

Vertical Accuracy Report

Wisconsin WROC - 3DEP 2019
Lafayette County Lidar

The logo for Ayres Associates, featuring the word "AYRES" in a bold, sans-serif font. The letters are white with a blue outline, set against a white background that is part of a larger blue graphic element.

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Vertical Accuracy Report

Project Information

Prepared By: Ayres

Project Name: Wisconsin WROC – 3DEP Lafayette County Lidar 2019

Sensor Info: Riegl VQ 1560i, serial number 061

USGS Quality Level: 2

Required Nominal Pulse Spacing: 0.7

Contractor Name: Ayres

Units: US Survey Feet

Date of Acquisition: Start: 4/8/2019 Finish: 4/8/2019

Report Information

This report documents the absolute vertical accuracy of the lidar data collected for the Lafayette County, WI, QL2 lidar project. Independent ground control checkpoints were collected by land surveyors using Trimble GNSS equipment connected to WISCRS base stations. The checkpoints were collected from April 20, 2019, to May 1, 2019.

The checkpoints were collected under various land cover types that are predominant in the County. Each land cover type falls into either the Non-vegetated Vertical Accuracy (NVA) or the Vegetated Vertical Accuracy (VVA) group. For this project, 41 NVA points and 35 VVA points were collected throughout the County.

The following report shows the final statistics for the NVA checkpoints compared against the raw swath point cloud and the bare earth DEM, and the VVA statistics compared against the DEM. Statistics are reported for LAS and DEM by NVA and VVA categories and by land cover type.

Vertical Accuracy Specifications per USGS QL2 level:

LAS:

NVA equates to 10 cm RMSEz, or 19.6 cm (0.64 ft) at the 95% confidence level.

DEM:

NVA equates to 10 cm RMSEz, or 19.6 cm (0.64 ft) at the 95% confidence level.

VVA equates to 29.4 cm (0.96 ft) at the 95th percentile.

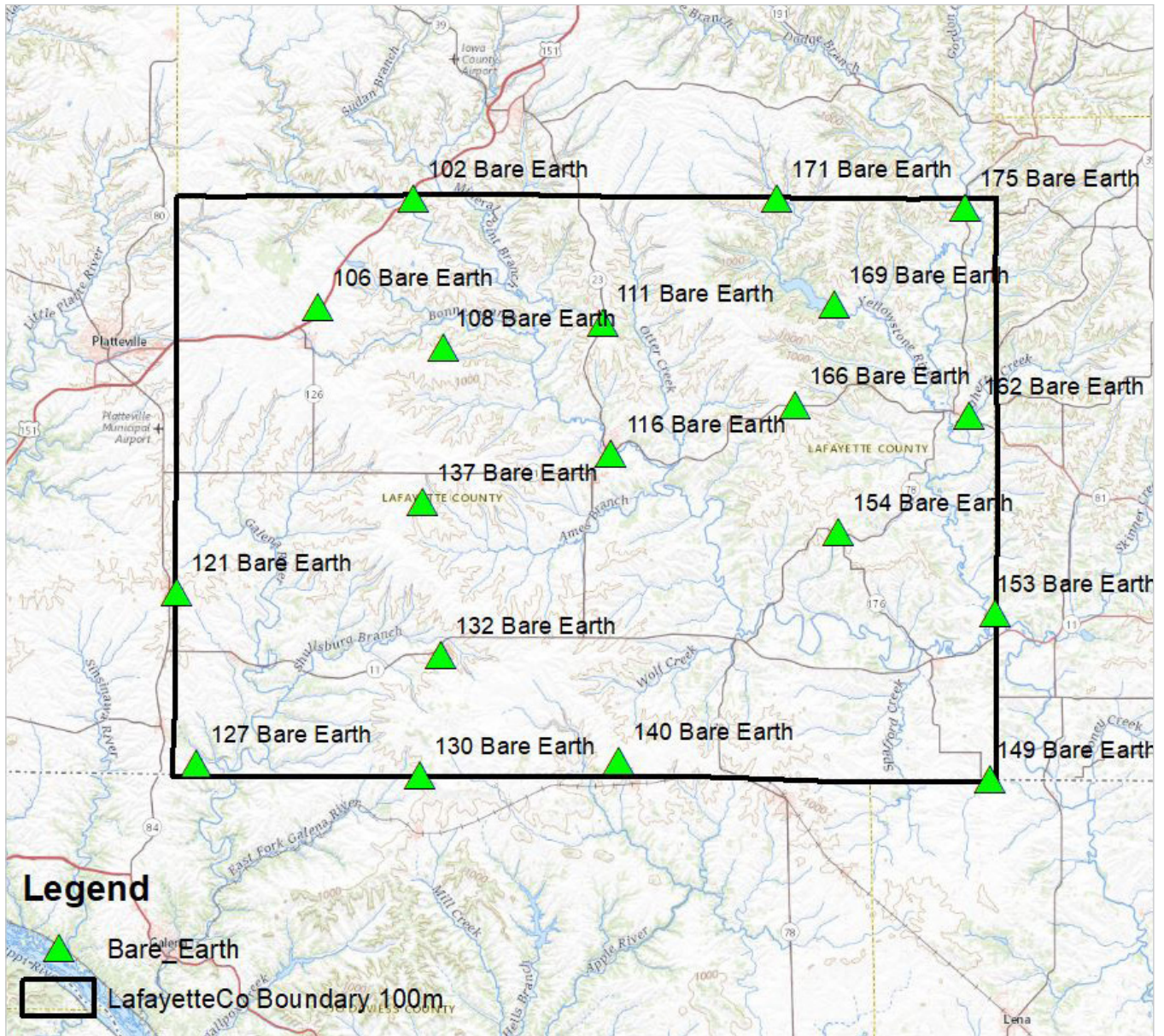
The NVA and VVA statistics for this project are within the above stated specifications.

