

Appendix A: Survey Report

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Check Point Survey Report

FL Southeast QL1

LiDAR Project

USGS CONTRACT NUMBER: G16PC00020
TASK ORDER NUMBER: 140G0218F0178

PREPARED FOR:
USGS



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9.	Deliverables	Sent via Electronic Transfer
9.1.	Including:	
	a) Point Documentation Report & Photos of Survey Points	
	b) Final Coordinate List in Excel Format	
	c) NGS Data Sheets for Project Control	

1. INTRODUCTION

1.1 Project Summary

Dewberry Consultants LLC is under contract with the United States Geological Survey (USGS) to collect and process LiDAR for Southeast Florida. This survey will be used to evaluate the vertical accuracy of the bare-earth terrain derived from LiDAR. The project area consists of approximately 1,641 square miles. In support of this project Dewberry surveyed 125 independent check points. As part of this work, Dewberry staff will complete a Control Survey of independent check points that will be used to test the accuracy of the LiDAR and derivative products. The field work was conducted from May 30, 2018 – January 18, 2019.

Existing National Geodetic Survey (NGS) control points were located and surveyed to check the accuracy of the RTK/GPS survey equipment with the results shown in Section 2.4 of this Report.

As an internal QA/QC procedure and to verify that the independent check points meet the 95% confidence level approximately 50% of the points were re-observed and their corresponding coordinate differences are shown in Section 5 of this report.

A map showing the overall project area is shown in section 1.3. Final horizontal coordinates are referenced to both the Contiguous USA Albers Coordinate System, NAD 83 (2011 Adjustment) in meters and the Florida State Plane Coordinate System, East Zone, NAD83 (2011 Adjustment) in U.S. Survey feet. Final vertical elevations are referenced to NAVD88 in both meters and U.S. Survey feet using Geoid model 2012B (Geoid12B).

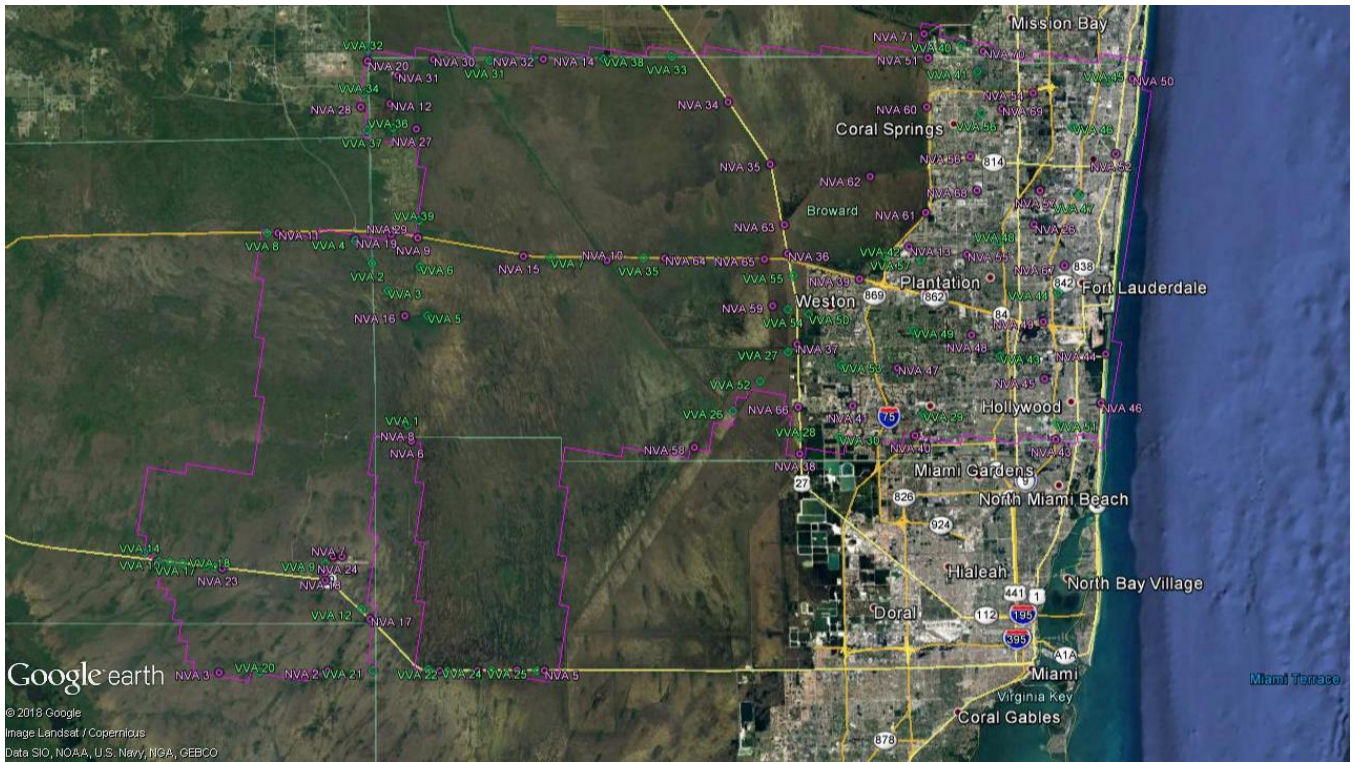
1.2 Point of Contact

Questions regarding the technical aspects of this report should be addressed to:

Dewberry Engineers, Inc.

William D. Donley, PSM
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Orlando, Florida 32806
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1.3 Project Area



Project Limits and Independent Check Point Locations

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2. PROJECT DETAILS

2.1 Survey Equipment

A Spectra Precision SP80 GPS receiver and a TOPCON GR5 GPS receiver were used to perform the survey observations. A two meter fixed height pole and bi-pod legs were used to mount and stabilize the receiver. A Spectra Precision Ranger 3 Data Collector was used to collect and store the data. Both GPS units are geodetic-quality dual-frequency GPS receivers.

