atlantic

Project Report

TASK ORDER NAME: NM_WhiteSandsNM_2020_D20
TASK ORDER NUMBER: 140G0220F0031
CONTRACT NUMBER: G16PC00042
ATLANTIC PROJECT NUMBER: 19095

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SECTION 1: PROJECT OVERVIEW AND PURPOSE

1.1 Aerial LiDAR Project

1.1.1 Project Overview

USGS task order 140G0220F0031 required leaf-off Winter 2020 LiDAR surveys to be collected over 81 square miles covering part or all of White Sands National Monument in New Mexico in support of the National Park Service. Aerial LiDAR data for this task order was planned, acquired, processed, and produced at an aggregate nominal pulse spacing (ANPS) of ≤ 0.25 meters and in compliance with USGS National Geospatial Program LiDAR Base Specification version 2.1.

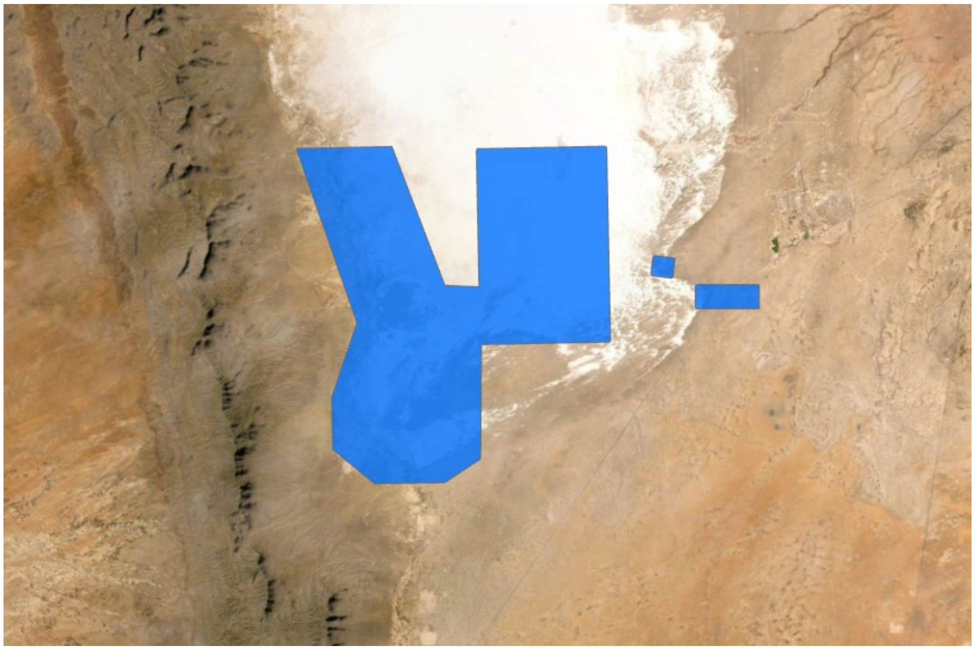

Figure 1: Aerial LiDAR Project Overview – Defined Project Area (DPA) and Associated Areas of Interest (AOIs)

1.1.2 Project Purpose

The processed data will be analyzed to document fossil trackways and archeological sites associated with the trackways that are eroding and are usually lost in less than two years after they are exposed. The monument has one of the greatest concentrations of fossilized human footprints is the world. Unfortunately, the prints are being lost as soon as they are found. This project is needed to efficiently survey thousands of acres to determine what areas are being eroded and to document the prints before they are lost. In addition, this project will help to identify and map significant natural and manmade structures and conduct project planning (including NEPA and NHPA compliance) including design for park development of public trail and new interpretive media. White Sands plans to analyze the point cloud and DEM's to identify soil erosion and dust storms that affect visitor access and public trail development.

1.1.3 Contract Deliverables

Item	Specification/Format
Classified Point Cloud	Tiled, LAS v1.4
Bare Earth DEM	GeoTIFF, 0.25m cell size
Mosaic DEM Dataset	GeoTIFF and .gdb format
Intensity Imagery	TIFF, 0.25m cell size
3-Band Imagery	Color corrected, unrectified TIFFs
3-Band Orthomosaic	Tiled, GeoTIFF format, 10cm gsd
Breaklines	.shp (if needed)
Control	.shp
Metadata	.xml
Project Report	.pdf
Pilot Data	LAS, DEM, Orthos

