AIRBORNE LIDAR TASK ORDER REPORT

NEW YORK CMGP SANDY 0.7M NPS LIDAR
UNITED STATES GEOLOGICAL SURVEY (USGS)

CONTRACT NUMBER: G10PC00057

TASK ORDER NUMBER: G13PD00797

Woolpert Project Number: 73666
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PROJECT REPORT

USGS NEW YORK CMGP SANDY LIDAR 0.7M NSP LIDAR PROCESSING

WOOLPERT PROJECT #73666

For:

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SECTION 1: OVERVIEW

PROJECT NAME: NEW YORK CMGP SANDY 0.7M NPS LIDAR

WOOLPERT PROJECT #73666

This report contains a comprehensive outline of the New York CMGP Sandy 0.7M NPS Lidar Processing task order for the United States Geological Survey (USGS). This task is issued under Contract Number G10PC00057, as task order number G13PD00797. This task order requires lidar data to be acquired over several areas in New York State to include the entire counties of Bronx, Kings, New York, Richmond, and Queens. Governors, Hoffman, and Swinburne Islands are part of the New York area of interest (AOI), and will be acquired as part of this task order. The total area of the New York Sandy Lidar AOI is approximately 304 square miles. The lidar was collected and processed to meet a maximum Nominal Post Spacing (NPS) of 0.7 meters. The NPS assessment is made against single swath, first return data located within the geometrically usable center portion (typically ~90%) of each swath.

This acquisition was part of a larger effort designed to capture one other USGS task order AOI in New Jersey. In addition, Woolpert acquired lidar data of New York City as part of a task order for the NGA. The flight plan for the New York City NGA Lidar task order was developed with 11 additional cross flights over the Manhattan Metropolitan area to minimize data shadowing and data voids in the lidar dataset caused by tall buildings. The lidar data for the NGA task order was acquired between August 5, 2013 and August 15, 2013. USGS requested use of this data from the NGA, in order to reduce the duplication of lidar data acquisition effort on the New York CMGP Sandy Lidar task order. The NGA approved the use of this lidar data for the USGS task order.

Following the approval by NGA, Woolpert was able to utilize the cross flights acquired as part of the NGA task order to minimize data shadowing and data voids caused by tall buildings in the USGS New York CMGP Sandy Lidar task order AOI.

The cross flights used in the New York CMGP Sandy 0.7M NPS Lidar Processing task order from the NGA New York City task order were flown on August 6, 2013. The lidar data acquisition parameters for this mission are detailed in the lidar processing report for this task order.

The data was collected using a Leica ALS70 500 kHz Multiple Pulses in Air (MPiA) lidar sensor installed in a Leica gyro-stabilized PAV30 mount. The ALS70 sensor collects up to four returns per pulse, as well as intensity data, for the first three returns. If a fourth return was captured, the system does not record an associated intensity value. The aerial lidar was collected at the following sensor specifications:

Post Spacing (Minimum):	2.3 ft / 0.7m
AGL (Above Ground Level) average flying height:	7,500 ft / 2,286 m
MSL (Mean Sea Level) average flying height:	variable
Average Ground Speed:	150 knots / 173 mph
Field of View (full):	32 degrees
Pulse Rate:	239 kHz
Scan Rate:	41.6 Hz
Side Lap (Average):	25%

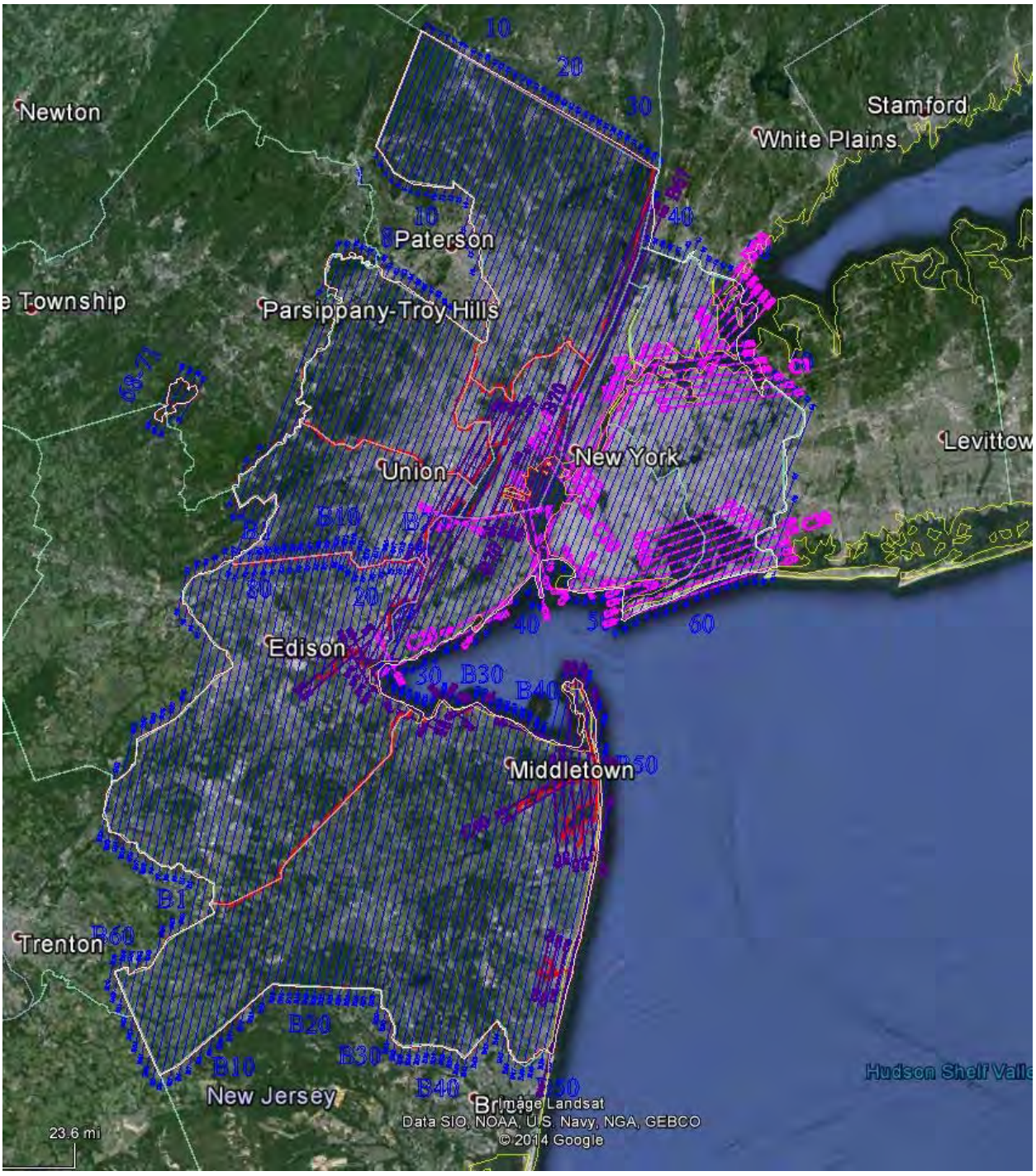
The data for the 2013 NGA project was collected using a Leica ALS70 500 kHz Multiple Pulses in Air (MPiA) lidar sensor installed in a Leica gyro-stabilized PAV30 mount. The ALS70 sensor collects up to four returns per pulse, as well as intensity data, for the first three returns. If a fourth return was

captured, the system does not record an associated intensity value. The aerial lidar was collected at the following sensor specifications:

Post Spacing (Minimum):	3.0ft / 0.91m
AGL (Above Ground Level) average flying height:	7,500 ft / 2,286 m
MSL (Mean Sea Level) average flying height:	variable
Average Ground Speed:	150 knots / 173 mph
Field of View (full):	40 degrees
Pulse Rate:	239 kHz
Scan Rate:	36.9 Hz
Side Lap (Average):	30%

The lidar data was processed and projected in UTM, Zone 18, North American Datum of 1983 (2011) in units of meters. The vertical datum used for the task order was referenced to NAVD 1988, GEOID12A, in units of meters.

Figure 1.1 Lidar Task Order AOI



SECTION 2: ACQUISITION

The existing lidar data was acquired with a Leica ALS70 500 kHz Multiple Pulses in Air (MPiA) Lidar sensor system, on board a Cessna 402. The ALS70 lidar system, developed by Leica Geosystems of Heerbrugg, Switzerland, includes the simultaneous first, intermediate and last pulse data capture module, the extended altitude range module, and the target signal intensity capture module. The system software is operated on an OC50 Operation Controller aboard the aircraft.

