Pope and Hardin Counties Final QAQC Report

Summary LiDAR QA/QC Report

Report generated on 5/26/2015

This document reports on compliance with the USGS National Geospatial Program LiDAR Base Specification Version 1.0. The complete specification, which also contains a list of abbreviations, acronyms, and a glossary of related terms, can be found [here.](#)

0.0 Report on LAS Statistics (By Tile)

The purpose of this section is to show basic quantifiable information about the LAS files tested.

Classified Files - E:\Pope_Hardin\Classified_LAS

Horizontal Units: US Survey Feet   Vertical Units: US Survey Feet
Number of boresighted LAS files: 172
Number of classified LAS files: 5025

All LAS statistic information can be reviewed in a geographic manner by accessing the shapefile located at
E:\Pope_Hardin\QAQC2\0_0\tile_index.shp

Average Point Density: 0.36/3.88 pp Square US Survey Foot / pp Square Meter
Average GSD: 1.70 US Survey Feet

Note: These statistics are for tiled LAS files. Not all LAS files fill tiles completely, especially along project boundaries. This may skew the results by including area, count, and density values for partially filled tiles.

0.0 Report on LAS Statistics (By Tile)
- Class Totals

The purpose of this section is to list the number of points in each classification present in the tested data so that the user can determine if any points were filtered to unintended classes.

Classified Files - E:\Pope_Hardin\Classified_LAS

Class(es) Expected: N/A
Class(es) Present: 1,2,3,4,5,6,7,8,9,10

Class	Total
1	4,008,069,432
2	2,067,839,005
3	154,584,868
4	285,277,973
5	2,638,710,368
6	9,854,387
7	1,941,997
8	399,437,218
9	66,622,375
10	321,298

1.1 Report on Multiple Discrete Returns (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 requires: "Data collection must be capable of at least three returns per pulse. Full waveform collection is acceptable and welcomed; however, waveform data are regarded as supplemental information. Deriving and delivering multiple discrete returns is required in all cases."

The purpose of this section is to report on the presence and quantities of LiDAR returns in the LAS tiled data. Empty return columns can indicate a collection or processing problem dealing with LiDAR return attribute information.

Classified Files - E:\Pope_Hardin\Classified_LAS

File	First return	Second return	Third return	Other return	Total points
Total	7,250,134,231	2,107,041,360	269,838,229	8,057,423	9,635,071,243

1.1 Report on Multiple Discrete Returns (Tiled Data) - All Returns

The purpose of this section is to show a graphic of LiDAR tiled data points colored by all returns. Blank tiles can indicate a collection or processing problem dealing with LiDAR return attribute information.

Data Source - E:\Pope_Hardin\Classified_LAS
Result Path - E:\Pope_Hardin\QAQC2\1_1\ColorByReturns_Classified.jpg

First   Second   Third   Fourth or other
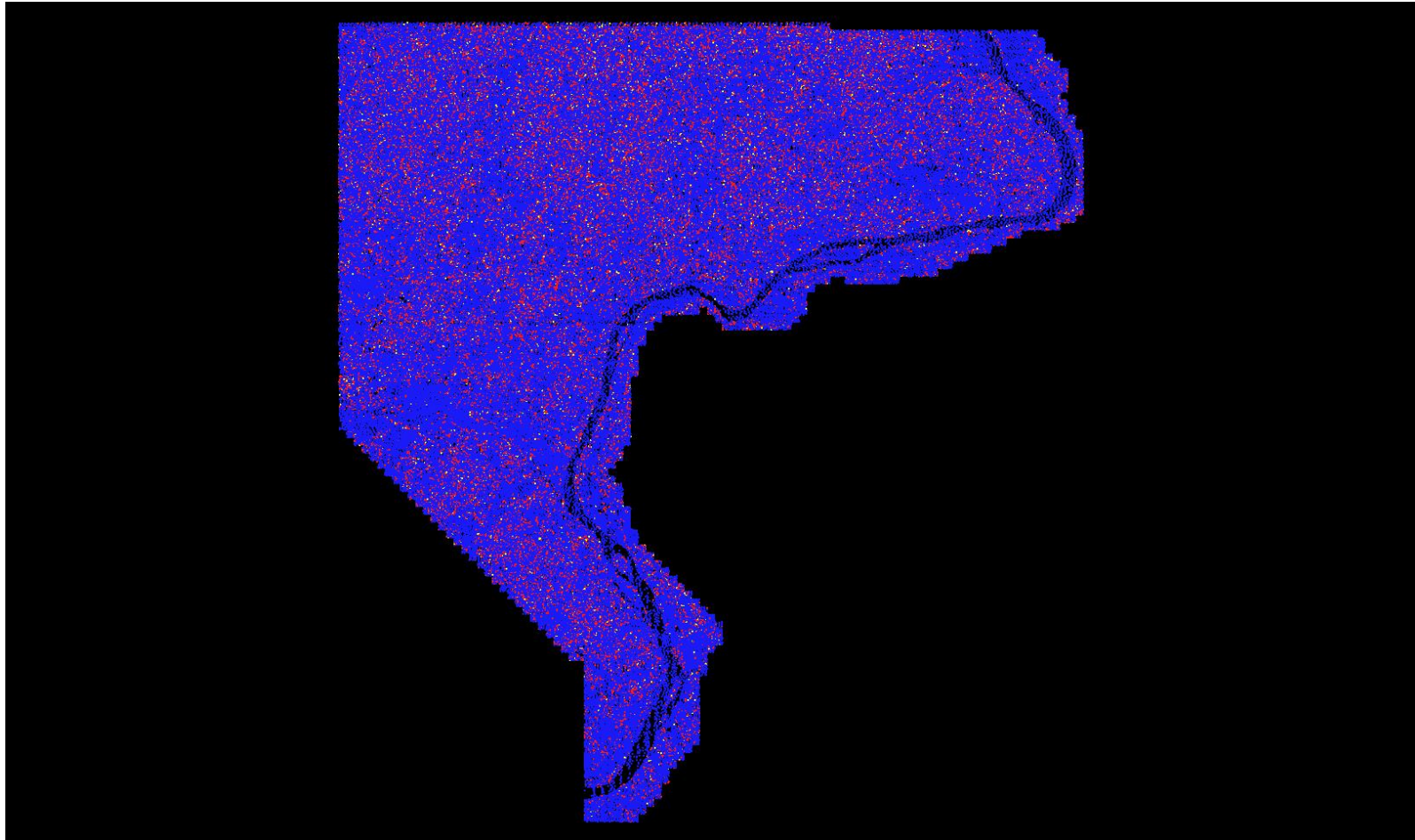
1.2 Report on Intensity Values (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 requires: "Intensity values are required for each return. The values are to be recorded in the .las files in their native radiometric resolution."

The purpose of this section is to report on the presence and quantities of LiDAR intensity in the LAS tiled data. It is important to understand that 8-bit intensity LiDAR systems have a valid intensity range from 0-255, and 12-bit intensity LiDAR systems have a valid intensity range from 0-4095.

Classified Files - E:\Pope_Hardin\Classified_LAS

File	Minimum	Maximum	Mean	Median	Mode
Average	00	255	84	92	00

1.2 Report on Intensity Values (Tiled Data)

The purpose of this section is to show a frequency distribution chart of intensities throughout all of the LiDAR tiled files. It is important to understand that 8-bit intensity LiDAR systems have a valid intensity range from 0-255, and 12-bit intensity LiDAR systems have a valid intensity range from 0-4095.
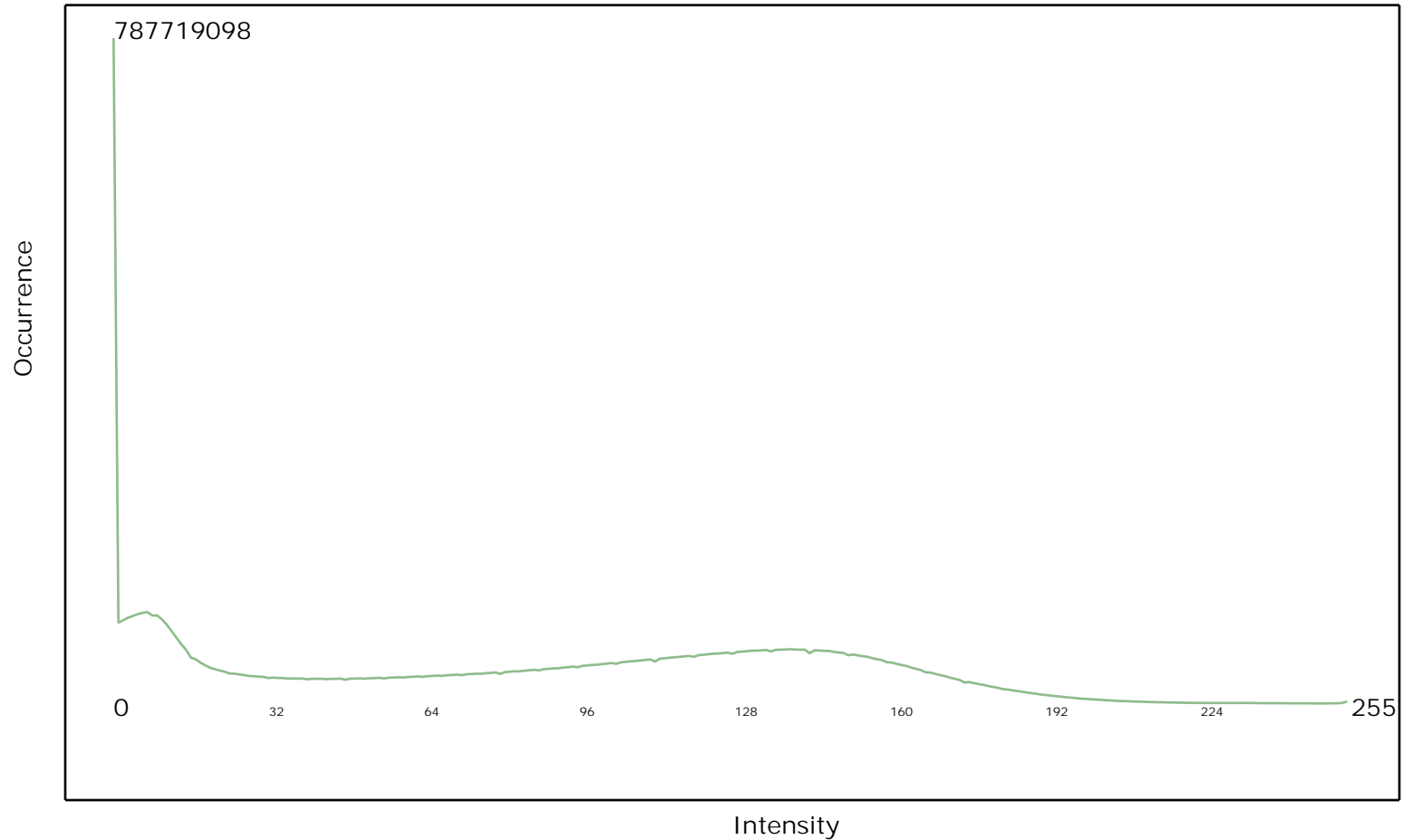
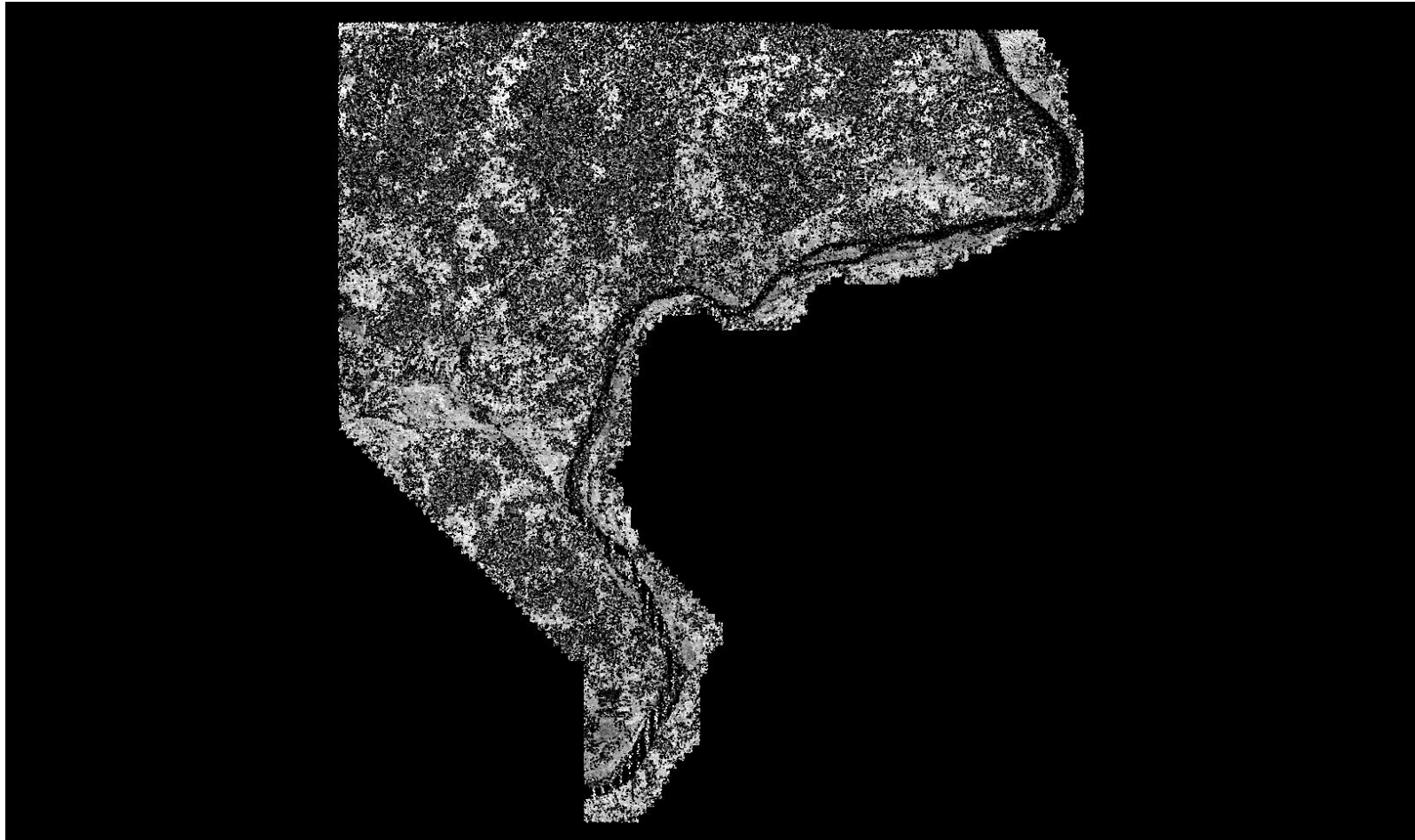Data Source - E:\Pope_Hardin\Classified_LAS

