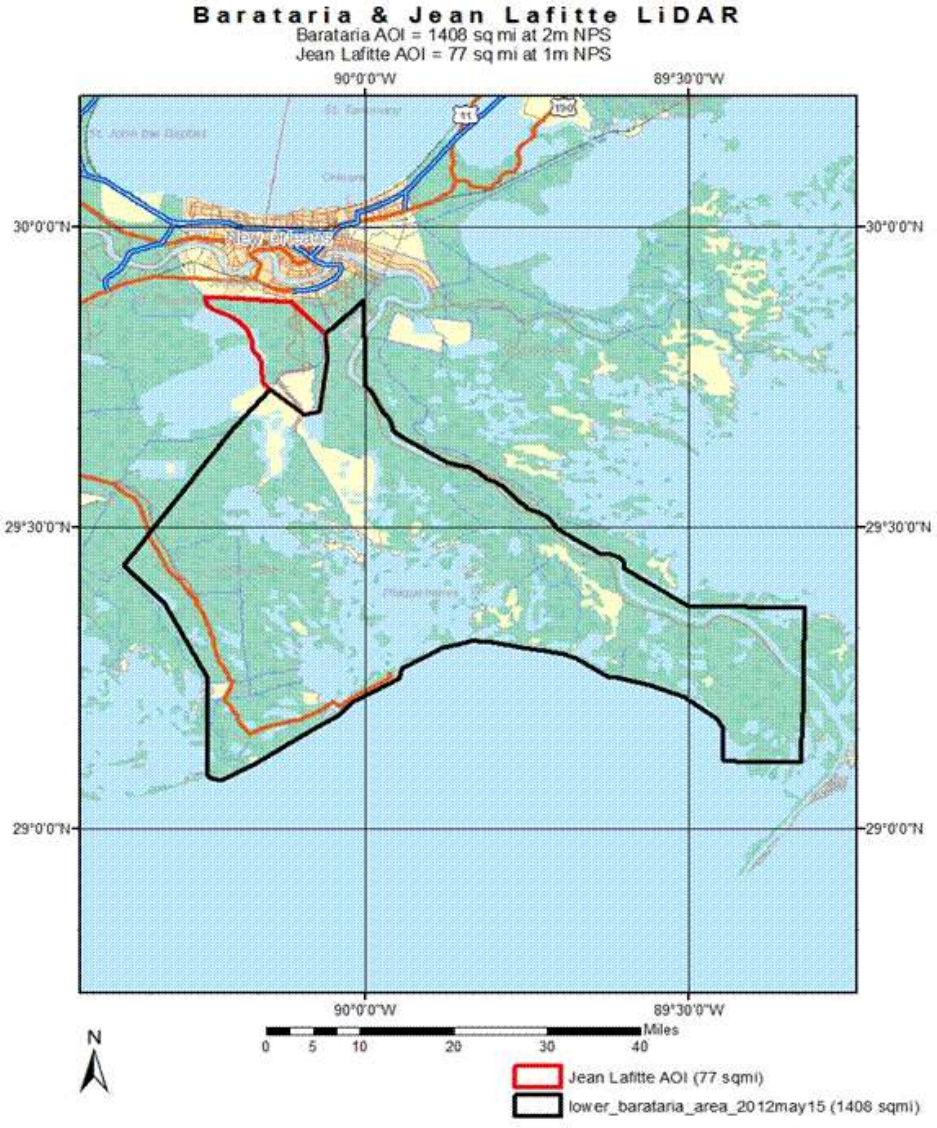
LiDAR Quality Assessment Report

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.

