

# ***GROUND CONTROL SURVEY REPORT HUMBUG CREEK WATERSHED***

## **GPS SURVEY FOR LIDAR CONTROL**

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## 1. ABSTRACT

This report documents the GPS ground surveys conducted in support of LIDAR data collection for the Humbug Creek Watershed area. The surveyed ground control was established on September 2-5, 2013 for the aerial collection with the Optech ALTM Gemini LiDAR Sensor on September 4, 6, and 7, 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 21 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:

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

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:	<b>NAVD88, Geoid12A</b>
Horizontal Datum:	<b>NAD83</b>
Projection:	<b>UTM Zone 10</b>
Units:	<b>METERS</b>

**Plan Survey Grid**

☐ Lock Flight Lines

Add New Area    Import Areas    Remove Area

Create Plan from File    Export to KML

**Active Area**

Area **1** of **1**

Draw Area    Edit Corners    Generate Box    Load Area from File

**Pass Orientation**

Optimize    0    30    60    90    120    150    180    210    240    270    300    330    360

Flight Profile		LIDAR Settings	
Altitude (ft AGL)	2500	System PRF (kHz)	70
Pass Heading (deg)	210	Scan Freq (Hz)	64
Overlap (%)	60	Scan Angle +/-	10
Speed (kts)	120	Scan Offset	0
Turn Time (min)	5	Desired Res (m)	0.486
Passes	50	CT Res	0.491
Pass Spacing (m)	107.27	DT Res	0.482
Min DEM Altitude	1070	PPM^2	4.23
Max DEM Altitude	3173	Scan Cutoff (deg)	0.02
		Swath (m)	268.17

**Survey Totals**

Total Passes	50	Swath Area (km^2)	70.256
Total Length (km)	654.948	AOI Area (km^2)	58.789
Total Flight Time	07:14:38	Total Laser Time	02:56:49

**Costs**

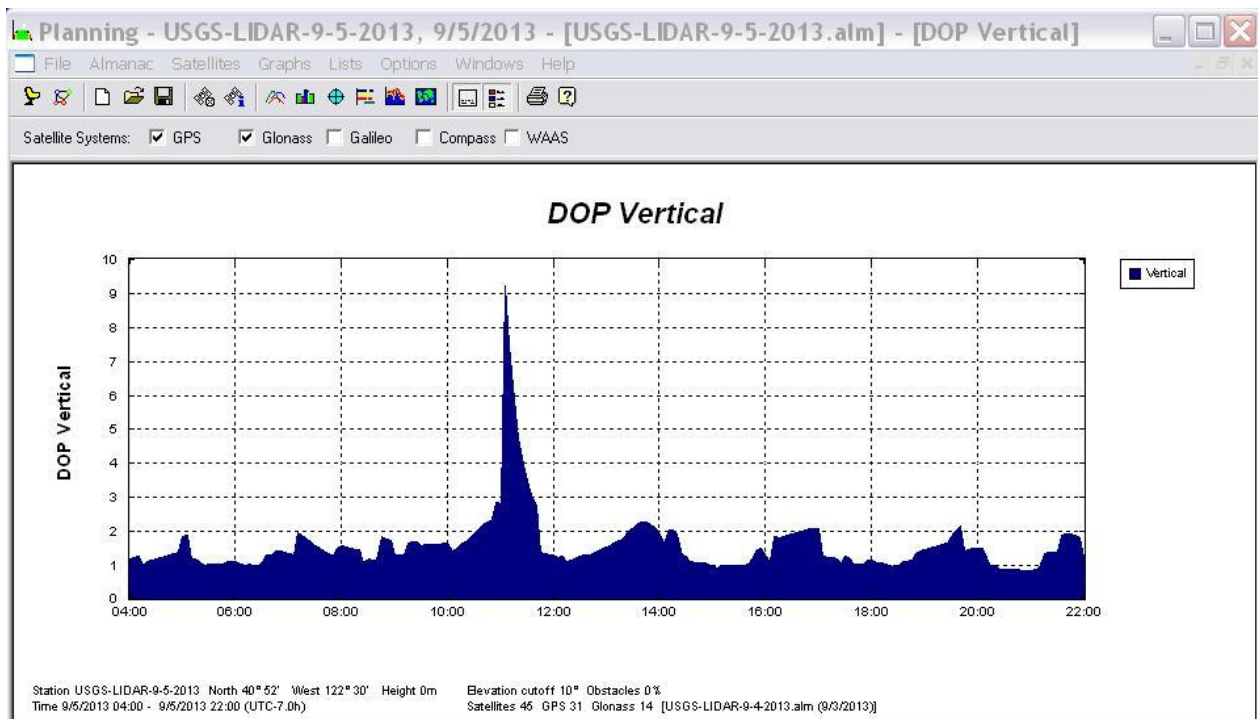
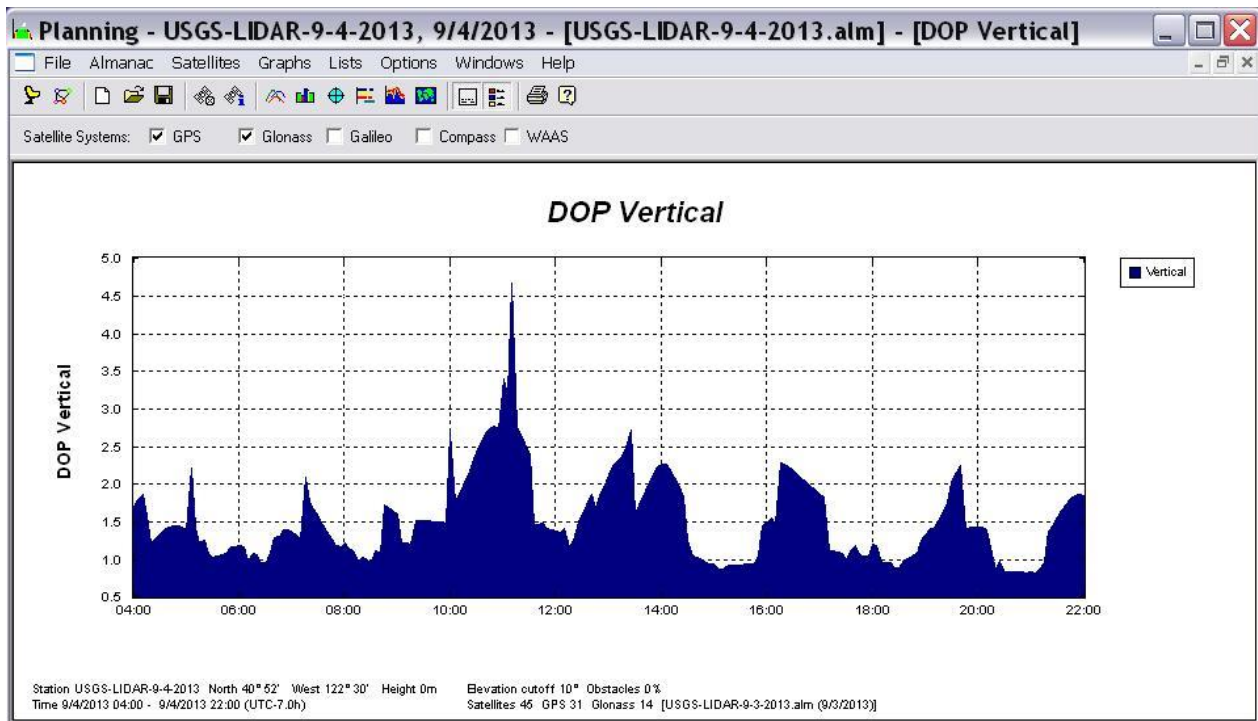
☐ Use Swath Area    Cost per Acre    0    Area Cost    \$0

