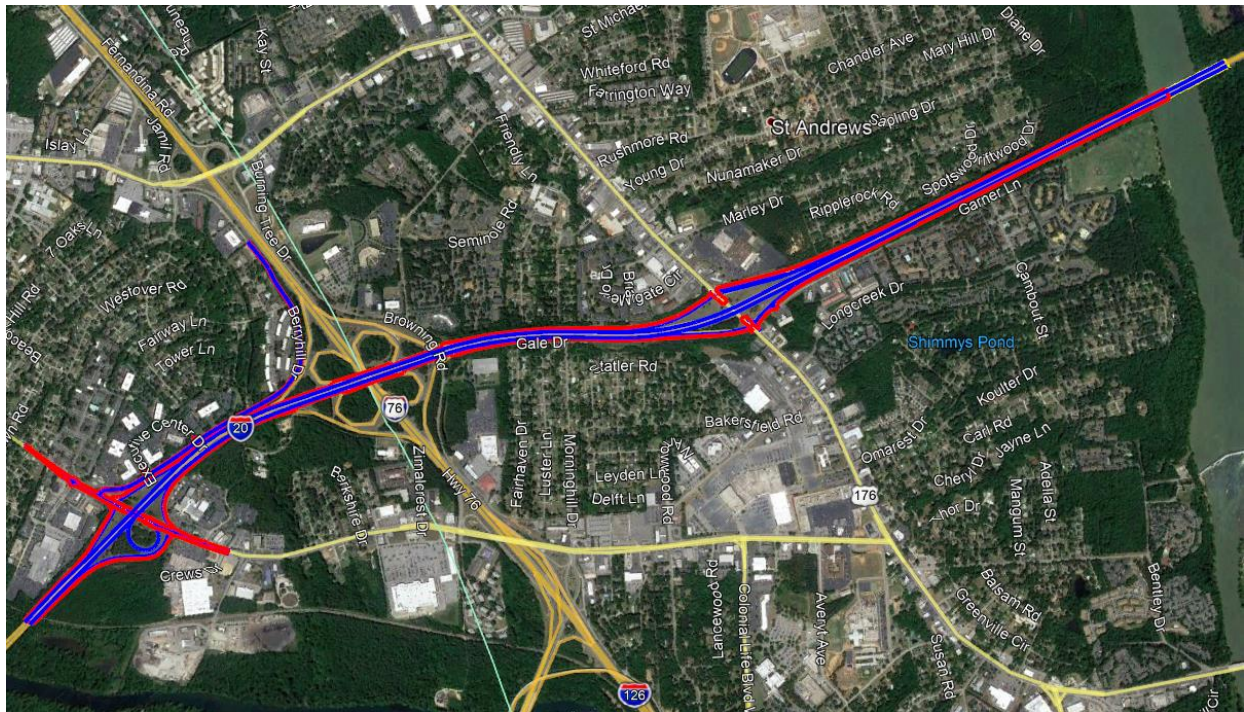




P027662 Carolina Crossroads
Richland and Lexington Counties

Mobile LiDAR Pavement DTM
Priority No. 1



SOUTH CAROLINA DEPARTMENT OF TRANSPORTATION
Carolina Crossroads - Richland/Lexington Counties (P027662)
Mobile LiDAR Pavement DTM Mapping Priority No. 1



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PROJECT REPORT

Carolina Crossroads Mobile LiDAR Pavement DTMs Priority No. 1

(I-20, Berryhill Drive, & Bush River Road)

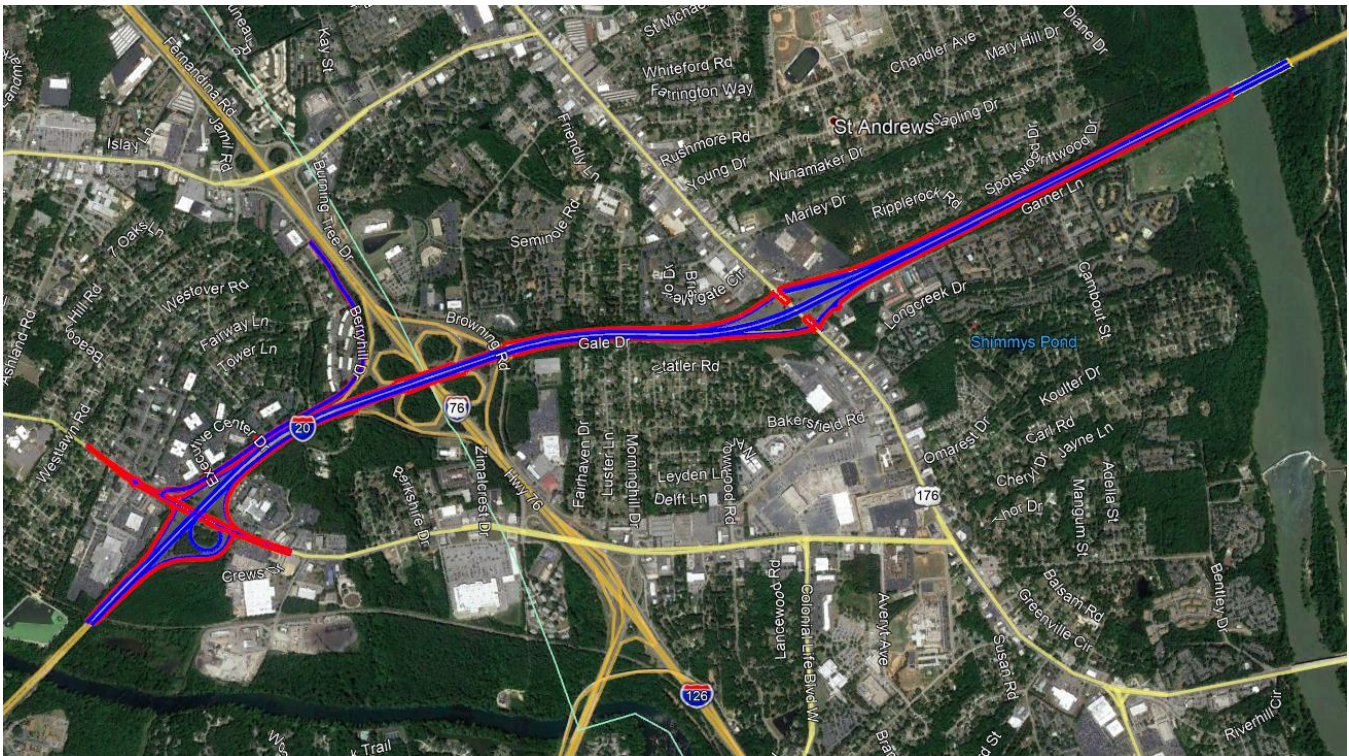
SCDOT Project #: P027662

May 14, 2020

Overview

ESP Associates, Inc. (ESP) met with SCDOT to scope additional areas requested as part of the Carolina Crossroads project on March 6, 2020. This section covers surveying pavement DTMs, using mobile LiDAR, for designated sections of I-20, Berryhill Drive, and Bush River Road. The project falls within both Lexington and Richland Counties, South Carolina.

