Airborne Lidar Report

Indiana Statewide Lidar 2017 B17

Base Option

Contract Number: G16PC00022
Task Number: G17PD00269

Contractor: Woolpert, Inc.
Woolpert Project # 77391

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Section 1: Overview

TASK ORDER NAME: Indiana Statewide LiDAR_2017_B17

Project: # 77267

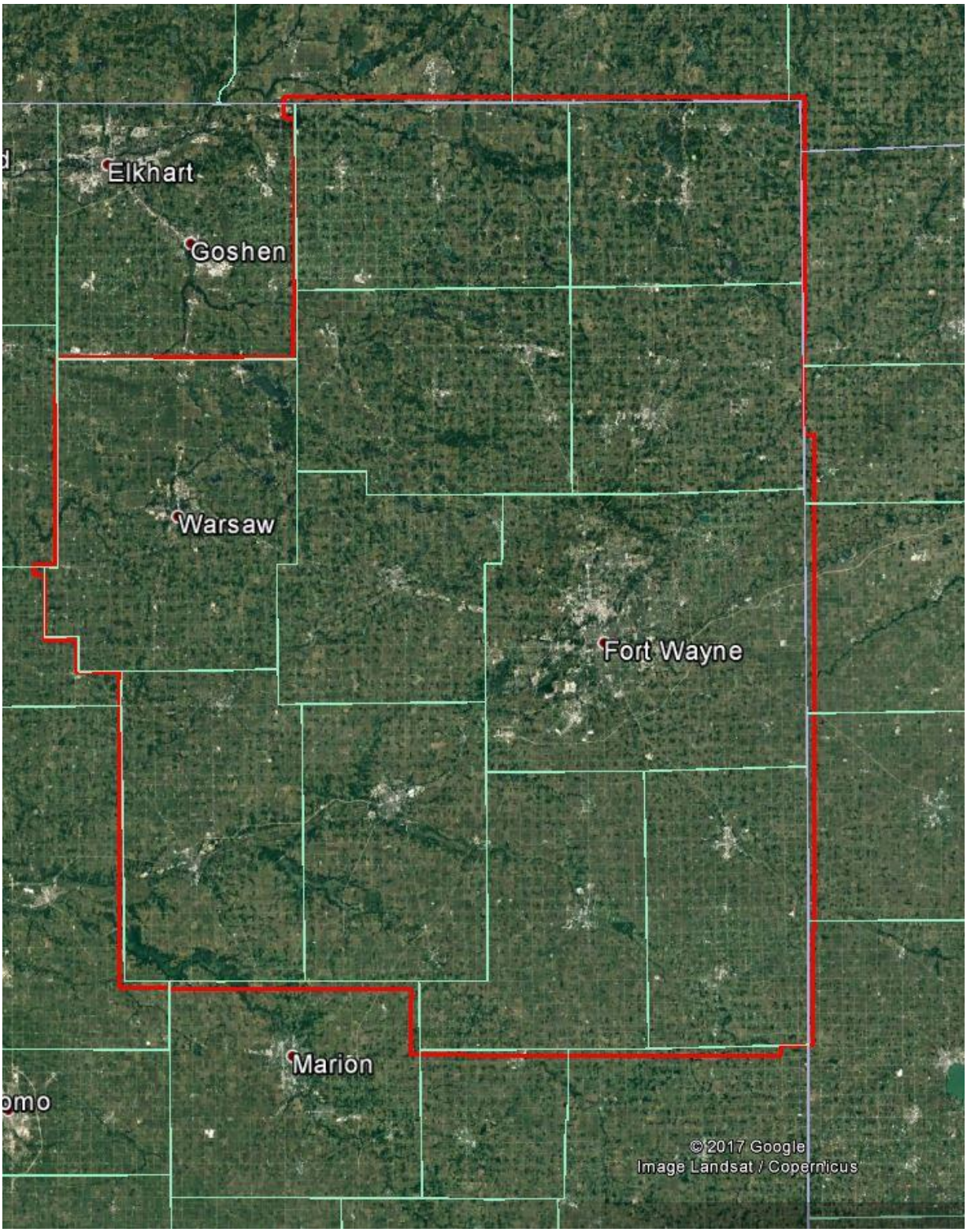
This report contains a comprehensive outline of the Indiana Statewide LiDAR_2017_B17 Base Option Lidar task order. Processing task order for the United States Geological Survey (USGS). This task is issued under USGS Contract No. G16PC00022, Task Order No. G17PD00269. This task order requires lidar data to be collected at a nominal pulse spacing (NPS) of 0.7 meters over 4,690 square miles to meet the requirements specified in the referenced "National Geospatial Program Lidar Base Specification Version 1.2. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.

The data was collected using three Leica ALS80 HP 1000 kHz Multiple Pulses in Air (MPiA) lidar systems on board Woolpert aircraft. The ALS80 sensor collects up to four returns per pulse, as well as intensity data, for the first three returns. If a fourth return was captured, the system does not record an associated intensity value. The aerial lidar was collected at the following sensor specifications:

Table 1.1: ALS80 Specifications – WOOLPERT	
Post Spacing	0.70 m
AGL (Above Ground Level) average flying height	2,377m
Average Ground Speed:	150 knots
Field of View (full)	40 degrees
Pulse Rate	346kHz
Scan Rate	35.5 Hz
Side Lap	25%

The horizontal datum used for the task order was referenced to NAD83 (HARN), StatePlane Indiana EastFIPS 1301, US Feet. The vertical datum used for the task order was referenced to NAVD 1988, US Feet, GEOID12B.

Figure 1.1: Indiana Statewide Lidar 2017 B17 Base Option Lidar Task Order AOI



Section 2: Acquisition

The lidar data was acquired with three Leica ALS80HP 1000 kHz Multiple Pulses in Air (MPiA) Lidar Sensor Systems. The ALS80 HP lidar system, developed by Leica Geosystems of Heerbrugg, Switzerland, includes the simultaneous first, intermediate and last pulse data capture module, the extended altitude range module, and the target signal intensity capture module.

The ALS80HP 1000 kHz Multiple Pulses in Air (MPiA) Lidar System has the following specifications:

Table 2.1: ALS80 HP Lidar System Specifications	
Operating Altitude	100 – 7,620 meters
Scan Angle	0 to 72° (variable)
Swath Width	0 to 1.5 X altitude (variable)
Scan Frequency	0 – 200 Hz (variable based on scan angle)
Maximum Pulse Rate	1000 kHz (Effective)
Range Resolution	Better than 1 cm
Elevation Accuracy	6 - 19 cm single shot (one standard deviation)
Horizontal Accuracy	5 – 43 cm (one standard deviation)
Number of Returns per Pulse	Unlimited
Number of Intensities	3 (first, second, third)
Intensity Digitization	8 bit intensity + 8 bit AGC (Automatic Gain Control) level
MPiA (Multiple Pulses in Air)	8 bits @ 1nsec interval @ 50kHz
Laser Beam Divergence	0.22 mrad @ $1/e^2$ (~0.15 mrad @ 1/e)
Laser Classification	Class IV laser product (FDA CFR 21)
Eye Safe Range	400m single shot depending on laser repetition rate
Roll Stabilization	Automatic adaptive, range = 75 degrees minus current FOV
Power Requirements	28 VDC @ 25A
Operating Temperature	0-40°C
Humidity	0-95% non-condensing
Supported GNSS Receivers	Ashtech Z12, Trimble 7400, Novatel Millenium

Prior to mobilizing to the project site, flight crews coordinated with the necessary Air Traffic Control personnel to ensure airspace access.

Crews were onsite, operating a Global Navigation Satellite System (GNSS) Base Station for the airborne GPS support.

The Lidar data was collected in twenty-two (22) missions, flown as close together as the weather permitted, to ensure consistent ground conditions across the project area. An initial quality control process was performed immediately on the Lidar data to review the data coverage, airborne GPS data, and trajectory solution. Collection of lidar data took place from March 8 through April 2 of 2017.

Figure 2.1: Lidar Flight Layout, Indiana Statewide Lidar 2017 B17 Base Option

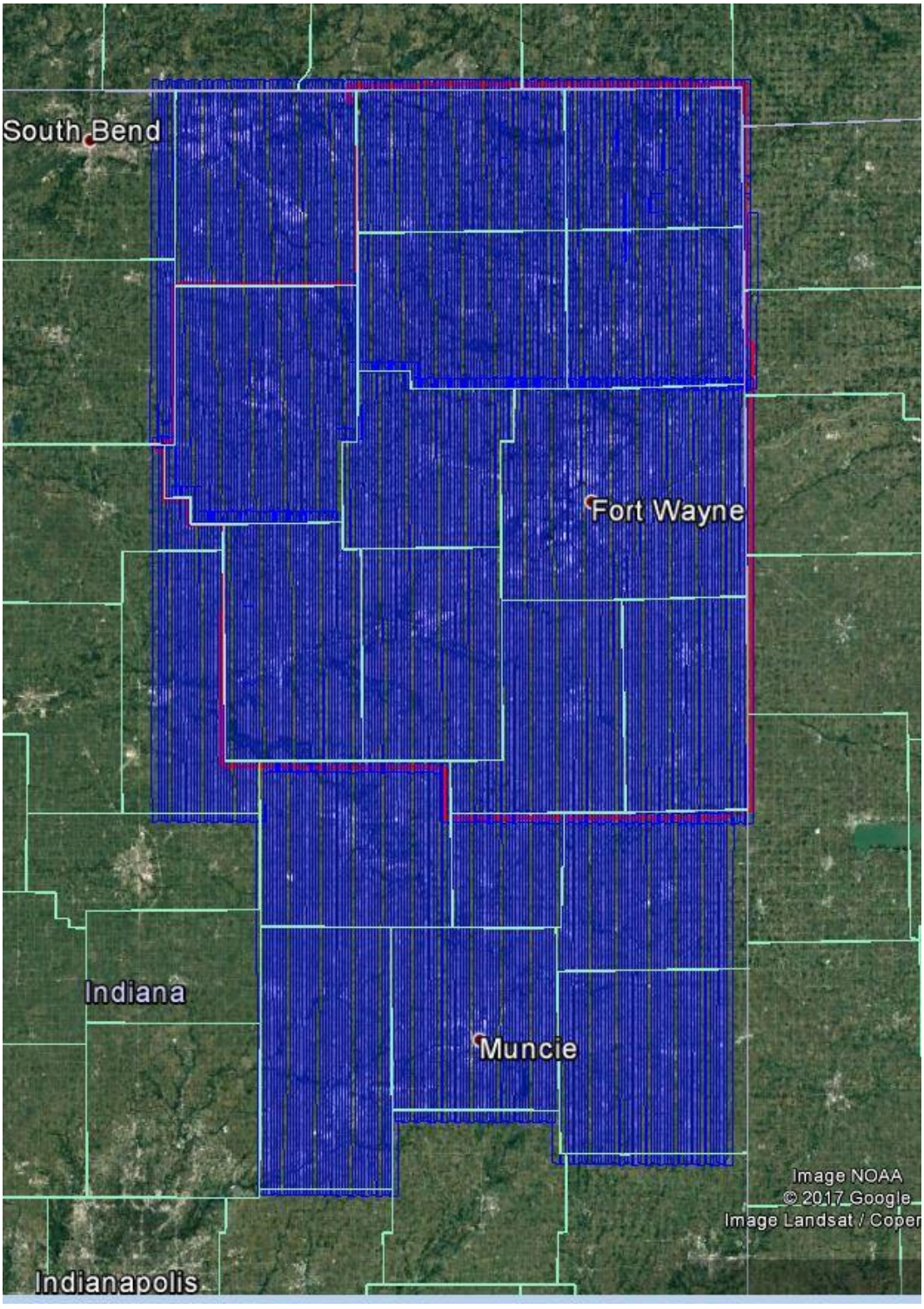


Table 2.3: Airborne Lidar Acquisition Flight Summary

Date of Mission	Lines Flown	Mission Time (UTC) Start Time/ Stop Time
March 8, 2017_SH8191	**02122-02126**	**14:48 – 16:24**
March 9, 2017_SH8191	**02100-02118**	**14:30 – 20:25**
March 11, 2017_SH8170	**01107-01122, 11121**	**21:45 – 01:49**
March 12, 2017_SH8170	**01102-01106, 11107-11110**	**14:07 - 15:53**
March 12, 2017_SH8191	**02097, 02098, 02119-02121**	**14:03 - 15:46**
March 12, 2017_SH8194	**02076 - 02079**	**14:40 - 15:51**
March 16, 2017_SH8170_A	**03057-03070**	**12:37 - 16:37**
March 16, 2017_SH8170_B	**03047-03056**	**18:21 - 21:42**
March 16, 2017_SH8194	**03071-03090**	**13:44 - 18:59**
March 16, 2017_SH8191	**03091-03108**	**13:50 - 18:52**
March 21, 2017_SH8170	**01085-01101, 11102**	**17:23 - 21:51**
March 22, 2017_SH8170_A	**01067-01084**	**12:41 - 17:14**
March 22, 2017_SH8170_B	**01055-01066**	**18:53 - 22:27**
March 22, 2017_SH8191	**03037-03046, 02093-02096**	**13:31 - 19:21**
March 23, 2017_SH8170_A	**01041-01054**	**13:07 - 17:51**
March 23, 2017_SH8170_B	**01033-01040**	**19:27 - 22:02**
March 23, 2017_SH8194	**02075, 02080-02092, 02099**	**14:00 - 18:58**
March 24, 2017_SH8170	**01031, 01032**	**14:49 - 15:24**
March 29, 2017_SH8170	**02069-02074**	**19:03 - 20:57**
April 1, 2017_SH8194	**02048-02056, 11033, 11084**	**19:11 - 21:46**
April 2, 2017_SH8170_A	**02036-02040**	**14:12 - 15:34**
April 2, 2017_SH8194	**02041-02047, 02057-02068, 12050**	**13:57 - 18:57**

