

Ground Control Report

Wisconsin Coastal Counties, Manitowoc County LiDAR mission, November 2015

1.1 Ground Control Design

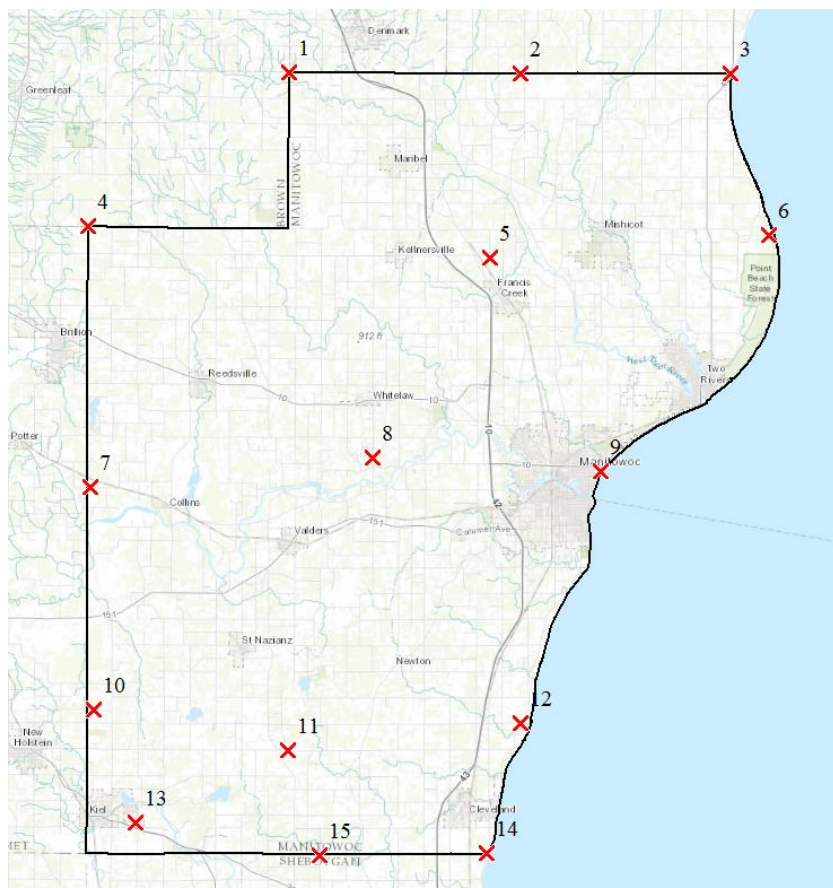
The ground control network and design used for the Manitowoc County LiDAR acquisition was made up of calibration points, GPS base stations, NGS base stations, and independent check points from the vertical accuracy ground control survey. This report will focus on the lidar calibration points that were collected at 15 locations in and around the Manitowoc County project area. The control points are used for QC checks and calibration of the raw point cloud and for additional vertical checks against the processed bare earth surface.

The ground control calibration survey was done in WISCRS Manitowoc County, NAD83 (2011), US survey feet; NAVD88 (Geoid 12A), US survey feet. The field work was conducted by Ayres Associates surveyors in November 2015.

1.1.2 Control Layout

The locations were selected around the outer geometry of the project boundary and on major roads within the project area. This layout design is preferred when the calibration points will be used to check different areas across a large flight block. The control survey was conducted with a Trimble R-8 GPS receiver and a VRS connection with a TSC3 data collector.

