

Metadata Report

Project Name

Waste Dump Landslide, Trappers Loop Road (UT-167), Morgan County, Utah – Aerial reconnaissance and landslide monitoring project (June 2019)

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 June 2019.

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 6/11/2019 at approximately 11 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 36.81 cm using all 8 GCPs. GCP error was 36.74 cm horizontal and 2.3 cm vertical.

- Alignments

- Collection methods

416 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

6/11/2019

- Coordinate system of datasets

WGS 84 datum (EPSG::4326)

- Spatial resolution

Ground resolution – 2.19 cm/pix, DEM resolution 8.77 cm/pix, Point density – 130 points/m²

- Horizontal Accuracy

36.74 cm

- Vertical Accuracy

2.3 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, June 2019, Trappers Loop Road (UT-167), Morgan County,
Utah

12 August 2019



Survey Data

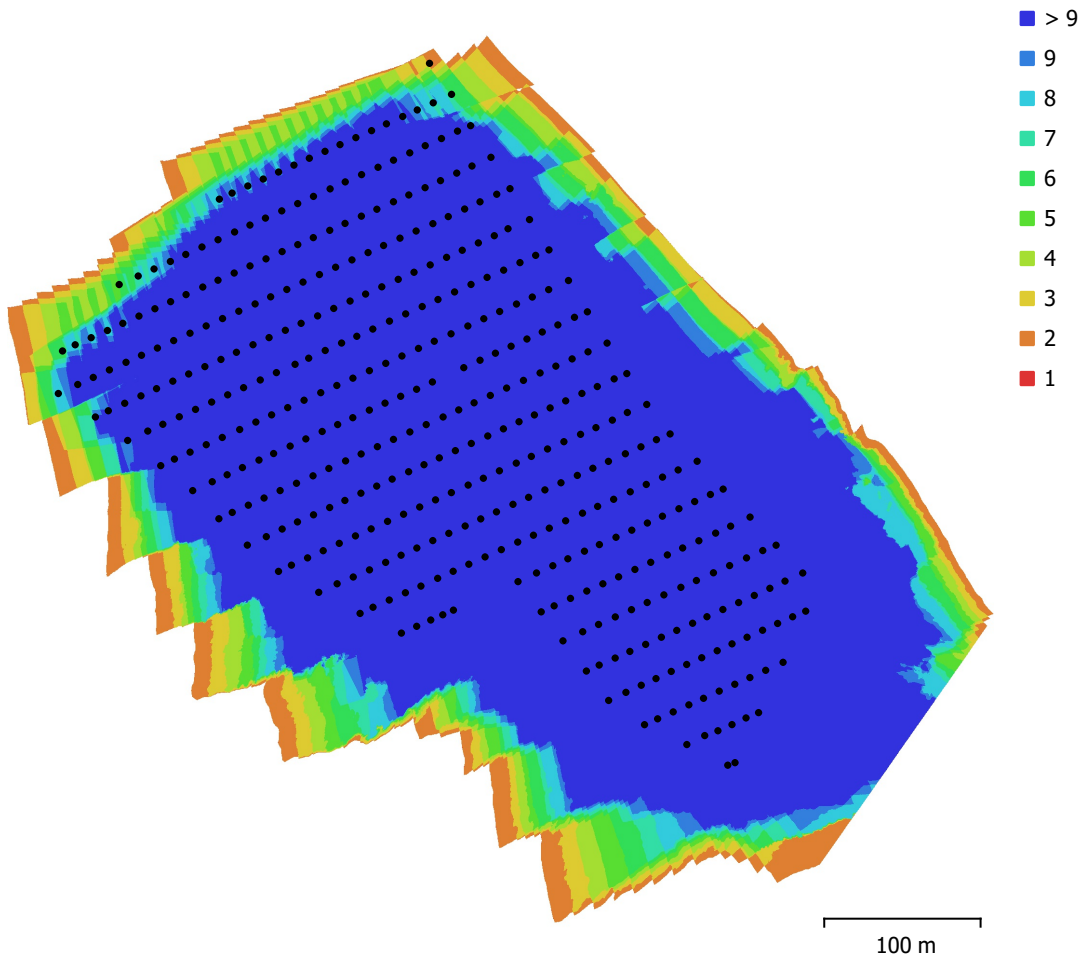


Fig. 1. Camera locations and image overlap.

Number of images:	416	Camera stations:	416
Flying altitude:	87.2 m	Tie points:	90,203
Ground resolution:	2.19 cm/pix	Projections:	410,790
Coverage area:	0.204 km ²	Reprojection error:	0.474 pix

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

Table 1. Cameras.