Section 3: LiDAR Data Processing

Applications and Work Flow Overview

1. Resolved kinematic corrections for three subsystems: inertial measurement unit (IMU), sensor orientation information and airborne GPS data. Developed a blending post-processed aircraft position with attitude data using Kalman filtering technology or the smoothed best estimate trajectory (SBET).
Software: POSPac Software v. 5.3, IPAS Pro v.1.35., Novatel Inertial Explorer v8.60.6129
2. Calculated laser point position by associating the SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in LAS format. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift.
Software: ALS Post Processing Software v.2.75 build #25, Proprietary Software, TerraMatch v. 17, Add Leica Cloud Pro v1.2.3
3. Imported processed LAS point cloud data into the task order tiles. Resulting data were classified as ground and non-ground points with additional filters created to meet the task order classification specifications. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Based on the statistical analysis, the lidar data was then adjusted to reduce the vertical bias when compared to the survey ground control.
Software: TerraScan v.17
4. The LAS files were evaluated through a series of manual QA/QC steps to eliminate remaining artifacts from the ground class.
Software: TerraScan v.17

Global Navigation Satellite System (GNSS)–Inertial Measurement Unit (IMU) Trajectory Processing

Equipment

The pilots are skilled at maintaining their planned trajectory, while holding the aircraft steady and level. If atmospheric conditions are such that the trajectory, ground speed, roll, pitch and/or heading cannot be properly maintained, the mission is aborted until suitable conditions occur.

Base stations were set by acquisition staff and were used to support the Lidar data acquisition. The GNSS base station operated during the Lidar acquisition missions is listed below:

Table 3.1: GNSS Base Station

Station (Name)	Latitude (DMS)	Longitude (DMS)	Ellipsoid Height (L1 Phase center) (Meters)
INFW CORS	41°07'40.81793"	85°10'39.13790"	230.466
INSB CORS	39°52'01.86063"	84°56'27.05027"	292.098
INAB CORS	40°17'53.68807"	85°12'41.20138"	267.181
INNC CORS	41°22'59.52564"	85°25'23.09052"	264.151
INTP CORS	40°16'49.30695"	86°03'19.84558"	236.799
INWR CORS	41°16'12.93199"	85°53'40.69339"	230.554
INWB CORS	40°49'29.02329"	85°48'11.62170"	218.56
INGG CORS	39°21'35.41596"	85°30'53.73708"	254.669

INPD CORS	39°58'23.49386"	85°46'10.77263"	235.442
IUCO CORS	39°10'26.60590"	86°30'23.18241"	230.719

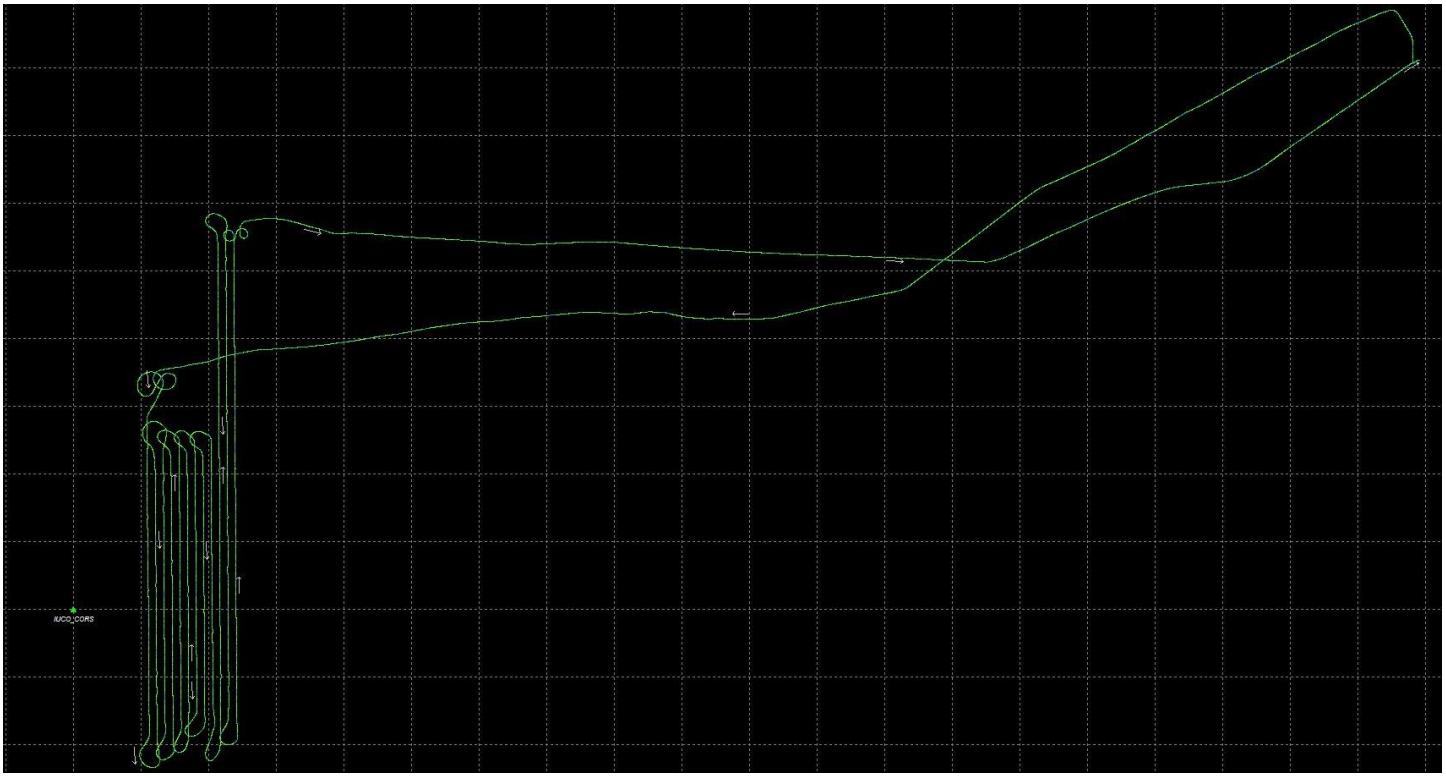
Data Processing

All airborne GNSS and IMU data was post-processed and quality controlled using Applanix MMS software. GNSS data was processed at a 1 and 2 Hz data capture rate and the IMU data was processed at 200 Hz.

Trajectory Quality

The GNSS Trajectory, along with high quality IMU data are key factors in determining the overall positional accuracy of the final sensor data. Within the trajectory processing, there are many factors that affect the overall quality, but the most indicative are the combined separation, the estimated positional accuracy, and the Positional Dilution of Precision (PDOP).

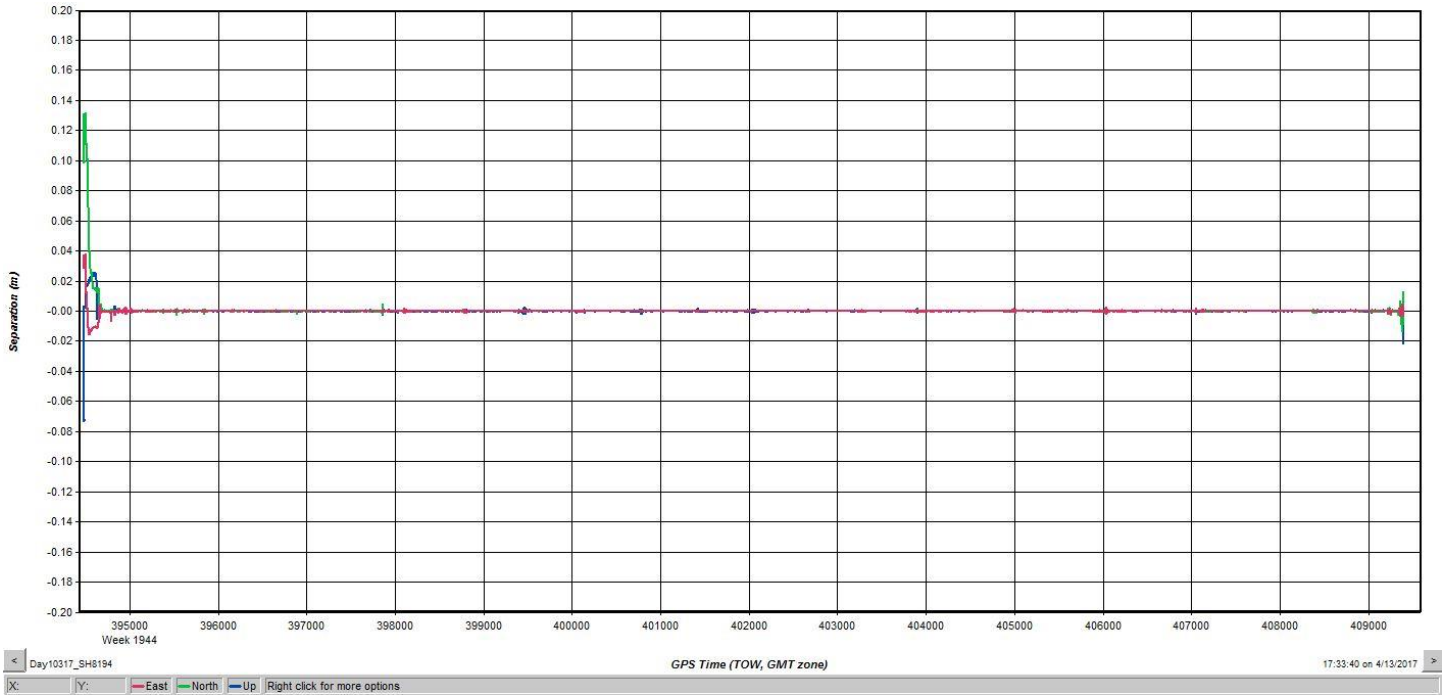
Figure 3.1: Trajectory, Day10317_SH8194



Combination Separation

The Combined Separation is a measure of the difference between the forward run and the backward run solution of the trajectory. The Kalman filter is processed in both directions to remove the combined directional anomalies. In general, when these two solutions match closely, an optimally accurate reliable solution is achieved.
Woolpert's goal is to maintain a Combined Separation Difference of less than ten (10) centimeters. In most cases we achieve results below this threshold.

