

# Metadata Report

## Project Name

Waste Dump Landslide, Trappers Loop Road (UT-167), Morgan County, Utah – Aerial reconnaissance and landslide monitoring project (November 2021)

## 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 November 2021.

## Personnel

- PI(s)

Adam I. Hiscock (adamhiscock@utah.gov)

- Field staff

Adam I. Hiscock, Ben E. Erickson, Elizabeth Williams

- 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, clear skies

- Date/time spent at each site

Flight conducted on 11/15/2021 at approximately 10 AM

## Survey Results

- Equipment used

DJI Mavic 2 Pro drone with 20 MP camera and fixed 10.26 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 32.64 cm using all 8 GCPs. GCP error was 32.44 cm horizontal and 3.59 cm vertical.

- Alignments

- Collection methods

701 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, g20aus geoid.

## Products

- Date of dataset collection

11/15/2021

- Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- Spatial resolution

Ground resolution – 1.63 cm/pix, DEM resolution 6.52 cm/pix, Point density – 235 points/m<sup>2</sup>

- Horizontal Accuracy

32.44 cm

- Vertical Accuracy

3.59 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](mailto:adamhiscock@utah.gov)

## Ground Control Points Coordinates

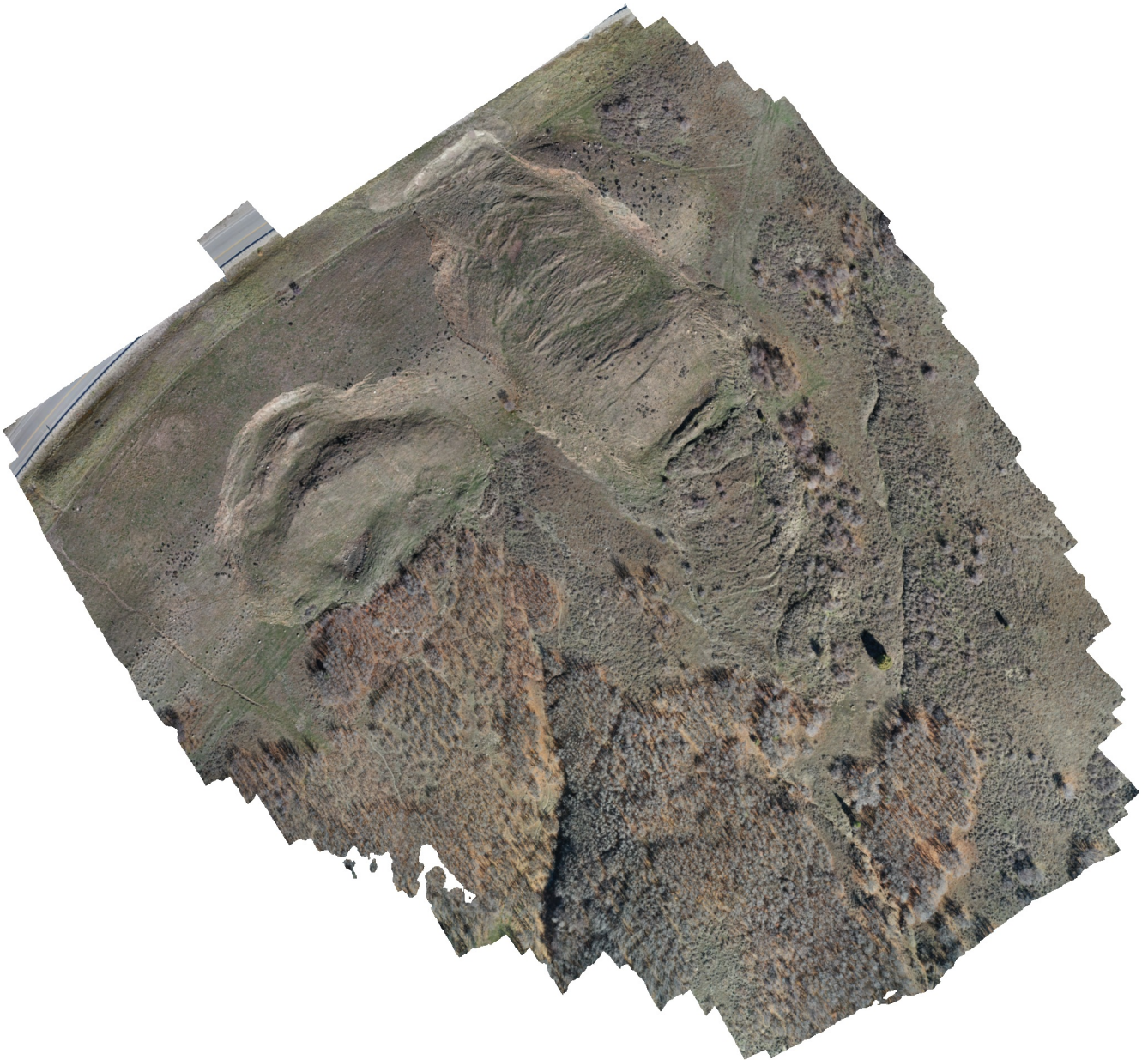
<b>Point ID</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Elevation (m)</b>
wd-01	41.21135	-111.80933	1822.768
wd-02	41.21094	-111.80996	1831.769
wd-03	41.21044	-111.81033	1826.349
wd-04	41.21067	-111.80912	1814.523
wd-05	41.20992	-111.8091	1801.879
wd-06	41.21045	-111.80804	1801.996
wd-07	41.20989	-111.80799	1792.018
wd-08	41.20936	-111.80764	1782.274