1.1.2.1 Map of Manitowoc County calibration points



1.1.2.2 Manitowoc County calibration points, WISCRS Manitowoc County, NAD83 (2011), US survey feet;
 NAVD88 (Geoid 12A), US survey feet:

| Point Number | Northing | Easting | Elevation | Description |
|---------------------|-----------------|----------------|------------------|--------------------|
| 1 | 386810.73 | 173650.03 | 856.98 | Calibration |
| 2 | 386676.37 | 220725.57 | 736.39 | Calibration |
| 3 | 386710.93 | 263181.30 | 622.42 | Calibration |
| 4 | 355565.21 | 132698.89 | 890.98 | Calibration |
| 5 | 349325.55 | 214388.73 | 744.65 | Calibration |
| 6 | 353729.50 | 271157.95 | 595.46 | Calibration |
| 7 | 302598.68 | 133076.51 | 832.88 | Calibration |
| 8 | 308629.44 | 190557.00 | 793.96 | Calibration |
| 9 | 305907.50 | 236894.31 | 596.18 | Calibration |
| 10 | 257417.35 | 133830.90 | 884.79 | Calibration |
| 11 | 249247.11 | 173251.58 | 910.41 | Calibration |
| 12 | 254725.94 | 220712.11 | 600.40 | Calibration |
| 13 | 234600.19 | 142404.36 | 895.54 | Calibration |
| 14 | 228199.67 | 213733.49 | 638.63 | Calibration |
| 15 | 227904.68 | 179762.73 | 803.02 | Calibration |

1.1.3 Field Notes

| 72-0124-00 MANITOWOC Co SURVEY | | | | PN | CODE | ROD HEIGHT | LOCATION (APPROX) |
|-----------------------------------|------------------------------|---------------|-----------------------------|--------------------|-------|------------|-----------------------------|
| CREW: | GARRICK LOEBIGGER | | | 103 | FO 01 | 2M | APPROX 770' E OF |
| EQUIP: | RS-4 | SN 5116140134 | 56:93:1105B | | | | CL CITY RD + 75' N OF |
| | TSC3 | SN R512301154 | | | | | CL COOPERSTOWN RD |
| WEATHER: | 52° CLOUDY | | DATE: 10-26-15 | | | | |
| HOB DATUM: | NA 83 (2011) | | | 104 | CP | 2M | |
| VERT DATUM: | NA 86 (2012) | | | 105 | CP | 2M | |
| COORD. SYSTEM: | WISCONSIN COUNTY - MANITOWOC | | | | | | |
| | | | | 106 | BE 01 | 2M | APPROX 430' W OF CL |
| NGS | COOPERSTOWN | GPS - D77682 | | | | | SCANDAL RD + 80' N OF |
| | AN 003 | DE 009 | | | | | CL CITY RD DE PUT BEAN FLD |
| | UV 0034 | | | | | | |
| | AREA 1 | | | | | | |
| PN | CODE | ROD HEIGHT | LOCATION (APPROX) | | | | |
| 100 | BE 01 | 2M | GRAVEL DRIVEWAY | | | | APPROX 740' W OF CL |
| | | | EMBRASE TO "THE COOP" | 108 | CP | 2M | SCANDAL RD + 70' S OF |
| | | | BAR SOUTH OF CITY RD | 109 | CP | 2M | CL CITY RD BB |
| | | | COOPERSTOWN RD INTERSECTION | | | | |
| | | | | 110 ²⁰⁰ | FO 02 | 2M | APPROX 650' W OF CL CITY RD |
| 1 | CB 01 | 2M | EMBRASE W OF EC, SW | | | | + 80' N OF CL CITY RD |
| | | | LOAD CITY RD | | | | |
| | | | COOPERSTOWN INTERSECTION | 110 ²⁰¹ | BE 02 | 2M | APPROX 700' W OF CL CITY RD |
| | | | | | | | + 80' N OF CL CITY RD |
| 101 | CP | 2M | | | | | |
| 102 | CP | 2M | | | | | |

