



North Carolina Department of Public Safety

Emergency Management North Carolina Geodetic Survey

Pat McCrory, Governor
Frank L. Perry, Secretary

Michael A. Sprayberry, Director

LiDar Quality Control Report – 2015 Statewide LiDAR Project

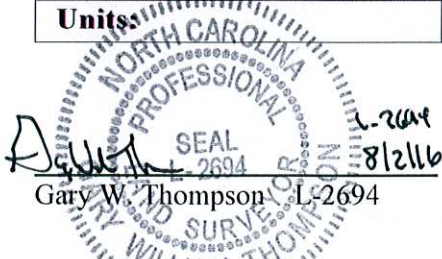
The North Carolina Geodetic survey performed a vertical quality control (QC) survey in Phase three (3) of the statewide LiDAR elevation project. The purpose of the survey was to test the elevation points contained in a dataset that was obtained by utilizing airborne Light Detection and Ranging (LiDAR) technology. The attached report contains the results of the vertical QC survey.

The QC test points were collected utilizing the North Carolina Continuous Operating Reference System (NCCORS) and the North Carolina Real Time Network. (NCRTN), and with conventional survey methods in areas unsuitable for GNSS observations.

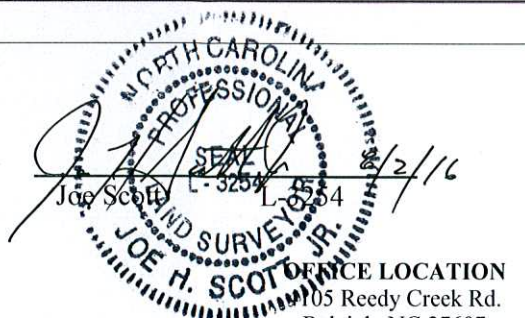
The field survey data that was used to generate the attached report was performed by five (5) firms that are licensed by the NC Board of Examiners for Engineers and Surveyors. Each of these firms provided a signed and sealed report that included all of the data that they collected under the responsible charge of a North Carolina Professional Land Surveyor. Some of the quality control points were collected by the North Carolina Geodetic survey (NCGS) under the supervision of Joe Scott (L-3254). The review of the field data and the generation of the final QC report were performed under the supervision of Gary Thompson (L-2694).

The GNSS portion of the survey (performed by NCGS) was performed to the following parameters:

Class of survey:	Class C
Positional accuracy:	Vertical 0.04 USft Horizontal 0.03 USft
Type of field procedure:	North Carolina Real Time Network (NCRTN)
Dates of survey:	December 18, 2015
Horizontal datum/epoch:	North American Datum 83(2011) epoch 2010.0
Vertical datum/epoch	North American Vertical Datum of 1988 (NAVD88)
Published fixed control used:	North Carolina Continuously Operating Reference Station (CORS) Network and NCRTN
Geoid model:	Geoid12A
Combined grid factor:	See attached control datasheets
Units:	US Survey Feet


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 8/2/16

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2015 Phase 3 NC LiDAR Independent Quality Control Summary
Non-Vegetated Area

<i>County</i>	<i>NVA Type</i>	<i>NVA Minimum DZ</i>	<i>NVA Maximum DZ</i>	<i>NVA Mean DZ</i>	<i>NVA Mean Magnitude DZ</i>	<i>NVA Observations</i>	<i>NVA Standard Deviation DZ</i>	<i>NVA RMSE Z</i>	<i>95% Confidence Level Z</i>
Cumberland	2U, 2B	-0.428	0.511	-0.005	0.389	47	0.204	0.202	0.396
Hoke	2U, 2B	-0.431	0.271	-0.060	0.358	29	0.153	0.162	0.318
Montgomery	2U, 2B	-0.267	0.860	0.082	0.399	33	0.218	0.229	0.449
Moore	2U, 2B	-0.414	0.422	0.042	0.396	46	0.192	0.195	0.381
Richmond	2U, 2B	-0.354	0.606	0.070	0.474	39	0.276	0.281	0.551
Scotland	2U, 2B	-0.447	0.502	0.045	0.460	19	0.257	0.254	0.498

Vegetated Area

<i>County</i>	<i>VVA Class</i>	<i>VVA Minimum DZ</i>	<i>VVA Maximum DZ</i>	<i>VVA Mean DZ</i>	<i>VVA Mean Magnitude DZ</i>	<i>VVA Observations</i>	<i>VVA Standard Deviation DZ</i>	<i>VVA RMSE Z</i>	<i>95th Percentile</i>
Cumberland	2L, 2M, 2H	-0.159	1.343	0.279	0.564	32	0.332	0.430	0.758
Hoke	2L, 2M, 2H	-0.254	0.616	0.068	0.404	20	0.221	0.226	0.493
Montgomery	2L, 2M, 2H	-0.100	0.661	0.323	0.578	23	0.197	0.376	0.626
Moore	2L, 2M, 2H	-0.532	0.774	0.155	0.522	33	0.317	0.349	0.696
Richmond	2L, 2M, 2H	-0.059	0.583	0.303	0.557	28	0.192	0.357	0.563
Scotland	2L, 2M, 2H	0.008	1.428	0.425	0.652	18	0.365	0.553	0.858

All values except observations in US Feet

Phase 3 Overall Results			
Non-Vegetated Area		Vegetated Area	
Minimum DZ:	-0.447	Minimum DZ:	-0.532
Maximum DZ:	0.860	Maximum DZ:	1.428
Mean DZ:	0.029	Mean DZ:	0.253
Mean Magnitude DZ:	0.412	Mean Magnitude DZ:	0.549
Observations:	213	Observations:	154
Standard Deviation DZ:	0.220	Standard Deviation DZ:	0.296
RMSE Z:	0.222	RMSE Z:	0.389
95% Confidence Level Z:	0.435	95th Percentile:	0.762

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Project Information

Prepared By: Watson Ross
Project Name: 2015 Phase 3 LiDAR QC
Sensor Info: N/A
Required Nominal Pulse Spacing: 0.7
Vendor Name: Woolpert, Inc.
Units: US Survey Feet
Percent of Extent Tolerance: Extents Not Checked
Date of Acquisition: Start: 1/5/2015 Finish: 3/31/2015

Metadata Information

Tile Index:

Path: \\NCEMJFHQFS01\gim\GIS\LiDAR2015\Phase 3 QC\county_files\cumberland_tiles.shp
Number of Polys: 0

Intensity:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

DEM:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

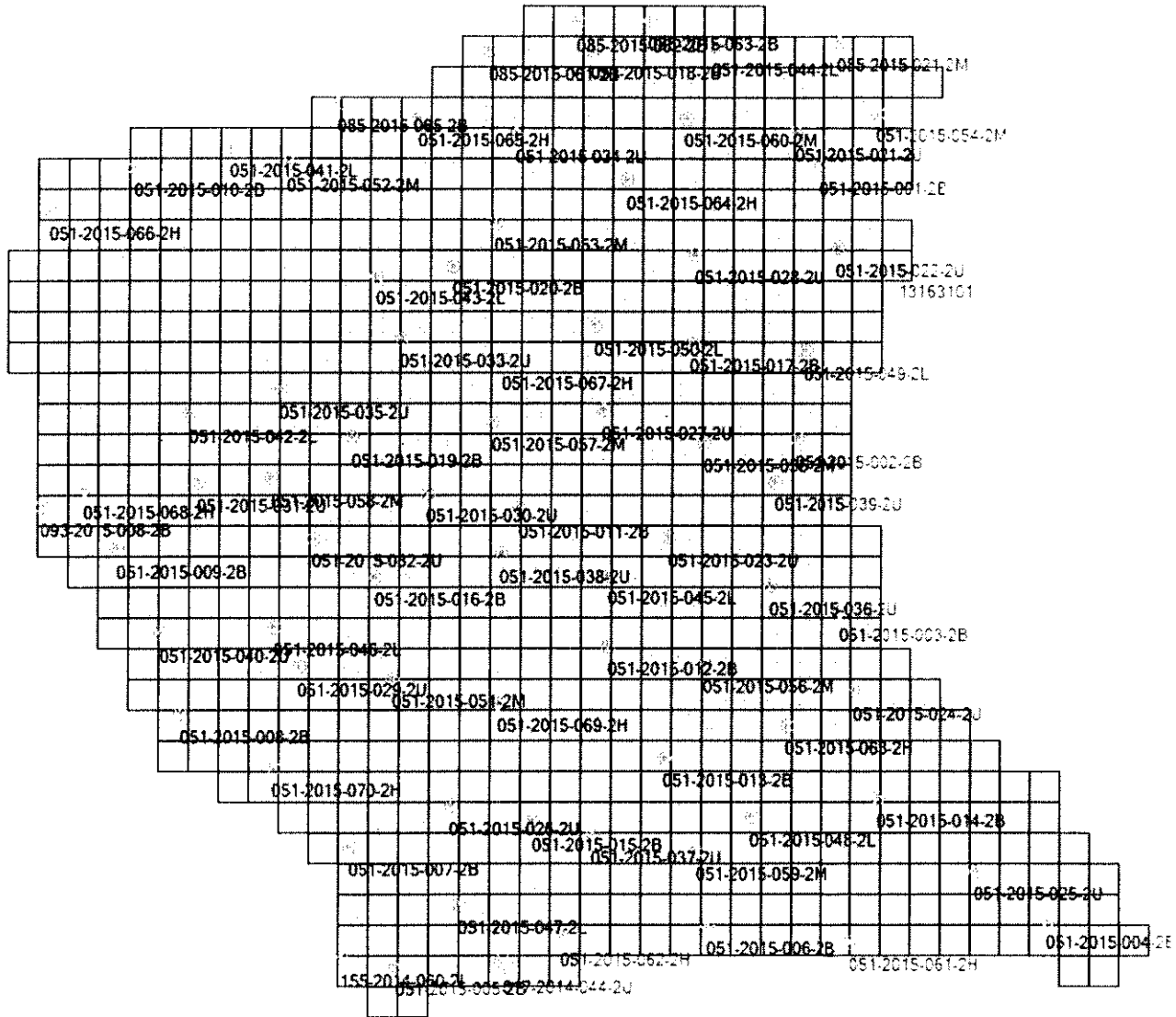
LAS:

Tile Index Attribute: LiDARTiles
Path to Data: \\ncemjfhqclpshp\hdata\Phase_3\Woolpert\Cumberland\LAS_1.3
Number of Data Files Matching Attribute: 810 out of 810

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Tiled-Data Area





LiDAR Accuracy Assessment Summary

LC Type	# of Points	NVA	SVA	VVA
LAS				
ALL	79			
2U	21	0.334	0.310	
2L	11		0.400	0.400
2B	26	0.440	0.468	
2M	11		0.736	0.736
2H	10		1.087	1.087
Total	79			

Units: US Survey Feet

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LAS

Non-vegetated Vertical Accuracy

LandCover Type: 2U, 2B

Minimum DZ: -0.428

Maximum DZ: 0.511

Mean DZ: -0.005

Mean Magnitude DZ: 0.389

Number Observations: 47

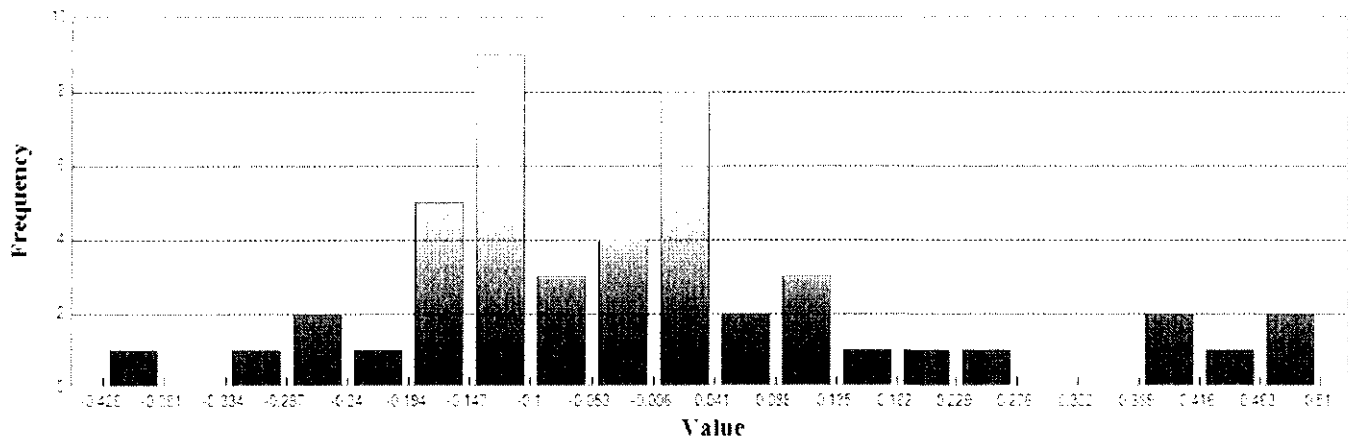
Standard Deviation DZ: 0.204

RMSE Z: 0.202

95% Confidence Level Z: 0.396

Units: US Survey Feet

Histogram



Min: -0.428

Max: 0.511

Number Of Bins: 20

Bin Interval: 0.047

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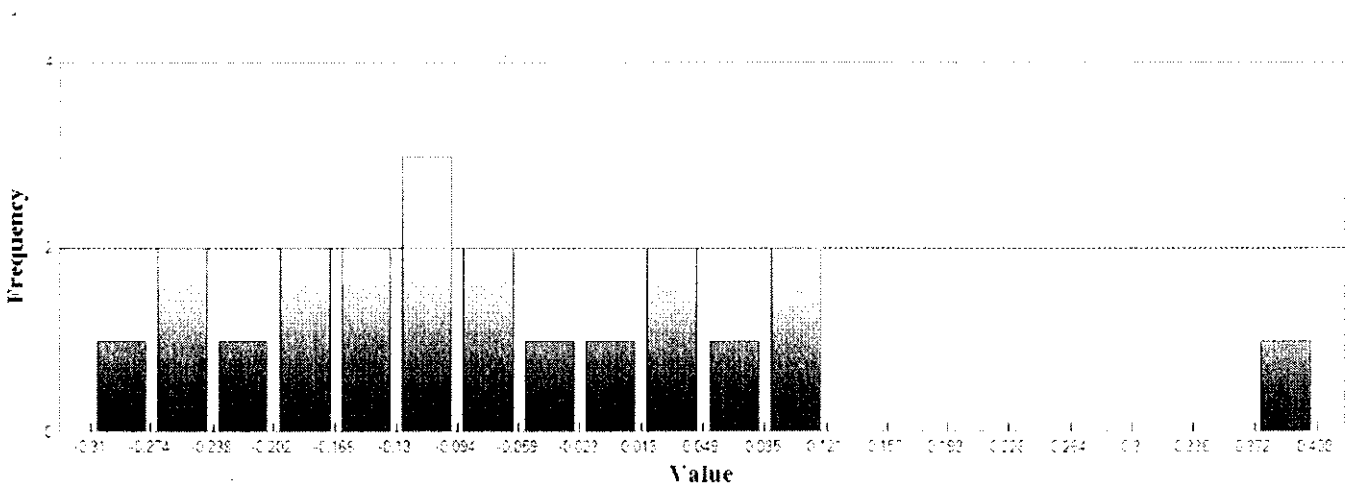


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2U
 Minimum DZ: -0.31
 Maximum DZ: 0.408
 Mean DZ: -0.071
 Mean Magnitude DZ: 0.372
 Number Observations: 21
 Standard Deviation DZ: 0.159
 RMSE Z: 0.171
 95th Percentile: 0.31
 Units: US Survey Feet

