HUTT CITY COUNCIL

Ortho-photography & Associated Digital Products 2020/21 AD16-4417

VOLUME PRJ38768NOM04

Summary

Project

AAM NZ was engaged by Hutt City Council to undertake acquisition of Aerial Survey (LiDAR & imagery) for Orthophotos, LiDAR and vector generated products. LiDAR data was captured between the 23rd and 27th of March 2021.

This volume contains the LiDAR data products.

Data

LiDAR products supplied in this volume are as follows:

- Classified Point Cloud Data in LAS v1.4, NZTopo50 1:500 tiles
- 1m DEM in ESRI ASCII GRID, NZTopo50 1:500 tiles
- 1m DSM in ESRI ASCII GRID, NZTopo50 1:500 tiles
- 5m contours 3D Shapefile format, NZTopo50 1:500 tiles
- 1m contours 3D Shapefile format, NZTopo50 1:500 tiles
- 0.5m contours 3D Shapefile format, NZTopo50 1:500 tiles
- Breaklines, Tile Index Metadata and Trajectories in Shapefile format
- Project Report - PDF file format.

Additional Products:

- 1m DEM in GeoTiff, NZTopo50 1:1000 tiles
- 1m DSM in GeoTiff, NZTopo50 1:1000 tiles
- Tile Index Metadata in Shapefile format

The vertical accuracy ≤10cm and positional accuracy for this dataset is ≤50cm (95% confidence in clear, open grounds). This dataset is supplied in NZTM, heights are in NZVD2016.

(Ref PRJ38768)

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1. PROJECT REPORT

Safety: No safety Incidents were reported during the project.

Acquisition: LiDAR data was acquired from a fixed wing aircraft on:

Date	Time range	
23/03/2021	19:51	23:00
25/03/2021	20:10	22:54
27/03/2021	17:30	23:01

Ground Support: RTX processing was used to calculate the GPS trajectory solution. Trimble CenterPoint® RTX™ is a proprietary GPS, GLONASS, BeiDou, and QZSS enabled technology that provides high-accuracy GNSS positioning worldwide without the use of traditional local base stations or a VRS network. By combining real-time data from a global reference station infrastructure with innovative positioning and compression algorithms, Trimble RTX technology computes centimeter-level positions based on satellite orbit and clock information. Ground surveyed test point sites were acquired by WSP, these allowed an assessment of the accuracy of the ALS point cloud data.

Data Processing: Laser strikes were classified into ground and non-ground points using a single algorithm across the project area. Manual checking and editing of the data classification further improved the quality of the ground point classification. Further detail is provided on page 6.

Data Presentation: The data provided on this volume has been supplied in accordance with a specification agreed with the primary client. Subsequent users experiencing difficulties in handling the data should please contact AAM to arrange a more alternate data presentation.

Project Contacts:

Client
John Floyd — John.Floyd@huttcity.govt.nz
Hutt City Council

AAM Account Manager
Rohan Potter — R.Potter@aamgroup.com

AAM Project Manager
Lorraine Claydon (Ph +64 275 323 382) — L.Claydon@aamgroup.com

2. DATA INSTALLATION

Data formats	:	LAS v1.4, ESRI ASCII GRID, GeoTiff, SHP, PDF
Number & type of media	:	HDD
Information files on media	:	Readme_PRJ38768NOM04
Data formatted on	:	22/07/2021
Disk volume	:	PRJ38768NOM04

README FILE

This document (Readme_PRJ38768NOM04.pdf) is provided as an Acrobat file in this volume.

FILE SIZES AND NAMES

Hutt City Council project extents are defined in standard LINZ NZTopo 50 1:500 tiles, 240m x 360m. Products have been named according to the LINZ LiDAR file naming convention:

Product_NZTopo50Sheet_MapScale_TileNumber
eg. CL2_BP32_2021_500_086064.abc
DEM_BP32_2021_500_086064.abc
DSM_BP32_2021_500_086064.abc
CON05_BP32_2021_500_086064.abc
CON1_BP32_2021_500_086064.abc

An additional set of for DEM and DSM products have been supplied in NZTopo 50 1:1000 tiles, 480m x 720m - with the standard LINZ file naming convention:

Product_NZTopo50Sheet_MapScale_TileNumber
eg. DEM_BP32_2021_1000_1605.tif
DSM_BP32_2021_1000_1605.tif

Please Note: The Hutt CC LiDAR project boundary extent is based on 1:500 tiles, therefore some 1:1000 tiles will contain “NODATA” values beyond the Hutt CC LiDAR project extent, as agreed with the client.