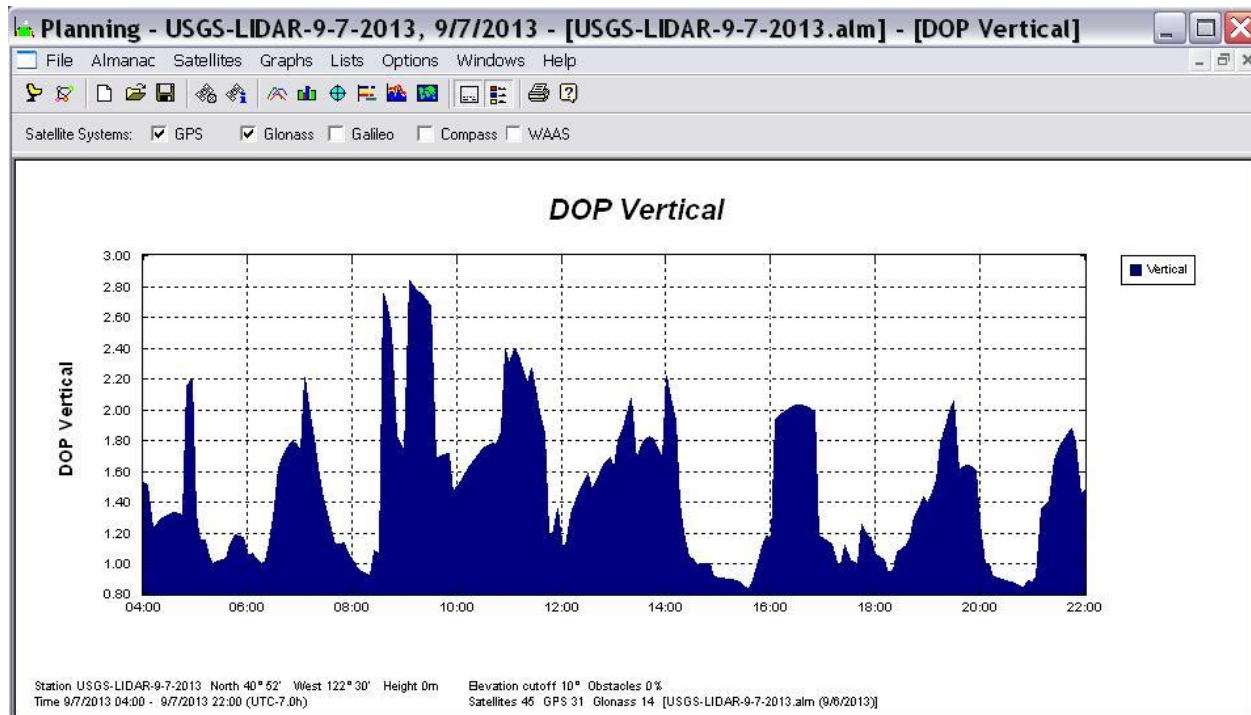
☒ Use AOI Area    Cost per Hour    0    Time Cost    \$0

Options    Errors    DEM Tools    Apply    Apply to All Areas    Help    Close

### LiDAR MISSION PARAMETERS

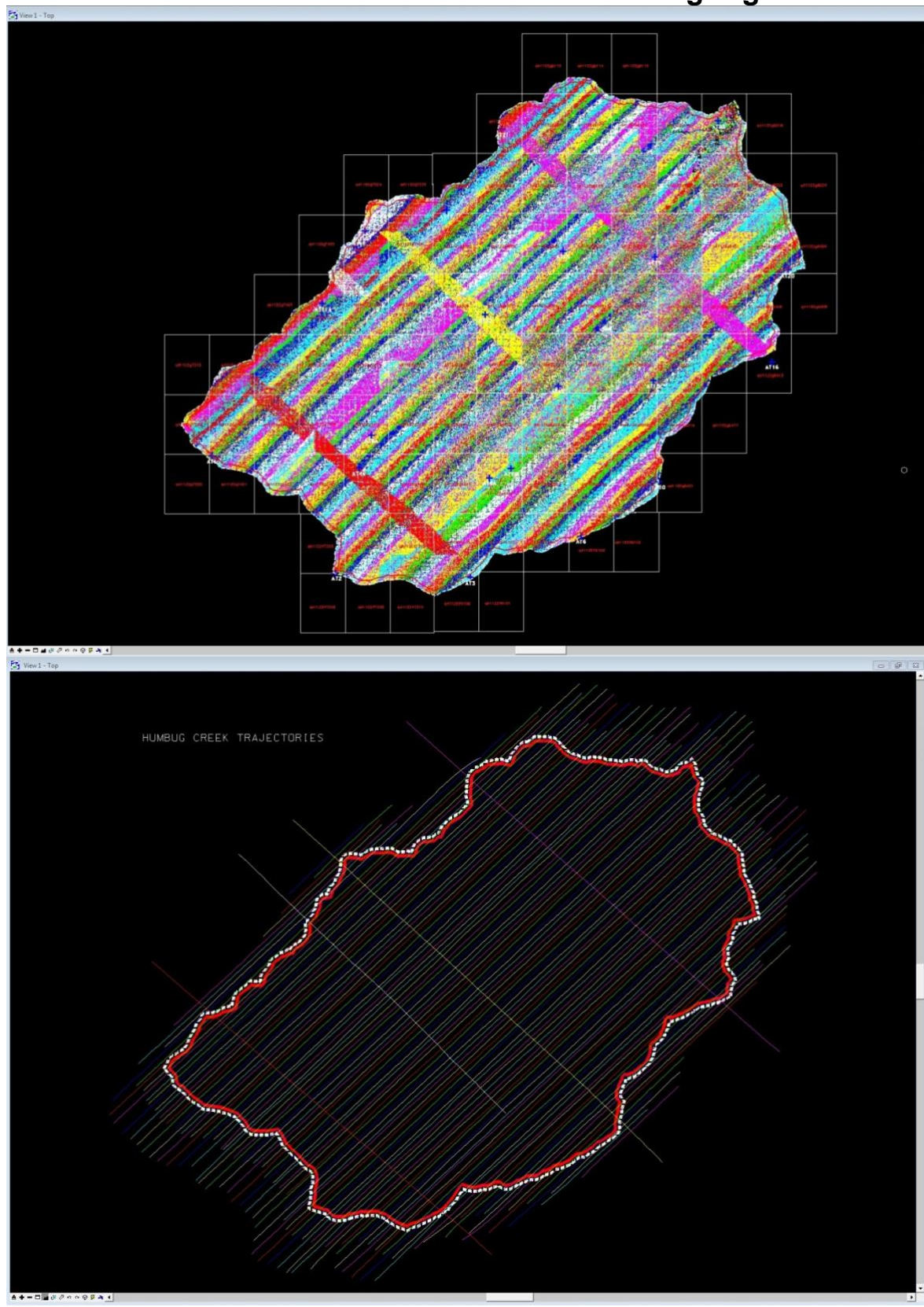
DMI always checked PDOP before commencing flight (weather permitting) – next page shows data collection and dates with PDOP report (Sept. 4th, 6th, 7th, 2013)