Figure 3.2: Combined Separation, Day10317_SH8194

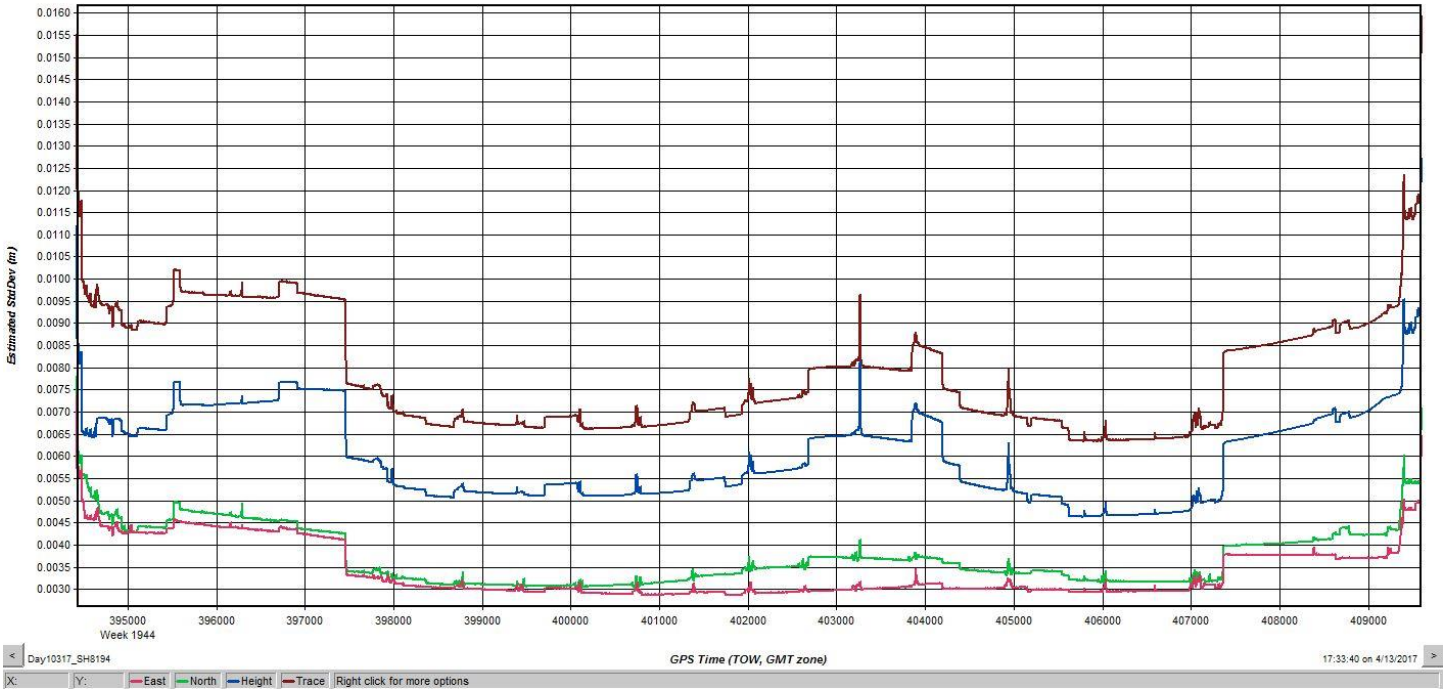


Estimated Positional Accuracy

The Estimated Positional Accuracy plots the standard deviations of the east, north, and vertical directions along a time scale of the trajectory. It illustrates loss of satellite lock issues, as well as issues arising from long baselines, noise, and/or other atmospheric interference.

Woolpert's goal is to maintain an Estimated Positional Accuracy of less than ten (10) centimeters, often achieving results well below this threshold.

Figure 3.3: Estimated Positional Accuracy, Day10317_SH8194

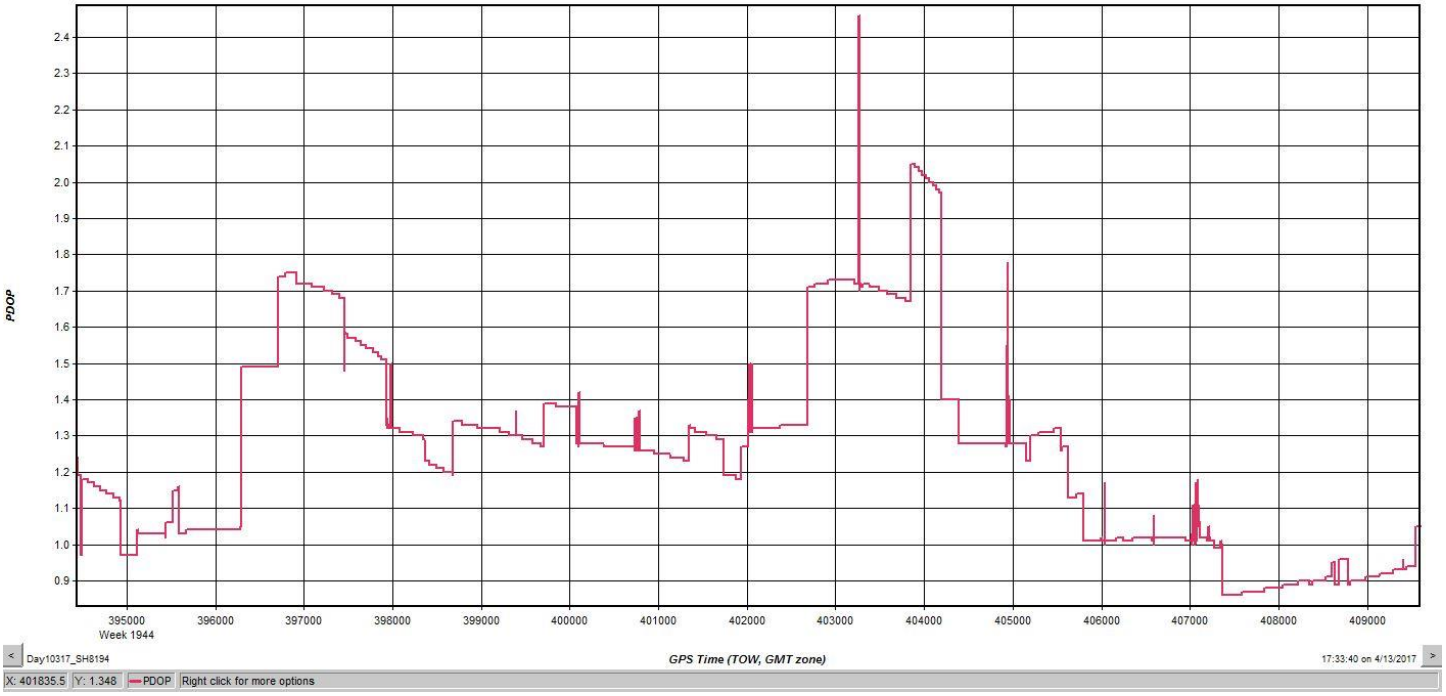


PDOP

The PDOP measures the precision of the GPS solution in regards to the geometry of the satellites acquired and used for the solution.

Woolpert's goal is to maintain an average PDOP value below 3.0. Brief periods of PDOP over 3.0 are acceptable due to the calibration and control process if other metrics are within specification.

Figure 3.4: PDOP, Day10317_SH8194



LiDAR Data Processing

When the sensor calibration, data acquisition, and GPS processing phases were complete, the formal data reduction processes by Woolpert lidar specialists included:

- Processed individual flight lines to derive a raw “Point Cloud” LAS file. Matched overlapping flight lines, generated statistics for evaluation comparisons, and made the necessary adjustments to remove any residual systematic error.
- Calibrated LAS files were imported into the task order tiles and initially filtered to create a ground and non-ground class. Then additional classes were filtered as necessary to meet client specified classes.
- Once all project data was imported and classified, survey ground control data was imported and calculated for an accuracy assessment. As a QC measure, Woolpert has developed a routine to generate accuracy statistical reports by comparisons against the TIN and the DEM using surveyed ground control of higher accuracy. The lidar is adjusted accordingly to meet or exceed the vertical accuracy requirements.
- The lidar tiles were reviewed using a series of proprietary QA/QC procedures to ensure it fulfills the task order requirements. A portion of this requires a manual step to ensure anomalies have been removed from the ground class.
- The lidar LAS files are classified into the Processed, but unclassified (Class 1), Bare-earth ground (Class 2), Low Noise (Class 7), Water (Class 9), Ignored Ground (Class10), Bridge Decks (Class 17), and High Noise (Class 18) classifications.
- FGDC Compliant metadata was developed for the task order in .xml format per product.
- The horizontal datum used for the task order was referenced to NAD83 (HARN), StatePlane Indiana East FIPS 1301, US Feet. The vertical datum used for the task order was referenced to NAVD 1988, US Feet, GEOID12B

Section 4: Hydrologic Flattening

HYDROLOGIC FLATTENING OF LIDAR DEM DATA

Indiana Statewide LiDAR_2017_B17 processing task order required the compilation of breaklines defining water bodies and rivers. The breaklines were used to perform the hydrologic flattening of water bodies, and gradient hydrologic flattening of double line streams and rivers. Lakes, reservoirs and ponds, at a minimum size of 2-acre or greater, were compiled as closed polygons. The closed water bodies were collected at a constant elevation. Rivers and streams, at a nominal minimum width of 30 meters (100 feet), were compiled in the direction of flow with both sides of the stream maintaining an equal gradient elevation.

LIDAR DATA REVIEW AND PROCESSING

Woolpert utilized the following steps to hydrologically flatten the water bodies and for gradient hydrologic flattening of the double line streams within the existing lidar data.

1. Woolpert used the newly acquired lidar data to manually draw the hydrologic features in a 2D environment using the lidar intensity and bare earth surface. Open Source imagery was used as reference when necessary.
2. Woolpert utilizes an integrated software approach to combine the lidar data and 2D breaklines. This process “drapes” the 2D breaklines onto the 3D lidar surface model to assign an elevation. A monotonic process is performed to ensure the streams are consistently flowing in a gradient manner. A secondary step within the program verifies an equally matching elevation of both stream edges. The breaklines that characterize the closed water bodies are draped onto the 3D lidar surface and assigned a constant elevation at or just below ground elevation.
3. The lakes, reservoirs and ponds, at a minimum size of 2-acre or greater and streams at a minimum size of 30 meters (100 feet) nominal width, were compiled to meet task order requirements. **Figure 4.1** illustrates an example of 30 meters (100 feet) nominal streams identified and defined with hydrologic breaklines. The breaklines defining rivers and streams, at a nominal minimum width of 30 meters (100 feet), were draped with both sides of the stream maintaining an equal gradient elevation.
4. All ground points were reclassified from inside the hydrologic feature polygons to water, class nine (9).
5. All ground points were reclassified from within a buffer along the hydrologic feature breaklines to buffered ground, class ten (10).
6. The lidar ground points and hydrologic feature breaklines were used to generate a new digital elevation model (DEM).

Figure 4.1: Example Hydrologic Breaklines

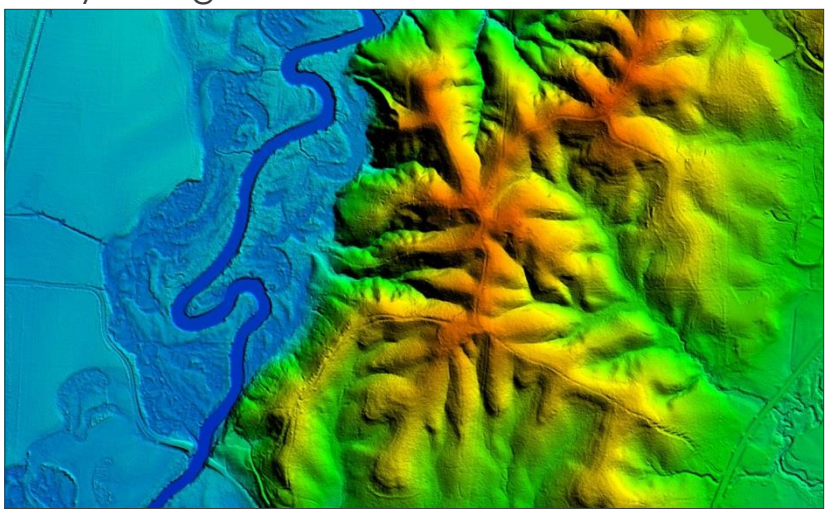


Figure 4.2 reflects a DEM generated from original lidar bare earth point data prior to the hydrologic flattening process. Note the "tinning" across the lake surface.

Figure 4.3 reflects a DEM generated from lidar with breaklines compiled to define the hydrologic features. This figure illustrates the results of adding the breaklines to hydrologically flatten the DEM data. Note the smooth appearance of the lake surface in the DEM.

