



LiDAR Quality Assessment Report

The USGS National Geospatial Technical Operations Center, Data Operations Branch is responsible for conducting reviews of all Light Detection and Ranging (LiDAR) point-cloud data and derived products delivered by a data supplier before it is approved for inclusion in the National Elevation Dataset and the Center for LiDAR Information Coordination and Knowledge. The USGS recognizes the complexity of LiDAR collection and processing performed by the data suppliers and has developed this Quality Assessment (QA) procedure to accommodate USGS collection and processing specifications with flexibility. The goal of this process is to assure LiDAR data are of sufficient quality for database population and scientific analysis. Concerns regarding the assessment of these data should be directed to the Chief, Data Operations Branch, 1400 Independence Road, Rolla, Missouri 65401 or NGTOCooperations@usgs.gov.

Materials Received:

2/23/2011

Project Type: Partnership W/O Agreement

Project ID:

AL_BlountCounty_2010-2011

Project Description:

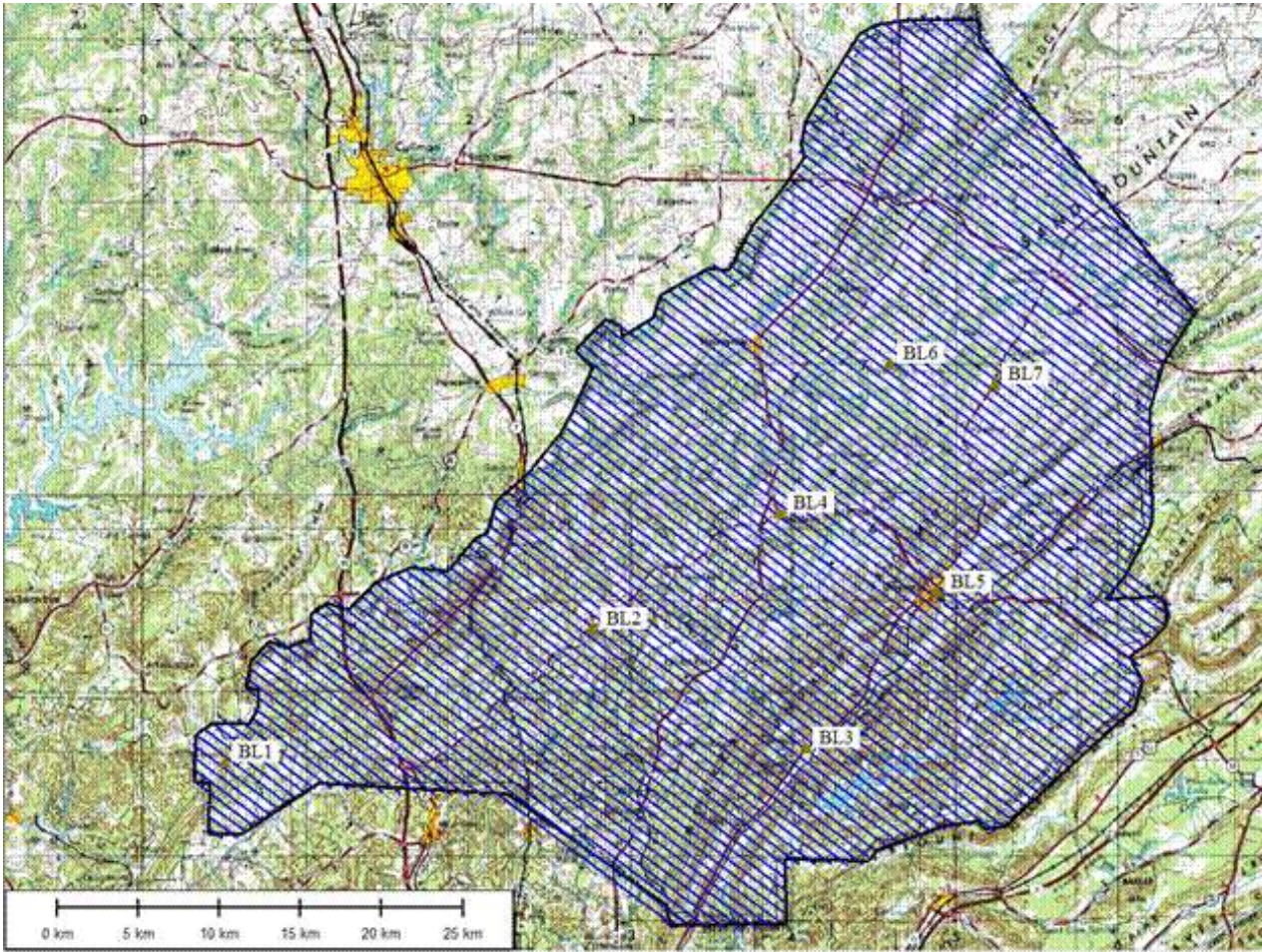
Project Alias(es):

Year of Collection: 2010

Lot of lots.

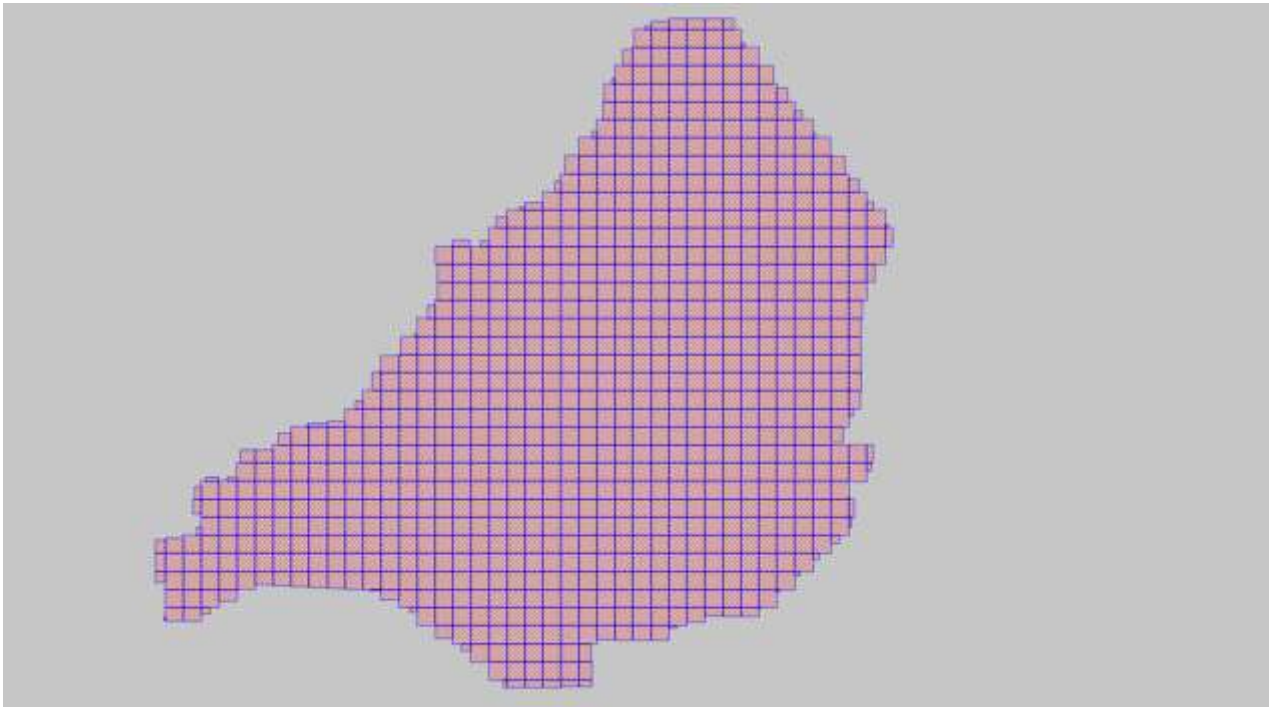
Project Extent:

Project Extent image?



Project Tiling Scheme:

Project Tiling Scheme image?



Contractor:

The Atlantic Group

Applicable Specification:

Select or type...

