



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 NGTOOperations@usgs.gov.

Materials Received:

3/5/2013

Project Type: NSDI Agreement

Project ID:

KS_Area3-NortheastA_2012

Project Description:

The project consists of 3 areas: Area 1 as one lot, Area 2 as one lot and Area 3 as four lots. Area 3 Kansas will consist of the Northeast area (in two lots) including Brown, Doniphan, Jackson, Leavenworth, Nemaha, Pottawatomie, Webaunsee, and Wyandotte counties; the Southeast including Cherokee, Crawford, Linn and Bourbon counties; and Butler County. Areas were defined and supplied by Kansas Department of Administration and includes approximately 9700 square miles for analysis.

Project Alias(es):

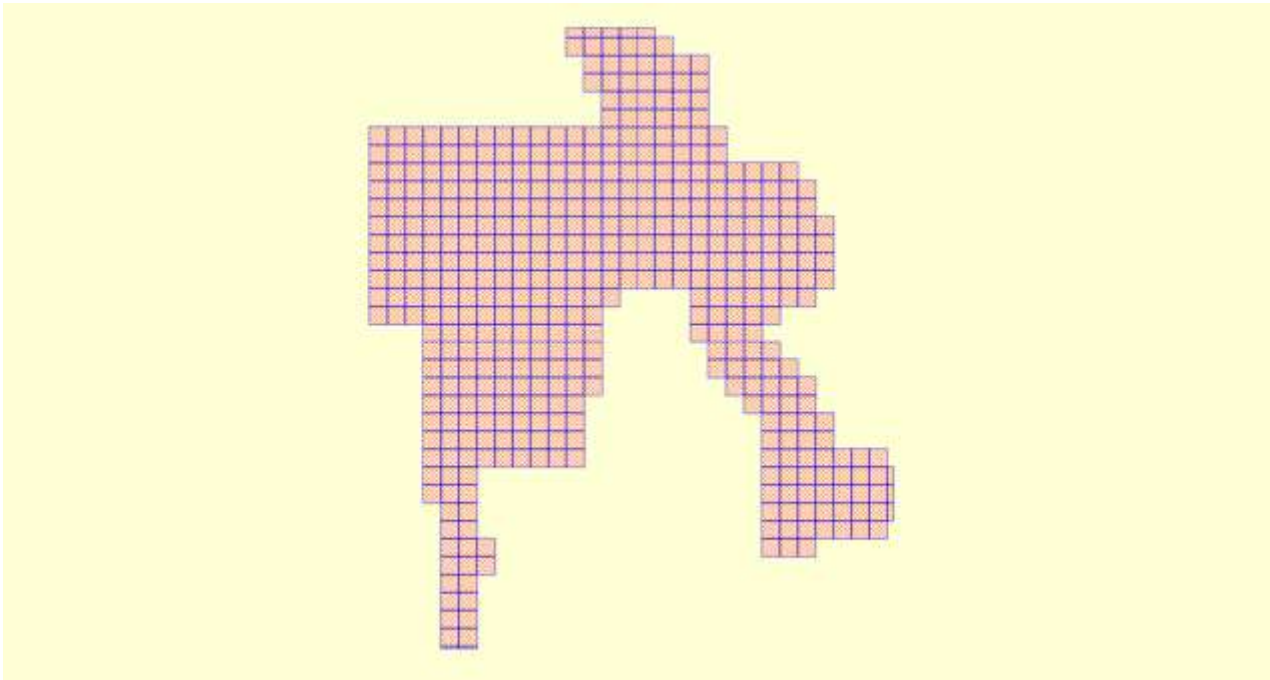
KS_25 COUNTIES LIDAR #1

Year of Collection: 1/13/2012 to 4/17/12

Lot 3 of 6 lots.

