LiDAR Quality Assurance (QA) Report
Coastal New York LiDAR
NOAA Coastal Services Center

NOAA Contract: EA133C-11-CQ-0007

October 4, 2012

Submitted to:
NOAA Coastal Services Center

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1 Executive Summary

Contract: Coastal New York LiDAR	**Production Contractor:** Photo Science, Inc.	**Date Prepared:** 10/4/2012	**Delivery #:** Area 2, Delivery 2	**Dewberry Recommendation:** Accept all Data for Priority Area 2 (Long Island)
Data History: ❑ Area 2, Delivery 2				

The following LiDAR quality assurance report documents Dewberry's secondary review of LiDAR data and derived products for the Priority Area 2 of the Coastal New York LiDAR Project by Photo Science, Inc. (PSI) for the NOAA Coastal Services Center. Priority Area 2 consists of approximately 847 square miles that amount to 1,338 LAS tiles (1500 meters x 1500 meters) and 433 hydro enforced DEMs (3000 meters x 3000 meters). Each tile contains LAS point cloud data classified according to the ASPRS classification scheme. The deliverables also include an ESRI Geodatabase containing hydrographic breaklines.

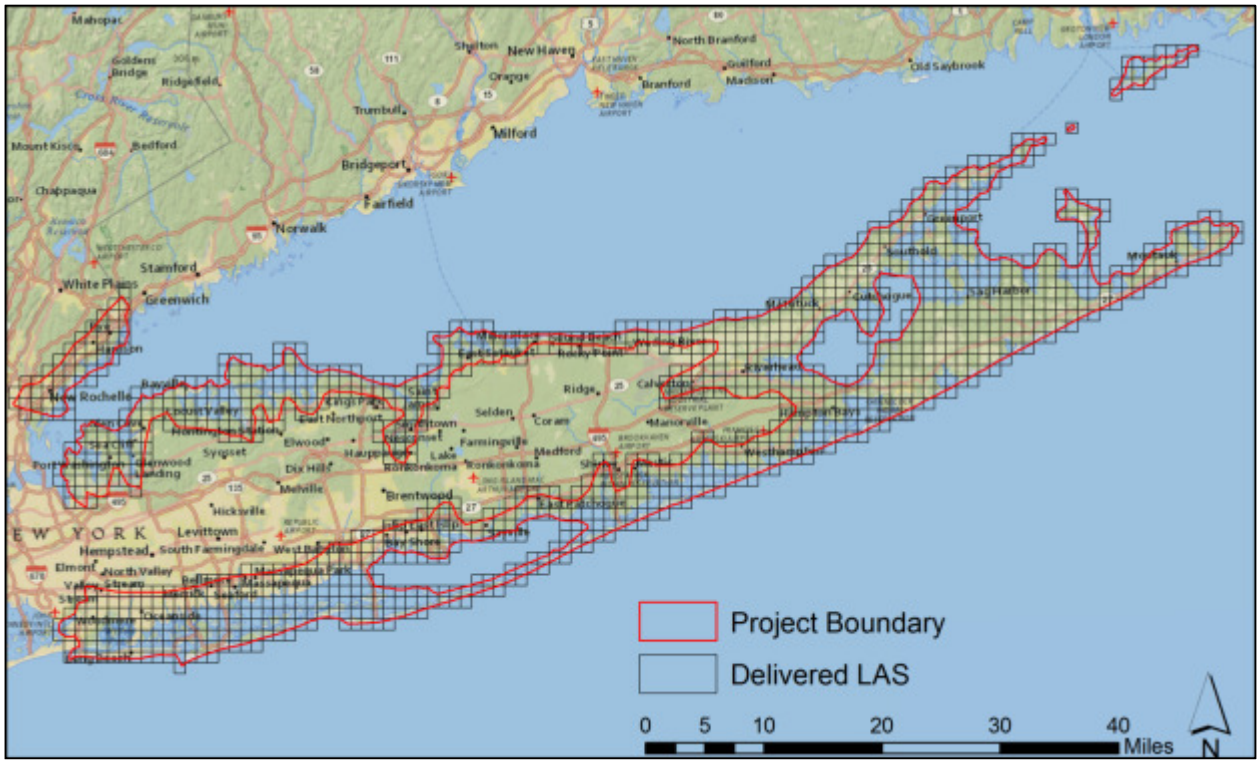

Figure 1 - Location of LAS tiles for Priority Area 2.

The LiDAR data and derived products were processed through Dewberry's comprehensive quantitative/qualitative review. This multipart analysis determines the degree to which the data met expectations for completeness, relative accuracy, and conformity to specific project requirements for each data product. As this is the second review of the data, only areas previously identified for corrections were reviewed.

The LiDAR data for the Coastal NY Priority Area 2 was thoroughly examined by Dewberry for completeness and conformity to project specifications. All qualitative issues, including misclassifications and artifacts, that were identified during the first review have been corrected by PSI.

The first breakline review resulted in a few edit calls for small breakline issues, such as topologic errors and horizontal placement issues. All issues have been corrected or addressed by PSI.

During the first review, there were no DEM specific edit calls. However, LiDAR and breakline edit calls from the first review required DEM modifications. All DEMs have been modified and updated accordingly to reflect LiDAR and breakline corrections.

While metadata is a final deliverable, it was not delivered as part of the Priority Area 2 deliverables. FGDC compliant metadata should be delivered for each deliverable, including LiDAR, breaklines, and DEMs.

1.1 Deliverables Summary for Priority Area 2

Deliverable	Applicable Acceptance Criteria	Dewberry Recommendation
All-Return LAS Point Cloud Data	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 35, 36, 37, 38, 39, 41, 42, 43, 47, 50	☑ Accept ☐ Accept with Comments ☐ Return for Corrections ☐ Reject
Breakline Geodatabase	35, 36, 37, 38, 39, 54, 55, 56, 57	☑ Accept ☐ Accept with Comments ☐ Return for Corrections ☐ Reject
Hydro-Enforced DEMs	35, 36, 37, 38, 39, 43, 44, 45, 48, 49	☑ Accept ☐ Accept with Comments ☐ Return for Corrections ☐ Reject
LAS Metadata	46	☐ Accept ☐ Accept with Comments ☐ Return for Corrections ☐ Reject
Breakline Metadata	58	☐ Accept ☐ Accept with Comments ☐ Return for Corrections ☐ Reject
DEM Metadata	46	☐ Accept ☐ Accept with Comments ☐ Return for Corrections ☐ Reject

The applicable acceptance criteria refer to the numbered criteria found in “Appendix B-Acceptance Criteria” on pages 11-14 of the Quality Plan.

Overview

The goal of the NOAA Coastal Services Center LiDAR Task Order is to provide high accuracy elevation datasets of multiple deliverable products including LiDAR, hydro enforced digital elevation models (DEMs), and 3D breaklines for areas of coastal New York including Long Island, eastern Westchester, and the tidal extent of the Hudson River. The data is intended for use in coastal management decision making, including applications such as detailed mapping of areas at risk of sea level rise and the remapping of Coastal Erosion Hazard Areas. The mission of the NOAA Coastal Services Center is to support the environmental, social, and economic well being of the coast by linking people, information, and technology. NOAA Coastal Services Center is working with the New York State Department of Environmental Conservation.

Dewberry's role is to provide Quality Assurance (QA) of the LiDAR data and supplemental deliverables provided by PSI that includes completeness checks, vertical accuracy testing, and a qualitative review of the bare earth surface. Each product is reviewed independently and against the other products to verify the degree to which the data meets expectations.

The total project area for LiDAR acquisition is ~950 square miles. This report documents the quality of the LiDAR deliverables for Priority Area 2, which consists of ~847 square miles.

2 LiDAR Analysis

The LiDAR data is reviewed on project, tile, and per point levels to determine the relative accuracy, proper classification and conformity to project requirements. This review begins with a computational analysis of the points for completeness and to determine point data format, projection, classification scheme, number of returns per pulse, and intensity values of the points.

2.1 LiDAR Quantitative Review

One of the first steps in assessing the quality of the LiDAR is a vertical accuracy analysis of the ground models in comparison to surveyed checkpoints. Dewberry provided 110 checkpoints for the entire project area.