1.2 Report on Intensity Values (Tiled Data)

The purpose of this section is to show a graphic of LiDAR tiled data points colored by intensity. Blank tiles can indicate a processing problem dealing with LiDAR intensity attribute information.

Data Source - E:\Pope_Hardin\Classified_LAS
Result Path - E:\Pope_Hardin\QAQC2\1_2\ColorByIntensity_Classified.jpg

1.3 Report on Point Density and Nominal Pulse Spacing (NPS) (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "An NPS of 2 meters or less is required. Dependent on the local terrain and land cover conditions in the project area, a greater point density may be required on specific projects. Assessment of the NPS will be made against single swath, first-return only data, located within the geometrically usable center portion (typically 90 percent) of each swath, acceptable data voids excluded. NPS will be calculated as the square root of the average area per point. Average along-track and cross-track point spacing should be comparable (within 10 percent)."

The purpose of this section is to report on the LiDAR point density and nominal point spacing by swath file. Averages by swath files (not including overlap), project boundary polygons (including swath overlap), and aggregate project boundary polygons (including swath overlap) are reported.

Boresighted Files - E:\Pope_Hardin\Swath_LAS
Units: US Survey Feet

File	Number of First Returns	Area of Swath	Point Density	NPS
Average			0.18/1.94	2.37/0.72
			pp Square US Survey Feet/ pp Square Meter	US Survey Feet/ Meter
Aggregate	7,249,584,634	20,096,000,028	0.36/3.88	1.66/0.51
			pp Square US Survey Feet/ pp Square Meter	US Survey Feet/ Meter

1.4 Report on Point Density and Nominal Pulse Spacing (NPS) (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 states: "In general, the target NPS for a project should not be achieved through swath overlap or multiple passes. Such collection techniques may be permitted with prior approval."

The purpose of this section is to report on the LiDAR point density and nominal point spacing by tiled file. Point densities and NPS by tile are calculated by including any overlapping swath data within each tile. These statistics are for tiled LAS files. Not all LAS files fill tiles completely, especially along project boundaries. This may skew the calculated density and NPS values for partially filled tiles.

Classified Files - E:\Pope_Hardin\Classified_LAS
Units: US Survey Feet

File	Point Density	Nominal Pulse Spacing (NPS)
Average	0.35/3.77	1.70/0.52
	pp Square US Survey Feet/ pp Square Meter	US Survey Feet/ Meter

1.5 Report on Data Voids (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states that: "Data voids within a single swath are not acceptable, except in the following circumstances:
(1) where caused by water bodies. (2) where caused by areas of low near infra-red (NIR) reflectivity such as asphalt or composition roofing and
(3) where appropriately filled-in by another swath."

The purpose of this section is to show graphically where possible LiDAR data voids are located. Data voids can be caused by a lack of coverage at the time of collection, water bodies not reflecting the laser beam back to the receiver, LiDAR occlusions caused by objects above ground like tall buildings, etc. Not all data voids are problematic. The intention of this test is to isolate the first example of LiDAR data voids - a lack of coverage at the time of collection. A close inspection must be done on the results to determine if the LiDAR coverage was collected and processed to meet the intended specifications.

Data Source - E:\Pope_Hardin\Swath_LAS
E:\Pope_Hardin\QAQC2\1_5\Boresighted_DataVoids_SingleFile.jp2

Cell size: 10 US Survey Feet

Green: No data void (number of cells = 199,509,356)
Red: Data void (number of cells = 1,451,024)
Background Color: Null data
See JPG2000 file for full resolution results

1.6.1 Report on Spatial Distribution Verification

The USGS LiDAR Base Specification Version 1.0 states that: "The spatial distribution of geometrically usable points is expected to be uniform. Although it is understood that lidar instruments do not produce regularly gridded points, collections should be planned and executed to produce a first-return point cloud that approaches a regular lattice of points, rather than a collection of widely spaced high density profiles of the terrain. The uniformity of the point density throughout the dataset is important and will be assessed using the following steps:
(1) Generating a density grid from the data with cell sizes equal to the design NPS times 2, using a radius equal to the design NPS
(2) Ensuring at least 90 percent of the cells in the grid contain at least one lidar point.
(3) The assessment is to be made against individual (single) swaths, using only the first-return points located within the geometrically usable center portion
    (typically 90 percent) of each swath.
Excluding acceptable data voids previously identified in this specification.
Note: This requirement may be relaxed in areas of substantial relief where it is impractical to maintain a consistent and uniform distribution.
Note: The process described in this section relates only to the uniformity of the point distribution. It in no way relates to, nor can it be used for the
    assessment of point density or NPS."

The purpose of this section is to show graphically where unacceptable LiDAR spatial distributions are located. LiDAR spatial distribution can be affected by problems in flight planning (e.g., incorrect scan frequency / pulse rate pairing) or flight execution (e.g., strong headwinds or tailwinds), a lack of coverage at the time of collection, water bodies not reflecting the laser beam back to the receiver, LiDAR occlusions caused by objects above ground like tall buildings, etc. Not all LiDAR spatial distribution violations are truly problematic. The intention of this test is to isolate the first example of LiDAR spatial distribution violations - problems in flight planning or flight execution. A close inspection must be done on the results to determine if the LiDAR spatial distribution was collected and processed to meet the intended specifications.

Data Source - E:\Pope_Hardin\Swath_LAS
E:\Pope_Hardin\QAQC2\1_6\Boresighted_SpatialDistribution_SingleFile.jp2

1.6.1 Report on Spatial Distribution Verification - Continued

Cell size: 5 US Survey Feet

Green: Cells containing at least 1 first return LiDAR point(s) (number of cells = 793,398,907)
Red: Cells not containing at least 1 first return LiDAR point(s) (number of cells = 10,441,853)
Background Color: Null data
Percentage of cells in the grid that contain at least 1 first return LiDAR point(s) = 98.70% (Requirement is typically 90%)
See JPG2000 file for full resolution results

1.6.2 Report on Spatial Distribution Verification of Individual Swath

Swath	Percentage of Cells that Contain >= 1
00001	95.58%
00002	95.23%
00003	97.04%
00004	95.88%
00005	93.22%
00006	82.85%
00007	84.14%
00008	81.14%
00009	83.43%
00010	85.25%
00011_Split1	89.23%
00011_Split2	90.14%
00012_Split1	87.28%
00012_Split2	89.81%
00013_Split1	87.41%
00013_Split2	85.32%
00014_Split1	89.76%
00014_Split2	81.36%
00015_Split1	90.05%
00015_Split2	90.58%
00016_Split1	88.85%
00016_Split2	83.57%
00017_Split1	88.56%
00017_Split2	87.77%
00018_Split1	89.71%
00018_Split2	84.53%
00019_Split1	95.71%
00019_Split2	86.05%
00020_Split1	95.98%
00020_Split2	91.22%
00021_Split1	97.12%
00021_Split2	91.81%
00022_Split1	96.49%
00022_Split2	89.44%
00023_Split1	95.70%
00023_Split2	82.65%
00024_Split1	96.25%
00024_Split2	91.22%
00025_Split1	96.05%
00025_Split2	86.71%
00026	96.41%
00027_Split1	96.92%
00027_Split2	79.64%
00028	96.22%
00029	97.28%
00030	96.24%

1.6.1 Report on Spatial Distribution Verification of Individual Swath

Swath	Percentage of Cells that Contain >= 1
00031	97.50%
00032	96.33%
00033	97.43%
00034	96.73%
00035	97.98%
00036	96.80%
00037	97.02%
00038	95.67%
00039	94.98%
00040	93.97%
00041	96.58%
00042	94.99%
00043	96.88%
00044_Split1	93.83%
00044_Split2	97.54%
00045	91.72%
00066	89.75%
00067_Split1	92.47%
00067_Split2	85.34%
00068_Split1	96.01%
00068_Split2	86.99%
00069_Split1	95.94%
00069_Split2	86.02%
00070_Split1	96.06%
00070_Split2	87.44%
00071_Split1	96.98%
00071_Split2	91.22%
00072_Split1	95.78%
00072_Split2	91.65%
00073_Split1	94.64%
00073_Split2	95.45%
00073_Split3	83.16%
00074_Split1	94.09%
00074_Split2	95.08%
00074_Split3	75.81%
00075_Split1	90.08%
00075_Split2	96.93%
00075_Split3	95.04%
00076_Split1	90.50%
00076_Split2	95.97%
00076_Split3	91.14%
00077_Split1	88.52%
00077_Split2	96.49%
00077_Split3	96.02%
00078_Split1	91.15%
00078_Split2	96.44%

