

Airborne Lidar Report



SD Missouri River Lidar 2016 D16

Contract Number: G16PC00022

Task Number: G15PD01025

Contractor: Woolpert, Inc.

Woolpert Project # 77086

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Section 1: Overview

TASK ORDER NAME: SD Missouri River Lidar 2016 D16

Project: # 77086

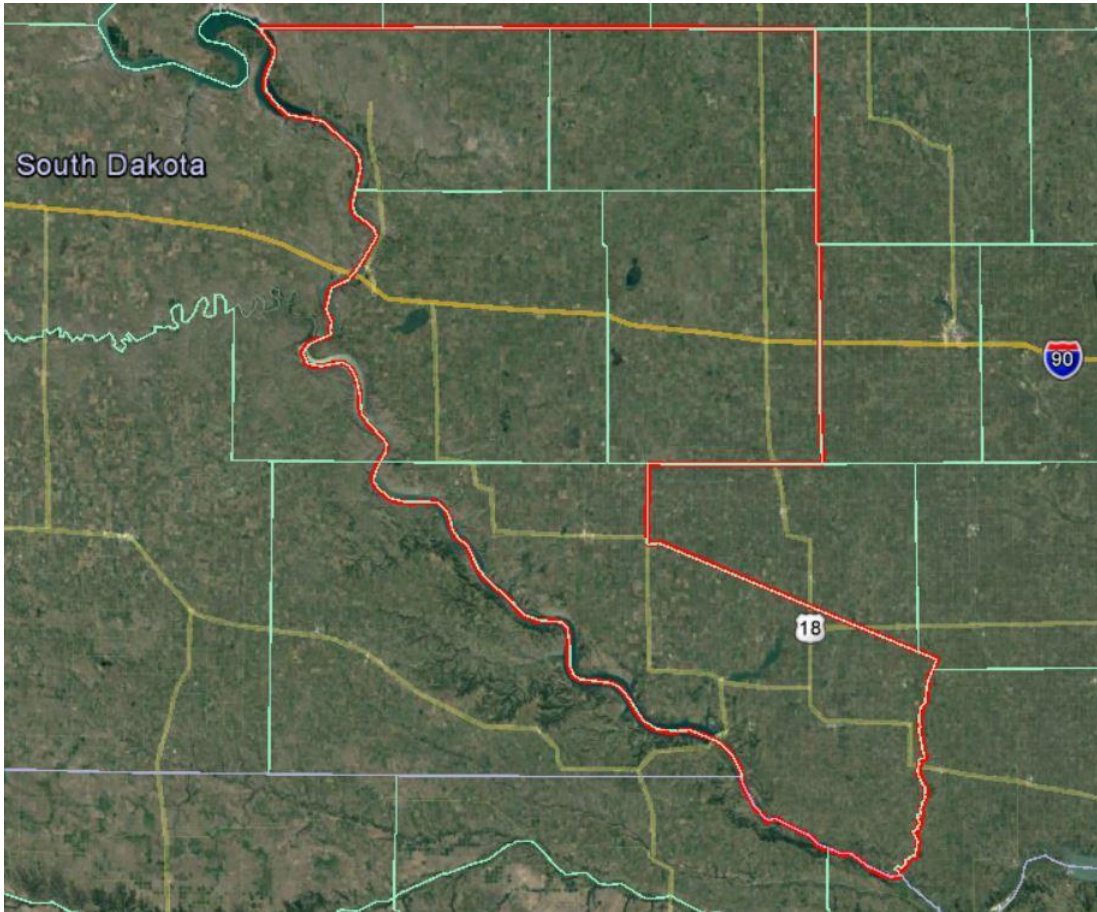
This report contains a comprehensive outline of the SD Missouri River Lidar 2016 D16 Lidar task order. Processing task order for the United States Geological Survey (USGS). This task is issued under USGS Contract No. G16PC00022, Task Order No. G15PD01025. This task order requires lidar data to be acquired over 3,726 square miles located in southeastern South Dakota. The lidar data was acquired in compliance with U.S. Geological Survey National Geospatial Program Lidar Base Specification version 1.2., for the area of interest (AOI) collected at a nominal pulse spacing (NPS) of 0.35meters or greater.

Using a Leica SPL100 (lidar) system on board Woolpert aircraft, high density data, at a nominal pulse spacing (NPS) of 0.35 meters or greater, was collected for this task order.

Table 1.1: Leica SPL100 Specifications	
Post Spacing	0.35 m
AGL (Above Ground Level) average flying height	3,750 m
Average Ground Speed:	200 knots
Field of View (full)	15 degrees
Pulse Rate	50 kHz
Scan Rate	21Hz
Side Lap	50%

The horizontal datum used for the task order was referenced to NAD1983(2011) UTM Zone14N, Meters. The vertical datum used for the task order was referenced to NAVD 1988, Meters, GEOID12B.

Figure 1.1: SD Missouri River Lidar 2016 D16 Task Order AOI



Section 2: Acquisition

The lidar data was acquired with Leica SPL100 (lidar) Sensor Systems. The Leica SPL100, up to 10 returns per channel per laser shot.

Table 2.1: SPL100 Lidar System Specifications	
Beam configuration	<i>10 x 10 array</i>
Laser wavelength	<i>532 nm</i>
Laser divergence	<i>0.08 mrad (1/e² per beam, nominal)</i>
Laser pulse width	<i>400 psec</i>
Laser optical output	<i>5 W average</i>
Eye safety	<i>NOHD <300 m</i>
Pulse repetition frequency	<i>60 kHz (6.0 MHz effective puls rate)</i>
Return pulses	<i>Up to 10 returns per channel per laser shot including intensity</i>
Operation altitude	<i>2,000 - 4,500 m AGL</i>
Scanner pattern	<i>Oblique scanner</i>
Scan speed	<i>Programmable up to 25 Hz (1,500 RPM)</i>
Field of view	<i>20°, 30°, 40° or 60° fixed</i>
Point density	<i>Typically 20 points / sqm at 4,000 m AGL</i>
Vertical accuracy	<i>< 10 cm 1 σ</i>
Horizontal accuracy	<i>< 15 cm 1 σ</i>

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

The Lidar data was 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, and trajectory solution.

Figure 2.1: Lidar Flight Layout, SD Missouri River Lidar 2016 D16

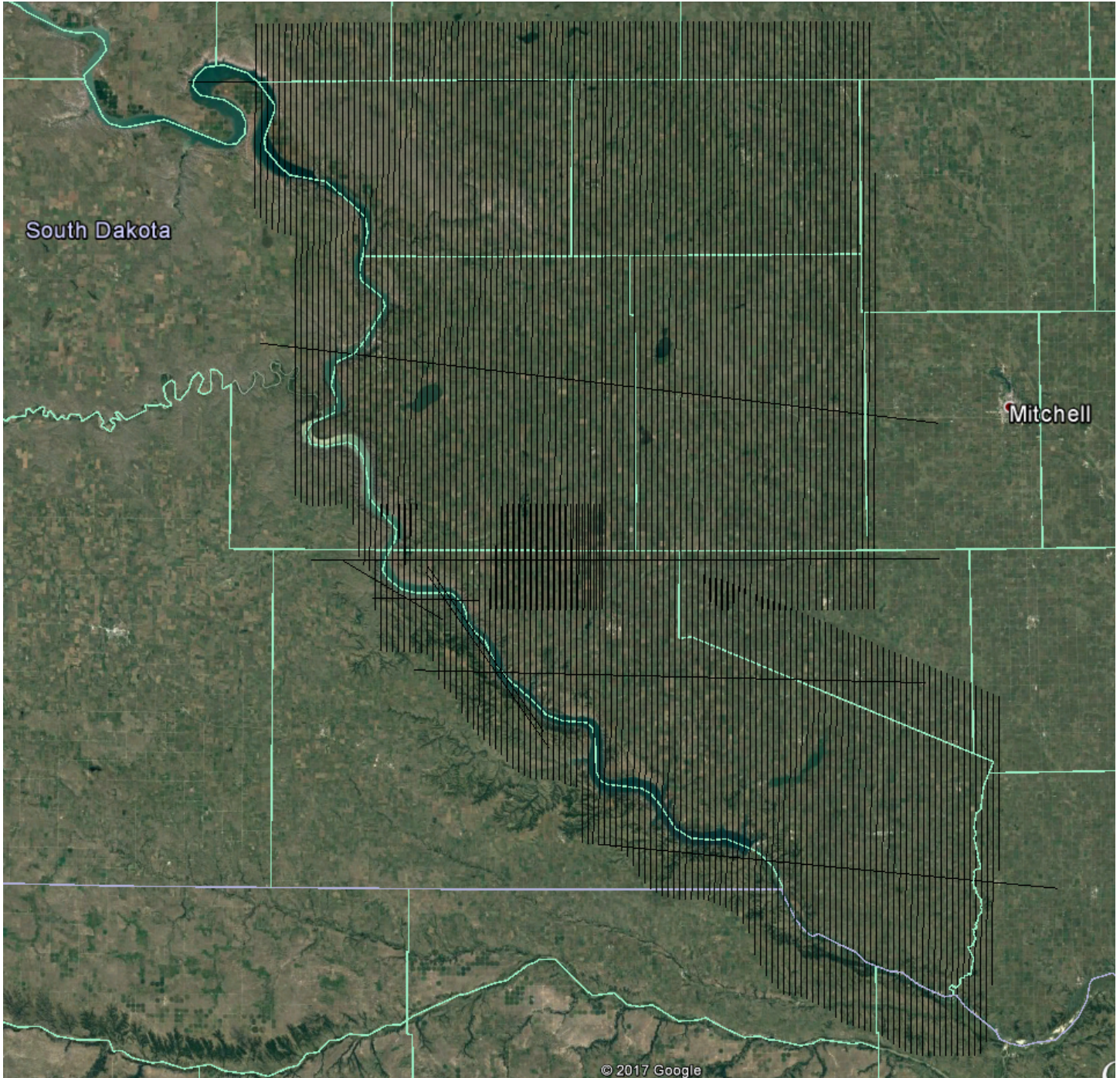


Table 2.3: Airborne Lidar Acquisition Flight Summary

Date of Acquisition	Lines Flown	Acquisition Time (UTC)
November 28, 2016	1-25, 204, 205	22:50 – 2:56
March 17, 2017	26-33, 107, 108	17:24 – 19:37
March 18, 2017_A	34-40, 70-72	14:52 – 17:39
March 18, 2017_B	41-51	20:08 – 22:31
March 19, 2017_A	52-62	15:02 – 17:16
March 19, 2017_B	63-67	20:31 – 21:31
March 20, 2017	68, 69, 73-80	14:51 – 17:04
March 27, 2017_A	81-88	19:43 – 21:25
March 27, 2017_B	89-101	23:22 – 2:09
April 4, 2017	1-3, 202	15:52 – 16:45
April 6, 2017_A	14-19, 201, 203	13:48 – 16:26
April 6, 2017_B	4-13, 20-22	18:36 – 21:59
April 7, 2017_A	23-25, 102-108	15:12 – 18:07
April 7, 2017_B	26-35	20:32 – 23:46
April 8, 2017_A	36-44	15:00 – 17:57
April 8, 2017_B	45-54	20:33 – 23:45
April 16, 2017_A	39-47, 55, 56	13:36 – 17:11
April 16, 2017_B	34-38	19:27 – 21:01
April 17, 2017_A	1-3, 5, 6, 57-61	14:33 – 17:49
April 17, 2017_B	4, 26-33	20:17 – 23:13
April 21, 2017	22-25	15:32 – 16:49
April 22, 2017_A	7, 8, 19-21	14:27 – 16:01
April 22, 2017_B	9-18, 301-304	18:50 – 22:30

Section 3: Lidar Data Processing

Applications and Work Flow

Upon receipt of data, processing commenced by downloading raw TOF and GPS files. This data was backed up, then called by HxMAP (proprietary software tool for processing SPL100 data) to begin processing. The processing includes solar noise removal using a series of specialized filters. The first filter clips data around surface returns, then a statistical outlier filter is applied. Once denoised, uncalibrated, unregistered LAS files are created, the calibration tool is run in HxMAP and those values are applied to the data set. Finally, line-to-line registration is completed. SPL100 data density increases as the angle from nadir increases. Density measurements were taken approximately in the middle of overlap between adjacent flight lines in clear open areas.