Licensing Restrictions:

Third Party Performed QA?

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
George Heleine	NSDI Liaison	601-933-2950	gheleine@usgs.gov

Project Deliverables

All project deliverables must be supplied according to collection and processing specifications. The USGS will postpone the QA process when any of the required deliverables are missing. When deliverables are missing, the Contracting Officer Technical Representative (COTR) will be contacted by the Elevation/Orthoimagery Section supervisor and informed of the problem. Processing will resume after the COTR has coordinated the deposition of remaining deliverables.

- Collection Report
- Survey Report
- Processing Report
- QA/QC Report
- Control and Calibration Points
- Project Shapefile/Geodatabase
- Control Point Shapefile/Gdb
- Project Tiling Scheme Shapefile/Gdb
- Breakline Shapefile/Gdb
- Project XML Metadata
- Swath LAS XML Metadata
- Classified LAS XML Metadata
- Breakline XML Metadata
- Bare-Earth DEM XML Metadata

Multi-File Deliverables

File Type	Quantity
<input checked="" type="checkbox"/> Swath LAS Files	879
<input type="checkbox"/> Intensity Image Files	1
<input checked="" type="checkbox"/> Tiled LAS Files	879
<input checked="" type="checkbox"/> Breakline Files	13
<input type="checkbox"/> Bare-Earth DEM Files	1753

Additional Deliverables

Project Geographic Information

Areal Extent:

690

Sq Mi

Grid Size:

1 X 1

meters

Tile Size:

1502 X 1502

meters

Nominal Pulse Spacing: Select...

Vertical Datum: NAVD88 meters

Horizontal Datum: NAD83 meters

Project Projection/Coordinate Reference System: UTM - Zone 16 meters.

This Projection Coordinate Reference System is consistent across the following deliverables:

- | | |
|--|--|
| <input type="checkbox"/> Project Shapefile/Geodatabase | <input checked="" type="checkbox"/> Breaklines XML Metadata File |
| <input type="checkbox"/> Project Tiling Scheme Shapefile/Gdb | <input checked="" type="checkbox"/> Bare-Earth DEM XML Metadata File |
| <input type="checkbox"/> Checkpoints Shapefile/Geodatabase | <input checked="" type="checkbox"/> Swath LAS Files |
| <input type="checkbox"/> Project XML Metadata File | <input checked="" type="checkbox"/> Classified LAS Files |
| <input type="checkbox"/> Swath LAS XML Metadata File | <input checked="" type="checkbox"/> Breaklines Files |
| <input type="checkbox"/> Classified LAS XML Metadata File | <input checked="" type="checkbox"/> Bare-Earth DEM Files |

Project Shapefile/Geodatabase CRS

Project Tiling Scheme Shapefile/Geodatabase CRS

Check Point Shapefile/Geodatabase CRS

Project XML Metadata CRS

Swath LAS XML Metadata CRS

Classified LAS XML Metadata CRS

Review Cycle

This section documents who performed the QA Review on a project as well as when QA reviews were started, actions passed, received, and completed.

Review Start Date:

10/3/2011

Action to Contractor Date	Issue Description	Return Date
10/6/2011	Several ground anomalies and hydro-flattening errors, as well as missing data ***Rechecked 9/4/2012*** All errors in the DEM have been corrected by the vendor.	

Review Complete: 10/6/2011

Metadata Review

Provided metadata files have been parsed using 'mp' metadata parser. Any errors from generated by the parser are documented below for reference and/or corrective action.

The Project XML Metadata file parsed without errors.

The Swath LAS XML Metadata file parsed without errors.

The Classified LAS XML Metadata file parsed without errors.

The Breakline XML Metadata file parsed with errors.

Error (line 4): Lineage is not permitted in Metadata
Error (line 4): Process_Step is required in Lineage

Error (line 4): improper value for Publication_Date
Warning (line 4): Online_Linkage does not have a value
Error (line 4): improper value for Calendar_Date
Error (line 4): improper value for Progress
Error (line 4): improper value for West_Bounding_Coordinate
Error (line 4): improper value for East_Bounding_Coordinate
Error (line 4): improper value for North_Bounding_Coordinate
Error (line 4): improper value for South_Bounding_Coordinate
Error (line 4): Distributor is required in Distribution_Information
Error (line 4): Distribution_Liability is required in Distribution_Information
Error (line 4): Fees is required in Standard_Order_Process
Error (line 4): Digital_Transfer_Option is required in Digital_Form
Error (line 4): Format_Name is required in Digital_Transfer_Information
Error (line 4): improper value for Transfer_Size
Error (line 4): improper value for Point_and_Vector_Object_Count
Error (line 4): improper value for Abscissa_Resolution
Error (line 4): improper value for Ordinate_Resolution
Error (line 4): Altitude_Datum_Name is required in Altitude_System_Definition
Error (line 4): Altitude_Distance_Units is required in Altitude_System_Definition
Error (line 4): Entity_Type_Definition is required in Entity_Type
Error (line 4): Entity_Type_Definition_Source is required in Entity_Type
Error (line 4): Attribute_Definition is required in Attribute
Error (line 4): Attribute_Definition_Source is required in Attribute
Error (line 4): Attribute_Domain_Values is required in Attribute
Error (line 4): Attribute_Definition is required in Attribute
Error (line 4): Attribute_Definition_Source is required in Attribute
Error (line 4): Attribute_Domain_Values is required in Attribute
Error (line 4): Logical_Consistency_Report is required in Data_Quality_Information
Error (line 4): Completeness_Report is required in Data_Quality_Information
Error (line 4): Time_of_Day is not permitted in Process_Step
Error (line 4): Process_Date is required in Process_Step
Warning (line 4): Source_Used_Citation_Abbreviation does not have a value
34 errors: 2 misplaced, 19 missing, 2 empty, 11 bad_value

The Bare-Earth DEM XML Metadata file parsed with errors.

Error (line 14): Issue_Identification is required in Series_Information
Error (line 27): improper value for Beginning_Date
Error (line 28): improper value for Beginning_Time
Error (line 29): improper value for Ending_Date
Error (line 30): improper value for Ending_Time
Error (line 46): Altitude_Distance_Units is not permitted in Spatial_Domain
Error (line 41): improper value for West_Bounding_Coordinate
Error (line 48): Place_Keyword_Thesaurus is required in Place
Error (line 52): Theme_Keyword_Thesaurus is required in Theme
Error (line 95): Source_Citation is required in Source_Information
Error (line 95): Type_of_Source_Media is required in Source_Information
Error (line 95): Source_Citation_Abbreviation is required in Source_Information
Error (line 95): Source_Contribution is required in Source_Information

Error (line 99): improper value for Beginning_Date
Error (line 100): improper value for Beginning_Time
Error (line 101): improper value for Ending_Date
Error (line 102): improper value for Ending_Time
Error (line 110): improper value for Process_Date
Error (line 124): Time_of_Day is not permitted in Process_Step
Error (line 124): Process_Date is required in Process_Step
Error (line 148): improper value for Abscissa_Resolution
Error (line 149): improper value for Ordinate_Resolution
Error (line 164): improper value for Altitude_Resolution
Error (line 172): Entity_Type_Definition is required in Entity_Type
Error (line 172): Entity_Type_Definition_Source is required in Entity_Type
Error (line 177): Distributor is required in Distribution_Information
Error (line 177): Distribution_Liability is required in Distribution_Information
Error (line 179): Fees is required in Standard_Order_Process
Error (line 180): Digital_Transfer_Option is required in Digital_Form
Error (line 190): improper value for Metadata_Future_Review_Date
Error (line 216): Metadata_Security_Classification_System is required in Metadata_Security_Information
31 errors: 2 misplaced, 15 missing, 14 bad_value

Project QA/QC Report Review

ASPRS recommends that checkpoint surveys be used to verify the vertical accuracy of LiDAR data sets. Checkpoints are to be collected by an independent survey firm licensed in the particular state(s) where the project is located. While subjective, checkpoints should be well distributed throughout the dataset. National Standards for Spatial Data Accuracy (NSSDA) guidance states that checkpoints may be distributed more densely in the vicinity of important features and more sparsely in areas that are of little or no interest. Checkpoints should be distributed so that points are spaced at intervals of at least ten percent of the diagonal distance across the dataset and at least twenty percent of the points are located in each quadrant of the dataset.