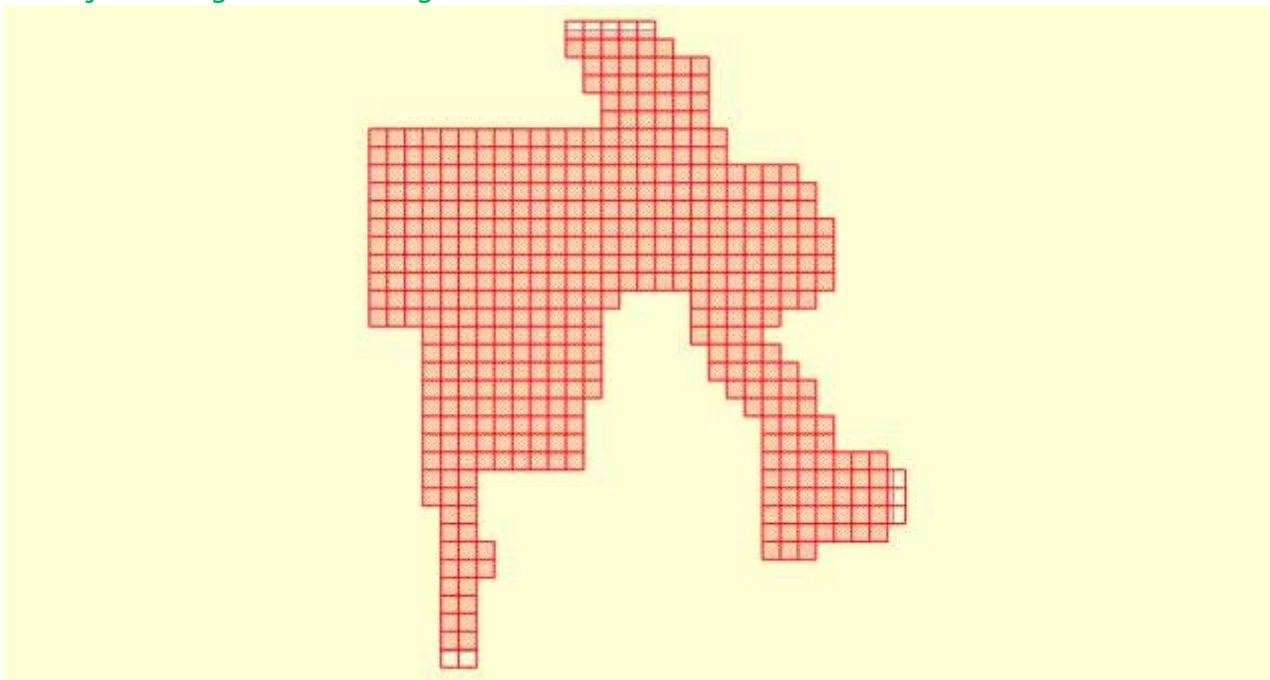
Project Extent:

Project Extent image?



Project Tiling Scheme:

Project Tiling Scheme image?



Contractor:

Aerometric, Inc.

Applicable Specification:

V13

Licensing Restrictions:

Third Party Performed QA?

Project Points of Contact:

POC Name	Type	Primary Phone	E-Mail
Ingrid Landgraf	NSDI Liaison	785-832-3566	imlandgraf@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
- Project Tiling Scheme Shapefile/Gdb
- Control Point Shapefile/Gdb
- Breakline Shapefile/Gdb
- Project XML Metadata

Multi-File Deliverables

File Type	Quantity
<input checked="" type="checkbox"/> Swath LAS Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	525
<input type="checkbox"/> Intensity Image Files <input type="checkbox"/> Required?	1
<input checked="" type="checkbox"/> Tiled LAS Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	467
<input checked="" type="checkbox"/> Breakline Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	3
<input checked="" type="checkbox"/> Bare-Earth DEM Files <input checked="" type="checkbox"/> Required? <input checked="" type="checkbox"/> XML Metadata?	467

First Return DEM - 467 .img files

Errors, Anomalies, Other Issues to document? Yes No

Project Geographic Information

Areal Extent:

3796.4

Sq Mi

Grid Size:

1

meters

Tile Size:

5000 x 5000

meters

Nominal Pulse Spacing: [Select...](#)

Vertical Datum: meters

Horizontal Datum: meters

Project Projection/Coordinate Reference System: meters.

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

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

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:

3/11/2013

Action to Contractor Date	Issue Description	Return Date
5/3/2013	Water issues, incomplete swath file, checkpoints.	6/10/2013
6/12/2013	Swath issues and error along the river need addressed.	9/10/2013
9/10/2013	Issues still with Vertical Accuracy and metadata. Incomplete swath file not addressed.	11/15/2013

Review Complete: 12/23/2013

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 Swath LAS XML Metadata file parsed without errors.