1.6.1 Report on Spatial Distribution Verification of Individual Swath

Swath	Percentage of Cells that Contain >= 1
00078_Split3	96.27%
00079_Split1	91.43%
00079_Split2	96.93%
00079_Split3	96.55%
00080_Split1	94.60%
00080_Split2	95.26%
00080_Split3	95.42%
00081_Split1	94.58%
00081_Split2	94.89%
00081_Split3	95.25%
00081_Split4	97.91%
00082_Split1	95.43%
00082_Split2	96.32%
00082_Split3	96.34%
00083_Split1	95.10%
00083_Split2	96.24%
00083_Split3	96.99%
00084_Split1	94.02%
00084_Split2	95.73%
00084_Split3	96.20%
00085_Split1	94.59%
00085_Split2	95.93%
00085_Split3	96.14%
00085_Split4	84.13%
00086_Split1	94.56%
00086_Split2	95.05%
00086_Split3	96.45%
00087_Split1	95.75%
00087_Split2	96.47%
00087_Split3	96.40%
00087_Split4	96.18%
00088	96.58%
00129_Split1	95.08%
00129_Split2	96.92%
00129_Split3	96.93%
00130_Split1	96.51%
00130_Split2	97.62%
00130_Split3	96.88%
00130_Split4	95.04%
00131_Split1	94.46%
00131_Split2	95.23%
00131_Split3	97.02%
00132_Split1	94.41%
00132_Split2	97.68%
00132_Split3	97.12%
00132_Split4	97.66%

1.6.1 Report on Spatial Distribution Verification of Individual Swath

Swath	Percentage of Cells that Contain >= 1
00133_Split1	94.62%
00133_Split2	95.53%
00133_Split3	96.38%
00134_Split1	94.41%
00134_Split2	96.91%
00134_Split3	97.80%
00134_Split4	97.17%
00135_Split1	94.73%
00135_Split2	96.19%
00135_Split3	96.68%
00136_Split1	94.83%
00136_Split2	97.42%
00136_Split3	97.05%
00136_Split4	98.13%
00137_Split1	94.42%
00137_Split2	94.97%
00137_Split3	95.78%
00138_Split1	94.67%
00138_Split2	95.86%
00138_Split3	97.24%
00138_Split4	87.99%
00139_Split1	94.14%
00139_Split2	95.71%
00139_Split3	95.47%
00140_Split1	94.95%
00140_Split2	96.95%
00140_Split3	97.44%
00140_Split4	96.20%
00141_Split1	95.25%
00141_Split2	96.24%
00141_Split3	96.75%
00142_Split1	96.65%
00142_Split2	97.13%
00143	95.90%

1.8 Report on Vertical Accuracy (Tiled Data)

The USGS LiDAR Base Specification Version 1.0 states that: "Vertical Accuracy of the LiDAR data will be assessed and reported in accordance with the guidelines developed by the NDEP and subsequently adopted by the ASPRS.

(1) The minimum vertical accuracy requirement for the unclassified lidar point cloud, using the NDEP/ASPRS methodology, is listed below:. See: http://www.ndep.gov/NDEP_Elevation_Guidelines_Ver1_10May2004.pdf

(2) Fundamental Vertical Accuracy (FVA)<= 24.5 centimeters (cm) Accuracyz (ACCz), 95 percent (12.5 cm Root Mean Square Error (RMSE)z).

(3) Accuracy for the LiDAR point cloud data is to be reported independently from accuracies of derivative products (i.e., DEMs). Point cloud data accuracy is to be tested against a TIN constructed from bare-earth LiDAR points.

Point cloud data accuracy is to be tested against a Triangulated Irregular Network (TIN) constructed from lidar points in clear and open areas. A clear and open area can be characterized with respect to topographic and ground cover variation such that a minimum of 5 times the NPS exists with less than 1/3 of the RMSEz deviation from a low-slope plane. Slopes that exceed 10 percent should be avoided. Ground that has been plowed or otherwise disturbed is not acceptable. All tested locations should be photographed showing the position of the tripod and the surrounding area ground condition."

The purpose of this section is to report on the fundamental vertical accuracy of the LiDAR data measured against surveyed ground check points.

This reports only the Fundamental Vertical Accuracy (FVA)

E:\Pope_Hardin\QAQC2\1_8\Report_VerticalAccuracy.csv

Units: US Survey Feet (/Meter)

		Classified Data
Control Points		20
Points with Coverage		20
Points With Required Accuracy		20
Percent of Points With Required Accuracy		100.00%
Average Z Error		0.09/0.03
Maximum Z Error		0.37/0.11
Median Z Error		0.11/0.03
Minimum Z Error		-0.31/-0.09
NSSDA Vertical Accuracy	at the 95 confidence level	0.34/0.10 PASS
Standard Deviation (sigma) of Z for Sample		0.15/0.05
RMSE of Z for Sample		0.17/0.05 PASS
FGDC/NSSDA/FEMA Contour Interval		0.60/0.18
ASPRS Contour Interval		0.60/0.18
NMAS Contour Interval		0.60/0.18

1.8 Report on Vertical Accuracy (Tiled Data)

The purpose of this section is to show a frequency distribution chart of the the fundamental vertical accuracy of the LiDAR data measured against surveyed ground check points.

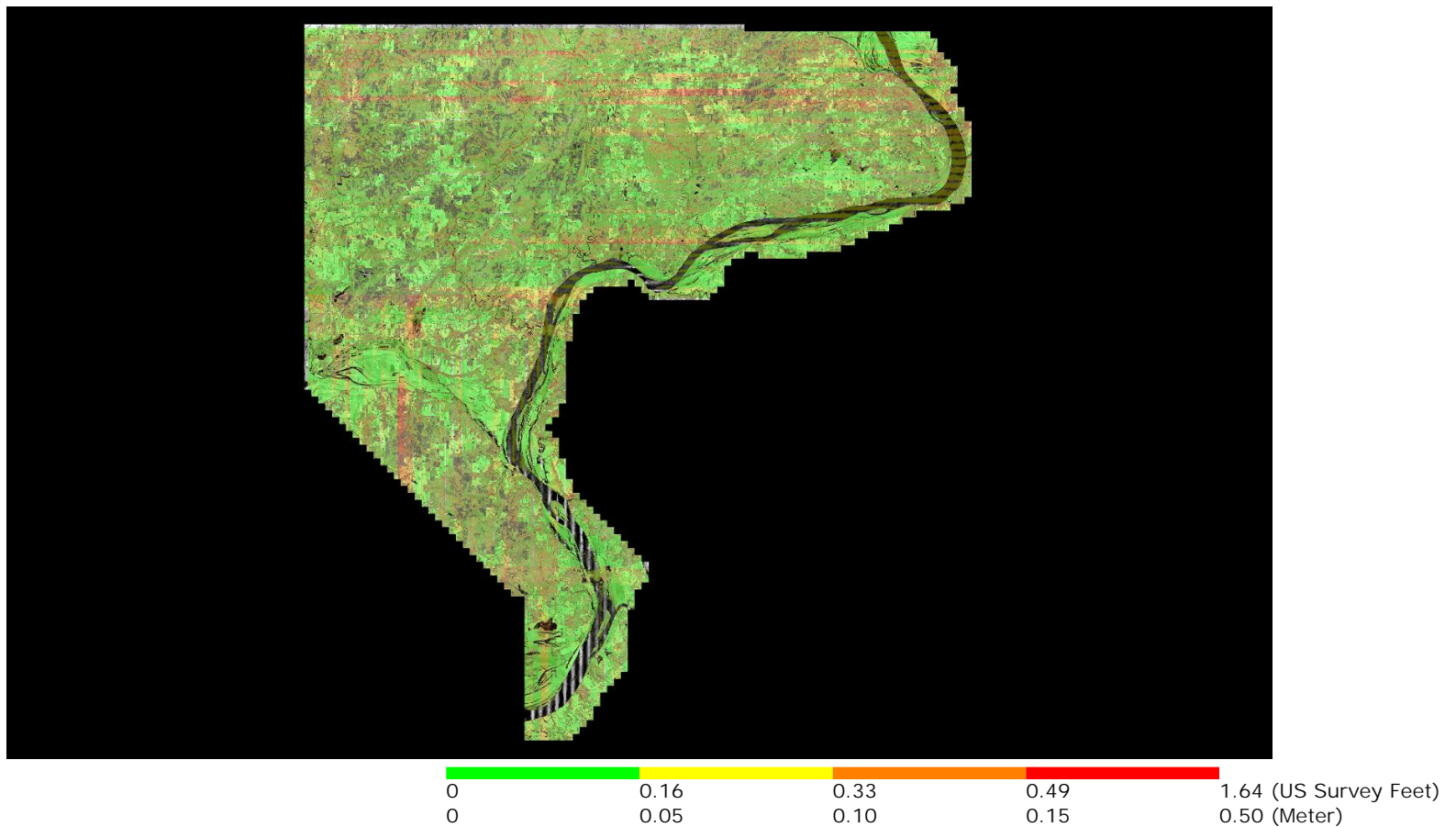Data Source - E:\Pope_Hardin\Classified_LAS
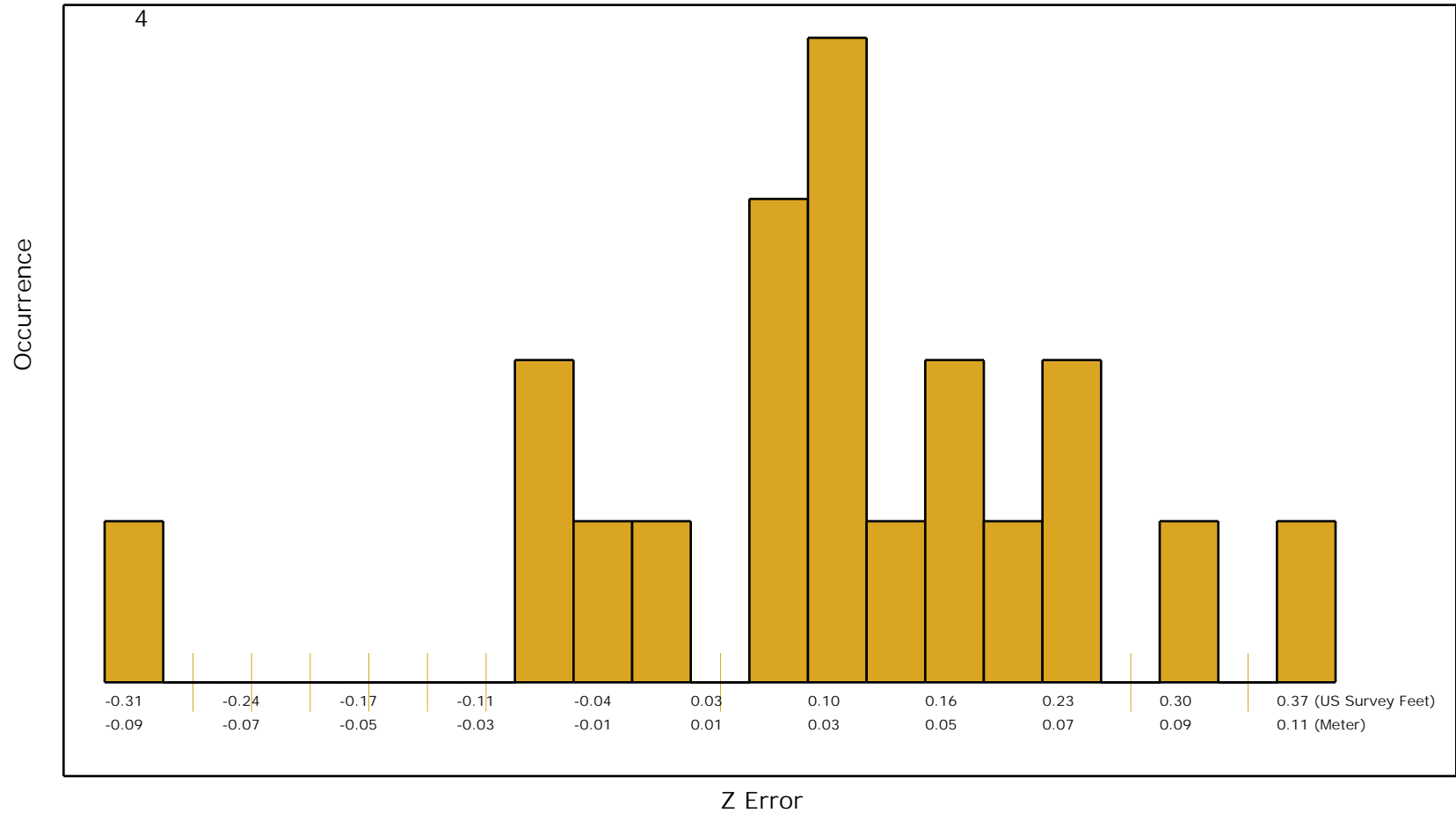
1.9.1 Report on Flight Line Separation (Relative Accuracy) per Project