2.2 Survey Point Details

The 125 LiDAR independent check points were well distributed throughout the project area by pre-selecting them in the office using aerial imagery. The American Society for Photogrammetry and Remote Sensing (ASPRS) guidelines were followed for point selection as closely as possible. The independent check points consist of two classifications: Non-vegetated Vertical Accuracy (NVA) and Vegetated Vertical Accuracy (VVA) points. There are a total of 69 NVA points consisting of bare earth/open terrain and urban points. There are a total of 56 VVA points consisting of tall weeds/crops, brush lands and forested land covers. A sketch was made for each check point location and a nail & disk or an iron rod & cap were set at the point. The independent check point locations are detailed on the “Final Coordinates List” attached to this report.

2.3 Network Design

Two real-time kinematic (RTK) networks were used to establish and verify the accuracy of the observations. The Trimble VRS Now Network and the Florida Permanent Reference Network (FPRN) were used for the observations. The GPS units connected to the networks using a cellular connection and a virtual reference station. The RTK networks provide instant access to RTK corrections utilizing a network of permanent (fixed) continuously operating reference stations. The published accuracy for the networks are less than 2 centimeters. All recorded observations were within 5 centimeters of each other. These observations were averaged to produce the final coordinate value for the ground control points.

2.4 Field Survey Procedures and Analysis

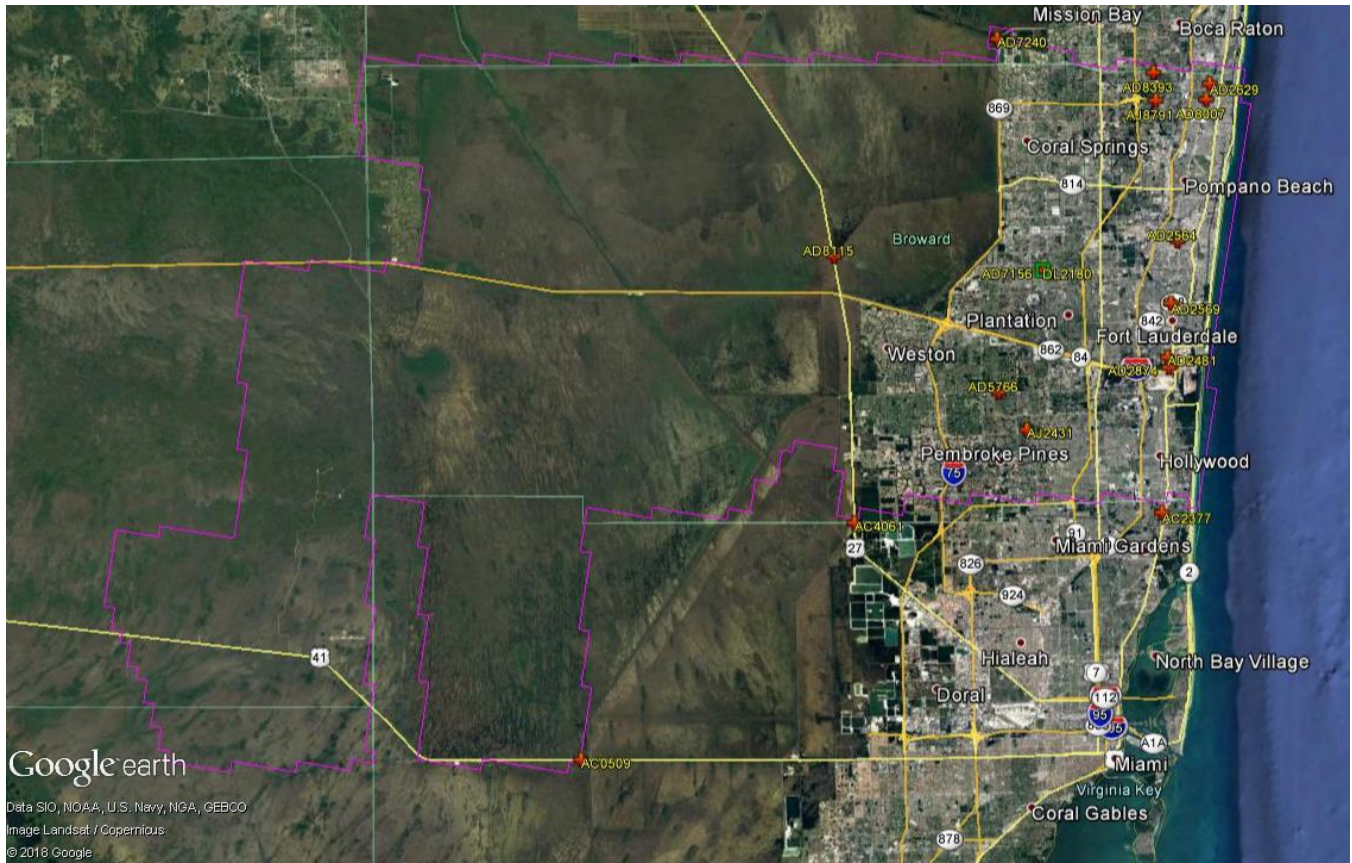
All locations were occupied once with approximately 50% of the locations being re-observed. All re-observations matched the initially derived station positions within the allowable tolerance of ± 5 centimeters or within the 95% confidence level. Each occupation was approximately 1.5 minutes in duration and measured to 90 epochs. The second observation occurred at least four hours after the first observation.

Seventeen (17) existing National Geodetic Survey (NGS) control points with published coordinates were located as an additional QA/QC method to check the accuracy of the networks. A NGS control point was located at the beginning and end of each day to ensure measurement quality. The checks all individually conformed to the required accuracy and the average coordinates for the surveyed NGS control points are shown below and compared to the published coordinates.