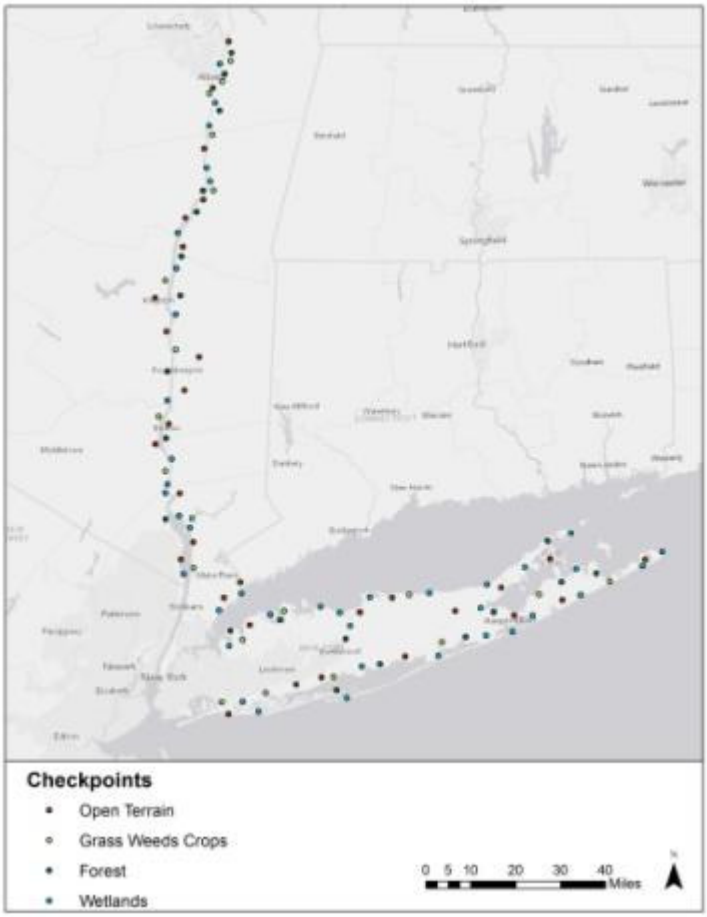

Figure 2 - Checkpoints distribution for the Coastal NY project area.

The vertical accuracy assessment compares the measured survey checkpoint elevations with those of the TIN as generated from the bare-earth LiDAR. The X/Y locations of the survey checkpoints are overlaid on the TIN and the interpolated Z values of the LiDAR are recorded. These interpolated Z values are then compared with the survey checkpoint Z values and this difference represents the amount of error between the measurements. Once all the Z values are recorded, the Root Mean Square Error (RMSE) is calculated and the vertical accuracy scores are interpolated from the RMSE value. The RMSE equals the square root of the average of the set of squared differences between the dataset coordinate values and the coordinate values from the survey checkpoints.

The first method of evaluating vertical accuracy uses the FEMA specification which follows the methodology set forth by the National Standard for Spatial Data Accuracy. The accuracy is reported at the 95% confidence level using the Root Mean Square Error (RMSE) which is valid when errors follow a normal distribution. By this method, vertical accuracy at the 95% confidence level equals $RMSE_Z$ x 1.9600.

The second method of testing vertical accuracy, endorsed by the National Digital Elevation Program (NDEP) and American Society for Photogrammetry and Remote Sensing (ASPRS) uses the same (RMSEZ x 1.9600) method in open terrain only; an alternative method uses the 95th percentile to report vertical accuracy in each of the other land cover categories (defined as Supplemental Vertical Accuracy – SVA) and all land cover categories combined (defined as

Consolidated Vertical Accuracy – CVA). The 95th percentile method is used when vertical errors may not follow a normal error distribution, as in vegetated terrain.

The Fundamental Vertical Accuracy (FVA) is calculated in the same way when implementing FEMA/NSSDA and NDEP/ASPRS methodologies; both methods utilize the 95% confidence level (RMSEZ x 1.9600) in open terrain where there is no reason for LiDAR errors to depart from a normal error distribution.

Table 1 outlines the calculated RMSEz and associated statistics in meters while Table 2 outlines vertical accuracy and the statistics of the associated errors as computed by the different methods in meters.

Table 1 - The table shows the calculated $RMSE_z$ values in meters as well as associated statistics of the errors for the Coastal NY project area.

100 % of Totals	RMSE Spec=0.09 m[1]	Mean (m)	Median (m)	Skew	Std Dev (m)	# of Points	Min (m)	Max (m)
Consolidated		0.06	0.04	0.50	0.16	109	-0.31	0.54
Open Terrain	0.09	-0.04	-0.03	-0.51	0.08	30	-0.27	0.10
Grass/Weeds/Crops		0.05	0.05	-1.00	0.12	20	-0.31	0.26
Wetlands		0.12	0.13	0.18	0.18	40	-0.30	0.54
Forest		0.13	0.10	0.52	0.19	19	-0.21	0.50

[1]Specification is only required for open terrain.

Table 2 - The table shows the calculated $Accuracy_z$ of the FVA in meters using FEMA/NSSDA guidelines (RMSEz x 1.9600) and the $Accuracy_z$ of the CVA in meters using NDEP/ASPRS guidelines (95th percentile).

Land Cover Category	# of Points	FVA — Fundamental Vertical Accuracy (RMSEz x 1.9600) Spec=0.18 m	CVA — Consolidated Vertical Accuracy (95th Percentile) Spec=0.363 m	SVA — Supplemental Vertical Accuracy (95th Percentile) Target=0.363 m
Consolidated	109		0.36	
Open Terrain	30	0.18		0.15
Grass/Weeds/Crops	20			0.27
Wetlands	40			0.43
Forest	19			0.48

One checkpoint (FO-3) had to be removed from the RMSE calculations due to it being located outside of the project boundary.

2.2 LiDAR Completeness Review

Dewberry received 1,338 LiDAR files. The LiDAR was delivered in LAS format 1.2 that adheres to the ASPRS LAS 1.2 specifications. The Point Data Format 1 is used, with intensity values present. The LAS files are named appropriately according to the SOW and have correct extents (1500m x 1500m).

All spatial projection information was correct and is as follows:

- Horizontal Datum: NAD83 (NSRS2007)
- Vertical Datum: NAVD88, processed with Geoid09
- Projection: UTM Zone 18N
- Horizontal and Vertical Units: Meters
-

Each record includes the following fields (among others):

- X, Y, Z coordinates
- Flight line data
- Intensity value
- Return number
- Number of returns
- Scan direction
- Edge of flight line
- Scan angle
- Classification
- GPSI time

The header for tile 18TXK105955 originally contained an incorrect value for in the X Min field. The header for this tile has been reprocessed and is now correct.

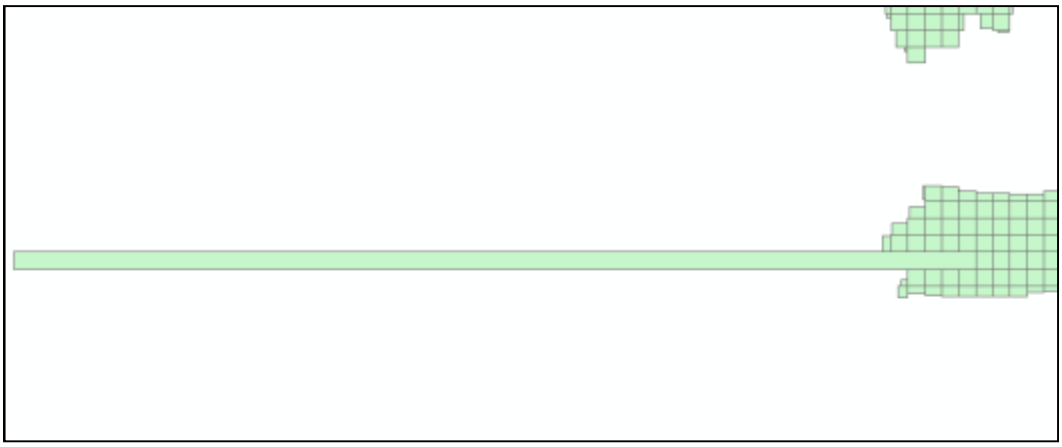

Figure 3 - A feature class of the LAS files' extent created from the header information. Tile 18TXK105955 from the first delivery does not have the correct extent.

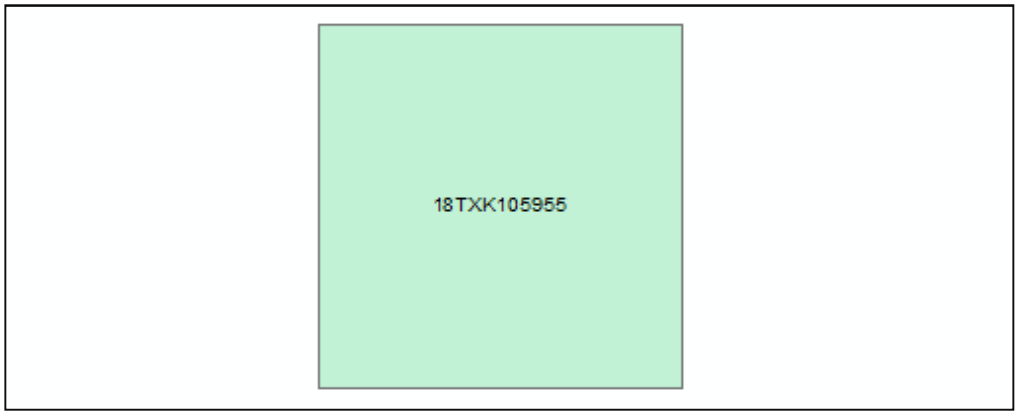

Figure 4 - A feature class of the LAS files' extent created from the header information. The extent of tile 18TXK105955 has been corrected in the second delivery.

