



Project Report

TASK ORDER NAME: GA_Statewide_2018_B18

TASK ORDER NUMBER: 140G0218F0420

CONTRACT NUMBER: G16PC00042

ATLANTIC PROJECT NUMBER: 18066 - Block 09

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SECTION 1: PROJECT OVERVIEW AND PURPOSE

1.1 Aerial LiDAR Project

1.1.1 Project Overview

USGS task order 140G0218F0420 required Winter, 2018/Spring, 2019 LiDAR surveys to be collected over 32,562 square miles covering part or all of 82 counties in Georgia and 3 partial counties in South Carolina in support of the State of Georgia and the USGS 3DEP program. Aerial LiDAR data for this task order was planned, acquired, processed and produced at an aggregate nominal pulse spacing (ANPS) of ≤ 0.71 meters and in compliance with USGS National Geospatial Program LiDAR Base Specification version 1.3. The Block 09 area encompasses approximately 3,067 square miles.

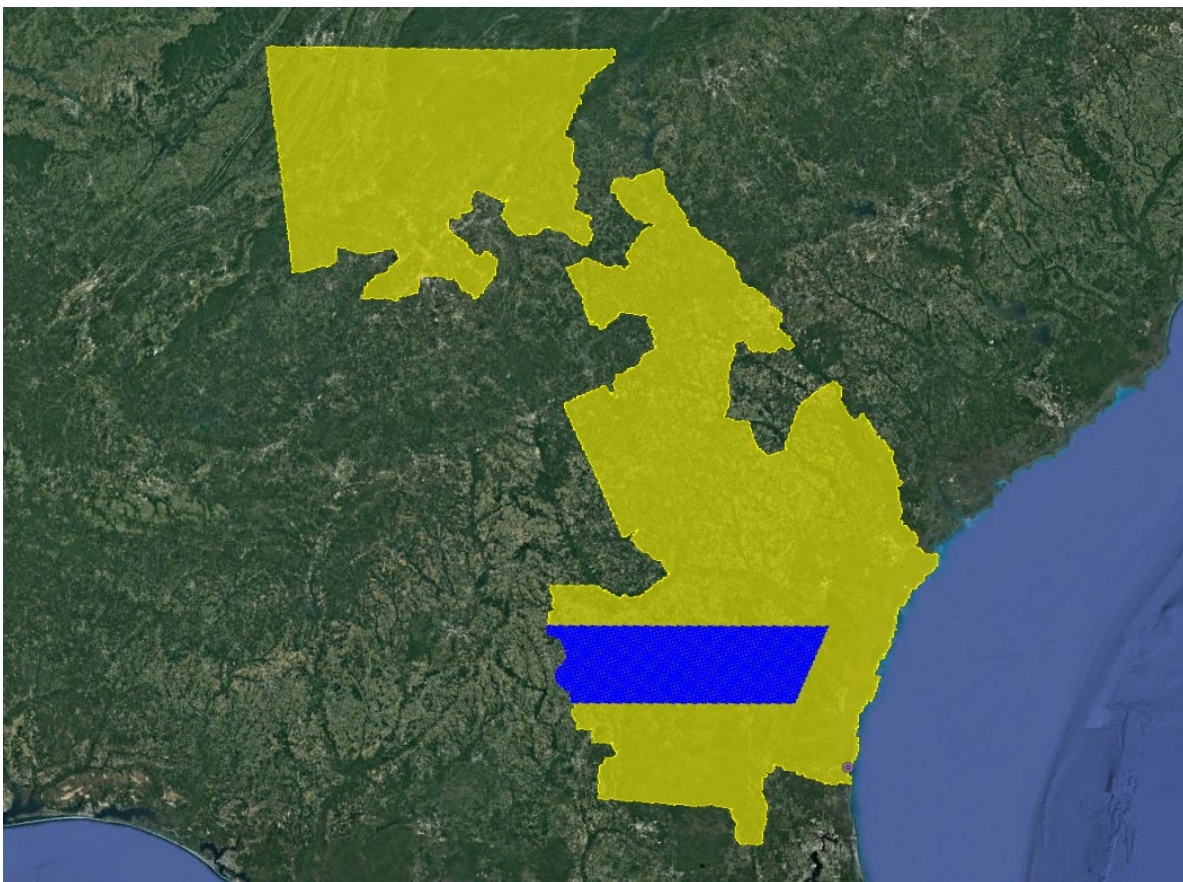


Figure 1: Aerial LiDAR Project Overview – Defined Project Area (DPA) in Yellow and Associated Areas of Interest (AOIs) in Blue

1.1.2 Project Purpose

Aerial lidar was collected to support the mapping efforts of individual counties in the State of Georgia and the USGS 3DEP program.

1.1.3 Contract Deliverables

Item	Specification/Format
Classified Point Cloud	LAS v1.4, tiled delivery
Bare Earth Surface	Raster DEM, 1m cell size, hydro flattened, GeoTIFF format
Breaklines	Hydro breaklines to BPA limit, .gdb format
Intensity Imagery	1m cell size, 8-bit, 256 gray scale, GeoTIFF format
Delivery Diagram	.shp format
Metadata	Per product, FGDC compliant, .xml format
Project Report	Field work procedures, QC procedures and results, overall accuracy, .pdf format

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 Cessna (N732JE) outfitted with a Leica ALS70-HP LiDAR system during the collection of the project area. The specifications of this system are presented in the following table:

Parameter	Specification
Model	ALS70-HP
Manufacturer	Leica
Platform	Fixed-Wing
Scan Pattern	Sine, Triangle, Raster
Maximum Scan Rate (Hz)	Sine: 200 Triangle: 158 Raster: 120
Field of View (°)	0 – 75 (Full Angle, User Adjustable)
Maximum Pulse Rate (kHz)	500
Maximum Flying Height (m AGL)	3500
Number of Returns	Unlimited
Number of Intensity Measurements	3 (First, Second, Third)
Roll Stabilization (Automatic Adaptive, °)	75 - Active FOV
Storage Media	Removable 500 GB SSD
Storage Capacity (Hours @ Max Pulse Rate)	6
Size (cm)	Scanner: 37 W x 68 L x 26 H Control Electronics: 45 W x 47 D x 36 H
Weight (kg)	Scanner: 43 Control Electronics: 45
Operation Temperature (°C)	0 – 40
Flight Management	FCMS
Power Consumption	927 @ 22.0 – 30.3 VDC

Table 2: System Specifications – ALS70-HP

2.1.2 Sensor Acquisition Information

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

Parameter	Specification
System	Leica ALS70-HP
Nominal Pulse Spacing (m)	0.6
Nominal Pulse Density (pls/m²)	2.2
Nominal Flight Height (AGL meters)	2000
Nominal Flight Speed (kts)	130
Pass Heading (°)	Varies
Sensor Scan Angle (°)	45
Scan Frequency (Hz)	35.1
Pulse Rate of Scanner (kHz)	265,000
Line Spacing (m)	1410
Pulse Duration of Scanner (ns)	4
Pulse Width of Scanner (m)	.30
Central Wavelength of Sensor Laser (nm)	1064
Sensor Operated with Multiple Pulses	2
Beam Divergence (mrad)	0.15
Nominal Swath Width (m)	1663
Nominal Swath Overlap (%)	20
Scan Pattern	Triangle

Table 3: Aerial LiDAR Sensor Acquisition Parameters

2.1.3 Flight Plan Execution

Atlantic acquired 310 passes of the AOI as a series of perpendicular and/or adjacent flight-lines executed in 25 flight missions conducted between February 8, 2019 and April 23, 2019. 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.