The screen capture below shows the drive paths/project limits of the mobile LiDAR collection and mapping.



Establishment of Project Elevations (PLM, 2009, & 2018 Control)

ESP performed double-run, closed digital level loops, using a Trimble DiNi Series 0.3mm per KM, throughout the entire project; tying together most of the 2009 and 2018 control that could be recovered and were relevant to the project area. A total of twenty-four (24) 2018 control points were included in the level runs. ESP balanced the level runs to establish a best-fit scenario amongst all control points. ESP held elevations on eight (8) of the 2018 control points. Adjusted elevation deviations on the remaining control points ranged from 0.01' to 0.15', with most of the greater deviations being with the MSC control points.

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The file “P027662_CCR_Final_Control_Elevations_Leveled_vs_Published_Priority1.pdf” shows which control point elevations were held ($\Delta Z = 0.00$) and what the deviations are for those that were adjusted.

In order to ensure elevation consistencies between existing control and the new Project Localization Monuments (PLM), previously established by ESP, we ran closed level loops between the 2009 control, PSC, MSC, and PLM when practical.

Mobile LiDAR Pavement DTMs

The intent of this project is to achieve mobile LiDAR pavement DTMs within the National Standard Spatial Data Accuracy (NSSDA) vertical requirement of 0.05'. This accuracy is achieved by taking the computed Root Mean Square Error (RMSE) of selected checkpoints and multiplying that number by 1.96 to reflect an overall error within a 95% confidence level. The field and office methodologies used to achieve this accuracy are described below.

The mobile LiDAR collection was performed using a Trimble MX8 Mobile LiDAR and Imagery System between September 3, 2019 and April 17, 2020. All mobile LiDAR trajectories were post-processed from a single GNSS base set on control point 10130_PSC. All baselines processed from this location to the mobile LiDAR trajectories were less than 5 miles.

ESP established our mobile LiDAR control (74 panels and 81 validation points) along the shoulders of the roadways where feasible. Panels consist of 1' x 2' white reflective adhesive material and validation points are PK nails set flush with the paved surface. The approximate spacing between panels and validations points are 1500' and 500' respectively, where spacing between any two mobile LiDAR control points is intended to be no greater than 500'.

All mobile LiDAR control elevations were established via double-run, closed level loops in conjunction with the available 2009 control, PSC, MSC, and PLM and adjustment methods described above.

The mobile LiDAR control coordinates were established within the existing project calibration site (defined within the initial project deliverables using designated control and PLMs) performing redundant GNSS observations using the South Carolina Real-Time-Network (RTN) for horizontal accuracies of $\pm 0.07'$. The highest horizontal residual within the site calibration is 0.036', and all details are provided within the file “P027662_CCR_GNSS_SITE_CALIB.pdf”.

The final mobile LiDAR control (panels and validation points) can be found within the file “P027662_CCR_Mobile_LiDAR_Control_Priority1.pdf”.

Mobile LiDAR Point Cloud Registration and Quality Control

ESP performed both cloud to control and cloud to cloud registrations on this project to provide a congruent and high accuracy data set throughout. Initial/outside lane runs were registered to all mobile LiDAR panels and validation points, and subsequent/inside lane runs were registered to the adjoining/initial runs. A RMSE report “P027662_CCR_RMSE_200513_Priority1.pdf” was run to compare the final TIN/DTM surface to the surveyed panels and validation points.



The calculated RMSE for the TIN-to-control point comparison was 0.0078'. The NSSDA vertical accuracy for the final DTM-to-panel/validation point comparison is $1.960 * 0.0078' = \mathbf{0.0153'}$ (95% Conf.)

Microstation/DTM Mapping Information

ESP created a digital terrain model using the following parameters:

Curve Stroking Tolerance - 0.15'

Minimum Linear Distance - 30'

Side Length of Triangles - 50'

Mapping Scale - 1" = 50'

Pavement DTM Grid = 2.5'

The 2.5' grid begins approximately 6" offset from the base of the barrier walls (EP).

The pavement DTM extends from the edge of the point grid over to the base of the barrier walls (EP).

Files submitted in Microstation V8i SS4

Classification of Delivered Point Clouds

The registered point clouds were classified into the following groups/levels:

Level 2 – Ground = Road Surface

Level 3 – Low Vegetation = Barrier Walls

Level 4 – Medium Vegetation = Overhead Signs

Level 5 – High Vegetation = Bridges

Project Anomalies

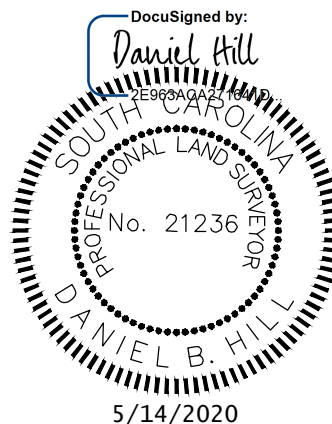
- ESP worked both daytime and late evening hours while performing this work. Daytime hours were restricted to between 9 AM and 3:30/4:00 PM.

Project Summary & Deliverables

ESP delivered all mobile LiDAR pavement DTMs and associated reports on May 14, 2020.

Please contact me if you have any questions regarding this project (803) 835-0875.

Daniel B. Hill, PLS – ESP Associates, Inc.