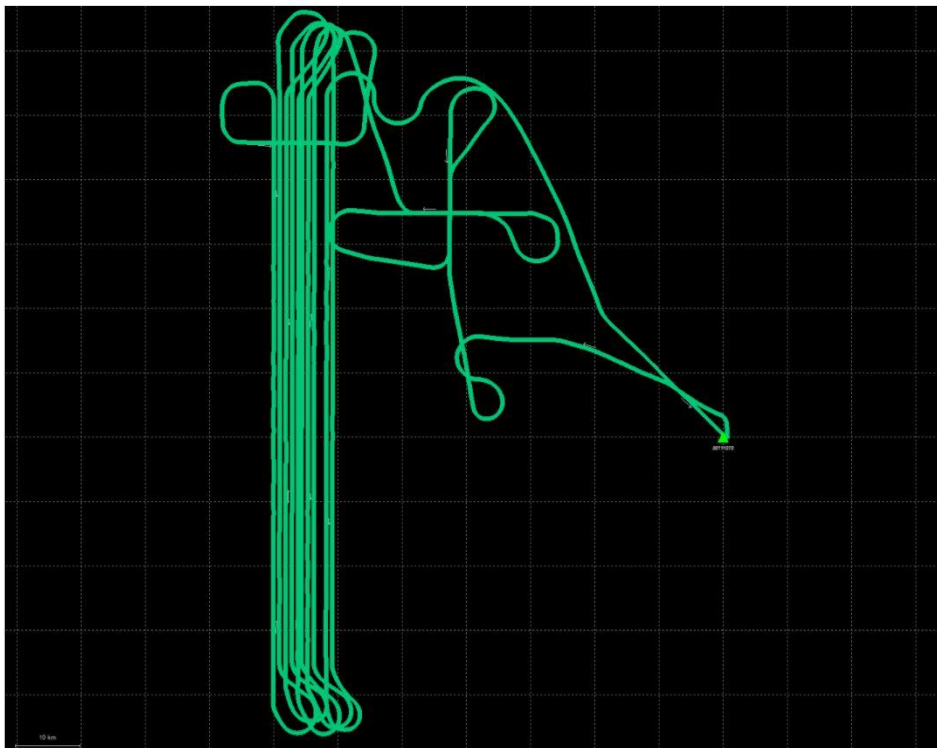
For the South Dakota Missouri River lidar acquisition, precise point positioning solutions were computed for GNSS positioning to support the Single Photon Lidar acquisition.

Below are sample plots

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, Day10717

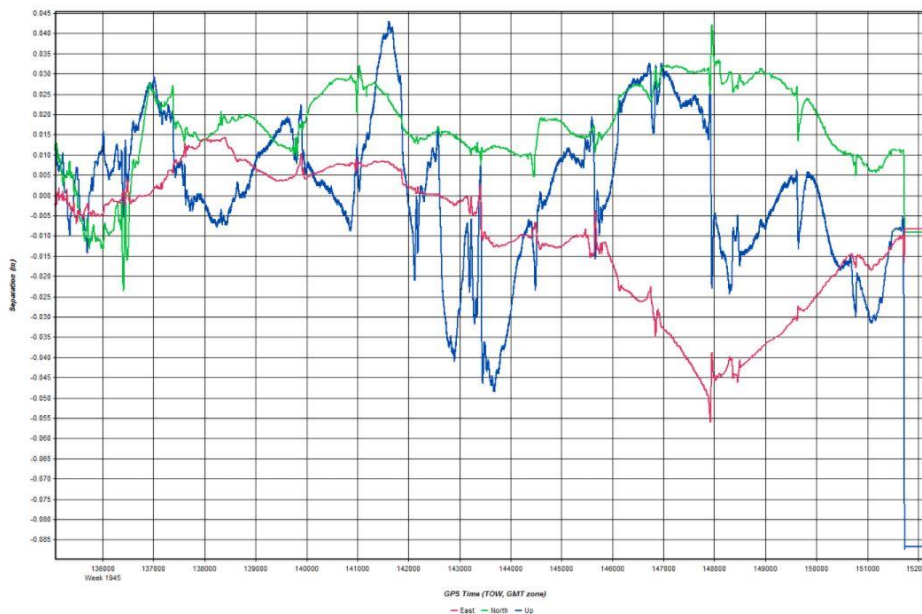


Combination Separation

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, Day10717

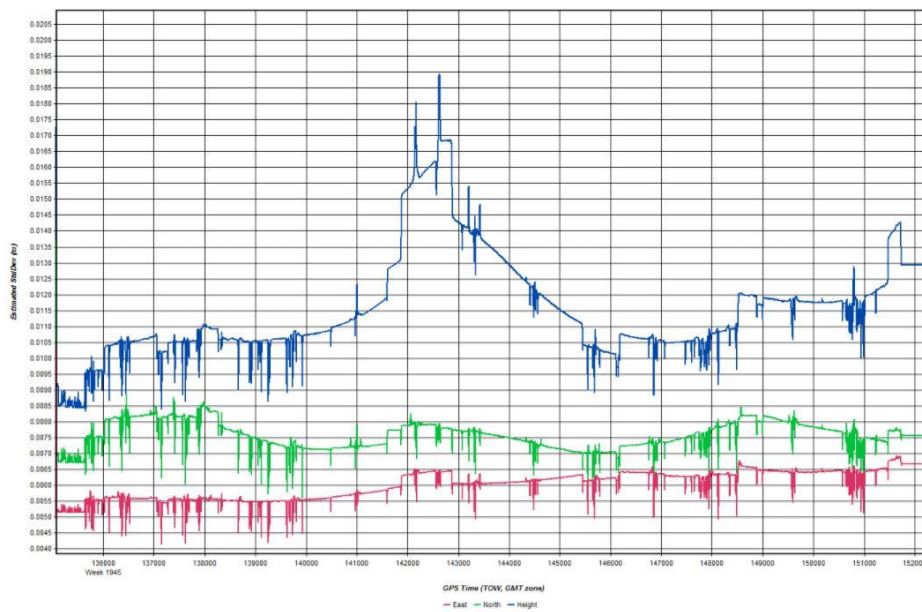


Estimated Positional Accuracy

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, Day10717

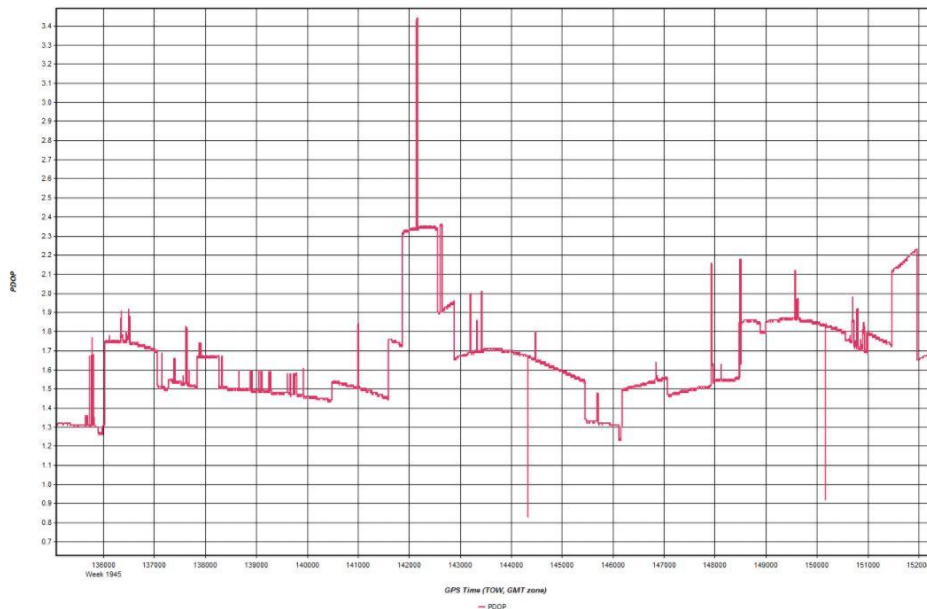


PDOP

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, Day10717



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:

- Geometric calibration: There are 14 calibration parameters - 3 boresight angles, 1 wedge angle bias and 10 coefficients. Each iterative estimation procedure (least squares adjustment) reports estimated parameters and the final sigma value after completing each estimation. The calibration tool also reports compatibility for each overlapping pair by evaluating discrepancies between randomly selected matched points from each overlapping strip pairs. There are 5 kinds of overlapping cases: fore-aft in a single flight line, fore-fore in two flight lines, aft-aft in two flight lines, fore-aft in two flight lines, and aft-fore in two flight lines. Each overlapping case reports flight line #, number of matched point-pairs, Mean error (XYZ), and RMSE (XYZ). Ideal mean error (XYZ) should be close to zero, and RMSE (XYZ) values should be similar to the final sigma value. Most significant errors are distributed along Z (height) direction.
- The SPL registration tool aligns point clouds to remove discrepancies between separate looks. The tool can be used to align data between the Fore and Aft of a circular scan, between the overlap of adjacent flight lines, or between multiple passes over the same area of interest. The registration is performed by spatially subdividing the point clouds into blocks and computing a shift correction in XYZ by using 3D phase correlation methods. Once the spatial shifts for all blocks are computed, a dense vector field is interpolated from the sparse set of spatial shifts. This dense vector field is then used to correct the point clouds into alignment.
- 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 Default (Class 1), Ground (Class 2), Low Noise (Class 7), Water (Class 9), Ignored ground (Class10), Bridge Decks (Class 17) classifications.
- Solar noise detected by the SPL100 system can represent a significant percentage of the acquired data. The noise data is classified as class 18 – high noise during post processing. To assist with ease of processing, storage, and manageability of the single photon lidar data set, Woolpert received technical guidance from USGS to remove solar noise points from the delivery data.
- 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 (2011), Zone 14, Meters. The vertical datum used for the task order was referenced to NAVD 1988, Meters, GEOID12B

Section 4: Hydrologic Flattening

HYDROLOGIC FLATTENING OF LIDAR DEM DATA

SD Missouri River Lidar 2016 D16 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

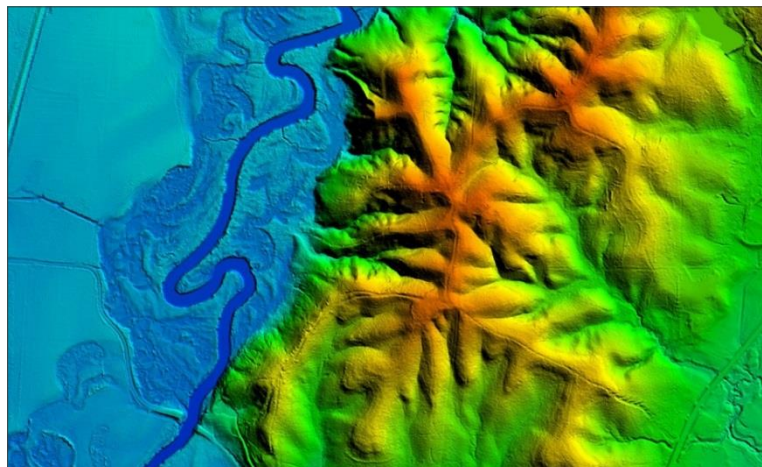


Figure 4.2 reflects a DEM generated from original lidar bare earth point data prior to the hydrologic flattening process. Note the “tinning” across the lake surface.

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.

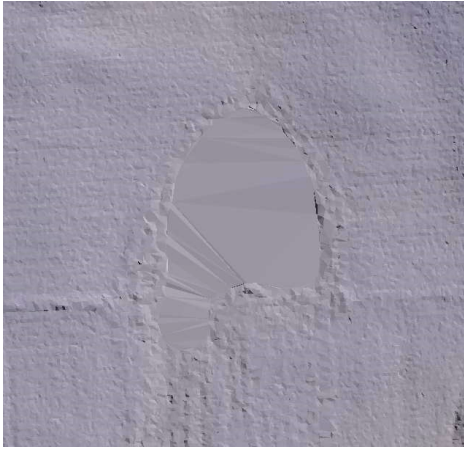


Figure 4.2



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 v18, 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	-0.053	Meter
Minimum error	-0.142	Meter
Maximum error	0.106	Meter
Average magnitude	0.060	Meter
Root mean square	0.071	Meter
Standard deviation	0.048	Meter

Table 5.2: RAW Swath Quality Check Point Analysis NVA

Point ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	TIN Elevation (Meter)	Dz (Meter)
2001	500995.223	4875488.541	519.566	519.530	-0.036
2002	473428.143	4850277.226	434.906	434.840	-0.066
2003	503050.032	4843251.240	542.742	542.710	-0.032
2004	523426.377	4842177.570	503.278	503.270	-0.008
2005	525046.223	4771597.070	429.930	429.940	0.010
2006	523917.548	4779731.876	461.434	461.500	0.066
2007	524291.999	4788634.331	490.109	490.070	-0.039
2008	512200.550	4803266.058	490.649	490.580	-0.069
2009	544860.710	4826508.415	501.001	500.910	-0.091
2010	541498.939	4839493.072	466.902	466.790	-0.112
2011	534950.486	4881135.403	494.338	494.240	-0.098
2012	483504.831	4891857.862	554.339	554.270	-0.069
2013	501080.538	4887511.596	542.410	542.370	-0.040
2014	494700.498	4880611.502	556.884	556.780	-0.104
2015	500991.886	4866258.246	509.270	509.250	-0.020
2016	476201.541	4864035.313	535.418	535.350	-0.068
2017	475783.110	4858269.905	422.686	422.620	-0.066
2018	515005.441	4819486.263	491.023	490.910	-0.113
2019	532720.151	4821046.600	506.168	506.090	-0.078
2020	485298.362	4843527.998	485.833	485.790	-0.043
2021	486087.910	4830753.702	520.554	520.570	0.016
2022	568527.284	4745208.400	381.824	381.780	-0.044
2023	509238.148	4832298.072	498.662	498.660	-0.002
2024	493289.873	4811496.856	513.321	513.260	-0.061