NGS PT. ID	Designation	As Surveyed (ft)			Published (ft)			Differences (ft)		
		Northing	Easting	Elevation	Northing	Easting	Elevation	ΔN	ΔE	Δ Elevation
AC0509	M 237	519332.474	760808.565	14.384	519332.56	760808.55	14.38	0.086	-0.015	-0.004
AC2377	Y 238	593760.121	936228.024	7.003	593760.19	936228.01	6.98	0.069	-0.014	-0.023
AC4061	SNAKE	590483.556	843279.012	4.743	590483.56	843279.06	4.89	0.004	0.048	0.147
AD2478	Y 235	637261.399	938251.353	8.017	637261.36	938251.39	7.89	-0.039	0.037	-0.127
AD2481	X 235	640262.613	937799.836	9.334	640262.62	937799.90	9.25	0.007	0.064	-0.084
AD2564	G 235	675216.778	940785.328	2.980	675216.84	940785.31	3.02	0.062	-0.018	0.040
AD2569	P 235	656490.954	938788.790	6.073	656490.95	938788.81	6.01	-0.004	0.020	-0.063
AD2629	E 235	722371.278	950519.228	13.740	722371.27	950519.22	13.67	-0.008	-0.008	-0.070
AD5766	CHARLIE	629693.273	886752.456	6.939	629693.14	886752.46	7.04	-0.133	0.004	0.101
AD7156	UNIVERSITY	666208.087	900255.254	N/A	666207.95	900255.12	6.00	-0.137	-0.133	N/A
AD7240	FCE 3943	735607.165	886152.981	22.305	735607.19	886152.97	22.37	0.025	-0.011	0.065
AD8007	T 400	717657.213	949427.347	14.412	717657.23	949427.32	14.43	0.017	-0.027	0.018
AD8115	FCE 4000	670338.196	836976.516	21.562	670338.17	836976.49	21.61	-0.026	-0.026	0.048
AD8393	HILL POWER	725639.198	933480.459	14.719	725639.20	933480.54	14.75	0.002	0.081	0.031
AJ2431	WALDREP	618466.584	895288.424	5.261	618466.55	895288.42	5.26	-0.034	-0.004	-0.001
AJ8791	N 548	717293.473	934160.918	11.648	717293.51	934160.97	11.63	0.037	0.052	-0.018
DL2180	K 664	666138.277	899997.742	9.616	N/A	N/A	9.48	N/A	N/A	-0.136



The above results indicate that the VRS network is providing positional values within the ± 5 cm parameters for this survey.

2.4 Field Survey Procedures and Analysis (continued)



NGS Monuments

Legend:

-  Horizontal + Vertical NGS Benchmark
-  Vertical NGS Benchmark

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2.5 Adjustment

Adjustment is not necessary for the survey data collected using the RTK GPS Trimble VRS Now Network and the Florida Permanent Reference Network. Both networks are designed to provide final processed coordinates, enabling high-accuracy positioning in real time across a geographic region. Both networks use real-time data streams from the system users and generate correction models for high-accuracy RTK GPS corrections throughout the networks. These corrections are applied to the points as they are being collected, negating the need for a post-process adjustment.

2.6 Data Processing Procedures

After the field data is collected the information is downloaded from the data collectors. Downloaded data is processed in the office to obtain the following reports: points list, point derivations and a vector spreadsheet. The reports are reviewed for point accuracy and precision.

After review of the point data an “ASCII” or “txt” file is created. Point files are loaded into AutoCAD Civil 3D to make a visual check of the point data (Point #, Coordinates, Elevation, and Description). The data is then organized using Excel spreadsheets and imported into the report.

3. FINAL COORDINATES

Contiguous USA Albers Coordinate System, NAD 83 (2011) / NAVD88

Point ID	Northing (m)	Easting (m)	Elevation (m)
NVA 1	430630.76	1501563.01	2.38
NVA 2	422436.77	1521096.53	2.59
NVA 3	420449.12	1509771.77	2.31
NVA 4	424372.80	1532692.03	4.02
NVA 5	426161.70	1543556.97	3.95
NVA 6	447155.68	1526026.19	5.14
NVA 7	434131.80	1519738.60	3.20
NVA 8	448745.14	1524745.55	2.45
NVA 9	467816.16	1523357.43	5.04
NVA 10	468720.24	1543350.48	4.23
NVA 11	465981.68	1508757.98	5.50
NVA 12	480958.08	1518259.94	4.37
NVA 13	475201.21	1574418.15	2.16
NVA 14	489082.19	1539718.05	4.29
NVA 15	467726.19	1534622.41	3.82
NVA 16	459704.67	1523286.62	3.96
NVA 17	428410.70	1524634.33	2.79
NVA 18	432374.14	1519178.74	3.23
NVA 19	466702.98	1516866.43	4.47
NVA 20	484922.50	1515226.11	6.96
NVA 21	425012.51	1536638.27	3.85
NVA 22	425713.09	1540735.48	3.35
NVA 23	431054.80	1508427.60	2.79
NVA 24	434281.34	1520691.58	3.19
NVA 25	431593.19	1519303.36	2.88
NVA 26	479592.13	1587031.01	1.64
NVA 27	478833.51	1521410.78	3.12
NVA 28	480134.69	1515285.52	4.48
NVA 29	467749.23	1520547.58	8.99
NVA 30	486182.70	1522041.32	3.99
NVA 31	483963.81	1518585.32	3.45
NVA 32	488054.32	1533427.88	4.87
NVA 34	486792.16	1553292.63	4.29
NVA 35	481203.91	1558677.11	4.80
NVA 36	472433.65	1561969.03	3.97

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3. FINAL COORDINATES (CONTINUED)