Table 2.1: ALS70 Lidar System Specifications

The ALS70 500 kHz Multiple Pulses in Air (MPiA) Lidar System has the following specifications:

Specification	
Operating Altitude	200 – 3,500 meters
Scan Angle	0 to 75° (variable)
Swath Width	0 to 1.5 X altitude (variable)
Scan Frequency	0 – 200 Hz (variable based on scan angle)
Maximum Pulse Rate	500 kHz (Effective)
Range Resolution	Better than 1 cm
Elevation Accuracy	7 - 16 cm single shot (one standard deviation)
Horizontal Accuracy	5 – 38 cm (one standard deviation)
Number of Returns per Pulse	7 (infinite)
Number of Intensities	3 (first, second, third)
Intensity Digitization	8 bit intensity + 8 bit AGC (Automatic Gain Control) level
MPiA (Multiple Pulses in Air)	8 bits @ 1nsec interval @ 50kHz
Laser Beam Divergence	0.22 mrad @ $1/e^2$ (~0.15 mrad @ 1/e)
Laser Classification	Class IV laser product (FDA CFR 21)
Eye Safe Range	400m single shot depending on laser repetition rate
Roll Stabilization	Automatic adaptive, range = 75 degrees minus current FOV
Power Requirements	28 VDC @ 25A
Operating Temperature	0-40°C
Humidity	0-95% non-condensing
Supported GNSS Receivers	Ashtech Z12, Trimble 7400, Novatel Millenium

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

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

The lidar data was collected in ten (10) separate missions, flown as close together as the weather permitted, to ensure consistent ground conditions across the project area. This acquisition was part of a larger effort designed to capture one other USGS task order AOI in New Jersey.

The cross flights used in the New York CMGP Sandy 0.7M NPS Lidar Processing task order from the NGA New York City task order were flown on August 6, 2013.

An initial quality control process was performed immediately on the lidar data to review the data coverage, airborne GPS data, and trajectory solution. Any gaps found in the Lidar data were relayed to the flight crew, and the area was re-flown.

Figure 2.1: Lidar Flight Layout, 2014 combined NY/NJ Task Orders

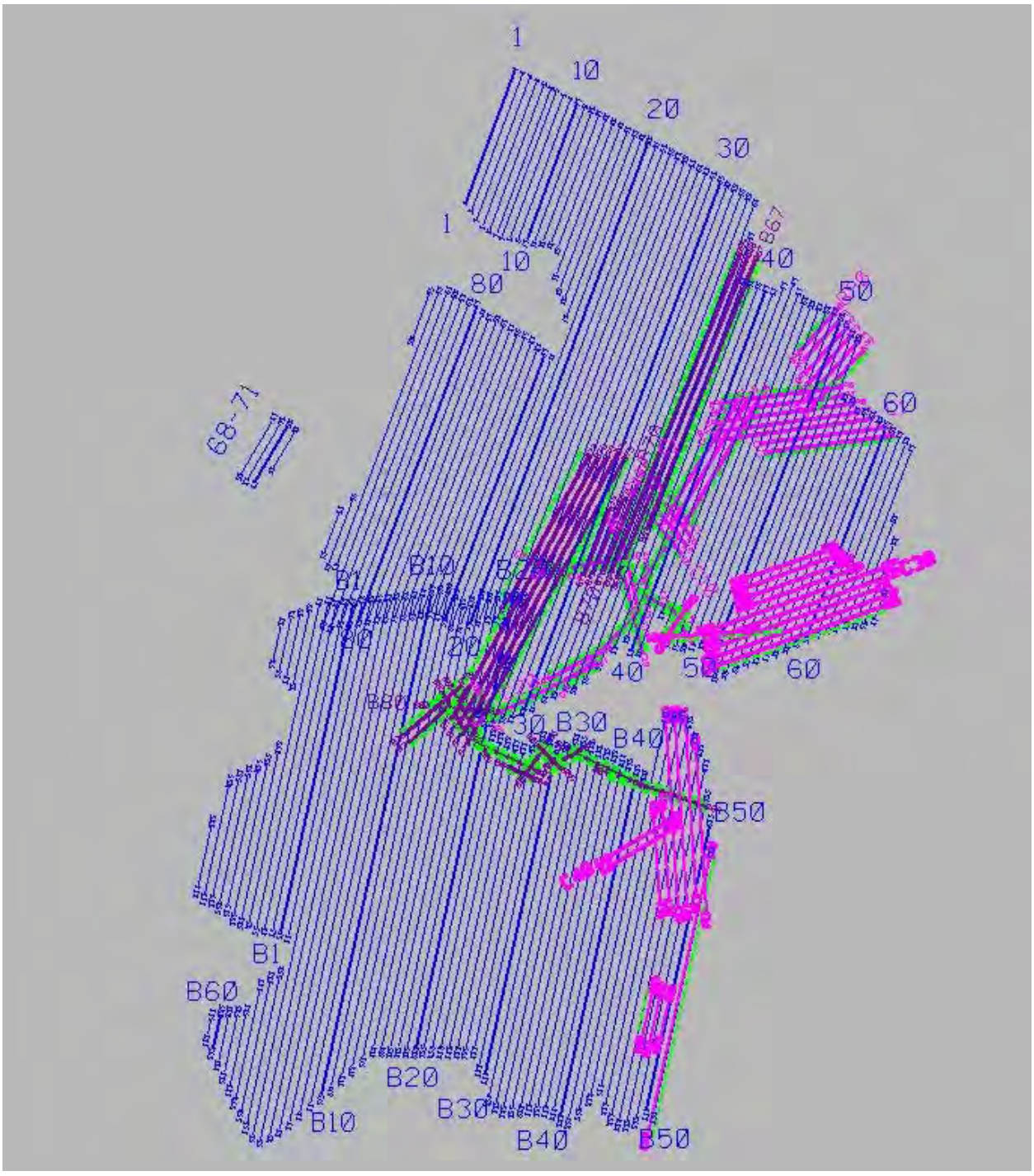


Table 2.2: Airborne Lidar Acquisition Flight Summary

Airborne Lidar Acquisition Flight Summary			
Date of Mission	**Lines Flown**	**Mission Time (UTC)** **Wheels Up/** **Wheels Down**	**Mission Time (Local = EDT)** **Wheels Up/** **Wheels Down**
August 6, 2013 – Sensor 7177	NGA T.O. X-Flights	11:25-16:50	7:25AM-12:50PM
March 21, 2014 – Sensor 7108	B7-B25	22:00 – 03:00	06:00PM – 11:00PM
March 22, 2014 – Sensor 7108	A52-A67	17:25 - 20:50	01:25PM – 04:50PM
March 23, 2014 – Sensor 7108	42-51	13:15 – 16:15	09:15AM – 12:15PM
March 26, 2014 – Sensor 7108	A32-A41	23:40 – 03:00	07:40PM – 11:00PM
March 27, 2014 – Sensor 7108	A4-A31, A52-A56, A61	13:10 – 20:40	09:10AM – 04:40PM
April 1, 2014 – Sensor 7108	14-25, 79-94	04:45 – 11:20	12:45PM – 07:20PM
April 1, 2014 – Sensor 7177	2C-3C, 23C-34C, 42C-45C, 67B-69B	18:59 – 22:32	02:59PM – 06:32PM
April 6, 2014 – Sensor 7108	C4, C42-C45, B67-B69, A42-A45, A77	10:24 – 13:20	06:24AM – 09:20AM
April 19, 2014 – Sensor 7177	C5-C10, C34, A96-A99	18:34 – 20:09	02:34PM – 04:09PM
April 21, 2014 – Sensor 7177	B74-B77	22:29 – 23:03	06:29PM – 07:03PM

SECTION 3: LIDAR DATA PROCESSING

APPLICATIONS AND WORK FLOW OVERVIEW

1. Resolved kinematic corrections for three subsystems: inertial measurement unit (IMU), sensor orientation information and airborne GPS data. Developed a blending post-processed aircraft position with attitude data using Kalman filtering technology or the smoothed best estimate trajectory (SBET).
   Software: POSPac Software v. 5.3, IPAS Pro v.1.35.

2. Calculated laser point position by associating the SBET position to each laser point return time, scan angle, intensity, etc. Created raw laser point cloud data for the entire survey in LAS format. Automated line-to-line calibrations were then performed for system attitude parameters (pitch, roll, heading), mirror flex (scale) and GPS/IMU drift.
   Software: ALS Post Processing Software v.2.75 build #25, Proprietary Software, TerraMatch v. 14.01.