1.1.3 Field Notes (continued)

| 72-0129.00 | | | | | | | | 7 |
|--------------------|---------------------------------|--------|--|-----|-------|--------|---|---|
| MANITOWOC GE LIDAR | | | | PN | CODE | ROD HT | LOCATION (APPROX) | |
| CREW | GARRICK LEBERGER | | | 5 | CB 05 | 2M | 3000' S OF CL QUARTER | |
| EQUIP | RE-4 SN 5419164136 SG: 93410313 | | | | | | RD. CL OF DIAMOND RD. | |
| | TSC3 SN RS1LC3041511 | | | | | | SW CORNER OF 2" HASH S | |
| WEATHER | 50° CLOUDY DATE: 10-27-15 | | | | | | OF LIGHTER ASPHALT PATCH. | |
| HOR. DATUM | NAD 83 (2011) | | | | | | | |
| VERT DATUM | NAVD 88 (2012) | | | | | | | |
| COORD SYSTEM | WGS 83 MANITOWOC | | | 400 | VA 01 | 2M | APPROX CL OF MANICAL RD | |
| | | | | | | | + 500' W OF CL MAN | |
| NGS | U 131 - PM0105 | | | | | | SW CORNER FOG HASH CME | |
| | AN 9.221 AE -3.931 | | | | | | | |
| | AV -0.052 | | | 401 | TW 01 | 2M | 75' SW CL MANICAL RD + 75' | |
| | | | | | | | SE CL MANICAL RD. 75' | |
| | AREA 5 | | | | | | GRASS. | |
| PN | CODE | ROD HT | LOCATION (APPROX) | | | | | |
| 502 | FO 05 | 2M | 2900' S OF CL QUARTER RD + 100' W OF CL DIAMOND RD. | 402 | SE 04 | 2M | 250' N OF CL MANICAL + MANICAL RD. ONLY 1 1.5 MIN (BE) COLLISION DATA CORNER, FOR SILEND. | |
| 503 | TW 05 | 2M | 2900' S OF CL QUARTER RD + 300' E OF CL DIAMOND RD. (JACK GUS) | 403 | BE 04 | 2M | 75' S CL N COUNTY LINE RD + 75' W CL DEAR LAKE RD. 677 FIELD. | |
| 504 | SW 05 | 2M | 2950' S OF CL QUARTER RD + 200' E OF CL DIAMOND RD | | | | | |

1.1.3 Field Notes (continued)

| 72-0129.00 MANITOWISH CO LICAR | | | | | | | |
|--------------------------------|----------|--|--------|------|-------|---|--------|
| PN | CODE | LOCATION | APPROX | PN | CODE | LOCATION | APPROX |
| 404 | SW 04 | 250' S CL N COUNTY LINE RD + 85' W CL LONG LAKE RD. | | 410 | FO 04 | 110' N OF ASPHALT + 250' W CL PARK ST. | |
| 4 | CB 04 | 35' W CL LONG LAKE RD 7' S CL N COUNTY LINE RD CORNER OF COLOR CHANGE IN ASPHALT. | | 2002 | NGS | 4K16 - DE7671 AN - 0.661 AE 0.597 AV + 0.086 | |
| 405 | TW 04 | 100' E EXTENDED CL LONG LAKE RD + 60' N CL N COUNTY LINE RD TALL GRASS. | | 2003 | NGS | ROCKLAND W BAS - DE7646 AN 0.697 AE -0.933 AV + 0.056 | |
| 406 | NA H2 04 | SW CORNER TENNIS COURT LINES, NW QUADRANT PARK ST + GREEN MEADOW DR. | | 700 | TW 07 | 60' S CL WELLS RD + 200' SW CL CITY JJ. HAY FIELD | AREA 7 |
| 407 | BE 04 | 260' W CL PARK ST + 80' N CL GREEN MEADOW DR. MOWED LAWN. | | 701 | BE 07 | 50' N CL WELLS RD + 80' SW CL CITY JJ. LAWN | |
| 408 | CP | | | 7 | CB 07 | SW CORNER FOG LINE NW QUAD WELLS RD + CITY JJ. | |
| 409 | CP | | | 702 | CP | | |
| | | | | 703 | CP | | |