Full list of files on HDD: ***PRJ38768NOM03-04_file_list.txt***

3. METADATA

SOURCE DATA

Item	Source	Description	Ref No	Date
Laser System	AAM	Optech Galaxy Prime 473	FL014794 FL014813 FL014826 FL014828	23/03/2021 25/03/2021 27/03/2021 “
Trajectory	AAM	CenterPoint® RTX™	PRJ38777	As above
Field Survey	WSP	RTK GPS	PRJ38777	February 2021

DATA CHARACTERISTICS

Characteristic	Description
Device Name	Galaxy Prime +
Half Scan Angle	9 degrees
Laser Pulse Rate	450kHz
Laser Pulse Mode	Multipulse Pulse
Returns	1st, second, third and last
Point Density	8.0pts/ m^2 per swath
Overlap	60% - to achieve 16pts/m^2 density required
Capture Altitude (AGL)	1850m
Survey Speed (Kts)	140
Horizontal Datum	NZGD2000
Vertical Datum	NZVD2016
Map Projection	NZTM
Vertical Accuracy Specification	±0.10m at 95% confidence level
Horizontal Accuracy Specification	±0.50m at 95% confidence level

ATC at Wellington Airport would not permit access at 805m (the original planned altitude), the project was replanned at higher altitude to gain access.

REFERENCE SYSTEMS

	Horizontal	Vertical
Datum	NZGD2000/NZTM	NZVD2016
Projection	NZTM	N/A
Geoid Model		NZGeoid2016

OTHER CAPTURE CRITERIA

Item	Description
Tidal Constraints	NA

4. DATA PROCESSING LINEAGE

LiDAR Processing Workflow:

- LiDAR upload and inspection
- Raw LiDAR processing – GPS & Flight line matching
- Accuracy assessment against test point sites
- Automated classification and manual classification editing
- Product creation
- Quality assurance

Classified LiDAR Point Cloud:

All LAS file point cloud files have been classified to the schema shown in the table below.

The data has been classified to ICSM Level 2 Classification (Ground Surface Improvement) within the clients defined project area of interest (AOI).

Number	Point Class	Description	ICSM Classification Level
1	Default	Unclassified	1
2	Ground	Bare ground	2
3	Low vegetation	<2m high	1
4	Medium Vegetation	2-8m high	1
5	High Vegetation	> 8m high	1
6	Buildings/ Structures		1
7	Low Noise		1
9	Water		2
10	Bridges		2
18	High Noise		1
22	Paved Ground	Public paved areas	2

AAM uses proprietary ground classification routines to provide the initial automated ground / non-ground classification and generate the initial ground surface. The classification is then manually edited to improve the ground classification to ICSM level 2 standard. Following this process, further automated techniques are used to classify the other classes shown above to ICSM level 1 standard.

The Paved Ground classification has been applied manually, transferring the existing paved classification from the 2015 Hutt CC LiDAR, and using the Hutt CC road surface assets to capture new roads, parking and paths.

Digital Elevation Model (DEM): Generated using LiDAR point cloud class 2, 22 (Ground/Paved Ground).

The main Hutt River system in the DEM has been hydro-sloped. No hydro-flattening or hydro-sloping has been applied to rivers less than 30m wide. There were no water bodies >10,000m^2 that required hydro-flattening.

Surface models (DSM): Generated using ground and non-ground classified points. No hydro-flattening or hydro-sloping undertaken on the DSM. Water strikes are included in the interpolation.

Elevation Grids were derived using the LAStools las2dem. This tool reads LIDAR points from the LAS/LAZ format (or some ASCII formats) and triangulates them temporarily into a TIN with a user defined interpolation distance. LAStools then applies a TIN to raster conversion to create the 1m DEM raster dataset.