LA Jean Lafitte LiDAR

NGTOC



Project Information

Project: LA Jean Lafitte LiDAR

Contractor: Digital Aerial Solutions

Project Type: GPSC

Applicable Specification: NGP LiDAR Base Specification V 1.0

Project Points of Contact:

Name:	Type:	Email:
Pat Emmett	CPT	pemmett@usgs.gov

REPORT QUALIFICATION SUMMARY:

Task Order Overall:
Meets Requirements

Metadata:
1 of 1 Reviews Accepted
0 Reviews Not Accepted

Vertical Accuracy:
1 of 1 Reviews Accepted
0 Reviews Not Accepted

Swath/Raw LAS:
1 of 1 Reviews Accepted
0 Reviews Not Accepted

Tiled/Classified LAS:
1 of 1 Reviews Accepted
0 Reviews Not Accepted

Breakline:
1 of 1 Reviews Accepted
0 Reviews Not Accepted

DEM(s):
1 of 1 Reviews Accepted
0 Reviews Not Accepted

NED Review:
1 of 1 DEM tile reviews recommended for NED 1/3rd
1 of 1 DEM tile reviews recommended for NED 1/9th

Project Delivery Lots: None

Dates Collected Range:
Collection Start: 3/5/2013
Collection End: 3/8/2013

Project Aliases: n/a

Licensing:
Public Domain

Project Description:

1. This task order is for Planning, Acquisition, processing, and derivative products of lidar data to be acquired for an area subdivided into two collection subareas. The majority of the area (Barataria), 1,408 mi^2, will be collected at a nominal pulse spacing (NPS) of 2.0 meter. A NPS of 1.0 meter will be used to collect a smaller 77 mi^2 area (Jean Lafitte). Total area to be acquired is 1,485 square miles. Specifications listed below are based on the **"U.S. Geological Survey National Geospatial Program Lidar Base Specification Version 1.0",** which is incorporated by reference into this task order. This specification may be viewed at ***http://pubs.usgs.gov/tm/11b4/.*** These lidar specifications are required baseline specifications. In addition to the requirements listed below, variations from the specifications will be shown and noted below. For any item, which is not specifically addressed, the referenced Version 1.0 specifications will be the required specification authority.

This task order requests LiDAR surveys be collected over two AOIs titled "Barataria" and "Jean Lafitte", covering a total of approximately 1,485 square miles of the Barataria Basin south of New Orleans, Louisiana. These AOIs consist of 1) the Jean Lafitte National Park Barataria Preserve (JLNP) AOI, approximately 77 square miles and 2) the southern Barataria (SB) AOI approximately 1,408 square miles. Total acquisition area is 1,485 mi^2. This regional LiDAR elevation mapping will be used for modeling, predicting coastal landscape change, promoting restoration of ecosystems, and mitigating risks associated with anthropomorphic and natural hazards.

Review Information

Reviewer:	Select or type...	*Date Delivered:*	
3rd Party QA Performed:	☐	*Date Assigned:*	3/21/2014

Action To Contractor Date:	*Issue Description:*	*Return Date:*
3/31/2014	Metadata (see section below) Swath files set to class 1	

Review Complete:

Dates Project Worked:

Start:	3/21/2014
End:	5/5/2014

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

Deliverables	*Delivered*	*XML Metadata*	*Required*	*Format*	*Quantity*	*Additional Details*
Collection Report:	☑		☑	*PDF*	1	Combined in 1 report
Survey Report:	☑		☑	*PDF*	1	Combined in 1 report
Processing Report:	☑		☑	*PDF*	1	Combined in 1 report
QA/QC Report:	☑		☑	*PDF*	1	Combined in 1 report
Project Level XML Metadata:	☑		☑	*XML*	2	This task was a combined lidar acquisition of 2m NPS(Barataria) and 1m NPS (JLNP). Listings of deliverables in this report include both deliveries.
Project Extent:	☑	☑	☑	*.shp*	2	1 for JLNP; 1 for Barataria
Tile Scheme:	☑	☑	☑	*.shp*	2	1 for JLNP; 1 for Barataria
Control						

(Calibration) Points:	☑	☑	☑	Select...		
Check (Validation) Points:	☑	☑	☑	.shp	1	Combined in 1 shapefile
Additional Comments:						