*ROD HEIGHT IS 2.17 UNLESS OTHER W/D

1.1.3 Field Notes (continued)

| PN | CODE | LOCATION (APPROX) | DN | CODE | LOCATION (APPROX) |
|------------|------------|--|-----|-------|--|
| 72-0129-00 | | MANITOWOC CC LIQAR | | | |
| 704 | UA H2 07 | INSIDE CORNER WHITE STOP STRIPE + CL JUST SOUTH OF RR TRACKS (TY J) 170' S CL BULLHEAD LAKE LN | 802 | CE 08 | INSIDE CORNER PARKING STALL SOUTH END SECOND ROW (REAR) EAST |
| 705 | SW 07 | 160' E CL (TY J) + 200' SW CL RR TRACKS | 803 | BE 08 | 260' W CL (TY S) + 185' S CL LAKE GATE RD |
| 706 | TW 07 | 100' E CL (TY J) + 40' SW CL RR TRACKS | 804 | TW 08 | 360' W CL (TY S) + 130' S CL LAKE GATE RD |
| 707 | FO 07 | 50' EAST CL (TY J) + 75' S CL BULLHEAD LAKE LN | 805 | SW 08 | 60' E CL (TY S) + 540' N FAR END CL MEADOWBROOK CT. PHRAGMITES |
| | | AREA B | | | |
| 800 | UA H2 08 | INSIDE CORNER CL + STOP LINE BRENNAN RD (TY J) | | | |
| 200-1 | NGS | VAL - 0.00183 | | | |
| | AN 0.010 | AI - 0.017 | | | |
| | AV - 0.012 | | | | |
| 801 | BE 08 | 100' S CL BRENNAN RD + 180' E CL SCHULLER ST | | | |

1.1.3 Field Notes (continued)

| 72-0129 CO MANITOWOC CO 61018 | | | | | | 13 |
|---------------------------------|---------------------------|---------------------------|------------------------------|----------|--|----|
| CREW: | PN | CODE | LOCATION (ADDRESS) | | | |
| EQUIP: RB-11 | 10 | CB 10 | 1380' E CL MEGGERS RD. | | | |
| 75E3 | | | NE CORNER CL NO PASS STRIPE. | | | |
| WEATHER | | | ON CHARLESBURG RD. | | | |
| SO ⁶ CLOUDY | | | | | | |
| DATE: | | | | | | |
| 10-28-15 | | | | | | |
| HOR DATUM: NAD 83 (2011) | | | | | | |
| VERT. DATUM: NAVD 83 (2012) | 901 | BE 09 | 1500' E CL MEGGERS RD + | | | |
| COORD. SYSTEM: NAD 83 MANITOWOC | | | 100' S CL CHARLESBURG RD. | | | |
| AREA E | | | | | | |
| PN | CODE | LOCATION (ADDRESS) | 902 | TW 09 | 690' E CL MEGGERS RD + | |
| 806 | UA HZ 08 | TIP OF ARROW IN SW CORNER | | | 65' S CL CHARLESBURG RD. | |
| | | OF PAIR PARKING LOT | | | 504 BEANS | |
| 807 | BE 08 | 40' W CL PARK LN + 180' S | | | AREA 13 | |
| | | CL CTRC | 1300 | UA HZ 13 | NW INSIDE CORNER OF THE EAST HALF | |
| | | | | | OF THE SOUTH BASKETBALL COURT. | |
| 808 | FO 08 | 250' S CL CTRC + 270' | | | | |
| | | E CL PARIS | 1301 | BE 13 | 75' N CL RAIDER HEIGHTS RD + | |
| | | | | | 35' E EXTENDED CL 41 st ST. | |
| NGS | SCHLESWIG W GPS - DE 7715 | | | | | |
| | ON - 06115 | DE - 0631 | 1302 | TW 13 | 320' W CL HWY 67 + 250' N CL | |
| | AV 12111 | | | | C74 HA TALL WOODS | |
| | AREA 9 | | | | | |
| 900 | FO 09 | 190' E CL MEGGERS RD + | 1303 | UA HZ 13 | NW CORNER STOP STRIPE @ | |
| | | 70' N CL CHARLESBURG RD | | | PAINE ST + CLEVELAND ST. | |

