



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.

AK Juneau 1 meter Lidar

NGTOC



Project Information

Project:

Contractor:

Project Type:
Contributed

Applicable Specification:
Other

Project Points of Contact:

Name:	Type:	Phone:	Email:
Rebecca Anderson	NSDI Liason	907-787-9211	rdanderson@usgs.gov

REPORT QUALIFICATION SUMMARY:

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
Intensity Image(s): 0 of 0 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 Subdivision: None

Dates Collected Range:

Collection Start:

Collection End:

Project Aliases:

Licensing:

Project Description:

This Juneau, AK Quality Assurance report is for planning, acquisition, processing, and derivative products of lidar data for a high resolution data set of approximately 190 square miles, in the city and borough of Alaska.

Review Information

Reviewer:

Date

Delivered:

3rd Party QA

Date

Performed:

Assigned:

Action To Contractor Date:	Issue Description:	Return Date:
<input type="text" value="1/16/2014"/>	<ul style="list-style-type: none"> - Classified tile count is less than DEM count by one - Metadata errors - No project extent metadata supplied with delivery. - Both Classified and Swath LAS metadata is labeled 'Juneau_PILOT_LiDAR_LAS_UTM' though this is not a pilot project. - Checkpoints are projected in state plane while swath las files are in UTM. These must be in the same coordinate system before swath FVA can be checked. Please re-project checkpoints to match the UTM system of the swath las. - Classified LAS contains class 12 points, which are incorrectly assigned to 'mobile' points. See Classified LAS section for details. - Corrections in the DEM needed 	<input type="text" value="3/10/2014"/>
<input type="text" value="3/17/2014"/>	<ul style="list-style-type: none"> - No classified metadata supplied with redelivery. - Corrected Classified LAS with no class 12 points and in UTM projection was not included in this redelivery. - Corrections in the DEM needed 	<input type="text" value="4/7/2014"/>

Review Complete:

Dates Project Worked:

Start:

End:

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"/>	<u>PDF</u>	1	Combined*
Survey Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<u>PDF</u>	1	Combined*
Processing Report:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<u>PDF</u>	1	Combined*
QA/QC Report:	<input type="checkbox"/>		<input type="checkbox"/>	<u>Select...</u>		
Project Level XML Metadata:	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<u>XML</u>	1	
Project Extent:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<u>.shp</u>	1	
Tile Scheme:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<u>.shp</u>	1	
Control (Calibration) Points:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<u>.shp</u>		
Check (Validation) Points:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<u>.shp</u>	1	

Additional Comments:

Classified metadata labelled as "True_Color_All>Returns"

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 checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<u>.las</u>	610	
Classified/ Tiled Data:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<u>.laz</u>	1,454	

Additional Comments:

NED

<i>Deliverables</i>	<i>Delivered</i>	<i>XML Metadata</i>	<i>Required</i>	<i>Format</i>	<i>Quantity</i>	<i>Additional Details</i>

DEM Tiles:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	GRID	400	
Breaklines:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	.shp	1	Polygon and polyline files

Additional Comments:

OTHER

Deliverables	Delivered	XML Metadata	Required	Format	Quantity	Additional Details
DSM(s):	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Select...		
Intensity Image (s):	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	TIF	400	
Flightline (SBETs):	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	.shp	25	

Additional Comments:

Geographic Information

Area Extent: Sq. Miles

Tile Size: Meters

DEM/DTM Grid Spacing: Meters

Coordinate Reference System:

Projection:

Horizontal Datum:

- Meters
- U.S. Feet
- Int'l Feet

Vertical Datum:

- Meters
- U.S. Feet
- Int'l Feet

THIS PROJECTION COORDINATE REFERENCE SYSTEM IS CONSISTENT ACROSS THE FOLLOWING DELIVERABLES

- Project Extent
- Project Extent XML Metadata
- DEM(s)
- DEM XML Metadata

- Project Tile Scheme
- Project Tile Scheme XML Metadata
- Checkpoints
- Checkpoint XML Metadata
- Project Level XML Metadata
- Swath/Raw LiDAR
- Swath/Raw LiDAR XML Metadata
- Tiled/Classified LiDAR
- Tiled/Classified XML Metadata
- Breakline(s)
- Breakline XML Metadata
- Intensity Image(s)
- Intensity Image(s) XML Metadata
- Flightline(s)
- Flightline XML Metadata

