

# LIDAR Accuracy Re-Assessment Report—Scotland County

## Scotland County

Subsequent to the first assessment and the failure to initially satisfy the 25-cm RMSE criteria, the LIDAR vendor (3Di) performed an exhaustive analysis of the data. The end result as outlined in the document "Corrective Action Methodology" was that a systematic error was detected during the processing stage and corrected. In order to verify the newly computed LIDAR values, additional secondary independent QAQC survey checkpoints were provided by NCGS for comparison along with the original primary 142 checkpoints. For both the primary and secondary checkpoints, comparisons were made with the Z values as interpolated by the LIDAR contractor. A series of secondary checkpoint spreadsheets were received from NCGS on August 24, 2001 which included:

1. All the new checkpoints with the RMSE calculation for combined land cover
2. 95% of the checkpoints with the RMSE calculation (5% of points having the largest error removed)
3. Comparison of the original TIN with the newly computed TIN utilizing the primary checkpoints

All data was reviewed and further analyzed to assess the quality of the data based on the original checkpoints and the newly acquired checkpoints. The review process examined the statistics for the combined land cover, trends for each specific land cover type and comparisons of the two TINs surfaces.

In order to verify the systematic correction, the interpolated values of the primary checkpoints from the corrected TIN were subtracted from the interpolated values of the original TIN. The majority of differences between the two TIN's did indicate a consistent systematic shift of 35 centimeters except for two quarter-quarter tiles. The two tiles in question exhibited a range of differences of approximately 0 to 15 cm with one outlier of 89 centimeters. This was due to additional manual vegetation removal, which helped smooth the data therefore exhibiting a different correction to the data. Based on mass point files provided to Dewberry & Davis on September 19, 2001, additional analysis was done on adjoining tiles to verify edge matching based on the systematic shift. All edges were smooth and conformed to the neighboring tile. The following graphs and figures illustrate the data quality as per the RMSE criteria.

Table 1 summarizes the RMSE of the original checkpoints with the corrected TIN based on all land classes using:

- 100% of the checkpoints
- 95% of the checkpoints

Table 1. RMSE of Corrected TIN with Original Checkpoints				
%	RMSE (cm)	# of Points	Land Class	RMSE Criteria (cm)
100	36.0	142	All	
95	18.9	135	All	25

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Table 2 summarizes the RMSE of the secondary checkpoints with the corrected TIN using:

- 100% of the checkpoints
- 95% of the checkpoints

Note: All Checkpoints are located in the land class of "Grass"

Table 2. RMSE of Secondary Checkpoints				
%	RMSE (cm)	# of Points	Land Class	RMSE Criteria (cm)
100	11.3	46	All	
<b>95</b>	<b>9.9</b>	<b>44</b>	<b>All</b>	<b>25</b>

Table 3 summarizes the RMSE of the primary and secondary checkpoints with the corrected TIN using:

- 100% of the checkpoints
- 95% of the checkpoints
- Checkpoints categorized by land cover type

Table 3. RMSE of Secondary Checkpoints				
%	RMSE (cm)	# of Points	Land Class	RMSE Criteria (cm)
100	31.8	188	All	
<b>95</b>	<b>16.6</b>	<b>179</b>	<b>All</b>	<b>25</b>
37	12.0	69	Grass	
12	22.0	23	Weeds/Crop	
12	17.9	22	Scrub	
22	19.0	42	Forest	
12	15.7	22	Built-up	

The LIDAR data for Scotland County meets the specification as per the RMSE criteria of 25 centimeters.

All figures represent the data with the 95% data set. The corrected data is of good quality and exceeds the RMSE criteria.

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Figure 1 illustrates the RMSE by specific land cover type.

