



Dewberry's Response to USGS' Review

of the

Northern Counties Acquisition and Classification for FEMA VA LiDAR

**USGS Contract:
G11PD00089**

**Prepared for:
United States Geological Survey & Federal Emergency Management Agency**

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Executive Summary

The primary purpose of this project was to develop a consistent and accurate surface elevation dataset derived from high-accuracy Light Detection and Ranging (LiDAR) technology for the USGS Virginia LiDAR project area.

Deliverables for this project included LAS, breaklines, and bare-earth Digital Elevation Models (DEMs). The USGS's review of these deliverables resulted in 44 edit calls. Of the 44 edit calls, 18 resulted in modifications to the dataset. A total of 40 DEMs were reprocessed as a result of these calls. In summary, 31 DEMs were reprocessed due to a processing error that resulted in a data void, 4 LAS tiles were modified to add culverts back into the ground, 3 modifications were made to the breaklines, 1 project boundary adjustment was made, 1 DEM was edited to remove an artifact, and 1 LAS tile was edited to remove additional bridge features. Detailed comments for the edit calls are provided in the following report.

Pixel Gap Issue – 31 DEMs reprocessed

The USGS called out a linear feature where no data appeared in the DEMs. The gap was ~10 feet in width, ran east to west, and occurred between the seams of tiles. Dewberry reprocessed the 31 DEMs and this issue no longer exists. Figure 1 shows an example of new DEMs with no pixel gap.

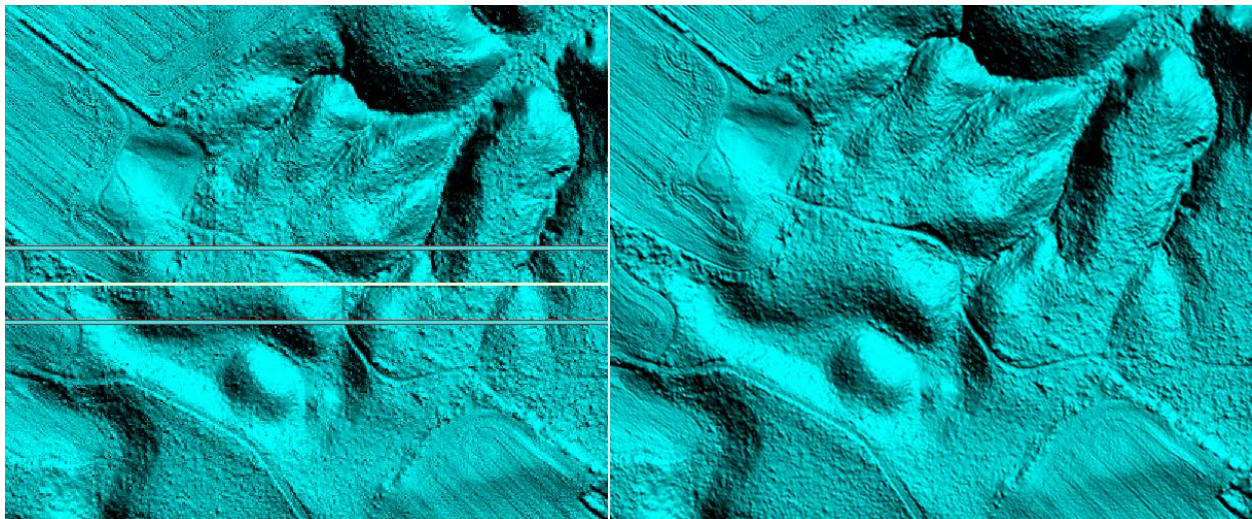


Figure 1 – Before/After image of DEM_N26_0618_30 and DEM_N26_0619_40 showing that the data gap is addressed in the new delivery (image on the right).

Culverts – 4 Changes Made

The USGS identified 4 culverts that were removed from the ground model because they were assumed to be bridges. These culverts were added back to the ground model in the LAS tiles and the DEMs were reprocessed to reflect these changes. Figure 2 to Figure 5 show two examples of how the culverts were added back to the ground model.

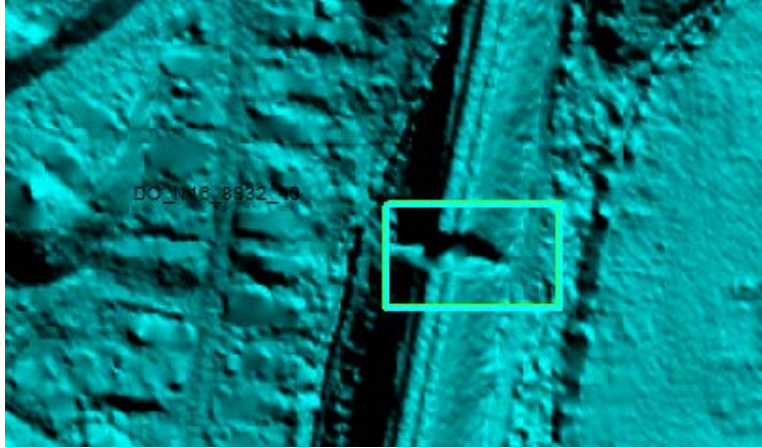


Figure 2 - Image provided by USGS of digital elevation model of tile DEM_N16_8932_40.