Camera Calibration

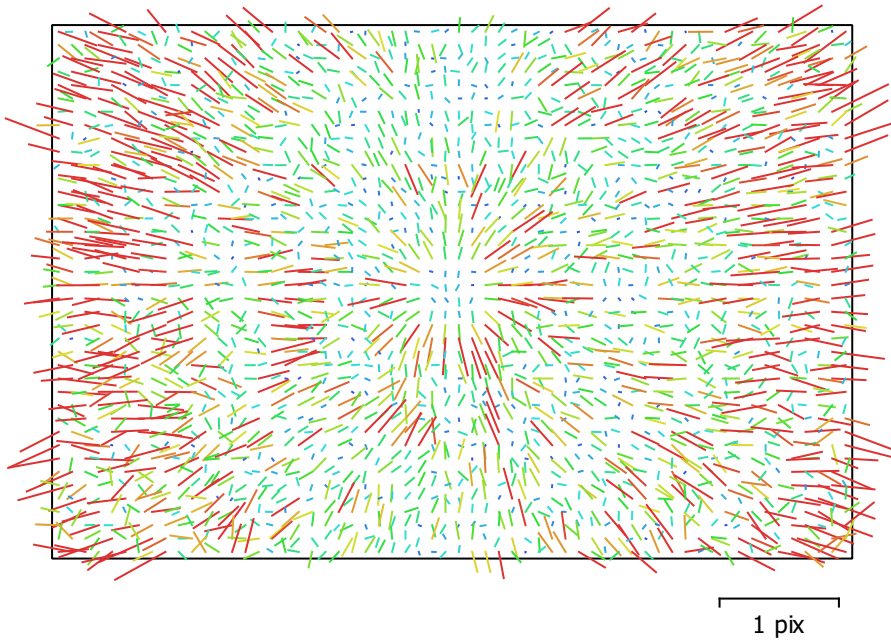


Fig. 2. Image residuals for FC6310 (8.8mm).

FC6310 (8.8mm)

416 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	3637.9	0.74	1.00	-0.07	-0.99	0.87	-0.32	-0.00	-0.06	0.10	-0.13	-0.11	0.08
Cx	-12.9902	0.068		1.00	0.06	-0.12	-0.10	0.02	-0.01	0.01	-0.00	0.51	0.02
Cy	19.568	0.41			1.00	-0.85	0.30	-0.03	0.09	-0.12	0.14	0.11	-0.03
B1	3.93637	0.072				1.00	-0.34	0.02	-0.09	0.11	-0.13	-0.11	0.14
B2	2.12681	0.039					1.00	-0.01	0.04	-0.05	0.06	0.09	-0.11
K1	0.00783654	0.0001						1.00	-0.96	0.91	-0.86	0.02	-0.08
K2	-0.0550944	0.00049							1.00	-0.99	0.95	-0.02	-0.00
K3	0.101308	0.00095								1.00	-0.99	0.02	0.01
K4	-0.0605933	0.00062									1.00	-0.01	-0.01
P1	-0.000780542	4e-006										1.00	-0.03
P2	-0.00133274	4.3e-006											1.00

Table 2. Calibration coefficients and correlation matrix.

