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 NGTOCoperations@usgs.gov.

Materials Received:
3/27/2012

Project ID:
AL_CoffeeDaleGenevaCo_2011

Project Alias(es):
Coffee County, Dale County, and Genev...

Project Type: Donated Data

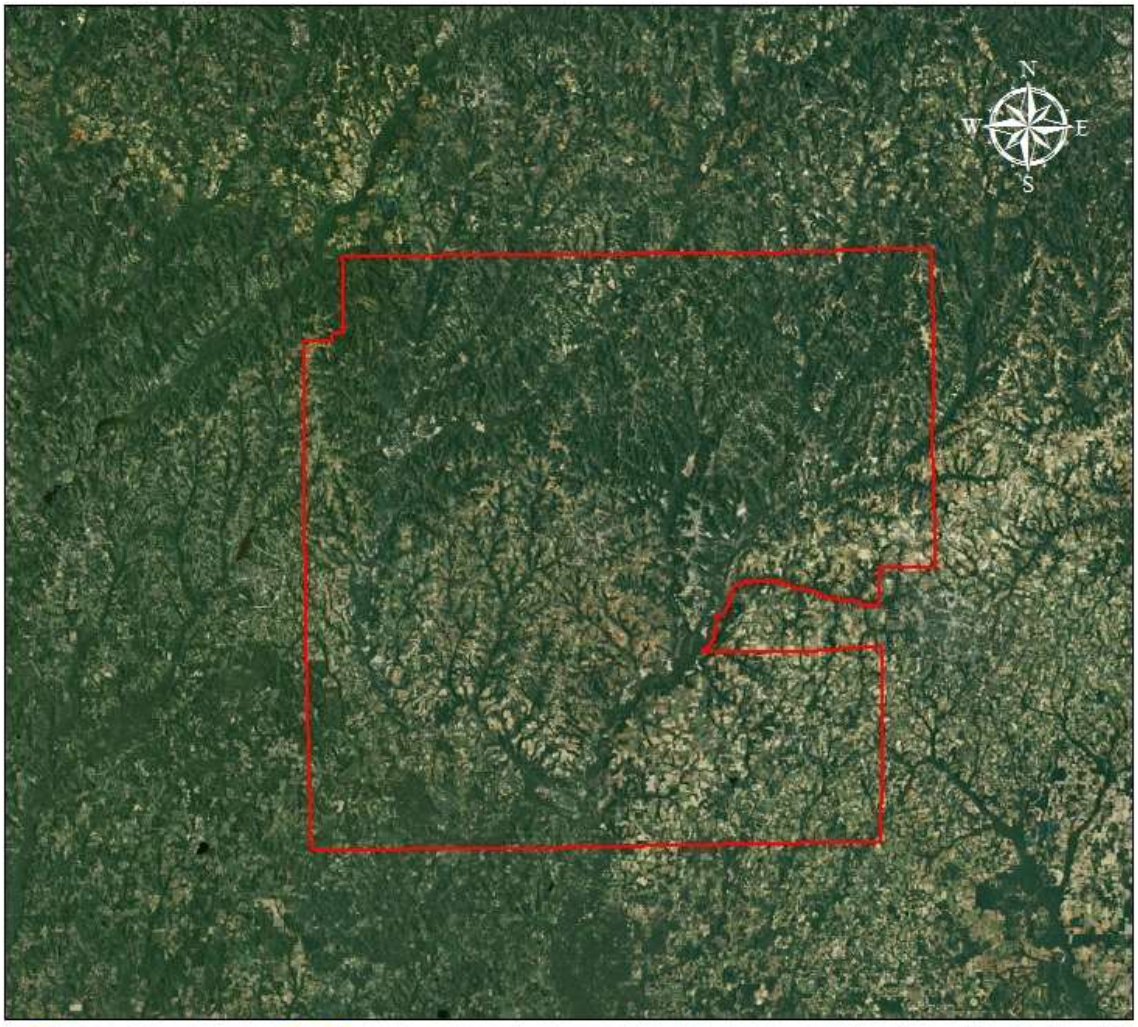
Project Description:
LiDAR generated point cloud acquired in January through February 2011 for a 1823-square mile area encompassing Coffee, Dale, and Geneva Counties in Alabama.

Year of Collection: 2011

Lot 1 of 1 lots.

Project Extent:
☑ Project Extent image?

