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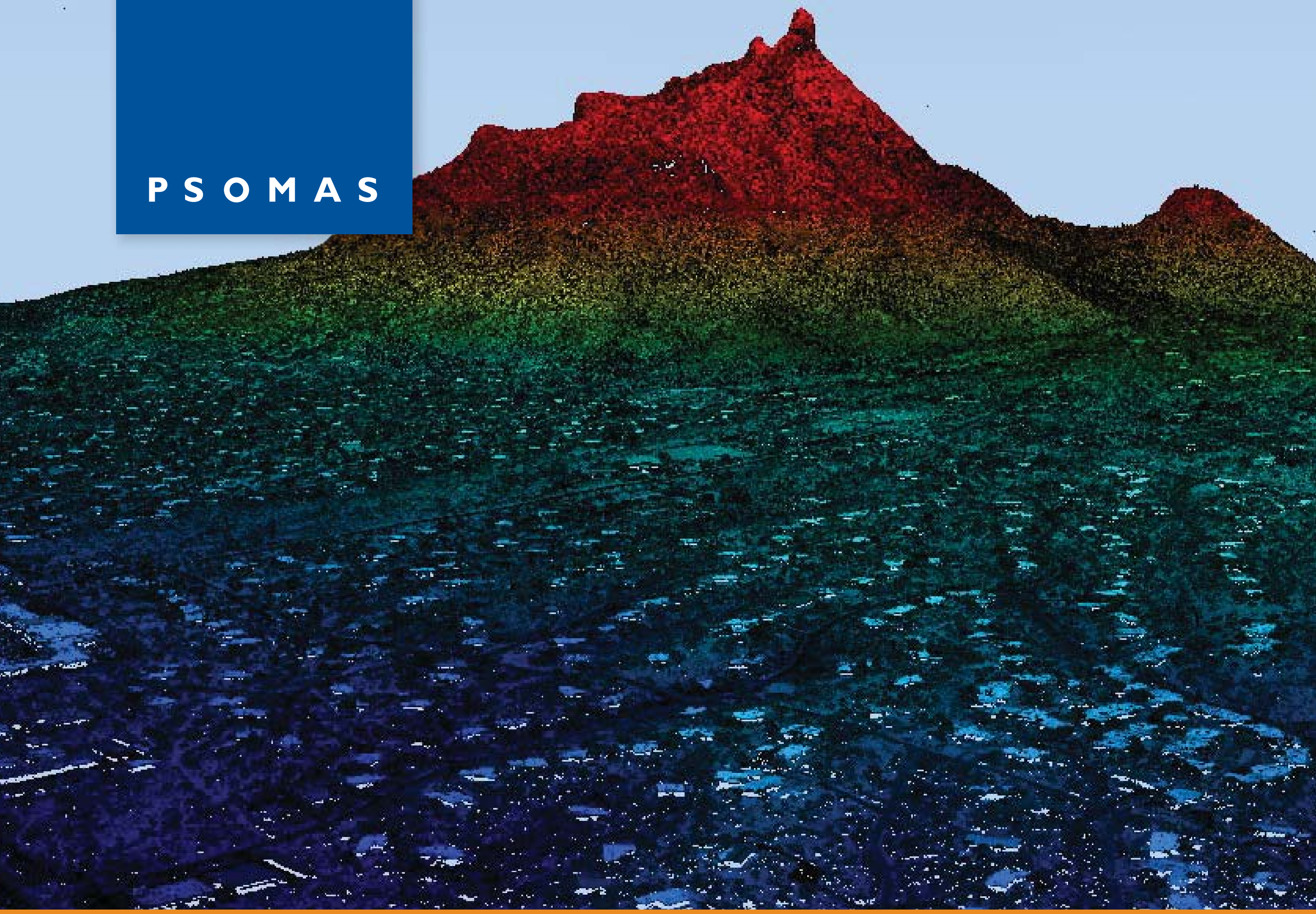

2015 PAG LiDAR Data Accuracy Assessment

PAG **Pima Association of Governments**

PIMA COUNTY **Pima County Regional Flood Control District**

Project No. 7PIM130303 | 07.30.2015

2015 PAG LiDAR Data Absolute Vertical Accuracy Assessment

Prepared by Psomas

Project No. 7PIM130303

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Introduction

In December of 2014 Psomas was contracted by the Pima County Regional Flood Control District to provide the Elevation Data Horizontal and Vertical Accuracy Assessment for the Pima Association of Governments 2015 LiDAR and Aerial Imagery acquisition. Psomas has a long and distinguished history of surveying in Pima County and welcomed the opportunity to participate in this vital local project.

