
LiDAR Project Report

140G0219F0110-CA_Riverside_2019_B19 QL1_QL2 LiDAR

Prepared For:

United States Geological Survey



Prepared By:

Digital Aerial Solutions, LLC



CONTRACT: # G16PC00044 CONTRACTOR: DIGITAL AERIAL SOLUTIONS

TASK ORDER: # 140G0219F0110-CA_Riverside_2019_B19

Project Report
LiDAR Collection, Processing, and QA/QC
140G0219F0110-CA_RIVERSIDE_2019 Q1_
QL1_QL2 LiDAR

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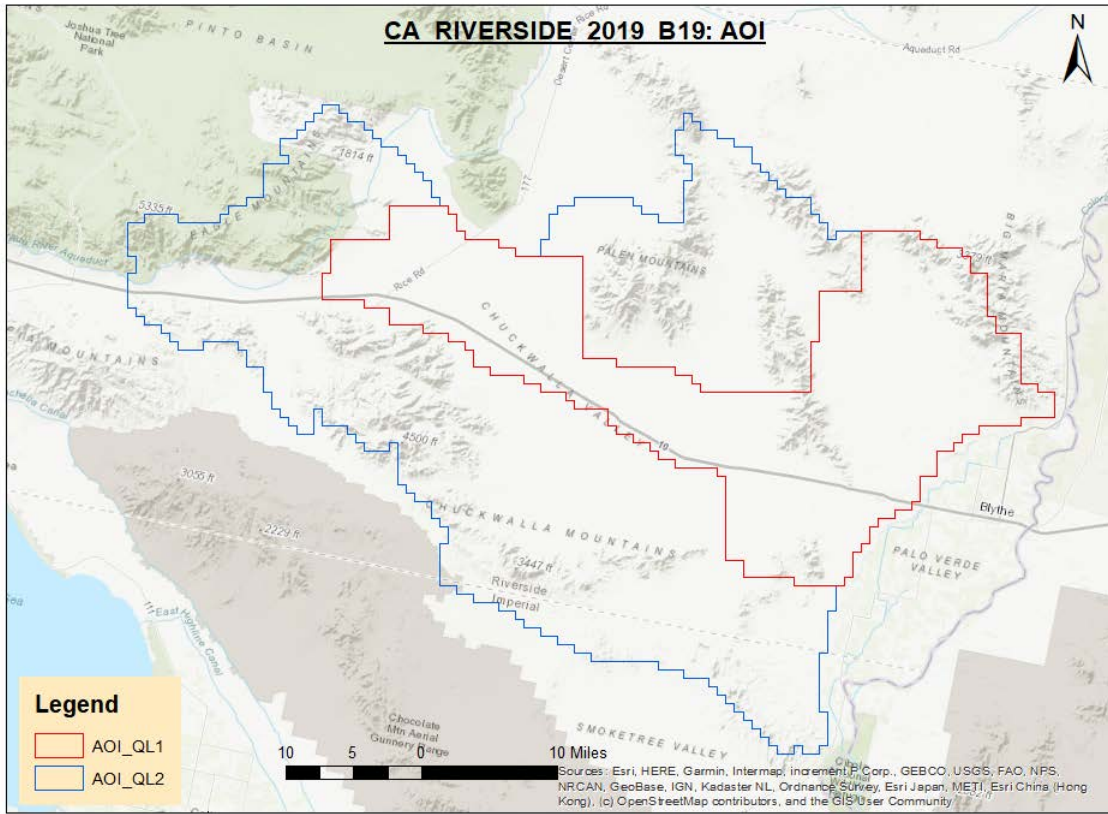


Image 1: CA RIVERSIDE 2019 D19 AOI

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1 Introduction and Specifications

Digital Aerial Solutions, LLC (DAS) was tasked to collect and process a Light Detection and Ranging (LiDAR) derived elevation dataset for the 140G0219F0110-CA_Riverside_2019_B19. The area encompasses approximately 1,613 square miles. Aerial LiDAR data was collected utilizing a Leica TERRAIN MAPPER. The TERRIAN MAPPER is a discrete return topographic LiDAR mapping system manufactured by Leica Geosystems. LiDAR data collected for the 140G0219F0110-CA_Riverside_2019_B19 QL1_QL2 LiDAR survey has an Aggregate Nominal Pulse (ANPS) spacing of (QL1 0.35, QL1_QL2 0.71 meters), and includes up to 2 discrete returns per pulse, along with intensity values for each return.

LiDAR datasets were post processed to generate elevation point cloud swaths for each flight line. Deliverables include tiled point cloud classified by land cover type, breaklines to support hydro-flattening of digital elevation models (DEM), intensity tiles, and bare-earth DEM tiles. The point cloud deliverables are stored in the LAS version 1.4, point data record format 6. The tiling scheme for tiled deliverables is a 1,000 meter x 1,000 meter grid. Tile naming convention is based on the eastern and northing locations of the lower left corner for each tile (w0002n0612). All deliverables were generated in conformance with the U.S. Geological Survey National Geospatial Program Guidelines and Base Specifications, Version 1.3.

2 Spatial Reference System

The spatial reference of the data is as follows:

Horizontal Spatial Reference

- Coordinates: Albers Equal Area, Meters (to 2 decimal places)
- Datum: North American Datum 1983 (2011), Meters (to 2 decimal places)

Vertical Spatial Reference

All datasets are available with orthometric elevation; point cloud datasets are also available with ellipsoid heights.

- Datum: North American Vertical Datum of 1988 (GEOID12B)

3 LiDAR Acquisition

3.1 Survey Area

The 140G0219F0110-CA_Riverside_2019_B192018 QL1_QL2 LiDAR survey covers approximately 1,613 square miles for the QL1_QL2 area of interest covering Riverside County in CA. The flight plan consisted of 221 survey lines and 2 control lines.

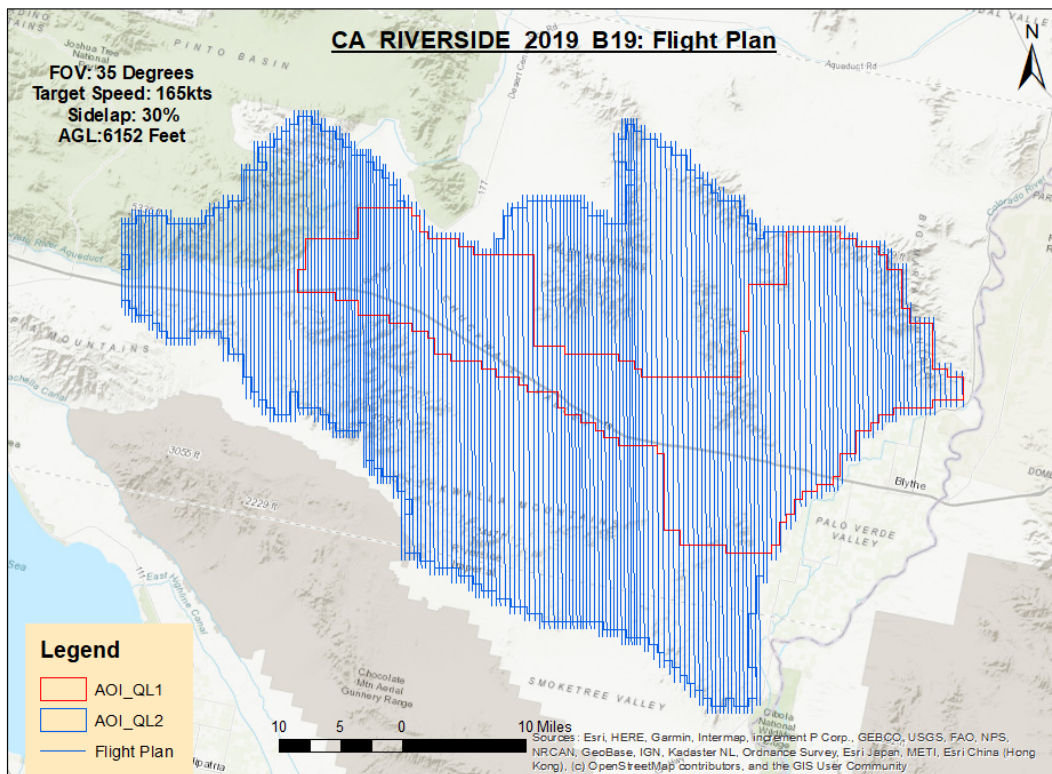


Image 2: CA Riverside 2019 B19 Flightlines

3.2 Acquisition Parameters

Acquisition parameters include the sensor configuration and the flight plan characteristics, and are selected based on a number of project specific criteria. Criteria reviewed include the required accuracies for the final dataset, the land cover types within the project survey area, and the required nominal pulse spacing. Aggregate Nominal Pulse Density (ANPD) for QL1 and QL2 AOIs is no less than 8ppm and 2ppm respectively. The project parameters are summarized below.

Parameter	QL1_QL1_QL2
Flying Height Above Ground Level:	6,152 feet
Nominal Sidelap:	30-55%
Nominal Speed Over Ground:	165 Knots
Field of View:	35°
Laser Rate:	200.00 kHz
Scan Rate:	150.00 Hz
Maximum Across Track Spacing:	0.37meters
Maximum Along Track Spacing:	0.57 meters
Average point Spacing:	0.32 meters

Table 1: Flight Parameters

3.3 Acquisition Mission

The acquisition mission for 140G0219F0110-CA_Riverside_2019_B19 QL1_QL2 LiDAR survey was coordinated for optimal collection conditions and was acquired within 2 weeks. Collection began on August 9, 2019 and was completed on August 21, 2019.

3.4 Airborne GPS/IMU

Airborne global positioning system (GPS) and inertial measurement unit (IMU) data was collected on the aircraft during the acquisition mission, providing sensor position and orientation information for geo- referencing the LiDAR data. Airborne GPS observations were collected at a frequency of 0.5Hz, and IMU observations are collected at a frequency of 200Hz.

Aircraft	Sensor	GPS Lever Arm (m)	IMU Lever Arm (m)
C441-N207SS	TM_9054	X: -0.054, Y: -0.199, Z: -1.081	X: -0.174, Y: -.0178, Z: 1.095

Table 2: Aircraft and Lever Arms

GPS data was collected with ground base stations during the acquisition missions, providing corrections to support differential post-processing of the airborne GPS. Base stations were setup at the following Airports: Lake Havasu City Airport (KHII) and Blythe Airport (KBLH). Ground GPS observations were collected at a frequency of 0.5Hz.

Name	Latitude	Longitude	Ellipsoid (m)
Lake Havasu City Airport-AC6812	34° 34' 04.29247"	-114° 21' 24.75929"	199.302
Blythe Airport- DW0746	33° 36' 57.12493"	-114° 43' 05.60846"	87.288

Table 3: Base Stations locations

4 LiDAR Processing

4.1 Acquisition Post-Processing

Inertial Explorer 8.8 software was used to compute inertial solution file (*.sol) for each mission using ground GPS base station (DW0746 & AC6812) and Grafnet position coordinate in table above. The resulting solution was checked to ensure a minimum accuracy of +/- 0.10m, combined separation, for horizontal and vertical positions. Inertial Explorer methodology integrates Inertial Navigation Solution by processing the GPS data and Inertial Measurement Unit (IMU). The software applies the reference lever arms for the GPS and IMU during the process to determine the trajectory (position and orientation) of the LiDAR sensor during the acquisition mission. Inertial Explorer generated graphical results were reviewed to ensure that the IMU data was healthy.

Raw LiDAR sensor ranging data and the final solution sensor trajectory (*.sol), from Inertial Explorer, were processed in Leica's HxMap software to produce LiDAR point cloud swath for each flight line in LAS version 1.4 file format. Quality control of the swath point cloud was performed to validate proper functioning of the sensor system, full coverage of the project area and point density of the LiDAR data. Swath point clouds were assigned unique file source identification. The data was found to be complete and consistent with the sensor calibration parameters.

4.2 Geometric Calibration

LiDAR data calibration was done using Leica HxMap v2.6.0 software. HxMap is the common workflow platform for Leica airborne sensors. The processing workflow involves; Ingest, Block Creation, LiDAR Matching, Quality Assurance (QA) and Product Generation. LiDAR is processed in HxMap by generating point clouds from raw sensor data during the Ingest step. Noise filtering, sensor installation calibration and atmospheric condition parameters are also applied during the ingest process. Once all data is processed through ingest, they are assembled into a

block for LiDAR Matching. The LiDAR Matching step resolves LiDAR registration errors which remain in the point clouds after sensor and installation calibration parameters are applied in the ingest step. QA tool is run on the Block after LiDAR Matching to verify quality of results. QA results are reviewed to ensure that, 95% of patches < 5cm for Vertical Scan Direction and Vertical Line Separation. Ground control points are also included to assess absolute accuracy for the point cloud data. LiDAR products are finally generated in the Product Generation step as LAS swaths (LAS 1.4). Vertical (Z) shift (calculated from QA step) is also applied during the product generation. The exported LAS 1.4 swath data from HxMap is imported into GeoCue Group's product workflow management software, GeoCue v2017. The full point cloud is tiled into a manageable size for processing in TerraScan.

For 140G0219F0110-CA_Riverside_2019_B19 QL1_QL2 LiDAR project, the control lines listed below were used in data adjustment.

Point Id	Easting	Northing	Orth. Height
GS0002	-1789095.626	1363571.877	426.2548981
GS0014	-1784987.424	1366561.202	420.1871298
GS0026	-1773108.376	1364580.192	273.9811408
GS0055	-1758192.314	1346703.049	309.3925539
GS0062	-1744698.15	1349032.092	116.3543252
GS0087	-1731775.378	1331085.261	177.7658591
GS0094	-1745270.185	1327870.222	304.473644
GS0108	-1755169.219	1336435.823	360.1549064
GS0115	-1725157.202	1312516.805	195.079289
GS0124	-1703752.399	1349533.262	133.8440811
GS0131	-1711998.781	1363988.856	240.8814307
GS0138	-1729656.642	1369801.319	253.1881307
GS0145	-1731557.51	1375713.102	322.3161353
GS0005	-1803302.617	1364906.672	521.1688917
GS0030	-1763562.138	1370876.305	161.8373
GS0036	-1776394.763	1381076.74	370.0880905
GS0044	-1759533.796	1358461.329	209.4663622
GS0069	-1714728.023	1340704.257	119.2598882
GS0078	-1730357.84	1344161.91	120.9809282
GS0103	-1715666.339	1350149.76	155.4059724
GS0002	-1789095.626	1363571.877	426.2548981
GS0014	-1784987.424	1366561.202	420.1871298
GS0026	-1773108.376	1364580.192	273.9811408
GS0055	-1758192.314	1346703.049	309.3925539
GS0062	-1744698.15	1349032.092	116.3543252

Table 5: Ground Control Points

The final geometrically calibrated swath point clouds were compared to the bare-earth profile survey data. The data fit the profile surveys within the vertical accuracy tolerance specified for the project. Full documentation of the vertical accuracy checks maybe found in section 5.1.