5/14/2020

GNSS Site Calibration Report

GPS Calibration Report

Project : CCR_SiteCalibration

User name	bmoravec	Date & Time	9:58:38 AM 12/12/2019
Coordinate System	US State Plane 1983	Zone	South Carolina 3900
Project Datum	NAD 1983 (Conus)		
Vertical Datum		Geoid Model	GEOID12B (Conus)
Coordinate Units	International feet		
Distance Units	International feet		
Height Units	International feet		

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Datum Transformation Parameters

Datum Transformation computation not requested

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Updated Default Projection (Transverse Mercator) Definition

Updated default projection not requested

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Horizontal Adjustment Parameters

Northing coordinate of rotation center	802259.320ift
Easting coordinate of rotation center	1964013.308ift
Rotation about the center point	0°00'00"
Translation north	-0.012ift
Translation east	0.033ift
Scale factor	0.99999946

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Vertical Adjustment Parameters

Vertical adjustment computation not requested

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Geoid Model Definition

GEOID12B (Conus)

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Residual Differences Between GPS And Known Coordinates

Summary

	Maximum error	Root Mean Square error	Point
--	---------------	------------------------	-------

Horizontal	0.036ft	0.005	36A_A
Vertical	?	?	?
Three-dimensional	0.036ft	0.005	36A_A

Point Residuals

GPS point		Calculated point		Control point	
Point	PLM01_A	Northing	820992.887ft	Point	PLM01
Latitude	34°05'22.93181"N	Easting	1943992.555ft	Northing	820992.910ft
Longitude	81°11'06.03752"W	Elevation	373.045ft	Easting	1943992.559ft
Height	272.290ft	Horizontal error	0.023ft	Elevation	373.080ft
		Vertical error	?	Type	Horizontal
		3D error	0.023ft	Point quality	Control quality
Point	PLM02_A	Northing	823980.029ft	Point	PLM02
Latitude	34°05'52.57432"N	Easting	1949196.763ft	Northing	823980.030ft
Longitude	81°10'04.20721"W	Elevation	329.501ft	Easting	1949196.768ft
Height	228.717ft	Horizontal error	0.005ft	Elevation	329.510ft
		Vertical error	?	Type	Horizontal
		3D error	0.005ft	Point quality	Control quality
Point	PLM03_A	Northing	808309.397ft	Point	PLM03
Latitude	34°03'17.56182"N	Easting	1951260.040ft	Northing	808309.400ft
Longitude	81°09'39.37818"W	Elevation	236.162ft	Easting	1951260.043ft
Height	135.082ft	Horizontal error	0.004ft	Elevation	236.200ft
		Vertical error	?	Type	Horizontal
		3D error	0.004ft	Point quality	Control quality
Point	PLM04_A	Northing	813317.445ft	Point	PLM04
Latitude	34°04'07.21495"N	Easting	1958503.061ft	Northing	813317.448ft
Longitude	81°08'13.35858"W	Elevation	297.485ft	Easting	1958503.064ft
Height	196.404ft	Horizontal error	0.004ft	Elevation	297.510ft
		Vertical error	?	Type	Horizontal
		3D error	0.004ft	Point quality	Control quality
Point	PLM05_A	Northing	793236.456ft	Point	PLM05
Latitude	34°00'48.43279"N	Easting	1951533.071ft	Northing	793236.460ft
Longitude	81°09'35.85519"W	Elevation	306.940ft	Easting	1951533.074ft
Height	205.574ft	Horizontal error	0.005ft	Elevation	306.940ft
		Vertical error	?	Type	Horizontal
		3D error	0.005ft	Point quality	Control quality
Point	PLM06_A	Northing	801164.548ft	Point	PLM06
Latitude	34°02'06.99908"N	Easting	1960501.273ft	Northing	801164.557ft
Longitude	81°07'49.41941"W	Elevation	255.731ft	Easting	1960501.280ft
Height	154.380ft	Horizontal error	0.012ft	Elevation	255.680ft
		Vertical error	?	Type	Horizontal
		3D error	0.012ft	Point quality	Control quality
Point	PLM07_A	Northing	804246.275ft	Point	PLM07
Latitude	34°02'37.59337"N	Easting	1969895.484ft	Northing	804246.283ft
Longitude	81°05'57.81004"W	Elevation	316.662ft	Easting	1969895.482ft
Height	215.236ft	Horizontal error	0.008ft	Elevation	316.640ft
		Vertical error	?	Type	Horizontal
		3D error	0.008ft	Point quality	Control quality
Point	PLM08_A	Northing	809611.052ft	Point	PLM08
Latitude	34°03'30.74683"N	Easting	1979062.145ft	Northing	809611.050ft
Longitude	81°04'08.90162"W	Elevation	259.075ft	Easting	1979062.152ft
Height	157.618ft	Horizontal error	0.007ft	Elevation	259.050ft
		Vertical error	?	Type	Horizontal

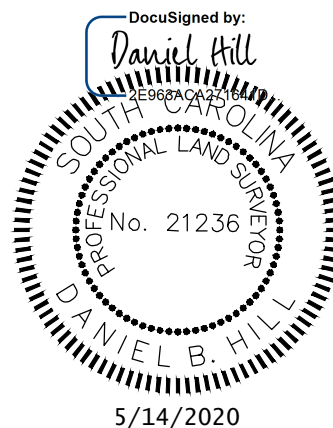
		3D error	0.007ift	Point quality	Control quality
Point	PLM09_A	Northing	790250.209ift	Point	PLM09
Latitude	34°00'18.94830"N	Easting	1955760.262ift	Northing	790250.213ift
Longitude	81°08'45.58015"W	Elevation	383.597ift	Easting	1955760.262ift
Height	282.116ift	Horizontal error	0.004ift	Elevation	383.590ift
		Vertical error	?	Type	Horizontal
		3D error	0.004ift	Point quality	Control quality
Point	PLM10_A	Northing	799606.278ift	Point	PLM10
Latitude	34°01'51.65624"N	Easting	1967034.372ift	Northing	799606.280ift
Longitude	81°06'31.75790"W	Elevation	231.125ift	Easting	1967034.373ift
Height	129.642ift	Horizontal error	0.002ift	Elevation	231.120ift
		Vertical error	?	Type	Horizontal
		3D error	0.002ift	Point quality	Control quality
Point	PLM11_A	Northing	799806.401ift	Point	PLM11
Latitude	34°01'53.69701"N	Easting	1973491.607ift	Northing	799806.407ift
Longitude	81°05'15.02330"W	Elevation	321.596ift	Easting	1973491.611ift
Height	220.020ift	Horizontal error	0.007ift	Elevation	321.550ift
		Vertical error	?	Type	Horizontal
		3D error	0.007ift	Point quality	Control quality
Point	PLM12_A	Northing	805461.829ift	Point	PLM12
Latitude	34°02'49.71730"N	Easting	1982905.958ift	Northing	805461.831ift
Longitude	81°03'23.18085"W	Elevation	343.414ift	Easting	1982905.968ift
Height	241.818ift	Horizontal error	0.010ift	Elevation	343.380ift
		Vertical error	?	Type	Horizontal
		3D error	0.010ift	Point quality	Control quality
Point	PLM13_A	Northing	786775.217ift	Point	PLM13
Latitude	33°59'44.67536"N	Easting	1964426.115ift	Northing	786775.210ift
Longitude	81°07'02.58065"W	Elevation	317.685ift	Easting	1964426.115ift
Height	215.997ift	Horizontal error	0.007ift	Elevation	317.690ift
		Vertical error	?	Type	Horizontal
		3D error	0.007ift	Point quality	Control quality
Point	PLM14_A	Northing	788060.199ift	Point	PLM14
Latitude	33°59'57.45043"N	Easting	1970363.004ift	Northing	788060.190ift
Longitude	81°05'52.07111"W	Elevation	261.767ift	Easting	1970363.005ift
Height	160.000ift	Horizontal error	0.009ift	Elevation	261.770ift
		Vertical error	?	Type	Horizontal
		3D error	0.009ift	Point quality	Control quality
Point	PLM15_A	Northing	790538.848ift	Point	PLM15
Latitude	34°00'22.00920"N	Easting	1974311.540ift	Northing	790538.848ift
Longitude	81°05'05.18889"W	Elevation	271.603ift	Easting	1974311.542ift
Height	169.820ift	Horizontal error	0.002ift	Elevation	271.610ift
		Vertical error	?	Type	Horizontal
		3D error	0.002ift	Point quality	Control quality
Point	PLM16_A	Northing	794186.468ift	Point	PLM16
Latitude	34°00'58.10926"N	Easting	1975558.683ift	Northing	794186.470ift
Longitude	81°04'50.40621"W	Elevation	232.349ift	Easting	1975558.698ift
Height	130.617ift	Horizontal error	0.015ift	Elevation	232.370ift
		Vertical error	?	Type	Horizontal
		3D error	0.015ift	Point quality	Control quality
Point	26W20_A	Northing	823631.444ift	Point	26W20
Latitude	34°05'49.10387"N	Easting	1947871.496ift	Northing	823631.411ift
Longitude	81°10'19.96178"W	Elevation	322.051ift	Easting	1947871.509ift
Height	221.280ift	Horizontal error	0.036ift	Elevation	322.050ift