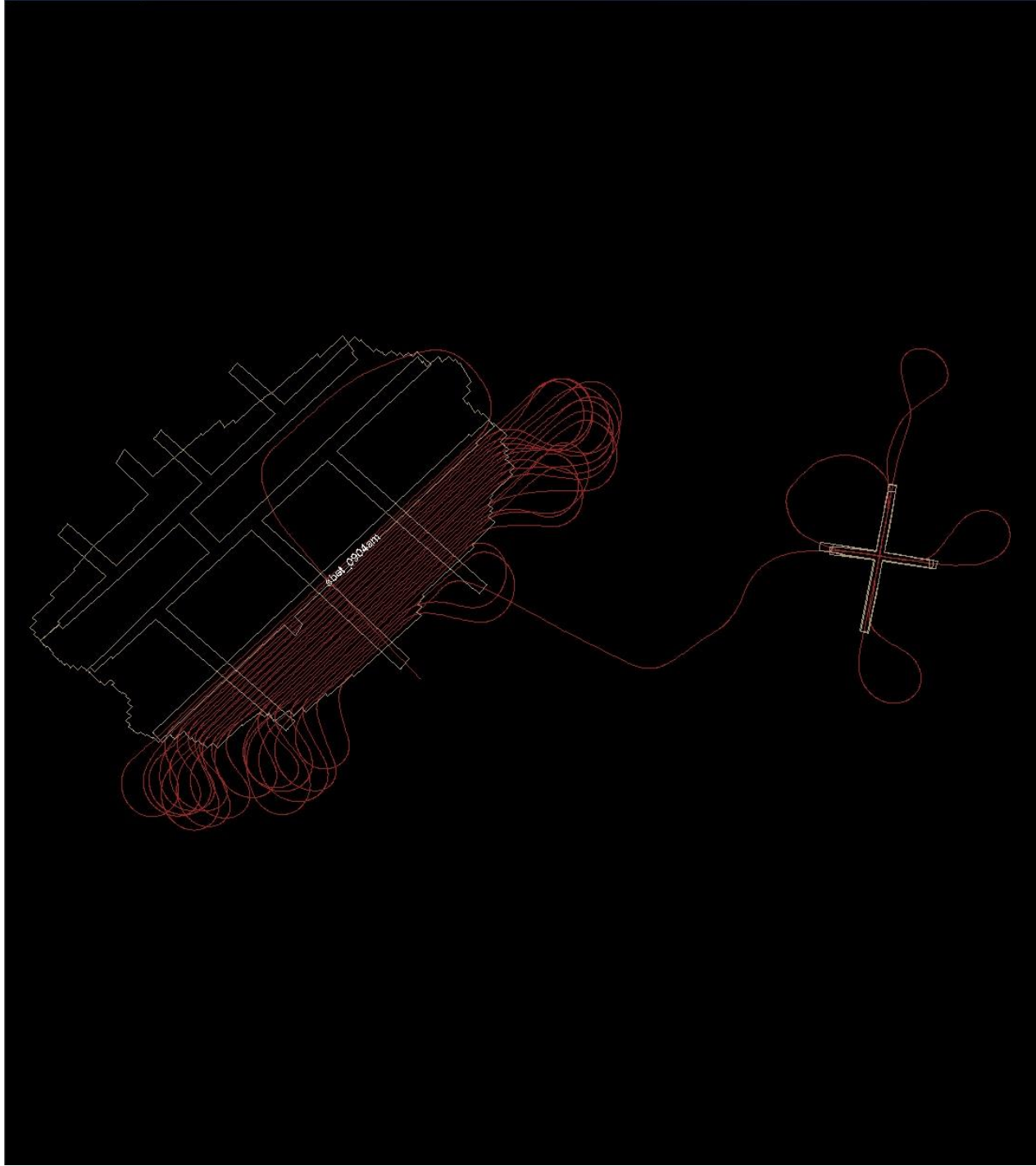




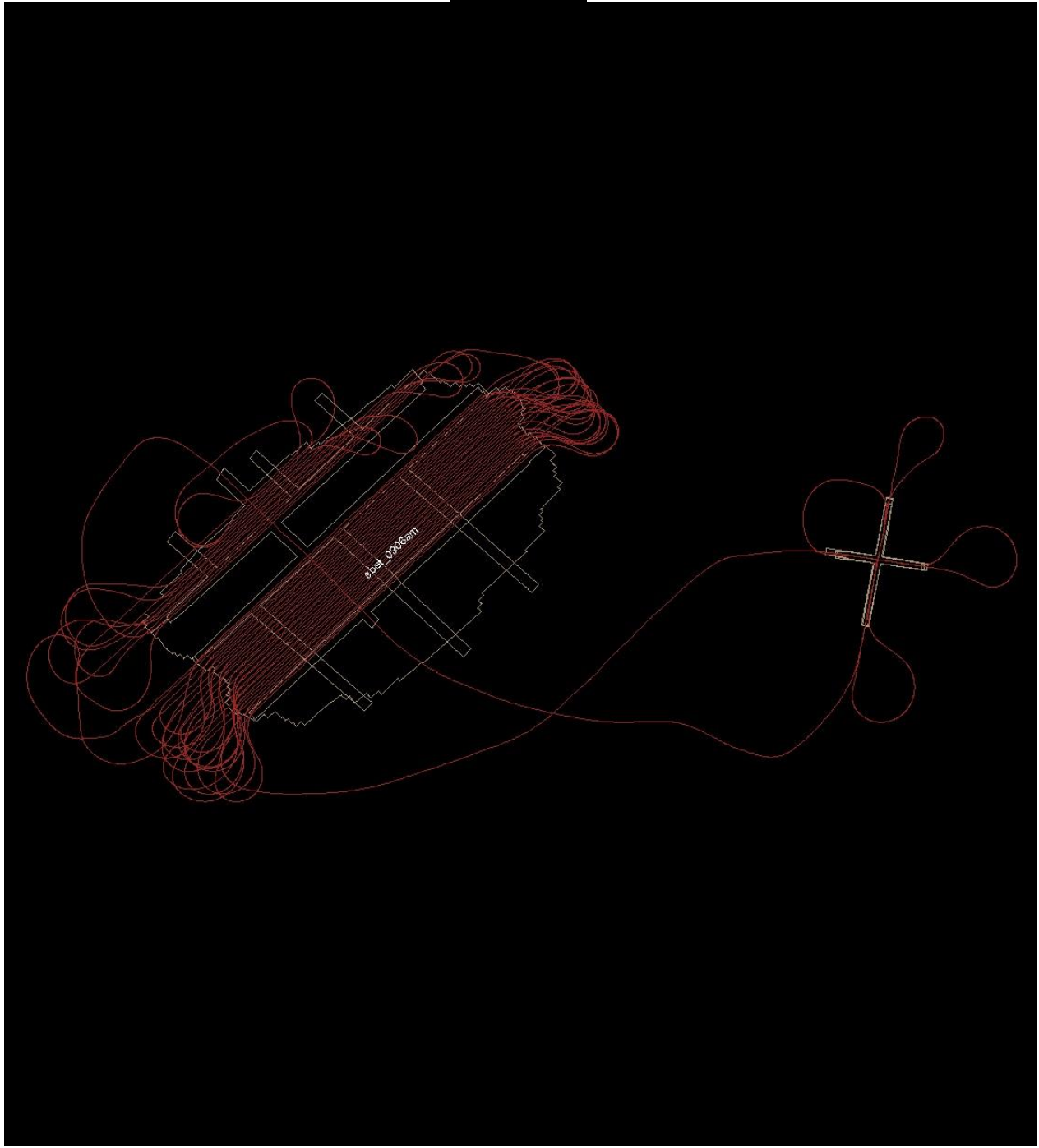
## SBET IMAGES and FLIGHT LINES/Tiling Algorithm



