

Vertical Accuracy Report

Wisconsin WROC - 3DEP 2019
Pepin 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 Pepin 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: 5/4/2019 | Finish: 5/4/2019

Report Information

This report documents the absolute vertical accuracy of the lidar data collected for the Pepin 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 May 6, 2019, to May 16, 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, 23 NVA points and 14 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.

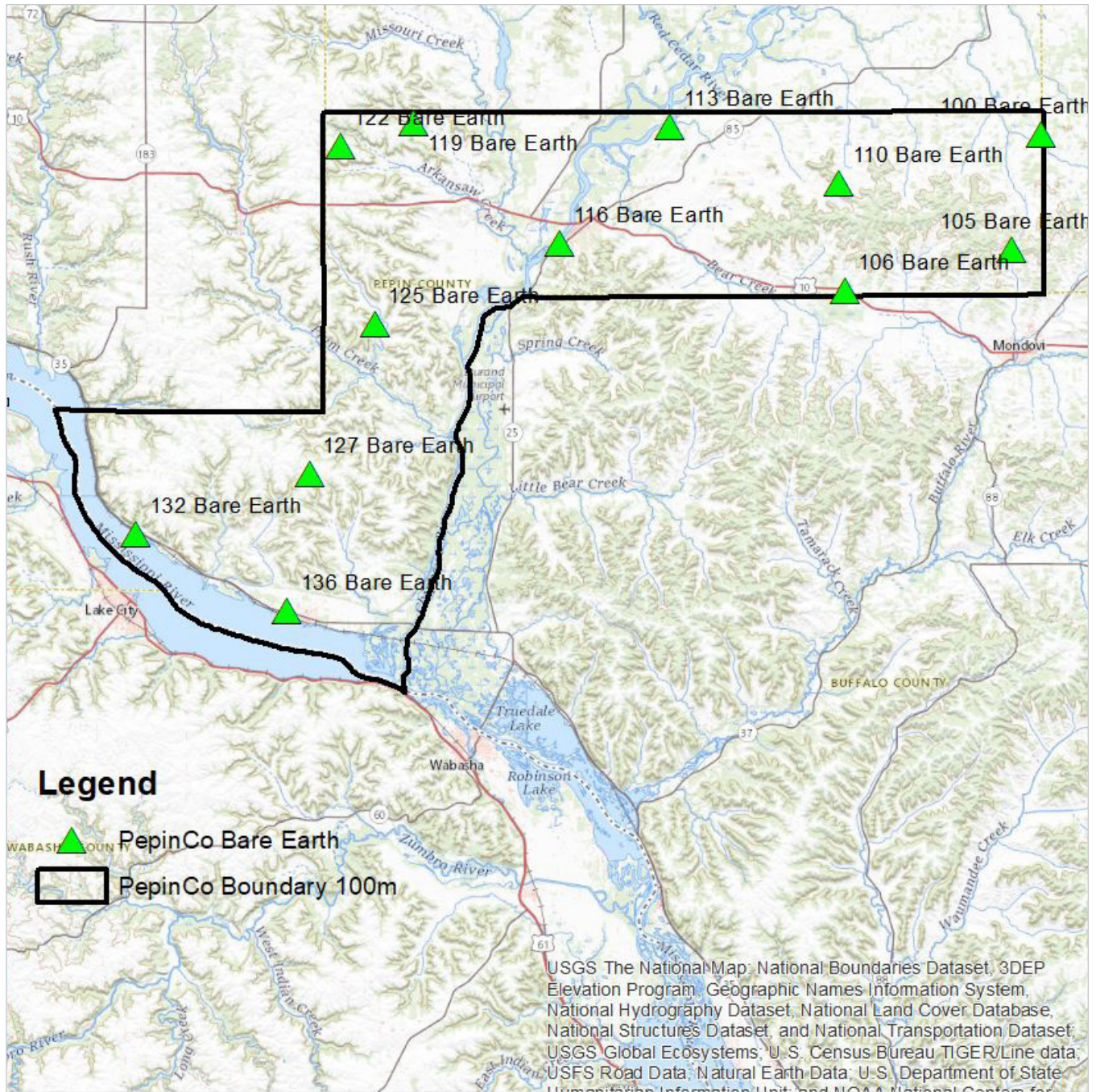
The NVA and VVA statistics for this project are within the above stated specifications.