The USGS LiDAR Base Specification Version 1.0 states that: "Relative accuracy within overlap between adjacent swaths: <=10 cm RMSDz"

The purpose of this section is to show a graphic of the flight line separation raster for all of the data processed. This grid/image shows the vertical separation of flight lines by thematically coloring the separation magnitude on a color ramp based on absolute distance. This color thematic rendering is modulated by intensity to show land cover features. If there is no flight line overlap, the raster is displayed as grayscale intensity alone. The relative accuracy RMSDz is reported in the bottom left of this page.

Data Source - E:\Pope_Hardin\Swath_LAS
E:\Pope_Hardin\QAQC2\1_9_1\Boresighted_FlightlineSeparation_SingleFile.jp2

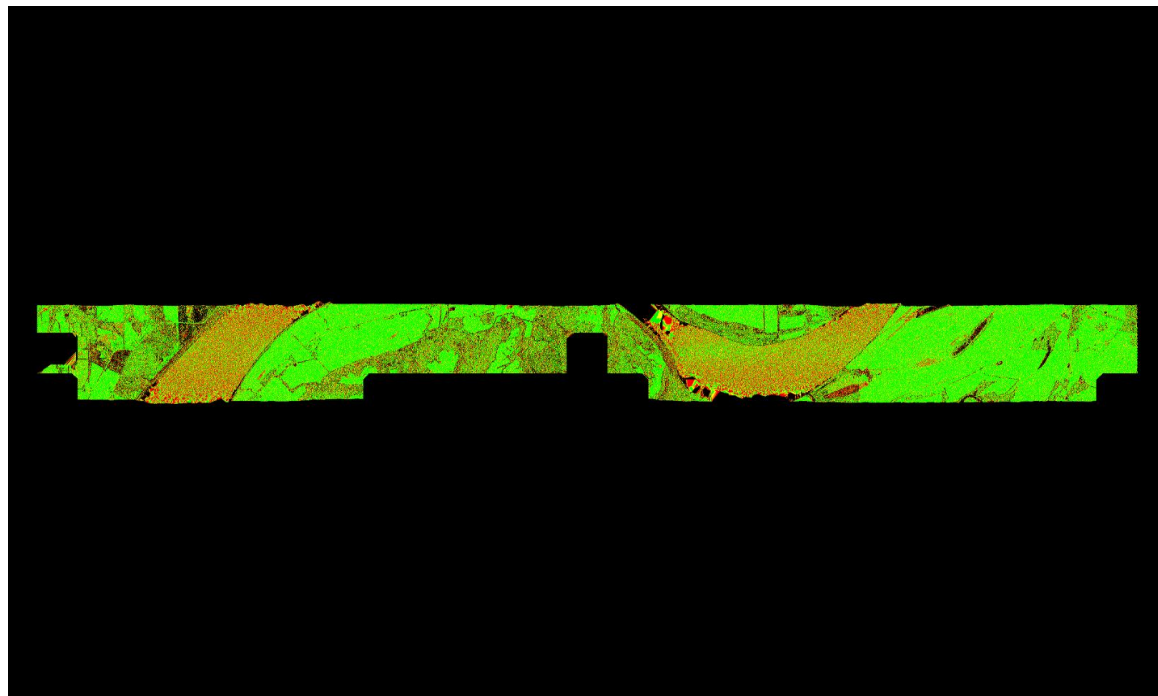| 0 | 0.16 | 0.33 | 0.49 | 1.64 (US Survey Feet) |
| 0 | 0.05 | 0.10 | 0.15 | 0.50 (Meter) |

A maximum vertical separation cutoff has been applied to this graphic for the purpose of masking out disruptive features that do not show calibration issues between flight lines (e.g., trees, moving cars, etc.). This can be modified in the Color Options settings window.

1.9.2 Report on Separation of Scan Direction (Relative Accuracy) per Flight Line

The USGS LiDAR Base Specification Version 1.0 states that: "Relative accuracy within individual swaths: <= 7 cm RMSDz."

The purpose of this section is to show a graphic of the relative vertical accuracy within a representative sample flight line. This automatically selected flight line will have the lowest multiple return to single return ratio. This vertical accuracy analysis is done by comparing the inbound and outbound scan lines to each other as two separate surfaces and then generating a vertical separation raster from their TIN deltas. This is displayed by thematically coloring the separation magnitude on a color ramp based on absolute distance. Good LiDAR data should have a consistent green coloration across the flight line (perpendicular to flight), ignoring warmer colorations due to above ground surface features. Small color variations are to be expected. The purpose of this test is to find problematic data indicated by warming color variation trends away from the center of the scan line. Flight lines that have inconsistent colorations from the center towards the edges of the flight line would highlight the possibility of a sensor or internal calibration problem, usually an incorrect encoder latency value. The relative accuracy RMSDz is reported in the bottom left of this page.

Data Source - E:\Pope_Hardin\Swath_LAS\00068_Split2.las
E:\Pope_Hardin\QAQC2\1_9_2\Individual_00068_Split2.jp2

| 0 | 0.12 | 0.23 | 0.35 | 1.15 (US Survey Feet) |
| 0 | 0.04 | 0.07 | 0.11 | 0.35 (Meter) |

A maximum vertical separation cutoff has been applied to this graphic for the purpose of masking out disruptive features that do not show calibration issues between flight lines (e.g., trees, moving cars, etc.). This can be modified in the Color Options settings window.
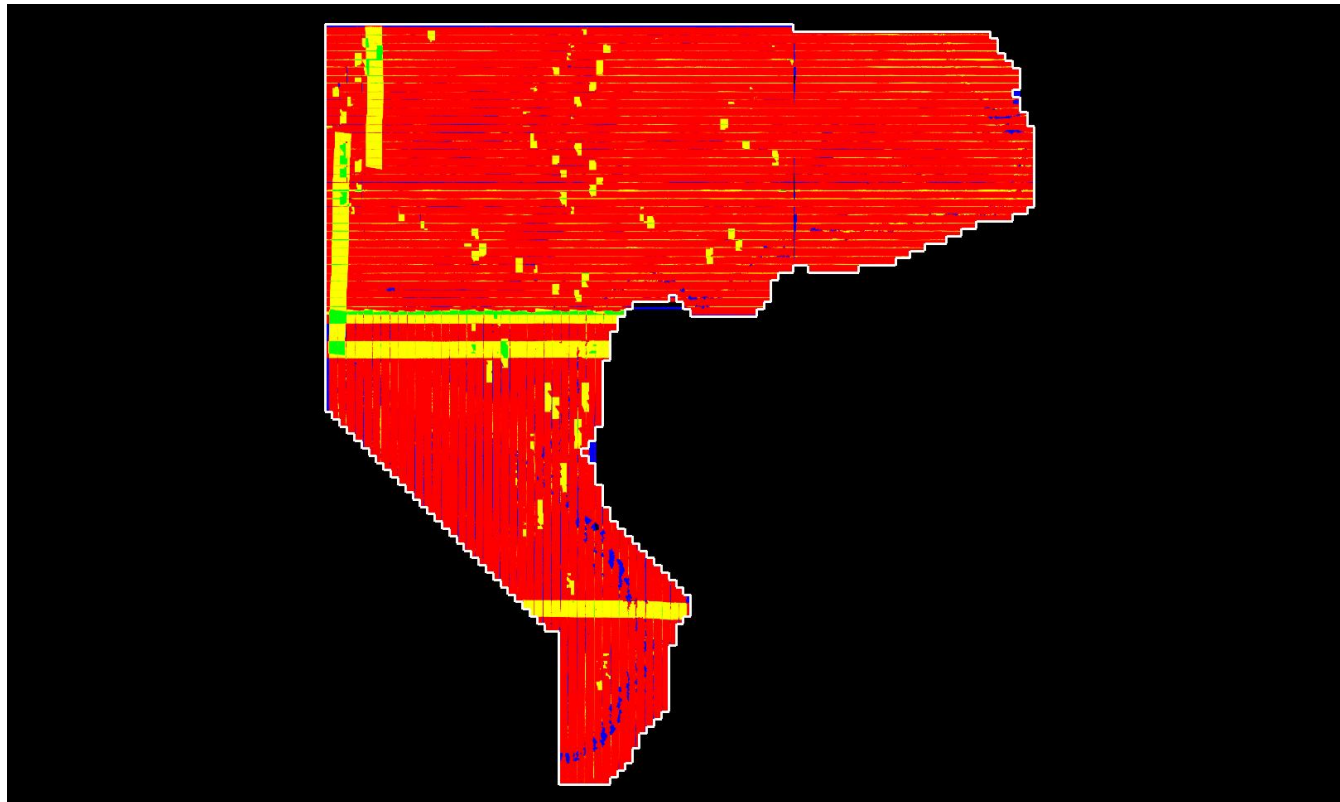
1.10.1 Report on Flight Line Overlap (Swath Data)

The USGS LiDAR Base Specification Version 1.0 requires: "Flightline overlap of 10 percent or greater is required to ensure there are no data gaps between the usable portions of the swaths. Collections in high relief terrain are expected to require greater overlap. Any data with gaps between the geometrically usable portions of the swaths will be rejected."

The purpose of this section is to show flight line overlap. Lack of flight line overlap would be displayed as black polygons or slivers between flight lines.

Data Source - E:\Pope_Hardin\Swath_LAS
Result Path - E:\Pope_Hardin\QAQC2\1_10\Flightline_Coverage_Overlap.jp2

White polygon is project boundary

| Single | Double | Triple | Quadruple coverage or more |

1.10.2 Report on Flight Line Sidelap

The USGS LiDAR Base Specification Version 1.0 requires: "Flightline overlap of 10 percent or greater is required to ensure there are no data gaps between the usable portions of the swaths. Collections in high relief terrain are expected to require greater overlap. Any data with gaps between the geometrically usable portions of the swaths will be rejected."
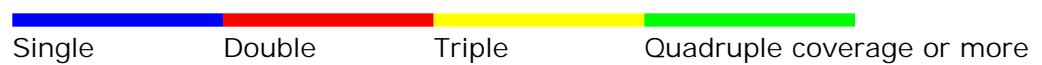
The purpose of this section is to show flight line overlap. Lack of flight line overlap would be displayed as black polygons or slivers between flight lines.