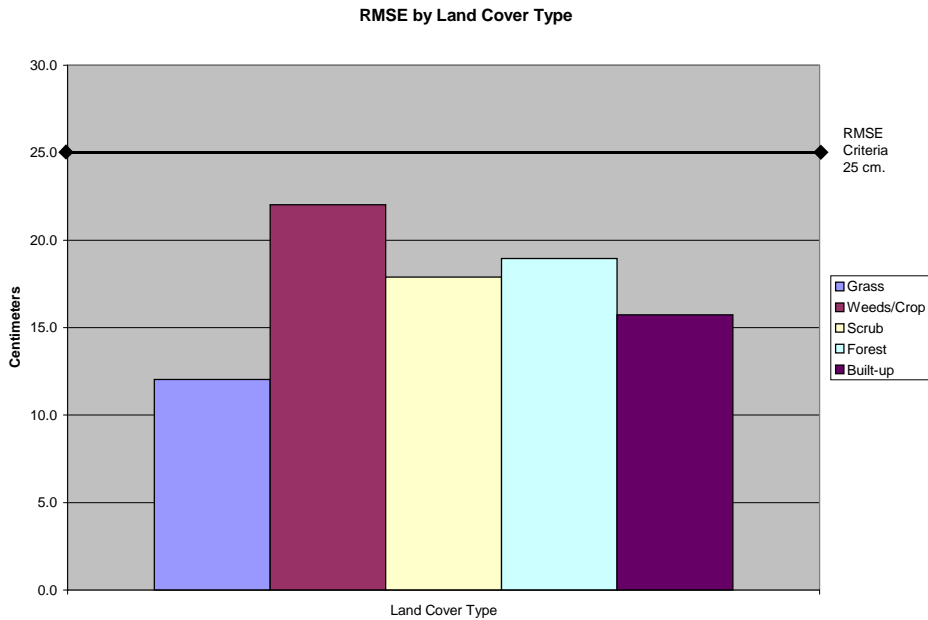
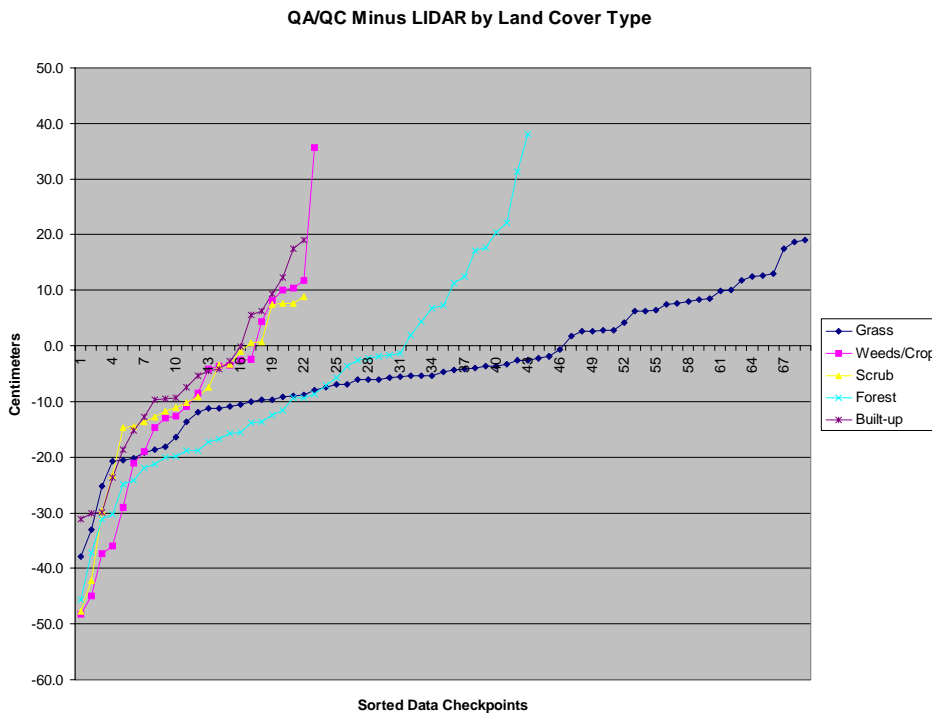


Figure 1

Figure 2 illustrates the magnitude of the differences between the checkpoints and LIDAR data by specific land cover type and sorted from lowest to highest.



