



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. 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.

TN NRCS 2011

NGTOC

2014-02-18



Project Information

Project:

Contractor:

Project Type:
Select...

Applicable Specification:
NGP LiDAR Base Specification Draft V13

Project Points of Contact:

Name:	Type:	Email:
Keith McFadden	NSDI Liaison	keithmc@usgs.gov

REPORT QUALIFICATION SUMMARY:

Task Order Overall: Does Not Meet Requirements
Metadata: 1 of 1 Reviews Accepted 0 Reviews Not Accepted
Vertical Accuracy: 0 of 1 Reviews Accepted 1 Reviews Not Accepted
Tiled/Classified LAS: 0 of 1 Reviews Accepted 1 Reviews Not Accepted
Breakline: 0 of 1 Reviews Accepted 1 Reviews Not Accepted
DEM(s): 0 of 1 Reviews Accepted 1 Reviews Not Accepted
NED Review: 0 of 1 DEM tile reviews recommended for NED 1/3rd 0 of 1 DEM tile reviews recommended for NED 1/9th

Project Delivery Lots: Select...

Dates Collected Range:

Collection Start:

Collection End:

Project Aliases:

Licensing:

Public Domain

Project Description:

The purpose of this LiDAR data was to produce high accuracy 3D elevation products, including tiled LiDAR in LAS 1.2 format, 3D breaklines, and 1 m cell size hydro flattened Digital Elevation Models (DEMs). This data was produced for the U.S. Army Corps of Engineers and USDA-NRCS Tennessee for use in projects dealing with conservation planning, design, research, floodplain mapping, dam safety assessments, and hydrologic modeling.

Laser Mapping Specialist Inc (LMSI) collected LiDAR data for approximately 5,558 square miles that either fully or partially cover the Tennessee counties of Lake, Obion, Weakley, Henry, Carroll, Gibson, Dyer, Lauderdale, Crockett, Haywood, Madison, Henderson, McNairy, and Chester. The project area also partially covers the Kentucky counties of Fulton, Hickman, Graves, and Calloway.

Acquisition for the initial task order began on January 3, 2011 and was completed on March 16, 2011. The Tennessee LiDAR project began on December 2, 2011 and was completed on January 4, 2012. One re-flight was conducted on June 13, 2012.

Review Information

3rd Party QA
 Performed:

Date
 Delivered:

Action To Contractor Date:	Issue Description:	Return Date:
<input type="text" value="2/18/2014"/>	<p>Missing swath and calibration points</p> <p>The DEM contains: 436 bridge errors: See bridge error shapefile</p> <p>332 hydro errors: including, floating, flooding, flattening, and steep cookie cutter affect in stream bank errors. See Hydro error shapefile.</p> <p>**Note: Double line streams have been flattened with a step down method. Extremely long sections of stream have the same elevation and do not step down gradually, especially along the Mississippi and Obion River. There is a cookie cutter affect in many areas along the Mississippi and Obion Rivers. Elevations range from 2- 18' below the bank or entering streams.</p> <p>**Note: Metadata and reports indicate 2 different dates of acquisition and one re-flight day. Reports also specify flooding and high water during one period of collection which causes errors in stream flow.</p> <p>41 Misc. errors: including but not limited too vegetation, pit/spikes, void/missing data and seamlines. Project boundary has zinger to the inside of the boundary @35° 54' 41.9904" N, 89° 33' 8.4961" W which caused a sliver of missing data. The affected grid is 16sbe6977. The grid needs to be re-created and the project boundary needs reshaped. See Remaining Misc errors shapefile.</p> <p>See LAS section for LAS See Breakline section for Breaklines</p>	<input type="text"/>

Review Complete:

Project Materials Received

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 Section supervisor and informed of the problem. Processing will resume after the COTR has coordinated the deposition of remaining deliverables.