4.3 Point Cloud Classification

Georeferenced information was applied to the swath point cloud LAS files. Geometrically calibrated swath point clouds were cut into USNG index, 1,000 meter x 1,000 meter LAS 1.4 format tiles for point cloud classification and derived in LAS 1.4 format for product creation.

Tiled point cloud data was processed in Terrasolid's Terrascan software to assign initial classification values. The Terrascan software provides a number of routines to algorithmically detect and assign points to their appropriate class. Points left unclassified by the algorithmic routine remain as Class 1- Processed, but unclassified. Automated classification routines assigned points to one of the following classes:

Class 1 - Processed, but unclassified

Class 2 - Bare-earth ground

Class 7 - Low Noise (low, manually identified, if necessary)

Class 9 - Water

Class 17 - Bridge Decks

Class 18 - High Noise (high, manually identified, if necessary)

Class 20 - Ignored Ground (Breakline Proximity)

Automated classification results were reviewed for each tiled point cloud, and manual edits made where necessary to correct for misclassified points. Points remaining in Class 1 after the automated classification routines were run were left in Class 1. Points falling outside of a 100 meter buffer of the project AOI polygon were excluded from the tiled point clouds.

4.4 Breakline Collection

Manual breakline collection was performed to support the hydro-flattening requirements of the project's DEM deliverables. Breaklines were collected directly from the classified point clouds and from triangulated irregular network (TIN) surface models built from the classified point clouds, in Terrasolid's Terrascan and Terramodeler software. Breakline features were collected as design file elements in Bentley's Microstation software. Breaklines were converted to ESRI 3D shapefile format for the breakline deliverable.

The data collected for the 140G0219F0110-CA_Riverside_2019_B19 survey maintained significant point density in the water, marsh, and swamp, limiting the usefulness of point density as guiding factor in breakline placement.

Points classified as Class 2 – Bare-earth ground, falling within a tenth of a meter buffer of the collected breaklines, were reassigned to Class 20 – Ignored Ground. These points are excluded from the surface model during DEM generation to preserve the hydro-flattening characteristics of the breaklines.

4.5 DEM Generation

The final classified point clouds and collected breaklines were reviewed for conformance to the task order (scope of work). Within the LP360 software, points in Class 2 – Bare-earth ground and breaklines were combined to generate TIN elevation models for each tile, from which the bare-earth DEM tiles were interpolated and exported as GeoTIFF 32-bit floating point raster format ".tif" format.

5 Quality Control

5.1 Point Clouds

Accuracy and completeness of the LiDAR point clouds directly impacts the quality of all other derived LiDAR derived products. Ensuring a quality LiDAR dataset begins with proper mission planning and execution. Ground GPS base stations are located such that GPS baselines between the ground and airborne receivers do not exceed 30km. For the 140G0219F0110-CA_Riverside_2019_B19 project, two base stations were used to meet this requirement, one at the field operations airport and one within the project area. Static alignment is performed both before take-off and after landing to allow for GPS integer ambiguity resolution. Sensor operators carefully monitor the LiDAR unit and its various subsystems during the acquisition mission to ensure proper function. Airborne GPS positional dilution of precision (PDOP) estimates are monitored to ensure they remain less than 3. The optical system is monitored to ensure there are no ranging errors encountered during the flight lines.

During acquisition post-processing estimates of the trajectory data accuracy are reviewed to ensure they will support the required accuracies of the point cloud data. The trajectory accuracy is a function of the differentially corrected GPS data and the IMU data.

Geometric calibration quality control validates that the positional accuracy requirements of the project are met, and includes relative accuracy assessments for intra-swath (within) and inter-swath (between) accuracy, along with absolute accuracy assessments against project ground control.

Image 3 below, shows the swath to swath calibration assessment depicted by an intensity ortho created by using all returns, and colored by elevation difference between the swaths. The source deltas are an image type used for visualizing the elevation mismatch between overlapping swaths of LAS data. The granularity is controlled by the interval's selection. The interval size specifies the Z threshold at which the color bands apply. The interval used to create the difference elevation image is 0.040m. Colors shown as green indicates swath

separation <0.040m, yellow indicates separation > 0.040m and <0.080m, red indicates separation >0.080m. All red areas depicted in the image have been reviewed and represent locations of high vegetation.

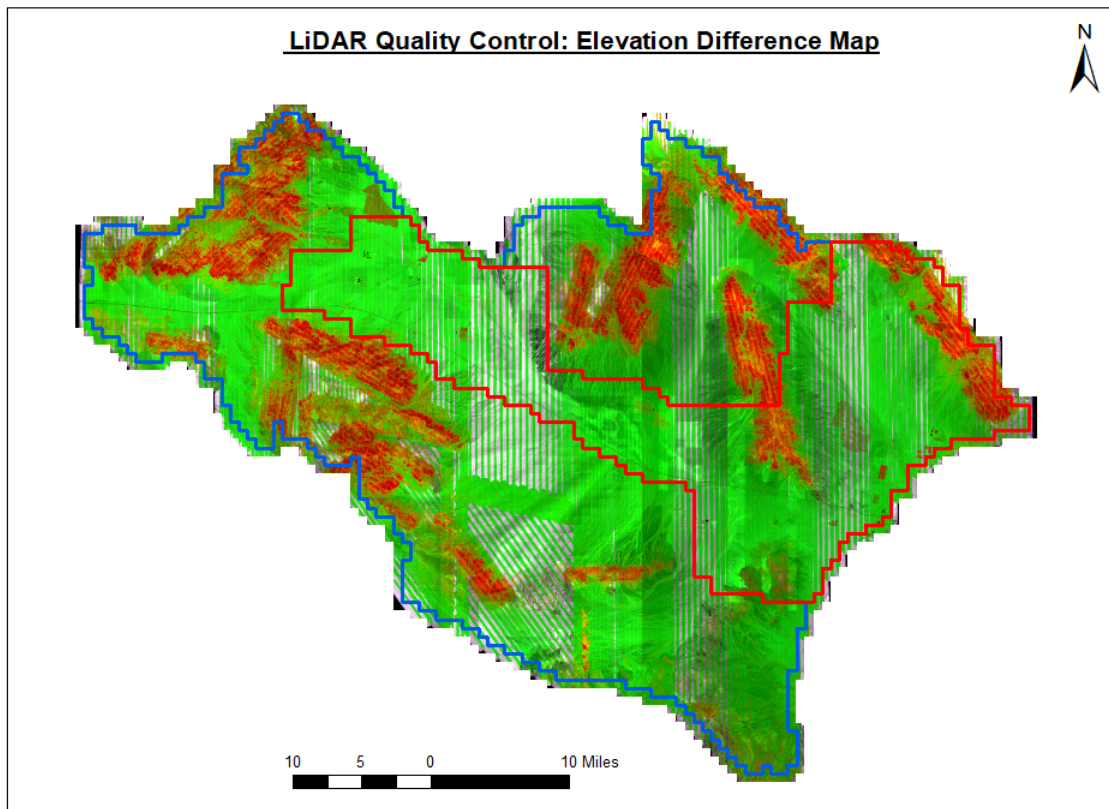


Image 3: Elevation Difference Map Image

This data set was produced to meet ASPRS "Positional Accuracy Standards for Digital Geospatial Data" (2014) for a 22.6 (cm) RMSE_x / RMSE_y Horizontal Accuracy Class which equates to Positional Horizontal Accuracy = \pm 78.3 cm at a 95% confidence level.

Estimated LiDAR Horizontal:	(cm)
Error Per Point (RMSE _R)	32.0
Error Per Point (RMSE _X /RMSE _Y)	22.6
Per Point at 95% confidence level	78.3

Table 6: Estimated LiDAR Horizontal Accuracy

Absolute vertical accuracy assessments for the point cloud data are made against ground check point data. For the 140G0219F0110-CA_Riverside_2019_B19, ground check point data consisted of the ground GPS base station and real-time kinematic (RTK) GPS techniques.

Check point locations were collected at .5 second intervals during the RTK survey. Points collected during the static pre-initialization and post-initialization was removed from the assessment so as not to bias the assessment.

Local TIN models of the elevation points are built around each ground check points. The tin model elevation is sampled at the horizontal position of the ground check point. The TIN model elevation and ground check point survey elevation values were used to calculate the Non-vegetated Vertical Accuracy (NVA) of the swath point clouds. Table 7 below shows the tested accuracy values for TIN and DEM data at 95% confidence level. The full calculations for all check points can be found in Appendix B.

Tested Accuracy	RMSE _Z	NVA	VVA
Classified LiDAR	0.093	67	53
Digital Elevation Model	0.092	67	53

Table 7: Tested RMSE_Z of NVA, NVA and VVA of LiDAR Point Cloud and Digital Elevation Model.

Total #	# NVA	# VVA
120	67	53

Table 8: Number of Survey Points used to calculate accuracy of data.

The tiled point cloud products were reviewed for full coverage of the AOI and proper classification. As part of the QC process, TINs are built in the Terramodeler software for each tile using the ground class and the hydro-flattening breaklines. The TINs are reviewed for non-ground features, and edited where necessary to remove any remaining non-ground features. Points were also reviewed for absolute elevation, and points falling below the selected orthometric elevation for water were removed from the ground class.

5.2 Breaklines

The final breaklines in ESRI 3D shapefile format were reviewed for topological consistency and correct elevation. Breaklines features are continuous and do not have overlaps or dangles.

5.3 Digital Elevation Models

Digital elevation models (DEMs) were reviewed for conformance with the SOW and the Base Mapping Specification version 1.3 guidelines. DEM files were loaded in the Global Mapper software and inspected visually for edge matching between tiles, void areas within the project AOI, and proper coding of the NODATA values. DEM file naming was verified for consistency with the USNG index.

Appendix A. Flight Logs



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	39	33	100.85		Cynthia Williams		
Date/Julian:	8.10.19	Disk Drive			Sensor				Pilot			
Hobbs End	6677.2	TM MM30 (101, 102)			TM_90524				Mike Wasielewski			
Hobbs ST	6672.2	TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:		
Flight Time	5	6,500	165		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)		
∟	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP	
	76	76	1:42	1:57	6299	158°	158	6539	25	1.1	0.6	
	75	75	2:00	2:15	6334	337°	169	6483	23	1.2	0.6	
	74	74	2:19	2:33	63147	155°	156	6437	23	1.3	0.6	
	73	73	2:37	2:51	6317	335°	164	6378	25	1.2	0.6	
	72	72	2:55	3:10	6279	161°	150	6326	23	1.1	0.6	
	71	71	3:14	2:19	6314	337°	161	6272	24	1.1	0.6	
	70	70	:33	3:49	6304	154°	155	6216	23	1.1	0.6	
	69	69	3:51	4:06	634	338°	163	6156	22	1.1	0.6	
	68	68	4:11	4:25	6289	156°	154	6099	23	1.1	0.6	
	67	67	4:29	3:38	6363	338°	162	6035	22	1.2	0.6	
	66	66	4:48	5:04	63.34	156°	152	5971	22	1.3	0.6	
	65	65	5:07	5:22	6348	338°	162	5907	20	1.2	0.6	
	64	64	5:26	5:41	6358	157°	158	5833	20	1.1	0.6	
	63	63	5:45	6:00	6356	337°	158	5765	21	1.2	0.7	



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before		Temp °C After		Pressure (kPa)		Sensor Operator	
					A	32		37		101.22		Stephen Overcast	
Date/Julian:		8.11.19		Disk Drive			Sensor					Pilot	
Hobbs End		6682.4		TM MM30 (103, 104)			TM_90524					Mike Wasielewski	
Hobbs ST		6677.2		TARGET MSL		Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:
Flight Time		5.2		6,500		165		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:	
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP		
	1	1	14:33	14:45	6357	252°	1519	7148	21	1.2	0.7		
	180	180	14:53	14:58	7320	337°	162	7067	20	1.2	0.7	Gimble angle warning	
	179	179	15:03	15:10	7321	157°	156	7052	20	1.1	0.7		
	178	178	15:14	15:21	7330	337°	162	7022	18	1.3	0.7		
	177	177	15:25	5:32	7321	159°	161	6998	16	1.6	0.8		
	176	176	15:37	15:44	7329	337°	161	6964	16	1.6	0.9		
	175	175	15:49	15:56	7320	158°	160	6935	17	1.3	0.8		
	174	174	16:01	16:08	7314	336°	162	6896	20	1.2	0.7		
	173	173	16:13	16:21	7310	157°	159	6868	20	1.2	0.7		
	172	172	16:26	16:34	7277	336°	161	6827	20	1.2	0.7		
	171	171	16:39	16:47	7257	156°	158	6794	21	1.1	0.6		
	170	170	16:51	16:58	7230	337°	164	6755	21	1.2	0.7		
	169	169	17:04	17:11	7232	156°	162	6716	22	1.1	0.6		
	168	168	17:16	17:24	7229	337°	160	6675	23	1.1	0.6		
	167	167	17:29	17:37	7186	157°	161	6629	23	1.1	0.6		
	166	166	17:41	17:49	7164	336°	164	6581	22	1.1	0.6		
	165	165	17:54	18:02	7116	155°	158	6536	22	1.2	0.6		
	164	164	18:06	18:14	7079	338°	157	6493	20	1.2	0.6		
	163	163	18:20	18:28	7004	157°	161	6454	20	1.1	0.6	Mount roll pitch out of limit	
	162	162	18:32	18:40	7019	337°	160	6417	19	1.3	0.6		
	2	2	18:48	19:01	6197	99°	159	6377	19	1.3	0.6		



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before		Temp °C After		Pressure (kPa)		Sensor Operator	
					A	39		34		101.22		Cynthia Williams	
Date/Julian:		8.11.19		Disk Drive			Sensor					Pilot	
Hobbs End		6687.2		TM MM30 (101, 102)			TM_90524					Wes Ashmore	
Hobbs ST		6682.4		TARGET MSL		Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:
Flight Time		4.8		6,500		165		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:	
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP		
	62	62	1:50	2:06	6425	158°	150	5695	25	1.0	0.5		
	61	61	2:09	2:23	6438	336°	159	5641	22	1.2	0.6		
	60	60	2:28	2:43	6396	158°	159	5585	23	1.3	0.6		
	59	59	2:46	3:01	6412	339°	163	5532	25	1.1	0.6		
	58	58	3:05	3:21	6403	157°	162	5475	25	1.1	0.6		
	57	57	3:23	3:37	6384	3337°	162	5424	23	1.1	0.6		
	56	56	3:42	3:56	6317	158°	156	5373	23	1.1	0.6		
	55	55	3:59	4:13	6328	337°	162	5324	23	1.1	0.6		
	54	54	4:18	4:32	6329	157°	157	5275	22	1.2	0.6		
	53	53	4:35	4:49	6334	336°	164	5225	23	1.1	0.6		
	52	52	4:53	5:07	6203	155°	159	5176	21	1.2	0.7		
	51	51	5:11	5:25	6215	338°	156	5129	21	1.2	0.7		
	50	50	5:30	5:43	6210	157°	157	5084	18	1.3	0.8		
	49	49	5:47	6:00	6214	337°	157	5037	22	1.1	0.6		



