

Ground Control Report

WISCONSIN WROC - 3DEP | WAUPACA COUNTY LIDAR 2018

1.1 GROUND CONTROL DESIGN AND METHODOLOGY

The ground control network and design used for the Waupaca 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 17 locations in and around the Waupaca 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 Wisconsin County Coordinate System-Waupaca County, NAD83 (2011), US survey feet; NAVD88 (Geoid 12B), US survey feet. The field work was conducted by Ayres Associates surveyors. All field work was completed between May 16, 2018, and June 1, 2018.

CONTROL SUMMARY AND METHODOLOGY

	Control Summary
Horizontal Datum:	NAD83 (2011)
Vertical Datum:	NAVD88 (2012), Wisconsin GEOID12B
Rectangular Coordinate System:	WCCS – Waupaca County
Used NGS Control?	🛛 Yes 🗌 No
List any NGS control points used:	DJ4329,DK4999,DJ4359,DJ4326,DK4962,DF6056,PN0762
Summary of control checks and	(See Field Notes for control checks on NGS monuments – No
calibration (if applicable):	calibration was needed)
Survey Methods Used:	RTK-GPS using WISCORS Network through VRS connection were
	used for direct observations and to set control pairs for Robotic Total
	Station shots under canopy, etc
Equipment Used:	GPS Trimble R10 GNSS S/N 5731470616 – (Ayres #70.57)
	Total station Trimble S 6 S/N 93410182 – (Ayres #75.38)
	Data Collector Trimble TSC 3 S/N RS0AC0216 (Ayres #74.58)

Crew Chief Notes

Set mag nails or hubs at control points used for total station measurements and for calibration points.

Recorded appropriate: NVA (Bare Earth & Urban) and VVA (Forested, Swamp/Wetland, Tall Weed/Crop). Took (4) pictures of each point – one from each cardinal direction.



Survey Methods (continued)

Established horizontal and vertical coordinate values on the points by a minimum of two – 90 epoch observations with separate initializations using RTK GPS and the WISCORS network. The resultant coordinates and elevations provided in the deliverables are an average of the two observations.

Check shots were taken on numerous NGS control points (see field notes) to verify that the values obtained are consistent with the datum/adjustment as described herein and meet the ±3 centimeter vertical accuracy requirement at the 95% confidence level.

Points not able to be directly occupied by GPS means were measured using Total Station methods from control point pairs set utilizing GPS methods outlined above.



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.

Ve, 510 515V515H 49 501V 509 Little Wolf Rive Clint ville reck 404 Flume 010 507 508 8 41 511 Shi 513 504 76 47 407 514 Waupaca Ri ndon 506 54 upaca 505 **Hortonville** 15 App Outagamie County Partridge 503 96 Regional Airport ake 402 512 + Little L Butte Des Legend Menas Waupaca Co Calibration Neenah Lake Poygan Waupaca Co Boundary 100m Lake Winneconne

1.1.2.1 MAP OF WAUPACA COUNTY CALIBRATION POINTS

1.1.3 WAUPACA 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 0.088'. 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.



1.1.3.1 STATISTICAL REPORT FOR CALIBRATION POINTS

Std Deviation

0.091

NUMBER	EASTING	Northing	KNOWN Z	LASER Z	Dz
402	627171.877	300113.477	836.322	836.310	-0.012
404	627806.380	426657.539	800.667	800.550	-0.117
407	626188.870	357717.893	759.577	759.650	+0.073
501V	621129.006	437904.410	817.420	817.410	-0.010
503	502911.279	305613.747	932.910	933.050	+0.140
504	578119.886	375478.946	827.620	827.510	-0.110
505	576250.451	328186.047	798.130	798.120	-0.010
506	536503.034	342482.908	852.370	852.490	+0.120
507	532503.206	408281.208	977.250	977.190	-0.060
508	606509.196	405247.050	886.450	886.510	+0.060
509	555071.407	436155.331	896.440	896.260	-0.180
510	587994.207	459130.989	884.560	884.440	-0.120
511	501494.724	383739.399	975.000	975.090	+0.090
512	578022.402	299759.545	796.520	796.530	+0.010
513	550520.864	376155.024	853.990	854.090	+0.100
515H	662069.843	456221.469	817.810	817.790	-0.020
515V	662044.789	456201.956	818.140	818.190	+0.050
	Average Dz	-0.000			
	Minimum Dz	-0.180			
	Maximum Dz	+0.140			
	Root Mean Square	0.088			



1.1.4 FIELD NOTES



CURVE FORMULAS

R=T cot. 1/1	Chord def chord
$R = \frac{y_0}{Sin. \frac{y_0}{2}D}$	No. chords- I
E=R ex. sec ½ I E=T tan ½ I	Thin. def =1/2 chord def
	R=T cot. $\frac{50}{5in. \frac{50}{2}D}$ E=R ex. sec $\frac{50}{2}$ I E=T tan $\frac{50}{2}$ I

the distance from tangent to curve, very nearly. To find angle for a given distance and deflection. Rule 1. Multiply the given distance by .or745 (def. for # for 1 ft.) and divide given deflection by the product. Rule 2. Multiply given deflection by 57.3, and divide the product by the given distance. To find deflection for a given angle and distance. Multiply the angle by .or745, and the product by the distance.

