

Metadata Report

Project Name

Waste Dump Landslide, Trappers Loop Road (UT-167), Morgan County, Utah – Aerial reconnaissance and landslide monitoring project

Summary

The Waste Dump landslide is located along the side of Trappers Loop Road (UT-167) in Morgan County, Utah. The Utah Geological Survey (UGS) began monitoring the movement with high-accuracy GPS in 2005, and currently collect GPS movement data on a yearly basis. Using Structure from Motion (SFM), the landslide was surveyed in October 2018.

Personnel

- PI(s)

Adam I. Hiscock (adamhiscock@utah.gov)

- Field staff

Adam I. Hiscock, Ben E. Erickson, Greg N. McDonald, Nathan Payne

- Additional team members

Site Information

- Site description

Landslide along Trappers Loop Road (Utah Highway 167) in Morgan County, Utah.

- Site objective

Collect SFM data for the active landslide to assist in landslide monitoring and movement.

- Site location (GPS cords and/or map)

41.211047°, -111.809308°

- Site conditions

Mid-morning, cool temperature, some small clouds

- Date/time spent at each site

Flight conducted on 10/30/2018 at approximately 10 AM

Survey Results

- Equipment used

DJI Phantom 4 Pro drone with 20 MP camera and fixed 8.8 mm focal length for image collection. Trimble R8 GNSS unit for Ground Control Point (GCP) survey data collection.



- GPS solutions

8 GCPs were surveyed using the Utah Reference Network (TURN) real-time kinematic network and processed in WGS 84.

- Errors

Overall point cloud error was 1.66 cm using all 8 GCPs. GCP error was 1.32 cm horizontal and 1.00 cm vertical.

- Alignments

- Collection methods

474 images were acquired from 150 ft (45 m) altitude at nadir. Camera positions, overlaps, and orientations were controlled automatically using Pix4D software running on an iPad. Images were processed using Agisoft Metashape Professional (see below for processing details). GCPs were provided by installing orange, black, and white bucket lid targets for visibility in images. GCPs were surveyed and processed in UTM North Zone 12, WGS 84 Datum, g12aus geoid.

Products

- Date of dataset collection

10/30/2018

- Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- Spatial resolution

Ground resolution – 2.04 cm/pix, DEM resolution 8.14 cm/pix, Point density – 151 points/m²

- Horizontal Accuracy

1.32 cm

- Vertical Accuracy

1.00 cm

- Data formats

Raw point cloud is provided in .LAZ format. DEM and orthomosaic are provided as geotiff.