NSSDA and ASPRS require that a minimum of twenty checkpoints (thirty is preferred) are collected for each major land cover category represented in the LiDAR data. Checkpoints should be selected on flat terrain, or on uniformly sloping terrain in all directions from each checkpoint. They should not be selected near severe breaks in slope, such as bridge abutments, edges of roads, or near river bluffs. Checkpoints are an important component of the USGS QA process. There is the presumption that the checkpoint surveys are error free and the discrepancies are attributable to the LiDAR dataset supplied.

For this dataset, USGS checked the spatial distribution of checkpoints with an emphasis on the bare-earth (open terrain) points; the number of points per class; the methodology used to collect these points; and the relationship between the data supplier and checkpoint collector. When independent control data are available, USGS has incorporated this into the analysis.

Checkpoint Shapefile or Geodatabase:

Checkpoint Distribution Image?

The following land cover classes are represented in this dataset (uncheck any that do not apply):

- Bare Earth
- Tall Weeds and Crops
- Brush Lands and Low Trees
- Forested Areas Fully Covered by Trees
- Urban Areas with Dense Man-Made Structures

There are a minimum of 20 checkpoints for each land cover class represented. Points

within each class are uniformly distributed throughout the dataset. USGS was not able to locate independent checkpoints for this analysis. USGS does not accept at this time the quality of the checkpoint data for these LiDAR datasets.

Errors, Anomalies, Other Issues to document? Yes No

Image?

Blind point checkpoint data shapefile not included with this dataset.

Accuracy values are reported in terms of Fundamental Vertical Accuracy (FVA), Supplemental Vertical Accuracy(s) (SVA), and Consolidated Vertical Accuracy (CVA).

Accuracy values are reported in:

Required FVA Value is or less.

Target SVA Value is or less.

Required CVA Value is or less.

The reported FVA of the LAS Swath data is .

The reported FVA of the Bare-Earth DEM data is **0.61** .

SVA are required for each land cover type present in the data set with the exception of bare-earth. SVA is calculated and reported as a 95th Percentile Error.

Land Cover Type	SVA Value	Units
Tall Weeds and Crops		N/A
Brush Lands and Low Trees		N/A
Forested Areas Fully Covered by Trees		N/A
Urban Areas with Dense Man-Made Structu...		N/A

The reported CVA of this data set is: .

LAS Swath File Review

LAS swath files or raw unclassified LiDAR data are reviewed to assess the quality

control used by the data supplier during collection. Furthermore, LAS swath data are checked for positional accuracy. The data supplier should have calculated the Fundamental Vertical Accuracy using ground control checkpoints measured in clear open terrain. The following was determined for LAS swath data for this project:

LAS Version

- LAS 1.2 LAS1.3 LAS 1.4

Swath File Characteristics

- Separate folder for LAS swath files
 Each swath files <= 2GB
 *If specified, *.wdp files for full waveform have been provided

The reported FVA of the LAS swath data is .

Based on this review, the USGS accepts the LAS swath file data.

Yes No

Image?

LAS Tile File Review

Classified LAS tile files are used to build digital terrain models using the points classified as ground. Therefore, it is important that the classified LAS are of sufficient quality to ensure that the derivative product accurately represents the landscape that was measured. The following was determined for classified LAS files for this project:

Classified LAS Tile File Characteristics

- Separate folder for Classified LAS tile files
 Classified LAS tile files conform to Project Tiling Scheme
 Quantity of Classified LAS tile files conforms to Project Tiling Scheme
 Classified LAS tile files do not overlap
 Classified LAS tile files are uniform in size
 Classified LAS tile files have no points classified as '12'

- Point classifications are limited to the standard values listed below:

Code	Description
1	Processed, but unclassified
2	Bare-earth ground
7	Noise (low or high, manually identified, if needed)
9	Water
10	Ignored ground (breakline proximity)
11	Withheld (if the "Withheld" bit is not implemented in processing software)

- Buy up?

Based on this review, the USGS does not accept at this time the classified LAS tile file data.

Overlap points (Class 12) found for classified LAS Yes No

- Image?

Class 12 (overlap) has been found. The classified LAS version has been processed to 1.0

Breakline File Review

Breaklines are vector feature classes that are used to hydro-flatten the bare earth Digital Elevation Models.

Breakline File Characteristics

- Separate folder for breakline files
- All breaklines captured as PolylineZ or PolygonZ features
- No missing or misplaced breaklines

Based on this review, the USGS accepts the breakline files.

Errors, Anomalies, Other Issues to document? Yes No

None.

Bare-Earth DEM Tile File Review

The derived bare-earth DEM file receives a review of the vertical accuracies provided by the data supplier, vertical accuracies calculated by USGS using supplied and independent checkpoints, and a manual check of the appearance of the DEM layer.

Bare-Earth DEM files provided in the following format:

Bare-Earth DEM Tile File Characteristics

- Separate folder for bare-earth DEM files
- DEM files conform to Project Tiling Scheme
- Quantity of DEM files conforms to Project Tiling Scheme
- DEM files do not overlap
- DEM files are uniform in size
- DEM files properly edge match
- Independent check points are well distributed

All accuracy values reported in .

Reported Accuracies

Land Cover Category	# of Points	Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy _z) Required FVA = <input type="text"/>	Supplemental Vertical Accuracy @95th Percentile Error Target SVA = <input type="text"/> or less.	Consolidated Vertical Accuracy @95th Percentile Error Required CVA = <input type="text"/> or less.
Open Terrain	<input type="text" value="20"/>	<input type="text" value="0.61"/>	<input type="text"/>	<input type="text"/>
Tall Weeds and Crops	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Brush Lands and Low Trees	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Forested Areas Fully Covered by Trees	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Urban Areas with Dense Man-Made Structures	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Consolidated	<input type="text" value="20"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

- QA performed Accuracy Calculations?

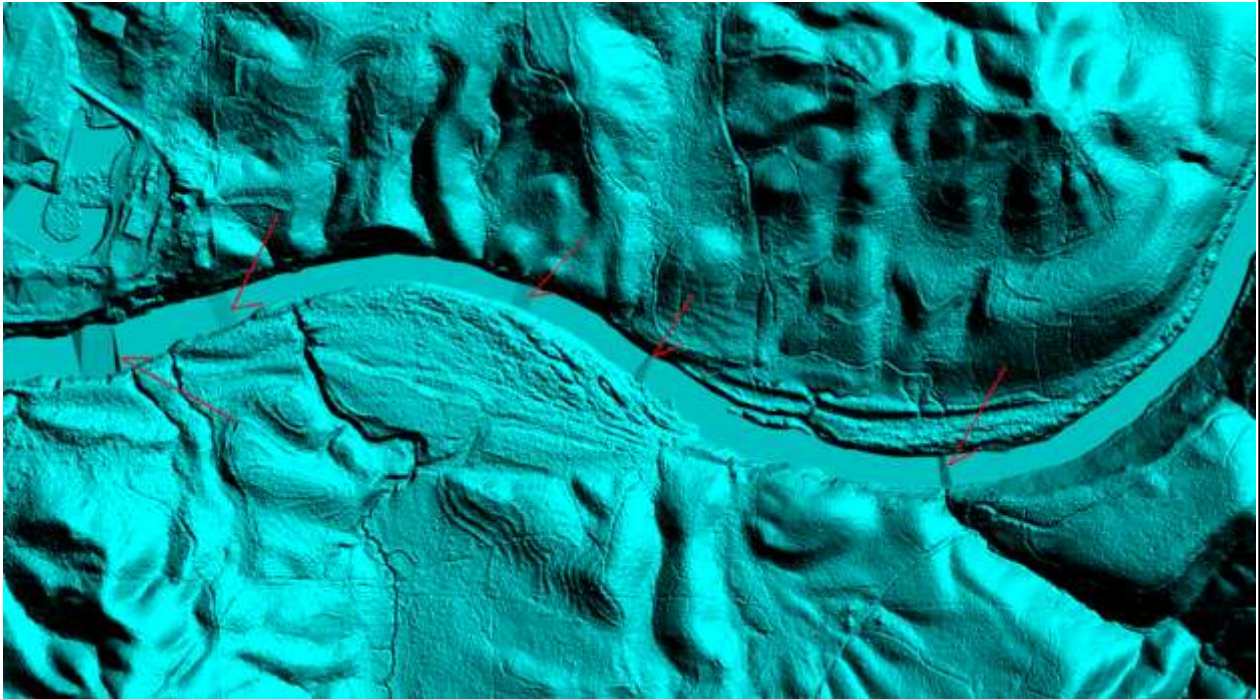
Based on this review, the USGS recommends the bare-earth DEM files for inclusion in the 1/3 Arc-Second National Elevation Dataset.