Project Description

The main project area is comprised of approximately 2,203 square miles of eastern Pima. The LiDAR data was acquired in March of 2015 by Sanborn Map Company using a Leica ALS70 Airborne Laser Scanner. The project horizontal datum is Arizona State Plane, Central zone, NAD83 (2011), epoch 2010.0, with units in International Feet. The vertical datum is NAVD88. Orthometric heights (elevations) were derived from ellipsoid heights using a high resolution geoid model, Geoid12A. The data acquisition was designed to comply with the requirements for QL2 LiDAR accuracy as stated in the USGS Survey Standards, Chapter 4 of Book 11, LiDAR Base Specifications for inclusion in the USGS 3DEP program. This report primarily deals with the absolute vertical accuracy assessment of the LiDAR coverage.

Methodology

Pima County, and the metro Tucson area in particular, has a well-established geodetic control network. Recent surveys by local agencies have densified the control and provided an opportunity to use this data to collect new check points specifically for this project. The quantity and location of check points was designed to meet the recommendations in the Positional Accuracy Standards for Digital Geospatial Data as published by the American Society for Photogrammetry and Remote Sensing (ASPRS) 2014 (see Figure 1). All new check points were collected in open, flat areas, such as parking lots, school yards, and parks. In rural areas the check points were positioned on flat, open areas away from trees and dense vegetation. All of the urban environment and rural areas are classified as Non-vegetated. A total of 134 points were selected for this project. A list of the check points and NGS control points used can be found in Appendix A. No assessment of Vegetated Vertical Accuracy is included in this report.

