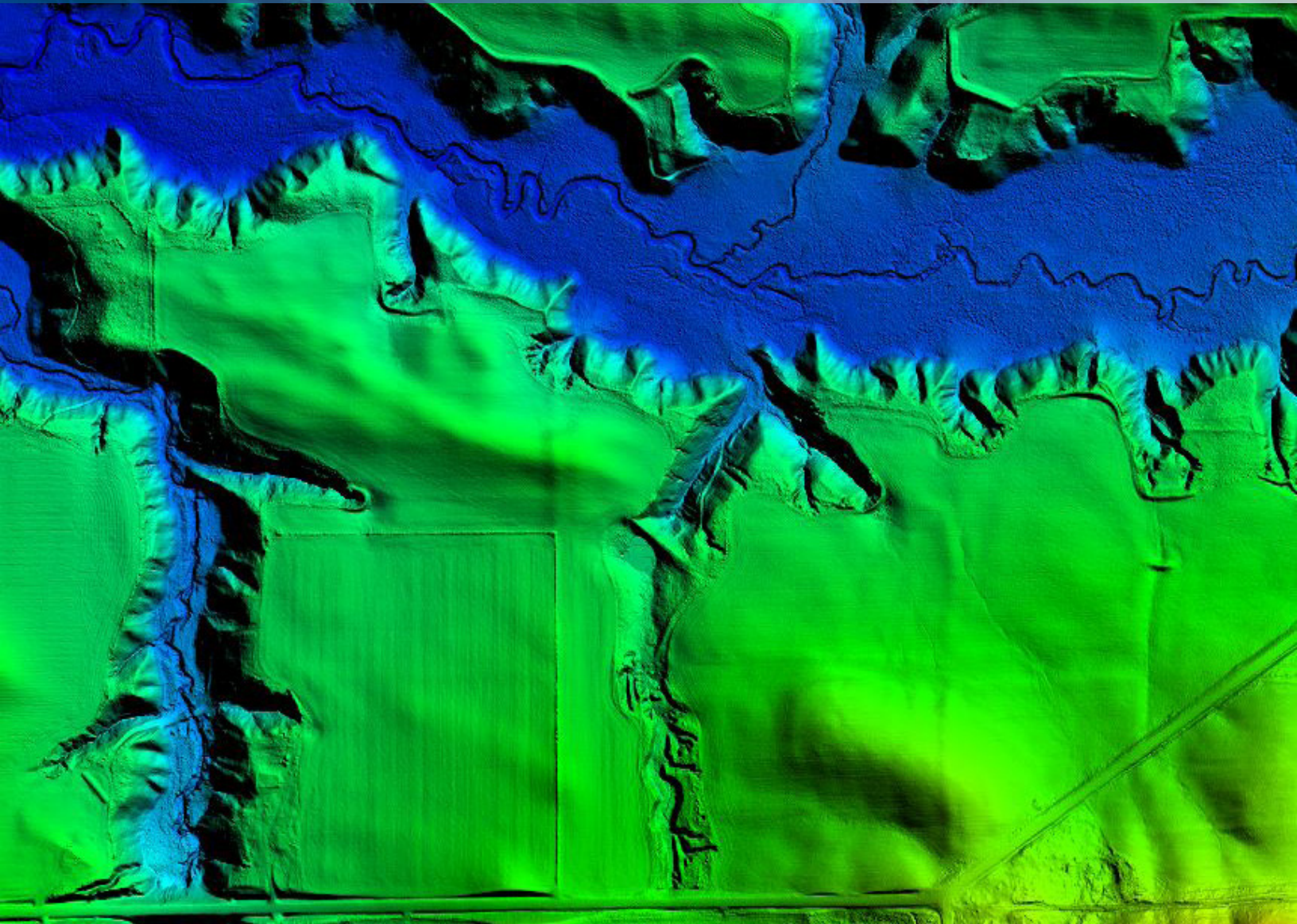


Green Lake County

Wisconsin WROC – 3DEP 2018

Green Lake County Lidar

VERTICAL ACCURACY REPORT



December 2018

PROJECT INFORMATION

Prepared By: Ayres Associates

Project Name: Wisconsin WROC – 3DEP Green Lake County Lidar 2018

Sensor Info: ALS70

USGS Quality Level: 2

Required Nominal Pulse Spacing: 0.7

Contractor Name: Ayres Associates

Units: US Survey Feet

Date of Acquisition: Start: 4/28/2018 Finish: 4/30/2018

REPORT INFORMATION

This report documents the absolute vertical accuracy of the lidar data collected for the Green Lake County, WI, QL2 lidar project. Independent ground control checkpoints were collected by land surveyors using Trimble GNSS equipment connected to WISCORS base stations. The checkpoints were collected from April 17, 2018, to May 18, 2018.