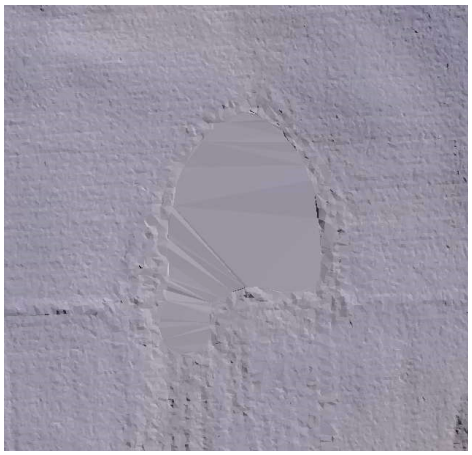


Figure 4.2

Figure 4.3

Terrascan was used to add the hydrologic breakline vertices and export the lattice models. The hydrologically flattened DEM data was provided to USGS in ERDAS .IMG format.

The hydrologic breaklines compiled as part of the flattening process were provided to the USGS in ESRI GDB format. The breaklines defining the water bodies greater than 2-acre and for the gradient flattening of all rivers and streams at a nominal minimum width of 30 meters (100 feet) were provided in geodatabase as a Polygon-Z and Polyline-Z shape file, respectively.

DATA QA/QC

Initial QA/QC for this task order was performed in Global Mapper v17, by reviewing the grids and hydrologic breakline features. Additionally, ESRI software and proprietary methods were used to review the overall connectivity of the hydrologic breaklines.

Edits and corrections were addressed individually by tile. If a water body breakline needed to be adjusted to improve the flattening of the DEM data, the area was cross referenced by tile number, corrected accordingly, a new DEM file was regenerated and reviewed.

Section 5: ACCURACY ASSESSMENT

Accuracy Assessment

The vertical accuracy statistics were calculated by comparison of all lidar points to the ground surveyed QC points.

Table 5.1: Overall Vertical Accuracy Statistics		
Average error	+0.035	US Feet
Minimum error	-0.275	US Feet
Maximum error	+0.292	US Feet
Average magnitude	0.096	US Feet
Root mean square	0.119	US Feet
Standard deviation	0.114	US Feet

Table 5.2: RAW Swath Quality Check Point Analysis NVA

Point ID	Easting (US Feet)	Northing (US Feet)	Elevation (US Feet)	TIN Elevation (US Feet)	Dz (US Feet)
2006	325431.4790	2370155.3260	809.2890	809.3400	0.0510
2007	352919.5030	2342458.0880	897.9050	897.9500	0.0450
2008	397619.3920	2333011.8350	905.4510	905.3300	-0.1210
2009	486851.8490	2326832.8870	980.6980	980.7300	0.0320
2010	511861.9720	2328598.1560	1015.7180	1015.7600	0.0420
2011	492631.3920	2287462.0280	1001.6770	1001.7900	0.1130
2012	496442.0860	2229260.9100	859.3980	859.6100	0.2120
2013	475773.9130	2222165.1980	881.0100	881.0700	0.0600
2014	445988.0910	2228653.4920	969.3260	969.5000	0.1740
2015	437203.3780	2258201.7020	962.3810	962.4600	0.0790
2019	279489.5760	2196906.2460	838.0040	838.0800	0.0760
2022	300407.0620	2094845.2380	765.6970	765.6300	-0.0670
2023	337330.5120	2125648.8120	806.1870	806.1800	-0.0070
2024	376414.3110	2157007.7030	883.9510	883.9900	0.0390
2025	468086.5550	2140840.7090	802.4870	802.4700	-0.0170
2026	517013.4980	2122096.6120	767.7530	767.8300	0.0770
2027	466382.8600	1993772.6830	824.3700	824.3200	-0.0500
2028	445940.8840	2032998.7990	812.7760	812.6900	-0.0860
2029	462792.6150	1937594.0360	920.3800	920.3700	-0.0100
2030	373800.2420	2043781.3820	737.7590	737.5300	-0.2290
2031	291950.6100	2009113.4240	789.2190	789.2100	-0.0090
2040	361864.2140	2291748.9610	918.1480	918.4100	0.2620
2041	529694.1820	2362894.5440	1056.2490	1056.3200	0.0710

2042	532775.9480	2292430.8290	900.5760	900.8300	0.2540
2043	549163.4030	2254510.5660	851.3610	851.5800	0.2190
2044	537475.1340	2233520.2370	852.0820	852.1300	0.0480
2045	545948.3420	2209928.9400	821.3040	821.4000	0.0960
2046	542473.7270	2183424.7440	819.5320	819.6000	0.0680
2047	525274.3430	1971008.6440	856.4810	856.3900	-0.0910
2048	530204.3560	2032810.4580	806.4840	806.5500	0.0660
2049	395077.4370	1980417.7130	837.1680	837.0200	-0.1480
2050	295707.9200	2074061.6100	790.8450	791.0100	0.1650
2051	230844.9930	2110688.3470	855.9840	855.9600	-0.0240
2060	267165.3770	2142753.3310	883.7190	883.7700	0.0510
2061	398537.5290	2239384.4750	961.2240	961.4000	0.1760
2062	455728.8410	2309463.2750	937.8840	937.7600	-0.1240
2063	463124.0600	2361771.0070	959.8420	959.6900	-0.1520
2064	393515.0390	2370659.9650	875.9050	876.0700	0.1650
2065	456788.9420	2199509.9760	873.6090	873.7600	0.1510
2066	423910.7990	2179533.5010	888.9900	889.0800	0.0900
2067	375913.8400	2216513.1220	918.4410	918.5800	0.1390
2068	233791.1870	2234786.1930	827.1120	827.2000	0.0880
2073	351428.7990	2002689.0890	814.9810	815.1200	0.1390
2074	412647.7230	2033011.6380	805.6120	805.4900	-0.1220
2075	376862.3830	2112527.8880	842.5150	842.6000	0.0850
2076	318512.5530	2233004.0760	914.7390	914.7600	0.0210
2077	277490.0350	2245385.2120	834.8640	834.8300	-0.0340
2078	244919.5400	2191683.5020	804.1810	804.1800	-0.0010
2079	274375.1960	1968148.6240	806.3300	806.4600	0.1300
2082	312724.9380	1975815.6670	798.2990	798.1700	-0.1290
2082A	312669.0530	1975834.8340	799.8950	799.6200	-0.2750
2083	430329.2900	1969300.9250	865.0230	865.0700	0.0470
2084	492254.3430	1943548.1740	857.9550	857.7900	-0.1650
2085	564335.1210	1940269.6550	854.0680	854.1700	0.1020
2086	557541.9820	2000795.6930	815.3650	815.4000	0.0350
2087	557322.3990	2051483.2650	827.6420	827.5700	-0.0720
2088	514567.4610	2077213.0020	825.0060	825.0000	-0.0060
2088A	514616.6050	2077119.6820	826.2310	826.2800	0.0490
2089	389764.4740	2075589.3230	814.4070	814.3300	-0.0770
2090	387158.4320	2011646.4140	831.3250	831.2800	-0.0450
2091	339745.1150	2075047.0750	850.4670	850.5000	0.0330
2092	420617.4700	2304459.2950	969.3690	969.3300	-0.0390
2093	392167.7800	2199399.7980	942.1330	942.0800	-0.0530
2094	317458.0970	2168335.3530	917.8060	917.8600	0.0540

2095	567409.5790	2152693.0680	744.2010	744.3800	0.1790
2096	566434.3250	2096309.0740	767.0940	767.3100	0.2160
2097	532212.7370	2166272.0560	780.2460	780.2800	0.0340
2098	440436.5470	2103929.4170	762.1180	762.1900	0.0720
2099	313576.6270	2053644.9880	865.5860	865.6100	0.0240
2100	267068.3130	2034043.0030	797.0600	797.2700	0.2100
2105	260553.3990	2094787.8820	802.5140	802.6800	0.1660
2106	358312.3630	2264087.1450	896.4180	896.4800	0.0620
2111	273362.4150	2058608.4020	774.6250	774.7200	0.0950
2112	420328.4610	2143587.4390	846.1360	846.0900	-0.0460
2113	483072.3080	2176571.1510	851.4530	851.4100	-0.0430
2114	494779.3210	2055302.1200	803.8820	803.7500	-0.1320
2115	301691.3010	2141421.1490	906.8380	907.1300	0.2920
2116	447309.3910	2059905.1140	824.3800	824.4900	0.1100
2119	395748.7590	2290337.1870	914.9980	915.1900	0.1920
2120	559468.0310	2336522.3100	998.7920	998.8200	0.0280
2122	435020.3560	2345424.7120	912.2180	912.0700	-0.1480
2123	498165.0970	2015368.4870	834.8580	834.8200	-0.0380
2124	357191.9090	1965100.5680	877.5460	877.5800	0.0340
2125	347577.1220	2183036.4730	908.9380	908.9300	-0.0080

VERTICAL ACCURACY CONCLUSIONS

Raw Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.071 Meters Non vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the TIN using all lidar points against 84 NVA points.

LAS Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.069 Meters Non vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the TIN using lidar ground points against 84 NVA points.

Table 5.3: NVA Check Point Analysis DEM

Point ID	Easting (US Feet)	Northing (US Feet)	Elevation (US Feet)	DEM Elevation (US Feet)	Dz (US Feet)
2001	2496248.379	314438.308	1441.568	1441.753	0.185
2002	2533738.019	278413.524	1461.691	1461.193	-0.498
2003	2555629.606	266740.877	1438.2	1438.183	-0.017
2004	2575971.105	283403.412	1398.491	1398.353	-0.138

2005	2574140.526	304133.246	1240.579	1240.712	0.133
2006	2567239.625	350341.668	1290.037	1289.843	-0.194
2007	2552276.053	349209.226	1228.142	1228.032	-0.110
2008	2559509.559	394249.159	1159.27	1159.162	-0.108
2009	2598308.722	416430.531	1117.311	1117.812	0.501
2010	2642866.648	461880.089	1068.149	1068.232	0.083
2011	2676670.544	498725.957	1284.355	1284.293	-0.062
2012	2771728.973	489179.623	963.866	963.712	-0.154
2013	2746857.903	516704.218	1084.286	1084.202	-0.084
2014	2739579.873	528950.248	1091.135	1090.882	-0.253
2015	2732290.996	549214.374	1165.804	1165.662	-0.142
2016	2726390.33	563630.601	1089.862	1089.812	-0.050
2017	2692019.562	581910.113	1092.799	1092.972	0.173
2018	2676514.246	547557.615	1244.139	1244.162	0.023
2019	2641663.744	559720.048	1140.835	1140.792	-0.043
2020	2592436.7	607180.716	1203.98	1204.012	0.032
2021	2609008.922	606708.122	1183.24	1183.192	-0.048
2022	2698631.345	643818.467	1083.965	1084.252	0.287
2023	2692959.464	648317.519	1090.811	1091.062	0.251
2024	2510029.864	432261.909	1318.387	1318.593	0.206
2025	2567242.421	443400.74	1269.38	1269.493	0.113
2026	2743319.358	496742.395	1126.662	1126.342	-0.320
2027	2707065.657	479039.267	1140.738	1140.642	-0.096
2028	2672520.382	456927.016	1073.84	1073.502	-0.338
2029	2504407.063	388901.225	1284.953	1285.273	0.320
2030	2498374.244	266769.338	1433.73	1433.703	-0.027
2031	2533403.734	331524.625	1323.814	1323.353	-0.461
2032	2513229.464	359811.666	1316.654	1317.103	0.449
2033	2535664.756	416290.565	1224.342	1224.002	-0.340
2034	2624233.01	276629.623	1368.943	1369.083	0.140
2035	2609049.571	300105.837	1423.834	1424.403	0.569
2036	2609136.384	328221.847	1281.79	1282.383	0.593
2037	2635655.44	437362.707	1134.59	1134.652	0.062
2038	2584370.43	604135.594	1210.977	1210.842	-0.135
2039	2588146.904	587169.729	1354.801	1354.733	-0.068
2040	2625529.103	599215.087	1162.121	1162.072	-0.049
2041	2613059.514	590575.745	1177.306	1177.122	-0.184
2042	2679737.933	621131.232	1187.176	1187.142	-0.034
2043	2708021.865	661979.064	1009	1009.092	0.092
2044	2712780.621	626806.438	1261.346	1261.063	-0.283
2045	2703239.881	610883.302	1229.242	1229.002	-0.240