- Data processing methods

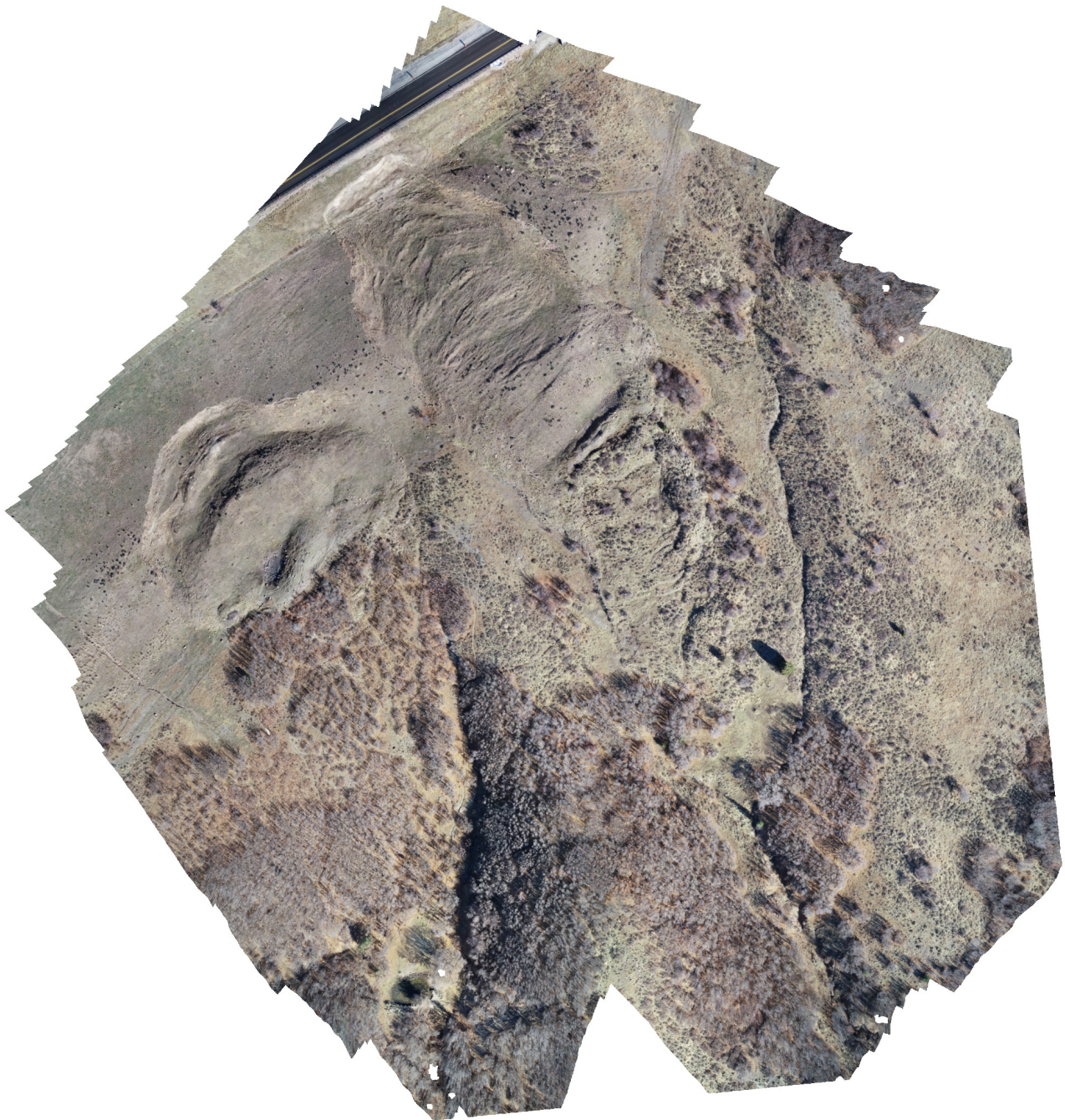
Point cloud, DEM, and orthomosaic data were generated by Agisoft Metashape Professional.

Misc Notes

Please send any questions about this dataset to adamhiscock@utah.gov

Agisoft Metashape

Processing Report
Waste Dump Landslide - October 2018, Trappers Loop Road (UT-167), Morgan
County, Utah
12 August 2019