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	32	38	101.25		Stephen Overcast		
Date/Julian:	8.12.19	Disk Drive			Sensor <th colspan="3">Pilot</th>			Pilot				
Hobbs End	6692.3	TM MM30 (101, 102)			TM_90524			Mike Wasielewski				
Hobbs ST	6687.2	TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:		
Flight Time	5.1	6,500	165		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)		
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available MM Space	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:						AVG PDOP	AVG HDOP	
	210	210	14:43	14:45	7659	156°	157	4989	19	1.4	0.8	Occular not disabled (no issue)
	209	209	14:49	14:51	7653	336°	162	4979	20	1.3	0.7	
	208	208	14:56	14:59	7643	158°	156	4971	20	1.2	0.7	
	207	207	15:02	15:05	7652	337°	163	4958	18	1.2	0.7	
	206	206	15:10	15:13	7644	158°	158	4944	16	1.3	0.7	
	205	205	15:16	15:19	7653	337°	159	4932	16	1.3	0.8	
	204	204	15:24	15:27	7651	158°	156	4919	16	1.3	0.8	
	161	161	15:35	15:43	7045	337°	156	4907	15	1.6	0.8	
	160	160	15:48	15:57	6850	155°	151	4866	16	1.3	0.8	Maual stop (1 second on line left)
	203	203	16:05	16:08	7580	336°	151	4831	18	1.2	0.7	
	202	202	16:13	16:16	7576	157°	159	4824	18	1.2	0.7	
	201	201	16:20	16:23	7591	338°	154	4811	18	1.3	0.7	
	200	200	16:28	16:32	7568	157°	160	4794	19	1.1	0.7	
	199	199	16:39	16:43	7541	337°	165	4780	20	1.1	0.6	
	198	198	16:47	16:51	7438	156°	159	4767	20	1.2	0.7	
	197	197	16:55	16:59	7456	338°	166	4749	20	1.2	0.7	
	48	48	17:19	17:29	6188	158°	155	4732	19	1.2	0.7	
	47	47	17:33	17:42	6203	337°	164	4695	17	1.4	0.7	
	46	46	17:47	17:56	6193	156°	156	4658	17	1.2	0.7	
	45	45	18:00	18:09	6220	336°	154	4625	18	1.2	0.7	
	44	44	18:14	18:23	6185	156°	153	4592	18	1.2	0.7	
	43	43	18:27	18:35	6223	337°	158	4561	20	1.3	0.7	
	42	42	18:40	18:48	6167	157°	159	4530	20	1.3	0.6	
	41	41	18:51	18:59	6229	338°	164	4501	20	1.3	0.6	



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	39	33	101.12		Cynthia Williams		
Date/Julian:	8.12.19		Disk Drive			Sensor						Pilot
Hobbs End	6697		TM MM30 (101, 102)			TM_90524						Mike Wasielewski
Hobbs ST	6692.3		TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:	
Flight Time	4.7		6,500		165			AC6812		DW0746	1.500	C441-N207SS KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP	
	40	40	2:28	2:36	6302	159°	159	6328	26	26.0	0.6	
	39	39	2:40	2:48	6264	338°	162	6299	25	25.0	0.6	
	38	38	2:51	2:59	6259	1591°	155	9221	24	24.0	0.7	
	37	37	3:03	3:11	6285	340°	1578	6242	24	24.0	0.7	
	36	36	3:14	3:22	6265	157°	155	6215	25	25.0	0.6	
	35	35	3:26	3:34	6273	336°	165	6188	25	25.0	0.6	
	34	34	3:37	3:45	6272	157°	162	6162	24	24.0	0.6	
	33	33	3:48	3:56	6293	338°	159	6135	25	25.0	0.6	
	32	32	4:00	4:07	6297	157°	159	6108	25	25.0	0.6	
	31	31	4:11	4:18	6291	338°	162	6082	24	24.0	0.6	
	30	30	4:22	4:29	6313	157°	161	6055	23	23.0	0.6	
	29	29	4:32	4:39	9696	340°	163	6032	23	23.0	0.6	
	28	28	4:43	4:50	6248	160°	167	6011	21	21.0	0.6	
	87	87	4:58	5:10	6326	335°	159	5989	21	21.0	0.6	
	88	88	5:14	5:26	6308	156°	160	5947	23	23.0	0.6	
	121	121	5:31	5:40	6419	335°	164	5906	18	18.0	0.7	
	122	122	5:44	5:54	6426	157°	151	5875	20	20.0	0.6	
	123	123	5:57	6:07	6430	339°	161	5842	20	20.0	0.6	
	124	124	6:10	6:20	6460	157°	160	5811	20	20.0	0.7	
	125	125	6:24	6:33	6491	336°	162	5778	19	19.0	0.7	



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	30	37	101.29		Stephen Overcast		
Date/Julian:	8.13.19	Disk Drive			Sensor				Pilot			
Hobbs End	6700.5	TM MM30 (103, 104)			TM_90524				Mike Wasielewski			
Hobbs ST	6697	TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:		
Flight Time	3.5	6,500	165		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)		
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available MM Space	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:						AVG PDOP	AVG HDOP	
	27	27	14:33	14:38	6226	156°	158	5744	21	1.2	0.7	
	26	26	14:43	14:48	6221	336°	158	5724	19	1.3	0.7	
	25	25	14:52	14:58	6255	158°	162	5703	19	1.2	0.7	
	24	24	15:02	15:07	6236	336°	162	5685	16	1.5	0.8	
	23	23	15:11	15:16	6239	157°	157	5665	15	1.8	0.9	
	22	22	15:20	15:25	6241	336°	158	5647	15	1.8	0.9	
	21	21	15:30	15:34	6247	157°	159	5630	16	1.8	0.9	
	20	20	15:38	15:43	6243	337°	159	5612	16	1.8	1	
	19	19	15:47	15:52	6250	157°	159	5597	16	1.8	1	Turned early
	18	18	15:56	16:00	6251	337°	164	5577	20	1.1	0.7	
	17	17	16:05	16:09	6255	156°	157	5564	21	1.1	0.7	
	16	16	16:12	16:17	6251	336°	158	5549	20	1.2	0.7	
	15	15	16:21	16:25	6263	156°	160	5536	20	1.3	0.7	
	14	14	16:28	16:31	6261	337°	162	5521	22	1.1	0.6	
	13	13	16:36	16:38	6256	158°	159	5511	22	1.1	0.6	
	12	12	16:42	16:45	6259	337°	159	5499	22	1.2	0.6	
	11	11	16:49	16:51	6265	158°	160	5486	22	1.2	0.6	
	10	10	16:55	16:58	6259	337°	161	5478	23	1.1	0.6	
	9	9	17:02	17:04	6265	156°	161	5467	23	1.1	0.6	
	8	8	17:09	17:10	6263	336°	163	5457	24	1.1	0.6	
	7	7	17:14	17:15	6255	156°	162	5453	23	1.2	0.6	
	6	6	17:19	17:20	6254	337°	161	5449	23	1.2	0.6	
	5	5	17:24	17:25	6256	157°	165	5441	22	1.2	0.6	
	4	4	17:29	17:30	6259	337°	164	5440	21	1.2	0.6	



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	40	33	101.22		Cynthia Williams		
Date/Julian:		8.13.19		Disk Drive			Sensor				Pilot	
Hobbs End		6700.5		TM MM30 (101, 102)			TM_90524				Mike Wasielewski	
Hobbs ST		6705.4		TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:
Flight Time		4.9		6,500		165		AC6812		DW0746	1.500	C441-N207SS KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP	
	89	89	3:01	3:13	6386	160°	160	4393	22	1.1	0.6	
	90	90	3:16	3:28	6384	157°	157	4350	23	1.1	0.6	
	91	91	3:31	3:43	6348	159°	159	4311	24	1.1	0.5	Roll Mount Out of Limit
	92	92	3:47	4:01	6355	158°	158	4268	23	1.1	0.6	
	93	93	4:04	4:15	6355	162°	162	4224	25	1.1	0.5	
	94	94	4:19	4:37	6386	162°	162	4183	23	1.1	0.6	
	95	95	4:36	4:27	6368	163°	163	4142	21	1.1	0.6	
	96	96	4:52	5:04	6382	152°	152	4103	20	1.2	0.7	
	97	97	5:08	5:23	6380	163°	163	4061	22	1.2	0.6	
	98	98	5:25	5:36	6382	157°	157	4022	18	1.0	0.7	
	181	181	5:49	5:54	7459	167°	167	3980	20	1.2	0.6	
	182	182	5:58	6:03	7484	161°	161	3964	20	1.0	0.6	
	183	183	6:07	6:12	7469	165°	165	3948	20	1.1	0.6	
	184	184	6:15	6:22	7415	162°	162	3344	20	1.1	0.6	
	185	185	6:25	6:28	7472	159°	159	3919	17	1.1	0.7	
	186	186	6:32	6:37	7472	150°	150	3905	16	1.5	0.8	
	187	187	6:41	6:45	7464	150°	150	3880	16	1.2	0.8	
	188	188	6:48	6:52	7455	160°	160	3878	16	1.2	0.8	
	189	189	6:56	7:00	7439	153°	153	3868	18	1.1	0.6	
	190	190	7:04	7:07	7459	159°	159	3853	18	1.1	0.6	



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator					
					A	32	41	100.95		Stephen Overcast					
Date/Julian:	8.14.2019		Disk Drive			Sensor						Pilot			
Hobbs End	6709.9		TM MM30 (101, 102)			TM_90524						Mike Wasielewski			
Hobbs ST	6705.4		TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:				
Flight Time	4.5		6,500		165		AC6812		DW0746		1.500		C441-N207SS	KHII (Lake Havasu, AZ)	
∠	Flight Line	239	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available MM Space	S/Vs:	Position Acc.		Comments and Conditions:			
			Begin:	End:						AVG PDOP	AVG HDOP				
	239	239	15:21	15:26	6480	157°	161	5433	16	1.6	0.8				
	282	282	15:30	15:31	6627	301°	153	5415	16	1.6	0.8				
	283	283	15:35	15:37	7112	122°	155	5412	16	1.7	0.8				
	306	306	15:44	15:45	7755	301°	163	5408	17	1.7	0.9				
	305	305	15:50	15:55	7802	302°	161	5402	21	1.2	0.7				
	304	304	15:59	16:04	7780	121°	162	5382	21	1.3	0.7				
	306	306	16:08	16:09	7772	301°	159	5363	21	1.3	0.8				
	303	303	16:16	16:21	7792	300°	164	5358	21	1.4	0.8				
	302	302	16:26	16:32	7680	121°	164	5335	24	1.1	0.7				
	301	301	16:36	16:42	7702	303°	161	5312	24	1.2	0.7				
	300	300	16:46	15:52	7706	122°	164	5288	23	1.2	0.7				
	299	299	16:56	17:02	7712	303°	161	5265	24	1.1	0.7				
	303	303	17:18	17:24	7716	303°	164	5243	24	1.2	0.6	refly			
	300	300	17:28	1:34	7721	121°	164	5222	24	1.2	0.6	refly			
	298	298	17:39	17:45	7738	299°	158	5201	23	1.2	0.6				
	297	297	17:49	17:55	7770	121°	154	5181	21	1.2	0.7				
	240	240	18:00	18:05	6590	336°	160	5161	21	1.2	0.7				
	241	241	18:09	18:14	6534	157°	161	5144	18	1.4	0.8				
	242	242	18:18	18:23	6518	335°	154	5123	21	1.4	0.7				
	243	243	18:27	18:32	6517	156°	159	5107	21	1.4	0.7				
	244	244	18:36	18:41	6511	337°	155	5088	21	1.4	0.7				
	245	245	18:45	18:51	6506	158°	156	5070	21	1.4	0.7				
	246	246	18:54	19:00	6512	336°	160	5046	23	1.2	0.7				



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator					
					A	41	34	100.98		Cynthia Williams					
Date/Julian:		8.14.19			Disk Drive		Sensor				Pilot				
Hobbs End		6715.1			TM MM30 (101, 102)		TM_90524				Mike Wasielewski				
Hobbs ST		6709.9			TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:		
Flight Time		5.2			6,500		165		AC6812		DW0746		1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available MM Space	S/Vs:	Position Acc.		Comments and Conditions:			
			Begin:	End:						AVG PDOP	AVG HDOP				
	247	247	3:24	3:31	6517	157°	155	3840	26	1.1	0.6				
	248	248	3:35	3:41	6539	337°	155	3813	28	1.1	0.6				
	249	2449	3:44	3:51	6456	157°	155	3795	28	1.1	0.6				
	250	250	3:54	4:01	6546	336°	146	3711	28	1.1	0.5				
	251	251	4:05	4:11	6583	155°	164	3748	26	1.2	0.6				
	252	252	4:15	4:21	6612	336°	143	3726	26	1.1	0.6				
	253	253	4:24	4:25	6590	370°	168	3704	25	1.1	0.6				
	254	254	4:35	4:42	6904	337°	153	3677	22	1.2	0.6				
	255	255	4:45	4:54	6653	159°	151	3654	21	1.2	0.6				
	256	256	4:56	5:03	6615	338°	156	3626	22	1.1	0.6				
	257	257	5:06	5:12	6666	159°	164	3603	22	1.0	0.6				
	258	258	5:16	5:23	6652	338°	150	3580	20	1.2	0.7				
	259	259	5:27	5:33	6723	159°	161	3554	22	1.0	0.7				
	191	191	5:40	5:45	7304	326°	154	3529	19	1.2	0.7				
	192	192	5:47	5:51	7302	158°	156	3514	20	1.2	0.7				
	193	193	5:54	5:58	7298	337°	155	3504	20	1.1	0.7				
	194	194	6:02	6:06	7289	157°	160	3491	20	1.1	0.6				
	195	195	6:09	6:16	73376	158°	160	3474	21	1.1	0.6				
	196	196	6:16	6:20	7312	162°	156	3467	18	1.1	0.7				
	260	260	6:28	6:35	6841	337°	155	3454	18	1.5	0.8				
	261	261	6:38	6:46	6850	162°	156	3430	18	1.2	0.7				
	262	262	6:49	6:56	6830	336°	159	3408	19	1.1	0.7				
	263	263	7:00	7:08	6781	160°	156	3380	20	1.3	0.7				
	264	264	7:11	7:18	6782	337°	159	3354	21	1.3	0.7				
	265	265	7:25	7:33	6791	158°	159	3329	21	1.3	0.7				
	266	266	7:36	7:43	6733	336°	163	3305	22	1.1	0.6				