Dewberry creates DeltaZ orthos from the LiDAR data with a 1 meter cell size to specifically analyze how well adjoining flight lines match. If the adjoining flight lines are within 5 cm, the overlapping or adjacent pixels are colored green. If the adjoining flight lines are between 5 cm and 10 cm of each other, the overlapping or adjacent pixels are colored yellow. If the adjoining flight lines are greater than 10 cm different from each other, the overlapping or adjacent pixels are colored red. Pixels that do not

contain points from overlapping flight lines are colored according to their intensity values. When there are large portions of overlapping flight lines that are not colored green, it is an indication that the flight lines do not match each other well, may not match the ground well, may have calibration issues, and may cause flight line ridges exceeding project specifications.

Dewberry created the DeltaZ orthos from the ground points so that we could examine the relative fit of overlapping flight lines. Some yellow and red pixels are expected due to terrain change greater than 10 cm that occurs in the same 1 meter pixel, such as on embankments, berms, and cliffs. Areas of flat, open terrain or bare earth, however, should not show large elevation discrepancies between adjacent flight lines. As the image below illustrates, all adjoining flight lines for Priority Area 2 matched within specifications.

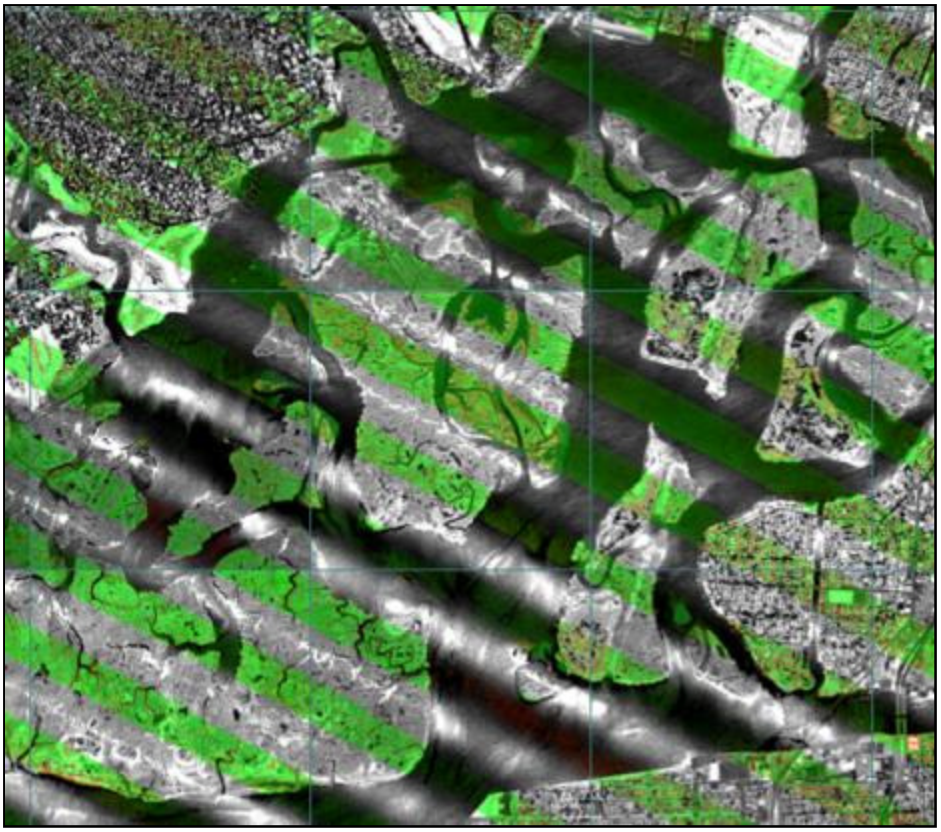

Figure 5 - DeltaZ Orthos for Priority Area 2 show adjoining flight lines match very well.

All tiles met the project requirement to have 20% overlap on adjoining swaths.

The LiDAR data has been classified to contain the appropriate classes as settled upon by PSI and NOAA:

- Class 1 (Unclassified)
- Class 2 (Bare Earth)
- Class 7 (Low point/Noise)
- Class 9 (Non Tidal Water)
- Class 10 (Breakline Proximity)
- Class 14 (Tidal Bare Water)
- Class 17 (Default Overlap Points)
- Class 18 (Ground Overlap Points)
- Class 25 (Water Overlap Points)

- Class 30 (Tidal Bare Water Overlap)

In addition, 1,338 tiles had points in class 11. Class 11 is generally used as withheld and is assumed to be used as such for this project. Priority Area 2 was updated to include classes 25 and 30 in its classification scheme. While these classes do not affect the ground model, including these classes in the dataset maintains consistency between the Priority Area 1 and Priority Area 2 datasets.

2.3 Point Count/Elevation Analysis

To verify the content of the data and validate the data integrity, a statistical analysis was performed on each tile. This process allows Dewberry to review 100% of the data at a macro level to identify any gross outliers. The statistical analysis consists of first extracting the header information and then reading the actual records and computing the number of points, minimum, maximum, and mean elevation for each class. Minimum and maximum for other relevant variables are also evaluated. No issues were identified.

Each tile was queried to extract the number of LiDAR points. With a nominal point spacing of 1.0 meters, the expected total number of points per tile should be approximately 2.3 million. Utilizing the full point cloud the mean in PSI's Priority Area 2 is approximately 4 million points per tile, which equates to a nominal point spacing of 1.8 points per square meter.

2.4 LiDAR Qualitative Review

The goal of Dewberry's qualitative review is to assess the continuity and the level of cleanliness of the bare earth product. Each LiDAR tile is expected to meet the following acceptance criteria:

- The point density is homogenous and sufficient to meet the user's needs;
- The ground points have been correctly classified (no man-made structures or vegetation remains, no gaps except over water bodies);
- The ground surface model exhibits a correct definition (no aggressive classification, no over-smoothing, no inconsistency in the post-processing);
- No obvious anomalies due to sensor malfunction or systematic processing artifacts are present (data voids, spikes, divots, ridges between flight lines or tiles, cornrows, etc);
- Residual artifacts <5%

Dewberry analysts performed a visual inspection of 100% of the bare earth data digital terrain model (DTM). 100% of the Priority Area 2 data was looked at the micro and macro levels. The DTMs are built by first creating a fishnet grid of the LiDAR masspoints with a grid distance equal to the cell size of the final DEM deliverables. Then a triangulated irregular network is built based on this gridded DTM and displayed as a 3D surface. A shaded relief effect was applied which enhances 3D rendering. The software used for visualization allows the user to navigate, zoom and rotate models and to display elevation information with an adaptive color coding in order to better identify anomalies. The table below shows a breakdown of the calls made during the first review of Priority Area 2 Data.

Table 3 - Breakdown of the edit calls made for the first delivery of Priority Area 2 LiDAR

Issue	Number of Occurrences
Aggressive Misclassification	75
Artifacts	11
Total	**86**

All issues have been corrected in the second delivery of data. There are no qualitative issues remaining in the dataset. Examples of the original issues along with corrections are shown below.

2.4.1 Aggressive Misclassification

Aggressive misclassification calls in this document imply that LiDAR points are unclassified in the delivered dataset when they should be classified to ground. This call indicates areas where some class 1 points could be reclassified to class 2, ground, to improve detail in the surface model and to more correctly model surface features. There were originally 75 instances of aggressive misclassification identified in the first delivery of Priority Area 2. All instances of aggressive misclassification have been corrected. Examples of aggressive misclassification calls made in Priority Area 2, along with corrections, can be found below.

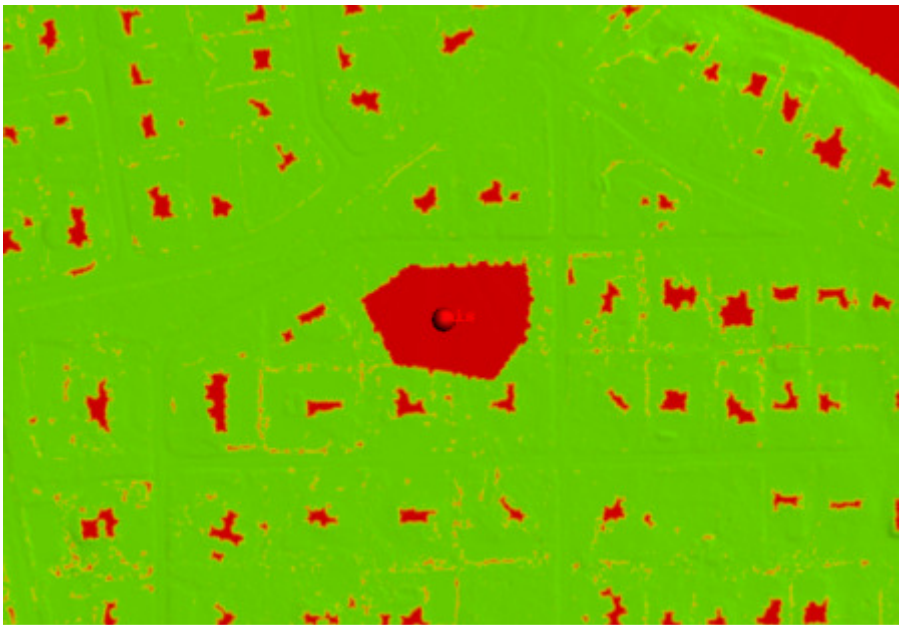

Figure 6 - Tile 18TYL050240 from the first delivery. Ground density model shows a residential area where ground points that have been removed from the ground model are colored red. Buildings and hydrographic features are expected to appear red, but large red sections on flat ground identify areas of possible misclassification.

