Desired Range	Planned Ground Speed	System Power	

				_					, — ,			_	-	_			_	_
FLIGHT NOTES																		
λS	S	<u>v</u>	iş.	>	٦	ነተ	hΙ	15	<u> </u>	15	15	15			-			
PDOP	0.89	1280	88.0	0.89	0.88	0.94	0.40	0.44	0.98	0.47	1.00	0.98			- 3			
SPEED	159	157	ી હ 3	165	169	163	101	167	173	િક્	1±1					-		
RANGE	[0±9]	1054	1096	مامادا	1085	1012	िष्य	11-01	االهاا	St01	111	1001						
HEADING	204.6	204.60	24.60	264.60	24.6	204,60 1072	24.6	204.6	24.6	204.60	24.60	204.6						
END	17:58	18:09	18:18	8:27		18:45		19:04	$\overline{}$	19:23	14:32	19:42						
START	17:57	8:03	18:12	18:20	(8:29	18:39	१८: ५४	18:57			19:25	9:34						
LINE	-	2	W	+	S	و	1+	8	9	10	11	12						
STRIPID	8	119	120	121	122	123	124	125	126	12	128	129						

	17:43	± h : £	19:53	19:52	
SAOBY	TIME ON UTC.	KIN ON UTC:	KON OFF UTC.	TIME OFF UTC.	

BASE STATION			Engine Stal
POINT ID		LOCATION	
POSITION TYPE	KNOWN / AUTONOMOUS	TIME ON (UTC)	J Depail:
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (
TATITUDE		PD0P	Ferry Stop
JONOJI		SAS	Depart:

Engine Stop (24HR LCL): 14:54 2,25 Depart: KFSM Arrive: KFSM

(24HR UTC):	•
erry Stop	•
	erry Stop (24HR UTC):

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Page

REPORT LIDAR FLIGHT

POS/AV Filename: 2019 11 26 - 81 T. 1 19PA- 719 FOUDSER 118172 11/20/19 400 HD: A / 100 Operator: Pilot: Aircraft: Project: Date: Sensor:

					Not	Ø	4.	
						241		
0	1.6.62	ુમા	ŝ	.20	life	b ,	10	
Meather Info	Gnd Pressure (inHg)	(C)) dwal Deno	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)	
0	u0	وما	5'51	จจก	0011	1.40	માનામ	
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	Laser PRF	Desired Range	Planned Ground Speed	System Power	



4:15-8:00	240 SA1	Notes: Missiem to PW 447
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FLIGHT NOTES							Modern to the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the second of the se					Possibly plant in path of laxe			- Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Comp			ŕ		
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PDOP	0.98	0.97	0.94	0.95	0.95	0.93	0.43	0.96	0.94	26.0	6.43	0.96	0.91	0.91	0.92	1.03	0.49			
SPEED	173	146	171	146	(73	नित	141	150	159	120	591	(52	1107	157	171	1510	159			
RANGE	1164	1125	1124	1084	1158	1111	1163	1120	1123	1010	1206	1137	(ILeh	1008	1186	loug	1078	, ,		
HEADING	24.Ce	204.6	24.6	204.C	24.6	204.40	24.6	204.6	24.6	204.6	24.6	204.60	24.6	264.6	24.10	204.6	24.6	-		
END	15:19	15:25	15:32	15:40	15:52	po:01	14:15	16:27	SS 21	10:21	17:02	11:11	17:27	17:40 F	(7:53	80:81	[8:22			
START	15:17	(5:22	15:29	15:36	I<:यष		16:08	16:19	15:31	(u:u3	16,54	90:41	17:18	(7:30	ከት: ተ/	[7:54	11:81		•	
LINE	721	131	136	129	[28	127	124	125	124	221	122	17.1	120	bl	1 18	11.7	ا ا ا			
STRIPID	151	152	153	154	155	. a Si	151	158	150	. ଦୁଣ୍ଡା	2	162.	168	. tall		ماماا	<u>F</u> 9			

ABOPS	TIME ON UTC:	KIN ON UTC:	KIN OFF UTC:	TIME OFF UTC:	
	14:12		16:34	18:32	

BASE STATION			Frame Star (24HK LCL):	24HK LCL): (041h): (04
POINT ID		LOCATION	Engine slop (24HK LCL):	ZAMK LOLU:
POSITION TYPE	POSITION TYPE KNOWN / AUTONOMOUS	TIME ON CUTC)	Depail: K	Depail: Krail Allive.
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24HR UTC):	HR UTC):
LATTTUDE		PDOP	Ferry Stop (24HR UTC):	HR UTC):
LONGITUDE		S.AS	Depart:	Arrive:

2	4.43	
80;60	(3:34	KPSM
ngine Start (24HR LCL):	ngine Stop (24HR LCL):	epart: KPSM Arrive: Kpsm
ngine St	ngine St	epart:

10:09-13.34 3.42	
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REPORT LIDAR FLIGHT

POS/AV Filename: 20191126-817-11	Date: [11/21.0/119]	Project: 19pg - 719	Aircraft: N41817	Sensor: 5040354	Pilot:	Operator: 16	HD: A / 🕲
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	0			AEK	Notes:	SAI	ાડ:38 ાહ
		,——,	· · · · ·		·	240	
0	29.93	150	S.	ا ،	lik-mod	3	10
Weather Info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)
fo	0u	116	15.5	gon	2011	100	HIGH
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	Laser PRF	Desired Range	Planned Ground Speed	System Power

	KEYSTONE	AERIAL SURVEYS
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	NOTONA	ARISIONE ABBIAN SHEWS	AEKIAL SURVEYS	Notes: 505	240 SAI	15:38 16:15-20:00	
					240		
29.93	13ه	ુડ્ડ	ا ہ	paw-Hil	E	01	
Gnd Pressure (inHg) 29,93	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)	
u0	911	15.5	gan	2011	100	HIGH	
Roll Comp	Scan Frequency	scan Half Angle	Laser PRF	Desired Range	ned Ground Speed いい	System Power	

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FLIGHTNOTES		DIO+ Display FAZE MIGLIAL (OFFILE)		The second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second second secon		Pilot Display Snut off - Restau system	ر 16:30 C				Polot Displanship aff	Restait System 22:17		- And Andrews Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company of the Company		The state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the state of the s			
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PD0P	0.76	0.92	00.1	0.94	46.0	0,92		C.99	0,89	6.84	1280		260	00.1	0,40	0.8%			
SPEED	15G	143	152	1+1	156	(43		157	143	12.5	lol		163	152	lal	[73			
RANGE	loten	1214	1631	1188	1028	1.61		1120	1203	1218	(210		1098	15-01	1207	1159			
HEADING	204.6	24.6	204.C	24.6	204.6	24.10		204.10	9.42	204 40	9.42		24.6	204.60	24 16	16.4			
END	19:52	50:05	20:23	20:38	H\$:02	51:04		21:36	21:51	10:22	22:23		425:22	23:09	23; 2ul	13:42			
START	14:41	19:5C	20:11	20:27	24:92	20:58		42:12	04:12	21:35	22:11		25:43	£5:22	23:13				
LINE	115	114	114	113	21	111		011	6 0)	80	107		£01	901	501	SS)			
STRIPID	lis	169	110	171	172	[43		ht)	r tr	<u>1</u> +6	144		1.18	179	92	181 31			
			6						5			•	رے)			 *	 •	

BASE STATION	TIME ON UTC: 19:16 21:14 22.3 POINT ID	7:20 POSITION TYPE	3:54 ANTERNA HEIGHT	S.54 LATITUDE	TONGILIDE
	19:16/2	KIN ON UTC: 19:20	KIN OFF UTC: 23:57	TIME OFF UTC: 23,54	

TIME ON CUTC) TIME OFF (UTC)

<u>200</u> SAS

LOCATION

(4:12	18:57	ZPSM
Engine Start (24HR LCL):	Engine Stop (24HR LCL):	Depart: K.PSM Arrive:

Ferry Start (24HR UTC): Ferry Stop (24HR UTC):

Depart:

Arrive:

Page 1

REPORT LIDAR FLIGHT

POS/AV Filename: 20191127_817_12
Date: 1127119
Project: 1999-719 5040354 JOP Tr これの下 Pilot: Operator: HD: (🔊 / B Date:
Project: Aircraft: Sensor:

					Notes	SA	Clor
						<u>5</u>	
0	29.43	(0)	2.	.17	lik-none	09	8
Weather Info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)
fo	u0	4۱۱	15.5	001	1100	୦୩	HIGH
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	Laser PRF	Desired Range	Planned Ground Speed	System Power

