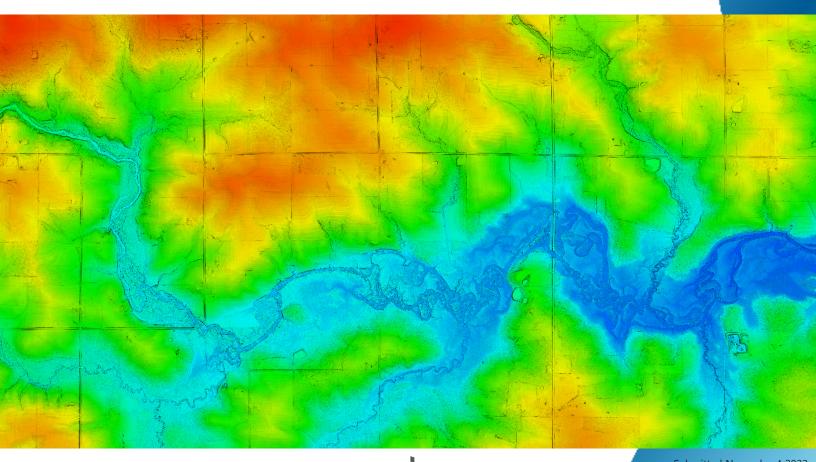
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37876_WI_Statewide_2021_B21 LIDAR PROCESSING REPORT

2022

Submitted:November4,2022

Project ID: 218064 Work Unit: 300034

Prepared for:



National Map Help Desk: tnm_help@usgs.gov

Prepared by:





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1. Summary / Scope

1.1. Summary

This report contains a summary of the 37876_WI_Statewide_2021_B21, Work Unit 300034 lidar acquisition task order, issued by USGS under their Contract G16PC00016 on April 8, 2021. The task order yielded a project area covering 6,730 square miles across 8 counties in Wisconsin with work unit 300034 accounting for 599 square miles in Pierce. The intent of this document is only to provide specific validation information for the data acquisition/collection, processing, and production of deliverables completed as specified in the task order.

1.2. Scope

Aerial topographic lidar was acquired using state of the art technology along with the necessary surveyed ground control points (GCPs) and airborne GPS and inertial navigation systems. The aerial data collection was designed with the following specifications listed in Table 1 below.

Table 1. Originally Planned Lidar Specifications

| Average Point Density | Flight Altitude (AGL) | Field of View | Minimum Side Overlap | RMSEz |
|--------------------------|--------------------------|---------------|-------------------------|---------|
| 2 pts / m ² | 2,300 m | 60° | 20% | ≤ 10 cm |

1.3. Coverage

The project boundary covers 599 square miles over Wisconsin. Project extents are shown in Figure 1.

1.4. Duration

Lidar data was acquired from April 1, 2021 to April 22, 2021 in 6 total lifts. See "Section: 2.4. Time Period" for more details.

1.5. Issues

There were no issues to report.



| Lidar Point Cloud | Classified Point Cloud in .LAS 1.4 format |
|-------------------|--|
| Rasters | 2-foot Hydro-flattened Bare Earth Digital Elevation Model (DEM) in GeoTIFF format 2-foot Intensity images in GeoTIFF format |
| Vectors | Shapefiles (*.shp) Project Boundary Lidar Tile Index Calibration and QC Checkpoints (NVA/VVA) Continuous Hydro-flattened Breaklines |
| Reports | Reports in PDF format • Focus on Delivery • Focus on Accuracy • Survey Report • Processing Report |
| Metadata | XML Files (*.xml) • Breaklines • Classified Point Cloud • DEM • Intensity Imagery |



37876_WI_Statewide_2021_B21 Pierce Work Unit 300034 Boundary

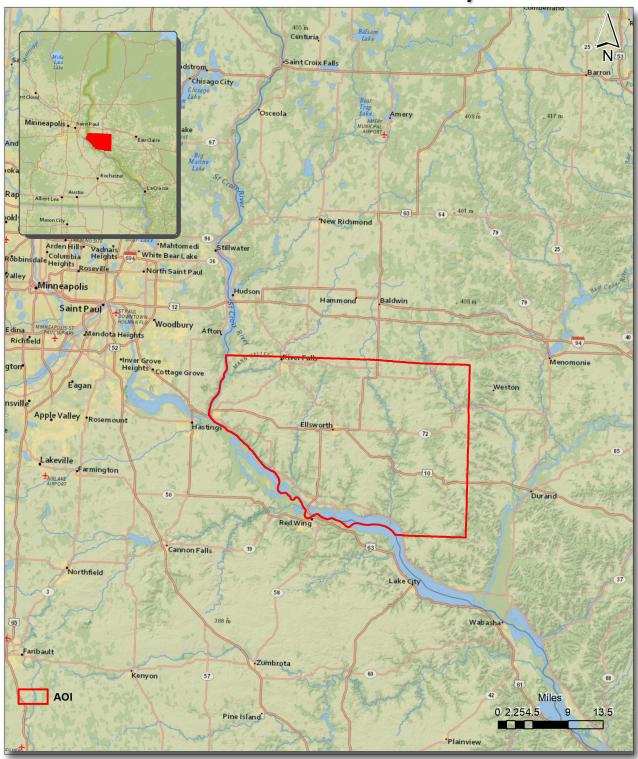


Figure 1. Work Unit Boundary



2. Planning / Equipment

2.1. Flight Planning

Flight planning was based on the unique project requirements and characteristics of the project site. The basis of planning included: required accuracies, type of development, amount / type of vegetation within project area, required data posting, and potential altitude restrictions for flights in project vicinity.

Detailed project flight planning calculations were performed for the project using RiParameter planning software.

2.2. Lidar Sensor

NV5 Geospatial utilized Riegl lidar sensors (Figure 2), serial number(s) 1264 for data acquisition.

The Riegl LMS-Q1560 system has a laser pulse repetition rate of up to 800 kHz. This sensor has forward/backward looking capability and a wide field of view for ultra wide area mapping. There is a two channel scanner that utilizes MTA processing, echo digitization, and waveform analysis.

A brief summary of the aerial acquisition parameters for the project are shown in the lidar System Specifications in Table 2.



Table 2. Lidar System Specifications

| | | Riegl LMS-Q1560 (SN1264) |
|---------------------|-----------------------------|-------------------------------|
| Terrain and | Flying Height | 2300 m |
| Aircraft Scanner | Recommended Ground Speed | 160 kts |
| | Field of View | 60° |
| Scanner | Scan Rate Setting Used | 178 Hz |
| Laser | Laser Pulse Rate Used | 800 kHz |
| | Multi Pulse in Air Mode | yes |
| Carramana | Full Swath Width | |
| Coverage | Line Spacing | 0.558 m |
| Point Spacing | Average Point Spacing | 0.71 m |
| and Density | Average Point Density | 2 x 1.16 pts / m ² |

Figure 2. Riegl LMS-Q1560





2.3. Aircraft

All flights for the project were accomplished through the use of customized planes. Plane type and tail numbers are listed below.

Lidar Collection Planes

Piper Navajo, Tail Number(s): C-GJMT

These aircraft provided an ideal, stable aerial base for lidar acquisition. These aerial platforms have relatively fast cruise speeds, which are beneficial for project mobilization / demobilization while maintaining relatively slow stall speeds, proving ideal for collection of high-density, consistent data posting using a state-of-the-art Riegl VQ1560i, VQ1560ii, LMS-Q1560 lidar systems. Some of NV5 Geospatial's operating aircraft can be seen in Figure 3 below.



Figure 3. Some of NV5 Geospatial's Planes



2.4. Time Period

Project specific flights were conducted between April 1, 2021 to April 22, 2021. Six aircraft lifts were completed. Accomplished lifts are listed below.

| Lift | Start UTC | End UTC |
|---------------------------|----------------------|-----------------------|
| 04012021A (SN1264,C-GJMT) | 4/01/2021 4:06:09 PM | 4/01/2021 9:38:33 PM |
| 04022021A (SN1264,C-GJMT) | 4/02/2021 1:29:24 PM | 4/02/2021 4:37:40 PM |
| 04032021B (SN1264,C-GJMT) | 4/03/2021 9:01:04 PM | 4/03/2021 10:38:57 PM |
| 04052021A (SN1264,C-GJMT) | 4/05/2021 1:52:13 PM | 4/05/2021 3:11:15 PM |
| 04182021A (SN1264,C-GJMT) | 4/18/2021 1:34:59 PM | 4/18/2021 6:45:49 PM |
| 04222021A (SN1264,C-GJMT) | 4/22/2021 2:03:32 PM | 4/22/2021 6:22:38 PM |
| | | |
| | | |
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3. Processing Summary

3.1. Flight Logs

Flight logs were completed by Lidar sensor technicians for each mission during acquisition. These logs depict a variety of information, including:

- Job / Project #
- Flight Date / Lift Number
- FOV (Field of View)
- Scan Rate (HZ)
- Pulse Rate Frequency (Hz)
- Ground Speed
- Altitude
- Base Station
- PDOP avoidance times
- Flight Line #
- Flight Line Start and Stop Times
- Flight Line Altitude (AMSL)
- Heading
- Speed
- Returns
- Crab

Notes: (Visibility, winds, ride, weather, temperature, dew point, pressure, etc). Project specific flight logs for each sortie are available in Appendix A.



3.2. Lidar Processing

Applanix + POSPac software was used for post-processing of airborne GPS and inertial data (IMU), which is critical to the positioning and orientation of the lidar sensor during all flights. Applanix POSPac combines aircraft raw trajectory data with stationary GPS base station data yielding a "Smoothed Best Estimate Trajectory" (SBET) necessary for additional post processing software to develop the resulting geo-referenced point cloud from the lidar missions.

During the sensor trajectory processing (combining GPS & IMU datasets) certain statistical graphs and tables are generated within the Applanix POSPac processing environment which are commonly used as indicators of processing stability and accuracy. This data for analysis include: max horizontal / vertical GPS variance, separation plot, altitude plot, PDOP plot, base station baseline length, processing mode, number of satellite vehicles, and mission trajectory.

Point clouds were created using the RiPROCESS software. The generated point cloud is the mathematical three dimensional composite of all returns from all laser pulses as determined from the aerial mission. The point cloud is imported into GeoCue distributive processing software. Imported data is tiled and then calibrated using TerraMatch and proprietary software. Using TerraScan, the vertical accuracy of the surveyed ground control is tested and any bias is removed from the data. TerraScan and TerraModeler software packages are then used for automated data classification and manual cleanup. The data are manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler.

DEMs and Intensity Images are then generated using proprietary software. In the bare earth surface model, above-ground features are excluded from the data set. Global Mapper is used as a final check of the bare earth dataset.