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, 33 NVA points and 19 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.

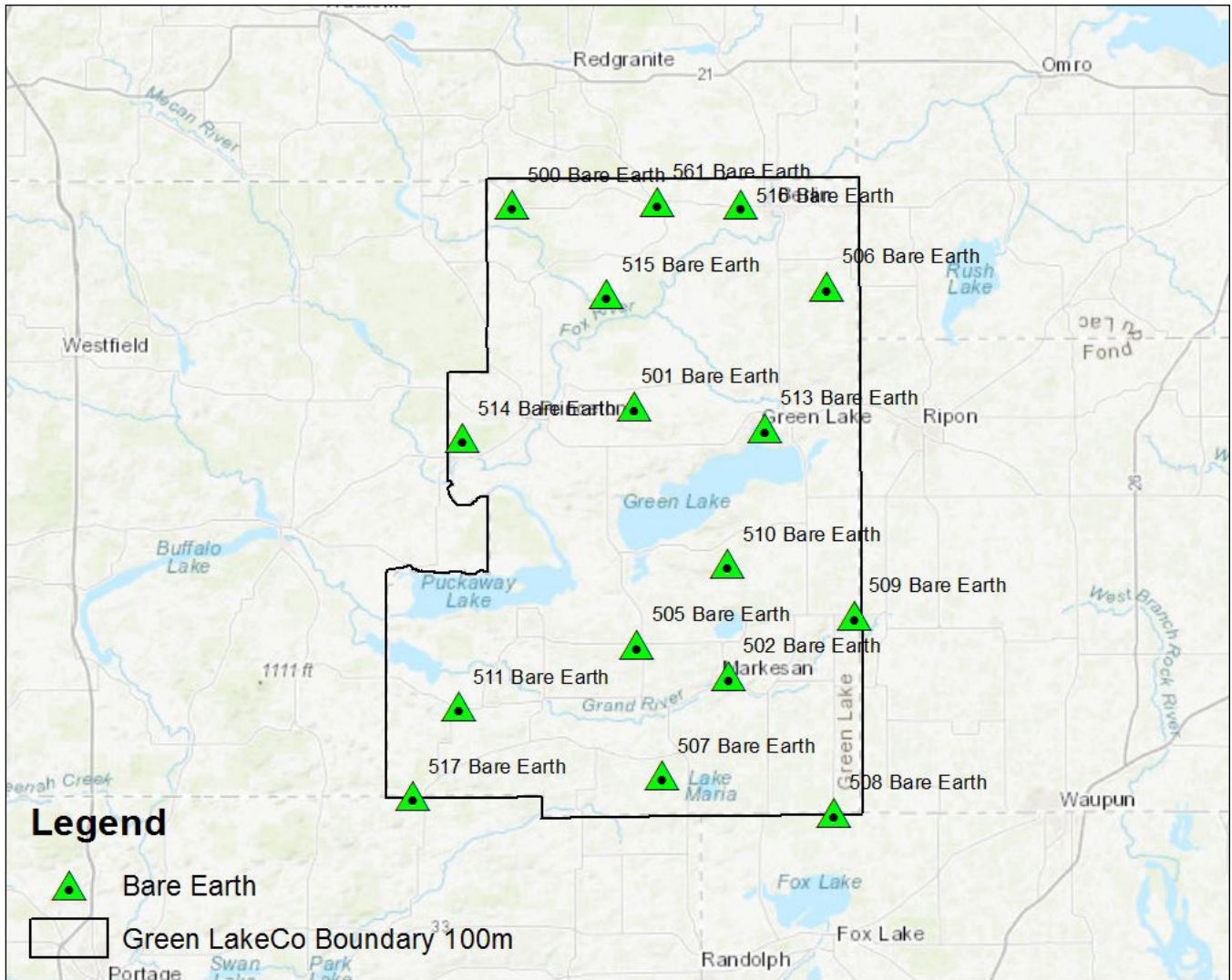
The NVA and VVA statistics for this project are within the above stated specifications.