Based on this review, the USGS accepts the bare-earth DEM files.

Bare-Earth DEM Anomalies, Errors, Other Issues

Errors, Anomalies, Other Issues to document? Yes No

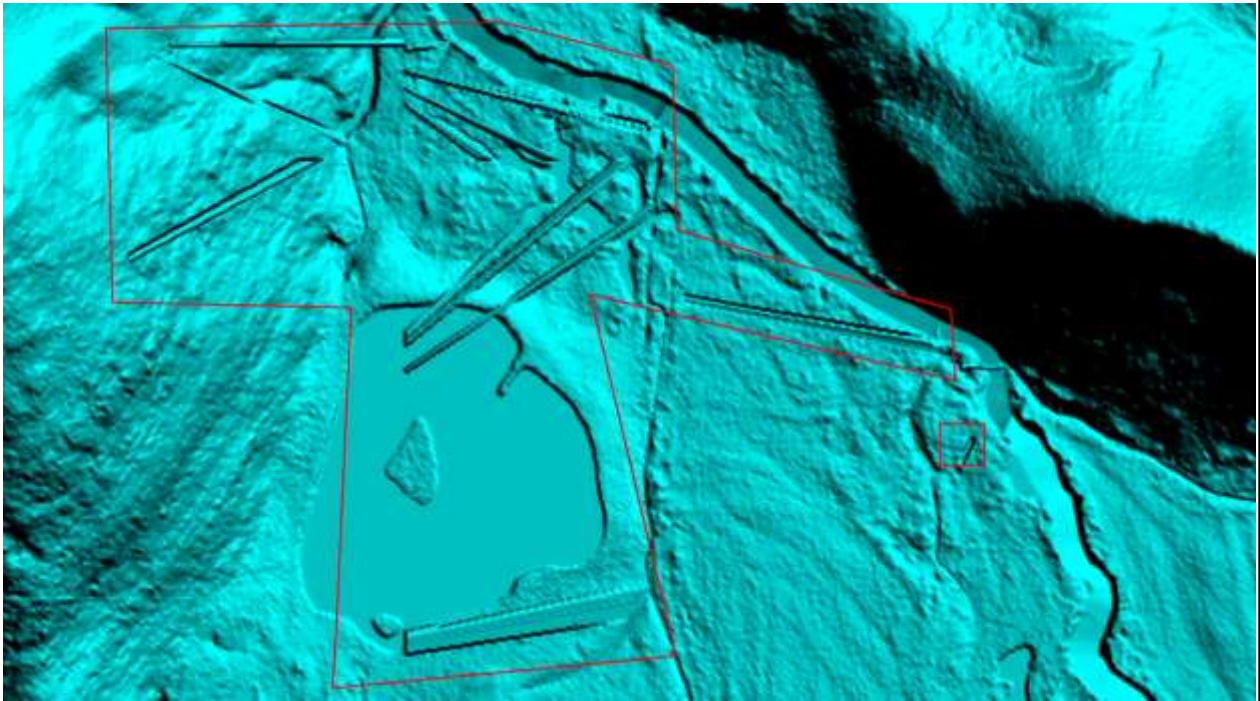
Image?



Errors such as these are endemic on streams throughout the DEM

corrected by vendor

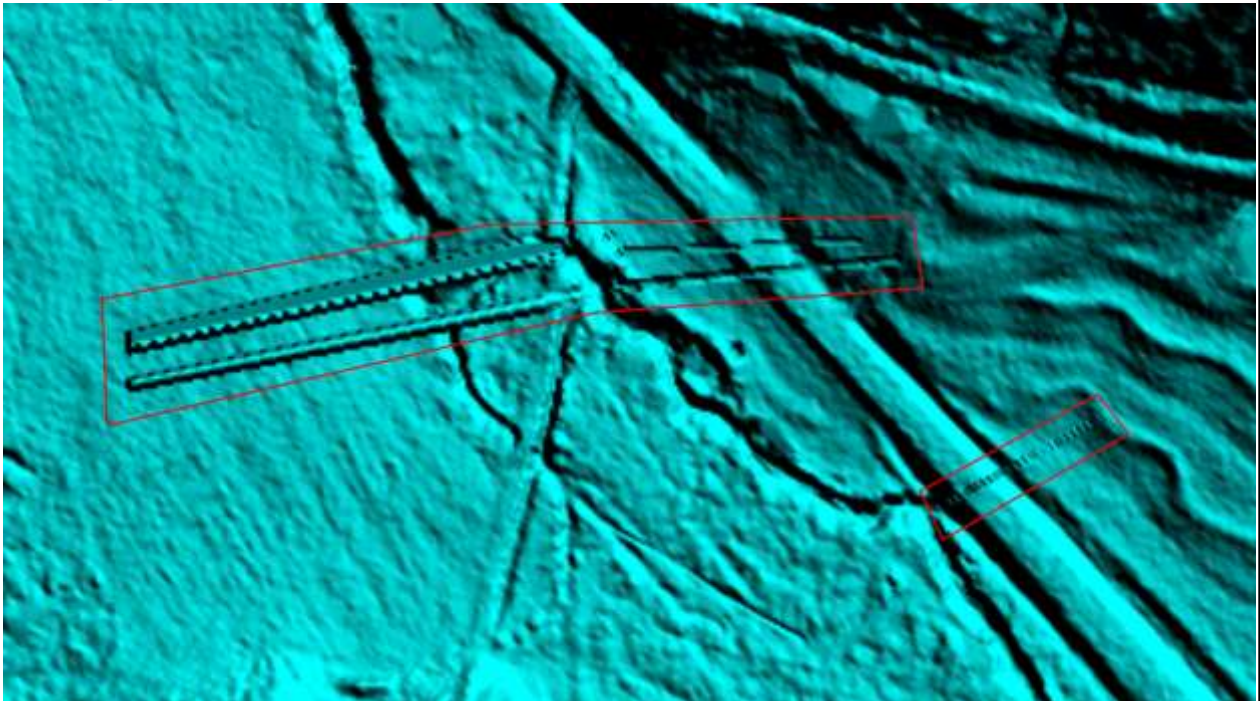
Image?



