GROUND CONTROL SURVEY REPORT MENDOCINO (SUMMIT SPRINGS)

GPS SURVEY FOR LIDAR CONTROL

CONTENTS

1. ABSTRACT

This report documents the GPS ground surveys conducted in support of LIDAR data collection for the Mendocino(Summit Springs) area. The surveyed ground control was established on October 23 ,2013. The aerial collection was performed with the Optech ALTM Gemini LiDAR Sensor on October 23th , 2013 . The ground control stations were established utilizing the **Leica RX1205 XC** Survey receiver. There were no problems encountered during this survey. The ground survey was conducted at 7 sites utilizing the CORS stations identified on the ***OPUS*** Data sheets. These surveys established "Ground Truth" data at each site.

A Beechcraft Bonanza A36TC, based out of Chino Airport, CA was utilized on this project for the LiDAR Mission. This aircraft was outfitted with an Optech Gemini ALTM 167kHZ system (s/n 07SEN204).

Mission planning parameters for the LiDAR noted below. These lines would be flown using the following settings:

Altitude:	**800 m**
Overlap:	**60 %**
Speed:	**120 kts**
System PRF:	**70 kHz**
Scan Freq:	**64 Hz**
Scan Half Angle:	**10°**
Cross Track Res.:	**0.491 m**
Down Track Res.:	**0.482 m**

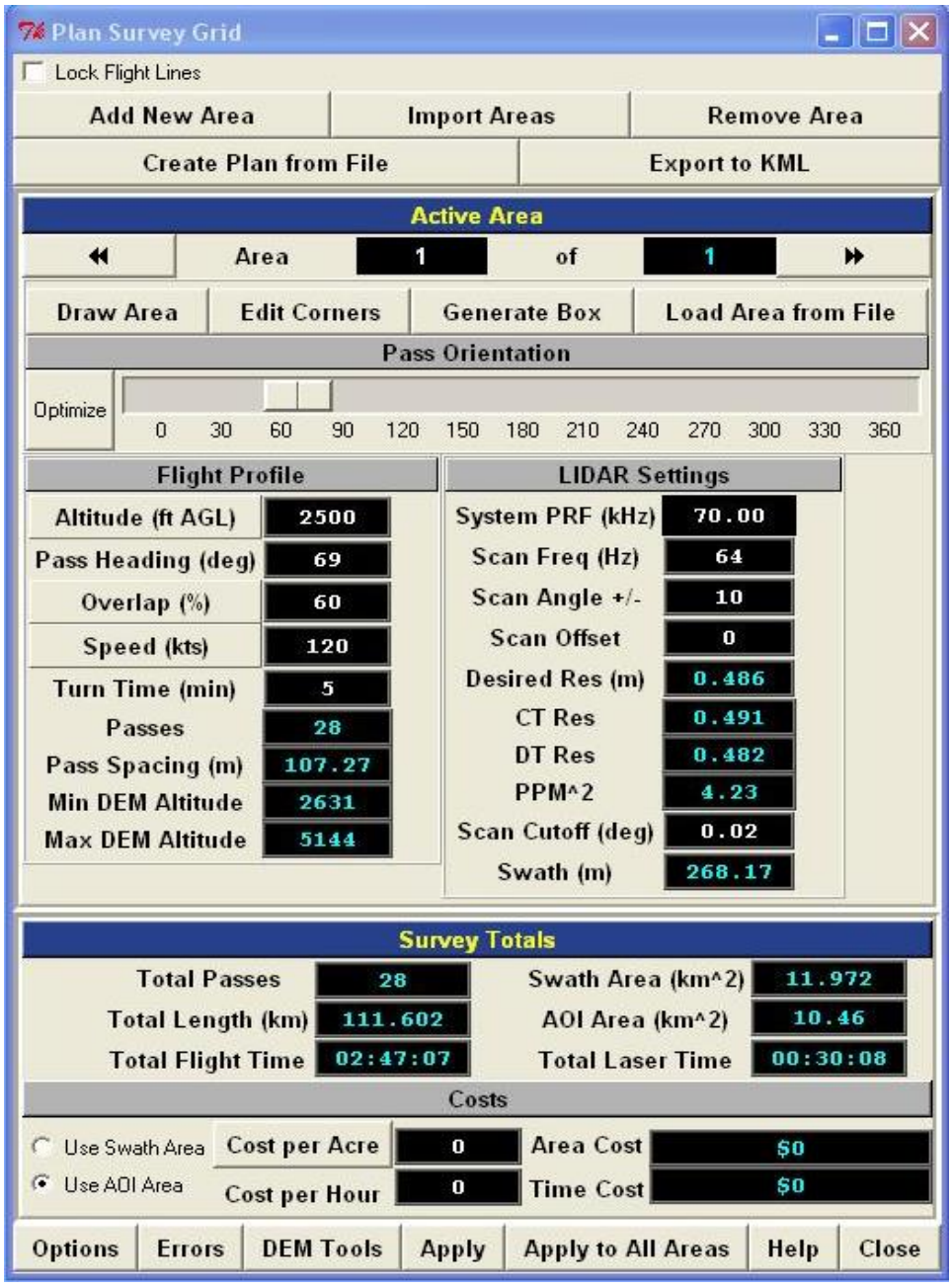
The actual local flight times and duration of flights were controlled by fuel consumption of the aircraft, safety of flight operations in the particular airspace and during times when the GPS constellation was most favorable, producing the highest number of satellites visible in the best geometric configuration relative to the GPS receivers onboard the aircraft as well as at the master stations on the ground. A standard of flying with no less than 6 satellites visible and a PDOP (position dilution of precision) of less than 3.0 was adopted.