Contiguous USA Albers Coordinate System, NAD 83 (2011) / NAVD88

Point ID	Northing (m)	Easting (m)	Elevation (m)
NVA 37	463435.95	1564422.00	3.41
NVA 38	452400.65	1566508.68	2.90
NVA 39	471094.94	1569830.41	2.77
NVA 40	456182.36	1578166.00	2.28
NVA 41	458148.50	1571208.83	1.63
NVA 43	458174.83	1592837.58	1.62
NVA 44	467675.72	1596633.03	1.01
NVA 45	464126.05	1590693.88	1.08
NVA 46	462636.64	1596949.41	0.20
NVA 47	462732.09	1575238.41	1.57
NVA 48	467316.79	1582368.35	1.78
NVA 49	469878.44	1589619.03	1.54
NVA 50	496068.53	1594878.40	1.23
NVA 51	494676.30	1573294.49	3.20
NVA 52	488134.09	1594362.13	2.40
NVA 53	480495.65	1595687.76	1.96
NVA 54	492888.17	1584784.53	4.14
NVA 55	475402.13	1580582.86	1.90
NVA 56	485378.05	1579295.05	3.55
NVA 57	483115.70	1587100.01	3.23
NVA 58	451265.09	1555482.22	5.19
NVA 59	466902.67	1561261.45	3.13
NVA 60	489661.21	1573961.96	5.81
NVA 61	478933.62	1575586.09	6.18
NVA 62	481638.43	1569234.95	5.31
NVA 63	475311.96	1561145.96	4.98
NVA 64	469905.98	1549303.29	3.41
NVA 65	471496.35	1559644.19	4.89
NVA 66	457092.84	1565571.97	2.79
NVA 67	475950.40	1590890.43	1.66
NVA 68	482052.44	1580554.91	3.12
NVA 69	490761.54	1581791.44	3.95
NVA 70	496276.75	1578932.06	4.25
NVA 71	497040.13	1572496.23	5.31
VVA 1	448610.42	1525307.72	3.11

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3. FINAL COORDINATES (CONTINUED)

Contiguous USA Albers Coordinate System, NAD 83 (2011) / NAVD88

Point ID	Northing (m)	Easting (m)	Elevation (m)
VVA 2	464402.29	1518984.74	2.92
VVA 3	461900.84	1521073.36	3.95
VVA 4	466417.72	1516869.25	3.17
VVA 5	460042.82	1525597.37	3.89
VVA 6	464859.66	1524006.06	2.60
VVA 7	467957.17	1537449.39	3.95
VVA 8	465744.85	1507584.60	3.85
VVA 9	433237.64	1519017.36	2.16
VVA 10	430752.00	1502838.27	1.69
VVA 11	431562.03	1519278.19	2.37
VVA 12	429195.50	1523534.20	2.17
VVA 13	487710.44	1532125.41	2.91
VVA 14	431266.17	1500011.38	1.62
VVA 15	430639.70	1501687.90	1.88
VVA 16	430810.77	1504151.63	1.79
VVA 17	430936.33	1506646.31	1.84
VVA 18	430978.32	1507595.60	1.85
VVA 20	421128.99	1513974.03	2.03
VVA 21	423183.58	1525697.46	2.43
VVA 22	424365.11	1533475.47	2.94
VVA 23	424208.45	1531484.89	3.25
VVA 24	425204.84	1538078.81	2.82
VVA 25	425938.07	1542793.50	2.93
VVA 26	455527.59	1558832.91	3.04
VVA 27	462408.34	1563578.23	2.16
VVA 28	454098.78	1566277.09	1.58
VVA 29	458475.28	1578607.35	1.29
VVA 30	454674.54	1570288.02	0.34
VVA 31	486942.28	1527870.52	3.03
VVA 32	485996.19	1515032.20	5.57
VVA 33	490396.33	1546677.05	3.07
VVA 34	481559.52	1515334.24	4.13
VVA 35	469516.27	1547059.14	2.58
VVA 36	478484.06	1518939.51	3.52
VVA 37	477843.48	1516281.20	3.58

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3. FINAL COORDINATES (CONTINUED)

Contiguous USA Albers Coordinate System, NAD 83 (2011) / NAVD88

Point ID	Northing (m)	Easting (m)	Elevation (m)
VVA 38	489003.73	1539635.11	2.94
VVA 39	469542.22	1523157.46	2.90
VVA 40	496512.95	1576493.89	3.51
VVA 41	494062.44	1578626.98	3.72
VVA 42	473745.87	1572035.32	1.92
VVA 43	465604.31	1585614.84	1.18
VVA 44	473020.04	1590643.93	1.74
VVA 45	495330.83	1592425.54	5.16
VVA 46	490119.30	1589419.61	3.58
VVA 47	483219.53	1591177.55	1.94
VVA 48	477151.45	1583705.66	2.03
VVA 49	466716.52	1576241.08	1.77
VVA 50	466580.74	1565103.15	1.27
VVA 51	459752.09	1592645.75	1.05
VVA 52	458978.73	1561172.88	3.59
VVA 53	462015.22	1569319.71	1.00
VVA 54	466725.38	1562855.47	2.04
VVA 55	470256.10	1562870.43	2.26
VVA 56	489870.57	1579684.33	3.64
VVA 57	473983.93	1575818.21	1.33

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3. FINAL COORDINATES (CONTINUED)

Florida State Plane Coordinate System, East Zone, NAD 83 (2011) / NAVD88

Point ID	Northing (SPC FL E)	Easting (SPC FL E)	Elevation (Feet)
NVA 1	555838.13	623364.35	7.81
NVA 2	518865.45	681859.75	8.49
NVA 3	518262.14	644511.49	7.57
NVA 4	519145.00	720050.56	13.18
NVA 5	519312.04	755822.63	12.94
NVA 6	597135.84	710333.20	16.86
NVA 7	557828.77	683483.90	10.50
NVA 8	603000.70	707036.47	8.04
NVA 9	666056.26	712353.95	16.53
NVA 10	658559.11	777030.66	13.86
NVA 11	667669.08	664520.04	18.03
NVA 12	711648.70	702715.88	14.34
NVA 13	663415.94	880145.04	7.08
NVA 14	726974.59	775838.70	14.09
NVA 15	659878.37	748488.67	12.54
NVA 16	639585.77	707968.28	12.98
NVA 17	536562.39	696266.56	9.16
NVA 18	552372.04	680788.17	10.58
NVA 19	665803.59	690934.45	14.68
NVA 20	726178.34	694999.18	22.83
NVA 21	519174.28	733038.09	12.65
NVA 22	519322.03	746541.20	10.98
NVA 23	553656.04	645611.62	9.15
NVA 24	557820.92	686618.72	10.47
NVA 25	549752.78	680788.68	9.45
NVA 26	671108.66	922923.18	5.38
NVA 27	703065.92	711750.23	10.25
NVA 28	710509.25	692736.53	14.69
NVA 29	667303.25	703294.44	29.49
NVA 30	726741.25	717546.36	13.09
NVA 31	721296.55	705302.51	11.32
NVA 32	726907.80	755097.60	15.98
NVA 34	712382.86	818274.66	14.09
NVA 35	691304.31	832689.50	15.74
NVA 36	660924.15	838736.63	13.02