Figure 3 - Bing aerial imagery showing the feature is a culvert.

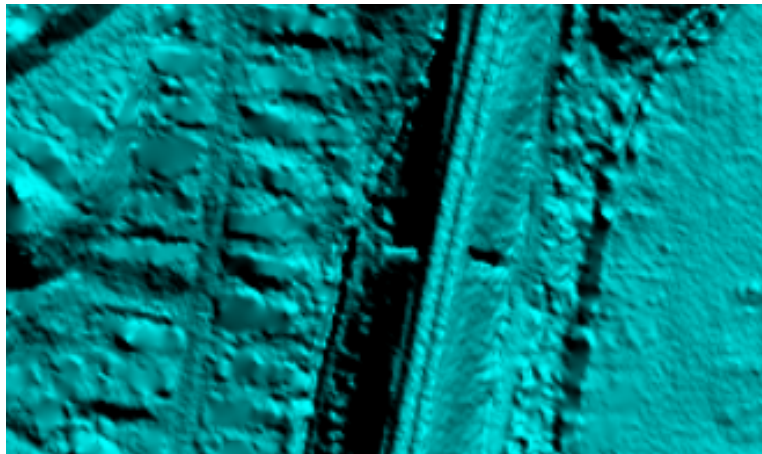


Figure 4 - New digital elevation model of DEM_N16_8932_40 showing the culvert is added back to the ground.

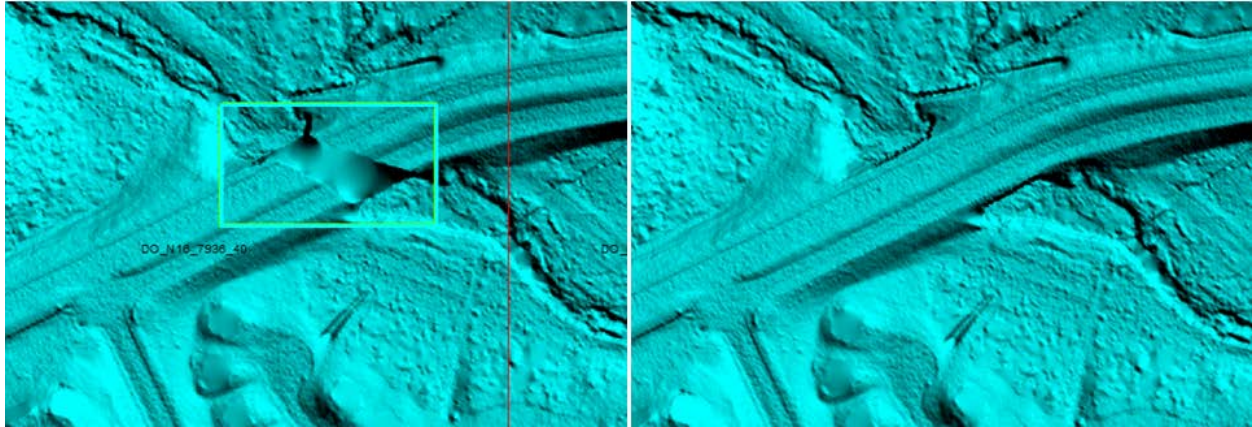


Figure 5 - Before/After image of tile DEM_N16_7936_40. The culvert is added back to the ground model.

Breakline Modifications – 3 Changes Made

The USGS called out 3 issues with the breaklines. One of these issues was a lake that was not collected in the initial delivery. The lake feature was added to the breaklines in the 2nd delivery and the LAS and DEM was reprocessed to address the change (Figure 6). An additional issue was an edit to the tidal waters breaklines where additional coastline was added to the breaklines. The change to the tidal waters breaklines was addressed in both the LAS and DEM (Figure 7 and Figure 8). The last change was a monotonicity issue where a river drops several feet in elevation over a short length. The area was reprocessed and manually edited to force the stream to flow monotonically (Figure 9 and Figure 10).