Statistical comparisons were made between ground truth points collected in the survey and airborne LIDAR points .

Comparisons were also made between the survey points and the LIDAR derived terrain surface. These comparisons provide an additional verification of the LIDAR data against the survey data.

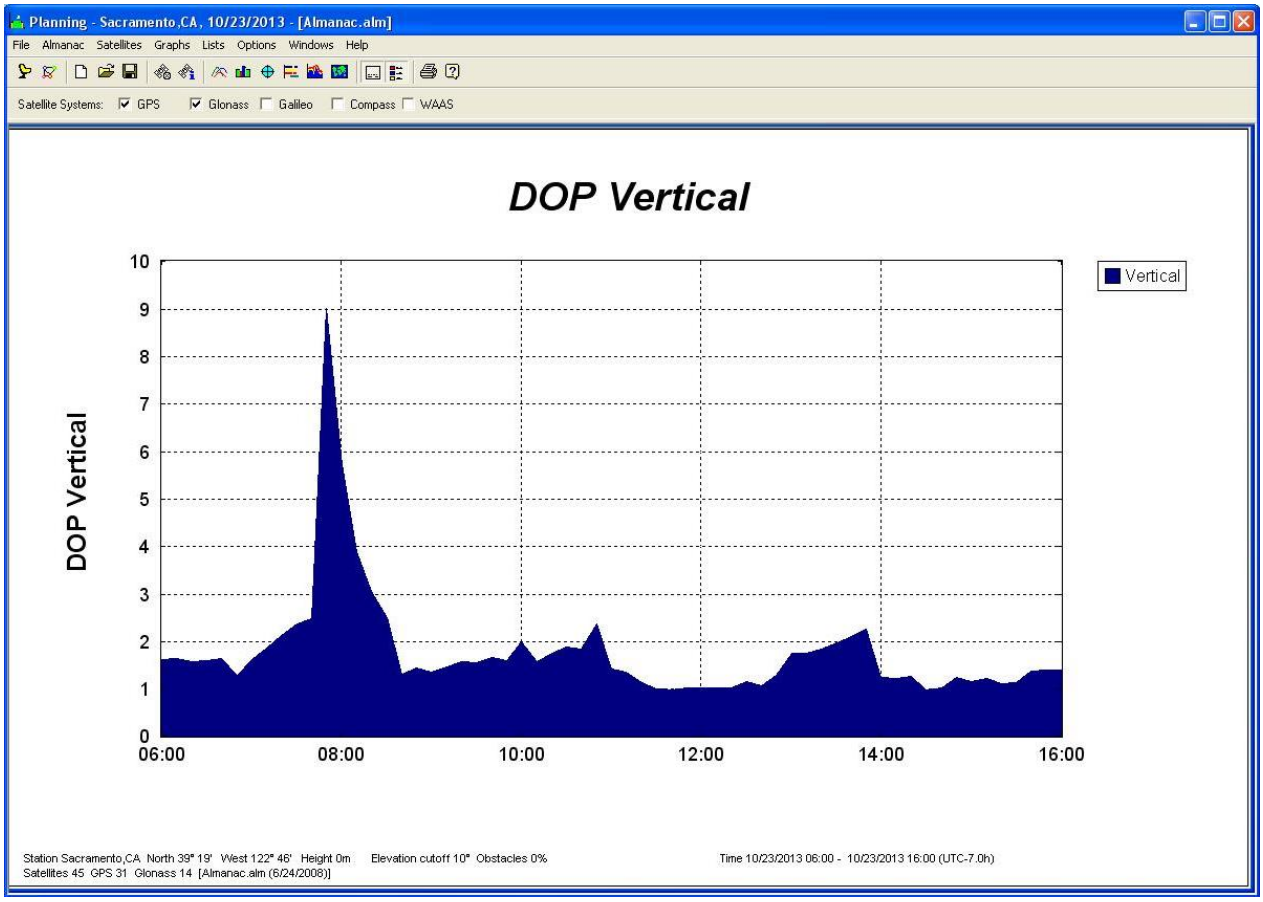
The horizontal and vertical datum used for this project are listed below:

Vertical Datum:	**NAVD88, Geoid12A**
Horizontal Datum:	**NAD83**
Projection:	**UTM Zone 10**
Units:	**METERS**

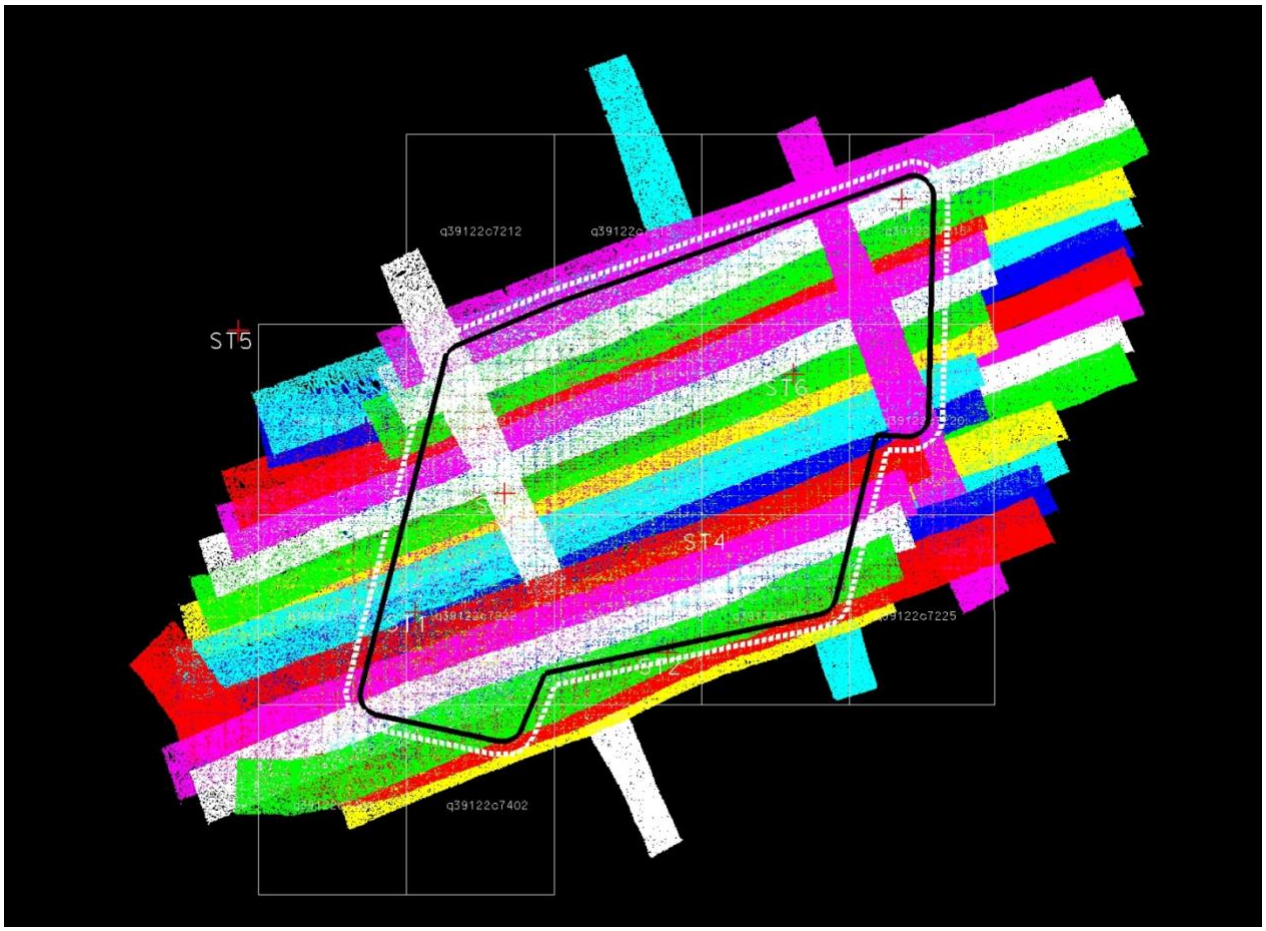


LiDAR MISSION PARAMETERS

DMI always checked PDOP before commencing flight (weather permitting) – *next page* shows data collection and dates with PDOP report October 23, 2013.


Planning - Sacramento,CA, 10/23/2013 - [Almanac.alm]
File Almanac Satellites Graphs Lists Options Windows Help
Satellite Systems: GPS Glonass Galileo Compass WAAS
DOP Vertical
DOP Vertical
Vertical
10
9
8
7
6
5
4
3
2
1
0
06:00
08:00
10:00
12:00
14:00
16:00
Station Sacramento,CA North 39° 19' West 122° 46' Height 0m Elevation cutoff 10° Obstacles 0%
Satellites 45 GPS 31 Glonass 14 [Almanac.alm (6/24/2008)]
Time 10/23/2013 06:00 - 10/23/2013 16:00 (UTC-7.0h)

SBET IMAGES and FLIGHT LINES


q39122c7212
ST5
ST6
ST4
q39122c7225
q39122c7402

OPUS: Online Positioning User Service – Solution Report
@ ½ Second