LIDAR ACCURACY ASSESSMENT SUMMARY

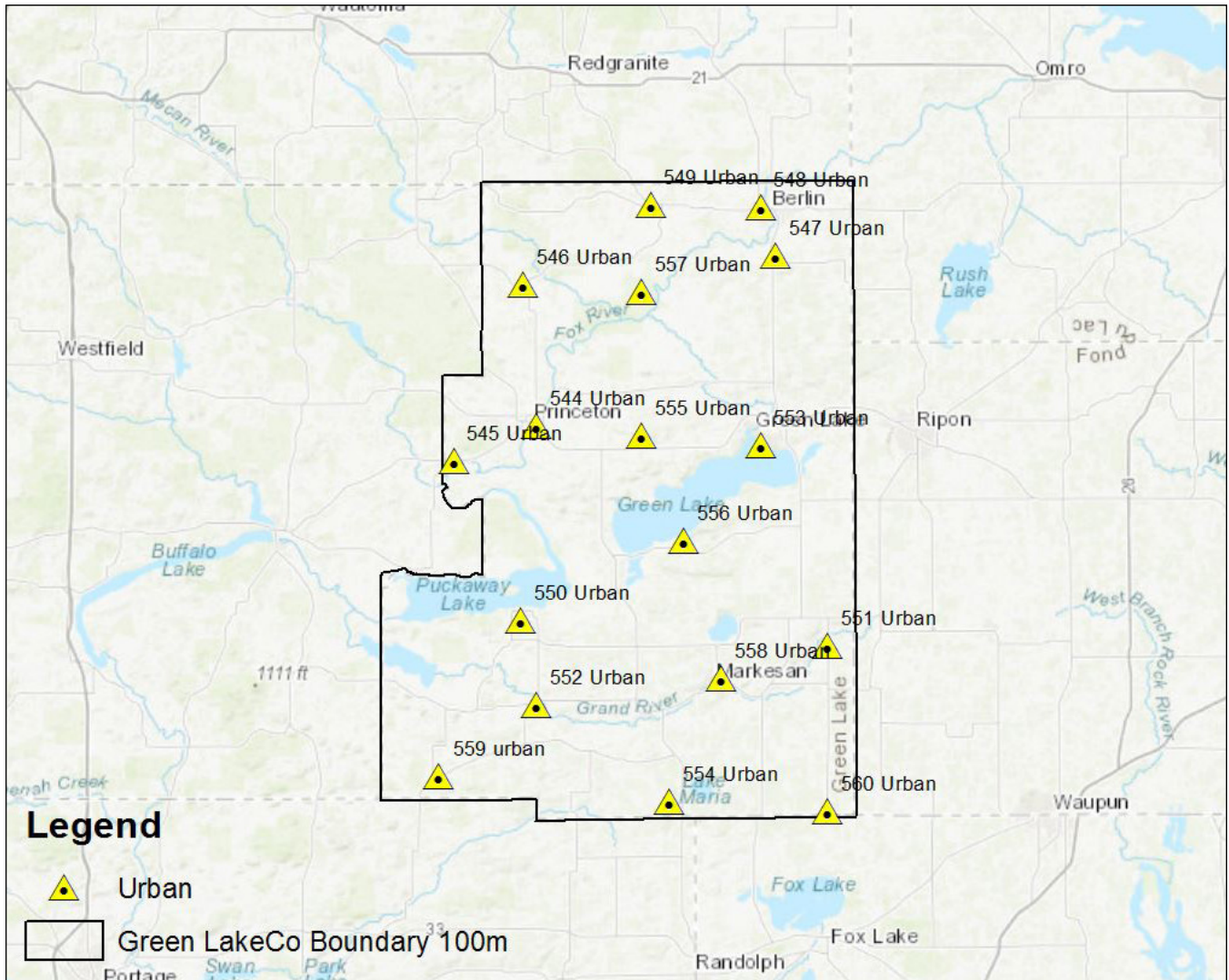
| LAND COVER TYPE | # OF POINTS | NVA | VVA |
|-----------------|-------------|----------------------|-----------------|
| LAS | | 95% confidence level | N/A |
| 1. Bare Earth | 16 | 0.181 | N/A |
| 2. Urban Areas | 17 | 0.247 | N/A |
| 3. Tall Weeds | 8 | N/A | N/A |
| 5. Forest | 11 | N/A | N/A |
| TOTAL | 52 | 0.217 | N/A |
| DEM | | | |
| | | 95% confidence level | 95th percentile |
| 1. Bare Earth | 16 | 0.168 | N/A |
| 2. Urban Areas | 17 | 0.284 | N/A |
| 3. Tall Weeds | 8 | N/A | 0.625 |
| 5. Forest | 11 | N/A | 0.517 |
| TOTAL | 52 | 0.235 | 0.517 |