METADATA

<i>Deliverables</i>	<i>Delivered</i>	<i>XML Metadata</i>	<i>Required</i>	<i>Format</i>	<i>Quantity</i>	<i>Additional Details</i>
Collection Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Select...	1	
Survey Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Select...	4	reports recheck, finals
Processing Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Select...	2	Appendix E & F
QA/QC Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	Select...	1	
Project Level XML Metadata:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	XML	1	
Project Extent:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	1	
Tile Scheme:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	1	
Control (Calibration) Points:	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	Select...	0	not delivered
Check (Validation) Points:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	1	
Additional Comments:						

LIDAR DATA

<i>Deliverables</i>	<i>Delivered</i>	<i>XML Metadata</i>	<i>Required</i>	<i>Format</i>	<i>Quantity</i>	<i>Additional Details</i>
Swath Data:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Select...	0	not delivered
Classified/ Tiled Data:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.las	14,820	
Additional Comments:	# of LAS tiles do not match # of DEM tiles. missing las tiles 16sce2833.las 16sce2859.las					

DERIVED DELIVERABLES

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
DEM Tiles:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	GRID	14,822	
Breaklines:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	2	ponds and streams
Additional Comments:						

Geographic Information

Area Extent: Sq. Miles

Tile Size: Meters

DEM/DTM Grid Spacing: Meters

Coordinate Reference System:

Projection:

Horizontal Datum: NAD83 Meters U.S. Feet Int'l Feet

Vertical Datum: NAVD88 Meters U.S. Feet Int'l Feet

THIS PROJECTION COORDINATE REFERENCE SYSTEM IS CONSISTENT ACROSS THE FOLLOWING DELIVERABLES

- Project Extent
- Project Tile Scheme
- Checkpoints
- Project Level XML Metadata
- Tiled/Classified XML Metadata
- Tiled/Classified LiDAR
- DEM(s)
- DEM XML Metadata
- Breakline(s)
- Breakline XML Metadata

Additional Comments:

Collection Information

Configured Project Nominal Pulse Spacing:

Meters

Detailed Date(s) Collected:

Start Date:

End Date:

Details:

Additional Comments:

Metadata Review **Accepted**

Vendor 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.

Parser can be located @ <http://geo-nsdi.er.usgs.gov/validation/>

The Project Level XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED:

The Classified XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED:

The DEM XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED:

The Breakline XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED:

Additional Comments:

Based on this review, the USGS accepts the xml metadata provided.

End of Metadata Review

Vertical Accuracy Review **Not Accepted**

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.

Required Vertical Accuracy

Yes No

REQUIRED FUNDAMENTAL VERTICAL ACCURACY FOR SWATH AND DEM FILES

Confidence Interval Required: th % CI

Required Unit:

Required # of checkpoints:

Required RMSEz:

Required Vertical Accuracy (RMSEz * .% CI)

REQUIRED SUPPLEMENTAL VERTICAL ACCURACY FOR DEM FILES

SVA Statistic Required: Percentile

SVA Confidence Level/Percentile Required:

Class	# of Checkpoints	SVA Required 95 th Percentile	
Tall Weeds & Crops	<input type="text" value="20"/>	<input type="text" value="36.3"/>	<input type="text" value="Centimeters"/>
Forested Areas Fully Covered by Trees	<input type="text" value="20"/>	<input type="text" value="36.3"/>	<input type="text" value="Centimeters"/>

REQUIRED CONSOLIDATED VERTICAL ACCURACY FOR DEM FILES

CVA Statistic Required: Percentile

CVA Confidence Level/Percentile Required:

Total number of checkpoints:

Required CVA: Centimeters at the 95 th Percentile

Additional Required Vertical Accuracy Information:

Reported Vertical Accuracy

Yes No

REPORTED FUNDAMENTAL VERTICAL ACCURACY FOR SWATH LIDAR FILES

Confidence Interval Reported: th % CI

Reported Unit:

Reported # of checkpoints:

Reported RMSEz:

Reported Vertical Accuracy (RMSEz * .% CI)

REPORTED FUNDAMENTAL VERTICAL ACCURACY FOR DEM FILES

Confidence Interval Reported: th % CI
 Reported Unit:
 Reported # of checkpoints:
 Reported RMSEz:
 Reported Vertical Accuracy (RMSEz * .% CI)