3. Imported processed LAS point cloud data into the task order tiles. Resulting data were classified as ground and non-ground points with additional filters created to meet the task order classification specifications. Statistical absolute accuracy was assessed via direct comparisons of ground classified points to ground RTK survey data. Based on the statistical analysis, the Lidar data was then adjusted to reduce the vertical bias when compared to the survey ground control.
   Software: TerraScan v.14.011.

4. The LAS files were evaluated through a series of manual QA/QC steps to eliminate remaining artifacts from the ground class.
   Software: TerraScan v.14.011.

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)-INERTIAL MEASUREMENT UNIT (IMU) TRAJECTORY PROCESSING

EQUIPMENT

Flight navigation during the Lidar data acquisition mission is performed using IGI CCNS (Computer Controlled Navigation System). The pilots are skilled at maintaining their planned trajectory, while holding the aircraft steady and level. If atmospheric conditions are such that the trajectory, ground speed, roll, pitch and/or heading cannot be properly maintained, the mission is aborted until suitable conditions occur.

The aircraft are all configured with a NovAtel Millennium 12-channel, L1/L2 dual frequency Global Navigation Satellite System (GNSS) receivers collecting at 2 Hz.

All Woolpert aerial sensors are equipped with a Litton LN200 series Inertial Measurement Unit (IMU) operating at 200 Hz.

A base-station unit was mobilized for each acquisition mission, and was operated by a member of the Woolpert acquisition team. Each base-station setup consisted of one Trimble 4000 – 5000 series dual frequency receiver, one Trimble Compact L1/L2 dual frequency antenna, one 2-meter fixed-height tripod, and essential battery power and cabling. Ground planes were used on the base-station antennas. Data was collected at 1 or 2 Hz.

Woolpert's acquisition team was on site, operating GNSS base stations at the Trenton Mercer Airport (KTTN), along with utilizing NJJ2, NJTP, NYBP, and NJTR CORS stations.

For the 2013 NGA Task Order collection, Woolpert's acquisition team was onsite, operating a (GNSS) Base Station for the ground control at Essex County Airport (KCDW) for the airborne GPS support.

The GNSS base station operated during the lidar acquisition missions are listed below:

Table 3.1: GNSS Base Station

Station Name	Latitude (DMS)	Longitude (DMS)	Ellipsoid Height (L1 Phase center) (Meters)
KCDW Airport Base	40°52'32.95791"	74°16'45.30356"	-19.870
KTTN Airport Base	40°16'51.15372"	74°48'34.15158"	25.786
KTTN Airport Base 2	40°16'51.18651"	74°48'34.18759"	25.907
NJI2 CORS	40°44'29.30552"	74°10'39.72659"	18.006
NJTP CORS	40°32'25.84158"	74°28'04.13510"	0.438
NYBP CORS	40°42'03.81687"	74°00'51.54905"	-14.385
NJTR CORS	40°16'51.18651"	74°48'34.18759"	41.360

DATA PROCESSING

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

TRAJECTORY QUALITY

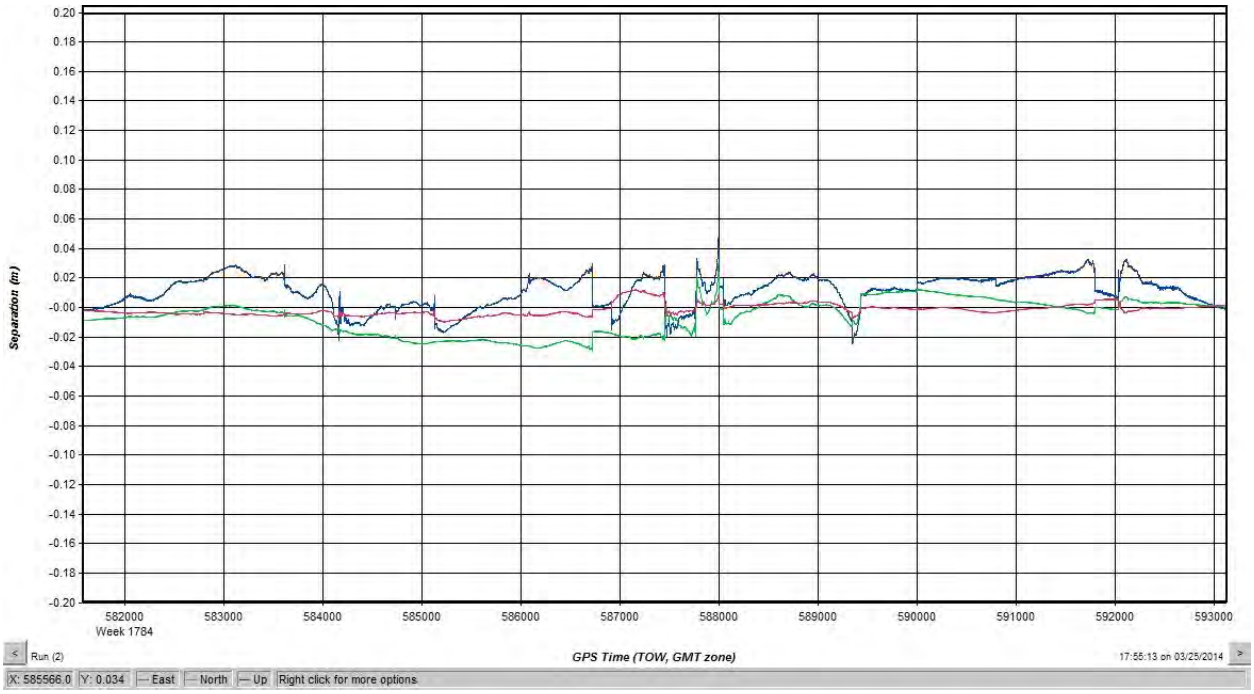
The GNSS Trajectory, along with high quality IMU data are key factors in determining the overall positional accuracy of the final sensor data. Within the trajectory processing, there are many factors that affect the overall quality, but the most indicative are the Combined Separation, the Estimated Positional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

Combined Separation

The Combined Separation is a measure of the difference between the forward run and the backward run solution of the trajectory. The Kalman filter is processed in both directions to remove the combined directional anomalies. In general, when these two solutions match closely, an optimally accurate reliable solution is achieved.

Woolpert's goal is to maintain a Combined Separation Difference of less than ten (10) centimeters. In most cases we achieve results below this threshold.

