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# Accuracy Report - LiDAR

TX\_Hurricane\_2018\_D18\_Supplemental | Texas

## **Block 4**

G17PC00015 | February 18, 2020

Version 01

**Prepared for: USGS**



# Document Control

## Document Information

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## Client Information

Client	Prepared for: USGS
Client Address	1400 Independence Road, Rolla, MO 65401
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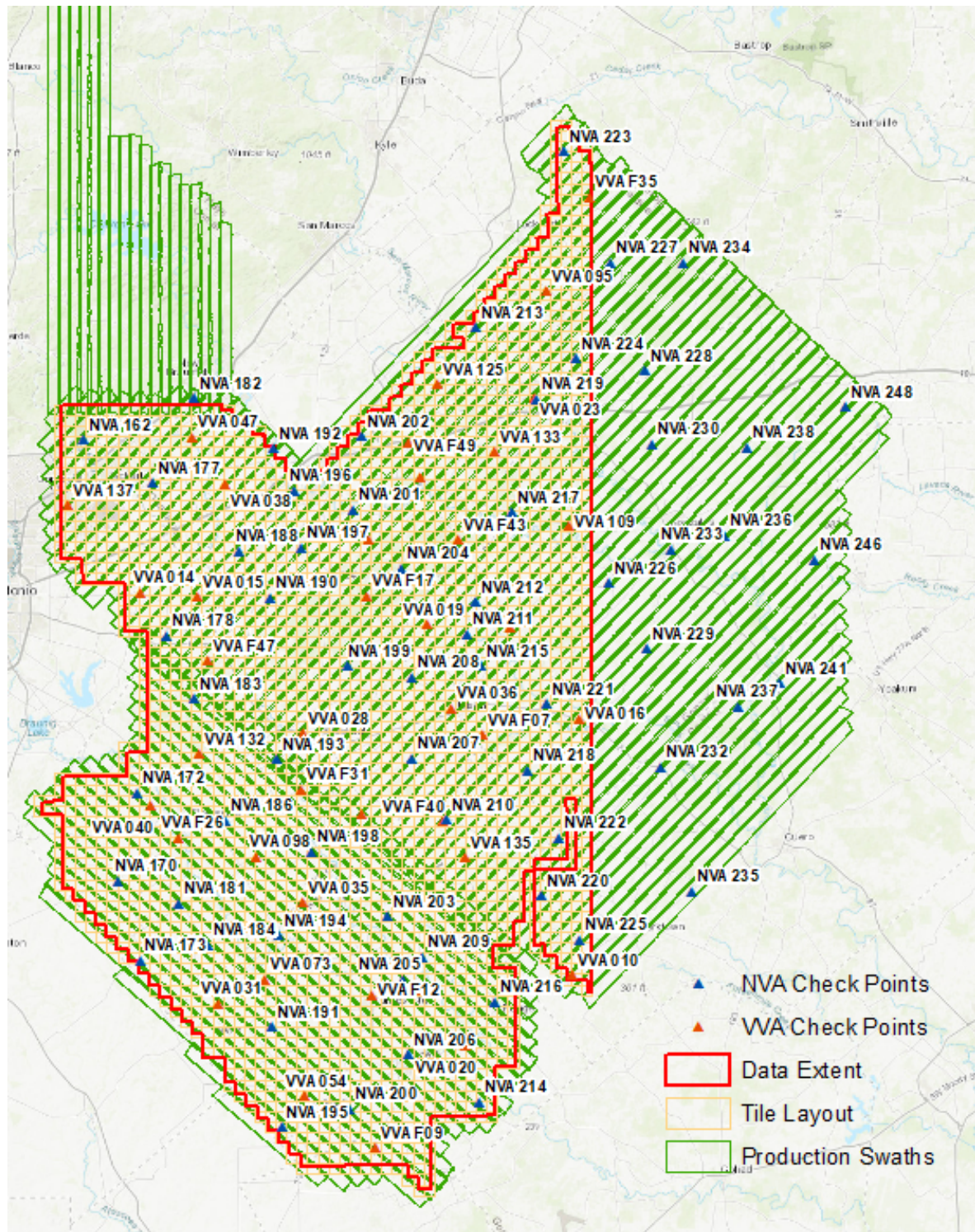
## Revision History

Issue	Date	Status	Comments on Content	Prepared By	Reviewed By
01	date	For Review	Awaiting client comments	CRM/JW	KS

## Project Team

Initials	Name	Role
KS	Katie Springman	Project Manager
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CRM	Courtney Malott	Production Analyst

# TX Harvey Block 4 – LiDAR Check Points



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# 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 (check points against swath covering Block 4)

Raw Flight Lines	RMSEz (non-vegetated)	NVA at 95-percent confidence level
Specification (cm)	≤ 10	≤ 19.6
Calculated Values (cm)	5.8	11.3
Specification (m)	≤ 0.100	≤ 0.196
Calculated Values (m)	0.058	0.113
Number of points	63	63

