

# Usina Felipe Cardoso

Processing Report  
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# Survey Data

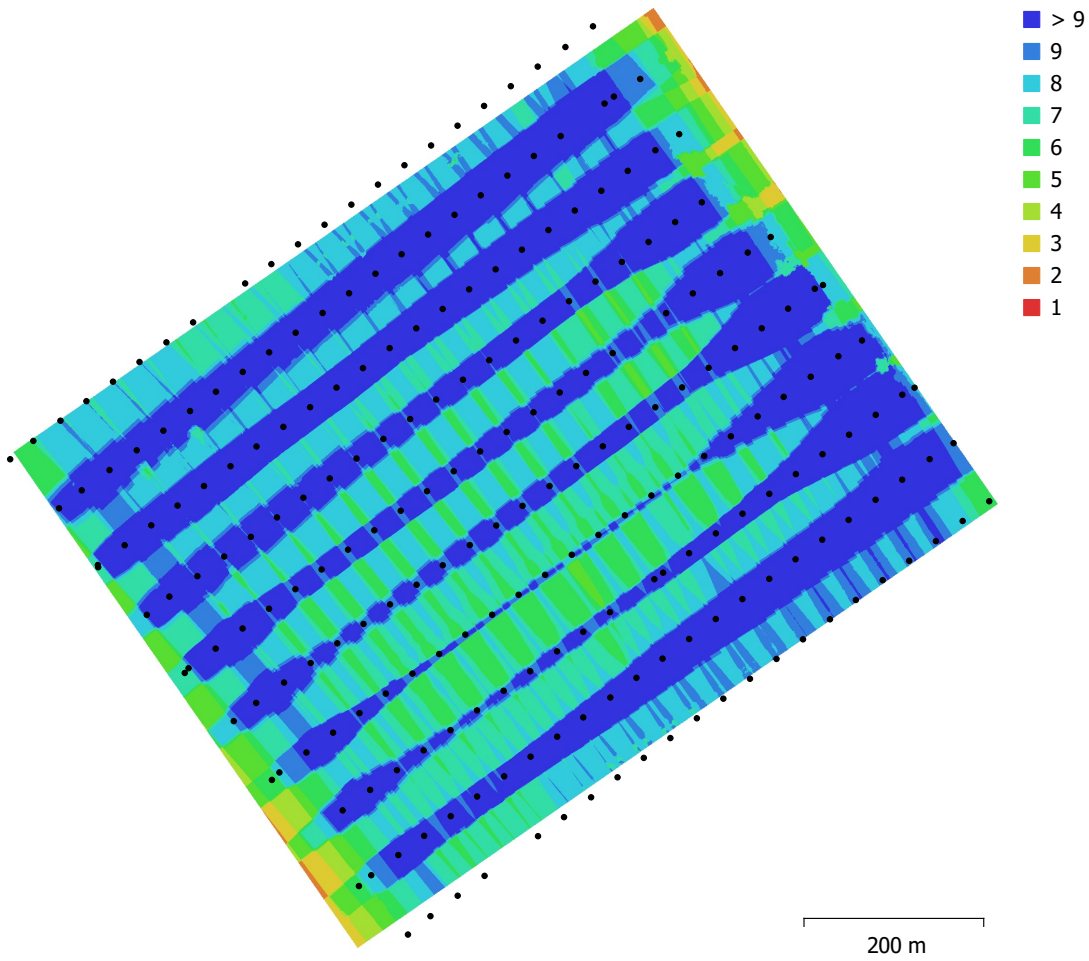


Fig. 1. Camera locations and image overlap.

Number of images:	231	Camera stations:	231
Flying altitude:	157 m	Tie points:	200,597
Ground resolution:	3.92 cm/pix	Projections:	919,463
Coverage area:	0.581 km <sup>2</sup>	Reprojection error:	0.543 pix

Camera Model	Resolution	Focal Length	Pixel Size	Precalibrated
FC6310 (8.8mm)	4864 x 3648	8.8 mm	2.61 x 2.61 μm	No

Table 1. Cameras.