Digital Aerial Solutions Flight Log

Project/Flight Plan:		Ca_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)			Sensor Operator		
					B	32	43	100.15			Stephen Overcast		
Date/Julian:	08-15-2019		Disk Drive			Sensor						Pilot	
Hobbs End	6719.9		TM MM30 (103, 104)			TM_90524						Wes Ashmore	
Hobbs ST	6715		TARGET MSL		Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:	
Flight Time	4.9				160		AC6812			1.500	C441-N207SS	KHII	
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:	
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP		
		296w	14:59	15:04	7832	302°	164	5027	11	1.7	1		
		295e	15:08	15:13	7842	121°	160	5008	12	1.6	1		
		294w	15:18	15:22	7760	301°	157	4989	13	1.5	0.8		
		293e	15:26	15:31	7752	121°	161	4973	13	1.5	0.9		
		292w	15:36	15:41	7664	302°	158	4956	14	1.3	0.8		
		291e	15:45	15:48	7600	121°	157	4940	15	1.1	0.7		
		290w	15:53	15:57	7590	301°	158	4925	15	1.2	0.7		
		289e	16:01	16:04	7572	122°	162	4913	16	1.2	0.7		
		288w	16:08	16:11	7471	301°	158	4903	15	1.3	0.7		
		287e	16:15	16:18	7456	121°	161	4893	18	1.2	0.7		
		286w	16:22	16:24	7356	301°	162	4885	19	1.2	0.6		
		285e	16:28	16:30	7356	121°	161	4874	19	1.2	0.7		
		284w	16:35	16:36	7289	303°	161	4869	18	1.3	0.7		

Digital Aerial Solutions Flight Log

Project/Flight Plan:		Ca_Riverside			Lift	Temp °C Before		Temp °C After		Pressure (kPa)		Sensor Operator	
					C	32		43		100.15		Stephen Overcast	
Date/Julian:		08-15-2019		Disk Drive			Sensor					Pilot	
Hobbs End		6719.9		TM MM30 (103, 104)			TM_90524					Wes Ashmore	
Hobbs ST		6715		TARGET MSL		Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:
Flight Time		4.9				160		AC6812			1.500	C441-N207SS	KHII
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:	
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP		
		393e	16:44	16:45	7395	122°	158	4862	18	1.3	0.7		
		392w	16:49	16:50	7311	301°	163	4861	19	1.3	0.7		
		391e	16:54	16:56	7255	121°	165	4852	19	1.3	0.7		
		390w	17:01	17:03	7157	301°	162	4848	19	1.3	0.7		
		389e	17:07	17:10	7158	120°	162	4838	20	1.3	0.7		
		388w	17:13	17:17	7168	302°	163	4828	21	1.2	0.6		
		387e	17:21	17:25	7103	121°	162	4817	21	1.2	0.6		
		386w	17:28	17:33	7098	300°	163	4803	21	1.1	0.6		
		385e	17:37	17:41	7003	121°	162	4788	21	1.2	0.8		
		384w	17:45	17:49	6960	301°	160	4772	22	1.2	0.7		
		383e	17:53	17:58	6951	122°	161	4753	19	1.2	0.8		
		382w	18:02	18:07	6960	301°	161	4737	19	1.2	0.8		
		381e	18:11	18:16	6949	122°	163	4720	18	1.3	0.7		
		380w	18:20	18:26	6975	302°	161	4700	18	1.3	0.7		
		379e	18:30	18:34	6963	121°	160	4681	19	1.3	0.7		
		378w	18:39	18:44	6950	301°	159	4662	19	1.4	0.7		
		377e	18:48	18:52	6957	121°	157	4646	20	1.4	0.7		
		376w	18:57	19:01	6926	302°	164	4626	22	1.2	0.6		



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator				
					A	42	37	100.75		Akeem Kerr				
Date/Julian:		8/15/2019		Disk Drive		Sensor					Pilot			
Hobbs End		6723.7		TM MM30 (103, 104)		TM_90524					Mike Wasielewski			
Hobbs ST		6719.9		TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:		
Flight Time		3.8		8,200		160			AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:		
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP			
	350	350	3:13	3:21	6390	156°	155	4613	26	1.1	0.6			
	351	351	3:25	3:22	6396	337°	165	4584	27	1.1	0.5			
	352	352	3:36	3:44	6376	159°	154	4556	27	1.1	0.6			
	353	353	3:47	3:55	6396	337°	161	4530	26	1.1	0.6			
	354	354	3:59	4:07	6399	156°	155	4504	27	1.1	0.5			
	355	355	4:10	4:18	6418	334°	150	4476	26	1.1	0.6			
	356	356	4:21	4:29	6380	158°	155	4450	26	1.1	0.6			
	357	357	4:33	4:40	6400	338°	159	4423	23	1.2	0.6			
	358	358	4:44	4:51	6385	156°	150	4398	22	1.1	0.6			
	359	359	4:54	5:02	6401	336°	164	4370	26	0.9	0.5			
	360	360	5:06	5:13	6376	158°	146	4345	25	1.0	0.6			
	361	361	5:17	5:23	6395	338°	166	4322	21	1.2	0.7			
	362	362	5:27	5:33	6386	156°	148	4295	23	1.0	0.6			
	363	363	5:36	5:42	6388	335°	161	4276	23	1.0	0.6			
	364	364	5:45	5:51	6383	158°	147	4255	23	1.0	0.6			
	365	365	5:55	6:01	6457	335°	159	4232	22	1.1	0.7			
	366	366	6:05	6:11	6436	156°	155	4212	22	1.1	0.6			
	367	367	6:14	6:20	6457	337°	164	4191	19	1.4	0.8			

Digital Aerial Solutions Flight Log

Project/Flight Plan:		Ca_Riverside				Lift	Temp °C Before		Temp °C After		Pressure (kPa)		Sensor Operator	
						A	32		38		100.95		Stephen Overcast	
Date/Julian:		08-16-2019		Disk Drive				Sensor				Pilot		
Hobbs End		6725.8		TM MM30 (103, 104)				TM_90524				Wes Ashmore		
Hobbs ST		6723.7		TARGET MSL		Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:	
Flight Time		2.1				160		AC6812			1.500	C441-N207SS	KHII	
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:		
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP			
		375w	15:05	15:08	6866	303°	160	4168	14	1.7	0.8			
		374e	15:12	15:16	6848	122°	162	4156	13	1.7	0.8			
		373w	15:20	15:23	6810	303°	163	4145	13	1.8	0.9			
		372e	15:27	15:30	6791	121°	161	4136	14	1.4	0.8			
		371w	15:34	15:36	6706	302°	163	4127	14	1.4	0.8			
		370e	15:40	15:42	6651	121°	158	4118	16	1.1	0.7			
		369w	15:47	15:48	6632	301°	161	4112	16	1.1	0.7			
		368e	15:52	15:53	6611	122°	160	4107	17	1.2	0.7	refly		
		368w	16:07	16:08	6585	302°	162	4103	14	1.3	0.7	refly		
		368w	16:21	16:22	6574	302°	160	4099	17	1.2	0.8			



Digital Aerial Solutions Flight Log

Project/Flight Plan:		CA_Riverside_Reflight			Lift	Temp °C Before	Temp °C After	Pressure (kPa)			Sensor Operator		
					A	30	32	101.12			Akeem Kerr		
Date/Julian:		8/19/2019		Disk Drive			Sensor					Pilot	
Hobbs End		6727.5		TM MM30 (103, 104)			TM_90524					Wes Ashmore	
Hobbs ST		6725.8		TARGET MSL		Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:
Flight Time		1.7		8,200		160		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∟	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:	
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP		
	401	401	14:51	14:55	8643	302°	149	4096	15	1.6	0.8		
	402	402	14:59	15:04	8628	122°	153	4085	15	1.6	0.8		
	403	403	15:07	15:12	8674	304°	155	4076	15	1.6	0.9		
	404	404	15:16	15:21	8673	121°	152	4065	16	1.3	0.8		
	405	405	15:25	15:31	8611	300°	151	4055	15	1.5	0.9		
	406	406	15:35	15:40	8579	122°	151	4044	18	1.2	0.7		
	407	407	15:45	15:50	8583	302°	155	4033	19	1.1	0.7		



Digital Aerial Solutions Flight Log

Project/Flight Plan:		CA Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	42	34	100.75		Akeem Kerr		
Date/Julian:	8/20/2019	Disk Drive			Sensor				Pilot			
Hobbs End	32.8	TM MM30 (103, 104)			TM_90524				Mike Wasielewski			
Hobbs ST	27.5	TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:		
Flight Time	5.3	9,672	160		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)		
∟	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available MM Space	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:						AVG PDOP	AVG HDOP	
	448	448	5:41	5:43	9640	102°	154	3844	19	1.1	0.7	
	449	449	5:47	5:49	9836	279°	156	3840	19	1.1	0.7	
	450	450	5:53	5:54	10193	101°	156	3829	16	1.4	0.8	
	451	451	6:03	6:05	10208	100°	157	3825	17	1.7	0.9	
	452	452	6:08	6:10	10211	281°	150	3821	17	1.3	0.8	
	468	468	6:15	6:17	10096	345°	160	3818	17	1.4	0.8	
	467	467	6:21	6:23	10094	166°	156	3813	17	1.4	0.8	
	466	466	6:27	6:29	10035	345°	155	3808	17	1.3	0.7	
	465	465	6:34	6:36	9985	166°	156	3803	17	1.3	0.7	
	456	456	6:41	6:43	10075	102°	153	3800	19	1.2	0.7	
	455	455	6:47	6:49	10065	281°	154	3793	18	1.3	0.7	
	454	454	6:53	6:54	10187	100°	158	3789	18	1.3	0.7	
	453	453	6:57	6:59	10191	282°	151	3784	18	1.3	0.7	
	441	441	7:07	7:09	8754	64°	154	3782	19	1.1	0.6	



Digital Aerial Solutions Flight Log

Project/Flight Plan:		CA_ Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	42	34	100.75		Akeem Kerr		
Date/Julian:	8/20/2019		Disk Drive			Sensor					Pilot	
Hobbs End	32.8		TM MM30 (103, 104)			TM_90524					Mike Wasielewski	
Hobbs ST	27.5		TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:	
Flight Time	5.3		9,672		160		AC6812		DW0746	1.500	C441-N207SS KHII (Lake Havasu, AZ)	
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP	
	471	471	2:39	2:44	9619	206°	156	4021	23	1.2	0.7	
	472	472	2:48	2:54	9773	25°	159	4008	24	1.1	0.6	
	473	473	2:58	3:03	9783	204°	155	3995	24	1.1	0.6	
	474	474	3:08	3:13	9778	26°	160	3982	24	1.2	0.6	
	475	475	3:16	3:18	9771	206°	150	3972	24	1.2	0.6	
	476	476	3:24	3:28	9783	25°	156	3970	23	1.3	0.6	
	477	477	3:31	3:36	9557	206°	153	3960	24	1.2	0.6	
	478	478	3:40	3:46	9131	26°	151	3951	22	1.3	0.6	
	479	479	3:50	3:55	9119	205°	155	3942	22	1.3	0.6	
	480	480	3:58	4:03	8878	26°	160	3932	22	1.3	0.6	
	481	481	4:08	4:12	9260	207°	149	3923	20	1.4	0.7	
	482	482	4:16	4:20	9265	26°	162	3913	20	1.3	0.7	
	483	483	4:24	4:27	9368	207°	154	3905	19	1.2	0.6	
	484	484	4:31	4:34	9379	26°	161	3899	19	1.1	0.6	
	485	485	4:37	4:40	9286	204°	155	3892	20	1.1	0.6	
	486	486	4:43	4:46	9247	23°	152	3886	19	1.1	0.6	
	487	487	4:50	4:53	9186	206°	148	3882	18	1.1	0.7	
	488	488	4:57	4:59	9422	27°	156	3874	17	1.1	0.7	
	489	489	5:02	5:05	9382	207°	153	3869	21	1.0	0.6	
	490	490	5:09	5:10	9329	27°	155	3865	20	1.0	0.6	
	491	491	5:14	5:15	9213	204°	149	3861	20	1.0	0.6	
	469	469	5:19	5:21	9555	258°	155	3859	20	1.0	0.6	
	470	470	5:24	5:26	9684	76°	159	3855	20	1.0	0.6	
	446	446	5:30	5:32	9440	101°	161	3853	20	1.0	0.6	
	447	447	5:35	5:37	9587	281°	150	3850	19	1.1	0.7	



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator			
					A	29	41	100.81		Cynthia Williams			
Date/Julian:	8.21.19		Disk Drive			Sensor						Pilot	
Hobbs End	6737.8		TM MM30 (101, 102)			TM_90524						Wes Ashmore	
Hobbs ST	6732.8		TARGET MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:		
Flight Time	5		6,500		165		AC6812		DW0746		1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:	
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP		
	424	424	14:42	14:47	8732	296°	155	3279	15	1.8	0.9		
	423	423	14:50	14:57	8730	115°	157	3267	15	1.8	0.9		
	422	422	15:00	15:05	8737	297°	157	3256	15	1.8	0.9		
	421	421	15:10	15:15	8726	115°	151	3243	15	1.8	1		
	420	420	15:20	15:25	8786	259°	152	32235	19	1.8	1		
	419	419	15:28	15:32	8789	114°	1563	3224	21	1.1	0.7		
	418	418	15:37	15:42	8871	295°	153	3216	21	1.2	0.7		
	417	417	15:46	15:50	8871	113°	154	3208	21	1.3	0.7		
	416	416	15:54	15:56	8879	296°	152	3199	24	1.1	0.6		
	425	425	16:01	16:05	9092	184°	155	3197	24	1.1	0.6		
	426	426	16:08	16:13	9248	7°	156	1919	24	1.1	0.6		
	427	427	16:17	16:23	9253	185°	152	184	25	1.1	0.6		
	428	428	16:26	16:31	8909	5°	159	3176	24	1.1	0.6		
	429	429	16:36	16:40	8881	184°	150	3165	25	1.1	0.6		
	430	430	16:43	16:48	8888	41°	158	3157	25	1.2	0.6		
	431	431	16:52	16:57	8884	186°	157	3146	25	1.2	0.6		
	432	432	17:01	17:07	8833	4°	156	3138	25	1.2	0.6		
	433	433	17:10	17:14	8829	184°	155	3127	25	1.2	0.6		
	434	434	17:17	17:20	8704	8°	161	3121	25	1.3	0.7		
	435	435	17:24	17:29	8611	185°	152	3117	22	1.2	0.7		
	408	408	17:35	17:39	8616	143°	151	3112	22	1.2	0.7		
	409	4049	17:04	17:47	8757	322°	155	3105	21	1.3	0.7		
	410	410	17:51	17:56	8588	146°	155	3093	22	1.3	0.7		
	411	411	17:59	18:05	8571	323°	154	3083	22	1.3	0.7		
	412	412	18:09	18:13	8596	142°	155	3072	21	1.3	0.7		
	413	413	18:17	18:23	8567	328°	158	3064	21	1.3	0.7		