AL_CoffeeDaleGenevaCo_2011



Legend

Boundary

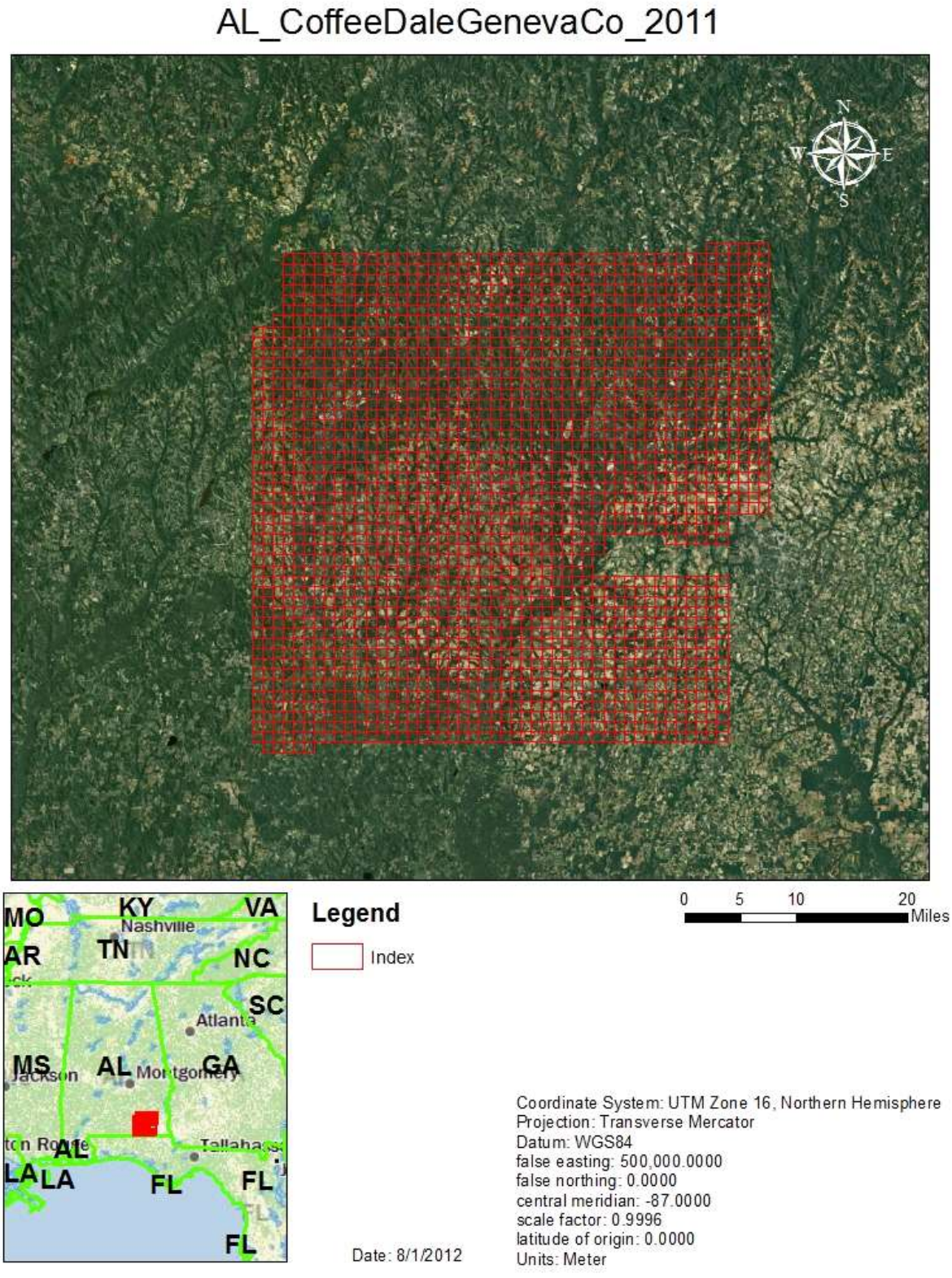
0 5 10 20 Miles

Coordinate System: UTM Zone 16, Northern Hemisphere
Projection: Transverse Mercator
Datum: WGS84
false easting: 500,000.0000
false northing: 0.0000
central meridian: -87.0000
scale factor: 0.9996
latitude of origin: 0.0000
Units: Meter

Date: 8/1/2012

Project Tiling Scheme:

☑ Project Tiling Scheme image?



Contractor:

Applicable Specification:

Atlantic Group LLC	Custom

Licensing Restrictions:

The data represent the results of data collection and processing per contract specifications and indicates the general existing conditions at the time of the data collection. As such, it is only valid for its intended use, content, time, and accuracy specifications. The user is responsible for the results of any application of the data for other than its intended purpose.

☑ Third Party Performed QA?

Third Party QA Performed By:

AMEC Earth & Environmental, Inc

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
George Heleine	NSDI Liaison	601-933-2950	gheleine@usgs.gov
Edwin Watkins	AMEC Earth & Envir...	615-333-0630	edwin.watkins@amec...
Paul Weyant	Atlantic Group Prod...	256-971-9991	prweyant@theatlgrp.c...
Paul Brown	LIDAR Analist (Atla...		
John Tidwell	LIDAR Analist (Atla...		
Michelle Maxisom	Select oLIDAR Anali...		

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
☐ Swath LAS Files	
☐ Intensity Image Files	
☑ Tiled LAS Files	2209
☑ Breakline Files	1
☑ Bare-Earth DEM Files	2209

Additional Deliverables

	Item
☑	AMEC QC Geodatabase (Point Cloud Information polygons), MXDs, and JPEGs

Errors, Anomalies, Other Issues to document? ◉ Yes ○ No

DEM XML Metadata File Makes Reference to Colbert and Lauderdale Counties, not Coffee, Geneva, or Dale Counties, appears to the metadata file for a different project.

As with the DEM XML Metadata File, the Breaklines Metadata File appears to be for the wrong project as well.

Project Geographic Information

Areal Extent:

1823

Sq Mi

Grid Size:

1

meters

Tile Size:

1500

meters

Nominal Pulse Spacing:

0.625

meters

Vertical Datum: NAVD88 meters

Horizontal Datum: NAD83 meters

Project Projection/Coordinate Reference System: UTM zone 16N meters.

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

- ☐ Project Shapefile/Geodatabase
- ☐ Project Tiling Scheme Shapefile/Gdb
- ☐ Checkpoints Shapefile/Geodatabase
- ☐ Project XML Metadata File
- ☐ Swath LAS XML Metadata File
- ☑ Classified LAS XML Metadata File
- ☑ Breaklines XML Metadata File
- ☑ Bare-Earth DEM XML Metadata File
- ☐ Swath LAS Files
- ☑ Classified LAS Files
- ☑ Breaklines Files
- ☑ Bare-Earth DEM Files

Project Shapefile/Geodatabase CRS

WGS84 UTMz16 Northern Hemisphere Meters

Project Tiling Scheme Shapefile/Geodatabase CRS

WGS84 UTMz16 Northern Hemisphere Meters

Check Point Shapefile/Geodatabase CRS

Not Delivered

Project XML Metadata CRS

Not Delivered

Swath LAS XML Metadata CRS

Not Delivered

Swath LAS Files CRS

Not Delivered

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.