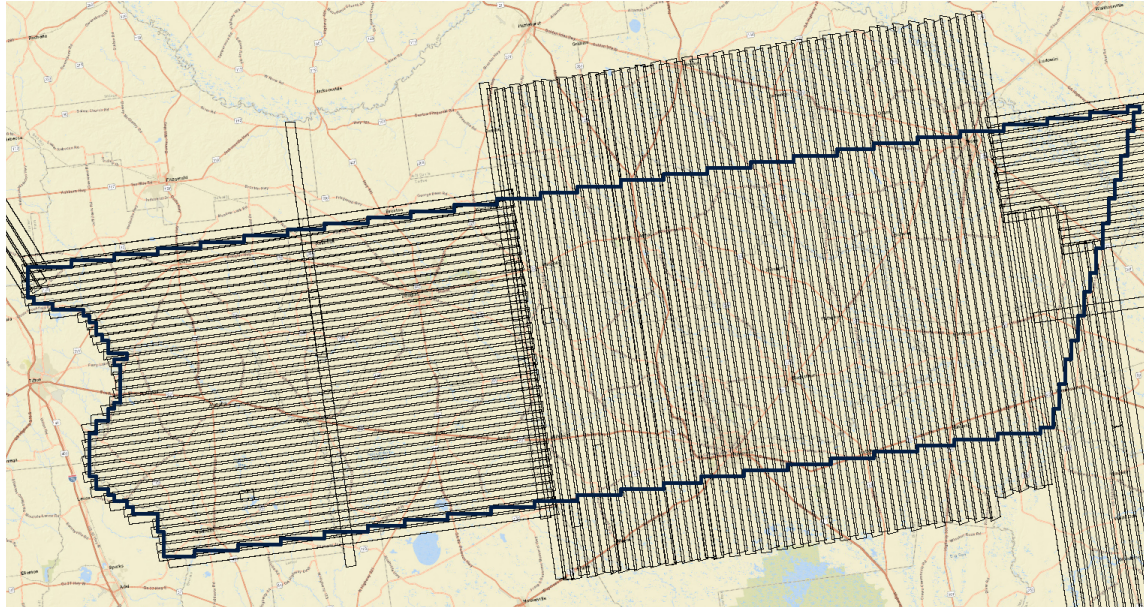


Figure 2: Orientation of Executed Flight-lines and LiDAR DPA

2.1.4 GNSS Reference Stations

Twenty-five (25) 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.

PID	Latitude (N)	Longitude (W)	Elevation
FERN	N30°37'04.91022"	W81°27'35.54270"	-13.993
GAAY	N31°39'40.92126"	W84°16'29.65368"	55.903
GABN	N31°09'02.51179"	W81°29'46.10549"	-14.891
GACD	N31°58'22.00717"	W83°46'54.94151"	71.996
GACR	N32°22'51.45938"	W83°20'46.43104"	97.787
GADG	N31°29'42.23355"	W82°52'14.88457"	59.125

PID	Latitude (N)	Longitude (W)	Elevation
GADU	N32°29'55.28770"	W82°55'41.98017"	54.226
GAEM	N32°10'34.04801"	W83°09'45.76703"	82.781
GAFL	N30°49'50.10052"	W82°00'33.91362"	0.838
GAHI	N31°50'31.78522"	W81°36'00.49028"	-1.203
GAHZ	N31°53'07.26257"	W82°36'00.81355"	52.375
GAMI	N31°47'01.37249"	W81°26'22.97669"	-19.792
GAMT	N31°12'07.41157	W83°46'15.50869	78.051
GASA	N32°01'25.51719"	W81°03'36.78442"	-22.745
GASC	N31°31'32.31172"	W82°04'11.96816"	11.240
GASH	N32°01'29.42188"	W81°06'35.77890"	-16.780
GASO	N32°27'38.28207"	W81°48'00.12354"	52.312
GASV	N31°57'43.65555"	W81°00'50.57920"	-23.726
GATF	N31°27'06.88834"	W83°30'32.85575"	96.084
GATO	N31°26'14.42792"	W83°32'54.73262"	70.600
GAWC	N31°12'27.97642"	W82°21'44.36508"	20.190
JKSV	N30°17'16.46048"	W81°32'19.06969"	-11.258
LVOK	N30°18'48.63384"	W82°58'57.73837"	7.695
STGG	N30°23'27.48018"	W82°07'36.63071"	5.934
ZJX1	N30°41'55.89505"	W81°54'29.46857"	1.725

Table 4: GNSS Reference Stations

2.2 Aerial LiDAR Project – Ground Acquisition

2.2.1 Ground Control Survey

A total of 148 ground survey points were collected in support of this project, including 39 LiDAR Control Points (LCP), 70 Non-vegetated Vertical Accuracy (NVA) and 39 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:

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
APPLI_CP54	1305221.645	1036078.519	41.779	LCP
ATKIN_CP30	1229725.626	988191.341	67.998	LCP
ATKIN_CP31	1234200.097	1009714.346	73.255	LCP
ATKIN_CP32	1250678.201	1006665.008	50.147	LCP
ATKIN_CP63	1233731.683	1005402.66	63.068	LCP
ATKIN_CP94	1242842.36	996517.834	60.013	LCP
BACON_CP39	1270210.816	1031186.811	60.475	LCP
BACON_CP40	1290549.227	1029593.855	52.693	LCP
BACON_CP95	1275389.543	1038035.272	63.414	LCP
BRANT_58	1327469.494	1013288.279	16.355	LCP

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
BRANT_CP34	1327148.162	1008031.288	19.919	LCP
BRANT_CP35	1343640.035	1018787.711	21.678	LCP
BRANT_CP90	1314294.996	1001842.435	31.044	LCP
COFF_BR4	1245091.229	1011487.037	66.972	LCP
COFF_CP36	1257590.256	1014551.886	48.36	LCP
COFF_CP97	1251960.997	1024901.667	63.423	LCP
COFFEE_CP61	1243772.171	1026880.716	73.491	LCP
COFFEE_CP62	1222274.694	1016185.611	83.09	LCP
COFFEE_WE16	1232003.914	1016898.583	68.388	LCP
LONG_UA30	1352197.749	1051497.582	12.968	LCP
PIER_CP42	1299527.285	1007357.907	37.111	LCP
PIER_CP43	1311050.086	1021599.545	31.962	LCP
PIER_FO21	1308497.764	1027491.811	41.151	LCP
SECP_BERRIEN_CP_A	1208960.912	983077.362	72.293	LCP
SECP_BERRIEN_CP_B	1212861.649	999684.634	78.996	LCP
SECP_BERRIEN_TG	1218364.975	994892.539	75.017	LCP
SEPL_BERRIEN_CP_A	1195867.835	1006351.265	87.323	LCP
SEPL_BERRIEN_CP_B	1207270.116	985470.831	66.492	LCP
SEPL_BERRIEN_CP_C	1210031.382	1005105.425	71.033	LCP
SEPL_BERRIEN_FO	1202622.195	1001306.758	87.617	LCP
SEPL_BERRIEN_OT_A	1210045.973	1005116.903	70.155	LCP
SEPL_IRWIN_OT63	1205670.127	1014435.438	96.256	LCP
WARE_CP92	1273452.196	992787.611	49.496	LCP