2046	2743837.901	593869.103	1310.71	1310.433	-0.277
2047	2522517.566	315044.031	1416.017	1415.873	-0.144
2048	2543600.151	305710.032	1280.353	1280.153	-0.200
2050	2585231.615	333270.498	1399.387	1399.273	-0.114
2051	2604069.201	376306.618	1312.063	1312.483	0.420
2052	2604970.92	455591.173	1195.608	1196.302	0.694
2053	2672624.25	480298.284	1265.947	1265.853	-0.094
2054	2699436.172	518416.019	1136.344	1136.602	0.258
2055	2703718.751	553120.946	1183.474	1183.392	-0.082
2056	2668518.782	570327.121	1306.455	1306.403	-0.052
2057	2646782.062	584368.04	1142.358	1142.162	-0.196
2058	2679289.054	638511.17	1278.778	1278.703	-0.075
2059	2684282.525	666654.606	1078.177	1078.212	0.035
2060	2695400.431	633897.53	1282.73	1282.983	0.253
2061	2710786.525	592348.119	1307.677	1307.363	-0.314
2062	2731108.712	582812.58	1294.842	1294.693	-0.149
2063	2750924.297	571482.333	1023.131	1022.842	-0.289
2064	2771300.19	551004.892	986.214	986.302	0.088
2065	2754587.625	540511.756	1099.257	1098.952	-0.305
2066	2753306.463	476194.117	994.781	994.582	-0.199
2067	2694015.779	464753.876	1146.408	1146.422	0.014
2068	2718179.478	504214.641	1105.243	1105.172	-0.071
2069	2529606.2	459596.368	1438.151	1437.853	-0.298
2070	2567113.847	422434.721	1281.137	1281.113	-0.024
2071	2517860.071	299076.131	1415.91	1416.203	0.293
2072	2593046.09	360019.066	1242.24	1242.352	0.112
2073	2617890.429	397938.62	1167.855	1168.122	0.267
2074	2605597.894	439774.434	1173.712	1174.452	0.740
2075	2648309.401	547332.18	1134.019	1133.822	-0.197
2076	2649207.404	530904.417	1116.434	1116.322	-0.112
2077	2659793.048	515259.858	1105.496	1105.282	-0.214

VERTICAL ACCURACY CONCLUSIONS

Bare-Earth DEM Non-Vegetated Vertical Accuracy (NVA) Tested 0.067 Meters Non-Vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 as defined by the National Standards for Spatial Data Accuracy (NSSDA); assessed and reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM against 84 NVA points.

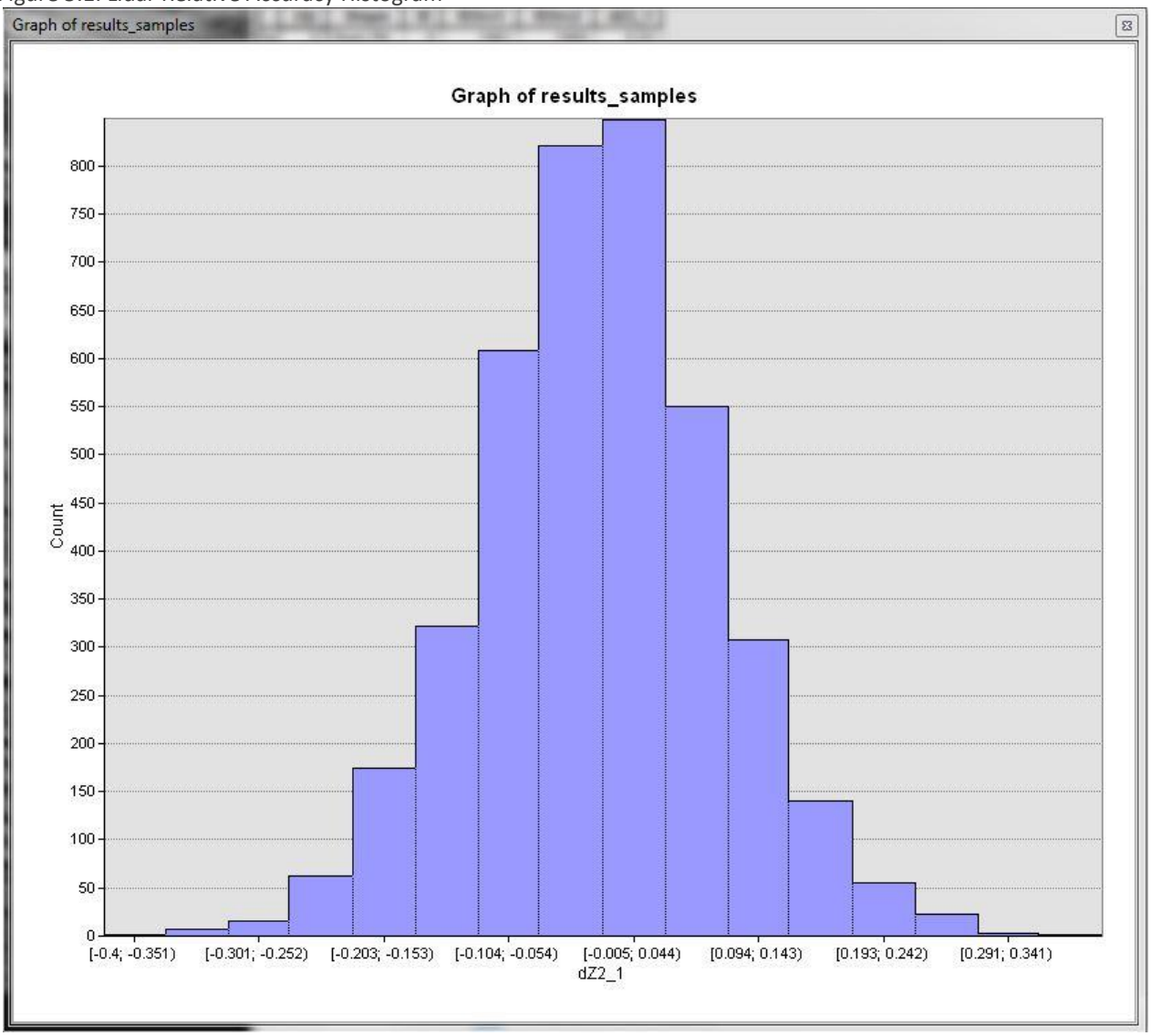
Table 5.4: VVA Quality Check Point Analysis DEM					
Point ID	**Easting (US Feet)**	**Northing (US Feet)**	**Elevation (US Feet)**	**DEM Elevation (US Feet)**	**Dz (US Feet)**
3001	492765.668	1943541.841	850.526	850.552	0.026
3002	392714.028	1963695.099	840.903	840.812	-0.091
3003	421966.697	2016946.408	824.65	825.042	0.392
3004	491322.253	1986879.405	830.558	830.592	0.034
3005	492813.256	2017635.774	839.88	839.982	0.102
3006	430183.324	1985143.108	841.932	842.032	0.100
3007	390047.572	1942539.836	858.985	859.072	0.087
3008	425366.43	1938280.505	858.861	858.932	0.071
3009	462982.949	1937752.537	916.094	916.072	-0.022
3010	459627.873	2066254.434	816.904	817.122	0.218
3011	455702.274	2032340.175	839.48	839.512	0.032
3012	461419.962	1997004.597	831.901	831.942	0.041
3013	450674.791	1969881.968	852.82	852.832	0.012
3014	468138.016	1993713.794	827.932	828.052	0.120
3015	465989.619	2049685.801	815.703	815.872	0.169
3016	444805.842	2033379.856	813.993	814.172	0.179
3020	318487.673	2235662.077	890.639	890.752	0.113
3021	397227.685	2332774.485	895.792	896.072	0.280
3022	275296.02	1968180.207	803.098	803.172	0.074
3024	440596.108	2105760.525	792.561	792.962	0.401
3026	527230.169	2356470.249	1024.716	1025.192	0.476
3028	436615.347	2258226.346	960.277	960.472	0.195
3028A	436616.604	2258276.729	961.561	962.092	0.531
3031	229374.193	2174307.715	791.958	792.562	0.604
3031A	229346.78	2174263.65	793.029	793.522	0.493
3032	313543.935	2053495.6	862.552	862.542	-0.010
3035	544725.339	2210566.085	809.249	809.562	0.313
3037	490468.917	2286957.5	1003.884	1004.162	0.278
3038	376251.88	2162532.827	883.65	884.022	0.372
3039	265818.991	2142426.356	883.554	883.862	0.308
3041	351229.835	2002695.326	811.514	811.662	0.148
3042	339401.652	2075045.715	846.114	846.402	0.288
3043	233751.417	2235397.876	828.326	828.442	0.116
3045	361730.646	2291805.398	918.784	919.302	0.518
3046	511159.202	2190139.539	826.003	826.332	0.329
3047	398041.831	2235882.989	931.029	931.102	0.073
3048	326152.222	2370216.81	808.283	808.432	0.149

3052	377004.333	2112523.993	841.443	841.712	0.269
3053	461560.609	2361177.698	952.643	952.762	0.119
3054	282787.124	2196226.449	828.526	829.122	0.596
3056	276303.034	2033640.827	791.858	792.242	0.384
3057	565967.633	2153377.249	740.247	740.791	0.544
3058	517006.831	2121955.758	765.706	766.032	0.326
3062	556526.751	2051409.329	823.778	823.912	0.134
3063	330011.743	1968612.02	858.903	859.582	0.679
3065	392801.754	2075692.43	816.166	816.202	0.036
3066	460645.884	2199553.804	871.256	871.702	0.446
3069	365865.545	2230680.232	921.674	921.852	0.178
3070	563605.263	1940193.894	843.411	843.752	0.341
3071	564033.56	2294946.447	911.689	911.982	0.293
3072	317759.307	2169223.543	924.467	924.812	0.345
3074	312338.59	2010713.836	836.578	836.802	0.224
3076	421034.729	2304512.007	968.549	968.872	0.323
3080	512098.564	2257984.679	909.555	909.932	0.377
3082	557714.547	2000668.51	811.38	811.252	-0.128
3082A	557742.621	2000551.692	793.106	793.212	0.106
3083	278927.795	2246630.074	825.441	826.122	0.681
3084	510041.203	2087195.847	817.696	818.202	0.506
3085	424676.675	2202091.382	893.614	894.272	0.658
3086	484621.193	2255550.846	925.413	925.642	0.229
3087	352640.182	2342279.221	900.326	900.312	-0.014
3088	230754.947	2110187.834	854.965	855.152	0.187
3089	484357.388	2176098.984	844.901	845.022	0.121
3090	529661.239	2040718.35	772.285	772.522	0.237

VERTICAL ACCURACY CONCLUSIONS

Vegetated Vertical Accuracy (VVA) Tested 0.197 Meters at the 95th percentile reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM against 64 VVA points. VVA Errors larger than 95th percentile include:
Point 3063, Easting 330011.743, Northing 1968612.02, Z-Error 0.207 Meters
Point 3083, Easting 278927.795, Northing 2246630.074, Z-Error 0.208 Meters
Point 3085, Easting 424676.675, Northing 2202091.382, Z-Error 0.201 Meters

Figure 5.1: Lidar Relative Accuracy Histogram



RELATIVE ACCURACY ASSESSMENT AND CONCLUSION

Relative accuracy also known as "between swath" accuracy was tested through a series of well distributed flight line overlap locations. The relative accuracy for the Indiana Statewide Lidar 2017 B17 Base Option measured at 0.097 US Feet RMSDz.