Additional Comments:

Collection Information

Configured Project Nominal Pulse Spacing:

 Meters

Sensor Information:

Sensor Type:

Aerial

Sensor Used:

Configured Scan Angle \pm from nadir:

 Degrees

Additional Comments:

Priority area 1 = 8 ppsm, priority areas 2 and 3 = 4 ppsm (as reported in Juneau LiDAR_Final.pdf page 21.)

Metadata Review Accepted

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 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: Project Level Tile Level

The Check Point XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: Project Level Tile Level

The Swath XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: Project Level Swath Level

The Classified XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: Project Level Tile Level

The DEM XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: Project Level Tile Level

The Breakline XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: Project Level Tile Level

The Intensity Image XML Metadata parsed select... errors.

Check if 'Best Use' metadata for NED: Project Level Tile Level

The Flightline XML Metadata parsed without errors.

Check if 'Best Use' metadata for NED: Project Level Tile Level

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

Additional
Comments:

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: 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	
Brush	20	36.3	Centimeters
Deciduous Forest	20	36.3	Centimeters
Evergreen Forest	20	36.3	Centimeters
Short Grass	20	36.3	Centimeters
Wetland Grass	20	36.3	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	
Brush	23	0.758	U.S. Feet
Deciduous Forest	21	0.405	U.S. Feet
Evergreen Forest	29	0.373	U.S. Feet
Short Grass	37	0.319	U.S. Feet
Wetland Grass	22	0.218	U.S. Feet

REPORTED CONSOLIDATED VERTICAL ACCURACY FOR DEM FILES

CVA Statistic Reported: Percentile

CVA Confidence Level/Percentile Reported:

Total number of checkpoints:

Reported CVA: Meters at the 95 th Percentile

Additional Reported
Vertical Accuracy
Information:

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: th % CI

Reviewed Unit:

Reviewed # of checkpoints:

Reviewed RMSEz:

Reviewed Vertical Accuracy (RMSEz * .% CI)

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 Reported 95 th Percentile	
Brush	25	0.256	Meters
deciduous forest	21	0.129	Meters
evergreen forest	30	0.161	Meters
short grass	37	0.147	Meters
wetland grass	22	0.113	Meters