Survey Data

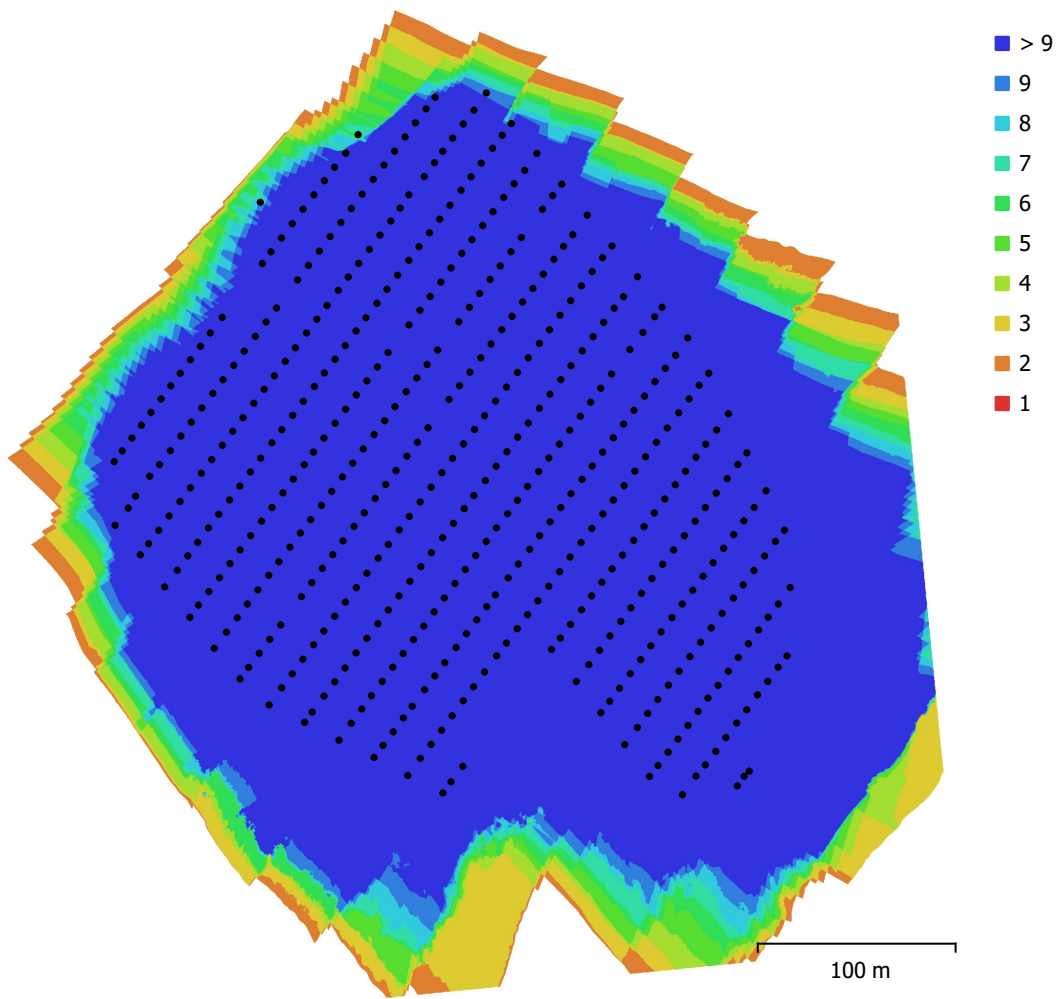


Fig. 1. Camera locations and image overlap.

Number of images:	474	Camera stations:	474
Flying altitude:	80.9 m	Tie points:	338,141
Ground resolution:	2.04 cm/pix	Projections:	2,339,918
Coverage area:	0.159 km ²	Reprojection error:	0.611 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC6310 (8.8mm)	5472 x 3648	8.8 mm	2.41 x 2.41 μ m	No

Table 1. Cameras.

Camera Calibration

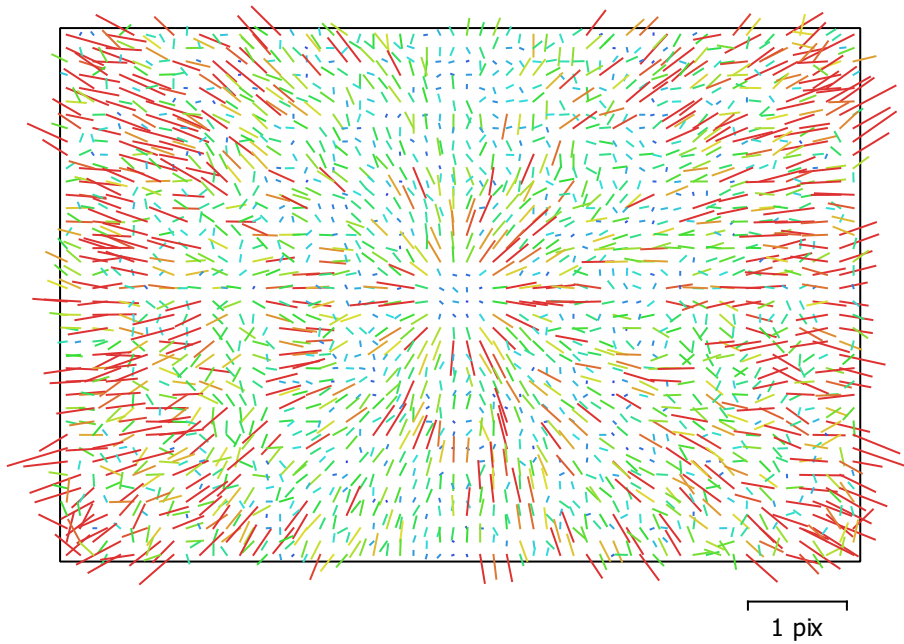


Fig. 2. Image residuals for FC6310 (8.8mm).