		Vertical error	?	Type	Horizontal
		3D error	0.036ift	Point quality	Control quality
Point	26W60 A	Northing	812731.480ift	Point	26W60
Latitude	34°04'01.39867"N	Easting	1957099.705ift	Northing	812731.460ift
Longitude	81°08'30.03354"W	Elevation	258.945ift	Easting	1957099.682ift
Height	157.871ift	Horizontal error	0.031ift	Elevation	258.970ift
		Vertical error	?	Type	Horizontal
		3D error	0.031ift	Point quality	Control quality
Point	36A A	Northing	804399.417ift	Point	36A
Latitude	34°02'39.04308"N	Easting	1963662.426ift	Northing	804399.429ift
Longitude	81°07'11.89564"W	Elevation	232.630ift	Easting	1963662.392ift
Height	131.299ift	Horizontal error	0.036ift	Elevation	232.630ift
		Vertical error	?	Type	Horizontal
		3D error	0.036ift	Point quality	Control quality
Point	26W113 A	Northing	799083.644ift	Point	26W113
Latitude	34°01'46.50387"N	Easting	1968873.393ift	Northing	799083.652ift
Longitude	81°06'09.89713"W	Elevation	210.875ift	Easting	1968873.389ift
Height	109.354ift	Horizontal error	0.009ift	Elevation	210.870ift
		Vertical error	?	Type	Horizontal
		3D error	0.009ift	Point quality	Control quality
Point	126E25 A	Northing	793129.566ift	Point	126E25
Latitude	34°00'47.65421"N	Easting	1975832.837ift	Northing	793129.580ift
Longitude	81°04'47.13908"W	Elevation	191.532ift	Easting	1975832.822ift
Height	89.774ift	Horizontal error	0.020ift	Elevation	191.570ift
		Vertical error	?	Type	Horizontal
		3D error	0.020ift	Point quality	Control quality
Point	26W150 A	Northing	787185.688ift	Point	26W150
Latitude	33°59'48.76618"N	Easting	1967157.710ift	Northing	787185.659ift
Longitude	81°06'30.13729"W	Elevation	283.154ift	Easting	1967157.710ift
Height	181.427ift	Horizontal error	0.029ift	Elevation	283.170ift
		Vertical error	?	Type	Horizontal
		3D error	0.029ift	Point quality	Control quality

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Final Project Control Elevation Comparisons Priority No. 1

ESP Final Leveled Elevations		Delta Z		Published Information - International Feet				
Name	Elevation	Pub - Leveled		ID	Northing	Easting	Elevation	Code
10121PSC	190.89	0.00		10121	806868.488	1979880.250	190.89	10121_PSC-REBAR
10122PSC	177.55	0.01		10122	807290.437	1980655.838	177.56	10122_PSC-REBAR
10123PSC	332.75	-0.03		10123	802539.030	1971685.230	332.72	10123_PSC-MONUMENT-HOLT
10124PSC	314.69	-0.02		10124	803006.284	1971155.972	314.67	10124_PSC-REBAR
10125PSC	246.21	0.09		10125	799794.940	1963388.880	246.30	10125_PSC-MONUMENTLEX113
10126PSC	210.45	0.00		10126	799360.652	1964131.513	210.45	10126_PSC-REBAR
10228MSC	216.74	0.03		10228	803389.558	1965061.526	216.77	10228_MSC-REBAR
10241MSC	217.20	0.15		10241	798472.858	1961821.307	217.35	10241_MSC-REBAR
10242MSC	217.99	0.00		10242	799316.565	1962626.832	217.99	10242_MSC-REBAR
10243MSC	233.22	0.08		10243	800632.371	1963945.200	233.30	10243_MSC-REBAR
10244MSC	213.05	0.00		10244	801196.756	1964842.523	213.05	10244_MSC-REBAR
10245MSC	236.15	0.11		10245	801578.446	1965916.647	236.26	10245_MSC-REBAR
10246MSC	268.75	0.08		10246	801901.915	1966863.305	268.83	10246_MSC-REBAR
10247MSC	286.19	-0.04		10247	802093.004	1967280.146	286.15	10247_MSC-REBAR
10248MSC	289.34	0.00		10248	802305.058	1968270.196	289.34	10248_MSC-REBAR
10249MSC	316.49	0.01		10249	802393.287	1969697.041	316.50	10249_MSC-REBAR
10250MSC	307.42	0.00		10250	802474.660	1970747.476	307.42	10250_MSC-REBAR
10251MSC	304.89	-0.02		10251	803159.004	1972471.998	304.87	10251_MSC-REBAR
10252MSC	259.02	0.00		10252	803697.396	1973518.097	259.02	10252_MSC-REBAR
10253MSC	216.83	0.02		10253	804152.892	1974457.356	216.85	10253_MSC-REBAR
10254MSC	179.33	-0.01		10254	804816.312	1975802.008	179.32	10254_MSC-REBAR
10255MSC	178.74	0.06		10255	805489.023	1977142.649	178.80	10255_MSC-REBAR
10256MSC	184.64	0.14		10256	806138.060	1978430.930	184.78	10256_MSC-REBAR
10257MSC	198.10	0.00		10257	806513.538	1979185.888	198.10	10257_MSC-REBAR
PLM-06	255.68	0.00		6	801164.557	1960501.280	255.68	PLM06
PLM-10	231.12	0.00		10	799606.280	1967034.373	231.12	PLM10