# Agisoft Metashape Metadata Report

Processing Report

Wastedump Landslide, November 2021, Trappers Loop Road (UT-167), Morgan  
County, Utah

17 November 2021



# Survey Data

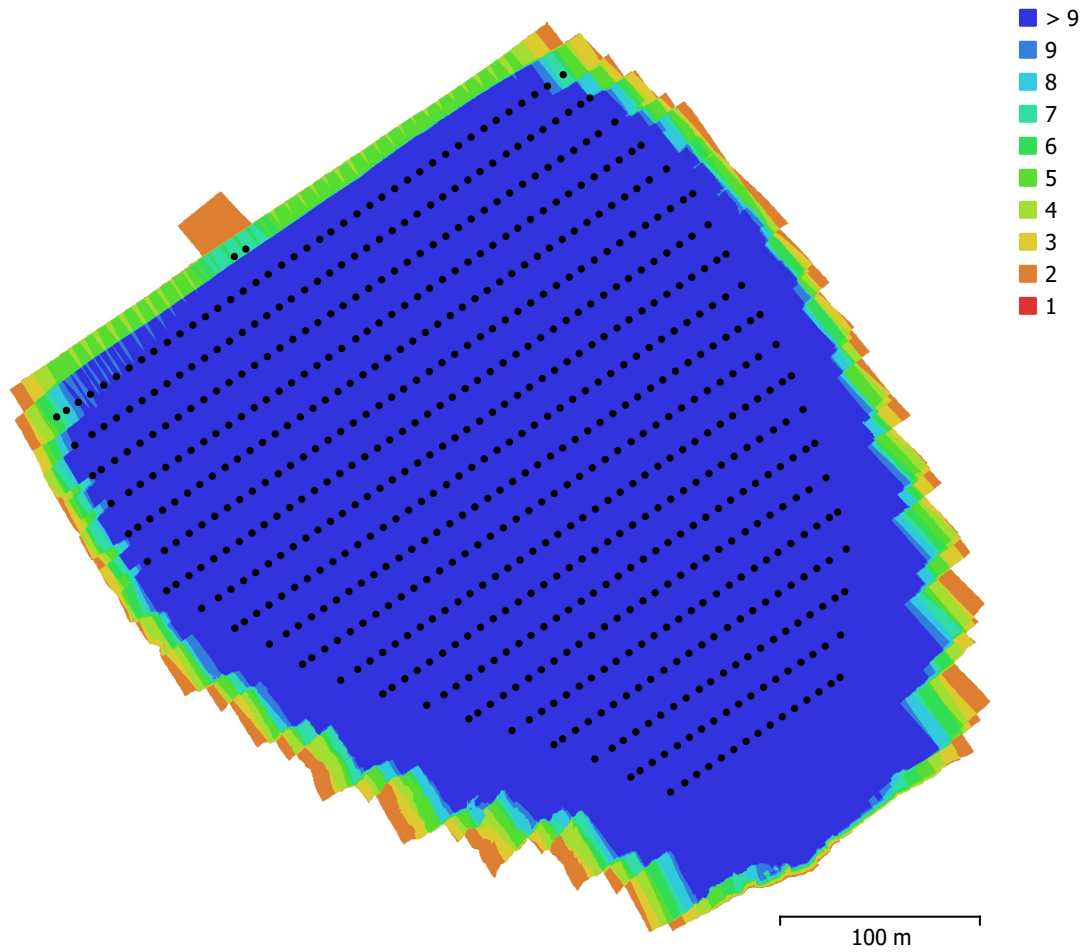


Fig. 1. Camera locations and image overlap.

Number of images:	701	Camera stations:	701
Flying altitude:	76.1 m	Tie points:	42,263
Ground resolution:	1.63 cm/pix	Projections:	518,562
Coverage area:	0.136 km <sup>2</sup>	Reprojection error:	0.338 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
Test_Pro (10.26mm)	5472 x 3648	10.26 mm	2.41 x 2.41 $\mu$ m	No

Table 1. Cameras.

# Camera Calibration

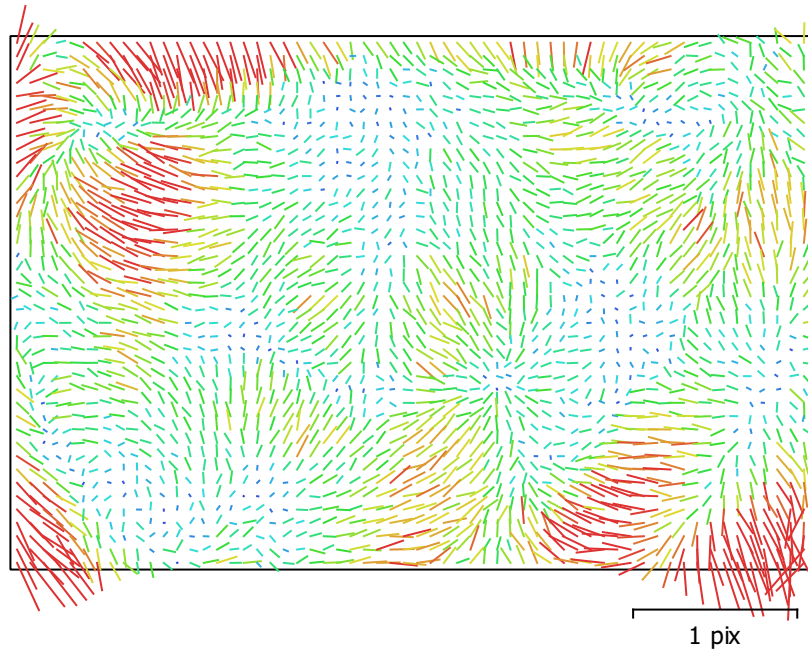


Fig. 2. Image residuals for Test\_Pro (10.26mm).

## Test\_Pro (10.26mm)

701 images

Type	Resolution	Focal Length	Pixel Size
<b>Frame</b>	<b>5472 x 3648</b>	<b>10.26 mm</b>	<b>2.41 x 2.41 <math>\mu</math>m</b>

	Value	Error	Cx	Cy	K1	K2	K3	P1	P2
<b>F</b>	<b>4256</b>								
<b>Cx</b>	<b>4.88006</b>	0.023	1.00	-0.01	-0.03	0.03	-0.02	0.70	0.00
<b>Cy</b>	<b>-16.3028</b>	0.019		1.00	-0.00	0.00	-0.00	-0.01	0.52
<b>K1</b>	<b>-0.0154306</b>	2.9e-05			1.00	-0.95	0.90	-0.08	-0.00
<b>K2</b>	<b>0.0206836</b>	0.00011				1.00	-0.98	0.03	-0.00
<b>K3</b>	<b>-0.0246703</b>	0.00012					1.00	-0.03	0.00
<b>P1</b>	<b>0.000127306</b>	1.5e-06						1.00	0.00
<b>P2</b>	<b>-0.000145824</b>	1.1e-06							1.00

Table 2. Calibration coefficients and correlation matrix.