**SBET Flight Dates**  
**9/4/2013**

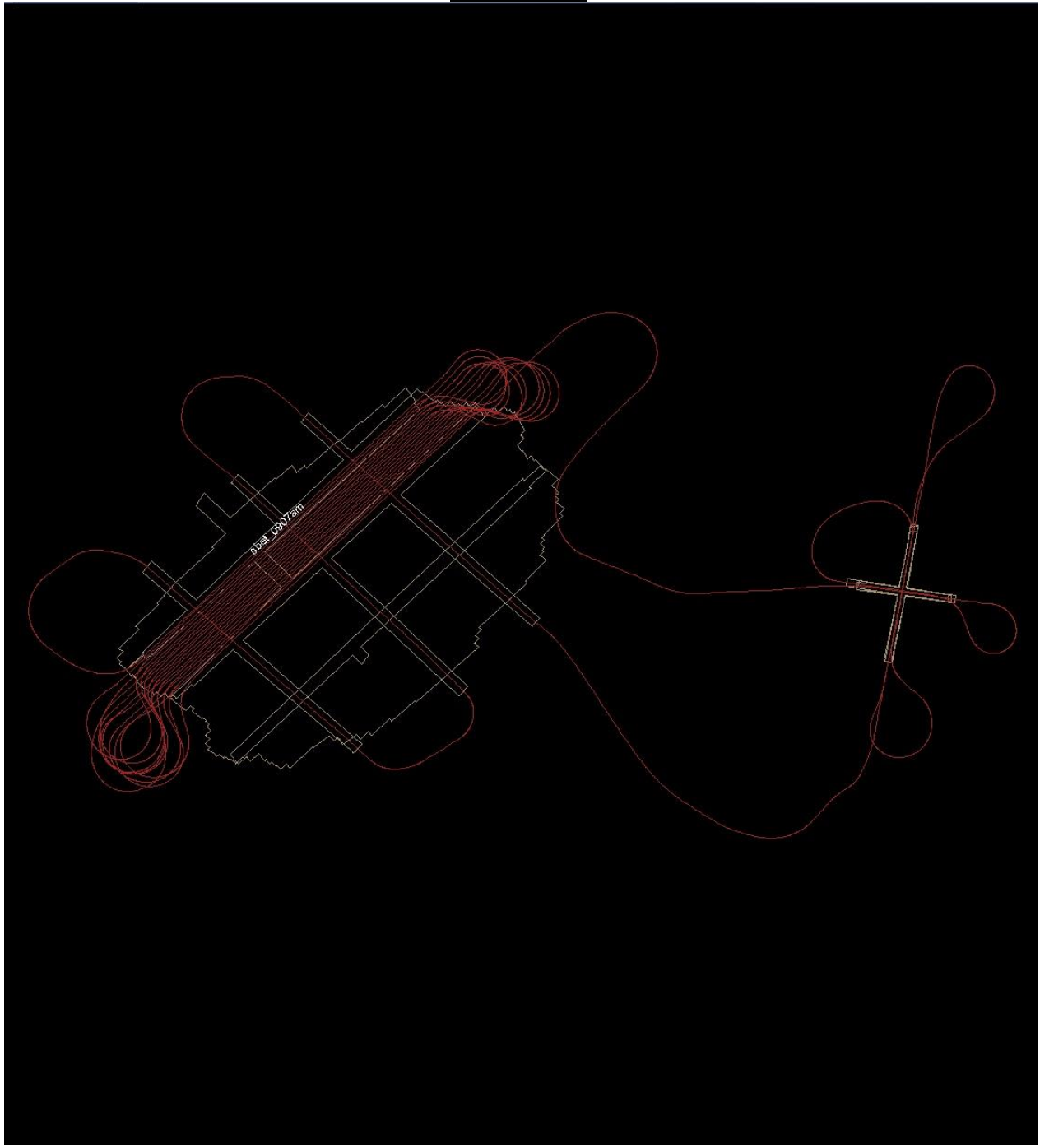


**9/6/2013**





**9/7/2013**



## **OPUS: Online Positioning User Service – Solution Report** **@ 1/2 Second**

### **Ground Receiver UNIT 1 - 09/04/2013**

START: 2013/09/04 13:19:00

STOP: 2013/09/04 19:31:00

ANT NAME: LEIAX1202 NONE # FIXED AMB: 93 / 103 : 90%

ARP HEIGHT: 1.6738

OVERALL RMS: 0.016(m)

**REF FRAME: NAD\_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.6758)**

X:	-2570354.442(m)	0.013(m)	-2570355.297(m)	0.013(m)
Y:	-4014408.945(m)	0.008(m)	-4014407.696(m)	0.008(m)
Z:	4224673.468(m)	0.016(m)	4224673.470(m)	0.016(m)
LAT:	41 44 26.93922	0.005(m)	41 44 26.95201	0.005(m)
E LON:	237 22 9.44173	0.006(m)	237 22 9.38143	0.006(m)
W LON:	122 37 50.55827	0.006(m)	122 37 50.61857	0.006(m)
EL HGT:	760.887(m)	0.021(m)	760.447(m)	0.021(m)
ORTHO HGT:	822.666(m)	0.026(m)	[NAVD88 (Computed using GEOID12A)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 10)	SPC (0401 CA 1)
Northing (Y) [meters]	4621065.908	767522.717
Easting (X) [meters]	530707.484	1947533.054
Convergence [degrees]	0.24586077	-0.41241178
Point Scale	0.99961160	1.00001968
Combined Factor	0.99949232	0.99990035

**US NATIONAL GRID DESIGNATOR: 10TEM3070721065(NAD 83)**

		BASE STATIONS USED			
PID	DESIGNATION		LATITUDE	LONGITUDE	DISTANCE(m)
DN7533	P154 ISHKESHRCHCN2007	CORS ARP	N414825.484	W1232136.124	61089.7
DN7515	P060 POLLARDFLTCHCN2005	CORS ARP	N405951.462	W1222453.528	84499.4
DN5668	P663 SHWHALEBAKCN2007	CORS ARP	N413154.969	W1220910.465	46111.8