Histogram



Min: -0.31
 Max: 0.408
 Number Of Bins: 20
 Bin Interval: 0.036

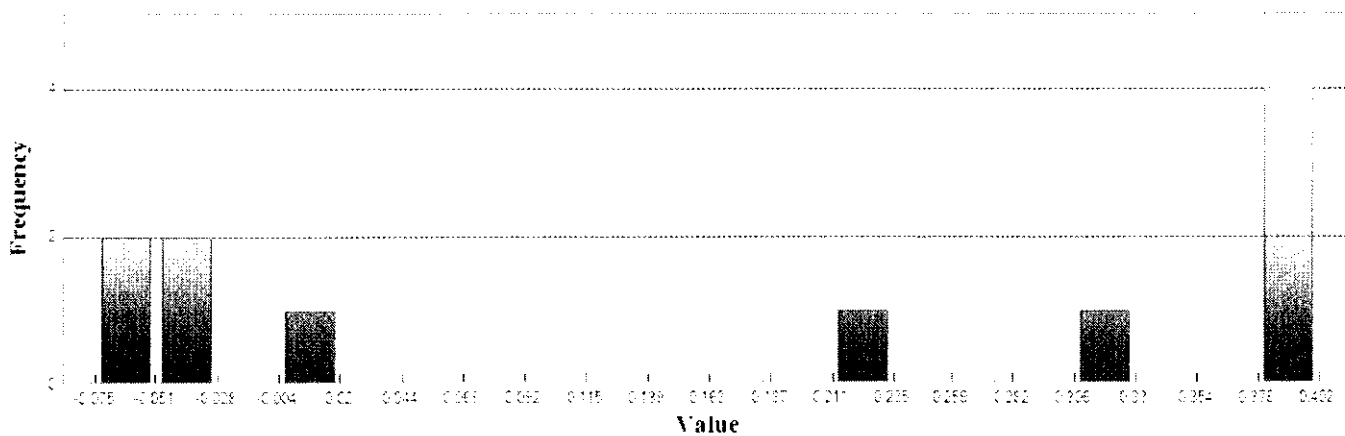


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2L
Minimum DZ: -0.075
Maximum DZ: 0.402
Mean DZ: 0.174
Mean Magnitude DZ: 0.462
Number Observations: 11
Standard Deviation DZ: 0.214
RMSE Z: 0.268
95th Percentile: 0.4
Units: US Survey Feet

Histogram



Min: -0.075

Max: 0.402

Number Of Bins: 20

Bin Interval: 0.024

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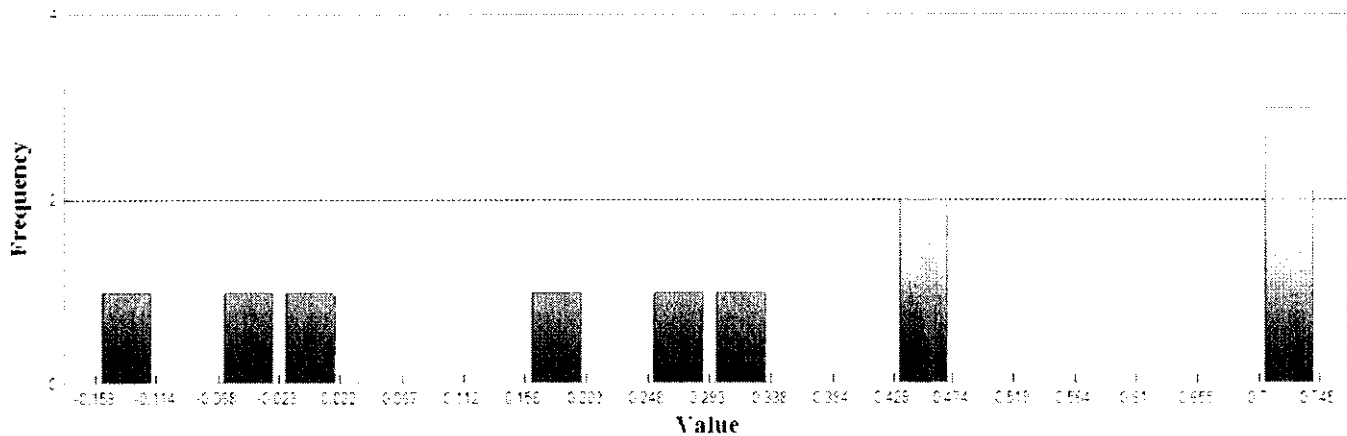


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2M
Minimum DZ: -0.159
Maximum DZ: 0.745
Mean DZ: 0.331
Mean Magnitude DZ: 0.608
Number Observations: 11
Standard Deviation DZ: 0.318
RMSE Z: 0.449
95th Percentile: 0.736
Units: US Survey Feet

Histogram



Min: -0.159
Max: 0.745
Number Of Bins: 20
Bin Interval: 0.045



LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: 2L, 2M, 2H

Minimum DZ: -0.159

Maximum DZ: 1.343

Mean DZ: 0.279

Mean Magnitude DZ: 0.564

Number Observations: 32

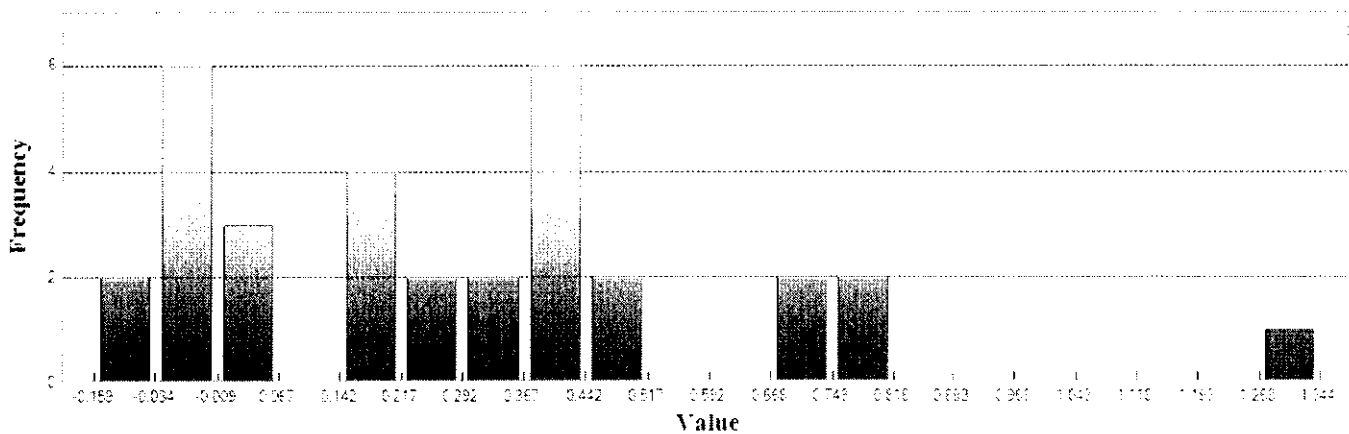
Standard Deviation DZ: 0.332

RMSE Z: 0.43

95th Percentile: 0.758

Units: US Survey Feet

Histogram



Min: -0.159

Max: 1.343

Number Of Bins: 20

Bin Interval: 0.075

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Project Information

Prepared By: Watson Ross
Project Name: 2015 Phase 3 LiDAR QC
Sensor Info: N/A
Required Nominal Pulse Spacing: 0.7
Vendor Name: Woolpert, Inc.
Units: US Survey Feet
Percent of Extent Tolerance: Extents Not Checked
Date of Acquisition: Start: 1/5/2015 Finish: 3/31/2015

Metadata Information

Tile Index:

Path: \\NCEMJFHQFS01\gtm\GIS\LIDAR2015\Phase 3 QC\county_files\hoke_tiles.shp

Number of Polys: 0

Intensity:

Tile Index Attribute: Not Specified

Path to Data: Not Specified

Number of Data Files Matching Attribute: Not Specified

DEM:

Tile Index Attribute: Not Specified

Path to Data: Not Specified

Number of Data Files Matching Attribute: Not Specified

LAS:

Tile Index Attribute: LiDARTiles

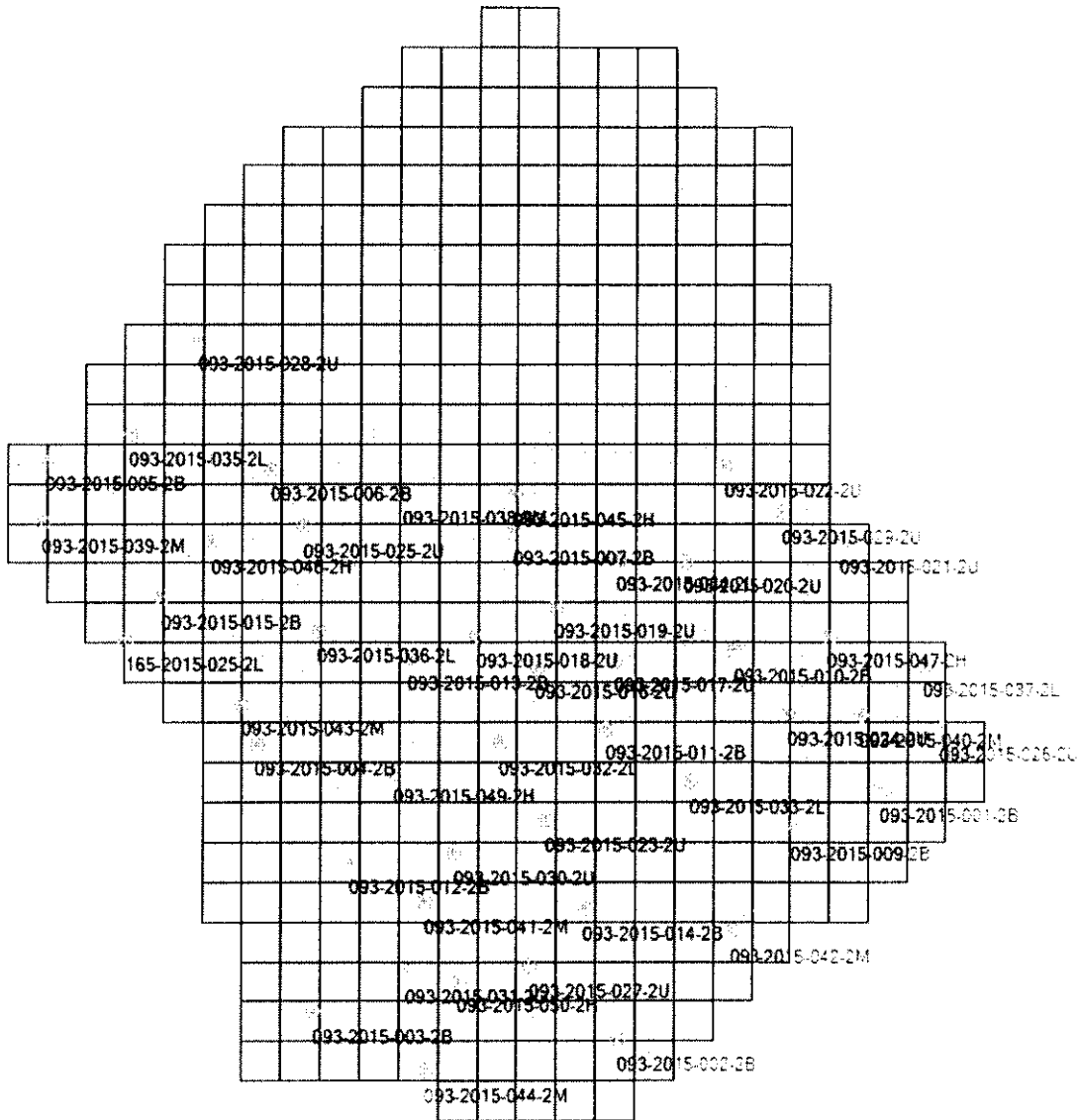
Path to Data: \\ncemjfhqclpshp\hdata\Phase_3\Woolpert\Lot2_Scotland_Hoke\LAS_1.3

Number of Data Files Matching Attribute: 446 out of 446

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LiDAR Accuracy Assessment Summary

LC Type	# of Points	NVA	SVA	VVA
LAS				
ALL	49			
2B	14	0.297	0.309	
2U	15	0.337	0.283	
2L	8		0.222	0.222
2M	7		0.577	0.577
2H	5		0.237	0.237
Total	49			

Units: US Survey Feet

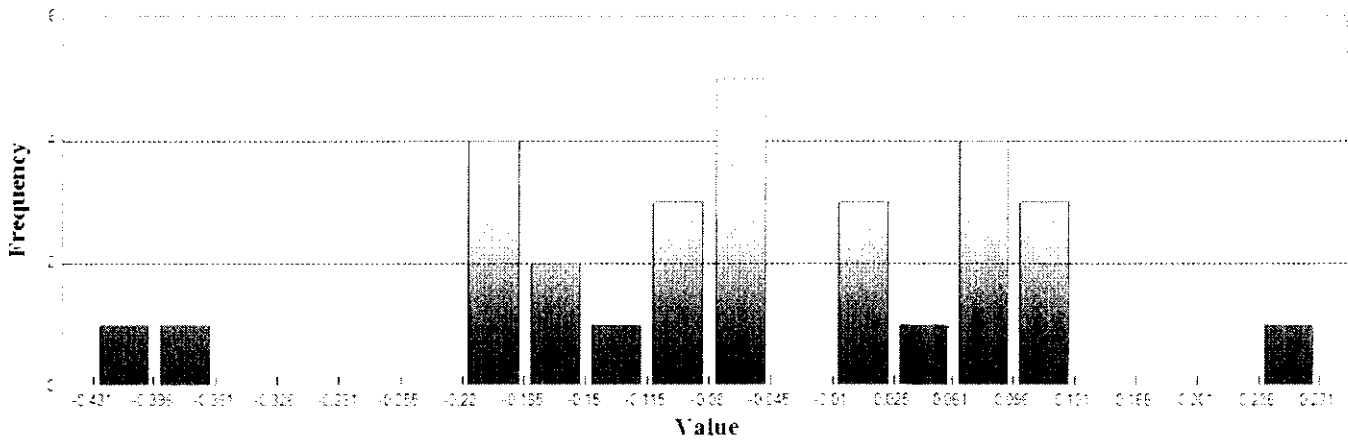


LAS

Non-vegetated Vertical Accuracy

LandCover Type: 2B, 2U
Minimum DZ: -0.431
Maximum DZ: 0.271
Mean DZ: -0.06
Mean Magnitude DZ: 0.358
Number Observations: 29
Standard Deviation DZ: 0.153
RMSE Z: 0.162
95% Confidence Level Z: 0.318
Units: US Survey Feet

Histogram



Min: -0.431
Max: 0.271
Number Of Bins: 20
Bin Interval: 0.035

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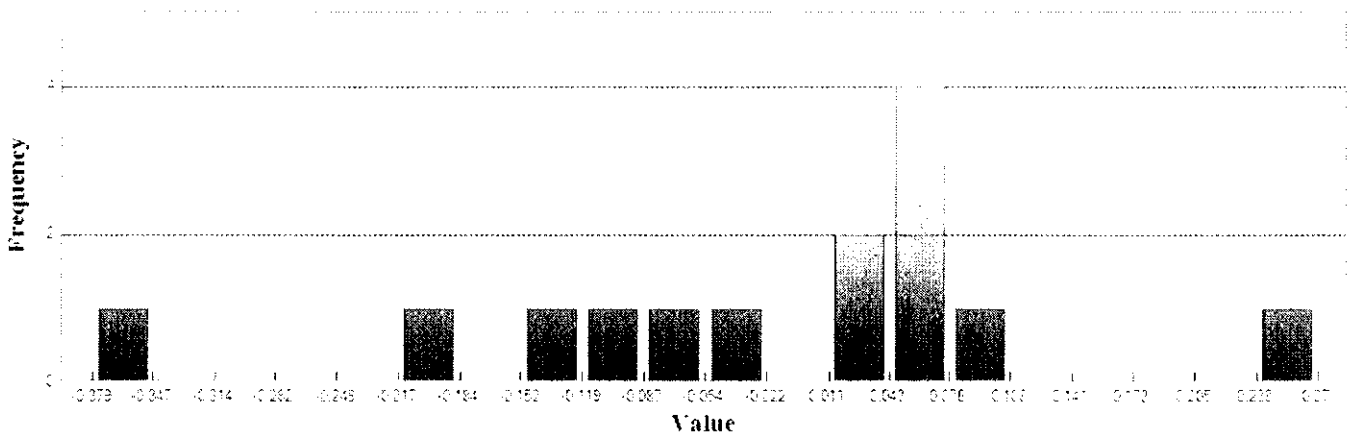


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2B
Minimum DZ: -0.379
Maximum DZ: 0.271
Mean DZ: -0.018
Mean Magnitude DZ: 0.338
Number Observations: 14
Standard Deviation DZ: 0.156
RMSE Z: 0.151
95th Percentile: 0.309
Units: US Survey Feet