The Classified LAS XML Metadata file parsed without errors.

The Breakline XML Metadata file parsed without errors.

The Bare-Earth DEM XML Metadata file parsed without errors.

Project QA/QC Report Review

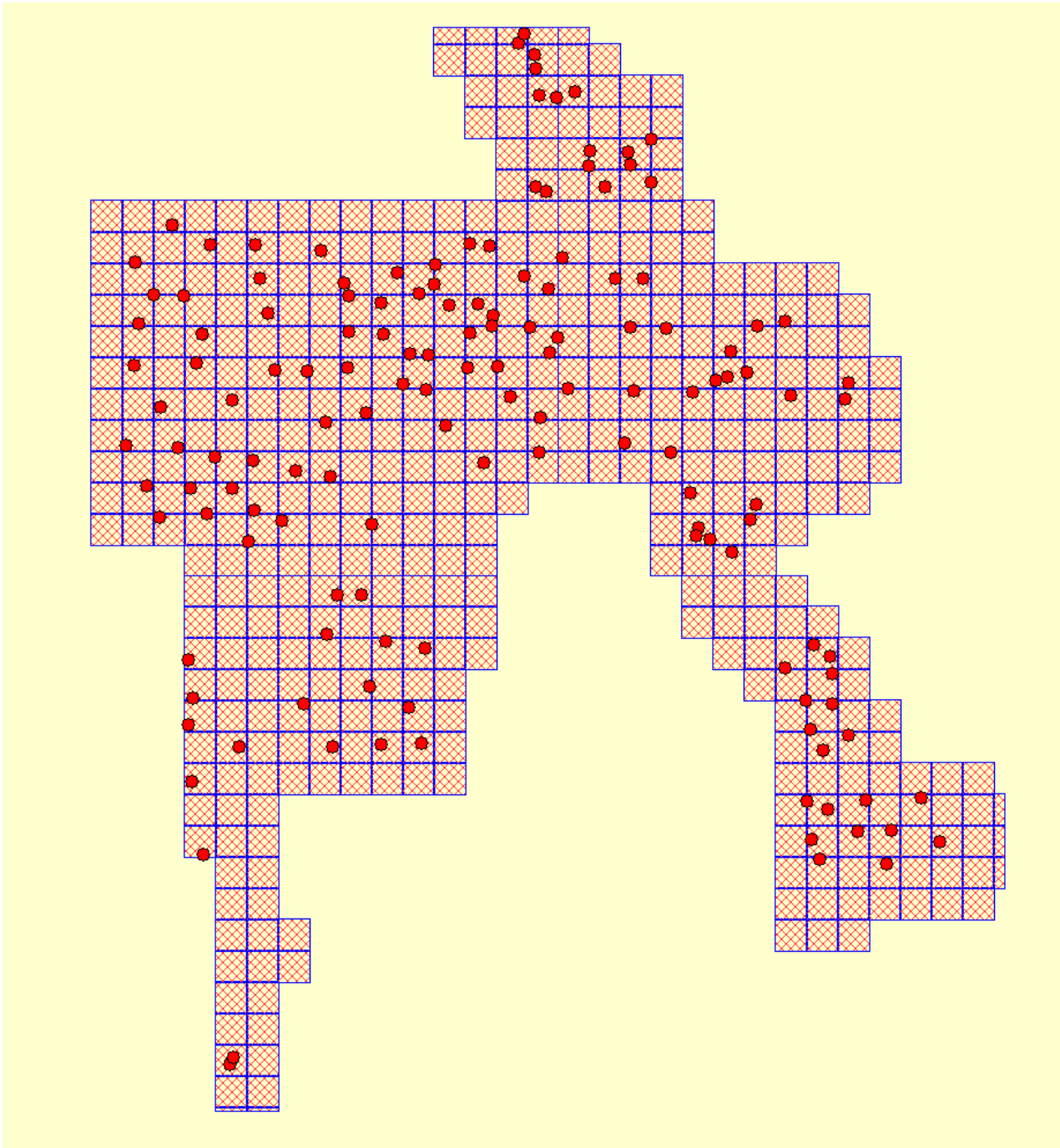
ASPRS recommends that checkpoint surveys be used to verify the vertical accuracy of LiDAR data sets. Checkpoints are to be collected by an independent survey firm licensed in the particular state(s) where the project is located. While subjective, checkpoints should be well distributed throughout the 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 able to locate independent checkpoints for this analysis. USGS accepts the quality of the checkpoint data for these LiDAR datasets.