		NEAREST NGS PUBLISHED CONTROL POINT			
MX0392	B 865		N414408.	W1223804.	662.7

## Ground Receiver UNIT 2 - 09/04/2013

START: 2013/09/04 13:25:00  
STOP: 2013/09/04 19:38:00

ANT NAME: LEIAX1202 NONE # FIXED AMB: 115 / 127 : 91%  
ARP HEIGHT: 1.6698 OVERALL RMS: 0.018(m)

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.6758)

X:	-2570403.117(m)	0.004(m)	-2570403.972(m)	0.004(m)
Y:	-4014430.564(m)	0.007(m)	-4014429.315(m)	0.007(m)
Z:	4224625.486(m)	0.006(m)	4224625.488(m)	0.006(m)
LAT:	41 44 24.81976	0.003(m)	41 44 24.83256	0.003(m)
E LON:	237 22 8.17239	0.003(m)	237 22 8.11209	0.003(m)
W LON:	122 37 51.82761	0.003(m)	122 37 51.88791	0.003(m)
EL HGT:	762.112(m)	0.010(m)	761.672(m)	0.010(m)
ORTHO HGT:	785.926(m)	0.028(m)	[NAVD88 (Computed using GEOID12A)]	

### UTM COORDINATES STATE PLANE COORDINATES

	UTM (Zone 10)	SPC (0401 CA 1)
Northing (Y) [meters]	4621000.418	767457.539
Easting (X) [meters]	530678.445	1947503.252
Convergence [degrees]	0.24562320	-0.41264234
Point Scale	0.99961158	1.00001952
Combined Factor	0.99949211	0.99990000
US NATIONAL GRID DESIGNATOR: 10TEM3067821000(NAD 83)		

### BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN7515	P060 POLLARDFLTCHN2005 CORS ARP	N405951.462	W1222453.528	84441.9
DN7470	P784 YORKMN040GCN2008 CORS ARP	N414950.922	W1222513.585	20196.1
DN7533	P154 ISHKESHRCHCN2007 CORS ARP	N414825.484	W1232136.124	61068.8

### NEAREST NGS PUBLISHED CONTROL POINT

MX0392	B 865	N414408.	W1223804.	591.1
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## Ground Receiver UNIT 1 - 09/06/2013

START: 2013/09/06 12:56:00  
STOP: 2013/09/06 19:09:00

ANT NAME: LEIAX1202 NONE # FIXED AMB: 81 / 87 : 93%

ARP HEIGHT: 1.7868 OVERALL RMS: 0.015(m)

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.6813)

X:	-2570357.388(m)	0.005(m)	-2570358.243(m)	0.005(m)
Y:	-4014406.227(m)	0.002(m)	-4014404.978(m)	0.002(m)
Z:	4224674.237(m)	0.005(m)	4224674.239(m)	0.005(m)
LAT:	41 44 26.97292	0.002(m)	41 44 26.98572	0.002(m)
E LON:	237 22 9.27096	0.003(m)	237 22 9.21066	0.003(m)
W LON:	122 37 50.72904	0.003(m)	122 37 50.78934	0.003(m)
EL HGT:	760.876(m)	0.007(m)	760.436(m)	0.007(m)
ORTHO HGT:	784.690(m)	0.025(m)	[NAVD88 (Computed using GEOID12A)]	

### UTM COORDINATES STATE PLANE COORDINATES

	UTM (Zone 10)	SPC (0401 CA 1)
Northing (Y) [meters]	4621066.930	767523.786
Easting (X) [meters]	530703.535	1947529.115
Convergence [degrees]	0.24582924	-0.41244280
Point Scale	0.99961160	1.00001968
Combined Factor	0.99949232	0.99990035

US NATIONAL GRID DESIGNATOR: 10TEM3070321066(NAD 83)

### BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN7533 P154	ISHKESHRCHCN2007 CORS ARP	N414825.484	W1232136.124	61085.7
AF9640 YBHB	YREKA CORS ARP	N414353.945	W1224238.593	6737.7
DN7470 P784	YORKMN040GCN2008 CORS ARP	N414950.922	W1222513.585	20141.0

### NEAREST NGS PUBLISHED CONTROL POINT

MX0392	B 865	N414408.	W1223804.	661.8
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## Ground Receiver UNIT 2 - 09/06/2013

START: 2013/09/06 13:03:00  
STOP: 2013/09/06 19:16:00

ANT NAME: LEIAX1202 NONE # FIXED AMB: 116 / 124 : 94%

ARP HEIGHT: 1.7598 OVERALL RMS: 0.018(m)

### REF FRAME: NAD\_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.6813)

X:	-2570403.119(m)	0.010(m)	-2570403.974(m)	0.010(m)
Y:	-4014430.558(m)	0.008(m)	-4014429.309(m)	0.008(m)
Z:	4224625.484(m)	0.008(m)	4224625.486(m)	0.008(m)
LAT:	41 44 24.81980	0.002(m)	41 44 24.83259	0.002(m)
E LON:	237 22 8.17217	0.004(m)	237 22 8.11187	0.004(m)
W LON:	122 37 51.82783	0.004(m)	122 37 51.88813	0.004(m)
EL HGT:	762.108(m)	0.014(m)	761.668(m)	0.014(m)
ORTHO HG	785.922(m)	0.033(m)	[NAVD88 (Computed using GEOID12A)]	

### UTM COORDINATES STATE PLANE COORDINATES

	UTM (Zone 10)	SPC (0401 CA 1)
Northing (Y) [meters]	4621000.419	767457.540
Easting (X) [meters]	530678.440	1947503.247
Convergence [degrees]	0.24562316	-0.41264238
Point Scale	0.99961158	1.00001952
Combined Factor	0.99949211	0.99990000

US NATIONAL GRID DESIGNATOR: 10TEM3067821000(NAD 83)

### BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN7533 P154	ISHKESHRCHCN2007 CORS ARP	N414825.484	W1232136.124	61068.8
DN7470 P784	YORKMN040GCN2008 CORS ARP	N414950.922	W1222513.585	20196.1
AF9640 YBHB	YREKA CORS ARP	N414353.945	W1224238.593	6702.8

### NEAREST NGS PUBLISHED CONTROL POINT

MX0392	B 865	N414408.	W1223804.	591.1
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## Ground Receiver UNIT 1 - 09/07/2013

START: 2013/09/07 13:14:00

STOP: 2013/09/07 16:58:00

ANT NAME: LEIAX1202 NONE # FIXED AMB: 72 / 72 : 100%

ARP HEIGHT: 1.7838 OVERALL RMS: 0.012(m)

**REF FRAME: NAD\_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.6647)**

X:	-2570360.092(m)	0.008(m)	-2570360.947(m)	0.008(m)
Y:	-4014404.230(m)	0.008(m)	-4014402.981(m)	0.008(m)
Z:	4224674.522(m)	0.012(m)	4224674.524(m)	0.012(m)
LAT:	41 44 26.98464	0.002(m)	41 44 26.99744	0.002(m)
E LON:	237 22 9.12582	0.003(m)	237 22 9.06552	0.003(m)
W LON:	122 37 50.87418	0.003(m)	122 37 50.93448	0.003(m)
EL HGT:	760.899(m)	0.017(m)	760.459(m)	0.017(m)
ORTHO HGT:	784.713(m)	0.036(m)	[NAVD88 (Computed using GEOID12A)]	