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3. FINAL COORDINATES (CONTINUED)

Florida State Plane Coordinate System, East Zone, NAD 83 (2011) / NAVD88

Point ID	Northing (SPC FL E)	Easting (SPC FL E)	Elevation (Feet)
NVA 37	630233.95	841969.58	11.20
NVA 38	593067.93	842973.53	9.52
NVA 39	652415.69	863290.10	9.09
NVA 40	599290.49	882342.38	7.49
NVA 41	609382.43	861027.30	5.34
NVA 43	598057.33	930463.25	5.32
NVA 44	627100.57	947573.44	3.32
NVA 45	618640.76	926667.17	3.54
NVA 46	610465.58	945974.49	0.65
NVA 47	622240.47	876331.23	5.17
NVA 48	633463.64	901592.79	5.84
NVA 49	638006.23	926198.21	5.05
NVA 50	720774.42	956678.22	4.04
NVA 51	727616.26	886611.42	10.50
NVA 52	695136.31	950899.74	7.87
NVA 53	669485.85	951191.90	6.43
NVA 54	715720.59	922600.20	13.58
NVA 55	660823.15	900045.57	6.23
NVA 56	694089.23	901074.82	11.66
NVA 57	682582.05	924971.37	10.61
NVA 58	595150.27	806996.82	17.04
NVA 59	643223.91	833610.59	10.28
NVA 60	710887.86	886160.46	19.06
NVA 61	674993.80	885826.54	20.27
NVA 62	687173.32	866826.70	17.44
NVA 63	670760.27	837578.75	16.35
NVA 64	659314.08	796758.39	11.20
NVA 65	659083.33	830787.07	16.05
NVA 66	608898.25	842388.03	9.15
NVA 67	657173.21	933428.55	5.43
NVA 68	682562.55	903399.24	10.24
NVA 69	710354.87	911882.54	12.95
NVA 70	729872.08	905553.58	13.94
NVA 71	735754.97	885269.89	17.41
VVA 1	602266.85	708772.20	10.22

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Florida State Plane Coordinate System, East Zone, NAD 83 (2011) / NAVD88

Point ID	Northing (SPC FL E)	Easting (SPC FL E)	Elevation (Feet)
VVA 2	657181.43	696559.75	9.57
VVA 3	647917.73	701986.08	12.94
VVA 4	664869.99	690797.39	10.38
VVA 5	639485.02	715562.04	12.77
VVA 6	656056.95	712921.32	8.53
VVA 7	659154.58	757686.59	12.95
VVA 8	667505.67	660629.80	12.63
VVA 9	555280.36	680711.92	7.08
VVA 10	555572.01	627519.01	5.54
VVA 11	549664.00	680691.97	7.77
VVA 12	539703.57	693138.25	7.12
VVA 13	726465.51	750735.50	9.54
VVA 14	558722.55	618708.40	5.33
VVA 15	555802.47	623769.72	6.17
VVA 16	555081.57	631764.10	5.89
VVA 17	554195.12	639834.45	6.05
VVA 18	553838.72	642902.44	6.07
VVA 20	518298.84	658340.73	6.68
VVA 21	518908.11	697002.34	7.98
VVA 22	518710.33	722559.93	9.66
VVA 23	519238.26	716093.77	10.66
VVA 24	519049.80	737757.97	9.24
VVA 25	518980.36	753258.68	9.63
VVA 26	607324.22	819948.26	9.98
VVA 27	627319.32	838730.36	7.07
VVA 28	598740.76	843106.44	5.19
VVA 29	606552.39	884944.69	4.23
VVA 30	598512.14	856277.57	1.12
VVA 31	726179.61	736668.20	9.95
VVA 32	729786.01	694926.32	18.28
VVA 33	727621.88	798876.54	10.09
VVA 34	715137.90	693623.20	13.55
VVA 35	659217.11	789350.69	8.46
VVA 36	703213.08	703631.04	11.55
VVA 37	702506.11	694761.69	11.76

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3. FINAL COORDINATES (CONTINUED)

Florida State Plane Coordinate System, East Zone, NAD 83 (2011) / NAVD88

Point ID	Northing (SPC FL E)	Easting (SPC FL E)	Elevation (Feet)
VVA 38	726761.78	775531.80	9.66
VVA 39	671800.40	712596.67	9.50
VVA 40	731928.19	897841.98	11.51
VVA 41	722802.53	903426.35	12.20
VVA 42	659916.17	871740.54	6.29
VVA 43	626154.26	911128.57	3.87
VVA 44	647729.59	931117.54	5.72
VVA 45	719662.04	948415.02	16.94
VVA 46	704231.46	936054.03	11.73
VVA 47	680767.55	938120.98	6.35
VVA 48	664890.73	910979.57	6.65
VVA 49	634732.91	881610.39	5.81
VVA 50	640152.46	845779.70	4.16
VVA 51	603314.00	930665.15	3.46
VVA 52	617374.92	829239.15	11.79
VVA 53	623014.45	856960.02	3.29
VVA 54	641806.83	838637.38	6.68
VVA 55	653335.72	840507.46	7.42
VVA 56	708556.31	904651.95	11.94
VVA 57	658701.43	884011.39	4.37

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4. GPS OBSERVATION & RE-OBSERVATION SCHEDULE