KEYSTONE AERIAL SURVEYS
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	d	()	Q.	٥									
FLIGHTNOTES	Ended for Clouds. P. S. Tic Line	^	Ended 12 miles from Nisad.	flown 18 miles from Signid noth									
SV	18	18	<u>t)</u>	llo									
PDOP	0.78	28.0	1.03	1.63									
SPEED	150	105	इप	1±1									
RANGE	080	1136	1054	1153									
HEADING		9· hZ	204.6	24.60									
END	१८:१५		18:34	18:44									
START	18:07	18:18	18:29	18:37									֟֝֟֝֟֟֝֟֝֟֟֝֟ ֓֟֓֞֓֞֞֞֓֞֓֞֞֞֞֞֞֞֞֓֞֞֞֞֞֞֞֞֞֞
LINE	10 h	103	102	101									
STRIPID	182	183	184	185									

		TIME ON UTC: 1-1; 43	KIN ON UTC: (7:47	KIN OFF UTC: 18:58	TIME OFF UTC: 18:58	
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BASE STATION			Engine Start (24HR LCL): 12:	; <u>17</u> ;
				×
POINT ID		LOCATION	Engline slop (24mk LCL	; 5 5 5 5
POSITION TYPE	POSITION TYPE KNOWN / AUTONOMOUS	TIME ON (UTC)	Depail: Krsw Allin	<u> </u>
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24HR UTC):	
LATITUDE		PD0P	Ferry Stop (24HR UTC):	
LONGITUDE		SAS	Depart: Arrive:	/e:

	d	4	4		Notes:	310 SA1.7.1	Mostin C	_
•		_	-1-		¥	10	10	
Weather Info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)	
fo	00		15.5	(100)	1100	(60	HIGH	
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	LaserPRF	Desired Range	Planned Ground Speed	System Power	

			VEVCTONE	AEISIONE	AERIAL SURVEYS	Notes:	310 SA1,7, MISSION 13		FLIGHT NOTES					رد د	STATE OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PERSON OF THE PER	Endeel For Clouds (Will refu whow line)	f					
				ļ-		*	ام	10						THE For pickup)	ودرا اوا	ं नियर						
	Weather Info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)		Pickup	—		-	后存	Susap	Ende						
		Gnd Pres	Ground	AirTe	o wa Q	Turb	Mind Speed	Visibilit	۸S	 	R	9	١٩	<u>Ļ</u>		+						
	fo	0n		15-5	ରଠଣ	4011	0அ)	FIGH	PDOP	101	0.43	0.95	6.91	680		O.88						
	Flight Plan Info	Roll Comp	can Frequency	Scan Half Angle	rPRF	Desired Range	Planned Ground Speed	System Power	SPEED	691	اما	[73	159	S7		145						
O R T	H	Roll (Scan Fre	Scan Ha	Laser PRF	Desired	Planned Gr	System	RANGE	1075	1140	1107	1173	1054		(148						
LIDAR FLIGHT REPOR									HEADING	204.60	24.6	204·6	34.6	111.8		215.5						
_ ⊢ ∓	-817-15								GNB	14;18	14:28	14.41	4.53	00:51		15:09						
: L I G	POS/AV Filename: 26191129-817-13	1119	19PA-719	ÖIT	354				START	(4:13	14:22	14:33	14:45	14:53		<u>90.S</u>						
4 R F	ename: 2	11/29/	19 P.A	NAIBIT	5040354	JOP	71	/ B	LINE	ो० प	<u>S</u>	162	<u>_</u> 0	134		228						
L I D /	POS/AV FIL	Date:	Project:	Aircraft:	Sensor:	Pilot:	Operator:	M H H	STRIP ID	ବଧ	<u>@</u>	188	189	TE 190		161						
											16)				₹	; ;					

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7007		C News	MAK SIMIKM	
TIME ON UTC:	TIME ON UTC: 13:57	6	POINT ID	
KIN ON UTC: 14170	10:01	POSIT	POSITION TYPE	¥
KIN OFF UTC:	57.5	ANTEN	INTENNA HEIGHT	
TIME OFF UTC:	14:7:	<u>רא</u>	LATITUDE	L

