



Accuracy Report - LiDAR

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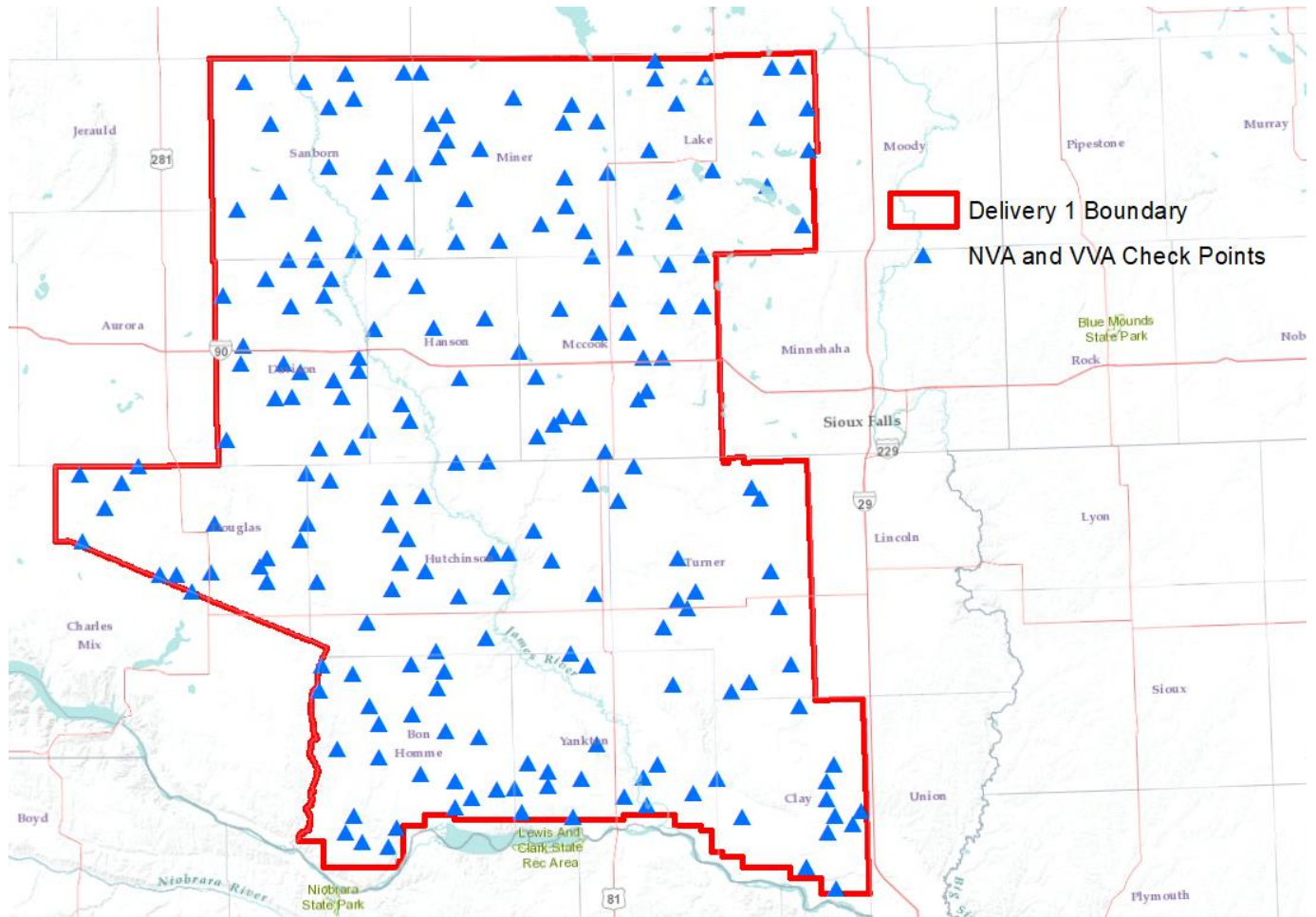
Revision History

Issue	Date	Status	Comments on Content	Prepared By	Reviewed By
01	11/2/2022	For Review	Awaiting client comments	JH	RR

Project Team

Initials	Name	Role
RR	Rob Rombough	Project Manager
JH	Jonathan Helta	Analyst

SD_EasternP2_2021 D21 – LiDAR Check Points



1. Accuracy reporting

Data collected under this Task Order meets the National Standard for Spatial Database Accuracy (NSSDA) accuracy standards. The NSSDA standards specify that vertical accuracy be reported at the 95 percent confidence level for data tested by an independent source of higher accuracy.

1.1 Positional Accuracy

Before classification and development of derivative products from the point cloud, the absolute and relative vertical accuracies of the point cloud were verified.

1.2 Absolute Vertical Accuracy

Unclassified Lidar Point Cloud Data: The Non-Vegetated Vertical Accuracy (NVA) of the Lidar Point Cloud data was calculated against TINs derived from the final calibrated and controlled swath data. The required accuracy (ACCZ) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSEz of 10 cm in the "open terrain" and/or "Urban" land cover categories. This is a required accuracy. Please refer to the table below for the achieved accuracies. The raw swath point cloud data met the required accuracy levels before point cloud classification and derivative product generation.