LIDAR DATA

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
Swath Data:	☑	☑	☑	.las	106	Barataria 79; JLNP 27
Classified/ Tiled Data:	☑	☑	☑	.las	1,916	Barataria 1791; JLNP 125
Additional Comments:						

DERIVED DELIVERABLES

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
DEM Tiles:	☑	☑	☑	TIF	1,919	Barataria 1795; JLNP 124
Breaklines:	☑	☑	☑	.shp	2	2 shapefiles for JLNP; 1 .gdb for Barataria
Additional Comments:						

OTHER

Additional Comments:	

Geographic Information

Area Extent: 82.54 *Sq. Miles*

Tile Size: 1500 x 1500 *Meters*

DEM/DTM Grid Spacing: 1 *Meters*

Coordinate Reference System:

UTM Zone 15

Projection: UTM

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

- [x] *Project Extent*
- [x] *Project Extent XML Metadata*
- [x] *Project Tile Scheme*
- [x] *Project Tile Scheme XML Metadata*
- [x] *Control Points*
- [x] *Control Points XML Metadata*
- [x] *Checkpoints*
- [x] *Checkpoint XML Metadata*
- [x] *Project Level XML Metadata*
- [x] *Tiled/Classified XML Metadata*
- [x] *Tiled/Classified LiDAR*
- [x] *Swath/Raw LiDAR XML Metadata*
- [x] *Swath/Raw LiDAR*
- [x] *DEM(s)*
- [x] *DEM XML Metadata*
- [x] *Breakline(s)*
- [x] *Breakline XML Metadata*

Additional Comments:

Collection Information

Configured Project Nominal Pulse Spacing:

1 Meters

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 found @ http://geo-nsdi.er.usgs.gov/validation/

The Project Level XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: [ ]

The Project Extent XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: [ ]

The Project Tile Scheme XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: [ ]

The Control Point XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: [ ]

The Check Point XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: [ ]

The Swath XML Metadata parsed <u>without</u>errors.
Check if 'Best Use' metadata for NED: ☐

The Classified XML Metadata parsed <u>without</u>errors.
Check if 'Best Use' metadata for NED: ☐

The DEM XML Metadata parsed <u>without</u>errors.
Check if 'Best Use' metadata for NED: ☐

The Breakline XML Metadata parsed <u>without</u>errors.
Check if 'Best Use' metadata for NED: ☐

Additional Comments:

Metadata Issues fixed by vendor

- Most metadata appears to be duplicates of each other, with minor changes. All metadata appears to be copied versions of project level metadata, although LAS classifications are not given in either project or classified las metadata.

- Why is vertical accuracy included in breakline metadata as well as LiDAR scans and LAS format? "**Tested 12.2 cm (0.4 ft.) vertical accuracy at the 95% confidence level in open terrain, based on open terrain.**" Based on open terrain…in water?

- FVA is listed as 12.2 cm in both classified and DEM metadata

- SVA and CVA should be included in project level metadata

- project extent metadata does not describe project extent

Based on this review, the USGS <u>accepts</u> the xml metadata provided.

End of Metadata Review

Vertical Accuracy Review 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:	95 th % CI
Required Unit:	Centimeters
Required # of checkpoints:	61
Required RMSEz:	12.5
*Required Vertical Accuracy (RMSEz * .% CI)*	24.5

REQUIRED SUPPLEMENTAL VERTICAL ACCURACY FOR DEM FILES

SVA Statistic Required: Percentile

SVA Confidence Level/Percentile Required: 95

Class	# of Checkpoints	SVA Required 95 th Percentile	
Tall Weeds & Crops	22	36.3	Centimeters
Brushlands & Low Trees	12	36.3	Centimeters
Forested Areas Fully Covered by Trees	6	36.3	Centimeters
Urban Areas with Dense Man Made Structures	9	36.3	Centimeters

REQUIRED CONSOLIDATED VERTICAL ACCURACY FOR DEM FILES

CVA Statistic Required: Percentile

CVA Confidence Level/Percentile Required: 95

Total number of checkpoints: 100

Required CVA: 36.3 Centimeters *at the* 95 th *Percentile*

Additional Required Vertical Accuracy Information: Ground Truth data was collected of the three major vegetative cover classes and "urban" dispersed within the area of interest. Land cover categories; urban, forested fully grown, brush lands represents less than 10% of the project land cover class in this project so a minimum 20 points in each categories could not be collected; however, a total 110 points were collected in all of the four classes.