Data Source - E:\Pope_Hardin\Swath_LAS
Result Path - E:\Pope_Hardin\QAQC2\1_10\Flightline_Coverage_Overlap_Side.jp2

White polygon is project boundary

1.10.2 Report on Flight Line Sidelap - Continued

Adjacent Flight Line 1	Adjacent Flight Line 2	Area 1	Area 2	Overlap Area	Sidelap 1 (%)	Sidelap 2 (%)
00001	00002	24544291.73	41297624.85	15229501.19	62	36.9
00002	00003	54697938.694	76129065.051	23122659.376	42.3	30.4
00003	00004	113427328.659	170610647.395	17498659.281	15.4	10.3
00004	00005	181019595.522	201934325.074	14249424.351	7.9	7.1
00005	00006	203978829.807	222755901.675	87696106.06	43	39.4
00006	00007	228713488.467	244351759.188	83211125.19	36.4	34.1
00007	00008	251675755.446	270766859.792	63265076.855	25.1	23.4
00008	00009	277386123.291	291561141.413	89983015.76	32.4	30.9
00009	00010	299173284.345	313129861.456	75209426.484	25.1	24
00010	00011_Split2	321561312.784	96957592.133	96256716.23	29.9	99.3
00011_Split1	00012_Split2	40267590.315	29103973.63	90488361.415	224.7	310.9
00011_Split1	00012_Split1	337619882.88	402790671.032	28706459.911	8.5	7.1
00011_Split2	00045	12289940.472	57423680.96	10143806.105	82.5	17.7
00012_Split1	00013_Split2	404238542.369	260113557.183	52488562.659	13	20.2
00012_Split2	00045	9139634.996	67648232.589	8058986.575	88.2	11.9
00013_Split1	00014_Split2	334072035.307	155398747.099	152897025.877	45.8	98.4
00013_Split1	00014_Split1	305644664.367	353636916.802	104148363.204	34.1	29.5
00014_Split1	00015_Split2	393278161.229	268263053.733	195422448.12	49.7	72.8
00015_Split1	00016_Split1	267424723.029	273773675.802	92565533.92	34.6	33.8
00015_Split1	00016_Split2	331190059.134	149152954.839	17474464.249	5.3	11.7
00015_Split2	00016_Split2	222741179.179	133264501.821	37216823.182	16.7	27.9
00016_Split1	00017_Split2	358584531.466	89605926.867	132191280.02	36.9	147.5
00017_Split1	00018_Split1	326661490.965	354764297.794	145614929.812	44.6	41
00017_Split1	00018_Split2	29322340.086	26875915.882	53164762.838	181.3	197.8
00018_Split1	00019_Split1	350962250.961	296764203.274	114801860.711	32.7	38.7
00019_Split1	00020_Split1	293573907.339	332451738.772	134111420.684	45.7	40.3
00020_Split1	00021_Split1	331429019.436	305761440.363	138190659.458	41.7	45.2
00021_Split1	00022_Split1	303715851.354	325984459.719	142610293.847	47	43.7
00022_Split1	00023_Split2	325940203.46	55307256.677	55362989.46	17	100.1
00022_Split2	00044_Split1	2717950.431	131906962.906	2665519.272	98.1	2
00023_Split1	00024_Split1	296749302.512	323884113.208	147948778.055	49.9	45.7
00024_Split1	00025_Split1	320464160.182	295677693.704	144834125.403	45.2	49
00025_Split1	00026	292490216.419	308873931.665	143032374.569	48.9	46.3
00026	00027_Split1	307626600.79	296137083.119	157605516.995	51.2	53.2

1.10.2 Report on Flight Line Sidelap - Continued

Adjacent Flight Line 1	Adjacent Flight Line 2	Area 1	Area 2	Overlap Area	Sidelap 1 (%)	Sidelap 2 (%)
00027_Split1	00028	294069418.462	289967662.962	136877346.742	46.5	47.2
00028	00029	289256019.766	279946121.92	150677263.441	52.1	53.8
00029	00030	274386309.302	269423437.07	127072333.65	46.3	47.2
00030	00031	266226159.39	260003003.982	140406061.253	52.7	54
00031	00032	256368265.441	248305235.02	118777278.371	46.3	47.8
00032	00033	246894268.773	238516629.959	129019739.147	52.3	54.1
00033	00034	236199387.872	225804886.089	109599729.271	46.4	48.5
00034	00035	225606772.556	215015819.837	116881446.715	51.8	54.4
00035	00036	209776065.038	205669276.516	97824605.098	46.6	47.6
00036	00037	203012719.678	193534023.95	107048611.531	52.7	55.3
00037	00038	190204518.103	182725294.921	87910867.561	46.2	48.1
00038	00039	182562660.663	175229455.943	96065042.68	52.6	54.8
00039	00040	172930058.757	161462811.797	77158129.529	44.6	47.8
00040	00041	160346311.789	149441957.653	81399178.653	50.8	54.5
00041	00042	145164451.626	138850242.638	67169564.36	46.3	48.4
00042	00043	135825703.085	98516617.079	72122433.432	53.1	73.2
00043	00088	42142219.056	54739451.719	29688360.472	70.4	54.2
00044_Split1	00044_Split2	173885513.111	10744058.924	1113389.561	0.6	10.4
00066	00067_Split1	376914575.825	384815631.434	187265791.234	49.7	48.7
00067_Split1	00068_Split1	323085201.001	320856238.242	176294669.777	54.6	54.9
00068_Split1	00069_Split1	293566548.025	293387368.508	133147042.038	45.4	45.4
00068_Split2	00069_Split2	226140088.519	247760123.191	117508293.395	52	47.4
00069_Split1	00070_Split1	293460631.109	291815216.517	155857543.732	53.1	53.4
00070_Split1	00071_Split1	262090646.183	262817643.628	125726890.144	48	47.8
00070_Split2	00071_Split2	245894519.32	258652597.235	121498393.795	49.4	47
00070_Split2	00072_Split2	244736735.76	264041437.295	3675730.616	1.5	1.4
00071_Split1	00072_Split1	248514217.538	248002970.663	133025083.376	53.5	53.6
00071_Split2	00072_Split2	318647151.245	329103791.16	180716349.783	56.7	54.9
00072_Split1	00073_Split1	194028480.112	190827823.628	90778731.287	46.8	47.6
00073_Split1	00074_Split1	190817222.749	194806289.228	103603959.98	54.3	53.2
00073_Split2	00074_Split2	294601219.816	294904354.905	161259199.755	54.7	54.7
00073_Split3	00074_Split3	76628255.259	70170696.037	36878069.789	48.1	52.6
00074_Split2	00075_Split2	277656846.747	277066992.685	135688442.656	48.9	49

1.10.2 Report on Flight Line Sidelap - Continued

Adjacent Flight Line 1	Adjacent Flight Line 2	Area 1	Area 2	Overlap Area	Sidelap 1 (%)	Sidelap 2 (%)
00074_Split3	00075_Split3	70373333.56	74946019.203	35328717.697	50.2	47.1
00075_Split2	00076_Split2	286544622.354	285481445.435	150560094.87	52.5	52.7
00075_Split3	00076_Split3	84250210.738	83969456.243	45803213.311	54.4	54.5
00076_Split2	00077_Split2	229741024.913	229899737.441	109775747.549	47.8	47.7
00077_Split2	00078_Split2	280243992.647	279791845.666	153135927.296	54.6	54.7
00077_Split3	00078_Split3	184462466.324	186682726.866	101092885.362	54.8	54.2
00078_Split2	00079_Split2	219433685.669	208875679.215	102580741.387	46.7	49.1
00079_Split1	00080_Split1	290030141.147	293617255.347	15828573.784	5.5	5.4
00079_Split1	00081_Split1	290002611.276	298998673.716	151017719.107	52.1	50.5
00079_Split2	00081_Split2	259851695.593	265367426.348	131186227.828	50.5	49.4
00079_Split3	00081_Split3	262343052.697	265104322.562	134002787.896	51.1	50.5
00079_Split3	00080_Split3	249605086.423	248189104.153	10265682.336	4.1	4.1
00080_Split1	00081_Split1	293584721.021	298834446.077	163283286.102	55.6	54.6
00080_Split2	00082_Split2	277902629.748	290517401.438	142442679.584	51.3	49
00080_Split3	00082_Split3	240749471.476	245925022.161	124259544.001	51.6	50.5
00082_Split2	00083_Split2	254164428.398	251758641.266	119852400.489	47.2	47.6
00082_Split3	00083_Split3	246026356.539	249617937.562	120179932.095	48.8	48.1
00083_Split1	00084_Split1	302801845.553	302923385.477	161028886.985	53.2	53.2
00083_Split1	00085_Split1	303165938.885	302002290.382	5314845.583	1.8	1.8
00083_Split2	00084_Split2	260912940.993	261103884.277	137044171.961	52.5	52.5
00083_Split3	00084_Split3	258752631.827	254190116.543	134830492.978	52.1	53
00084_Split2	00085_Split2	252137591.305	248884276.924	115869216.929	46	46.6
00084_Split3	00085_Split3	236206324.006	238154148.7	115646043.36	49	48.6
00085_Split1	00087_Split1	302020195.154	300084306.689	824929.807	0.3	0.3
00085_Split2	00086_Split2	266615654.37	265972616.174	137720772.923	51.7	51.8
00085_Split3	00086_Split3	254719436.43	251879285.708	134184455.904	52.7	53.3
00086_Split1	00129_Split1	302040651.25	301191487.399	3040989.939	1	1
00086_Split2	00087_Split2	238422892.934	238103637.529	111713247.832	46.9	46.9
00086_Split3	00087_Split3	215423404.759	214051718.86	100725304.905	46.8	47.1
00087_Split2	00129_Split2	238879771.724	241278943.586	125283920.868	52.4	51.9
00087_Split3	00129_Split3	232879547.52	238078213.363	122589039.136	52.6	51.5
00129_Split1	00130_Split1	301186718.711	289703295.688	138516487.135	46	47.8
00129_Split2	00130_Split2	224072237.743	223460324.445	103249463.159	46.1	46.2