REPORTED SUPPLEMENTAL VERTICAL ACCURACY FOR DEM FILES

SVA Statistic Reported: Percentile
 SVA Confidence Level/Percentile Reported:

Class	# of Checkpoints	SVA Reported 95 th Percentile	
Tall Weeds & Crops	<input type="text" value="86"/>	<input type="text" value="0.37"/>	<input type="text" value="Meters"/>
Forested Areas Fully Covered by Trees	<input type="text" value="80"/>	<input type="text" value="0.38"/>	<input type="text" value="Meters"/>

REPORTED CONSOLIDATED VERTICAL ACCURACY FOR DEM FILES

CVA Statistic Reported: Percentile
 CVA Confidence Level/Percentile Reported:
 Total number of checkpoints:
 Reported CVA: at the 95 th Percentile

Additional Reported Vertical Accuracy Information:

It is not clear as to what data vertical accuracy was tested. Page 42 of [USACE TN LiDAR Project Report 201221205 FINAL.pdf](#) under VERTICAL ACCURACY TESTING STEPS bullet 2 says:

Dewberry interpolated the bare-earth LiDAR DTM to provide the z-value for every checkpoint.

All other references of vertical accuracy are to the SWATH and classified LiDAR. See table 5 VERTICAL ACCURACY RESULTS on page 44 of [USACE TN LiDAR Project Report 201221205 FINAL.pdf](#)

Note: Reported accuracies for both Grass-Weeds-Crop and Forest fail accuracy standards.

After receiving the project data from LMSI it is reported that 251 checkpoints were used to verify accuracy of classified LiDAR (not DEM) data by Dewberry. However; NGTOC tested the DEM with said 251 points and the accuracies passed the NSSDA standards for V13 specifications. Due to indication that the classified LAS was tested rather than the DEM the above reported accuracies by Dewberry are not valid for the DEM. Calibration points were not

delivered.

Reviewed Vertical Accuracy

Yes No

CHECKPOINT REVIEW

Checkpoints are well distributed?

Enough checkpoints for task order?

Checkpoints meet USGS LiDAR base-spec in quantity and quality?

REVIEWED FUNDAMENTAL VERTICAL ACCURACY FOR DEM FILES

Confidence Interval Reviewed: th % CI

Reviewed Unit:

Reviewed # of checkpoints:

Reviewed RMSEz:

Reviewed Vertical Accuracy (RMSEz * .% CI)

REVIEWED SUPPLEMENTAL VERTICAL ACCURACY

SVA Statistic Reviewed: Percentile

SVA Confidence Level/Percentile Reviewed:

Class	# of Checkpoints	SVA Reviewed 95 th Percentile	
Tall Weeds & Crops	86	0.036	Meters
Forested Areas Fully Covered by Trees	80	0.382	Meters

