ACCURACY REPORT

FEMA R6 AR Dardanelle Reservoir QL2 Lidar Pilot

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Prepared for

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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.

The absolute accuracy for the entire project area is reported in the attachment, *DardanelleReservoirAR_Lidar_QC_Master_Control_NVA_Checkpoints_Raw_FlightLines.pdf*.

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 (ACC_Z) is: 19.6 cm at a 95% confidence level, derived according to NSSDA, i.e., based on $RMSE_Z$ 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.

Raw Flight Lines	RMSEz (non-vegetated)	NVA at 95-percent confidence level
Specification (cm)	≤ 10	≤ 19.6
Calculated Values (cm)	4.7	9.3
Specification (m)	*≤ 0.100*	*≤ 0.196*
Calculated Values (m)	*0.047*	*0.093*
Number of points	35	35

Table 1: Accuracy of the Lidar Point Cloud Data

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

1. **$RMSE_Z$ (Non-Vegetated):** The required $RMSE_Z$ 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 $RMSE_Z$ 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: ≤ 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.

DEM	RMSEz (non-vegetated)	NVA at 95-percent confidence level	VVA at 95th percentiles
Specification (cm)	≤ 10	≤ 19.6	≤ 29.4
Calculated Values (cm)	3.5	6.9	12.0
Specification (m)	*≤ 0.100*	*≤ 0.196*	*≤ 0.294*
Calculated Values (m)	*0.035*	*0.069*	*0.120*
Number of points	4	4	3

Table 2: Accuracy of the Derived DEM

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 approximately 50 square meters (m^2). 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 4 flat open sample areas over the pilot AOI. The result is shown in the table below, please also refer to *DardanelleReservoirAR_Lidar_Pilot_Relative_Accuracy_Smooth_Surface_Repeatability.shp*.

Max_DZ (m)	Area (sq m)
0.0368	94
0.0407	54
0.0345	100
0.0475	89

Table 3: Relative Accuracy, Smooth Surface Repeatability

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 bicolor 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:

- Swath overlap difference, RMSDz ≤ 8 cm
- 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. Consideration will be given for the effect of the expected isolated excursions over limits.

The result of the evaluation over 15 samples throughout the Block 1 project area is shown in the table below, please also refer to *DardanelleReservoirAR_Lidar_Block1_Relative_Accuracy_Flightline_Overlap.shp*.

RMS_DZ (m)	Max_DZ (m)	Min_DZ (m)	Area (sq m)
0.0226	0.054	-0.0808	3231
0.0175	0.056	-0.0475	3993
0.0152	0.0537	-0.0348	2844
0.0131	0.043	-0.0261	2674
0.0283	0.0668	-0.0129	3072
0.0115	0.0374	-0.0729	3666
0.0305	0.1203	-0.056	4141
0.0219	0.0689	-0.0588	2710
0.0409	0.13	-0.0999	3598
0.0282	0.0734	-0.0219	2943
0.0212	0.0821	-0.0878	3080
0.0182	0.0724	-0.0964	4103
0.0323	0.0115	-0.0722	3192
0.0235	0.0396	-0.1325	3902
0.0242	0.0713	-0.0206	2763

Table 4: Relative Accuracy, Overlap Consistency