**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  $\leq 10$  cm.
2. **Non-Vegetated Vertical Accuracy (NVA):** The required NVA is:  $\leq 19.6$  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. **Vegetated Vertical Accuracy (VVA):** The required VVA is:  $\leq 29.4$  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 (Block 4)

DEM	RMSEz (non-vegetated)	NVA at 95-percent confidence level	VVA at 95th percentiles
Specification (cm)	$\leq 10$	$\leq 19.6$	$\leq 29.4$
Calculated Values (cm)	4.1	8.0	14.0
Specification (m)	$\leq 0.100$	$\leq 0.196$	$\leq 0.294$
Calculated Values (m)	0.041	0.080	0.140
Number of points	47	47	40

### 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 (m<sup>2</sup>). 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 Block 4 AOI. The results are shown in the table below, please also refer to:

*Harvey\_B4\_Relative\_Accuracy\_Smooth\_Surface\_Repeatability.shp*

Table 3: Relative Vertical Accuracy, Smooth Surface Repeatability (Block 4)

Area (square meters)	RMSDz (meters)
78.266	0.0156
68.649	0.0170
68.791	0.0176
62.599	0.0165
152.991	0.0197
107.570	0.0156
135.272	0.0165
62.644	0.0229
74.832	0.0206
101.694	0.0165
60.547	0.0189
57.847	0.0164
110.493	0.0204
107.930	0.0210
201.470	0.0121
63.745	0.0282
169.028	0.0333
136.800	0.0202
84.995	0.0254
88.862	0.0254
140.949	0.0258
166.292	0.0198
189.597	0.0284
218.559	0.0196
120.100	0.0287
179.282	0.0141
131.535	0.0174
166.717	0.0223
129.451	0.0258
207.968	0.0193

**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  $\pm 16$  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.

The result of the evaluation over 51 samples throughout the Block 4 AOI is shown in the table below, please also refer to:

*Harvey\_B4\_Relative\_Accuracy\_Flightline\_Overlap.shp*

Table 4: Relative Vertical Accuracy, Overlap Consistency (Block 4)

Area (square meters)	RMSDz (meters)	Maximum DZ (meters)	Minimum DZ (meters)
1333.8388	0.0281	0.0201	-0.0692
865.5449	0.0202	0.0519	-0.0242
807.2017	0.0588	0.1096	0.0109
867.0610	0.0350	0.0680	-0.0058
1403.1258	0.0219	0.0503	-0.0467
633.6798	0.0247	0.0759	-0.0245
981.2928	0.0235	0.0554	-0.0133
948.1106	0.0382	0.0016	-0.0811
744.9406	0.0297	0.0653	-0.0112
678.6753	0.0213	0.0515	-0.0247
618.7902	0.0493	0.0848	0.0126
943.7469	0.0698	0.1114	0.0146
1182.7917	0.0755	0.1104	0.0309
640.0216	0.0364	0.0774	-0.0073
927.0602	0.0176	0.0510	-0.0328
789.8108	0.0193	0.0656	-0.0230
914.1289	0.0364	0.0103	-0.0869
821.2949	0.0164	0.0455	-0.0477
788.7092	0.0370	0.0017	-0.0955
1167.3425	0.0229	0.0941	-0.0421
908.4288	0.0254	0.0242	-0.0593

1084.6786	0.0189	0.0440	-0.0473
709.2058	0.0246	0.0573	-0.0171
716.0841	0.0403	0.0595	-0.0864
1145.6379	0.0304	0.0095	-0.0572
670.3616	0.0239	0.0761	-0.0496
1489.2376	0.0185	0.0543	-0.0375
625.5020	0.0175	0.0245	-0.0464
625.5020	0.0256	0.0525	-0.0803
625.5020	0.0219	0.0181	-0.0533
4462.0582	0.0321	0.0789	-0.0220
7679.1819	0.0295	0.0412	-0.0998
3941.2864	0.0195	0.0825	-0.0583
818.9104	0.0486	0.0870	0.0004
3145.4019	0.0340	0.0871	-0.1481
2929.1058	0.0250	0.0281	-0.0825
6531.8572	0.0363	0.0650	-0.1310
3670.2571	0.0209	0.0540	-0.0330
2677.7842	0.0540	0.1539	-0.0515
4851.9800	0.0136	0.0418	-0.0470
2276.5155	0.0345	0.0791	-0.0206
1413.3008	0.0487	0.1109	-0.0173
2188.3861	0.0419	0.0734	-0.1022
8593.4723	0.0204	0.0747	-0.0753
2406.0919	0.0237	0.0572	-0.0156
2028.7375	0.0275	0.0256	-0.0644
4093.8571	0.0211	0.0644	-0.0714
5747.2013	0.0271	0.0835	-0.0389
5980.0315	0.0432	0.0844	-0.0134
3311.0968	0.0325	0.0861	-0.0396
3370.6455	0.0329	0.0874	-0.1077