Histogram



Min: -0.379
Max: 0.271
Number Of Bins: 20
Bin Interval: 0.032

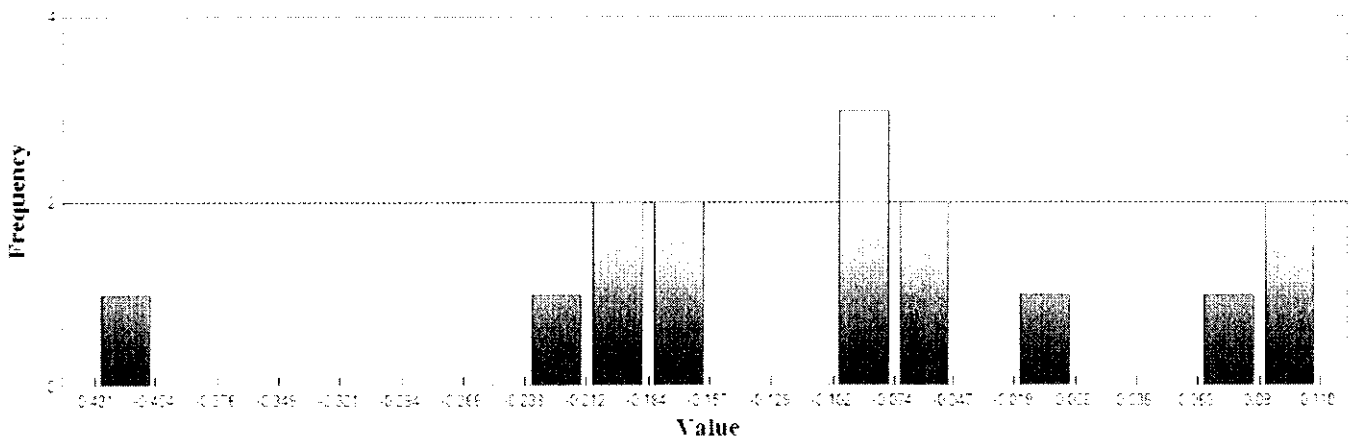


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2U
Minimum DZ: -0.431
Maximum DZ: 0.118
Mean DZ: -0.1
Mean Magnitude DZ: 0.376
Number Observations: 15
Standard Deviation DZ: 0.144
RMSE Z: 0.172
95th Percentile: 0.283
Units: US Survey Feet

Histogram



Min: -0.431
Max: 0.118
Number Of Bins: 20
Bin Interval: 0.027

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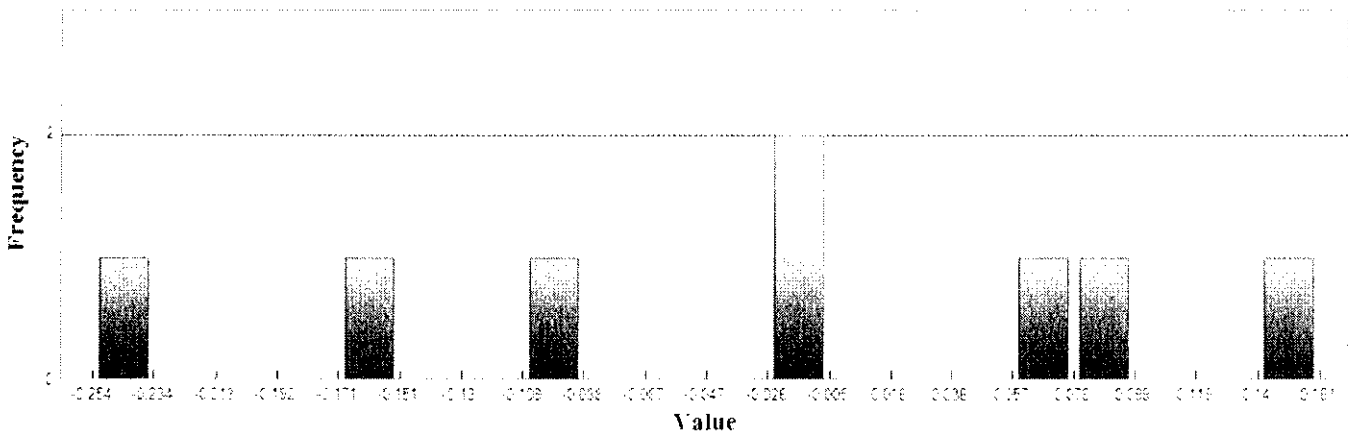


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2L
Minimum DZ: -0.254
Maximum DZ: 0.161
Mean DZ: -0.028
Mean Magnitude DZ: 0.321
Number Observations: 8
Standard Deviation DZ: 0.135
RMSE Z: 0.129
95th Percentile: 0.222
Units: US Survey Feet

Histogram



Min: -0.254
Max: 0.161
Number Of Bins: 20
Bin Interval: 0.021

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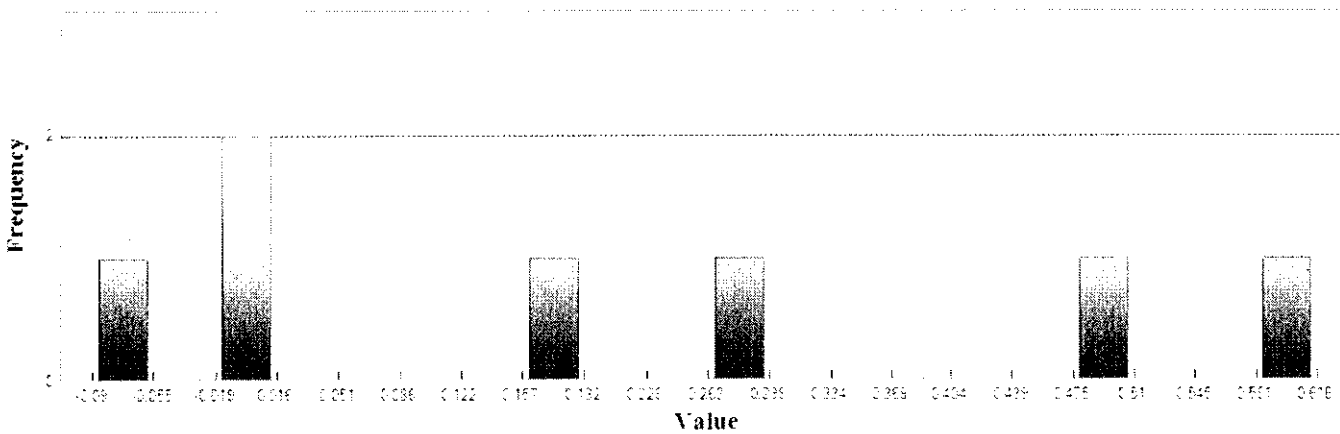


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2M
Minimum DZ: -0.09
Maximum DZ: 0.616
Mean DZ: 0.211
Mean Magnitude DZ: 0.491
Number Observations: 7
Standard Deviation DZ: 0.269
RMSE Z: 0.326
95th Percentile: 0.577
Units: US Survey Feet

Histogram



Min: -0.09
Max: 0.616
Number Of Bins: 20
Bin Interval: 0.035



LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: 2L, 2M, 2H

Minimum DZ: -0.254

Maximum DZ: 0.616

Mean DZ: 0.068

Mean Magnitude DZ: 0.404

Number Observations: 20

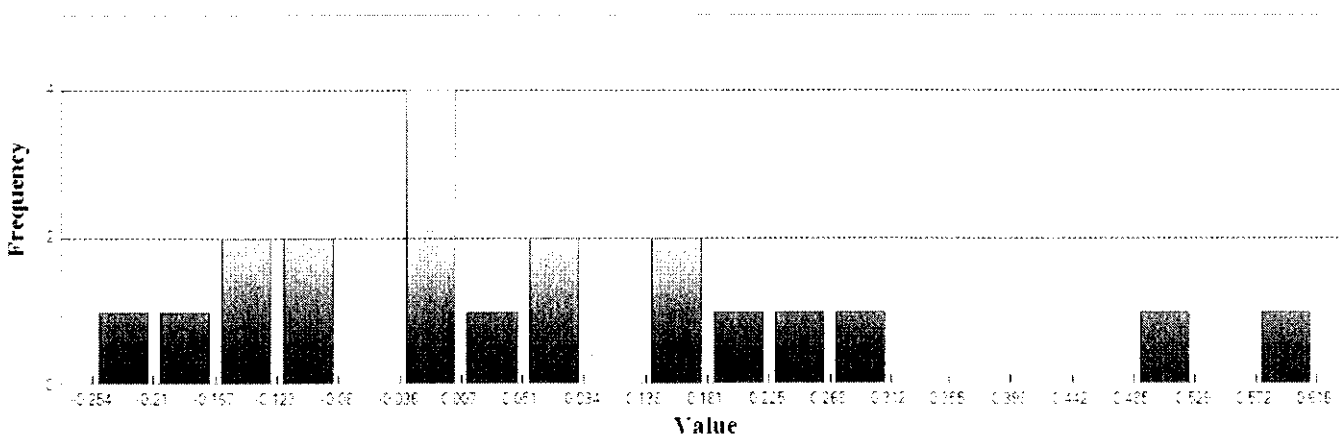
Standard Deviation DZ: 0.221

RMSE Z: 0.226

95th Percentile: 0.493

Units: US Survey Feet

Histogram



Min: -0.254

Max: 0.616

Number Of Bins: 20

Bin Interval: 0.043

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Project Information

Prepared By: Watson Ross
Project Name: 2015 Phase 3 LIDAR QC
Sensor Info: N/A
Required Nominal Pulse Spacing: 0.7
Vendor Name: Woolpert, Inc.
Units: US Survey Feet
Percent of Extent Tolerance: Extents Not Checked
Date of Acquisition: Start: 1/5/2015 Finish: 3/31/2015

Metadata Information

Tile Index:

Path: \\NCEMJFHQFS01\gtm\GIS\LIDAR2015\Phase 3 QC\county_files\montgomery_files.shp
Number of Polys: 0

Intensity:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

DEM:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

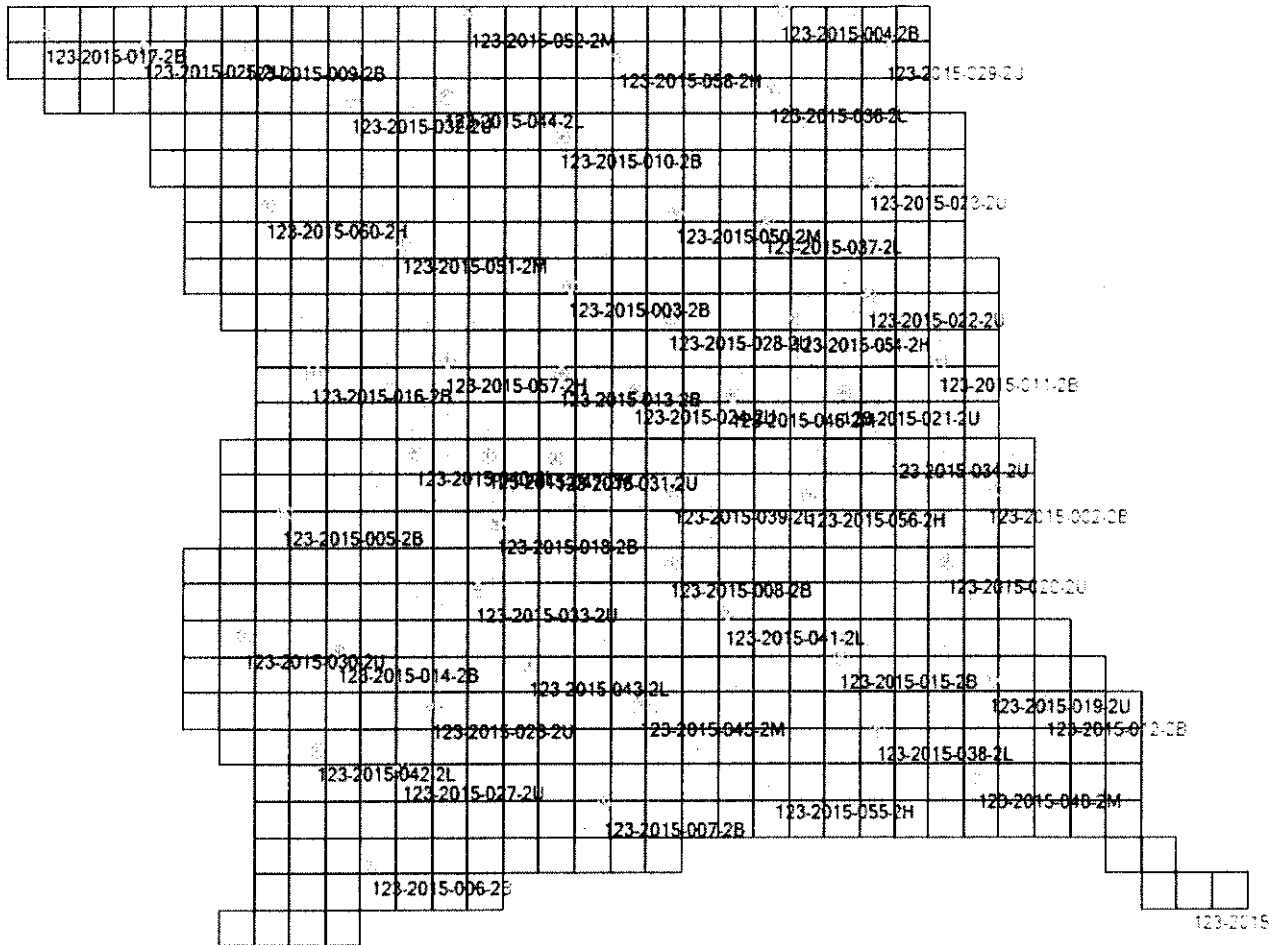
LAS:

Tile Index Attribute: LIDARTiles
Path to Data: \\ncemjfhqclpshp\hdata\Phase_3\Woolpert\Lot1_Montgomery_Moore\LAS_1.3
Number of Data Files Matching Attribute: 574 out of 574

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Tiled-Data Area



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LiDAR Accuracy Assessment Summary

LC Type	# of Points	NVA	SVA	VVA
LAS				
ALL	56			
2B	17	0.559	0.567	
2U	16	0.290	0.255	
2L	9		0.480	0.480
2M	7		0.623	0.623
2H	7		0.626	0.626
Total	56			

Units: US Survey Feet

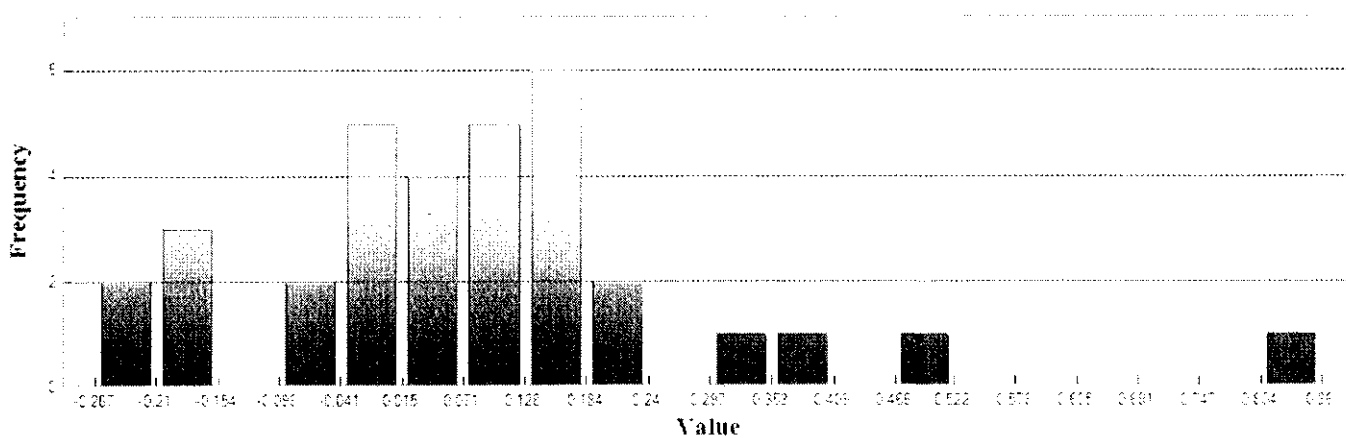


LAS

Non-vegetated Vertical Accuracy

LandCover Type: 2B, 2U
Minimum DZ: -0.267
Maximum DZ: 0.86
Mean DZ: 0.082
Mean Magnitude DZ: 0.399
Number Observations: 33
Standard Deviation DZ: 0.218
RMSE Z: 0.229
95% Confidence Level Z: 0.449
Units: US Survey Feet