Yes No

Image?

Contractor reports Short Grass SVA in all of the metadata. However, there is no land cover class for the checkpoints for short grass. The only land cover classes are Bare Earth/Low Grass for FVA, High Grass/weeds/crops for SVA, Forested for SVA, Urban/Hard Surface for SVA. The metadata does not state an SVA value for Urban. Please clarify/amend all metadata.

Discrepancies exist between reported vertical accuracy categories in the metadata and checkpoint shapefile provided.

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 .

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	<input type="text" value="0.156"/>	<input type="text" value="meters"/>
<i>Brush Lands and Low Trees</i>	<input type="text" value=""/>	<input type="text" value="meters"/>

Forested Areas Fully Covered by Trees	0.153	meters
Urban Areas with Dense Man-Made Structu...	0.128	meters

The reported CVA of this data set is: 0.153 meters.

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

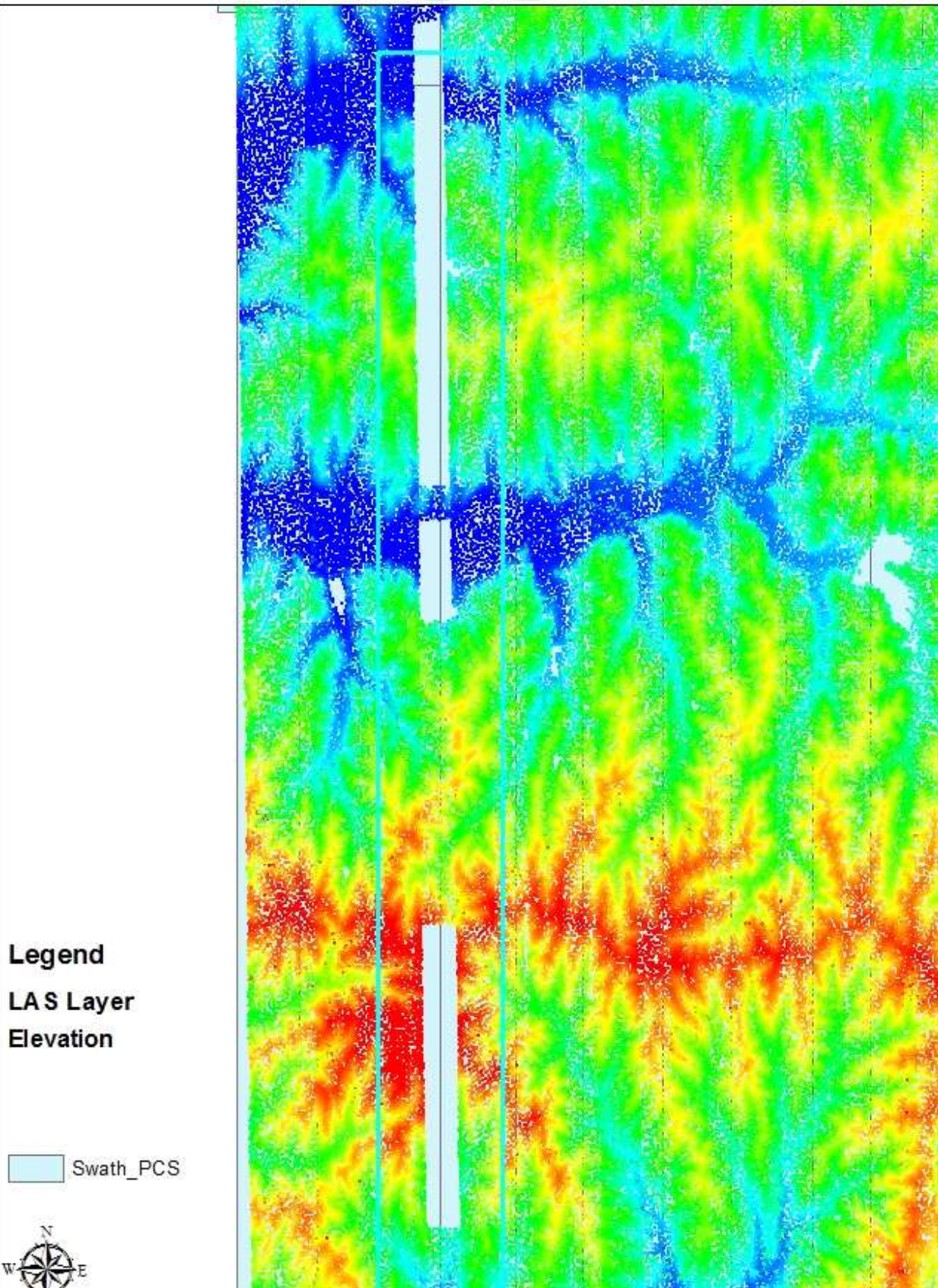
The reported FVA of the LAS swath data is 0.149 meters.