Finally, proprietary software is used to perform statistical analysis of the LAS files.

| Software | Version |
|-------------------|-------------|
| Applanix + POSPac | 8.6 |
| RiPROCESS | 1.8.6 |
| GeoCue | 2020.1.22.1 |
| Global Mapper | 19.1;20.1 |
| TerraModeler | 21.008 |
| TerraScan | 21.016 |
| TerraMatch | 21.007 |



3.3. LAS Classification Scheme

The classification classes are determined by Lidar Base Specifications 2020, Revision A and are an industry standard for the classification of lidar point clouds. All data starts the process as Class 1 (Unclassified), and then through automated classification routines, the classifications are determined using TerraScan macro processing.

The classes used in the dataset are as follows and have the following descriptions:

Table 3. LAS Classifications

| | Classification Name | Description |
|----|-----------------------------|---|
| 1 | Processed, but Unclassified | Laser returns that are not included in the ground class, or any other project classification |
| 2 | Bare earth | Laser returns that are determined to be ground using automated and manual cleaning algorithms |
| 7 | Low Noise | Laser returns that are often associated with scattering from reflective surfaces, or artificial points below the ground surface |
| 9 | Water | Laser returns that are found inside of hydro features |
| 17 | Bridge Deck | Laser returns falling on bridge decks |
| 18 | High Noise | Laser returns that are often associated with birds or artificial points above the ground surface |
| 20 | Ignored Ground | Ground points that fall within the given threshold of a collected hydro feature. |



3.4. Classified LAS Processing

The bare earth surface is then manually reviewed to ensure correct classification on the Class 2 (Ground) points. After the bare- earth surface is finalized; it is then used to generate all hydro-breaklines through heads-up digitization.

All ground (ASPRS Class 2) lidar data inside of the Lake Pond and Double Line Drain hydro flattening breaklines were then classified to water (ASPRS Class 9) using proprietary tools. A buffer of 3 feet was also used around each hydro flattened feature to classify these ground (ASPRS Class 2) points to Ignored ground (ASPRS Class 20). All Lake Pond Island and Double Line Drain Island features were checked to ensure that the ground (ASPRS Class 2) points were reclassified to the correct classification after the automated classification was completed.

Any noise that was identified either through manual review or automated routines was classified to the appropriate class (ASPRS Class 7 and/or ASPRS Class 18) followed by flagging with the withheld bit.

All data was manually reviewed and any remaining artifacts removed using functionality provided by TerraScan and TerraModeler. Global Mapper is used as a final check of the bare earth dataset. GeoCue was then used to create the deliverable industry-standard LAS files for all point cloud data. NV5 Geospatial's proprietary software was used to perform final statistical analysis of the classes in the LAS files, on a per tile level to verify final classification metrics and full LAS header information.

3.5. Hydro-Flattened Breakline Processing

Class 2 lidar was used to create a bare earth surface model. The surface model was then used to heads-up digitize 2D breaklines of Inland Streams and Rivers with a 100 foot nominal width and Inland Ponds and Lakes of 2 acres or greater surface area.

Elevation values were assigned to all Inland streams and rivers using NV5 Geospatial's proprietary software.

All ground (ASPRS Class 2) lidar data inside of the collected inland breaklines were then classified to water (ASPRS Class 9) using TerraScan macro functionality. A buffer of 3 feet was also used around each hydro-flattened feature. These points were moved from ground (ASPRS Class 2) to Ignored Ground (ASPRS Class 20).

The breakline files were then translated to Esri file geodatabase format using Esri conversion tools.

Breaklines are reviewed against lidar intensity imagery to verify completeness of capture. All breaklines are then compared to TINs (triangular irregular networks) created from ground only points prior to water classification. The horizontal placement of breaklines is compared to terrain features and the breakline elevations are compared to lidar elevations to ensure all breaklines match the lidar within acceptable tolerances. Some deviation is expected between breakline and lidar elevations due to monotonicity, connectivity, and flattening rules that are enforced on the breaklines. Once completeness, horizontal



placement, and vertical variance is reviewed, all breaklines are reviewed for topological consistency and data integrity using a combination of Esri Data Reviewer tools and proprietary tools.

3.6. Hydro-Flattened Raster DEM Processing

Hydro-Flattened DEMs (topographic) represent a lidar-derived product illustrating the grounded terrain and associated breaklines (as described above) in raster form. NV5 Geospatial's proprietary software was used to take all input sources (bare earth lidar points, bridge and hydro breaklines, etc.) and create a Triangulated Irregular Network (TIN) on a tile-by-tile basis. Data extending past the tile edge is incorporated in this process so that proper triangulation can occur. From the TIN, linear interpolation is used to calculate the cell values for the raster product. The raster product is then clipped back to the tile edge so that no overlapping cells remain across the project area. A 32-bit floating point GeoTIFF DEM was generated for each tile with a pixel size of 2-foot. NV5 Geospatial's proprietary software was used to write appropriate horizontal and vertical projection information as well as applicable header values into the file during product generation. Each DEM is reviewed in Global Mapper to check for any surface anomalies and to ensure a seamless dataset. NV5 Geospatial ensures there are no void or no-data values (-999999) in each derived DEM. This is achieved by using propriety software checking all cell values that fall within the project boundary. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the DEMs against what is required before final delivery.

3.7. Swath Separation Raster Processing

Swath Separation Images are rasters that represent the interswath alignment between flight lines and provide a qualitative evaluation of the positional quality of the point cloud. NV5 Geospatial proprietary software generated 2-foot raster images in GeoTIFF format using last returns, excluding points flagged with the withheld bit, and using a point-in-cell algorithm. Images are generated with a 75% intensity opacity and (4) absolute 8-cm intervals, see below for interval coloring. Intensity images are linearly scaled to a value range specific to the project area to standardize the images and reduce differences between individual tiles. Appropriate horizontal projection information as well as applicable header values are written to the file during product generation. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the images against what is required before final delivery.





3.8. Maximum Surface Height Raster Processing

Maximum Surface Height rasters (topographic) represent a lidar-derived product illustrating natural and built-up features. NV5 Geospatial's proprietary software was used to take all first-return classified lidar points, excluding those flagged with a withheld bit, and create a Triangulated Irregular Network (TIN) on a tile-by-tile basis. Data extending past the tile edge is incorporated in this process so that proper triangulation can occur. From the TIN, linear interpolation is used to calculate the cell values for the raster product. The raster product is then clipped back to the tile edge so that no overlapping cells remain across the project area. A 32-bit floating point GeoTIFF was generated for each tile with a pixel size of 2-foot. NV5 Geospatial's proprietary software was used to write appropriate horizontal and vertical projection information as well as applicable header values into the file during product generation. Each maximum surface height raster is reviewed in Global Mapper to check for any anomalies and to ensure a seamless dataset. NV5 Geospatial ensures there are no void or no-data values (-999999) in each derived raster. This is achieved by using propriety software checking all cell values that fall within the project boundary. NV5 Geospatial uses a proprietary tool called FOCUS on Delivery to check all formatting requirements of the DEMs against what is required before final delivery.



37876_WI_Statewide_2021_B21 Pierce Work Unit 300034 Tile Layout

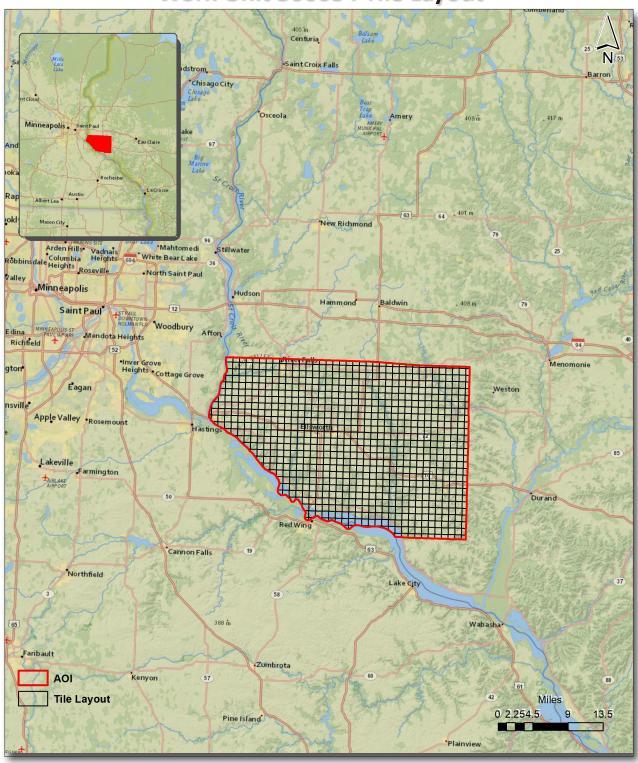


Figure 4. Lidar Tile Layout



4. Project Coverage Verification

Coverage verification was performed by comparing coverage of processed .LAS files captured during project collection to generate project shape files depicting boundaries of specified project areas. Please refer to Figure 5.



37876_WI_Statewide_2021_B21 Pierce Work Unit 300034 Lidar Coverage

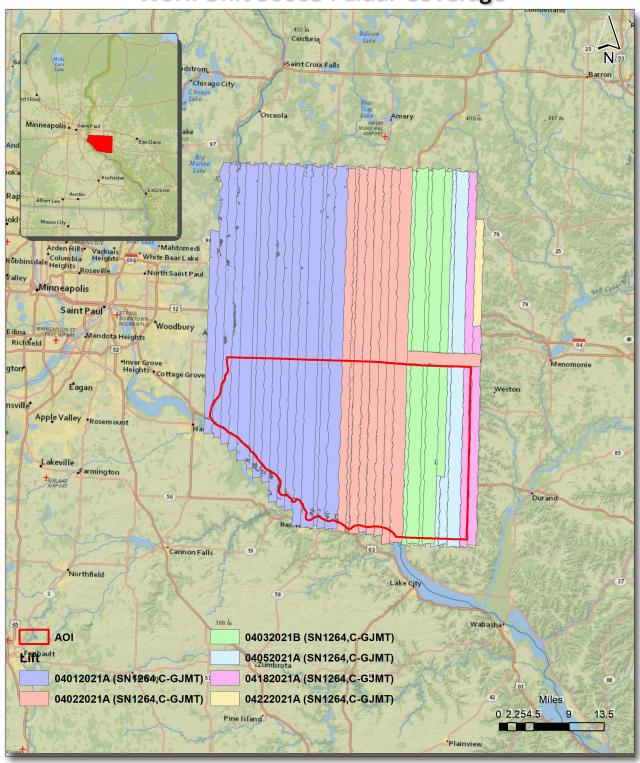


Figure 5. Lidar Coverage



5. Geometric Accuracy

5.1. Horizontal Accuracy

Lidar horizontal accuracy is a function of Global Navigation Satellite System (GNSS) derived positional error, flying altitude, and INS derived attitude error. The obtained RMSEr value is multiplied by a conversion factor of 1.7308 to yield the horizontal component of the National Standards for Spatial Data Accuracy (NSSDA) reporting standard where a theoretical point will fall within the obtained radius 95% of the time. Based on a flying altitude of 7,545 feet, an IMU error of 0.002 decimal degrees, and a GNSS positional error of 0.015 meters (0.049 ft), this project was compiled to meet 0.25 (0.82 ft) meter horizontal accuracy at the 95% confidence level. A summary is shown below.