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
WARE_FO15	1286416.916	1005871.446	27.861	LCP
WARE_OT8	1287324.513	997567.458	41.585	LCP
WAYNE_CP50	1327922.012	1031865.846	17.277	LCP
WAYNE_CP51	1329787.163	1040922.922	28.92	LCP
WAYNE_FO20	1333893.685	1027120.715	17.131	LCP
WAYNE_UA117	1327603.099	1023455.804	17.938	LCP

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
APPLI_UA116	1299133.5440	1040772.3140	41.5560	NVA
APPLI_UA41	1300133.7290	1035189.5410	48.0000	NVA
ATKIN_OT5	1225127.1800	1001824.3940	72.7940	NVA
ATKIN_OT58	1237858.0600	1009074.5450	67.0280	NVA
ATKIN_UA74	1243721.8360	1006976.2160	57.0540	NVA
ATKIN_UA81	1224579.0000	1001848.0540	74.0740	NVA
ATKIN_UA82	1254618.0350	998960.3670	53.4730	NVA
ATKIN_UA83	1229509.4170	992303.5060	68.1310	NVA
ATKIN_UA84	1243268.9020	999687.3770	61.6870	NVA
ATKIN_UA85	1249996.2020	994505.0550	57.2920	NVA
BACON_BE2	1276630.8450	1031464.9710	58.2900	NVA
BACON_UA50	1280497.7980	1020771.8720	45.0530	NVA
BACON_UA51	1278119.5770	1031963.9880	53.3740	NVA
BACON_UA52	1268848.1770	1031091.0280	61.6270	NVA
BACON_UA53	1288388.3830	1037916.9970	57.1280	NVA
BRANT_OT6	1338939.9940	1005087.0860	20.5400	NVA

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
BRANT_UA141	1338918.2100	1018546.3240	22.2790	NVA
BRANT_UA60	1326539.9610	1001363.1010	19.7360	NVA
COFF_OT9	1260113.3410	1027182.2080	57.2080	NVA
COFF_UA105	1231969.4580	1011237.8630	75.3910	NVA
COFF_UA77	1254719.9190	1035491.4610	68.8300	NVA
COFF_UA79	1253553.6010	1014234.8490	58.1950	NVA
COFF_UA80	1250775.3710	1008258.2400	57.3170	NVA
COFF_WE35	1258362.2120	1033630.3210	61.9870	NVA
COFFEE_CP78	1228139.8280	1027845.6450	89.8800	NVA
COFFEE_FO37	1222748.5670	1023619.0510	92.1650	NVA
COFFEE_OT55	1229464.3810	1032710.8560	79.6450	NVA
COFFEE_OT56	1225910.3280	1024657.7070	88.8440	NVA
COFFEE_OT57	1246930.3760	1016304.1850	68.0980	NVA
COFFEE_TG23	1235988.8770	1019930.6750	62.5530	NVA
NVA505	1329623.2200	1047568.1900	29.0470	NVA
PIER_CP41	1296119.2250	1019033.3070	46.0060	NVA
PIER_UA122	1299452.0730	1019295.3230	43.4940	NVA
PIER_UA123	1316503.0580	1009343.9410	18.5470	NVA
PIER_UA124	1290529.7240	1006929.9720	40.7240	NVA
PIER_UA125	1302875.7510	1011413.8930	39.1270	NVA
PIER_UA54	1300736.0990	1025037.8900	44.5520	NVA
PIER_UA55	1295760.7180	1012334.8550	35.3550	NVA
PIER_UA56	1311683.0590	1018026.2520	31.3850	NVA

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
PIER_UA57	1299256.3770	1002079.2520	36.5000	NVA
PIER_WE34	1312268.0860	1023116.9980	28.4320	NVA
SECP_BERRIEN_UA_A	1223173.1940	991992.5090	69.6300	NVA
SECP_BERRIEN_UA_B	1211705.1540	985615.5610	70.1870	NVA
SECP_BERRIEN_WE	1218070.5520	989533.5490	69.3630	NVA
SEPL_BERRIEN_OT_B	1204315.1320	983275.4190	67.7770	NVA
SEPL_BERRIEN_TG	1207410.5370	995077.9090	76.8860	NVA
SEPL_BERRIEN_UA_A	1207025.0790	1004401.5960	88.7480	NVA
SEPL_BERRIEN_UA_B	1207067.5270	984472.8100	71.6740	NVA
SEPL_BERRIEN_WE	1195222.3620	1010403.2020	96.1320	NVA
SEPL_IRWIN_BE5	1211209.1870	1028803.8980	99.5040	NVA
SEPL_IRWIN_OT62	1191277.2450	1023962.4740	108.7060	NVA
SEPL_IRWIN_TG25	1198207.5410	1020194.2310	88.4240	NVA
SEPL_IRWIN_UA72	1201511.6400	1027876.6280	105.8340	NVA
TR17	1224286.2740	1001941.1450	74.3480	NVA
TR18	1276527.8710	1031799.4200	58.0500	NVA
TR19	1300761.4170	1008912.5290	31.5740	NVA
TR20	1329632.7880	1047563.9360	29.1320	NVA
VVA505	1308680.7290	1019239.4780	32.4970	NVA
WARE_CP25	1276583.9290	1004215.4380	45.1590	NVA
WARE_UA126	1279200.4970	999732.6810	43.7750	NVA
WARE_UA72	1269114.6660	1015585.9920	50.1040	NVA
WARE_UA73	1261935.2320	998947.0740	45.1530	NVA

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
WARE_WE22	1274788.4620	993218.4770	47.4680	NVA
WARE_WE23	1267247.2060	1014935.4120	42.7020	NVA
WAYNE_UA120	1318651.4440	1031702.9720	37.5840	NVA
WAYNE_UA142	1334078.4850	1028269.6820	19.2940	NVA
WAYNE_UA38	1326353.0830	1045273.2820	32.3060	NVA
WAYNE_UA40	1309568.6490	1038459.8520	38.1710	NVA
WAYNE_WE29	1333338.2200	1023224.7490	19.9750	NVA
WAYNE_WE30	1316080.4480	1028834.7930	20.6610	NVA

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
ATKIN_FO14	1232903.0850	993720.2390	64.9870	VVA
ATKIN_WE19	1254002.6590	994436.7230	54.8010	VVA
BACON_FO22	1273407.3090	1026842.0990	51.2790	VVA
BACON_WE33	1275661.3030	1035046.3920	45.5560	VVA
BR17	1243655.5890	999696.4850	60.4620	VVA
BR18	1279097.3960	1009414.2430	47.3700	VVA
BR19	1308688.1740	1019236.9700	32.4460	VVA
BR20	1326474.8960	1000541.9330	20.0790	VVA
BRANT_FO16	1326244.6710	999169.0610	20.5250	VVA
BRANT_FO17	1343821.9510	1011566.9720	20.7430	VVA
BRANT_WE25	1320564.6290	999195.9600	19.3560	VVA
COFFEE_BR14	1232479.3020	1027066.1030	80.2340	VVA
COFFEE_CP77	1239901.5350	1014865.1820	68.2440	VVA
COFFEE_UA69	1223699.7640	1030433.1350	96.6890	VVA