REVIEWED CONSOLIDATED VERTICAL ACCURACY

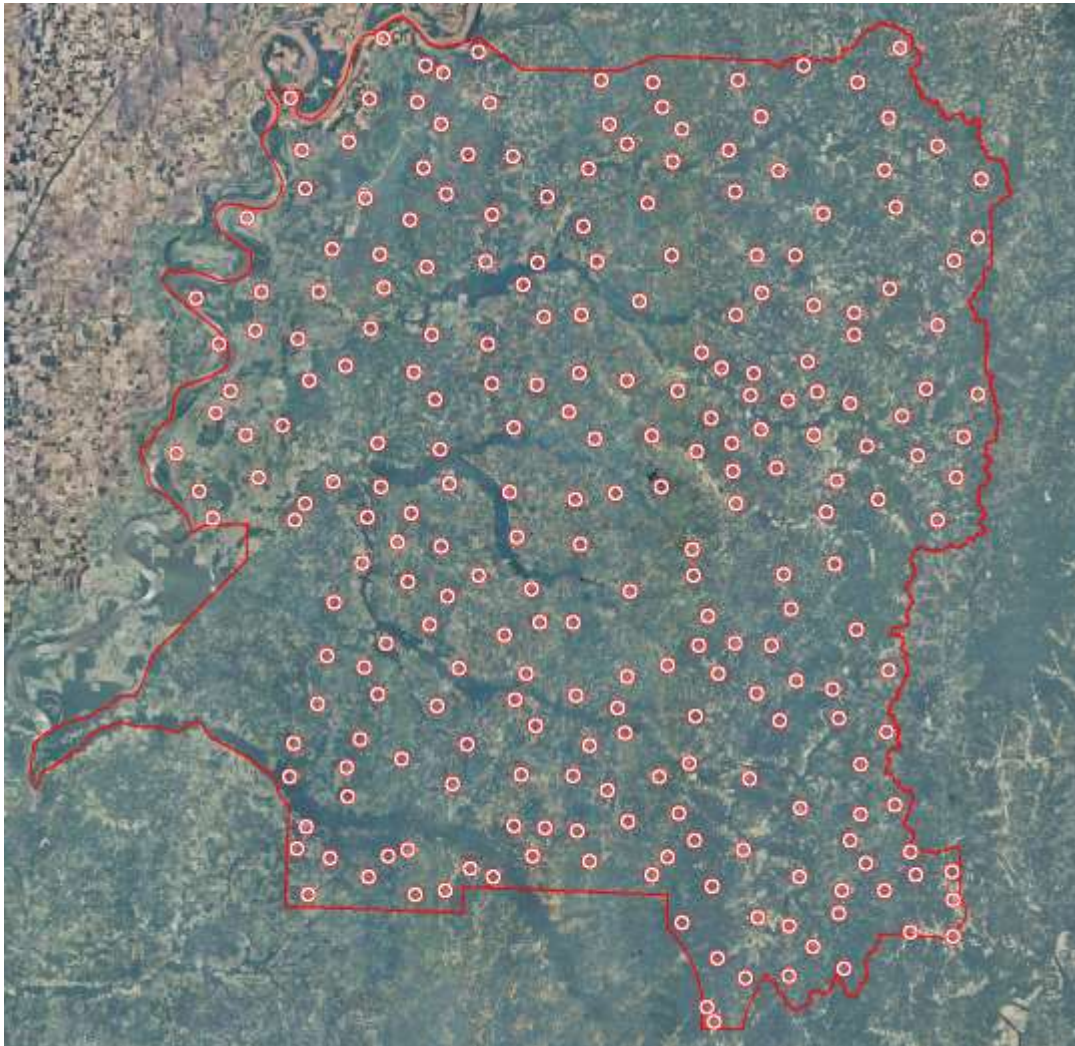
CVA Statistic Reviewed: Percentile

CVA Confidence Level/Percentile Reviewed:

Total number of checkpoints:

Reviewed CVA: Meters at the 95 th Percentile

Checkpoint Distribution Image



Vertical Accuracy Results:

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Additional Reviewed Vertical Accuracy Information:

Reports and metadata indicate that Dewberry tested the classified LiDAR instead of the DEM. Therefore vertical accuracy has not been accepted.

Based on this review, the USGS does not accept the vertical accuracy.

End of Vertical Accuracy Review

Raw-Swath LiDAR 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 (see Vertical Accuracy Review Section).

Review Required: Yes No Not Delivered

Tiled/Classified LiDAR Review **Not Accepted**

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. Classified LAS Tiles are comprised as follows, "all project swaths, returns, and collected points, fully calibrated, adjusted to ground, and classified and cut, by tiles, excluding calibration swaths, cross-ties, and other swaths not used, or intended to be used, in product generation".

Review Required: Yes No

CLASSIFIED LIDAR TILE CHARACTERISTICS

Separate folder for classified/tiled LiDAR files

LAS Version: 1.2

Point Record Format: 1

Classified LAS tile files conform to project tiling scheme

Quantity of classified LAS tile files conforms to project tiling scheme

LAS tiles missing are:

16sce2833.las
16sce2859.las

Classified LAS tile files do not overlap

Classified LAS tile files are uniform in size

Correct and properly formatted georeference information is included in all LAS file headers

Not all LAS tiles would pyramid through the LP360 stats extractor. Many tiles that did run successfully recorded Unknown Coord. System.

