Richmond County – Lumber Portion

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 and Preventive Action Report Richmond County, NC LIDAR Data" was that two systematic errors were detected during the processing stage and corrected October. In order to verify the newly computed LIDAR values, an additional 11 secondary independent QA/QC survey checkpoints were provided by NCGS for comparison along with the original primary 33 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

An additional set of 32 secondary checkpoints was added to the 33 original and 11 secondary checkpoints. These 32 points were geographically located in the north section of the county, which assisted in qualifying the LIDAR data. Two spreadsheets were submitted to Dewberry for review on Oct. 01, 2001 that 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)

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 and 10 centimeters located in the southern tiles. Based on the report provided to Dewberry & Davis on October 10, 2001, 3Di identified the systematic shift, applied the appropriate correction and implemented changes in their operating procedures to ensure this problem is not replicated in the future. 3Di also performed accuracy assessments of their own using different data sources supporting the accuracy of the corrected data.

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 Original TIN with Original Checkpoints				
%	**RMSE (cm)**	**# of Points**	**Land Class**	**RMSE Criteria (cm)**
100	33.8	33	All	
95	**31.2**	**31**	**All**	**25**

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

- 100% of the original checkpoints for all land cover types
- 95% of the original checkpoints for all land cover types

Table 2. RMSE of Corrected TIN with Original Checkpoints				
%	**RMSE (cm)**	**# of Points**	**Land Class**	**RMSE Criteria (cm)**
100	19.9	33	All	
95	**17.4**	**31**	**All**	**25**

Table 3 summarizes the RMSE of the primary and 11 secondary checkpoints with the corrected TIN using:

- 100% of the checkpoints for all land cover types
- 95% of the checkpoints for all land cover types

Table 3. RMSE of Corrected TIN with Primary and 11 Secondary Checkpoints				
%	**RMSE (cm)**	**# of Points**	**Land Class**	**RMSE Criteria (cm)**
100	18.2	44	All	
95	**16.1**	**42**	**All**	**25**

Table 4 summarizes the RMSE of the primary, 11 secondary checkpoints and additional 22 secondary checkpoints with the corrected TIN using:

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

Table 4. RMSE of Corrected TIN with All Checkpoints				
%	**RMSE (cm)**	**# of Points**	**Land Class**	**RMSE Criteria (cm)**
100	16.2	76	All	
95	**13.7**	**72**	**All**	**25**
26	12.1	20	Grass	
22	15.1	17	Weed/Crop	
22	14.5	17	Scrub	
13	15.8	10	Forest	
11	9.3	8	Built-up	

The LIDAR data for Richmond 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.

Figure 1 illustrates the RMSE by specific land cover type.

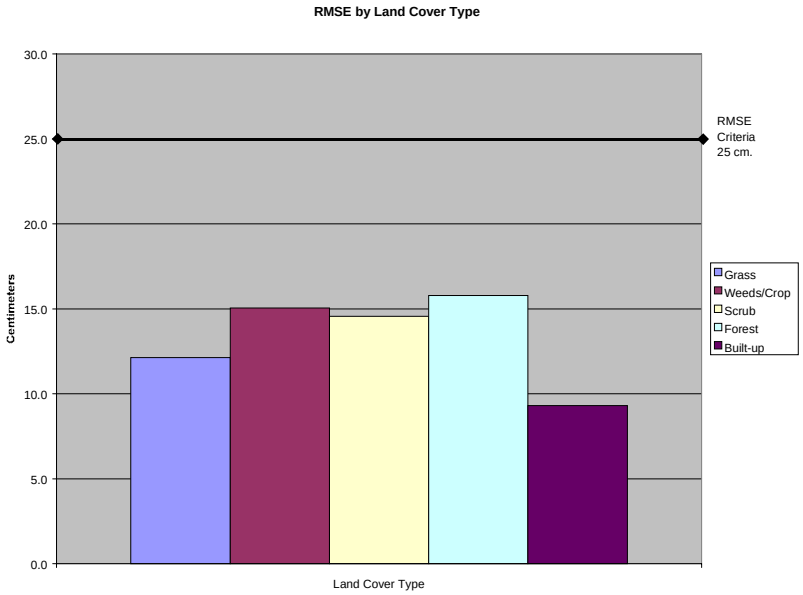

Figure 1

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.

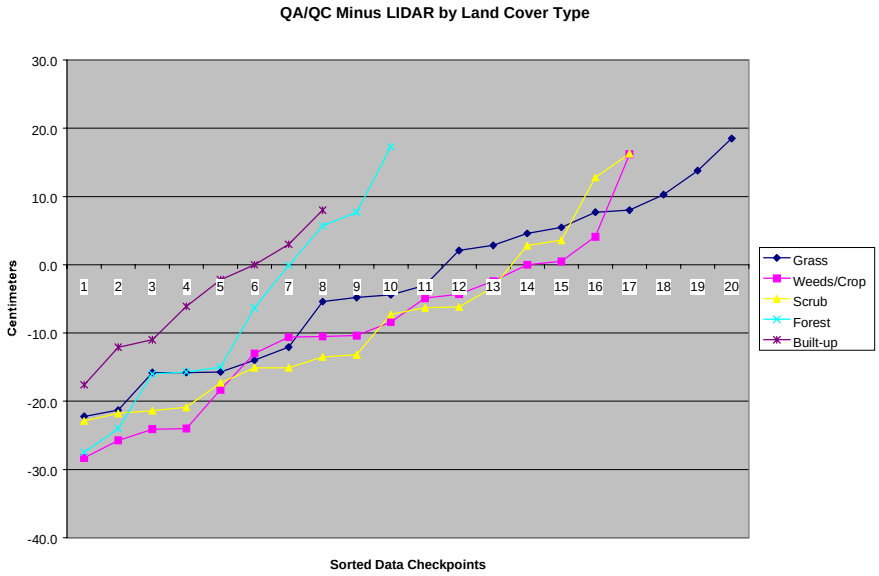

Figure 2

Table 5 illustrates the elevation difference (delta) between the QAQC survey checkpoints and that of the interpolated LIDAR.