Figure 3.1: Combined Separation, Day08114 SH7108_B

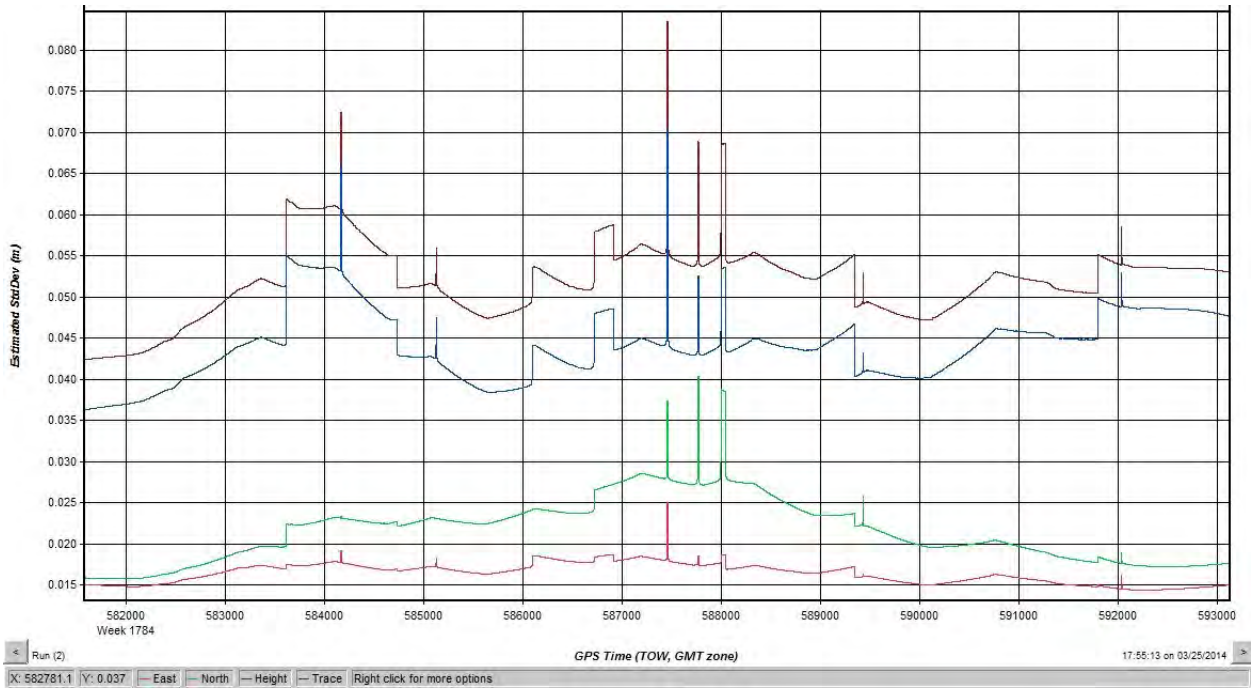


Estimated Positional Accuracy

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

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

Figure 3.2: Estimated Positional Accuracy, Day08114 SH7108_B

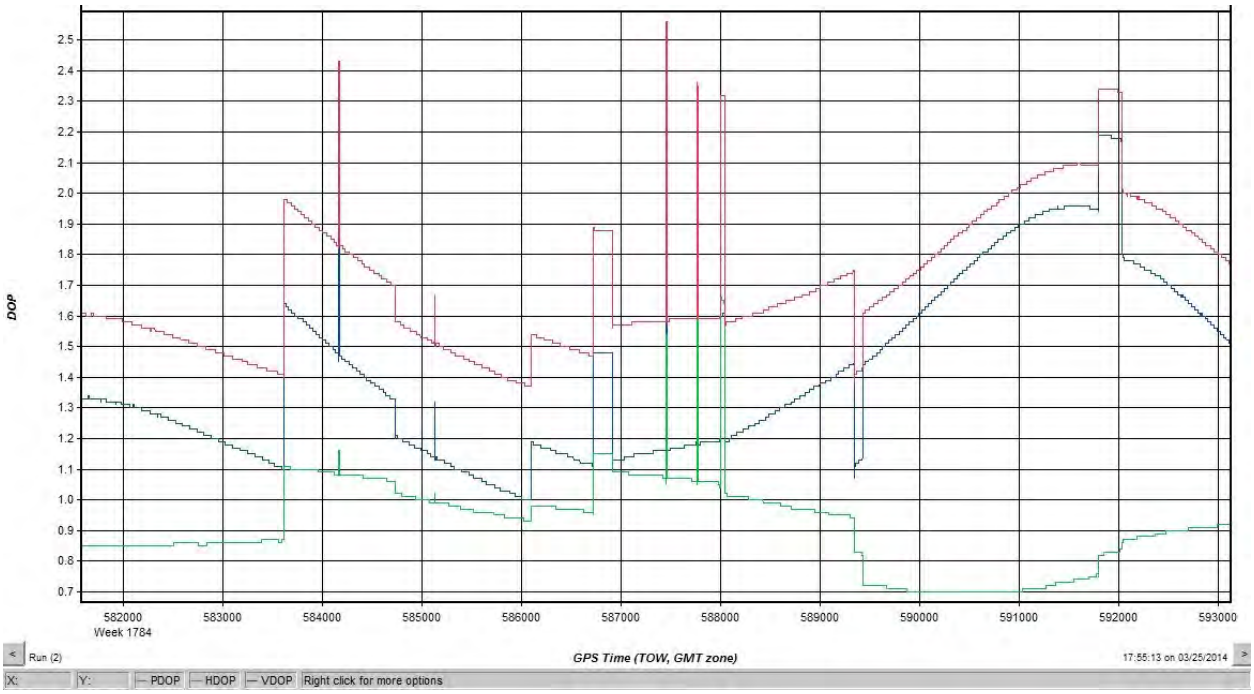


PDOP

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

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

Figure 3.3: PDOP, Day08114 SH7108_B



LIDAR DATA PROCESSING

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

- Processed individual flight lines to derive a raw "Point Cloud" LAS file. Matched overlapping flight lines, generated statistics for evaluation comparisons, and made the necessary adjustments to remove any residual systematic error.

- Calibrated LAS files were imported into the task order tiles and initially filtered to create a ground and non-ground class. Then additional classes were filtered as necessary to meet client specified classes.

- Once all project data was imported and classified, survey ground control data was imported and calculated for an accuracy assessment. As a QC measure, Woolpert has developed a routine to generate accuracy statistical reports by comparisons against the TIN and the DEM using surveyed ground control of higher accuracy. The Lidar is adjusted accordingly to meet or exceed the vertical accuracy requirements.

- The Lidar tiles were reviewed using a series of proprietary QA/QC procedures to ensure it fulfills the task order requirements. A portion of this requires a manual step to ensure anomalies have been removed from the ground class.

- The Lidar LAS files are classified into the Default (Class 1), Ground (Class 2), Noise (Class 7), Water (Class 9), Ignored Ground (Class 10), Overlap default (Class 17), and Overlap Ground (Class 18) classifications.

- FGDC Compliant metadata was developed for the task order in .xml format for the final data products.

- The horizontal datum used for the task order was referenced to UTM18N American Datum of 1983 (2011). The vertical datum used for the task order was referenced to NAVD 1988, meters, GEOID12A. Coordinate positions were specified in units of meters.

SECTION 4: HYDROLOGIC FLATTENING

HYDROLOGIC FLATTENING OF LIDAR DEM DATA

New York CMGP Sandy 0.7m NPS Lidar Processing task order required the compilation of breaklines defining water bodies and rivers. The breaklines were used to perform the hydrologic flattening of water bodies, and gradient hydrologic flattening of double line streams and rivers. Lakes, reservoirs and ponds, at a minimum size of 2-acres or greater, were compiled as closed polygons. The closed water bodies were collected at a constant elevation. Rivers and streams, at a nominal minimum width of 30.5 meters (100 feet), were compiled in the direction of flow with both sides of the stream maintaining an equal gradient elevation.

LIDAR DATA REVIEW AND PROCESSING

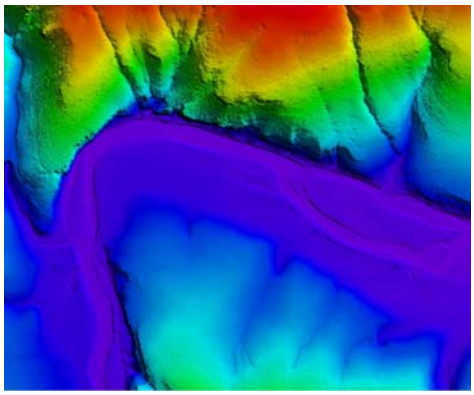
Woolpert utilized the following steps to hydrologically flatten the water bodies and for gradient hydrologic flattening of the double line streams within the existing lidar data.

1. Woolpert used the newly acquired lidar data to manually draw the hydrologic features in a 2D environment using the lidar intensity and bare earth surface. Open Source imagery was used as reference when necessary.

2. Woolpert utilizes an integrated software approach to combine the lidar data and 2D breaklines. This process "drapes" the 2D breaklines onto the 3D lidar surface model to assign an elevation. A monotonic process is performed to ensure the streams are consistently flowing in a gradient manner. A secondary step within the program verifies an equally matching elevation of both stream edges. The breaklines that characterize the closed water bodies are draped onto the 3D lidar surface and assigned a constant elevation at or just below ground elevation.

3. The lakes, reservoirs and ponds, at a minimum size of 2-acres or greater, were compiled as closed polygons. **Figure 4.1** illustrates a good example of 2-acre lakes and 30.5 meters (100 feet) nominal streams identified and defined with hydrologic breaklines. The breaklines defining rivers and streams, at a nominal minimum width of 30.5 meters (100 feet), were draped with both sides of the stream maintaining an equal gradient elevation.

Figure 4.1



4. All ground points were reclassified from inside the hydrologic feature polygons to water, class nine (9).

5. All ground points were reclassified from within a buffer along the hydrologic feature breaklines to buffered ground, class ten (10).

6. The lidar ground points and hydrologic feature breaklines were used to generate a new digital elevation model (DEM).

Figure 4.2 **Figure 4.3**

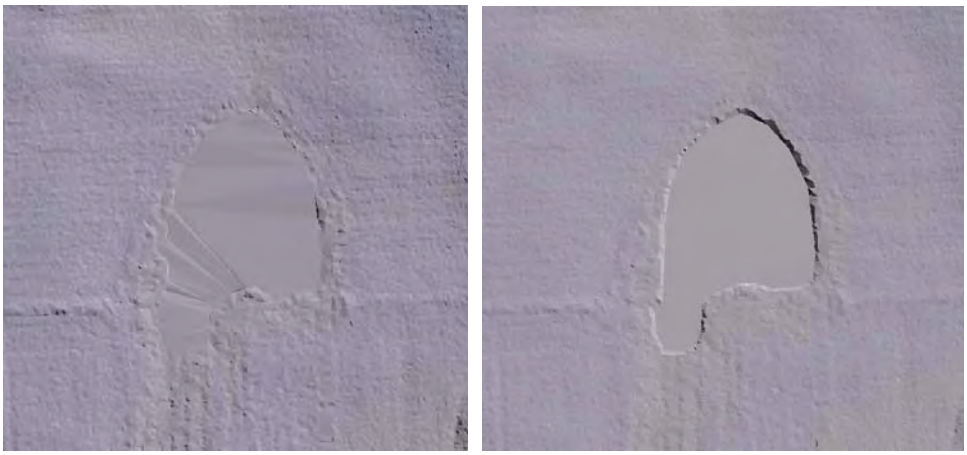


Figure 4.2 reflects a DEM generated from original lidar bare earth point data prior to the hydrologic flattening process. Note the "tinning" across the lake surface.