Digital Aerial Solutions Flight Log

Project/Flight Plan:		TM_CA_Riverside			Lift	Temp °C Before	Temp °C After	Pressure (kPa)		Sensor Operator		
					A	29	41	100.81		Cynthia Williams		
Date/Julian:		8.21.19	Disk Drive			Sensor				Pilot		
Hobbs End		6737.8	TM MM30 (101, 102)			TM_90524				Wes Ashmore		
Hobbs ST		6732.8	TARGET	MSL	Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:
Flight Time		5	6,500		165		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∠	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available MM Space	S/Vs:	Position Acc.		Comments and Conditions:
			Begin:	End:						AVG PDOP	AVG HDOP	
	414	414	18:26	18:31	8595	142°	153	3051	22	1.4	0.7	
	415	415	18:35	18:40	8565	322°	156	3042	22	1.2	0.6	
	437	437	18:45	18:48	8579	171°	157	3034	24	1.2	0.6	
	438	438	18:51	18:56	8570	352°	156	3029	24	1.2	0.6	
	439	439	18:58	19:00	8561	172°	151	3023	23	1.1	0.6	
	440	440	19:05	19:06	8572	351°	155	3019	23	1.2	0.6	




Digital Aerial Solutions Flight Log

Project/Flight Plan:		CA_Riverside		Lift	Temp °C Before		Temp °C After		Pressure (kPa)			Sensor Operator	
				A	43		38		100.41			Akeem Kerr	
Date/Julian:		8/21/2019		Disk Drive			Sensor					Pilot	
Hobbs End		40.3		TM MM30 (103, 104)			TM_90524					Mike Wasielewski	
Hobbs ST		37.8		TARGET MSL		Target AIRSPD	Base Name	PID	Base Name	PID	Base Height	Aircraft	Airport Identification:
Flight Time		2.5		9,672		160		AC6812		DW0746	1.500	C441-N207SS	KHII (Lake Havasu, AZ)
∟	Flight Line	Mission Line	UTC time:		GPS Altitude: ASL:	Direction	Speed: kts:	Available	S/Vs:	Position Acc.		Comments and Conditions:	
			Begin:	End:				MM Space		AVG PDOP	AVG HDOP		
	436	436	2:22	2:23	8678	248°	147	3777	24	1.2	0.6		
	442	442	2:29	2:31	9433	298°	147	3774	27	1.1	0.6		
	443	443	2:35	2:37	9501	118°	156	3769	25	1.1	0.6		
	444	444	2:41	2:43	9515	297°	159	3764	25	1.1	0.6		
	445	445	2:47	2:47	9509	119°	153	3760	25	1.1	0.6		
	464	464	2:54	2:59	9100	279°	156	3758	25	1.1	0.6		
	463	463	3:03	3:08	8982	100°	156	3747	28	1.1	0.6		
	462	462	3:12	3:17	9014	280°	151	3735	27	1.0	0.5		
	461	461	3:20	3:25	9005	99°	148	3726	26	1.1	0.6		
	460	460	3:29	3:33	9170	280°	158	3716	26	1.1	0.5		
	459	459	3:36	3:40	9148	99°	150	3708	24	1.2	0.6		
	458	458	3:44	3:46	9119	279°	149	3702	24	1.1	0.6		
	457	457	3:51	3:52	9093	99°	153	3697	25	1.1	0.6		

Appendix B. Base Station GPS Session Forms


GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.9.2019
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996	
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0809_222359.m00
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)				
Start Date (UTC) 8.9.2019		Start Time (UTC) 15:25		Approx. Lat. (if available) N 33 34 04.28842
End Date (UTC) 8.9.2019		End Time (UTC) 20:10		Approx. Long. (if available) W 114 21 24.89612
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo 	

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.10.2019
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996	
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0810_205256.m00
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)				
Start Date (UTC) 8.10.2019		Start Time (UTC) 14:00		Approx. Lat. (if available) N 33 34 04.28842
End Date (UTC) 8.10.2019		End Time (UTC) 19:30		Approx. Long. (if available) W 114 21 24.89612
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo 	


GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.11.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0811_210854.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.11.2019		Start Time (UTC) 14:15		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.11.2019		End Time (UTC) 19:30		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		


GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.11.2019
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996	
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0811_093835.m00
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)				
Start Date (UTC) 8.11.2019		Start Time (UTC) 2:41		Approx. Lat. (if available) N 33 34 04.28842
End Date (UTC) 8.11.2019		End Time (UTC) 8:40		Approx. Long. (if available) W 114 21 24.89612
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo 	


GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.12.2019
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996	
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0812_215357.m00
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)				
Start Date (UTC) 8.12.2019		Start Time (UTC) 15:00		Approx. Lat. (if available) N 33 34 04.28842
End Date (UTC) 8.12.2019		End Time (UTC) 20:15		Approx. Long. (if available) W 114 21 24.89612
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo 	

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.12.2019
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996	
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0812_093743.m00
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)				
Start Date (UTC) 8.12.2019		Start Time (UTC) 3:20		Approx. Lat. (if available) N 33 34 04.28842
End Date (UTC) 8.13.2019		End Time (UTC) 19:30		Approx. Long. (if available) W 114 21 24.89612
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo 	

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.13.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0813_220959.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.13.2019		Start Time (UTC) 3:10		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.14.2019		End Time (UTC) 8:10		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		


GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.13.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0813_095244.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.13.2019		Start Time (UTC) 16:41		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.13.2019		End Time (UTC) 20:40		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.14.2019
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996	
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0814_223153.m00
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)				
Start Date (UTC) 8.14.2019		Start Time (UTC) 3:32		Approx. Lat. (if available) N 33 34 04.28842
End Date (UTC) 8.15.2019		End Time (UTC) 8:30		Approx. Long. (if available) W 114 21 24.89612
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo 	


GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.14.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0814_103249.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.14.2019		Start Time (UTC) 15:33		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.14.2019		End Time (UTC) 20:37		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.15.2019
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996	
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0815_223055.m00
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)				
Start Date (UTC) 8.15.2019		Start Time (UTC) 3:30		Approx. Lat. (if available) N 33 34 04.28842
End Date (UTC) 8.16.2019		End Time (UTC) 7:59		Approx. Long. (if available) W 114 21 24.89612
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo 	

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.15.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0815_100010.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.15.2019		Start Time (UTC) 15:03		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.15.2019		End Time (UTC) 20:34		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.16.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0816_101924.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.16.2019		Start Time (UTC) 15:42		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.16.2019		End Time (UTC) 17:56		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.19.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0819_100747.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.19.2019		Start Time (UTC) 15:42		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.19.2019		End Time (UTC) 18:17		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.20.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0820_215046.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.20.2019		Start Time (UTC) 3:10		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.21.2019		End Time (UTC) 8:54		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.21.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0821_095647.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.21.2019		Start Time (UTC) 14:50		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.21.2019		End Time (UTC) 19:50		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8.21.2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Cynthia Williams	
Monument Name/Designation HII D			Exact Stamping (include photo in survey report) HII D 1996		
Monument No./PID AC6812		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6674_0821_213226.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1516674	
Antenna Part No. 6194452		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8.21.2019		Start Time (UTC) 3:10		Approx. Lat. (if available) N 33 34 04.28842	
End Date (UTC) 8.22.2019		End Time (UTC) 8:54		Approx. Long. (if available) W 114 21 24.89612	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/9/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation S 751			Exact Stamping (include photo in survey report) S 751 1945		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0809_174329.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/10/2019		Start Time (UTC) 0:45		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/10/2019		End Time (UTC) 7:40		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/10/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation S 751			Exact Stamping (include photo in survey report) S 751 1945		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0810_170454.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/11/2019		Start Time (UTC) 0:05		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/11/2019		End Time (UTC) 6:41		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/11/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation S 751			Exact Stamping (include photo in survey report) S 751 1945		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0811_060856.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/11/2019		Start Time (UTC) 13:10		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/12/2019		End Time (UTC) 12:55		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/12/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation			Exact Stamping (include photo in survey report)		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0812_055806.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/12/2019		Start Time (UTC) 13:00		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/13/2019		End Time (UTC) 12:50		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/13/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation S 751			Exact Stamping (include photo in survey report) S 751 1945		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0812_055806.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/13/2019		Start Time (UTC) 12:55		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/14/2019		End Time (UTC) 12:50		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/14/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation S 751			Exact Stamping (include photo in survey report) S 751 1945		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0813_055302.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/14/2019		Start Time (UTC) 12:55		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/15/2019		End Time (UTC) 12:50		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/15/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation S 751			Exact Stamping (include photo in survey report) S 751 1945		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0813_055302.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/15/2019		Start Time (UTC) 12:55		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/16/2019		End Time (UTC) 12:45		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

GPS SESSION FORM



Contract # / TO # G17PC00044		Client / Project Name U. S. GEOLOGICAL SURVEY Rolla, MO 140G0219F0110-CA_Riverside_2019_B19		Date 8/16/2019	
DAS Project No. 19011		Survey Firm DAS		Operator Name Geoffrey McCall	
Monument Name/Designation S 751			Exact Stamping (include photo in survey report) S 751 1945		
Monument No./PID DW0746		Collection Type (circle one) <input checked="" type="radio"/> ABGPS <input type="radio"/> STATIC <input type="radio"/> RTK		File Name (receiver generated) 6684_0814_055329.m00	
Receiver Manufacturer N/A		Receiver Model N/A		Receiver Serial No. N/A	
Data Collector Manufacturer Leica		Data Collector Model GS 15		Data Collector Serial No. 1506684	
Antenna Part No. 4255298		Antenna Model N/A		Antenna Serial No. N/A	
Starting Antenna Height in Feet 1 2 3 AVG		Starting Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Ending Antenna Height in Feet 1 2 3 AVG		Ending Antenna Height in Meters 1 2 3 AVG 1.5		Type of Measurement (circle one) TRUE VERTICAL <input checked="" type="radio"/> ARP	
Antenna Reference Point (include and reference a dimensional diagram in Survey Report) (e.g., bottom edge of notch in ground plane, Page 5, Figure 2)					
Start Date (UTC) 8/16/2019		Start Time (UTC) 12:55		Approx. Lat. (if available) N 33 36 57.11790	
End Date (UTC) 8/16/2019		End Time (UTC) 17:00		Approx. Long. (if available) W - 114 43 5.67446	
Describe any abnormalities and/or problems encountered during the session, include time of occurrence and duration.			Site Diagram/Setup-Photo		

Appendix C. Vertical Accuracy Calculations



Project Information

Prepared By: DAS
Project Name: CA_RIVERSIDE_2019_B19
Sensor Info: TM90524
Required Nominal Pulse Spacing: 0.35
Vendor Name: Digital Aerial Solutions, LLC
Units: Meters
Percent of Extent Tolerance: Extents Not Checked
Date of Aquisition: Start: 8/9/2019 Finish: 8/22/2019

Metadata Information

Tile Index:

Filename: Combo_Tiles_ALBERS.shp

Number of Polys: 0

Intensity:

Tile Index Attribute: Not Specified

Data Filename: Not Specified

DEM:

Tile Index Attribute: Tile_ID

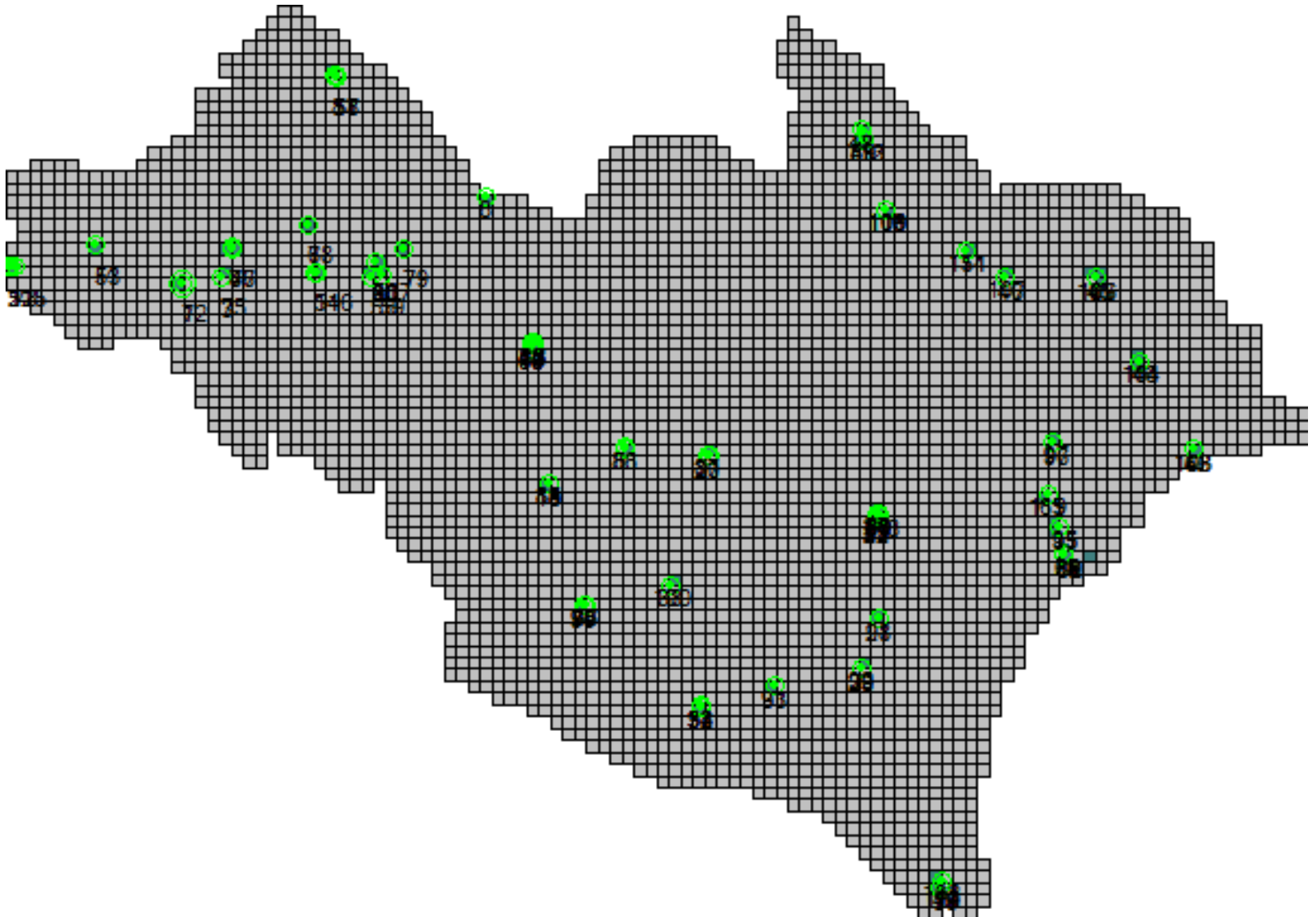
Data Filename: DEM_QL1_QL2

LAS:

Tile Index Attribute: Tile_ID

Data Filename: QL2_QL1_LAS

Tiled-Data Area



LiDAR Accuracy Assessment Summary

LC Type	# Points	NVA	VVA	RMSE Z
LAS		95% Confidence	95 Percentile	
Bare Earth	51	0.172		0.088
High Vegetation	4		0.216	0.149
Low Vegetation	43		0.180	0.115
Medium Vegetation	6		0.235	0.115
Urban Terrain	16	0.208		0.106
NVA Total:	67	0.181		0.093
VVA Total:	53		0.211	0.118
Total:	120			0.105
DEM		95% Confidence	95 Percentile	
Bare Earth	51	0.172		0.088
High Vegetation	4		0.194	0.134
Low Vegetation	43		0.269	0.139
Medium Vegetation	6		0.219	0.120
Urban Terrain	16	0.203		0.104
NVA Total:	67	0.180		0.092
VVA Total:	53		0.234	0.137
Total:	120			0.105
			Units:	Meters

Coordinates and Offsets of Analyzed Locations

	ID			Z1	Z DEM	Z LAS	
		Survey X	Survey Y				
				LC Type	ΔZ DEM	ΔZ LAS	
1)	<input checked="" type="checkbox"/>	1					
		-1789098.539	1363540.551	426.339	426.258	426.265	
				Bare Earth	-0.081	-0.074	
2)	<input checked="" type="checkbox"/>	2					
		-1803707.458	1364940.797	517.642	517.44	517.439	
				Bare Earth	-0.203	-0.203	
3)	<input checked="" type="checkbox"/>	3					
		-1785823.991	1364062.961	418.463	418.379	418.393	
				Bare Earth	-0.083	-0.069	
4)	<input checked="" type="checkbox"/>	4					
		-1785024.188	1366598.272	425.527	425.591	425.585	
				Bare Earth	0.064	0.058	
5)	<input checked="" type="checkbox"/>	5					
		-1785019.412	1366560.145	421.323	421.356	421.352	
				Bare Earth	0.033	0.029	
6)	<input checked="" type="checkbox"/>	6					
		-1778456.125	1368506.381	306.861	306.737	306.732	
				Bare Earth	-0.124	-0.129	
7)	<input checked="" type="checkbox"/>	7					
		-1770401.499	1366469.96	209.104	209.189	209.19	
				Bare Earth	0.085	0.086	

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
8)	<input checked="" type="checkbox"/>	8				
		-1763514.379	1370896.786	161.35	161.362	161.353
				Bare Earth	0.011	0.003
9)	<input checked="" type="checkbox"/>	9				
		-1772894.551	1365353.608	254.935	254.784	254.774
				Bare Earth	-0.152	-0.161
10)	<input checked="" type="checkbox"/>	10				
		-1772868.978	1365401.79	253.793	253.724	253.727
				Bare Earth	-0.069	-0.066
11)	<input checked="" type="checkbox"/>	11				
		-1776401.129	1381121.409	371.79	371.845	371.851
				Bare Earth	0.055	0.06
12)	<input checked="" type="checkbox"/>	12				
		-1759571.142	1358476.479	209.261	209.268	209.275
				Bare Earth	0.007	0.014
13)	<input checked="" type="checkbox"/>	13				
		-1759568.191	1358521.624	208.454	208.435	208.437
				Bare Earth	-0.019	-0.017
14)	<input checked="" type="checkbox"/>	14				
		-1759500.012	1358527.657	207.473	207.461	207.459
				Bare Earth	-0.012	-0.014

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
15)	<input checked="" type="checkbox"/>	15				
		-1759469.267	1358461.648	207.998	207.934	207.928
				Bare Earth	-0.065	-0.07
16)	<input checked="" type="checkbox"/>	16				
		-1759689.561	1358076.062	216.488	216.465	216.445
				Bare Earth	-0.023	-0.043
17)	<input checked="" type="checkbox"/>	17				
		-1759680.93	1358033.535	216.993	216.959	216.965
				Bare Earth	-0.034	-0.028
18)	<input checked="" type="checkbox"/>	18				
		-1758208.519	1346663.765	309.837	309.72	309.718
				Bare Earth	-0.117	-0.119
19)	<input checked="" type="checkbox"/>	19				
		-1758232.017	1346690.889	310.286	310.199	310.198
				Bare Earth	-0.088	-0.089
20)	<input checked="" type="checkbox"/>	20				
		-1744716.691	1349043.641	116.224	116.336	116.32
				Bare Earth	0.112	0.095
21)	<input checked="" type="checkbox"/>	21				
		-1744675.213	1349017.676	115.908	116.023	116.028
				Bare Earth	0.114	0.119

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
22)	<input checked="" type="checkbox"/>	22				
		-1730470.629	1343531.369	119.227	119.417	119.42
				Bare Earth	0.19	0.193
23)	<input checked="" type="checkbox"/>	23				
		-1730439.497	1343551.656	119.255	119.473	119.471
				Bare Earth	0.218	0.216
24)	<input checked="" type="checkbox"/>	24				
		-1714752.061	1340712.066	119.035	119.101	119.106
				Bare Earth	0.067	0.071
25)	<input checked="" type="checkbox"/>	25				
		-1714744.57	1340661.368	119.095	119.145	119.148
				Bare Earth	0.05	0.053
26)	<input checked="" type="checkbox"/>	26				
		-1714728.874	1340640.378	119.261	119.326	119.329
				Bare Earth	0.065	0.068
27)	<input checked="" type="checkbox"/>	27				
		-1730402.756	1344118.048	120.602	120.697	120.681
				Bare Earth	0.094	0.079
28)	<input checked="" type="checkbox"/>	28				
		-1730333.773	1335250.09	155.905	155.888	155.891
				Bare Earth	-0.017	-0.013

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
29)	<input checked="" type="checkbox"/>	29				
		-1731736.166	1331072.29	178.007	178.086	178.086
				Bare Earth	0.079	0.079
30)	<input checked="" type="checkbox"/>	30				
		-1731787.946	1331041.101	178.07	178.187	178.193
				Bare Earth	0.117	0.123
31)	<input checked="" type="checkbox"/>	31				
		-1739139.316	1329603.876	239.813	239.921	239.915
				Bare Earth	0.108	0.102
32)	<input checked="" type="checkbox"/>	32				
		-1745294.568	1327822.977	303.505	303.525	303.536
				Bare Earth	0.02	0.031
33)	<input checked="" type="checkbox"/>	33				
		-1745301.385	1327852.597	305.046	305.053	305.053
				Bare Earth	0.008	0.007
34)	<input checked="" type="checkbox"/>	34				
		-1745310.512	1327879.001	305.177	305.173	305.177
				Bare Earth	-0.004	0
35)	<input checked="" type="checkbox"/>	35				
		-1715029.752	1343000.213	123.188	123.185	123.179
				Bare Earth	-0.004	-0.009

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
36)	<input checked="" type="checkbox"/>	36				
		-1755135.961	1336410.93	359.889	359.982	359.975
				Bare Earth	0.092	0.086
37)	<input checked="" type="checkbox"/>	37				
		-1755134.677	1336440.099	359.257	359.331	359.344
				Bare Earth	0.074	0.086
38)	<input checked="" type="checkbox"/>	38				
		-1747868.729	1338099.474	230.915	230.872	230.871
				Bare Earth	-0.043	-0.044
39)	<input checked="" type="checkbox"/>	39				
		-1725164.608	1312540.286	194.755	194.734	194.738
				Bare Earth	-0.021	-0.016
40)	<input checked="" type="checkbox"/>	40				
		-1725157.022	1312567.796	194.019	193.969	193.968
				Bare Earth	-0.049	-0.051
41)	<input checked="" type="checkbox"/>	41				
		-1725022.589	1313103.816	175.421	175.433	175.456
				Bare Earth	0.012	0.035
42)	<input checked="" type="checkbox"/>	42				
		-1703749.663	1349595.744	134.313	134.334	134.335
				Bare Earth	0.021	0.022

Coordinates and Offsets of Analyzed Locations (Continued)

	ID			Z1	Z DEM	Z LAS	
		Survey X	Survey Y				
			LC Type				ΔZ DEM
43)	<input checked="" type="checkbox"/>	43					
		-1708238.573	1356977.643	189.97	189.94	189.936	
				Bare Earth	-0.03	-0.034	
44)	<input checked="" type="checkbox"/>	44					
		-1708222.892	1357014.55	190.558	190.531	190.531	
				Bare Earth	-0.027	-0.027	
45)	<input checked="" type="checkbox"/>	45					
		-1712013.746	1364021.105	240.937	240.934	240.919	
				Bare Earth	-0.003	-0.018	
46)	<input checked="" type="checkbox"/>	46					
		-1719624.927	1364079.834	246.56	246.488	246.481	
				Bare Earth	-0.072	-0.079	
47)	<input checked="" type="checkbox"/>	47					
		-1731777.196	1376543.189	333.909	333.811	333.804	
				Bare Earth	-0.098	-0.105	
48)	<input checked="" type="checkbox"/>	48					
		-1731754.183	1376548.285	333.825	333.696	333.705	
				Bare Earth	-0.129	-0.12	
49)	<input checked="" type="checkbox"/>	49					
		-1731535.824	1375699.198	322.101	322.013	322.014	
				Bare Earth	-0.089	-0.088	

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
50)	<input checked="" type="checkbox"/>	50				
		-1731560.01	1375669.205	321.891	321.757	321.762
				Bare Earth	-0.134	-0.129
51)	<input checked="" type="checkbox"/>	51				
		-1722902.526	1366292.168	281.21	281.105	281.107
				Bare Earth	-0.105	-0.103
52)	<input checked="" type="checkbox"/>	52				
		-1803743.468	1364927.33	517.987	517.81	517.805
				Urban Terrain	-0.177	-0.183
53)	<input checked="" type="checkbox"/>	53				
		-1796473.502	1366824.651	421.749	421.678	421.664
				Urban Terrain	-0.072	-0.085
54)	<input checked="" type="checkbox"/>	54				
		-1777877.38	1364491.14	342.429	342.263	342.273
				Urban Terrain	-0.166	-0.156
55)	<input checked="" type="checkbox"/>	55				
		-1773148.963	1364084.274	286.254	286.192	286.181
				Urban Terrain	-0.061	-0.073
56)	<input checked="" type="checkbox"/>	56				
		-1772895.182	1365411.297	254.245	254.068	254.066
				Urban Terrain	-0.177	-0.178

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
57)	<input checked="" type="checkbox"/>	57				
		-1776216.147	1381041.938	365.531	365.537	365.538
				Urban Terrain	0.006	0.007
58)	<input checked="" type="checkbox"/>	58				
		-1776184.957	1381034.383	364.707	364.722	364.728
				Urban Terrain	0.015	0.021
59)	<input checked="" type="checkbox"/>	59				
		-1772309.296	1364257.9	270.486	270.304	270.289
				Urban Terrain	-0.183	-0.197
60)	<input checked="" type="checkbox"/>	60				
		-1759658.993	1358066.52	216.58	216.439	216.448
				Urban Terrain	-0.14	-0.132
61)	<input checked="" type="checkbox"/>	61				
		-1751711.36	1349667.458	164.327	164.412	164.42
				Urban Terrain	0.085	0.093
62)	<input checked="" type="checkbox"/>	62				
		-1714689.658	1340613.844	119.32	119.375	119.38
				Urban Terrain	0.055	0.06
63)	<input checked="" type="checkbox"/>	63				
		-1730359.456	1344121.82	120.831	120.821	120.826
				Urban Terrain	-0.009	-0.005

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
64)	<input checked="" type="checkbox"/>	64				
		-1730266.88	1343963.591	121.072	121.078	121.069
				Urban Terrain	0.006	-0.003
65)	<input checked="" type="checkbox"/>	65				
		-1716031.029	1345791.157	145.584	145.665	145.667
				Urban Terrain	0.081	0.083
66)	<input checked="" type="checkbox"/>	66				
		-1703807.795	1349568.617	135.969	135.969	135.961
				Urban Terrain	0	-0.008
67)	<input checked="" type="checkbox"/>	67				
		-1711962.519	1364031.121	241.539	241.488	241.492
				Urban Terrain	-0.052	-0.047
68)	<input checked="" type="checkbox"/>	68				
		-1759634.69	1358078.467	215.443	215.541	215.572
				High Vegetation	0.098	0.129
69)	<input checked="" type="checkbox"/>	69				
		-1714765.178	1340679.663	119.041	119.236	119.258
				High Vegetation	0.194	0.216
70)	<input checked="" type="checkbox"/>	70				
		-1714714.265	1340589.509	119.332	119.355	119.346
				High Vegetation	0.023	0.015

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
71)	<input checked="" type="checkbox"/>	71				
		-1731757.878	1331038.042	178.286	178.44	178.443
				High Vegetation	0.154	0.157
72)	<input checked="" type="checkbox"/>	72				
		-1789070.309	1363556.385	426.257	426.183	426.164
				Low Vegetation	-0.074	-0.093
73)	<input checked="" type="checkbox"/>	73				
		-1803339.611	1364923.097	519.744	519.591	519.563
				Low Vegetation	-0.153	-0.18
74)	<input checked="" type="checkbox"/>	74				
		-1796490.227	1366865.191	422.793	422.976	422.881
				Low Vegetation	0.183	0.088
75)	<input checked="" type="checkbox"/>	75				
		-1785832.559	1364100.71	418.046	418.044	418.011
				Low Vegetation	-0.002	-0.035
76)	<input checked="" type="checkbox"/>	76				
		-1784981.534	1366597.647	421.344	421.366	421.317
				Low Vegetation	0.022	-0.028
77)	<input checked="" type="checkbox"/>	77				
		-1784972.813	1366512.134	418.221	418.274	418.257
				Low Vegetation	0.054	0.036

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
78)	<input checked="" type="checkbox"/>	78				
		-1778437.477	1368525.051	306.651	306.637	306.689
				Low Vegetation	-0.014	0.039
79)	<input checked="" type="checkbox"/>	79				
		-1770442.965	1366498.793	209.344	209.74	209.606
				Low Vegetation	0.397	0.263
80)	<input checked="" type="checkbox"/>	80				
		-1772872.985	1365345.58	254.895	254.758	254.721
				Low Vegetation	-0.136	-0.174
81)	<input checked="" type="checkbox"/>	81				
		-1776377.312	1381101.483	370.916	371.122	371.036
				Low Vegetation	0.206	0.12
82)	<input checked="" type="checkbox"/>	82				
		-1759543.534	1358538.026	208.158	208.239	208.193
				Low Vegetation	0.081	0.034
83)	<input checked="" type="checkbox"/>	83				
		-1759474.235	1358505.16	207.588	207.707	207.647
				Low Vegetation	0.118	0.058
84)	<input checked="" type="checkbox"/>	84				
		-1758180.418	1346672.691	309.251	309.245	309.201
				Low Vegetation	-0.006	-0.05

Coordinates and Offsets of Analyzed Locations (Continued)