### UTM COORDINATES STATE PLANE COORDINATES

	UTM (Zone 10)	SPC (0401 CA 1)
Northing (Y) [meters]	4621067.278	767524.171
Easting (X) [meters]	530700.181	1947525.764
Convergence [degrees]	0.24580241	-0.41246916
Point Scale	0.99961160	1.00001968
Combined Factor	0.99949232	0.99990035

US NATIONAL GRID DESIGNATOR: 10TEM3070021067(NAD 83)

### BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN7470 P784	YORKMN040GCN2008 CORS ARP	N414950.922	W1222513.585	20143.7
DN7533 P154	ISHKESHRCHCN2007 CORS ARP	N414825.484	W1232136.124	61082.3
AF9640 YBHB	YREKA CORS ARP	N414353.945	W1224238.593	6734.4

### NEAREST NGS PUBLISHED CONTROL POINT

MX0392	B 865	N414408.	W1223804.	660.6
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## Ground Receiver UNIT 2 - 09/07/2013

START: 2013/09/07 13:09:00  
STOP: 2013/09/07 17:00:30

ANT NAME: LEIAX1202 NONE # FIXED AMB: 61 / 64 : 95%

ARP HEIGHT: 1.7758 OVERALL RMS: 0.017(m)

REF FRAME: NAD\_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2013.6839)

X:	-2570403.111(m)	0.007(m)	-2570403.966(m)	0.007(m)
Y:	-4014430.547(m)	0.005(m)	-4014429.298(m)	0.005(m)
Z:	4224625.476(m)	0.007(m)	4224625.478(m)	0.007(m)
LAT:	41 44 24.81990	0.002(m)	41 44 24.83269	0.002(m)
E LON:	237 22 8.17221	0.006(m)	237 22 8.11191	0.006(m)
W LON:	122 37 51.82779	0.006(m)	122 37 51.88809	0.006(m)
EL HGT:	762.092(m)	0.010(m)	761.653(m)	0.010(m)
ORTHO HGT:	785.906(m)	0.028(m)	[NAVD88 (Computed using GEOID12A)]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 10)	SPC (0401 CA 1)
Northing (Y) [meters]	4621000.422	767457.543
Easting (X) [meters]	530678.441	1947503.248
Convergence [degrees]	0.24562316	-0.41264237
Point Scale	0.99961158	1.00001952
Combined Factor	0.99949211	0.99990000

US NATIONAL GRID DESIGNATOR: 10TEM3067821000(NAD 83)

BASE STATIONS USED					
PID	DESIGNATION		LATITUDE	LONGITUDE	DISTANCE(m)
DN7470	P784 YORKMN040GCN2008	CORS ARP	N414950.922	W1222513.585	20196.1
DN7515	P060 POLLARDFLTCN2005	CORS ARP	N405951.462	W1222453.528	84441.9
AF9640	YBHB YREKA	CORS ARP	N414353.945	W1224238.593	6702.8

NEAREST NGS PUBLISHED CONTROL POINT			
MX0392	B 865	N414408.	W1223804. 591.1

## 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.

### HUMBUG CREEK WATERSHED LIDAR 2013 / DIGITAL MAPPING INC./ UTM 10-Metric

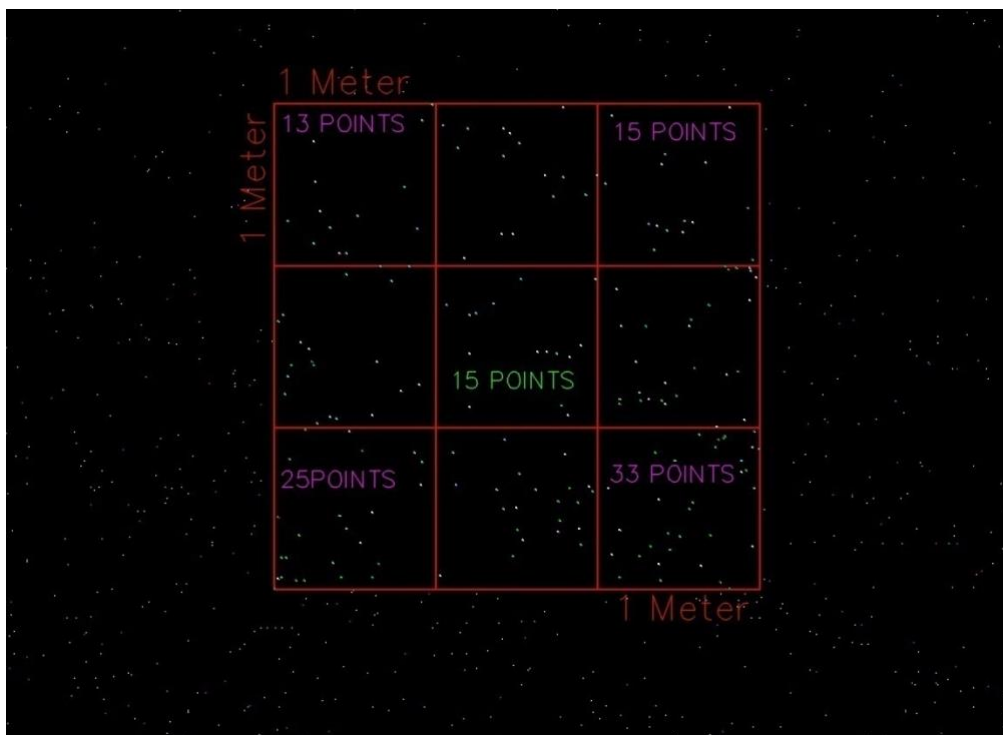
<u>AERIAL POINT#</u>	<u>LATITUDE</u>	<u>LONGITUDE</u>	<u>NORTH (M)</u>	<u>EAST (M)</u>	<u>TARGET ELEV.</u>	<u>DESCRIPTION</u>
AT 1	41°45'43.83397" N	122°48'42.70658" W	4623388.560	515638.949	1491.530	SET 60D SPIKE
AT 2	41°44'15.15079" N	122°46'38.79610" W	4620660.398	518507.162	1854.577	SET 60D SPIKE
AT 3	41°44'12.02120" N	122°44'23.03667" W	4620572.678	521643.389	1726.263	SET 60D SPIKE
AT 4A	41°45'34.43959" N	122°46'14.74554" W	4623107.125	519056.196	1424.883	SET 60D SPIKE
AT 6	41°44'42.18301" N	122°42'32.17879" W	4621511.070	524201.008	1563.793	SET 60D SPIKE
AT 8A	41°45'58.75944" N	122°46'02.25411" W	4623857.926	519342.611	1320.922	SET 60D SPIKE
AT 9A	41°45'26.33141" N	122°44'03.83169" W	4622865.762	522079.942	1236.026	SET 60D SPIKE
AT 9B	41°45'33.49577" N	122°43'42.08866" W	4623088.279	522581.337	1219.715	SET 60D SPIKE
AT 10	41°45'23.42716" N	122°41'13.68829" W	4622789.403	526009.241	1378.979	SET 60D SPIKE
AT 11A	41°47'38.07872" N	122°46'51.12363" W	4626917.987	518206.463	1322.665	SET 60D SPIKE
AT 12	41°47'29.30164" N	122°44'07.57240" W	4626657.919	521981.894	1107.560	SET 60D SPIKE
AT 13	41°46'35.32391" N	122°42'54.50242" W	4624998.621	523673.855	852.106	SET 60D SPIKE
AT 14	41°48'32.79857" N	122°46'08.02959" W	4628608.169	519196.493	1303.038	SET 60D SPIKE
AT 15	41°46'39.42847" N	122°41'18.84716" W	4625132.863	525881.624	988.806	SET 60D SPIKE
AT 16	41°46'52.92239" N	122°39'19.41336" W	4625559.535	528637.069	1035.294	SET 60D SPIKE
AT 17	41°48'47.83834" N	122°44'46.16569" W	4629077.330	521084.013	1640.672	SET 60D SPIKE
AT 18	41°48'16.90592" N	122°42'48.92547" W	4628131.865	523792.165	1160.105	SET 60D SPIKE
AT 19	41°48'12.31097" N	122°41'16.84396" W	4627997.552	525917.473	722.573	SET 60D SPIKE
AT 20	41°48'02.28000" N	122°39'02.98126" W	4627700.073	529007.692	1398.824	SET 60D SPIKE
AT 21	41°49'49.08017" N	122°43'50.02646" W	4630969.997	522373.337	1342.520	SET 60D SPIKE
AT 23	41°49'54.72262" N	122°40'12.76780" W	4631161.490	527383.947	661.944	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- ALL DAYS