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

Terrascan was used to add the hydrologic breakline vertices and export the lattice models. The hydrologically flattened DEM data was provided to USGS in ERDAS .IMG format at a 1-meter cell size.

The hydrologic breaklines compiled as part of the flattening process were provided to the USGS as an ESRI shapefile. The breaklines defining the water bodies greater than 2-acres were provided as a PolygonZ file. The breaklines compiled for the gradient flattening of all rivers and streams at a nominal minimum width of 30.5 meters (100 feet) were provided as a PolylineZ file.

DATA QA/QC

Initial QA/QC for this task order was performed in Global Mapper v15, by reviewing the grids and hydrologic breakline features. Additionally, ESRI software and proprietary methods were used to review the overall connectivity of the hydrologic breaklines.

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

SECTION 5: FINAL ACCURACY ASSESSMENT

FINAL VERTICAL ACCURACY ASSESSMENT

The vertical accuracy statistics were calculated by comparison of the lidAR bare earth points to the ground surveyed quality check points.

Table 5.1: Overall Vertical Accuracy Statistics

Average error	-0.003	meters
Minimum error	-0.110	meters
Maximum error	0.090	meters
Root mean square	0.053	meters
Standard deviation	0.055	meters

Table 5.2: Swath Quality Check Point Analysis, FVA, UTM 18N, NAD83, NAVD88 GEOID12A, New York CMGP Sandy Lidar

Point ID	Easting (UTM meters)	Northing (UTM meters)	TIN Elevation (meters)	Dz (meters)
2008	600937	4524448	2.33	-0.11
2009	590996.1	4514951	5.12	-0.04
2010	606819.7	4510672	37.19	0
2011	606788.5	4494752	1.98	-0.02
2012	591589.1	4490492	1.87	0.01
2013	600743.9	4502504	5.04	-0.09
2013A	600744.7	4502505	5.03	-0.05
2014	584458.9	4494371	3.97	0.04
2015	586184.6	4505653	4.44	0.09
2016	575258.9	4499506	6.66	0.05
2017	568709	4485599	5.78	0.05
4	568348.7	4493359	6.14	0.09
9	593116	4526757	6.71	-0.025
11	601169	4524962	1.46	-0.024
21	595090.2	4521315	13.62	0.015

Point ID	Easting (UTM meters)	Northing (UTM meters)	TIN Elevation (meters)	Dz (meters)
24	597720.9	4502793	7.3	-0.024
BEOT2	573190	4497744	6.32	-0.005
BEOT3	569059.6	4494843	3.08	-0.056
BEOT6	576676.5	4494900	34.8	0.04

VERTICAL ACCURACY CONCLUSIONS

LAS Swath Fundamental Vertical Accuracy (FVA) Tested 0.103 meters fundamental vertical accuracy at 95 percent confidence level, derived according to NSSDA, in open terrain in open using (RMSEz) x 1.9600, tested against the TIN.

Bare-Earth DEM Fundamental Vertical Accuracy (FVA) Tested 0.121 meters fundamental vertical accuracy at a 95 percent confidence level, derived according to NSSDA, in open terrain using (RMSEz) x 1.96000 Tested against the DEM.

SUPPLEMENTAL VERTICAL ACCURACY ASSESSMENTS

Table 5.3: Quality Check Point Analysis, Urban, UTM 18N, NAD83, NAVD88 GEOID12A, New York CMGP Sandy Lidar

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Abs. Dz (meters)
3008	597011.020	4526525.440	41.710	0.030
3009	592590.140	4514710.820	4.500	0.060
3010	607295.080	4510823.430	37.470	0.120
3011	606799.750	4494724.080	1.970	0.100
3012	591527.290	4490354.040	2.370	0.000
3013	600685.990	4502554.140	3.940	0.130
3013A	600685.980	4502554.470	3.940	0.080
3014	584540.930	4494297.640	2.920	0.030
3015	586189.850	4505712.490	3.640	0.020
3016	576977.450	4499961.600	2.680	0.010

Point ID	Easting (UTM meters)	Northing (UTM meters)	DEM Elevation (meters)	Abs. Dz (meters)
3017	568044.320	4485026.640	2.090	0.050
13	591900.063	4511322.728	28.420	0.026
15	587554.966	4502664.672	45.880	0.085
17	585591.269	4492976.788	3.220	0.011
20	591753.231	4520229.610	10.750	0.018
22	586838.413	4514154.127	23.530	0.047
URBAN2	570265.476	4490308.485	4.140	0.008
URBAN3	573166.325	4497727.768	6.440	0.042
URBAN4	576709.115	4494871.248	34.020	0.055
URBAN5	568302.370	4494832.294	2.680	0.030
URBAN1	564460.141	4486160.862	9.310	0.053
URBAN2	565214.020	4484771.097	17.470	0.015
URBAN6	584005.633	4500213.628	38.300	0.002
URBAN7	595429.875	4500636.579	4.030	0.062
URBAN10	590544.815	4503752.562	16.040	0.061

ACCURACY CONCLUSIONS

Urban Land Cover Classification Supplemental Vertical Accuracy (SVA) Tested 0.116 meters supplemental vertical accuracy at the 95th percentile, tested against the DEM. Urban Errors larger than 95th percentile include:

- Point 3010, Easting 607295.08, Northing 4510823.43, Z-Error 0.120 meters
- Point 3013, Easting 600685.99, Northing 4502554.14, Z-Error 0.130 meters

CONSOLIDATED VERTICAL ACCURACY ASSESSMENT

ACCURACY CONCLUSIONS

Consolidated Vertical Accuracy (CVA) Tested 0.116 meters consolidated vertical accuracy at the 95th percentile level, tested against the DEM. Consolidated errors larger than 95th percentile include:

- Point 2008, Easting 600936.95, Northing 4524448.32, Z-Error 0.120 meters
- Point 3010, Easting 607295.08, Northing 4510823.43, Z-Error 0.120 meters
- Point 3013, Easting 600685.99, Northing 4502554.14, Z-Error 0.130 meters

Approved By:			
Title	Name	Signature	Date
Associate LiDAR Specialist Certified Photogrammetrist #1281	Qian Xiao		October 2014

SECTION 6: FLIGHT LOGS

FLIGHT LOGS

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

Woolpert

Leica LIDAR					
	9/21/2014	All	73666		NY-NJ-----8 LINES
SIMMONS		N475TC	5000.9	18:00:00	21:00:00	WOOLPERT P/N
PIC		Sensor Type		Lidar End Time	Data End Time	PIC
SWAN		AUS-710R	5005.5	23:00:00	3:00:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Haz/Cloud	Departing	KTTN
calm	10	clr						Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	120
				Gain - Fine/Down	12	Multi	X	B	100

Air Speed	AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	kts	7500	Ft		Ft	Yes		No	X	@	NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↑ Times entered are Zulu / GMT ↑						Verify 2 Turns Before Mission Start: Yes / No
B25	NE	22:23:00	22:31:00	21:13:00				
B24	SW	22:33:00	22:40:00	0:00:00				FAST AT START OF LINE-RED PARACHU
B23	NE	22:43:00	22:51:00	0:00:00				
B22	SW	22:54:00	23:03:00	0:00:00				
B20	NE	23:04:00	23:15:00	0:00:00				
B21	SW	23:18:00	23:20:00	0:00:00				
B19	SW	23:25:00	23:37:00	0:00:00				
B18	NE	23:40:00	23:51:00	0:00:00				
B17	SW	23:53:00	0:04:00	0:00:00				
B16	NE	0:08:00	0:19:00	0:00:00				
B15	SW	0:21:00	0:33:00	0:00:00				
B14	NE	0:36:00	0:47:00	0:00:00				
B13	SW	0:50:00	1:01:00	0:00:00				
B12	NE	1:04:00	1:16:00	0:00:00				
B11	SW	1:19:00	1:32:00	0:00:00				EARLY ABORT DUE TO ATC (RESTRICTE
B10	NE	1:33:00	1:46:00	0:00:00				
B09	SW	1:48:00	2:01:00	0:00:00				EARLY ABORT DUE TO ATC (RESTRICTE
B08	NE	2:04:00	2:16:00	0:00:00				LATE START DUE TO ATC (RESTRICTED
B07	SW	2:19:00	2:32:00	0:00:00				EARLY ABORT DUE TO ATC (RESTRICTE
				0:00:00				
				0:00:00				
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				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes / No