REVIEWED CONSOLIDATED VERTICAL ACCURACY

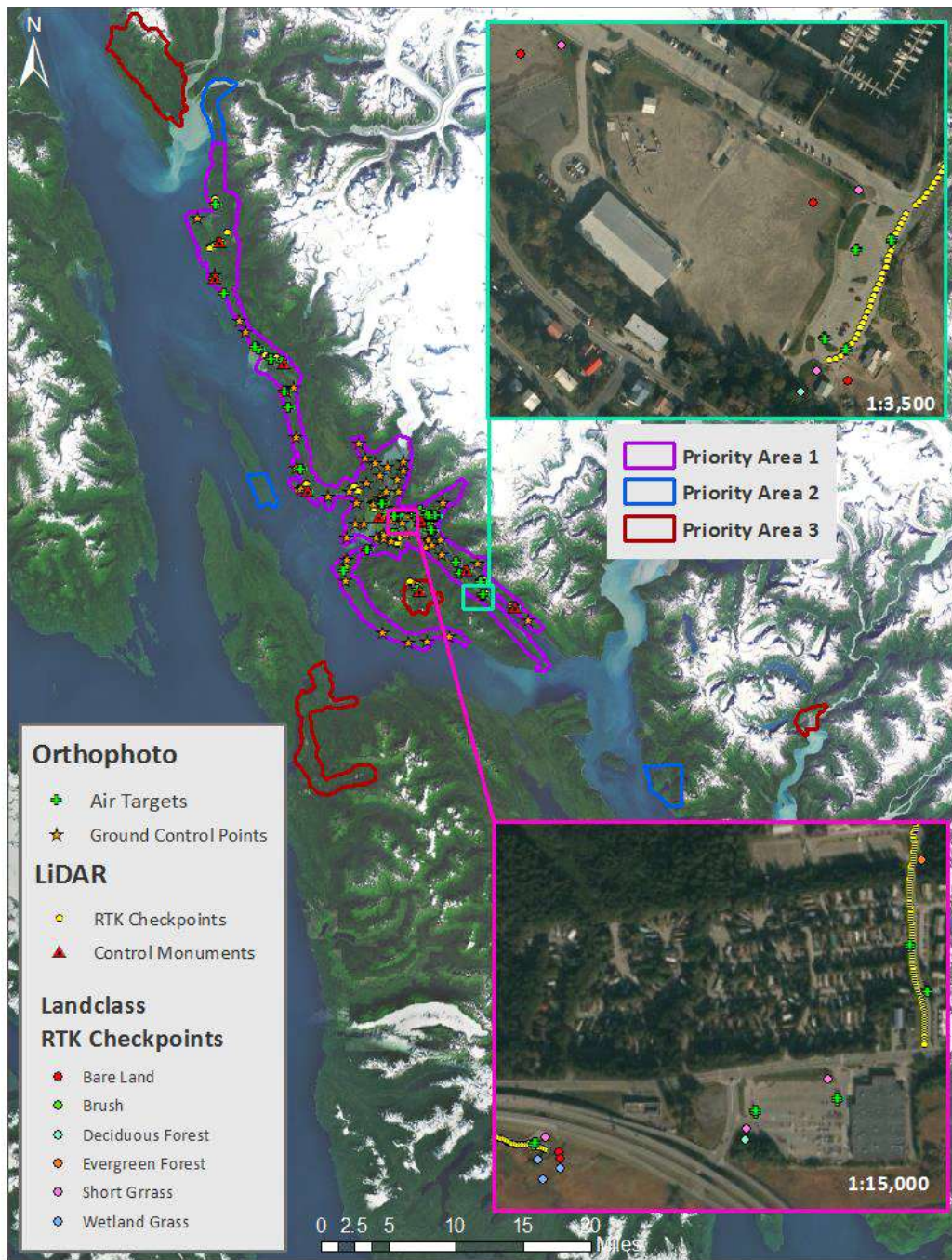
CVA Statistic Reviewed: Percentile

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:*

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

End of Vertical Accuracy Review

Swath/Raw 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

SWATH LIDAR FILE CHARACTERISTICS

Separate folder for swath/raw LiDAR files

LAS Version: 1.2

Point Record Format: 1

- Each swath file ≤ 2 GB and properly segmented
- 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
- Scan Angles conform to USGS base-spec recommendations
- All points set to class '0'

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

Additional comments:

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: Select...

- 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
- 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'
- 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 checked="" type="checkbox"/>
7	Noise(low or high, manually identified, if needed)	<input checked="" type="checkbox"/>

8	Model key points	<input type="checkbox"/>
9	Water	<input checked="" type="checkbox"/>
10	Ignored ground (breakline proximity)	<input checked="" type="checkbox"/>
11	Withheld (if the "Withheld Bit" is not implemented in the processing software)	<input checked="" type="checkbox"/>

Additional Classes:

Class	Description
3	Vegetation (Low)
4	Vegetation (Medium)
5	Vegetation (High)
6	Building
13	Utilities
14	Bridges
15	Ice
16	Snow
17	Decks
18	Awnings
19	Mobile

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

Additional comments:

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 (ZEnabled)

Units: Meters

- Waterbody Breaklines.

Polyline Polygon

- Single elevation value per waterbody feature.
- Required.

Waterbody Elevations were created via Select... waterbody level techniques.

- Double Line Stream Breaklines (Streams Approximately > 100 ft).
- Single Line Breaklines.
- No missing or misplaced breaklines.

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

ADDITIONAL COMMENTS, ERRORS, ANOMALIES, OR OTHER ISSUES:

Deliverables include polygon and polyline shapefiles.