Histogram



Min: -0.267

Max: 0.86

Number Of Bins: 20

Bin Interval: 0.056

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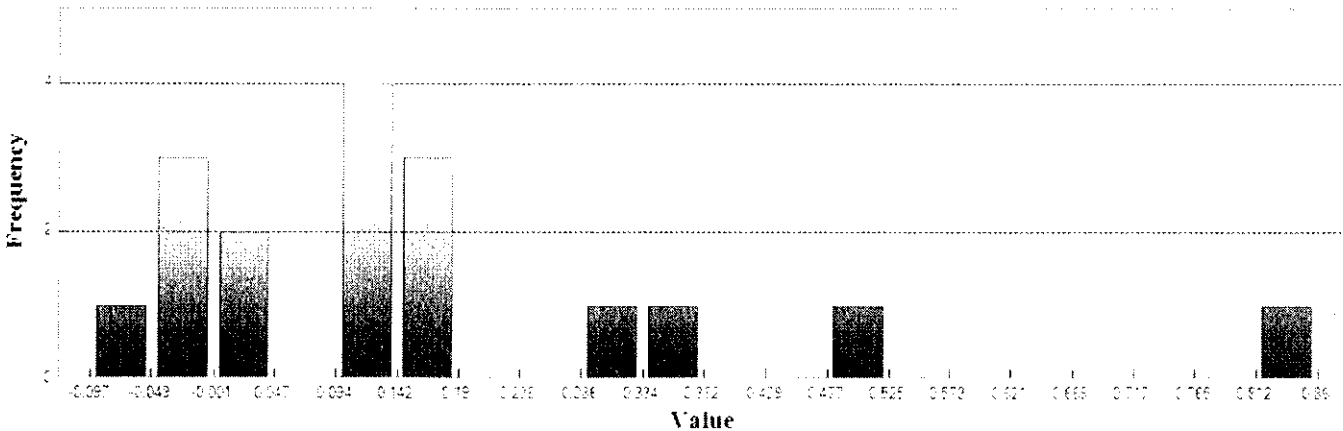


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2B
Minimum DZ: -0.097
Maximum DZ: 0.86
Mean DZ: 0.175
Mean Magnitude DZ: 0.438
Number Observations: 17
Standard Deviation DZ: 0.232
RMSE Z: 0.285
95th Percentile: 0.567
Units: US Survey Feet

Histogram



Min: -0.097
Max: 0.86
Number Of Bins: 20
Bin Interval: 0.048

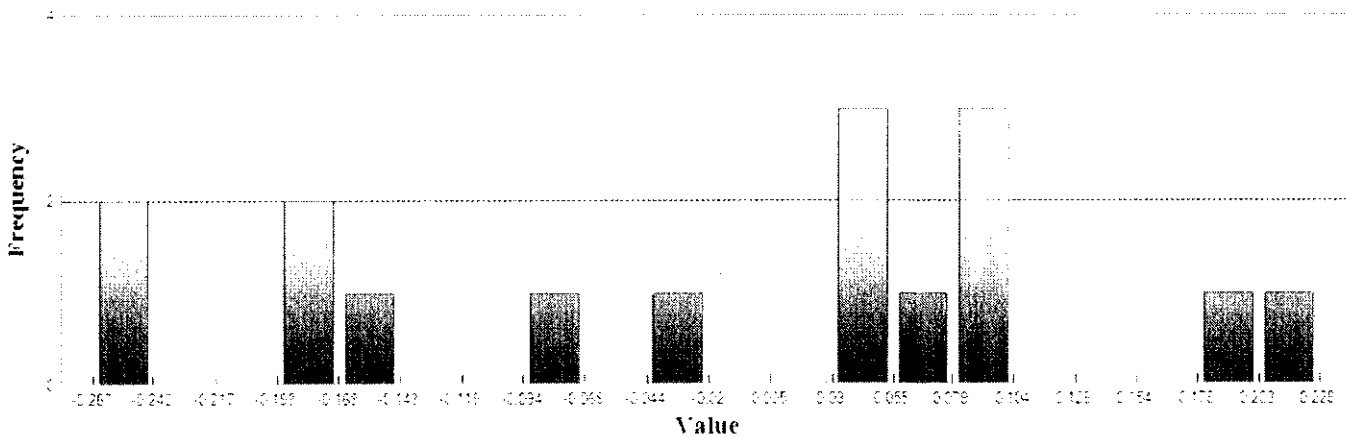


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2U
 Minimum DZ: -0.267
 Maximum DZ: 0.228
 Mean DZ: -0.018
 Mean Magnitude DZ: 0.354
 Number Observations: 16
 Standard Deviation DZ: 0.152
 RMSE Z: 0.148
 95th Percentile: 0.255
 Units: US Survey Feet

Histogram



Min: -0.267
 Max: 0.228
 Number Of Bins: 20
 Bin Interval: 0.025

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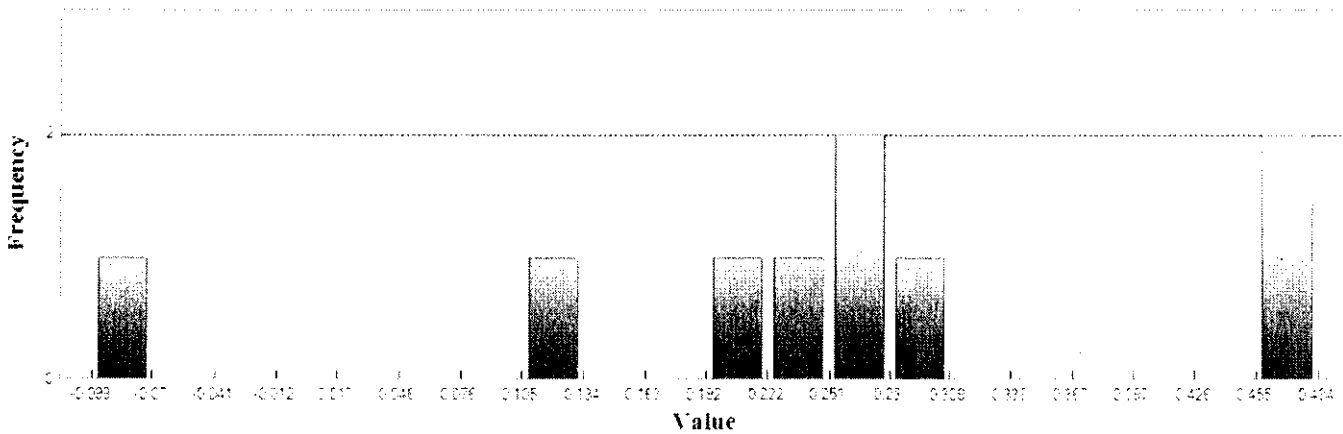


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2L
 Minimum DZ: -0.1
 Maximum DZ: 0.484
 Mean DZ: 0.25
 Mean Magnitude DZ: 0.522
 Number Observations: 9
 Standard Deviation DZ: 0.176
 RMSE Z: 0.3
 95th Percentile: 0.48
 Units: US Survey Feet

Histogram



Min: -0.1
 Max: 0.484
 Number Of Bins: 20
 Bin Interval: 0.029

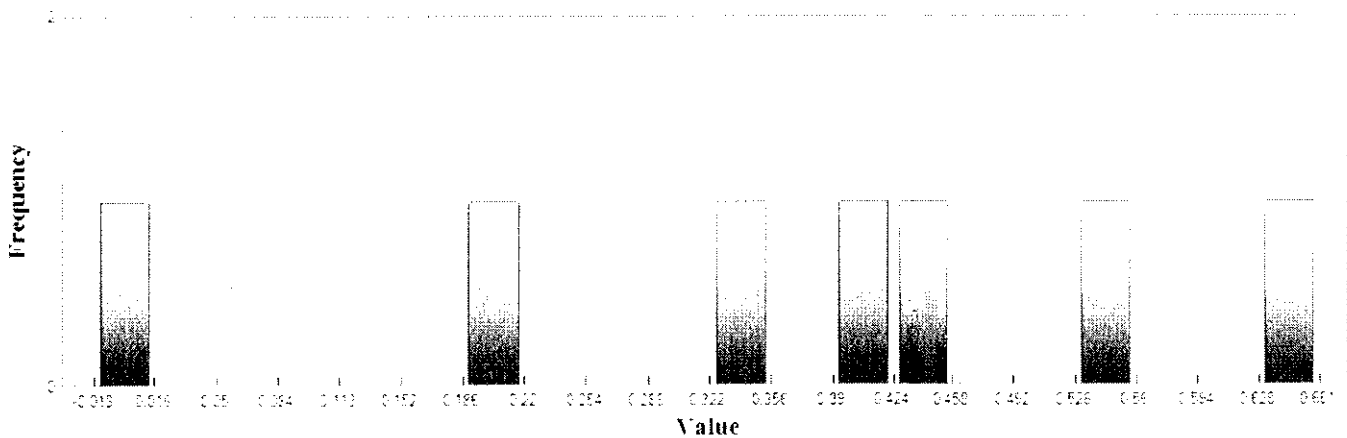


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2M
Minimum DZ: -0.018
Maximum DZ: 0.661
Mean DZ: 0.359
Mean Magnitude DZ: 0.604
Number Observations: 7
Standard Deviation DZ: 0.224
RMSE Z: 0.415
95th Percentile: 0.623
Units: US Survey Feet

Histogram



Min: -0.018

Max: 0.661

Number Of Bins: 20

Bin Interval: 0.034

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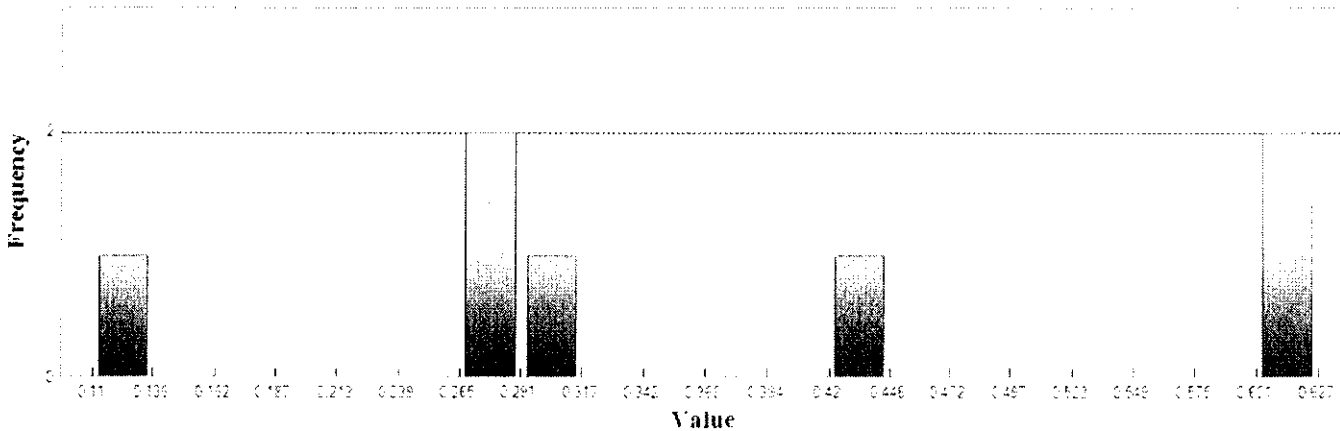


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2H
Minimum DZ: 0.11
Maximum DZ: 0.627
Mean DZ: 0.382
Mean Magnitude DZ: 0.618
Number Observations: 7
Standard Deviation DZ: 0.192
RMSE Z: 0.421
95th Percentile: 0.626
Units: US Survey Feet

Histogram



Min: 0.11

Max: 0.627

Number Of Bins: 20

Bin Interval: 0.026



LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: 2L, 2M, 2H

Minimum DZ: -0.1

Maximum DZ: 0.661

Mean DZ: 0.323

Mean Magnitude DZ: 0.578

Number Observations: 23

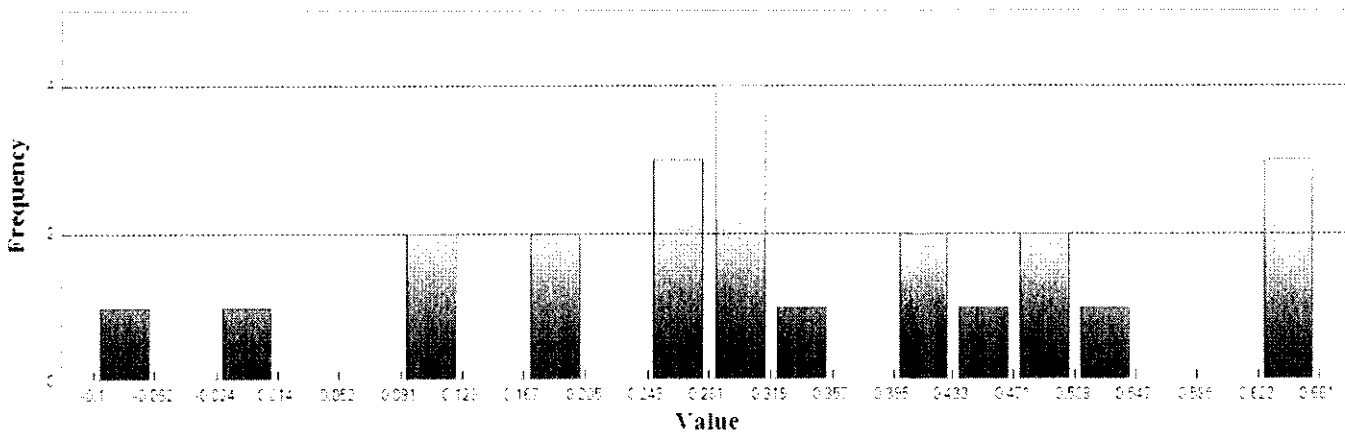
Standard Deviation DZ: 0.197

RMSE Z: 0.376

95th Percentile: 0.626

Units: US Survey Feet

Histogram



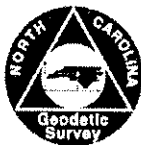
Min: -0.1

Max: 0.661

Number Of Bins: 20

Bin Interval: 0.033

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Project Information

Prepared By: Watson Ross
Project Name: 2015 Phase 3 LiDAR QC
Sensor Info: N/A
Required Nominal Pulse Spacing: 0.7
Vendor Name: Woolpert, Inc.
Units: US Survey Feet
Percent of Extent Tolerance: Extents Not Checked
Date of Acquisition: Start: 1/5/2015 Finish: 3/31/2015

Metadata Information

Tile Index:

Path: \\NCEMJFHQFS01\gfm\GIS\LiDAR2015\Phase 3 QC\county_tiles\moore_files.shp
Number of Polys: 0

Intensity:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

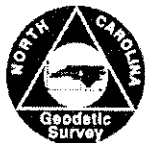
DEM:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

LAS:

Tile Index Attribute: LiDARTiles
Path to Data: \\ncemjfhqclpshp\hdata\Phase_3\Woolpert\Lot1_Montgomery_Moore\LAS_1.3
Number of Data Files Matching Attribute: 574 out of 574

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LIDAR Accuracy Assessment Summary

LC Type	# of Points	NVA	SVA	VVA
LAS				
ALL	79			
2B	23	0.392	0.366	
2L	11		0.559	0.559
2H	12		0.698	0.698
2U	23	0.371	0.343	
2M	10		0.536	0.536
Total	79			

Units: US Survey Feet

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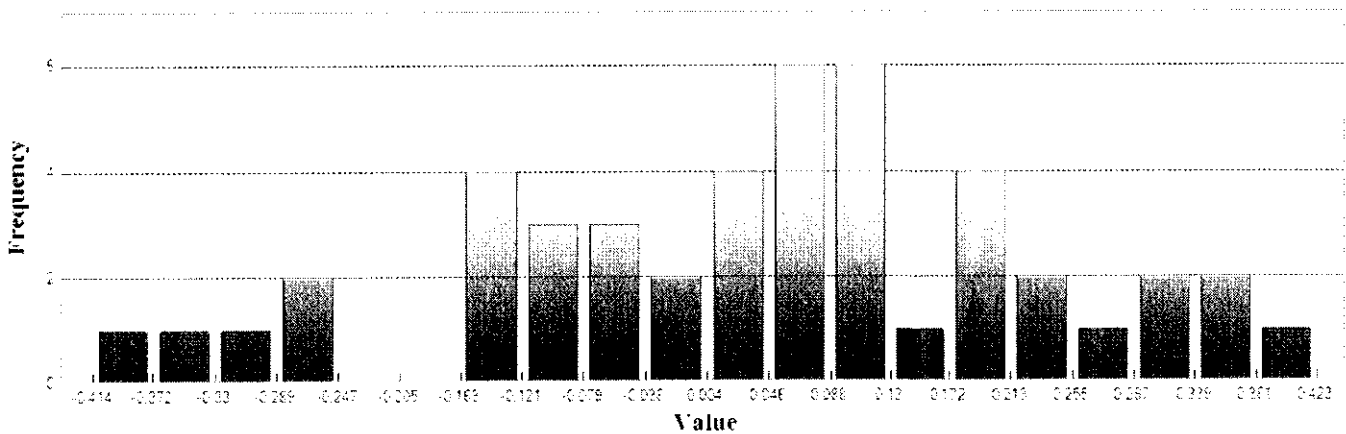