Reviewer:
J. Vinyard-Houx

Review Start Date:
7/10/2012

Action to Contractor Date	Issue Description	Return Date
8/8/2012	fix metadata errors and deliver metadata for correct project, deliver actualy checkpoint in shapefile or excel/txt tables (if possible), Deliver Swath (if possible), Correct DEM issues cited below and in DEM Error Tags Shapfile.	

Review Complete: 8/8/2012

Metadata Review

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

The Project XML Metadata file parsed without errors.

The Classified LAS XML Metadata file parsed with errors.

Type	Description or line numbers	Line(s) (or count)
Severity 5: Misplaced elements		
Error	City (10.4.3) is not permitted in Metadata (0)	1 1 1 1

		1 1
Error	Country (10.4.6) is not permitted in Metadata (0)	1 1 1 1 1 1

The Breakline XML Metadata file parsed with errors.

Type	Description or line numbers	Line(s) (or count)
Severity 5: Misplaced elements		
Error	City (10.4.3) is not permitted in Metadata (0)	366 366 366 366 366 366 366
Error	Country (10.4.6) is not permitted in Metadata (0)	366 366 366 366 366 366 366
Error	Time_of_Day (9.1.2) is not permitted in Process_Step (2.5.2)	1
Severity 3: Missing elements		
Error	Computer_Contact_Information (6.4.2.2.1.1) is required in Online_Option (6.4.2.2.1)	1
Error	Theme_Keyword_Thesaurus (1.6.1.1) is required in Theme (1.6.1)	1

The Bare-Earth DEM XML Metadata file parsed witherrors.

Type	Description or line numbers	Line(s) (or count)
Severity 5: Misplaced elements		
Error	City (10.4.3) is not permitted in Metadata (0)	366 366 366 366 366 366 366
Error	Country (10.4.6) is not permitted in Metadata (0)	366 366 366 366 366 366 366
Severity 3: Missing elements		
Error	Theme_Keyword_Thesaurus (1.6.1.1) is required in Theme (1.6.1)	1

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 notable to locate independent checkpoints for this analysis. USGS acceptsthe quality of the checkpoint data for these LiDAR datasets.

Errors, Anomalies, Other Issues to document? (•) Yes ( ) No

☐ Image?

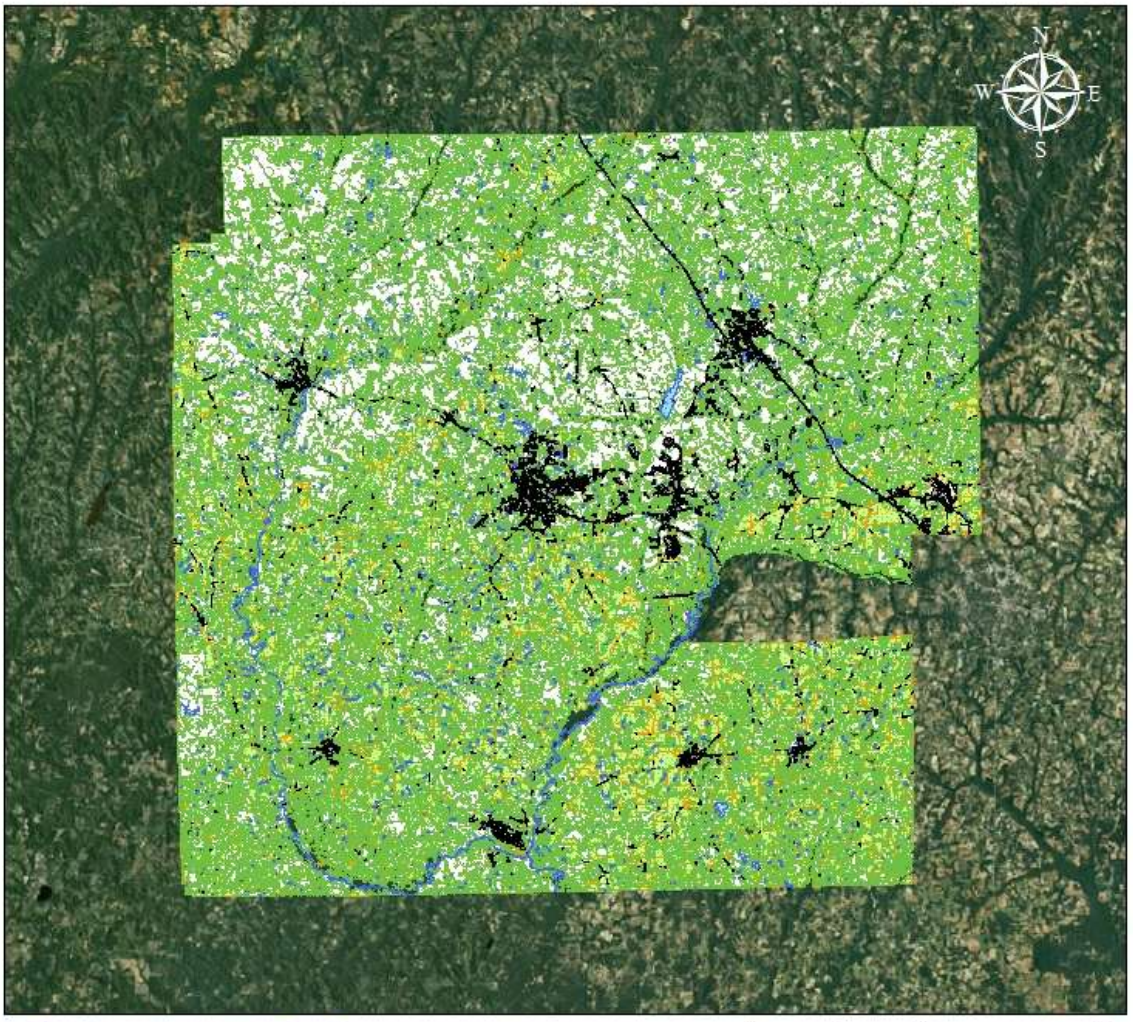
Checkpoints not delivered.

☐ Image?