FC6310 (8.8mm)

474 images

Type	Resolution	Focal Length	Pixel Size
Frame	5472 x 3648	8.8 mm	2.41 x 2.41 μm

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2
F	3651.21	0.25	1.00	-0.10	-1.00	0.89	0.03	0.02	-0.09	0.15	-0.19	-0.13	-0.07
Cx	-9.52618	0.013		1.00	0.10	-0.10	-0.28	0.00	0.00	-0.01	0.01	0.56	0.03
Cy	7.8579	0.14			1.00	-0.88	-0.02	-0.04	0.11	-0.16	0.21	0.13	0.08
B1	0.4446	0.02				1.00	0.03	0.02	-0.10	0.15	-0.19	-0.13	0.02
B2	0.447671	0.0094					1.00	-0.00	0.01	-0.00	0.00	-0.01	-0.03
K1	0.00699239	2.3e-005						1.00	-0.96	0.91	-0.86	-0.02	-0.13
K2	-0.0517696	0.00011							1.00	-0.99	0.95	0.02	0.01
K3	0.0955811	0.00021								1.00	-0.99	-0.03	-0.01
K4	-0.0574549	0.00014									1.00	0.03	0.01
P1	-0.000913514	7.8e-007										1.00	0.02
P2	-0.00118318	1e-006											1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