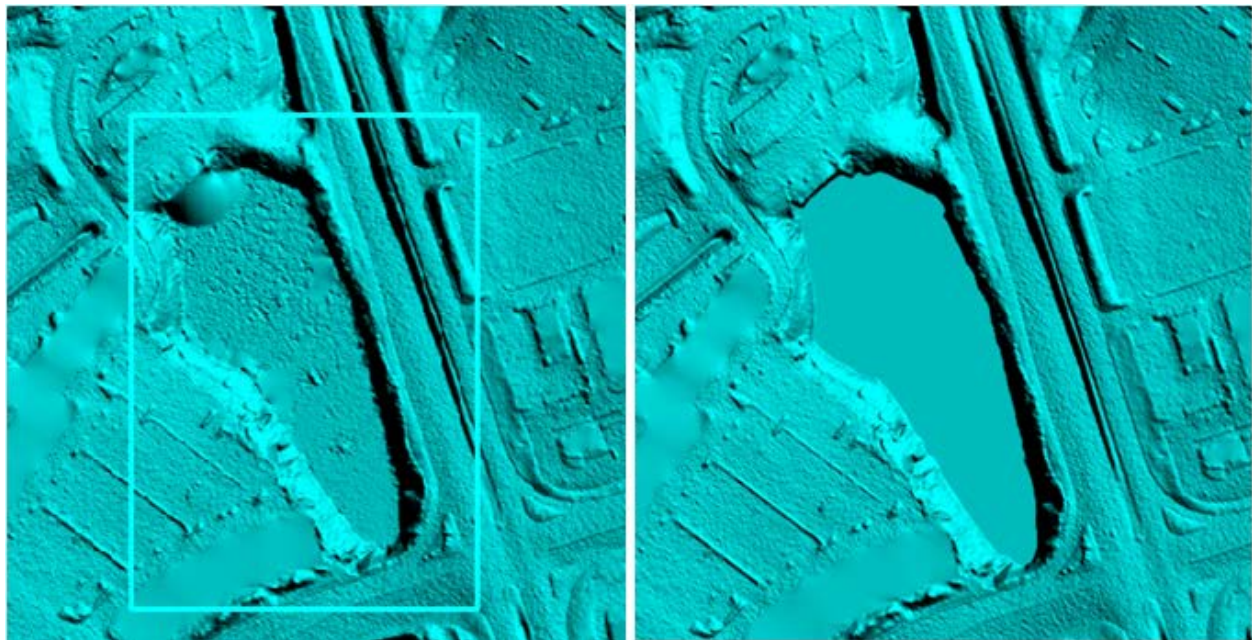


Figure 6 – Before/After of tile DEM_N16_7967_10 showing that the lake feature is now hydro-flattened in the DEM. The breakline features are added to the breakline GDB.

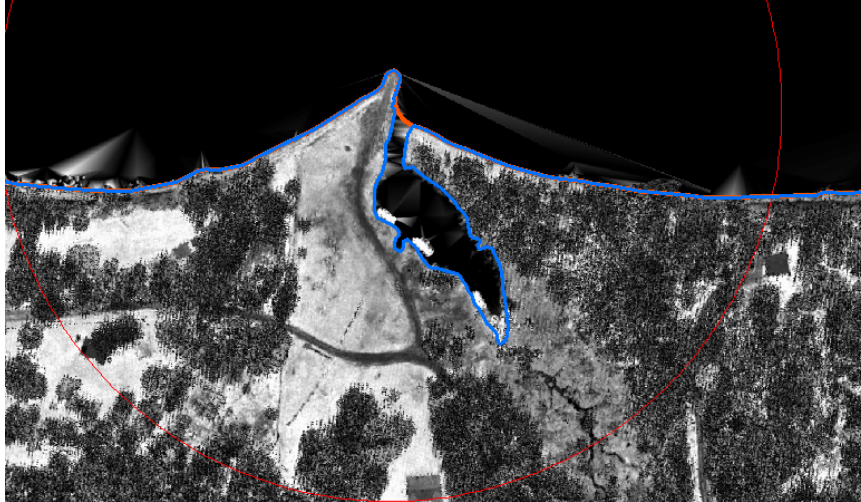


Figure 7 - Full point cloud intensity of LAS_N16_8850_30. The blue line is the new breakline and the orange line is the old breakline. The new breakline incorporates the inlet.

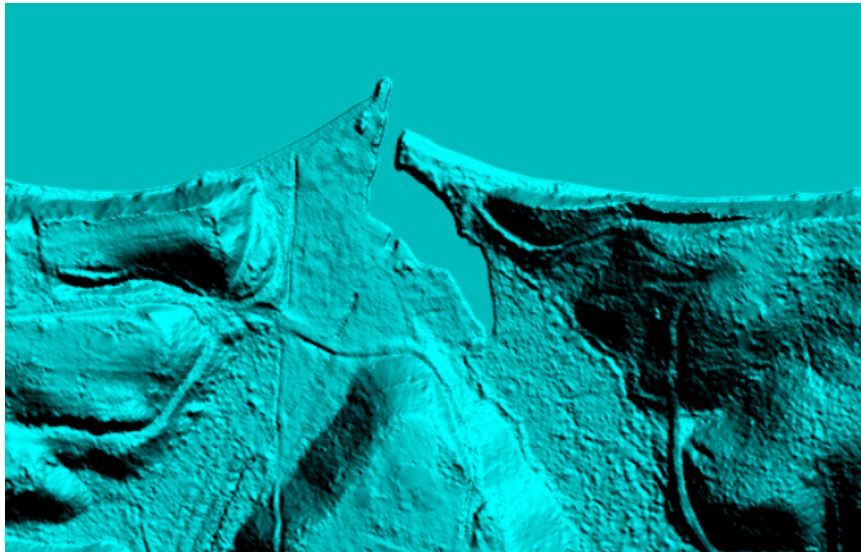


Figure 8 - Digital elevation model of DEM_N16_8850_30 showing the area is hydro-flattened.