Point ID	Observation Date	Julian Date	Time of Day	Re-observation Date	Re-observation Julian Date	Re-observation Time of Day
NVA 1	1/10/2019	10	11:56	1/17/2019	17	9:40
NVA 2	1/10/2019	10	9:40	1/17/2019	17	8:33
NVA 3	1/10/2019	10	10:43	1/17/2019	17	9:12
NVA 4	12/19/2018	353	16:47	N/A	N/A	N/A
NVA 5	12/19/2018	353	14:15	N/A	N/A	N/A
NVA 6	1/18/2019	18	8:51	N/A	N/A	N/A
NVA 7	1/15/2019	15	13:05	1/17/2019	17	11:25
NVA 8	1/18/2019	18	9:46	N/A	N/A	N/A
NVA 9	1/9/2019	9	14:06	N/A	N/A	N/A
NVA 10	1/9/2019	9	15:15	1/16/2019	16	14:12
NVA 11	1/9/2019	9	12:38	N/A	N/A	N/A
NVA 12	1/8/2019	8	12:48	N/A	N/A	N/A
NVA 13	12/13/2018	347	9:13	12/17/2018	351	16:36
NVA 14	1/7/2019	7	13:14	1/16/2019	16	8:26
NVA 15	1/9/2019	9	14:54	N/A	N/A	N/A
NVA 16	1/9/2019	9	11:07	N/A	N/A	N/A
NVA 17	1/10/2019	10	16:02	1/17/2019	17	12:39
NVA 18	1/15/2019	15	12:44	1/17/2019	17	11:20
NVA 19	1/8/2019	8	16:58	N/A	N/A	N/A
NVA 20	1/8/2019	8	11:54	N/A	N/A	N/A
NVA 21	12/19/2018	353	15:42	N/A	N/A	N/A
NVA 22	12/19/2018	353	14:55	1/17/2019	17	7:54
NVA 23	1/10/2019	10	14:17	N/A	N/A	N/A
NVA 24	1/10/2019	10	15:08	N/A	N/A	N/A
NVA 25	1/10/2019	10	14:47	1/17/2019	17	11:14
NVA 26	7/17/2018	198	9:03	7/19/2018	200	12:20
NVA 27	1/9/2019	9	9:20	1/16/2019	16	12:42
NVA 28	1/8/2019	8	14:41	1/16/2019	16	9:46
NVA 29	1/8/2019	8	16:07	1/16/2019	16	11:00
NVA 30	1/8/2019	8	11:01	1/16/2019	16	9:24
NVA 31	1/8/2019	8	13:28	N/A	N/A	N/A
NVA 32	1/7/2019	7	13:36	N/A	N/A	N/A
NVA 34	12/18/2019	352	14:19	N/A	N/A	N/A
NVA 35	12/18/2019	352	12:52	1/16/2019	16	7:18
NVA 36	12/18/2019	352	12:22	N/A	N/A	N/A

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4. GPS OBSERVATION & RE-OBSERVATION SCHEDULE (CONTINUED)

Point ID	Observation Date	Julian Date	Time of Day	Re-observation Date	Re-observation Julian Date	Re-observation Time of Day
NVA 37	12/13/2018	347	10:55	12/17/2018	351	17:11
NVA 38	12/14/2018	348	9:57	12/18/2018	352	7:47
NVA 39	12/13/2018	347	10:06	N/A	N/A	N/A
NVA 40	12/14/2018	348	8:00	N/A	N/A	N/A
NVA 41	12/14/2018	348	9:05	12/18/2018	352	10:21
NVA 43	7/26/2018	207	7:51	N/A	N/A	N/A
NVA 44	7/16/2018	197	17:48	N/A	N/A	N/A
NVA 45	7/18/2018	199	9:30	7/26/2018	207	9:28
NVA 46	7/26/2018	207	8:32	N/A	N/A	N/A
NVA 47	12/13/2018	347	14:04	12/18/2018	352	10:02
NVA 48	12/13/2018	347	15:08	12/18/2018	352	8:58
NVA 49	7/18/2018	199	9:15	7/26/2018	207	10:37
NVA 50	7/17/2018	198	12:39	7/26/2018	207	14:23
NVA 51	12/12/2018	346	12:01	N/A	N/A	N/A
NVA 52	7/17/2018	198	13:36	7/26/2018	207	11:07
NVA 53	7/19/2018	200	13:25	1/18/2018	18	12:24
NVA 54	12/12/2018	346	10:10	12/17/2018	351	13:37
NVA 55	12/12/2018	346	16:26	N/A	N/A	N/A
NVA 56	12/12/2018	346	14:58	N/A	N/A	N/A
NVA 57	7/17/2018	198	9:26	7/19/2018	200	9:34
NVA 58	12/19/2018	353	11:38	N/A	N/A	N/A
NVA 59	12/19/2018	353	9:43	N/A	N/A	N/A
NVA 60	12/12/2018	346	12:37	12/17/2018	351	14:31
NVA 61	12/12/2018	346	13:03	N/A	N/A	N/A
NVA 62	12/19/2018	353	8:29	N/A	N/A	N/A
NVA 63	12/14/2018	348	11:09	12/18/2019	352	7:05
NVA 64	1/9/2019	9	7:46	N/A	N/A	N/A
NVA 65	1/9/2019	9	16:25	N/A	N/A	N/A
NVA 66	12/14/2018	348	9:33	N/A	N/A	N/A
NVA 67	7/17/2018	193	15:25	7/26/2018	207	11:41
NVA 68	12/12/2018	346	15:25	12/17/2018	351	15:25
NVA 69	12/12/2018	346	14:26	N/A	N/A	N/A
NVA 70	12/12/2018	346	9:38	N/A	N/A	N/A
NVA 71	12/12/2018	346	7:50	12/17/2018	351	12:50
VVA 1	1/18/2019	18	9:22	N/A	N/A	N/A

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4. GPS OBSERVATION & RE-OBSERVATION SCHEDULE (CONTINUED)