1.10.2 Report on Flight Line Sidelap - Continued

Adjacent Flight Line 1	Adjacent Flight Line 2	Area 1	Area 2	Overlap Area	Sidelap 1 (%)	Sidelap 2 (%)
00129_Split3	00130_Split3	210286600.376	206894000.49	98620301.276	46.9	47.7
00130_Split1	00131_Split1	285937787.188	290143808.623	153863416.849	53.8	53
00130_Split2	00131_Split2	223495173.489	223190306.524	114950222.398	51.4	51.5
00130_Split3	00131_Split3	192269412.36	193430773.231	100496384.751	52.3	52
00130_Split4	00132_Split4	73227596.311	72982180.555	851825.098	1.2	1.2
00131_Split1	00132_Split1	283179477.6	281866855.371	135012915.179	47.7	47.9
00131_Split2	00132_Split2	222464961.663	222606938.715	106486185.94	47.9	47.8
00131_Split3	00132_Split3	202686056.297	203816272.589	98851691.091	48.8	48.5
00132_Split1	00133_Split1	281569660.823	282526401.332	151812297.314	53.9	53.7
00132_Split2	00133_Split2	214512545.677	214738708.619	111868914.986	52.2	52.1
00132_Split3	00133_Split3	200624019.456	200246982.591	105440028.541	52.6	52.7
00133_Split1	00134_Split1	282582174.43	286163999.14	134758379.292	47.7	47.1
00133_Split2	00134_Split2	228127905.55	228772361.843	108697668.537	47.6	47.5
00133_Split3	00134_Split3	223137139.563	222713369.111	107662635.27	48.2	48.3
00134_Split1	00136_Split1	286160882.951	283490318.123	13315129.016	4.7	4.7
00134_Split2	00135_Split2	210887280.954	210410506.401	111869346.478	53	53.2
00135_Split1	00137_Split1	283317393.713	280901183.213	15277935.544	5.4	5.4
00135_Split2	00136_Split2	241264118.767	241030833.457	118818670.441	49.2	49.3
00135_Split3	00136_Split3	235074805.916	234527599.567	115845812.096	49.3	49.4
00135_Split3	00137_Split3	237023363.615	236630312.374	9374265.827	4	4
00136_Split1	00138_Split1	283479358.555	270395786.157	15153548.98	5.3	5.6
00136_Split2	00137_Split2	238129302.43	237988791.294	127405853.845	53.5	53.5
00137_Split2	00138_Split2	251786946.625	253114634.336	119923998.646	47.6	47.4
00137_Split3	00138_Split3	244846318.616	241071320.223	119955377.958	49	49.8
00138_Split1	00139_Split1	270363875.727	260838014.01	146077057.517	54	56
00138_Split2	00139_Split2	235281908.25	238044806.275	129912060.983	55.2	54.6
00138_Split3	00139_Split3	231021264.104	226569422.449	122165276.472	52.9	53.9
00139_Split1	00140_Split1	256608148.005	256973085.526	123153641.115	48	47.9
00139_Split2	00140_Split2	238225137.507	239347660.828	113016014.296	47.4	47.2
00139_Split3	00140_Split3	203935218.96	206741435.291	97433871.546	47.8	47.1
00140_Split1	00141_Split1	256934579.956	195331288.077	142475775.57	55.5	72.9
00140_Split2	00141_Split2	175238774.604	176786083.986	94350147.341	53.8	53.4
00140_Split3	00141_Split3	143878854.035	143740390.47	76388630.901	53.1	53.1

1.10.2 Report on Flight Line Sidelap - Continued

Adjacent Flight Line 1	Adjacent Flight Line 2	Area 1	Area 2	Overlap Area	Sidelap 1 (%)	Sidelap 2 (%)
00140_Split4	00142_Split2	26817302.873	18624571.259	491807.439	1.8	2.6
00141_Split2	00142_Split1	198478160.18	135986032.766	92893000.056	46.8	68.3
00141_Split3	00142_Split2	169689010.548	117585919.736	78964999.636	46.5	67.2
00142_Split1	00143	21913920.744	29131609.018	14662437.57	66.9	50.3

1.11 Report on Collection Area Buffered by 330 US Survey Feet (Swath Data)

The USGS LiDAR Base Specification Version 1.0 requires: "Data collection for the Defined Project Area, buffered by a minimum of 100 meters, is required. The buffered boundary is the Buffered Project Area. In order that all products are consistent to the edge of the Defined Project Area, all products must be generated to the limit of the Buffered Project Area. Since these areas are being generated, they shall also be delivered."

The purpose of this section is to show LiDAR coverage to the extent of a 100 meter buffer of the project boundary.

Data Source - E:\Pope_Hardin\Swath_LAS
Result Path - E:\Pope_Hardin\QAQC2\1_11\CollectionArea.jpg
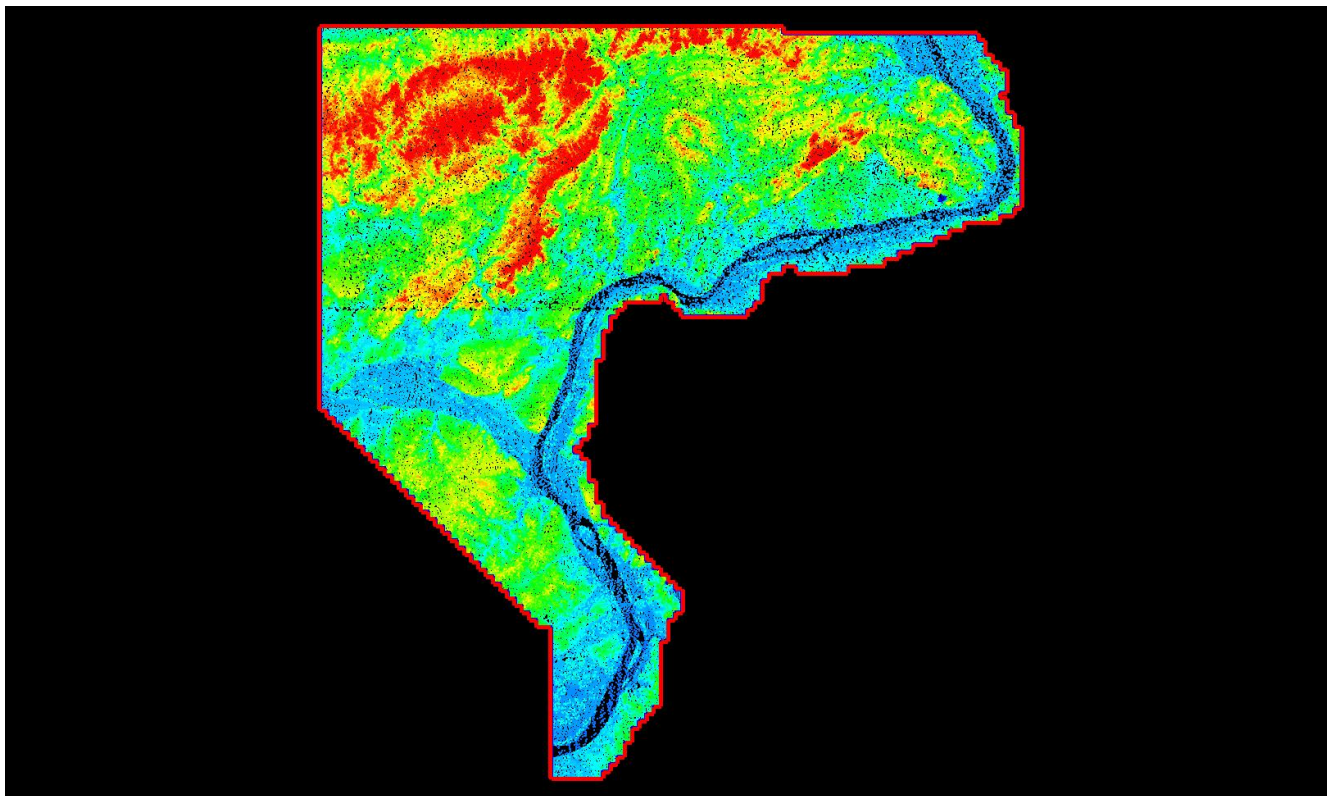
Blue polygon is project boundary
Red polygon is project boundary buffered by 330 US Survey Feet

2.1 Report on ASPRS LAS File Format (Swath Data)

The USGS LiDAR Base Specification Version 1.0 requires: "All processing should be carried out with the understanding that all point deliverables are required to be in fully compliant LAS format, either v1.2 or v1.3. The version selected must be used for all LAS deliverables in the project. Data producers are encouraged to review the LAS specification in detail (ASPRS, 2011)."

The purpose of this section is to show the LAS format for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

All LAS swath files are formatted as LAS 1.2.

2.1 Report on ASPRS LAS File Format (Tiled Data)

The purpose of this section is to show the LAS format for the LiDAR tiled data.

Classified Files - E:\Pope_Hardin\Classified_LAS

All LAS tiled files are formatted as LAS 1.2.

2.2 Report on Full Waveform Data (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "If full waveform data are collected, delivery of the waveform packets is required. LAS v1.3 deliverables with waveform data are to use external auxiliary files with the extension .wdp for the storage of waveform packet data. See the LAS v1.3 Specification for additional information (ASPRS, 2011)."

The purpose of this section is to show the presence of waveform data for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

All LAS swath files have no waveform data present.

2.2 Report on Full Waveform Data (Tiled Data)

The purpose of this section is to show the presence of waveform data for the LiDAR tiled data.

Classified Files - E:\Pope_Hardin\Classified_LAS

All LAS tiled files have no waveform data present.

2.3 Report on Global Positioning System (GPS) Times Type (Swath Data)

The USGS LiDAR Base Specification Version 1.0 requires: "GPS times are to be recorded as Adjusted GPS Time, at a precision sufficient to allow unique timestamps for each pulse. Adjusted GPS Time is defined to be Standard (or satellite) GPS time minus 1*109. See the LAS v1.3 Specification for more detail (ASPRS, 2011)."

The purpose of this section is to show the GPS time type within the LAS files for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

All LAS swath files are formatted as Adjusted GPS Time.

2.3 Report on Global Positioning System (GPS) Times Type (Tiled Data)

The purpose of this section is to show the GPS time type within the LAS files for the LiDAR tiled data.

Classified Files - E:\Pope_Hardin\Classified_LAS

All LAS tiled files are formatted as Adjusted GPS Time.

2.4 Report on Datums (Swath Data)

The USGS LiDAR Base Specification Version 1.0 requires: "All data collected must be tied to the datums listed below:

(1) Horizontal datum reference to the North American Datum of 1983/HARN adjustment (NAD83 HARN) is required.

(2) Vertical datum reference to the North American Vertical Datum of 1988 (NAVD 88) is required.

(3) The most recent National Geodetic Survey (NGS)-approved geoid model is required to perform conversions from ellipsoidal heights to orthometric heights."

The purpose of this section is to show the datums of the LAS files for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

All LAS swath files are defined as:

      EPSG Code = None
      Vertical Datum = NAVD88 - Geoid12A (Feet)

2.4 Report on Datums (Tiled Data)

The purpose of this section is to show the datums of the LAS files for the LiDAR tiled data.

Classified Files - E:\Pope_Hardin\Classified_LAS

All LAS tiled files are defined as:

    EPSG Code = None
    Vertical Datum = NAVD88 - Geoid12A (Feet)

2.5 Report on Coordinate Reference System (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "The USGS preferred Coordinate Reference System for the Conterminous United States (CONUS) is Universal Transverse Mercator UTM, NAD83 HARN, Meters; NAVD88, Meters. Each discrete project is to be processed using the single predominant UTM zone for the overall collection area. The USGS will also accept data in other Coordinate Reference Systems that meet the conditions below:

(1) State Plane and State Coordinate Reference Systems that have been accepted by the European Petroleum Survey Group (EPSG) may be used.

(2) Coordinate Reference Systems for collections in Alaska, Hawaii, and other areas Outside the Conterminous United States (OCONUS) must be approved by the USGS before collection."

The purpose of this section is to show the projections of the LAS files for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

All LAS swath files are defined as:

     EPSG Code = 32767
     Projection = EPSG Code: 32767   Horizontal Units: US Survey Feet   Vertical Units: US Survey Feet   Projection: NAD_1983_20

2.5 Report on Coordinate Reference System (Tiled Data)

The purpose of this section is to show the projections of the LAS files for the LiDAR tiled data.

Classified Files - E:\Pope_Hardin\Classified_LAS

All LAS tiled files are defined as:

EPSG Code = 32767
Projection = EPSG Code: 32767   Horizontal Units: US Survey Feet   Vertical Units: US Survey Feet   Projection: NAD_1983_20

2.6 Report on Units of Reference (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "All references to the unit of measure "Feet" and "Foot" must specify "International", "Intl", "U.S. Survey", or "US"."