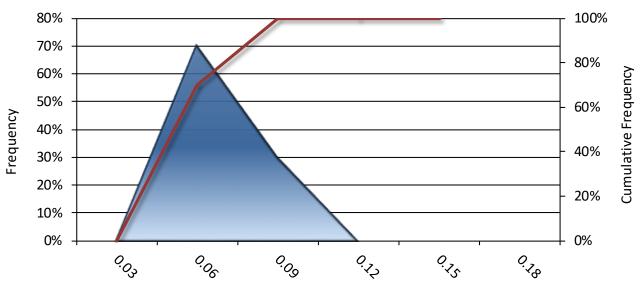
| Horizontal Accuracy | | |
|---------------------|---------|--|
| RMSE _r | 0.47 ft | |
| | 0.14 m | |
| ACC _r | 0.82 ft | |
| | 0.25 m | |



5.2. Relative Vertical Accuracy

Relative vertical accuracy refers to the internal consistency of the data set as a whole: the ability to place an object in the same location given multiple flight lines, GPS conditions, and aircraft attitudes. When the lidar system is well calibrated, the swath-to-swath vertical divergence is low (<0.10 meters). The relative vertical accuracy was computed by comparing the ground surface model of each individual flight line with its neighbors in overlapping regions. The average (mean) line to line relative vertical accuracy for the WI_Statewide_2021_B21 project was 0.050 feet (0.015 meters). A summary is shown below.

| Relative Vertical Accuracy | | | |
|----------------------------------|--------------------------|--|--|
| Sample | 117 flight line surfaces | | |
| Average | 0.050 ft | | |
| | 0.015 m | | |
| Median | 0.046 ft | | |
| | 0.014 m | | |
| RMSE | 0.052 ft | | |
| | 0.016 m | | |
| Standard Deviation (1σ) | 0.012 ft | | |
| | 0.003 m | | |
| 1.96σ | 0.023 ft | | |
| | 0.007 m | | |



Pierce County, Wisconsin Relative Vertical Accuracy (ft) Total Compared Points (n = 10,446,343,727)



Project Report Appendices

The following section contains the appendices as listed in the 37876_WI_8_Counties Lidar Project Report.



Appendix A

Flight Logs

| \triangleleft |
|-----------------|
| Flight |
| 112 |
| Day, |
| Julian |



| C-GJMT | System | Riegl Q1560 |
|----------|-----------------|----------------|
| Krista R | Unit | 64 |
| Daniel A | NMI | Applanix AP60 |
| | GPS Rx | Trimble GNSS17 |
| | Scanner 1 Drive | 1 Drive |
| | Scanner 2 Drive | 2 Drive |

Operator

Aircraft

Project 3218_QSI_PierceMarathon | Pilot

April 22, 2021

Date

Location Eau Claire WI Airport

Mission Objective

| System | Riegl Q1560 | |
|-----------------|----------------|--|
| Unit | 64 | |
| IMU | Applanix AP60 | |
| GPS Rx | Trimble GNSS17 | |
| Scanner 1 Drive | 1 Drive | |
| Scanner 2 Drive | 2 Drive | |
| | | |

| Mission Plan | AGL Height 2300 m Pulse Rate 800Khz | Target Speed 160 kts Scan Rate | Laser Current 100 % FOV 60 | |
|---------------------|-------------------------------------|--------------------------------|----------------------------|--|
| Aircraft Block Time | 13:10 Takeoff 13:30 | 18:59 Landing 18:49 | hrs Total 5.3 hrs | |
| 7 | ine On 13:10 | ingine Off 18:59 | al 5.8 hrs | |

| <u> </u> | | | | | | | | | | | | | | |
|---------------------|-------------|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|------|--------|
| Comments | | | | | | | | | | | | | | |
| Mission ID | Time Stamp | ı | 140330 | 142544 | 143928 | 150504 | 152737 | 154958 | 161217 | 163415 | 165537 | ı | ı | 180020 |
| Line Aborted | nmi to End | | | | | | | | | | | | | |
| Line | Time | | | | | | | | | | | | | |
| Time | End | 1350 | 1422 | 1427 | 1458 | 1521 | 1545 | 1606 | 1629 | 1651 | 1658 | 1703 | 1757 | 1801 |
| GPS Tim | Start | 1345 | 1403 | 1425 | 1439 | 1505 | 1527 | 1549 | 1612 | 1634 | 1655 | 1658 | 1752 | 1800 |
| Flight Direction | | ı | 092 | ı | 274 | 092 | 274 | 092 | 274 | 092 | | ı | | ı |
| LIDAR | File Name | | | | | | | | | | | | | |
| | Flight Line | F8 | 1028 | X-Tie | 1006 | 1005 | 1004 | 1003 | 1002 | 1001 | X-Tie | F8 | F8 | X-Tie |

180845

1823 1828

1808 1823

181

1062 F8

| ⋖ |
|------------|
| Flight |
| 112 |
| Julian Day |



A Clean Harbors Company

| | | | | ļ |
|-------------------|---|----------|----------|----------|
| Date / | April 22, 2021 | Aircraft | C-GJMT | |
| Project 3218 | Project 3218_QSI_PierceMarathon Pilot | Pilot | Krista R | |
| Location Ea | Location Eau Claire WI Airport | Operator | Daniel A | |
| Mission Objective | ive | | | |
| | | | | <u> </u> |
| | | | | |

| System | Riegl Q1560 | |
|-----------------|----------------|--|
| Unit | 64 | |
| NMI | Applanix AP60 | |
| GPS Rx | Trimble GNSS17 | |
| Scanner 1 Drive | 1 Drive | |
| Scanner 2 Drive | 2 Drive | |
| | | |

| System | Riegl Q1560 | ĕ |
|-----------------|----------------|---|
| Unit | 64 | _ |
| NMI | Applanix AP60 | |
| GPS Rx | Trimble GNSS17 | ⋖ |
| Scanner 1 Drive | 1 Drive | ㅗ |
| Scanner 2 Drive | 2 Drive | • |

| | Static | В | GPS Time |
|-----|--------------|----------|----------|
| | Alignment | Start | End |
| | Pre Mission | 1317 | 1322 |
| sgs | Post Mission | 1851 | 1856 |
| | | | |

800Khz 178

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Takeoff 13:30 Landing 18:49 Total 5.3 hrs

Engine Off 18:59 Engine On 13:10

5.8 hrs

Total

9

% FOV

100 160

Laser Current Target Speed AGL Height

⊙ 50 hr O 100 hr

| Comments | | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|---|
| Mission ID | Time Stamp | | | | | | | | ı |
| Line Aborted | nmi to End | | | | | | | | |
| | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| | Start | | | | | | | | |
| Flight | Direction | | | | | | | | ı |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

Page 2 of 5

| ⋖ |
|------------|
| Flight |
| 112 |
| Julian Day |



| Date | April 22, 2021 | Aircraft | Aircraft C-GJMT | Sysi |
|-------------------|---|----------|-----------------|------|
| Project 32 | Project 3218_QSI_PierceMarathon Pilot | Pilot | Krista R | Unit |
| Location | Location Eau Claire WI Airport Operator | Operator | Daniel A | IMU |
| Mission Objective | jective | | | GPS |
| | | | | Scal |
| | | | | Sca |

| System Riegl Q1560 Unit 64 IMU Applanix AP60 GPS Rx Trimble GNSS17 Scanner 1 Drive Scanner 2 Drive | | |
|---|---------|----------------|
| Rx Iner 1 [| System | Riegl Q1560 |
| Rx nner 1 [| Unit | 64 |
| GPS Rx Trimble GNSS17 Scanner 1 Drive Scanner 2 Drive | IMU | Applanix AP60 |
| Scanner 1 Drive Scanner 2 Drive | GPS Rx | Trimble GNSS17 |
| Scanner 2 Drive | Scanner | 1 Drive |
| | Scanner | 2 Drive |

| System | Riegl Q1560 | Additional Notes |
|-----------------|----------------|-------------------|
| Unit | 64 | T3C |
| MU | Applanix AP60 | %98 -H |
| GPS Rx | Trimble GNSS17 | AMLS-278m |
| Scanner 1 Drive | 1 Drive | Hpa-1016 |
| Scanner 2 Drive | 2 Drive | Time to next main |
| | | |

| | | Comments |
|---|-------------|-------------|
| | Mission ID | Time Stamp |
| | ine Aborted | nmi to End |
| | Line | Time |
| | Time | End |
|] | Sd9 | Start |
| - | Flight | Direction |
| - | I iDAR | File Name |
| | | Flight Line |

m Pulse Rate kts Scan Rate

Mission Plan

Aircraft Block Time

Engine On 13:10 | Takeoff 13:30 Engine Off 18:59 | Landing 18:49 9

Laser Current 100 % FOV 160 2300

Total 5.8 hrs | Total 5.3 hrs

Target Speed AGL Height

| | | | I | | l | | | | | Ī |
|--------------|-------------|--|---|--|---|--|--|--|--|---|
| | Comments | | | | | | | | | |
| Mission ID | Time Stamp | | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | | |
| Line | Time | | | | | | | | | |
| GPS Time | End | | | | | | | | | |
| S49 | Start | | | | | | | | | |
| Flight | Direction | | | | | | | | | |
| LiDAR | File Name | | | | | | | | | |
| | Flight Line | | | | | | | | | |

Page 3 of 5

| ⋖ |
|------------|
| Flight |
| 112 |
| Julian Day |



A Clean Harbors Company

| _ | | ⋖ | | |
|----------------|---|--------------------------------|-------------------|--|
| C-GJMT | Krista R | Daniel A | | |
| Aircraft | Pilot | Operator | | |
| April 22, 2021 | Project 3218_QSI_PierceMarathon Pilot | Location Eau Claire WI Airport | bjective | |
| Date | Project 3; | Location | Mission Objective | |

| System | Riegl Q1560 |
|-----------------|----------------|
| Unit | 64 |
| NWI | Applanix AP60 |
| GPS Rx | Trimble GNSS17 |
| Scanner 1 Drive | 1 Drive |
| Scanner 2 Drive | 2 Drive |

| U Applanix AP60 H- 8 SRx Trimble GNSS17 AMI anner 1 Drive Hpa | ايدا | Riegl Q1560 64 | Additional Notes T3C |
|---|---------|------------------------------|-----------------------|
| | S S | Applanix AP60 Trimble GNSS17 | H- 86% AMI S- 278m |
| | anner ' | 1 Drive | Hpa-1016 |
| anner 2 Drive | anner ; | 2 Drive | Time to next mainte |

| пра-1016 | | | |
|---------------------------|--------------|-------------------------|----------|
| Time to next maintenance: | | ⊙ 50 hr O 100 hr | _ |
| | | | |
| | Static | 49 | GPS Time |
| 800Khz | Alignment | Start | End |
| 178 | Pre Mission | 1317 | 1322 |
| 0 degs | Post Mission | 1851 | 1856 |
| | | | |

m Pulse Rate kts | Scan Rate

2300

AGL Height

Mission Plan

Aircraft Block Time

Engine On 13:10 | Takeoff 13:30

Landing 18:49 Total 5.3 hrs

Engine Off 18:59

hrs

5.8

Total

9

₽ 2 %

100 160

Target Speed Laser Current

| | Comments | | | | | | | |
|--------------------|------------|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | |
| Line Aborted | nmi to End | | | | | | | |
| Line | Time | | | | | | | |
| GPS Time | End | | | | | | | |
| GPS | Start | | | | | | | |
| Flight | Direction | | | | | | | |
| LiDAR File Name | | | | | | | | |
| Flight Line | | | | | | | | |