Lidar Accuracy Assessment Summary

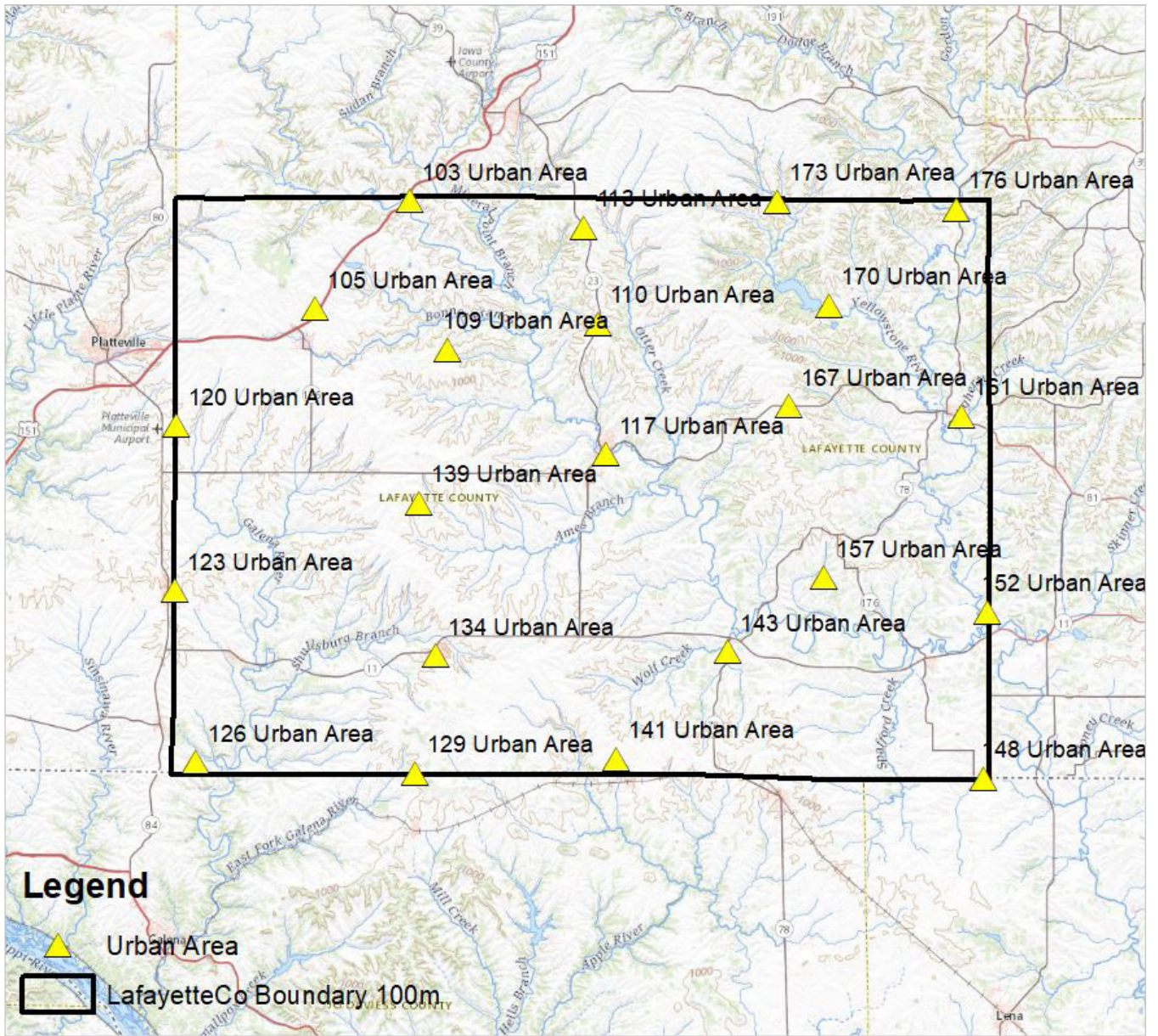
LAND COVER TYPE	# OF POINTS	NVA	VVA
LAS		95% confidence level	N/A
1. Bare Earth	19	0.270	N/A
2. Urban Areas	22	0.300	N/A
3. Tall Weeds	20	N/A	N/A
5. Forest	15	N/A	N/A
TOTAL	76	0.286	N/A
DEM		95% confidence level	95th percentile
1. Bare Earth	19	0.258	N/A
2. Urban Areas	22	0.280	N/A
3. Tall Weeds	20	N/A	0.471
5. Forest	15	N/A	0.216
TOTAL	76	0.270	0.417