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
COFFEE_UA70	1241159.6860	1021480.0870	75.2730	VVA
COFF_FO23	1250797.6620	1018950.1380	58.1460	VVA
COFF_UA78	1260013.8730	1028474.6300	54.9150	VVA
HG17	1240817.6470	1019365.3320	76.8950	VVA
HG18	1292933.7450	996422.0140	40.5900	VVA
HG19	1322281.9240	1041404.0240	42.5840	VVA
HG20	1326751.9420	1016124.4500	16.5080	VVA
LCP505	1326471.8970	1000529.9450	19.9250	VVA
PIER_UA121	1288692.5180	1018781.2230	42.1650	VVA
SECP_BERRIEN_11	1213438.3820	992221.7230	74.0690	VVA
SECP_BERRIEN_UA_C	1212219.1510	1000535.3010	80.2150	VVA
SEPL_BERRIEN_BR	1202315.2110	997462.0690	81.6160	VVA
SEPL_BERRIEN_CP_D	1196556.4750	993216.3500	85.2120	VVA
SEPL_BERRIEN_OT_C	1193734.9680	998243.3380	89.0860	VVA
SEPL_BERRIEN_UA_C	1189149.8900	998442.1690	95.0270	VVA
SEPL_IRWIN_CP67	1208953.4670	1021867.4860	88.9760	VVA
SEPL_IRWIN_UA73	1215089.9650	1015594.6150	93.4320	VVA
WARE_CP26	1273775.1530	1020018.0640	50.6890	VVA
WARE_TG7	1270113.9340	998968.0760	46.6060	VVA
WARE_UA71	1291693.7220	997562.1710	37.9020	VVA
WAYNE_BR6	1327343.8530	1018163.3220	18.8660	VVA
WAYNE_CP108	1337064.1910	1044309.9500	15.8000	VVA
WAYNE_CP49	1346350.8880	1034492.8570	19.7140	VVA

Point ID	Easting [X]	Northing [Y]	Elevation [Z]	Point Type
WAYNE_UA118	1328607.5740	1038372.8150	27.0470	VVA
WAYNE_WE31	1344142.2230	1041357.3080	19.8740	VVA