# Ground Control Points

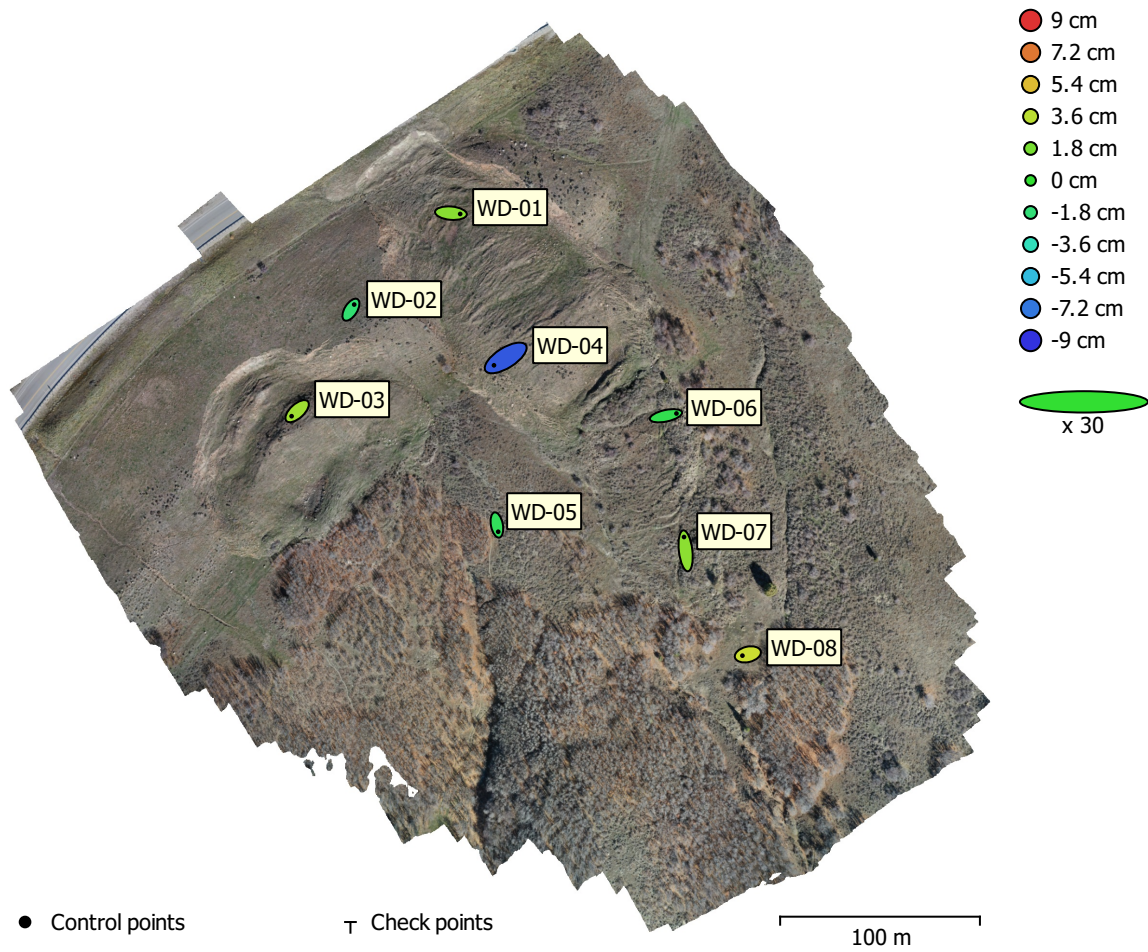


Fig. 3. GCP locations and error estimates.

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	23.8011	22.0448	3.59629	32.4417	32.6404

Table 3. Control points RMSE.