Units: US Survey Feet

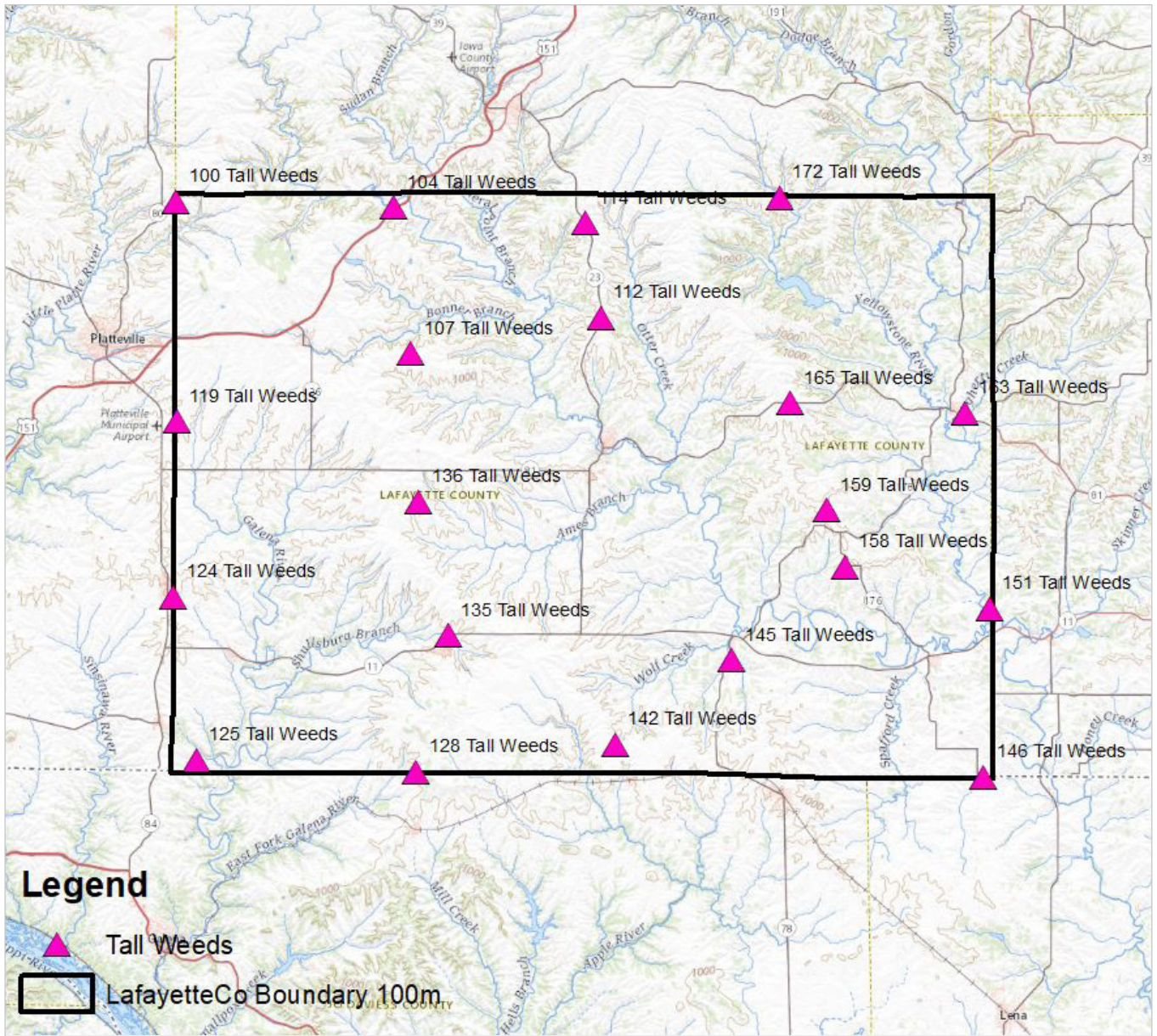
Map of NVA Checkpoint Locations - 1. Bare Earth



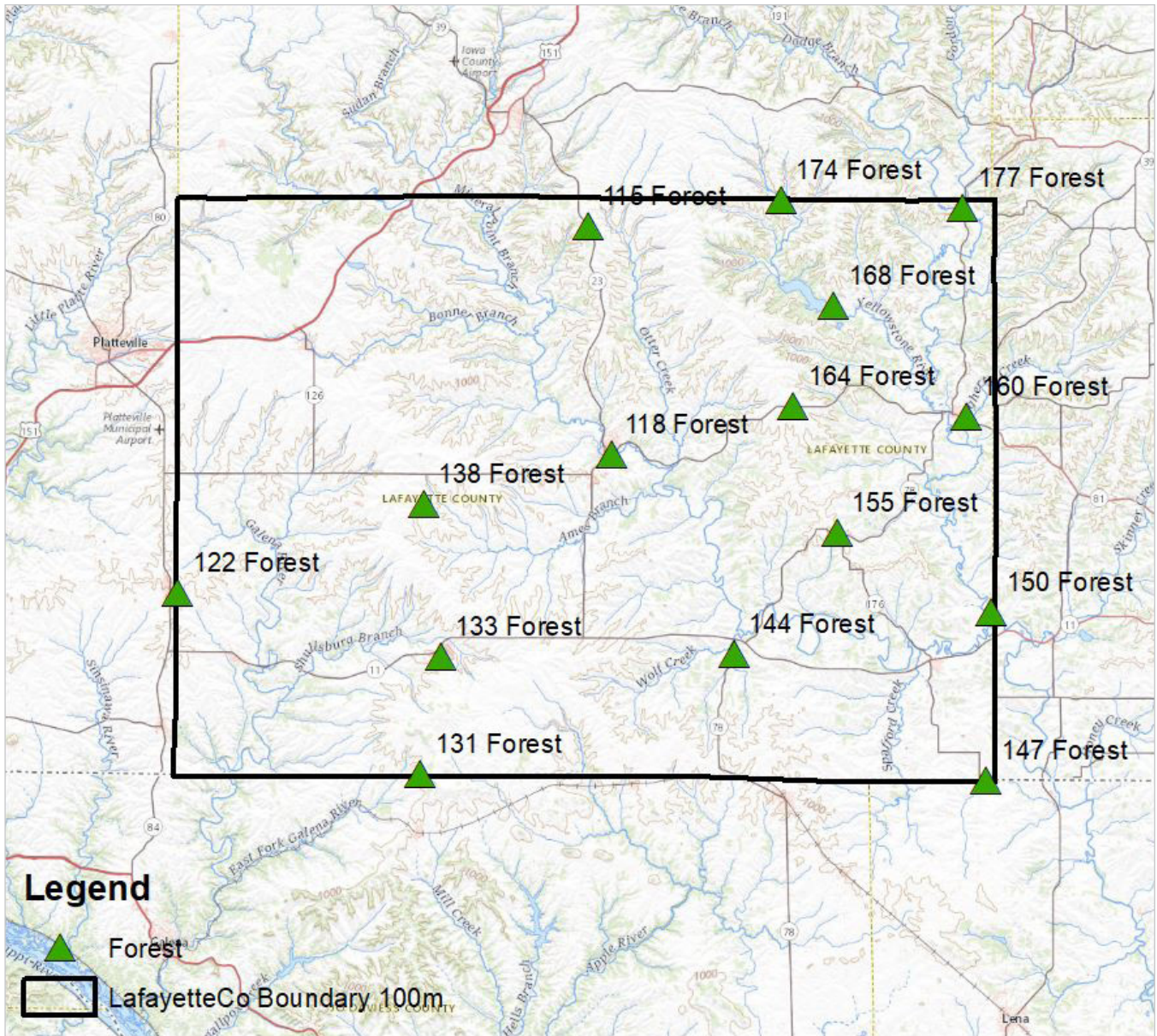
Map of NVA Checkpoint Locations - 2. Urban Areas