Additional Comments:

Drive #: 97

Woolpert

Leica LIDAR					
	9/22/2014	81	73666		NY-NJ ——A LINES
Operator	Aircraft	Depart Local	Land Local Time	Depart End Time	Base
SIMMONS	N475RC	5007.2	13:25:00	17:25:00	WOOLPERT PVA
PIC	Sensor Type	Depart End Time	Land End Time	Base End Time	PIC
SWAN	AUS-710R	5010.2	16:55:00	20:55:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud	Departing	KTTN
							HAZE	Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode			Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	120	
				Gain - Fine/Down	12	Multi	X	B	100	

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	kts	7500	Ft		Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↑ Times entered are Zulu / GMT ↑						Verify 2 Turns Before Mission Start: Yes / No
A67	NE	17:59:00	18:00:00	12:10:00				
A66	SW	18:04:00	18:06:00	0:00:00				
A65	NE	18:09:00	18:12:00	0:00:00				
A64	SW	18:16:00	18:22:00	0:00:00				
A63	NE	18:24:00	18:29:00	0:00:00				
A62	SW	18:32:00	18:38:00	0:00:00				
A61	NE	18:41:00	18:47:00	0:00:00				CLOUDS W/P 6-4
A60	SW	18:49:00	18:55:00	0:00:00				
A59	NE	18:58:00	19:04:00	0:00:00				
A58	SW	19:08:00	19:14:00	0:00:00				
A57	NE	19:17:00	19:24:00	0:00:00				
A56	SW	19:26:00	19:33:00	0:00:00				CLOUDS W/P 6
A55	NE	19:36:00	19:43:00	0:00:00				CLOUDS W/P 8-6
A54	SW	19:45:00	19:53:00	0:00:00				CLOUDS W/P 10
A53	NE	19:55:00	20:04:00	0:00:00				CLOUDS W/P 32,31,22,21,20,4
A52	SW	20:07:00	20:14:00	0:00:00				ROLL MAY HAVE EXCEEDED DUE TO AI
				0:00:00				
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes / No

Additional Comments:

Drive #: 98

Woolpert

Leica LIDAR					
	9/19/2014	82	73666	1	NY-NJ ——A LINES
Operator	Aircraft				
SIMMONS	N475RC	5010.2	9:15:00	13:15:00	WOOLPERT P/N
Pilot	Sensor Type				
SWAN	ALS-710R	5012.7	12:15:00	16:15:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud	Departing	KTTN
							HAZE	Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	120
				Gain - Fine/Down	12	Multi	X	B	100

Air Speed	AGL	MSL	Waveform Used				Waveform Mode	Pre-Trigger Dist.
150 kts	7500 Ft	Ft	Wave		Alt	X	@ NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↑ Times entered are Zulu / GMT ↑						Verify 5 Turns Before Mission Start: Y / N
51	NE	13:51:00	14:00:00	4:14:00				
50	SW	14:03:00	14:11:00	0:00:00				
49	NE	14:14:00	14:23:00	0:00:00				
48	SW	14:25:00	14:34:00	0:00:00				
47	NE	14:36:00	14:45:00	0:00:00				
46	SW	14:48:00	14:57:00	0:00:00				
45	NE	15:00:00	15:09:00	0:00:00				W/P 17
44	SW	15:11:00	15:20:00	0:00:00				CLOUD W/P 29,30,31
43	NE	15:23:00	15:32:00	0:00:00				CLOUD W/P 41, 13
42	SW	15:35:00	15:43:00	0:00:00				CLOUD W/P 25,26,36,39
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page	1			Verify 5-Turns After Mission: Yes / No

Additional Comments:

Drive #: 112

Woolpert

Leica LIDAR					
	9/26/2014	85	73666	1	NY-NJ ——A LINES

SIMMONS	N475SC	5012.7	19:40:00	23:40:00	WOOLPERT P/N
SWAN	AUS-710R	5015.7	23:00:00	3:00:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud	Departing	KTTN
							HAZE	Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode			Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	120
				Gain - Fine/Down	12	Multi	X	B	100

Air Speed	AGL	MSL	Waveform Used				Waveform Mode		Pre-Trigger Dist.
150 kts	7500 Ft	Ft	Yes		No	X	@ NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		* Times entered are Zulu / GMT *						Verify 5 Turns Before Mission Start: Yes / No
A41	NE	0:11:00	0:21:00	0:56:00				
A40	SW	0:23:00	0:33:00	0:00:00				
A39	NE	0:35:00	0:47:00	0:00:00				
A38	SW	0:49:00	0:59:00	0:00:00				
A37	NE	1:03:00	1:15:00	0:00:00				
A36	SW	1:18:00	1:30:00	0:00:00				
A35	NE	1:33:00	1:47:00	0:00:00				
A34	SW	1:49:00	2:02:00	0:00:00				
A33	NE	2:05:00	2:19:00	0:00:00				
A32	SW	2:22:00	2:35:00	0:00:00				
				0:00:00				
				0:00:00				
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↑ Times entered are Zulu / GMT ↑				Page	1		Verify 5-Turns After Mission	Yes	No

Additional Comments:

Tail winds on south bound runs; Wind kept shifting, so the speed fluctuated from fast to slow at times.

Drive #: 112

Woolpert

Leica LIDAR					
	3/27/2014	86	73666	1	NY-NJ ——A LINES

SIMMONS	N475YC	5015.7	9:10:00	13:10:00	WOOLPERT PIN
PIC	Sensor Type				POI
SWAN	AUS-710R	5022.8	16:45:00	20:40:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud		
330 @ 08	10 SM	CLR		-4	-15	3042		Departing	KTTN
								Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	120
				Gain - Fine/Down	12	Multi	X	B	100

Nr Speed		AGL		SBL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	Kts	7500	Ft		Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		↑ Times entered are Zulu / GMT ↑						Verify 2 Turns Before Mission Start: Yes / No
A31	NE	13:52:00	14:06:00	4:30:00				
A30	SW	14:08:00	14:22:00	0:00:00				
A29	NE	14:24:00	14:37:00	0:00:00				
A28	SW	14:40:00	14:54:00	0:00:00				
A27	NE	14:56:00	15:10:00	0:00:00				
A26	SW	15:13:00	15:28:00	0:00:00				
A25	NE	15:30:00	15:45:00	0:00:00				
A24	SW	15:49:00	16:01:00	0:00:00				
A23	NE	16:04:00	16:16:00	0:00:00				
A22	SW	16:19:00	16:31:00	0:00:00				
A21	SW	16:34:00	16:46:00	0:00:00				
A20	NE	16:48:00	17:01:00	0:00:00				
A19	SW	17:03:00	17:16:00	0:00:00				
A52	NE	17:23:00	17:32:00	0:00:00				
A53	SW	17:35:00	17:43:00	0:00:00				
A54	NE	17:46:00	17:53:00	0:00:00				
A55	SW	17:56:00	17:59:00	0:00:00				
A56	NE	18:02:00	18:05:00	0:00:00				
A61	SW	18:08:00	18:10:00	0:00:00				
A18	NE	18:21:00	18:25:00	0:00:00				
A17	SW	18:29:00	18:34:00	0:00:00				
A16	NE	18:36:00	18:40:00	0:00:00				
A15	SW	18:43:00	18:47:00	0:00:00				
A13	NE	18:50:00	18:53:00	0:00:00				
A12	SW	18:56:00	18:59:00	0:00:00				
A11	NE	19:02:00	19:06:00	0:00:00				
A10	SW	19:08:00	19:12:00	0:00:00				
A9	NE	19:15:00	19:18:00	0:00:00				
A6	SW	19:21:00	19:25:00	0:00:00				
A5	NE	19:28:00	19:32:00	0:00:00				
A4	SW	19:35:00	19:39:00	0:00:00				
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission: Yes / No

Additional Comments: Drive #

Tail winds on south bound runs; Wind kept shifting, so the speed fluctuated from fast to slow at times..