Lidar Accuracy Assessment Summary

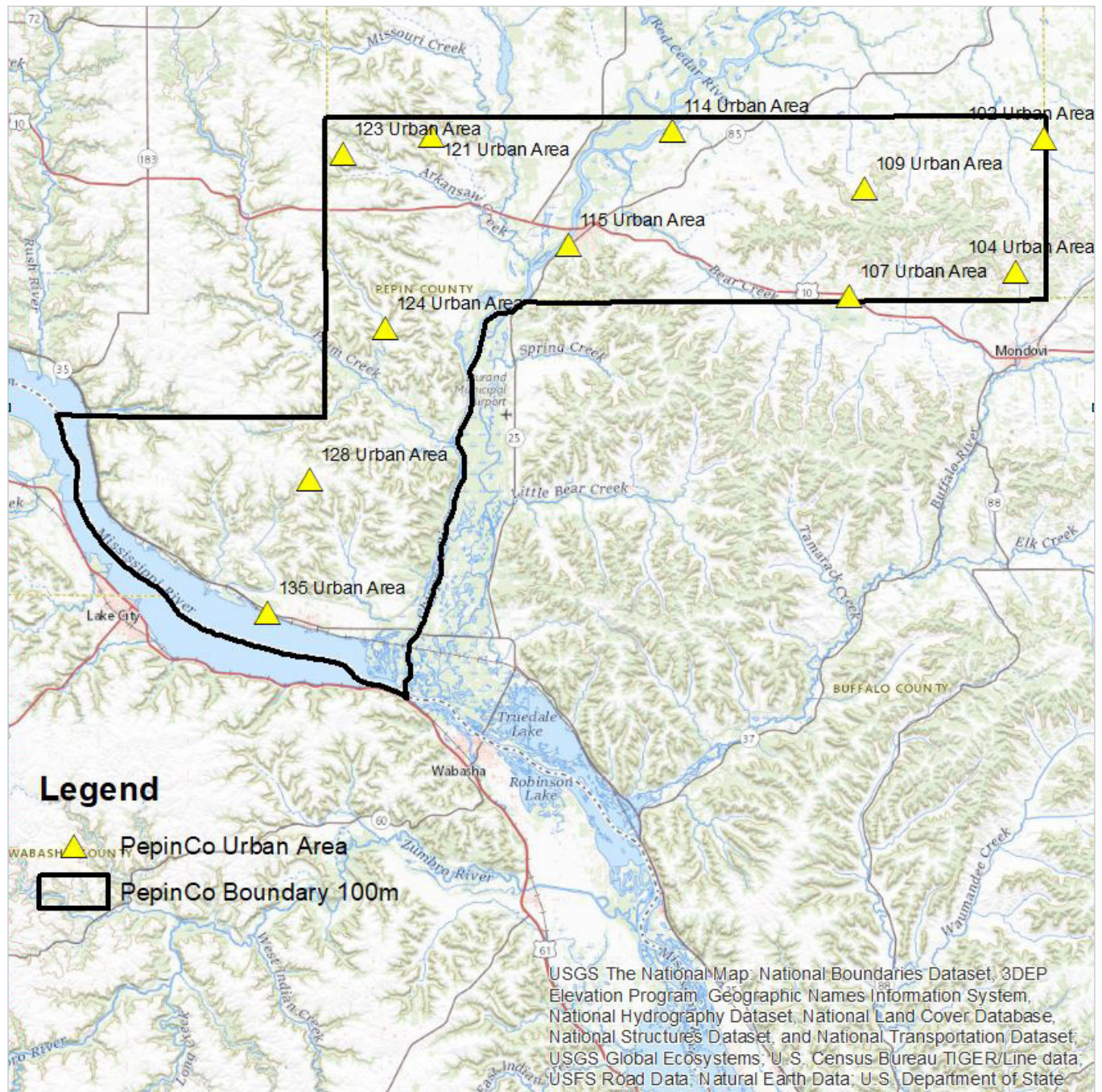
LAND COVER TYPE	# OF POINTS	NVA	VVA
LAS		95% confidence level	N/A
1. Bare Earth	12	0.177	N/A
2. Urban Areas	11	0.149	N/A
3. Tall Weeds	8	N/A	N/A
5. Forest	6	N/A	N/A
TOTAL	37	0.164	N/A
DEM		95% confidence level	95th percentile
1. Bare Earth	12	0.170	N/A
2. Urban Areas	11	0.149	N/A
3. Tall Weeds	8	N/A	0.733
5. Forest	6	N/A	0.260
TOTAL	37	0.160	0.454