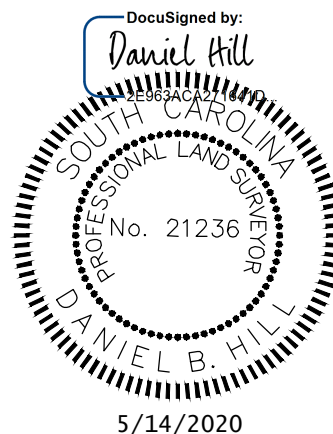
Mobile LiDAR Panel and Validation Point Control Priority No. 1

P027662 - Carolina Crossroads Mobile LiDAR Panels and Validation Control Priority 1							
NAD 83 SCSPC / Site Calibration (See "P027662_CCR_GNSS_SITE_CALIB.pdf")							
NAVD 88 Elevations / International Feet							
ID	International Feet			Panel & Validation Pt #	Metric		
	North	East	Elev	Code	Y	X	Z
1215	798263.452	1961762.135	212.79	P215	243310.700	597945.099	64.858
1216	798313.634	1961677.249	212.13	P216	243325.996	597919.225	64.657
1217	798942.633	1962439.016	219.80	P217	243517.715	598151.412	66.995
1218	799194.314	1962539.049	218.50	P218	243594.427	598181.902	66.599
1219	799865.740	1963358.777	228.14	P219	243799.078	598431.755	69.537
1220	799758.702	1963095.347	221.77	P220	243766.452	598351.462	67.595
1221	800278.178	1963762.892	234.70	P221	243924.789	598554.929	71.537
1222	800505.654	1963832.017	236.52	P222	243994.123	598575.999	72.091
1223	800898.540	1964557.713	213.61	P223	244113.875	598797.191	65.108
1224	801285.670	1965090.503	214.55	P224	244231.872	598959.585	65.395
1225	801310.920	1965491.644	222.49	P225	244239.568	599081.853	67.815
1226	801595.479	1965991.717	238.47	P226	244326.302	599234.275	72.686
1227	801537.566	1966135.493	241.69	P227	244308.650	599278.098	73.667
1228	801882.707	1966831.310	267.54	P228	244413.849	599490.183	81.546
1229	801826.670	1966991.389	273.21	P229	244396.769	599538.975	83.274
1230	802077.207	1967401.751	288.54	P230	244473.133	599664.054	87.947
1231	802047.651	1967635.747	290.03	P231	244464.124	599735.376	88.401
1232	802126.040	1967541.782	291.87	P232	244488.017	599706.735	88.962
1233	802263.145	1969002.978	298.84	P233	244529.807	600152.108	91.086
1234	802366.856	1968984.586	301.00	P234	244561.418	600146.502	91.745
1235	802253.061	1970226.423	320.85	P235	244526.733	600525.014	97.795
1236	802364.641	1970230.809	316.71	P236	244560.743	600526.351	96.533
1237	802321.226	1970727.098	309.20	P237	244547.510	600677.619	94.244
1238	802652.503	1971486.189	304.15	P238	244648.483	600908.990	92.705
1239	802652.890	1971723.881	310.60	P239	244648.601	600981.439	94.671
1240	803244.458	1972651.389	298.64	P240	244828.911	601264.143	91.025
1241	803098.183	1972615.881	302.27	P241	244784.326	601253.321	92.132
1242	803857.802	1973881.116	243.52	P242	245015.858	601638.964	74.225
1243	803763.283	1973938.391	243.45	P243	244987.049	601656.422	74.204
1244	804493.254	1975171.821	189.75	P244	245209.544	602032.371	57.836
1245	804419.600	1975247.732	188.86	P245	245187.094	602055.509	57.565
1246	804976.140	1976139.627	176.84	P246	245356.727	602327.358	53.901
1247	804891.821	1976188.590	176.65	P247	245331.027	602342.282	53.843
1248	805458.151	1977098.519	179.31	P248	245503.644	602619.629	54.654
1249	805378.164	1977157.495	179.36	P249	245479.264	602637.604	54.669
1250	806133.138	1978442.415	184.65	P250	245709.380	603029.248	56.281
1251	806058.277	1978504.600	184.74	P251	245686.563	603048.202	56.309
1264	799974.472	1962822.211	242.05	P264	243832.219	598268.210	73.777
1265	800045.530	1962867.795	242.47	P265	243853.878	598282.104	73.905
1266	800016.405	1963019.988	244.19	P266	243845.000	598328.492	74.429