Woolpert

Leica LIDAR					
	4/1/2014	81	73666	1	NY-NJ ——— B & C LINES
Operator	Aircraft		Local Start Time		Base
SIMMONS	N475RC	5022.8	12:45:00	4:45:00	WOOLPERT PAN
Pilot	Sensor Type		Local End Time		PIC
SWAN	AUS-7 IDR	5029.0	7:20:00	11:20:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KTTN
360 @ 05	10 SM	CLR		6	-2	3009		Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	120
				Gain - Fine/Down	12	Multi	X	B	100

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	kts	7500	Ft		Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
↑ Times entered are Zulu / GMT ↑								Verify 2 Turns Before Mission Start: Yes / No
C45	S	5:14:00	5:15:00	10:38:00				
C44	N	5:18:00	5:20:00	0:00:00				
C43	S	5:23:00	5:24:00	0:00:00				
C42	N	5:29:00	5:37:00	0:00:00				
C34	N	5:43:00	5:48:00	0:00:00				
C35	S	5:51:00	5:56:00	0:00:00				
C36	N	5:58:00	6:04:00	0:00:00				
C37	S	6:06:00	6:11:00	0:00:00				
C38	N	6:14:00	6:17:00	0:00:00				
C39	S	6:19:00	6:22:00	0:00:00				
C41	E	6:26:00	6:28:00	0:00:00				
C40	W	6:31:00	6:33:00	0:00:00				
B89	W	6:40:00	6:43:00	0:00:00				
B88	W	6:48:00	6:50:00	0:00:00				
B87	SW	6:54:00	6:55:00	0:00:00				
B86	NW	6:59:00	7:00:00	0:00:00				
B85	SW	7:04:00	7:05:00	0:00:00				
B84	NW	7:09:00	7:10:00	0:00:00				
B83	NW	7:14:00	7:16:00	0:00:00				
C22	NW	7:21:00	7:22:00	0:00:00				
B81	SE	7:25:00	7:27:00	0:00:00				
B82	NW	7:32:00	7:34:00	0:00:00				
B78	SW	7:37:00	7:39:00	0:00:00				
B79	SE	7:42:00	7:45:00	0:00:00				
B80	E	7:50:00	7:51:00	0:00:00				
C21	E	7:57:00	8:00:00	0:00:00				
C20	E	8:07:00	8:09:00	0:00:00				
C19	NE	8:13:00	8:16:00	0:00:00				
C18	N	8:21:00	8:24:00	0:00:00				
C17	S	8:28:00	8:30:00	0:00:00				
C14	N	8:34:00	8:35:00	0:00:00				
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission: Yes / No

Additional Comments: Drive #

Tail winds on south bound runs; Wind kept shifting, so the speed fluctuated from fast to slow at times..

Woolpert

Leica LIDAR	6/1/2014	81	75606/75714	1	NJ_NY Port Sandy
Operator: DALAMBOS	Aircraft: N111SD				Base: WOOLPERT PIN
Pilot: LeROCQUE	Sensor Type: ALS-7177				

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KTTN
vbr4	10	clear		13	1	3006		Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	X	B	170

Nr Speed	AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.
150	7500	Ft	7500	Ft	Yes		No	X	@	NS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At: 18:35:03
		↑ Times entered are Zulu / GMT ↑						Verify 5 Turns Before Mission Yes X No
34C	N	18:59:00	19:03:02	0:00:00	16	0.7	1.1	TAKEOFF: 18:41Z
42C	S	19:07:56	19:14:22	0:00:00	16	0.7	1.1	TOO FAST
43C	N	19:18:04	19:19:01	0:00:00	16	0.7	1.4	
44C	S	19:21:35	19:22:44	0:00:00	16	0.7	1.4	
45C	N	19:25:00	19:26:35	0:00:00	16	0.6	1.1	
33C	E	19:34:44	19:39:02	0:00:00	18	0.7	1.4	
32C	W	19:41:53	19:46:05	0:00:00	16	0.7	1.1	
31C	E	19:49:22	19:53:24	0:00:00	16	0.7	1.1	
30C	W	19:56:02	20:00:17	0:00:00	18	0.7	1.1	
29C	E	20:02:56	20:07:14	0:00:00	18	0.7	1.1	
28C	W	20:11:00	20:13:30	0:00:00	18	0.7	1.1	
27C	E	20:16:04	20:18:21	0:00:00	17	0.8	1.2	
26C	W	20:21:29		0:00:00	16	0.7	1.3	ATC VECTOR
26C	W	20:28:22	20:30:32	0:00:00	19	0.6	1	
25C	E	20:33:11	20:35:03	0:00:00	20	0.6	1	
24C	W	20:40:08	20:42:13	0:00:00	19	0.6	1	
23C	E	20:44:54	20:45:45	0:00:00	18	0.6	1.1	
67B	NE	20:51:05	20:54:00	0:00:00	18	0.7	1.4	TDC ERROR
				0:00:00	18	0.7	1.4	OVERFLY BASE 21:
67B	NE	21:49:53	21:56:40	0:00:00	11	0.9	1.4	OVERFLY BASE! 21:35:20
68B	SW	21:59:52	22:08:00	0:00:00	10	0.9	1.5	
69B	NE	22:10:45	22:18:34	0:00:00	10	1	1.5	
3C	E	22:25:36	22:28:31	0:00:00	11	1.2	1.7	
2C	W	22:32:13		0:00:00	10	1.2	1.7	TDC ERROR DATA FETCH DUE TO
				0:00:00	11	1.2	1.7	NO MEM SWITCH SIGNAL ON
				0:00:00	17	0.7	1.2	I/O AUX 1 CONNECTION ON TDC
				0:00:00				
				0:00:00				LANDING: 22:55
				0:00:00				STATIC: 22:58
				0:00:00				
				0:00:00				
↑ Times entered are Zulu / GMT ↑				Page		1		Verify 5-Turns After Mission Yes X No

Additional Comments: Drive #

783516

WOOLPERT FLIGHT LOG SHEET #1

Leica ALS-70	MM/DD/YYYY: 4/6/2014	Day of Year: 96	Mission Name / Job #: 74257

Operator	Aircraft	Hobbs Start	Local Start Time	Zulu Start Time
Annen	N475BC X, N404CP, N707BF, N475CP, N1107Q	5035.6	6:24	10:24
Pilot	**Sensor** SH-7177, SH_6157, SH-7186 X	**Hobbs End**	**Local End Time**	**Zulu End Time**
Albers		5042.2	16:14	20:14

Passengers	Using or Relying on GCPS	GPS Base #1	Operator	Annen	PID	ICTTN
	Yes ☐ No ☒	GPS Base #2	Operator	NYCI	PID	DI0446

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing ICAO / Arriving ICAO
320/9	10	Clr	0	34f	21f	30.17		

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	GAIN: Course/Up ___ Fine/Down ___	MODE: Single ☐ Multi ☐ 2+2 ☐ 4+3 ☐
32	41.6	239	100		

Air Speed	AGL	MSL	Threshold	Waveform Mode @ NS	Pre-Trigger Dist.
150 Kts	7500 Ft	7500 Ft	/		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:
		‡ Times entered are Zulu / GMT ‡						Verify S-Turns Before Mission Yes X No ☐
C42	N	10:57:00	11:04:00					New York
C43	S	11:09:00	11:10:00					
C44	N	11:12:00	11:14:00					
C45	S	11:16:00	11:18:00					
C4	E	11:33:00	11:37:00					
B67	S	11:43:00	11:50:00					
B68	N	11:53:00	12:02:00					
B69	S	12:05:00	14:14:00					
A42	S	12:16:00	12:25:00					
A43	N	12:28:00	12:37:00					
A44	S	12:39:00	12:48:00					
A45	N	12:51:00	13:00:00					
A77	N	13:11:00	13:20:00					
								Long Island
23	E	13:31:00	13:47:00					
24	W	13:49:00	14:05:00					
25	E	14:07:00	14:22:00					
26	W	14:25:00	14:40:00					
27	E	14:42:00	14:57:00					
28	W	15:00:00	15:16:00					
29	E	15:18:00	15:34:00					
30	W	15:37:00	15:53:00					
31	E	15:56:00	16:12:00					MANUAL START UL001
32	W	16:14:00	16:31:00					
31	E	16:34:00	16:35:00					GAP FILL
C2	W	16:41:00	16:44:00					NEW YORK
C3	E	16:46:00	16:49:00					
		† Times entered are Zulu / GMT †		0:00:00	Total Time On Line			Verify S-Turns After Mission Yes ☐ No ☐

Additional Comments: Drive #

Woolpert

Leica LIDAR	[illegible]	Day of Year	Project #	Flight #	Project Name
	4/19/2014	109	73714	1	NY_NJ_Post-Hurricane_Sandy

Operator	Aircraft	[illegible]	[illegible]	[illegible]	Base
GALAMBOS	N111SD	2542.5	2:34:00	18:34:00	WOOLPERT PIN
Pilot	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LaROCQUE	ALS-7177	2544.6	4:09:00	20:09:00	new pin 1:45 start