# Camera Calibration

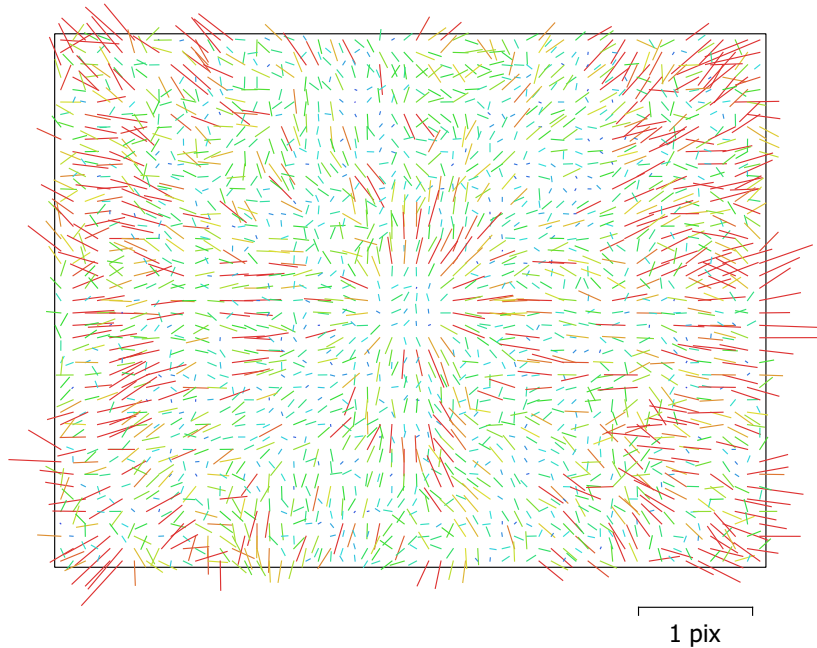


Fig. 2. Image residuals for FC6310 (8.8mm).

## FC6310 (8.8mm)

231 images

Type  
Frame

Resolution  
**4864 x 3648**

Focal Length  
**8.8 mm**

Pixel Size  
**2.61 x 2.61  $\mu$ m**

	Value	Error	F	Cx	Cy	B1	B2	K1	K2	K3	K4	P1	P2	P3	P4
<b>F</b>	<b>3639.76</b>	0.29	1.00	0.10	0.13	-0.06	-0.10	-0.01	-0.08	0.11	-0.14	-0.01	-0.02	-0.00	0.00
<b>Cx</b>	<b>-5.25293</b>	0.029		1.00	0.00	-0.06	-0.04	-0.00	-0.01	0.01	-0.01	0.41	0.04	0.06	-0.05
<b>Cy</b>	<b>16.5291</b>	0.026			1.00	0.02	-0.03	0.01	-0.02	0.03	-0.03	0.00	0.38	0.05	-0.04
<b>B1</b>	<b>-0.587388</b>	0.0061				1.00	0.01	0.03	-0.02	0.02	-0.01	-0.03	0.01	-0.00	0.00
<b>B2</b>	<b>-0.500047</b>	0.0061					1.00	-0.01	0.01	-0.01	0.02	-0.00	0.01	0.01	-0.01
<b>K1</b>	<b>0.017084</b>	5e-05						1.00	-0.97	0.92	-0.87	-0.00	-0.01	-0.02	0.03
<b>K2</b>	<b>-0.0997607</b>	0.00029							1.00	-0.99	0.96	0.00	0.01	0.02	-0.03
<b>K3</b>	<b>0.196609</b>	0.00064								1.00	-0.99	-0.00	-0.01	-0.02	0.02
<b>K4</b>	<b>-0.131029</b>	0.00048									1.00	0.00	0.00	0.01	-0.02
<b>P1</b>	<b>-0.000186708</b>	2.4e-06										1.00	0.45	0.56	-0.51
<b>P2</b>	<b>-0.000410331</b>	3.1e-06											1.00	0.76	-0.70
<b>P3</b>	<b>-0.239854</b>	0.027												1.00	-0.98
<b>P4</b>	<b>-0.0578384</b>	0.036													1.00

Table 2. Calibration coefficients and correlation matrix.