2025	512643.674	4788686.328	548.300	548.290	-0.010
2026	535289.721	4789252.068	500.320	500.310	-0.010
2026A	535289.841	4789445.419	502.097	502.100	0.003
2027	551174.649	4832573.792	459.991	459.890	-0.101
2028	529689.382	4830710.302	498.312	498.230	-0.082
2029	544632.120	4851833.697	436.072	436.010	-0.062
2030	550471.760	4892452.066	402.698	402.610	-0.088
2031	547036.033	4882784.641	411.170	411.150	-0.020
2032	523745.254	4893774.353	564.773	564.690	-0.083
2033	523254.746	4886300.957	557.028	557.000	-0.028
2034	523306.225	4880839.282	540.953	540.880	-0.073
2035	486687.539	4887000.482	554.899	554.840	-0.059
2036	521833.932	4863128.552	560.315	560.320	0.005
2037	519740.320	4850081.834	486.524	486.440	-0.084
2038	508306.837	4853191.218	524.592	524.530	-0.062
2039	494022.459	4855007.300	527.641	527.630	-0.011
2040	509029.138	4877023.114	513.522	513.440	-0.082
2041	476255.976	4825093.602	529.663	529.650	-0.013
2042	465142.668	4835687.942	449.075	449.060	-0.015
2043	468576.576	4844292.544	454.050	453.950	-0.100
2044	468826.993	4846289.560	496.891	496.750	-0.141
2045	472021.339	4849286.797	415.567	415.540	-0.027
2046	474362.306	4845925.737	512.765	512.770	0.005
2047	543766.197	4869863.613	429.951	429.910	-0.041
2048	494154.844	4838703.165	514.651	514.610	-0.041
2049	509021.428	4863046.609	485.888	485.810	-0.078
2050	532295.673	4871314.833	561.085	561.020	-0.065
2051	537557.875	4871381.495	469.286	469.180	-0.106
2052	521757.333	4872761.887	544.747	544.670	-0.077
2053	534382.371	4856629.552	471.496	471.360	-0.136
2054	534202.181	4893817.071	443.041	442.940	-0.101
2055	535050.587	4848496.179	470.456	470.340	-0.116
2056	523122.727	4825848.418	502.964	502.910	-0.054
2057	523020.674	4821104.625	486.389	486.360	-0.029
2058	486332.111	4821124.175	557.198	557.230	0.032
2059	476484.140	4838784.788	486.105	486.040	-0.065
2060	483068.215	4853130.949	512.074	512.050	-0.024
2061	513781.514	4887084.087	597.236	597.100	-0.136
2062	516582.036	4833934.912	476.187	476.090	-0.097
2063	503805.473	4816282.965	495.858	495.810	-0.048
2064	515758.975	4797056.356	499.264	499.230	-0.034

2065	558395.520	4770156.334	434.223	434.270	0.047
2066	499704.628	4793979.414	417.626	417.500	-0.126
2067	490457.755	4804674.610	416.415	416.380	-0.035
2068	492973.052	4864580.472	472.704	472.810	0.106
2069	464931.429	4879186.214	439.914	439.930	0.016
2070	552930.828	4838286.296	437.028	436.960	-0.068
2071	552005.347	4868366.689	405.502	405.360	-0.142
2072	553512.225	4879018.907	399.631	399.570	-0.061
2073	540614.418	4889178.046	437.616	437.500	-0.116
2074	474048.917	4874093.173	464.092	464.040	-0.052
2075	547259.865	4860216.908	413.954	413.880	-0.074
2076	494121.698	4849916.840	502.663	502.570	-0.093
2077	479701.171	4837181.775	498.843	498.780	-0.063
2078	474868.746	4830683.735	540.344	540.330	-0.014
2079	506211.598	4798673.671	488.744	488.730	-0.014
2080	496551.938	4802001.830	519.236	519.180	-0.056
2081	497355.757	4833881.846	507.954	507.890	-0.064
2082	503753.320	4829083.290	514.613	514.620	0.007
2083	502056.444	4855065.171	500.358	500.280	-0.078
2084	502651.929	4860675.232	478.387	478.350	-0.037
2085	515460.275	4858248.456	551.014	550.900	-0.114
2086	523494.323	4855107.448	483.196	483.160	-0.036
2087	483476.877	4880490.861	528.356	528.240	-0.116
2088	494685.881	4891898.506	543.447	543.360	-0.087
2089	484984.316	4860515.592	507.180	507.120	-0.060
2090	522121.670	4808368.550	486.584	486.540	-0.044
2091	503089.211	4790726.507	451.061	451.010	-0.051
2092	526835.529	4816291.306	480.715	480.620	-0.095
2093	540464.674	4833971.965	481.867	481.750	-0.117
2094	502169.848	4849946.569	521.154	521.090	-0.064
2095	545504.114	4874719.684	413.820	413.730	-0.090
2096	532682.901	4889023.952	454.643	454.520	-0.123
2097	493091.163	4873367.393	489.139	489.130	-0.009
2098	485252.861	4849919.095	482.296	482.260	-0.036
2099	481322.189	4827525.701	536.859	536.880	0.021
2100	503759.299	4837133.363	519.189	519.180	-0.009
2101	492563.645	4827465.684	523.929	523.880	-0.049
2102	512056.333	4824311.131	499.026	499.020	-0.006
2103	518985.238	4784429.215	485.640	485.620	-0.020
2104	492851.727	4821097.960	558.279	558.260	-0.019
2105	523758.545	4801954.891	488.625	488.700	0.075

2106	532632.961	4842034.873	483.488	483.370	-0.118
2107	528061.943	4877695.617	575.469	575.390	-0.079

VERTICAL ACCURACY CONCLUSIONS

Raw Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.139 Meters Non vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 0.071 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 108 NVA points.

LAS Swath Non-Vegetated Vertical Accuracy (NVA) Tested 0.141 Meters Non vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 0.072 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 108 NVA points.

Table 5.3: NVA Check Point Analysis DEM

Point ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	DEM Elevation (Meter)	Dz (Meter)
2001	500995.223	4875488.541	519.566	519.510	-0.056
2002	473428.143	4850277.226	434.906	434.840	-0.066
2003	503050.032	4843251.240	542.742	542.700	-0.042
2004	523426.377	4842177.570	503.278	503.270	-0.008
2005	525046.223	4771597.070	429.930	429.930	0.000
2006	523917.548	4779731.876	461.434	461.470	0.036
2007	524291.999	4788634.331	490.109	490.080	-0.029
2008	512200.550	4803266.058	490.649	490.600	-0.049
2009	544860.710	4826508.415	501.001	500.910	-0.091
2010	541498.939	4839493.072	466.902	466.800	-0.102
2011	534950.486	4881135.403	494.338	494.220	-0.118
2012	483504.831	4891857.862	554.339	554.290	-0.049
2013	501080.538	4887511.596	542.410	542.370	-0.040
2014	494700.498	4880611.502	556.884	556.790	-0.094
2015	500991.886	4866258.246	509.270	509.250	-0.020
2016	476201.541	4864035.313	535.418	535.350	-0.068
2017	475783.110	4858269.905	422.686	422.630	-0.056
2018	515005.441	4819486.263	491.023	490.910	-0.113
2019	532720.151	4821046.600	506.168	506.070	-0.098
2020	485298.362	4843527.998	485.833	485.780	-0.053
2021	486087.910	4830753.702	520.554	520.580	0.026
2022	568527.284	4745208.400	381.824	381.780	-0.044
2023	509238.148	4832298.072	498.662	498.630	-0.032
2024	493289.873	4811496.856	513.321	513.260	-0.061

2025	512643.674	4788686.328	548.300	548.290	-0.010
2026	535289.721	4789252.068	500.320	500.300	-0.020
2026A	535289.841	4789445.419	502.097	502.090	-0.007
2027	551174.649	4832573.792	459.991	459.890	-0.101
2028	529689.382	4830710.302	498.312	498.240	-0.072
2029	544632.120	4851833.697	436.072	436.000	-0.072
2030	550471.760	4892452.066	402.698	402.590	-0.108
2031	547036.033	4882784.641	411.170	411.110	-0.060
2032	523745.254	4893774.353	564.773	564.690	-0.083
2033	523254.746	4886300.957	557.028	557.000	-0.028
2034	523306.225	4880839.282	540.953	540.880	-0.073
2035	486687.539	4887000.482	554.899	554.860	-0.039
2036	521833.932	4863128.552	560.315	560.330	0.015
2037	519740.320	4850081.834	486.524	486.440	-0.084
2038	508306.837	4853191.218	524.592	524.520	-0.072
2039	494022.459	4855007.300	527.641	527.610	-0.031
2040	509029.138	4877023.114	513.522	513.450	-0.072
2041	476255.976	4825093.602	529.663	529.640	-0.023
2042	465142.668	4835687.942	449.075	449.070	-0.005
2043	468576.576	4844292.544	454.050	453.920	-0.130
2044	468826.993	4846289.560	496.891	496.740	-0.151
2045	472021.339	4849286.797	415.567	415.540	-0.027
2046	474362.306	4845925.737	512.765	512.750	-0.015
2047	543766.197	4869863.613	429.951	429.910	-0.041
2048	494154.844	4838703.165	514.651	514.610	-0.041
2049	509021.428	4863046.609	485.888	485.800	-0.088
2050	532295.673	4871314.833	561.085	561.020	-0.065
2051	537557.875	4871381.495	469.286	469.190	-0.096
2052	521757.333	4872761.887	544.747	544.670	-0.077
2053	534382.371	4856629.552	471.496	471.350	-0.146
2054	534202.181	4893817.071	443.041	442.950	-0.091
2055	535050.587	4848496.179	470.456	470.330	-0.126
2056	523122.727	4825848.418	502.964	502.910	-0.054
2057	523020.674	4821104.625	486.389	486.360	-0.029
2058	486332.111	4821124.175	557.198	557.240	0.042
2059	476484.140	4838784.788	486.105	486.050	-0.055
2060	483068.215	4853130.949	512.074	512.040	-0.034
2061	513781.514	4887084.087	597.236	597.110	-0.126
2062	516582.036	4833934.912	476.187	476.070	-0.117
2063	503805.473	4816282.965	495.858	495.830	-0.028
2064	515758.975	4797056.356	499.264	499.210	-0.054

2065	558395.520	4770156.334	434.223	434.260	0.037
2066	499704.628	4793979.414	417.626	417.520	-0.106
2067	490457.755	4804674.610	416.415	416.380	-0.035
2068	492973.052	4864580.472	472.704	472.770	0.066
2069	464931.429	4879186.214	439.914	439.930	0.016
2070	552930.828	4838286.296	437.028	436.970	-0.058
2071	552005.347	4868366.689	405.502	405.360	-0.142
2072	553512.225	4879018.907	399.631	399.570	-0.061
2073	540614.418	4889178.046	437.616	437.490	-0.126
2074	474048.917	4874093.173	464.092	464.020	-0.072
2075	547259.865	4860216.908	413.954	413.870	-0.084
2076	494121.698	4849916.840	502.663	502.570	-0.093
2077	479701.171	4837181.775	498.843	498.780	-0.063
2078	474868.746	4830683.735	540.344	540.330	-0.014
2079	506211.598	4798673.671	488.744	488.700	-0.044
2080	496551.938	4802001.830	519.236	519.180	-0.056
2081	497355.757	4833881.846	507.954	507.890	-0.064
2082	503753.320	4829083.290	514.613	514.630	0.017
2083	502056.444	4855065.171	500.358	500.280	-0.078
2084	502651.929	4860675.232	478.387	478.350	-0.037
2085	515460.275	4858248.456	551.014	550.900	-0.114
2086	523494.323	4855107.448	483.196	483.150	-0.046
2087	483476.877	4880490.861	528.356	528.250	-0.106
2088	494685.881	4891898.506	543.447	543.370	-0.077
2089	484984.316	4860515.592	507.180	507.120	-0.060
2090	522121.670	4808368.550	486.584	486.570	-0.014
2091	503089.211	4790726.507	451.061	451.020	-0.041
2092	526835.529	4816291.306	480.715	480.620	-0.095
2093	540464.674	4833971.965	481.867	481.750	-0.117
2094	502169.848	4849946.569	521.154	521.080	-0.074
2095	545504.114	4874719.684	413.820	413.730	-0.090
2096	532682.901	4889023.952	454.643	454.550	-0.093
2097	493091.163	4873367.393	489.139	489.110	-0.029
2098	485252.861	4849919.095	482.296	482.250	-0.046
2099	481322.189	4827525.701	536.859	536.850	-0.009
2100	503759.299	4837133.363	519.189	519.180	-0.009
2101	492563.645	4827465.684	523.929	523.880	-0.049
2102	512056.333	4824311.131	499.026	499.030	0.004
2103	518985.238	4784429.215	485.640	485.620	-0.020
2104	492851.727	4821097.960	558.279	558.260	-0.019
2105	523758.545	4801954.891	488.625	488.690	0.065

2106	532632.961	4842034.873	483.488	483.370	-0.118
2107	528061.943	4877695.617	575.469	575.400	-0.069

VERTICAL ACCURACY CONCLUSIONS

Bare-Earth DEM Non-Vegetated Vertical Accuracy (NVA) Tested 0.139 Meters Non-Vegetated vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) 0.071 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 108 NVA points.