Map of VVA Checkpoint Locations - 3. Tall Weeds



Map of VVA Checkpoint Locations - 5. Forested Areas



LAS

NONVEGETATED VERTICAL ACCURACY – OVERALL	
Land Cover Type	1. Bare Earth, 2. Urban Areas
Minimum DZ	-0.303
Maximum DZ	0.302
Mean DZ	-0.106
Mean Magnitude DZ	0.356
Number Observations	41
Standard Deviation DZ	0.102
RMSE Z	0.146
95% Confidence Level Z	0.286
Units	US Survey Feet

DEM

NONVEGETATED VERTICAL ACCURACY – OVERALL	
Land Cover Type	1. Bare Earth, 2. Urban Areas
Minimum DZ	-0.256
Maximum DZ	0.166
Mean DZ	-0.106
Mean Magnitude DZ	0.345
Number Observations	41
Standard Deviation DZ	0.089
RMSE Z	0.138
95% Confidence Level Z	0.27
Units	US Survey Feet

DEM (Continued)

VEGETATED VERTICAL ACCURACY	
Land Cover Type	3. Tall Weeds
Minimum DZ	-0.142
Maximum DZ	0.522
Mean DZ	0.159
Mean Magnitude DZ	0.42
Number Observations	20
Standard Deviation DZ	0.174
RMSE Z	0.232
95% Confidence Level Z	0.471
Units	US Survey Feet

DEM (Continued)

VEGETATED VERTICAL ACCURACY	
Land Cover Type	5. Forest
Minimum DZ	-0.216
Maximum DZ	0.417
Mean DZ	0.056
Mean Magnitude DZ	0.329
Number Observations	15
Standard Deviation DZ	0.15
RMSE Z	0.155
95% Confidence Level Z	0.216
Units	US Survey Feet

Point: 100 Tall Weeds

Survey X: 400253.24, Survey Y: 213919.71, Z1: 1071.14, Z DEM: 1071.15, Z LAS: 1071.1, ΔZ DEM: 0.01, ΔZ LAS: -0.04



North



South



East



West

Point: 102 Bare Earth

Survey X: 445767.99, Survey Y: 214780.82, Z1: 912.76, Z DEM: 912.67, Z LAS: 912.67, ΔZ DEM: -0.08, ΔZ LAS: -0.09



North



South



East



West

Point: 103 Urban Area

Survey X: 445725.74, Survey Y: 214794.08, Z1: 913.46, Z DEM: 913.41, Z LAS: 913.38, ΔZ DEM: -0.05, ΔZ LAS: -0.08



North



South



East



West

Point: 104 Tall Weeds

Survey X: 442448.27, Survey Y: 212655.74, Z1: 1010.1, Z DEM: 1010.42, Z LAS: 1010.47, ΔZ DEM: 0.32, ΔZ LAS: 0.37



North



South



East



West

Point: 105 Urban Area

Survey X: 427140.93, Survey Y: 193781.93, Z1: 1099.94, Z DEM: 1099.76, Z LAS: 1099.82, ΔZ DEM: -0.18, ΔZ LAS: -0.12



North



South



East



West

Point: 106 Bare Earth

Survey X: 427308.5, Survey Y: 193842.52, Z1: 1102.15, Z DEM: 1102.22, Z LAS: 1102.17, ΔZ DEM: 0.08, ΔZ LAS: 0.02



North



South



Point: 107 Tall Weeds

Survey X: 445743.02, Survey Y: 184417.07, Z1: 1043.22, Z DEM: 1043.39, Z LAS: 1043.52, ΔZ DEM: 0.17, ΔZ LAS: 0.29



North



South



East



West

Point: 108 Bare Earth

Survey X: 451558.83, Survey Y: 185986.19, Z1: 1061.84, Z DEM: 1061.73, Z LAS: 1061.67, ΔZ DEM: -0.11, ΔZ LAS: -0.17



North



South



East



West

Point: 109 Urban Area

Survey X: 452943.81, Survey Y: 185727.72, Z1: 1053.13, Z DEM: 1052.91, Z LAS: 1052.93, ΔZ DEM: -0.21, ΔZ LAS: -0.2



North



South



East



West

Point: 110 Urban Area

Survey X: 482415.17, Survey Y: 190796.8, Z1: 1046.29, Z DEM: 1046.22, Z LAS: 1046.2, ΔZ DEM: -0.06, ΔZ LAS: -0.08



North



South



East



West

Point: 111 Bare Earth

Survey X: 482359.54, Survey Y: 190751.23, Z1: 1045.8, Z DEM: 1045.76, Z LAS: 1045.71, ΔZ DEM: -0.03, ΔZ LAS: -0.09



North



South



East



West

Point: 112 Tall Weeds

Survey X: 482542.03, Survey Y: 191281.8, Z1: 1022.31, Z DEM: 1022.29, Z LAS: 1022.44, ΔZ DEM: -0.02, ΔZ LAS: 0.12



North



South



East



West

Point: 113 Urban Area

Survey X: 479707.52, Survey Y: 209593.45, Z1: 1091.13, Z DEM: 1090.94, Z LAS: 1090.97, ΔZ DEM: -0.19, ΔZ LAS: -0.16