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

<b>Label</b>	<b>X error (cm)</b>	<b>Y error (cm)</b>	<b>Z error (cm)</b>	<b>Total (cm)</b>	<b>Image (pix)</b>
WD-03	-18.4636	-16.7963	2.84766	25.1223	1.410 (25)
WD-02	10.9215	17.2277	-1.62411	20.4624	1.370 (18)
WD-01	30.8494	-2.61925	2.25468	31.0424	1.747 (25)
WD-05	4.31156	-22.4811	-1.06025	22.9153	0.945 (49)
WD-04	-39.0911	-24.5919	-8.02485	46.8751	2.122 (37)
WD-06	34.8955	7.51462	-0.748921	35.7033	1.321 (51)
WD-07	-5.33325	46.0127	2.35489	46.3806	1.555 (68)
WD-08	-18.0895	-4.26656	4.00092	19.0116	1.058 (63)
<b>Total</b>	<b>23.8011</b>	<b>22.0448</b>	<b>3.59629</b>	<b>32.6404</b>	<b>1.437</b>

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



# Digital Elevation Model

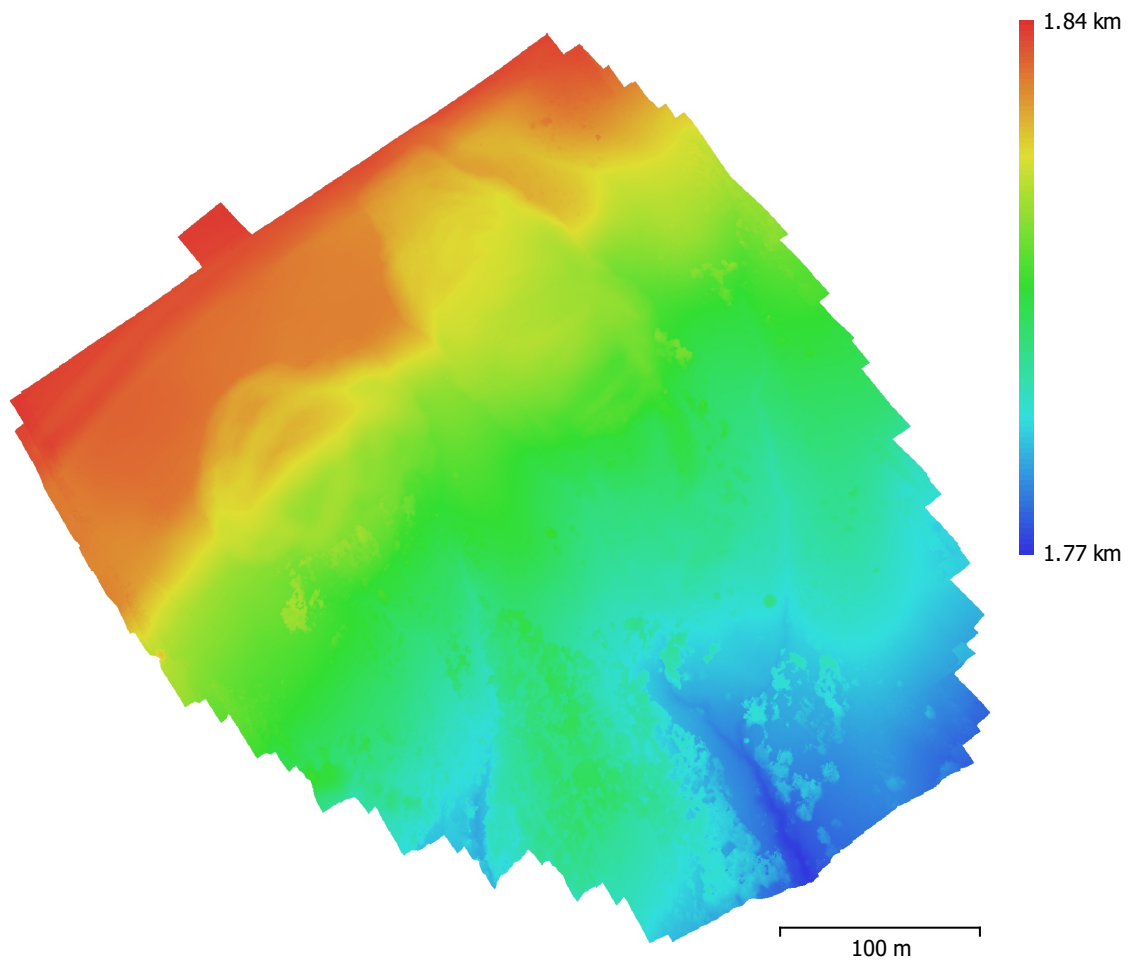


Fig. 4. Reconstructed digital elevation model.