Page 4 of 5

| ⋖ |
|------------|
| Flight |
| 112 |
| Julian Day |

LIDAR Flight Log



A Clean Harbors Company

| System | Unit | IMO | GPS R | Scanne |
|-----------------|---|--|-------------------|--------|
| Aircraft C-GJMT | Krista R | Daniel A | | |
| Aircraft | | Operator | | |
| April 22, 2021 | Project 3218_QSI_PierceMarathon Pilot | Location Eau Claire WI Airport Operator Daniel A | bjective | |
| Date | Project 32 | Location | Mission Objective | |

| Syctem | |
|-----------------|----------------|
| Oysian | Riegl Q1560 |
| Unit | 64 |
| IMU Ap | Applanix AP60 |
| GPS Rx T | Trimble GNSS17 |
| Scanner 1 Drive | ive |
| Scanner 2 Drive | ive |

| stem | Riegl Q1560 | Addition | tio |
|-------|----------------|-------------------|--------|
| it | 64 |) - T- | \sim |
| | Applanix AP60 | 98 - H | ွတ္တ |
| S Rx | Trimble GNSS17 | AMLS | တ |
| anner | anner 1 Drive | Hpa-1 | Ξ |
| anner | anner 2 Drive | Time to | e E |
| | | | |

| Additional Notes | T3C | %98 -H | AMLS-278m | Hpa-1016 | Time to next maintenance: | Ctat |
|------------------|-----|----------|------------|----------|---------------------------|--------------|
| egl Q1560 | 64 | nix AP60 | ble GNSS17 | | | Mission Plan |

⊙ 50 hr **O** 100 hr

| GPS Time | ent Start End | 1317 1322 | in 1851 1856 | |
|----------|---------------|-------------|--------------|--|
| Static | Alignment | ssion | Post Mission | |
| SE | Alić | Pre Mission | Post | |

800Khz 178

m Pulse Rate kts | Scan Rate

2300

Aircraft Block Time

Engine On 13:10 | Takeoff 13:30

Landing 18:49 Total 5.3 hrs

Engine Off 18:59 5.8 hrs

Total

9

% F0V

100 160

Laser Current Target Speed AGL Height

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| GPS | Start | | | | | | | | |
| Flight | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

Page 5 of 5

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

Date: 4/1/2021

CORS: Gd Temp beg: GPS Unit: Y / N Dep Apr: LLSE Aircraft: 4737W Begin Hobbs: 5794,0 End Hobbs: 5800,3 Total: 6.3 Project: UL LiDAR FOV 58,52 Scan 500 K HZ ₹ Z Sta 1:00 Sta 1: റ Dep Time (Lcl): 10:06 (Z): 15:06 Serial # 4045 റ് (email log daily to flight_log_distribution_list@quantumspatial.com) AGL 236 MpiA Y / Z OAT beg: Sta 2: Sta 2: Proj #: 37876 Pulses in Air റ് End Arr Apt: ICTMT Arr Time (Local): 4729 (Z): 2 120 Avg Terr Pulse Rate °c Altimeter begin: Flyovers: Y / N Flyovers: Y / N Flight Mgmt File: 20210401_504045 Gdspd / 30 + Luy 140 Spacing Pilot: Ban Lydet / Co-Pilot: If Y, times: Sta1) If Y, times: Sta1) end: Sta2) 5ta2) Tot Time Aloft: 6:23 Tech: 1/cal Tollow 200 10t 10t 28 28 Storage Name/*

| × () | Ī | 6 | S | ī | w | 2 | | 0 | 2 | 00 | 1 | | 2 | <u>_</u> | ۸, | Li | ~ | Line # |
|-----------------------|----------------------------|---|-------------------|-----------------------------------|--|-------------------|------------------|------------------|-----------------|-----------------|--------------------|--|----------------------|----------------------------------|--------------------|---|-------------------|---|
| 75 | 5 | S | ? | ~ | 2 | 5 | 7 | S | 7 | N | 7 | 5 | 2 | S | 2 | S | 7 | Hdg |
| K-112 /W 211519 21716 | 9 E1 251112 022500 N | 241 62602 521602 | N 200917 TURBO130 | 2 41 838702224BABI | 17: 555 HD 1758 W | (4) 11 Kby 25/1h1 | 451 01511 122581 | 56 KI | 561 (SNB! 1242A | ifue 3 | (51 EDROR 217561 N | 527 (1554) 821/LII | V 172845 17 403817 2 | 5 171810 17278133 .48/14 2635 -3 | V 17646 171648 132 | > 165602 176518 152 | 051 MHS 164M N | Hdg Start (UTC): End (UTC): Gd Spd |
| 1 211 | 2113 | 505 | 7 W | 6220 | Sibil | 7 1931 | 1111 E | Ori Gressi BARKI | Ē | 18432 18258 1+5 | 2 1808 | 8 175 | 5174 | 0 17: | 11119 | 2/17/5 | 1654 | 2): End (L |
| 91 | 175 | 13 i | 1068 | 1838 | (55 j | i 11 | 101 | المرا أر | 153 | 1 84 | 123 | 31) [18 | 1869 | 1 3/15 | 18 | 18 1 | 7 | лс): |
| | 9 | 42 | 30 | 47 | 5 | 43 | 77 | 6 | 2 | 5 | 33 | 53 | 7 | 2 | 7 | 25 | 05 | Gd Spd |
| | 18/2 | .87/ | 1118 | 2/18 | 1442 | A4/2 | A612 | 189/21255 | 31/2 | 176/12 2570 | 25.52 12/18. | 14/1 | A421 2610 | 188. | 195/21 2165 | 2/3/2 | 115 hs | PDOP/# Sa |
| | 18/2-2495 5 | .87/ 2500 -5 | SHAZ 17/18 | 87/23 2510 | 14721 2525 | 24/22 2540 | 461222545 | 2): | 31/23 2560 | 275 | 1.52 | ,94/10 2580 | 1261 | 926 | (216 | 46/21 266 m | 115h | PDOP/# Sats GPS Altitude Crab |
| | 5 5 | 00 ~ | . 53 | | | | 5 | 55 | Ö | 1 500 | 7 | 0 | | - 58 | S | | HD. | ltitude (|
| | | | 2 | - | 0 4 | 4 | 0 | W. | C | -7 [| 2 | 0 | N | | 3 | 2 | 2 | |
| | } | 2 | 3 | 3 | - | 0 | O | Q, | C | S | 0 1 | O | 0 | 0 | رن | 0 | 10 | Turb (0, -, +) |
| | - ten small thousantervals | and offered on light two list half line | | this starting mid line you by and | touched on 200 ft low to a second mid line | | | | | | | Some lakes the have ice mount looks supplied | | O loster 75ts burning will line | breadwind | trilling Stocked the -160 gives 140 13 in | Fill sun, (4/m a) | FLIGHT UNE NOTES – visibility, clouds, smoke, partial, etc. |

Total Proj Lines: 125

Lines Flown: 17

Lines Remain: 62

Online Time: U. S

Mob Time:

÷

| Eure Personstes as A | | - Company of the Comp | | | And the second s | |
|--|-----|--|--------------|--|--|-------------|
| Stary: 316 Start: 263 End 263 | | mobe total | time time | | 2 SS | Hony ton 28 |
| | | | | | | |
| | | | | | | |
| <760) Sats wandy from 4-8miles | 2 | 37/21 2490 | 632 148 | 119262 | 5 | 6 |
| and (7 6%) sats waring midline | + | .85/23 2495 | 812 138 | 23838 23812 | N | h) |
| 0 | w | 148/22 2500 | 254 142 | 230212 23254 142 | 5 2 | 8 |
| C Latt 2.56 | | 2530 | 144 | 96852V 809622 | 7 | 120 |
| The Note | - | 1 | - | Start Stap | S -30H | CIME A HACE |
| Annival KLSTE 8:15 1641, 115 & Hotel eloft: 2:48 | 313 | Junival KL | | 1/1/21 B WI SPEP 37876 1/1/21 B WI SPEP 37876 | IM 4 | 12/1/51 |

Airborne LiDAR Data Collection Log Sheet :: Quantum Spatial, Inc

Date: 4/2/202

email log daily to flight_log_distribution_list@quantumspatial.com

CORS: Project: WI 3DEP Dep Apt: (C CWA Dep Time (Lct):2.58 GPS Unit: Y / N Aircraft: 4777 Begin Hobbs: 5204.1 LiDAR Gd Temp beg: FOV 58,52 Scan SOO KITZ MPIAY IN In Air Type 156077 \mathfrak{G}/N Sta 1: $\mathfrak{Pf}/$ Sta 1: Serial # YOUS AGE 2300 Mg End: OAT beg: (Z): 19 S8 End Hobbs: Sta 2: Sta 2: Proj #: 37876 റ് Arr Apt: KSDM Total: Pulse Rate Avg Terr Flyovers: Y / N Flyovers: Y / N Altimeter begin: Arr Time (Local): 8, 2 (Z): 12Flight Mgmt File: 202/0402 - 5,44045 - C - 37876 Gdspd 180, Set 18 Power Wodo Pilot: Dan Lulkett Co-Pilot: If Y, times: Sta1) If Y, times: Sta1) PPSM ~ end: Sta2) Sta2) Tot Time Aloft: 5:23 Tech. Noah Edelson S E GB Tot S & Pg L of \ Storage Name/s