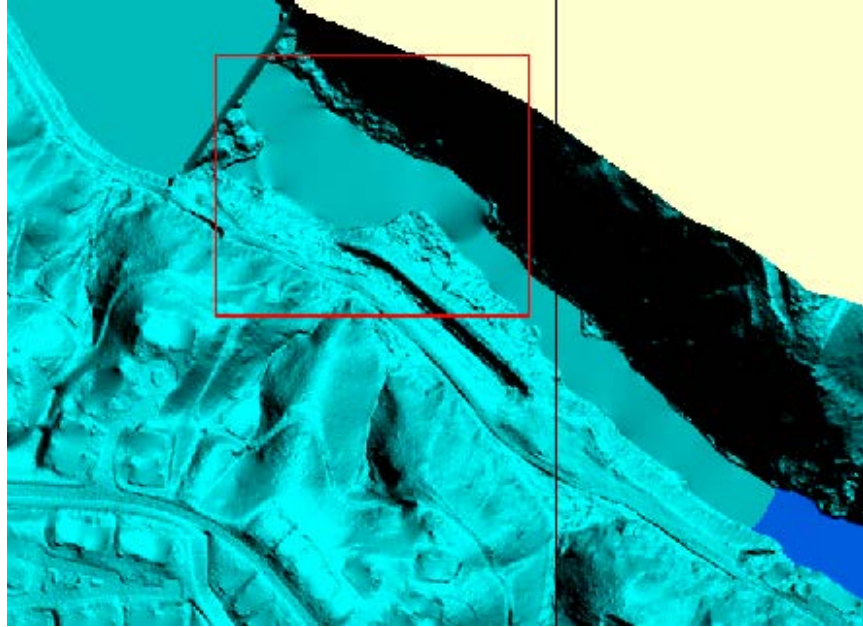


Figure 9 – Digital elevation model of DEM_N16_8933_20 and DEM_N16_8933_30 of initial delivery. There are monotonic issues in this delivery.

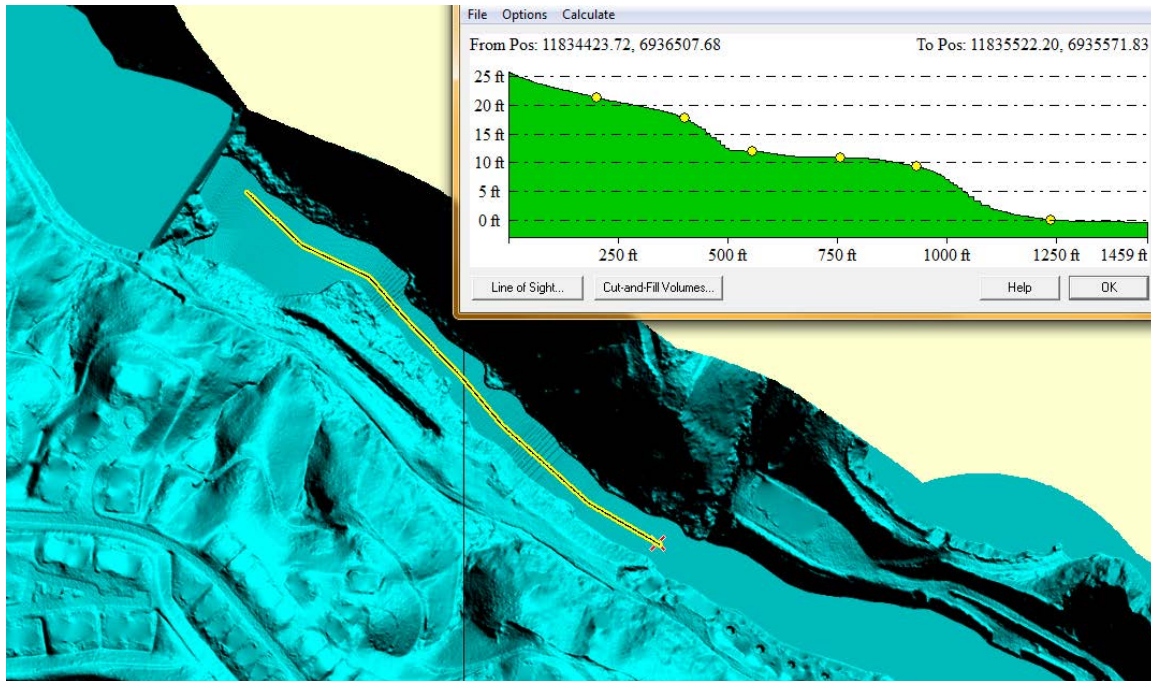


Figure 10 - Digital elevation model of DEM_N16_8933_20 and DEM_N16_8933_30 of second delivery. The monotonic issues are addressed and the stream flows downhill correctly.

Project Boundary Adjustment – 1 Change Made

The USGS called out 6 areas of data voids. Upon review, it was determined that these areas fall outside the project boundary and, with the exception of one call, occur in water. Therefore, no edits were made to the majority of the calls. One change was made to the project boundary to add an island to the



ground model. The LAS, breaklines, and DEMs were all reprocessed to reflect this addition (Figure 11 and Figure 12).