Below Required Accuracy is calculated from the Metadata statements.
"LiDAR vertical data accuracy determination shall employ the National Standard for Spatial Data Accuracy (NSSDA). Contracted to meet 18.5cm (RMSE) or better on open bare terrain and 37.0 cm (RMSE) or better in vegetative areas"

☑ Image?

AL_CoffeeDaleGenevaCo_2011



0 5 10 20 Miles

Legend

SVA_Class, Percent

- Bare Earth, 5.18952904858
- Brushlands & Low Trees, 14.2080470205
- Forested Areas Fully Covered by Trees, 44.9407440314
- Open Water, 0.874941791179
- Tall Weeds & Crops, 26.9084268325
- Urban Areas with Dense Man Made Structures, 1.369300823

Date: 8/2/2012

Coordinate System:
UTM Zone 16, Northern Hemisphere
Projection: Transverse Mercator
Datum: WGS84
false easting: 500,000.0000
false northing: 0.0000
central meridian: -87.0000
scale factor: 0.9996
latitude of origin: 0.0000
Units: Meter

SVA Landcover Percentage Map

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: centimeters

Required FVA Value is 36.26 centimeters or less.
Target SVA Value is 72.52 centimeters or less.
Required CVA Value is 72.52 centimeters or less.

The reported FVA of the LAS Swath data is 08.8 centimeters.

The reported FVA of the Bare-Earth DEM data is **Not Reported** centimeters.
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	**Not Provided**	centimeters
Brush Lands and Low Trees	**Not Provided**	centimeters
Forested Areas Fully Covered by Trees	**Not Provided**	centimeters
Urban Areas with Dense Man-Made Structu...		N/A

The reported CVA of this data set is: 08.8 centimeters.

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 08.8 centimeters.

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

Errors, Anomalies, Other Issues to document? (•) Yes ( ) No

☐ Image?

Swath Not Delivered.

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 accepts the classified LAS tile file data.

Errors, Anomalies, Other Issues to document? ◉ Yes ○ No

☐ Image?

Class 12 cited as overlap class in metadata; however, review of the LAS point cloud shows no points on class 12.

☐ Image?

Unknown Spatial Reference System in LAS Headers

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: TIFF

Bare-Earth DEM Tile File Characteristics

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

All accuracy values reported in centimeters.

Reported Accuracies

Land Cover Category	# of Points	Fundamental Vertical Accuracy @95% Confidence Interval ($Accuracy_z$) Required FVA = 36.26 or less.	Supplemental Vertical Accuracy @95th Percentile Error Target SVA = 72.52 or less.	Consolidated Vertical Accuracy @95th Percentile Error Required CVA = 72.52 or less.
Open Terrain		**Not Reported**		
Tall Weeds and Crops			**Not Provided**	
Brush Lands and Low Trees			**Not Provided**	
Forested Areas Fully Covered by Trees			**Not Provided**	
Urban Areas with Dense Man-Made Structures				
Consolidated	0			08.8

- [ ] QA performed Accuracy Calculations?

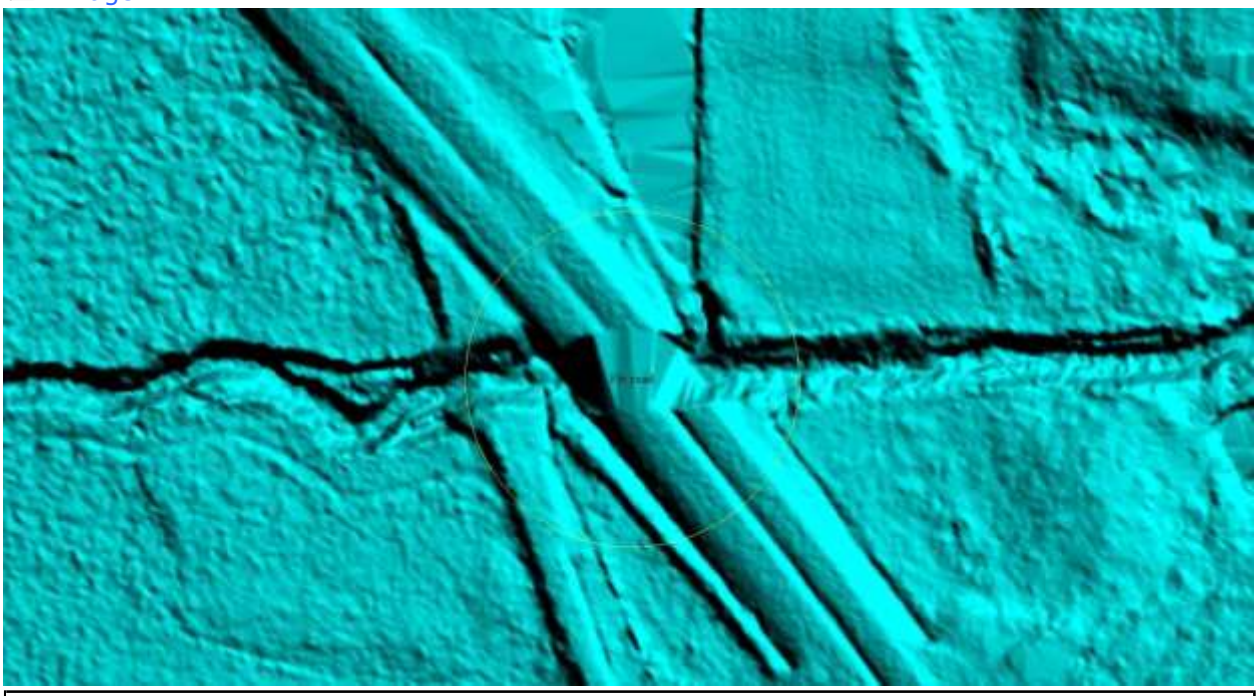
Based on this review, the USGS does not recommend the bare-earth DEM files for inclusion in the 1/3 Arc-Second National Elevation Dataset.