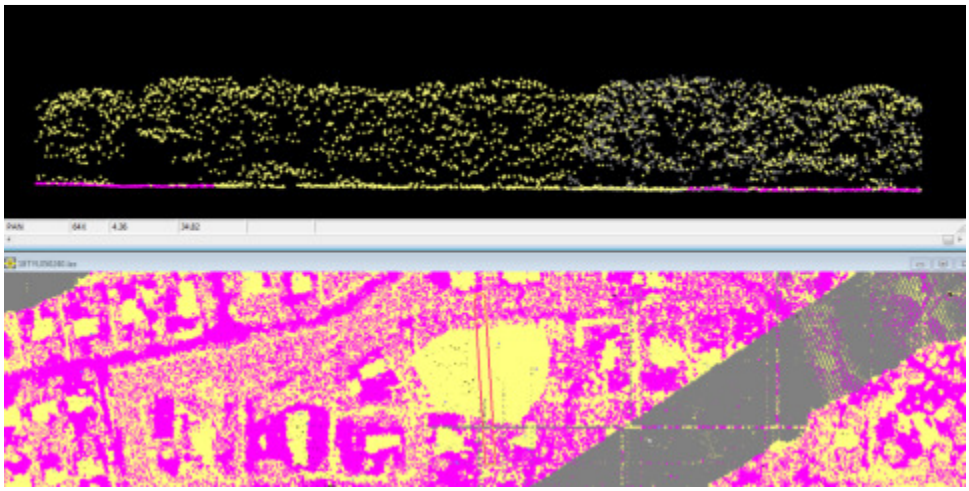

Figure 7 - Tile 18TYL050240 from the first delivery. Profile view of LAS cloud colored by classification is shown on top while LAS colored by classification is shown on bottom. This image shows that there are legitimate class 1 (yellow) points that could be reclassified to class 2 (purple), in order to improve the definition of the bare-earth surface.

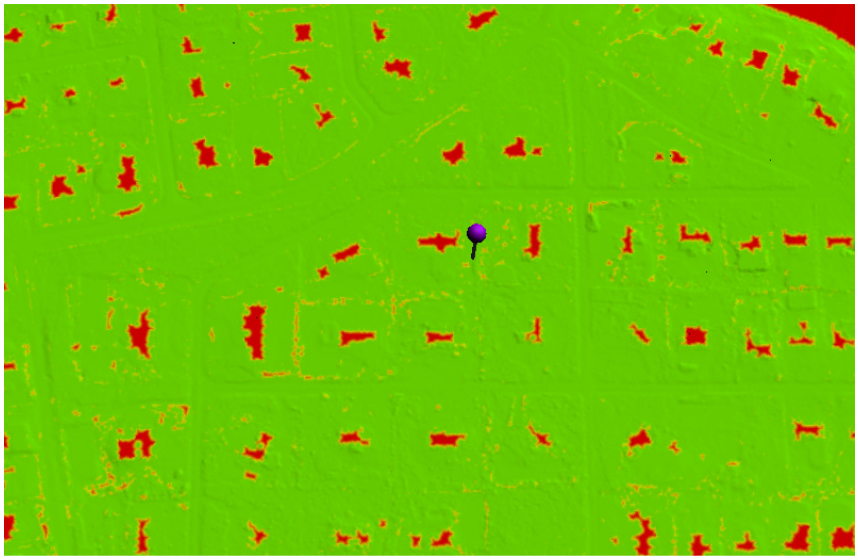

Figure 8 - Tile 18TYL050240 from the second delivery. Ground density model shows points have been added back to ground.

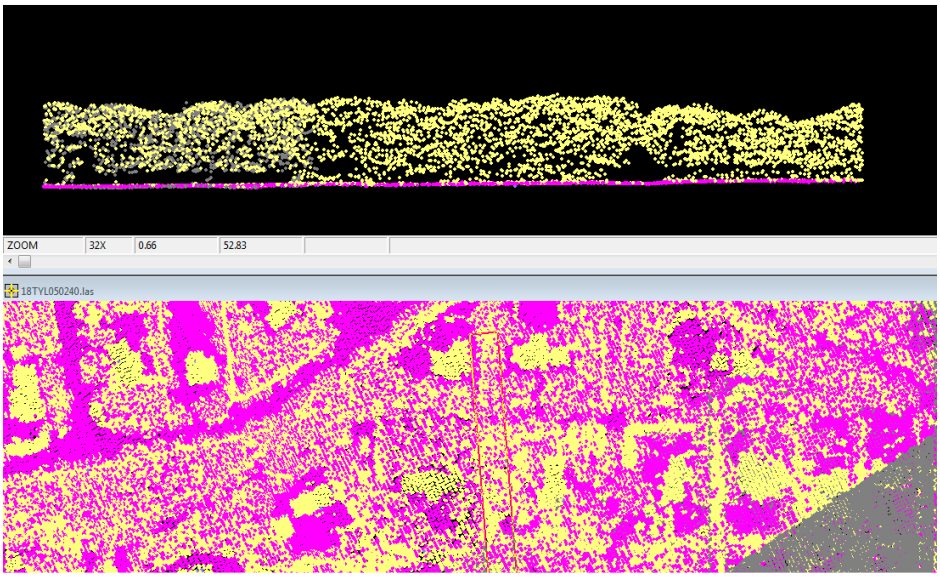

Figure 9 - Tile 18TYL050240 from the second delivery. Profile view of LAS cloud colored by classification is shown on top while LAS colored by classification is shown on bottom. Class 1 (yellow) points have been reclassified to class 2 (purple) in order to improve the definition of the bare-earth surface.

Delivery 1 contained 9 instances of misclassification where islands were incorrectly classified as water. These islands were removed from the breaklines but were not classified to ground. In order to preserve the accuracy of the ground model, these land masses needed to be changed from class 14 to class 2 (ground). All 9 instances of this type of misclassification have been corrected in the second delivery. An example of this type of misclassification, along with the correction, is shown below.

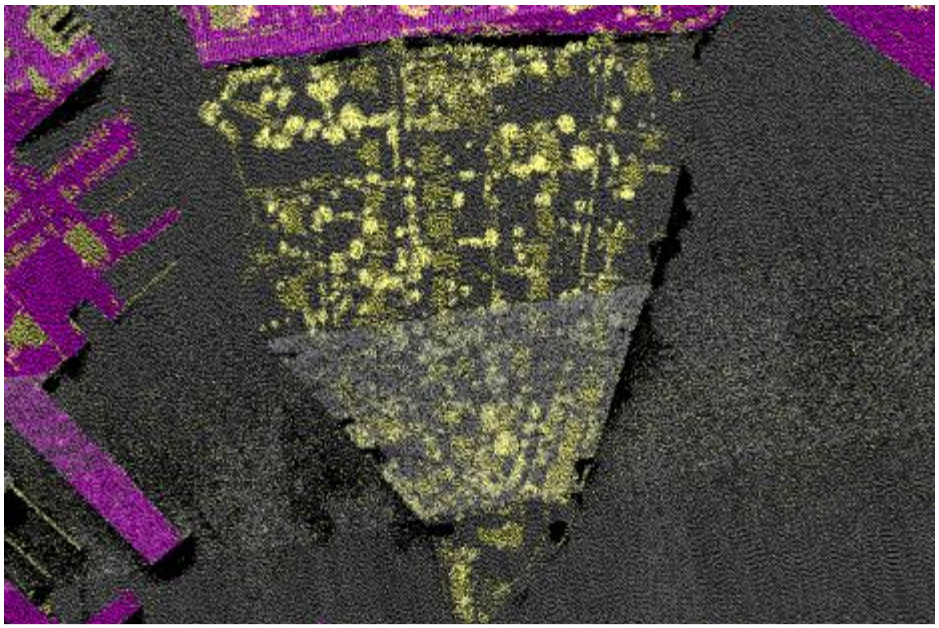

Figure 10 - Tile 18TXL480075 from the first delivery. LAS point cloud colored by classification. The island feature can be identified as incorrectly classified as tidal water (gray) and should be reclassified as ground (purple).

Figure 11 - Tile 18TXL480075. Intensity model showing land where it does not appear in the ground model.