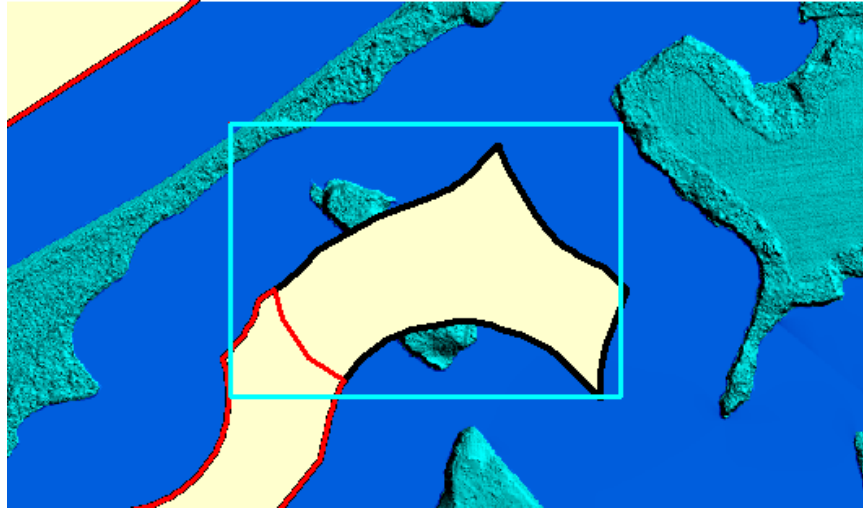


Figure 11 - Image provided by USGS of digital elevation model of tiles DEM_N26_0618_30 and DEM_N26_0619_40. The red line is the new project boundary and the black line is the old project boundary. The new line incorporates the island into the ground model.

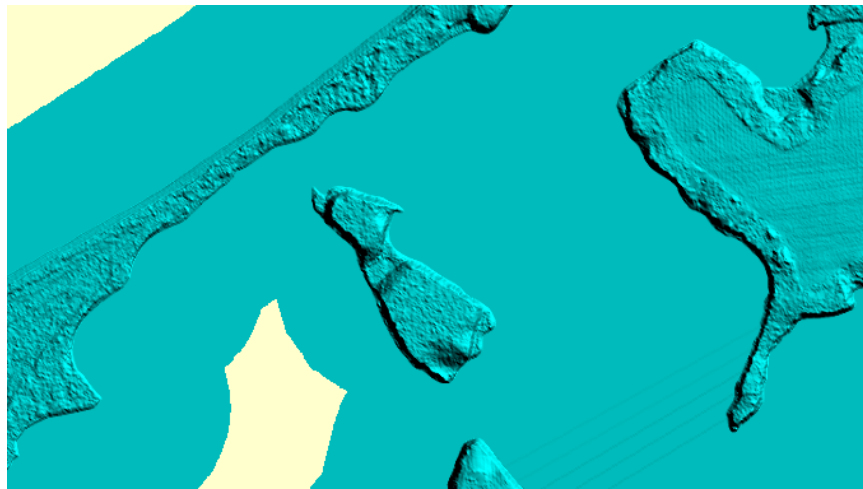


Figure 12 – Digital elevation model of tiles DEM_N26_0618_30 and DEM_N26_0619_40 showing the island is incorporated into the ground model in the 2nd delivery.

Artifact – 1 Change Made

The USGS identified an artifact from clipping a DEM that was left in the original dataset. The DEM was reprocessed and does not exist in the 2nd delivery (Figure 13).

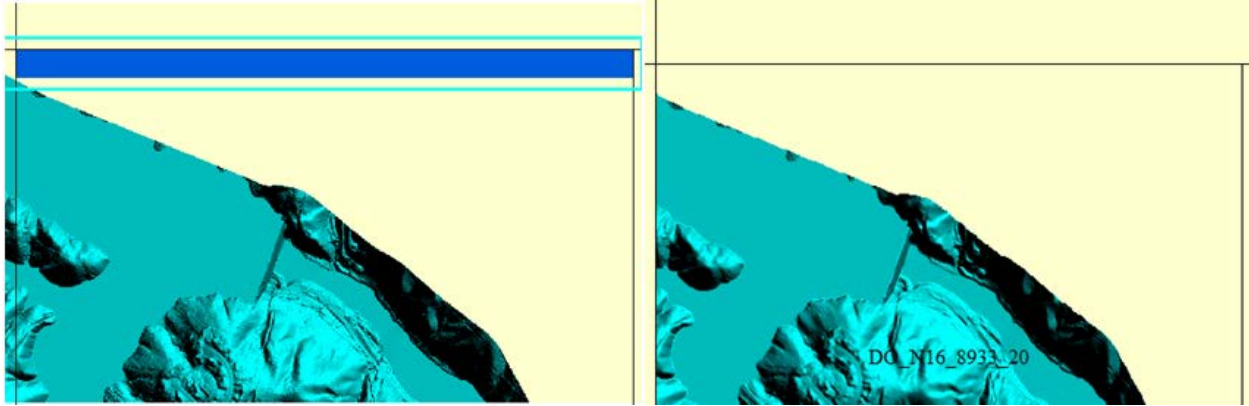


Figure 13 - Before/After of tile DEM_N16_8933_20 showing that the artifact is removed in the 2nd delivery (image to the right).