North



South



East



West

Point: 114 Tall Weeds

Survey X: 479725.29, Survey Y: 209716.64, Z1: 1079.21, Z DEM: 1079.24, Z LAS: 1079.02, ΔZ DEM: 0.03, ΔZ LAS: -0.19



North



South



East



West

Point: 115 Forest

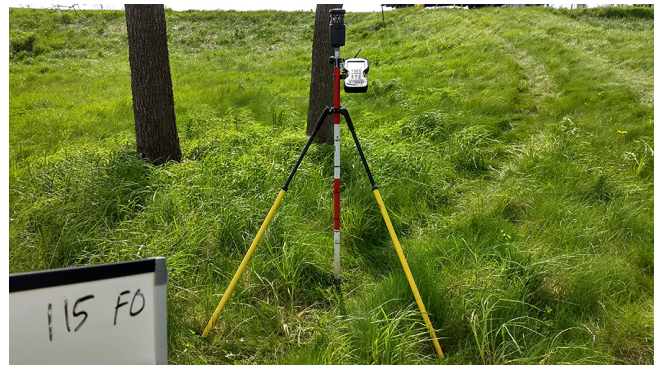
Survey X: 479681.95, Survey Y: 209866.67, Z1: 1079.38, Z DEM: 1079.53, Z LAS: 1079.52, ΔZ DEM: 0.15, ΔZ LAS: 0.14



North



South



Point: 116 Bare Earth

Survey X: 484033.68, Survey Y: 165525.05, Z1: 817.86, Z DEM: 817.79, Z LAS: 817.84, ΔZ DEM: -0.07, ΔZ LAS: -0.02



North



South



East



West

Point: 117 Urban Area

Survey X: 484039.27, Survey Y: 165458.37, Z1: 817.31, Z DEM: 817.26, Z LAS: 817.26, ΔZ DEM: -0.05, ΔZ LAS: -0.05



North



South



East



West

Point: 118 Forest

Survey X: 484067.47, Survey Y: 165558.28, Z1: 816.62, Z DEM: 816.65, Z LAS: 816.71, ΔZ DEM: 0.03, ΔZ LAS: 0.09



North



South



East



West

Point: 119 Tall Weeds

Survey X: 400322.65, Survey Y: 171247.95, Z1: 1031.89, Z DEM: 1031.75, Z LAS: 1031.69, ΔZ DEM: -0.14, ΔZ LAS: -0.21



North



South



East



West

Point: 120 Urban Area

Survey X: 400187.56, Survey Y: 171031.3, Z1: 1033.63, Z DEM: 1033.48, Z LAS: 1033.44, ΔZ DEM: -0.15, ΔZ LAS: -0.19



North



South



East



West

Point: 121 Bare Earth

Survey X: 400035.7, Survey Y: 138702.59, Z1: 1013.54, Z DEM: 1013.39, Z LAS: 1013.39, ΔZ DEM: -0.16, ΔZ LAS: -0.15



North



South



East



West

Point: 122 Forest

Survey X: 399986.97, Survey Y: 138749.13, Z1: 1012.48, Z DEM: 1012.48, Z LAS: 1012.49, ΔZ DEM: 0, ΔZ LAS: 0.01



North



South



East



West

Point: 123 Urban Area

Survey X: 399993.87, Survey Y: 138827.34, Z1: 1014.05, Z DEM: 1013.91, Z LAS: 1013.89, ΔZ DEM: -0.14, ΔZ LAS: -0.16



North



South



East



West

Point: 124 Tall Weeds

Survey X: 399717.07, Survey Y: 137178.91, Z1: 998.07, Z DEM: 998.17, Z LAS: 998.18, ΔZ DEM: 0.1, ΔZ LAS: 0.11



North



South



East



West

Point: 125 Tall Weeds

Survey X: 404102.87, Survey Y: 105533.33, Z1: 740.37, Z DEM: 740.71, Z LAS: 740.73, ΔZ DEM: 0.35, ΔZ LAS: 0.37



North



South



East



West

Point: 126 Urban Area

Survey X: 404018.36, Survey Y: 105469.47, Z1: 743.33, Z DEM: 743.35, Z LAS: 743.39, ΔZ DEM: 0.02, ΔZ LAS: 0.07



North



South



East



West

Point: 127 Bare Earth

Survey X: 403808.88, Survey Y: 105459.65, Z1: 748, Z DEM: 747.93, Z LAS: 747.95, ΔZ DEM: -0.07, ΔZ LAS: -0.05



North



South



East



West

Point: 128 Tall Weeds

Survey X: 446717.17, Survey Y: 103302.18, Z1: 986.3, Z DEM: 986.4, Z LAS: 986.42, ΔZ DEM: 0.1, ΔZ LAS: 0.12



North



South



East



West

Point: 129 Urban Area

Survey X: 446756.75, Survey Y: 103248.25, Z1: 992.01, Z DEM: 991.95, Z LAS: 991.94, ΔZ DEM: -0.06, ΔZ LAS: -0.06



North



South



East



West

Point: 130 Bare Earth

Survey X: 447003.05, Survey Y: 103274.86, Z1: 999.06, Z DEM: 998.99, Z LAS: 999.01, ΔZ DEM: -0.06, ΔZ LAS: -0.05



North



South



East



West

Point: 131 Forest

Survey X: 447099.97, Survey Y: 103360.81, Z1: 993.46, Z DEM: 993.46, Z LAS: 993.5, ΔZ DEM: 0, ΔZ LAS: 0.04



North



South



East



West

Point: 132 Bare Earth

Survey X: 451112.72, Survey Y: 126431.22, Z1: 987.18, Z DEM: 986.98, Z LAS: 987.02, ΔZ DEM: -0.19, ΔZ LAS: -0.16