Table 5.4: VVA Quality Check Point Analysis DEM

Point ID	Easting (Meter)	Northing (Meter)	Elevation (Meter)	DEM Elevation (Meter)	Dz (Meter)
3001	500977.530	4875534.502	520.945	520.930	-0.015
3002	473556.996	4851804.530	416.747	416.680	-0.067
3003	503083.675	4842960.311	540.683	540.720	0.037
3004	523468.750	4842181.706	503.682	503.700	0.018
3005	525029.802	4771623.005	429.828	430.050	0.222
3006	523870.018	4779632.409	459.825	459.940	0.115
3007	522032.680	4789166.740	500.772	500.920	0.148
3008	513076.736	4803126.493	496.795	496.970	0.175
3009	545058.382	4826321.941	500.360	500.340	-0.020
3010	541721.269	4841065.316	462.179	462.220	0.041
3011	534176.001	4880475.967	524.490	524.460	-0.030
3012	483546.994	4891823.525	553.268	553.190	-0.078
3013	501143.528	4887482.699	542.482	542.510	0.028
3014	494725.861	4880634.113	556.549	556.450	-0.099
3015	500970.008	4866288.680	507.931	508.020	0.089
3016	476165.645	4864004.436	534.579	534.500	-0.079
3017	474977.237	4858837.587	415.159	415.190	0.031
3018	515027.522	4820002.433	493.661	493.580	-0.081
3019	568480.658	4745245.204	381.896	381.910	0.014
3020	485345.165	4843659.466	483.616	483.630	0.014
3021	486082.416	4830783.944	520.035	520.070	0.035
3022	496056.641	4824324.351	514.224	514.240	0.016
3023	508165.551	4833884.954	501.225	501.320	0.095
3024	491693.562	4811476.798	484.282	484.280	-0.002
3025	512664.377	4788685.444	548.151	548.180	0.029
3026	499211.850	4806660.532	516.615	516.720	0.105
3027	550849.976	4832579.989	459.124	459.130	0.006
3028	529440.953	4830693.929	496.657	496.690	0.033

3029	544656.576	4851474.420	434.345	434.300	-0.045
3030	550208.774	4892980.341	404.146	404.100	-0.046
3031	547001.796	4882808.678	410.643	410.720	0.077
3032	523754.683	4893735.589	563.373	563.350	-0.023
3033	523344.468	4886408.413	556.145	556.260	0.115
3034	523283.880	4880013.852	534.926	534.840	-0.086
3035	486655.265	4887033.844	553.013	552.960	-0.053
3036	521859.090	4863105.010	559.525	559.540	0.015
3037	519762.035	4849799.096	484.411	484.440	0.029
3038	508327.785	4853211.011	524.312	524.280	-0.032
3039	494586.117	4855045.017	520.305	520.330	0.025
3040	464470.245	4879392.147	437.195	437.230	0.035
3041	476275.403	4825074.368	528.651	528.670	0.019
3042	465122.403	4835641.017	448.358	448.410	0.052
3043	468546.153	4844270.663	453.484	453.400	-0.084
3044	468772.987	4846570.873	485.094	484.960	-0.134
3045	472416.412	4849609.571	427.600	427.620	0.020
3046	474433.932	4845933.437	511.979	512.020	0.041
3047	474039.398	4874069.782	463.061	463.080	0.019
3048	494175.004	4838681.759	513.268	513.310	0.042
3049	508992.006	4863019.382	485.263	485.220	-0.043
3050	533439.509	4871296.644	521.493	521.450	-0.043
3051	537497.816	4871375.600	469.735	469.730	-0.005
3052	521732.783	4872655.241	543.921	544.010	0.089
3053	533757.683	4856793.072	476.874	476.740	-0.134
3054	534226.349	4893794.745	443.042	442.980	-0.062
3055	535060.293	4848546.815	469.612	469.470	-0.142
3056	523153.724	4827453.152	503.764	503.710	-0.054
3057	522994.954	4820467.045	477.592	477.570	-0.022
3058	486335.276	4821149.747	556.152	556.260	0.108
3059	476460.354	4838820.427	485.500	485.480	-0.020
3060	483006.644	4853152.762	510.945	511.050	0.105
3061	513750.789	4887063.199	596.218	596.190	-0.028
3062	517150.971	4833960.204	474.906	474.940	0.034
3063	504423.184	4816310.437	499.274	499.290	0.016
3064	515743.192	4796472.977	501.455	501.500	0.045
3065	535269.582	4789249.052	499.030	499.260	0.230
3065A	535261.580	4789462.832	501.035	501.220	0.185
3066	499876.852	4794169.461	418.114	418.060	-0.054
3067	490375.224	4804034.660	428.192	428.190	-0.002
3068	492976.487	4864559.675	472.305	472.310	0.005

3069	511487.543	4867826.335	528.962	528.980	0.018
3070	552973.022	4838253.873	435.457	435.410	-0.047
3071	551362.917	4868387.388	403.008	403.020	0.012
3072	551880.990	4879364.808	407.278	407.280	0.002
3073	539204.729	4889183.821	429.497	429.520	0.023
3074	531341.388	4863176.193	520.191	520.080	-0.111
3075	546797.843	4860173.547	412.032	411.940	-0.092
3076	494100.299	4849928.075	502.615	502.560	-0.055
3077	479667.177	4837156.143	498.173	498.170	-0.003
3078	474920.001	4830765.794	539.978	539.950	-0.028
3079	506191.353	4798826.144	488.351	488.400	0.049
3080	498470.182	4801873.105	505.693	505.770	0.077
3081	497326.141	4833895.424	505.954	506.110	0.156
3082	559620.703	4770168.636	423.112	423.210	0.098
3083	502051.083	4855031.073	498.305	498.350	0.045
3084	502637.735	4860691.927	478.353	478.400	0.047
3085	515430.869	4858278.903	549.021	549.040	0.019
3086	523549.045	4855131.945	482.477	482.450	-0.027
3087	483497.890	4880507.775	526.368	526.360	-0.008

VERTICAL ACCURACY CONCLUSIONS

Vegetated Vertical Accuracy (VVA) Tested 0.166 Meters at the 95th percentile reported using National Digital Elevation Program (NDEP)/ASPRS Guidelines and tested against the DEM against 88 VVA points. VVA Errors larger than 95th percentile include:

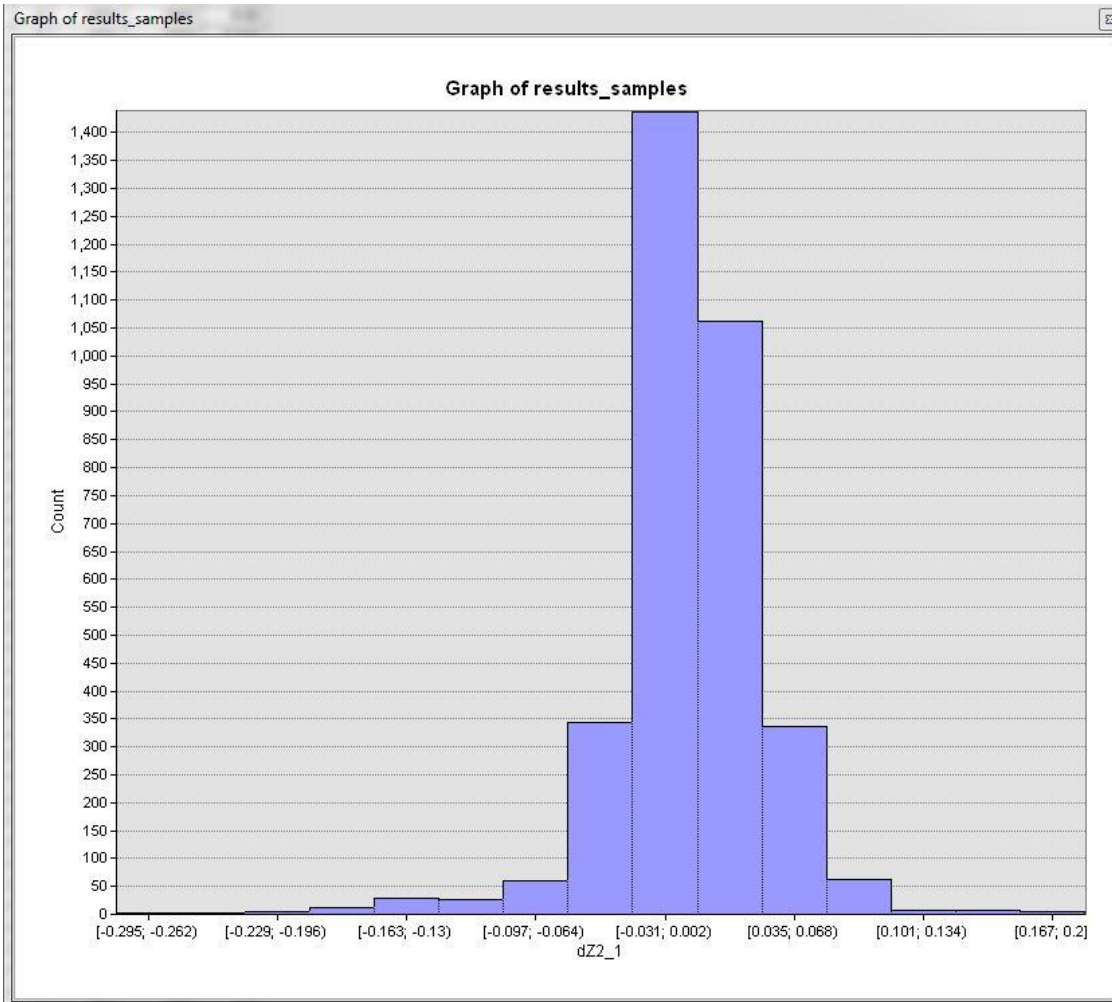
Point 3005, Easting 525029.802, Northing 4771623.005, Z-Error 0.222 Meters

Point 3008, Easting 513076.736, Northing 4803126.493, Z-Error 0.175 Meters

Point 3065, Easting 535269.582, Northing 4789249.052, Z-Error 0.230 Meters

Point 3065A, Easting 535261.580, Northing 4789462.832, Z-Error 0.185 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 SD Missouri River Lidar 2016 D16 measured at 0.040 Meters RMSDz.

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

Section 6: Flight Logs

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



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KHME	20161126 1600	KHME	20161126 2130	5.5	Jay Mundy	Production
2							
3							

Sigma Space Job #	Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #	
02_S16-001_USGS	S16-001_USGS_SD				A90	N89F		MicroIRS	5W	50kHz	500	500	10.0	Nick Bellis	001	
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht	
26-Nov-16	16-331				HRQLS2 002		20.6	15	12.3	50%	175.00	-6	-10.0			
Flight Name	Flight #	Wpt	Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
20161126153000	SSC	From To	Begin	End	Start	End									21	1.1
PRE-FLIGHT GPS STATIC START TIME					21:56:08	22:06:10										
204					600610	601340	WE	13505	183	20.6	kinda fast at max pitch. Mount cant compensate. Snow in lines, along roads					
205					601982	602843	EW	13397	130	20.6	Head Wind					
001					603673	603741	SN	13438	180	20.6						
009					604250	604341	NS	13475	173	20.6						
002					604607	604698	SN	13488	156	20.6	laser not auto starting/stoping					
010					181	267	NS	13513	175	20.6						
003					544	630	SN	13501	157	20.6						
011					916	1007	NS	13495	176	20.6						
004					1296	1387	SN	13494	161	20.6						
012					1682	1767	NS	13482	175	20.6	didn't auto turn off					
005					2055	2158	SN	13500	140	20.6						
013					2435	2538	NS	13515	171	20.6						
006					2799	2908	SN	13494	141	20.6						
014					3191	3333	NS	13502	175	20.6						
007					3576	3678	SN	13505	141	20.6						
015					3962	4111	NS	13500	176	20.6						
008					4351	4459	SN	13490	142	20.6						
022					4797	5048	NS	13493	175	20.6						
016					5309	5508	SN	13492	142	20.6						
023					5774	6025	NS	13496	176	20.6	May have stopped firing towards the end of this line but didn't notice anything					
017							SN			20.6	Laser did not fire/ had to power cycle instrument					
024					6857	7125	NS	13499	175	20.6						
017					7403	7620	SN	13486	143	20.6						
025					7889	8169	NS	13488	177	20.6						
018					8409	8654	SN	13493	142	20.6						
021					8932	9183	NS	13502	179	20.6						



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KHME	20161126 1600	KHME	20161126 2130	5.5	Jay Mundy	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #	
Flight Date (mm/dd/yyyy)		GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht	
Flight Name	Flight #	Wpt	Distance			GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
02_S16-001_USGS	S16-001_USGS_SD				A90	N89F		MicroIRS	5W	50kHz	500	500	10.0	Nick Bellis	001		
26-Nov-16	16-331					HRQLS2 002	20.6	15	12.3	50%	175.00	-6	-10.0				
20161126153000	SSC	From	To	Begin	End	Start	End	Dir	(feet)	(knots)	Rate					SVs	PDOP
PRE-FLIGHT GPS STATIC START TIME						21:56:08	22:06:10									21	1.1
019						9505	9768	SN	13497	146	20.6						
020						10326	10549	NS	13507	177	20.6						
POST-FLIGHT GPS STATIC STOP TIME						12081	12681									16	1.1