Bridges – 1 Change Made

The USGS called out 19 occurrences where the appearance of a bridge was left in the digital elevation model. The DEM surface models are created from Terrains. Terrain models create continuous surfaces from the inputs, in this instance LiDAR ground points and breaklines. Because a continuous surface is being created, the Terrain will interpolate and triangulate across a bridge opening from legitimate ground points on either side of the actual bridge. This makes the model appear to contain a bridge feature when in fact the points on the bridge have been removed from the ground. Therefore, 18 of the 19 edit calls resulted in no change. Figure 1 through Figure 4, below, show examples of how a bridge appears to be left in the surface model due to interpolation, but is in fact removed from the ground surface. Figure 5 below shows the one change to the LAS where a bridge was fully removed from the ground model.

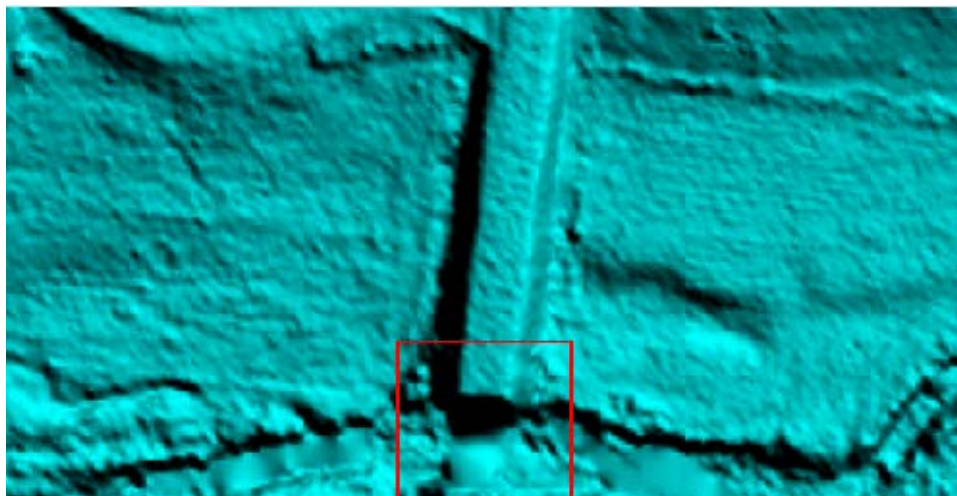


Figure 14 - Image provided by USGS of digital elevation model of tile DEM_N17_7020_30.

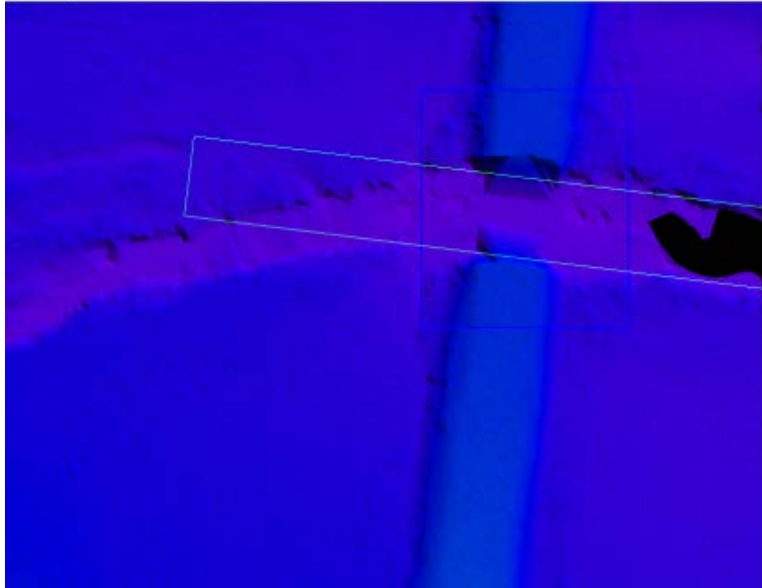


Figure 15 - Ground model of tile LAS_N17_7020_30 showing the same area as image above. The rectangular box shows the location of the two cross-sections provided below.

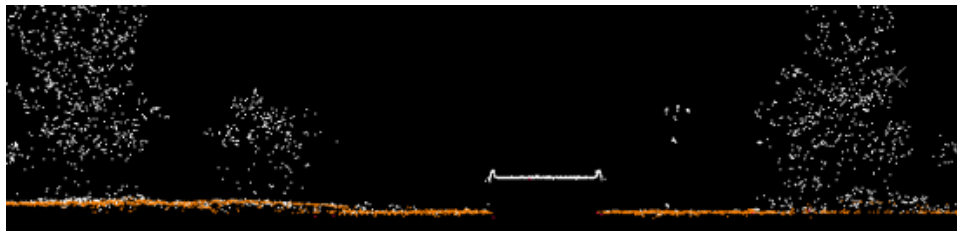


Figure 16 - Profile of LAS from tile LAS_N17_7020_30. The white points are Class 1 (unclassified) and orange points are Class 2 (ground). The bridge is completely removed from the ground points.



Figure 17 - Same profile as image above, but with all points turned off except for ground points. No extraneous points exist in the ground model.