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: GRID

Raster Cell Size: Meters

Tile bit depth/pixel Type:

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
- Tiles do not exhibit systematic sensor error or corrowing

DEM tiles are properly Hydro Flattened Yes No

Waterbodies 2 Acres or greater are flattened

Waterbodies greater than 2 acres need hydroflattening:

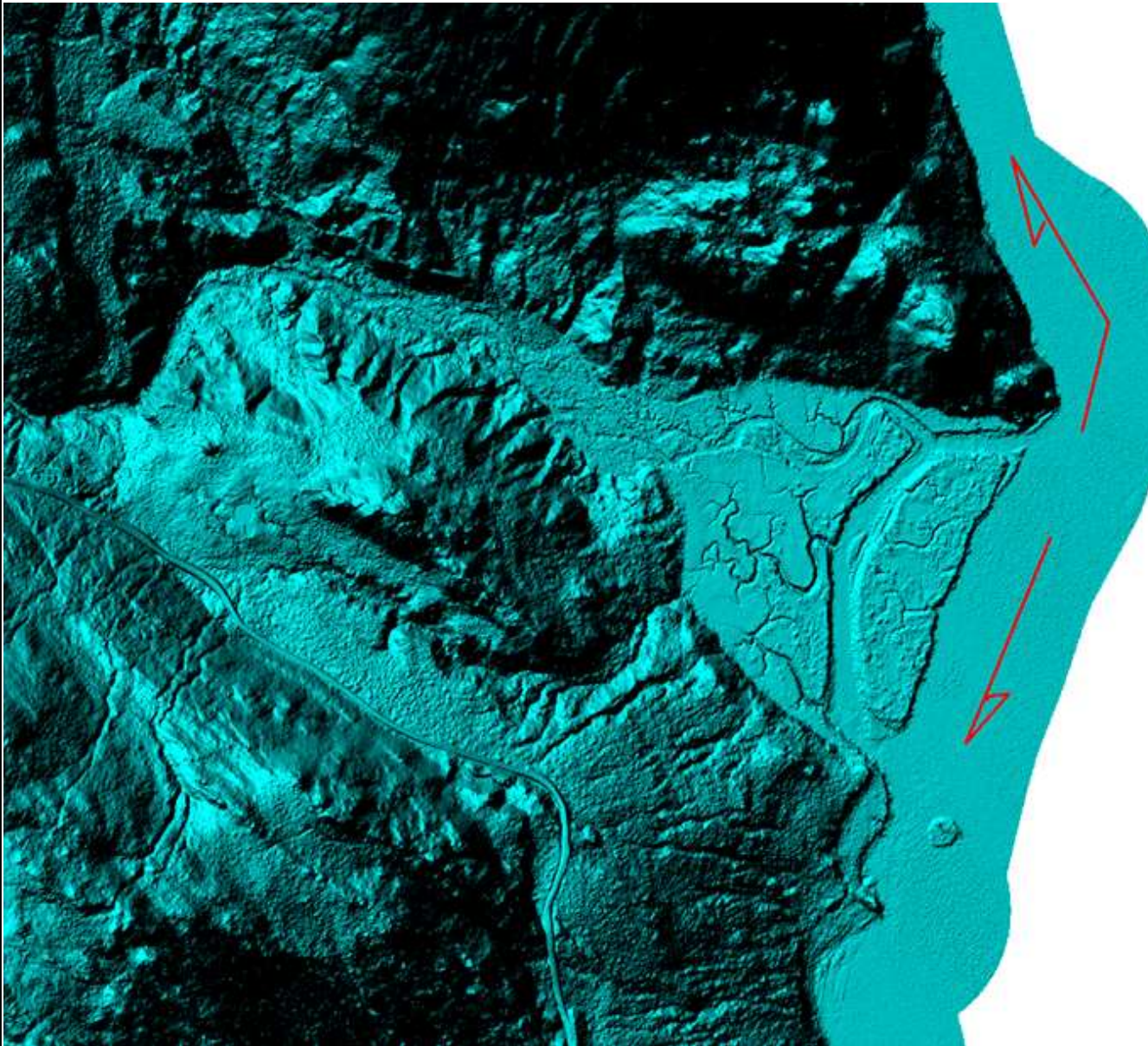
Waterbody at 58° 17' 41.4767" N, 134° 25' 8.4047" W; Tiles bh_utm_bg49 /50/51/52