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KMHE	20161204 1030	KMHE	20161204 0130			Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #	
002_S16-001_USG		S16-001_USGS_SD				A90	N89F		MicroIRS	5W	50kHz	500	500	2.0	Nick Bellis	002	
Flight Date (mm/dd/yyyy)		GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht	
4-Dec-16		16-339				HRQLS2 002		20.6	15	12.3	50%	175	-6	-17.0			
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
2.01612E+13	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						60533	61164									17	1.1
141								SN	8842	180	25.0	9kft cal lines for nwgeo (Detector problem, lost a lot of pixels)					
141							62615	NS	8858	177	25.0	9kft cal lines for nwgeo (Detector problem, lost a lot of pixels)					
142						63169	63243	WE	8849	185	25.0	9kft cal lines for nwgeo (Power cycle fixed laser)					
142						63636	63716	EW	8876	154	25.0	9kft cal lines for nwgeo (large headwind 37 knots)					
221						64454	64528	SN	13387	169	20.6	13Kft cal lines for nwgeo (lots of wind)					
221						64821	64875	NS	13372	181	20.6	13Kft cal lines for nwgeo					
222						65285	65354	WE	13386	187	20.6	13Kft cal lines for nwgeo					
222						65793	65867	EW	13401	163	20.6	13Kft cal lines for nwgeo					
203						66374	67429	WE	13492	169	20.6	37 knt headwind					
026						67885	68182	NS	13465	186	20.6	quite a bit of snow, causing tofs to roll off in some places					
027						68432	68740	SN	13497	184	20.6						
028						69122	69447	NS	13482	186	20.6						
029						70132	70445	SN	13504	187	20.6						
030						70794	71107	NS	13457	185	20.6						
POST-FLIGHT GPS STATIC STOP TIME						72577	73179										



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KHME	15:37	KHME	19:57	4.5	Bob Shelton	Production
2							
3							

Sigma Space Job #		Project Name			Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #	
		USGS SD			AC90	690LS		MicroIRS	5W	50kHz	1920	200	8.0	8.0	Cody Huber	1 of 2	
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht		
7-Mar-17	17-066	9mV_2us_700m			HRQLS2 002	2	15	12.3AGL	50%	160.00	-6	-14	-7.0		1.75m		
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen011642 0_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						15:23:00	15:35:00				20.6	GP: 1020.7mb steady					
MITCHELL CAI	222			5.46		15:54:00	15:57:00	EB	13396	200	20.6	Snow in ditches, around treelines, etc.				15	1.3
	221			5.47		16:04:00	16:08:00	NB	13397	122	20.6					15	1.3
	222			5.46		16:15:00	16:20:00	WB	13396	90	20.6					15	1.6
	221			5.47		16:04:00	16:28:00	SB	13397	160	20.6					13	1.6
WAGNER CAI	221			5.44		16:38:00	16:42:00	SB	13497	190	20.6					13	1.6
	222			5.44		16:50:00	16:53:00	EB	13497	209	20.6					13	1.6
	221			5.44		17:00:00	17:02:00	NB	13497	175	20.6					13	1.6
	222			5.44		17:08:00	17:12:00	WB	13497	134	20.6					13	1.5
BLOCK C	108			9.27		17:24:00	17:29:00	NB	13796	170	20.6					14	1.4
	107			19.7		17:32:00		SB	13496	199	20.6	ABORTED AT 17:40 DUE TO CLOUDS				14	1.3
	25			17.3		17:56:00	18:03:00	NB	13496	201	20.6					13	1.9
	26			17.7		18:07:00	18:15:00	SB	13496	170	20.6					14	1.4
	27			17.7		18:20:00	18:27:00	NB	13497	190	20.6					14	1.4
	28			17.8		18:31:00	18:39:00	SB	13496	175	20.6					15	1.2
	29			18		18:44:00	18:50:00	NB	13496	180	20.6					16	1.1
	30			18.1		18:55:00	19:02:00	SB	13496	180	20.6	Very small wisp, most likely not in sights, did not appear in preview imagery				16	1.1
	31			18.1		19:06:00	19:13:00	NB	13496	175	20.6					13	1.4
POST-FLIGHT GPS STATIC STOP TIME						20:00:00	20:10:00				20.6						
	32			18.02		19:17	####	SB	##	185	20.6					13	1.4
	33			18.44		19:31	####	NB	##	180	20.6	DRIVES FULL. WILL REFLY				15	1.2



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KHOB		KHOB			Jay Mundy	Production
2						Peter Cain	
3							

Sigma Space Job #		Project Name			Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #		
0116420_002_01		Oncor POC			A90	N89F	MicroIRS		5W	50kHz	1920	200			Cody Huber	2 of 2		
Flight Date (mm/dd/yyyy)		GPS Day		Config File		Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
16-Feb-17		17-047		N2_50kHz_6kft_		HRQLS2 002		25	15	6.5	50%	140.00	-6				1.75m	
Flight Name		Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100		SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
												25.0						
POST-FLIGHT GPS STATIC STOP TIME																		



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	13:34	KMHE	17:58		Bob Shelton	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	-5.0	3.0	Cody Huber	2-Jan
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
18-Mar-17	17-077	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-4	-2.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						13:21:00	13:33:00				20.6	gp 1030.5mb					
WAGNER CAI	221			5.44		13:55:00	13:57:00	SB	13497	180	20.6					17	1.2
	222			5.44		14:03:00	14:06:00	WB	13497	165	20.6	minor wisps				18	1.3
	221			5.44		14:11:00	14:15:00	NB	13497	140		wisps, can still see ground clearly in imagery				17	1.4
	222			5.44		14:22:00	14:25:00	EB	13497	172	20.6					20	1.3
BLOCK C	33			18.4		14:39:00	14:47:00	NB	13496	145	20.6					20	1.2
	34			18.4		14:52:00	15:00:00	SB	13496	190						18	1.4
	35			18.7		15:05:00	15:12:00	NB	13496	173	20.6	Minor minor wisps. 1 or 2, 90% transparent				19	1.3
	36			23.5		15:39:00	15:48:00	SB	13496	170	20.6					18	1.4
	37			23.7		15:53:00	16:02:00	nb	13496	155						16	1.3
	38			23.7		16:07:00	16:16:00	SB	13496	180	20.6					18	1.4
	39			23.8		16:22:00	16:31:00	nb	13496	180	20.6					17	1.3
	40			23.8		16:36:00	16:45:00	SB	13496	186		Had to skip lines due to a smoke cloud from a controlled agriculture burn				16	1.3
	70			27.9		16:58:00	17:09:00	NB	13396	180	20.6					16	1.2
	71			28.3		17:13:00	17:24:00	SB	13396	170	20.6					16	1.2
	72			28		17:29:00	17:39:00	NB	13396	170						14	1.5
POST-FLIGHT GPS STATIC STOP TIME						18:00:00	18:10:00					gp 1028.8 falling					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KHOB		KHOB			Jay Mundy	Production
2						Peter Cain	
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU	Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #
0116420_002_01		Oncor POC				A90	N89F	MicroIRS	5W	50kHz	1920	200		Cody Huber	2 of 2
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht	
16-Feb-17	17-047	N2_50kHz_6kft_			HRQLS2 002	25	15	6.5	50%	140.00	-6			1.75m	
Flight Name	Flight #	Wpt	Distance	GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End								
PRE-FLIGHT GPS STATIC START TIME									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
									25.0						
POST-FLIGHT GPS STATIC STOP TIME															



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	19:12	KMHE	22:49		Bob Shelton	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #	
0116420_001_01		USGS SD				AC90	690LS%		MicroIRS	5W	50kHz	600	400	10.0		Cody Huber	3	
Flight Date (mm/dd/yyyy)		GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive		Ant Ht
18-Mar-17		17-077	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-2 -1.0				1.75m
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP	
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End											
PRE-FLIGHT GPS STATIC START TIME						18:58:00	19:08:00				20.6	gp 1027.8 falling						
WAGNER CAI	221			5.44		19:28:00	19:32:00	SB	13497	190	20.6	Scanner was not to speed at start of line(operator error)				14	1.9	
	221			5.44		19:33:00	19:37:00	NB	13497	190	20.6					14	1.9	
	221			5.44		19:40:00	19:43:00	SB	13497	180	20.6					14	1.9	
	222			5.44		19:47:00	19:50:00	WB	13497	150	20.6					13	2	
	222			5.44		19:53:00	19:57:00	EB	13497	185	20.6					14	1.9	
BLOCK C	41			23.9		20:08:00	20:17:00	NB	13496	180	20.6					14	1.4	
	42			23.9		20:21:00	20:29:00	SB	13496	182	20.6					14	1.4	
	43			24.2		20:33:00	20:41:00	NB	13496	175	20.6					14	1.5	
	44			24.9		20:45:00	20:55:00	SB	13496	180	20.6					14	1.5	
	45			25.6		20:58:00	21:06:00	NB	13496	175	20.6					14	1.5	
	46			26.5		21:11:00	21:21:00	SB	13496	180	20.6					14	1.6	
	47			27.3		21:24:00	21:34:00	NB	13497	180	20.6					16	1.4	
	48			27.7		21:37:00	21:48:00	SB	13497	180	20.6					16	1.3	
	49			27.9		21:53:00	22:03:00	NB	13497	180	20.6					15	1.2	
	50			28.2		22:06:00	22:17:00	SB	13497	180	20.6					13	1.6	
	51			28.4		22:21:00	22:31:00	NB	13497	180	20.6					14	1.4	
POST-FLIGHT GPS STATIC STOP TIME						22:50:00	23:00:00											



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	19:12	KMHE	22:49		Bob Shelton	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS%		MicroIRS	5W	50kHz	600	400	10.0		Cody Huber	3
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
18-Mar-17	17-077	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-2 -1.0			1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						18:58:00	19:08:00				20.6	gp 1027.8 falling					
WAGNER CAI	221			5.44		19:28:00	19:32:00	SB	13497	190	20.6	Scanner was not to speed at start of line(operator error)				14	1.9
	221			5.44		19:33:00	19:37:00	NB	13497	190	20.6					14	1.9
	221			5.44		19:40:00	19:43:00	SB	13497	180	20.6					14	1.9
	222			5.44		19:47:00	19:50:00	WB	13497	150	20.6					13	2
	222			5.44		19:53:00	19:57:00	EB	13497	185	20.6					14	1.9
BLOCK C	41			23.9		20:08:00	20:17:00	NB	13496	180	20.6					14	1.4
	42			23.9		20:21:00	20:29:00	SB	13496	182	20.6					14	1.4
	43			24.2		20:33:00	20:41:00	NB	13496	175	20.6					14	1.5
	44			24.9		20:45:00	20:55:00	SB	13496	180	20.6					14	1.5
	45			25.6		20:58:00	21:06:00	NB	13496	175	20.6					14	1.5
	46			26.5		21:11:00	21:21:00	SB	13496	180	20.6					14	1.6
	47			27.3		21:24:00	21:34:00	NB	13497	180	20.6					16	1.4
	48			27.7		21:37:00	21:48:00	SB	13497	180	20.6					16	1.3
	49			27.9		21:53:00	22:03:00	NB	13497	180	20.6					15	1.2
	50			28.2		22:06:00	22:17:00	SB	13497	180	20.6					13	1.6
	51			28.4		22:21:00	22:31:00	NB	13497	180	20.6					14	1.4
POST-FLIGHT GPS STATIC STOP TIME						22:50:00	23:00:00										



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	14:07	KMHE	17:36		Bob Shelton	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	6.0	19.0	Cody Huber	4
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
19-Mar-17	17-078	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	0	0.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						13:54:00	14:04:00				20.6	1012.2 falling					
WAGNER CAI	221			5.44		14:27:00	14:30:00	SB	13497	180	20.6					17	1.3
	221			5.44		14:33:00	14:36:00	NB	13497	180	20.6					16	1.4
	222			5.44		14:40:00	14:43:00	EB	13497	200	20.6					15	1.4
	222			5.44		14:47:00	14:50:00	WB	13497	180	20.6					16	1.4
BLOCK C	52			28.5		15:02:00	15:13:00	SB	13497	190	20.6					17	1.3
	53			28.7		15:16:00	15:27:00	NB	13496	180	20.6					18	1.2
	54			28.5		15:31:00	15:42:00	SB	13496	180	20.6					18	1.3
	55			22.7		15:45:00	15:54:00	NB	13496	180	20.6					19	1.2
	56			22.7		15:58:00	16:06:00	SB	13497	180	20.6					18	1.3
	57			22.4		16:09:00	16:17:00	NB	13496	180	20.6					19	1.2
	58			22.1		16:21:00	16:29:00	SB	13496	180	20.6					16	1.3
	59			22.4		16:32:00	16:41:00	NB	13497	180	20.6					18	1.2
	60			22.4		16:44:00	16:52:00	SB	13497	180	20.6					16	1.4
	61			22.5		16:55:00	17:04:00	NB	13496	180	20.6					17	1.4
	62			22.8		17:07:00	17:16:00	SB	13496	180	20.6					17	1.3
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						17:39:00	17:49:00				20.6	1011.5mb falling					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	19:01	KMHE	21:52		Bob Shelton	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	22.0	20.0	Cody Huber	5
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
19-Mar-17	17-078	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-0.5	0.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End					1010.8 falling					
PRE-FLIGHT GPS STATIC START TIME						18:49:00	18:59:00				20.6	1010.8 falling					
WAG CAL	221			5.44		19:19:00	19:22:00	SB	13497	180	20.6					14	1.4
	221			5.44		19:24:00	19:27:00	NB	13497	180	20.6					14	1.4
	222			5.44		19:31:00	19:35:00	WB	13497	160	20.6					13	1.7
	222			5.44		19:38:00	19:41:00	EB	13497	175	20.6					13	1.8
CROSS LINE	205			34.7		19:47:00	20:00:00	WB	13397	180	20.6					13	1.9
	204			38.9		20:09:00	20:24:00	EB	13497	180	20.6					13	1.8
BLOCK C	63			22.9		20:31:00	21:40:00	SB	13496	180	20.6					14	1.6
	64			23.3		20:43:00	20:52:00	NB	13496	180	20.6					15	1.4
	65			23.8		20:56:00	21:05:00	SB	13496	180	20.6					14	1.6
	66			25.6		21:09:00	21:18:00	NB	13396	180	20.6					16	1.3
	67			26.4		21:21:00	21:31:00	SB	13396	180	20.6					16	1.3
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						21:57:00	22:07:00				20.6						