# Camera Locations

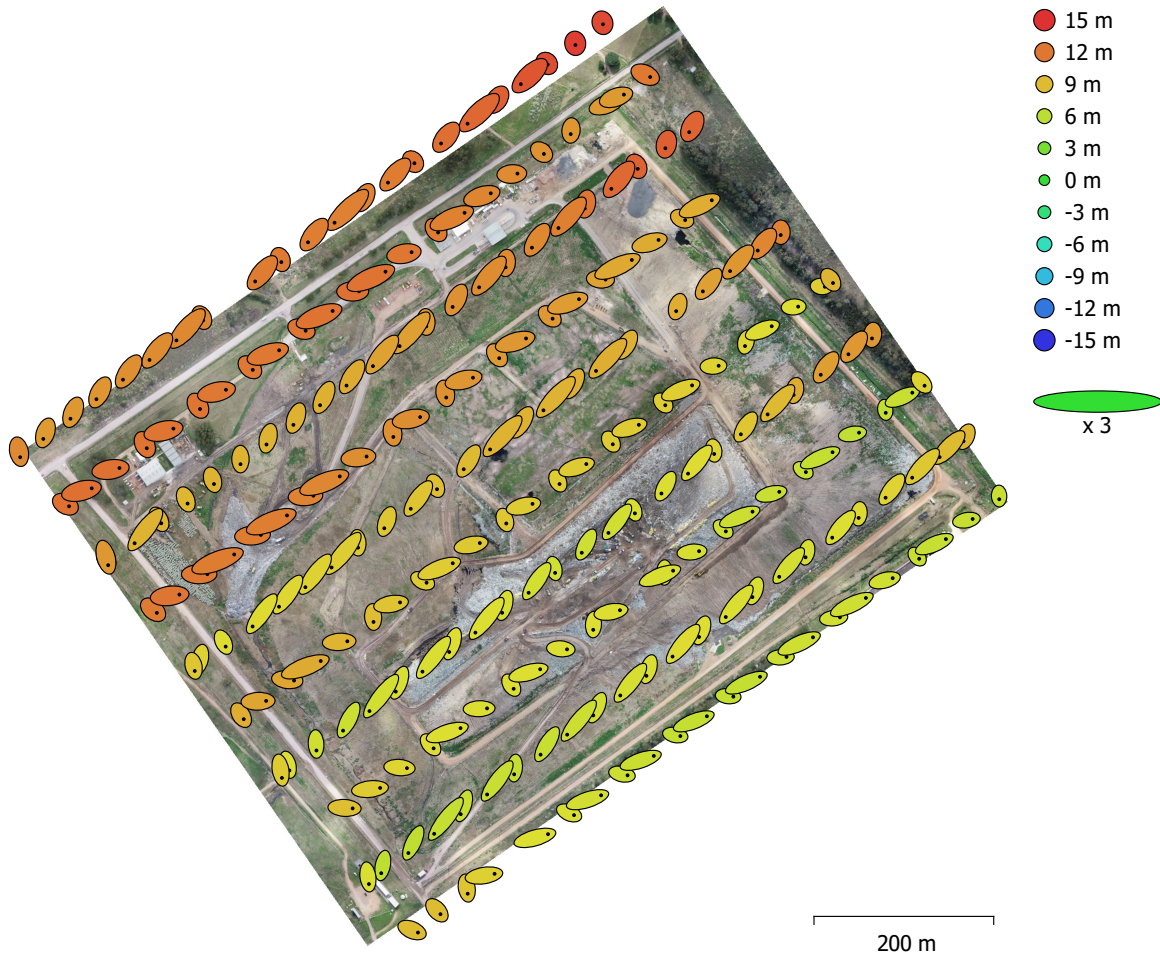


Fig. 3. Camera locations and error estimates.