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fog/Cloud		
010 11g19	10	clear		18	-6	3024		Departing	KTTN
								Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Coarse/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode		Pre-Trigger Dist.	
150	kts	7500	Ft	7500	Ft	Yes		No	X	@	NS		Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	18:10:52
↓ Times entered are Zulu / GMT ↓								Verify S-Turns Before Mission	Yes X No
A96	SW	18:34:08	18:41:42	0:00:00	16	0.7	1.5	T/O: 18:17Z	
A97	NE	18:44:13	18:52:24	0:00:00	16	0.7	1.5		
A98	SW	18:55:01	19:02:49	0:00:00	16	0.7	1.5		
A99	NE	19:05:57	19:13:57	0:00:00	18	0.6	1.1		
C5	NE	19:21:57	19:25:36	0:00:00	17	0.6	1.3		
C6	SW	19:28:28	19:32:24	0:00:00	18	0.6	1.1	OFFLINE	
C7	NW	19:34:29	19:36:38	0:00:00	18	0.6	1.1		
C8	SE	19:39:08	19:41:01	0:00:00	17	0.6	1.1		
C9	NW	19:43:48	19:45:50	0:00:00	17	0.6	1.1		
C10	SE	19:48:25	19:50:15	0:00:00	17	0.6	1.1		
C6	NE	19:52:59	19:56:51	0:00:00	17	0.6	1.1		
C34	S	20:05:37	20:09:35	0:00:00	18	0.6	1.2		
				0:00:00				Landing: 20:26z	
				0:00:00				Static: 20:27:17	
				0:00:00					
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				0:00:00					
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↑ Times entered are Zulu / GMT ↑			Page		1			Verify S-Turns After Mission	Yes X No

Additional Comments:

Drive # 783516

Woolpert

Leica LIDAR	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	4/21/2014	11114	73846/73714	1	NJ_NY Post Sandy

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
GALAMBOS	N111SD	2553.0	6:29:00	22:29:00	WOOLPERT PVN
LaROCQUE	ALS-7177	2555.3	7:03:00	23:03:00	

Wind Dir/Speed	Visibility	Ceiling	Cloud Cover %	Temp	Dew Point	Pressure	Haze/Fire/Cloud	Departing	KHYA
250 3	10	clear		9	-3	29.95		Arriving	KTTN

Scan Angle (FOV)	Scan Frequency (Hz)	Pulse Rate (kHz)	Laser Power %	Fixed Gain		Mode		Threshold Values	
32	41.6	239	100	Gain - Course/Up	6	Single		A	180
				Gain - Fine/Down	12	Multi	x	B	170

Air Speed		AGL		MSL		Waveform Used				Waveform Mode	Pre-Trigger Dist.
150	Kts	7500	Ft	7500	Ft	Yes		No	X	@ MS	Ft

Line #	Dir.	Line Start Time	Line End Time	Time On Line	SV's	HDOP	PDOP	Line Notes/Comments	
Test	n/a			n/a	n/a	n/a	n/a	GPS Began Logging At:	22:08:53
↓ Times entered are Zulu / GMT ↓								Verify 5-Turns Before Mission	Yes X No
				0:00:00				6:20-10:20PM TIDES	
				0:00:00				8:20 LOW TIDE	
				0:00:00				ARR TTN: 2554.3	
				0:00:00				takeoff:22:15z	
874	NE	22:29:11	22:36:38	0:00:00	18	0.7	1.1		
875	SW	22:39:32	22:46:42	0:00:00	20	0.6	1		
876	NE	22:49:19	22:56:58	0:00:00	18	0.7	1.2		
877	SW	22:58:49	23:02:42	0:00:00	18	0.7	1.3		
				0:00:00				landing ttn:23:16z	
				0:00:00				Static:	
				0:00:00					
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↑ Times entered are Zulu / GMT ↑			Page	1				Verify 5-Turns After Mission	Yes X No

Additional Comments:

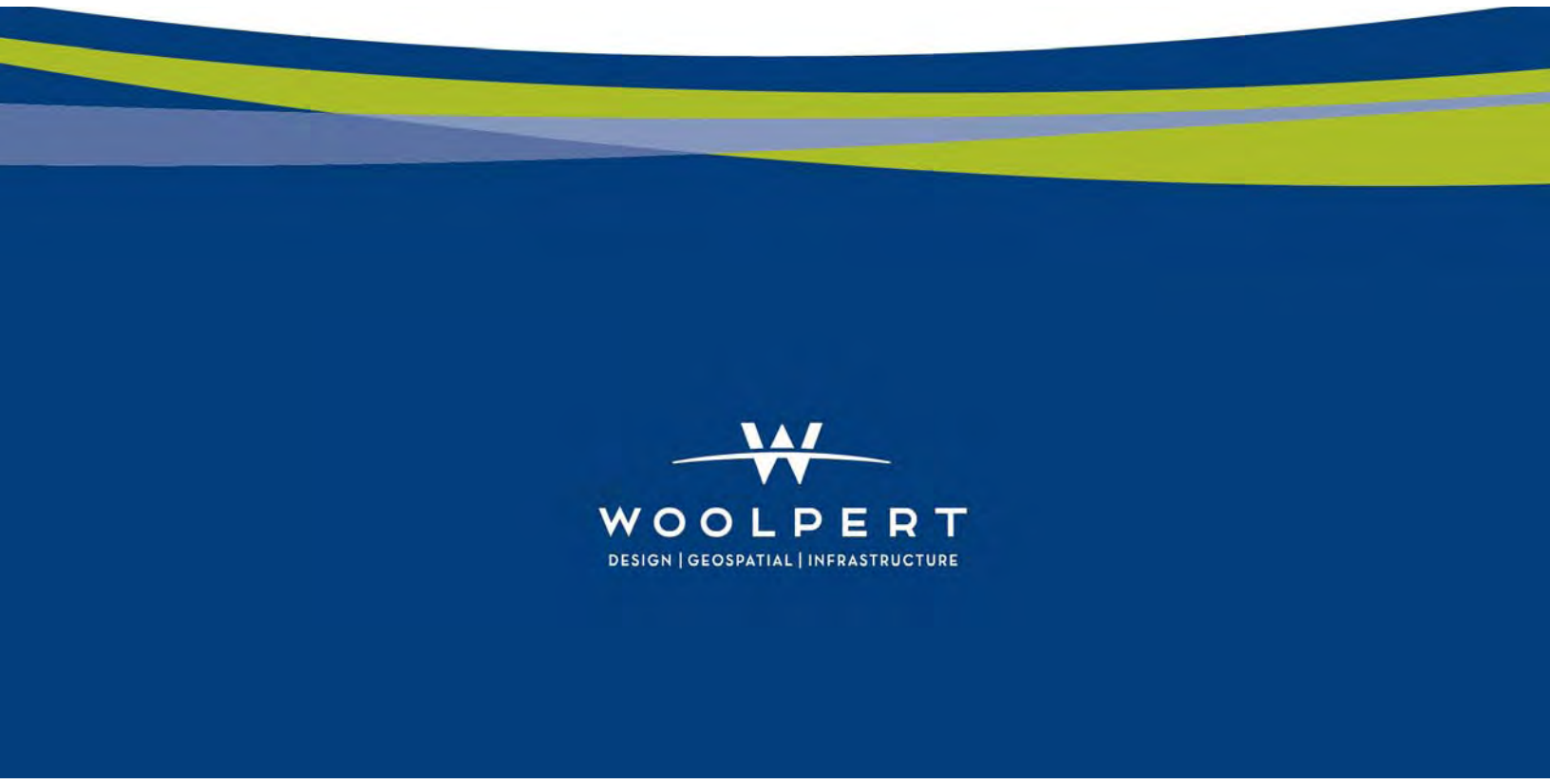
Drive # 783516

SECTION 7: FINAL DELIVERABLES

FINAL DELIVERABLES

The final liDAR deliverables are listed below.

- LAS v1.2 classified point cloud
- LAS v1.2 raw unclassified point cloud flight line strips no greater than 2GB. Long swaths greater than 2GB will be split into segments)
- Hydrologically flattened Polygon z and Polyline z shapefiles
- Hydrologically flattened bare earth 1-meter DEM in ERDAS .IMG format
- 8-bit gray scale intensity images
- Tile layout and data extent provided as ESRI shapefile
- Control points provided as ESRI shapefile
- FGDC compliant metadata per product in XML format
- LiDAR processing report in pdf format
- Survey report in pdf format


WOOLPERT
DESIGN | GEOSPATIAL | INFRASTRUCTURE