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	14:05	KMHE	17:27		Bob Shelton	Production
2							
3							

Sigma Space Job #		Project Name			Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #	
0116420_001_01		USGS SD			AC90	690LS		MicroIRS	5W	50kHz	500	500	2.0	10.0	Cody Huber	6	
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht		
20-Mar-17	17-079	z_19mV_2us_70			HRQLS2 002	2	15	12.3AGL	50%	180.00	-6	-6	-5.0		1.75m		
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						13:50:00	14:01:00				20.6	1022.0 steady					
WAG CAL	221			5.44		14:21:00	14:24:00	SB	13497	180	20.6					19	1.3
	221			5.44		14:26:00	14:29:00	NB	13497	180	20.6					19	1.3
	222			5.44		14:36:00	14:39:00	EB	13497	185	20.6					17	1.4
	222			5.44		14:42:00	14:45:00	WB	13497	180	20.6					17	1.4
BLOCK C	68			27.2		14:51:00	15:01:00	NB	13396	180	20.6					18	1.2
	69			27.6		15:05:00	15:15:00	SB	13396	180	20.6					20	1.1
	73			28		15:19:00	15:30:00	NB	13396	180	20.6					20	1.1
	74			27.6		15:33:00	15:43:00	SB	13396	180	20.6					17	1.2
	75			27.6		15:47:00	15:56:00	NB	13396	190	20.6					17	1.2
	76			27.7		15:59:00	16:10:00	SB	13396	180	20.6					17	1.4
	77			28		16:13:00	16:23:00	NB	13396	180	20.6					17	1.4
	78			27.8		16:26:00	16:36:00	SB	13396	180	20.6					13	1.7
	79			28.1		16:40:00	16:51:00	NB	13396	180	20.6					14	1.4
	80			28.5		16:55:00	17:04:00	SB	13396	180	20.6					14	1.3
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						17:31:00	17:41:00				20.6	1023.4 steady					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	18:57	KMHE	21:45		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	15.0	14.0	Cody Huber	7
Flight Date (mm/dd/yyyy)		GPS Day	Config File			Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
27-Mar-17		17-086	lz_19mV_2us_70			HRQLS2 002	2	15	12.3AGL	50%	180.00	-6	-8	0.0		1.75m	
Flight Name	Flight #	Wpt	Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP	
046Sen0116420_002_0100	SSC	From To	Begin	End	Start	End											
PRE-FLIGHT GPS STATIC START TIME					18:44:00	18:54:00				20.6	1015.6 falling						
WAGNER CAI	221		5.44		19:15:00	19:17:00	SB	13497	195	20.6	little haze				13	1.7	
	221		5.44		19:21:00	19:23:00	NB	13497	190	20.6					13	1.7	
	222		5.44		19:27:00	19:30:00	WB	13497	176	20.6					12	1.8	
	222		5.44		19:33:00	19:35:00	EB	13497	200	20.6					15	1.7	
BLOCK C	81		29.4		19:43:00	19:53:00	NB	13396	185	20.6					14	1.6	
	82		28.5		19:58:00	20:07:00	SB	13396	187	20.6					14	1.6	
	83		28.4		20:10:00	20:19:00	NB	13396	187	20.6					14	1.9	
	84		28.2		20:23:00	20:32:00	SB	13396	200	20.6					14	1.6	
	85		28.3		20:35:00	20:45:00	NB	13396	191	20.6					16	1.3	
	86		28.5		20:48:00	20:58:00	SB	13396	177	20.6					16	1.3	
	87		28		21:02:00	21:12:00	NB	13396	177	20.6					15	1.3	
	88		28		21:14:00	21:25:00	SB	13396	174	20.6					15	1.3	
										20.6							
										20.6							
										20.6							
										20.6							
POST-FLIGHT GPS STATIC STOP TIME					21:46:00	21:56:00				20.6	1014.2 mb						



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	22:37	KMHE	2:23		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	18.0	10.0	Cody Huber	8
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
27-Mar-17	17-086	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-7			1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						22:25:00	22:35:00				20.6	1014.2					
Wag CAL	221			5.44		22:53:00	22:57:00	SB	13497	185	20.6					13	1.8
	221			5.44		23:00:00	23:04:00	NB	13497	185	20.6					18	1.3
	222			5.44		23:06:00	23:08:00	WB	13497	165	20.6					18	1.3
	222			5.44		23:12:00	23:14:00	EB	13497	185	20.6					18	1.3
BLOCK C	89			28.4		23:22:00	23:33:00	NB	13396	190	20.6					18	1.4
	90			28.7		23:35:00	23:45:00	SB	13396	175	20.6					18	1.4
	91			28.8		23:48:00	23:59:00	NB	13396	178	20.6					16	1.4
	92			28.8		00:02:00	00:12:00	SB	13396	170	20.6					17	1.4
	93			28.8		00:15:00	00:26:00	NB	13396	180	20.6	Haze layer forming				16	1.5
	94			28.8		00:29:00	00:39:00	SB	13396	170	20.6					17	1.4
	95			28.4		00:42:00	00:52:00	NB	13396	176	20.6					16	1.3
	96			28.1		00:55:00	01:05:00	SB	13396	180	20.6	Thin Smoke				18	1.1
	97			28.2		01:08:00	01:18:00	NB	13396	180	20.6					17	1.2
	98			27.8		01:21:00	01:31:00	SB	13396	180	20.6					17	1.2
	99			27.7		01:34:00	01:44:00	NB	13397	180	20.6					14	1.4
	100			24.3		01:47:00	01:58:00	SB	13396	180	20.6					15	1.1
	101			28.8		02:00:00	02:09:00	NB	13397	180	20.6					16	1.2
POST-FLIGHT GPS STATIC STOP TIME						02:25:00	02:35:00				20.6	1015.2					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	14:45	KMHE	17:00		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU	Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #	
0116420_001_01		USGS SD				AC90	690LS	MicroIRS	5W	50kHz	500	550	7.0	15.0	Cody Huber	10	
Flight Date (mm/dd/yyyy)	GPS Day	Config File				Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
4-Apr-17	17-094	lz_19mV_2us_70				HRQLS2 002	2	15	12.3AGL	50%	180.00	-6	-16			1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						14:32:00	14:42:00				20.6	1013.2 mb stdy					
Chamberlain CAI	221			5.31		15:16:00	15:19:00	NB	13497	190	20.6					17	1.1
	221			5.31		15:23:00	15:26:00	SB	13497	190	20.6					17	1.2
	222			5.3		15:32:00	15:35:00	WB	13497	180	20.6					17	1.2
	222			5.3		15:39:00	15:42:00	EB	13497	180	20.6					17	1.2
BLOCK A	1			9.95		15:52:00	15:57:00	NB	13596	170	20.6					16	1.4
	2			10.7		16:01:00	16:06:00	SB	13596	185	20.6					16	1.4
	3			11.4		16:11:00	16:15:00	NB	13596	175	20.6	Very small wispy clouds				16	1.3
Cross Line	202			54.3		16:26:00	16:45:00	EB	13496	180	20.6	minor wispy clouds				15	1.4
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						17:02:00	17:12:00				20.6	1014.6 stdy					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	12:55	KMHE	16:46		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	-1.0	7.0	Cody Huber	11
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
6-Apr-17	17-096	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-15	-12.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						12:41:00	12:51:00				20.6	1025.7 stdy					
CHAMBERLAIN CAI	222			5.3		13:11:00	13:14:00	WB	13497	175	20.6					18	1.4
	222			5.3		13:18:00	13:20:00	EB	13497	180	20.6					18	1.4
	221			5.31		13:26:00	13:29:00	SB	13497	200	20.6					15	1.4
	221			5.31		13:34:00	13:36:00	NB	13497	185	20.6					15	1.4
CROSS FLIGHT	201			60.1		13:48:00	14:08:00	EB	13396	190	20.6					15	1.2
	203			49.5		14:19:00	14:38:00	WB	13496	190	20.6					16	1.2
BLOCK A	19			41		14:43:00	14:57:00	NB	13496	185	20.6					13	1.8
	18			38.1		15:01:00	15:14:00	SB	13497	190	20.6					14	1.6
	17			36.6		15:21:00	15:34:00	NB	13497	185	20.6					13	1.6
	16			36.2		15:40:00	15:51:00	SB	13497	200	20.6					13	1.6
	15			36.5		15:55:00	16:08:00	NB	13496	190	20.6					13	1.5
	14			36.4		16:13:00	16:26:00	SB	13496	195	20.6					14	1.3
											20.6						
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						16:48:00	16:58:00				20.6	1027.8 stdy					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	17:43	KMHE	22:19		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	10.0	13.0	Cody Huber	12
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
6-Apr-17	17-096	lz_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-9	-7.5		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						17:30:00	17:40:00				20.6	1027.4 stdy					
Chamberlain	221			5.3		18:03:00	18:05:00	NB	13497	185	20.6					12	1.6
	221			5.3		18:10:00	18:13:00	SB	13497	195	20.6					13	1.6
	222			5.3		18:18:00	18:21:00	EB	13497	170	20.6					13	1.5
	222			5.3		18:25:00	18:28:00	WB	13497	180	20.6					12	1.6
BLOCK A	13			36.5		18:36:00	18:49:00	NB	13496	180	20.6					12	1.6
	12			36.5		18:54:00	19:07:00	SB	13496	190	20.6					12	1.6
	11			36.5		19:11:00	19:23:00	NB	13496	180	20.6					13	1.7
	10			36.5		19:29:00	19:41:00	SB	13496	200	20.6					14	1.8
	9			36.1		19:49:00	20:02:00	NB	13496	185	20.6					14	1.5
	4			11.8		20:09:00	20:12:00	SB	13596	200	20.6					16	1.2
	5			12.2		20:17:00	20:22:00	NB	13596	177	20.6					16	1.3
	6			12.2		20:27:00	20:31:00	SB	13596	196	20.6					17	1.2
	7			12.6		20:36:00	02:52:00	NB	13596	180	20.6					16	1.3
	8			35.4		20:45:00	20:58:00	SB	13496	175	20.6					15	1.5
	20			41.8		21:04:00	21:19:00	NB	13496	190	20.6					15	1.3
	21			42.4		21:23:00	21:40	SB	13496	180	20.6					15	1.3
	22			45.8		21:44:00	21:59:00	NB	13496	190	20.6					14	1.4
POST-FLIGHT GPS STATIC STOP TIME						22:21:00	22:31:00				20.6	1023 stdy					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	13:59	KMHE	18:25		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	450	600	7.0	15.0	Cody Huber	13
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
7-Apr-17	17-097	lz_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-5	-4.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						13:44:00	13:54:00				20.6	1019.0 falling					
WAG CAL	221			5.44		14:14:00	14:17:00	SB	13497	195	20.6					15	1.3
	221			5.44		14:22:00	14:24:00	NB	13497	175	20.6					15	1.3
	222			5.44		14:29:00	14:32:00	WB	13497	170	20.6					15	1.2
	222			5.44		14:37:00	14:40:00	EB	13497	200	20.6					14	1.3
BLOCK C	108			9.27		14:49:00	14:53:00	SB	13796	190	20.6					14	1.6
	107			19.7		15:01:00	15:08:00	NB	13496	190	20.6					14	1.6
	106			24.9		15:12:00	15:22:00	SB	13396	190	20.6					12	1.6
	105			26.1		15:26:00	15:35:00	NB	13396	180	20.6					13	1.6
	104			26.5		15:40:00	15:49:00	SB	13396	200	20.6					13	1.6
	103			26.9		15:54:00	16:04:00	NB	13397	185	20.6					13	1.5
	102			26.9		16:08:00	16:17:00	SB	13397	190	20.6					14	1.4
CHAMB CAL	222			5.3		16:38:00	16:41:00	WB	13497	175	20.6					13	1.8
	222			5.3		16:45:00	16:48:00	EB	13497	200	20.6					13	1.8
	221			5.31		16:53:00	16:56:00	NB	13497	190	20.6					13	1.7
	221			5.31		17:00:00	17:03:00	SB	13497	175	20.6					14	1.4
BLOCK A	23			45.9		17:11:00	17:27:00	NB	13496	190	20.6					14	1.3
	24			45.7		17:31:00	17:47:00	SB	13496	190	20.6					13	1.5
POST-FLIGHT GPS STATIC STOP TIME						18:30:00	18:40:00				20.6	1011.8 falling					
25		45.71		17:51		####	NB	####	190	20.6					13	1.5	