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

Estimated camera locations are marked with a black dot.

<b>X error (m)</b>	<b>Y error (m)</b>	<b>Z error (m)</b>	<b>XY error (m)</b>	<b>Total error (m)</b>
5.55671	4.88305	9.44428	7.39738	11.9965

Table 3. Average camera location error.

X - Easting, Y - Northing, Z - Altitude.

# Ground Control Points

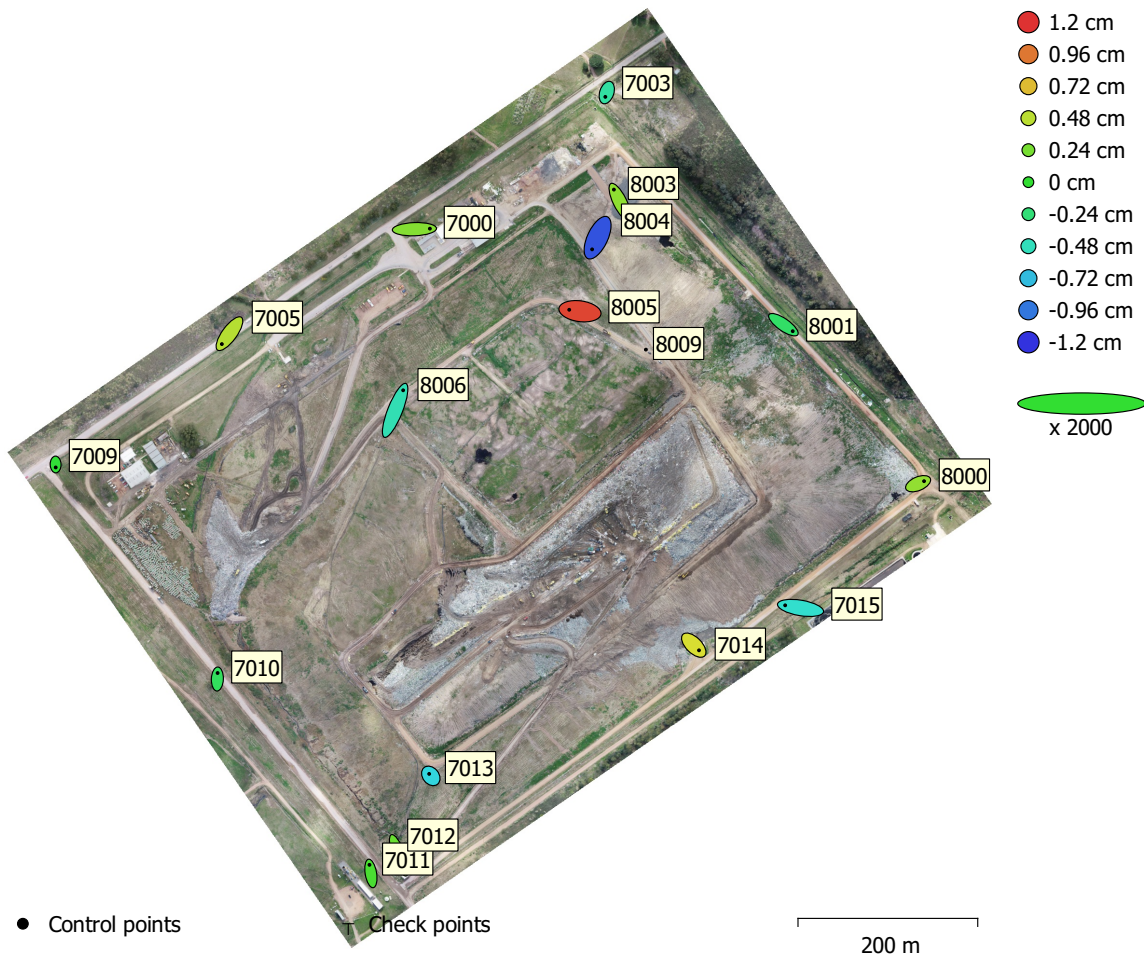


Fig. 4. GCP locations and error estimates.