Table 5: LiDAR Control/Check Point Coordinates

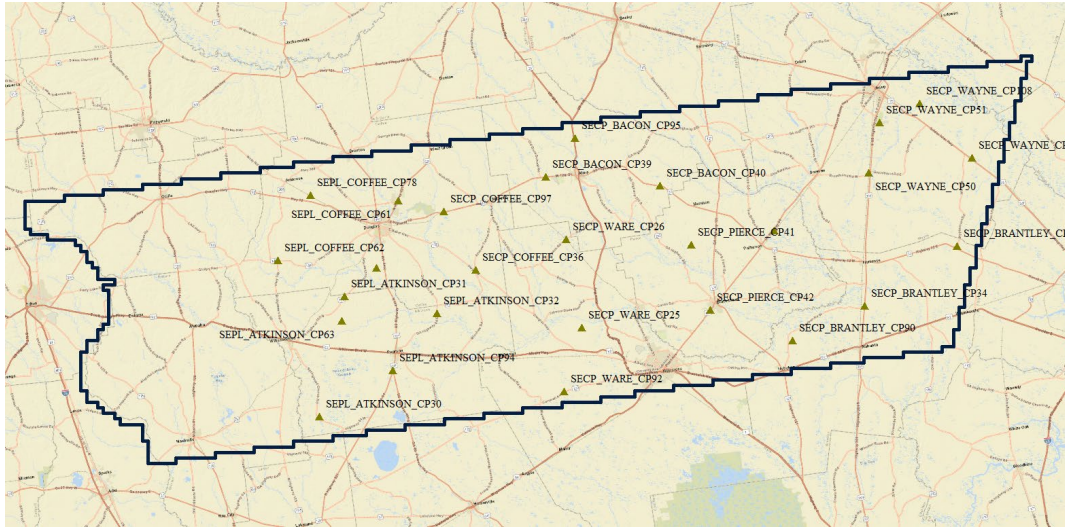


Figure 3: LiDAR Control Point Distribution

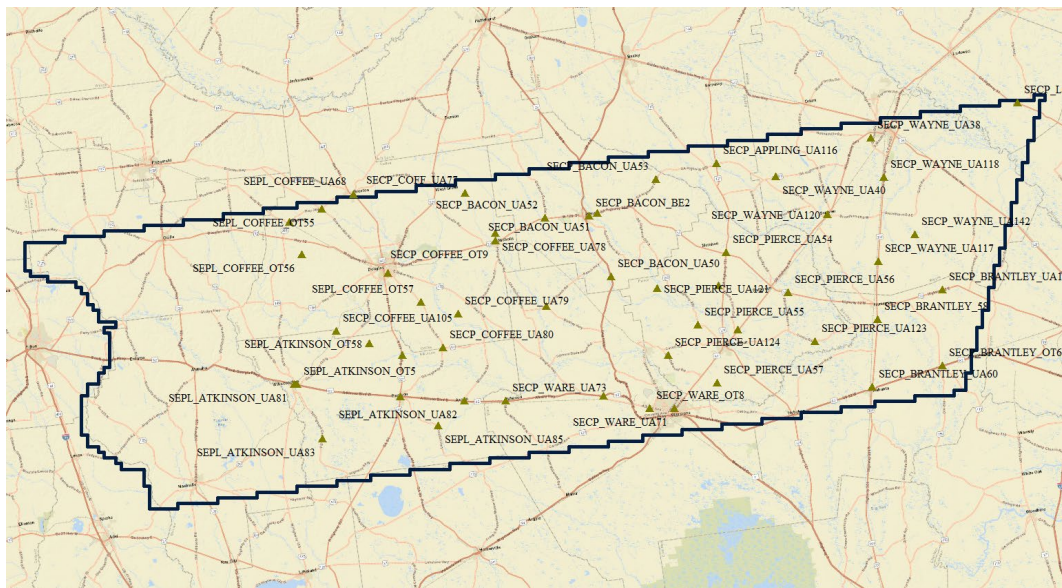


Figure 4: Non-Vegetated Vertical Accuracy (NVA) Point Distribution

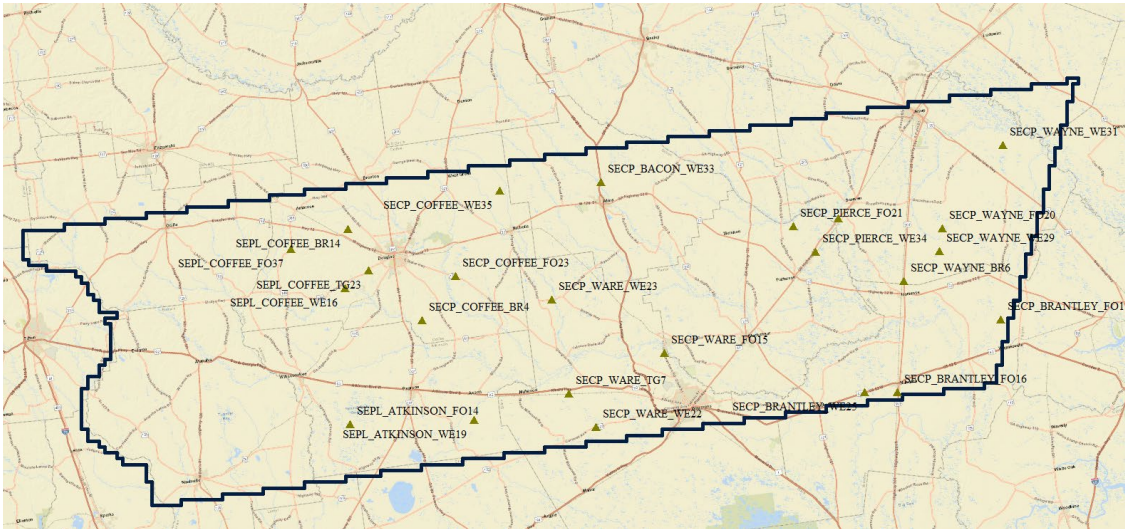


Figure 5: Vegetated Vertical Accuracy (VVA) Point Distribution

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	NAD83 (NAD 2011)
Coordinate System	Albers Conic
Vertical Datum	NAVD88
Geoid Model	12B
EPSG Code	6350
Units of Reference	Meter

Table 6: Coordinate Reference System

3.1.3 LiDAR Point Cloud Statistics

Category	Value
Total Points (Nominal)	31,650,017,770
Nominal Pulse Spacing (M)	0.5100
Nominal Pulse Density (PLS/M²)	3.8447
Total Points (Aggregate)	31,695,702,930
Aggregate Pulse Spacing (M)	0.5077
Aggregate Pulse Density (PLS/M²)	3.8803

Table 1: 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.

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 $\leq 2\text{cm}$. 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
1	Processed but unclassified
2	Bare-earth ground
3	Low Vegetation (0.5 – 5 feet)
4	Medium Vegetation (5 – 20 feet)
5	High Vegetation (>20 feet)
6	Building footprints
7	Low Noise
9	Water
17	Bridge Decks
18	High Noise
20	Ignored ground (breakline proximity)
21	Snow (where reliable identifiable)
22	Temporal Exclusion (typically non-favored data in intertidal zones)

Table 8: 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 1-meter cell size. Intensity images were cut to match the tile index and its corresponding tile names and delivered in GeoTIFF format.

3.1.8 Hydro-line Collection/Conflation

Hydro breaklines were compiled using LiDAR intensity data and surface terrain models of the entire project area. After the collection, all delineated hydro features were validated for monotonicity and vertical variance. This procedure ensures that no points were floating above ground. Hydro-lines were then encoded into the LiDAR surface and used to hydro-enforce/flatten all significant water bodies. These final hydro-lines were then used in the production of bare Earth digital models to hydro flatten significant water bodies. This product was delivered as an ESRI geodatabase for the entire project area.

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

Bare earth Digital Elevation Models (DEMs) were derived using the hydro-lines and bare earth (ground) LiDAR points. All DEMs were created with a grid spacing of 1 meter. DEMs for this project were cut to match the tile index and its corresponding tile names and delivered in 32-bit floating point GeoTIFF 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 IV.


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

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)
IX	100.0	196.0	294.0
X	333.3	653.3	980.0

Table 9: 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)	70	0.0767	0.1504	0.1051
NVA (DEM)	70	0.0777	0.1522	0.0891
VVA (Point Cloud)	39	0.0747	0.1465	0.1342
VVA (DEM)	39	0.0711	0.1393	0.1000

Table 10: NVA/VVA Accuracies

SECTION 5: CERTIFICATION STATEMENTS

5.1 Aerial LiDAR Project

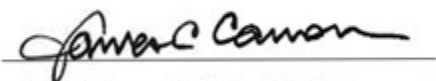
This accuracy assessment confirms that the data may be used for the intended applications stated in Section I of this document. This dataset may also be used as a topographic input for other applications, but the user should be aware that this LiDAR dataset was designed with a specific purpose and was 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.



James C. Cannon, ASPRS Certified Photogrammetrist #R1594CP



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
APPLI_UA116	1299133.5440	1040772.3140	41.5560	41.6000	0.0440	NVA
APPLI_UA41	1300133.7290	1035189.5410	48.0000	47.9500	-0.0500	NVA
ATKIN_FO14	1232903.0850	993720.2390	64.9870	64.8700	-0.1170	VVA
ATKIN_OT5	1225127.1800	1001824.3940	72.7940	72.9000	0.1060	NVA
ATKIN_OT58	1237858.0600	1009074.5450	67.0280	66.9900	-0.0380	NVA
ATKIN_UA74	1243721.8360	1006976.2160	57.0540	57.0500	-0.0040	NVA
ATKIN_UA81	1224579.0000	1001848.0540	74.0740	74.0300	-0.0440	NVA
ATKIN_UA82	1254618.0350	998960.3670	53.4730	53.3600	-0.1130	NVA
ATKIN_UA83	1229509.4170	992303.5060	68.1310	68.0600	-0.0710	NVA
ATKIN_UA84	1243268.9020	999687.3770	61.6870	61.5900	-0.0970	NVA
ATKIN_UA85	1249996.2020	994505.0550	57.2920	57.2600	-0.0320	NVA
ATKIN_WE19	1254002.6590	994436.7230	54.8010	54.7100	-0.0910	VVA
BACON_BE2	1276630.8450	1031464.9710	58.2900	58.3200	0.0300	NVA
BACON_FO22	1273407.3090	1026842.0990	51.2790	51.3400	0.0610	VVA
BACON_UA50	1280497.7980	1020771.8720	45.0530	45.2700	0.2170	NVA
BACON_UA51	1278119.5770	1031963.9880	53.3740	53.4600	0.0860	NVA
BACON_UA52	1268848.1770	1031091.0280	61.6270	61.7000	0.0730	NVA
BACON_UA53	1288388.3830	1037916.9970	57.1280	57.1700	0.0420	NVA
BACON_WE33	1275661.3030	1035046.3920	45.5560	45.6600	0.1040	VVA
BR17	1243655.5890	999696.4850	60.4620	60.3500	-0.1120	VVA