Units: US Survey Feet

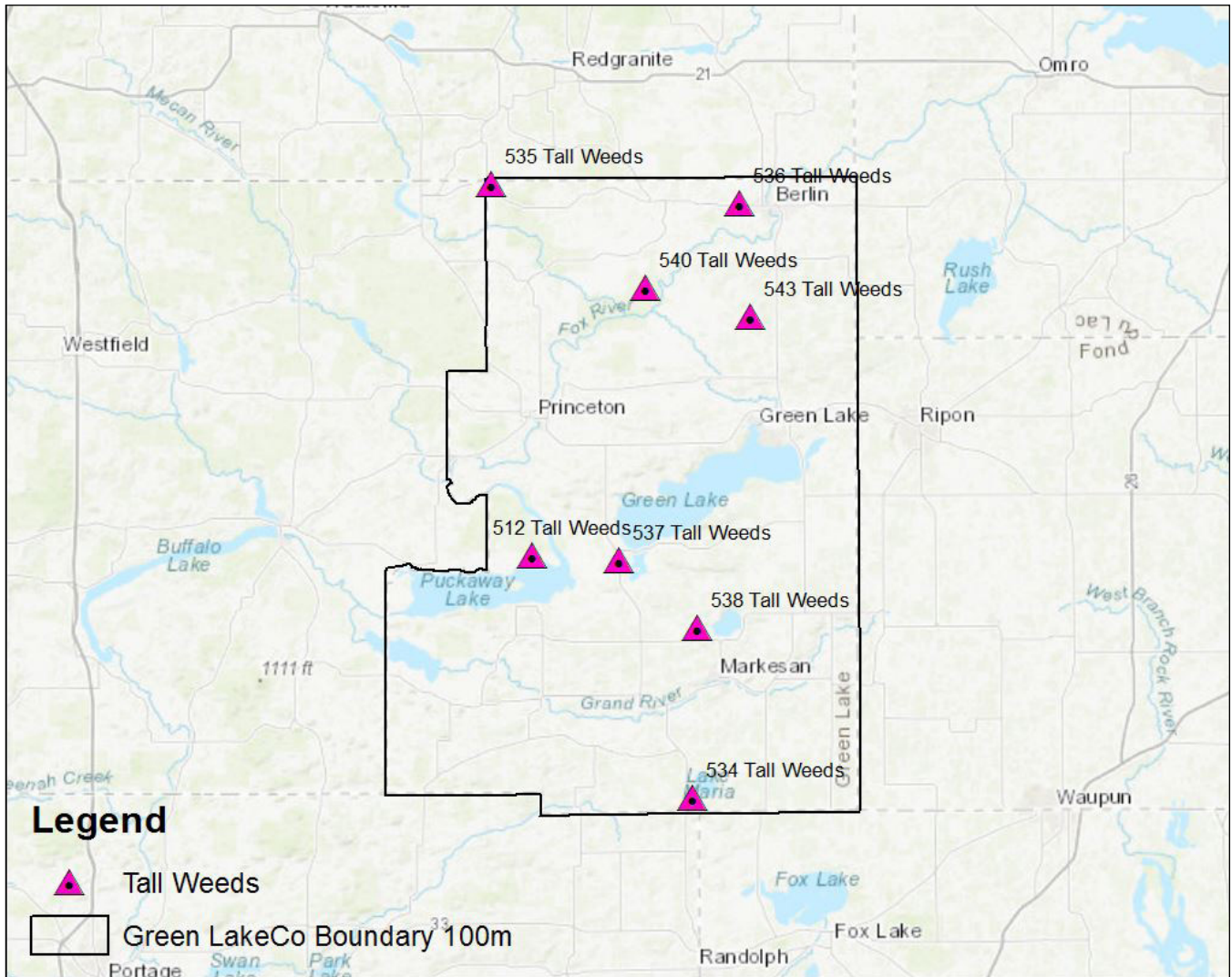
MAP OF NVA CHECKPOINT LOCATIONS - 1. BARE EARTH