BASE STATION			Engine Start (24HR LCL): 08:51
POINT ID		LOCATION	Engine Stop (24HK LCU): (0:45
POSITION TYPE	POSITION TYPE KNOWN / AUTONOMOUS	TIME ON CUTC)	Depart: Kryld Allive: Kryld
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24HR UTC):
LATITUDE		POOP	Ferry Stop (24HR UTC):
LONGITUDE		SVS	Depart: Arrive:

Page of (

REPORT

LIDAR FLIGHT R
POS/AV Filename: 20191129-871_14

Date: 11/29/19
Project: 19PA_719
Aircraft: N41817
Sensor: 50L0354
Pilot: 30P

Operator: 7L

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						326	
0	36,01	22	*9 1	-۱۱۵	lite man	12 21	9
ojul redibeW	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)
fo	uo	٩١١	15.5	COO	1100	(क)	HIGH
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	Laser PRF	Desired Range	Planned Ground Speed	System Power

	O DEVOTED NE	NEISIONE	AERIAL SURVEYS	Notes:	320 SA1, Mission 14		FLIGHT NOTES												,							
3501	27	٩	-	11-1-mag	12 21	9																				
Gnd Pressure (inHa)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)																				
Gnd Pre	Groun	Air	Dew	. Tur	Wind Spe	Visibi	SV	17	1	1.1	7	٩	81	js l	14	011	11	11	and a	35	No	11	<u>7</u>	2		
ő	911	931	00 <i>4</i> 1	Q011	(का)	#51H	PDOP	260	06.0	1 0-1	±0'	SIQ!	6.95	9P.O	6,93	68.0	hb.()	28.0	1,541	1.09	0.04	78.0	0.88	080		
Roll Comp	equency	lf Angle	Laser PRF	Range	paedS pund	Power	SPEED	1+1	hS!	100	(30	173	157	163	159	(7 1	Sto	1.13	152	60	15to	11	148	159		
Roll C	Scan Frequency	Scan Half Angle	Laser	Desired Range	Planned Ground Speed	System Power	RANGE	10(48	1124	1092	(082	1677	155	1009	1099	1148	1110	1138	10 W.S.	1128	1118	1092	1098	1148		
							HEADING	204.C	24.6	264.60	24.16	204.00	24.6	204.6	24.te	204·Le	24.60	204,60	24.10	204.6	24.60	204.6	24.6	110,41		
							END	23:40	23:53	100:14	12:09	DD:40	hS:00	01:07	01:21	01:35	bh:1V	62:02	02:17	02:31	62:46	13:00	03:15	03:25		
2	19	17	3554	۵			START	12:22	23:43	50:00	F1:00	00:30	00:43	60:57	01:10	01:24	616.37	01.51	02:05	02:20	02:34	02:48	63:02	12:50		
11/20/10	19/04-719	TISITA	5000354	JOP	길	В	LINE	30	18	32	2.30	34	35	36	37	35	39	40	4	42	4.3	ተተ	45	133		
Date:	Project:	Aircraft:	Sensor:	Pilot:	Operator:	HD:	STRIPID	761	<u>2</u>	70	195	اماها	40	198	bbl	200	201	202	203	204	205	2010	107	TIE 208		

TIME ON UTC: KAN ON UTC: KAN OFF UTC: TIME OFF UTC:

BASE STATION			Engine Star
POINT 10		LOCATION	Engine stok
POSITION TYPE	KNOWN / AUTONOMBUS	TIME ON (UTC)	Depart: Fa
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (
LATITUDE		PD0P	Ferry Stop (
LONGITUDE		S.A.S	Depart:

	Engine start (24HK LCL): (2 1.2	^	8
	(1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	, ,	こり
2	Engine Stop (24th CCU): 72.36	12.30	:
J. J.		× 50 7	
ITU	Debail: 673/7 Allive: Project	750	
010			
UTC	Ferry Start (24HR UTC):		

	Page c	
Ferry Stop (24HR UTC):	Arrive:	

 POS/AV Filename:
 20191130_811_15

 Date:
 11130/19

 Project:
 19pa-719

 Aircraft:
 NULTRIT

 Sensor:
 50Le0354

 Pilot:
 JOP

 Operator:
 7L

 HD:
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						3.50	
٥	2988	٥.	-2°	,1)-	lite-mod	13	†Q1
Weather Info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)
fo	uo		15.5	000	1160	1120	ዘካዝ
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	Laser PRF	Desired Range	Planned Ground Speed	System Power