Table 1: Aerial LiDAR Contract Deliverables

SECTION 2: FIELD OPERATIONS

2.1 Aerial LiDAR Project – Aerial Acquisition

2.1.1 Aircraft and Sensor Information

Atlantic operated a Caravan (N167PM) outfitted with an Optech Galaxy Prime LiDAR system during the collection of the project area. The specifications of this system are presented in the following table:

Parameter	Specification
Model	Galaxy Prime
Manufacturer	Optech
Performance Envelope	150 – 4700 m AGL, nominal
Absolute Horizontal Accuracy	1/10,000 x altitude
Absolute Elevation Accuracy	< 0.03 – 0.20 m RMSE from 150 – 4700 m AGL
Topographic Laser	1064-nm near-infrared
Laser Classification	Class IV
Pulse Repetition Frequency (Effective)	Programmable, 50 – 1000 kHz
Beam Divergence	0.25 mrad (1/e)
Laser Range Precision	< 0.008 m
Minimum Target Separation Distance	< 0.7 m (discrete)
Range Capture	Up to 8 range measurements, including last
Intensity Capture	Up to 8 intensity measurements, including last (12-bit)
Scan Angle (Fov)	10 – 60°
Swath Width	10 – 115% of altitude AGL
Scan Frequency	0 – 120 Hz advertised (0 – 240 scan lines/sec)
Scan Product	2000 maximum
Roll Compensation	±5° minimum
Data Storage	Internal solid-state drive (SSD)
Power Requirements	28 V; 300 W
Dimensions and Weight	Sensor: 0.34 x 0.34 x 0.25 m, 27 kg PDU: 0.42 x 0.33 x 0.10 m, 6.5 kg
Operation Temperature	0 to +35°C

Table 2: System Specifications – Galaxy Prime

2.1.2 Sensor Acquisition Information

The following table illustrates project specific system parameters for LiDAR acquisition on this project:

Parameter	Specification
System	Optech Galaxy Prime
Nominal Pulse Spacing (m)	0.35
Nominal Pulse Density (pls/m²)	16
Nominal Flight Height (AGL meters)	1500
Nominal Flight Speed (kts)	120
Pass Heading (°)	0
Sensor Scan Angle (°)	40
Scan Frequency (Hz)	86
Pulse Rate of Scanner (kHz)	700
Line Spacing (m)	682
Central Wavelength of Sensor Laser (nm)	1064
Sensor Operated with Multiple Pulses	8
Beam Divergence (mrad)	0.25
Nominal Swath Width (m)	1090
Nominal Swath Overlap (%)	55
Scan Pattern	Triangle

Table 3: Aerial LiDAR Sensor Acquisition Parameters

2.1.3 Flight Plan Execution

Atlantic acquired 64 passes of the AOI as a series of perpendicular and/or adjacent flight-lines executed in 2 flight missions conducted between January 18, 2020 and January 19, 2020. Onboard differential Global Navigation Satellite System (GNSS) unit(s) recorded sample aircraft positions at 2 hertz (Hz) or more frequency. LiDAR data was only acquired when a minimum of six (6) satellites were in view.

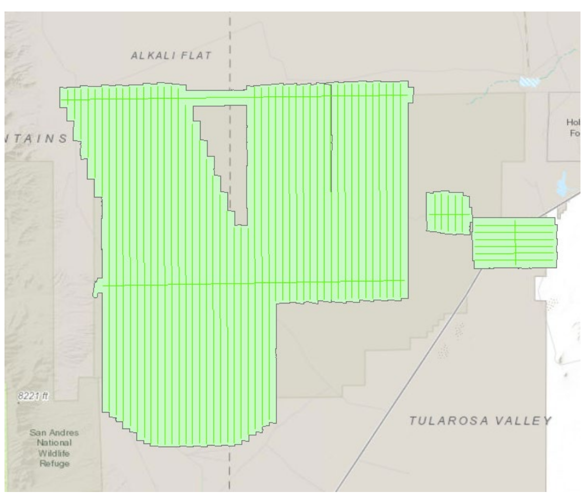

Figure 2: Orientation of Executed Flight-lines and LiDAR DPA

2.1.4 GNSS Reference Stations

Twelve (12) Continuously Operating Reference Stations (CORS) were used to control the LiDAR acquisition for the defined project area. The coordinates provided in below are in NAD83 (2011), Geographic Coordinate System, Ellipsoid, Meters.