Ground Control Points

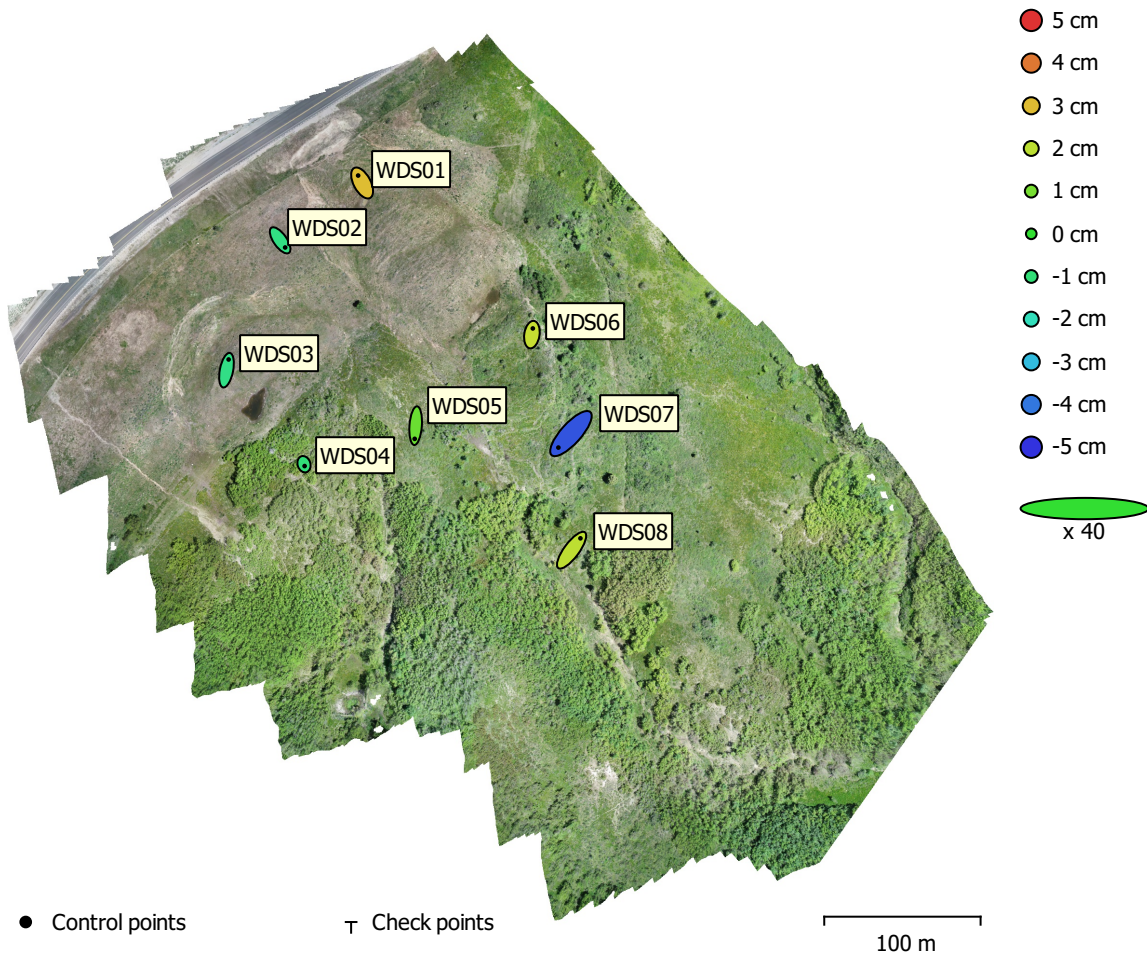


Fig. 3. GCP locations and error estimates.

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	19.0454	31.4159	2.3049	36.7381	36.8103

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)
WDS01	-12.684	23.8175	2.98371	27.1488	0.310 (19)
WDS02	16.0625	-22.8201	-1.17634	27.9311	0.228 (15)
WDS04	1.94047	-5.96552	-1.00889	6.3538	0.226 (35)
WDS05	-3.10248	-42.1162	0.804916	42.238	0.292 (44)
WDS08	28.2717	37.9141	2.0272	47.3379	0.313 (55)
WDS07	-40.1916	-44.7198	-4.50845	60.2955	0.377 (45)
WDS03	6.78117	34.2518	-1.22463	34.9381	0.222 (18)
WDS06	2.98159	19.6917	2.14778	20.0317	0.287 (31)
Total	19.0454	31.4159	2.3049	36.8103	0.299