Reported Vertical Accuracy

(•) Yes ( ) No

REPORTED FUNDAMENTAL VERTICAL ACCURACY FOR SWATH LIDAR FILES

Confidence Interval Reported:	95 th % CI
Reported Unit:	Meters
Reported # of checkpoints:	110
Reported RMSEz:	0.062
*Reported Vertical Accuracy (RMSEz * .% CI)*	0.122

REPORTED FUNDAMENTAL VERTICAL ACCURACY FOR DEM FILES

Confidence Interval Reported: 95 th % CI

Reported Unit: Meters

Reported # of checkpoints: 61

Reported RMSEz: 0.055

*Reported Vertical Accuracy (RMSEz * .% CI)* 0.109

REPORTED SUPPLEMENTAL VERTICAL ACCURACY FOR DEM FILES

SVA Statistic Reported: Confidence Level

SVA Confidence Level/Percentile Reported: 95

Class	# of Checkpoints	SVA Reported 95 th Confidence Level	
Tall Weeds & Crops	22	0.208	Meters
Brushlands & Low Trees	12	0.210	Meters
Forested Areas Fully Covered by Trees	6	0.121	Meters
Urban Areas with Dense Man Made Structures	9	0.146	Meters

REPORTED CONSOLIDATED VERTICAL ACCURACY FOR DEM FILES

CVA Statistic Reported: Confidence Level

CVA Confidence Level/Percentile Reported: 95

Total number of checkpoints: 110

Reported CVA: 0.203 Meters *at the* 95 th *Confidence Level*

Additional Reported Vertical Accuracy Information: Ground Truth data was collected of the three major vegetative cover classes and "urban" dispersed within the area of interest. Land cover categories; urban, forested fully grown, brush lands represents less than 10% of the project land cover class in this project so a minimum 20 points in each categories could not be collected; however, a total 110 points were collected in all of the four classes.

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 SWATH LIDAR FILES

Confidence Interval Reviewed: 95 th % CI

Reviewed Unit: Meters

Reviewed # of checkpoints: 51

Reviewed RMSEz: .079

*Reviewed Vertical Accuracy (RMSEz * .% CI)* 0.154

REVIEWED FUNDAMENTAL VERTICAL ACCURACY FOR DEM FILES

Confidence Interval Reviewed: 95 th % CI

Reviewed Unit: Meters

Reviewed # of checkpoints: 51

Reviewed RMSEz: .057

*Reviewed Vertical Accuracy (RMSEz * .% CI)* 0.104

REVIEWED SUPPLEMENTAL VERTICAL ACCURACY

SVA Statistic Reviewed: Percentile

SVA Confidence Level/Percentile Reviewed: 95

Class	# of Checkpoints	SVA Reviewed 95 th Percentile	
Tall Weeds	22	0.208	Meters
Urban Areas	9	0.139	Meters
Forested Areas Fully Covered by Trees	6	0.110	Meters
Brushlands & Low Trees	12	0.208	Meters