Ground Anomalies such as these were found scattered throughout the DEM.
Location: 33° 59' 58.0701" N, 86° 26' 39.9903" W

corrected by vendor

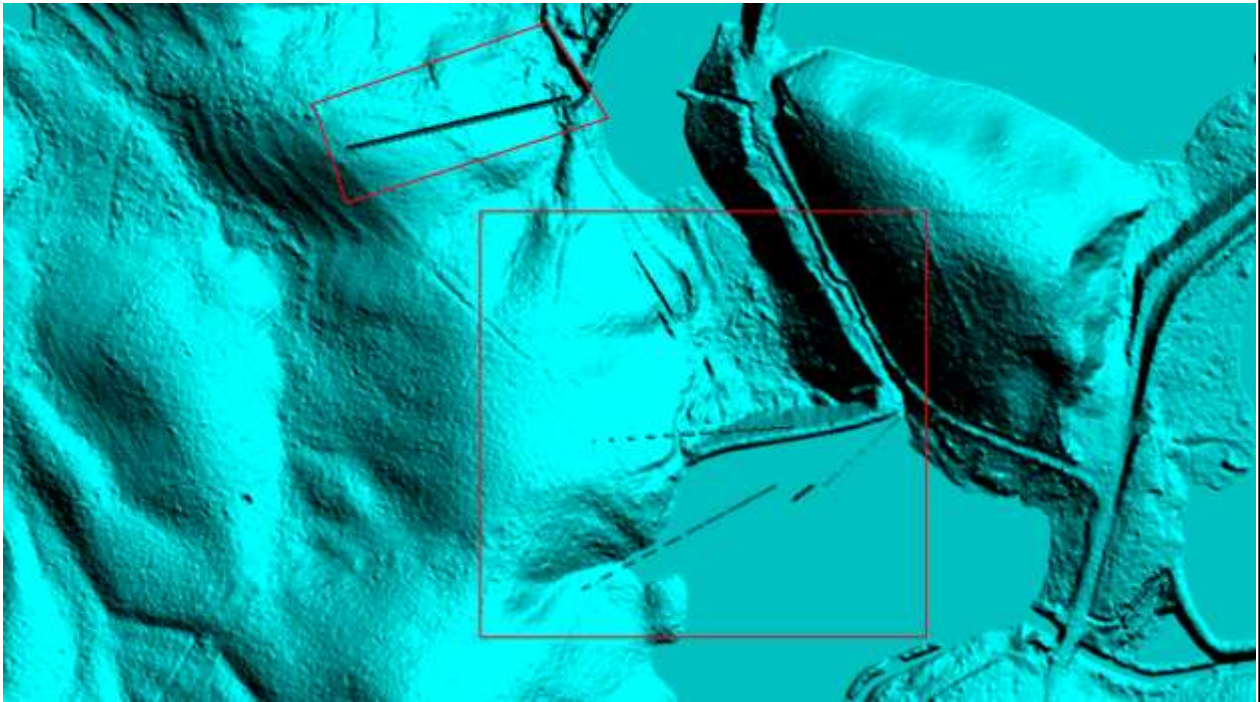
Image?



Ground anomaly example at 34° 00' 7.4437" N, 86° 26' 31.6982" W

corrected by vendor

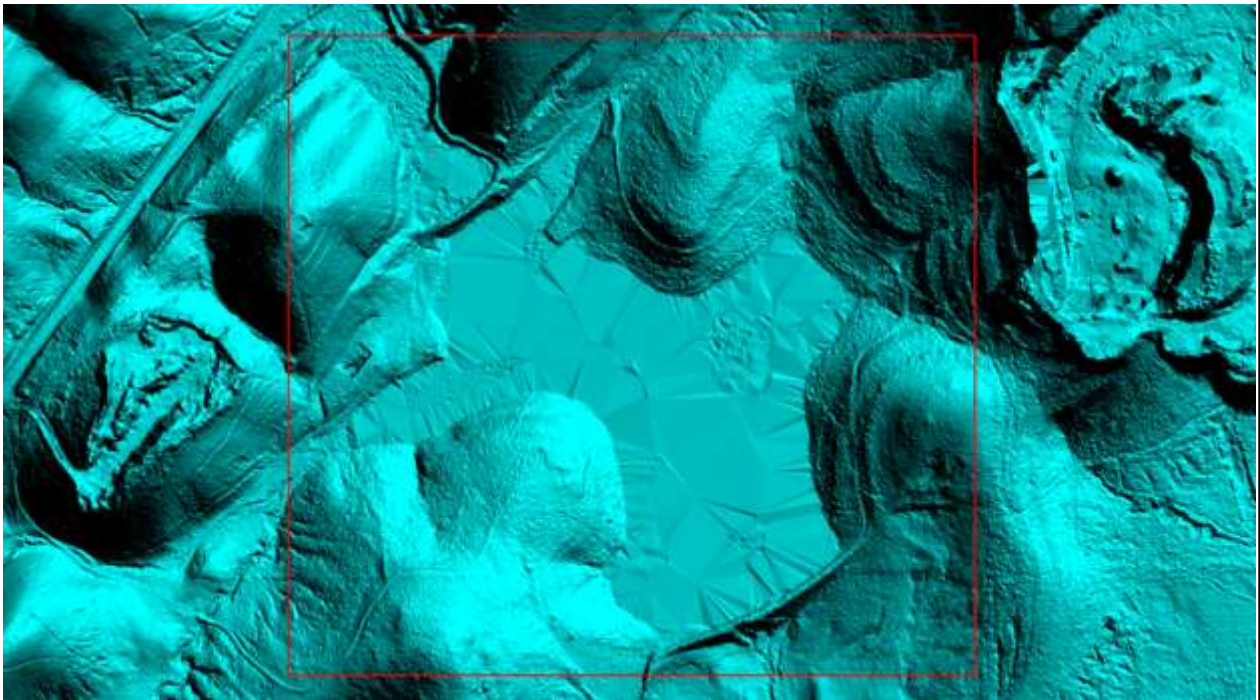
Image?



Ground anomaly example at $33^{\circ} 57' 12.5889''$ N, $86^{\circ} 26' 27.8465''$ W

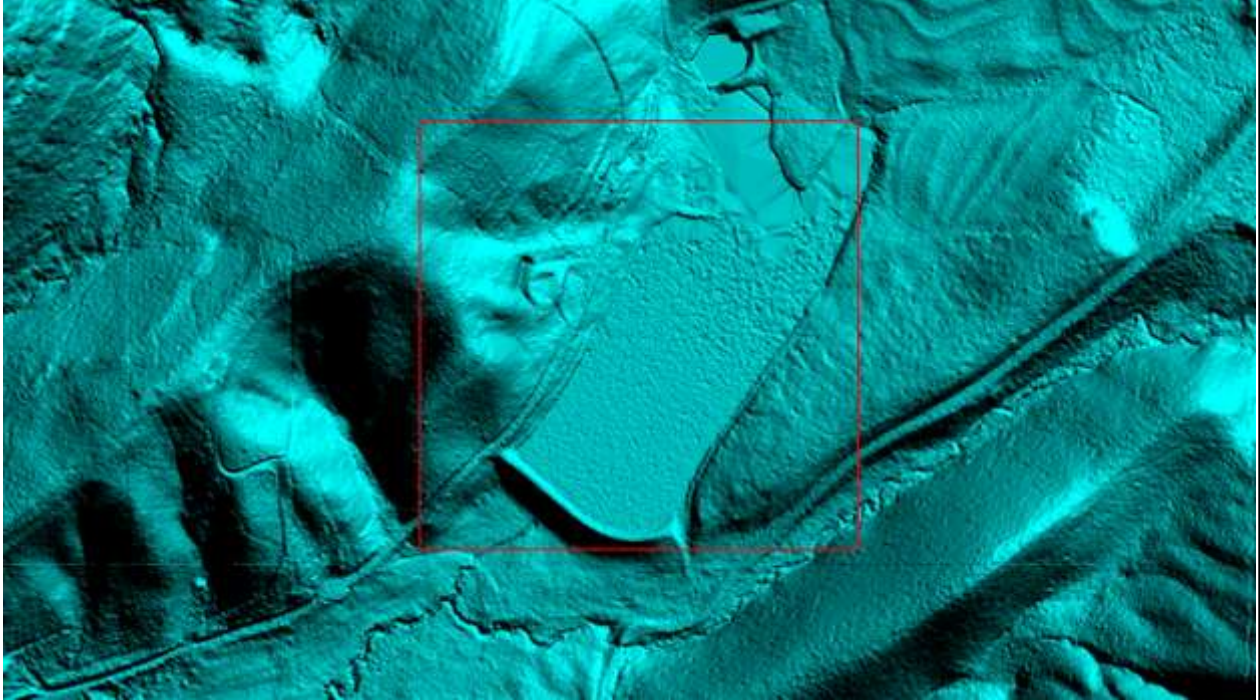
corrected by vendor

Image?