| Total Proj Lines | 7 | ~ | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 24 | 20 | \ \ - | 32 | 2 | かん | 25 | 114 | Line # |
|-------------------|------------------------------|---|-----------------------------------|--|--|---|-------------------|--------------|------------------|---|------------------|--------------------|-----------------------------------|--------------------|------------------|----------------|--|--|
| ines: | 2 | ~ | 7 | 5 | 4 | 5 | 1 | S | ? | V | 8 | 2 | > | S | 5 | V | 11 | Mg. |
| | 4613 N | 17be 9531 | 12 42 81 12 45CZ | 23401 5350 | 271856 | 225925 | 224006 | 727117 | 220134 | 215017 | 618812 | 213775 | 354112 | 2(0727 | 821502 | 204762 | 20256 | Start (UTC): End (UTC): |
| Lines Flown: | | 177bs | 1824 | | 231856 233753 151 | 225925 23/124 150 | 224006 55800 14 W | 122117 25961 | 52012 5514P 1192 | 213017 22026 155 | 213817 21407 151 | 213/12 CASISES 155 | N 211456 212547 144 | 151 255112 622 151 | Shi hessa 121502 | 571 BLAM 29103 | 20250 walle 153 | End (UTC): |
| 16,1 | | 1251 | 153 | 148m | 15/ | 150 | hhi | 725 | 148 | 155 | 15/ | 155 | アカ | 151 | 57 | 143 | 153 | Gd Spd |
| Lines | | 106 (22 2500 | 5hh2 52/m | 148 m 85/24 2440 | SHKS 2490 | 11/23 2480 | .95/23 2480 | J4/25 2480 | 36/26 2470 | ash 92158 | 37/25 2475 | 25/24 2475 | 8425 2475 | A4/22 | 2465 | \$123 2476 | 87/23 2270 | PDOP/# Sats GPS Altitude Crab |
| Lines Remain: | | 2500 | Shh | THUB | abbr | 845 | 2480 | 2480 | 2470 | asri | 2475 | 2475 | 2475 | 8-1012 22/14 | 2465 | 2476 | 2470 | GPS Altitud |
| 0 | | 1 ,0 | ox | ك | O | 7-7 | 7 | K | _0 | 19 | ∞ | 19 | 7 | 8 | 7 | 50 | | le Crab |
| 0 | | 1 0 | } | Q | 0 | 0 | 0 | 0 | 0 | 0 | Ö | 0 | Ø | Q | 0 | 0 | -2 b | Turb (0, -, +) |
| Online Time: 4, 3 | rether first 15 seconds to 1 | biref light two s | sporan ught + | <77 bus sab lua | went trape a | -7 0 live dobat spy recording after the | | | | C7 GMs Sels war | | | L764PS SCHSWafe | | | (| hazey slives, hi | |
| Mob Time: 48 | seconds to cover | ame spotas last line | - sporan ight the norther 13 line | the star by | stanetocil, Stehal | edigate la | | | | C7 GMs Sols warney, b seconds from asles in | | | L7649 Serswary widthe 1844 OF ABE | | | | of broken overlast | FLIGHT LINE NOTES - 1 |
| Notes: | over the 1st start | byce light this same spotas last line, sanget during line | | O <7 both Sab harming 23.5 will this court longitudity the | 10 0 the ditest theyer extractions, stated loggy - 3 seconds, 2/2 1, the | | | | | ÷ | | | | | | , | hazen skies, high broken overast, C75sts GNS lunis, heall bys behave the | FLIGHT LINE NOTES – visibility, clouds, smoke, partial, etc. |

duy total: 4,3

Mob Time: 48

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Project 3218_QSI_PierceMarathon

April 01, 2021

Date

Eau Claire WI Airport

Location

Mission Objective

ght A

LIDAR Flight Log

GPS Scar Scar Syst Unit NN. Pilot Andy S-Krista R D.Arteaga C-GJMT Operator Aircraft

| | 1 | | |
|----|---|----------------|-------|
| F | | nner 2 Drive | nner |
| Ĭ | | nner 1 Drive | ınner |
| ₹ | | Trimble GNSS17 | s Rx |
| İ | | Applanix AP60 | |
| Ļ | | 64 | t. |
| Ad | | Riegl VQ-1560 | tem |

| | į | 278m 35 | next maintenance: | | Z | | degs |
|-------------|---------------------------------------|------------|-------------------|----------|-----------|-------------|--------------|
| | | | | Static | Alignment | Pre Mission | Post Mission |
| | e e e e e e e e e e e e e e e e e e e | | O 50 hr O 100 hr | 19 | Start | 1537 | 2211 |
| M A G I N G | A Clean narbors comp | | ľ | GPS Time | End | 1542 | 2216 |

800Khz 89

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Takeoff 15:54 **Landing** 22:08 **Total** 6.2 hrs

Engine Off 22:18 Engine On 15:26

hrs

6.9

Total

9

<u></u> %

100 160

Laser Current **Target Speed AGL Height**

| | LiDAR | Flight | GPS | GPS Time | Line | Line Aborted | Mission ID | |
|-------------|-----------|-----------|-------|----------|------|--------------|------------|----------|
| Flight Line | File Name | Direction | Start | End | Time | nmi to End | Time Stamp | Comments |
| Test Strip | | - | 1602 | 1603 | | | 160220 | |
| X- tie | | _ | 1606 | 1618 | | | 160625 | |
| F8 | | ı | 1624 | 1629 | | | ı | |
| 1030 | | 180 | 1638 | 1647 | | | 163858 | |
| 1031 | | 000 | 1654 | 1706 | | | 165430 | |
| 1032 | | 180 | 1712 | 1724 | | | 174722 | |
| 1033 | | 000 | 1730 | 1742 | | | 173003 | |
| 1034 | | 180 | 1747 | 1800 | | | 174722 | |
| 1035 | | 000 | 1806 | 1819 | | | 180617 | |
| 1036 | | 180 | 1824 | 1838 | | | 182444 | |
| 1037 | | 000 | 1844 | 1857 | | | 184405 | |

190224 192239

1917 1937 1957

1902

180 000 180 000

1038 1039 1040 1041

200230 194227

2018

2002

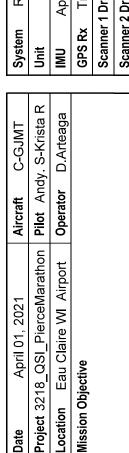
1922 1942

| ⋖ | |
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| Flight | |
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Date



tional Notes



Mission Objective

| Cychom | 0:0.21.7.0.4560 |
|-----------------|-----------------|
| System | Riegi VQ-1000 |
| Unit | 64 |
| NWI | Applanix AP60 |
| GPS Rx | Trimble GNSS17 |
| Scanner 1 Drive | 1 Drive |
| Scanner 2 Drive | 2 Drive |

| /stem | Riegl VQ-1560 | Additional |
|----------------|----------------|------------|
| nit | 64 | T2C |
| ⊋ | Applanix AP60 | H-37% |
| PS Rx | Trimble GNSS17 | AMLS-2 |
| canner 1 Drive | 1 Drive | Hpa-103 |
| canner 2 Drive | 2 Drive | Time to ne |
| | | |

A Clean Harbors Company

| AMLS- 278m Hpa-1035 | Time to next maintenance: | | 800Khz | 89 | sbap (| |
|------------------------|---------------------------|----------|-----------|-------------|--------------|--|
| | | Static | Alignment | Pre Mission | Post Mission | |
| | © 50 hr O 100 hr | d9 | Start | 1537 | 2211 | |
| | _ | GPS Time | End | 1542 | 2216 | |

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Takeoff 15:54 **Landing** 22:08 Total 6.2 hrs

Engine On 15:26 Engine Off 22:18

hrs

6.9

Total

9

₽ 2 %

100 160

Laser Current **Target Speed** AGL Height

| | | | | _ | | | _ | _ | | _ | | _ |
|--------------|-------------|--------|--------|--------|--------|------|---|---|------|---|------|---|
| | Comments | | | | | | | | | | | |
| Mission ID | Time Stamp | 202209 | 204254 | 210256 | 212330 | • | | | | | | |
| Line Aborted | nmi to End | | | | | | | | | | | |
| Line | Time | | | | | | | | | | | |
| Time | End | 2037 | 2058 | 2118 | 2138 | 2144 | | | | | | |
| GPS Time | Start | 2022 | 2042 | 2102 | 2123 | 2139 | | | | | | |
| Fliaht | Direction | 180 | 000 | 180 | 000 | I | | | | | | |
| LiDAR | File Name | | | | | | | | | | | |
| | Flight Line | 1042 | 1043 | 1044 | 1045 | F8 | | | | | | |

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| Flight | |
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| ulian Day | |



| Project 3218_QSI_PierceMarathonPilot Andy. S-Krista RLocationEau Claire WI AirportOperatorD.ArteagaMission Objective | Project 3218_QSI_PierceMarathonPilot Andy. S-Krista RLocationEau Claire WI AirportOperatorD.ArteagaMission Objective | Date | April 01, 2021 | Aircraft | C-GJMT |
|--|--|------------|------------------------|-----------|---------------|
| | | Project 32 | 218_QSI_PierceMarathon | Pilot And | y. S-Krista R |
| Mission Objective | Mission Objective | Location | | Operator | D.Arteaga |
| | | Mission O | bjective | | |
| | | | | | |

| System | Riegl VQ-1560 |
|-----------------|----------------|
| Unit | 64 |
| IMU | Applanix AP60 |
| GPS Rx | Trimble GNSS17 |
| Scanner 1 Drive | Drive |
| Scanner 2 Drive | Drive |

| ystem | Riegl VQ-1560 | Add | ╤ |
|----------------|----------------|-----------------|---------------|
| lnit | 64 | <u>'</u> | |
| NN. | Applanix AP60 | Ψ <u>+</u> | က |
| PS Rx | Trimble GNSS17 | AM | $\overline{}$ |
| canner 1 Drive | 1 Drive | <u>Н</u> | <u></u> |
| canner 2 Drive | 2 Drive | . <u>E</u> — | Ξ |
| | | | ı |

| Additional Notes | Ø | 4 | AIRBORNE |
|---------------------------|--------------|-------------------------|-------------------------|
| T2C | | | A Clean Harbors Company |
| H-37% | | | _ |
| AMLS-278m | | | |
| Hpa-1035 | | | |
| Time to next maintenance: | | © 50 hr O 100 hr | |
| | | | |
| | Static | 49 | GPS Time |
| 800Khz | Alignment | Start | End |
| 89 | Pre Mission | 1537 | 1542 |
| o degs | Post Mission | 2211 | 2216 |

9

% FOV

100 160

Laser Current Target Speed AGL Height

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Takeoff 15:54 **Landing** 22:08 **Total** 6.2 hrs

Engine Off 22:18 Engine On 15:26

6.9 hrs

Total

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| Time | End | | | | | | | | |
| GPS Time | Start | | | | | | | | |
| Fliaht | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

Page 3 of 5

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|-----------------|
| Flight |
| 091 |
| ulian Day |



Project 3218_QSI_PierceMarathon | Pilot Andy. S-Krista R

Location Eau Claire WI Airport

Mission Objective

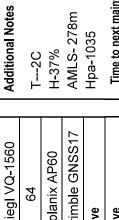
C-GJMT

Aircraft

April 01, 2021

Date

Operator D.Arteaga



| System | Riegl VQ-1560 | Additional No |
|-----------------|----------------|---------------|
| Unit | 64 | T2C |
| IMU | Applanix AP60 | H-37% |
| GPS Rx | Trimble GNSS17 | AMLS-278 |
| Scanner 1 Drive | 1 Drive | Hpa-1035 |
| Scanner 2 Drive | 2 Drive | Time to next |
| | | |

| Notes | Ş | 4 | AIRBORNE |
|-------|-----------------|--------------------------------|-------------------------|
| | | A Clea | A Clean Harbors Company |
| 78m | | | |
| ıO | | | |
| xt m | xt maintenance: | © 50 hr O 100 hr | |
| | | | |
| | Static | 49 | GPS Time |
| | Alignment | Start | End |
| | Pre Mission | 1537 | 1542 |
| egs | Post Mission | 2211 | 2216 |