	ID			Z1	Z DEM	Z LAS	
		Survey X	Survey Y				
			LC Type				ΔZ DEM
85)	<input checked="" type="checkbox"/>	85					
		-1758239.437	1346730.604	310.037	310.003	309.947	
				Low Vegetation	-0.034	-0.09	
86)	<input checked="" type="checkbox"/>	86					
		-1751673.801	1349691.918	163.529	163.764	163.679	
				Low Vegetation	0.234	0.149	
87)	<input checked="" type="checkbox"/>	87					
		-1744743.572	1349051.52	116.291	116.561	116.467	
				Low Vegetation	0.269	0.175	
88)	<input checked="" type="checkbox"/>	88					
		-1730450.873	1343523.905	119.304	119.446	119.454	
				Low Vegetation	0.142	0.15	
89)	<input checked="" type="checkbox"/>	89					
		-1730327.062	1344155.246	120.618	120.722	120.646	
				Low Vegetation	0.104	0.028	
90)	<input checked="" type="checkbox"/>	90					
		-1730389.216	1344087.639	120.404	120.675	120.571	
				Low Vegetation	0.272	0.168	
91)	<input checked="" type="checkbox"/>	91					
		-1730374.252	1335286.696	156.704	156.738	156.681	
				Low Vegetation	0.034	-0.023	

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
92)	<input checked="" type="checkbox"/>	92				
		-1731739.751	1331103.874	177.801	178.004	177.947
				Low Vegetation	0.204	0.146
93)	<input checked="" type="checkbox"/>	93				
		-1739114.15	1329594.759	239.676	239.765	239.749
				Low Vegetation	0.089	0.073
94)	<input checked="" type="checkbox"/>	94				
		-1745269.348	1327836.494	303.668	303.721	303.726
				Low Vegetation	0.053	0.058
95)	<input checked="" type="checkbox"/>	95				
		-1715013.138	1342988.772	123.015	123.187	123.13
				Low Vegetation	0.172	0.114
96)	<input checked="" type="checkbox"/>	96				
		-1715697.897	1350143.974	155.776	155.916	155.902
				Low Vegetation	0.14	0.126
97)	<input checked="" type="checkbox"/>	97				
		-1715700.215	1350178.644	155.855	155.998	155.967
				Low Vegetation	0.143	0.111
98)	<input checked="" type="checkbox"/>	98				
		-1755186.444	1336410.784	360.921	361.023	361.033
				Low Vegetation	0.102	0.112

Coordinates and Offsets of Analyzed Locations (Continued)

		ID				
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
99)	<input checked="" type="checkbox"/>	99				
		-1755164.29	1336397.896	360.61	360.833	360.821
				Low Vegetation	0.223	0.211
100)	<input checked="" type="checkbox"/>	100				
		-1747896.283	1338099.872	231.326	231.337	231.263
				Low Vegetation	0.011	-0.063
101)	<input checked="" type="checkbox"/>	101				
		-1725134.593	1312571.972	193.227	193.347	193.305
				Low Vegetation	0.12	0.078
102)	<input checked="" type="checkbox"/>	102				
		-1725069.246	1313121.721	176.513	176.521	176.524
				Low Vegetation	0.008	0.011
103)	<input checked="" type="checkbox"/>	103				
		-1703736.7	1349567.656	134.08	134.142	134.12
				Low Vegetation	0.062	0.04
104)	<input checked="" type="checkbox"/>	104				
		-1708212.427	1356981.853	190.005	190.121	190.089
				Low Vegetation	0.116	0.084
105)	<input checked="" type="checkbox"/>	105				
		-1711990.371	1364027.803	241.256	241.262	241.22
				Low Vegetation	0.006	-0.036

Coordinates and Offsets of Analyzed Locations (Continued)

	ID						
		Survey X	Survey Y	Z1	Z DEM	Z LAS	
				LC Type	ΔZ DEM	ΔZ LAS	
106)	<input checked="" type="checkbox"/>	106					
		-1711963.982	1363999.898	241.615	241.603	241.611	
				Low Vegetation	-0.013	-0.004	
107)	<input checked="" type="checkbox"/>	107					
		-1719620.587	1364105.735	247.221	247.265	247.132	
				Low Vegetation	0.044	-0.089	
108)	<input checked="" type="checkbox"/>	108					
		-1729667.428	1369779.9	253.115	252.991	252.983	
				Low Vegetation	-0.124	-0.132	
109)	<input checked="" type="checkbox"/>	109					
		-1729685.047	1369797.447	253.506	253.374	253.333	
				Low Vegetation	-0.132	-0.173	
110)	<input checked="" type="checkbox"/>	110					
		-1729699.748	1369813.73	253.531	253.393	253.378	
				Low Vegetation	-0.139	-0.154	
111)	<input checked="" type="checkbox"/>	111					
		-1729693.162	1369835.527	253.665	253.555	253.532	
				Low Vegetation	-0.11	-0.133	
112)	<input checked="" type="checkbox"/>	112					
		-1731540.339	1375729.133	322.448	322.407	322.347	
				Low Vegetation	-0.04	-0.1	

Coordinates and Offsets of Analyzed Locations (Continued)

	ID			Z1	Z DEM	Z LAS	
		Survey X	Survey Y				
			LC Type				ΔZ DEM
113)	<input checked="" type="checkbox"/>	113					
		-1731539.372	1375675.975	321.561	321.533	321.536	
				Low Vegetation	-0.028	-0.025	
114)	<input checked="" type="checkbox"/>	114					
		-1722927.828	1366309.834	280.92	280.819	280.755	
				Low Vegetation	-0.101	-0.165	
115)	<input checked="" type="checkbox"/>	115					
		-1803728.192	1364991.806	517.023	517.03	516.938	
				Medium Vegetation	0.007	-0.085	
116)	<input checked="" type="checkbox"/>	116					
		-1777816.062	1364521.406	340.479	340.556	340.494	
				Medium Vegetation	0.077	0.015	
117)	<input checked="" type="checkbox"/>	117					
		-1772855.123	1365375.512	254.18	254.154	254.151	
				Medium Vegetation	-0.026	-0.029	
118)	<input checked="" type="checkbox"/>	118					
		-1730299.833	1343960.915	120.495	120.672	120.621	
				Medium Vegetation	0.177	0.126	
119)	<input checked="" type="checkbox"/>	119					
		-1716059.271	1345797.629	145.912	146.132	146.148	
				Medium Vegetation	0.219	0.235	

Coordinates and Offsets of Analyzed Locations (Continued)

	ID					
		Survey X	Survey Y	Z1	Z DEM	Z LAS
				LC Type	ΔZ DEM	ΔZ LAS
120)	<input checked="" type="checkbox"/>	120				
		-1725128.643	1312608.153	191.889	191.89	191.912
				Medium Vegetation	0	0.022