Approved by:	Name	Signature	Date
Associate Member, Lidar Specialist Certified Photogrammetrist #1381	Qian Xiao		October 2017

Section 6: Flight Logs

Flight logs for the project are shown on the following pages:

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/8/2017	67	77391	2	in block 2

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
SMITH	N404CP	5898.1	9:23:00	14:23:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
RADER	OTHER	5901.4	12:41:00	17:41:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
240/17	10			7	-2	3013		Departing	day
								Arriving	day

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8346	Ft	Yes		No		@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		⇕ Times entered are Zulu / GMT ⇕						Verify S-Turns Before Mission Yes X No
126	n	14:50:00	15:07:00		21	0.6	1	
125	s	15:09:00	15:26:00		21	0.6	1.1	
124	n	15:28:00	15:45:00		20	0.6	1.2	
123	s	15:47:00	16:04:00		19	0.6	1.2	
122	n	16:06:00	16:23:00		20	0.6	1	
121	s	16:25:00	16:42:00		17	0.6	1.1	cld wp 40
120	n	16:44:00	17:01:00		18	0.6	1	cld wp 51.50,17-15
119	s	17:04:00	17:20:00		16	0.6	1.3	cld wp 4
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments: Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/9/2017	68	77391	2	in block 2

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
SMITH	N404CP	5901.4	9:03:00	14:03:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
RADER	OTHER	5908.6	4:09:00	21:09:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
080/3	10			2	-3	3016		Departing	day
								Arriving	day

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8346	Ft	Yes		No		@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission: Yes X No
118	n	14:32:00	14:49:00		19	0.6	1.1	
117	s	14:51:00	15:07:00		20	0.6	1.1	
116	n	15:09:00	15:26:00		19	0.6	1.2	
115	s	15:28:00	15:45:00		17	0.6	1.4	
114	n	15:47:00	16:03:00		18	0.6	1.2	
113	s	16:05:00	16:22:00		19	0.6	1	
112	n	16:24:00	16:40:00		16	0.6	1.2	
111	s	16:42:00	16:59:00		17	0.6	1.1	
110	n	17:01:00	17:17:00		16	0.6	1.3	
109	s	17:19:00	17:36:00		18	0.6	1.1	
108	n	17:38:00	17:54:00		17	0.6	1.2	
107	s	17:57:00	18:14:00		16	0.6	1.6	
106	n	18:16:00	18:32:00		19	0.6	1.1	
105	s	18:34:00	18:51:00		18	0.6	1.2	
104	n	18:53:00	19:09:00		18	0.6	1.1	
103	s	19:11:00	19:28:00		19	0.6	1.1	
102	n	19:30:00	19:47:00		19	0.6	1.1	
101	s	19:49:00	20:05:00		19	0.6	1.1	
100	n	20:07:00	20:24:00		19	0.6	1.1	
99	s	20:26:00	20:43:00		18	0.6	1.2	
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/11/2017	70	77391	2	IND 2017 QL2 LiDAR Block 1

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	517.0	16:23:00	21:23:00	CORS
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	521.5	21:08:00	2:08:00	INFW

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
310/9	10+	15K	75	0	-13	30.39	CLR	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8450	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes X No
122	N	21:47:36	21:54:48	0:00:00	21	0.6	1.2	Clear below 15K
121	S	21:59:46	22:07:56	0:00:00	21	0.6	1.3	Cut line at 24 mi from S end for clouds
120	N	22:10:57	22:23:35	0:00:00	21	0.6	1.2	Clear
119	S	22:26:45	22:38:22	0:00:00	21	0.6	1.2	Clear
118	N	22:41:45	22:54:12	0:00:00	21	0.6	1.1	Clear
117	S	22:57:22	23:09:10	0:00:00	19	0.7	1.4	Clear
116	N	23:12:35	23:24:51	0:00:00	19	0.7	1.3	Clear
115	S	23:28:10	23:39:48	0:00:00	20	0.7	1.2	Clear
114	N	23:43:11	23:55:25	0:00:00	18	0.7	1.2	Clear
				0:00:00				
121	S	23:59:06	0:03:26	0:00:00	16	0.8	1.4	complete N end of line, now clear
				0:00:00				
113	S	0:12:59	0:24:38	0:00:00	17	0.7	1.2	Clear
112	N	0:27:59	0:40:10	0:00:00	19	0.7	1.1	Clear
111	S	0:43:31	0:55:07	0:00:00	18	0.7	1.1	Clear
110	N	0:58:26	1:10:33	0:00:00	18	0.7	1.2	clds 0 to 3 and 7 mi from N end
109	S	1:13:49	1:25:30	0:00:00	19	0.7	1.2	clds 0 to 7 mi from N end
108	N	1:28:54	1:37:00	0:00:00	20	0.7	1.1	Cut line at 23 mi from S end for clouds
107	S	1:40:59	1:48:26	0:00:00	19	0.7	1.2	Cut line at 23 mi from S end for clouds
				0:00:00				end mission for clouds
				0:00:00				
				0:00:00				
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				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/12/2017	71	77391	2	IND 2017 QL2 LiDAR Block 1

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	521.5	9:42:00	13:42:00	CORS
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	523.9	12:22:00	16:22:00	INFW

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
5-May	10+	CLR	0	-7	-13	30.46	CLR	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	7800	Ft	8450	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
106	N	14:08:31	14:20:55	0:00:00	21	0.6	1	Clear
				0:00:00				
110	S	14:24:16	14:27:41	0:00:00	22	0.6	1	Refly N 10 mi, Clear
109	N	14:31:03	14:34:40	0:00:00	22	0.7	1.1	Refly N 10 mi, Clear
108	S	14:38:02	14:42:29	0:00:00	23	0.7	1.1	complete N end of line, now clear
107	N	14:45:58	14:51:16	0:00:00	22	0.7	1.2	complete N end of line, now clear
				0:00:00				
105	S	14:54:32	15:06:28	0:00:00	23	0.7	1.2	Clear
104	N	15:09:46	15:22:00	0:00:00	23	0.8	1.3	Clear
103	S	15:25:20	15:37:09	0:00:00	22	0.8	1.3	Clear
102	N	15:40:14	15:52:23	0:00:00	23	0.8	1.2	Clouds 3, 6 and 6.5 mi from N end
				0:00:00				end mission for clouds
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes X No

Additional Comments:	Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/12/2017	71	77391	2	in block 2

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
SMITH	N404CP	5910.0	9:38:00	13:38:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
RADER	OTHER	5913.2	12:51:00	16:51:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
360/9	10			-7	-12	3042		Departing	day
								Arriving	day

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8346	Ft	Yes		No		@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		⇕ Times entered are Zulu / GMT ⇕						Verify S-Turns Before Mission Yes X No
121	n	14:05:00	14:22:00		20	0.6	1	
120	s	14:25:00	14:41:00		19	0.6	1	
119	n	14:44:00	15:01:00		19	0.6	1.2	
98	s	15:09:00	15:25:00		20	0.6	1.3	
97	n	15:27:00	15:44:00		19	0.6	1.2	cld wp 5
96	s	15:46:00	16:03:00		20	0.6	1.1	cld wp 66-75
95	n	16:05:00	16:16:00		18	0.6	1.1	clds throughout, stopped
								flew over ksmb

↑ Times entered are Zulu / GMT ↑		Page	1	Verify S-Turns After Mission	Yes	X	No	

Additional Comments:	Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/12/2017	71	77391	2	Indiana Statewide Block 2

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
GALAMBOS	N475RC	838.7	10:41:00	14:41:00	CORS
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
GEBHART	OTHER	841.5	12:08:00	16:08:00	INBF

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
030 3	10	few 250		16	7	30.44		Departing	KDAY
								Arriving	KDAY

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	255	Mode		Threshold Values	
40	35.5	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8450	Ft	Yes		No	x	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 13:56:12
		⇕ Times entered are Zulu / GMT ⇕						Verify S-Turns Before Mission Yes x No
				0:00:00				8194
				0:00:00				takeoff:14:04z
79	N	14:41:13	14:56:43	0:00:00	22	0.7	1.2	Block 2
78	S	14:58:55	15:13:51	0:00:00	22	0.7	1.2	
77	N	15:16:24	15:31:55	0:00:00	22	0.7	1.2	
76	S	15:34:16	15:49:38	0:00:00	22	0.7	1.2	
75	N	15:52:00	16:08:02	0:00:00	22	0.7	1.2	Clouds wpt 1-26
				0:00:00				Hobbs 841.0/FWA
111	S	16:30:37	16:44:55	0:00:00	19	0.7	1.1	Block 3 east end
				0:00:00				CORS INBF Wasbash KIWH
				0:00:00				Text from Jonas--Block 3 not open
				0:00:00				
				0:00:00				Hobbs:841.5 end
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes x No

Additional Comments:	Drive #
	155

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/16/2017	75	77391	2	IND 2017 QL2 LiDAR Block 3 Lift 1

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	523.9	8:14:00	12:14:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	528.5	13:02:00	17:02:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
250/06	10+	CLR	0	-7	-11	30.31	CLR	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission: Yes X No
70	S	12:39:30	12:51:14	0:00:00	19	0.6	1.2	Clear, trace of snow shaded areas
69	N	12:54:40	13:07:23	0:00:00	19	0.6	1.2	
68	S	13:10:47	13:22:23	0:00:00	21	0.6	1	
67	N	13:26:25	13:38:57	0:00:00	19	0.6	1.1	
66	S	13:42:24	13:54:11	0:00:00	19	0.6	1	
65	N	13:58:04	14:12:28	0:00:00	20	0.6	1	
64	S	14:15:56	14:29:30	0:00:00	19	0.6	1	
63	N	14:33:08	14:47:25	0:00:00	19	0.7	1.1	
62	S	14:50:51	15:04:34	0:00:00	19	0.7	1.1	
61	N	15:08:01	15:22:10	0:00:00	18	0.7	1.2	
60	S	15:25:33	15:39:06	0:00:00	19	0.6	1.1	
59	N	15:42:36	15:56:46	0:00:00	19	0.6	1	
58	S	16:00:21	16:13:50	0:00:00	17	0.7	1.1	
57	N	16:19:40	16:36:28	0:00:00	17	0.7	1.2	
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/16/2017	75	77391	2	IND 2017 QL2 LiDAR Block 3 Lift 2

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	528.5	13:59:00	17:59:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	532.3	18:05:00	22:05:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
250/16	10+	CLR	0	3	-9	30.33	CLR	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission: Yes X No
56	S	18:23:57	18:40:49	0:00:00	18	0.7	1.1	Clear
55	N	18:44:04	19:01:16	0:00:00	19	0.6	1.1	
54	S	19:04:15	19:20:56	0:00:00	19	0.6	1.1	
53	N	19:24:10	19:41:13	0:00:00	18	0.7	1.2	
52	S	19:44:36	20:01:00	0:00:00	19	0.6	1.1	
51	N	20:04:42	20:21:58	0:00:00	18	0.6	1.1	
50	S	20:25:17	20:41:44	0:00:00	17	0.6	1.5	
49	N	20:45:04	21:02:07	0:00:00	17	0.6	1.5	
48	S	21:05:25	21:21:49	0:00:00	19	0.6	1.2	
47	N	21:24:54	21:42:04	0:00:00	19	0.6	1.2	
				0:00:00				
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				0:00:00				
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↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/16/2017	75	77391	2	in block 3

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
SMITH	N404CP	5913.2	9:01:00	13:01:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
ALBERS	OTHER	5919.8	2:49:00	18:49:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	day
270/8	10			-8	-11	3032		Arriving	day

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8504	Ft	Yes		No		@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes X No
110	n	13:19:00	13:33:00		20	0.6	1	
109	s	13:35:00	13:48:00		20	0.6	1	
108	n	13:51:00	14:04:00		19	0.6	1	
107	s	14:06:00	14:20:00		19	0.6	1	
106	n	14:22:00	14:36:00		20	0.6	1	
105	s	14:38:00	14:51:00		19	0.6	1.1	
104	n	14:54:00	15:07:00		18	0.6	1.2	
103	s	15:10:00	15:23:00		18	0.6	1.2	
102	n	15:26:00	15:39:00		19	0.6	1.1	
101	s	15:41:00	15:55:00		19	0.6	1	
100	n	15:57:00	16:10:00		17	0.6	1.1	
99	s	16:12:00	16:25:00		18	0.6	1	
98	n	16:27:00	16:42:00		16	0.6	1.3	
97	s	16:44:00	16:57:00		18	0.6	1.1	
96	n	17:00:00	17:13:00		17	0.6	1.2	
95	s	17:16:00	17:30:00		17	0.6	1.2	
94	n	17:32:00	17:46:00		16	0.6	1.4	
93	s	17:48:00	18:02:00		16	0.6	1.3	
92	n	18:04:00	18:17:00		18	0.6	1.1	
91	s	18:20:00	18:33:00		19	0.6	1	
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/16/2017	75	77391	2	Indiana Statewide Block 3

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
GALAMBOS	N475RC	841.5	9:45:00	13:45:00	CORS
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
GEBHART	OTHER	847.9	2:59:00	18:59:00	INAB

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KDAY
280 9	10	Clear		-6	-10	30.33		Arriving	KDAY