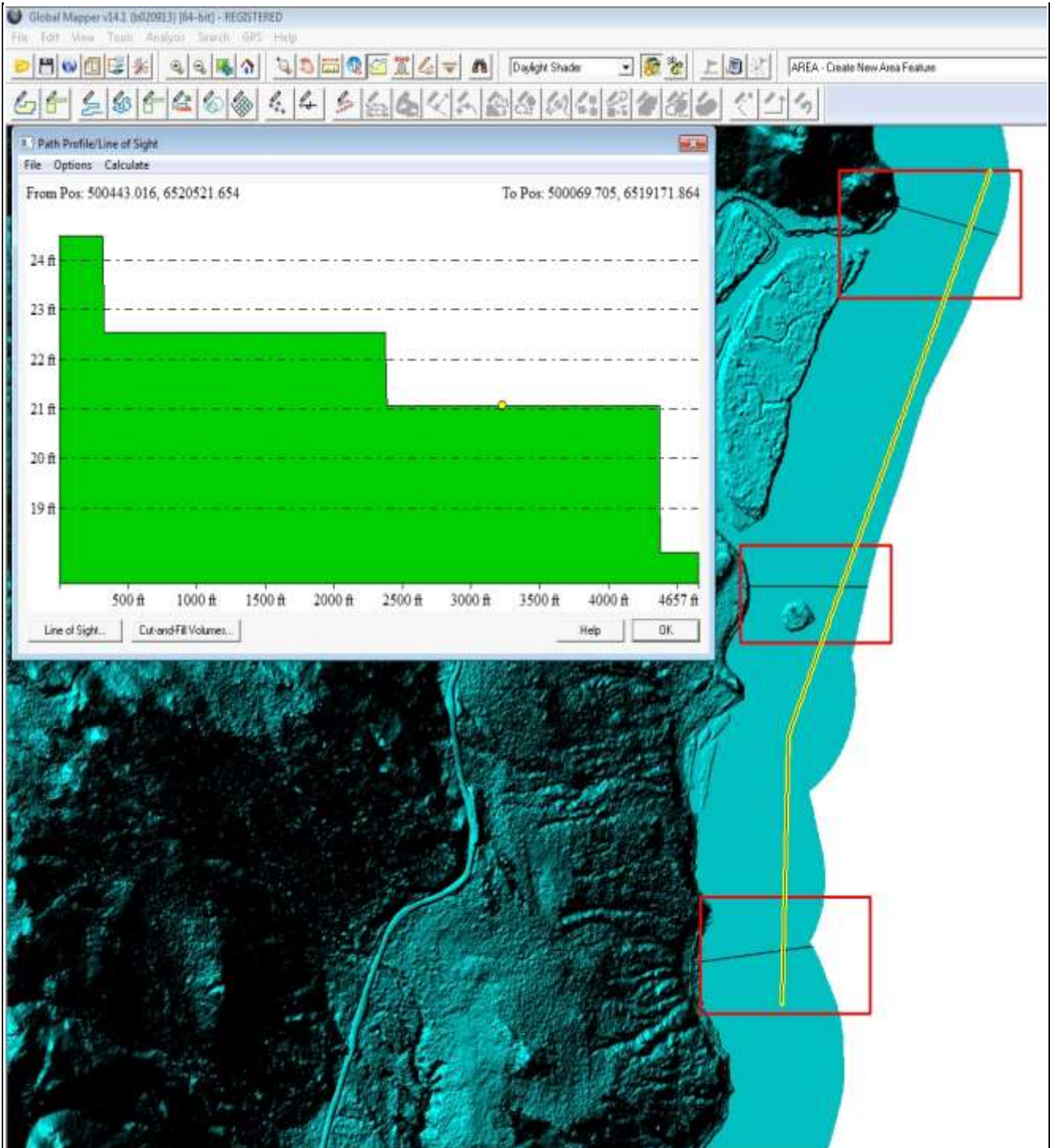
Waterbody at 58° 15' 49.1654" N, 134° 31' 34.3076" W; tile bh_utm_ba52 **** Fixed by contractor****