1267	799944.243	1962987.926	246.05	P267	243823.005	598318.720	74.996
1268	799868.006	1962935.501	243.81	P268	243799.768	598302.741	74.313
1269	799660.310	1963461.040	242.88	P269	243736.462	598462.925	74.030
1270	799549.158	1963720.537	234.46	P270	243702.583	598542.020	71.463
1271	799511.489	1963705.811	234.81	P271	243691.102	598537.531	71.570
1272	799505.896	1963828.062	228.45	P272	243689.397	598574.793	69.632
1273	799578.471	1963843.938	227.40	P273	243711.518	598579.632	69.312
1274	799201.822	1963103.838	221.96	P274	243596.715	598354.050	67.653
1275	799385.280	1964223.653	207.11	P275	243652.633	598695.369	63.127
1285	802915.288	1971261.620	317.34	P285	244728.580	600840.542	96.725
1286	802940.024	1971357.384	319.47	P286	244736.119	600869.731	97.374
1287	802860.940	1971301.830	319.40	P287	244712.015	600852.798	97.353
1288	802894.111	1971383.630	321.05	P288	244722.125	600877.730	97.856
1289	802535.160	1971793.453	332.71	P289	244612.717	601002.644	101.410
1290	802489.850	1971755.529	332.84	P290	244598.906	600991.085	101.450
1291	802490.482	1971875.870	333.79	P291	244599.099	601027.765	101.739
1292	802463.476	1971907.046	334.59	P292	244590.867	601037.268	101.983
1293	802306.597	1971951.056	332.58	P293	244543.051	601050.682	101.370
1294	802363.900	1971991.533	334.36	P294	244560.517	601063.019	101.913
1295	802698.422	1972121.845	318.89	P295	244662.479	601102.738	97.198
1296	802714.975	1972265.242	313.84	P296	244667.524	601146.446	95.658
1297	803168.690	1972303.828	305.42	P297	244805.817	601158.207	93.092
1322	799246.153	1964562.577	195.56	P322	243610.227	598798.673	59.607
1323	799303.656	1964583.915	193.84	P323	243627.754	598805.177	59.082
1324	800099.852	1962756.555	238.80	P324	243870.435	598248.198	72.786
1325	800788.580	1961701.489	259.00	P325	244080.359	597926.614	78.943
1326	800360.404	1963406.057	243.64	P326	243949.851	598446.166	74.261
1327	800499.454	1963331.796	245.38	P327	243992.234	598423.531	74.792
1328	800835.707	1964097.963	226.79	P328	244094.723	598657.059	69.126
1329	800909.778	1964048.371	229.10	P329	244117.300	598641.943	69.830
1330	801319.923	1964961.591	193.42	P330	244242.313	598920.293	58.954
1331	801996.146	1965561.112	234.95	P331	244448.425	599103.027	71.613
1332	802850.759	1965333.891	219.31	P332	244708.911	599033.770	66.846
1333	803647.296	1964781.299	206.46	P333	244951.696	598865.340	62.929
2171	798600.138	1962098.199	221.01	V171	243413.322	598047.531	67.364
2172	798618.795	1961965.481	219.89	V172	243419.009	598007.079	67.022
2173	799175.148	1962659.049	218.16	V173	243588.585	598218.478	66.495
2174	798922.746	1962255.974	220.26	V174	243511.653	598095.621	67.135
2175	799444.336	1962924.250	217.28	V175	243670.634	598299.311	66.227
2176	799477.956	1962817.913	217.15	V176	243680.881	598266.900	66.187
2177	799672.938	1963148.256	221.18	V177	243740.312	598367.588	67.416
2178	799913.283	1963245.718	227.39	V178	243813.569	598397.295	69.308
2179	800049.770	1963536.346	233.54	V179	243855.170	598485.878	71.183
2180	800228.585	1963555.736	235.65	V180	243909.673	598491.788	71.826
2181	800486.939	1964010.042	229.60	V181	243988.419	598630.261	69.982
2182	800826.405	1964215.635	226.75	V182	244091.888	598692.926	69.113
2183	800715.099	1964291.967	221.39	V183	244057.962	598716.192	67.480

2184	801074.080	1964614.366	215.62	V184	244167.380	598814.459	65.721
2185	801142.544	1965029.050	209.45	V185	244188.247	598940.854	63.840
2186	801387.681	1965393.194	221.19	V186	244262.965	599051.846	67.419
2187	801422.680	1965797.294	231.62	V187	244273.633	599175.015	70.598
2188	801517.158	1965769.725	231.78	V188	244302.430	599166.612	70.647
2189	801629.424	1966428.003	249.92	V189	244336.648	599367.255	76.176
2190	801711.596	1966292.212	246.80	V190	244361.694	599325.866	75.225
2191	801701.200	1966657.977	258.35	V191	244358.526	599437.351	78.745
2192	801803.170	1966571.971	256.86	V192	244389.606	599411.137	78.291
2193	801991.112	1967452.408	287.72	V193	244446.891	599679.494	87.697
2194	801984.420	1967129.318	279.92	V194	244444.851	599581.016	85.320
2195	802137.099	1968037.929	289.12	V195	244491.388	599857.961	88.124
2196	802245.855	1968002.579	292.51	V196	244524.537	599847.186	89.157
2197	802225.494	1968506.941	286.69	V197	244518.331	600000.916	87.383
2198	802324.980	1968476.767	289.47	V198	244548.654	599991.719	88.230
2199	802264.192	1969409.548	312.28	V199	244530.126	600276.030	95.183
2200	802373.666	1969399.918	311.74	V200	244563.493	600273.095	95.018
2201	802254.263	1969804.415	319.39	V201	244527.099	600396.386	97.350
2202	802380.585	1969816.398	318.85	V202	244565.602	600400.038	97.185
2203	802419.686	1970709.349	305.65	V203	244577.520	600672.210	93.162
2204	802423.866	1971140.454	302.96	V204	244578.794	600803.610	92.342
2205	802515.493	1971103.862	299.35	V205	244606.722	600792.457	91.242
2206	802592.145	1971593.019	308.77	V206	244630.086	600941.552	94.113
2207	802723.619	1971648.874	307.58	V207	244670.159	600958.577	93.750
2208	802870.966	1972161.186	311.97	V208	244715.070	601114.729	95.088
2209	802944.548	1972086.821	312.22	V209	244737.498	601092.063	95.165
2210	803094.148	1972384.527	307.69	V210	244783.096	601182.804	93.784
2211	803295.783	1973053.827	283.07	V211	244844.555	601386.806	86.280
2212	803441.497	1972963.840	283.11	V212	244888.968	601359.378	86.292
2213	803524.483	1973487.734	263.64	V213	244914.262	601519.061	80.357
2214	803649.267	1973427.132	263.30	V214	244952.297	601500.590	80.254
2215	803984.625	1974376.526	223.67	V215	245054.514	601789.965	68.175
2216	804063.814	1974293.478	224.99	V216	245078.651	601764.652	68.577
2217	804194.497	1974799.266	204.65	V217	245118.483	601918.816	62.377
2218	804279.751	1974724.679	205.69	V218	245144.468	601896.082	62.694
2219	804637.838	1975682.882	182.33	V219	245253.613	602188.142	55.574
2220	804718.771	1975625.571	182.64	V220	245278.281	602170.674	55.669
2221	805125.540	1976656.216	176.99	V221	245402.265	602484.815	53.947
2222	805198.719	1976582.899	177.18	V222	245424.570	602462.468	54.004
2285	802329.688	1971129.888	311.81	V285	244550.089	600800.390	95.040
2286	802365.127	1971545.760	327.42	V286	244560.891	600927.148	99.798
2287	802378.753	1971852.283	332.79	V287	244565.044	601020.576	101.434
2288	802899.964	1972349.960	308.36	V288	244723.909	601172.268	93.988
2289	803045.006	1971844.376	318.84	V289	244768.118	601018.166	97.182
2290	802628.683	1970964.800	308.89	V290	244641.223	600750.071	94.150
2291	802465.354	1970585.743	309.31	V291	244591.440	600634.534	94.278
2292	800267.766	1963398.465	239.58	V292	243921.615	598443.852	73.024