Table 5. Elevation Delta	
Delta (cm)	**Land cover**
-22.2	Grass
-21.3	Grass
-15.8	Grass
-15.8	Grass
-15.7	Grass
-14.0	Grass
-12.1	Grass
-5.4	Grass
-4.8	Grass
-4.4	Grass
-3.0	Grass
2.1	Grass
2.8	Grass
4.6	Grass
5.5	Grass
7.7	Grass
8.0	Grass
10.3	Grass
13.8	Grass
18.5	Grass
-28.3	Weeds/Crop
-25.7	Weeds/Crop
-24.1	Weeds/Crop
-24.0	Weeds/Crop
-18.3	Weeds/Crop
-13.0	Weeds/Crop
-10.6	Weeds/Crop
-10.5	Weeds/Crop
-10.4	Weeds/Crop
-8.4	Weeds/Crop
-4.9	Weeds/Crop
-4.3	Weeds/Crop
-2.4	Weeds/Crop
0.0	Weeds/Crop
0.5	Weeds/Crop
4.1	Weeds/Crop
16.2	Weeds/Crop
-22.9	Scrub
-21.8	Scrub
-21.4	Scrub
-20.9	Scrub
-17.3	Scrub
-15.1	Scrub
-15.1	Scrub
-13.5	Scrub
-13.2	Scrub
-7.3	Scrub
-6.3	Scrub
-6.2	Scrub
-3.3	Scrub
2.8	Scrub
3.6	Scrub
12.8	Scrub
16.3	Scrub
-27.5	Forest
-24.0	Forest
-16.0	Forest
-15.7	Forest
-15.0	Forest
-6.3	Forest
-0.1	Forest
5.7	Forest
7.7	Forest
17.3	Forest
-17.6	Built-up
-12.1	Built-up
-11.0	Built-up
-6.1	Built-up
-2.2	Built-up
0.0	Built-up
3.0	Built-up
8.0	Built-up

Table 6 illustrates the overall statistics for the total checkpoint data.

Table 6. Overall Descriptive Statistics								
	RMSE (cm)	**Mean (cm)**	**Median (cm)**	**Skew**	**Std Dev (cm)**	**# of Points**	**Min (cm)**	**Max (cm)**
Total	**13.7**	-6.7	-6.3	0.2	12.0	72	-28.3	18.5
Grass	**12.1**	-3.1	-3.7	0.0	12.0	20	-22.2	18.5
Weeds/Crop	**15.1**	-9.7	-10.4	0.2	11.9	17	-28.3	16.2
Scrub	**14.5**	-8.8	-13.2	0.8	12.0	17	-22.9	16.3
Forest	**15.8**	-7.4	-10.6	0.3	14.7	10	-27.5	17.3
Built-up	**9.3**	-4.7	-4.1	0.0	8.5	8	-17.6	8.0

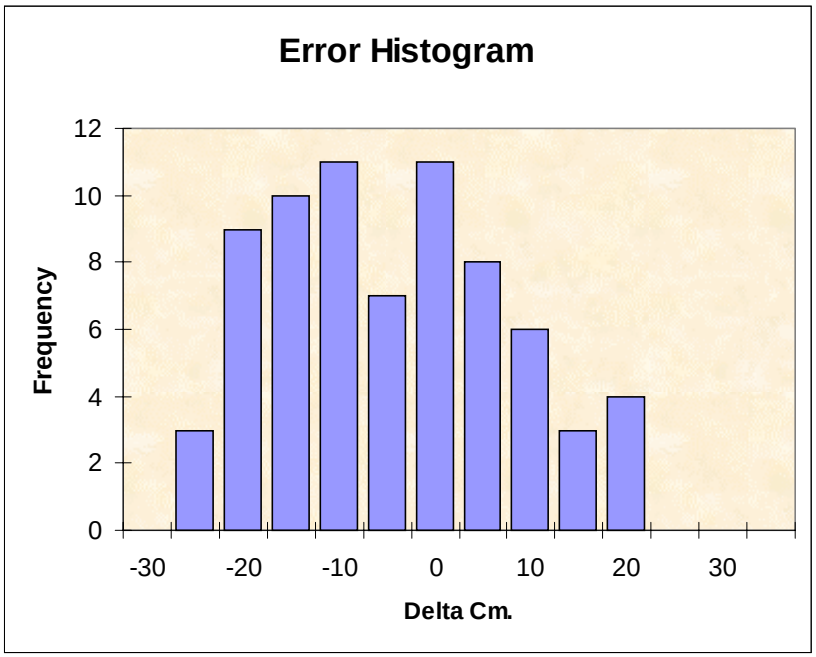

Figure 3 illustrates a histogram of the associated delta errors between the data checkpoints and the interpolated TIN values.

Figure 3