Point ID	Given (X)	Given (Y)	Given (Z)	Laser (Z)	Delta (Z)	Report Point Type
BR18	1279097.3960	1009414.2430	47.3700	47.4500	0.0800	VVA
BR19	1308688.1740	1019236.9700	32.4460	32.5400	0.0940	VVA
BR20	1326474.8960	1000541.9330	20.0790	20.0600	-0.0190	VVA
BRANT_FO16	1326244.6710	999169.0610	20.5250	20.5300	0.0050	VVA
BRANT_FO17	1343821.9510	1011566.9720	20.7430	20.9200	0.1770	VVA
BRANT_OT6	1338939.9940	1005087.0860	20.5400	20.6200	0.0800	NVA
BRANT_UA141	1338918.2100	1018546.3240	22.2790	22.3700	0.0910	NVA
BRANT_UA60	1326539.9610	1001363.1010	19.7360	19.7100	-0.0260	NVA
BRANT_WE25	1320564.6290	999195.9600	19.3560	19.2200	-0.1360	VVA
COFF_FO23	1250797.6620	1018950.1380	58.1460	58.2800	0.1340	VVA
COFF_OT9	1260113.3410	1027182.2080	57.2080	57.1900	-0.0180	NVA
COFF_UA105	1231969.4580	1011237.8630	75.3910	75.4000	0.0090	NVA
COFF_UA77	1254719.9190	1035491.4610	68.8300	68.7900	-0.0400	NVA
COFF_UA78	1260013.8730	1028474.6300	54.9150	54.9100	-0.0050	VVA
COFF_UA79	1253553.6010	1014234.8490	58.1950	58.1300	-0.0650	NVA
COFF_UA80	1250775.3710	1008258.2400	57.3170	57.3100	-0.0070	NVA
COFF_WE35	1258362.2120	1033630.3210	61.9870	62.3500	0.3630	NVA
COFFEE_BR14	1232479.3020	1027066.1030	80.2340	80.2400	0.0060	VVA
COFFEE_CP77	1239901.5350	1014865.1820	68.2440	68.2700	0.0260	VVA
COFFEE_CP78	1228139.8280	1027845.6450	89.8800	89.8800	0.0000	NVA
COFFEE_FO37	1222748.5670	1023619.0510	92.1650	92.1300	-0.0350	NVA
COFFEE_OT55	1229464.3810	1032710.8560	79.6450	79.6000	-0.0450	NVA
COFFEE_OT56	1225910.3280	1024657.7070	88.8440	88.7600	-0.0840	NVA



Point ID	Given (X)	Given (Y)	Given (Z)	Laser (Z)	Delta (Z)	Report Point Type
COFFEE_OT57	1246930.3760	1016304.1850	68.0980	68.1000	0.0020	NVA
COFFEE_TG23	1235988.8770	1019930.6750	62.5530	62.6100	0.0570	NVA
COFFEE_UA69	1223699.7640	1030433.1350	96.6890	96.6700	-0.0190	VVA
COFFEE_UA70	1241159.6860	1021480.0870	75.2730	75.3000	0.0270	VVA
HG17	1240817.6470	1019365.3320	76.8950	76.8900	-0.0050	VVA
HG18	1292933.7450	996422.0140	40.5900	40.6600	0.0700	VVA
HG19	1322281.9240	1041404.0240	42.5840	42.6900	0.1060	VVA
HG20	1326751.9420	1016124.4500	16.5080	16.5200	0.0120	VVA
LCP505	1326471.8970	1000529.9450	19.9250	19.8900	-0.0350	VVA
NVA505	1329623.2200	1047568.1900	29.0470	28.9500	-0.0970	NVA
PIER_CP41	1296119.2250	1019033.3070	46.0060	46.1000	0.0940	NVA
PIER_UA121	1288692.5180	1018781.2230	42.1650	42.2200	0.0550	VVA
PIER_UA122	1299452.0730	1019295.3230	43.4940	43.4800	-0.0140	NVA
PIER_UA123	1316503.0580	1009343.9410	18.5470	18.4900	-0.0570	NVA
PIER_UA124	1290529.7240	1006929.9720	40.7240	40.7900	0.0660	NVA
PIER_UA125	1302875.7510	1011413.8930	39.1270	39.0600	-0.0670	NVA
PIER_UA54	1300736.0990	1025037.8900	44.5520	44.4900	-0.0620	NVA
PIER_UA55	1295760.7180	1012334.8550	35.3550	35.3700	0.0150	NVA
PIER_UA56	1311683.0590	1018026.2520	31.3850	31.3800	-0.0050	NVA
PIER_UA57	1299256.3770	1002079.2520	36.5000	36.5400	0.0400	NVA
PIER_WE34	1312268.0860	1023116.9980	28.4320	28.4600	0.0280	NVA
SECP_BERRIEN_11	1213438.3820	992221.7230	74.0690	74.1300	0.0610	VVA
SECP_BERRIEN_UA_A	1223173.1940	991992.5090	69.6300	69.5900	-0.0400	NVA

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Point ID	Given (X)	Given (Y)	Given (Z)	Laser (Z)	Delta (Z)	Report Point Type
SECP_BERRIEN_UA_B	1211705.1540	985615.5610	70.1870	70.2200	0.0330	NVA
SECP_BERRIEN_UA_C	1212219.1510	1000535.3010	80.2150	80.2400	0.0250	VVA
SECP_BERRIEN_WE	1218070.5520	989533.5490	69.3630	69.3600	-0.0030	NVA
SEPL_BERRIEN_BR	1202315.2110	997462.0690	81.6160	81.5000	-0.1160	VVA
SEPL_BERRIEN_CP_D	1196556.4750	993216.3500	85.2120	85.1600	-0.0520	VVA
SEPL_BERRIEN_OT_B	1204315.1320	983275.4190	67.7770	67.8300	0.0530	NVA
SEPL_BERRIEN_OT_C	1193734.9680	998243.3380	89.0860	89.0600	-0.0260	VVA
SEPL_BERRIEN_TG	1207410.5370	995077.9090	76.8860	76.9900	0.1040	NVA
SEPL_BERRIEN_UA_A	1207025.0790	1004401.5960	88.7480	88.7000	-0.0480	NVA
SEPL_BERRIEN_UA_B	1207067.5270	984472.8100	71.6740	71.6200	-0.0540	NVA
SEPL_BERRIEN_UA_C	1189149.8900	998442.1690	95.0270	94.9800	-0.0470	VVA
SEPL_BERRIEN_WE	1195222.3620	1010403.2020	96.1320	96.1600	0.0280	NVA
SEPL_IRWIN_BE5	1211209.1870	1028803.8980	99.5040	99.5200	0.0160	NVA
SEPL_IRWIN_CP67	1208953.4670	1021867.4860	88.9760	89.0200	0.0440	VVA
SEPL_IRWIN_OT62	1191277.2450	1023962.4740	108.7060	108.7500	0.0440	NVA
SEPL_IRWIN_TG25	1198207.5410	1020194.2310	88.4240	88.3600	-0.0640	NVA
SEPL_IRWIN_UA72	1201511.6400	1027876.6280	105.8340	105.8300	-0.0040	NVA
SEPL_IRWIN_UA73	1215089.9650	1015594.6150	93.4320	93.4400	0.0080	VVA
TR17	1224286.2740	1001941.1450	74.3480	74.2700	-0.0780	NVA
TR18	1276527.8710	1031799.4200	58.0500	58.1200	0.0700	NVA
TR19	1300761.4170	1008912.5290	31.5740	31.6200	0.0460	NVA
TR20	1329632.7880	1047563.9360	29.1320	29.1500	0.0180	NVA
VVA505	1308680.7290	1019239.4780	32.4970	32.4800	-0.0170	NVA