The purpose of this section is to show the horizontal and vertical units of the LAS files for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

All LAS swath files are defined as:

      Horizontal Unit = US Survey Feet
      Vertical Unit = US Survey Feet

2.6 Report on Units of Reference (Tiled Data)

The purpose of this section is to show the horizontal and vertical units of the LAS files for the LiDAR tiled data.

Classified Files - E:\Pope_Hardin\Classified_LAS

All LAS tiles files are defined as:

      Horizontal Unit = US Survey Feet
      Vertical Unit = US Survey Feet

2.7 Report on Swath Size and Segmentation (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "Swath files will be 2 gigabytes (GB) in size or less. Long swaths (those which result in a LAS file larger than 2 GB) will be split into segments no greater than 2 GB each.
(1) Each sub-swath will retain the original File Source ID of the original complete swath.
(2) Points within each sub-swath will retain the Point Source ID of the original complete swath.
(3) Each sub-swath file will be named identically to the original complete swath, with the addition of an ordered alphabetic suffix to the name ("-a", "-b" … "-n"). The order of the named sub-swaths shall be consistent with the collection order of the points ("-a" will be the chronological beginning of the swath; "-n" will be the chronological end of the swath).
(4) Point families shall be maintained intact within each sub-swath.
(5) Sub-swaths should be broken at the edge of the scan line.
(6) Other swath segmentation approaches may be acceptable, with prior approval."

The purpose of this section is to show the files sizes of the LAS files for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

There are 0 swath files over 2 GB in size.

2.8 Report on File Source ID (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "Each swath will be assigned a unique File Source ID. It is required that the Point Source ID field for each point within each LAS swath file be set equal to the File Source ID before any processing of the data. See the LAS v1.3 Specification (ASPRS, 2011)."

The purpose of this section is to report on the File Source ID and Point Source ID values for the LiDAR swath data. Note that sub-swaths of original swaths (see Test 2.7) may violate the unique values specification described in this test.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

There are 83 unique Point Source IDs.
There are 83 unique File Source IDs.
141 files are in violation with duplicated File Source ID or Point Source ID values.

This is in violation of the USGS LiDAR Base Specification Version 1.0 which states that each swath shall be assigned a unique File Source ID. The Point Source ID field for each point within each LAS swath file shall be set equal to the File Source ID prior to any processing of the data. Again, note that this requirement may be violated when sub-swaths of original swaths (to comply with Test 2.7) are present in the folder being tested.

2.9 Report on Point Families (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "Point families (multiple return "children" of a single "parent" pulse) shall be maintained intact through all processing before tiling. Multiple returns from a given pulse will be stored in sequential (collected) order."

The purpose of this section is to report on the presence and integrity of point families for the LiDAR swath data.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

All LAS swath files have point families present.

2.9 Report on Point Families (Tiled Data)

The purpose of this section is to report on the presence and integrity of point families for tiled data.

Classified Files - E:\Pope_Hardin\Classified_LAS

All LAS tiled files have point families present.

2.10 Report on Scope of Collection / Swath Coverage

The USGS LiDAR Base Specification Version 1.0 states: "All collected swaths are to be delivered as part of the Raw Data Deliverable. This includes calibration swaths and crossties. This in no way requires or implies that calibration swath data are to be included in product generation. All collected points are to be delivered. No points are to be deleted from the swath LAS files. Excepted from this are extraneous data outside of the buffered project area (aircraft turns, transit between the collection area and airport, transit between fill-in areas, and the like). These points may be permanently removed. Busted swaths that are being completely discarded by the vendor and re-flown do not need to be delivered."

The purpose of this section is to show the presence and extent of all LiDAR swath data files.

Data Source - E:\Pope_Hardin\Swath_LAS
Result Path - E:\Pope_Hardin\QAQC2\2_10\CollectionArea.jpg

Blue polygon is project boundary
Red polygon is project boundary buffered by 330 US Survey Feet

2.11 Report on Noise Classes and Withheld Points (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states: "Outliers, blunders, noise points, geometrically unreliable points near the extreme edge of the swath, and other points the vendor deems unusable are to be identified using the Withheld flag, as defined in the LAS specification. This applies primarily to points that are identified during pre-processing or through automated post-processing routines. If processing software is not capable of populating the Withheld bit, these points may be identified using Class=11. Noise points subsequently identified during manual Classification and Quality Assurance/Quality Control (QA/QC) may be assigned the standard LAS classification value for Noise (Class=7), regardless of whether the noise is "low" or "high" relative to the ground surface."

The purpose of this section is to list the presence and quantities of noise and withheld points for all LiDAR swath data files.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

Class 7	0
Class 11	0
Withheld	0

2.11 Report on Noise Classes and Withheld Points (Tiled Data)

The purpose of this section is to list the presence and quantities of noise and withheld points for all LiDAR tiled data files.

Classified Files - E:\Pope_Hardin\Classified_LAS

Class 7   1942594
Class 11   0
Withheld   0

2.12 Report on Overlap Points (Swath Data)

The USGS LiDAR Base Specification Version 1.0 states:

(1) ALL points not identified as Withheld are to be classified.

(2) No points in the Classified LAS deliverable will be assigned Class=0.

(3) Use of the ASPRS/LAS Overlap classification (Class=12) is prohibited.

If overlap points are required to be differentiated by the data producer or cooperating partner, they must be identified using a method that does not interfere with their classification:

(1) Overlap points are tagged using Bit:0 of the User Data byte, as defined in the LAS specification. (SET=Overlap).

(2) Overlap points are classified using the Standard Class values + 16.

(3) Other techniques as agreed upon in advance.

The technique used to identify overlap must be clearly described in the project metadata files.

Note: A standard bit flag for identification of overlap points has been included in LAS v1.4, released on November 14, 2011.

The purpose of this section is to list the presence and quantities of overlap and unclassified points for all LiDAR swath data files.

Boresighted Files - E:\Pope_Hardin\Swath_LAS

Class 12   0

2.12 Report on Overlap Points (Tiled Data)

The purpose of this section is to list the presence and quantities of overlap and unclassified points for all LiDAR tiled data files.

Classified Files - E:\Pope_Hardin\Classified_LAS

Class 12   0

2.13.1 Report on Positional Accuracy Validation

The USGS LiDAR Base Specification Version 1.0 states that: "Before classification of and development of derivative products from the point cloud, verification of the vertical accuracy of the point cloud, absolute and relative, is required. The Fundamental Vertical Accuracy (absolute) is to be assessed in clear, open areas as described in the section called Vertical Accuracy above. Swath-to-swath and within swath accuracies (relative) are to be documented. A detailed report of this validation process is a required deliverable."

The purpose of this section is to compare the fundamental vertical accuracy of the LiDAR swath data and the tiled data measured against surveyed ground check points. The reason for this comparison is to ensure that inappropriate steps were not taken after the filtering process to "warp" the LiDAR data to control/check points. The control check statistics of each dataset should look very similar, with only constant offsets as differences or variations due to the filtering process.

This reports only the Fundamental Vertical Accuracy (FVA)
E:\Pope_Hardin_Counties\QAQC_final\2_13\Report_PositionalAccuracy.csv
Vertical Units: US Survey Feet (/Meter)

	Boresighted Data	Classified Data
Control Points	20	20
Points with Coverage	20	20
Points With Required Accuracy	20	20
Percent of Points With Required Accuracy	100.000%	100.000%
Average Z Error	0.140/0.043	0.091/0.028
Maximum Z Error	0.520/0.158	0.365/0.111
Median Z Error	0.103/0.031	0.107/0.033
Minimum Z Error	-0.187/-0.057	-0.308/-0.094
NSSDA Vertical Accuracy at the 95 confidence level	0.432/0.132	0.336/0.102
Standard Deviation (sigma) of Z for Sample	0.175/0.053	0.149/0.045
RMSE of Z for Sample	0.220/0.067	0.171/0.052
FGDC/NSSDA/FEMA Contour Interval	0.800/0.244	0.600/0.183
ASPRS Contour Interval	0.700/0.213	0.600/0.183
NMAS Contour Interval	0.800/0.244	0.600/0.183

2.13.2 Overview of Separation between Boresighted and Classified

The purpose of this section is to graphically show the vertical separation deltas (after removing any constant vertical distance offset – i.e., shift) between the swath data and the tiled data. The graphic should look entirely green. If there is a checkerboard pattern of colors, it is highly likely that the tiled data was warped to fit the control check points. This unauthorized practice is also known as custom error geoid adjustment.

This reports only the Fundamental Vertical Accuracy (FVA)
E:\Pope_Hardin\QAQC2\2_13\Separation_Boresighted_With_Classified.jp2

| 0 | 0.16 | 0.33 | 0.49 | 0.66 (US Survey Feet) |
| 0 | 0.05 | 0.10 | 0.15 | 0.20 (Meter) |
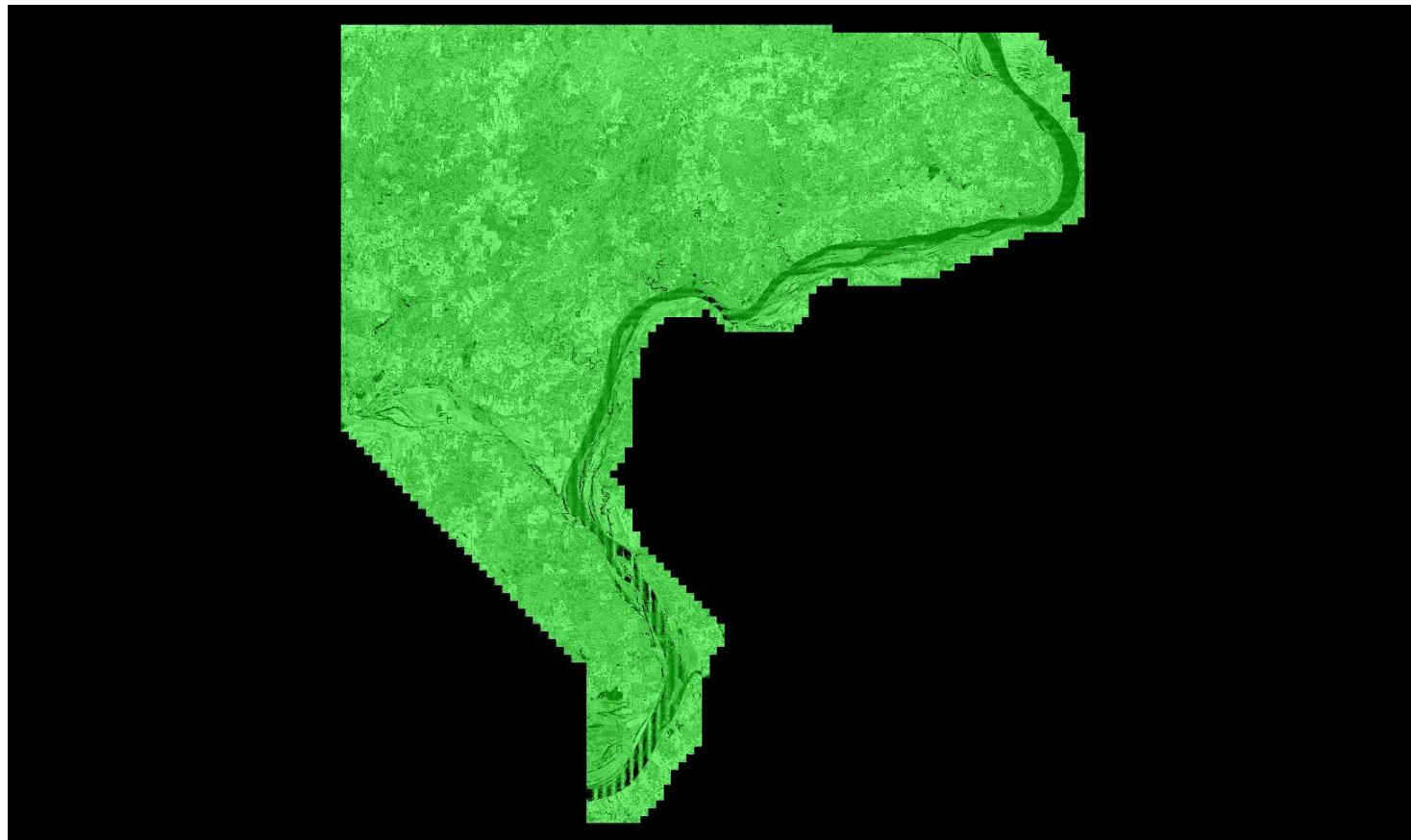
2.14 Report on Classification Accuracy
   – Hillshade Displayed with 1 km X 1km tiles Overlayed

The USGS LiDAR Base Specification Version 1.0 states that: "It is required that due diligence in the classification process will produce data that meet the following tests:

(1) Following classification processing, no non-withheld points should remain in Class 0.