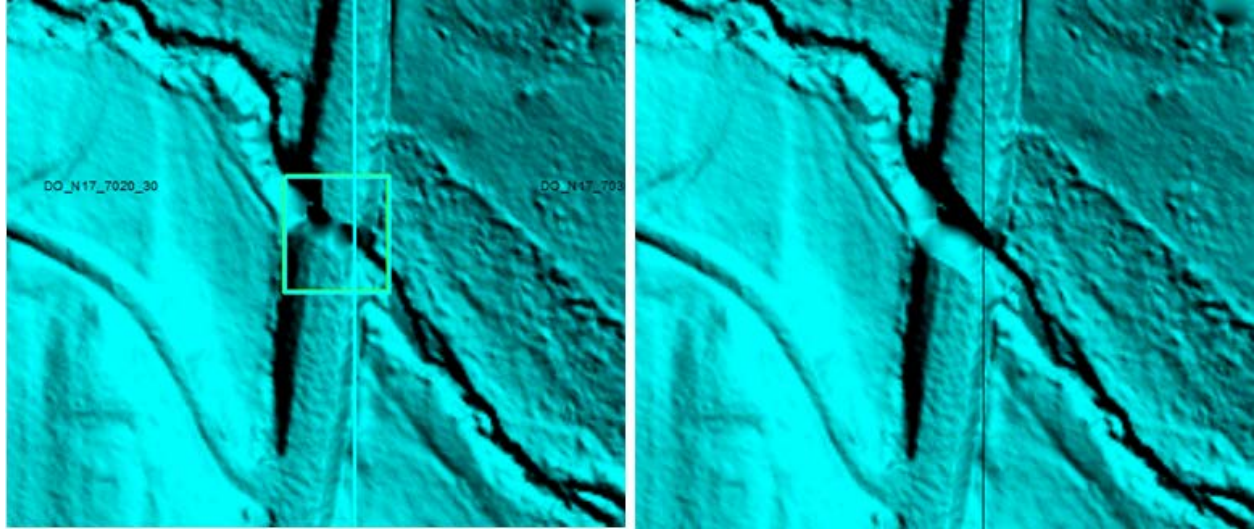


Figure 18 – Before/After image of tile DEM_N17_7020_30. The bridge is fully removed in the ground.

Seam Offset Anomalies – No Changes Made

The USGS identified 2 areas where a visible seam appeared between 2 tiles. This seam is a product of the way Global Mapper visually represents the data and is not an artifact that requires fixing in the DEMs. No changes were made to the DEMs. DEMs were mosaicked at these seams to show that no visible difference in elevation or shift in pixels is present in the final data (Figure 19 and Figure 20).

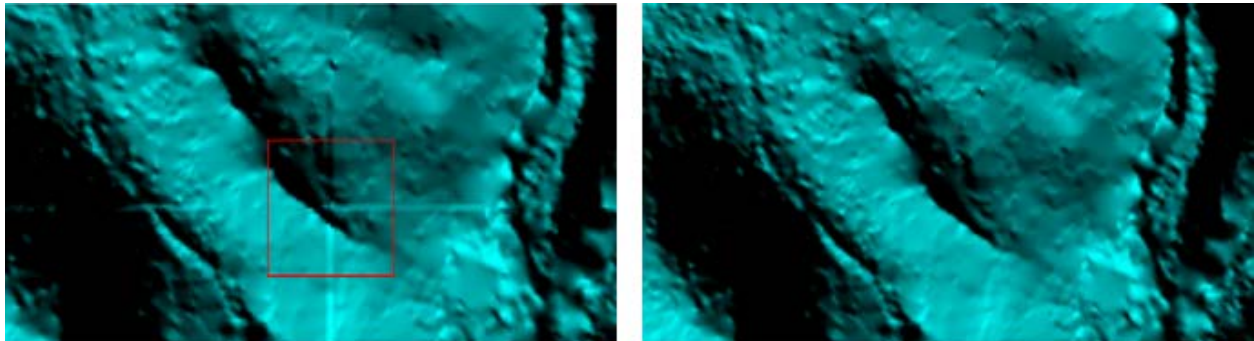


Figure 19 – Image to the left is how Global Mapper represents the data and image on the right are the DEMs mosaicked together showing no visible seam exists. The 4 DEMs shown here are DEM_S13_9932_20, DEM_S13_9932_30, DEM_S13_9932_10, and DEM_S13_9932_40.

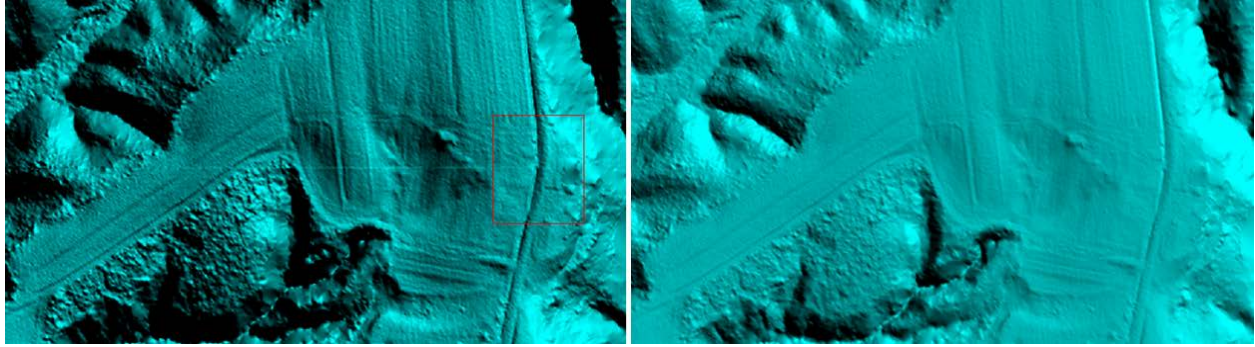


Figure 20 - Image to the left is how Global Mapper represents the data and image on the right are the DEMs mosaicked together showing no visible seam exists. The 4 DEMs shown here are DEM_S13_9940_20, DEM_S13_9940_30, DEM_S13_9940_10, and DEM_S13_9940_40.