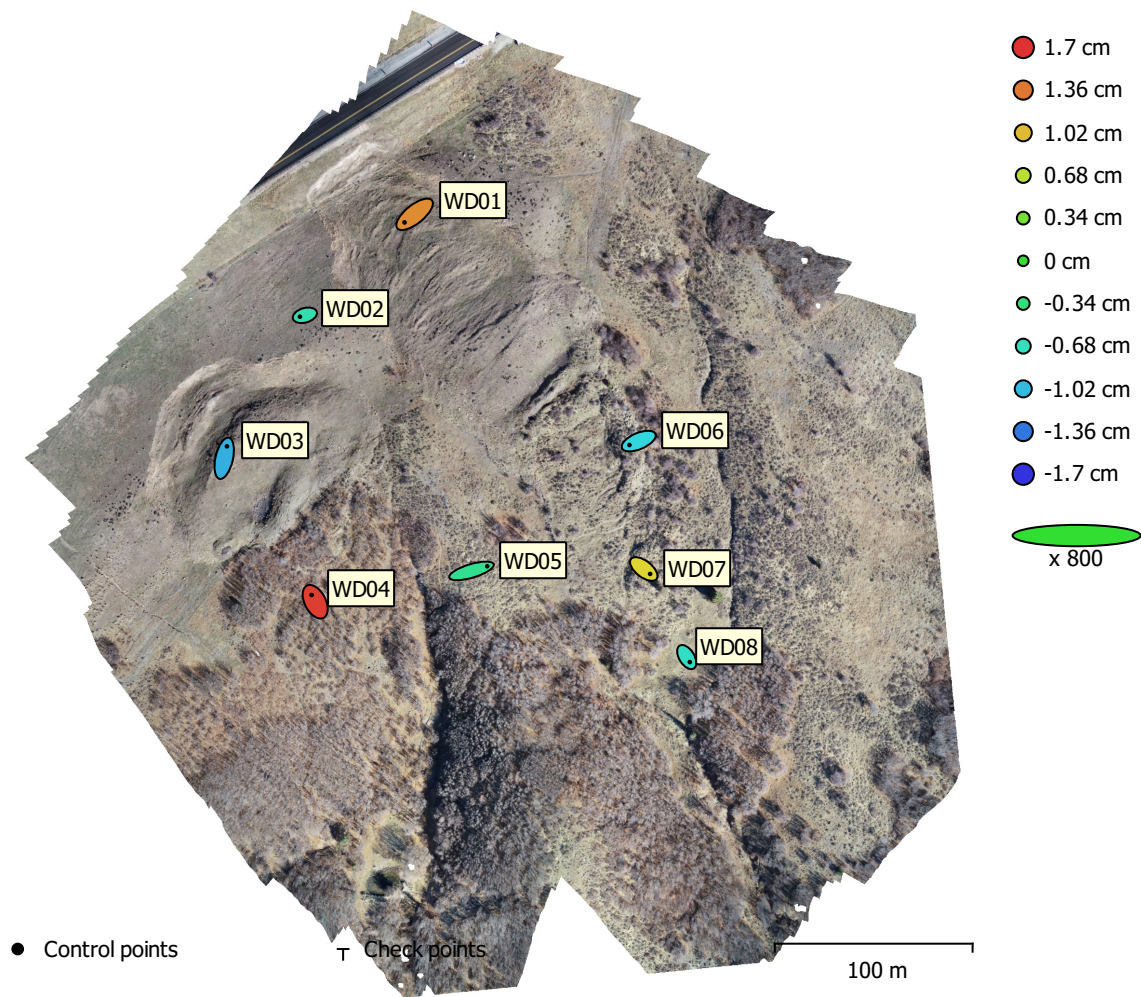


Fig. 3. GCP locations and error estimates.

Z error is represented by ellipse color. X,Y errors are represented by ellipse shape.

Estimated GCP locations are marked with a dot or crossing.

Count	X error (cm)	Y error (cm)	Z error (cm)	XY error (cm)	Total (cm)
8	1.02773	0.830485	1.0085	1.32134	1.66223

Table 3. Control points RMSE.

X - Longitude, Y - Latitude, Z - Altitude.

Label	X error (cm)	Y error (cm)	Z error (cm)	Total (cm)	Image (pix)
WD01	-1.27672	-1.02537	1.2612	2.06689	0.315 (31)
WD02	-0.625925	-0.18092	-0.612576	0.894295	0.250 (20)
WD03	0.343219	1.52067	-1.08078	1.89693	0.281 (28)
WD04	-0.449095	0.859073	1.64112	1.90603	0.231 (26)
WD05	1.98359	0.591658	-0.466803	2.12193	0.298 (28)
WD06	-1.17095	-0.497999	-0.885147	1.55003	0.382 (47)
WD07	0.804479	-0.623173	0.895578	1.35558	0.316 (24)
WD08	0.394439	-0.629815	-0.711332	1.02871	0.336 (61)
Total	1.02773	0.830485	1.0085	1.66223	0.316

Table 4. Control points.
X - Longitude, Y - Latitude, Z - Altitude.