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Figure 2

Table 4 illustrates the elevation difference (delta) between the QAQC survey checkpoints and that of the interpolated LIDAR.

Table 4. Elevation Delta					
Delta (cm)	Land Cover				
-37.9	Grass	-3.2	Grass	-3.7	Weeds/Crop
-33.1	Grass	-2.6	Grass	-3.4	Weeds/Crop
-25.3	Grass	-2.5	Grass	-2.6	Weeds/Crop
-20.8	Grass	-2.2	Grass	-2.4	Weeds/Crop
-20.5	Grass	-1.9	Grass	4.3	Weeds/Crop
-20.2	Grass	-0.6	Grass	8.2	Weeds/Crop
-19.2	Grass	1.8	Grass	10.1	Weeds/Crop
-18.6	Grass	2.6	Grass	10.4	Weeds/Crop
-18.1	Grass	2.6	Grass	11.7	Weeds/Crop
-16.4	Grass	2.8	Grass	35.7	Weeds/Crop
-13.7	Grass	2.8	Grass	-47.8	Scrub
-11.9	Grass	4.1	Grass	-42.1	Scrub
-11.2	Grass	6.2	Grass	-29.7	Scrub
-11.2	Grass	6.3	Grass	-23.3	Scrub
-10.8	Grass	6.4	Grass	-14.7	Scrub
-10.6	Grass	7.4	Grass	-14.5	Scrub
-10.1	Grass	7.6	Grass	-13.7	Scrub
-9.7	Grass	8.0	Grass	-12.8	Scrub
-9.6	Grass	8.3	Grass	-11.7	Scrub
-9.2	Grass	8.5	Grass	-11.0	Scrub
-9.0	Grass	9.8	Grass	-10.2	Scrub
-8.8	Grass	10.0	Grass	-9.2	Scrub
-7.9	Grass	11.8	Grass	-7.5	Scrub
-7.5	Grass	12.5	Grass	-3.4	Scrub
-6.9	Grass	12.6	Grass	-3.2	Scrub
-6.9	Grass	13.0	Grass	-1.0	Scrub
-6.1	Grass	17.4	Grass	0.6	Scrub
-6.0	Grass	18.7	Grass	0.7	Scrub
-6.0	Grass	19.0	Grass	7.5	Scrub
-5.7	Grass	-48.2	Weeds/Crop	7.6	Scrub
-5.5	Grass	-44.9	Weeds/Crop	7.6	Scrub
-5.4	Grass	-37.3	Weeds/Crop	8.8	Scrub
-5.3	Grass	-36.0	Weeds/Crop	-45.7	Forest
-5.3	Grass	-29.1	Weeds/Crop	-37.1	Forest
-4.6	Grass	-21.0	Weeds/Crop	-31.2	Forest
-4.3	Grass	-19.0	Weeds/Crop	-30.3	Forest
-4.1	Grass	-14.7	Weeds/Crop	-24.9	Forest
-3.9	Grass	-12.9	Weeds/Crop	-24.2	Forest
-3.7	Grass	-12.6	Weeds/Crop	-22.0	Forest
-3.6	Grass	-10.8	Weeds/Crop	-21.2	Forest
		-8.4	Weeds/Crop	-20.0	Forest
		-4.2	Weeds/Crop	-19.8	Forest