Ground Receiver UNIT –SOUTH1 - 10/23/2013

START: 2013/10/23 14:04:00
STOP: 2013/10/23 17:45:00

ANT NAME: LEIAX1202 NONE # FIXED AMB: 76 / 77 : 99%

ARP HEIGHT: 1.8428 OVERALL RMS: 0.015(m)

REF FRAME:	NAD_83(2011)(EPOCH:2010.0000)		IGS08 (EPOCH:2013.8100)	
X:	-2674258.385(m)	0.006(m)	-2674259.261(m)	0.006(m)
Y:	-4154779.112(m)	0.004(m)	-4154777.813(m)	0.004(m)
Z:	4021704.149(m)	0.008(m)	4021704.142(m)	0.008(m)
LAT:	39 19 55.21338	0.004(m)	39 19 55.22591	0.004(m)
E LON:	237 13 56.28846	0.002(m)	237 13 56.22836	0.002(m)
W LON:	122 46 3.71154	0.002(m)	122 46 3.77164	0.002(m)
EL HGT:	1277.942(m)	0.009(m)	1277.459(m)	0.009(m)
ORTHO HGT:	1306.180(m)	0.027(m)	[NAVD88 (Computed using GEOID12A)]	

UTM COORDINATES STATE PLANE COORDINATES

	UTM (Zone 10)	SPC (0402 CA 2)
Northing (Y) [meters]	4353646.170	685142.133
Easting (X) [meters]	520021.134	1933814.842
Convergence [degrees]	0.14723674	-0.48400906
Point Scale	0.99960494	0.99992396
Combined Factor	0.99940456	0.99972352