Digital Elevation Model

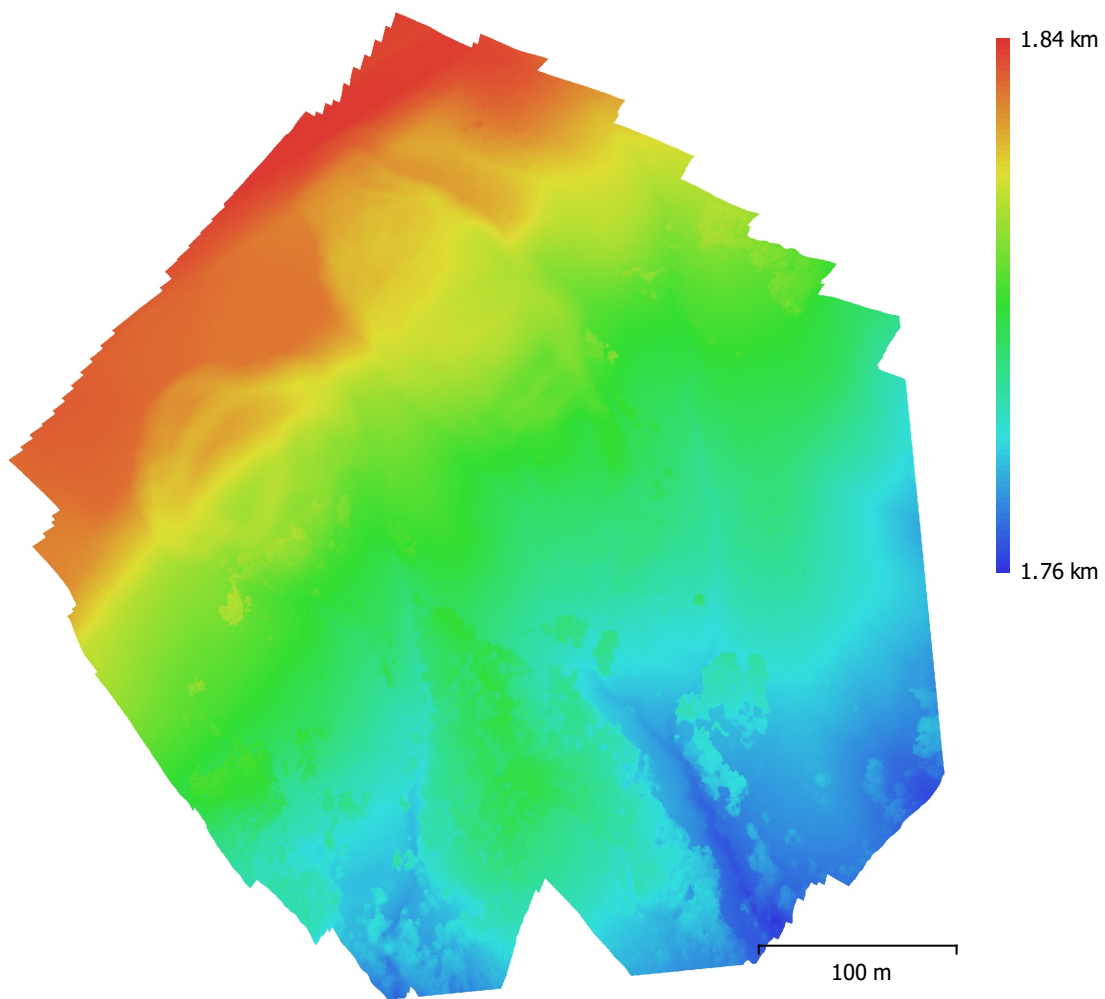


Fig. 4. Reconstructed digital elevation model.

Resolution: 8.14 cm/pix
Point density: 151 points/m²

Processing Parameters

General

Cameras	474
Aligned cameras	474
Markers	8
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	338,141 of 373,656
RMS reprojection error	0.196897 (0.610617 pix)
Max reprojection error	0.841469 (43.0566 pix)
Mean key point size	2.70796 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	8.1062

Alignment parameters

Accuracy	High
Generic preselection	Yes
Reference preselection	Yes
Key point limit	40,000
Tie point limit	6,000
Adaptive camera model fitting	Yes
Matching time	17 minutes 39 seconds
Alignment time	5 minutes 37 seconds

Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	29 seconds

Dense Point Cloud

Points	29,372,522
Point colors	3 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive
Processing time	56 minutes 17 seconds

Dense cloud generation parameters

Processing time	1 hours 51 minutes
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Model

Faces	5,874,486
Vertices	2,941,094
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive

Reconstruction parameters

Surface type	Arbitrary
Source data	Dense cloud
Interpolation	Enabled
Processing time	20 minutes 51 seconds

Texturing parameters

General

Mapping mode	Adaptive orthophoto
Blending mode	Mosaic
Texture size	4,096
Enable hole filling	Yes
Enable ghosting filter	No
UV mapping time	52 seconds
Blending time	10 minutes 14 seconds

DEM

Size	6,519 x 7,193
Coordinate system	WGS 84 (EPSG::4326)

Reconstruction parameters

Source data	Dense cloud
Interpolation	Enabled
Processing time	36 seconds

Orthomosaic

Size	23,252 x 24,504
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8

Reconstruction parameters

Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	18 minutes 19 seconds

Software

Version	1.5.3 build 8469
Platform	Windows 64