- Streams 100 ft or greater are flattened in a downstream manner
- Tidal Boundaries/Shorelines are flattened

Tidal zone needs hydroflattening at 58° 49' 17.3383" N, 134° 59' 45.1588" W. This Issue is found throughout the dataset, and these images are only representative samples.

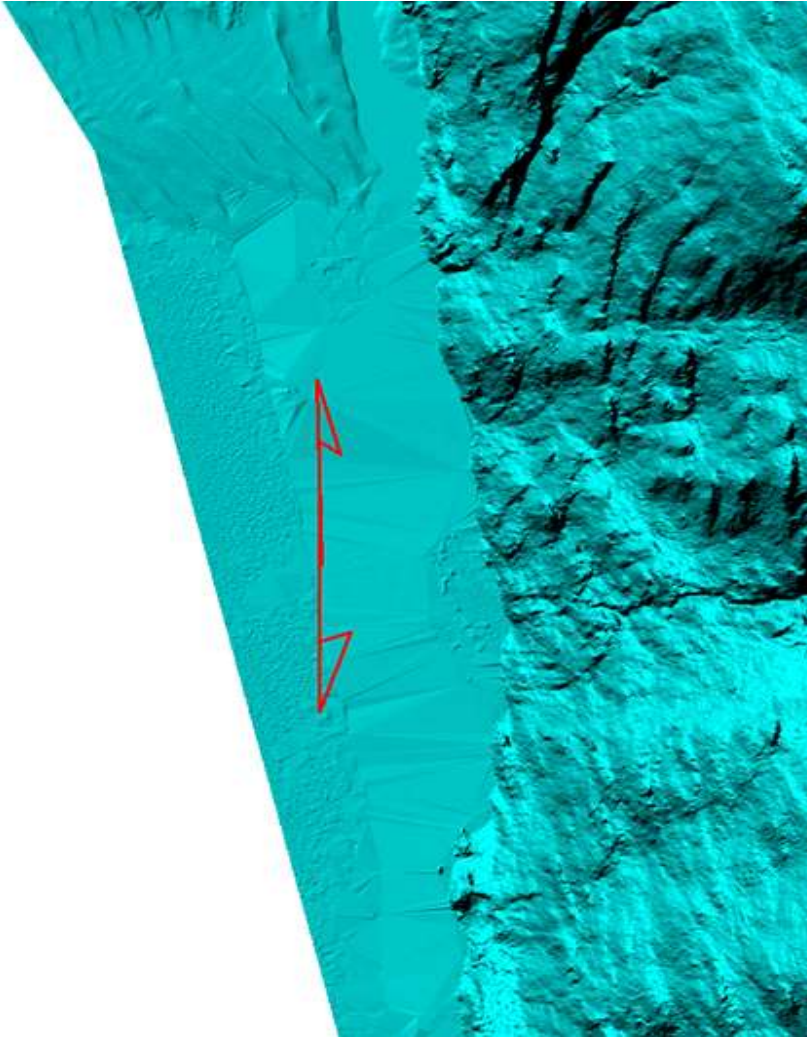
****Area hydroflattened for redelivery, however area has stair-step features in elevation profile. Review of this area's swath shows that this area was flown on the same day, but unknown what time of day. Thus, it can not be determined if this is a result of tidal influences or just a hydroflattening artifact. See second image below.****