Units: US Survey Feet

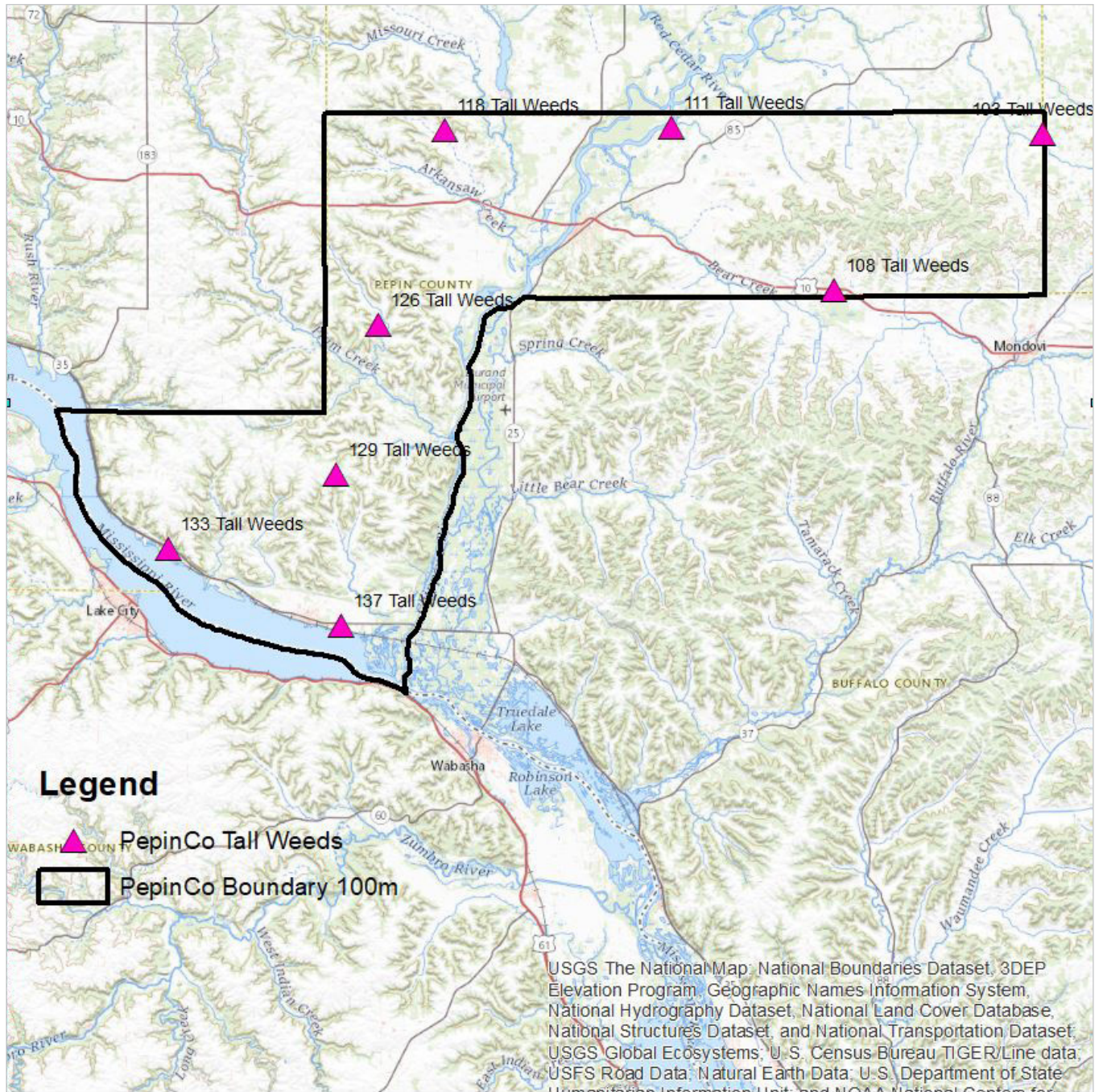
Map of NVA Checkpoint Locations - 1. Bare Earth