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	19:35	KMHE	0:03		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	450	650	19.0	18.0	Cody Huber	14
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
7-Apr-17	17-097	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-5	-2.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						19:21:00	19:31:00				20.6	1010.2 mb falling, plane slightly moved at 19:28, high winds					
Chamb Cal	222			5.3		19:56:00	19:58:00	WB	13497	200	20.6					16	1.3
	222			5.3		20:04:00	20:07:00	EB	13497	175	20.6					15	1.4
	221			5.31		20:12:00	20:15:00	NB	13497	200	20.6					17	1.2
	221			5.31		20:20:00	20:23:00	SB	13497	190	20.6					16	1.3
BLOCL A	26			45.9		20:32:00	20:47:00	NB	13497	185	20.6					13	1.7
	27			45.7		20:52:00	21:08:00	SB	13497	185	20.6					13	1.7
	28			45.8		21:12:00	21:28:00	NB	13496	200	20.6					15	1.4
	29			45.8		21:31:00	21:47:00	SB	13496	185	20.6					17	1.3
	30			45.6		21:51:00	22:07:00	NB	13496	190	20.6					17	1.3
	31			45.6		22:12:00	22:26:00	SB	13596	195	20.6					15	1.7
	32			46		22:30:00	22:46:00	NB	13597	185	20.6					16	1.5
	33			46		22:51:00	23:06:00	SB	13597	190	20.6					14	1.7
	34			45.7		23:11:00	23:26:00	NB	13596	200	20.6					17	1.3
	35			45.9		23:31:00	23:46:00	SB	13597	190	20.6					14	1.5
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						00:06:00	00:16:00				20.6	1006.1 mb falling					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	14:03	KMHE	18:25		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	12.0	24.0	Cody Huber	15
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
8-Apr-17	17-098	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	3	-5.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						13:51:00	14:01:00				20.6	999.7 fall					
CHAMB CAL	222			5.3		14:25:00	14:28:00	WB	13497	192	20.6					17	1.3
	222			5.3		14:34:00	14:36:00	EB	13497	205	20.6					17	1.3
	221			5.31		14:41:00	14:44:00	NB	13497	200	20.6					16	1.5
	221			5.31		14:48:00	14:51:00	SB	13497	175	20.6					17	1.2
BLOCK A	36			45.9		15:00:00	15:17:00	NB	13597	200	20.6					17	1.2
	37			45.7		15:22:00	15:36:00	SB	13597	190	20.6					13	1.5
	38			45.8		15:40:00	15:56:00	nB	13597	000.0 stc	20.6					14	1.4
	39			45.7		16:01:00	16:17:00	SB	13596	180	20.6					15	1.4
	40			45.7		16:22:00	16:37:00	NB	13596	190	20.6					13	1.5
	41			45.8		16:41:00	16:57:00	SB	13596	185	20.6					12	1.5
	42			45.9		17:02:00	17:17:00	NB	13596	195	20.6					14	1.3
	43			45.8		17:23:00	17:37:00	SB	13596	190	20.6					15	1.2
	44			45.8		17:42:00	17:57:00	NB	13596	185	20.6					14	1.4
											20.6	Cal ended at 18:10					
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						18:27:00	18:37:00				20.6	1000.0 stdy					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	19:36	KMHE	0:09		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	25.0	23.0	Cody Huber	16
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
8-Apr-17	17-098	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	1	-3.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						19:24:00	19:34:00				20.6	999.0 stdy					
CHAMB CAL	222			5.3		19:57:00	20:01:00	WB	13497	200	20.6					16	1.3
	222			5.3		20:04:00	20:06:00	EB	13497	205	20.6					16	1.3
	221			5.31		20:14:00	20:16:00	NB	13497	175	20.6					16	1.3
	221			5.31		20:20:00	20:22:00	SB	13497	180	20.6					17	1.2
Block A	45			45.8		20:33:00	20:48:00	NB	13596	200	20.6					17	1.2
	46			45.8		20:52:00	21:08:00	SB	13596	190	20.6					12	1.4
	47			45.6		21:11:00	21:28:00	NB	13597	200	20.6					16	1.3
	48			45.9		21:32:00	21:47:00	SB	13696	180	20.6					17	1.3
	49			45.9		22:51:00	22:06:00	NB	13696	185	20.6					15	1.4
	50			45.9		22:11:00	22:27:00	SB	13696	200	20.6					13	1.4
	51			45.9		22:30:00	22:46:00	NB	13696	190	20.6					15	1.4
	52			45.9		22:51:00	23:05:00	SB	13696	190	20.6					17	1.3
	53			45.9		23:09:00	23:25:00	NB	13696	185	20.6					16	1.4
	54			45.9		23:20:00	23:45:00	SB	13696	185	20.6					14	1.5
											20.6	cal ended ~23:54					
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						00:10:00	00:20:00				20.6	999.0 falling					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	18:39	KMHE	21:19		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	19.0	19.0	Cody Huber	18
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
16-Apr-17	17-106	lz_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-10	-10.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						18:27:00	18:37:00				20.6	1021.0 stdy					
WESS CAL	221			5.33		18:55:00	18:57:00	NB	13696	200	20.6					16	1.8
	221			5.33		19:03:00	19:04:00	SB	13696	185	20.6					15	1.5
	222			5.28		19:10:00	19:12:00	WB	13596	190	20.6					17	1.6
	222			5.28		19:17:00	19:20:00	EB	13596	205	20.6					16	1.3
BLOCK B	38			45.9		19:27:00	19:43:00	SB	13496	180	20.6	Cloud around 16 miles in, 20 miles in				17	1.3
	37			45.9		19:48:00	20:03:00	NB	13496	180	20.6	Clouds ~63				17	1.3
	36			45.9		20:07:00	20:22:00	SB	13496	200	20.6	clouds				16	1.5
	35			46		20:27:00	20:41:00	NB	13496	200	20.6	clouds @ north end				17	1.3
	34			46		20:45:00	21:01:00	SB	13496	200	20.6	clouds @ north end				16	1.4
											20.6	cal is UL002					
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						21:20:00	21:30:00				20.6	1019.0mb fall					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	12:42	KMHE	17:29		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	4.0	17.0	Cody Huber	17
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
16-Apr-17	17-106	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-10	-12.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						12:30:00	12:40:00				20.6	1020.0 stdy					
WESS CAL	221			5.33		13:00:00	13:02:00	NB	13696	190	20.6					12	1.7
	221			5.33		13:08:00	13:11:00	SB	13696	200	20.6					12	1.5
	222			5.28		13:16:00	13:19:00	EB	13596	200	20.6					13	1.4
	222			5.28		13:24:00	13:27:00	WB	13596	140	20.6					14	1.4
BLOCK A	55			45.9		13:36:00	13:51	SB	13697	185	20.6					13	1.4
	56			45.9		13:56:00	14:11:00	NB	13696	190	20.6	Wispy cloud on south end. Myabe 3-5 frames				13	1.4
BLOCK B	47			45.4		14:19:00	14:34:00	SB	13396	200	20.6					17	1.2
	46			45.8		14:39:00	14:54:00	NB	13396	180	20.6					15	1.3
	45			45.9		14:55:00	15:13:00	SB	13396	190	20.6	Wispy clouds 3-4 frames				15	1.3
	44			45.9		15:17:00	15:33:00	NB	13397	200	20.6	wispy @~70				15	1.4
	43			45.9		15:36:00	15:52:00	SB	13397	190	20.6					15	1.2
	42			45.9		15:56:00	16:11:00	NB	13397	190	20.6					13	1.5
	41			45.9		16:16:00	16:31:00	SB	13497	195	20.6					13	1.5
	40			45.9		16:37:00	16:51:00	NB	13497	200	20.6	Cloud at last 2 frames				16	1.2
	39			45.1		16:56:00	17:11:00	SB	13497	190	20.6					14	1.3
											20.6	17:19 end cal					
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						17:31:00	17:41:00				20.6	1021.7 stdy					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	13:43	KMHE	18:06		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	6.0	12.0	Cody Huber	19
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
17-Apr-17	17-107	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-7			1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						13:30:00	13:40:00				20.6	1025.1 stdy					
WESS CAL	221			5.33		13:59:00	14:01:00	NB	13696	180	20.6					18	1.2
	221			5.33		14:06:00	14:09:00	SB	13696	190	20.6					147	1.4
	222			5.28		14:15:00	14:17:00	EB	13596	190	20.6					17	1.4
	222			5.28		14:22:00	14:25:00	WB	13596	190	20.6					17	1.3
BLOCK B	3			45.8		14:33:00	14:47:00	SB	13696	190	20.6					16	1.4
	2			45.8		14:52:00	15:08:00	NB	13696	200	20.6					15	1.4
	1			45.9		15:12:00	15:27:00	SB	13697	200	20.6					15	1.3
BLOCK A	61			45.9		15:31:00	15:46:00	NB	13696	200	20.6					14	1.5
	60			45.9		15:50:00	16:06:00	SB	13696	200	20.6					15	1.4
	59			45.9		16:10:00	16:25:00	NB	13696	200	20.6					14	1.5
	58			45.9		17:30:00	16:45:00	SB	13696	200	20.6					15	1.3
	57			45.8		16:49:00	17:05:00	NB	13696	200	20.6					15	1.2
CROSS CAL							17:10:00			200	20.6	CROSS CAL					
BLOCK B	6			45.8		17:16:00	17:31:00	SB	13697	200	20.6					13	1.6
	5			45.8		17:35:00		NB	13697	200	20.6					12	1.6
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						18:09:00	18:19:00				20.6	1022 fall					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	19:27	KMHE	23:29		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	17.0	18.0	Cody Huber	19
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
17-Apr-17	17-107	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-5	-6.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End					1020.7mb falling					
PRE-FLIGHT GPS STATIC START TIME						19:14:00	19:24:00				20.6	1020.7mb falling					
WESS CAL	221			5.33		19:44:00	19:46:00	NB	13696	200	20.6					18	1.3
	221			5.33		19:50:00	19:53:00	SB	13696	195	20.6					18	1.3
	222			5.28		20:00:00	20:02:00	EB	13596	190	20.6					18	1.3
	222			5.28		20:07:00	20:10:00	WB	13596	160	20.6					16	1.4
BLOCK B	4			45.8		20:17:00	20:33:00	SB	13696	200	20.6					16	1.3
	33			46		20:39:00	20:55:00	NB	13496	200	20.6					19	1.3
	32			45.9		20:59:00	21:15:00	SB	13496	200	20.6					21	1.2
	31			45.9		21:19:00	21:35:00	NB	13496	190	20.6					20	1.4
	30			45.9		21:39:00	21:55:00	SB	13497	190	20.6					21	1.2
	29			45.8		21:59:00	22:14:00	NB	13496	200	20.6					19	1.5
	28			45.9		22:18:00	22:34:00	SB	13496	180	20.6					18	1.5
	27			45.9		22:38:00	22:53:00	NB	13496	200	20.6	1 or 2 frames w thin cloud				17	1.4
	26			46		22:58:00	23:13:00	SB	13496	200	20.6	1 or 2 frames w thin cloud				17	1.4
CROSS CAL	UL001			4.25		23:17:00	23:18:00	EB	13596	190	20.6					20	1.1
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						23:30:00	23:40:00				20.6	1013.2 falling					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	14:20	KMHE	17:36		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #	
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	500	500	13.0	15.0	Cody Huber	20	
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht		
18-Apr-17	17-108	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	0	-1.0		1.75m		
Flight Name	Flight #	Wpt	Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions					SVs	PDOP	
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End				963.1 md							
PRE-FLIGHT GPS STATIC START TIME					14:07:00	14:17:00				20.6								
WAG CAL	221	5				14:46:00	14:48:00	SB	13497	200	20.6						14	1.5
	221	5				14:53:00	15:55:00	NB	13497	205	20.6						14	1.5
	222	5				15:00:00	15:03:00	WB	13497	170	20.6						14	1.4
	222	5				15:09:00	15:12:00	EB	13497	200	20.6						14	1.4
BLOCK C	88	28				15:20:00	15:30:00	SB	13396	200	20.6						12	1.6
	87	28				15:35:00	15:45:00	NB	13396	200	20.6						12	2
	86	28				15:50:00	16:00:00	SB	13396	200	20.6						11	1.7
	85	28				16:05:00	16:14:00	NB	13396	190	20.6						13	1.5
	84	28				16:19:00	16:29:00	SB	13396	200	20.6						16	1.2
	83	28				16:33:00	16:42:00	NB	13396	190	20.6						17	1.2
	82	28				16:46:00	16:57:00	SB	13396	200	20.6						16	1.2
	81	28				17:00:00	17:11:00	NB	13396	200	20.6						15	1.3
CROSS CAL	UL001	6				17:14:00	17:16:00	EB	13396	180	20.6						14	1.6
											20.6							
											20.6							
											20.6							
POST-FLIGHT GPS STATIC STOP TIME					17:38:00	17:48:00				20.6	1011.5mb stdy							