* 2M ROD HEIGHT UNLESS NOTED OTHERWISE

1.1.3 Field Notes (continued)

| PN | CODE | LOCATION (APPROX) | PN | CODE | LOCATION (APPROX) |
|------|---------------|--|------|---------------------|---|
| 1324 | WA H2 B | SW CORNER STOP LINE @ 12 th ST @ DAYNE ST | 1502 | SW 15 | 950' E CL CTX + 45' S CL COUNTY LINE RD |
| 1325 | SW 13 | 400' S CL DAYNE ST + 70' W CL 12 th ST | NGS | MGRNG NGPS - DE7689 | |
| NGS | 3450 - DE7559 | | | AN 0.000 | AE - 0.067 |
| | AN 9.498 | AE - 7.055 | | AV 10.111 | |
| | AV - 0.031 | | | AREA 11 | |
| 13 | CB | SEV CORNER CHURCH PARK LOT TIP OF ARROW | 1100 | BE 11 | 65' N CL CTX + 1100' E CL CTX |
| | | AREA 15 | 11 | CB 11 | TAR X IN ASPHALT 150' N CL CTX + 1100' E CL CTX |
| 15 | CB 15 | NW CORNER CL HIGHLAND RD @ COUNTY LINE RD | 1101 | TW 11 | 130' S CL CTX + 1200' E CL CTX |
| 1500 | TW 15 | 130' S CL COUNTY LINE RD + 75' W CL HIGHLAND RD | 1102 | SW 11 | 60' E CL MINERAL SPRINGS RD + 680' S CL CTX |
| 1501 | BE 15 | 350' E CL SCHWARTZWALD RD + 60' N CL COUNTY LINE RD | 1103 | EP 11 | 610' S CL CTX + 90' W CL MINERAL SPRINGS RD |

1.1.3 Field Notes (continued)

| 72-0129.00 MANITOWOC CO LIDAR | | | | | | 17 | |
|-------------------------------|--------------------|-----------------------------|----------------|--------------------------------|--|----|--|
| CREW: | GARRICK LUGERGER | PN | CODE | LOCATION (ADDRESS) | | | |
| EQUIP: | RB-41 SN 541810436 | 1102 | TW 141 | 320' S CL E JEFFERSON AVE + | | | |
| | TSC3 SN R51LC30454 | | | 80' E CL BIRCH ST. | | | |
| WEATHER: | 415° CLOUDY | DATE: | 10-29-15 | | | | |
| HOR DATUM: | NAD83 (2011) | | | AREA 12 | | | |
| VERT. DATUM: | NAVD83 (2012) | 12 | CB 12 | NE CORNER OF CL POINT CREEK RD | | | |
| COORD SYSTEM: | NCCS MANITOWOC | | | R LAKESHORE DR | | | |
| NGS | 3622 - DE 7694 | 1200 | TW 12 | 55' W CL LAKESHORE DR + 40' | | | |
| | AN 5.737 | | | S CL POINT CREEK RD | | | |
| | AV 10.019 | | | | | | |
| | AREA 141 | 1201 | BE 12 | 75' W CL LAKESHORE DR + | | | |
| PN | CODE | LOCATION (ADDRESS) | | | | | |
| 1400 | FO 141 | 5500' S CL S CLEVELAND RD + | | | | | |
| | | 220' E CL LAKESHORE RD | | | | | |
| | | 1202 | FO 12 | 500' S CL POINT CREEK RD + | | | |
| | | | | 75' W CL LAKESHORE DR | | | |
| 1401 | BE 141 | 5550' S CL S CLEVELAND RD + | | | | | |
| | | 75' E CL LAKESHORE RD | | | | | |
| | | NGS | 3490 - DE 7673 | | | | |
| | | | AN 11.017 | DE - 0.621 | | | |
| | | | AV 10.023 | | | | |
| 141 | CB 141 | 5250' S CL S CLEVELAND RD. | | | | | |
| | | NE CORNER CL MASH THAT | | | | | |
| | | RUNS THROUGH NEW + OLD | | | | | |
| | | ASPHALT. | | | | | |
| | | 1203 | VA H2 12 | 900' E CL SOMMERBURG LN. | | | |
| | | | | S.W. CORNER CL END. OF SOLID | | | |
| | | | | NO PASS STRIP. | | | |