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?

FL_221_E



Legend
LAS Layer
Elevation

Swath_PCS



The scan angle shows -128 and 124 and there are missing points in the flight line. Number of classes used in this flight line is 6: Classes 0, 1, 4, 17, 18 and 26. There are classified .las points for this area. The above image shows missing data long FL 221E, FL 221F and FL 231B. Looking at the classified .las and DEM, there are points in the missing areas noted in the swath.

**There were no re-deliveries of swath data by the vendor.

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?

Additional classifications in this data set.

- 3 - Tall weeds and crops (low vegetation)
- 4 - Brush lands and low trees (medium vegetation)

- 5 - Forested areas fully covered by trees
- 6 - Urban area with dense man-made structures

<input checked="" type="checkbox"/>	17	-	Overlap - Unclassified
<input checked="" type="checkbox"/>	18	-	Overlap - Bare Earth
<input checked="" type="checkbox"/>	24	-	Overlap - Water
<input checked="" type="checkbox"/>	25	-	Overlap - Ignored Ground

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

Yes No

None.

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

Image for error?

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	<u>Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy_z)</u> Required FVA = <input type="text" value="0.245"/> or less.	<u>Supplemental Vertical Accuracy @95th Percentile Error</u> Target SVA = <input type="text" value="0.363"/> or less.	<u>Consolidated Vertical Accuracy @95th Percentile Error</u> Required CVA = <input type="text" value="0.363"/> or less.
Open Terrain	<input type="text" value="52"/>	<input type="text" value="0.150"/>		
Tall Weeds and Crops	<input type="text" value="52"/>		<input type="text" value="0.156"/>	
<i>Brush Lands and Low Trees</i>	<input type="text" value="1"/>		<input type="text" value="1"/>	
Forested Areas Fully Covered by Trees	<input type="text" value="52"/>		<input type="text" value="0.153"/>	
Urban Areas with Dense Man-Made Structures	<input type="text" value="52"/>		<input type="text" value="0.128"/>	
Consolidated	<input type="text" value="208"/>			<input type="text" value="0.153"/>

- QA performed Accuracy Calculations?

Calculated Accuracies

Land Cover Category	# of Points	Fundamental Vertical Accuracy @95% Confidence Interval (Accuracy _z) Required FVA = 0.245 or less.	Supplemental Vertical Accuracy @95th Percentile Error Target SVA = 0.363 or less.	Consolidated Vertical Accuracy @95th Percentile Error Required CVA = 0.363 or less.
Open Terrain	38	0.117		
Tall Weeds and Crops	34		0.124	
<i>Brush Lands and Low Trees</i>	1		1	
Forested Areas Fully Covered by Trees	35		0.189	
Urban Areas with Dense Man-Made Structures	40		0.137	
Consolidated	147			0.136