KEYSTONE AERIAL SURVEYS	
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Note SA 1	AERIAL SURVEYS	. 2	SAI, Mission 15	PDS 5100
	4	Notes:	310 SA1.	*
	17.	lite-mod	13	4

-	Const. See at Arrivo		NOI	LOCATION		_	POINTID	일	TIME ON UTC: USS 19:15	TIME ON UTC:
のようでは、	Engine Start (24HR LCL): 11:27 Engine Stan (24HR LCL): 11:178 3.52		•			*	BASE STATION			SABOT
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	Screen Proze	V	0.94	159	100	204,6	19.09	19:04	વેવ	212
	Screen Froze	و	1.03	150	15 200	47.47.60		ナト・ル	90	211
			0.99	173	1125	204.6	18:43	18:25	160	210
	Screen froze	ام	0.89	ीम्।	1173	24.C	8,24	18:12	30	209
	FLIGHT NOTES	λS	PDOP	SPEED	RANGE	HEADING	END	START	LINE	STRIP ID

BASE STATION			Engine start
POINT 10		LOCATION	Engine stop
POSITION TYPE	POSITION TYPE KNOWN / AUTONOMOUS	TIME ON (UTC)	Depair:
ANTENNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (2
LATITUOE		PDOP	Ferry Stop (2
LONGITUDE		SAS	Depart:

	3,52			
ente Col	0 V: 17	K PSM		
Engine Start (24HR LCL):	Engine Stop (24HR LCL): 4:< 5 3.52	Depart: KRSM Arrive: KPSM	Ferry Start (24HR UTC):	Ferry Stop (24HR UTC):

Page | of |

Arrive:

POS/AV Filename: 20191130_817_16

Date: 1130/19

Project: 1999-719

Aircraft; N41817

Sensor: 5060354

Pilot: 309

Operator: 76

HD: \(\hat{\Pa} \) B

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						35.0		
0	29.94	-5,	-4°	-1Ha	Ne-ma	11/21	10	
Weather info	Gnd Pressure (inHg)	Ground Temp (°C)	Air Temp (°C)	Dew Point (°C)	Turbulence	Wind Speed/Gusts (kts.)	Visibility (Miles)	
fo	u0	<u>م]]</u>	15.5	997)	OH) I Le C	HEAR	
Flight Plan Info	Roll Comp	Scan Frequency	Scan Half Angle	Laser PRF	Desired Range	Planned Ground Speed	System Power	

KEYSTONE	AERIAL SURVEYS	Notes:	SA1, Mission 16	
			Q	

FLIGHT NOTES			,				Syckm Off for 6105 Michigh Sat Sun 23:39	. D								·			
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RANGE	122	1183	1133	139	1155	カタニ		1219	1142	lliu	1154	1053	1550	,					
HEADING	204.6	24.co	204.60	24.10	204.4¢	24.60		20.H.C	24.6	204.02	24.10	204.60	17-17-12						
END	t0:77	22:22	Sh:22	23:02	23:23	73:44		00:33	HS:00	01:12	01:31	01:45	02,04						
START	21:53	11:22	22:30	22:49		45:22 F2:25		8 1300	t£:00	100:57	91;10	N:33	15:10						
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STRIPID	HIZ	215	216	112	812	219		220	122	222	223	224	TIE225						

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		1:38	1:7	TIME OFF UTC: 23/59	
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POINT ID LOGATION LOGATION LOGATION LOGATION LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CATTION CAN Arrive: LOGATION CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRIVE CAN ARRI	BASE STATION			Engine Start (24HR LCL): 16:30	16:30 1::14 U X
KNOWN / AUTONOMOUS TIME ON (UTC) METERS TIME OFF (UTC) PDOP SV'S	POINT ID		LOCATION	Erigirie slop (z4nk LCL). Z	0.1 0 -1.5
METERS TIME OFF (UTC) Ferry Start (24HR U1) P00P Ferry Stop (24HR U1) SVTS Depart:	POSITION TYPE	KNOWN / AUTONOMOUS	TIME ON CUTCO	Depail: Cham Allive:	
P00P Ferry Stop (24HR U) SVS Depart:	ANTERNA HEIGHT	METERS	TIME OFF (UTC)	Ferry Start (24HR UTC):	
SWS Depart:	LATITUDE		PD0P	Ferry Stop (24HR UTC):	
	LONGITUDE		SYS	Depart: Arrive:	Pa

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