2293	799525.983	1962723.993	225.70	V293	243695.520	598238.273	68.793
2294	799121.808	1962756.221	217.74	V294	243572.327	598248.096	66.367
2295	799233.892	1963472.755	229.50	V295	243606.490	598466.496	69.952
2296	799894.519	1963641.339	233.36	V296	243807.849	598517.880	71.128
2297	799300.676	1963369.251	223.87	V297	243626.846	598434.948	68.236
2339	799316.941	1964332.810	202.89	V339	243631.804	598728.640	61.841
2340	799370.606	1964364.435	201.24	V340	243648.161	598738.280	61.338
2341	799445.275	1963974.521	220.23	V341	243670.920	598619.434	67.126
2342	799499.905	1964001.960	218.66	V342	243687.571	598627.797	66.648
2343	799729.962	1963491.574	243.61	V343	243757.692	598472.232	74.252
2344	800238.036	1962478.161	233.43	V344	243912.553	598163.343	71.149
2345	800198.061	1962425.191	235.36	V345	243900.369	598147.198	71.738
2346	800486.320	1962100.420	250.44	V346	243988.230	598048.208	76.334
2347	800752.925	1961748.364	259.33	V347	244069.492	597940.901	79.044
2348	800173.559	1963119.903	243.88	V348	243892.901	598358.946	74.335
2349	800558.461	1963750.703	232.66	V349	244010.219	598551.214	70.915
2350	801086.166	1964524.712	206.61	V350	244171.063	598787.132	62.975
2351	801581.808	1965349.182	210.13	V351	244322.135	599038.431	64.048
2352	802469.633	1965520.833	232.49	V352	244592.744	599090.750	70.863
2353	803251.553	1965093.573	212.94	V353	244831.073	598960.521	64.904
2354	803601.961	1964818.873	206.76	V354	244937.878	598876.792	63.020



5/14/2020

Mobile LiDAR Control to DTM Surface RMSE Report Priority No. 1

Compare COGO Points to TIN Surface

JOB File:

C:\dgn\CCR\Working\Microstation\P027662_CCR_Supp_Area1_3_I20_BerryHill_Bush_HN42.001.000\job001.gpk

TIN File:

C:\dgn\CCR\Working\Microstation\P027662_CCR_Supp_Area1_3_I20_BerryHill_Bush_HN42.001.000\P027662_tin.tin

Point	Feature	COGO Elevation	TIN Elevation	Elev Diff	Location
1217	NOFEAT	219.8000	219.7892	0.0108	ABOVE
1218	NOFEAT	218.5000	218.4945	0.0055	ABOVE
1219	NOFEAT	228.1400	228.1263	0.0137	ABOVE
1220	NOFEAT	221.7700	221.7614	0.0086	ABOVE
1221	NOFEAT	234.7000	234.6940	0.0060	ABOVE
1222	NOFEAT	236.5200	236.5034	0.0166	ABOVE
1223	NOFEAT	213.6100	213.6023	0.0077	ABOVE
1224	NOFEAT	214.5500	214.5434	0.0066	ABOVE
1225	NOFEAT	222.4900	222.4782	0.0118	ABOVE
1226	NOFEAT	238.4700	238.4435	0.0265	ABOVE*
1227	NOFEAT	241.6900	241.6896	0.0004	ABOVE
1228	NOFEAT	267.5400	267.5254	0.0146	ABOVE
1229	NOFEAT	273.2100	273.2061	0.0039	ABOVE
1230	NOFEAT	288.5400	288.5234	0.0166	ABOVE
1231	NOFEAT	290.0300	290.0283	0.0017	ABOVE
1232	NOFEAT	291.8700	291.8614	0.0086	ABOVE
1233	NOFEAT	298.8400	298.8327	0.0073	ABOVE
1234	NOFEAT	301.0000	300.9954	0.0046	ABOVE
1235	NOFEAT	320.8500	320.8439	0.0061	ABOVE
1236	NOFEAT	316.7100	316.7089	0.0011	ABOVE
1237	NOFEAT	309.2000	309.2048	-0.0048	BELOW
1238	NOFEAT	304.1500	304.1313	0.0187	ABOVE
1239	NOFEAT	310.6000	310.5937	0.0063	ABOVE
1240	NOFEAT	298.6400	298.6352	0.0048	ABOVE
1241	NOFEAT	302.2700	302.2654	0.0046	ABOVE
1242	NOFEAT	243.5200	243.5112	0.0088	ABOVE
1243	NOFEAT	243.4500	243.4407	0.0093	ABOVE
1244	NOFEAT	189.7500	189.7440	0.0060	ABOVE
1245	NOFEAT	188.8600	188.8606	-0.0006	BELOW
1246	NOFEAT	176.8400	176.8332	0.0068	ABOVE
1247	NOFEAT	176.6500	176.6520	-0.0020	BELOW
1248	NOFEAT	179.3100	179.3050	0.0050	ABOVE
1249	NOFEAT	179.3600	179.3555	0.0045	ABOVE
1266	NOFEAT	244.1900	244.1941	-0.0041	BELOW
1267	NOFEAT	246.0500	246.0467	0.0033	ABOVE
1268	NOFEAT	243.8100	243.8137	-0.0037	BELOW
1269	NOFEAT	242.8800	242.8761	0.0039	ABOVE
1270	NOFEAT	234.4600	234.4578	0.0022	ABOVE
1271	NOFEAT	234.8100	234.8033	0.0067	ABOVE
1272	NOFEAT	228.4500	228.4450	0.0050	ABOVE
1273	NOFEAT	227.4000	227.4058	-0.0058	BELOW