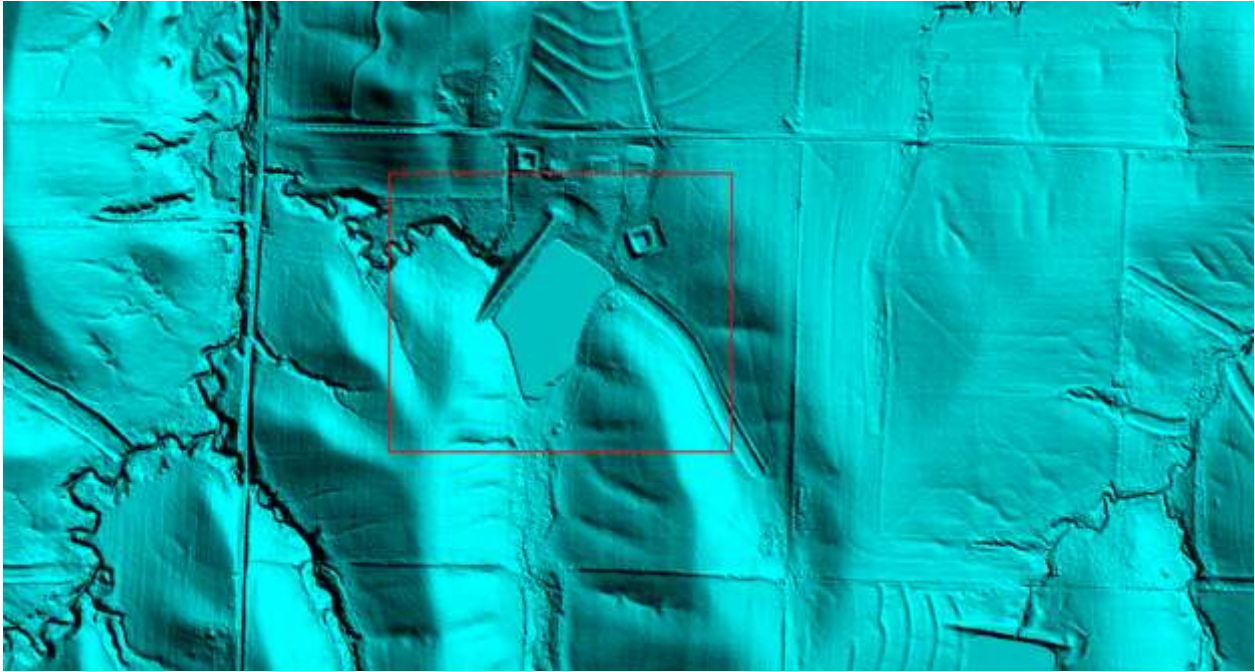
Based on this review, the USGS does not recommend the bare-earth DEM files for inclusion in the 1/3 Arc-Second National Elevation Dataset.

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

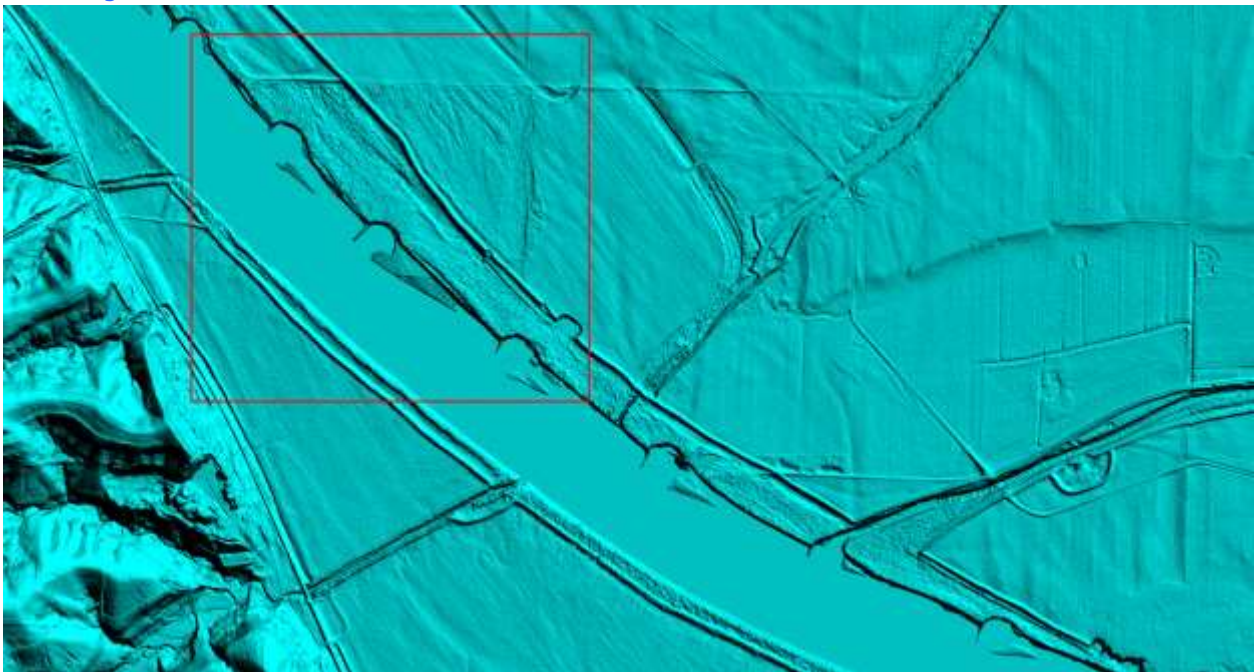
Image?