LAS

Nonvegetated Vertical Accuracy

LandCover Type: Bare Earth, Urban Terrain

Minimum DZ: -0.203

Maximum DZ: 0.216

Mean DZ: -0.015

Mean Magnitude DZ: 0.272

Number Observations: 67

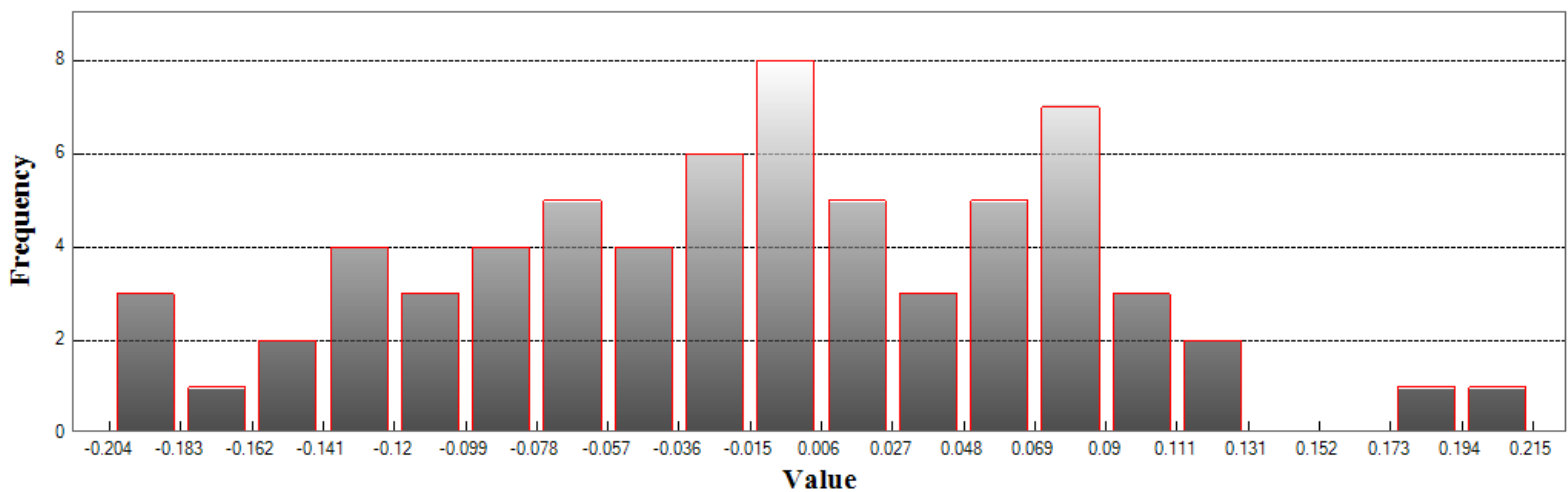
Standard Deviation DZ: 0.092

RMSE Z: 0.093

95% Confidence Level Z: 0.181

Units: Meters

Histogram



Min: -0.203
 Max: 0.216
 Number Of Bins: 20
 Bin Interval: 0.021

LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: High Vegetation

Minimum DZ: 0.015

Maximum DZ: 0.216

Mean DZ: 0.129

Mean Magnitude DZ: 0.36

Number Observations: 4

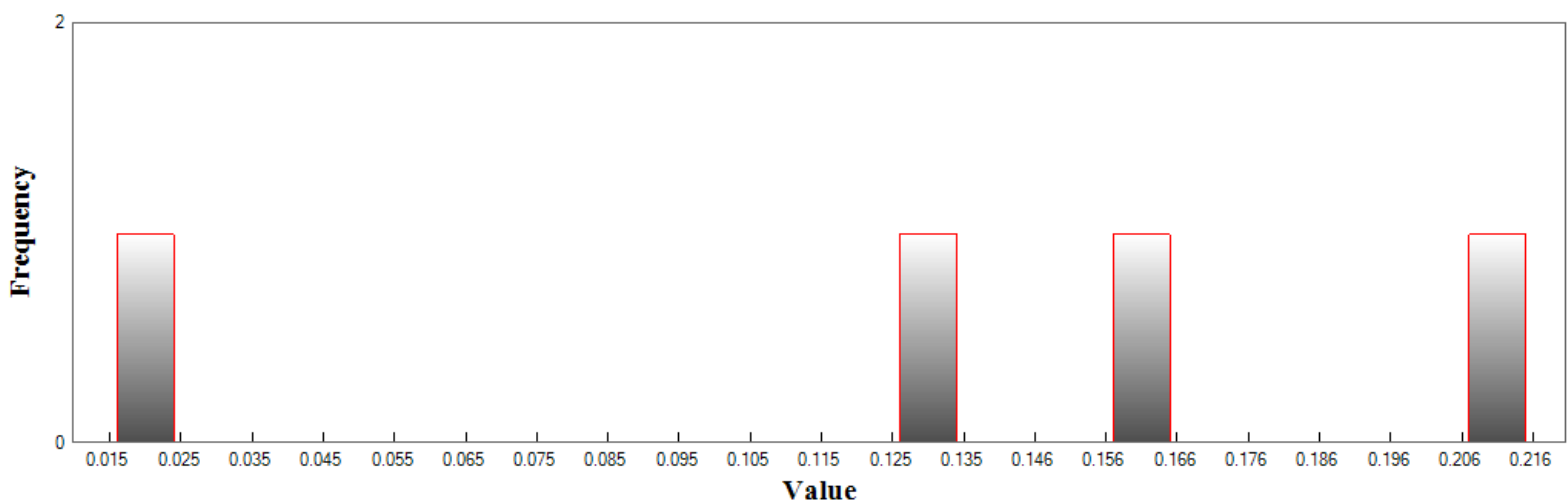
Standard Deviation DZ: 0.085

RMSE Z: 0.149

95th Percentile: 0.216

Units: Meters

Histogram



Min: 0.015

Max: 0.216

Number Of Bins: 20

Bin Interval: 0.01

LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: Low Vegetation

Minimum DZ: -0.18

Maximum DZ: 0.263

Mean DZ: 0.017

Mean Magnitude DZ: 0.313

Number Observations: 43

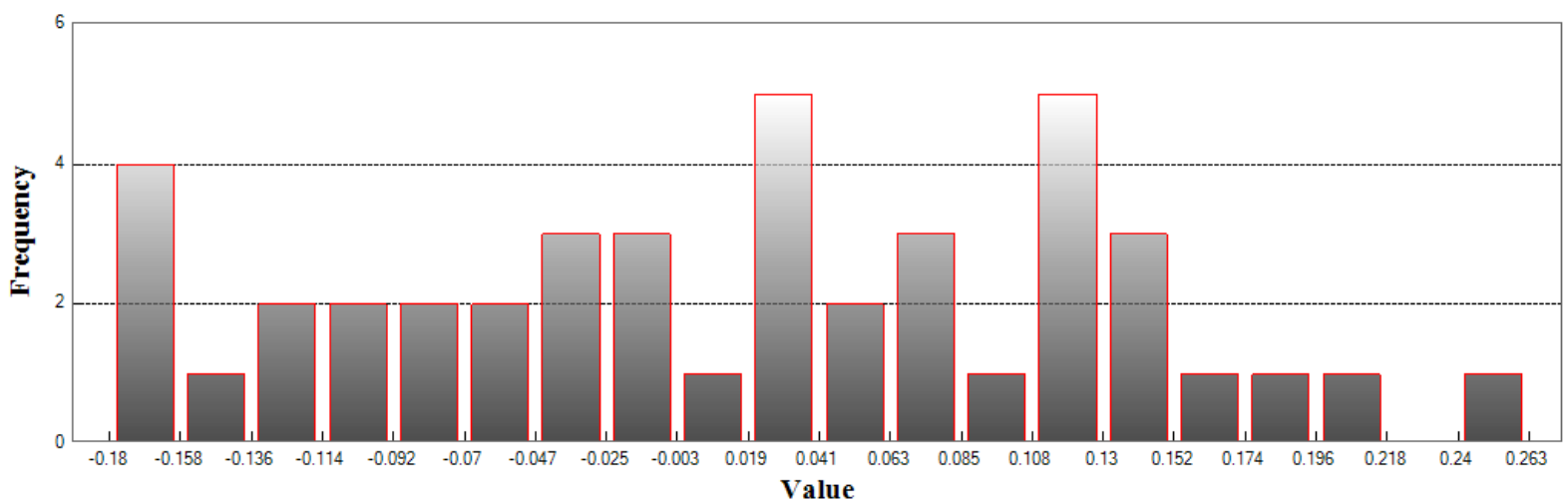
Standard Deviation DZ: 0.115

RMSE Z: 0.115

95th Percentile: 0.18

Units: Meters

Histogram



Min: -0.18

Max: 0.263

Number Of Bins: 20

Bin Interval: 0.022

LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: Medium Vegetation

Minimum DZ: -0.085

Maximum DZ: 0.235

Mean DZ: 0.047

Mean Magnitude DZ: 0.292

Number Observations: 6

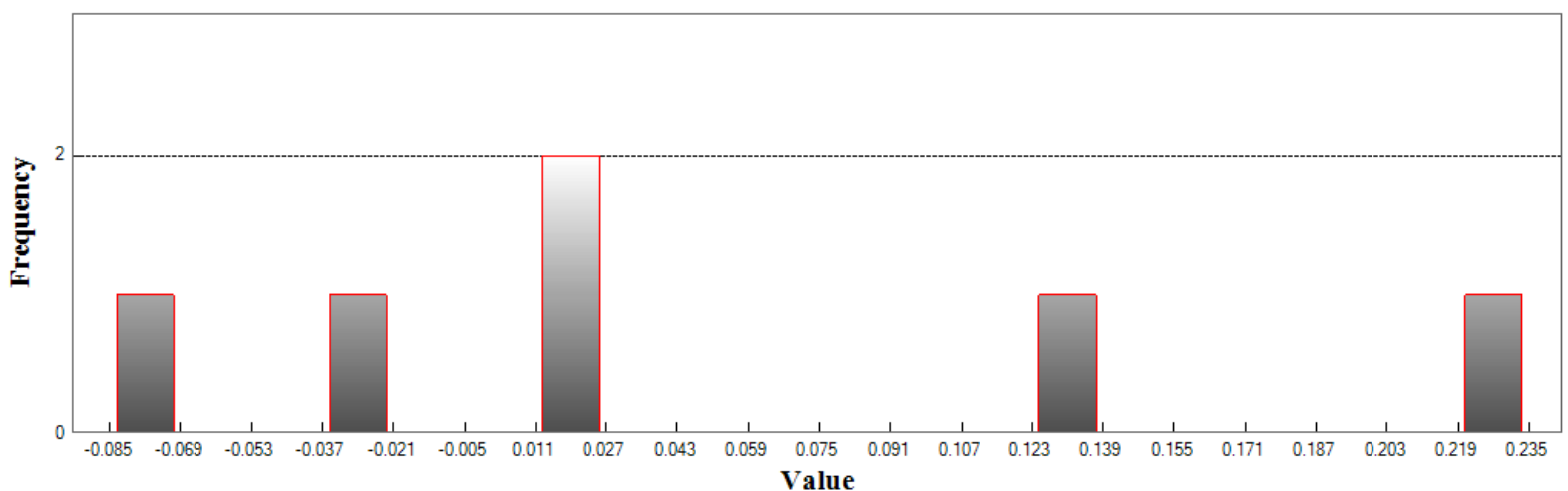
Standard Deviation DZ: 0.115

RMSE Z: 0.115

95th Percentile: 0.235

Units: Meters

Histogram



Min: -0.085

Max: 0.235

Number Of Bins: 20

Bin Interval: 0.016

DEM

Nonvegetated Vertical Accuracy

LandCover Type: Bare Earth, Urban Terrain

Minimum DZ: -0.203

Maximum DZ: 0.218

Mean DZ: -0.015

Mean Magnitude DZ: 0.27

Number Observations: 67

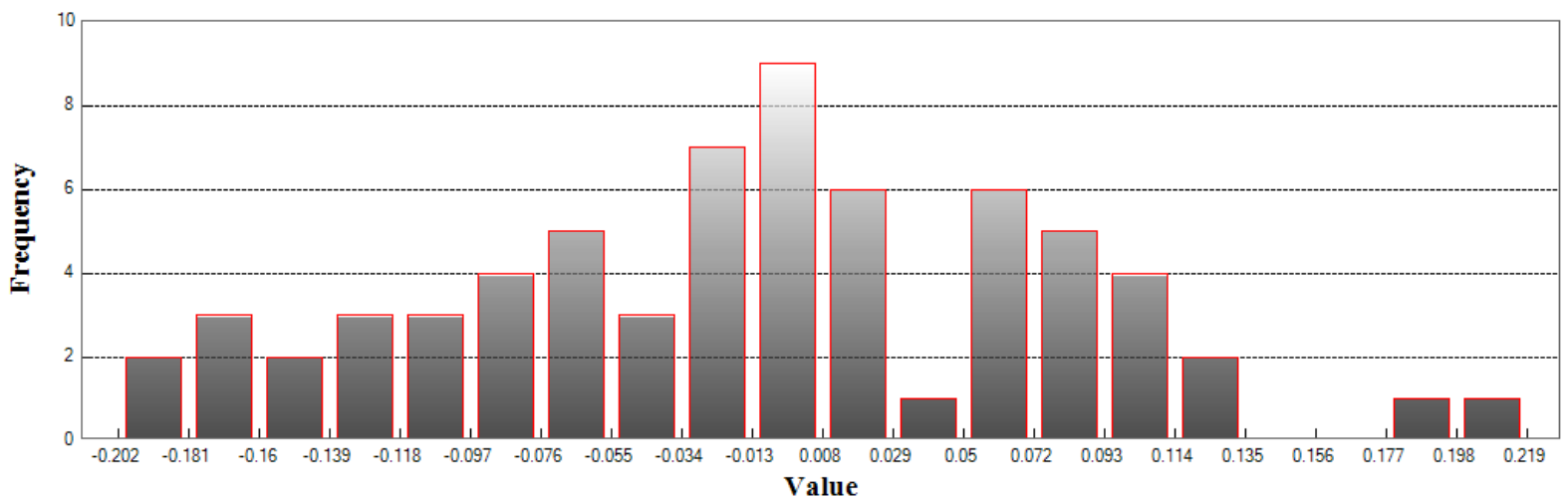
Standard Deviation DZ: 0.091

RMSE Z: 0.092

95% Confidence Level Z: 0.18

Units: Meters

Histogram



Min: -0.203
 Max: 0.218
 Number Of Bins: 20
 Bin Interval: 0.021

DEM (Continued)

Vegetated Vertical Accuracy

LandCover Type: High Vegetation

Minimum DZ: 0.023

Maximum DZ: 0.194

Mean DZ: 0.117

Mean Magnitude DZ: 0.343

Number Observations: 4

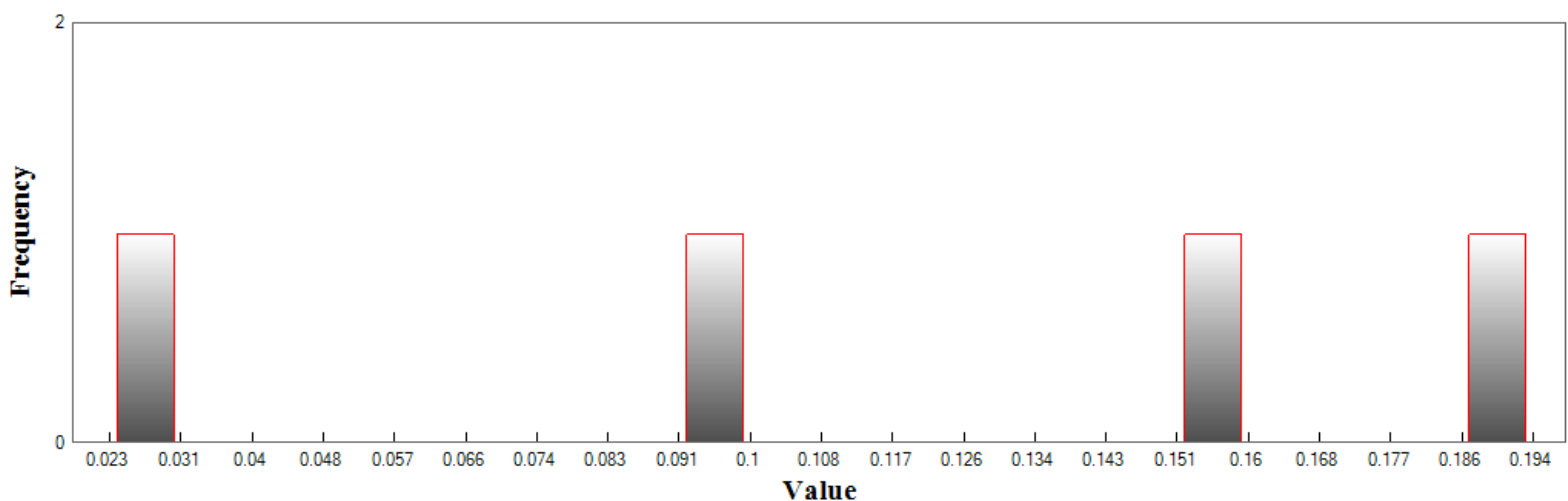
Standard Deviation DZ: 0.074

RMSE Z: 0.134

95th Percentile: 0.194

Units: Meters

Histogram



Min: 0.023

Max: 0.194

Number Of Bins: 20

Bin Interval: 0.009

DEM (Continued)

Vegetated Vertical Accuracy

LandCover Type: Low Vegetation

Minimum DZ: -0.153

Maximum DZ: 0.397

Mean DZ: 0.058

Mean Magnitude DZ: 0.331

Number Observations: 43

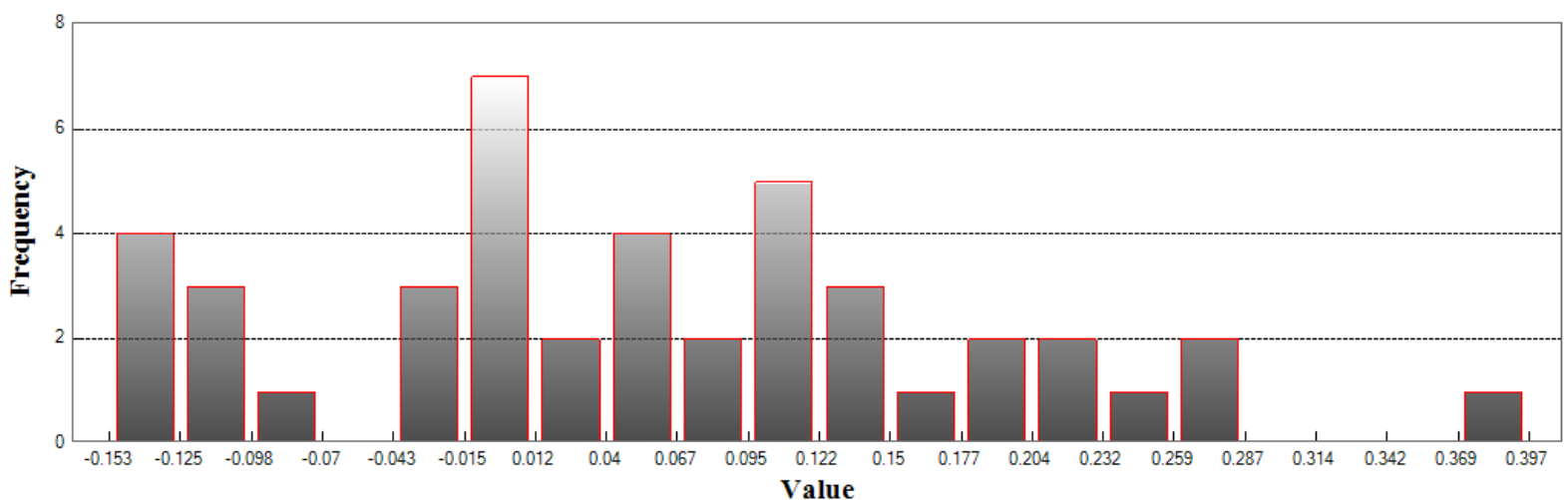
Standard Deviation DZ: 0.128

RMSE Z: 0.139

95th Percentile: 0.269

Units: Meters

Histogram



Min: -0.153

Max: 0.397

Number Of Bins: 20

Bin Interval: 0.027

DEM (Continued)

Vegetated Vertical Accuracy

LandCover Type: Medium Vegetation

Minimum DZ: -0.026

Maximum DZ: 0.219

Mean DZ: 0.076

Mean Magnitude DZ: 0.291

Number Observations: 6

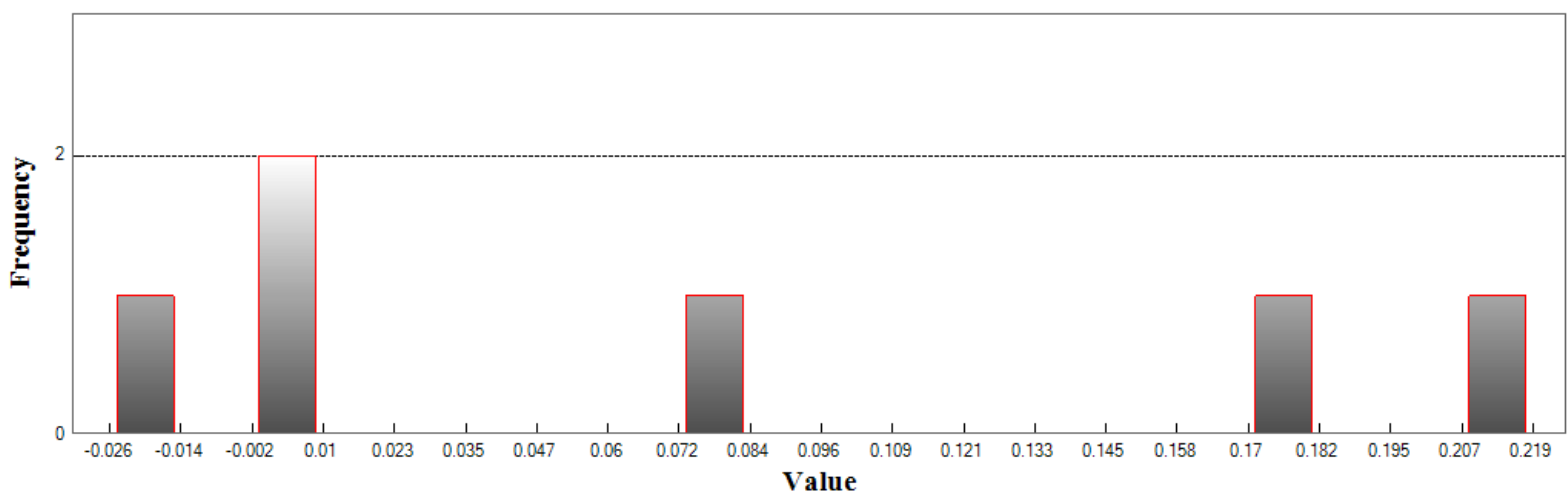
Standard Deviation DZ: 0.102

RMSE Z: 0.12

95th Percentile: 0.219

Units: Meters

Histogram



Min: -0.026

Max: 0.219

Number Of Bins: 20

Bin Interval: 0.012