Designation	Type	PID	Latitude (N)	Longitude (W)	Elevation
NMDE	CORS	NMDE	N32°16'02.16001"	W107°43'33.87463"	1297.806
NMLL	CORS	NMLL	N34°48'10.85839"	W106°42'28.00775"	1464.028
NMRO	CORS	NMRO	N33°23'41.84835"	W104°35'20.78350"	1094.688
NMSU	CORS	NMSU	N32°16'27.36535"	W106°44'40.85741"	1187.506
P026	CORS	P026	N32°39'32.25675"	W107°11'41.54872"	1236.854
P027	CORS	P027	N32°48'06.68808"	W105°48'14.98171"	2896.73
P034	CORS	P034	N34°56'44.22743"	W106°27'33.36679"	1810.905
RG03	CORS	RG03	N33°39'16.88774"	W105°09'14.99610"	1572.583
RG07	CORS	RG07	N32°29'47.37479"	W106°50'35.93712"	1400.663
RG08	CORS	RG08	N32°43'42.06677"	W104°59'38.63179"	1488.624
SC01	CORS	SC01	N34°04'04.62655"	W106°57'59.56016"	2097.381
TXWT	CORS	TXWT	N31°52'12.41212"	W106°26'33.66161"	1193.333

Table 4: GNSS Reference Stations

2.2 Aerial LiDAR Project – Ground Acquisition

2.2.1 Ground Control Survey

A total of 44 ground survey points were collected in support of this project, including 10 LiDAR Control Points (LCP), 25 Non-vegetated Vertical Accuracy (NVA) and 9 Vegetated Vertical Accuracy (VVA).

Point cloud data accuracy was tested against a Triangulated Irregular Network (TIN) constructed from LiDAR points in clear and open areas. A clear and open area can be characterized with respect to topographic and ground cover variation such that a minimum of five (5) times the Nominal Pulse Spacing (NPS) exists with less than 1/3 of the RMSEZ deviation from a low-slope plane. Slopes that exceed ten (10) percent were avoided.

Each land cover type representing ten (10) percent or more of the total project area were tested and reported with a VVA. In land cover categories other than dense urban areas, the tested points did not have obstructions forty-five (45) degrees above the horizon to ensure a satisfactory TIN surface. The VVA value is provided as a target. It is understood that in areas of dense vegetation, swamps, or extremely difficult terrain, this value may be exceeded.

The NVA value is a requirement that must be met, regardless of any allowed “busts” in the VVA(s) for individual land cover types within the project. Checkpoints for each assessment (NVA and VVA) are required to be well-distributed throughout the land cover type, for the entire project area.

The following tables and figures outline the coordinate values and distribution of LCP, NVA and VVA points collected in support of this project:

ID	Easting	Northing	Elevation
LCP01	392703.669	3626900.889	1219.921
LCP02	367511.945	3623811.013	1186.979
LCP03	366504.033	3636818.457	1189.317
LCP04	367092.437	3629132.229	1187.709
LCP05	377074.625	3631915.109	1197.396
LCP06	380726.933	3631831.806	1208.595
LCP07	377010.62	3629444.951	1204.078
LCP08	386471.41	3629091.38	1214.319
LCP09	389818.173	3627838.65	1219.458
LCP501	391278.523	3627037.684	1219.221