Based on this review, the USGS does not accept at this time the bare-earth DEM files.

Bare-Earth DEM Anomalies, Errors, Other Issues

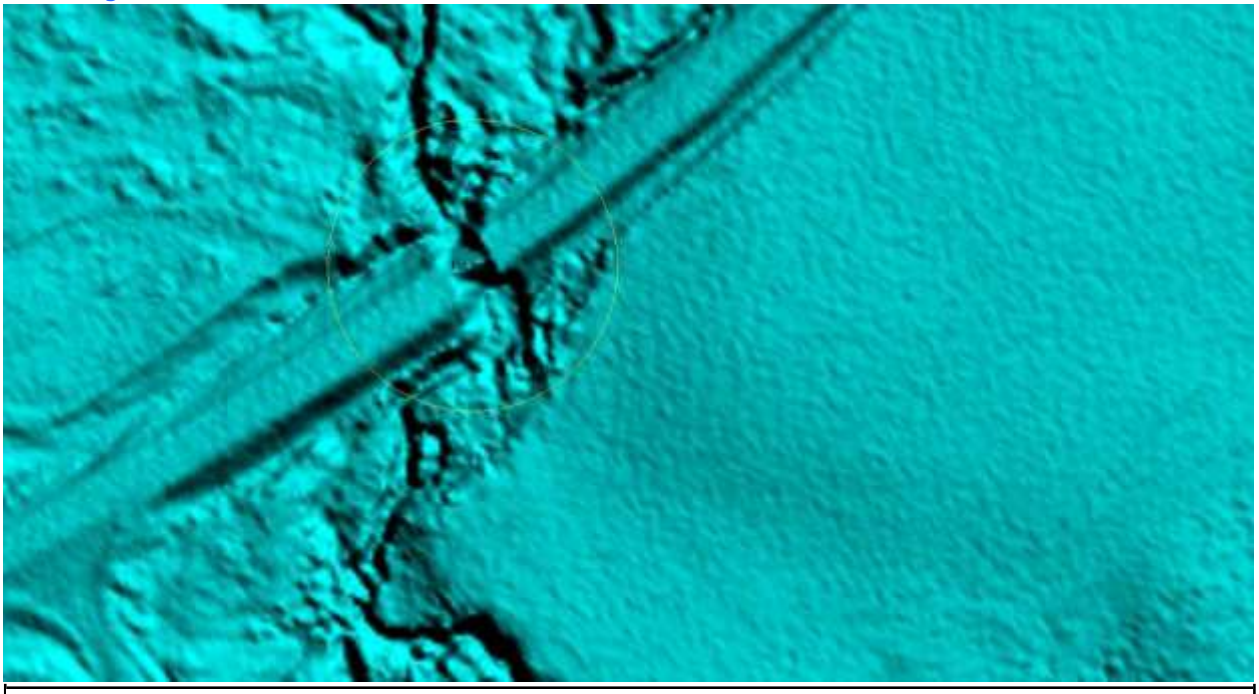
Errors, Anomalies, Other Issues to document? (•) Yes ( ) No

☑ Image?



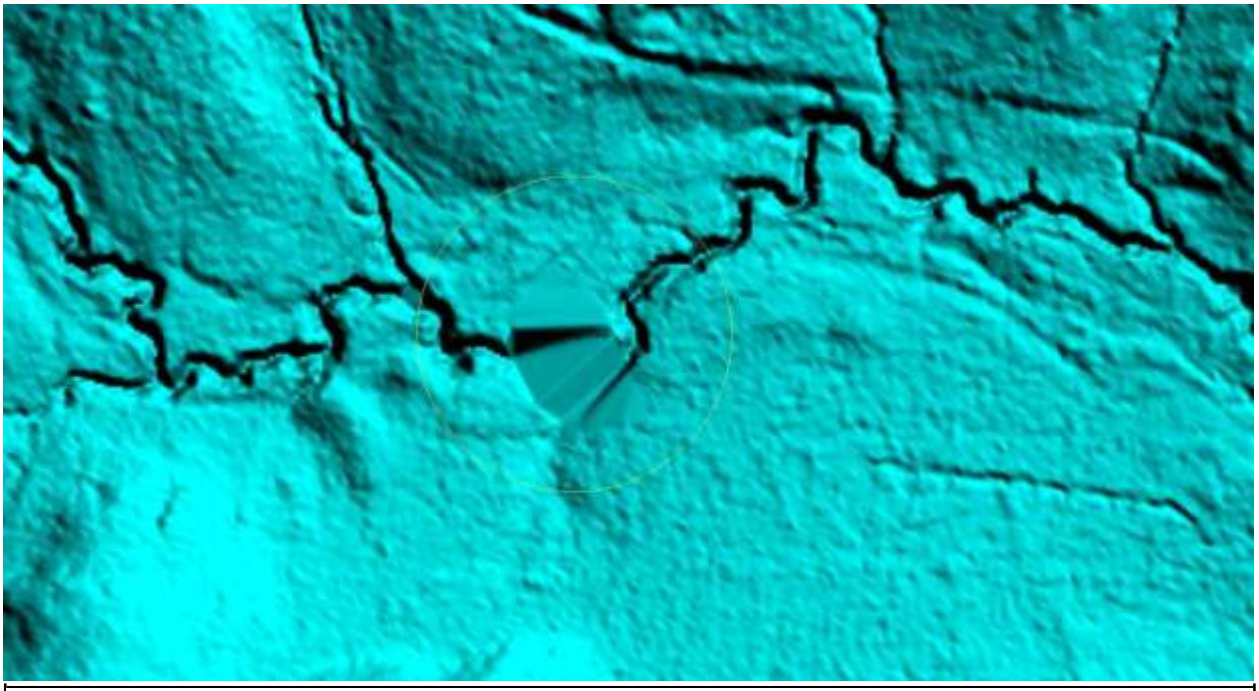
Fix road (example) 1

☑ Image?