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-18.9	Forest	-1.8	Forest	-15.2	Built-up
-18.8	Forest	-1.4	Forest	-12.8	Built-up
-17.3	Forest	2.0	Forest	-9.7	Built-up
-16.8	Forest	4.4	Forest	-9.5	Built-up
-15.8	Forest	6.8	Forest	-9.4	Built-up
-15.5	Forest	7.2	Forest	-7.4	Built-up
-13.8	Forest	11.2	Forest	-5.3	Built-up
-13.6	Forest	12.4	Forest	-4.5	Built-up
-12.5	Forest	17.2	Forest	-4.1	Built-up
-11.5	Forest	17.7	Forest	-2.8	Built-up
-9.3	Forest	20.4	Forest	-0.2	Built-up
-9.3	Forest	22.2	Forest	5.6	Built-up
-8.7	Forest	31.3	Forest	6.3	Built-up
-7.0	Forest	38.1	Forest	9.3	Built-up
-5.7	Forest	-31.1	Built-up	12.3	Built-up
-3.6	Forest	-30.0	Built-up	17.4	Built-up
-2.6	Forest	-29.9	Built-up	19.0	Built-up
-2.2	Forest	-23.7	Built-up		
-1.9	Forest	-18.7	Built-up		

Table 5 illustrates the overall statistics for the total checkpoint data.

<b>Table 5. Overall Descriptive Statistics</b>								
	<b>RMSE (cm)</b>	<b>Mean (cm)</b>	<b>Median (cm)</b>	<b>Skew</b>	<b>Std Dev (cm)</b>	<b># of Points</b>	<b>Min (cm)</b>	<b>Max (cm)</b>
<b>Total</b>	<b>16.6</b>	-6.5	-5.7	-0.2	15.3	179	-48.2	38.1
<b>Grass</b>	<b>12.0</b>	-3.9	-4.6	-0.3	11.5	69	-37.9	19.0
<b>Weeds/Crop</b>	<b>22.0</b>	-10.0	-8.4	-0.1	20.1	23	-48.2	35.7
<b>Scrub</b>	<b>17.9</b>	-10.1	-9.7	-1.0	15.1	22	-47.8	8.8
<b>Forest</b>	<b>19.0</b>	-6.8	-9.3	0.4	17.9	43	-45.7	38.1
<b>Built-up</b>	<b>15.7</b>	-6.6	-6.4	0.0	14.6	22	-31.1	19.0

Figure 3 illustrates a histogram of the associated delta errors between the data checkpoints and the interpolated TIN values.

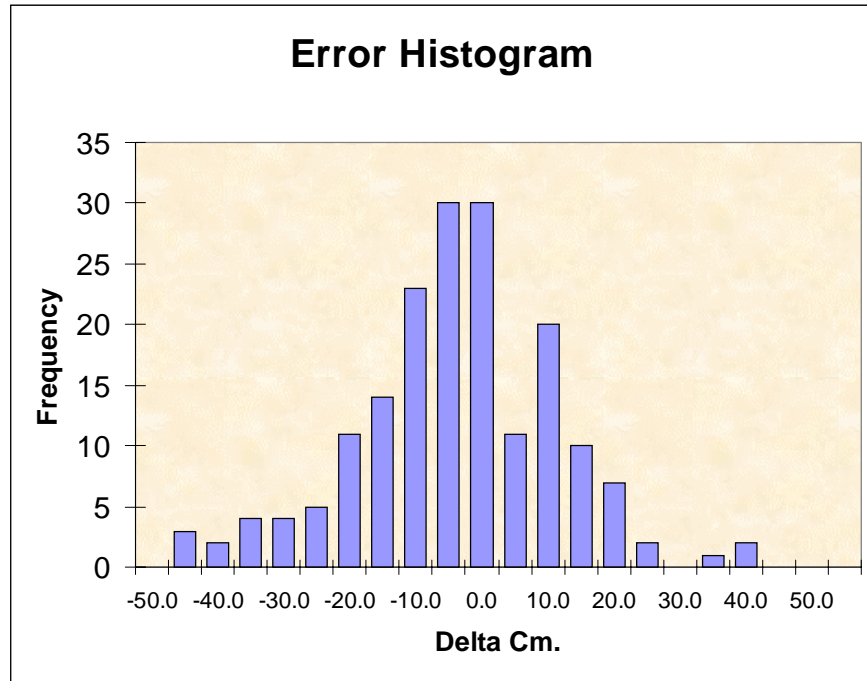


Figure 3