LAS

Non-vegetated Vertical Accuracy

LandCover Type: 2B, 2U
Minimum DZ: -0.414
Maximum DZ: 0.422
Mean DZ: 0.042
Mean Magnitude DZ: 0.396
Number Observations: 46
Standard Deviation DZ: 0.192
RMSE Z: 0.195
95% Confidence Level Z: 0.381
Units: US Survey Feet

Histogram



Min: -0.414
Max: 0.422
Number Of Bins: 20
Bin Interval: 0.042

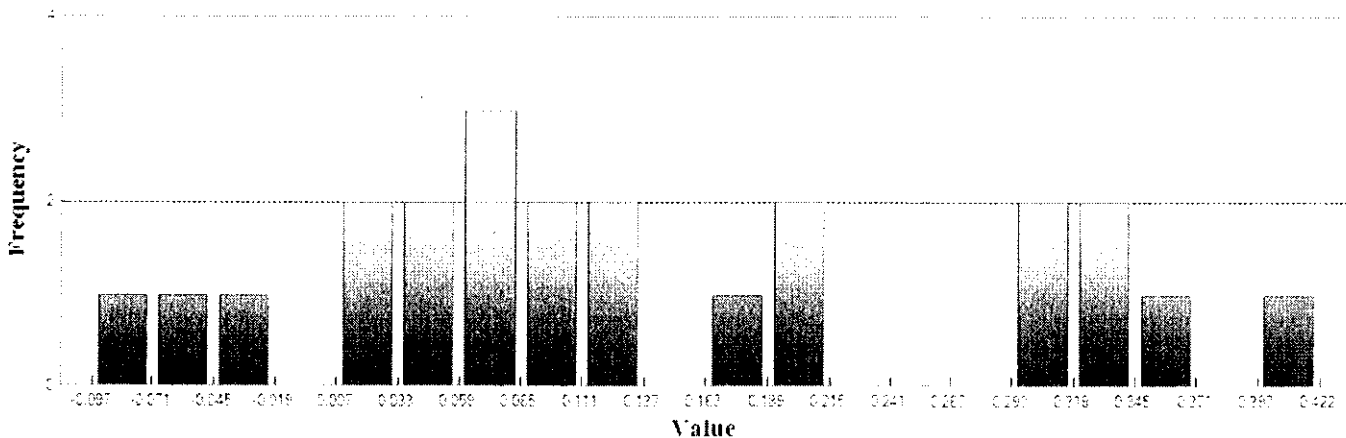


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2B
Minimum DZ: -0.097
Maximum DZ: 0.422
Mean DZ: 0.142
Mean Magnitude DZ: 0.398
Number Observations: 23
Standard Deviation DZ: 0.144
RMSE Z: 0.2
95th Percentile: 0.366
Units: US Survey Feet

Histogram



Min: -0.097
Max: 0.422
Number Of Bins: 20
Bin Interval: 0.026

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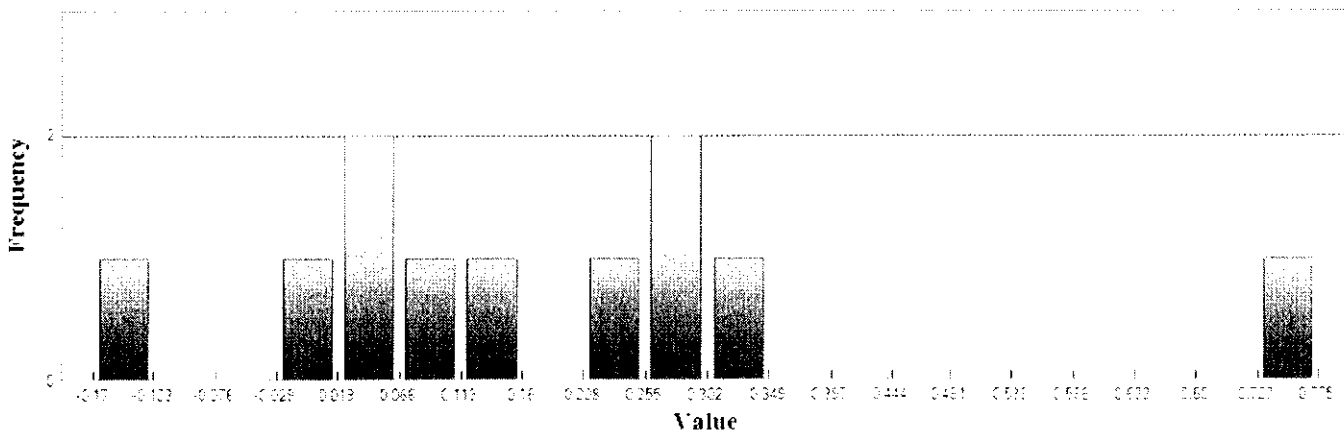


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2L
Minimum DZ: -0.171
Maximum DZ: 0.774
Mean DZ: 0.18
Mean Magnitude DZ: 0.464
Number Observations: 11
Standard Deviation DZ: 0.249
RMSE Z: 0.297
95th Percentile: 0.559
Units: US Survey Feet

Histogram



Min: -0.171

Max: 0.774

Number Of Bins: 20

Bin Interval: 0.047

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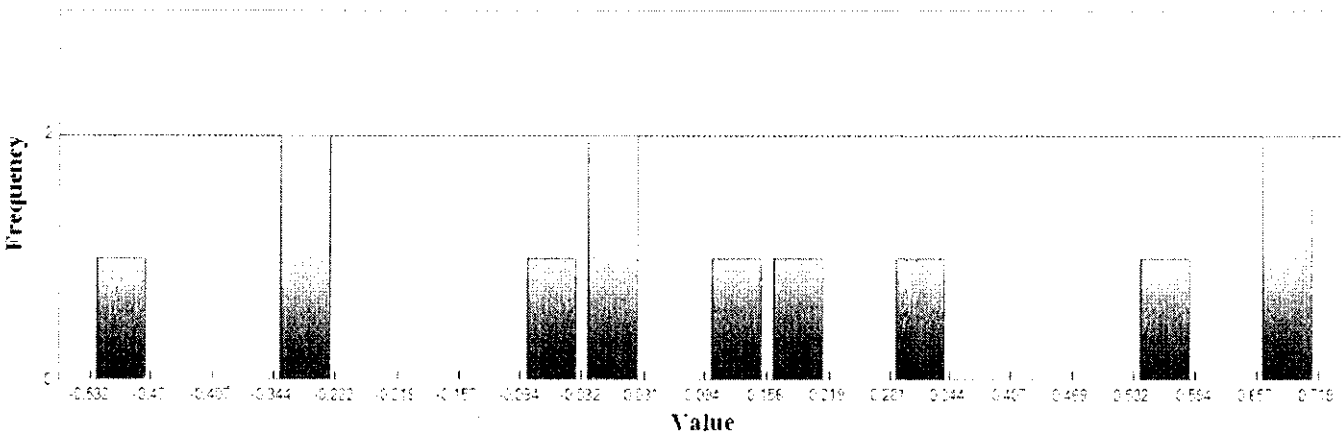


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2H
Minimum DZ: -0.532
Maximum DZ: 0.72
Mean DZ: 0.119
Mean Magnitude DZ: 0.563
Number Observations: 12
Standard Deviation DZ: 0.4
RMSE Z: 0.401
95th Percentile: 0.698
Units: US Survey Feet

Histogram



Min: -0.532
Max: 0.72
Number Of Bins: 20
Bin Interval: 0.063

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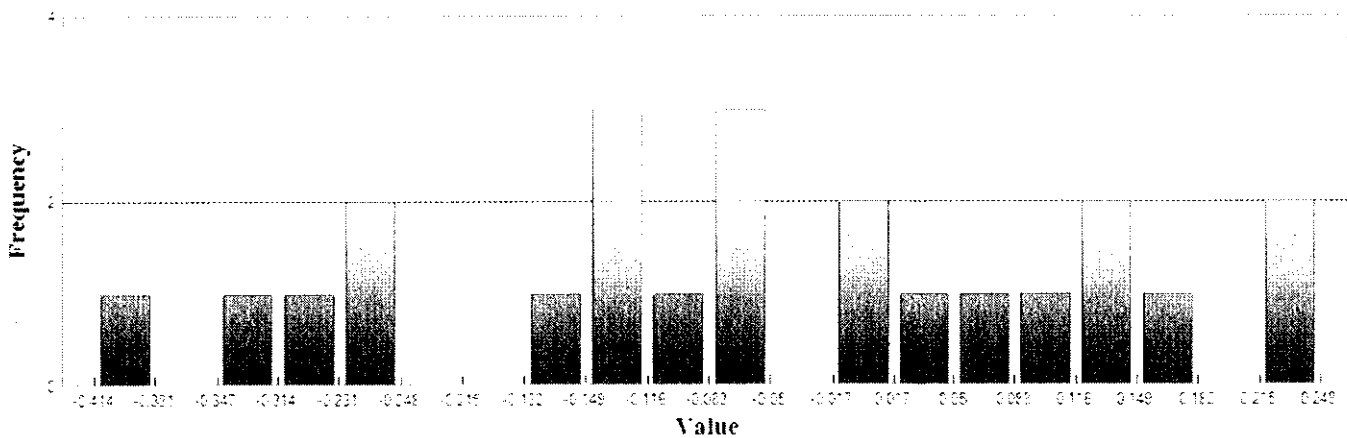


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2U
Minimum DZ: -0.414
Maximum DZ: 0.248
Mean DZ: -0.059
Mean Magnitude DZ: 0.393
Number Observations: 23
Standard Deviation DZ: 0.184
RMSE Z: 0.189
95th Percentile: 0.343
Units: US Survey Feet

Histogram



Min: -0.414
Max: 0.248
Number Of Bins: 20
Bin Interval: 0.033

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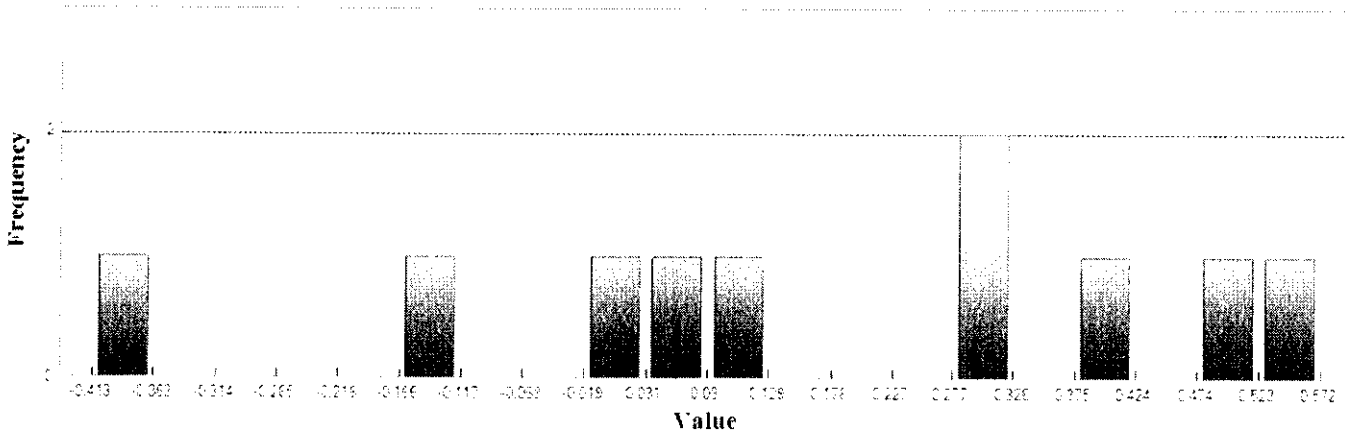


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2M
Minimum DZ: -0.413
Maximum DZ: 0.572
Mean DZ: 0.172
Mean Magnitude DZ: 0.53
Number Observations: 10
Standard Deviation DZ: 0.301
RMSE Z: 0.333
95th Percentile: 0.536
Units: US Survey Feet

Histogram



Min: -0.413
Max: 0.572
Number Of Bins: 20
Bin Interval: 0.049

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LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: 2L, 2H, 2M

Minimum DZ: -0.532

Maximum DZ: 0.774

Mean DZ: 0.155

Mean Magnitude DZ: 0.522

Number Observations: 33

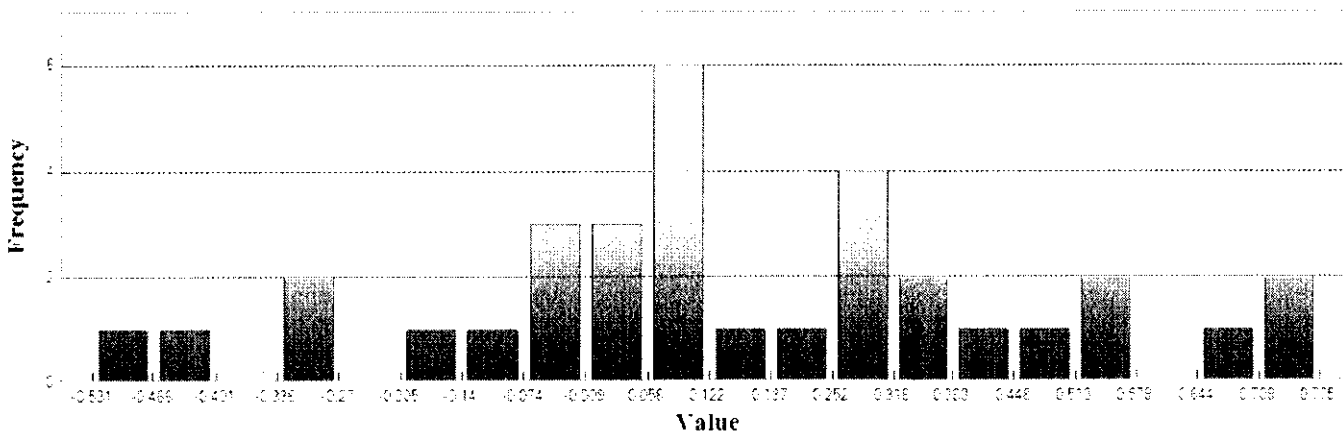
Standard Deviation DZ: 0.317

RMSE Z: 0.349

95th Percentile: 0.696

Units: US Survey Feet

Histogram



Min: -0.532

Max: 0.774

Number Of Bins: 20

Bin Interval: 0.065

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Project Information

Prepared By: Watson Ross
Project Name: 2015 Phase 3 LIDAR QC
Sensor Info: N/A
Required Nominal Pulse Spacing: 0.7
Vendor Name: Woolpert, Inc.
Units: US Survey Feet
Percent of Extent Tolerance: Extents Not Checked
Date of Acquisition: Start: 1/5/2015 Finish: 3/31/2015

Metadata Information

Tile Index:

Path: \\NCEMJFHQFS01\gtm\GIS\LIDAR2015\Phase 3 QC\county_files\richmond_files.shp
Number of Polys: 0

Intensity:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

DEM:

Tile Index Attribute: Not Specified
Path to Data: Not Specified
Number of Data Files Matching Attribute: Not Specified