* 2M ROD HEIGHT UNLESS OTHERWISE NOTED

1.1.3 Field Notes (continued)

| AREA J | | | 19 | | |
|--------|----------|--|-----|----------|---|
| PN | CODE | LOCATION (APPROX) | PN | CODE | LOCATION (APPROX) |
| 903 | VA H2 09 | PARK LOT SE OF S END 4 TH ST NORTHERN MOST ROW OF DOUBLE STALLS INTERSECTION OF LINES 4 TH LINE FROM EAST | 910 | EO 07 | 60' E EXTENDED CL S 14 TH ST & 50' S CL VIEBACH ST. |
| 904 | TW 07 | 100' E CL DUFER DR & 950' S CL W CUSTER ST | 911 | VA H2 09 | SE CORNER STOP LINE S END 5 TH ST (P. VIEBACH ST.) |
| 905 | BE 09 | 150' S CL DUFER DR & 80' W CL WAS DR. LAWN | | | |
| 906 | BE 09 | 250' S CL VITS DR & 880' E CL WEST DR | | | |
| 907 | VA H2 09 | N END OF S 63 RD ST. NW CORNER STOP LINE. | | | |
| 908 | VA H2 09 | 175' E CL S 20 TH ST. IN CENTER W MARSHALL ST SE CORNER NEW SECTION OF CONCRETE. | | | |
| 909 | VA H2 09 | 200' S CL DIVISION ST & 115' W CL 21 ST ST. SW CORNER EAST TENNIS COURT. | | | |

1.1.3 Field Notes (continued)

| 72-0129.00 MANITOWOC CO LIPAR | | | | | | | | 21 | | |
|-------------------------------|---------------------------|--|---------|--|---------------------------|------------|---|----|--|--|
| CREW: | GARRICK LODERGER | PN | CODE | LOCATION (APPROX) | | | | | | |
| EQUIP: | RB-3 SN 5220167402 | 300 | TW 03 | 60' N CL CITY DR + 160' W CL HWY 42 CUT CORN | | | | | | |
| | TSC3 SN R316030454 | | | | | | | | | |
| WEATHER: | 50° SUNNY | DATE: | 11-9-15 | | | | | | | |
| HOB DATUM: | MAR 83 (2011) | 301 | PO 03 | 50' N EXTENDED CL CITY DR + 140' E CL HWY 42 | | | | | | |
| VEST DATUM: | NAVO 88 (2012) | | | | | | | | | |
| UNITS SYSTEM: | WCS MANITOWOC | | | | | | | | | |
| | AREA 2 | 302 | BE 03 | 10' S EXTENDED CL CITY DR + 150' E CL HWY 42 | | | | | | |
| PN | CODE | LOCATION (APPROX) | | | | | | | | |
| 2051 | WA 02 | NE CORNER CL STRIPE CITY DR ETISCH MILLS S.E. SIDE INTERSECTION | | NGS | TWO RIVERS N GPS - 062527 | | | | | |
| | | | | | AN - 0.003 | OE - 0.093 | | | | |
| | | | | | AV - 0.186 | | | | | |
| 205 | BE 02 | 440' N CL CITY DR + 50' W CL TISH MILLS RD GRASS LAWN | | | | AREA 6 | | | | |
| | | | | 6 | CB 06 | | SE CORNER FOG LINE CITY DR BIRCH DR W SIDE OF BIRCH DR | | | |
| 206 | TW 02 | 15' E EXTENDED CL MILL DR + 50' S CL CITY DR | | | | | | | | |
| | | | | 600 | BE 06 | | 80' S CL CITY V + 810' W CL LAKE SHORE RD. | | | |
| NGS | TWO CREEKS N GPS - 062524 | | | | | | AREA 5 | | | |
| | AN - 0.025 | AP - 0.087 | | | | | | | | |
| | AV - 0.030 | | | 601 | FO 06 | | 110' S CL CITY V + 870' E CL LAKE SHORE RD. | | | |
| | AREA 3 | | | | | | | | | |
| 3 | CB 03 | SE CORNER FL STRIPE CITY DR @ HWY 42 | | 500 | BE 05 | | 75' W CL WOODLAND DR + 670' S CL WASHINGTON ST. | | | |