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	255	Mode		Threshold Values	
40	35.5	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi		B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8450	Ft	Yes		No	x	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 13:02:53
⇕ Times entered are Zulu / GMT ⇕								Verify S-Turns Before Mission Yes x No
				3:44:06				Sensor 8194/ takeoff 1308z
90	S	13:45:22	13:58:44	0:00:00	19	0.6	1	CORS INAB Butler County
89	N	14:01:31	14:16:54	0:00:00	19	0.6	1	Over CORS 13:32:22
88	S	14:19:24	14:32:53	0:00:00	19	0.6	1	Dusting of snow south end
87	N	14:35:34	14:50:13	0:00:00	19	0.6	1	
86	S	14:53:18	15:06:50	0:00:00	18	0.7	1.2	
85	N	15:09:34	15:24:25	0:00:00	18	0.7	1.2	
84	S	15:26:48	15:40:40	0:00:00	18	0.7	1.2	
83	N	15:43:24	15:58:02	0:00:00	18	0.7	1.2	
82	S	16:00:18	16:14:06	0:00:00	18	0.7	1.2	
81	N	16:18:16	16:30:55	0:00:00	18	0.7	1.2	
80	S	16:33:22	16:45:35	0:00:00	16	0.7	1.4	
79	N	16:47:58	17:00:34	0:00:00	16	0.7	1.4	
78	S	17:03:02	17:15:16	0:00:00	16	0.7	1.4	
77	N	17:17:43	17:30:11	0:00:00	16	0.7	1.4	
76	S	17:32:34	17:44:31	0:00:00	16	0.7	1.4	
75	N	17:47:05	17:59:42	0:00:00	17	0.7	1.4	
74	S	18:02;19	`18:14:17	0:00:00	17	0.8	1.2	
73	N	18:16:50	18:29:35	0:00:00	17	0.8	1.2	
72	S	18:31:47	18:43:01	0:00:00	17	0.8	1.2	
71	N	18:46:32	18:59:00	0:00:00	17	0.8	1.2	126 GB
				0:00:00				
				0:00:00				Over CORS:19:06:39
				0:00:00				
				0:00:00				
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				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes x No

Additional Comments:

Drive #: 155

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/21/2017	80	77391	2	IND 2017 QL2 LiDAR Block 1

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	532.6	13:01:00	17:01:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	537.6	18:09:00	22:09:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
350/11	10	Few 130	50%	11	1	30.13	CLR	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission: Yes X No
102	N	17:26:05	17:34:57	0:00:00	18	0.7	1.1	Reflew N 25 mi Clear
101	S	17:37:59	17:50:14	0:00:00	17	0.7	1.1	Clear
100	N	17:53:11	18:05:23	0:00:00	17	0.7	1.2	
99	S	18:08:25	18:20:24	0:00:00	19	0.6	1.1	
98	N	18:23:28	18:35:41	0:00:00	20	0.6	1.1	
97	S	18:38:53	18:50:45	0:00:00	20	0.6	1.1	
96	N	18:53:52	19:05:58	0:00:00	19	0.6	1.1	
95	S	19:09:01	19:20:58	0:00:00	19	0.7	1.2	
94	N	19:24:15	19:36:18	0:00:00	20	0.7	1.2	
93	S	19:39:22	19:51:24	0:00:00	20	0.6	1.1	
92	N	19:54:14	20:06:24	0:00:00	18	0.7	1.3	
91	S	20:09:30	20:21:28	0:00:00	17	0.7	1.5	
90	N	20:24:06	20:36:00	0:00:00	18	0.6	1.3	
89	S	20:38:08	20:50:59	0:00:00	17	0.7	1.3	
88	N	20:53:48	21:05:44	0:00:00	19	0.6	1.2	
87	S	21:08:41	21:20:50	0:00:00	21	0.6	1.2	
86	N	21:23:26	21:35:30	0:00:00	21	0.6	1.2	
85	N	21:38:28	21:50:27	0:00:00	21	0.6	1.2	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/22/2017	81	77391	2	IND 2017 QL2 LiDAR Block 1 Lift One

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	537.6	8:16:00	12:16:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	542.6	13:35:00	17:35:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
030 /10	10	CLR	0%	-6	-12	30.48	CLR	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission: Yes X No
84	N	12:43:27	12:55:40	0:00:00	21	0.6	1	Clear
83	S	12:59:07	13:11:04	0:00:00	21	0.6	1.1	
82	N	13:14:40	13:26:43	0:00:00	21	0.6	1.1	
81	S	13:30:15	13:42:01	0:00:00	22	0.6	1.1	
80	N	13:45:28	13:57:30	0:00:00	21	0.6	1	
79	S	14:01:01	14:12:50	0:00:00	21	0.7	1.2	
78	N	14:16:11	14:28:09	0:00:00	22	0.7	1.1	
77	S	14:31:33	14:43:18	0:00:00	22	0.7	1.1	
76	N	14:46:52	14:58:51	0:00:00	21	0.7	1.2	
75	S	15:02:31	15:14:09	0:00:00	21	0.7	1.1	
74	N	15:17:25	15:29:30	0:00:00	21	0.6	1	
73	S	15:32:55	15:44:32	0:00:00	18	0.7	1.2	
72	N	15:47:55	15:59:57	0:00:00	18	0.7	1.1	
71	S	16:03:22	16:15:01	0:00:00	17	0.7	1.3	
70	N	16:17:59	16:30:01	0:00:00	18	0.7	1.2	
69	S	16:33:19	16:44:28	0:00:00	18	0.7	1.2	
68	N	16:47:22	16:58:39	0:00:00	18	0.7	1.2	
67	N	17:02:08	17:13:29	0:00:00	17	0.7	1.3	
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/22/2017	81	77391	2	IND 2017 QL2 LiDAR Block 1 Lift Two

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	542.6	14:27:00	18:27:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	546.6	18:46:00	22:46:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
100/09	10	CLR	0%	1	-10	30.56	CLR	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission	Yes X No
66	N	18:56:00	19:07:25	0:00:00	20	0.7	1.2	Clear	
65	S	19:10:50	19:22:18	0:00:00	22	0.6	1.1		
64	N	19:25:22	19:36:41	0:00:00	21	0.6	1.1		
63	S	19:39:58	19:51:29	0:00:00	21	0.6	1.1		
62	N	19:56:41	20:10:34	0:00:00	18	0.7	1.6		
61	S	20:13:59	20:28:00	0:00:00	18	0.7	1.5		
60	N	20:31:12	20:45:05	0:00:00	18	0.7	1.3		
59	S	20:48:26	21:05:34	0:00:00	20	0.6	1.1		
58	N	21:08:50	21:25:50	0:00:00	19	0.6	1.2		
57	S	21:28:57	21:46:13	0:00:00	19	0.6	1.1		
56	N	21:49:18	22:06:04	0:00:00	21	0.6	1		
55	S	22:09:33	22:26:52	0:00:00	19	0.7	1.3		
				0:00:00					
				0:00:00					
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				0:00:00					
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission	Yes X No

Additional Comments:	Drive #

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/22/2017	81	77391	2	in block 3,2

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
SMITH	N404CP	5919.7	8:59:00	12:59:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
RADER	OTHER	5926.4	4:14:00	20:14:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
040/12	10			-5	-10	3042		Departing	day
								Arriving	day

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8504	Ft	Yes		No		@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission Yes X No
46	n	13:33:00	13:52:00		20	0.6	1	blk 3
45	s	13:54:00	14:10:00		18	0.6	1.2	
44	n	14:12:00	14:30:00		19	0.6	1.1	
43	s	14:32:00	14:49:00		18	0.6	1.2	
42	n	14:51:00	15:09:00		18	0.6	1.2	
41	s	15:11:00	15:27:00		19	0.6	1.1	
40	n	15:29:00	15:47:00		18	0.6	1.1	
39	s	15:49:00	16:05:00		17	0.6	1.1	
38	n	16:07:00	16:24:00		16	0.6	1.3	
37	s	16:26:00	16:42:00		18	0.6	1.1	
36	n	16:44:00	16:59:00		17	0.6	1.2	cld wp 26
35	s	17:02:00	17:10:00		16	0.6	1.1	
34	n	17:13:00	17:21:00		17	0.6	1.3	cld wp 35,34
33	s	17:23:00	17:32:00		17	0.6	1.1	cld wp 30
32	n	17:34:00	17:42:00		16	0.6	1.2	cld wp 24
31	s	17:44:00	17:52:00		17	0.6	1.3	
96	n	18:08:00	18:24:00		18	0.6	1.1	blk 2
95	s	18:27:00	18:43:00		19	0.6	1.1	
94	n	18:45:00	19:02:00		19	0.6	1.1	
93	s	19:04:00	19:21:00		18	0.6	1.2	
111	s	19:30:00	19:43:00		19	0.6	1.1	blk3
107	n	19:48:00	19:50:00		18	0.6	1.2	reflt wp 45-42
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/23/2017	82	77391	2	IND 2017 QL2 LiDAR Block 1 Lift One

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	546.6	8:43:00	12:43:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	551.9	14:12:00	18:12:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
080 / 07	10	OVC 110	100%	-4	-9	30.49	Lt Haze	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission: Yes X No
54	N	13:10:23	13:27:28	0:00:00	19	0.6	1.1	Clear below 11K
53	S	13:30:52	13:47:55	0:00:00	19	0.6	1.1	
52	N	13:51:05	14:08:15	0:00:00	20	0.6	1	
51	S	14:11:31	14:28:51	0:00:00	19	0.6	1.1	Short range 1st returns 8 mi fr N end *
50	N	14:31:56	14:48:46	0:00:00	18	0.7	1.2	Short range 1st returns 21, 23 fr S end
49	S	14:52:04	15:09:10	0:00:00	18	0.7	1.1	Short range 1st returns 15, 26 fr S end
48	N	15:12:14	15:29:28	0:00:00	19	0.6	1	
47	S	15:32:46	15:49:56	0:00:00	17	0.7	1	
46	N	15:53:00	16:09:34	0:00:00	16	0.9	1.7	
45	S	16:12:36	16:29:40	0:00:00	17	0.7	1.3	
44	N	16:32:37	16:49:21	0:00:00	17	0.7	1.2	
43	S	16:52:32	17:09:57	0:00:00	16	0.7	1.4	
42	N	17:12:59	17:29:40	0:00:00	18	0.7	1.2	
41	S	17:32:45	17:50:15	0:00:00	19	0.6	1.2	
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↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

* No clouds/obstructions observed below aircraft

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/23/2017	82	77391	2	IND 2017 QL2 LiDAR Block 1 Lift Two

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	551.9	15:00:00	19:00:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	555.2	18:26:00	22:26:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
130 / 08	10	Bkn 110	90%	5	-6	30.42	CLR below 110	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission: Yes X No
40	N	19:28:43	19:46:02	0:00:00	17	0.7	1.2	Clear
39	S	19:48:59	20:06:28	0:00:00	15	0.7	1.5	
38	N	20:09:25	20:26:17	0:00:00	14	0.8	1.9	
37	S	20:29:11	20:47:05	0:00:00	16	0.7	1.3	
36	N	20:50:17	21:05:58	0:00:00	17	0.6	1.2	
35	S	21:08:59	21:25:37	0:00:00	17	0.6	1.3	
34	N	21:28:35	21:44:45	0:00:00	17	0.6	1.2	
33	S	21:47:41	22:02:15	0:00:00	19	0.6	1.1	Clouds 1 mi from S end
				0:00:00				
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				0:00:00				
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↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

* No clouds/obstructions observed below aircraft

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	3/23/2017	82	77391	2	Indiana Statewide 2017

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Denham	N475RC	855.1	8:48:00	12:48:00	CORS
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
Gebhart	ALS-8194	862.2	4:12:00	20:12:00	INAB

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	K
100 / 10	10	25000		4	-10	30.47		Arriving	K

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshol
40	35.5	346	100	Gain - Course/Up		Single		A
				Gain - Fine/Down		Multi		B

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist
150	Kts	7800	Ft	8350	Ft	Yes		No		@	NS	