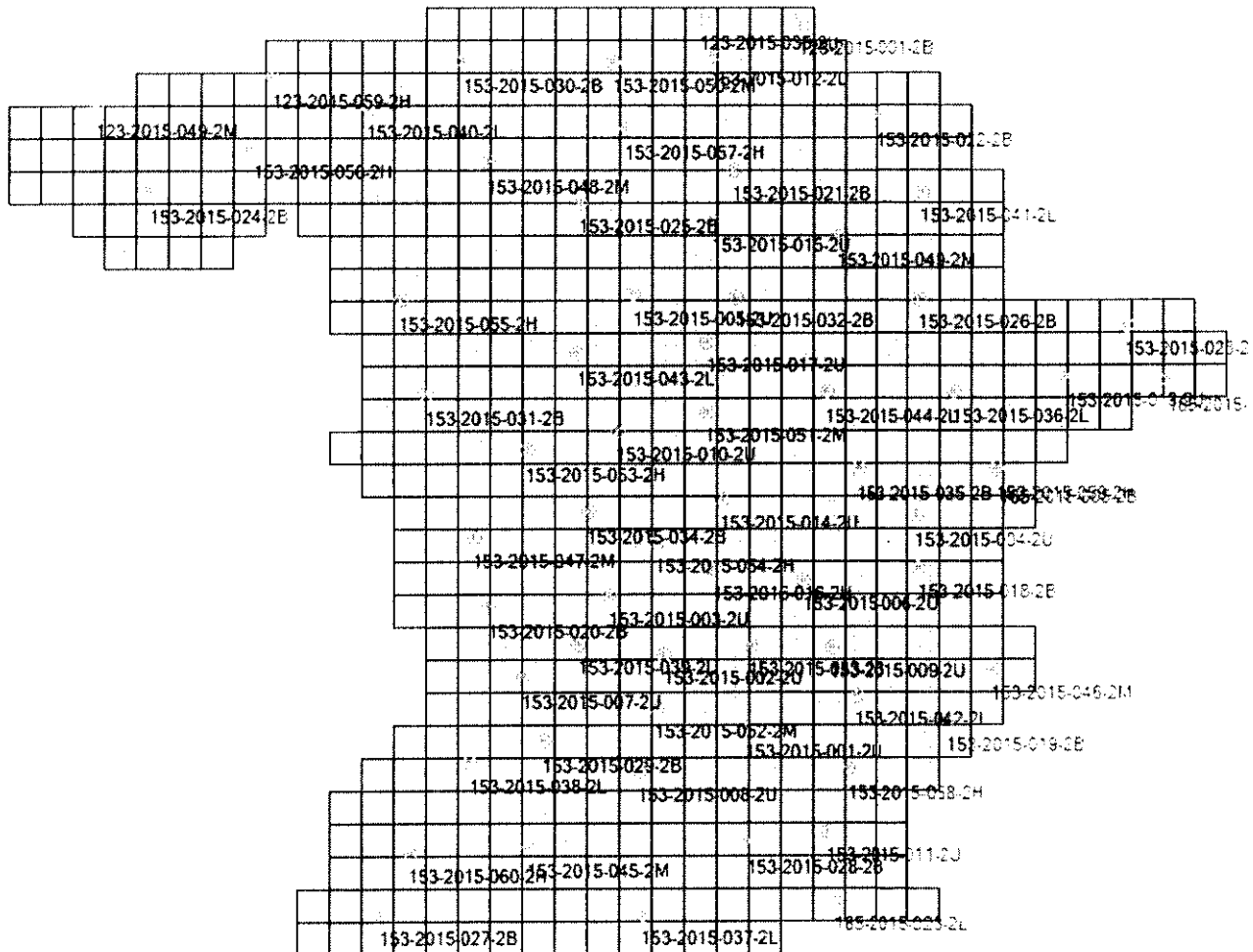
LAS:

Tile Index Attribute: LIDARTiles
Path to Data: \\ncemjfhqclpshp\hdata\Phase_3\Woolpert\Richmond\LAS_1.3
Number of Data Files Matching Attribute: 627 out of 627

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Tiled-Data Area



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LIDAR Accuracy Assessment Summary

LC Type	# of Points	NVA	SVA	VVA
LAS				
ALL	67			
2B	20	0.699	0.594	
2U	19	0.328	0.332	
2M	9		0.566	0.566
2H	9		0.550	0.550
2L	10		0.519	0.519
Total	67			

Units: US Survey Feet



LAS

Non-vegetated Vertical Accuracy

LandCover Type: 2B, 2U

Minimum DZ: -0.354

Maximum DZ: 0.606

Mean DZ: 0.07

Mean Magnitude DZ: 0.474

Number Observations: 39

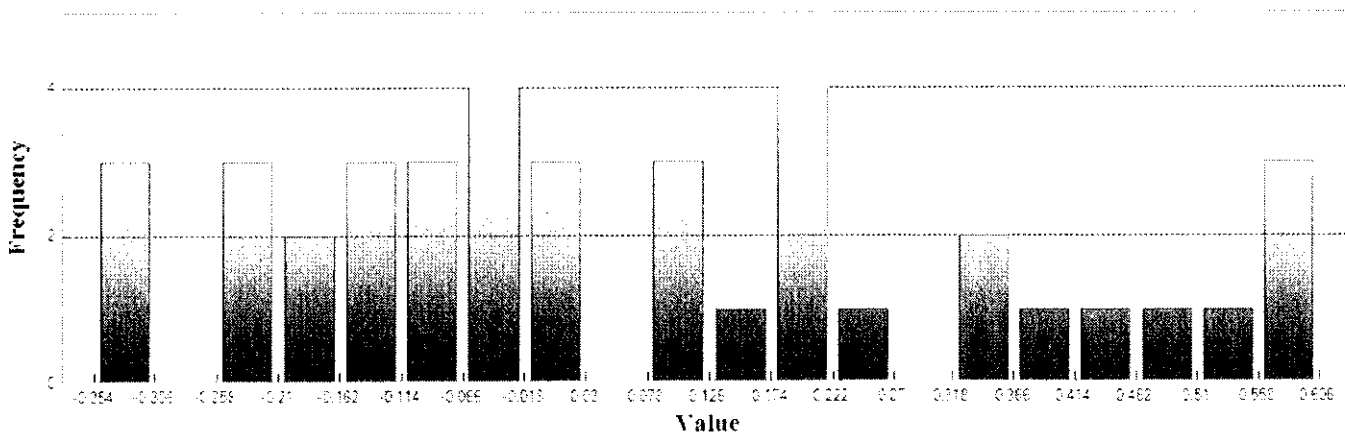
Standard Deviation DZ: 0.276

RMSE Z: 0.281

95% Confidence Level Z: 0.551

Units: US Survey Feet

Histogram



Min: -0.354

Max: 0.606

Number Of Bins: 20

Bin Interval: 0.048

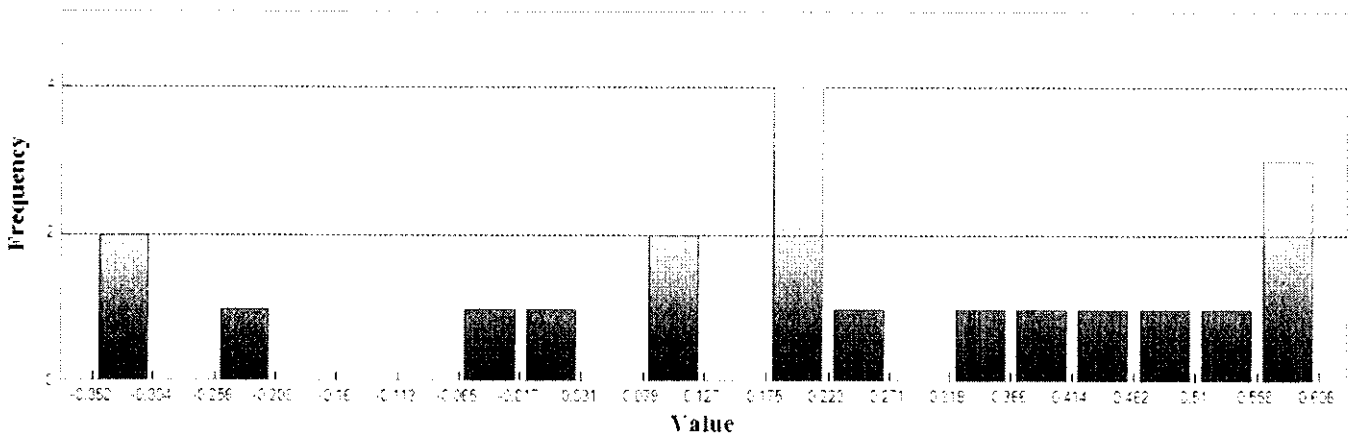


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2B
Minimum DZ: -0.352
Maximum DZ: 0.606
Mean DZ: 0.211
Mean Magnitude DZ: 0.556
Number Observations: 20
Standard Deviation DZ: 0.295
RMSE Z: 0.357
95th Percentile: 0.594
Units: US Survey Feet

Histogram



Min: -0.352
Max: 0.606
Number Of Bins: 20
Bin Interval: 0.048

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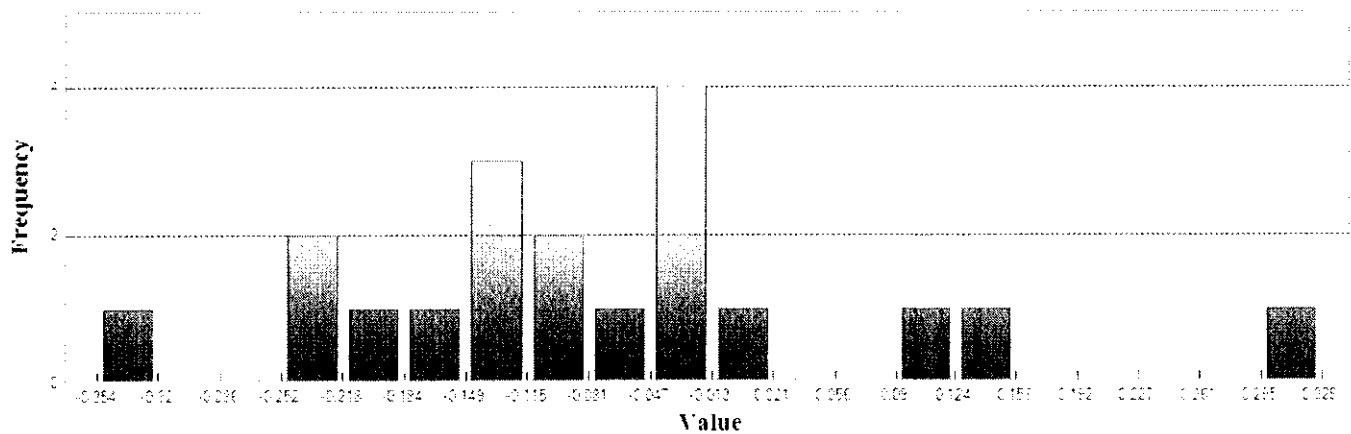


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2U
Minimum DZ: -0.354
Maximum DZ: 0.329
Mean DZ: -0.078
Mean Magnitude DZ: 0.369
Number Observations: 19
Standard Deviation DZ: 0.152
RMSE Z: 0.167
95th Percentile: 0.332
Units: US Survey Feet

Histogram



Min: -0.354
Max: 0.329
Number Of Bins: 20
Bin Interval: 0.034

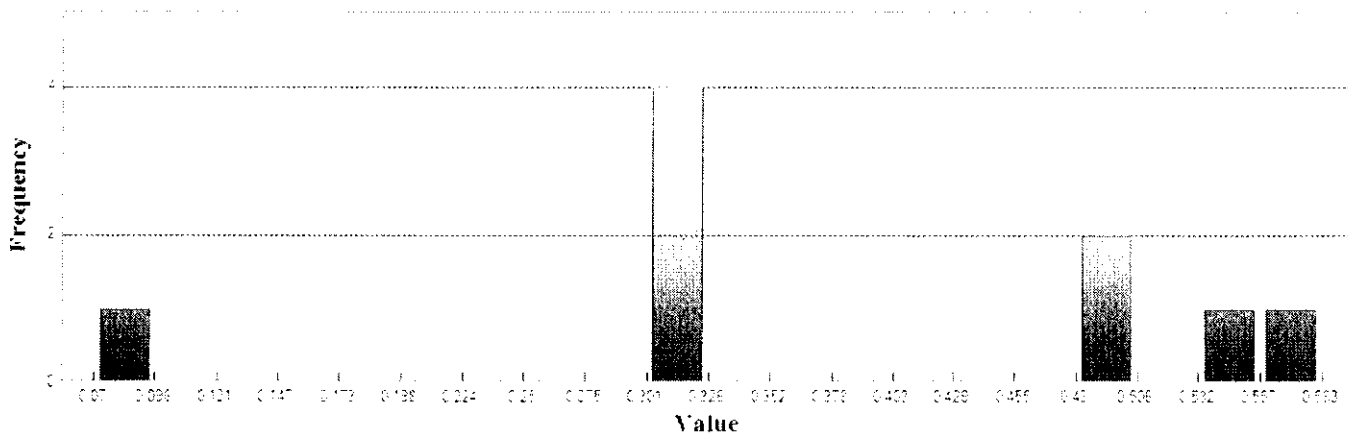


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2M
Minimum DZ: 0.07
Maximum DZ: 0.583
Mean DZ: 0.38
Mean Magnitude DZ: 0.617
Number Observations: 9
Standard Deviation DZ: 0.161
RMSE Z: 0.409
95th Percentile: 0.566
Units: US Survey Feet

Histogram



Min: 0.07
Max: 0.583
Number Of Bins: 20
Bin Interval: 0.026

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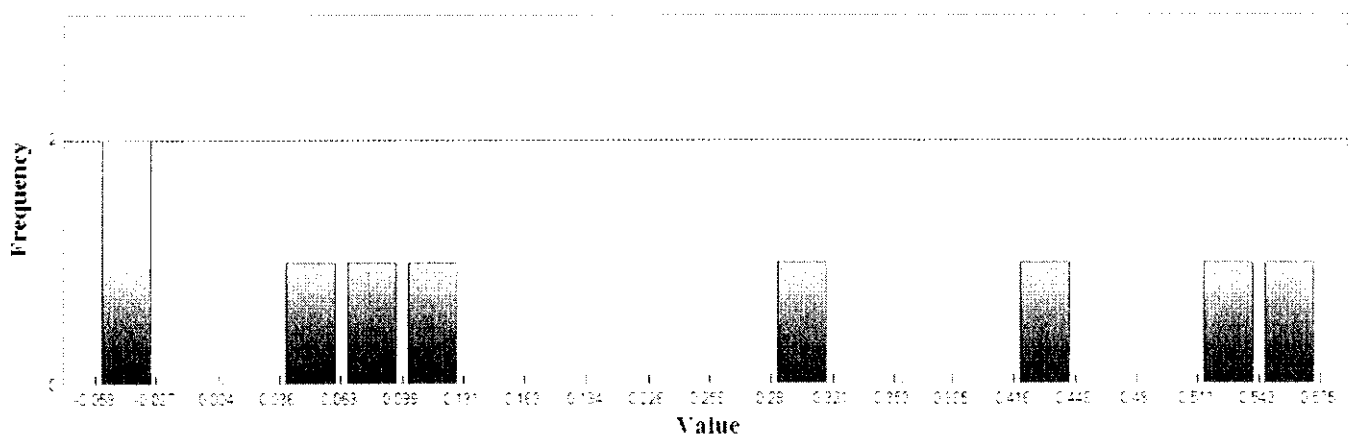


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2H
Minimum DZ: -0.059
Maximum DZ: 0.575
Mean DZ: 0.223
Mean Magnitude DZ: 0.493
Number Observations: 9
Standard Deviation DZ: 0.241
RMSE Z: 0.318
95th Percentile: 0.55
Units: US Survey Feet