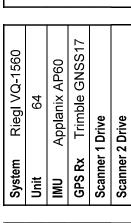
| | Aircraft Block Time | | <u>S</u> | sion | Mission Plan | Static | | |
|---|---------------------|--------------------------------|----------|------|--------------------------|----------------|-----|----|
| Engine On 15:26 Takeoff 15:54 | Takeoff 15:54 | AGL Height | 2300 | Ε | 2300 m Pulse Rate 800Khz | Alignmen | ınt | Ś |
| Engine Off 22:18 Landing 22:08 | Landing 22:08 | Target Speed 160 kts Scan Rate | 160 | cts | Scan Rate 89 | Pre Mission | | 1, |
| Total 6.9 hrs Total 6.2 hrs | Total 6.2 hrs | Laser Current 100 % FOV | 100 | % | .00 degs | s Post Mission | u | 22 |
| | | | | | | | | |

| | | . | | | | | | | | |
|-------------------------------------|----------------------|----------|--------------|-------------|--|--|--|--|--|---|
| 1342 | 2216 | | | S | | | | | | Ī |
| 1001 | 2211 | | Comments | | | | | | | Ī |
| rie mission | Post Mission | | | | | | | | | |
| _ | P | | | | | | | | | |
| 60 | sbep | | Mission ID | Time Stamp | | | | | | |
| ocall rate | FOV 60 | | Line Aborted | nmi to End | | | | | | |
| IOO KIS | 100 % | | Line | Time | | | | | | |
| I alget Speed 100 Kts Scall rate | Laser Current 100 % | | GPS Time | End | | | | | | |
| | | | 3d9 | Start | | | | | | |
| 00 | hrs | | Fliaht | Direction | | | | | | |
| Laliuliy 22. | Total 6.2 hrs | | LiDAR | File Name | | | | | | |
| Flighte Oil 22.10 Latiuitig 22.00 | Fotal 6.9 hrs | | | Flight Line | | | | | | |

| Flight / | |
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LIDAR Flight Log



| Q-1560 Additional | T2C | AP60 H-37% | GNSS17 AMLS-2 | Hpa-103 | |
|-------------------|-----|---------------|----------------|---------|--|
| Riegl VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | Drive | |

| iditional Notes | A |
|--------------------------|-------------------------|
| 2C | A Clean F |
| -37% | |
| MLS-278m | |
| pa-1035 | |
| ime to next maintenance: | © 50 hr O 100 hr |

Clean Harbors Company

| ⊙ 50 hr (|
|------------------|
| |
| maintenance: |
| to next ma |
| me |

| System Riegl VQ-1560 | t 64 | l Applanix AP60 | GPS Rx Trimble GNSS17 | Scanner 1 Drive | Scanner 2 Drive | Mission Plan |
|----------------------|--|---|-----------------------|-----------------|-----------------|---------------------|
| Sys | Unit | IMO | GP | Sca | Sce | |
| Aircraft C-GJMT | Pilot Andy. S-Krista R | Operator D.Arteaga | | | | ne |
| April 01, 2021 | Project 3218_QSI_PierceMarathon Pilot Andy. S-Krista R | Location Eau Claire WI Airport Operator D.Arteaga | Mission Objective | | | Aircraft Block Time |
| Date | Project | Location | Mission | | | |

| Mission | n Plan | | Static | <u>Б</u> | GPS Time |
|---------|-----------------|---------|--------------|----------|-----------------|
| Ε | m Pulse Rate | 800Khz | Alignment | Start | 3 |
| kts | kts Scan Rate | 89 | Pre Mission | 1537 | 11 |
| % | % FOV | 60 degs | Post Mission | 2211 | 77 |
| | | | | | |

2300

AGL Height

Engine On 15:26 | Takeoff 15:54 Engine Off 22:18 | Landing 22:08 **Total** 6.2 hrs

6.9 hrs

Total

100 160

Target Speed Laser Current

2216

1542 End

| Comments | | | | | | | | | |
|---------------------|------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| | Start | | | | | | | | |
| Flight Direction | | | | | | | | | |
| LiDAR File Name | | | | | | | | | |
| Flight Line | | | | | | | | | |

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LIDAR Flight Log



D.Arteaga

Operator

C-GJMT Andy. S

Aircraft Pilot

Project 3218_QSI_PierceMarathon

April 02, 2021

Date

Location Eau Claire WI Airport

Mission Objective

| Time | r 2 Drive |
|----------|----------------|
| Нра- | 1 Drive |
| AML8 | Trimble GNSS17 |
| H-47 | Applanix AP60 |
| T-80 | 64 |
| Addition | Riegl VQ-1560 |

| Notes | |
|--------|--|
| tional | |
| Addi | |

A Clean Harbors Company AIRBORN IMAGING

.C 7% -S-278m -1028

⊙ 50 hr **O** 100 hr 32hrs to next maintenance:

| | Aircraft Block Time | |
|-----------------|----------------------------------|----------|
| Engine On 12:56 | Takeoff 13:17 | AGL Hei |
| gine Off 17:43 | Engine Off 17:43 Landing 17:35 | Target S |
| Total 4.8 hrs | Total 4.3 hrs | Laser Cu |

| | Σ | issio | Mission Plan | |
|---------------|------|-------|---------------|---------|
| AGL Height | 2300 | Ε | m Pulse Rate | 800Khz |
| Target Speed | 160 | kts | kts Scan Rate | 178 |
| Laser Current | 100 | % | % FOV | eo degs |
| | | | | |

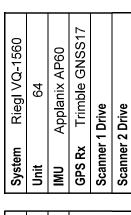
| Static | GP | GPS Time |
|--------------|-------|----------|
| Alignment | Start | End |
| Pre Mission | 1304 | 1308 |
| Post Mission | - | - |

| | LiDAR | Flight | GPS Tim | Time | Line | Line Aborted | Mission ID | |
|-------------|-----------|-----------|---------|------|------|--------------|------------|---|
| Flight Line | File Name | Direction | Start | End | Time | nmi to End | Time Stamp | Comments |
| X-tie | | ı | 1329 | 1336 | | | 132923 | |
| F8 | | 1 | 1344 | 1349 | | | 1 | |
| 1046 | | 180 | 1355 | 1411 | | | 135536 | |
| 1047 | | 000 | 1415 | 1431 | | | 141558 | |
| 1048 | | 180 | 1436 | 1453 | | | 143644 | |
| 1049 | | 000 | 1457 | 1512 | | | 145729 | |
| 1050 | | 180 | 1518 | 1535 | | | 151849 | |
| 1051 | | 000 | 1539 | 1555 | | | 153935 | |
| 1052 | | 180 | 1600 | 1618 | | | 160046 | |
| 1053 | | 000 | 1622 | 1637 | | | 162212 | |
| 1054 | | 180 | | | | | | DR Crashed while aproching the line |
| | | | | | | | | Full system restart and troubleshooting |
| | | | | | | | | for 20 minutes- Riacquire crashed |
| | | | | | | | | |
| | | | | | | | | |

| Flight |
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Flight A

LIDAR Flight Log



D.Arteaga

Operator

C-GJMT Andy. S

Aircraft Pilot

Project 3218_QSI_PierceMarathon

April 02, 2021

Date

Location Eau Claire WI Airport

Mission Objective

| dditional Notes | |
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T--8C H-47% AMLS-278m Hpa-1028

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A I R B O R N G I M G A Clean Harbors Company

Time to next maintenance: 32hrs \odot 50 hr O 100 hr

| lock Time | 13:17 | 17:35 | 3 hrs |
|---------------------|----------------------|------------------|---------------|
| Aircraft Block Time | Takeoff 13:17 | Landing 17:35 | Total 4.3 hrs |
| , | Engine On 12:56 | Engine Off 17:43 | hrs |
| | ou (|) Off | 4.8 |
| | Engine | Engine | Total 4.8 hrs |

| | Σ | issio | Mission Plan | |
|---------------|------|-------|-----------------|----------|
| AGL Height | 2300 | Е | m Pulse Rate | 800Khz |
| Target Speed | 160 | kts | kts Scan Rate | 178 |
| Laser Current | 100 | % | FOV | ego degs |

| Static | GP | GPS Time |
|--------------|-------|----------|
| Alignment | Start | End |
| Pre Mission | 1304 | 1308 |
| Post Mission | - | - |

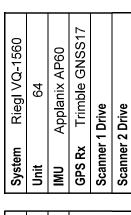
| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|---|
| Mission ID | Time Stamp | | | | | | | | - |
| Line Aborted | nmi to End | | | | | | | | |
| | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| | Start | | | | | | | | |
| Flight | Direction | | | | | | | | - |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

Page 2 of 5

| Flight |
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| 092 |
| ılian Day |

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LIDAR Flight Log



D.Arteaga

Operator

C-GJMT Andy. S

Aircraft Pilot

Project 3218_QSI_PierceMarathon

April 02, 2021

Date

Location Eau Claire WI Airport

Mission Objective

| Additional Notes | T-80 |
|------------------|------|
| | |
| | |

AMLS-278m H-47%

A Clean Harbors Company AIRBORN

Hpa-1028

⊙ 50 hr **O** 100 hr 32hrs Time to next maintenance:

| lock Time | 13:17 | 17:35 | 3 hrs |
|---------------------|-----------------|------------------|---------------|
| Aircraft Block Time | Takeoff | Landing 17:35 | Total 4.3 hrs |
| | Engine On 12:56 | Engine Off 17:43 | hrs |
| | 00 t | off of | 4.8 |
| | Engine | Engine | Total 4.8 hrs |

| | IN | 115510 | MISSION FIAN | |
|---------------|------|---------------|--------------|---------|
| AGL Height | 2300 | ш | Pulse Rate | 800Khz |
| Target Speed | 160 | kts | Scan Rate | 178 |
| Laser Current | 100 | % | % FOV | 60 degs |
| | | | | |

| Static | GP. | GPS Time |
|--------------|-------|----------|
| Alignment | Start | End |
| Pre Mission | 1304 | 1308 |
| Post Mission | - | - |

| | Comments | | | | | | | | |
|--------------|------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| | Start | | | | | | | | |
| Fliaht | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| Flight Line | | | | | | | | | |

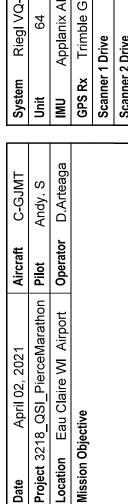
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April 02, 2021

Date

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Mission Objective

| System | Riegl VQ-1560 | ◂ |
|-----------------|----------------|---|
| Unit | 64 | • |
| IMU | Applanix AP60 | _ |
| GPS Rx | Trimble GNSS17 | _ |
| Scanner 1 Drive | 1 Drive | |
| Scanner 2 Drive | 2 Drive | |

| Additional Notes | T8C | H-47% | AMLS-278m | Hpa-1028 | Time to next maint |
|------------------|-----|---------------|----------------|-----------|--------------------|
| Riegl VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | · 1 Drive | · 2 Drive |

| A Clean Harbors Con | 32hrs © 50 hr O 100 hr | GPS Time | ent Start End | 1304 1308 | - u |
|---------------------------------------|---------------------------|----------|---------------|-------------|--------------|
| | | Static | Alignment | Pre Mission | Post Mission |
| T8C H-47% AMLS-278m Hpa-1028 | Time to next maintenance: | | 800Khz | 178 | o degs |