Point ID	Observation Date	Julian Date	Time of Day	Re-observation Date	Re-observation Julian Date	Re-observation Time of Day
VVA 2	1/11/2019	11	10:31	1/14/2019	14	15:04
VVA 3	1/11/2019	11	11:54	1/16/2019	16	11:47
VVA 4	1/11/2019	11	11:12	1/16/2019	16	11:25
VVA 5	1/9/2019	9	11:32	N/A	N/A	N/A
VVA 6	1/9/2019	9	10:26	1/14/2019	14	16:25
VVA 7	1/14/2019	14	13:26	1/16/2019	16	14:24
VVA 8	1/14/2019	14	14:09	N/A	N/A	N/A
VVA 9	1/15/2019	15	12:54	N/A	N/A	N/A
VVA 10	1/15/2019	15	14:44	1/17/2019	17	10:41
VVA 11	1/15/2019	15	12:38	1/17/2019	17	11:10
VVA 12	1/10/2019	10	15:40	1/17/2019	17	12:25
VVA 13	1/11/2019	11	8:30	1/16/2019	16	8:45
VVA 14	1/10/2019	10	13:29	1/17/2019	17	10:17
VVA 15	1/15/2019	15	14:26	N/A	N/A	N/A
VVA 16	1/15/2019	15	14:57	N/A	N/A	N/A
VVA 17	1/15/2019	15	15:13	1/17/2019	17	10:53
VVA 18	1/15/2019	15	15:27	N/A	N/A	N/A
VVA 20	1/10/2019	10	10:09	1/17/2019	17	8:53
VVA 21	1/10/2019	10	9:13	N/A	N/A	N/A
VVA 22	12/19/2018	353	16:15	N/A	N/A	N/A
VVA 23	1/10/2019	10	8:30	1/17/2019	17	8:14
VVA 24	12/19/2018	353	15:25	1/17/2019	17	8:02
VVA 25	12/19/2018	353	14:35	N/A	N/A	N/A
VVA 26	12/19/2018	353	10:54	1/16/2019	16	15:40
VVA 27	12/13/2018	347	11:21	N/A	N/A	N/A
VVA 28	12/14/2018	348	10:22	12/18/2018	352	8:03
VVA 29	12/14/2018	348	7:24	12/18/2018	352	9:36
VVA 30	12/14/2018	348	8:33	N/A	N/A	N/A
VVA 31	1/11/2019	11	8:50	1/16/2019	16	9:10
VVA 32	1/8/2019	8	11:34	N/A	N/A	N/A
VVA 33	1/8/2019	8	9:58	1/16/2019	16	8:12
VVA 34	1/8/2019	8	12:21	N/A	N/A	N/A
VVA 35	1/14/2019	14	12:58	N/A	N/A	N/A
VVA 36	1/11/2019	11	9:50	1/16/2019	16	10:41
VVA 37	1/8/2019	8	15:16	1/16/2019	16	10:07

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4. GPS OBSERVATION & RE-OBSERVATION SCHEDULE (CONTINUED)

Point ID	Observation Date	Julian Date	Time of Day	Re-observation Date	Re-observation Julian Date	Re-observation Time of Day
VVA 38	1/11/2019	11	7:47	N/A	N/A	N/A
VVA 39	1/9/2019	9	8:35	N/A	N/A	N/A
VVA 40	12/12/2018	346	8:35	12/17/2018	351	13:04
VVA 41	12/12/2018	346	11:30	N/A	N/A	N/A
VVA 42	12/13/2018	347	9:33	12/17/2018	351	16:22
VVA 43	12/13/2018	347	16:07	N/A	N/A	N/A
VVA 44	7/18/2018	199	8:48	7/26/2018	207	12:02
VVA 45	7/26/2018	207	13:50	N/A	N/A	N/A
VVA 46	7/17/2018	198	10:39	7/26/2018	207	13:14
VVA 47	7/17/2018	198	10:02	7/19/2018	200	9:22
VVA 48	12/12/2018	346	15:57	12/17/2018	351	15:52
VVA 49	12/13/2018	347	14:36	N/A	N/A	N/A
VVA 50	12/13/2018	347	12:07	N/A	N/A	N/A
VVA 51	7/16/2018	197	15:40	7/26/2018	207	9:05
VVA 52	12/18/2018	352	11:24	N/A	N/A	N/A
VVA 53	12/13/2018	347	12:43	N/A	N/A	N/A
VVA 54	1/14/2019	14	12:13	1/16/2019	16	14:59
VVA 55	12/13/2018	347	10:36	12/18/2018	352	7:16
VVA 56	12/12/2018	346	13:59	12/17/2018	351	14:03
VVA 57	12/13/2018	347	8:39	N/A	N/A	N/A

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5. POINT COMPARISON REPORT

Florida State Plane Coordinate System, East Zone, NAD 83 (2011) / NAVD88 (U.S. Survey Feet)

Point ID	Check Point ID	Δ North	Δ East	Δ Vertical
NVA 1	CHK_NVA1	-0.002	0.040	-0.025
NVA 2	CHK_NVA2	-0.027	-0.065	0.090
NVA 3	CHK_NVA3	-0.039	0.024	-0.069
NVA 7	CHK_NVA7	-0.060	-0.025	0.037
NVA 10	CHK_NVA10	0.052	0.025	0.082
NVA 13	CHK_NVA13	0.015	-0.006	-0.017
NVA 14	CHK_NVA14	0.026	0.016	0.090
NVA 17	CHK_NVA17	0.029	0.016	-0.082
NVA 18	CHK_NVA18	0.047	0.005	-0.004
NVA 22	CHK_NVA22	-0.007	0.044	-0.126
NVA 25	CHK_NVA25	-0.042	-0.026	-0.014
NVA 26	CHK_NVA26	0.000	-0.037	0.020
NVA 27	CHK_NVA27	0.009	-0.039	0.000
NVA 28	CHK_NVA28	0.086	0.100	-0.108
NVA 29	CHK_NVA29	0.047	0.018	0.113
NVA 30	CHK_NVA30	-0.015	-0.025	-0.013
NVA 35	CHK_NVA35	0.052	0.009	0.019
NVA 37	CHK_NVA37	-0.013	0.014	0.053
NVA 38	CHK_NVA38	0.003	0.040	0.150
NVA 41	CHK_NVA41	-0.052	-0.035	-0.027
NVA 45	CHK_NVA45	-0.022	0.046	-0.050
NVA 47	CHK_NVA47	-0.041	0.054	0.123
NVA 48	CHK_NVA48	-0.008	0.047	-0.108
NVA 49	CHK_NVA49	-0.054	0.037	0.130
NVA 50	CHK_NVA50	-0.076	0.108	-0.096
NVA 52	CHK_NVA52	0.056	-0.053	0.138
NVA 53	CHK_NVA53	-0.024	0.100	0.070
NVA 54	CHK_NVA54	-0.029	-0.084	0.002
NVA 57	CHK_NVA57	0.034	0.053	-0.007
NVA 60	CHK_NVA60	-0.013	0.001	0.022
NVA 63	CHK_NVA63	0.006	-0.020	-0.060
NVA 67	CHK_NVA67	0.079	0.030	-0.087
NVA 68	CHK_NVA68	-0.007	-0.020	-0.059
NVA 71	CHK_NVA71	0.058	0.022	0.129
VVA 2	CHK_VVA2	0.001	-0.031	0.030