Ground Anomaly – No Changes Made

The USGS identified one ground anomaly. This area was investigated and it was determined that the model represents the current ground conditions so no changes were made.

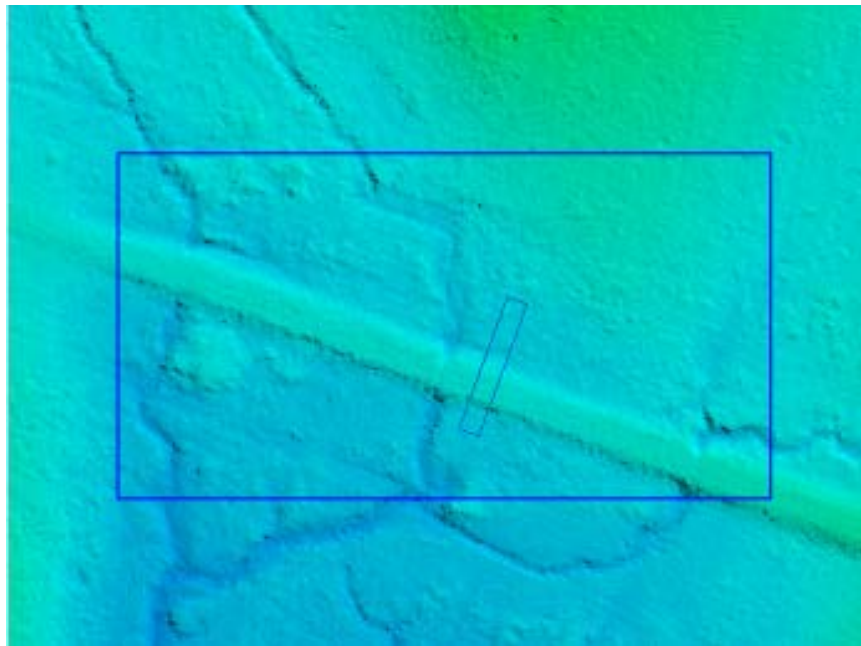


Figure 21 - Digital ground elevation model of tile LAS_N16_7981_10. The larger boxed area was called by the USGS. The smaller box shows the profile of the next image.

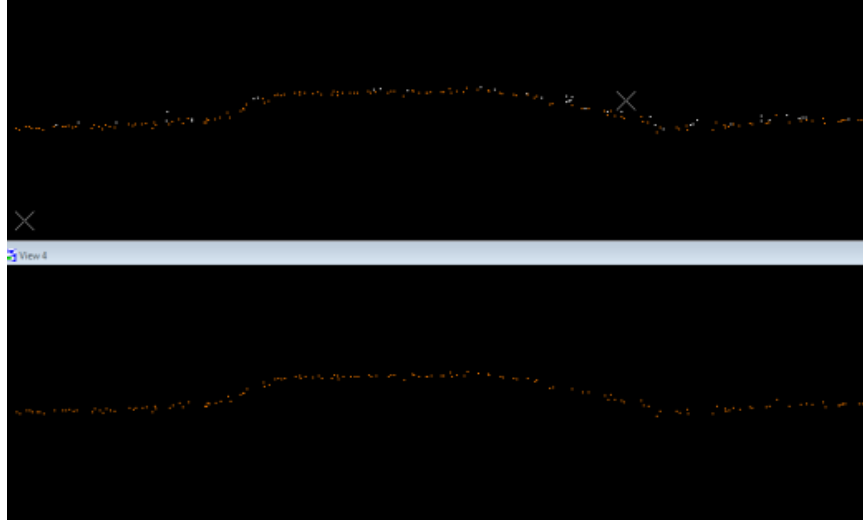


Figure 22 - Profile of LAS from tile LAS_N16_7981_10. The white points are Class 1 (unclassified) and orange points are Class 2 (ground). The ground is accurately depicted in this area.

Other Comments

Dewberry has provided a shapefile that contains the calls made by the USGS with a comment field describing changes that Dewberry performed. This file is named “USGS_Calls_NorthernCounties.shp” and can be found in the “Other_Ancillary_Data” folder.

Summary of Edit Calls

18 edit calls out of 44 resulted in modifications to the dataset. All changes were minor and include:

1. 31 DEM tiles being reprocessed to remove a strip of null pixels.
2. 4 LAS tiles edited to add culverts back to ground.
3. 3 modifications were made to breaklines.
4. 1 project boundary was adjusted to add an island to the ground model.
5. 1 DEM was edited to remove an artifact.
6. 1 LAS tile was edited to remove additional bridge features.