US NATIONAL GRID DESIGNATOR: 10SEJ2002153646(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN9089	P334 SHEETIRON_CN2007 CORS ARP	N392936.918	W1224409.083	18164.6
DN7554	P192 POTRVLYSCHCN2005 CORS ARP	N391911.007	W1230618.627	29153.0
DN7390	P335 BLACKBUTTECN2008 CORS ARP	N394334.270	W1225225.038	44724.2
	NEAREST NGS PUBLISHED CONTROL POINT			
KT1920	POTATO	N392109.333	W1224814.353	3874.7

Ground Receiver UNIT –SOUTH 2 - 10/23/2013

START: 2013/10/23 14:10:00
STOP: 2013/10/23 17:48:00

ANT NAME: LEIAX1202 NONE # FIXED AMB: 50 / 57 : 88%

ARP HEIGHT: 1.8228 OVERALL RMS: 0.015(m)

REF FRAME:	NAD_83(2011)(EPOCH:2010.0000)		IGS08 (EPOCH:2013.8100)	
X:	-2674327.075(m)	0.007(m)	-2674327.951(m)	0.007(m)
Y:	-4154787.299(m)	0.009(m)	-4154786.000(m)	0.009(m)
Z:	4021654.004(m)	0.002(m)	4021653.997(m)	0.002(m)
LAT:	39 19 53.05057	0.008(m)	39 19 53.06309	0.008(m)
E LON:	237 13 54.06227	0.004(m)	237 13 54.00217	0.004(m)
W LON:	122 46 5.93773	0.004(m)	122 46 5.99783	0.004(m)
EL HGT:	1280.241(m)	0.007(m)	1279.758(m)	0.007(m)
ORTHO HGT:	1308.484(m)	0.025(m)	[NAVD88 (Computed using GEOID12A)]	

	UTM COORDINATES UTM (Zone 10)	STATE PLANE COORDINATES SPC (0402 CA 2)
Northing (Y) [meters]	4353579.359	685075.891
Easting (X) [meters]	519968.009	1933760.967
Convergence [degrees]	0.14684292	-0.48439893
Point Scale	0.99960491	0.99992392
Combined Factor	0.99940417	0.99972312

US NATIONAL GRID DESIGNATOR: 10SEJ1996853579(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN9089	P334 SHEETIRON_CN2007 CORS ARP	N392936.918	W1224409.083	18238.5
DN7390	P335 BLACKBUTTECN2008 CORS ARP	N394334.270	W1225225.038	44778.7
DN7554	P192 POTRVLYSCHCN2005 CORS ARP	N391911.007	W1230618.627	29096.9
	NEAREST NGS PUBLISHED CONTROL POINT			
KT1920	POTATO	N392109.333	W1224814.353	3872.3

2. GROUND TRUTH SUMMARY

Surveys were conducted to establish ground truth data at representative sites throughout the project area. These sites were selected on the basis of the optimizing visibility needed for the LIDAR survey over the area.