## 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.

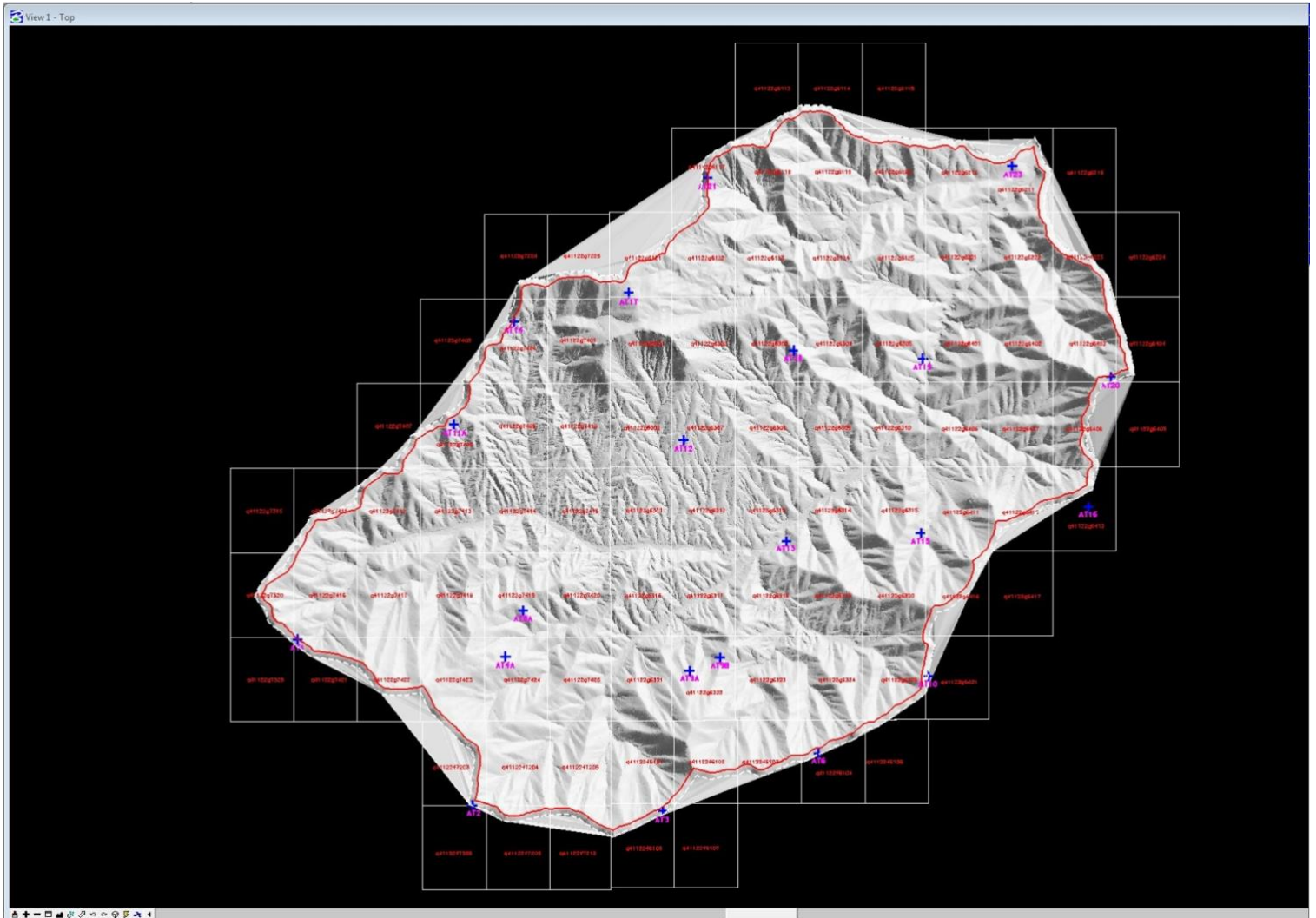
### SPATIAL REFERENCE FRAMEWORK

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

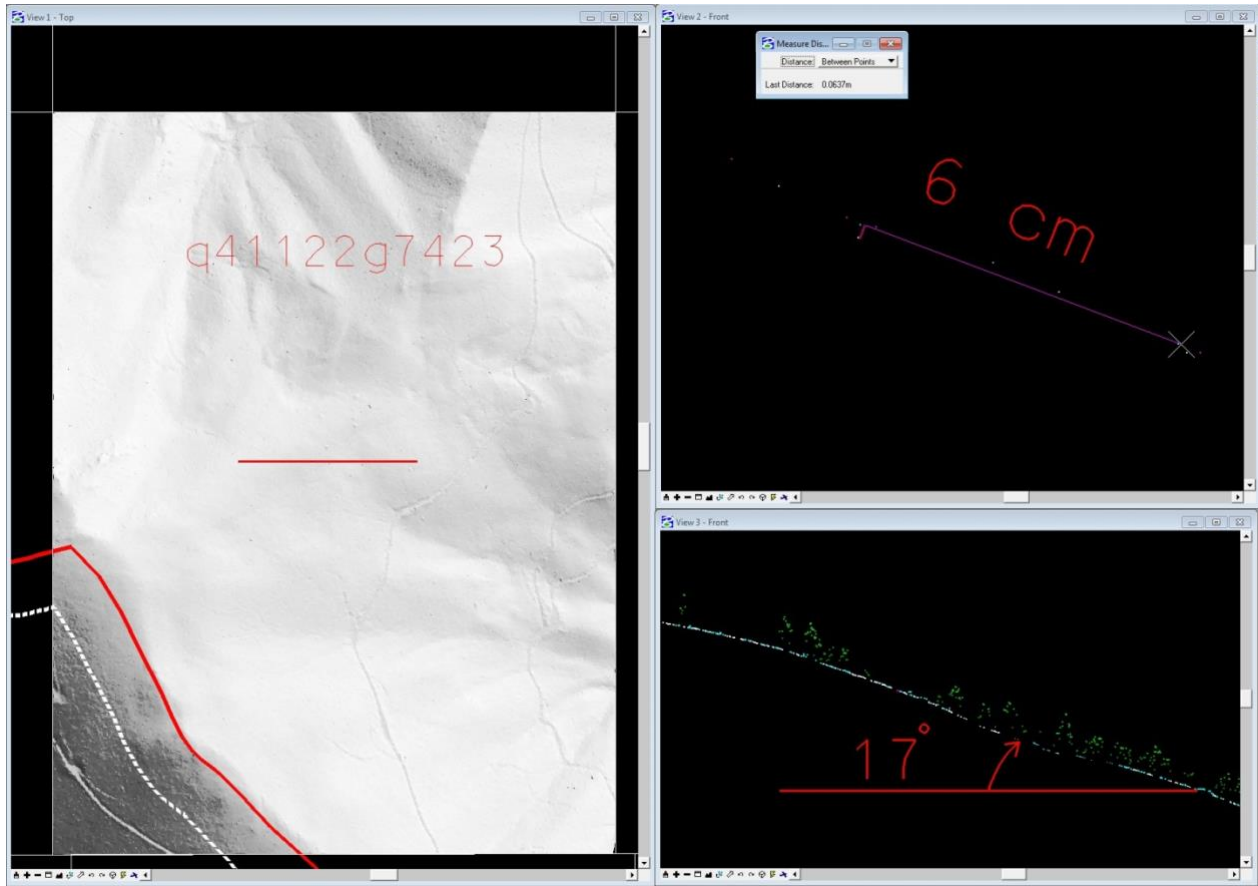
#### Ground Control Z vs. Aerial Surveyed/ Laser Pointing Z (QA/QC)