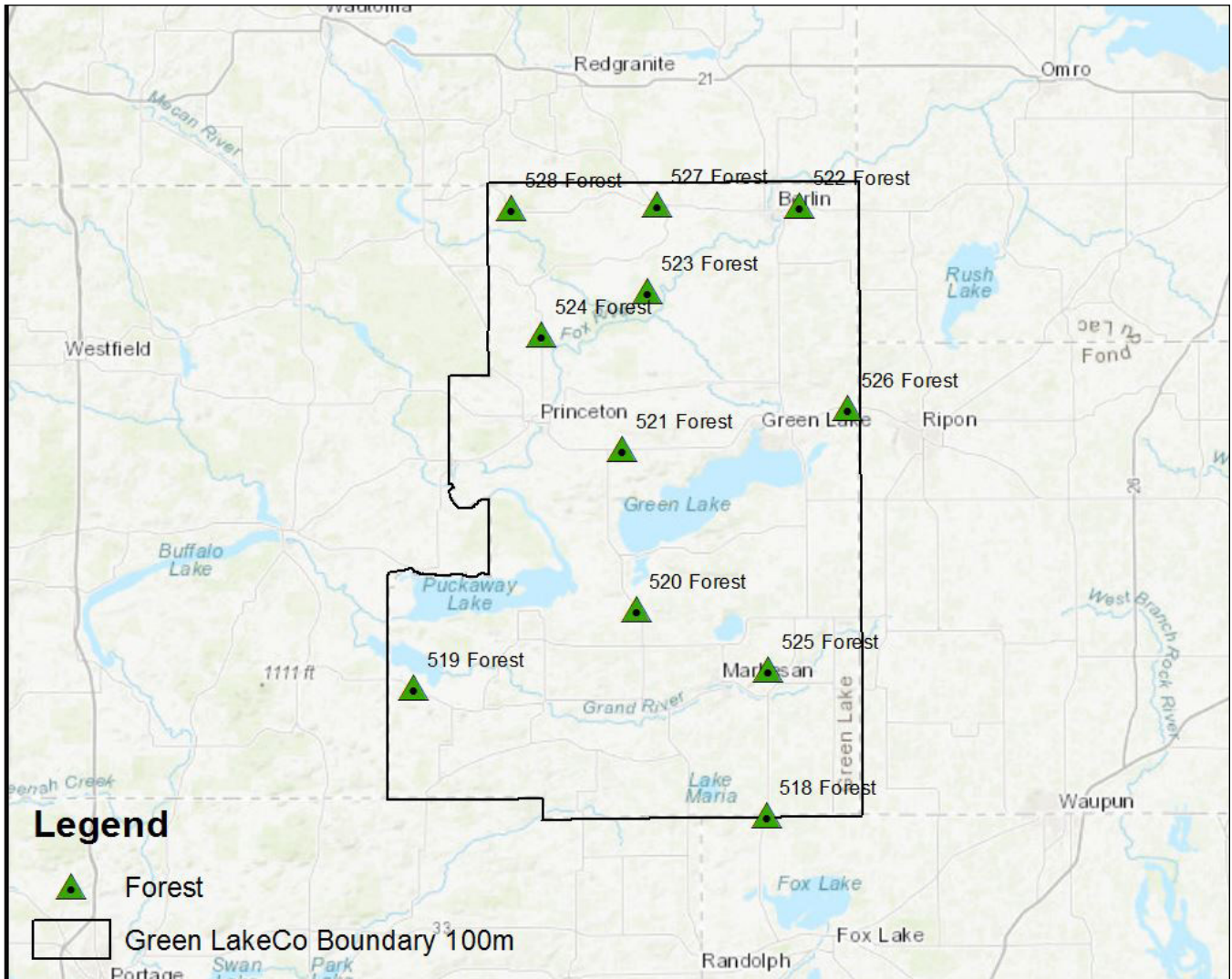
MAP OF NVA CHECKPOINT LOCATIONS - 2. URBAN AREA



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 | -0.248 |
| Maximum DZ | 0.242 |
| Mean DZ | -0.016 |
| Mean Magnitude DZ | 0.293 |
| Number Observations | 33 |
| Standard Deviation DZ | 0.111 |
| RMSE Z | 0.111 |
| 95% Confidence Level Z | 0.217 |
| Units | US Survey Feet |

DEM

| NONVEGETATED VERTICAL ACCURACY – OVERALL | |
|---|------------------------------|
| Land Cover Type | 1. Bare Earth, 2. Urban Area |
| Minimum DZ | -0.21 |
| Maximum DZ | 0.387 |
| Mean DZ | 0.005 |
| Mean Magnitude DZ | 0.286 |
| Number Observations | 33 |
| Standard Deviation DZ | 0.122 |
| RMSE Z | 0.12 |
| 95% Confidence Level Z | 0.235 |
| Units | US Survey Feet |

DEM (CONTINUED)

| VEGETATED VERTICAL ACCURACY | |
|------------------------------------|----------------|
| Land Cover Type | 3. Tall Weeds |
| Minimum DZ | -0.198 |
| Maximum DZ | 0.625 |
| Mean DZ | 0.216 |
| Mean Magnitude DZ | 0.516 |
| Number Observations | 8 |
| Standard Deviation DZ | 0.24 |
| RMSE Z | 0.312 |
| 95th Percentile | 0.625 |
| Units | US Survey Feet |