Table 5: LiDAR Control Point Coordinates

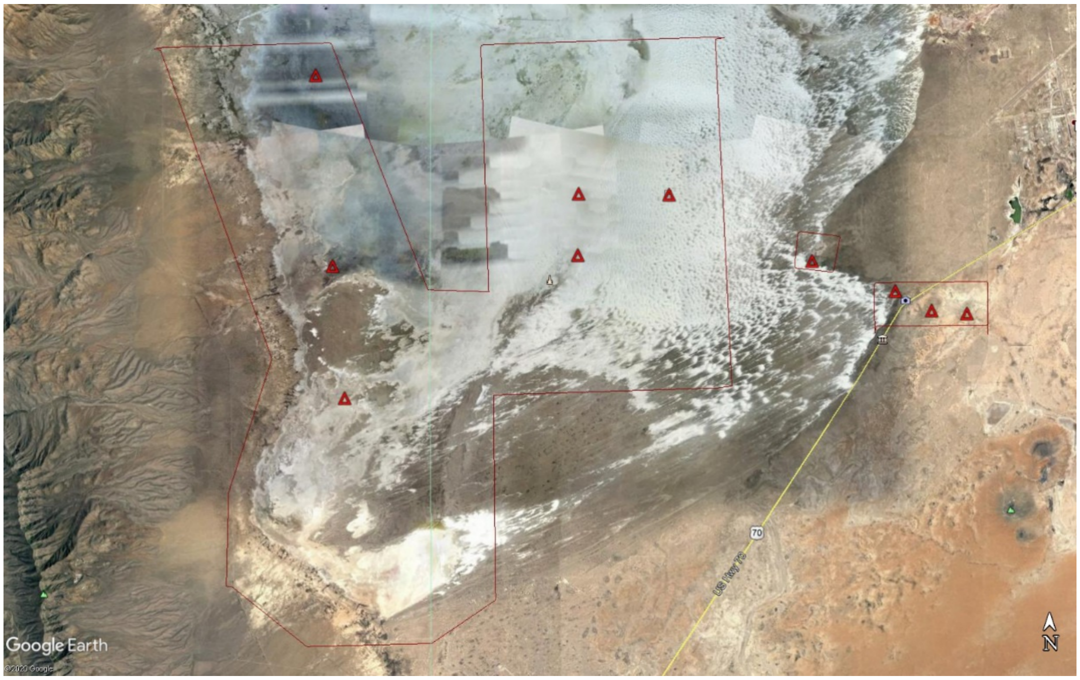

Figure 3: LiDAR Control Point Distribution

ID	Easting	Northing	Elevation
BE01	362883.883	3636579.448	1197.682
BE02	380348.459	3636493.128	1209.92
BE03	372664.97	3620791.421	1211.455
BE04	367580.736	3629809.948	1187.723
BE05	381290.159	3627520.066	1212.687
BE06	368503.106	3620013.365	1187.195
BE07	364440.989	3631258.08	1189.247
BE301	381002.652	3636642.989	1208.042
BE501	386481.092	3629069.323	1214.426
BE502	392682.125	3626914.354	1220.07
BE503	380982.67	3631851.534	1208.782
OT01	365099.533	3634287.571	1188.379
OT02	365985.088	3625675.273	1188.801
OT03	369692.201	3626324.285	1188.927
OT04	373085.474	3625488.407	1189.251
OT05	370689.52	3622580.852	1188.644
OT06	364817.405	3621972.421	1185.482
OT07	364966.937	3618029.663	1185.627
UR01	371474.929	3617420.921	1193.438
UR02	368046.176	3615845.158	1185.66
UR03	375183.928	3636584.115	1191.296

ID	Easting	Northing	Elevation
UR04	375737.143	3631991.693	1194.37
UR05	377342.649	3625645.958	1211.508
UR06	380309.077	3625696.269	1212.935
UR07	387403.984	3629020.934	1217.837