Water that is higher than the terrain. Location at 39° 25' 8.7115" N, 95° 47' 19.6699" W

****Vendor corrected error****

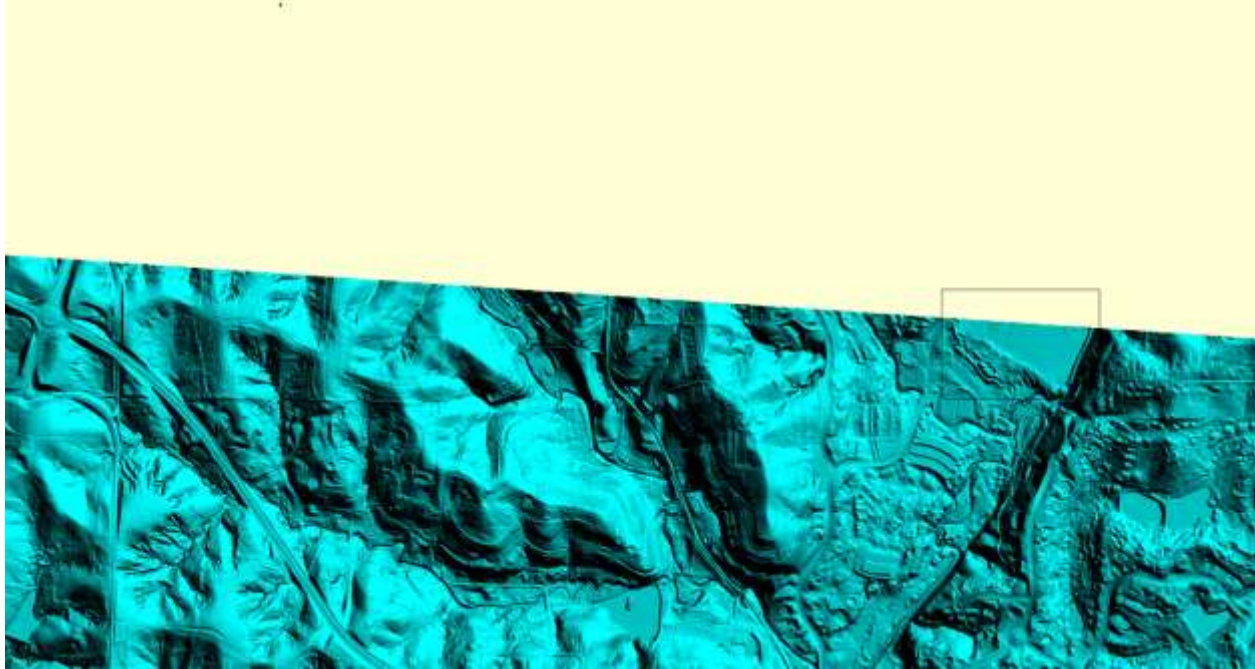
Image?



Along a portion of the creek, there are errors relating to tinning across the water, land below water and areas that look as if too many points were removed along the bank.

Not Corrected by vendor

Image?



Water body on edge of data that was not completely hydroflattened.

Vendor corrected error

Image?



This is the end of the report.

QA Form V1.4 12OCT11.xsn