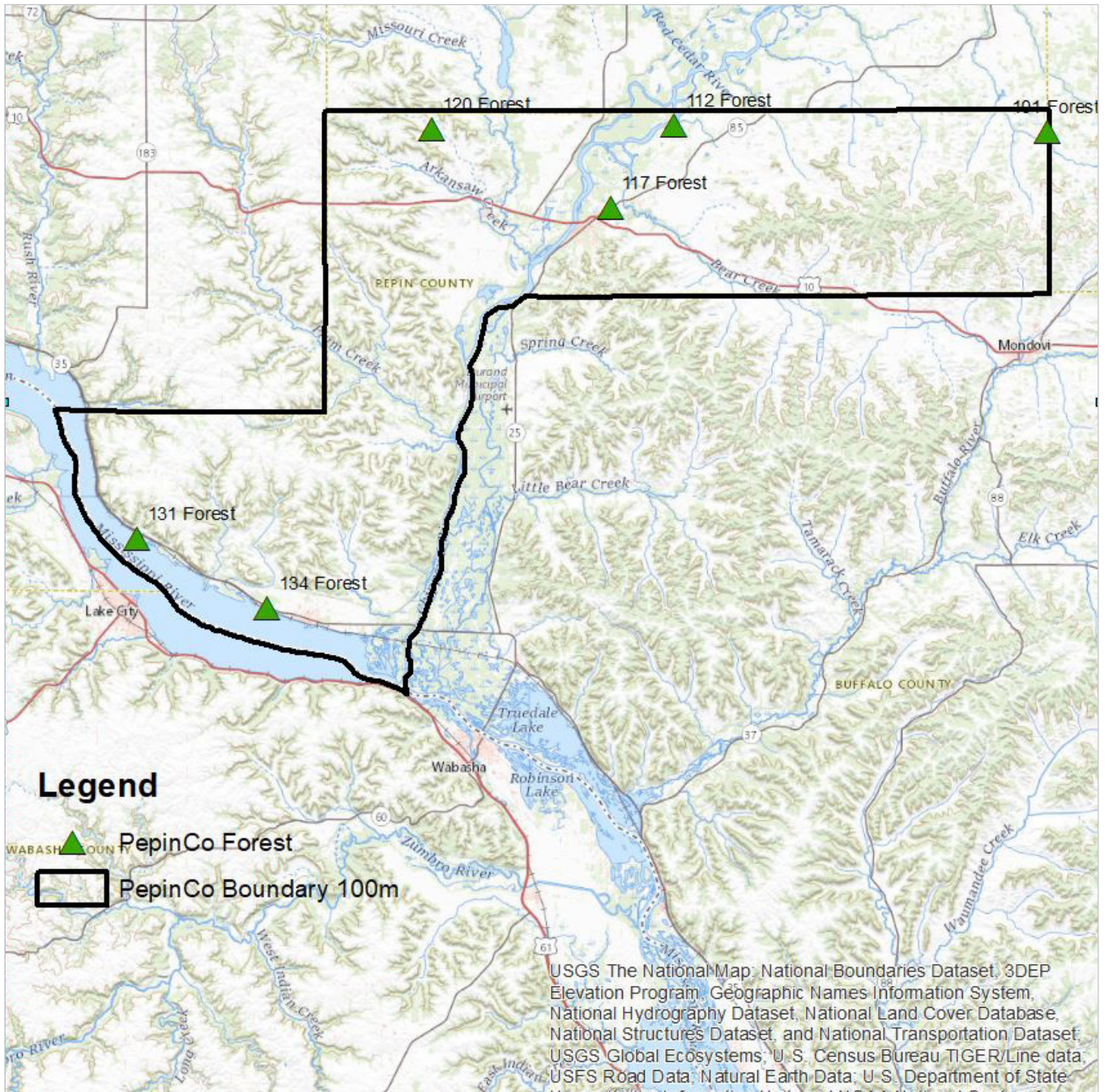
Map of NVA Checkpoint Locations - 2. Urban Areas