Histogram



Min: -0.059
Max: 0.575
Number Of Bins: 20
Bin Interval: 0.032

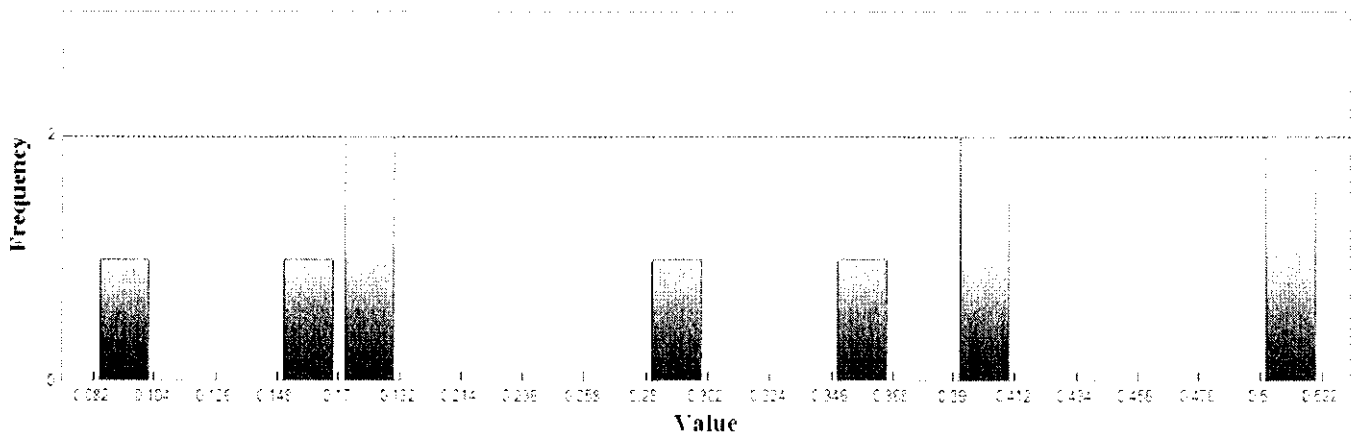


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2L
Minimum DZ: 0.082
Maximum DZ: 0.522
Mean DZ: 0.307
Mean Magnitude DZ: 0.554
Number Observations: 10
Standard Deviation DZ: 0.155
RMSE Z: 0.34
95th Percentile: 0.519
Units: US Survey Feet

Histogram



Min: 0.082

Max: 0.522

Number Of Bins: 20

Bin Interval: 0.022

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LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: 2M, 2H, 2L

Minimum DZ: -0.059

Maximum DZ: 0.583

Mean DZ: 0.303

Mean Magnitude DZ: 0.557

Number Observations: 28

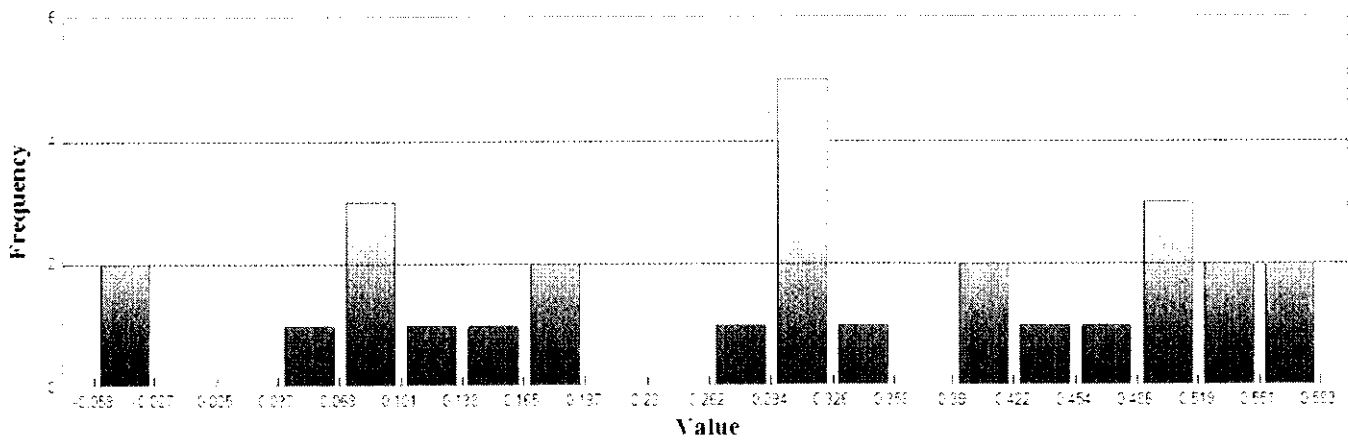
Standard Deviation DZ: 0.192

RMSE Z: 0.357

95th Percentile: 0.563

Units: US Survey Feet

Histogram



Min: -0.059

Max: 0.583

Number Of Bins: 20

Bin Interval: 0.032

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Project Information

Prepared By: Watson Ross
Project Name: 2015 Phase 3 LiDAR QC
Sensor Info: N/A
Required Nominal Pulse Spacing: 0.7
Vendor Name: Woolpert, Inc.
Units: US Survey Feet
Percent of Extent Tolerance: Extents Not Checked
Date of Acquisition: Start: 1/5/2015 Finish: 3/31/2015

Metadata Information

Tile Index:

Path: \\ncemjfhqf\gis\lidar\2015\phase_3\qc\county_files\scotland_files.shp

Number of Polys: 0

Intensity:

Tile Index Attribute: Not Specified

Path to Data: Not Specified

Number of Data Files Matching Attribute: Not Specified

DEM:

Tile Index Attribute: Not Specified

Path to Data: Not Specified

Number of Data Files Matching Attribute: Not Specified

LAS:

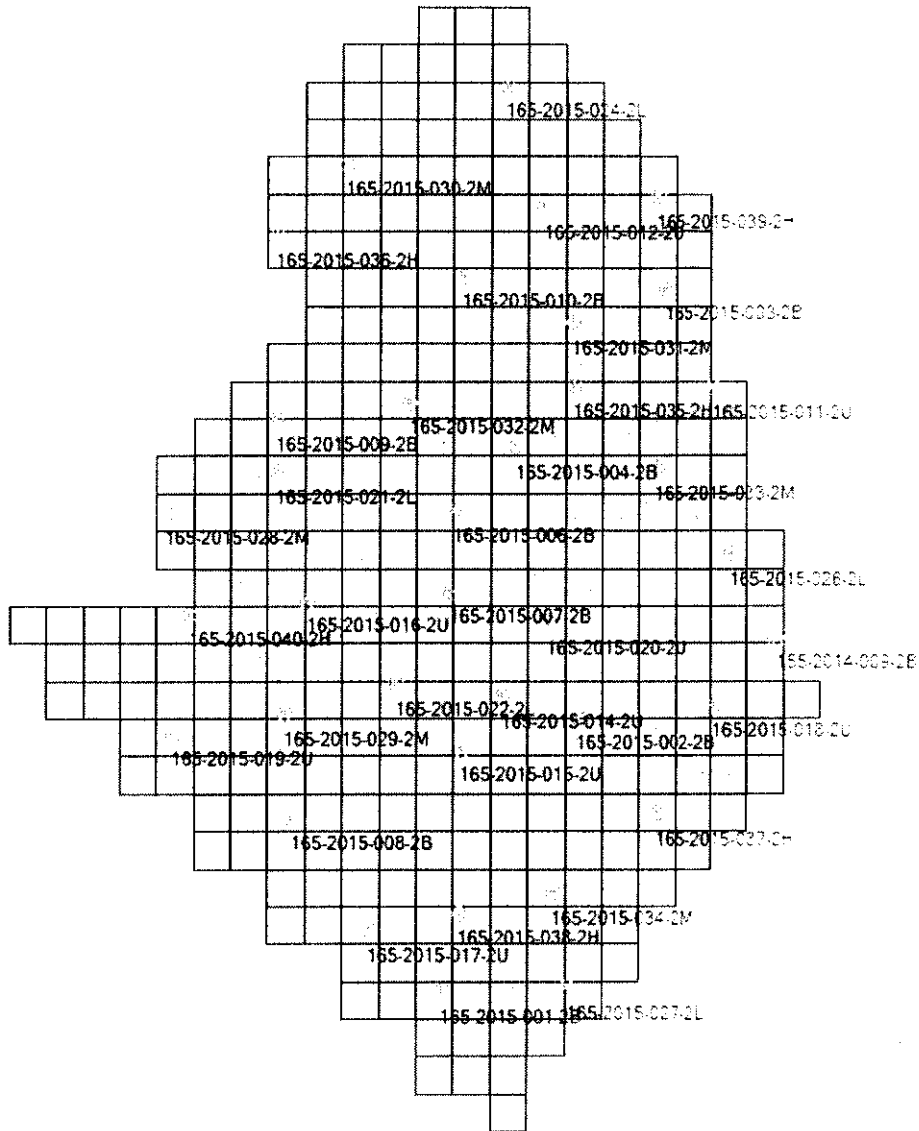
Tile Index Attribute: LiDARTiles

Path to Data: \\ncemjfhqf\gis\lidar\2015\phase_3\qc\county_files\scotland_files\shp

Number of Data Files Matching Attribute: 360 out of 360



Tiled-Data Area



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LIDAR Accuracy Assessment Summary

LC Type	# of Points	NVA	SVA	VVA
LAS				
ALL	37			
2B	10	0.589	0.482	
2U	9	0.373	0.309	
2L	5		0.363	0.363
2M	7		0.752	0.752
2H	6		1.246	1.246
Total	37			

Units: US Survey Feet

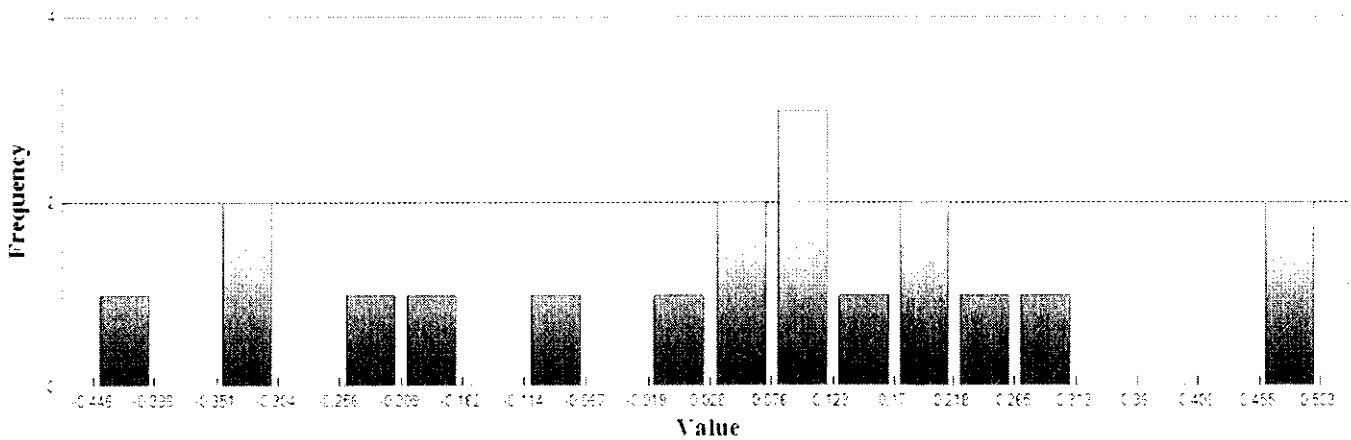


LAS

Non-vegetated Vertical Accuracy

LandCover Type: 2B, 2U
Minimum DZ: -0.447
Maximum DZ: 0.502
Mean DZ: 0.045
Mean Magnitude DZ: 0.46
Number Observations: 19
Standard Deviation DZ: 0.257
RMSE Z: 0.254
95% Confidence Level Z: 0.498
Units: US Survey Feet

Histogram



Min: -0.447
Max: 0.502
Number Of Bins: 20
Bin Interval: 0.047

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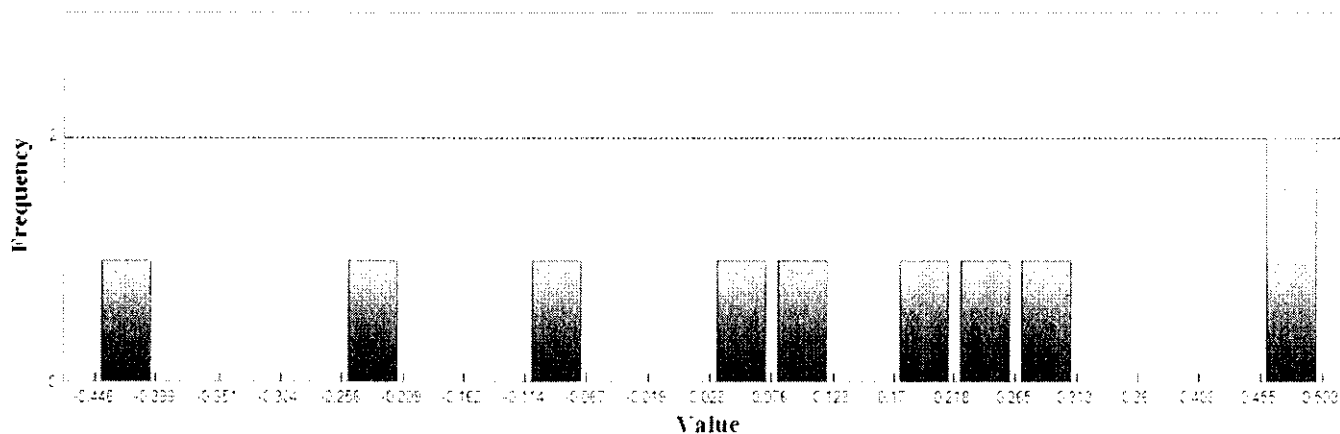


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2B
Minimum DZ: -0.447
Maximum DZ: 0.502
Mean DZ: 0.106
Mean Magnitude DZ: 0.505
Number Observations: 10
Standard Deviation DZ: 0.296
RMSE Z: 0.3
95th Percentile: 0.482
Units: US Survey Feet

Histogram



Min: -0.447

Max: 0.502

Number Of Bins: 20

Bin Interval: 0.047

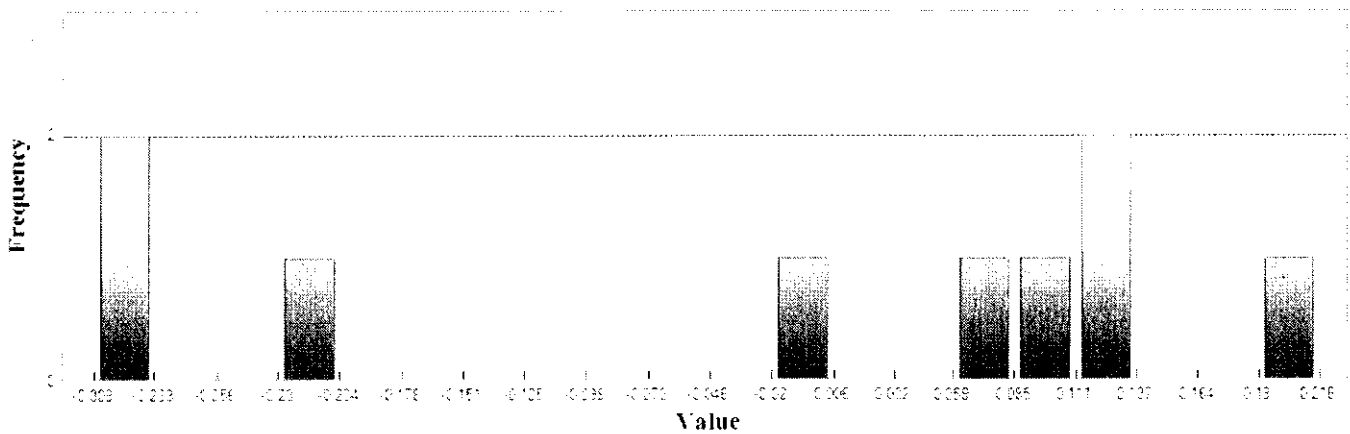


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2U
Minimum DZ: -0.309
Maximum DZ: 0.216
Mean DZ: -0.023
Mean Magnitude DZ: 0.404
Number Observations: 9
Standard Deviation DZ: 0.2
RMSE Z: 0.19
95th Percentile: 0.309
Units: US Survey Feet