GENERAL DATA

GENERAL DATA RIGHT ANGLE TRIANGLES. Square the altitude, divide by twice the base. Add quotient to base for hypotenuse. Given Base 100, Alt. 10.10²+200=.5. 100+.5=100.5 hyp. Given Hyp. 100, Alt. 12.32²=200=3.23; 100=9.135=96.875=Base. Error in first example, coz; in last, .045-To find Tons of Rail in one mile of track: multiply weight per yard by n, and divide by 7.

LEVELING. The correction for curvature and refraction, in feet and decimals of feet is equal to 0.574 d⁹, where d is the distance in miles. The correction for curvature alone is closely, %d⁹. The combined correction is negative.

PROBABLE ERROR. If d₁, d₂, d₃, etc. are the discrepancies of various results from the mean, and if $\mathbb{Z}d^2$ -the sum of the squares of these differences and n-the number of observations, then the probable error of the mean = $\pm 0.6745 \sqrt{\frac{\mathbb{Z}d^T}{n(n-1)}}$







1.1.4 FIELD NOTES (CONTINUED)

T#	NGS CHECKS	ΔN	ΔE	ΔZ
300	BARRISON GPS	0.019	0.000	
301	IOLA W GPS	0.074	-0.036	-0003
302	WANPACA C GPS	0.000	-0.022	
303	UNION S GPS	-0.021	-0.010	-0.045
304	X 219	0.002	-0.002	-0.012
305	BEAR CREEK GPS	-0.032	0.018	0,013
306	WEYAWEGA N GAS	-0.042	-0.019	

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s 10	00 00	DR	VEVA	YA	Hous	CH NIOL	6
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110		L		CHANGER TO THE NORTH, ON EAST SIDE OF ROAD.
404	PID	2M	TIPNU	· CENTER OF WHITE CROSS IN INTERSECTION
				OF WALNUT RO AND CTH D.

407 PID	2M TIP.N.S	NE CORNER OF STORM PRAIN ON SOUTH SIDE
		OF AUSTIN CT.

				- 190 B OF CTHG & STURGER ON LU
501 V	PID	21	TANCO	A STATICK KD MTERSICAT
			MCG ESSI	212 CTHC + DWWAY TO ACC A LINE
SOLH	PID	2M	TIPNECU	The set of the set with the set with the set with the set of the s
			TRUCCU	AVERAGED SHOTS ON E + ULLERS
and a second			11,14,6,5,60	25-16-6 0/21 SIDE OF 1906 #



1.1.4 FIELD NOTES (CONTINUED)

503	PID	2M	TRNESW	SE CORNER END DE CURB NE QUAD WEST D
		-		+ STH 22

		un	N, E, S, J	NE QUAD CTHN & FLATER RD
504	PID	2M	TIENES	
			1 ar styster	CENTER OF MH STA IND \$ 200 NOF CTH B

10.0	30	6/1	M,E,S,W	100 E OF ONA PINES RD
505	PID	2M	TPNESW	CENTER OF MH W SIDE OF MULST 220'S OF ALFECOST
1024	0.0		- 12	

	UT	LM	N,E,S,W	E GURHALT RD 2 100° N DE CTUR
506	PID	21	THMESH	
				CENTER OF MH ON N UNSHWGTON ST + 100
1				O OF GRAVITE ST.

507	PID	21	TPNESL	SE CORVER END OF CURA ON N SIDE
				OF CTH GG AT CTH G INTERSECTION
CREW !	T6			
DATE	5-17-18 AM - SU PM - PART	NNY 5. Y CLAD	30	

1											
	508	DI	2.M	TP, NE, S, W	SE	CORNEL	OF CURB	NE	QUAD	CTHT	+ STH 22



1.1.4 FIELD NOTES (CONTINUED)

	_			OF CENTER ST
.509	PID	2M	TIP, N,E, ≦ ∪	CORNER OF CONCRETE NE QUAD CTHE & CENTERS
	0.0			
SIO	PIO	2M	TRINESSU	CONTER OF AT INTERSECTION OF MANIS RD & STHID
			1.1 m 1 m 1 m	1/5 NOF STP 161 5 1500 W OF HARRIS RA
511	PID	2M	THINES, W	SW CORNER 300 STRIPE E OF DRIVENING D HEE # E149 CTH R
CREW :	TG	-		
DATE	5-23-18	0		
WEATHER.	AM-35 AM-78	SUNNY SUNNY		
PT#	CODE	HEIGHT	PHOTOS	DESCRIPTION
512	PID	2M	TIPNESS	NE CONVER FOR LINE IN SW QUAD STH 49 H TRI COUNTY RD.
513	PID	2M	TIP, NESN	SW CORNER INCET N SIDE CTHR ± 150° C. DE SPENIG ST OGDENSBURG
DT a	(
514	PID	2M	TRMESN	DESCRIPTION SUNCCEPTER CONCRETE TISAL UNE REFERE ON
				SW COLLEGE THE A OF MEASE NO
	0.1	61	NESW	SNEWALS IN NE GUADI STA 45 + REINKE RD
515.11	PID	2M	THPNESW	S MH BT WITCHISCTION OF 9th STILL I CHILLET
		6	NESW	SIDELALS IN NE QUADI STAL 45 + REINKE RD
515.V	PID	2M	THPNESW	S MH BT INTERSECTION OF 9th ST 1 1540 CT



1.15 FIELD PHOTOS



Point 402





Point 407



Point 501



Point 502

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FIELD PHOTOS (CONTINUED)





Point 504





Point 506



Point 507



Point 508

Point 509



FIELD PHOTOS (CONTINUED)





Point 511



Point 512



Point 513



Point 514

Point 515