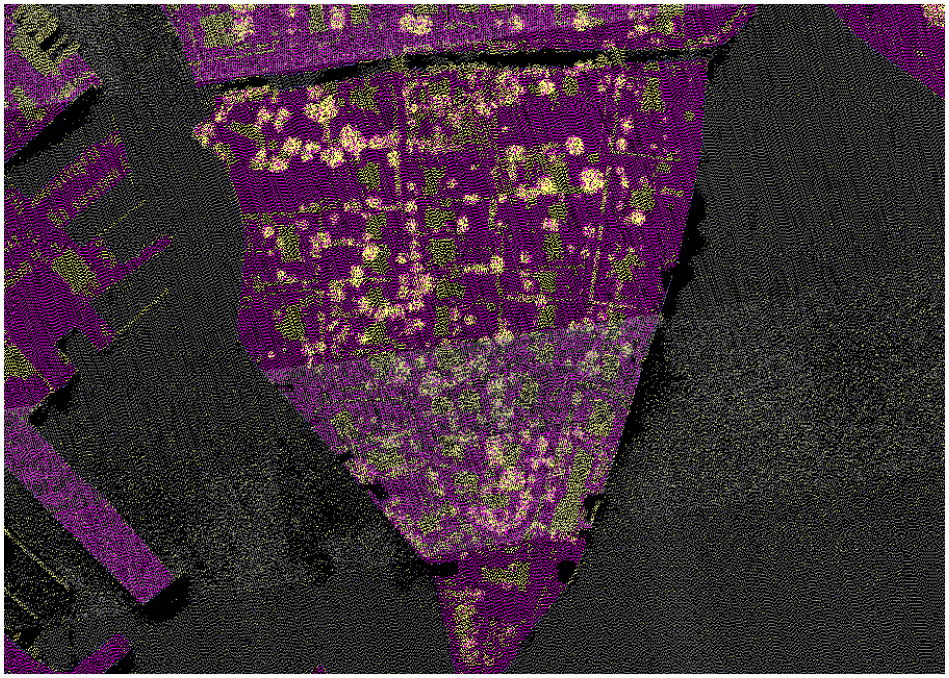

Figure 12 - Tile 18TXL480075 from the second delivery. LAS point cloud colored by classification. Tidal water (gray) has been reclassified as ground (purple) to properly show island features.

2.4.2 Artifacts

Artifacts are features that are left in the ground model that should be removed. There were 11 artifacts identified in the first delivery of Priority Area 2 and included vegetation, bridges and structures. These were removed in the second delivery in order to improve the bare-earth surface model. Examples of the calls made in Priority Area 2, along with corrections, can be found below.

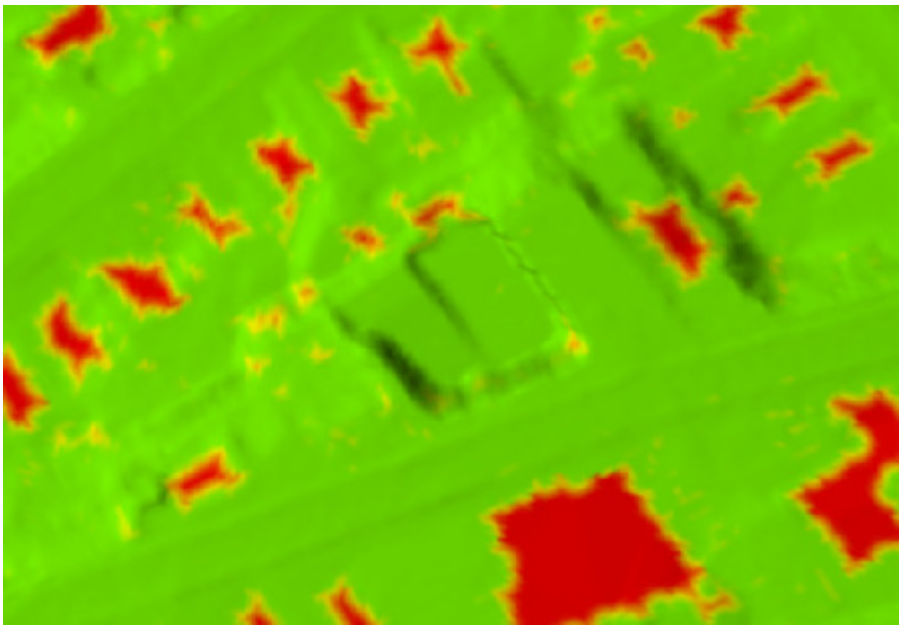

Figure 13 - Tile 18TXL105195 from the first delivery. Ground density model showing a structure that was left in the ground.

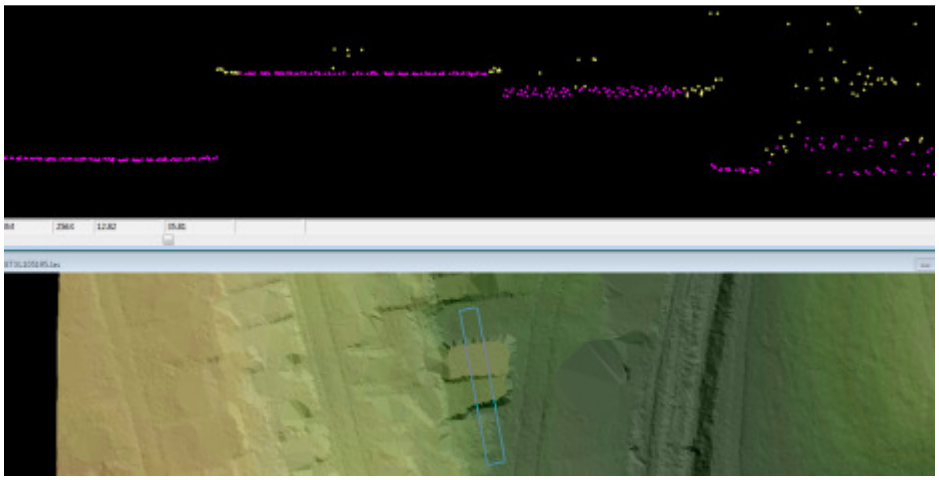

Figure 14 - Tile 18TXL105195 from the first delivery. Profile view of the LAS cloud colored by classification is shown on top while bare-earth TIN colored by elevation is shown on bottom. The structure can be seen next to the hillside and should be reclassified to unclassified (class 1).

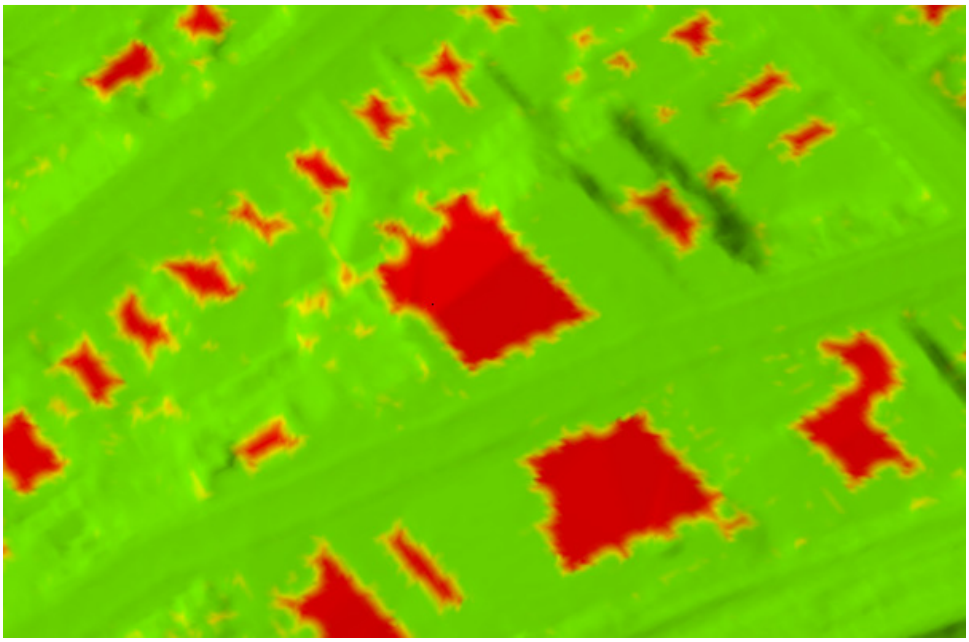

Figure 15 - Tile 18TXL105195 from the second delivery. Ground density model showing structure was removed.