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	-0.172
Maximum DZ	0.138
Mean DZ	-0.018
Mean Magnitude DZ	0.263
Number Observations	23
Standard Deviation DZ	0.084
RMSE Z	0.084
95% Confidence Level Z	0.164
Units	US Survey Feet

DEM

NONVEGETATED VERTICAL ACCURACY – OVERALL	
Land Cover Type	1. Bare Earth, 2. Urban Areas
Minimum DZ	-0.143
Maximum DZ	0.205
Mean DZ	0.002
Mean Magnitude DZ	0.25
Number Observations	23
Standard Deviation DZ	0.084
RMSE Z	0.082
95% Confidence Level Z	0.16
Units	US Survey Feet

DEM (Continued)

VEGETATED VERTICAL ACCURACY	
Land Cover Type	3. Tall Weeds
Minimum DZ	-0.101
Maximum DZ	0.733
Mean DZ	0.23
Mean Magnitude DZ	0.505
Number Observations	8
Standard Deviation DZ	0.266
RMSE Z	0.339
95% Confidence Level Z	0.733
Units	US Survey Feet

DEM (Continued)

VEGETATED VERTICAL ACCURACY	
Land Cover Type	5. Forest
Minimum DZ	-0.26
Maximum DZ	0.204
Mean DZ	0.01
Mean Magnitude DZ	0.33
Number Observations	6
Standard Deviation DZ	0.154
RMSE Z	0.141
95% Confidence Level Z	0.26
Units	US Survey Feet

Point: 100 Bare Earth

Survey X: 700192.5, Survey Y: 296313.58, Z1: 898.52, Z DEM: 898.4, Z LAS: 898.39, ΔZ DEM: -0.12, ΔZ LAS: -0.13



North



South



East



West

Point: 101 Forest

Survey X: 700310.38, Survey Y: 296538.27, Z1: 901.36, Z DEM: 901.56, Z LAS: 901.59, ΔZ DEM: 0.2, ΔZ LAS: 0.23



North



South



East



West

Point: 102 Urban Area

Survey X: 700215.4, Survey Y: 296542.07, Z1: 899.35, Z DEM: 899.41, Z LAS: 899.29, ΔZ DEM: 0.06, ΔZ LAS: -0.06



North



South



East



West

Point: 103 Tall Weeds

Survey X: 700163.39, Survey Y: 296584.56, Z1: 897.03, Z DEM: 897.14, Z LAS: 897.17, ΔZ DEM: 0.11, ΔZ LAS: 0.14



North



South



East



West

Point: 104 Urban Area

Survey X: 695270.56, Survey Y: 273083.16, Z1: 879.24, Z DEM: 879.37, Z LAS: 879.31, ΔZ DEM: 0.13, ΔZ LAS: 0.06



North



South



East



West

Point: 105 Bare Earth

Survey X: 695034.3, Survey Y: 276033.84, Z1: 1027.58, Z DEM: 1027.61, Z LAS: 1027.61, ΔZ DEM: 0.02, ΔZ LAS: 0.03



North



South



East



West

Point: 106 Bare Earth

Survey X: 665723.17, Survey Y: 268949.18, Z1: 901.95, Z DEM: 902.15, Z LAS: 902.01, ΔZ DEM: 0.21, ΔZ LAS: 0.06



North



South



East



West

Point: 107 Urban Area

Survey X: 665894.04, Survey Y: 268943.62, Z1: 901.34, Z DEM: 901.46, Z LAS: 901.41, ΔZ DEM: 0.11, ΔZ LAS: 0.06