Table 1: Accuracy of the Lidar Point Cloud Data

Raw Flight Lines	RMSEz (non-vegetated)	NVA at 95-percent confidence level
Specification (cm)	≤ 10	≤ 19.6
Calculated Values (cm)	3.3	6.5
Specification (m)	≤ 0.100	≤ 0.196
Calculated Values (m)	0.033	0.065
Number of points	120	120

Bare Earth Surface: The accuracy (ACCZ) of the derived DEM was calculated and is being reported in three (3) ways:

1. **RMSEZ (Non-Vegetated):** The required RMSEZ is ≤ 10 cm.
2. **Non-Vegetated Vertical Accuracy (NVA):** The required NVA is: ≤ 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on RMSEZ of 10 cm in the “open terrain” and/or “Urban” land cover categories. This is a required accuracy.
3. **Vertical Accuracy (VVA):** The required VVA is: ≤ 29.4 cm at a 95th percentile level, derived according to ASPRS Guidelines, Vertical Accuracy for Reporting LiDAR Data, i.e. based on the 95th percentile error in Vegetated land cover categories combined (Tall Grass, Brush, Forested Areas). This is a required accuracy.

Please refer to the table below for the achieved accuracies.

Table 2: Accuracy of the Derived DEM

DEM	RMSEz (non-vegetated)	NVA at 95-percent confidence level	VVA at 95th percentiles
Specification (cm)	≤ 10	≤ 19.6	≤ 29.4
Calculated Values (cm)	3.4	6.6	15.5
Specification (m)	≤ 0.100	≤ 0.196	≤ 0.294
Calculated Values (m)	0.034	0.066	0.154
Number of points	120	120	83

1.3 Relative Accuracy

Smooth Surface Repeatability: In ideal theoretical conditions, smooth surface repeatability is a measure of variations documented on a surface that would be expected to be flat and without variation. Users of lidar technology commonly refer to these variations as “noise.” Single-swath data was assessed using only single returns in non-vegetated areas. Repeatability was evaluated by measuring departures from planarity of single returns from hard planar surfaces, normalizing for actual variation in the surface elevation. Repeatability of only single returns was then assessed at multiple locations within hard surfaced areas (for example, parking lots or large rooftops).

Each sample area was evaluated using a signed difference raster (maximum elevation – minimum elevation) at a cell size equal to twice the ANPS, rounded up to the next integer. Sample areas were larger than 50 square meters (m²). The maximum acceptable variations within sample areas for this project is 6 cm. Isolated noise is expected within the sample areas and was disregarded.

The evaluation was done on 30 flat open sample areas over the AOI. A sample of the results are shown in the table below, please also refer to:

SD_EasternP2_2021_D21_Relative_Accuracy_Smooth_Surface_repeatability.shp

Table 3: Relative Vertical Accuracy, Smooth Surface Repeatability

Area (square meters)	RMSDz (meters)
78	0.040444
78	0.043450
78	0.026897
78	0.052410
78	0.039623
78	0.048280
78	0.044934
78	0.048499
78	0.018082
78	0.027300
78	0.033917
78	0.029127
78	0.026969
78	0.022880
78	0.044055

Overlap Consistency: Overlap consistency is a measure of geometric alignment of two overlapping swaths; the principles used with swaths can be applied to overlapping lifts and projects as well. Overlap consistency is the fundamental measure of the quality of the calibration or boresight adjustment of the data from each lift and is of particular importance as the match between the swaths of a single lift is a strong indicator of the overall geometric quality of the data, establishing the quality and accuracy limits of all downstream data and products.

Overlap consistency was assessed at multiple locations within overlap in non-vegetated areas of only single returns.

Each overlap area was evaluated using a signed difference raster with a cell size equal to twice the ANPS, rounded up to the next integer. The difference rasters are visually examined using a

bicolored ramp from the negative acceptable limit to the positive acceptable limit. Although isolated excursions beyond the limits are expected and accepted, differences in the overlaps shall not exceed the following limits:

1. Swath overlap difference, $RMSDz \leq 8$ cm
2. Swath overlap difference, maximum ± 16 cm

The difference rasters are also statistically summarized to verify that root mean square difference in z (RMSDz) values do not exceed the project specifications. Consideration will be given for the effect of the expected isolated excursions over limits.

A sample of the result of the evaluation of 46 samples throughout the AOI is shown in the table below, please also refer to:

Overlap SD_EasternP2_2021_D21_Relative_Accuracy_Swath_Overlap.shp

Table 4: Relative Vertical Accuracy, Overlap Consistency

Area (square meters)	RMSDz (meters)	Maximum DZ (meters)	Minimum DZ (meters)
408	0.0165	0.0380	-0.0547
657	0.0188	0.0472	-0.0455
707	0.0186	0.0561	-0.0458
600	0.0175	0.0564	-0.0432
456	0.0152	0.0430	-0.0393
566	0.0126	0.0351	-0.0406
408	0.0126	0.0332	-0.0331
596	0.0164	0.0454	-0.0344
503	0.0197	0.0537	-0.0475
418	0.0187	0.0446	-0.0447
495	0.0175	0.0686	-0.0504
406	0.0172	0.0371	-0.0487
543	0.0245	0.0617	-0.0616
426	0.0226	0.0593	-0.0637
463	0.0343	0.0323	-0.0674
438	0.0201	0.0495	-0.0528
418	0.0160	0.0425	-0.0376
479	0.0156	0.0364	-0.0370