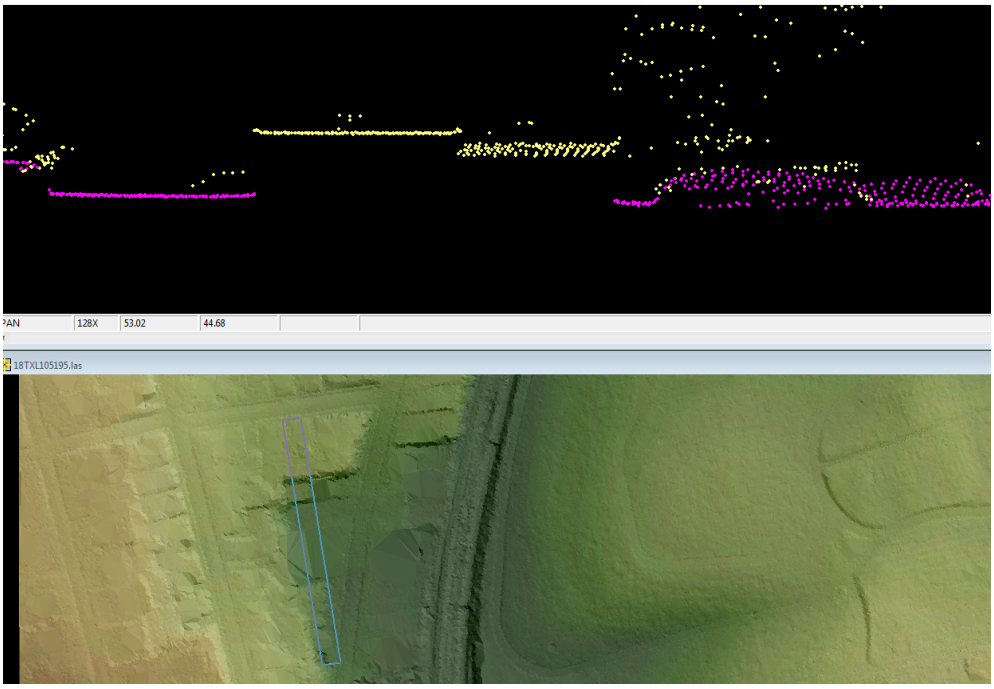

Figure 16 - Tile 18TXL105195 from the second delivery. Profile view of the LAS cloud colored by classification is shown on top while bare-earth TIN colored by elevation is shown on bottom. The structure has been removed.

2.5 LiDAR Recommendation

Dewberry recommends the LiDAR for Priority Area 2 (Long Island) is accepted. All identified qualitative issues have been addressed by PSI. The one tile with an incorrect X-Minimum value has been

corrected and the classification of all LiDAR tiles has been updated to show classes 25 and 30, where applicable, to maintain consistency with Priority Area 1.

3 Breakline Analysis

A qualitative/quantitative review was completed on the breaklines. The comprehensive qualitative review consisted of a visual review of the breaklines for completeness in compilation and horizontal placement. This visual analysis was followed by several automated tests for hydro-enforcement and topology using ESRI PLTS tools and proprietary tools developed by Dewberry. The breakline review followed the Breakline QA/QC Checklist provided in the Quality Plan.

3.1 Breakline Data Overview

The breakline qualitative review starts with an overview. First, the ESRI geodatabase is reviewed in ArcCatalog for correct spatial projection and data organization.

The delivered geodatabase contained the correct feature classes, shown below:

- PONDS_AND_LAKES
- STREAMS_AND_RIVERS
- COASTAL_SHORELINE

The coordinate system of the delivered breaklines is correct and defined below:

- Horizontal Datum: NAD83 (NSRS2007)
- Vertical Datum: NAVD88
- Projection: UTM Zone 18N
- Horizontal and Vertical Units: Meters

3.2 Breakline Completeness Review

The breakline completeness review includes ensuring all necessary features are present and have the correct extents.

The breaklines were reviewed against intensity imagery Dewberry creates for its QC process. A review was performed on 100% of the data in an ESRI environment to validate data collection consistency and to validate all necessary features were collected.

3.3 Breakline Qualitative Review

During the completeness review, the quality of the collected breaklines is assessed. This includes validating the horizontal placement of breaklines as well as verifying the coding and attribution of breaklines. A breakdown of the edit calls made during the first review of Priority Area 2 data can be seen in the table below.

Table 4 - Breakdown of the edit calls made for the first delivery of Priority Area 2 Breaklines

Issue	Number of Occurrences
Breakline Should Be Removed	1
Horizontal Placement Issues	5
Total	**6**

All issues have been corrected or appropriately addressed in the second delivery of data. There was one edit call requesting the expansion of a pond breakline. PSI did not make any changes to this breakline. Dewberry agrees with this course of action as upon further review, this call was placed in an area of “wet” ground, but not water. The breakline models the correct extent of the pond/lake as is with

no further changes required. There are no qualitative issues remaining in the dataset. Examples of the original issues along with corrections are shown below.

3.3.1 Breakline Should Be Removed

One (1) issue was previously identified for a small stream breakline that did not collect any legitimate water or meet any topological requirements. This breakline was removed from the dataset. An example of the issue, along with the correction, is shown below.

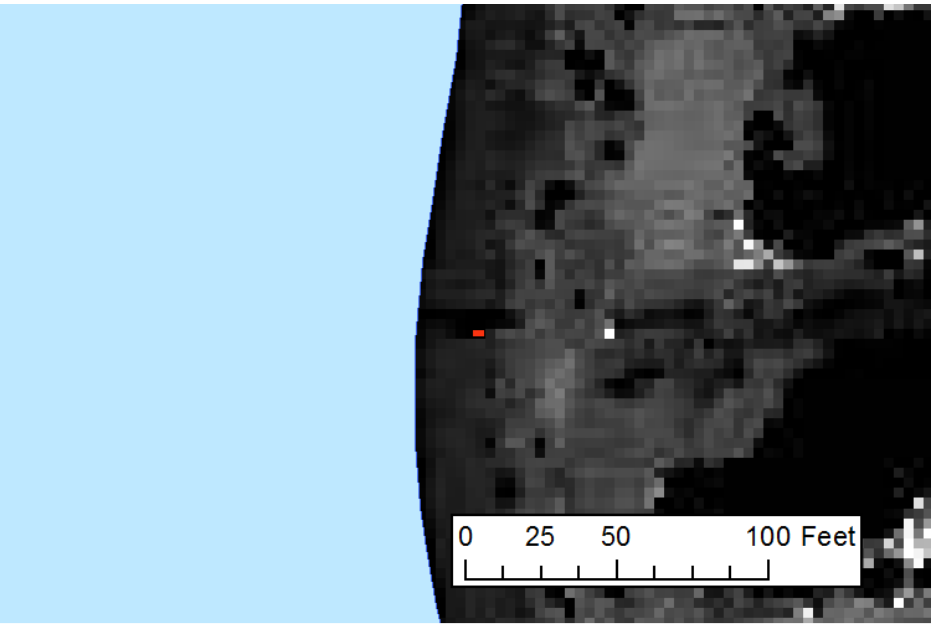

Figure 17- Tile 18TXL045165 from the first delivery. Full point cloud intensity image overlaid with a stream breakline (red) 1 meter in length. This feature should be removed from the breaklines.

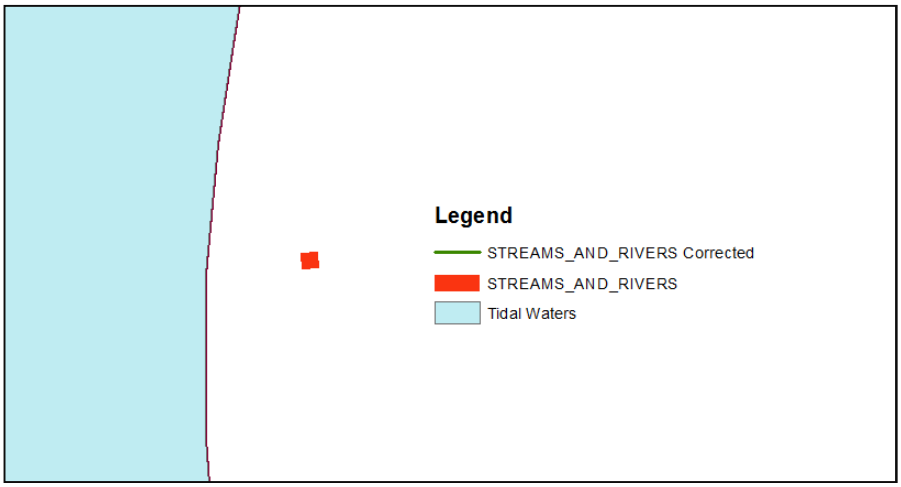

Figure 4- Tile 18TXL045165 from the second delivery. Stream breakline (red) 1 meter in length has been removed from the new stream breakline data (green).

3.3.2 Horizontal Placement

During the review of the first delivery, three (3) areas were identified where the current hydrographic breaklines did not capture all of the water in the immediate area. In the second delivery, these breaklines were either extended to fully capture the hydrographic feature or addressed with comments reflecting that extending the current breakline would only capture "wet" ground and not actual water. Two (2) issues occurred in the first delivery where breaklines captured ground within the breakline extent. These breaklines were adjusted in the second delivery to contain only water. Examples of edit calls, along with corrections, are shown below.

Figure 19 - Tiles 18TXL780105 and 18TXL780120 from the first delivery. Coastal water breakline (blue) is overlaid on the full point cloud intensity imagery. The breakline should be adjusted to capture all of the water in the area.