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Landing 17:35 **Takeoff** 13:17

Engine Off 17:43 Engine On 12:56

Total 4.3 hrs

4.8 hrs

Total

9

% F0V

100 160

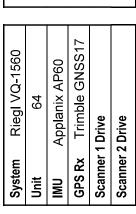
Laser Current Target Speed AGL Height

| | Comments | | | | | | | | |
|--------------|------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| | Start | | | | | | | | |
| Flight | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| Flight Line | | | | | | | | | |

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LIDAR Flight Log



D.Arteaga

Operator

Project 3218_QSI_PierceMarathon

April 02, 2021

Date

Location Eau Claire WI Airport

Mission Objective

C-GJMT Andy. S

Aircraft Pilot

| stem | Riegl VQ-1560 | Addir |
|------|----------------|--------|
| | 64 | H-8 |
| | Applanix AP60 | H 4 |
| S Rx | Trimble GNSS17 | AMI |
| nner | anner 1 Drive | Нра |
| nner | anner 2 Drive | Ë |
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| onal N | |
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A Clean Harbors Company AIRBORN IMAGING

-8C 47% ALS-278m 1a-1028

le to next maintenance:

| | | Aircraft Block Time | |
|---------------|------|----------------------------------|------------|
| <u>-</u> | 2:56 | Engine On 12:56 Takeoff 13:17 | AGL Heigh |
| ₩ 1 | 7:43 | Engine Off 17:43 Landing 17:35 | Target Spe |
| Total 4.8 hrs | | Total 4.3 hrs | Laser Curi |

| | Σ | issio | Mission Plan | |
|---------------|------|-------|-----------------|---------|
| AGL Height | 2300 | Ε | m Pulse Rate | 800Khz |
| Target Speed | 160 | kts | kts Scan Rate | 178 |
| Laser Current | 100 | % | FOV | 60 degs |
| | | | | |

| Static | Alignment | Pre Mission | Post Mission |
|----------|-----------|-------------|--------------|
| 9 | Start | 1304 | - |
| GPS Time | риЭ | 1308 | - |

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| GPS | Start | | | | | | | | |
| Fliaht | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

| Flight |
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| 093 |
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LIDAR Flight Log

Additional Notes



A Clean Harbors Company

| Date April 03, 2021 | 21 | Aircraft | C-GJMT | |
|---|----------|----------|--------------------|---|
| Project 3218_QSI_PierceMarathon Pilot | Marathon | Pilot | Andy. S | |
| Location Eau Claire WI Airport | | Operator | Operator D.Arteaga | |
| Mission Objective | | | | |
| | | | | |
| | | | | _ |

| System | Riegl VQ-1560 |
|-----------------|----------------|
| Unit | 64 |
| NMI | Applanix AP60 |
| SPS Rx | Trimble GNSS17 |
| Scanner 1 Drive | 1 Drive |
| Scanner 2 Drive | 2 Drive |

| System | Riegl VQ-1560 | Additiona |
|-----------------|----------------|------------|
| Unit | 64 | T21C |
| NWI | Applanix AP60 | H-16% |
| SPS Rx | Trimble GNSS17 | AMLS-27 |
| Scanner 1 Drive | 1 Drive | Hpa-101 |
| Scanner 2 Drive | 2 Drive | Time to ne |

AMLS-278m

Hpa-1018

| | | | degs |
|----------|-----------|-------------|--------------|
| Static | Alignment | Pre Mission | Post Mission |
| GP | Start | 2006 | - |
| GPS Time | pug | 2011 | - |

800Khz

m Pulse Rate kts | Scan Rate

2300

AGL Height

Mission Plan

Aircraft Block Time

Takeoff 20:16 Landing 22:58 **Total** 2.7 hrs

Engine On 20:00 Engine Off 23:02

hrs

3.0

Total

178

9

. 2

%

100 160

Target Speed Laser Current

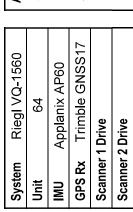
Time to next maintenance:

| | | | | | | | | | ne | | | Γ |
|--------------|-------------|----------------------------------|------------------------|------|--------|--------|--------|--------|--|--|--|---|
| | Comments | Data recorder error- full system | restart and cable swap | | | | | | System crashed after 8 minutes on line | | | |
| Mission ID | Time Stamp | | 204836 | - | 210103 | 212113 | 214306 | 220425 | 222609 | | | |
| Line Aborted | nmi to End | | | | | | | | | | | |
| Line | Time | | | | | | | | 2233 | | | |
| GPS Time | End | | 2049 | 2055 | 2117 | 2138 | 2159 | 2221 | 2226 | | | |
| GPS | Start | | 2048 | 2050 | 2101 | 2121 | 2143 | 2204 | 180 | | | |
| Flight | Direction | - | | - | 180 | 000 | 180 | 000 | 180 | | | |
| LiDAR | File Name | | | | | | | | | | | |
| | Flight Line | Test Strip 01 | Test Strip 02 | F8 | 1054 | 1055 | 1056 | 1057 | 1058 | | | |

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|-------------------|
| Flight |
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| Julian |

LIDAR Flight Log





D.Arteaga

Operator

C-GJMT Andy. S

Aircraft Pilot

Project 3218_QSI_PierceMarathon

April 03, 2021

Date

Location Eau Claire WI Airport

Mission Objective

| system | Riegl VQ-1560 | | Ad |
|-----------------|----------------|---|----|
| Jnit | 64 | | Ė |
| MU | Applanix AP60 | | Ĭ |
| 3PS Rx | Trimble GNSS17 | | ₹ |
| Scanner 1 Drive | 1 Drive | | Ī |
| Scanner 2 Drive | 2 Drive | | - |
| | | • | |

| Additional Notes | T21C | H-16% | AMLS-278m | Hpa-1018 | Time to next maint |
|------------------|------|---------------|----------------|----------|--------------------|
| Riegl VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | 1 Drive | 2 Drive |

| 8m. Static Alignment Start Brost Mission Compared to the Archen Harbors Compared to the Ar |
|--|
| © 50 hr O 100 h Start 2006 |
| |

800Khz 178

m Pulse Rate kts | Scan Rate

2300

AGL Height

Mission Plan

Aircraft Block Time

Takeoff 20:16 Landing 22:58 **Total** 2.7 hrs

Engine Off 23:02 Engine On 20:00

hrs

3.0

Total

9

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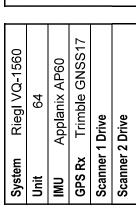
100 160

Target Speed Laser Current

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|---|
| Mission ID | Time Stamp | | | | | | | | - |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| Time | End | | | | | | | | |
| GPS Time | Start | | | | | | | | |
| Flight | Direction | | | | | | | | - |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

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| Flight |
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LIDAR Flight Log



D.Arteaga

Operator

Eau Claire WI Airport

Location

Mission Objective

C-GJMT Andy. S

Aircraft Pilot

Project 3218_QSI_PierceMarathon

April 03, 2021

Date

| Additi | T21 | H-16 | AML | Нра- | Time |
|---------------|-----|---------------|----------------|--------------|--------------|
| Riegl VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | nner 1 Drive | nner 2 Drive |
| tem | _ | | S RX | nner | nner |

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%

100 160

Laser Current **Target Speed AGL Height**

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Takeoff 20:16 Landing 22:58 **Total** 2.7 hrs

Engine On 20:00 Engine Off 23:02

hrs

3.0

Total

| Comments | | | | | | | | | | | | |
|-------------|--------------------------------|--|--|--|--|--|--|--|---|---|--|--|
| Time Stamp | | | | | | | | | | | | |
| nmi to End | | | | | | | | | | | | |
| Time | | | | | | | | | | | | |
| End | | | | | | | | | | | | |
| Start | | | | | | | | | | | | |
| Direction | | | | | | | | | | | | |
| File Name | | | | | | | | | | | | |
| Flight Line | | | | | | | | | | | | |
| | End Time nmi to End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp | File Name Direction Start End Time Stamp Image: Control of the properties of the pr | File Name Direction Start End Time nmi to End Time Stamp Time Stamp | File Name Direction Start End Time Stamp | File Name Direction Start End Time nmi to End Time Stamp |

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| Flight | |
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LIDAR Flight Log



| Date | April 03, 2021 | Aircraft | Aircraft C-GJMT | Ś |
|-------------------|---|----------|-----------------|---|
| Project 32 | Project 3218_QSI_PierceMarathon Pilot | Pilot | Andy S | |
| Location | Location Eau Claire WI Airport Operator D.Arteaga | Operator | D Arteaga | |
| Mission Objective | jective | | | 9 |
| | | | | Š |
| | | | | Š |

| System | Riegl VQ-1560 |
|-----------------|----------------|
| Unit | 64 |
| NMI | Applanix AP60 |
| GPS Rx | Trimble GNSS17 |
| Scanner 1 Drive | 1 Drive |
| Scanner 2 Drive | 2 Drive |

| ystem | Riegl VQ-1560 | Addi |
|----------------|----------------|-----------------|
| nit | 64 | |
| Q Q | Applanix AP60 | <u> </u> |
| PS Rx | Trimble GNSS17 | AM |
| canner 1 Drive | 1 Drive | <u>й</u> — |
| canner 2 Drive | 2 Drive | . <u>⊨</u> — |
| | | |

| dditional Notes F.–21C A Clean Harbors Company H-16% AMLS-278m Hpa-1018 Time to next maintenance: Static Static Alignment Start Bre Mission Contain Harbors Company A Clean Harbors Comp |
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<u>М</u> %

100 160

Laser Current **Target Speed** AGL Height

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Takeoff 20:16 **Landing** 22:58 **Total** 2.7 hrs

Engine On 20:00 Engine Off 23:02 hrs

3.0

Total

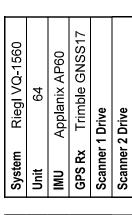
| | Comments | | | | | | | |
|--------------|-------------|------|--|--|------|--|--|--|
| Mission ID | Time Stamp | | | | | | | |
| Line Aborted | nmi to End | | | | | | | |
| Line | Time | | | | | | | |
| GPS Time | End | | | | | | | |
| GPS | Start | | | | | | | |
| Fliaht | Direction | | | | | | | |
| LiDAR | File Name | | | | | | | |
| | Flight Line | | | | | | | |
| | | | | | | | | |

