3DR

Measuring Accuracy of the 3DR Site Scan Drone Data Platform

White Paper

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Abstract

Drones have quickly become a common fixture on construction and engineering projects across the world. They are helping enhance traditional surveying and reality capture by providing a fast, safe, and cost-effective way to take high-resolution photos and process them into orthomosaics, point clouds, and other data products through photogrammetry software.

However, for these data products to be useful to 3DR's customer base in the architecture, engineering, and construction (AEC) industries, there's a single metric that matters: accuracy. It's critical that photogrammetric data products—created with drone imagery—are just as accurate as alternative surveying methods, so they can be relied upon throughout the course of a project. Accuracy levels vary, depending on a variety of factors, such as: flight altitude, camera sensor, ground control points, and much more.

3DR performed this study to demonstrate the level of vertical and horizontal accuracy that can be achieved using the Site Scan platform, and to share best practices for optimal data capture using drones. The study was done in collaboration with Banner Associates, an engineering, architectural, and licensed land surveying consulting firm based in South Dakota, USA. Banner Associates performed the drone flights that were used as the basis for the accuracy figures shown in this report.

The study determined that the deliverables created by 3DR Site Scan—orthomosaics, point clouds, and more—were horizontally accurate within 0.0319 feet (0.97 cm) and vertically accurate within 0.0382 feet (1.1 cm).

Introduction

Goals for this study

The goal of this study was to demonstrate the level of vertical and horizontal accuracy that can be achieved using the Site Scan platform, and to share best practices for optimal data capture using drones.

Drone model used in this study

To collect aerial imagery for this study, we used the 3DR Site Scan drone equipped with the 20.1MP Sony R10C camera. The Site Scan software platform was also used to store, georeference, and perform photogrammetric processing of the images collected.

We chose to use the Site Scan drone data platform for this study because it is the primary drone used by our customers in the architecture, construction, and engineering (AEC) industry.

About Banner Associates

Based in Sioux Falls, South Dakota, Banner Associates is a multidisciplinary engineering, architectural, and licensed land surveying consulting firm. Their drone operations are led by Nathan Nielson, who manages their surveying department. This study will focus on one of their key projects: a water treatment plant and sludge drying pond. They use Site Scan to survey this area and perform grading analysis on a regular basis.

Methodology

We flew Site Scan on one of Banner Associate's active projects, a 17.6 acre sludge drying pond.