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5. POINT COMPARISON REPORT (CONTINUED)

Florida State Plane Coordinate System, East Zone, NAD 83 (2011) / NAVD88 (U.S. Survey Feet)

Point ID	Check Point ID	Δ North	Δ East	Δ Vertical
VVA 3	CHK_VVA3	0.074	0.005	0.040
VVA 4	CHK_VVA4	0.100	-0.046	-0.049
VVA 6	CHK_VVA6	-0.025	0.048	-0.069
VVA 7	CHK_VVA7	-0.009	-0.008	0.059
VVA 10	CHK_VVA10	-0.012	0.020	-0.157
VVA 11	CHK_VVA11	-0.073	-0.044	-0.015
VVA 12	CHK_VVA12	-0.092	0.029	-0.039
VVA 13	CHK_VVA13	0.029	-0.027	-0.104
VVA 14	CHK_VVA14	0.080	-0.028	-0.054
VVA 17	CHK_VVA17	-0.077	-0.046	-0.148
VVA 20	CHK_VVA20	0.064	-0.002	-0.046
VVA 23	CHK_VVA23	0.088	-0.004	0.038
VVA 24	CHK_VVA24	0.100	0.002	-0.084
VVA 26	CHK_VVA26	0.029	-0.049	-0.078
VVA 28	CHK_VVA28	-0.027	-0.022	0.045
VVA 29	CHK_VVA29	0.019	-0.024	-0.021
VVA 31	CHK_VVA31	0.043	-0.005	0.149
VVA 33	CHK_VVA33	0.038	-0.064	0.059
VVA 36	CHK_VVA36	0.000	0.038	0.049
VVA 37	CHK_VVA37	0.032	0.032	0.062
VVA 40	CHK_VVA40	0.022	-0.036	0.020
VVA 42	CHK_VVA42	0.024	0.038	-0.072
VVA 44	CHK_VVA44	0.029	-0.020	-0.062
VVA 46	CHK_VVA46	-0.017	-0.130	-0.119
VVA 47	CHK_VVA47	0.038	0.065	-0.020
VVA 48	CHK_VVA48	0.003	0.001	-0.031
VVA 51	CHK_VVA51	0.044	0.012	0.015
VVA 54	CHK_VVA54	0.036	-0.045	0.027
VVA 55	CHK_VVA55	-0.035	-0.065	-0.006
VVA 56	CHK_VVA56	-0.009	-0.042	0.069

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6. SURVEY NOTES

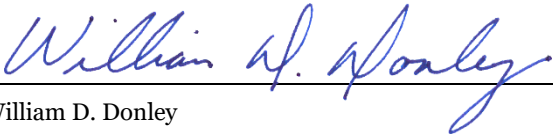
- 1) Coordinates shown hereon are based on both the Contiguous USA Albers Coordinate System, North American Datum of 1983 (2011 Adjustment) in meters and the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (2011 Adjustment) in U.S. Survey feet.
- 2) Elevations shown hereon are based on the North American Vertical Datum of 1988, in both meters and U.S. Survey feet.
- 3) The purpose of this survey was to establish independent check points across Southeast Florida to test the accuracy of the LiDAR data and derivative products.

7. GLOSSARY/LEGEND

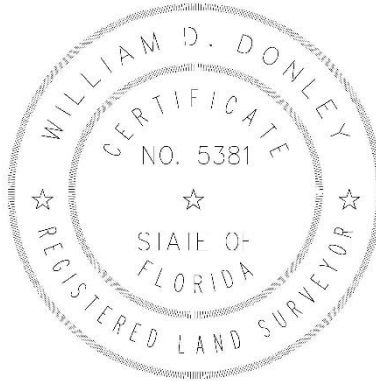
CHK	Check
ELEV	Elevation
FPRN	Florida Permanent Reference Network
ft	feet
GPS	Global Positioning System
ID	Identification
LiDAR	Light Detection and Ranging
LS	Land Surveyor
m	Meter
NAD	North American Datum
NAVD	North American Vertical Datum
NGS	National Geodetic Survey
NVA	Non-vegetated Vertical Accuracy
QA/QC	Quality Assurance/Quality Control
RTK	Real Time Kinematic
RTN	Real-Time Network
SPC	State Plane Coordinate
USGS	United States Geological Survey
VRS	Virtual Reference System
VVA	Vegetated Vertical Accuracy

8. SURVEYOR'S CERTIFICATION

I hereby certify this survey report meets the applicable "Standards of Practice" as set forth by the Florida Board of Professional Surveyors and Mappers in rule 5J17.050-.052, Florida Administrative Code.



William D. Donley
Florida Licensed Surveyor & Mapper No. LS 5381



03-27-2019

Date

This Survey is not valid without the signature and original raised seal of a Florida Licensed Surveyor and Mapper.

Certificate of Authorization No. LB8011