Number	Easting	Northing	Known Z	Laser Z	Dz
AT1	515638.949	4623388.560	1491.530	1491.590	+0.060
AT2	518507.162	4620660.398	1854.577	1854.590	+0.013
AT3	521643.389	4620572.678	1726.263	1726.330	+0.067
AT4A	519056.196	4623107.125	1424.883	1424.850	-0.033
AT6	524201.008	4621511.070	1563.793	1563.850	+0.057
AT8A	519342.611	4623857.926	1320.922	1320.900	-0.022
AT9A	522079.942	4622865.762	1236.026	1236.060	+0.034
AT9B	522581.337	4623088.279	1219.715	1219.900	+0.185
AT10	526009.241	4622789.403	1378.979	1378.970	-0.009
AT11A	518206.463	4626917.987	1322.665	1322.650	-0.015
AT12	521981.894	4626657.919	1107.560	1107.480	-0.080
AT13	523673.855	4624998.621	852.106	852.000	-0.106
AT14	519196.493	4628608.169	1303.038	1303.070	+0.032
AT15	525881.624	4625132.863	988.806	988.910	+0.104
AT16	528637.069	4625559.535	1035.294	1035.270	-0.024
AT17	521084.013	4629077.330	1640.672	1640.680	+0.008
AT18	523792.165	4628131.865	1160.105	1160.080	-0.025
AT19	525917.473	4627997.552	722.573	722.520	-0.053
AT20	529007.692	4627700.073	1398.824	1398.780	-0.044
AT21	522373.337	4630969.997	1342.520	1342.500	-0.020
AT23	527383.947	4631161.490	661.944	661.880	-0.064

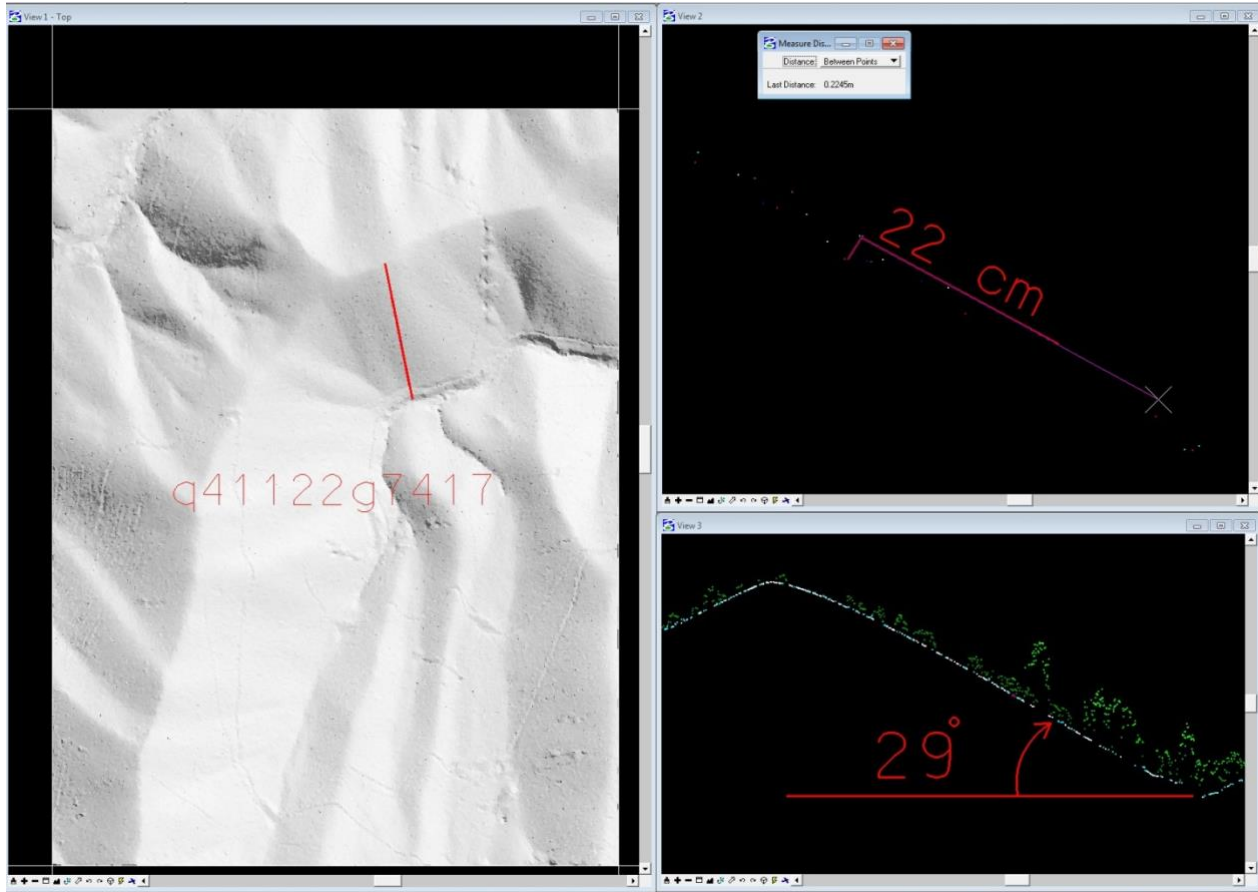
Average dz        +0.003  
Minimum dz        -0.106  
Maximum dz        +0.185  
Average magnitude    0.050  
Root mean square    0.065  
Std deviation        0.067



## 17 DEGREE SLOPE



## 29 DEGREE SLOPE



### 35 DEGREE SLOPE