North



South



East



West

Point: 133 Forest

Survey X: 450909.42, Survey Y: 126301.92, Z1: 1001.7, Z DEM: 1001.48, Z LAS: 1001.51, ΔZ DEM: -0.22, ΔZ LAS: -0.19



North



South



East



West

Point: 134 Urban Area

Survey X: 450718.07, Survey Y: 126172.3, Z1: 1010.33, Z DEM: 1010.08, Z LAS: 1010.08, ΔZ DEM: -0.25, ΔZ LAS: -0.25



North



South



East



West

Point: 135 Tall Weeds

Survey X: 452975.77, Survey Y: 129786.87, Z1: 938.38, Z DEM: 938.48, Z LAS: 938.48, ΔZ DEM: 0.1, ΔZ LAS: 0.1



North



South



East



West

Point: 136 Tall Weeds

Survey X: 447334.57, Survey Y: 155679.71, Z1: 1048.53, Z DEM: 1048.51, Z LAS: 1048.5, ΔZ DEM: -0.02, ΔZ LAS: -0.03



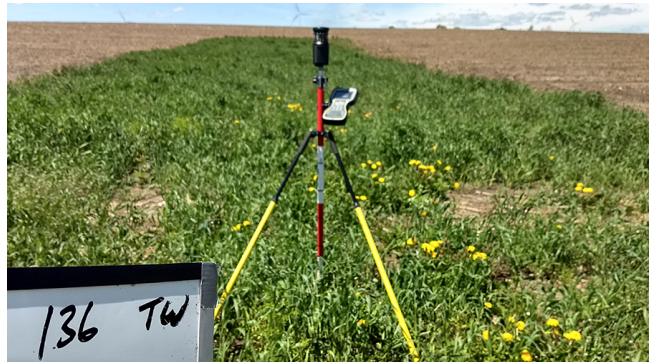
North



South



East



West

Point: 137 Bare Earth

Survey X: 447419.48, Survey Y: 156035.71, Z1: 1050.2, Z DEM: 1050.03, Z LAS: 1050.03, ΔZ DEM: -0.17, ΔZ LAS: -0.17



North



South



East



West

Point: 138 Forest

Survey X: 447678.57, Survey Y: 155794.49, Z1: 1038.76, Z DEM: 1038.61, Z LAS: 1038.58, ΔZ DEM: -0.15, ΔZ LAS: -0.19



North



South



East



West

Point: 139 Urban Area

Survey X: 447395.47, Survey Y: 155941.11, Z1: 1052.05, Z DEM: 1051.86, Z LAS: 1051.85, ΔZ DEM: -0.19, ΔZ LAS: -0.2



North



South



East



West

Point: 140 Bare Earth

Survey X: 485516.68, Survey Y: 106071.71, Z1: 1029.35, Z DEM: 1029.18, Z LAS: 1029.2, ΔZ DEM: -0.17, ΔZ LAS: -0.15



North



South



East



West

Point: 141 Urban Area

Survey X: 485816.18, Survey Y: 106048.51, Z1: 1029.94, Z DEM: 1029.7, Z LAS: 1029.76, ΔZ DEM: -0.24, ΔZ LAS: -0.18



North



South



East



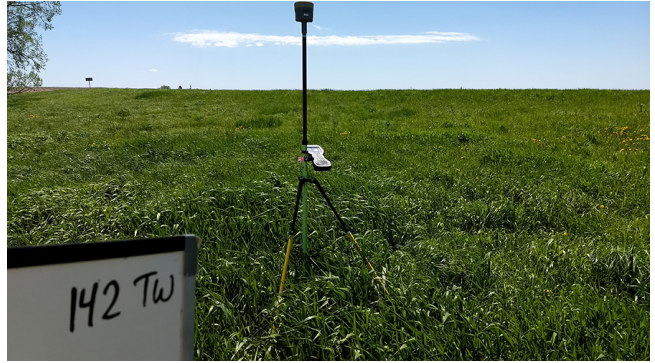
West

Point: 142 Tall Weeds

Survey X: 485387.43, Survey Y: 108628.89, Z1: 1032.93, Z DEM: 1032.99, Z LAS: 1033.03, ΔZ DEM: 0.06, ΔZ LAS: 0.1



North



South



East



West

Point: 143 Urban Area

Survey X: 507739.38, Survey Y: 126916.17, Z1: 805.96, Z DEM: 805.95, Z LAS: 805.89, ΔZ DEM: -0.01, ΔZ LAS: -0.07



North



South



East



West

Point: 144 Forest

Survey X: 507841.87, Survey Y: 126796.35, Z1: 809.22, Z DEM: 809.21, Z LAS: 809.23, ΔZ DEM: 0, ΔZ LAS: 0.01



North



South



East



West

Point: 145 Tall Weeds

Survey X: 507915.07, Survey Y: 124974.32, Z1: 811, Z DEM: 811.12, Z LAS: 811.03, ΔZ DEM: 0.12, ΔZ LAS: 0.03



North



South



East



West

Point: 146 Tall Weeds

Survey X: 556856.01, Survey Y: 102244.04, Z1: 806.23, Z DEM: 806.37, Z LAS: 806.24, ΔZ DEM: 0.13, ΔZ LAS: 0