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	14:46	KMHE	17:16		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	450	650	8.0	14.0	Cody Huber	21
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
21-Apr-17	17-111	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-10	-10.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						14:32:00	14:43:00				20.6	1022.7mb fall					
WESS CAL	221			5.33		14:59:00	15:01:00	NB	13696	180	20.6					14	1.4
	221			5.33		15:06:00	15:08:00	SB	13696	180	20.6					16	1.2
	222			5.28		15:14:00	15:16:00	EB	13596	185	20.6					14	1.4
	222			5.28		15:21:00	15:24:00	WB	13596	190	20.6					12	1.9
BLOCK B	25			45.9		15:32:00	15:47:00	SB	13596	200	20.6					14	1.5
	24			45.9		15:54:00	16:10:00	NB	13596	190	20.6	small clouds at north end				12	1.9
	23			45.9		16:14:00	16:28:00	SB	13596	200	20.6	small clouds at north end				14	1.4
	22			45.9		16:33:00	16:49:00	NB	13596	200	20.6	small clouds at north end				14	1.3
	UL001					17:01:00	17:03:00	EB	13596	180	20.6					13	1.5
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						17:17:00	17:27:00				20.6	1024.0 stdy					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	13:40	KMHE	16:25		Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
0116420_001_01		USGS SD				AC90	690LS		MicroIRS	5W	50kHz	450	650	7.0	15.0	Cody Huber	22
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
22-Apr-17	17-112	z_19mV_2us_70			HRQLS2 002		2	15	12.3AGL	50%	180.00	-6	-10	-11.0		1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						13:26:00	13:37:00				20.6	1026.4 stdy					
WESS CAL	221			5.33				NB	13696		20.6					12	1.6
	221			5.33		14:01:00	14:04:00	SB	13696	190	20.6					14	1.5
	222			5.28		14:09:00	14:12:00	EB	13596	200	20.6					13	1.6
	222			5.28		14:16:00	14:19:00	WB	13596	200	20.6					13	1.6
BLOCK B	21			45.9		14:27:00	14:42:00	SB	13596	200	20.6					13	1.6
	20			45.9		14:47:00	15:02:00	NB	13596	200	20.6					13	1.5
	19			45.9		15:06:00	15:21:00	SB	13596	200	20.6	cloud in ~3 frames at north end				14	1.3
	7			45.7		15:26:00	15:41:00	NB	13696	200	20.6	Cloud in ~5 frames at north end				11	1.9
	8			45.7		15:45:00	16:01:00	SB	13696	200	20.6					13	1.6
	UL001			10		16:09:00	16:12:00	EB	13696	200	20.6					17	1.1
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
											20.6						
POST-FLIGHT GPS STATIC STOP TIME						16:28:00	16:38:00				20.6	1026.1 stdy					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Take Off	Airport	Landing			
1	KMHE	18:05	KMHE	23:10	5:05	Brian Albers	Production
2							
3							

Sigma Space Job #		Project Name		Aircraft	Tail	IMU	Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #		
0116420_001_01		USGS SD		AC90	690LS	MicroIRS	5W	50kHz	500	500	17.0	Cody Huber	23		
Flight Date (mm/dd/yyyy)	GPS Day	Config File		Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht		
22-Apr-17	17-112	z_19mV_2us_70		HRQLS2 002	2	15	12.3AGL	50%	180.00	-6	-10 -9.0		1.75m		
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions		SVs	PDOP
046Sen0116420_002_0100	SSC	From	To	Begin	End	Start	End								
PRE-FLIGHT GPS STATIC START TIME						17:50:00	18:00:00				20.6	1025.7 fall			
WESS	221			5.33		18:17:00	18:19:00	NB	13696	195	20.6			10	1.9
	221			5.33		18:24:00	18:27:00	SB	13696	200	20.6			11	1.9
	222			5.28		18:32:00	18:35:00	EB	13596	200	20.6			12	1.8
	222			5.28		18:40:00	18:43:00	WB	13596	190	20.6			12	1.4
BLOCK B	9			45.7		18:50:00	19:05:00	SB	13696	200	20.6			13	1.4
	10			45.8		19:10:00	19:24:00	NB	13696	200	20.6			15	1.3
	11			45.8		19:29:00	19:44:00	SB	13697	200	20.6			14	1.5
	12			46		19:48:00	20:03:00	NB	13696	200	20.6			14	1.4
	13			45.6		20:08:00	00:00:00	SB	13697	200	20.6			16	1.4
	14			46		20:27:00	20:42:00	NB	13696	200	20.6			16	1.3
	15			45.9		20:47:00	21:02:00	SB	13697	200	20.6			13	1.8
	16			46		21:06:00	21:21:00	NB	13696	200	20.6			14	1.7
	17			45.9		21:26:00	21:44:00	SB	13697	200	20.6			15	1.3
BLOCK C REF	303			17.4		21:53:00	21:59:00	SB	13496	200	20.6	Drive swap		15	1.5
	304			16.4		22:03:00	22:09:00	NB	13496	200	20.6			15	1.5
	301			8.61		22:16:00	22:19:00	SB	13496	200	20.6			15	1.4
	302			7.88		22:26:00	22:30:00	EB	13497	200	20.6			14	1.5
POST-FLIGHT GPS STATIC STOP TIME						23:15:00	23:25:00				20.6				

BLOCK B	18			45.92		22:37	####	NB	####	200	20.6			15	1.4
CROSS CAL	UL001					22:57		EB	####	200	20.6			15	1.3



HRQLS2 Flight Log

	Lift Begin		Lift End		Fit Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KHME	20170511 2025	KHME	20170511 2344		Tim Russell	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #	
						A90	N89F		MicroIRS	5W	50kHz	550	450	22.0	Nick Bellis	001	
Flight Date (mm/dd/yyyy)	GPS Day	Config File				Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht		
11-May-17	17-131					HRQLS2 001	20.6	15	12.3	50%	175.0	-5	-4		1.75m		
Flight Nmae	Flight #	Wpt	Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP	
	SSC	From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						419680	420280				30.11 in Hg (101.96 kpa)				22	1.1	
Block B Line 45				32	65	422642	423027	NS	13343	180	20.6						
Block B Line 44				40	80	423401	423966	SN	13380	167	20.6						
Block B Line 43				50	75	424279	424730	NS	13374	179	20.6						
Block B Line 39				80	96	425644	425935	NS	13333	184	20.6						
Block B Line 8								NS			20.6	Clouds developed in west, will not fly this lift					
Block B Line 7				70	96			SN			20.6	clouds developed in west, will not fly this lift					
Line 201						426911	427105	WE	13652	183	20.6						
Line 221						427645	427765	NS	13398	184	20.6						
Line 222						428140	428272	WE	13339	177	20.6						
Line 221						428618	428749	SN	13480	161	20.6						
Line 222						429092	429224	EW	13404	178	20.6						
POST-FLIGHT GPS STATIC STOP TIME						430495	431095				30.08 in Hg (101.86 kpa)				22	1.1	



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KFSD	20170505 1715	KMHE	20170505 2121		Tim Russell	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #
5-May-17		17-125		HRQLS2 002		A90	89F	MicroIRS	5W	50kHz	650	450	22.0	26.0	Nick Bellis	002	
Flight Date (mm/dd/yyyy)	GPS Day	Config File				Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht	
5-May-17	17-125					HRQLS2 002	20.6	15	12.3	50%	175.0	-5	-4			1.75m	
Flight Name	Flight #	Wpt		Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
		From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME						494470	495070										
Block B Line 39				80	96	498193	498419	NS	13470	190	20.6					19	1.2
Block B Line 42				75	96	498769	499069	SN	13459	171	20.6					20	1.1
Block B Line 43				50	75	499393	499712	NS	13292	178	20.6					19	1.1
Block B Line 44				40	80	500100	500630	SN	13449	169	20.6					17	1.5
Block B Line 45				32	65	500957	501379	NS	13230	179	20.6					20	1.1
Block B Line 46				0	30	502002	502390	SN	13505	175	20.6					21	1.1
Line 202						502859	503167	EW	13591	180	20.6					21	1.1
Block C Line 81						503802	504378	NS	13288	184	20.6					19	1.2
Block C Line 82						504699	505281	SN	13436	175	20.6					18	1.3
Block C Line 83						505627	506209	NS	13224	187	20.6					21	1.1
Line 205						506861	507100	WE	13207	175	20.6					18	1.2
POST-FLIGHT GPS STATIC STOP TIME						508995	509595										



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KMHE	20170505 1120	KFSD	20170505 1535		Tim Russell	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C		Operator	Lift #	
5-May-17		17-125		HRQLS2 002		A90	89F	MicroIRS	5W	50kHz	650	450	9.0	20.0	Nick Bellis	001		
Flight Date (mm/dd/yyyy)	GPS Day	Config File				Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C		Data Logger Drive	Ant Ht		
5-May-17	17-125					HRQLS2 002	20.6	15	12.3	50%	175.0	-5	-5			1.75m		
Flight Name	Flight #	Wpt	Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions					SVs	PDOP	
			From	To	Begin	End	Start	End										
PRE-FLIGHT GPS STATIC START TIME					472797	473397											19	1.2
Block B Line 19			45	96	476813	477387	NS	13536	178	20.6						22	0.9	
Block B Line 8			0	30	477863	478219	NS	13658	182	20.6						18	1.1	
Block B Line 34			28	96	479725	480470	NS	13719	180	20.6						16	1.2	
Block B Line 35			28	96	480819	481617	SN	13755	167	20.6						16	1.3	
Block B Line 36			38	96	481955	482700	NS	13492	183	20.6						16	1.2	
Block B Line 37			38	96	483025	483816	SN	13670	167	20.6						17	1.2	
Block B Line 38			45	75	484182	484722	NS	13591	190	20.6						17	1.3	
Line 221					485203	485316	SN	13433	165	20.6						16	1.5	
Line 222					485738	485849	WE	13452	175	20.6						16	1.4	
POST-FLIGHT GPS STATIC STOP TIME					487595	488195												



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KHME	20170512 1718	KHME			Tim Russell	Production
2							
3							

Sigma Space Job #	Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #	
					A90	N89F		MicroIRS	5W	50kHz	550	450	24.0	Nick Bellis	002	
Flight Date (mm/dd/yyyy)	GPS Day	Config File			Unit		Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht	
12-May-17	17-132				HRQLS2 001		20.6	15	12.3	50%	175.0	-5			1.75m	
Flight Name	Flight #	Wpt	Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
	SSC	From	To	Begin	End	Start	End									
PRE-FLIGHT GPS STATIC START TIME					494770	495370					30.02 in Hg (101.66 kpa)				18	1.1
Block B Line 7				70	96			SN		20.6	laser malfunctioning					
Block B Line 8								NS		20.6						
Line 202								EW		20.6						
Line 202								WE		20.6						
Line 221								NS		20.6						
Line 222								WE		20.6						
Line 221								SN		20.6						
Line 222								EW		20.6						
POST-FLIGHT GPS STATIC STOP TIME											30.04 in Hg (101.73 kpa)					



HRQLS2 Flight Log

	Lift Begin		Lift End		Flt Hours	Pilot	Activity
	Airport	Chocks	Airport	Chocks			
1	KHME	20170512 1415	KHME	20170512 1630		Tim Russell	Production
2							
3							

Sigma Space Job #		Project Name				Aircraft	Tail	IMU		Laser Pwr	Pulse Rate	Gate Delay	Gate Dur.	Ground Temp °C	Operator	Lift #
12-May-17		17-132		HRQLS2 001		A90	N89F	MicroIRS	5W	50kHz	550	450		Nick Bellis	001	
Flight Date (mm/dd/yyyy)	GPS Day	Config File				Unit	Scanner	Scan Angle	Altitude	Side Lap	Speed	UTC Zone	Flying Temp °C	Data Logger Drive	Ant Ht	
12-May-17	17-132					HRQLS2 001	20.6	15	12.3	50%	175.0	-5			1.75m	
Flight Name	Flight #	Wpt	Distance		GPS Time		Flt Dir	Altitude (feet)	Speed (knots)	Scan Rate	Comments and Conditions				SVs	PDOP
	SSC	From	To	Begin	End	Start	End									
PRE-FLIGHT GPS STATIC START TIME					483855	484455					30.06 in Hg (101.79 kpa)				16	1.3
Block B Line 7			70	96	486538	486949	SN	13702	169	20.6						
Block B Line 8					487260	488544	NS	13718	175	20.6						
Line 202					489336		WE	13479	173	20.6	Laser stopped firing, had to power cycle, trying EW					
Line 202							EW			20.6	Laser Malfunctioning, landing to troubleshoot					
Line 221							NS			20.6	unable to fly					
Line 222							WE			20.6	unable to fly					
Line 221							SN			20.6	unable to fly					
Line 222							EW			20.6	unable to fly					
POST-FLIGHT GPS STATIC STOP TIME					490866	491466					30.04 in Hg (101.73 kpa)				18	1.3

Section 7: Final Deliverables

The final lidar deliverables are listed below

- LAS v1.4 classified point cloud
- 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 as ESRI shapefile
- Control Points provided as ESRI format
- Flight Lines provided in ESRI format
- Delivery blocks provided in ESRI format
- FGDC compliant metadata per product in XML format
- Lidar processing report in PDF format
- Survey report in PDF format