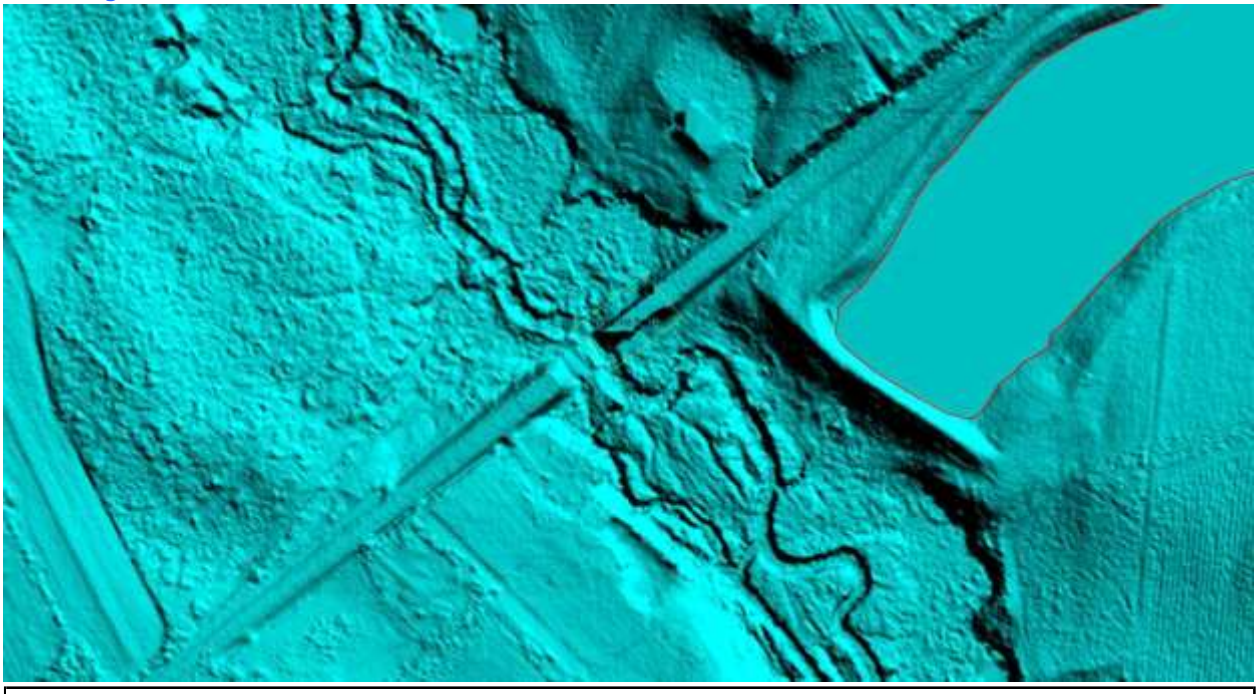
Fix road (example) 2

☑ Image?



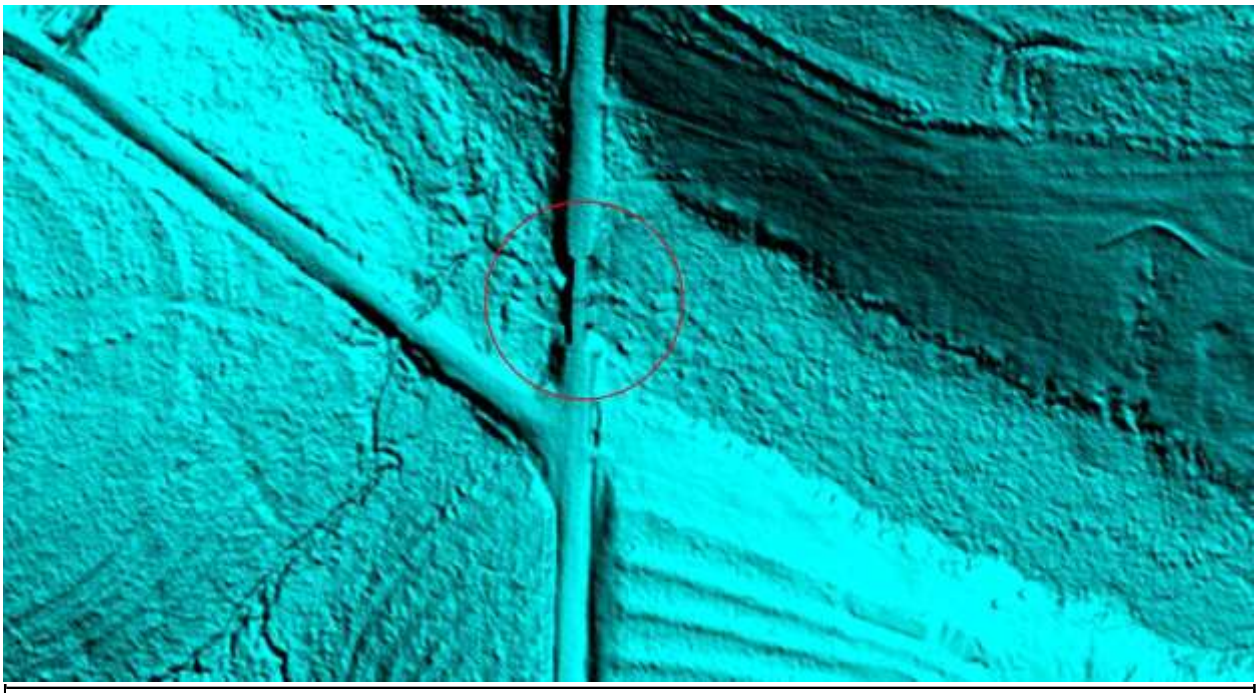
Missing data (example)

☑ Image?