Histogram



Min: -0.309
Max: 0.216
Number Of Bins: 20
Bin Interval: 0.026

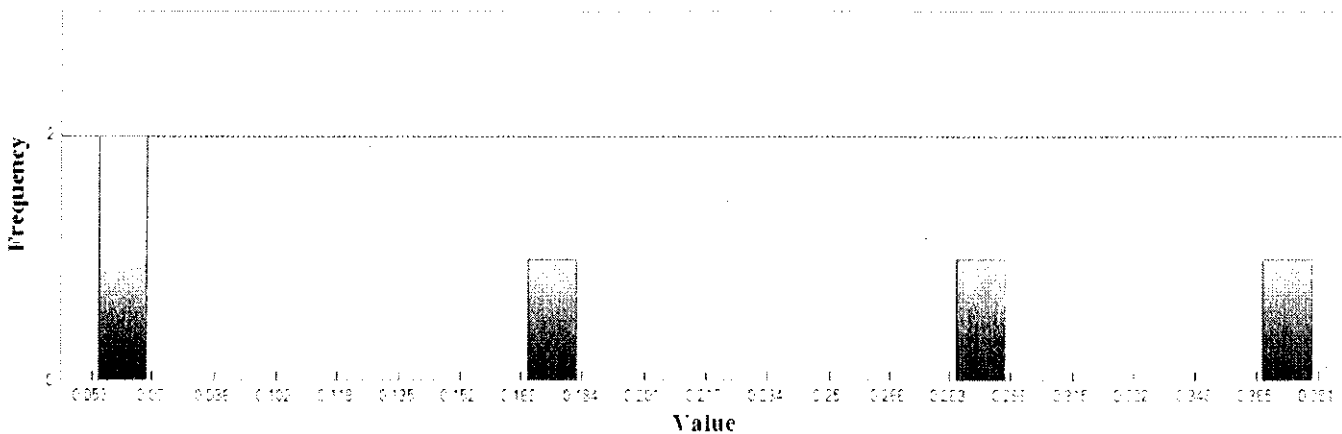


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2L
Minimum DZ: 0.054
Maximum DZ: 0.381
Mean DZ: 0.191
Mean Magnitude DZ: 0.437
Number Observations: 5
Standard Deviation DZ: 0.145
RMSE Z: 0.231
95th Percentile: 0.363
Units: US Survey Feet

Histogram



Min: 0.054
Max: 0.381
Number Of Bins: 20
Bin Interval: 0.016

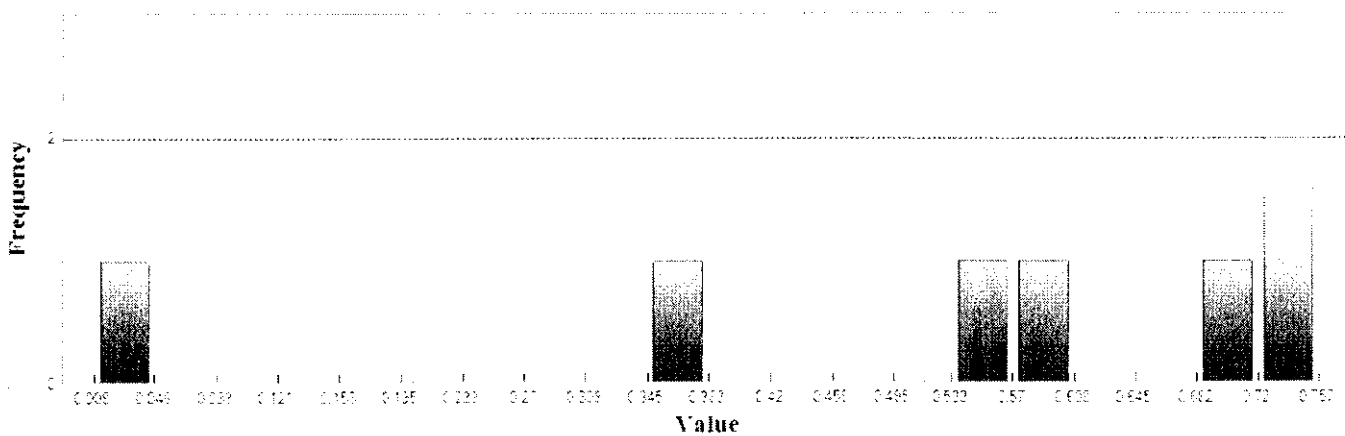


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2M
Minimum DZ: 0.008
Maximum DZ: 0.757
Mean DZ: 0.533
Mean Magnitude DZ: 0.73
Number Observations: 7
Standard Deviation DZ: 0.267
RMSE Z: 0.588
95th Percentile: 0.752
Units: US Survey Feet

Histogram



Min: 0.008

Max: 0.757

Number Of Bins: 20

Bin Interval: 0.037

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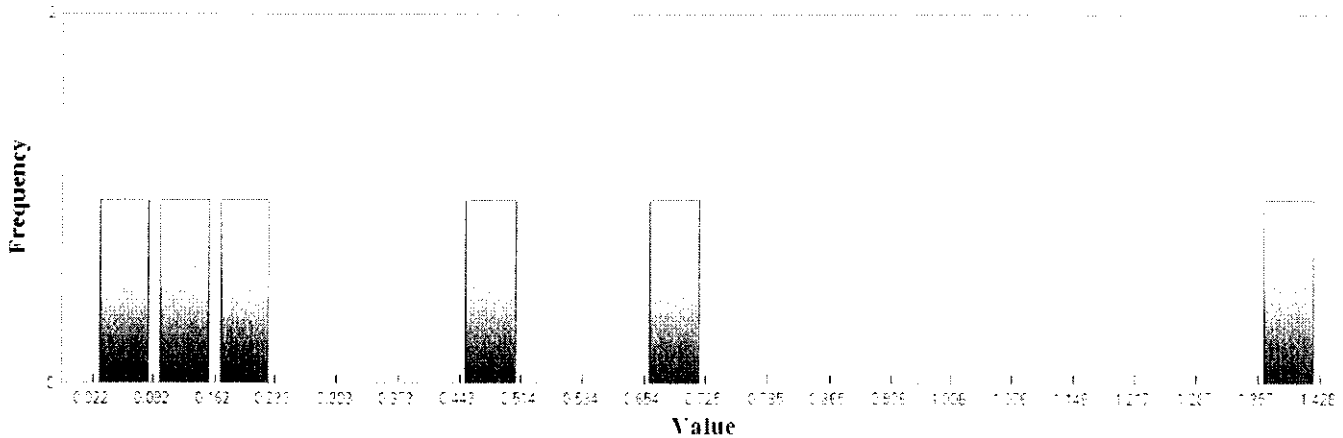


LAS (Continued)

Supplemental Vertical Accuracy

LandCover Type: 2H
Minimum DZ: 0.022
Maximum DZ: 1.428
Mean DZ: 0.493
Mean Magnitude DZ: 0.702
Number Observations: 6
Standard Deviation DZ: 0.523
RMSE Z: 0.686
95th Percentile: 1.246
Units: US Survey Feet

Histogram



Min: 0.022

Max: 1.428

Number Of Bins: 20

Bin Interval: 0.07



LAS (Continued)

Vegetated Vertical Accuracy

LandCover Type: 2L, 2M, 2H

Minimum DZ: 0.008

Maximum DZ: 1.428

Mean DZ: 0.425

Mean Magnitude DZ: 0.652

Number Observations: 18

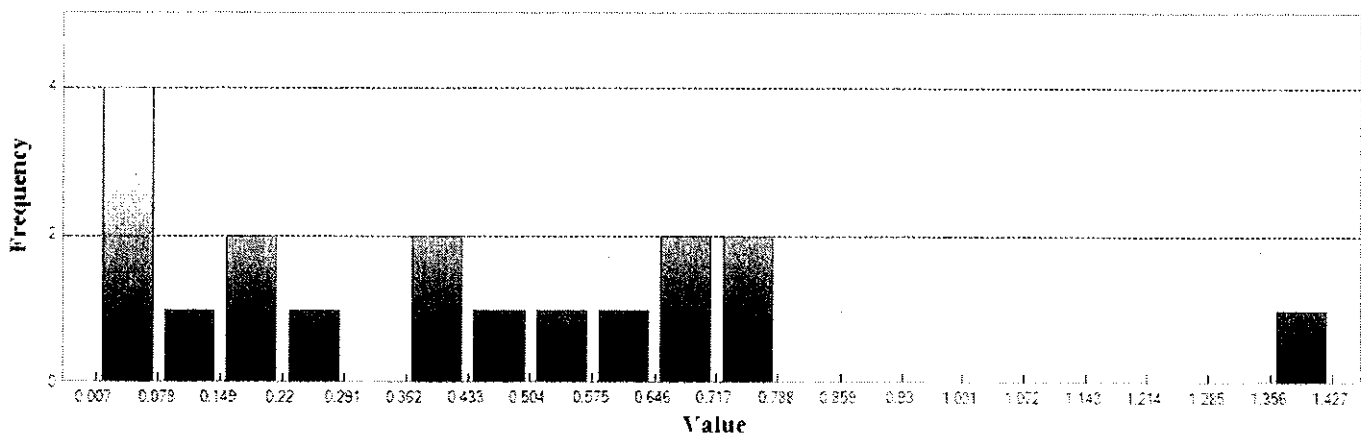
Standard Deviation DZ: 0.365

RMSE Z: 0.553

95th Percentile: 0.858

Units: US Survey Feet

Histogram



Min: 0.008

Max: 1.428

Number Of Bins: 20

Bin Interval: 0.071

Station Name	PID	NAVD88		Latitude DMS	NAD83(2011) Epoch 2010.0		SPC East (m)	SPC Combined Factor
		Ellipsoid Height (m)	Orthometric Height (m)		Longitude DMS	SPC North (m)		
POLKTON CORS ARP	DG7402	84.929	115.530	34 59 33.17297 N	080 10 37.85763 W	138473.153	502143.744	0.99986944
LILLINGTON 2004 CORS ARP	DG5759	25.706	58.730	35 25 12.54674 N	078 48 40.33946 W	185286.626	626745.253	0.99987286
CARTHAGE CORS ARP	DG5938	149.613	181.000	35 20 30.04880 N	079 23 05.08515 W	176632.942	574629.599	0.99985034
LEXINGTON CORS ARP	DG5757	194.102	225.340	35 48 53.14318 N	080 13 46.20206 W	229736.512	498497.891	0.99989030
ALBEMARLE CORS ARP	DG5755	112.630	142.970	35 20 17.30339 N	080 12 48.52476 W	176846.600	499299.251	0.99985604
ASHEBORO 2 CORS ARP	DL6900	210.381	240.790	35 37 49.38501 N	079 45 53.75304 W	208859.939	540319.797	0.99986134
WILSON CORS ARP	DK7563	11.179	46.030	35 42 26.29637 N	077 55 57.08393 W	217645.964	706192.128	0.99990236
BURLINGTON CORS ARP	DF9213	173.401	203.610	36 05 29.58604 N	079 26 12.17620 W	259845.465	570271.809	0.99995269
WALNUT COVE CORS ARP	DL1894	276.319	309.540	36 22 19.68806 N	080 11 05.62514 W	291528.706	503266.558	1.00002046
WARRENTON CORS ARP	DM3529	76.208	109.530	36 23 41.68571 N	078 10 13.74958 W	293732.691	684023.061	1.00005974
LUMBERTON CORS ARP	DI1682	15.824	49.560	34 37 36.33605 N	079 04 39.69481 W	97263.238	602477.201	0.99992918
ELIZABETHTOWN CORS ARP	DI1680	-9.537	25.460	34 39 13.60147 N	078 31 11.73447 W	100363.878	653606.669	0.99992817
SANFORD CORS ARP	AM7024	95.450	127.140	35 28 24.67784 N	079 09 28.98436 W	191202.330	595258.352	0.99986507
DURHAM COOP CORS ARP	DG9328	117.466	148.790	35 59 46.12942 N	078 53 58.03641 W	249177.805	618666.816	0.99993843
CONCORD CORS ARP	DF7471	154.382	184.810	35 22 35.24392 N	080 33 51.11399 W	181542.684	467489.138	0.99985072
SMITHFIELD CORS ARP	DK6525	24.469	58.660	35 33 49.60980 N	078 20 10.80495 W	201405.073	669760.307	0.99988353
HIGH POINT CORS ARP	AI4198	267.948	299.220	35 57 56.48686 N	080 00 48.93737 W	246260.723	518178.455	0.99990805
GREENSBORO 5 CORS ARP	DJ6107	217.179	247.880	36 04 03.61208 N	079 44 41.84535 W	257360.899	542492.959	0.99993979
MONROE CORS ARP	DF5880	144.332	174.600	34 58 54.77687 N	080 31 25.79009 W	137720.671	470484.517	0.99986097
TROY CORS ARP	DK4045	144.044	174.590	35 22 01.84517 N	079 52 12.77094 W	179740.437	530528.389	0.99985200
JORDAN LAKE CORS ARP	DL3891	45.996	77.430	35 46 52.49646 N	079 02 03.92766 W	225330.877	606489.109	0.99990797
RALEIGH DOT CORS ARP	DG4687	51.789	85.040	35 45 49.50795 N	078 34 44.39448 W	223469.874	647669.715	0.99990429
NASHVILLE CORS ARP	DK7576	34.500	68.960	35 58 09.06797 N	078 01 11.34161 W	246618.195	698006.712	0.99994546
REIDSVILLE CORS ARP	DM3525	234.815	266.700	36 21 42.71489 N	079 39 56.54007 W	289954.707	549851.005	1.00002348
ROXBORO CORS ARP	DM3527	194.654	225.650	36 23 28.05620 N	078 59 54.41890 W	293001.606	609740.318	1.00003983
FAYETTEVILLE 2006 CORS ARP	DH9594	16.914	50.450	35 02 02.48998 N	078 52 14.73160 W	142444.626	621393.108	0.99987712
GOLDSBORO CORS ARP	DK5550	14.068	48.900	35 25 16.86892 N	078 03 30.57562 W	185808.939	695094.939	0.99987475
SALISBURY CORS ARP	DN5840	174.906	206.250	35 42 41.69212 N	080 25 55.99488 W	218535.902	480015.188	0.99987726
ROCKINGHAM CORS ARP	DM3995	91.872	122.950	34 57 51.98780 N	079 47 47.74087 W	135010.039	536859.244	0.99987067
RAEFORD BASE ARP		51.567	84.270	34 58 45.00929 N	079 13 04.01644 W	136373.746	589717.557	0.99987575
WINSTON SALEM 2 BASE ARP		252.005		36 06 20.42399 N	080 14 16.05963 W	262020.720	498150.922	0.99994400
CLINTON BASE ARP	DP9434	23.891	58.490	34 59 25.64828 N	078 21 31.47858 W	137793.223	668139.836	0.99987918

Note: Published positional informaton of published Continuous Operating Reference Stations (CORS) are denoted in meters (m)

Acronyms, Abbreviations, and Definitions

ARP – Antenna Reference Point

CORS – Continuous Operating Reference Station

DMS – Degrees Minutes Seconds

m – Meter

PID – Permanent Identifier

SPC – State Plane Coordinates

Statistical Definitions:

Nonvegetated Vertical Accuracy (NVA) – The vertical accuracy at the 95-percent confidence level in nonvegetated open terrain, where errors should approximate a normal distribution.

Supplemental Vertical Accuracy (SVA) – Term for reporting the vertical accuracy at the 95th percentile in each separate land cover category where vertical errors may not follow a normal error distribution.

Vegetated Vertical Accuracy (VVA) – An estimate of the vertical accuracy, based on the 95th percentile, in vegetated terrain where errors do not necessarily approximate a normal distribution.

Minimum DZ – This statistic represents the change in value between the Z-coordinate location based on LiDAR and Z-coordinate location in the survey. The minimum of each simply represents the smallest value out of all of the analyzed locations. This component of the statistics can be used to show which locations most closely correspond to the surveyed points.

Maximum DZ – This statistic represents the change in value between the Z-coordinate location based on LiDAR and Z-coordinate location in the survey. The maximum value of each represents the largest value out of all of the analyzed locations. Maximum values can be used to show which locations most closely correspond to the surveyed points.

Mean DZ - The statistic of the mean DZ is intended to show the average values of the DZ. These statistics show the change in value between the Z-coordinate location based on LiDAR and Z-coordinate location in the survey. The mean values can be used to show the average off-sets of all of the analyzed locations

Mean Magnitude DZ - The statistic of the mean DZ is intended to show the average values of the DZ. These statistics show the change in value between the Z-coordinate location based on LiDAR and Z-coordinate location in the survey. The mean values can be used to show the average off-sets of all of the analyzed locations.

Number Observations – Number of observations

Standard Deviation DZ - A measure of spread or dispersion of a sample of errors around the sample mean error. It is a measure of precision, rather than accuracy; the standard deviation does not account for uncorrected systematic errors.

RMSE Z - The square root of the average of the set of squared differences between dataset coordinate values and coordinate values from an independent source of higher accuracy for identical points. The RMSE is used to estimate the absolute accuracy of both horizontal and vertical coordinates when standard or accepted values are known, as with GPS-surveyed check points of higher accuracy than the data being tested. In the United States, the independent source of higher accuracy is expected to be at least three times more accurate than the dataset being tested. RMSE Z measures RMSE in the Z direction only.

95th Percentile – A measure used in statistics indicating the value below which a given percentage of observations (absolute values of errors) in a group of observations fall. For example, the 95th percentile is the value (or score) below which 95 percent of the observations may be found.