Resolution: 6.52 cm/pix  
Point density: 235 points/m<sup>2</sup>

# Processing Parameters

## General

Cameras	701
Aligned cameras	701
Markers	8
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

## Point Cloud

Points	42,263 of 62,352
RMS reprojection error	0.237182 (0.338046 pix)
Max reprojection error	1.06306 (14.4251 pix)
Mean key point size	1.43396 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	13.7825

## Alignment parameters

Accuracy	Highest
Generic preselection	Yes
Reference preselection	Source
Key point limit	40,000
Key point limit per Mpx	1,000
Tie point limit	1,000
Exclude stationary tie points	Yes
Guided image matching	No
Adaptive camera model fitting	Yes
Matching time	15 minutes 50 seconds
Matching memory usage	5.43 GB
Alignment time	2 minutes 6 seconds
Alignment memory usage	623.15 MB

## Optimization parameters

Parameters	cx, cy, k1-k3, p1, p2
Adaptive camera model fitting	No
Optimization time	8 seconds
Date created	2021:11:16 16:42:49
Software version	1.7.4.13028
File size	14.35 MB

## Dense Point Cloud

Points	44,014,474
Point colors	3 bands, uint8

## Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive
Max neighbors	40
Processing time	1 hours 49 minutes
Memory usage	3.52 GB

## Dense cloud generation parameters

Processing time	1 hours 1 minutes
Memory usage	5.04 GB
Date created	2021:11:16 20:50:11
Software version	1.7.4.13028
File size	575.43 MB

**Model**

Faces	8,802,893
Vertices	4,409,859
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8

**Depth maps generation parameters**

Quality	Medium
Filtering mode	Aggressive
Max neighbors	40
Processing time	1 hours 49 minutes
Memory usage	3.52 GB

**Reconstruction parameters**

Surface type	Arbitrary
Source data	Dense cloud
Interpolation	Enabled
Strict volumetric masks	No
Processing time	26 minutes 50 seconds
Memory usage	23.27 GB

**Texturing parameters**

Mapping mode	Generic
Blending mode	Mosaic
Texture size	4,096
Enable hole filling	Yes
Enable ghosting filter	Yes
UV mapping time	5 minutes 48 seconds
UV mapping memory usage	3.01 GB
Blending time	11 minutes 56 seconds
Blending memory usage	3.21 GB
Blending GPU memory usage	1.59 GB
Date created	2021:11:16 21:01:09
Software version	1.7.4.13028
File size	407.37 MB

**DEM**

Size	10,132 x 10,725
Coordinate system	WGS 84 (EPSG::4326)

**Reconstruction parameters**

Source data	Dense cloud
Interpolation	Enabled
Processing time	53 seconds
Memory usage	306.44 MB
Date created	2021:11:17 15:46:38
Software version	1.7.4.13028
File size	110.50 MB

**Orthomosaic**

Size	30,290 x 28,130
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8

**Reconstruction parameters**

Blending mode	Mosaic
Surface	Mesh
Enable hole filling	Yes
Enable ghosting filter	No
Processing time	26 minutes 33 seconds
Memory usage	4.67 GB
Date created	2021:11:16 22:15:21
Software version	1.7.4.13028

File size	22.82 GB
<b>System</b>	
Software name	Agisoft Metashape Professional
Software version	1.7.4 build 13028
OS	Windows 64 bit
RAM	31.92 GB
CPU	Intel(R) Xeon(R) CPU E5-1630 v4 @ 3.70GHz
GPU(s)	Quadro M4000