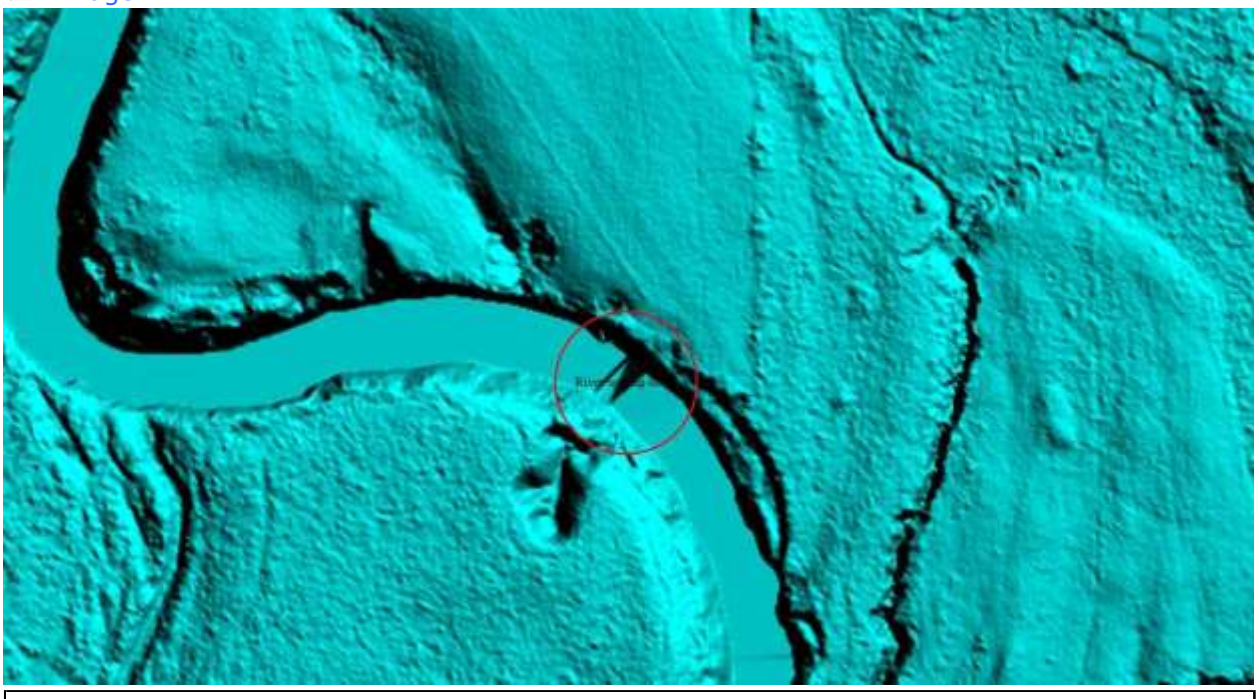
Remove bridge (example) 1

☑ Image?



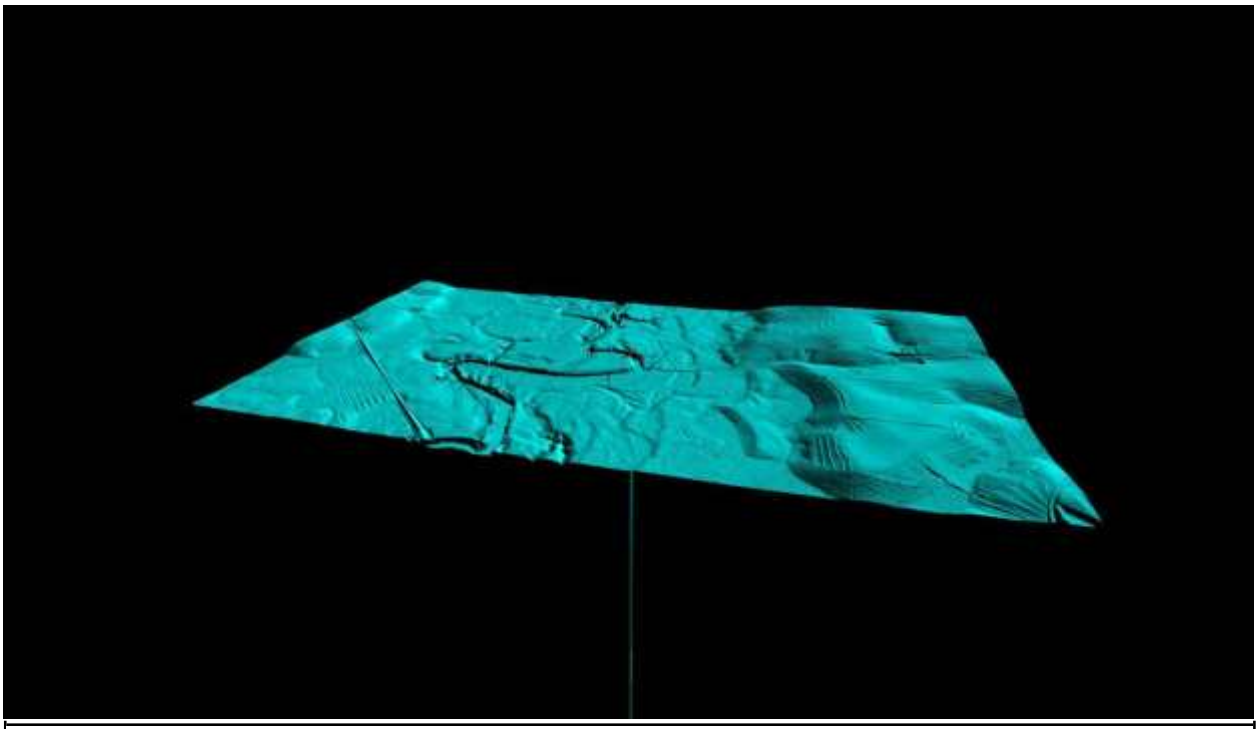
Remove bridge (example) 2

☑ Image?