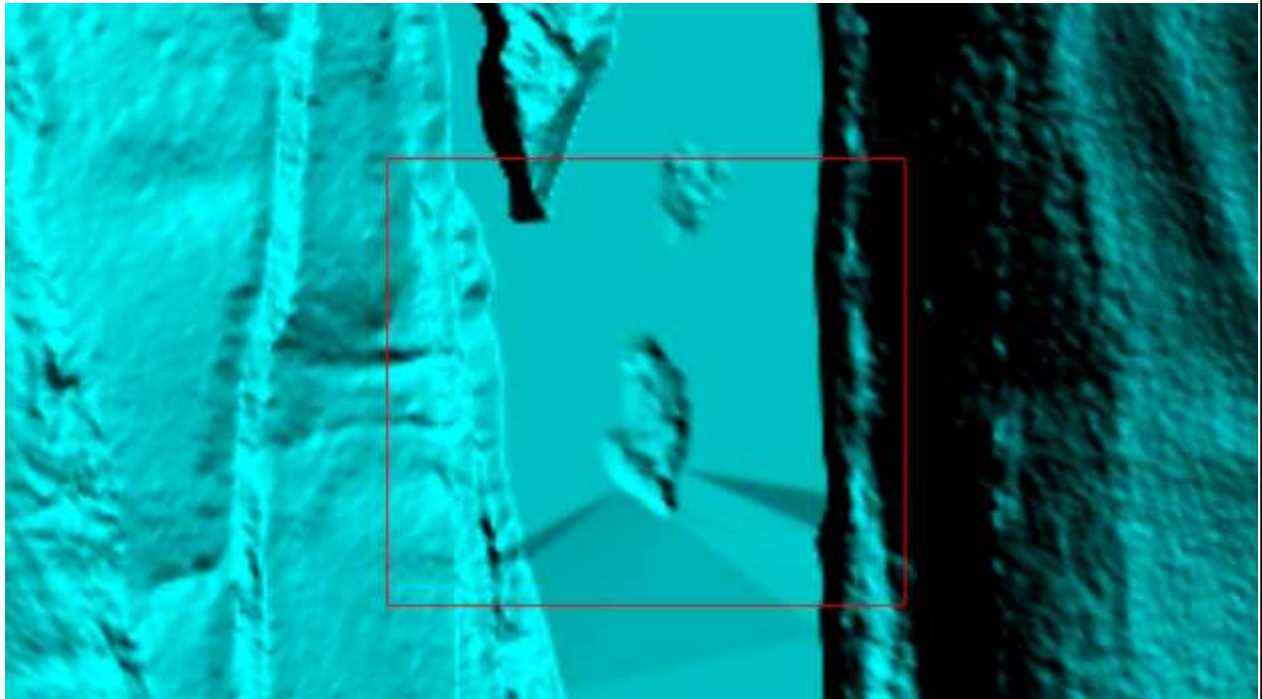
Hydro-flattening error example at $34^{\circ} 11' 19.7709''$ N, $86^{\circ} 29' 40.6400''$ W
corrected by vendor

Image?



Hydro-flattening error example at $33^{\circ} 58' 19.1366''$ N, $86^{\circ} 27' 53.1278''$ W
corrected by vendor

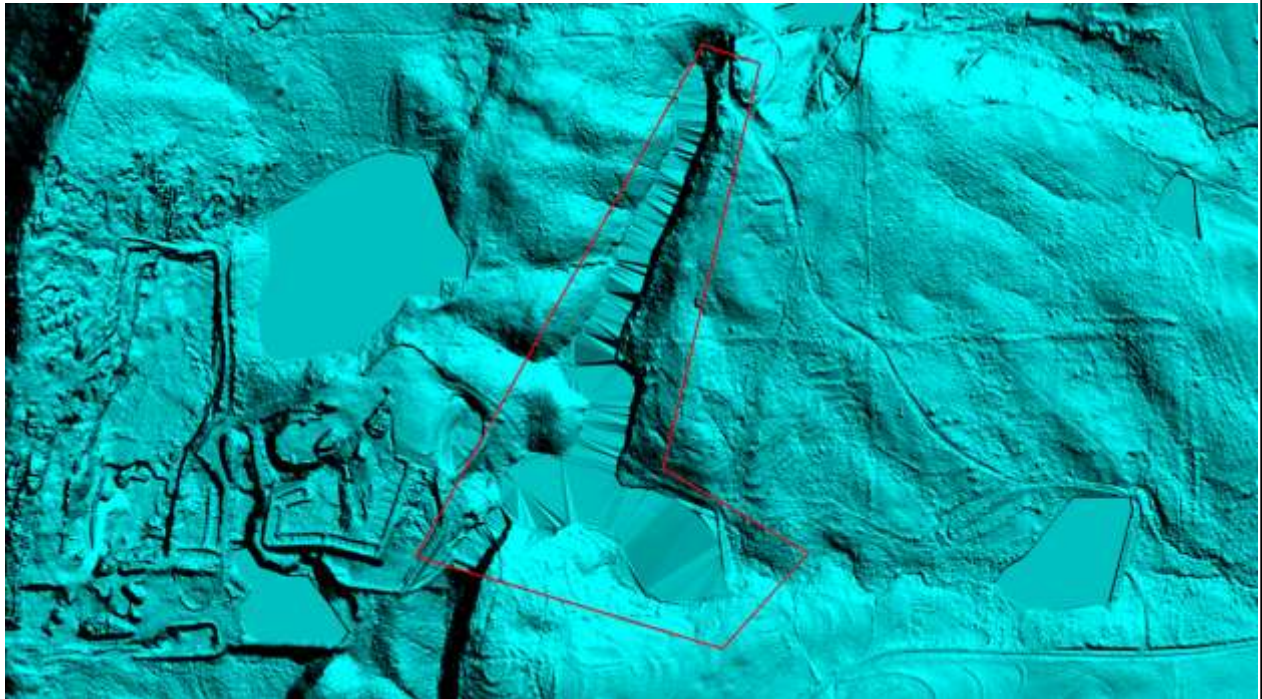
Image?



Hydro-flattening error at 33° 58' 39.6841" N, 86° 36' 54.6783" W

corrected by vendor

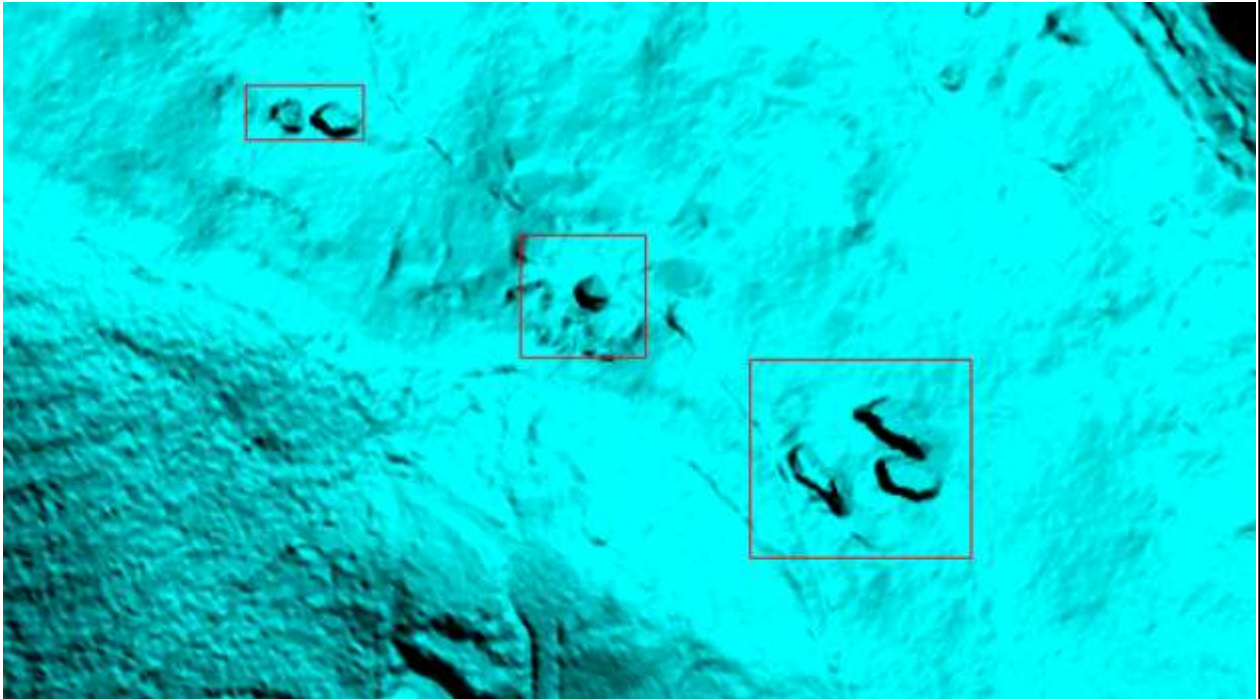
Image?