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

Digital Elevation Model

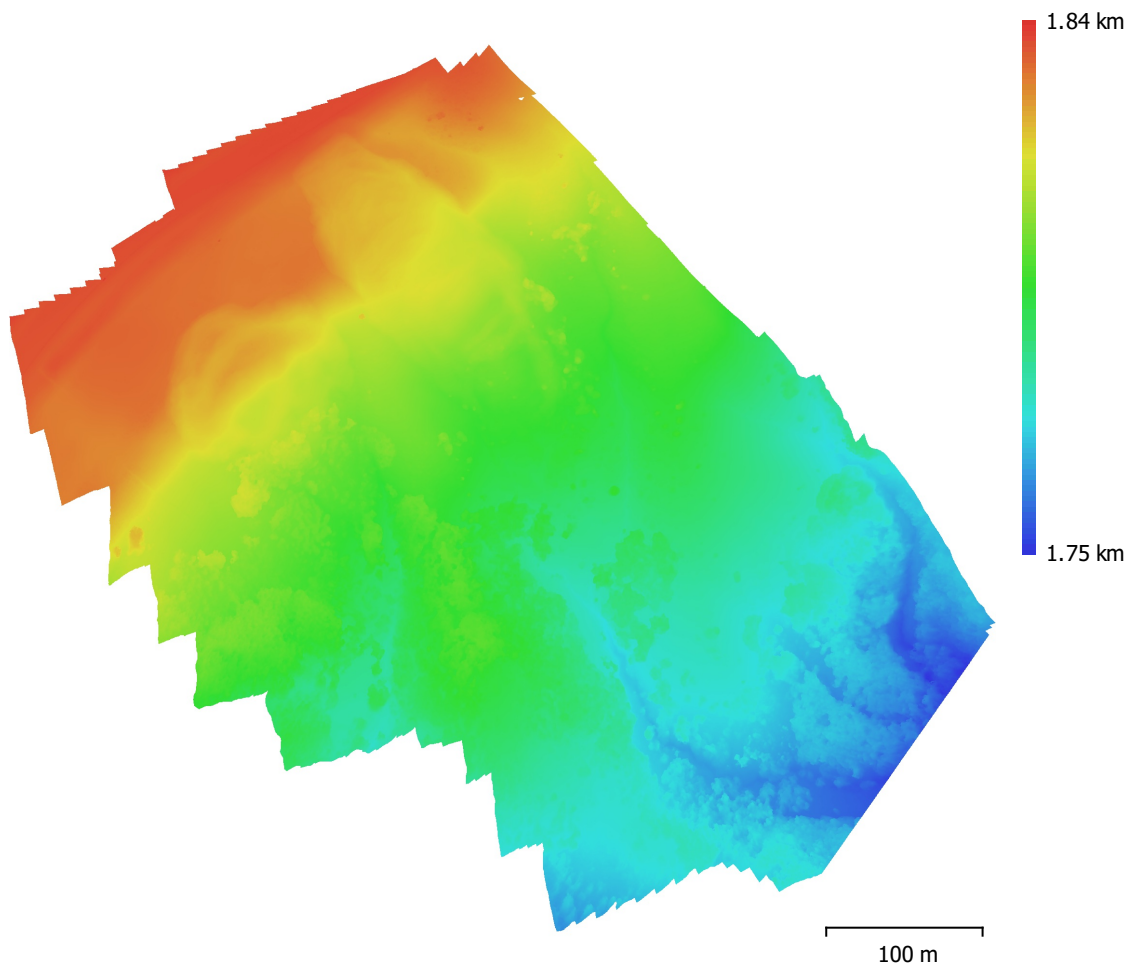


Fig. 4. Reconstructed digital elevation model.

Resolution: 8.77 cm/pix
Point density: 130 points/m²

Processing Parameters

General

Cameras	416
Aligned cameras	416
Markers	8
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Point Cloud

Points	90,203 of 93,997
RMS reprojection error	0.237527 (0.473778 pix)
Max reprojection error	2.06926 (9.22917 pix)
Mean key point size	2.00954 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.73096

Alignment parameters

Accuracy	Highest
Generic preselection	Yes
Reference preselection	Yes
Key point limit	40,000
Tie point limit	1,000
Adaptive camera model fitting	Yes
Matching time	6 minutes 15 seconds
Alignment time	43 seconds

Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1, p2
Adaptive camera model fitting	No
Optimization time	4 seconds
Software version	1.5.2.7838

Dense Point Cloud

Points	37,598,485
Point colors	3 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive
Processing time	30 minutes 55 seconds

Dense cloud generation parameters

Max neighbors	All
Processing time	1 hours 0 minutes
Software version	1.5.2.7838

Model

Faces	7,519,685
Vertices	3,763,988
Vertex colors	3 bands, uint8
Texture	4,096 x 4,096, 4 bands, uint8

Depth maps generation parameters

Quality	Medium
Filtering mode	Aggressive
Processing time	30 minutes 55 seconds

Reconstruction parameters

Surface type	Arbitrary
--------------	-----------

General

Source data	Dense cloud
Interpolation	Enabled
Strict volumetric masks	No
Processing time	26 minutes 55 seconds

Texturing parameters

Blending mode	Mosaic
Texture size	4,096
Enable hole filling	Yes
Enable ghosting filter	Yes
UV mapping time	1 minutes 49 seconds
Blending time	47 minutes 46 seconds
Software version	1.5.2.7838

DEM

Size	9,386 x 8,800
Coordinate system	WGS 84 (EPSG::4326)

Reconstruction parameters

Source data	Dense cloud
Interpolation	Enabled
Processing time	40 seconds
Software version	1.5.2.7838

Orthomosaic

Size	28,779 x 25,848
Coordinate system	WGS 84 (EPSG::4326)
Colors	3 bands, uint8

Reconstruction parameters

Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	17 minutes 14 seconds
Software version	1.5.2.7838

Software

Version	1.5.3 build 8469
Platform	Windows 64