Point ID	Given (X)	Given (Y)	Given (Z)	Laser (Z)	Delta (Z)	Report Point Type
WARE_CP25	1276583.9290	1004215.4380	45.1590	45.1100	-0.0490	NVA
WARE_CP26	1273775.1530	1020018.0640	50.6890	50.7000	0.0110	VVA
WARE_TG7	1270113.9340	998968.0760	46.6060	46.6900	0.0840	VVA
WARE_UA126	1279200.4970	999732.6810	43.7750	43.7700	-0.0050	NVA
WARE_UA71	1291693.7220	997562.1710	37.9020	37.9800	0.0780	VVA
WARE_UA72	1269114.6660	1015585.9920	50.1040	50.1800	0.0760	NVA
WARE_UA73	1261935.2320	998947.0740	45.1530	45.1600	0.0070	NVA
WARE_WE22	1274788.4620	993218.4770	47.4680	47.4900	0.0220	NVA
WARE_WE23	1267247.2060	1014935.4120	42.7020	42.8200	0.1180	NVA
WAYNE_BR6	1327343.8530	1018163.3220	18.8660	18.9200	0.0540	VVA
WAYNE_CP108	1337064.1910	1044309.9500	15.8000	15.8300	0.0300	VVA
WAYNE_CP49	1346350.8880	1034492.8570	19.7140	19.7300	0.0160	VVA
WAYNE_UA118	1328607.5740	1038372.8150	27.0470	27.0900	0.0430	VVA
WAYNE_UA120	1318651.4440	1031702.9720	37.5840	37.5600	-0.0240	NVA
WAYNE_UA142	1334078.4850	1028269.6820	19.2940	19.2800	-0.0140	NVA
WAYNE_UA38	1326353.0830	1045273.2820	32.3060	32.3700	0.0640	NVA
WAYNE_UA40	1309568.6490	1038459.8520	38.1710	38.1900	0.0190	NVA
WAYNE_WE29	1333338.2200	1023224.7490	19.9750	19.8500	-0.1250	NVA
WAYNE_WE30	1316080.4480	1028834.7930	20.6610	20.5500	-0.1110	NVA
WAYNE_WE31	1344142.2230	1041357.3080	19.8740	20.0100	0.1360	VVA

Table 21: 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
APPLI_UA116	1299133.5440	1040772.3140	41.5560	41.5000	0.0560	NVA



Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
APPLI_UA41	1300133.7290	1035189.5410	48.0000	47.9770	0.0230	NVA
ATKIN_OT5	1225127.1800	1001824.3940	72.7940	72.9100	-0.1160	NVA
ATKIN_OT58	1237858.0600	1009074.5450	67.0280	67.0050	0.0230	NVA
ATKIN_UA74	1243721.8360	1006976.2160	57.0540	57.0300	0.0240	NVA
ATKIN_UA81	1224579.0000	1001848.0540	74.0740	74.0200	0.0540	NVA
ATKIN_UA82	1254618.0350	998960.3670	53.4730	53.3600	0.1130	NVA
ATKIN_UA83	1229509.4170	992303.5060	68.1310	68.0300	0.1010	NVA
ATKIN_UA84	1243268.9020	999687.3770	61.6870	61.5990	0.0880	NVA
ATKIN_UA85	1249996.2020	994505.0550	57.2920	57.2790	0.0130	NVA
BACON_BE2	1276630.8450	1031464.9710	58.2900	58.2300	0.0600	NVA
BACON_UA50	1280497.7980	1020771.8720	45.0530	45.1900	-0.1370	NVA
BACON_UA51	1278119.5770	1031963.9880	53.3740	53.4900	-0.1160	NVA
BACON_UA52	1268848.1770	1031091.0280	61.6270	61.7100	-0.0830	NVA
BACON_UA53	1288388.3830	1037916.9970	57.1280	57.2000	-0.0720	NVA
BRANT_OT6	1338939.9940	1005087.0860	20.5400	20.6100	-0.0700	NVA
BRANT_UA141	1338918.2100	1018546.3240	22.2790	22.3350	-0.0560	NVA
BRANT_UA60	1326539.9610	1001363.1010	19.7360	19.7350	0.0010	NVA
COFF_OT9	1260113.3410	1027182.2080	57.2080	57.2000	0.0080	NVA
COFF_UA105	1231969.4580	1011237.8630	75.3910	75.4300	-0.0390	NVA
COFF_UA77	1254719.9190	1035491.4610	68.8300	68.7400	0.0900	NVA
COFF_UA79	1253553.6010	1014234.8490	58.1950	58.1200	0.0750	NVA
COFF_UA80	1250775.3710	1008258.2400	57.3170	57.2800	0.0370	NVA
COFF_WE35	1258362.2120	1033630.3210	61.9870	62.3170	-0.3300	NVA

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Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
COFFEE_CP78	1228139.8280	1027845.6450	89.8800	89.8900	-0.0100	NVA
COFFEE_F037	1222748.5670	1023619.0510	92.1650	92.1770	-0.0120	NVA
COFFEE_OT55	1229464.3810	1032710.8560	79.6450	79.6020	0.0430	NVA
COFFEE_OT56	1225910.3280	1024657.7070	88.8440	88.8220	0.0220	NVA
COFFEE_OT57	1246930.3760	1016304.1850	68.0980	68.1080	-0.0100	NVA
COFFEE_TG23	1235988.8770	1019930.6750	62.5530	62.5800	-0.0270	NVA
NVA505	1329623.2200	1047568.1900	29.0470	28.9910	0.0560	NVA
PIER_CP41	1296119.2250	1019033.3070	46.0060	46.1400	-0.1340	NVA
PIER_UA122	1299452.0730	1019295.3230	43.4940	43.4600	0.0340	NVA
PIER_UA123	1316503.0580	1009343.9410	18.5470	18.4700	0.0770	NVA
PIER_UA124	1290529.7240	1006929.9720	40.7240	40.7800	-0.0560	NVA
PIER_UA125	1302875.7510	1011413.8930	39.1270	39.0600	0.0670	NVA
PIER_UA54	1300736.0990	1025037.8900	44.5520	44.4900	0.0620	NVA
PIER_UA55	1295760.7180	1012334.8550	35.3550	35.3730	-0.0180	NVA
PIER_UA56	1311683.0590	1018026.2520	31.3850	31.3100	0.0750	NVA
PIER_UA57	1299256.3770	1002079.2520	36.5000	36.5500	-0.0500	NVA
PIER_WE34	1312268.0860	1023116.9980	28.4320	28.4150	0.0170	NVA
SECP_BERRIEN_UA_A	1223173.1940	991992.5090	69.6300	69.6400	-0.0100	NVA
SECP_BERRIEN_UA_B	1211705.1540	985615.5610	70.1870	70.2050	-0.0180	NVA
SECP_BERRIEN_WE	1218070.5520	989533.5490	69.3630	69.3700	-0.0070	NVA
SEPL_BERRIEN_OT_B	1204315.1320	983275.4190	67.7770	67.8100	-0.0330	NVA
SEPL_BERRIEN_TG	1207410.5370	995077.9090	76.8860	77.0270	-0.1410	NVA
SEPL_BERRIEN_UA_A	1207025.0790	1004401.5960	88.7480	88.7020	0.0460	NVA



Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
SEPL_BERRIEN_UA_B	1207067.5270	984472.8100	71.6740	71.6100	0.0640	NVA
SEPL_BERRIEN_WE	1195222.3620	1010403.2020	96.1320	96.1200	0.0120	NVA
SEPL_IRWIN_BE5	1211209.1870	1028803.8980	99.5040	99.5000	0.0040	NVA
SEPL_IRWIN_OT62	1191277.2450	1023962.4740	108.7060	108.7700	-0.0640	NVA
SEPL_IRWIN_TG25	1198207.5410	1020194.2310	88.4240	88.3600	0.0640	NVA
SEPL_IRWIN_UA72	1201511.6400	1027876.6280	105.8340	105.7800	0.0540	NVA
TR17	1224286.2740	1001941.1450	74.3480	74.2600	0.0880	NVA
TR18	1276527.8710	1031799.4200	58.0500	58.1520	-0.1020	NVA
TR19	1300761.4170	1008912.5290	31.5740	31.6400	-0.0660	NVA
TR20	1329632.7880	1047563.9360	29.1320	29.1500	-0.0180	NVA
VVA505	1308680.7290	1019239.4780	32.4970	32.5700	-0.0730	NVA
WARE_CP25	1276583.9290	1004215.4380	45.1590	45.0800	0.0790	NVA
WARE_UA126	1279200.4970	999732.6810	43.7750	43.7600	0.0150	NVA
WARE_UA72	1269114.6660	1015585.9920	50.1040	50.1900	-0.0860	NVA
WARE_UA73	1261935.2320	998947.0740	45.1530	45.1430	0.0100	NVA
WARE_WE22	1274788.4620	993218.4770	47.4680	47.4700	-0.0020	NVA
WARE_WE23	1267247.2060	1014935.4120	42.7020	42.8200	-0.1180	NVA
WAYNE_UA120	1318651.4440	1031702.9720	37.5840	37.5110	0.0730	NVA
WAYNE_UA142	1334078.4850	1028269.6820	19.2940	19.2700	0.0240	NVA
WAYNE_UA38	1326353.0830	1045273.2820	32.3060	32.4100	-0.1040	NVA
WAYNE_UA40	1309568.6490	1038459.8520	38.1710	38.2100	-0.0390	NVA
WAYNE_WE29	1333338.2200	1023224.7490	19.9750	19.8940	0.0810	NVA
WAYNE_WE30	1316080.4480	1028834.7930	20.6610	20.5300	0.1310	NVA

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Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
ATKIN_FO14	1232903.0850	993720.2390	64.9870	64.8600	0.1270	VVA
ATKIN_WE19	1254002.6590	994436.7230	54.8010	54.7200	0.0810	VVA
BACON_FO22	1273407.3090	1026842.0990	51.2790	51.2870	-0.0080	VVA
BACON_WE33	1275661.3030	1035046.3920	45.5560	45.6000	-0.0440	VVA
BR17	1243655.5890	999696.4850	60.4620	60.3650	0.0970	VVA
BR18	1279097.3960	1009414.2430	47.3700	47.4300	-0.0600	VVA
BR19	1308688.1740	1019236.9700	32.4460	32.5500	-0.1040	VVA
BR20	1326474.8960	1000541.9330	20.0790	20.1200	-0.0410	VVA
BRANT_FO16	1326244.6710	999169.0610	20.5250	20.4900	0.0350	VVA
BRANT_FO17	1343821.9510	1011566.9720	20.7430	20.8700	-0.1270	VVA
BRANT_WE25	1320564.6290	999195.9600	19.3560	19.2220	0.1340	VVA
COFFEE_BR14	1232479.3020	1027066.1030	80.2340	80.2700	-0.0360	VVA
COFFEE_CP77	1239901.5350	1014865.1820	68.2440	68.2610	-0.0170	VVA
COFFEE_UA69	1223699.7640	1030433.1350	96.6890	96.6400	0.0490	VVA
COFFEE_UA70	1241159.6860	1021480.0870	75.2730	75.2550	0.0180	VVA
COFF_FO23	1250797.6620	1018950.1380	58.1460	58.3200	-0.1740	VVA
COFF_UA78	1260013.8730	1028474.6300	54.9150	54.9700	-0.0550	VVA
HG17	1240817.6470	1019365.3320	76.8950	76.8640	0.0310	VVA
HG18	1292933.7450	996422.0140	40.5900	40.6800	-0.0900	VVA
HG19	1322281.9240	1041404.0240	42.5840	42.6500	-0.0660	VVA
HG20	1326751.9420	1016124.4500	16.5080	16.5000	0.0080	VVA
LCP505	1326471.8970	1000529.9450	19.9250	19.9090	0.0160	VVA
PIER_UA121	1288692.5180	1018781.2230	42.1650	42.2000	-0.0350	VVA

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Point ID	Given (X)	Given (Y)	Given (Z)	DEM (Z)	DEM (DZ)	Report Point Type
SECP_BERRIEN_11	1213438.3820	992221.7230	74.0690	74.1170	-0.0480	VVA
SECP_BERRIEN_UA_C	1212219.1510	1000535.3010	80.2150	80.2490	-0.0340	VVA
SEPL_BERRIEN_BR	1202315.2110	997462.0690	81.6160	81.5500	0.0660	VVA
SEPL_BERRIEN_CP_D	1196556.4750	993216.3500	85.2120	85.1230	0.0890	VVA
SEPL_BERRIEN_OT_C	1193734.9680	998243.3380	89.0860	89.0570	0.0290	VVA
SEPL_BERRIEN_UA_C	1189149.8900	998442.1690	95.0270	94.9500	0.0770	VVA
SEPL_IRWIN_CP67	1208953.4670	1021867.4860	88.9760	89.0270	-0.0510	VVA
SEPL_IRWIN_UA73	1215089.9650	1015594.6150	93.4320	93.4300	0.0020	VVA
WARE_CP26	1273775.1530	1020018.0640	50.6890	50.6400	0.0490	VVA
WARE_TG7	1270113.9340	998968.0760	46.6060	46.6400	-0.0340	VVA
WARE_UA71	1291693.7220	997562.1710	37.9020	37.9900	-0.0880	VVA
WAYNE_BR6	1327343.8530	1018163.3220	18.8660	18.8900	-0.0240	VVA
WAYNE_CP108	1337064.1910	1044309.9500	15.8000	15.7780	0.0220	VVA
WAYNE_CP49	1346350.8880	1034492.8570	19.7140	19.7640	-0.0500	VVA
WAYNE_UA118	1328607.5740	1038372.8150	27.0470	27.0670	-0.0200	VVA
WAYNE_WE31	1344142.2230	1041357.3080	19.8740	20.0100	-0.1360	VVA

Table 12: DEM Check Point Assessment

SECTION 7: ADDENDUM

7.1 Low Confidence Polygons

Low confidence polygons have been delivered with this dataset. These polygons represent areas where heavy vegetation or inundated areas greatly diminish penetration of the lidar pulse, resulting in a bare earth surface that is potentially less accurate due to the lack of lidar returns from the ground beneath the vegetation or surface water. Low confidence polygons delineate areas where conformance to VVA standards may not be met. The low confidence polygons created for this dataset were delineated according to the criteria and assumptions outlined in the ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014). Low confidence areas are identified using a ground density raster. All areas with a Nominal Ground Point Density less than the threshold of 0.5 pts/m² are identified as low confidence cells in the ground density raster. The low confidence cells are exported to polygons and aggregated into larger shapes. Areas of expected low density in the ground, such as water or where buildings/structures have been removed, are deleted from the aggregated low confidence polygons. The size of all polygons is then calculated and polygons below the minimum size threshold of 5 acres are removed from the final low confidence polygon dataset.

7.2 Cloud Polygons

Small areas of this block were found to have clouds/fog affecting the lidar. These areas have been delineated in the following shapefile: GA_Statewide_10_2018_Clouds.shp.