(2) Within any 1 kilometer (km) x 1 km area, no more than 2 percent of non-withheld points will possess a demonstrably erroneous classification value.

(3) Points remaining in Class 1 that should be classified in any other required Class are subject to these accuracy requirements and will be counted towards the 2 percent threshold.

Note: These requirements may be relaxed to accommodate collections in areas where the USGS agrees classification to be particularly difficult.

The purpose of this section is to overlay a 1km x 1km tile scheme over the bare earth surface hillshade product to use for ground filter QC inspections.

Data Source - E:\Pope_Hardin\Classified_LAS

Result Path - E:\Pope_Hardin\QAQC2\2_14_15\Hillshade_SingleFile.jp2

Tile Shapefile - E:\Pope_Hardin\QAQC2\2_14_15\tile.shp
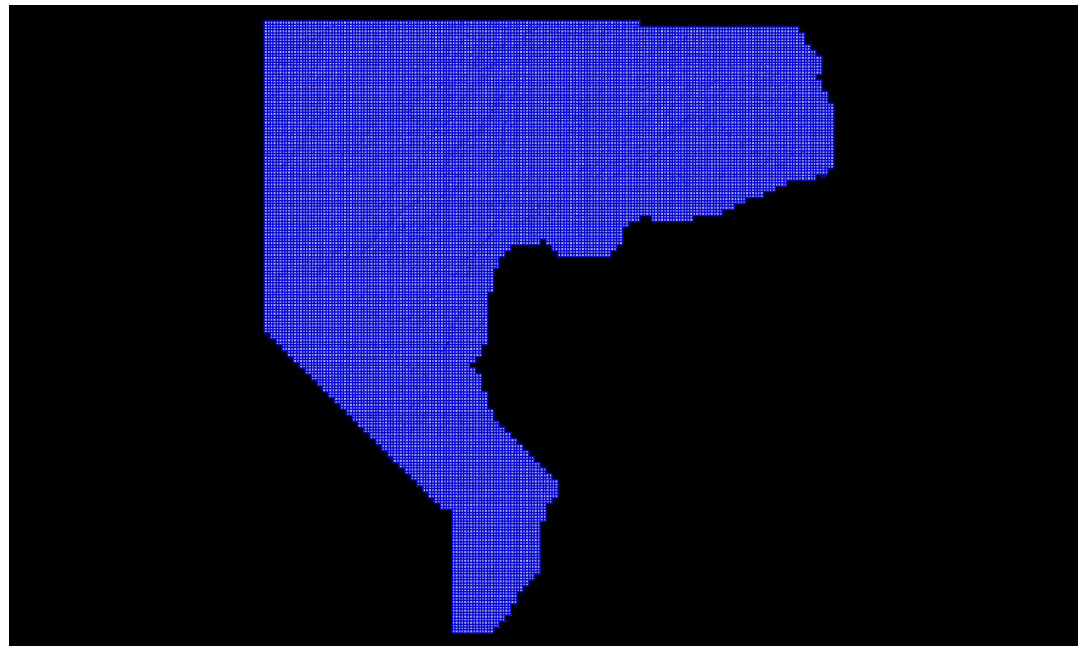
2.15 Report on Classification Consistency – Hillshade Displayed

The USGS LiDAR Base Specification Version 1.0 states that: "Point classification is to be consistent across the entire project. Noticeable variations in the character, texture, or quality of the classification between tiles, swaths, lifts, or other non-natural divisions will be cause for rejection of the entire deliverable."

The purpose of this section is to show the bare earth surface hillshade product for classification consistency inspection.

Data Source - E:\Pope_Hardin_Counties\Classified_LAS
Result Path - E:\Pope_Hardin_Counties\QAQC_final\2_14_15\Hillshade_SingleFile.jp2
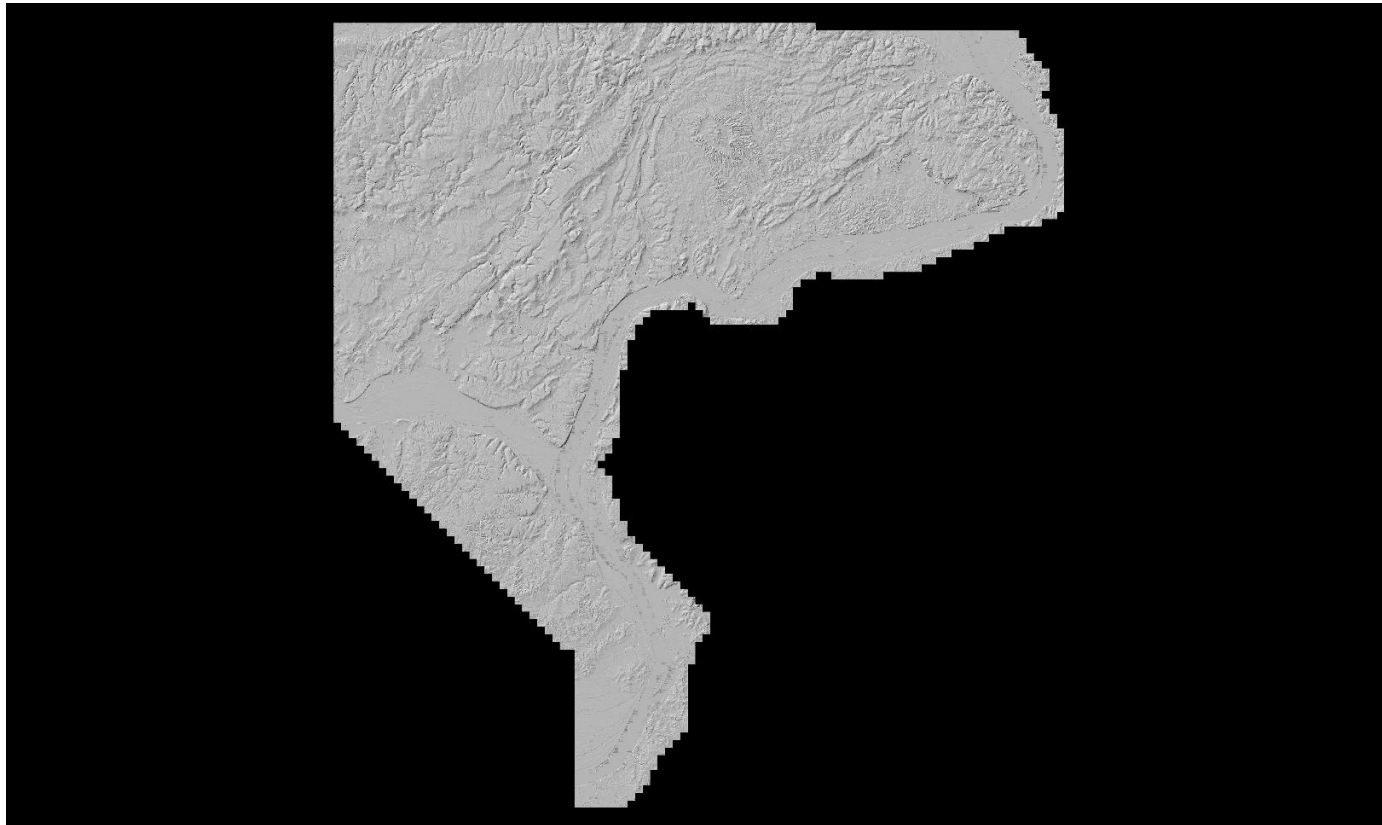
2.16 Report on Tiles

The USGS LiDAR Base Specification Version 1.0 states that:

Tiles:

Note: This section assumes a projected coordinate reference system.

A single non-overlapped tiling scheme (the Project Tiling Scheme) will be established and agreed upon by the data producer and the USGS before collection. This scheme will be used for ALL tiled deliverables.

(1) Tile size is required to be an integer multiple of the cell size of raster deliverables.

(2) Tiles are required to be sized using the same units as the coordinate system of the data.

(3) Tiles are required to be indexed in X and Y to an integer multiple of the tile's X-Y dimensions.

(4) All tiled deliverables will conform to the Project Tiling Scheme, without added overlap.

(5) Tiled deliverables will edge-match seamlessly and without gaps.

The purpose of this section is to report on the unallowed presence of skew and overlap in the project tile scheme.

Tile File: E:\Pope_Hardin\tile_index\tile_index.shp

Units: US Survey Feet

The following lists tiles that are either skewed or overlapped.

Tile	Non-Skewed Tile	Width	Height	Overlap

NONE

The following lists tile widths/heights in the project.

2000.00/2000.00

Skipped Tests

1.7 Overview of Scan Angles Exceeding Limitations
1.12 Report on Collection Conditions

USGS QC Module Input Requirements Matrix

Test number	Boresighted LAS (Swath Data)	Classified LAS (Tiled Data)	Shapefile Tile Scheme	Shapefile Boundary	Shapefile SBET(s)	NPS	LiDAR Check Points	Project Name	Description	Logo	Output Folder	PDF Name
0.0		X	X					X	O	O	X	X
1.1	X	X						X	O	O	X	X
1.2	X	X						X	O	O	X	X
1.3	X			O				X	O	O	X	X
1.4		X	X					X	O	O	X	X
1.5	X			O		X		X	O	O	X	X
1.6	X			O		X		X	O	O	X	X
1.7	X			O	X	X		X	O	O	X	X
1.8	X	X					X	X	O	O	X	X
1.9	X			O				X	O	O	X	X
1.10	X			O		X		X	O	O	X	X
1.11	X			X				X	O	O	X	X
1.12					X			X	O	O	X	X
2.1	X	X						X	O	O	X	X
2.2	X	X						X	O	O	X	X
2.3	X	X						X	O	O	X	X
2.4	X	X						X	O	O	X	X
2.5	X	X						X	O	O	X	X
2.6	X	X						X	O	O	X	X
2.7	X							X	O	O	X	X
2.8	X							X	O	O	X	X
2.9	X	X						X	O	O	X	X
2.10	X			X				X	O	O	X	X
2.11	X	X						X	O	O	X	X
2.12	X	X						X	O	O	X	X
2.13	X	X		X		X	X	X	O	O	X	X
2.14		X				X		X	O	O	X	X
2.15		X						X	O	O	X	X
2.16			X					X	O	O	X	X

X = Required
X = Will use Classified LAS if available, else Boresighted (Swath) LAS
O = Optional
O = Optional for single-area density reporting, but required for multi-area (multiple boundary) reporting of individual and aggregate areas