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	PDOP	Kts	Alt.	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	n/a	GPS Began Logging At:
⇕ Times entered are Zulu / GMT ⇕									Verify S-Turns Before Mission: Yes X No
									Take Off: 9:00
107	S	13:40:00	13:42:00	0:00:00	20	1			BLOCK 3 Reflight (Manual Captu
99	N	14:01:00	14:18:00	0:00:00	19	1.1			
92	S	14:22:00	14:39:00	0:00:00	19	1.2			
91	N	14:41:00	14:59:00	0:00:00	18	1.2			
90	S	15:01:00	15:18:00	0:00:00	20	1			
89	N	15:21:00	15:38:00	0:00:00	18	1			
88	S	15:41:00	15:58:00	0:00:00	17	1			
87	N	16:00:00	16:17:00	0:00:00	16	1.6			
86	S	16:19:00	16:37:00	0:00:00	18	1.2			
85	N	16:39:00	16:56:00	0:00:00	17	1.2			
84	S	16:59:00	17:17:00	0:00:00	16	1.4			
83	N	17:19:00	17:35:00	0:00:00	17	1.2			
82	S	17:38:00	17:56:00	0:00:00	18	1.3			
81	N	17:58:00	18:16:00	0:00:00	18	1.2			
80	S	18:18:00	18:37:00	0:00:00	19	1.2			
75	N	18:41:00	18:57:00	0:00:00	18	1.2			
128	E	19:08:00	19:23:00	0:00:00	18	1.2			
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↑ Times entered are Zulu / GMT ↑				Page		1			Verify S-Turns After Mission: Yes X No

Additional Comments: Driv

BLOCK 2

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/24/2017	83	77391	2	IND 2017 QL2 LiDAR Block 1

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Stanton	N6255Q	555.2	10:18:00	14:18:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**19:23**	**PID**
LaRocque	ALS 8170	560.4	15:37:00	19:37:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
210 / 16	10	Bkn 140	50%	14	8	30.07	Mod Haze	Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	X	Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	3	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission: Yes X No
32	N	14:51:38	15:05:40	0:00:00	20	0.6	1	Clear
31	S	15:08:27	15:23:01	0:00:00	19	0.6	1	
30	N	15:26:05	15:40:30	0:00:00	17	0.7	1.1	
29	S	15:43:22	15:58:14	0:00:00	18	0.6	1	
28	N	16:01:02	16:15:31	0:00:00	16	0.7	1.3	
27	S	16:18:30	16:33:16	0:00:00	17	0.6	1.2	
26	N	16:36:12	16:50:36	0:00:00	17	0.7	1.2	
25	S	16:53:15	17:08:20	0:00:00	16	0.7	1.4	
24	N	17:11:09	17:25:26	0:00:00	17	0.7	1.1	
23	S	17:28:32	17:43:46	0:00:00	18	0.7	1.1	
22	N	17:46:42	18:01:00	0:00:00	19	0.7	1.1	Small cloud 6 mi from S end
21	S	18:03:49	18:19:08	0:00:00	18	0.7	1.1	Small clouds 3 - 5 mi from S end
123	E	18:33:23	18:48:09	0:00:00	20	0.6	1.1	
124	E	18:52:51	19:07:53	0:00:00	20	0.6	1.1	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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				0:00:00				
↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission: Yes X No

Additional Comments: Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	3/29/2017	88	77391	2	IND 2017 QL2 LiDAR Block 2

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Galambos	N6255Q	560.4	3:05:00	19:05:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**		**PID**
LaRocque	ALS 8170	562.9	5:01:00	21:01:00	KFWA

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KFWA
080 19 g 24	10	few 150		12	3	30.22		Arriving	KFWA

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	255	Mode		Threshold Values
40	36	346	100	Gain - Course/Up		Single		A
				Gain - Fine/Down		Multi	3	B

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 18:36:09
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
				0:00:00				takeoff 1845z
74	S	19:05:08	19:21:19	0:00:00	21	0.6	1.1	
73	N	19:24:08	19:40:07	0:00:00	21	0.6	1.1	
72	S	19:42:50	19:58:47	0:00:00	21	0.6	1.1	
71	N	20:01:36	20:17:21	0:00:00	21	0.6	1.1	
70	S	20:20:13	20:36:42	0:00:00	21	0.6	1.1	
69	N	20:39:13	21:01:25	0:00:00	17	0.7	1.2	
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes X No

Additional Comments:	Drive #
	156

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	4/1/2017	91	77391		in blk 1,2

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
SMITH	N475RC	862.2	12:03:00	16:03:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
RADER	OTHER	868.5	6:21:00	22:21:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	day
350/9	10			4	2	3017		Arriving	day

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8346	Ft	Yes		No		@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↕ Times entered are Zulu / GMT ↕						Verify S-Turns Before Mission: Yes X No
20	n	16:55:00	17:09:00		18	0.6	1.1	cors inab clds wp 11,10
19	s	17:11:00	17:25:00		19	0.6	1.1	clds wp 12
18	n	17:27:00	17:41:00		19	0.6	1.1	
17	s	17:43:00	17:57:00		21	0.6	1.1	
16	n	17:59:00	18:13:00		21	0.6	1.1	
15	s	18:15:00	18:29:00		20	0.6	1.2	
14	n	18:31:00	18:45:00		21	0.6	1.1	
19	s	18:48:00	18:49:00		21	0.6	1.1	reflt wp12
20	n	18:51:00	18:52:00		21	0.6	1.1	reflt wp11,10
13	s	18:57:00	19:11:00		20	0.6	1.1	
33	n	19:17:00	19:18:00		18	0.6	1.5	reflt wp68-65
84	n	19:32:00	19:33:00		17	0.6	1.7	reflt wp 13-10
50	s	19:51:00	20:03:00		18	0.6	1.3	in blk 2 clds wp 19,29-31,37
49	n	20:05:00	20:17:00		19	0.6	1.2	clds wp 43.42
48	s	20:19:00	20:30:00		19	0.6	1.2	
51	n	20:32:00	20:44:00		19	0.6	1.1	clds wp 35
52	s	20:46:00	20:57:00		19	0.6	1.1	
53	n	21:00:00	21:10:00		20	0.6	1.2	
54	s	21:12:00	21:21:00		20	0.6	1.1	
55	n	21:23:00	21:33:00		20	0.6	1.1	
56	s	21:35:00	21:45:00		19	0.6	1.4	
↑ Times entered are Zulu / GMT ↑				Page		1		Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #

Woolpert

Leica ALS80	DD/MM/YEAR	Day of Year	Project #	Phase #	Project Name
	4/2/2017	92	77391	2	IND 2017 QL2 LiDAR Block 2

Operator	Aircraft	HOBBS Start	Local Start Time	ZULU Start Time	Base
Galambos	N6255Q	569.8	10:12:00	14:12:00	WOOLPERT PIN
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**		**PID**
Swain	ALS 8170	575.5	2:40:00	18:40:00	KDAY

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KDAY
130 6	9	250 bkn		5	3	30.24		Arriving	KOKK

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain	255	Mode		Threshold Values
40	36	346	100	Gain - Course/Up		Single		A
				Gain - Fine/Down		Multi	3	B

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8510	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 12:58:26
↕ Times entered are Zulu / GMT ↕								Verify S-Turns Before Mission Yes X No
				0:00:00				Flight "A"/ TAKEOFF: 1317Z
40	N	14:12:49	14:25:35	0:00:00	17	0.7	1.1	Over CORS:INPR 13:49:40
39	S	14:27:33	14:40:15	0:00:00	17	0.7	1.1	OC60 malufunction, controlling
38	N	14:43:12	14:47:50	0:00:00	17	0.7	1.1	ALS with Pilot Display
37	S	15:01:16	15:15:57	0:00:00	19	0.6	1.1	
36	N	15:18:08	15:32:54	0:00:00	19	0.6	1.1	INPR Cors: N40 49 09.97
35	S	15:35:01	15:49:37	0:00:00	19	0.6	1.1	W 086 07 38.49
34	N	15:51:49	16:06:26	0:00:00	19	0.6	1.1	
33	S	16:08:55	16:23:30	0:00:00	19	0.6	1.1	
32	N	16:25:33	16:40:09	0:00:00	19	0.6	1.1	
31	S	16:42:26	16:57:01	0:00:00	19	0.7	1.3	
30	N	16:59:20	17:14:03	0:00:00	19	0.7	1.3	
29	S	17:16:07	17:30:54	0:00:00	19	0.7	1.3	
28	N	17:33:25	17:47:51	0:00:00	19	0.7	1.3	
27	S	17:50:11	18:05:00	0:00:00	19	0.7	1.3	
26	N	18:07:29	18:22:00	0:00:00	19	0.7	1.3	
25	S	18:24:51	18:39:42	0:00:00	19	0.7	1.3	
				0:00:00				Over CORS:INPR 18:48:28
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				0:00:00	Total Time On Line			Verify S-Turns After Mission Yes X No

Additional Comments:

Drive #: 134

Woolpert

Leica LIDAR	MM/DD/YEAR	Day of Year	Project #	Phase #	Project Name
	4/2/2017	92	77391		in blk 2

Operator	Aircraft	HOBBS Start	Local Start Time	Zulu Start Time	Base
SMITH	N475RC	868.5	9:19:00	13:19:00	
Pilot	**Sensor Type**	**HOBBS END**	**Local End Time**	**Zulu End Time**	**PID**
RADER	OTHER	876.0	4:54:00	20:54:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
130/5	10			5	3	3024		Departing	day
								Arriving	day

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
40	36	346	100	Gain - Course/Up		Single		A	
				Gain - Fine/Down		Multi	X	B	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7800	Ft	8346	Ft	Yes		No		@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
⇕ Times entered are Zulu / GMT ⇕								Verify S-Turns Before Mission: Yes X No
68	n	13:59:00	14:14:00		19	0.6	1.2	cors inab
67	s	14:16:00	14:31:00		21	0.6	1	
66	n	14:33:00	14:48:00		19	0.6	1	
65	s	14:52:00	15:05:00		17	0.6	1.1	
64	n	15:07:00	15:19:00		17	0.6	1.2	
63	s	15:23:00	15:33:00		17	0.6	1.3	
62	n	15:35:00	15:44:00		18	0.6	1.2	
61	s	15:46:00	15:56:00		18	0.6	1.2	
60	n	15:58:00	16:08:00		18	0.6	1.2	lt precip n end
59	s	16:10:00	16:20:00		17	0.6	1.4	
58	n	16:22:00	16:31:00		16	0.6	1.4	
57	s	16:33:00	16:43:00		19	0.6	1.1	
49	n	16:48:00	16:51:00		18	0.6	1.1	reflt wp 43,42
50	s	16:57:00	17:00:00		19	0.6	1.1	reflt wp 19,30,31
51	n	17:03:00	17:04:00		18	0.6	1.2	reflt wp 35
47	n	17:12:00	17:23:00		20	0.6	1	
46	s	17:26:00	17:37:00		19	0.6	1.1	
45	n	17:39:00	17:51:00		20	0.6	1.1	
44	s	17:53:00	18:04:00		19	0.6	1.1	
43	n	18:06:00	18:18:00		19	0.6	1.1	
42	s	18:20:00	18:33:00		18	0.6	1.2	
41	n	18:35:00	18:47:00		19	0.6	1.1	
9	s	18:57:00	19:09:00		17	0.6	1.3	
8	n	19:11:00	19:16:00		16	0.6	1.6	
7	s	19:18:00	19:24:00		16	0.6	1.6	
6	n	19:26:00	19:31:00		15	0.6	1.7	
5	s	19:33:00	19:39:00		15	0.6	1.6	
4	n	19:41:00	19:47:00		18	0.6	1.2	
3	s	19:50:00	19:55:00		17	0.6	1.3	
2	n	19:57:00	20:02:00		18	0.6	1.2	
1	s	20:04:00	20:08:00		18	0.6	1.2	
↑ Times entered are Zulu / GMT ↑				Page	1			Verify S-Turns After Mission: Yes X No

Additional Comments:

Drive #

Section 7: Final Deliverables

The final lidar deliverables are listed below.

- LAS v1.4 classified point cloud
- LAS v1.4 raw unclassified point cloud flight line strips.
- Hydro Breaklines as ESRI GDB
- Bridge Breaklines as ESRI GDB
- Digital Elevation Model in ERDAS .IMG format
- 8-bit gray scale intensity images in .TIF format
- Tile layout provided in ESRI format
- Control Points provided in ESRI format
- Flight Line provided in ESRI format
- FGDC compliant metadata per product in XML format
- Lidar processing report in pdf format
- Survey report in pdf format