Table 6: Non-Vegetated Vertical Accuracy (NVA) Point Coordinates

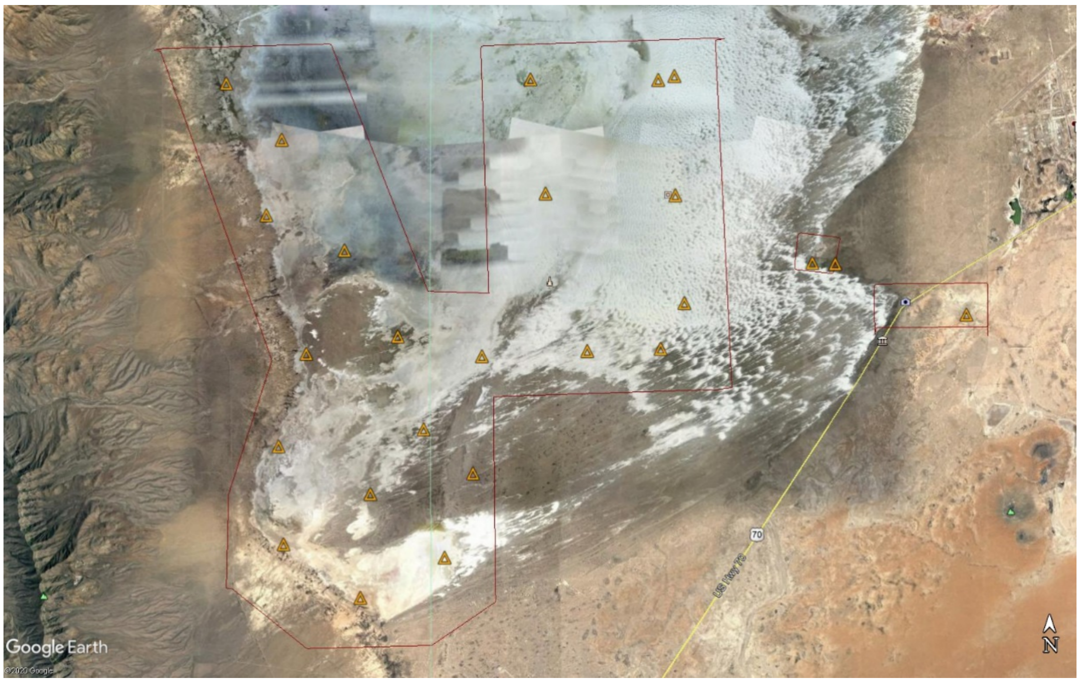

Figure 4: Non-Vegetated Vertical Accuracy (NVA) Point Distribution

ID	Easting	Northing	Elevation
BR01	377215.454	3630455.591	1201.318
BR02	364733.805	3636080.424	1188.839
BR501	387418.019	3629043.644	1217.58
BR502	389860.092	3627774.396	1219.049
HG01	385856.361	3629427.63	1213.854
HG02	365868.453	3630507.622	1190.143
TR01	368831.67	3618616.327	1192.999
TR02	391266.186	3627054.132	1219.568
TR302	379869.88	3636410.238	1206.481

Table 7: Vegetated Vertical Accuracy (VVA) Point Coordinates

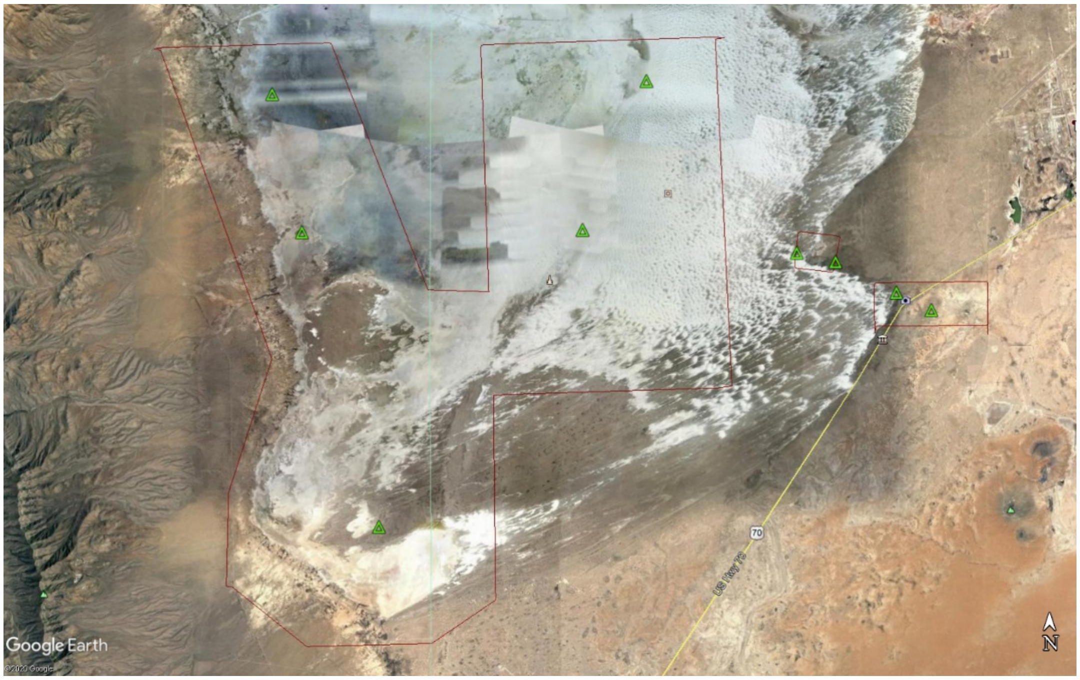

Figure 5: Vegetated Vertical Accuracy (VVA) Point Distribution

SECTION 3: DATA PRODUCTION

3.1 Aerial LiDAR Project – Calibration/Classification

3.1.1 LiDAR Point Cloud Generation

Atlantic used Leica software products to download the IPAS ABGNSS/IMU data and raw laser scan files from the airborne system. Waypoint Inertial Explorer is used to extract the raw IPAS ABGNSS/IMU data, which is further processed in combination with controlled base stations to provide the final Smoothed Best Estimate Trajectory (SBET) for each mission. The SBETs are combined with the raw laser scan files to export the LiDAR ASCII Standard (*.las) formatted swath point clouds.