SUMMIT SPRINGS LIDAR 2013 / DIGITAL MAPPING INC./ UTM 10

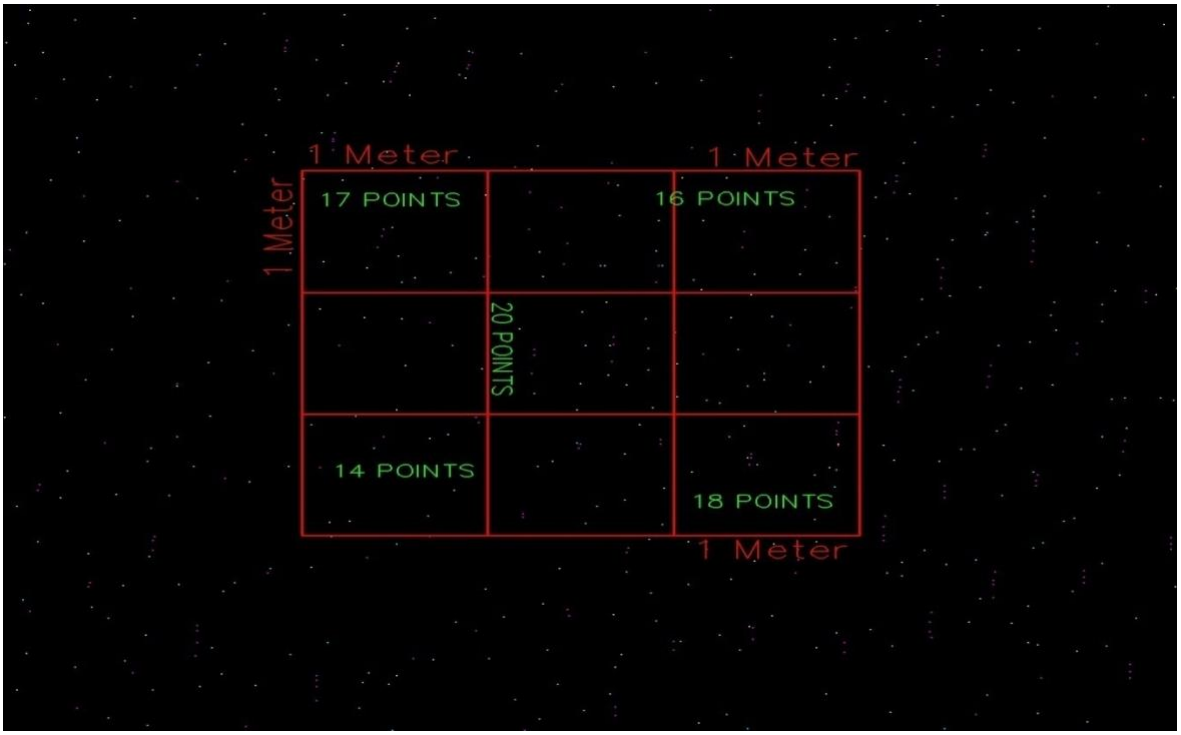
AERIAL POINT#	LATITUDE	LONGITUDE	NORTH (M)	EAST (M)	TARGET ELEV.	DESCRIPTION
ST 1	39°19'06.81997" N	122°47'56.78018" W	4352147.857	517317.531	1029.988	SET 60D SPIKE
ST 2	39°18'57.15533" N	122°46'39.75282" W	4351854.241	519162.689	1334.315	SET 60D SPIKE
ST 3	39°19'35.01150" N	122°47'29.44216" W	4353018.400	517970.138	1114.118	SET 60D SPIKE
ST 4	39°19'26.37777" N	122°46'25.96775" W	4352755.900	519490.533	1359.709	SET 60D SPIKE
ST 5	39°20'13.77750" N	122°48'50.72487" W	4354209.199	516021.577	928.918	SET 60D SPIKE
ST 6	39°20'02.99919" N	122°46'01.15276" W	4353886.341	520081.774	1313.106	SET 60D SPIKE
ST 7	39°20'44.50034" N	122°45'27.83527" W	4355167.800	520875.957	1543.508	SET 60D SPIKE

3. DATA ANALYSIS

Data analysis was accomplished by comparing ground truth checkpoints with LIDAR points from the edited data set. The only exception to this were the ground truth points collected under the tree/forest canopy, where comparisons were made with LIDAR pulses that fell near known positions. This is because fewer LIDAR pulses are able to reach the ground in heavily forested areas, so the point spacing is larger than in cleared areas.

The base stations used to collect survey data were included in the static GPS network, and were selected on the basis of their having an unobstructed view of the sky, as well as being in a location considered favorable for collecting ground truth data. The vertical and horizontal accuracy of each base station was determined by the statistical tests performed in the least squares adjustment process.

Note that the edited LIDAR points are simply a subset of the raw LIDAR points. The points that fell above the ground surface on vegetation canopies, buildings, or other obstructions were removed from the data set. Comparisons were also made between the survey points and the LIDAR derived terrain surface. These comparisons provide an additional verification of the LIDAR data against the survey data.