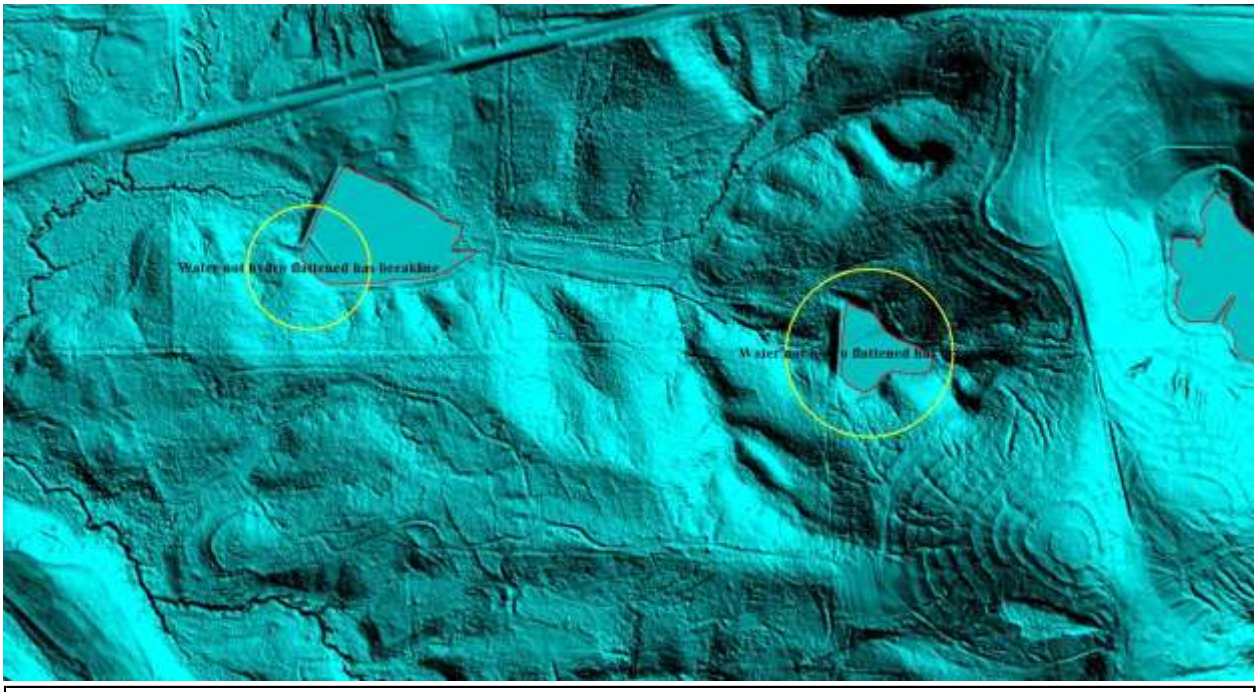
River spiking down (example)

☑ Image?



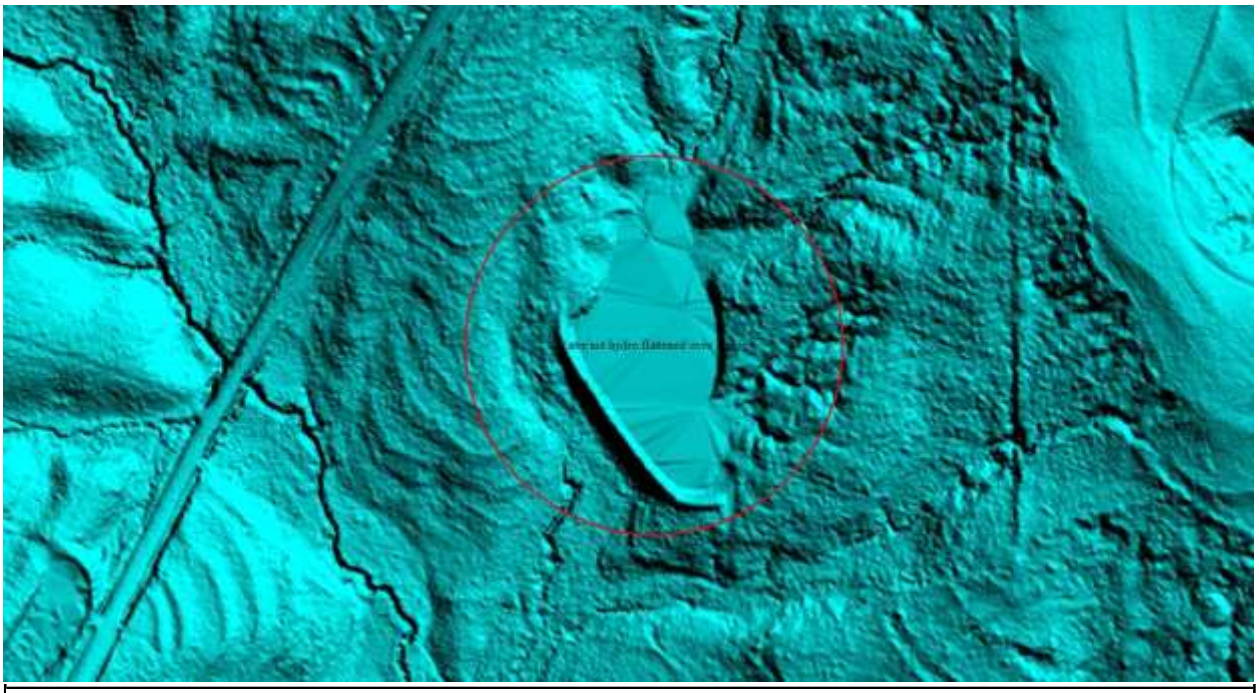
River spiking down (example) 3D

☑ Image?



Water not hydro flattened has break line (example)

☑ Image?



Water not hydro flattened over 2 acres (example)

Internal Note:

The error JEPGS above are examples of errors found throughout this project. A georeferenced error shape file was created of all the errors found.

This is the end of the report.

QA Form V1.4 12OCT11.xsn