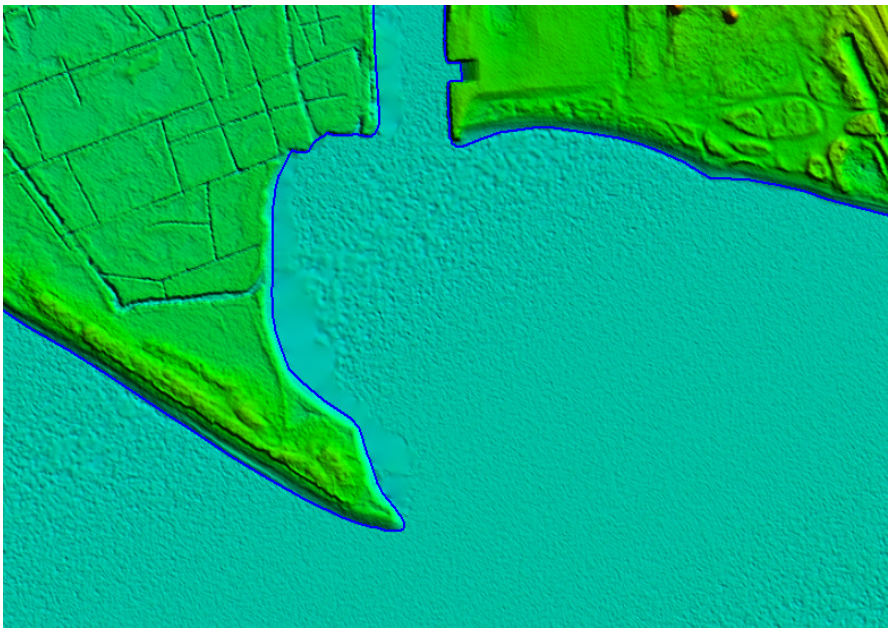

Figure 20 – DEM tiles 18TXL780090 and 18TXL780120 from the second delivery showing coastal water breakline (blue) has been adjusted to capture all of the water in the area.

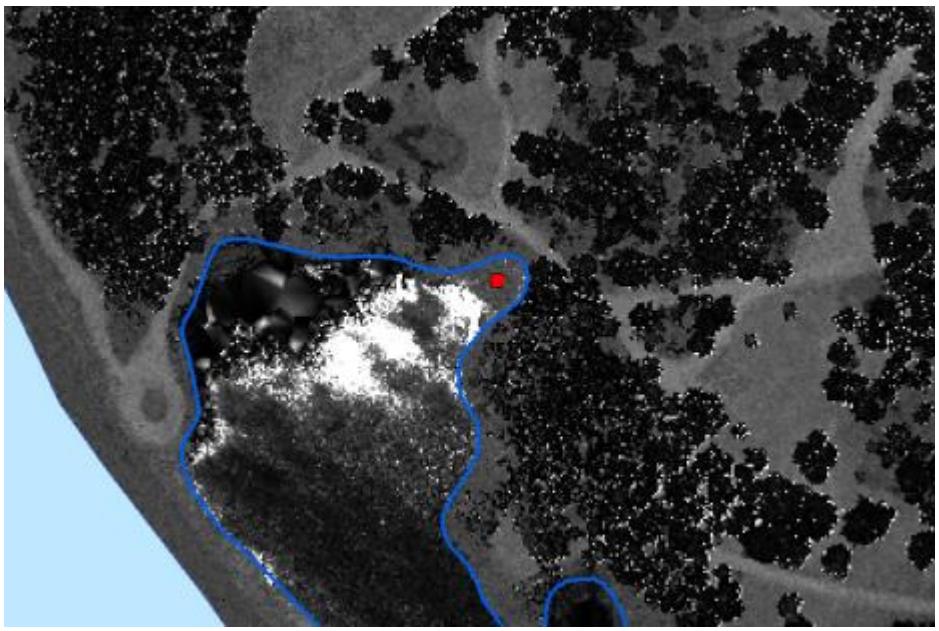

Figure 21 - Tiles 18TYL395525 from the first delivery. Pond breakline (blue) is overlaid on the full point cloud intensity imagery. The pond breakline should be adjusted to better represent the land/water interface and to exclude ground from the breakline capture.

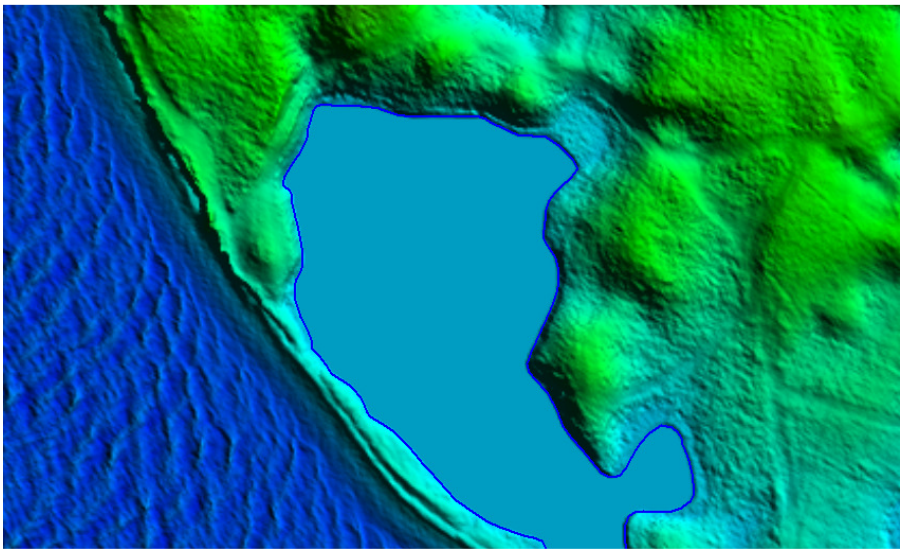

Figure 22 – DEM tile 18TYL380510 from the second delivery showing pond breakline (blue) has been modified to exclude ground from the breakline capture.

3.4 Breakline Quantitative Review

The Quantitative Vertical Analysis compares the breakline vertices against the bare-earth LiDAR data. Dewberry begins this process by converting all breakline vertices to points. At the same time an ESRI Terrain is created from the LiDAR using only the ground points. The LiDAR elevation, extracted from the terrain, is recorded for every breakline vertex. An analysis of the differences in elevation between

the breakline vertices and LiDAR is conducted to determine the vertical accuracy of the breakline collection.

Dewberry found no issues in this portion of the review.

3.5 Topology

One of the requirements of hydrographic breaklines intended for modeling is valid topology. Dewberry tested the topology using ESRI's PLTS extension and proprietary tools to ensure that the breakline vertices are snapped together, that hydro-lines fulfill monotonicity requirements within a specified tolerance, that all water bodies are flat within a tolerance, and that all breaklines have elevations defined. These data checks allow automated validation of 100% of the data. The data checks used are listed in detail in the Quality Plan under the "Breakline QA/QC Checklist." The issues identified during the first review with these checks are listed below and provided in the edit call GDB that accompanies this report:

- Adjacent Vertex Elevation Change: 1 issue with Ponds and Lakes features
- Feature on Feature: 3 issues with the Streams and Rivers feature
- Different Z at Intersection: 3 issues where overlapping vertices between pond/lake and stream/river features do not have matching Z-values
- Find Dangles: 10 issues with the Streams and Rivers Features.
    - These corrections are optional since the issues occur when a stream intersects a waterbody and a "closed polygon" is created. The stream breaklines for priority 1 created "closed polygons" without the intersection of a waterbody breaklines. Dewberry recommends that the stream breaklines for priority 2 be adjusted to maintain consistency between the project areas.

All topology issues have been corrected in the second delivery of Priority Area 2 data.

3.6 Breakline Recommendation

Dewberry recommends accepting breaklines for Priority Area 2 (Long Island). All issues, including topologic errors and qualitative issues, have been corrected.

4 Hydro-enforced Digital Elevation Model Analysis

Dewberry received 433 hydro-enforced bare earth DEMs as part of the deliverables for Priority Area 2. The specifications for the project require the DEMs to be 1 foot cell size, tiled in 3,000 meters by 3,000 meters tiles and projected to NAD83 (NSRS 2007) UTM Zone 18 , Meters. DEMs are to be free of artifacts, gaps, and artificial smoothing.

4.1 Qualitative Review

Dewberry ran a proprietary tool on all of the delivered DEMs to check their size and completeness. All the DEMs were correctly formatted with a 1 foot cell size, were in 3,000 m by 3,000 m tiles, and were projected to include the NSRS 2007 adjustment.

The following figure illustrates the extent of the DEMs for Priority Area 2.