Page 4 of 5

| Flight |
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LIDAR Flight Log



D.Arteaga

Operator

Project 3218_QSI_PierceMarathon | Pilot

April 03, 2021

Date

Location Eau Claire WI Airport

Mission Objective

C-GJMT Andy. S

Aircraft

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next

| O 50 hr O 100 hr | |
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| t maintenance: | |

| , | Aircraft Block Time | | Z | Mis |
|--|----------------------|------------------|------|-----|
| Engine On 20:00 Takeoff 20:16 | Takeoff 20:16 | AGL Height | 2300 | |
| Engine Off 23:02 Landing 22:58 | Landing 22:58 | Target Speed 160 | 160 | ¥ |
| Total 3.0 hrs Total 2.7 hrs | Total 2.7 hrs | Laser Current | 100 | _ |
| | | | | |

| | Σ | Mission | n Plan | | |
|---------------|------|---------|--------------|---------|---|
| AGL Height | 2300 | ш | m Pulse Rate | 800Khz | |
| Target Speed | 160 | kts | Scan Rate | 178 | |
| Laser Current | 100 | % | % FOV | 60 degs | |
| | | | | | l |

| | Static | GР | GPS Time |
|----|--------------|-------|----------|
| | Alignment | Start | End |
| | Pre Mission | 2006 | 2011 |
| 'n | Post Mission | - | - |

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| GPS | Start | | | | | | | | |
| Flight | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

Page 5 of 5

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Project 3218_QSI_PierceMarathon | Pilot Andy. S- Krista R

LIDAR Flight Log

Scanner GPS Rx Scanner System NM Unit

D.Arteaga

Operator

Location Eau Claire WI Airport

Mission Objective

C-GJMT

Aircraft

April 05, 2021

Date

| Additional Notes | T-6C | H-70% | AMLS-278m | Hpa-1010 | Time to next maintens |
|------------------|------|---------------|----------------|-----------|-----------------------|
| Riegl VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | r 1 Drive | r 2 Drive |

| Additional Notes |
|------------------|
| T-6C |
| H-70% |
| AMLS-278m |
| Hpa-1010 |

A Clean Harbors Company AIRBORN IMAGING

| ⊙ 50 hr O 100 hr |
|--------------------------------|
| |
| enance: |

| | | | Aircraft Block Time | lock Tim | • |
|---------------|-----|------------------|----------------------|----------|---|
| Engine | o | Engine On 13:22 | Takeoff | 13:41 | |
| Engine | Off | Engine Off 15:53 | Landing 15:50 | 15:50 | |
| Total 2.5 hrs | 2.5 | hrs | Total 2.2 hrs | 2 hrs | |

| | Σ | VIISSION | n Plan | |
|---------------|------|------------|------------|---------|
| AGL Height | 2300 | Ε | Pulse Rate | 800Khz |
| Target Speed | 160 | kts | Scan Rate | 178 |
| Laser Current | 100 | 1 % | FOV | e0 degs |
| | | | | |

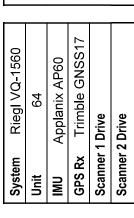
| | | l | | l | l | 1 | l | | | 1 | l | l | l | |
|--------------|-------------|--------|------|--------|--------|--------|-------------------------------|--|---------------------------------|---|---|---|---|--|
| | Comments | | | | | | System crashed just before we | enter the line- tried to restart while | in the air but it froze 2 times | | | | | |
| Mission ID | Time Stamp | 135212 | - | 141350 | 143404 | 145534 | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | | | | | | |
| Line | Time | | | | | | | | | | | | | |
| Time | End | 1354 | 1409 | 1429 | 1450 | 1511 | | | | | | | | |
| GPS Tim | Start | 1352 | 1404 | 1413 | 1434 | 1455 | | | | | | | | |
| Fliaht | Direction | ı | - | 180 | 000 | 180 | 000 | | | | | | | |
| LiDAR | File Name | | | | | | | | | | | | | |
| | Flight Line | X-Tie | F8 | 1058 | 1059 | 1060 | 1061 | | | | | | | |

| Flight | |
|-----------|--|
| 095 | |
| ılian Day | |

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Project 3218_QSI_PierceMarathon | Pilot Andy. S- Krista R

LIDAR Flight Log



D.Arteaga

Operator

Location Eau Claire WI Airport

Mission Objective

C-GJMT

Aircraft

April 05, 2021

Date

| Additio | T-6C | 60-H | AMLS | Hpa-1 | Time to | |
|---------------|------|---------------|----------------|------------|------------|---|
| Riegl VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | er 1 Drive | er 2 Drive | |
| п | | | × | er | e | ı |

| | Additional Notes | AIR |
|---|---------------------------|-------------------------|
| | T-6C | A Clean |
| | H-70% | |
| | AMLS-278m | |
| | Hpa-1010 | |
| | Time to next maintenance: | © 50 hr O 100 hr |
| | | |
| | Static | Sd9 |
| ı | | |

Clean Harbors Company

| | Σ | lissio | Mission Plan | | Static |
|--------------------------------|------|--------|--------------|----------|--------------|
| AGL Height | 2300 | | m Pulse Rate | 800Khz | Alignmer |
| Target Speed 160 kts Scan Rate | 160 | kts | Scan Rate | 178 | Pre Mission |
| Laser Current 100 % FOV | 100 | % | FOV | s60 degs | Post Mission |
| | | | | • | |

Aircraft Block Time

Takeoff 13:41 Landing 15:50 **Total** 2.2 hrs

Engine Off 15:53 Engine On 13:22

hrs

2.5

Total

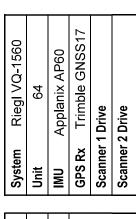
| | Static | GF | GPS Time |
|--------|--------------|-------|----------|
| 300Khz | Alignment | Start | End |
| 178 | Pre Mission | 1330 | 1335 |
| degs | Post Mission | - | - |

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|---|
| Mission ID | Time Stamp | | | | | | | | - |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| Time | End | | | | | | | | |
| GPS Time | Start | | | | | | | | |
| Flight | Direction | | | | | | | | - |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

| Flight |
|-----------|
| 095 |
| ılian Day |

⋖





Pilot Andy. S- Krista R

Project 3218_QSI_PierceMarathon

April 05, 2021

Date

Location Eau Claire WI Airport

Mission Objective

C-GJMT

Aircraft

D.Arteaga

Operator

| stem | Riegl VQ-1560 | Add |
|-------|----------------|--------------|
| iit | 64 | 9 <u>-</u> L |
| n | Applanix AP60 | Η- |
| S Rx | Trimble GNSS17 | ¥ |
| anner | anner 1 Drive | Η̈́ |
| anner | anner 2 Drive | Ë |
| I | | I |

| dditional Notes | Si | A . | AIRBORNE |
|---------------------------|-------------|-------------------------|-------------------------|
| -ec | | A Clea | A Clean Harbors Company |
| %0 / -1 | | | |
| MLS-278m | | | |
| Ipa-1010 | | | |
| Time to next maintenance: | | © 50 hr O 100 hr | |
| | | | |
| | Static | 49 | GPS Time |
| 800Khz | Alignment | Start | End |
| 178 | Pre Mission | 1330 | 1335 |

| | , | Aircraft Block Time | |
|------------------|---|---------------------|---|
| Engine On 13:22 | | Takeoff 13:41 | |
| Engine Off 15:53 | | Landing 15:50 | |
| Total 2.5 hrs | | Total 2.2 hrs | |
| | | | ı |

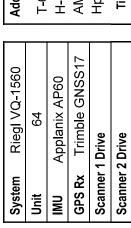
| | Δ | ISSIO | Mission Plan | | |
|---------------|-------|-------|-------------------|---------|--|
| AGL Height | 2300 | Ε | m Pulse Rate | 800Khz | |
| Target Speed | 160 | kts | 160 kts Scan Rate | 178 | |
| Laser Current | 100 % | % | FOV | eo degs | |
| | | | | | |

| | Static | d9 | GPS Time |
|------|--------------|-------|----------|
|)Khz | Alignment | Start | риЭ |
| 78 | Pre Mission | 1330 | 1335 |
| degs | Post Mission | - | - |

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| GPS | Start | | | | | | | | |
| Fliaht | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

| ⋖ |
|--------|
| Flight |
| 095 |
| Day |
| ılian |





Pilot Andy. S- Krista R

Project 3218_QSI_PierceMarathon

April 05, 2021

Date

C-GJMT

Aircraft

D.Arteaga

Operator

Eau Claire WI Airport

Location

Mission Objective

| Addition | | %0/-H | AMLS | Hpa-1 | Time to |
|---------------|----|---------------|----------------|-------------|-------------|
| Riegl VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | ner 1 Drive | ner 2 Drive |
| Ë | | | RX | ner | ner |

9

₽ 2

%

100 160

Laser Current **Target Speed AGL Height**

m Pulse Rate kts | Scan Rate

2300

Mission Plan

Aircraft Block Time

Takeoff 13:41 Landing 15:50 **Total** 2.2 hrs

Engine Off 15:53 Engine On 13:22

hrs

2.5

Total

| | Comments | | | | | | | | |
|--------------|-------------|--|--|--|--|--|--|--|--|
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| GPS Time | End | | | | | | | | |
| Sd9 | Start | | | | | | | | |
| Fliaht | Direction | | | | | | | | |
| LiDAR | File Name | | | | | | | | |
| | Flight Line | | | | | | | | |

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LIDAR Flight Log

Syste GPS Scan Scan Unit $\frac{1}{8}$

Pilot Andy. S- Krista R

Project 3218_QSI_PierceMarathon

April 05, 2021

Date

Location Eau Claire WI Airport

Mission Objective

C-GJMT

Aircraft

D.Arteaga

Operator

| Additic | T-6C | H-70 | AMLS | Нра-` | Time 1 |
|---------------|------|---------------|----------------|--------------|--------------|
| | | | | | |
| RiegI VQ-1560 | 64 | Applanix AP60 | Trimble GNSS17 | iner 1 Drive | ıner 2 Drive |
| em | | | RX | ıner | ıner |

| Additional Notes | T-6C | %0L-H | AMLS-278m | Hpa-1010 | Time to next main |
|------------------|------|---------|-----------|----------|-------------------|
| I VQ-1560 | 94 | ix AP60 | le GNSS17 | | |

| A Clean Hain. | Static GPS Ti | Alignment Start | Pre Mission 1330 | |
|----------------------|---------------|-----------------|------------------|--|
| A Clean Harbors Corr | GPS Time | End | 1338 | |

800Khz 178

m Pulse Rate kts | Scan Rate

2300 160

Target Speed AGL Height

Mission Plan

Aircraft Block Time

Takeoff 13:41 Landing 15:50

Engine Off 15:53 **Engine On 13:22**

| | | | | , | | | | | |
|--------------------|------------|--|--|---|--|--|--|--|--|
| | Comments | | | | | | | | |
| Mission ID | Time Stamp | | | | | | | | |
| Line Aborted | nmi to End | | | | | | | | |
| Line | Time | | | | | | | | |
| Time | End | | | | | | | | |
| GPS Time | Start | | | | | | | | |
| Flight | Direction | | | | | | | | |
| LiDAR File Name | | | | | | | | | |
| Flight Line | | | | | | | | | |