North



South



East



West

Point: 108 Tall Weeds

Survey X: 663436.44, Survey Y: 269071.55, Z1: 854.02, Z DEM: 854.75, Z LAS: 854.59, ΔZ DEM: 0.73, ΔZ LAS: 0.57



North



South



East



West

Point: 109 Urban Area

Survey X: 668640.29, Survey Y: 287842.92, Z1: 931.15, Z DEM: 931.17, Z LAS: 931.16, ΔZ DEM: 0.02, ΔZ LAS: 0.01



North



South



East



West

Point: 110 Bare Earth

Survey X: 664699.14, Survey Y: 287718, Z1: 1018.22, Z DEM: 1018.19, Z LAS: 1018.31, ΔZ DEM: -0.04, ΔZ LAS: 0.09



North



South



East



West

Point: 111 Tall Weeds

Survey X: 634959.13, Survey Y: 297650.45, Z1: 739.52, Z DEM: 739.64, Z LAS: 739.6, ΔZ DEM: 0.12, ΔZ LAS: 0.09



North



South



East



West

Point: 112 Forest

Survey X: 634820.01, Survey Y: 297712.78, Z1: 739.76, Z DEM: 739.72, Z LAS: 739.81, ΔZ DEM: -0.04, ΔZ LAS: 0.06



North



South



East



West

Point: 113 Bare Earth

Survey X: 634846.58, Survey Y: 297793.83, Z1: 740.11, Z DEM: 739.97, Z LAS: 739.94, ΔZ DEM: -0.14, ΔZ LAS: -0.17



North



South



East



West

Point: 114 Urban Area

Survey X: 634798.16, Survey Y: 297900.26, Z1: 740.17, Z DEM: 740.03, Z LAS: 740.04, ΔZ DEM: -0.14, ΔZ LAS: -0.14



North



South



Point: 115 Urban Area

Survey X: 616507.44, Survey Y: 277874.53, Z1: 720.25, Z DEM: 720.2, Z LAS: 720.22, ΔZ DEM: -0.05, ΔZ LAS: -0.03



North



South



East



West

Point: 116 Bare Earth

Survey X: 615521.16, Survey Y: 277100.32, Z1: 710.91, Z DEM: 710.87, Z LAS: 710.85, ΔZ DEM: -0.04, ΔZ LAS: -0.07



North



South



East



West

Point: 117 Forest

Survey X: 623699.97, Survey Y: 283381.36, Z1: 738.57, Z DEM: 738.31, Z LAS: 738.6, ΔZ DEM: -0.26, ΔZ LAS: 0.03



North



South



East



West

Point: 118 Tall Weeds

Survey X: 595069.86, Survey Y: 297134, Z1: 829.4, Z DEM: 829.71, Z LAS: 829.67, ΔZ DEM: 0.31, ΔZ LAS: 0.27



North



South



East



West

Point: 119 Bare Earth

Survey X: 589873.08, Survey Y: 298335.31, Z1: 834.66, Z DEM: 834.66, Z LAS: 834.55, ΔZ DEM: -0.01, ΔZ LAS: -0.11



North



South



East



West

Point: 120 Forest

Survey X: 592451.17, Survey Y: 297050.09, Z1: 819.6, Z DEM: 819.67, Z LAS: 819.65, ΔZ DEM: 0.08, ΔZ LAS: 0.05



North



South



East



West

Point: 121 Urban Area

Survey X: 592497.45, Survey Y: 296917.38, Z1: 821.88, Z DEM: 821.81, Z LAS: 821.78, ΔZ DEM: -0.07, ΔZ LAS: -0.1



North



South



East



West

Point: 122 Bare Earth

Survey X: 576854.05, Survey Y: 294274.31, Z1: 1205.16, Z DEM: 1205.16, Z LAS: 1205.18, ΔZ DEM: -0.01, ΔZ LAS: 0.02



North



South



East



West

Point: 123 Urban Area

Survey X: 576835.29, Survey Y: 293844.49, Z1: 1195.1, Z DEM: 1195.06, Z LAS: 1194.99, ΔZ DEM: -0.04, ΔZ LAS: -0.11