North



South



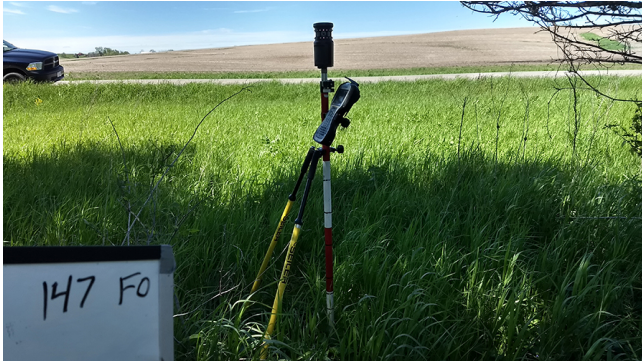
East



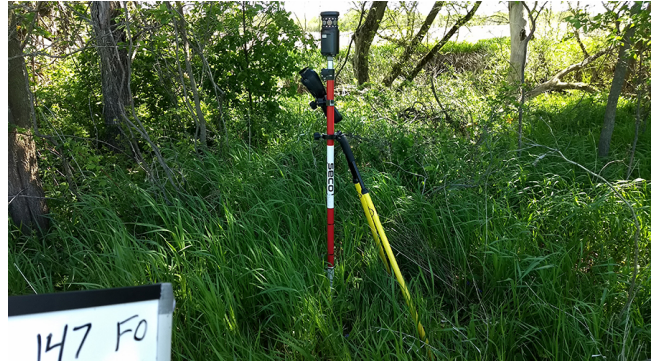
West

Point: 147 Forest

Survey X: 556811.18, Survey Y: 102225.91, Z1: 806.07, Z DEM: 806.1, Z LAS: 806.03, ΔZ DEM: 0.03, ΔZ LAS: -0.04



North



South



East



West

Point: 148 Urban Area

Survey X: 557429.26, Survey Y: 102293, Z1: 807.42, Z DEM: 807.16, Z LAS: 807.11, ΔZ DEM: -0.26, ΔZ LAS: -0.3



North



South



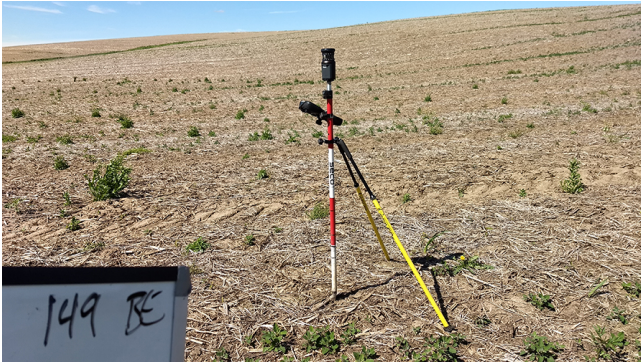
East



West

Point: 149 Bare Earth

Survey X: 557359.4, Survey Y: 102347.61, Z1: 805.23, Z DEM: 805.06, Z LAS: 805.09, ΔZ DEM: -0.17, ΔZ LAS: -0.14



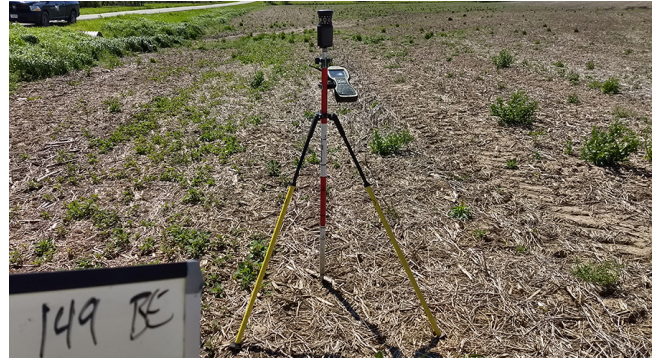
North



South



East



West

Point: 150 Forest

Survey X: 557896.31, Survey Y: 134969.73, Z1: 788.15, Z DEM: 788.34, Z LAS: 788.21, ΔZ DEM: 0.19, ΔZ LAS: 0.06



North



South



East



West

Point: 151 Tall Weeds

Survey X: 557929.42, Survey Y: 134922.2, Z1: 787.7, Z DEM: 788.22, Z LAS: 788.07, ΔZ DEM: 0.52, ΔZ LAS: 0.37



North



South



East



West

Point: 152 Urban Area

Survey X: 558222.46, Survey Y: 134684.18, Z1: 787.82, Z DEM: 787.8, Z LAS: 787.76, ΔZ DEM: -0.03, ΔZ LAS: -0.06



North



South



East



West

Point: 153 Bare Earth

Survey X: 558245.11, Survey Y: 134624.38, Z1: 786.94, Z DEM: 786.91, Z LAS: 786.91, ΔZ DEM: -0.03, ΔZ LAS: -0.03



North



South



East



West

Point: 154 Bare Earth

Survey X: 527903.45, Survey Y: 150180.73, Z1: 1021.1, Z DEM: 1020.91, Z LAS: 1020.88, ΔZ DEM: -0.19, ΔZ LAS: -0.22



North



South



East



West

Point: 155 Forest

Survey X: 527837.25, Survey Y: 150218.3, Z1: 1020.56, Z DEM: 1020.57, Z LAS: 1020.67, ΔZ DEM: 0.01, ΔZ LAS: 0.11



North



South



East



West

Point: 157 Urban Area

Survey X: 526525.71, Survey Y: 141380.14, Z1: 945.26, Z DEM: 945.21, Z LAS: 945.2, ΔZ DEM: -0.05, ΔZ LAS: -0.06



North



South



East



West

Point: 158 Tall Weeds

Survey X: 529951.73, Survey Y: 143038.16, Z1: 986.82, Z DEM: 987.02, Z LAS: 987.01, ΔZ DEM: 0.2, ΔZ LAS: 0.19



North



South



East



West

Point: 159 Tall Weeds

Survey X: 526523.29, Survey Y: 154059.47, Z1: 973.78, Z DEM: 973.83, Z LAS: 973.83, ΔZ DEM: 0.05, ΔZ LAS: 0.05



North



South



East



West

Point: 160 Forest

Survey X: 553044.94, Survey Y: 172795.34, Z1: 800.47, Z DEM: 800.89, Z LAS: 800.86, ΔZ DEM: 0.42, ΔZ LAS: 0.4



North



South



East



West

Point: 161 Urban Area

Survey X: 553169.47, Survey Y: 172810.52, Z1: 800.12, Z DEM: 800.03, Z LAS: 800.02, ΔZ DEM: -0.08, ΔZ LAS: -0.09