3.1.2 Coordinate Reference System

Parameter	Specification
Horizontal Datum	NAD 83 2011
Coordinate System	UTM zone 13N
Vertical Datum	NAVD 88
269Geoid Model	Geoid 12B
EPSG Code	6342
Units of Reference	Meters

Table 8: Coordinate Reference System

3.1.3 LiDAR Point Cloud Statistics

Category	Value
Total Points	7,734,707,787
Nominal Pulse Spacing (m)	0.1900
Nominal Pulse Density (pls/m²)	27.7008
Aggregate Total Points	7,700,003,925
Aggregate Nominal Pulse Spacing (m)	0.2191
Aggregate Nominal Pulse Density (pls/m²)	20.8363

Table 9: LiDAR Point Cloud Statistics

3.1.4 Smooth Surface Repeatability (Interswath)

Departures from planarity of first returns within single swaths in non-vegetated areas were assessed at multiple locations with hard surface areas (parking lots or large rooftops) inside the project area. Each area was evaluated using signed difference rasters (maximum elevation – minimum elevation) at a cell size equal to 2 x ANPS, rounded to the next integer. The following figure depicts a sample of the assessment.

3.1.5 LiDAR Calibration

Using a combination of GeoCue, TerraScan and TerraMatch; overlapping swath point clouds are corrected for any orientation or linear deviations to obtain the best fit swath-to-swath calibration. Relative calibration was evaluated using advanced plane-matching analysis and parameter corrections derived. This process was repeated interactively until residual errors between overlapping swaths, across all project missions, was reduced to ≤2cm. A final analysis of the calibrated lidar is preformed using a TerraMatch tie line report for an overall statistical model of the project area. Individual control point assessments for this project can be found in Section VI of this report.

Upon completion of the data calibration, a complete set of elevation difference intensity rasters (dZ Orthos) are produced. A user-defined color ramp is applied depicting the offsets between overlapping swaths based on project specifications. The dZ orthos provide an opportunity to review the data calibration in a qualitative manner. Atlantic assigns green to all offset values that fall below the required RMSDz requirement of the project. A yellow color is assigned for offsets that fall between the RMSDz value and 1.5x of that value. Finally, red values are assigned to all values that fall beyond 1.5x of the RMSDz requirements of the project.

3.1.6 LiDAR Classification

Multiple automated filtering routines are applied to the calibrated LiDAR point cloud identifying and extracting bare-earth and above ground features. GeoCue, TerraScan, and TerraModeler software was used for the initial batch processing, visual inspection and any manual editing of the LiDAR point clouds. Atlantic utilized collected breakline data to preform classification for class 9 (Water).

Code	Description
0	Created, Never Classified
1	Unclassified
2	Ground
7	Low Point (“Low Noise”)
9	Water
17	Bridge Deck
18	High Noise
20	Ignored Ground
21	Snow
22	Temporal Exclusion

Table 10: LiDAR Point Classification Codes and Descriptions

3.1.7 LiDAR Intensity Imagery

LiDAR intensity imagery was created from the final calibrated and classified lidar point cloud. Intensity images were produced from all classified points and posted to a 0.25-meter cell size. Intensity images were cut to match the tile index and its corresponding tile names and delivered in .TIFF format.

3.1.8 Bare-Earth Surface – Digital Elevation Model (DEM)

Bare earth Digital Elevation Models (DEMs) were derived using the bare earth (ground) LiDAR points. All DEMs were created with a grid spacing of 0.25 meter. DEMs for this project were cut to match the tile index and its corresponding tile names and delivered in 32-bit floating point .TIFF format.

SECTION 4: ACCURACY ASSESSMENT

4.1 Aerial LiDAR Project – Vertical Accuracy Assessment

4.1.1 Requirements

Per the table below, the Vertical Accuracy Assessment utilized the required parameters for Vertical Data Accuracy Class III.

Vertical Data Accuracy Class	RMSEz in Non-Vegetated Terrain (cm)	Non-Vegetated Vertical Accuracy (NVA) at 95% Confidence Level (cm)	Vegetated Vertical Accuracy (VVA) at 95th Percentile (cm)
I	1.0	2.0	2.9
II	2.5	4.9	7.4
III	5.0	9.8	14.7
IV	10.0	19.6	29.4
V	12.5	24.5	36.8
VI	20.0	39.2	58.8
VII	33.3	65.3	98.0
VIII	66.7	130.7	196.0
IX	100.0	196.0	294.0
X	333.3	653.3	980.0

Table 1: Vertical Accuracy Standards, Source: ASPRS Positional Accuracy Standards for Digital Geospatial Data v1.0 (2014)

*The terms NVA and VVA are from the American Society for Photogrammetry and Remote Sensing (ASPRS) Positional Accuracy Standards for Digital Geospatial Data v1.0 (2014). The term NVA refers to assessments in clear, open areas (which typically produce only single LiDAR returns); the term VVA refers to assessments in vegetated areas (typically characterized by multiple return LiDAR).