ONE METER SQUARE > 9 points

LiDAR POINT CHECK

Our ground control check from QA/QC supported in attached documents

4. GROUND TRUTH SURVEY

A. Map of Control Point Locations/ Base Station- Both Days

10/23/2013

B. Ground Truth Analysis of LIDAR Points

GROUND TRUTH ANALYSIS

Comparison of LIDAR Points to Ground Truth Points

GeoCue software was used to compare known , position established and occupied for twenty-minutes , control points versus identical position of LiDAR XYZ point data. The intensity image produced from the *LIDAR collection, was used to pick areas where ground and truth data collection could be collected. In areas of flat terrain or areas where detail is important it can be used as areas to collect X,Y,Z ground truth data for accessing the accuracy of the LIDAR data. Ground truth data can be collected using conventional survey techniques or DGPS techniques.*

SPATIAL REFERENCE FRAMEWORK

Vertical Datum **NAVD88, Geoid12A**
Horizontal Datum **NAD83**
Projection **UTM Zone 10**
Units **METERS**

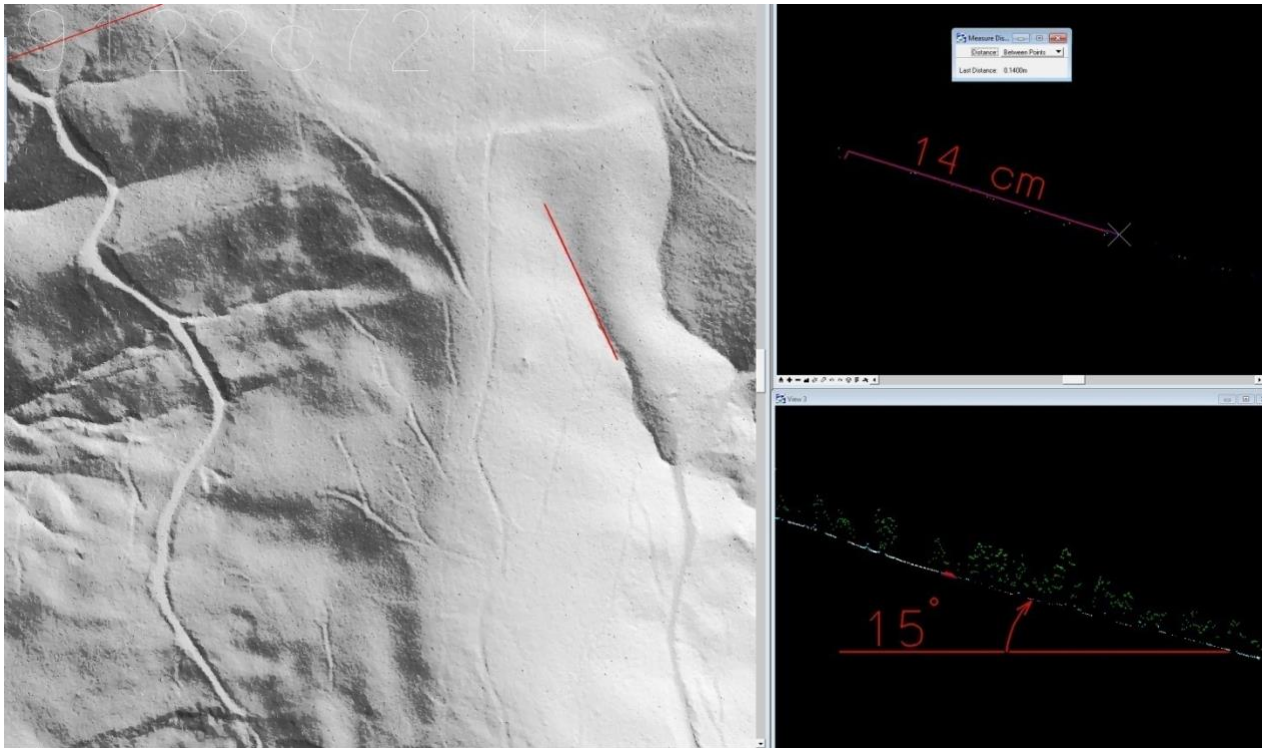
Ground Control Z vs. Aerial Surveyed/ Laser Pointing Z (QA/QC)