Contours: Contours were generated using contour key points, which are a sub-set of the ground classified points. The key points are used to build a triangulated surface (TIN) from which the contours are generated. These are engineering contours designed to closely follow the TIN and provide an accurate representation of the terrain - especially in clear ground.

The contours have "Elevations" and "Type" attributes. Types are INDEX or INTER (Intermediate) – every fifth contour is designated an INDEX contour.

The 5m and 1m contours have been extracted from the 0.5m contour dataset.

5. ACCURACY

PROJECT DESIGN ACCURACY

Project specifications and technical processes were designed to achieve data accuracies as follows:

	Measured Point	Basis of Estimation
Vertical Data	<=0.10m	Project design
Horizontal data	<=0.5m	
Test Points	0.05m	Survey methodology used

Notes on Expected Accuracy

- Values shown represent standard error (68% confidence level or 1 sigma), in meters.
- "Measured points" are those observed directly.
- Accuracy estimates for terrain modeling refer to the terrain definition on clear ground. Ground definition in vegetated terrain may contain localized areas with systematic errors or outliers which fall outside this accuracy estimate.
- Laser strikes have been classified into "ground" and "non-ground", based upon algorithms tailored for major terrain/vegetation combinations existing in the project area. The definition of the ground may be less accurate in isolated pockets of dissimilar terrain/vegetation combinations.

LIMITATIONS OF DATA

- The definition of the ground under trees may be less accurate due to fewer ground returns.

LiDAR DATA VALIDATION

- Ground data in this volume has been compared to test points obtained by field survey and assumed to be error-free. The test points were located on open clear ground. Comparison of the field test points with elevations interpolated from measured data, after removing the mean offset of -0.118m yielded the following accuracy assessment:

Test Point Sites	No. of Points	Mean Difference	Std Deviation	RMS (m)
5	154	0.000	0.023	0.023

A table of the Test Point Analysis can be found on page 10.

6. CONDITIONS OF SUPPLY

The data in this volume has been commissioned by **HUTT CITY COUNCIL**.

The data in this volume is provided by AAM NZ Limited (AAM) to **HUTT CITY COUNCIL** under **Hutt City Contract AD16-4417: Ortho-photography and Associated Digital Products 2020/21**, this allows for release of the data under Creative Commons Attribution 4.0 International, and is subject to the following conditions:

1. This file (Readme_PRJ38768NOM04.PDF) is always stored with the unaltered data contained in this volume.

2. The data is not used for purposes beyond that explicitly agreed in the description of the Services provided by AAM.

Any problems associated with the information in the data files contained in this volume should be reported to AAM NZ Limited. A list of project related contacts is listed on page 3 under the Project Report heading.

Email info@aamgroup.com
Web www.aamgroup.com

7. TEST POINT ANALYSIS

Project:	PRJ38768 – PRJ38776 Hutt Valley LiDAR
Name:	Test_Sites_Check
Coordinate system:	NZTM2000
Report type:	LiDAR