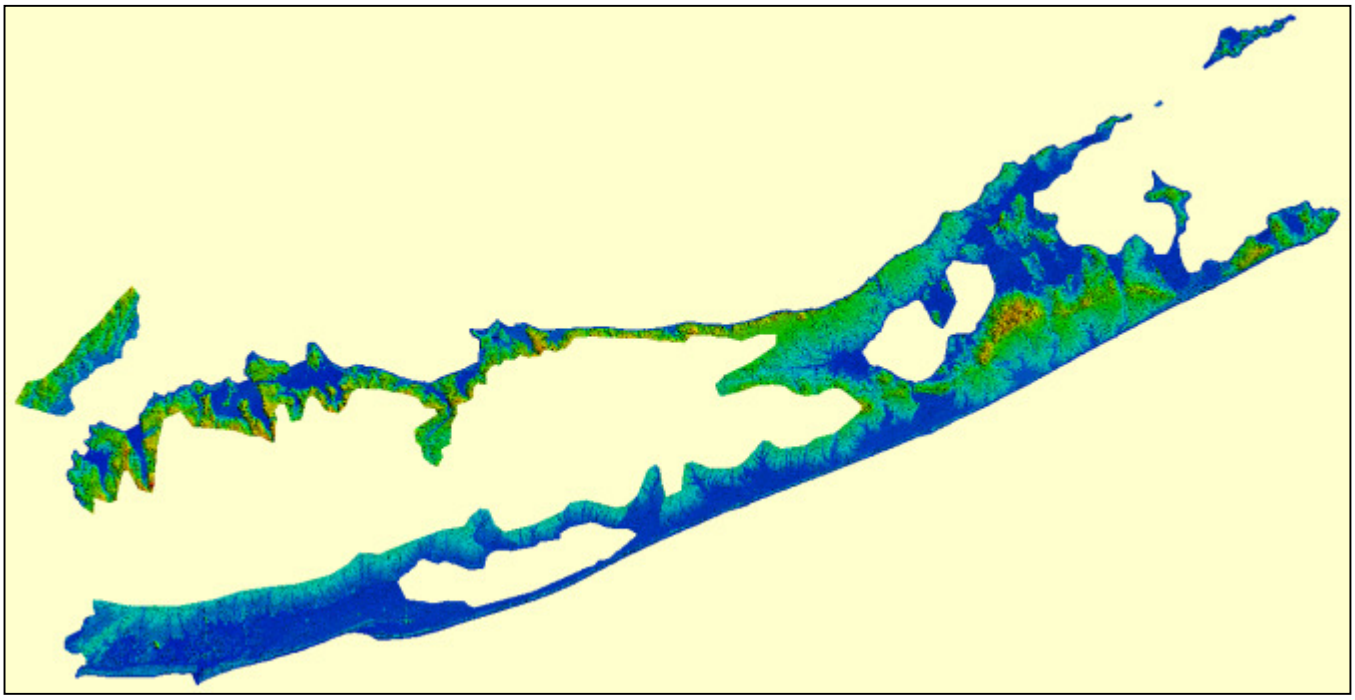

Figure 23 - DEMs for Priority Area 2

4.2 Qualitative Review

Dewberry performed a visual analysis on 100% of the DEMs. The DEMs were reviewed in Global Mapper. This software allows the viewer to see the DEMs as if in 3D. This helps with the identification of errors and anomalies. The DEM is required to be free of artifacts, gaps, and artificial smoothing.

Dewberry did not identify any DEM specific issues during the first review of Priority Area 2 data. DEMs have been modified where necessary to reflect LiDAR and breakline corrections that affected the final DEM model. An example is shown below.

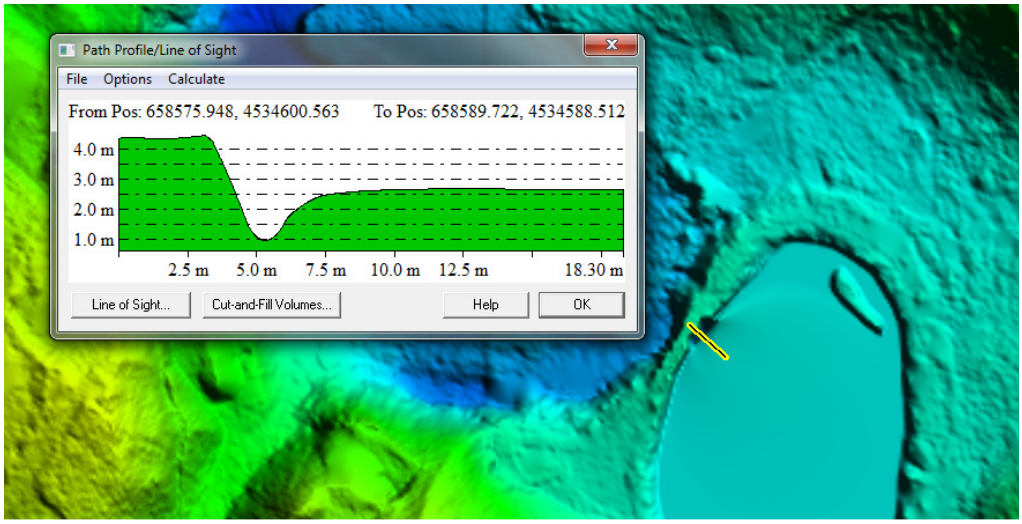

Figure 24 – DEM tile 18TXL570330 from the first delivery. The image above shows the DEM is affected by a topological error (vertices at 0 m elevation) in the ponds and lakes breaklines. This tile should be reprocessed with corrected z-values.

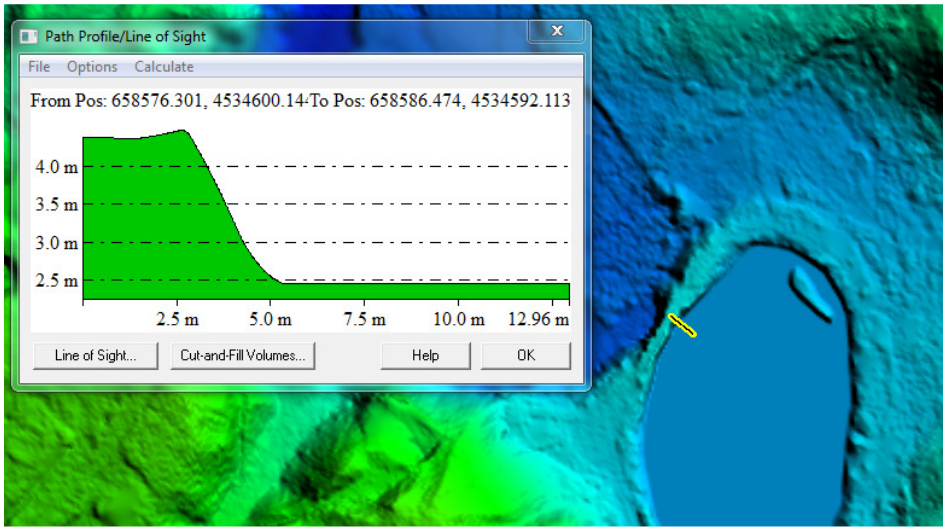

Figure 25 – DEM tile 18TXL570330 from the second delivery. The image above shows the DEM has been updated to reflect the modifications made to the ponds and lakes breaklines to correct topological errors.

4.3 DEM Recommendation

Dewberry recommends accepting the DEMs for Priority Area 2 (Long Island). There were no DEM specific issues and all DEMs impacted by LiDAR or breakline issues have been updated and are correct.

5 Metadata

Metadata was not delivered with the Priority Area 2 deliverables. Project level metadata is required for all data products including, LAS, breaklines, and DEMs. FGDC compliant metadata should be created with sufficient content to detail the full product lineage, including flight dates and times, datum information, re-projections, re-sampling algorithms, processing steps, field records, and any other pertinent information.

Flight lines, as flown, should be delivered in ESRI GDB format and should include start and stop dates and times for each flight line. Lastly, the control points used to control the LiDAR flight missions should be delivered in ASCII format.

These deliverables do not need to be delivery area specific, but could be delivered once for the entire project area. These deliverables were not included with the Priority Area 1 data or this Priority 2 data.

6 GDB

Along with this report, Dewberry is providing a GDB named “PriorityArea02_D2_QAQC_10042012” that contains all the LiDAR, breakline, and DEM edit calls from the first review, PSI’s comments to each edit call, and Dewberry’s comments for the review of those corrections. While all issues have been corrected, the GDB is redelivered with this report as a record that all edit calls have been addressed by PSI and reviewed by Dewberry.

7 Recommendation Summary

The following represents a summary of Dewberry's recommendations for Photo Science, Inc. These recommendations can be found throughout the various sections of this report but are summarized here for convenience.

7.1 LiDAR:

1. There are no remaining LiDAR issues to be addressed.

7.2 Breaklines:

1. There are no remaining Breakline issues to be addressed.

7.3 DEMs:

1. There are no remaining DEM issues to be addressed.

7.4 Metadata:

1. FGDC compliant metadata in XML format should be delivered for each deliverable product, including LiDAR, breaklines, and DEMs.
2. An ESRI shapefile or GDB showing flight lines, as flown, should be delivered for the project area.
3. An ASCII file of the control points used to control the LiDAR flight missions should be delivered for the project area.