Hydro-flattening error at 34° 09' 41.1899" N, 86° 26' 44.3888" W

corrected by vendor

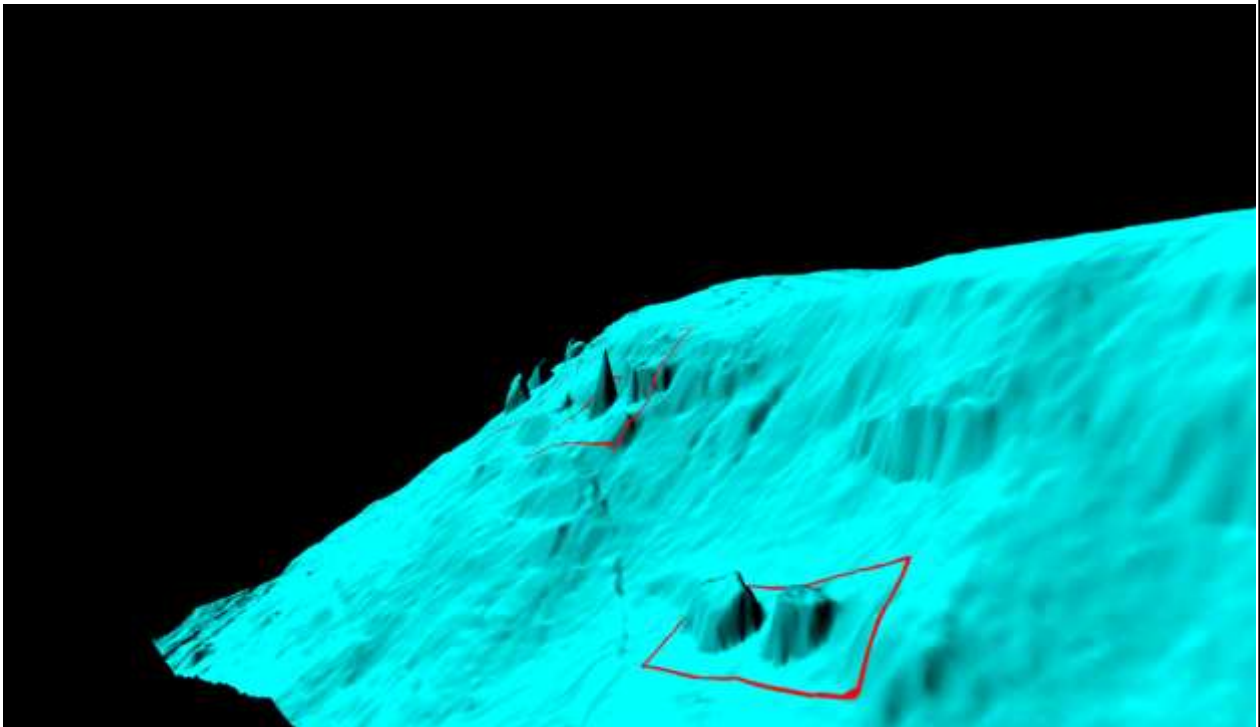
Image?



Spikes in terrain at $33^{\circ} 58' 56.9366''$ N, $86^{\circ} 40' 21.9491''$ W

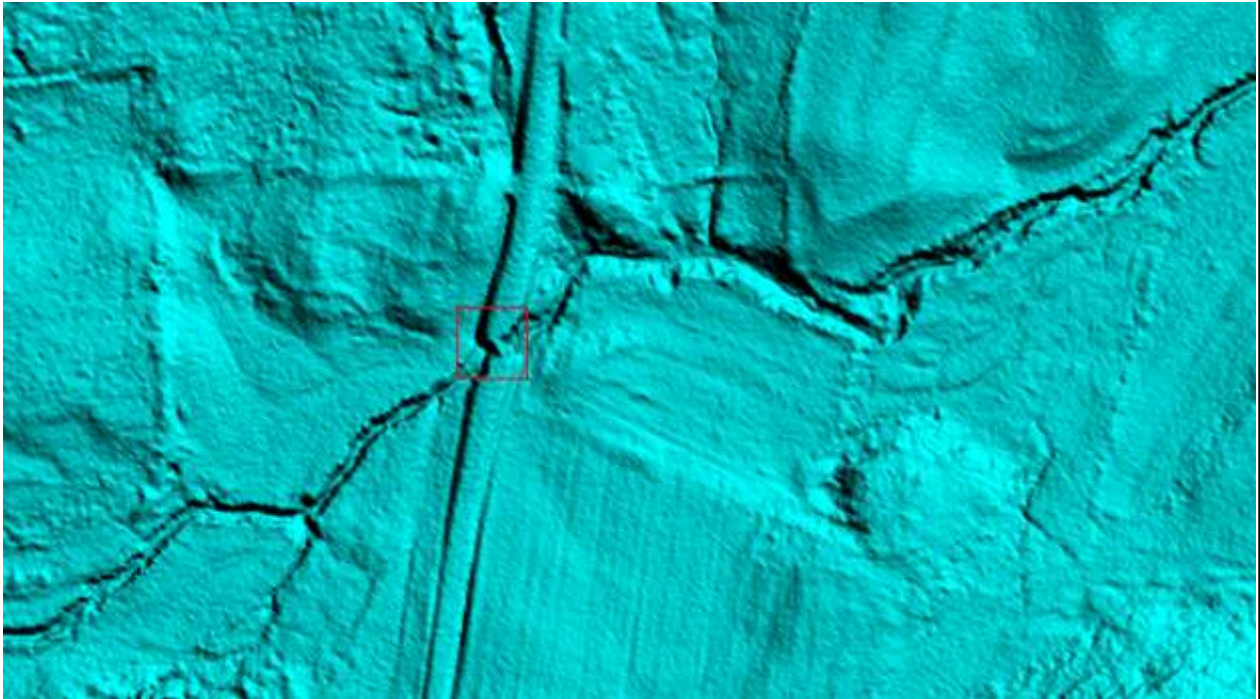
corrected by vendor

Image?