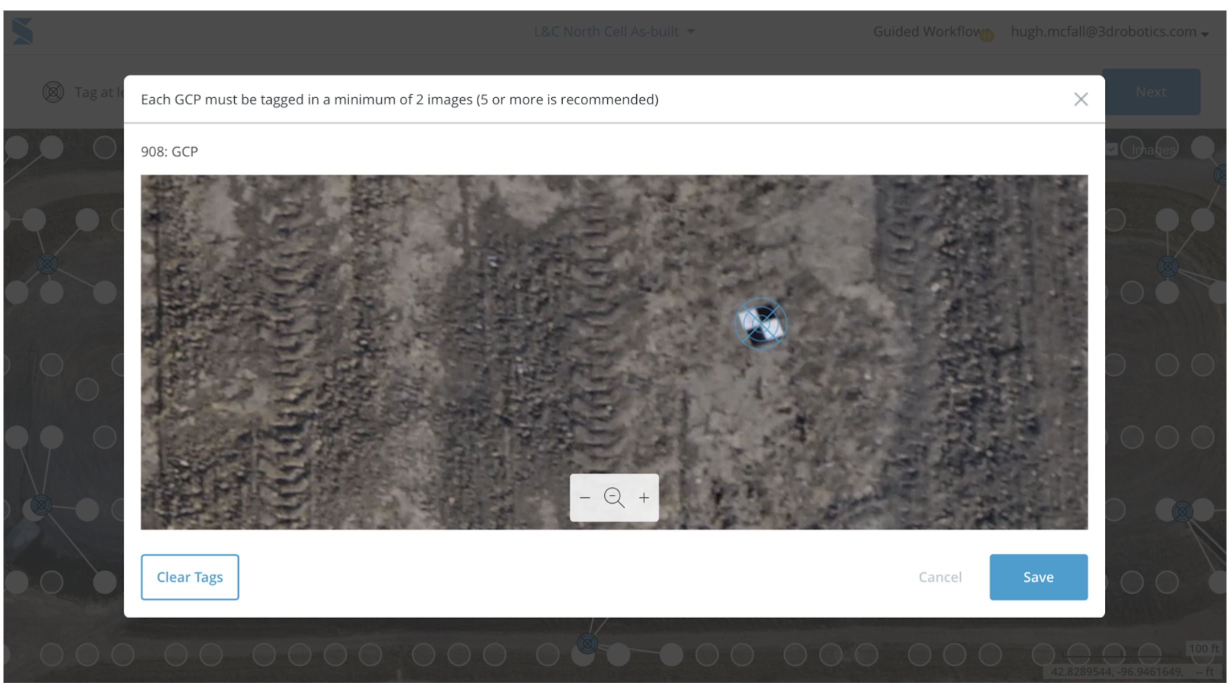
Flight details

Using the Area Survey flight mode in Site Scan, we flew at a 150 foot altitude—a common altitude for drones used in surveying, engineering, and construction projects—and captured 288 high-resolution photos in total, using one battery. The flight time was approximately twelve minutes.

In total, 11 ground control points were set on-site. 9 of them were used as true ground control points, while the remaining two were used as checkpoints to independently validate accuracy. For this study, we used the WGS84 image coordinate system and the NAD83 / South Dakota South ground control point coordinate system.

Georeferencing

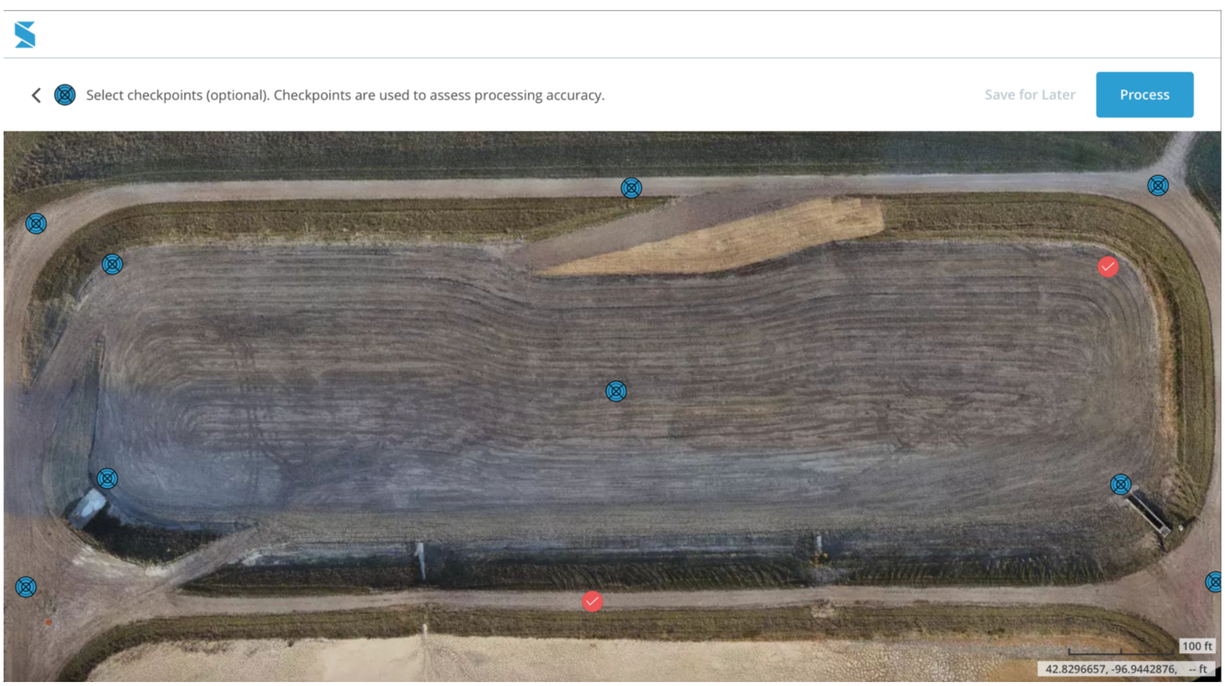
All 288 photos were uploaded to the Site Scan cloud and georeferenced using Site Scan's in-browser ground control point workflow, as shown:



Identifying and tagging ground control points

To ensure accuracy, each ground control point was tagged with at least 5 different images from the surrounding area:

Once each of the 11 ground control points were tagged in Site Scan, two of them were set as “Checkpoints”, which are used to assess processing accuracy:



Ground control points marked in blue, checkpoints marked in red

With the georeferencing workflow completed, we then processed the images collected by Site Scan into photogrammetric data products, including an orthomosaic, digital surface model, point cloud, and 3D mesh. They were processed by the Pix4D engine, which is integrated with Site Scan.