SUMMIT SPRINGS ANNEX

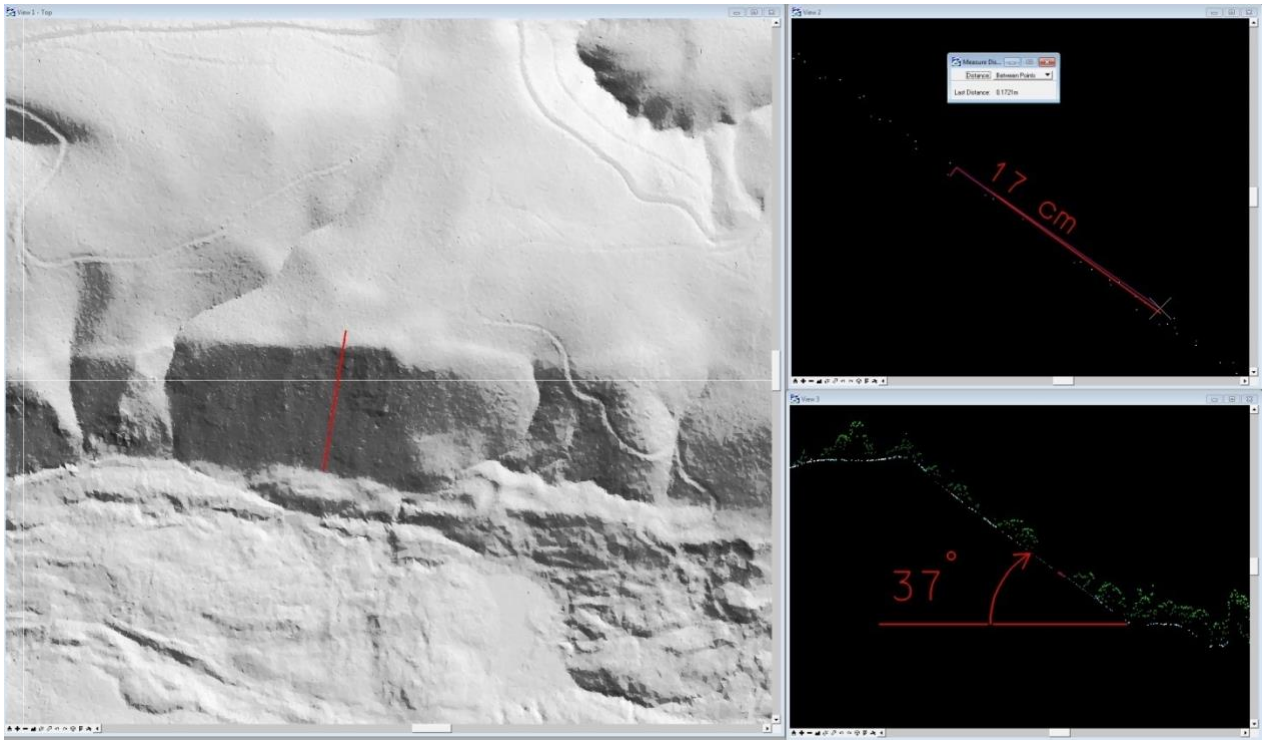
Number	Easting	Northing	Known Z	Laser Z	Dz
ST1	517317.531	4352147.857	1029.988	1029.940	-0.048
ST2	519162.689	4351854.241	1334.315	1334.330	+0.015
ST3	517970.138	4353018.400	1114.118	1114.190	+0.072
ST4	519490.533	4352755.900	1359.709	1359.640	-0.069
ST5	516021.577	4354209.199	928.918	outside	*
ST6	520081.774	4353886.341	1313.106	1313.140	+0.034
ST7	520875.957	4355167.800	1543.508	1543.520	+0.012

Average dz	+0.003
Minimum dz	-0.069
Maximum dz	+0.072
Average magnitude	0.042
Root mean square	0.048
Std deviation	0.052

15 DEGREE SLOPE



37 DEGREE SLOPE



40 DEGREE SLOPE