DEM (CONTINUED)

| VEGETATED VERTICAL ACCURACY | |
|------------------------------------|----------------|
| Land Cover Type | 5. Forest |
| Minimum DZ | -0.001 |
| Maximum DZ | 0.517 |
| Mean DZ | 0.2 |
| Mean Magnitude DZ | 0.448 |
| Number Observations | 11 |
| Standard Deviation DZ | 0.197 |
| RMSE Z | 0.274 |
| 95th Percentile | 0.517 |
| Units | US Survey Feet |

Point: 500 Bare Earth

Survey X: 519004.75, Survey Y: 319177.25, Z1: 825.08, Z DEM: 825.07, Z LAS: 825.08, ΔZ DEM: -0.01, ΔZ LAS: 0



North



South



East



West

Point: 501 Bare Earth

Survey X: 543573.38, Survey Y: 278568.69, Z1: 784.39, Z DEM: 784.18, Z LAS: 784.25, ΔZ DEM: -0.21, ΔZ LAS: -0.13



North



South



East



West

Point: 502 Bare Earth

Survey X: 562535.02, Survey Y: 224326.96, Z1: 915.23, Z DEM: 915.24, Z LAS: 915.21, ΔZ DEM: 0.01, ΔZ LAS: -0.02



North



South



East



West

Point: 505 Bare Earth

Survey X: 544045.57, Survey Y: 230632.33, Z1: 881.09, Z DEM: 881.14, Z LAS: 881.07, ΔZ DEM: 0.04, ΔZ LAS: -0.02



North



South



East



West

Point: 506 Bare Earth

Survey X: 582480.22, Survey Y: 302700.56, Z1: 938.43, Z DEM: 938.43, Z LAS: 938.32, ΔZ DEM: -0.01, ΔZ LAS: -0.11



North



South



East



West

Point: 507 Bare Earth

Survey X: 549267.03, Survey Y: 204234.62, Z1: 932.64, Z DEM: 932.73, Z LAS: 932.69, ΔZ DEM: 0.09, ΔZ LAS: 0.06



North



South



East



West

Point: 508 Bare Earth

Survey X: 583908.12, Survey Y: 196704.13, Z1: 964.82, Z DEM: 965.02, Z LAS: 964.97, ΔZ DEM: 0.2, ΔZ LAS: 0.15



North



South



East



West

Point: 509 Bare Earth

Survey X: 587865.65, Survey Y: 236507, Z1: 993.52, Z DEM: 993.52, Z LAS: 993.53, ΔZ DEM: 0, ΔZ LAS: 0



North



South



East



West

Point: 510 Bare Earth

Survey X: 562468.48, Survey Y: 246839.07, Z1: 1036.88, Z DEM: 1036.87, Z LAS: 1036.77, ΔZ DEM: -0.01, ΔZ LAS: -0.1



North



South



East



West

Point: 511 Bare Earth

Survey X: 508243.37, Survey Y: 218026.23, Z1: 799.44, Z DEM: 799.4, Z LAS: 799.37, ΔZ DEM: -0.04, ΔZ LAS: -0.07



North



South



East



West

Point: 512 Tall Weeds

Survey X: 523479.14, Survey Y: 247994.76, Z1: 771.77, Z DEM: 772.1, Z LAS: 772.06, ΔZ DEM: 0.34, ΔZ LAS: 0.29



North



South



East



West

Point: 513 Bare Earth

Survey X: 569903.81, Survey Y: 274235.57, Z1: 794.34, Z DEM: 794.32, Z LAS: 794.28, ΔZ DEM: -0.02, ΔZ LAS: -0.06



North



South



East



West

Point: 514 Bare Earth

Survey X: 509155.61, Survey Y: 272166.44, Z1: 848.35, Z DEM: 848.22, Z LAS: 848.14, ΔZ DEM: -0.12, ΔZ LAS: -0.21



North



South



East



West

Point: 515 Bare Earth

Survey X: 538037.38, Survey Y: 301176.54, Z1: 761.34, Z DEM: 761.3, Z LAS: 761.26, ΔZ DEM: -0.04, ΔZ LAS: -0.08



North



South



East



West

Point: 516 Bare Earth

Survey X: 565158.12, Survey Y: 319272.86, Z1: 817.03, Z DEM: 817.02, Z LAS: 817.05, ΔZ DEM: -0.01, ΔZ LAS: 0.02



North



South



East



West

Point: 517 Bare Earth

Survey X: 499023.8, Survey Y: 200015.25, Z1: 853.62, Z DEM: 853.66, Z LAS: 853.69, ΔZ DEM: 0.05, ΔZ LAS: 0.07