REVIEWED CONSOLIDATED VERTICAL ACCURACY

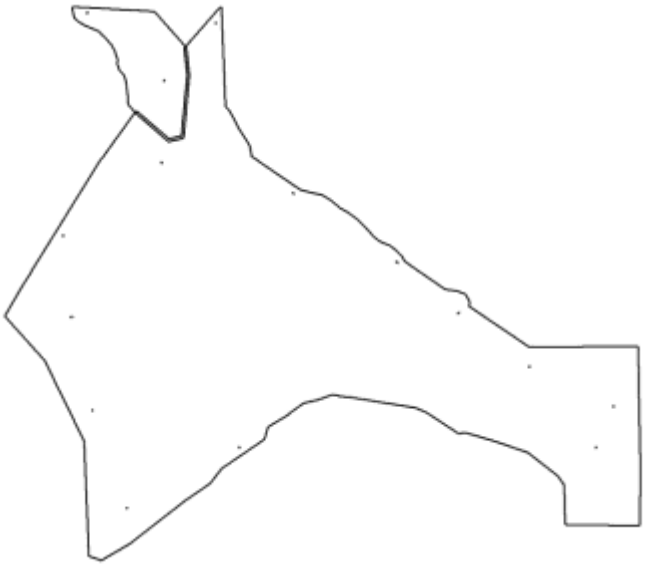
CVA Statistic Reviewed: Percentile

CVA Confidence Level/Percentile Reviewed: 95

Total number of checkpoints: 100

Reviewed CVA: 0.200 Meters *at the 95 th Percentile*

Checkpoint Distribution Image



Vertical Accuracy Results:

Additional Reviewed Vertical Accuracy Information:	Due to difficulties accessing swampy interior portions of the project area, the quantity of checkpoints is smaller than required number for each SVA class. USGS accepts the lower number of checkpoints for this project. Vertical accuracy values are for both Barataria and Jean Lafitte combined.

Based on this review, the USGS accepts the vertical accuracy.

End of Vertical Accuracy Review

Raw-Swath LiDAR Review Accepted

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*

RAW-SWATH LIDAR FILE CHARACTERISTICS

- [x] *Separate folder for swath/raw LiDAR files*

LAS Version: 1.2

Point Record Format: 1

- [x] *Each swath file ≤ 2 GB and properly segmented*
- [x] *Correct and properly formatted georeference information is included in all LAS file headers*
- [x] *Adjusted GPS time used with the global encoder id set to 1*
- [x] *Scan Angles conform to USGS base-spec recommendations*
- [x] *All points set to class '0' (not classified)*

Additional comments:

Based on this review, the USGS accepts the swath/raw LiDAR data.

End of Swath/Raw LiDAR Review

Tiled/Classified LiDAR Review 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

- [x] *Classified LAS tile files conform to project tiling scheme*
- [x] *Quantity of classified LAS tile files conforms to project tiling scheme*
- [x] *Classified LAS tile files do not overlap*
- [x] *Classified LAS tile files are uniform in size*

☑ *Correct and properly formatted georeference information is included in all LAS file headers*
☑ *Adjusted GPS time used with the global encoder id set to 1*
☐ *Classified LAS tile files have no points classified as '12' (Overlap)*

☐ *Point classifications are limited to the standard values listed below:*

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

Additional Classes:

Class	Description
17	reserve
18	reserve

Additional comments:

Based on this review, the USGS accepts classified/tiled LiDAR data.

End of Tiled/Classified LiDAR Review

Breakline Review 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 and Attribute Table .
Units: U.S. Feet

☑ 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 Select... .
☐ Required.

☐ Single Line Breaklines.
☑ No missing or misplaced breaklines.

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

End of Breakline Review

DEM Review 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: TIF
Raster Cell Size: 1 Meters
Tile bit depth/pixel Type: 32_BIT_FLOAT
Interpolation or Resampling Technique: Unknown

☑ 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
☑ Tiles are free from Data Holidays (*voids due to processing or collection errors*)
☑ Tiles do not exhibit systematic sensor error or cornrowing

DEM tiles are properly Hydro Flattened ◉ Yes ○ No

☑ Waterbodies 2 Acres or greater are flattened
☑ Streams 100 ft. or greater are flattened in a downstream manner
☐ Tidal Boundaries/Shorelines are flattened

☑ No missing islands 1 Acre or larger
☑ Bridges/Overpasses are properly removed
☑ 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 accepts the DEM tiles.

End of DEM Review

Based on this review, the provided delivery Meets the Contract and/or Task Order requirements.

Additional Comments:

INTERNAL COMMENTS

END OF REPORT (v2.1.1)