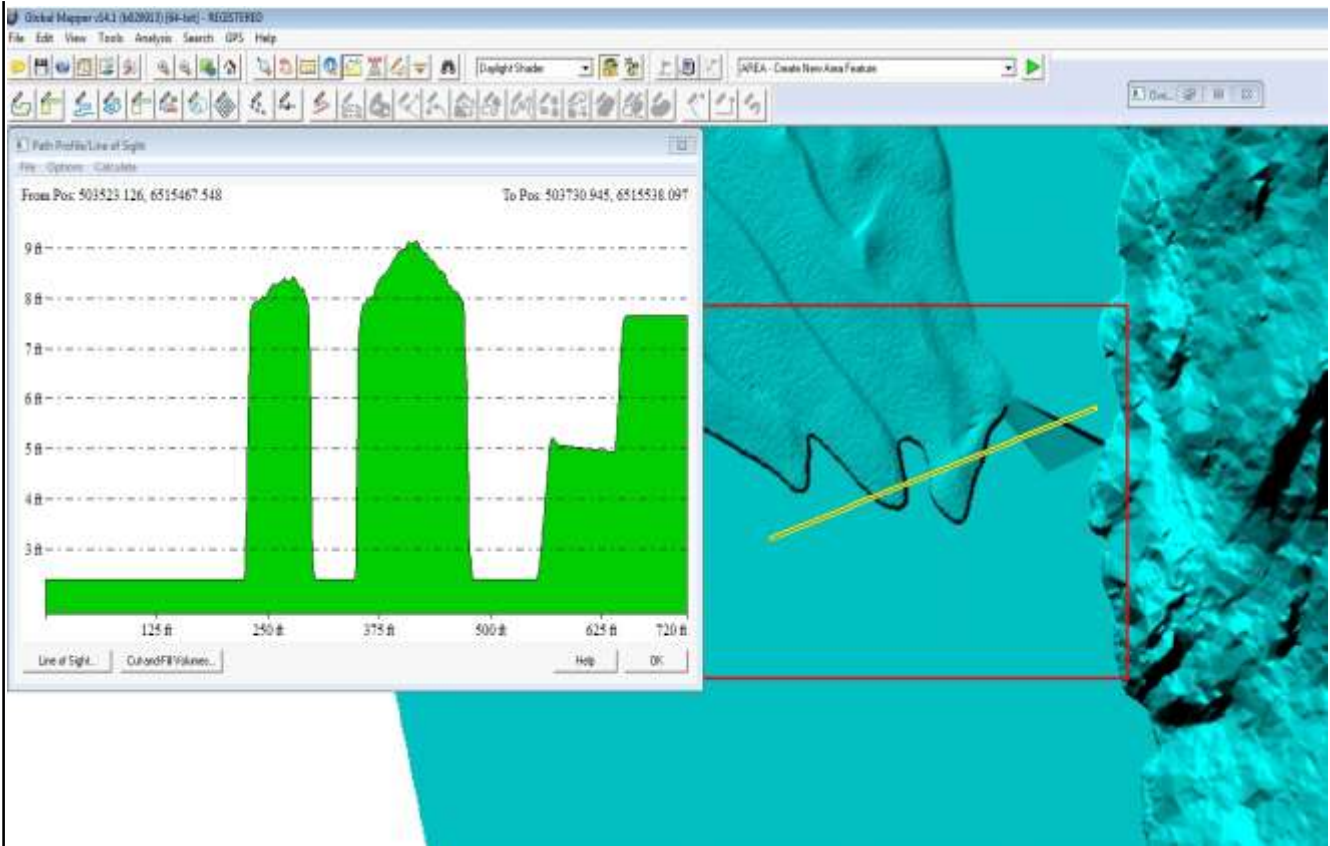


****Area hydroflattened for redelivery, however area shows ~ 5.5 ft drop from land to water in elevation profile. See second image below.****