North



South



East



West

Point: 518 Forest

Survey X: 570345.09, Survey Y: 196565.86, Z1: 1016.66, Z DEM: 1016.68, Z LAS: 1016.64, ΔZ DEM: 0.02, ΔZ LAS: -0.02



North



South



East



West

Point: 519 Forest

Survey X: 498996.62, Survey Y: 222257.67, Z1: 779.93, Z DEM: 780.27, Z LAS: 780.31, ΔZ DEM: 0.34, ΔZ LAS: 0.38



North



South



East



West

Point: 520 Forest

Survey X: 544040.44, Survey Y: 238176.04, Z1: 849.16, Z DEM: 849.16, Z LAS: 849.2, ΔZ DEM: 0, ΔZ LAS: 0.04



North



South



East



West

Point: 521 Forest

Survey X: 541248.76, Survey Y: 270542.58, Z1: 893.19, Z DEM: 893.19, Z LAS: 893.16, ΔZ DEM: 0, ΔZ LAS: -0.03



North



South



East



West

Point: 522 Forest

Survey X: 577066.84, Survey Y: 319672.16, Z1: 847.6, Z DEM: 847.61, Z LAS: 847.61, ΔZ DEM: 0, ΔZ LAS: 0



North



South



East



West

Point: 523 Forest

Survey X: 546433.08, Survey Y: 302421.89, Z1: 759.2, Z DEM: 759.62, Z LAS: 759.43, ΔZ DEM: 0.43, ΔZ LAS: 0.24



North



South



East



West

Point: 524 Forest

Survey X: 524890.1, Survey Y: 293559.7, Z1: 790.3, Z DEM: 790.31, Z LAS: 790.34, ΔZ DEM: 0.01, ΔZ LAS: 0.04



North



South



East



West

Point: 525 Forest

Survey X: 570757.91, Survey Y: 225854.21, Z1: 975.01, Z DEM: 975.33, Z LAS: 975.41, ΔZ DEM: 0.32, ΔZ LAS: 0.4



North



South



East



West

Point: 526 Forest

Survey X: 586687.65, Survey Y: 278794.95, Z1: 803.53, Z DEM: 803.81, Z LAS: 803.87, ΔZ DEM: 0.28, ΔZ LAS: 0.33



North



South



East



West

Point: 527 Forest

Survey X: 548222.29, Survey Y: 319838.2, Z1: 774.91, Z DEM: 775.19, Z LAS: 775.1, ΔZ DEM: 0.29, ΔZ LAS: 0.2



North



South



East



West

Point: 528 Forest

Survey X: 518894.78, Survey Y: 319158.52, Z1: 823.92, Z DEM: 824.44, Z LAS: 824.39, ΔZ DEM: 0.52, ΔZ LAS: 0.47



North



South



East



West

Point: 534 Tall Weeds

Survey X: 555840.91, Survey Y: 199018.68, Z1: 940.42, Z DEM: 940.78, Z LAS: 940.81, ΔZ DEM: 0.36, ΔZ LAS: 0.39



North



South



East



West

Point: 535 Tall Weeds

Survey X: 515087.79, Survey Y: 323167.29, Z1: 795.88, Z DEM: 796.11, Z LAS: 796.13, ΔZ DEM: 0.23, ΔZ LAS: 0.25



North



South



East



West

Point: 536 Tall Weeds

Survey X: 565322.24, Survey Y: 319239.06, Z1: 817.59, Z DEM: 817.75, Z LAS: 817.71, ΔZ DEM: 0.16, ΔZ LAS: 0.13



North



South



East



West

Point: 537 Tall Weeds

Survey X: 541008.03, Survey Y: 247145.96, Z1: 819.45, Z DEM: 819.54, Z LAS: 819.57, ΔZ DEM: 0.08, ΔZ LAS: 0.12



North



South



East



West

Point: 538 Tall Weeds

Survey X: 556717.72, Survey Y: 233486.91, Z1: 960, Z DEM: 959.8, Z LAS: 959.87, ΔZ DEM: -0.2, ΔZ LAS: -0.13



North



South



East



West

Point: 540 Tall Weeds

Survey X: 546416.53, Survey Y: 302280.8, Z1: 758.89, Z DEM: 759.52, Z LAS: 759.46, ΔZ DEM: 0.62, ΔZ LAS: 0.57



North



South



East



West

Point: 543 Tall Weeds

Survey X: 567439.53, Survey Y: 296408.91, Z1: 804.09, Z DEM: 804.22, Z LAS: 804.14, ΔZ DEM: 0.13, ΔZ LAS: 0.05