North



South



East



West

Point: 124 Urban Area

Survey X: 584331.21, Survey Y: 263222.16, Z1: 794.61, Z DEM: 794.61, Z LAS: 794.61, ΔZ DEM: 0, ΔZ LAS: 0



North



South



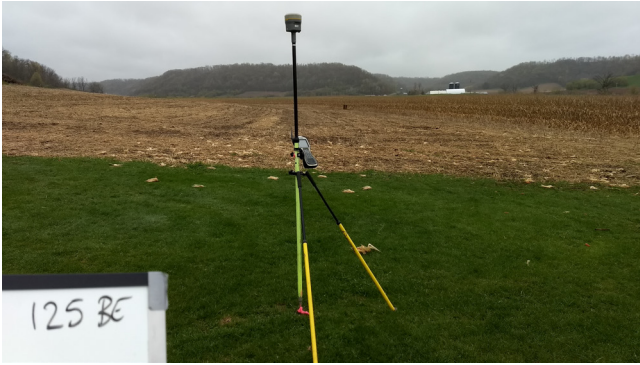
East



West

Point: 125 Bare Earth

Survey X: 582962.18, Survey Y: 262936.1, Z1: 800.6, Z DEM: 800.61, Z LAS: 800.57, ΔZ DEM: 0.01, ΔZ LAS: -0.02



North



South



East



West

Point: 126 Tall Weeds

Survey X: 583342.72, Survey Y: 262951.93, Z1: 788.86, Z DEM: 788.87, Z LAS: 788.82, ΔZ DEM: 0.01, ΔZ LAS: -0.04



North



South



East



West

Point: 127 Bare Earth

Survey X: 571496.14, Survey Y: 236536.47, Z1: 1143.69, Z DEM: 1143.76, Z LAS: 1143.83, ΔZ DEM: 0.07, ΔZ LAS: 0.14



North



South



East



West

Point: 128 Urban Area

Survey X: 571043.59, Survey Y: 236561.89, Z1: 1165.75, Z DEM: 1165.76, Z LAS: 1165.74, ΔZ DEM: 0.01, ΔZ LAS: -0.01



North



South



East



West

Point: 129 Tall Weeds

Survey X: 575911.69, Survey Y: 236503.92, Z1: 1132.12, Z DEM: 1132.57, Z LAS: 1132.41, ΔZ DEM: 0.45, ΔZ LAS: 0.29



North



South



East



West

Point: 131 Forest

Survey X: 540769.02, Survey Y: 225356.32, Z1: 675.3, Z DEM: 675.33, Z LAS: 675.39, ΔZ DEM: 0.03, ΔZ LAS: 0.09



North



South



Point: 132 Bare Earth

Survey X: 540922.48, Survey Y: 226048.77, Z1: 680.7, Z DEM: 680.65, Z LAS: 680.71, ΔZ DEM: -0.05, ΔZ LAS: 0.01



North



South



East



West

Point: 133 Tall Weeds

Survey X: 546310.71, Survey Y: 223526.22, Z1: 726.74, Z DEM: 726.64, Z LAS: 726.65, ΔZ DEM: -0.1, ΔZ LAS: -0.09



North



South



East



West

Point: 134 Forest

Survey X: 563649.38, Survey Y: 213169.96, Z1: 719.64, Z DEM: 719.69, Z LAS: 719.71, ΔZ DEM: 0.05, ΔZ LAS: 0.07



North



South



East



West

Point: 135 Urban Area

Survey X: 563641.3, Survey Y: 213115.59, Z1: 721.41, Z DEM: 721.46, Z LAS: 721.51, ΔZ DEM: 0.05, ΔZ LAS: 0.1



North



South



East



West

Point: 136 Bare Earth

Survey X: 567522.62, Survey Y: 212423.58, Z1: 719.63, Z DEM: 719.68, Z LAS: 719.59, ΔZ DEM: 0.04, ΔZ LAS: -0.05



North



South



East



West

Point: 137 Tall Weeds

Survey X: 576733.11, Survey Y: 210107.5, Z1: 712.76, Z DEM: 712.96, Z LAS: 712.99, ΔZ DEM: 0.2, ΔZ LAS: 0.24



North



South



East



West