1274	NOFEAT	221.9600	221.9534	0.0066	ABOVE
1275	NOFEAT	207.1100	207.1062	0.0038	ABOVE
1287	NOFEAT	319.4000	319.3857	0.0143	ABOVE
1295	NOFEAT	318.8900	318.8849	0.0051	ABOVE
1297	NOFEAT	305.4200	305.4206	-0.0006	BELOW
1324	NOFEAT	238.8000	238.7942	0.0058	ABOVE
1326	NOFEAT	243.6400	243.6264	0.0136	ABOVE
1328	NOFEAT	226.7900	226.7897	0.0003	ABOVE
1330	NOFEAT	193.4200	193.4089	0.0111	ABOVE
1331	NOFEAT	234.9500	234.9499	0.0001	ABOVE
1332	NOFEAT	219.3100	219.2995	0.0105	ABOVE
2171	NOFEAT	221.0100	221.0084	0.0016	ABOVE
2172	NOFEAT	219.8900	219.8897	0.0003	ABOVE
2173	NOFEAT	218.1600	218.1324	0.0276	ABOVE*
2174	NOFEAT	220.2600	220.2510	0.0090	ABOVE
2175	NOFEAT	217.2800	217.2459	0.0341	ABOVE*
2176	NOFEAT	217.1500	217.1465	0.0035	ABOVE
2177	NOFEAT	221.1800	221.1798	0.0002	ABOVE
2178	NOFEAT	227.3900	227.3871	0.0029	ABOVE
2179	NOFEAT	233.5400	233.5397	0.0003	ABOVE
2180	NOFEAT	235.6500	235.6488	0.0012	ABOVE
2181	NOFEAT	229.6000	229.5984	0.0016	ABOVE
2182	NOFEAT	226.7500	226.7482	0.0018	ABOVE
2183	NOFEAT	221.3900	221.3994	-0.0094	BELOW
2184	NOFEAT	215.6200	215.6209	-0.0009	BELOW
2185	NOFEAT	209.4500	209.4498	0.0002	ABOVE
2186	NOFEAT	221.1900	221.1844	0.0056	ABOVE
2187	NOFEAT	231.6200	231.6144	0.0056	ABOVE
2188	NOFEAT	231.7800	231.7820	-0.0020	BELOW
2189	NOFEAT	249.9200	249.9188	0.0012	ABOVE
2190	NOFEAT	246.8000	246.7982	0.0018	ABOVE
2191	NOFEAT	258.3500	258.3552	-0.0052	BELOW
2192	NOFEAT	256.8600	256.8599	0.0001	ABOVE
2193	NOFEAT	287.7200	287.7169	0.0031	ABOVE
2194	NOFEAT	279.9200	279.9216	-0.0016	BELOW
2195	NOFEAT	289.1200	289.1176	0.0024	ABOVE
2196	NOFEAT	292.5100	292.5062	0.0038	ABOVE
2197	NOFEAT	286.6900	286.6759	0.0141	ABOVE
2198	NOFEAT	289.4700	289.4662	0.0038	ABOVE
2199	NOFEAT	312.2800	312.2802	-0.0002	BELOW
2200	NOFEAT	311.7400	311.7348	0.0052	ABOVE
2201	NOFEAT	319.3900	319.3886	0.0014	ABOVE
2202	NOFEAT	318.8500	318.8503	-0.0003	BELOW
2203	NOFEAT	305.6500	305.6492	0.0008	ABOVE
2204	NOFEAT	302.9600	302.9662	-0.0062	BELOW
2205	NOFEAT	299.3500	299.3346	0.0154	ABOVE
2206	NOFEAT	308.7700	308.7818	-0.0118	BELOW
2207	NOFEAT	307.5800	307.5754	0.0046	ABOVE
2208	NOFEAT	311.9700	311.9569	0.0131	ABOVE
2209	NOFEAT	312.2200	312.2202	-0.0002	BELOW
2210	NOFEAT	307.6900	307.6887	0.0013	ABOVE
2211	NOFEAT	283.0700	283.0623	0.0077	ABOVE
2212	NOFEAT	283.1100	283.1077	0.0023	ABOVE
2213	NOFEAT	263.6400	263.6234	0.0166	ABOVE

2214	NOFEAT	263.3000	263.2920	0.0080	ABOVE
2215	NOFEAT	223.6700	223.6642	0.0058	ABOVE
2216	NOFEAT	224.9900	224.9928	-0.0028	BELOW
2217	NOFEAT	204.6500	204.6460	0.0040	ABOVE
2218	NOFEAT	205.6900	205.6868	0.0032	ABOVE
2219	NOFEAT	182.3300	182.3274	0.0026	ABOVE
2220	NOFEAT	182.6400	182.6374	0.0026	ABOVE
2221	NOFEAT	176.9900	176.9940	-0.0040	BELOW
2222	NOFEAT	177.1800	177.1730	0.0070	ABOVE
2285	NOFEAT	311.8100	311.8101	-0.0001	BELOW
2286	NOFEAT	327.4200	327.4282	-0.0082	BELOW
2288	NOFEAT	308.3600	308.3586	0.0014	ABOVE
2289	NOFEAT	318.8400	318.8388	0.0012	ABOVE
2290	NOFEAT	308.8900	308.8934	-0.0034	BELOW
2291	NOFEAT	309.3100	309.3107	-0.0007	BELOW
2292	NOFEAT	239.5800	239.5801	-0.0001	BELOW
2293	NOFEAT	225.7000	225.6990	0.0010	ABOVE
2294	NOFEAT	217.7400	217.7402	-0.0002	BELOW
2295	NOFEAT	229.5000	229.5016	-0.0016	BELOW
2296	NOFEAT	233.3600	233.3597	0.0003	ABOVE
2297	NOFEAT	223.8700	223.8696	0.0004	ABOVE
2339	NOFEAT	202.8900	202.8917	-0.0017	BELOW
2340	NOFEAT	201.2400	201.2400	0.0000	EQUAL
2341	NOFEAT	220.2300	220.2321	-0.0021	BELOW
2342	NOFEAT	218.6600	218.6699	-0.0099	BELOW
2343	NOFEAT	243.6100	243.6120	-0.0020	BELOW
2344	NOFEAT	233.4300	233.4307	-0.0007	BELOW
2345	NOFEAT	235.3600	235.3610	-0.0010	BELOW
2346	NOFEAT	250.4400	250.4431	-0.0031	BELOW
2347	NOFEAT	259.3300	259.3241	0.0059	ABOVE
2348	NOFEAT	243.8800	243.8785	0.0015	ABOVE
2349	NOFEAT	232.6600	232.6553	0.0047	ABOVE
2350	NOFEAT	206.6100	206.6082	0.0018	ABOVE
2351	NOFEAT	210.1300	210.1279	0.0021	ABOVE
2352	NOFEAT	232.4900	232.4906	-0.0006	BELOW
2353	NOFEAT	212.9400	212.9406	-0.0006	BELOW
2354	NOFEAT	206.7600	206.7496	0.0104	ABOVE

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The Sum of (Elev Diff)Squared = 0.0081

The Ave of (Elev Diff)Squared = 0.0001

The Root Mean Square Error is = 0.0078

National Standard for Spatial Data Accuracy(NSSDA) is = 0.0153

Points PASS the 95% confidence test based on 1.96 Chi Square Value.

User defined Tolerance = 0.0500

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2.3% of points are between Half Tolerance and Tolerance *

0.0% of the points are greater than Tolerance ***

-0.0118 is the maximum difference BELOW

0.0341 is the maximum difference ABOVE

132 Total number of points

35 Points are below the TIN Surface

96 Points are above the TIN Surface

1 Points are equal to the TIN Surface