North



South



East



West

Point: 162 Bare Earth

Survey X: 553264.96, Survey Y: 172780.75, Z1: 799.13, Z DEM: 798.97, Z LAS: 798.98, ΔZ DEM: -0.16, ΔZ LAS: -0.15



North



South



East



West

Point: 163 Tall Weeds

Survey X: 553243.88, Survey Y: 172826.82, Z1: 797.4, Z DEM: 797.87, Z LAS: 797.81, ΔZ DEM: 0.47, ΔZ LAS: 0.41



North



South



East



West

Point: 164 Forest

Survey X: 519401.5, Survey Y: 174793.33, Z1: 1062.43, Z DEM: 1062.61, Z LAS: 1062.79, AZ DEM: 0.18, AZ LAS: 0.35



North



South



East



West

Point: 165 Tall Weeds

Survey X: 519427.05, Survey Y: 174776.38, Z1: 1062.71, Z DEM: 1063.08, Z LAS: 1063.07, ΔZ DEM: 0.38, ΔZ LAS: 0.36



North



South



East



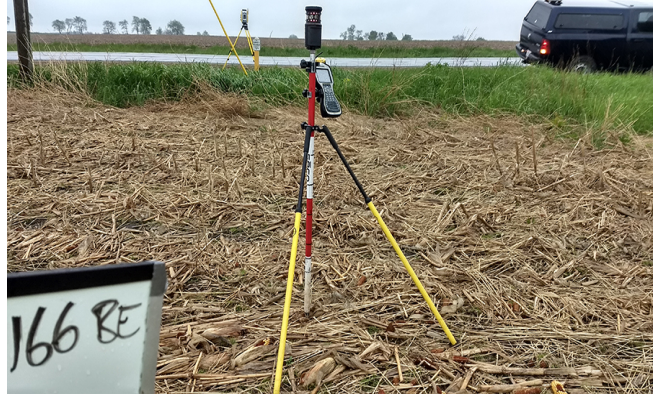
West

Point: 166 Bare Earth

Survey X: 519479.03, Survey Y: 174791.3, Z1: 1060.92, Z DEM: 1061.09, Z LAS: 1061.22, ΔZ DEM: 0.17, ΔZ LAS: 0.3



North



South



East



West

Point: 167 Urban Area

Survey X: 519510.57, Survey Y: 174732.28, Z1: 1063.42, Z DEM: 1063.42, Z LAS: 1063.37, ΔZ DEM: 0, ΔZ LAS: -0.05



North



South



East



West

Point: 168 Forest

Survey X: 527266.82, Survey Y: 194257.9, Z1: 820.1, Z DEM: 820.22, Z LAS: 820.23, ΔZ DEM: 0.12, ΔZ LAS: 0.13



North



South



East



West

Point: 169 Bare Earth

Survey X: 527282.22, Survey Y: 194301.46, Z1: 819.72, Z DEM: 819.55, Z LAS: 819.58, ΔZ DEM: -0.17, ΔZ LAS: -0.14



North



South



East



West

Point: 170 Urban Area

Survey X: 527315.89, Survey Y: 194331.77, Z1: 820.64, Z DEM: 820.49, Z LAS: 820.44, ΔZ DEM: -0.15, ΔZ LAS: -0.21



North



South



East



West

Point: 171 Bare Earth

Survey X: 515949.12, Survey Y: 214685.48, Z1: 984.76, Z DEM: 984.62, Z LAS: 984.79, ΔZ DEM: -0.14, ΔZ LAS: 0.03



North



South



East



West

Point: 172 Tall Weeds

Survey X: 517198.06, Survey Y: 214671.74, Z1: 900.34, Z DEM: 900.58, Z LAS: 900.68, ΔZ DEM: 0.24, ΔZ LAS: 0.34



North



South



East



West

Point: 173 Urban Area

Survey X: 517213.1, Survey Y: 214637.41, Z1: 902.53, Z DEM: 902.4, Z LAS: 902.34, ΔZ DEM: -0.13, ΔZ LAS: -0.19



North



South



East



West

Point: 174 Forest

Survey X: 516967.77, Survey Y: 214696.39, Z1: 904.75, Z DEM: 904.85, Z LAS: 904.96, ΔZ DEM: 0.1, ΔZ LAS: 0.21



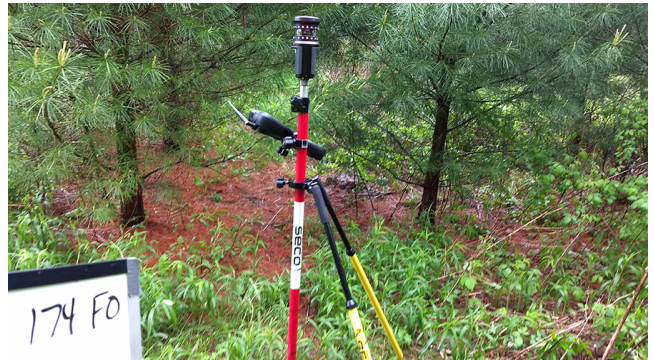
North



South



East



West

Point: 175 Bare Earth

Survey X: 552505.8, Survey Y: 213005.2, Z1: 814.52, Z DEM: 814.44, Z LAS: 814.44, ΔZ DEM: -0.08, ΔZ LAS: -0.08



North



South



East



West

Point: 176 Urban Area

Survey X: 552278.05, Survey Y: 213046.76, Z1: 816.58, Z DEM: 816.48, Z LAS: 816.42, ΔZ DEM: -0.1, ΔZ LAS: -0.16



North



South



East



West

Point: 177 Forest

Survey X: 552339.7, Survey Y: 213327.33, Z1: 814.59, Z DEM: 814.57, Z LAS: 814.6, ΔZ DEM: -0.02, ΔZ LAS: 0



North



South



East



West