Terrain spikes 3D

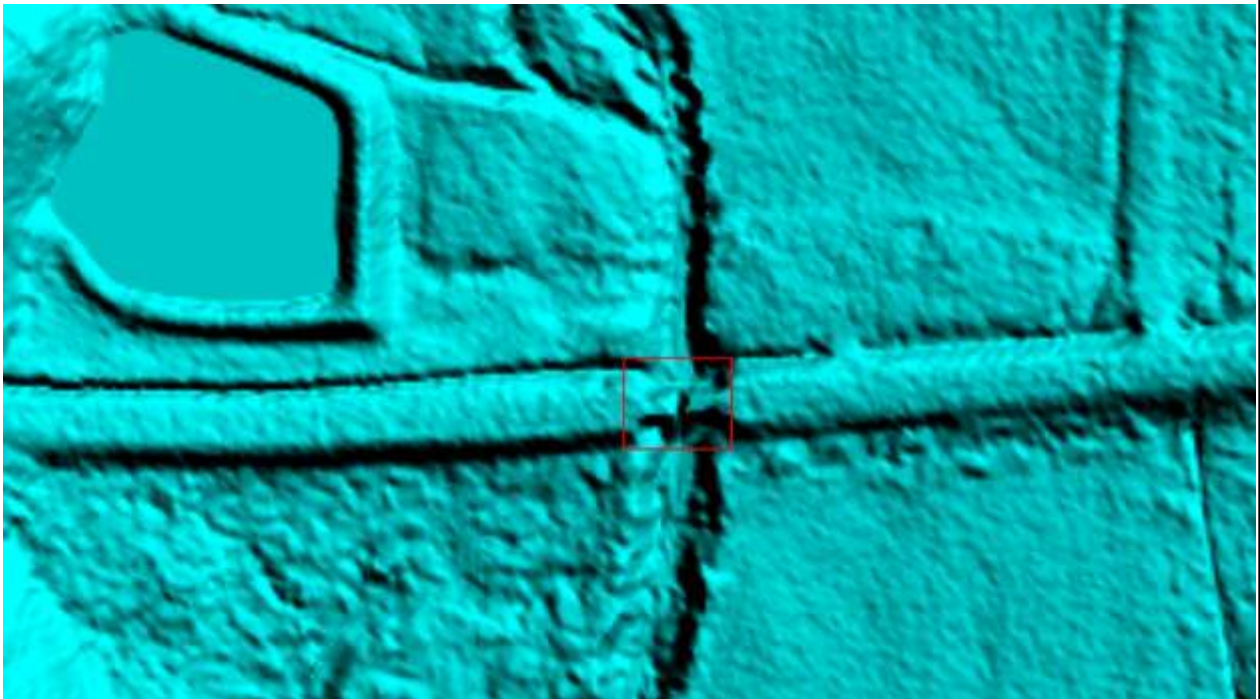
Image?



Bridge removal error at $34^{\circ} 11' 4.6748''$ N, $86^{\circ} 29' 11.0990''$ W

corrected by vendor

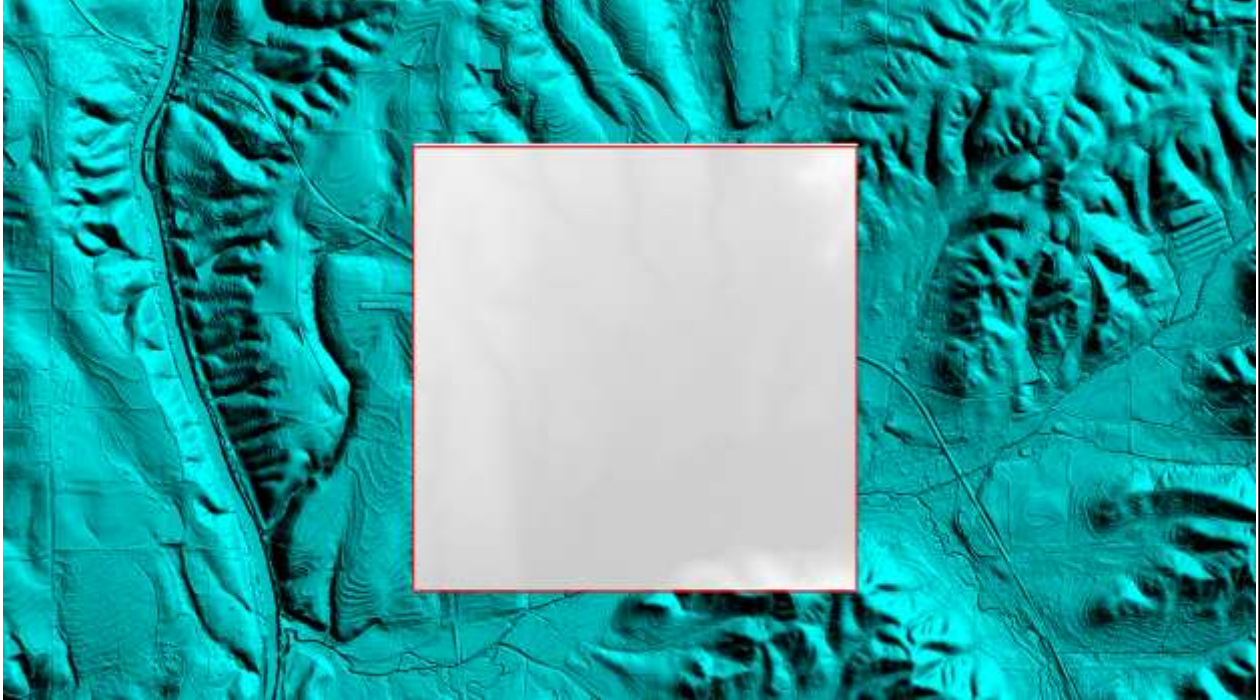
Image?



Bridge removal error at 33° 59' 26.3216" N, 86° 33' 59.0608" W

corrected by vendor

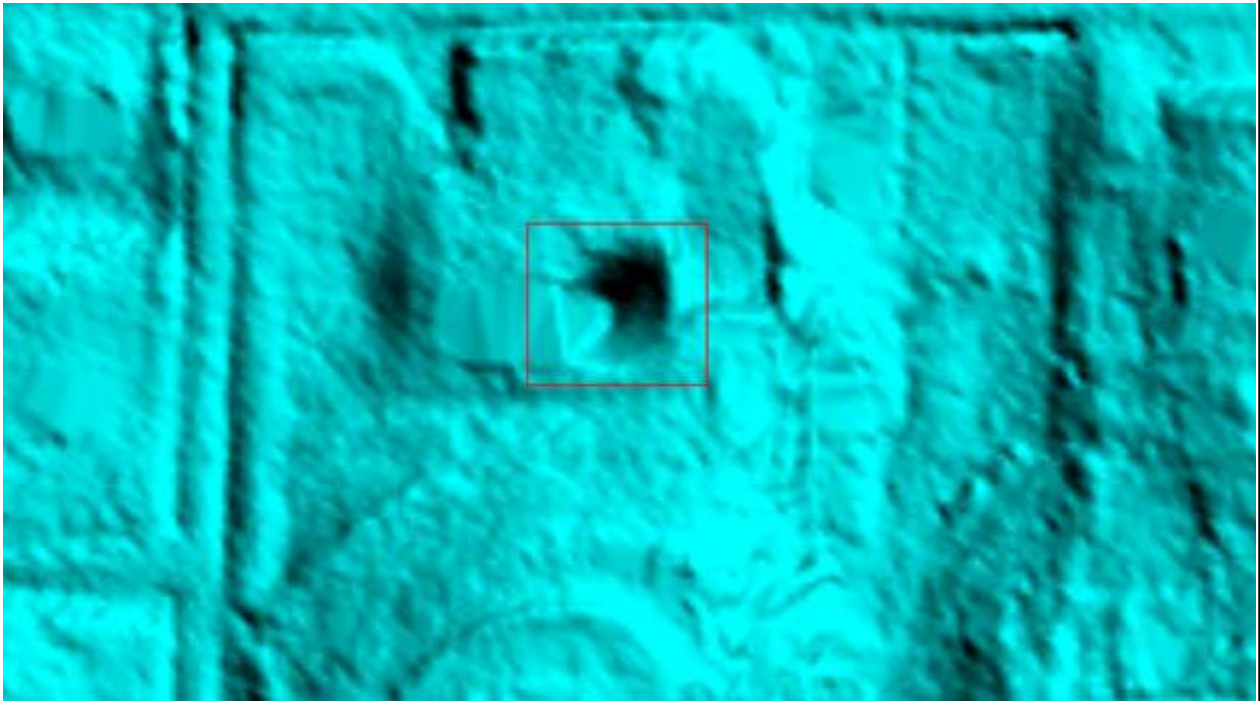
Image?



Tile 547500_3768000 includes no DEM data

corrected by vendor

Image?



Structure removal pit at 34° 04' 48.1232" N, 86° 35' 39.0719" W

corrected by vendor

This is the end of the report.