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)
16	0.863622	0.979889	0.527331	1.30615	1.40858

Table 4. Control points RMSE.

X - Easting, Y - Northing, 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>
7000	1.72182	0.0615072	0.284455	1.74625	0.217 (8)
7003	-0.161839	-0.480986	-0.386801	0.638086	0.339 (12)
7005	-0.846456	-1.15642	0.459087	1.50484	0.150 (7)
7009	0.00862659	-0.328599	-0.0204862	0.32935	0.195 (6)
7010	0.0251479	0.668015	-0.148286	0.684738	0.231 (6)
7011	-0.160421	0.958635	0.0832252	0.975522	0.232 (9)
7012	0.594169	-1.64845	0.191635	1.76271	0.341 (10)
7013	-0.181798	0.224274	-0.62558	0.688984	0.216 (7)
7014	0.583402	-0.576225	0.580531	1.00469	0.163 (12)
7015	-1.70966	0.287243	-0.542035	1.81639	0.417 (7)
8000	0.661931	0.280219	0.335147	0.793094	0.192 (12)
8001	1.037	-0.723345	-0.181981	1.27739	0.206 (11)
8003	-0.663413	1.35174	0.319853	1.53936	0.206 (12)
8004	-0.612193	-1.29873	-1.08682	1.80073	0.337 (8)
8005	-1.19405	0.16226	1.13497	1.65537	0.297 (9)
8006	0.892254	2.23452	-0.450182	2.44783	0.179 (8)
8009					
<b>Total</b>	<b>0.863622</b>	<b>0.979889</b>	<b>0.527331</b>	<b>1.40858</b>	<b>0.255</b>

Table 5. Control points.  
X - Easting, Y - Northing, Z - Altitude.