4 2M ROD HEIGHT UNLESS OTHERWISE NOTED

1.1.3 Field Notes (continued)

23

| PN | CODE | LOCATION (APPROX) |
|-----|--------|--|
| 501 | VAH205 | X IN TAIL CL S END OF WOODLAWN DR. |
| 505 | VAH205 | TIP OF ARROW E END PARKLET 480' W CL WOODLAWN DR & 220' S CL WASHINGTON ST |
| 506 | EQ 05 | 50' N CL DOLLAR LN & 280' NE CL HWY 147. |

1.1.3 Field Notes (continued)

| 72-0129-00 | | MANITOWOC CO. ROAD | | 27 | |
|----------------|-------------------------|--|----------|---------------------------------|--|
| CREW: | GARRICK COLBERNIG | PN | CODE | LOCATION (APPROX.) | |
| EQUIP: | BB-3 3M SURVEY BRUIZ | 605 | UA 4206 | NE CORNER 32' LUTHERLY CRT TUNN | |
| | 7503 PAULRSILVERBUSH | | | N. END COLUMBUS ST. | |
| WEATHER: | 45° CLOUDY | DATE: | 11-10-15 | | |
| W.A. DATUM: | NAD 83 (2011) | | | | |
| WGS 84 DATUM: | NAD 83 (2011) | | | | |
| COORD. SYSTEM: | NAD 83 MANITOWOC | | | | |
| PN | CODE | LOCATION (APPROX.) | | | |
| 605 | 3WD PULLS GPS - DL 2529 | | | | |
| | AN 0.023 | AE | -0.026 | | |
| | AV 0.192 | | | | |
| | | AREA 9 | | | |
| 602 | UA 4206 | NE CORNER STOP STRIPE ON 411 th ST. E. SIDE OF COLUMBUS ST. | | | |
| 603 | UA 4206 | SW CORNER STOP STRIPE ON 37 th ST. E. WILLEMUS PL. | | | |
| 604 | UA 4206 | SE CORNER OF 100' E. 30 th ST. | | | |
| 605 | 150 06 | 10' E EXTENDED CL 27 th ST + 160' E CL ADAMS ST. | | | |
| 912 | UA 4209 | NW CORNER WHITE TURN LANE DUMPER ON N.W. 1/2 POUND @ N. RAPIDS RD. | | | |
| 913 | UA 4209 | SW CORNER STOP STRIPE W. POUND KAMMER ST. @ MENASHA AVE. | | | |
| 914 | DE 01 | 60' E CL WILLEMUS ST + 80' S CL MENASHA AVE. | | | |
| 915 | TW 09 | 50' E CENTER OF CULDESAC @ N. END KULLIEN ST. | | | |

* 2M ROD HEIGHT UNLESS OTHERWISE NOTED.