Tidal zone at 58° 46' 19.1587" N, 134° 55' 53.7303" W

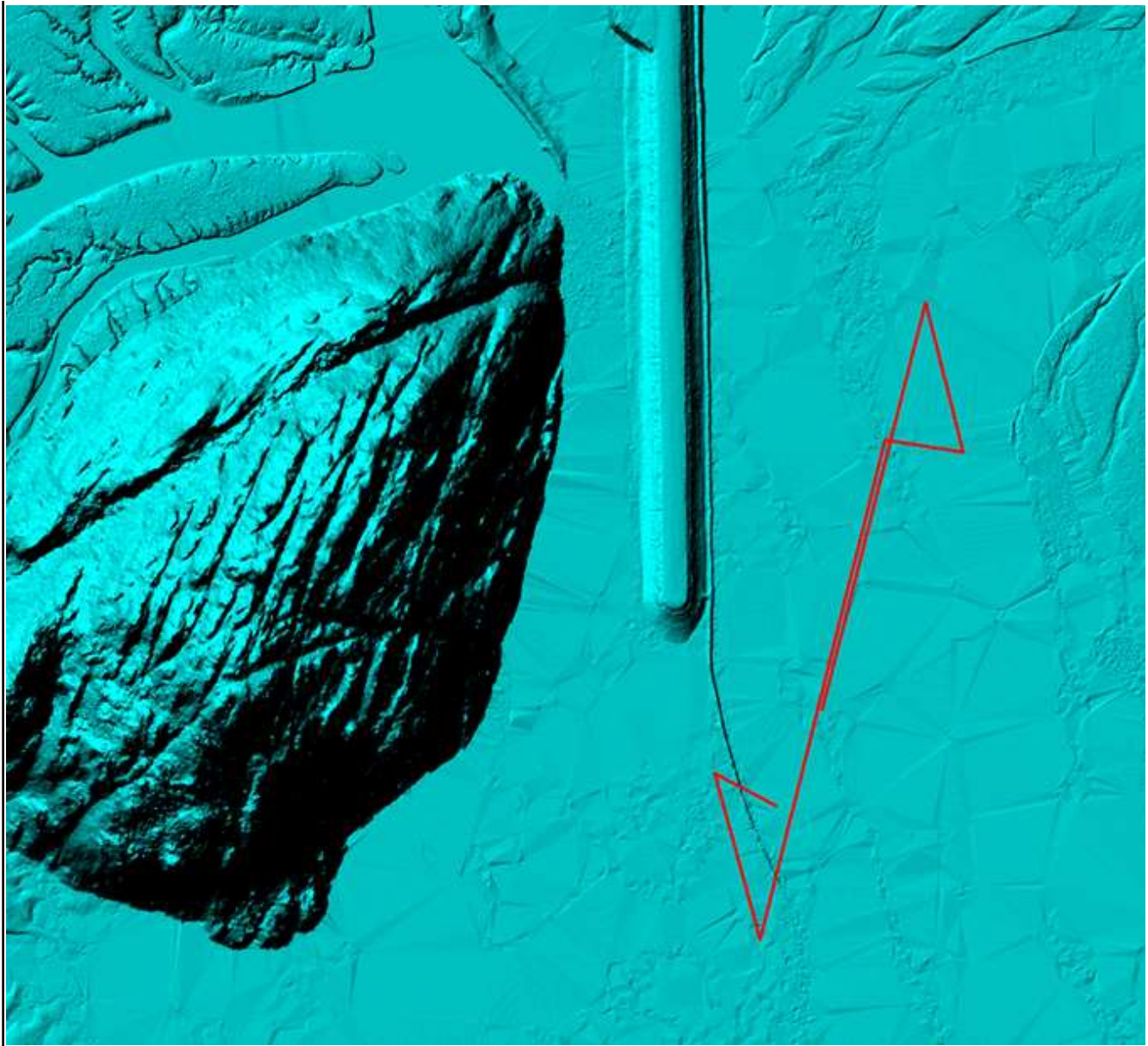


Elevation profile showing drastic drops from land to water in hydroflattened tidal area.



**** Issue was fixed by contractor ****

58° 07' 46.6824" N, 133° 43' 30.1831" W



- 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.

ADDITIONAL COMMENTS, ERRORS, ANOMALIES, OR OTHER ISSUES:

End of DEM Review

NED Information
<i>Final to NED mosaic created:</i> <input type="radio"/> Yes <input checked="" type="radio"/> No
<i>Additional Comments:</i> <p>_____</p>

END OF REPORT