# Digital Elevation Model

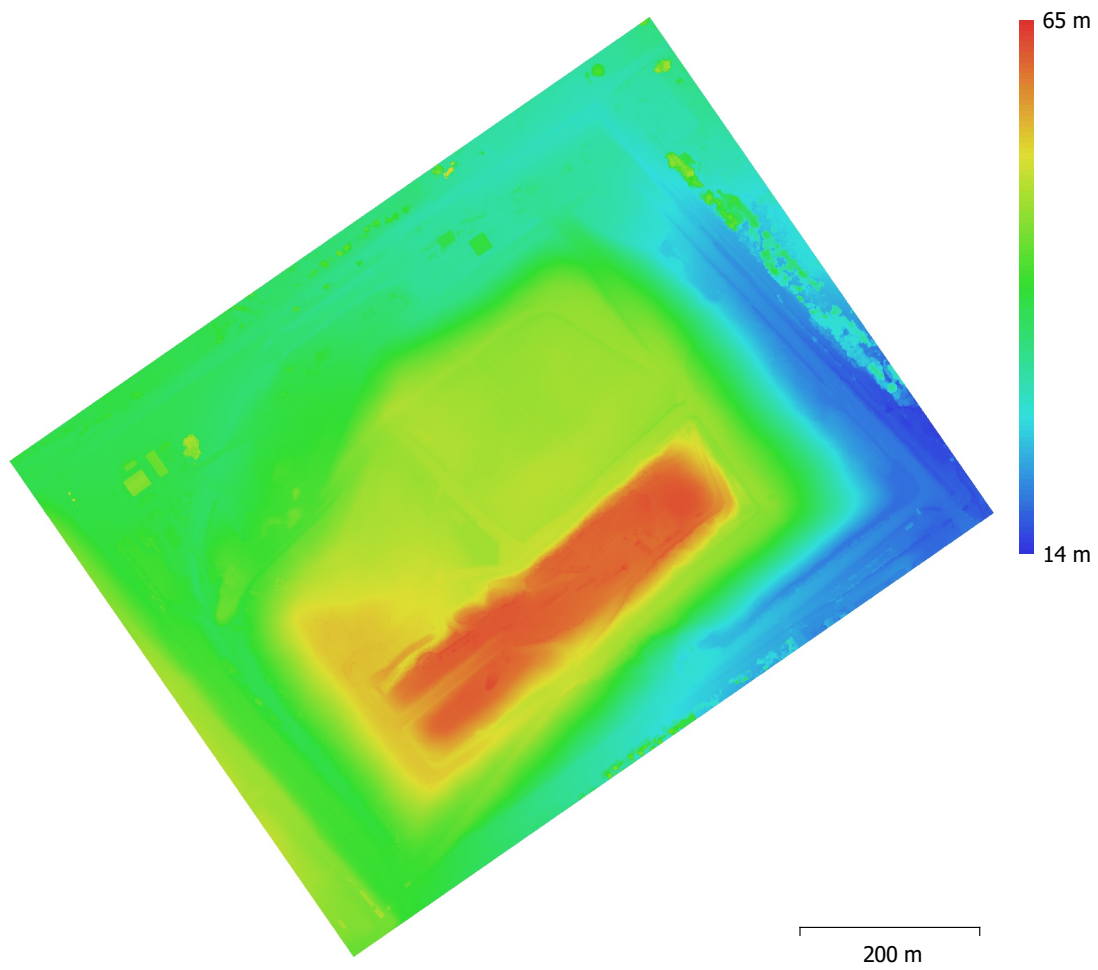


Fig. 5. Reconstructed digital elevation model.

Resolution: 7.83 cm/pix  
Point density: 163 points/m<sup>2</sup>

# Processing Parameters

## General

Cameras	231
Aligned cameras	231
Markers	21
<b>Shapes</b>	
Point	3
LineString	1117
Polygon	22291
Coordinate system	WGS 84 / UTM zone 21S (EPSG::32721)
Coordinate system	WGS 84 / UTM zone 21S EGM96
Rotation angles	Yaw, Pitch, Roll

## Point Cloud

Points	200,597 of 211,738
RMS reprojection error	0.173893 (0.54282 pix)
Max reprojection error	0.838567 (17.3585 pix)
Mean key point size	3.16115 pix
Point colors	3 bands, uint8
Key points	No
Average tie point multiplicity	4.67923

## Alignment parameters

Accuracy	High
Generic preselection	No
Reference preselection	Yes
Key point limit	40,000
Tie point limit	4,000
Adaptive camera model fitting	Yes
Matching time	9 minutes 14 seconds
Alignment time	1 minutes 4 seconds

## Optimization parameters

Parameters	f, b1, b2, cx, cy, k1-k4, p1-p4
Adaptive camera model fitting	No
Optimization time	5 seconds
File size	20.35 MB

## Dense Point Cloud

Points	113,151,793
Point colors	3 bands, uint8

## Depth maps generation parameters

Quality	High
Filtering mode	Aggressive
Processing time	33 minutes 28 seconds

## Dense cloud generation parameters

Processing time	15 minutes 33 seconds
File size	1.43 GB

## DEM

Size	13,980 x 13,358
Coordinate system	WGS 84 / UTM zone 21S EGM96

## Reconstruction parameters

Source data	Dense cloud
Interpolation	Enabled
Processing time	2 minutes 30 seconds



File size	389.10 MB
<b>Orthomosaic</b>	
Size	27,941 x 26,687
Coordinate system	WGS 84 / UTM zone 21S (EPSG::32721)
Colors	3 bands, uint8
<b>Reconstruction parameters</b>	
Blending mode	Mosaic
Surface	DEM
Enable hole filling	Yes
Processing time	5 minutes 49 seconds
File size	3.50 GB
<b>System</b>	
Software name	Agisoft Metashape Professional
Software version	1.7.2 build 12070
OS	Windows 64 bit
RAM	63.93 GB
CPU	Intel(R) Core(TM) i7-9700F CPU @ 3.00GHz
GPU(s)	Radeon(TM) RX 460 Graphics (Baffin)