1.1.3 Field Notes (continued)

| PN | CODE | LOCATION (APPROX) | PN | CODE | LOCATION (APPROX) |
|-----|----------|--|-----|----------|---|
| 916 | FO 09 | 60' W CL KANDEL ST + 930' N CL DEERBROOK LN | 922 | VA HZ 09 | SE CORNER STOP STRIP ON S 357 th ST SPANND @ MADON LN |
| 917 | FO 09 | 50' N CL LINCOLN PARK RD + 320' E CL CITY E. | 923 | VA HZ 09 | NW CORNER STOP STRIP ON N FRONT COR @ S RAPIOS RD. |
| 918 | VA HZ 09 | NW CORNER OF NORTH CENTER TENNIS COURT, LINCOLN PARK. | 924 | TW 09 | 50' NE CL RAINY DR + 90' SE CL S RAPIOS RD. |
| 919 | VA HZ 09 | TIP OF ARROW EXITING SMALL PARK LOT 30' SE MARINE DR + 660' S CL WALDO BLVD E BOUND. | 925 | FO 09 | 80' N CL EXPD DR + 250' E CL S RAPIOS RD. |
| 9 | CO 09 | CENTER OF X ENTERING SMALL PARK LOT 510' SE CL MARINE DR + 810' S CL WALDO BLVD E BOUND. | | | AREA 5 |
| 920 | VA HZ 09 | SE CORNER IN TENNIS COURT RED ARROW PARK | 507 | VA HZ 09 | W END RE N REC LINE ON CITY W @ CITY T. |
| 921 | FO 09 | 80' N CL JAYCEE DR + 230' E CL 57 th ST | 508 | SW 05 | 40' E CL CITY T + 810' S CL POLIKA RD. |

1.1.4 Manitowoc County LiDAR, calibration point statistics

The final step in using the calibration points is to run a statistical comparison against the bare earth ground surface to confirm that the vertical accuracy is within specification. The follow results indicate that the overall RMSEz of the calibration points is 0.181'. This is a separate check as compared to the Vertical Accuracy Survey QA/QC Report. These points are used in the calibration of the raw point cloud, and therefore are not an independent set of checkpoints like those used in the vertical accuracy testing.

1.1.4.1 Statistical Report for calibration points (WISCRS Manitowoc Co, US Survey Feet):

| Number | Easting | Northing | Known Z | Laser Z | Dz |
|---------------------------|------------|------------|---------|---------|--------|
| 1 | 173650.030 | 386810.730 | 856.980 | 857.470 | +0.490 |
| 11 | 173251.580 | 249247.110 | 910.410 | 910.700 | +0.290 |
| 14 | 213733.490 | 228199.670 | 638.630 | 638.820 | +0.190 |
| 10 | 133830.900 | 257417.350 | 884.790 | 884.890 | +0.100 |
| 6 | 271157.950 | 353729.500 | 595.460 | 595.520 | +0.060 |
| 4 | 132698.890 | 355565.210 | 890.980 | 891.030 | +0.050 |
| 5 | 214388.730 | 349325.550 | 744.650 | 744.670 | +0.020 |
| 8 | 190557.000 | 308629.440 | 793.960 | 793.920 | -0.040 |
| 12 | 220712.110 | 254725.940 | 600.400 | 600.330 | -0.070 |
| 15 | 179762.730 | 227904.680 | 803.020 | 802.950 | -0.070 |
| 7 | 133076.510 | 302598.680 | 832.880 | 832.770 | -0.110 |
| 2 | 220725.570 | 386676.370 | 736.390 | 736.250 | -0.140 |
| 9 | 236894.310 | 305907.500 | 596.180 | 596.040 | -0.140 |
| 13 | 142404.360 | 234600.190 | 895.540 | 895.400 | -0.140 |
| 3 | 263181.300 | 386710.930 | 622.420 | 622.240 | -0.180 |
| Average Dz | | +0.021 ft | | | |
| Minimum Dz | | -0.180 ft | | | |
| Maximum Dz | | +0.049 ft | | | |
| Root Mean Square | | 0.181 ft | | | |
| Standard Deviation | | 0.186 ft | | | |