4.1.2 Results

An overall statistical assessment of the check points can be found in the following two tables (values provided in meters):

Broad Land Cover Type	Points (#)	RMSEz	Confidence Level (95%)	Percentile (95th)
NVA (Point Cloud)	24	0.0486	0.0953	0.0994
NVA (DEM)	24	0.0479	0.0939	0.1013
VVA (Point Cloud)	8	0.0819	0.1605	0.1631
VVA (DEM)	8	0.0788	0.1545	0.1583

Table 12: NVA/VVA Accuracies

SECTION 5: CERTIFICATION STATEMENTS

5.1 Aerial LiDAR Project

This accuracy assessment confirms that the data may be used for the intended applications stated in Section I of this document. This dataset may also be used as a topographic input for other applications, but the user should be aware that this LiDAR dataset was designed with a specific purpose and was not intended to meet specifications and/or requirements of users outside of the United States Geological Survey.

It should also be noted that LiDAR points do not represent a continuous surface model. LiDAR points are discrete measurements of the surface and any values derived within a triangle of three LiDAR points are interpolated. As such, the user should not use the resultant LiDAR dataset for vertical placement of a planimetric feature such as a headwall, building footprint or any other planimetric feature unless there is an associated LiDAR point that can be reasonably located on this structure.

Consideration should be given by the end user of this dataset to the fact that this LiDAR dataset was developed differently and separately than previous LiDAR datasets that may be available for this geographic location. It is likely that the data in this project was created using different geodetic control, a different Geoid, newer LiDAR technology and more up-to-date processing techniques. As such, any direct comparative analysis performed between this dataset and previous datasets could result in misleading or inaccurate results. Users are encouraged to proceed with caution while performing this type of comparative analysis and to completely understand the variables that make each of these datasets unique and not corollary.

It is encouraged that the user refers to the full FGDC Metadata and project reports for a complete understanding on the content of this dataset.

I, hereby, certify to the extent of my knowledge that the statements and statistics represented in this document are true and factual.

Brian J. Mayfield, ASPRS Certified Photogrammetrist #R1276

SECTION 6: CONTROL POINT ASSESSMENTS

6.1 Aerial LiDAR Project

6.1.1 Point Cloud Check Point Assessment

Point ID	Given (X)	Given (Y)	Given (Z)	Laser (Z)	Delta (Z)	Report Point Type
BE01	362883.8830	3636579.4480	1197.6820	1197.6690	-0.0130	NVA
BE02	380348.4590	3636493.1280	1209.9200	1210.0290	0.1090	NVA
BE03	372664.9700	3620791.4210	1211.4550	1211.4280	-0.0270	NVA
BE04	367580.7360	3629809.9480	1187.7230	1187.7260	0.0030	NVA
BE05	381290.1590	3627520.0660	1212.6870	1212.5930	-0.0940	NVA
BE06	368503.1060	3620013.3650	1187.1950	1187.2300	0.0350	NVA
BE07	364440.9890	3631258.0800	1189.2470	1189.2770	0.0300	NVA
BE301	381002.6520	3636642.9890	1208.0420	1208.1690	0.1270	NVA
BE501	386481.0920	3629069.3230	1214.4260	1214.4200	-0.0060	NVA
BE502	392682.1250	3626914.3540	1220.0700	1220.0040	-0.0660	NVA
BE503	380982.6700	3631851.5340	1208.7820	1208.7590	-0.0230	NVA
BR01	377215.4540	3630455.5910	1201.3180	1201.3220	0.0040	VVA
BR02	364733.8050	3636080.4240	1188.8390	1188.9540	0.1150	VVA
BR501	387418.0190	3629043.6440	1217.5800	1217.5540	-0.0260	VVA
BR502	389860.0920	3627774.3960	1219.0490	1219.0540	0.0050	VVA
HG01	385856.3610	3629427.6300	1213.8540	1213.8510	-0.0030	VVA
HG02	365868.4530	3630507.6220	1190.1430	1190.2100	0.0670	VVA
OT01	365099.5330	3634287.5710	1188.3790	1188.3620	-0.0170	NVA
OT02	365985.0880	3625675.2730	1188.8010	1188.8250	0.0240	NVA
OT03	369692.2010	3626324.2850	1188.9270	1188.9100	-0.0170	NVA
OT04	373085.4740	3625488.4070	1189.2510	1189.2210	-0.0300	NVA
OT05	370689.5200	3622580.8520	1188.6440	1188.6400	-0.0040	NVA
OT06	364817.4050	3621972.4210	1185.4820	1185.4960	0.0140	NVA
OT07	364966.9370	3618029.6630	1185.6270	1185.6720	0.0450	NVA
TR01	368831.6700	3618616.3270	1192.9990	1193.0060	0.0070	VVA
TR02	391266.1860	3627054.1320	1219.5680	1219.5580	-0.0100	VVA
TR302	379869.8800	3636410.2380	1206.4810	1206.6700	0.1890	VVA
UR01	371474.9290	3617420.9210	1193.4380	1193.4710	0.0330	NVA
UR02	368046.1760	3615845.1580	1185.6600	1185.6890	0.0290	NVA
UR03	375183.9280	3636584.1150	1191.2960	1191.2780	-0.0180	NVA
UR04	375737.1430	3631991.6930	1194.3700	1194.3010	-0.0690	NVA
UR05	377342.6490	3625645.9580	1211.5080	1211.4880	-0.0200	NVA
UR06	380309.0770	3625696.2690	1212.9350	1212.9490	0.0140	NVA
UR07	387403.9840	3629020.9340	1217.8370	1217.8270	-0.0100	NVA