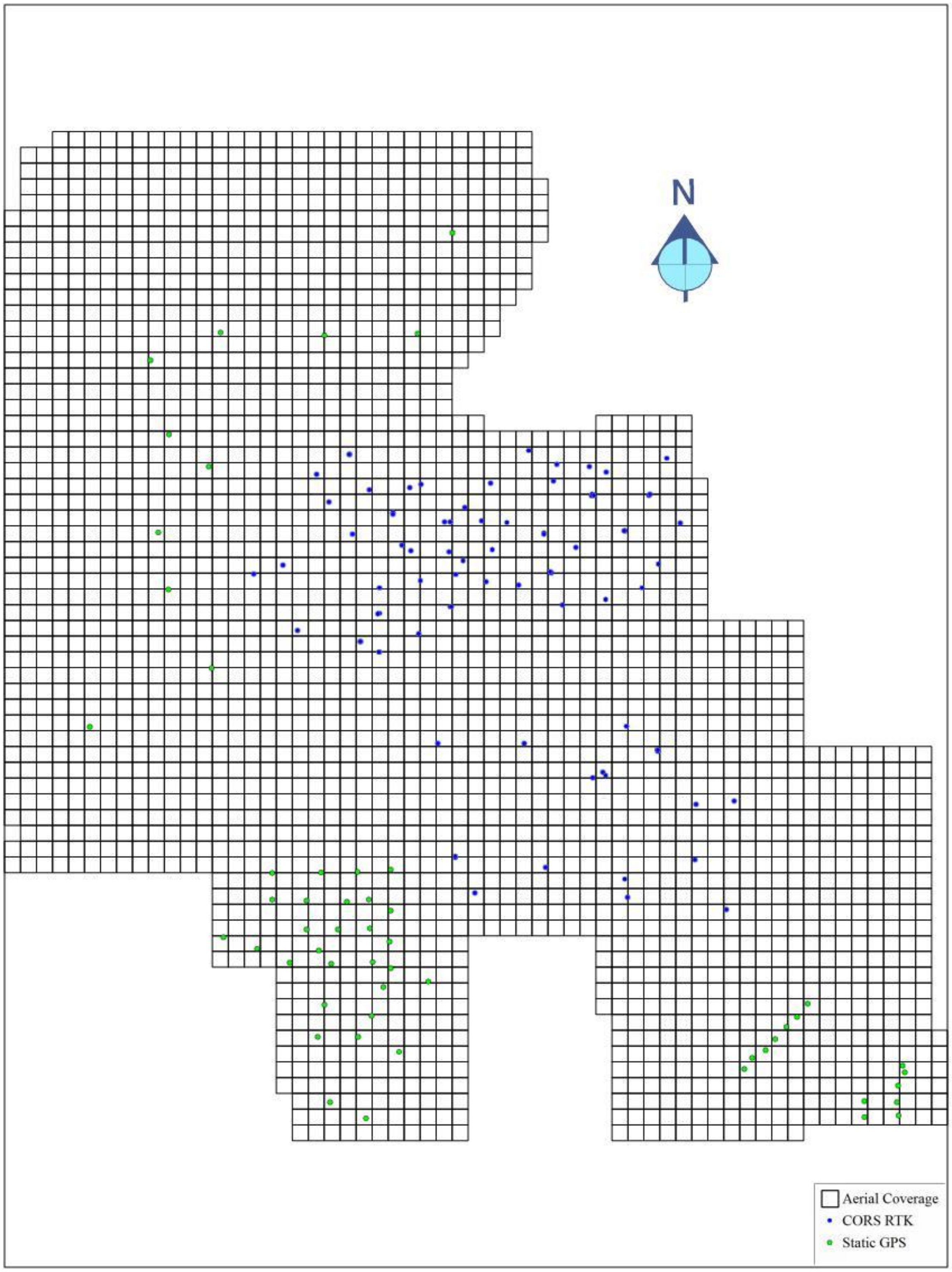

Figure 1

QL2 Vertical Check Point Distribution

The check points can be classified into 2 groups that reflect the survey method used to collect the location and elevation: Static GPS, and CORS RTK. The following describes each method in more detail.

1) Static GPS points: these check points were collected and post-processed to FGDC local network accuracy standards. Primarily used in areas of the coverage that lack existing survey control and/or validation points. The occupation times varied from 5 to 30 minutes per point and at least 2 CORS stations vector ties to each point. The nearest NGS control point was also collected to provide validation of the GPS control solution. Points were then post-processed in Trimble Business Center to the 95% confidence level.

2) CORS RTK points: random points collected from single base line RTK solution using the nearest AZCORS station. These points were collected at sites that offered an open expanse and varied surfaces, such as school playgrounds, parks, large parking lots, and open terrain.

Absolute Vertical Accuracy Assessment

The vertical accuracy assessment was performed using Applied Imagery's Quick Terrain Modeler program. A list of tiles was generated by evaluating the check point locations against the tile index. This list was used to load the corresponding LAS files into QT Modeler. The check points were loaded into the Point Query Utility which compares the elevation of the points to elevations in the model. QT Modeler then creates a TIN surface at each point to calculate the surface elevation and reports the elevation differences. The method used is in compliance with standards for establishing RMSE and quality control of LIDAR surveys. The output from the Point Query Utility was converted to an MS Excel file for further computational analysis. The results of the analysis can be found in Appendix B (raw LAS NVA), Appendix C (DEM NVA), and Appendix D (Classified LAS NVA).

Results of the Absolute Vertical Accuracy Assessment

Per the project specifications the absolute vertical accuracy for Quality Level 2 is ≤ 10 cm, or ≤ 19.6 cm at the 95% confidence level. The set of 134 check points yielded an RMSEz of 10.3 cm for the raw LAS files, and 8.8 cm for the DEM.

This data set was tested to meet ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) for a 10 cm RMSEz Vertical Accuracy Class. Actual NVA accuracy was found to be RMSEz = 10.3 cm, equating to +/- 20.2 cm at the 95% confidence level. The DEM or bare-earth data, had an accuracy of 8.8 cm, or 17.2 cm at the 95% confidence level.

Horizontal error in LiDAR is mainly a function of the position and attitude errors at the sensor, and the flying height. An estimate of the horizontal error can be made assuming the positional, attitudinal, and height accuracies are known. This error estimate comes from the LiDAR provider and per the ASPRS Positional Accuracy Standards for Digital Geospatial Data (2014) those values are:

GNSS Positional Error= 2cm
IMU Error= 0.5°
Mean Flying Height= 3,200m

From this the estimated horizontal positional error is calculated to be 0.50 cm.

Well defined points typically used for checking planimetric accuracies in topographic mapping and orthophotography may not be appropriate for LiDAR analysis. For this project we collected a small number of check points that fell at the end of paint stripes and other high contrast features for use as horizontal checks. Most of the rural areas within the coverage did not contain adequate features for horizontal assessment. Unfortunately the LiDAR point spacing did not provide enough density to make exact measurement of these features and no definable assessment of the horizontal accuracy can be made with this methodology.

This report is based upon field work and office calculations performed under my direct supervision.

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