The total processing time for all data products was 40 minutes and 7 seconds. Once they finished processing, they became available to use in Site Scan Manager, our web application, for further analysis and exporting. A summary of flight and processing details can be found in the table below:

Altitude	150 feet
Flight time	12 minutes
Photos	288 photos calibrated
Camera model	Sony UMC-R10C, 20.1MP APS-C sensor
Average ground sampling distance (GSD)	0.93 cm / 0.36 in
Area covered	17.6 acres
Ground control points	9 used as GCPs, 2 used as checkpoints
Processing time	40 minutes, 7 seconds

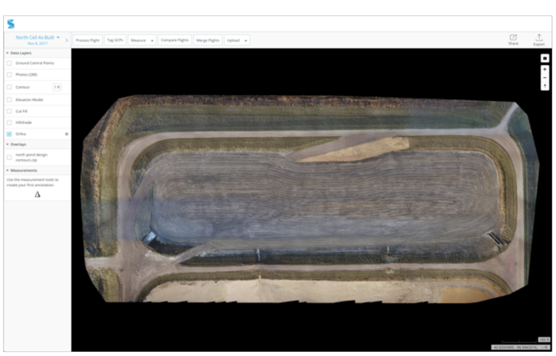
Key Findings

With this methodology, we were able to create photogrammetric data products that are horizontally accurate under 0.03 feet, and vertically accurate under 0.04 feet. This is measured by the root mean square error in the table below, shown in both US survey feet and in centimeters.

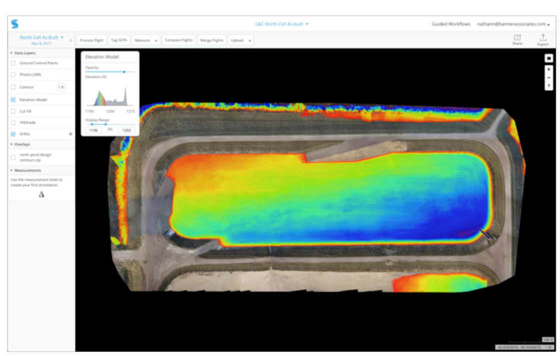
	Horizontal	Vertical
RMSE (Root Mean Square Error) in US survey feet	0.03 feet	0.04 feet
RMSE (Root Mean Square Error) in centimeters	0.97 cm	1.1 cm

We had a resolution and ground sampling distance of 0.03 feet (0.36 inches per pixel). See the resulting orthomosaic and the digital elevation model:

Orthomosaic



Digital elevation model



Conclusion

In this study, we’ve outlined a methodology—regularly used by licensed land surveyors like Banner Associates—for earning industry-leading accuracy figures.

While there are a variety of factors that determine the accuracy of your drone data, this study has shown that there are a few simple steps you can take to improve the precision of your deliverables. For example: flying at lower altitudes, taking high-resolution photos with the 20.1MP Sony R10C camera, and using ground control points are all proven ways to increase horizontal and vertical accuracy.

By following this methodology, not only is Banner Associates able to regularly achieve survey-grade precision, but they can also verify it independently using GCP checkpoints in Site Scan. Checkpoints are a vital part of the workflow: they make it possible to exclude certain points from GCP processing, and instead use them to conservatively validate the accuracy of your data.

By enabling the architecture, engineering, and construction (AEC) industry to collect sub-inch accurate data—at a fraction of the time and cost of traditional surveying—drones have proven that they’ve quickly become a must-have tool on jobsites across the world.

Additional Resources

For more information on 3DR Site Scan and how it's being used in the field, check out the following resources:

3DR.com

About Site Scan

New in Site Scan: Ground Control Points

Get Automated Accuracy Reports With GCP Checkpoints

Site Scan Processing is Now Powered by the Pix4D Engine

How PCL Construction Got Started With Drones On-Site

eBook: How to get survey results 6X faster

eBook: How to win more business with drones

Acknowledgements

BANNER
engineering a better community

Special thanks to Banner Associates, 3DR Site Scan customer and engineering and land surveying firm based in South Dakota, for collaborating with us on this study. Learn more about them here: bannerassociates.com.