Table 13: Point Cloud Check Point Assessment

6.1.2 Digital Elevation Model (DEM) Check Point Assessment

Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
BE01	362883.8830	3636579.4480	1197.6820	1197.6702	-0.0098	NVA
BE02	380348.4590	3636493.1280	1209.9200	1210.0316	0.1116	NVA
BE03	372664.9700	3620791.4210	1211.4550	1211.4263	-0.0237	NVA
BE04	367580.7360	3629809.9480	1187.7230	1187.7250	0.0050	NVA
BE05	381290.1590	3627520.0660	1212.6870	1212.6044	-0.0856	NVA
BE06	368503.1060	3620013.3650	1187.1950	1187.2299	0.0399	NVA
BE07	364440.9890	3631258.0800	1189.2470	1189.2591	0.0091	NVA
BE301	381002.6520	3636642.9890	1208.0420	1208.1775	0.1375	NVA
BE501	386481.0920	3629069.3230	1214.4260	1214.4202	-0.0098	NVA
BE502	392682.1250	3626914.3540	1220.0700	1220.0349	-0.0351	NVA
BE503	380982.6700	3631851.5340	1208.7820	1208.7448	-0.0352	NVA
OT01	365099.5330	3634287.5710	1188.3790	1188.3607	-0.0193	NVA
OT02	365985.0880	3625675.2730	1188.8010	1188.8204	0.0204	NVA
OT03	369692.2010	3626324.2850	1188.9270	1188.9105	-0.0195	NVA
OT04	373085.4740	3625488.4070	1189.2510	1189.2156	-0.0344	NVA
OT05	370689.5200	3622580.8520	1188.6440	1188.6403	0.0003	NVA
OT06	364817.4050	3621972.4210	1185.4820	1185.4955	0.0155	NVA
OT07	364966.9370	3618029.6630	1185.6270	1185.6729	0.0429	NVA
UR01	371474.9290	3617420.9210	1193.4380	1193.4710	0.0310	NVA
UR02	368046.1760	3615845.1580	1185.6600	1185.6599	-0.0001	NVA
UR03	375183.9280	3636584.1150	1191.2960	1191.2761	-0.0239	NVA
UR04	375737.1430	3631991.6930	1194.3700	1194.3053	-0.0647	NVA
UR05	377342.6490	3625645.9580	1211.5080	1211.4748	-0.0352	NVA
UR06	380309.0770	3625696.2690	1212.9350	1212.9511	0.0111	NVA

Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
BR01	377215.4540	3630455.5910	1201.3180	1201.3218	0.0018	VVA
BR02	364733.8050	3636080.4240	1188.8390	1188.9560	0.1160	VVA
BR502	389860.0920	3627774.3960	1219.0490	1219.0552	0.0052	VVA
HG01	385856.3610	3629427.6300	1213.8540	1213.8489	-0.0011	VVA
HG02	365868.4530	3630507.6220	1190.1430	1190.1981	0.0581	VVA
TR01	368831.6700	3618616.3270	1192.9990	1192.9990	-0.0010	VVA
TR02	391266.1860	3627054.1320	1219.5680	1219.5652	-0.0048	VVA
TR302	379869.8800	3636410.2380	1206.4810	1206.6611	0.1811	VVA

Table 14: DEM Check Point Assessment