North



South



East



West

Point: 544 Urban

Survey X: 525104.76, Survey Y: 275187.86, Z1: 779.76, Z DEM: 780.15, Z LAS: 779.99, ΔZ DEM: 0.39, ΔZ LAS: 0.23



North



South



East



West

Point: 545 Urban

Survey X: 508461.48, Survey Y: 268139.38, Z1: 788.49, Z DEM: 788.31, Z LAS: 788.24, ΔZ DEM: -0.18, ΔZ LAS: -0.25



North



South



East



West

Point: 546 Urban

Survey X: 522494.28, Survey Y: 303597.67, Z1: 796.23, Z DEM: 796.34, Z LAS: 796.35, ΔZ DEM: 0.11, ΔZ LAS: 0.13



North



South



East



West

Point: 547 Urban

Survey X: 573307.75, Survey Y: 309358.58, Z1: 928.22, Z DEM: 928.25, Z LAS: 928.23, ΔZ DEM: 0.03, ΔZ LAS: 0.01



North



South



East



West

Point: 548 Urban

Survey X: 570322.75, Survey Y: 319327.75, Z1: 763.38, Z DEM: 763.36, Z LAS: 763.36, ΔZ DEM: -0.02, ΔZ LAS: -0.02



North



South



East



West

Point: 549 Urban

Survey X: 548158.97, Survey Y: 319781.14, Z1: 774.38, Z DEM: 774.68, Z LAS: 774.63, ΔZ DEM: 0.3, ΔZ LAS: 0.24



North



South



East



West

Point: 550 Urban

Survey X: 522031.73, Survey Y: 235998.9, Z1: 901.24, Z DEM: 901.34, Z LAS: 901.32, ΔZ DEM: 0.1, ΔZ LAS: 0.08



North



South



East



West

Point: 551 Urban

Survey X: 583948.35, Survey Y: 230868.69, Z1: 895.7, Z DEM: 895.61, Z LAS: 895.63, ΔZ DEM: -0.09, ΔZ LAS: -0.08



North



South



East



West

Point: 552 Urban

Survey X: 525243.96, Survey Y: 218944.72, Z1: 800.34, Z DEM: 800.31, Z LAS: 800.33, ΔZ DEM: -0.03, ΔZ LAS: 0



North



South



East



West

Point: 553 Urban

Survey X: 570336.21, Survey Y: 271162.83, Z1: 831.75, Z DEM: 831.61, Z LAS: 831.62, ΔZ DEM: -0.14, ΔZ LAS: -0.13



North



South



East



West

Point: 554 Urban

Survey X: 551903, Survey Y: 199480.93, Z1: 949.25, Z DEM: 949.3, Z LAS: 949.32, ΔZ DEM: 0.04, ΔZ LAS: 0.06



North



South



East



West

Point: 555 Urban

Survey X: 546257.7, Survey Y: 273185.3, Z1: 856.25, Z DEM: 856.27, Z LAS: 856.26, ΔZ DEM: 0.02, ΔZ LAS: 0.01



North



South



East



West

Point: 556 Urban

Survey X: 554819.18, Survey Y: 252093.98, Z1: 828.64, Z DEM: 828.51, Z LAS: 828.48, ΔZ DEM: -0.12, ΔZ LAS: -0.16



North



South



East



West

Point: 557 Urban

Survey X: 546363.78, Survey Y: 302255.27, Z1: 760.59, Z DEM: 760.52, Z LAS: 760.5, ΔZ DEM: -0.07, ΔZ LAS: -0.09



North



South



East



West

Point: 558 Urban

Survey X: 562480.22, Survey Y: 224306.14, Z1: 908.85, Z DEM: 908.88, Z LAS: 908.94, ΔZ DEM: 0.03, ΔZ LAS: 0.09



North



South



East



West

Point: 559 urban

Survey X: 505498.85, Survey Y: 204523.13, Z1: 855.28, Z DEM: 855.29, Z LAS: 855.28, ΔZ DEM: 0.01, ΔZ LAS: 0



North



South



East



West

Point: 560 Urban

Survey X: 583843.47, Survey Y: 197328.73, Z1: 966.14, Z DEM: 966.05, Z LAS: 966.06, ΔZ DEM: -0.09, ΔZ LAS: -0.08



North



South



East



West

Point: 561 Bare Earth

Survey X: 548294.38, Survey Y: 319710.51, Z1: 775.88, Z DEM: 775.84, Z LAS: 775.8, ΔZ DEM: -0.04, ΔZ LAS: -0.08



North



South



East



West