Adjusted GPS time used with the global encoder id set to 1

Global Encoder field = 0

Classified LAS tile files have no points classified as '12' (Overlap)

class 12 exists in LAS

Point classifications are limited to the standard values listed below:

Code	Description	Used
1	Processed, but unclassified	<input type="checkbox"/>
2	Bare-earth/Ground	<input type="checkbox"/>
7	Noise(low or high, manually identified, if needed)	<input type="checkbox"/>
8	Model key points	<input type="checkbox"/>
9	Water	<input type="checkbox"/>
10	Ignored ground (breakline proximity)	<input type="checkbox"/>
11	Withheld (if the "Withheld Bit" is not implemented in the processing software)	<input type="checkbox"/>

Additional Classes:

Class	Description
12	Dewberry states class 12 was used for outliers

Additional comments:

All LAS would not pyramid. class 12 exists in LAS that did run

Based on this review, the USGS does not accept classified/tiled LiDAR data.

Breakline Review **Not Accepted**

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

Review Required: Yes No

BREAKLINE FILE CHARACTERISTICS:

- Separate folder for breakline files.
- Breaklines contain elevation values.

Elevation values stored in Geometry (ZEnabled)

Units: Meters

- Waterbody Breaklines.

Polyline Polygon

Single elevation value per waterbody feature.

Required.

Waterbody Elevations were created via Unknown waterbody level techniques.

- Double Line Stream Breaklines (Streams Approximately > 100 ft).

Polyline Polygon

Downstream DLS Flow is Stairstepped

Required.

- Single Line Breaklines.
- No missing or misplaced breaklines.

ADDITIONAL COMMENTS, ERRORS, ANOMALIES, OR OTHER ISSUES:

double line streams have been flattened with a step down method. Extremely long sections of stream have the same elevation and do not step down gradually. Banks are too steep-deep along the Mississippi and Obion River. Elevations range from 2- 18' below the bank or entering streams. This project was collected at 2 different time intervals.

Based on this review, the USGS does not accept the breakline files.

End of Breakline Review

DEM Review **Not Accepted**

The derived bare-earth file(s) receive a review of the vertical accuracies provided by the data supplier, vertical accuracies calculated by the USGS using supplied and independent checkpoints (*see the prior Vertical Accuracy Review Section*), and a thorough visual review for any anomalies or inconsistencies in assessing the quality of the DEM(s).

BARE-EARTH DEM TILE CHARACTERISTICS:

- Separate folder for bare-earth DEM files
- Raster File Type: GRID
- Raster Cell Size: 1 Meters
- Tile bit depth/pixel Type: 32_BIT_FLOAT
- Interpolation or Resampling Technique: Select...
- DEM tiles do not overlap
 - DEM tiles conform to Project Tiling Scheme

- Quantity of DEM files conforms to Project Tiling Scheme
- DEM tiles are uniform in size

- DEM tiles properly edge match and free of edge artifacts
- Tiles are free from Spikes and Pits

see Remaining Misc Errors shapefile

- Tiles are free from Data Holidays (*voids due to processing or collection errors*)

DEM contains 41 Misc Errors. see Remaining Misc errors shapefile

- Tiles do not exhibit systematic sensor error or conrowing

DEM tiles are properly Hydro Flattened Yes No

- Waterbodies or greater are flattened
- Streams or greater are flattened in a downstream manner

DEM contains 332 hydro errors. See Hydro Errors shapefile

- Tidal Boundaries/Shorelines are flattened

n/a

- No missing islands or larger
- Bridges/Overpasses are properly removed

DEM contains 436 bridge errors. See Bridge Errors shapefile

- Culverts are maintained (Not Hydro Enforced)
- Depressions, Sinks, are not filled in (Not Hydro Conditioned)
- Vegetation properly removed
- Manmade structures properly removed

Tiles recommended for NED 1/3rd: Yes. No.

Tiles recommended for NED 1/9th: Yes. No.

Based on this review, the USGS does not accept the DEM tiles.

End of DEM Review

Based on this review, the provided delivery Does Not Meet the Contract and/or Task Order requirements.
Additional Comments:

END OF REPORT (v2.1.1)