Name	Easting	Northing	Known Z	Laser Z	Dz
1	1758580.581	5426936.727	3.268	3.288	0.020
2	1758577.691	5426931.617	3.219	3.266	0.047
3	1758574.905	5426927.158	3.235	3.253	0.018
4	1758572.059	5426922.360	3.227	3.232	0.005
5	1758576.342	5426919.133	3.200	3.202	0.002
6	1758579.639	5426923.675	3.212	3.227	0.015
7	1758582.533	5426928.152	3.233	3.249	0.016
8	1758585.057	5426932.097	3.247	3.260	0.013
9	1758587.416	5426935.859	3.284	3.303	0.019
10	1758592.124	5426932.920	3.292	3.298	0.006
11	1758589.254	5426928.557	3.240	3.265	0.025
12	1758586.510	5426923.944	3.220	3.243	0.023
13	1758583.816	5426919.350	3.195	3.222	0.027
14	1758581.022	5426914.783	3.168	3.185	0.017
15	1758585.529	5426911.618	3.187	3.177	-0.010
16	1758588.507	5426916.378	3.226	3.207	-0.019
17	1758591.511	5426921.237	3.218	3.235	0.017
18	1758594.183	5426925.835	3.249	3.252	0.003
19	1758596.891	5426930.110	3.268	3.292	0.024
20	1758601.579	5426926.933	3.255	3.283	0.028
21	1758598.709	5426922.091	3.229	3.256	0.027
22	1758595.938	5426917.452	3.209	3.233	0.024
23	1758593.131	5426912.795	3.210	3.223	0.013
24	1758590.363	5426908.442	3.164	3.204	0.040
26	1759792.479	5435452.206	3.601	3.605	0.004
27	1759787.772	5435452.557	3.896	3.885	-0.011
28	1759782.171	5435452.888	3.815	3.815	0.000
29	1759781.950	5435459.584	3.821	3.788	-0.033
30	1759787.333	5435459.772	3.975	3.937	-0.038
31	1759792.723	5435459.485	3.703	3.657	-0.046
32	1759793.363	5435465.583	3.721	3.673	-0.048
33	1759787.451	5435465.913	3.967	3.949	-0.018
34	1759782.063	5435466.475	3.842	3.809	-0.033
35	1759782.463	5435472.043	3.876	3.830	-0.046
36	1759788.035	5435471.997	3.998	3.985	-0.013
37	1759793.779	5435471.658	3.740	3.710	-0.030
38	1759794.611	5435477.931	3.742	3.728	-0.014
39	1759788.386	5435478.454	4.038	4.030	-0.008
40	1759782.932	5435479.157	3.858	3.864	0.006
41	1759783.362	5435484.944	3.879	3.868	-0.011

42	1759789.014	5435484.930	4.051	4.047	-0.004
43	1759794.821	5435484.433	3.805	3.820	0.015
44	1759795.525	5435490.533	3.820	3.812	-0.008
45	1759789.330	5435491.075	4.084	4.085	0.001
46	1759783.818	5435491.498	3.908	3.891	-0.017
47	1759784.261	5435497.590	3.938	3.938	0.000
48	1759790.041	5435497.211	4.115	4.134	0.019
49	1759795.785	5435496.608	3.860	3.856	-0.004
50	1759796.326	5435502.681	3.918	3.879	-0.039
51	1759790.285	5435503.180	4.144	4.138	-0.006
52	1759784.674	5435503.679	3.974	3.970	-0.004
53	1759785.108	5435509.769	4.010	4.007	-0.003
54	1759790.816	5435509.387	4.189	4.194	0.005
55	1759796.613	5435509.006	3.919	3.922	0.003
56	1759796.792	5435515.320	4.033	4.000	-0.033
57	1759797.703	5435522.393	3.966	3.966	0.000
58	1759791.857	5435522.788	4.263	4.273	0.010
59	1759786.037	5435522.913	4.088	4.073	-0.015
60	1759791.200	5435515.547	4.275	4.233	-0.042
61	1759785.540	5435516.019	4.043	4.048	0.005
62	1762793.872	5430946.625	87.532	87.534	0.002
63	1762798.585	5430944.749	87.485	87.500	0.015
64	1762803.281	5430942.985	87.514	87.511	-0.003
65	1762808.188	5430940.559	87.552	87.554	0.002
66	1762813.640	5430938.376	87.613	87.603	-0.010
67	1762819.087	5430936.382	87.603	87.586	-0.017
68	1762821.231	5430941.528	87.672	87.640	-0.032
69	1762816.286	5430944.175	87.724	87.678	-0.046
70	1762811.008	5430946.576	87.689	87.683	-0.006
71	1762805.695	5430949.201	87.615	87.615	0.000
72	1762799.926	5430951.880	87.602	87.599	-0.003
73	1762796.926	5430953.701	87.610	87.618	0.008
74	1762799.404	5430958.659	87.734	87.711	-0.023
75	1762804.411	5430956.380	87.711	87.680	-0.031
76	1762809.407	5430953.899	87.729	87.719	-0.010
77	1762814.752	5430951.365	87.762	87.755	-0.007
78	1762820.242	5430949.393	87.720	87.709	-0.011
79	1762822.882	5430954.590	87.764	87.744	-0.020
80	1762817.899	5430957.501	87.819	87.801	-0.018
81	1762812.889	5430960.228	87.847	87.846	-0.001
82	1762807.179	5430962.572	87.821	87.831	0.010
83	1762802.090	5430964.940	87.827	87.804	-0.023
84	1762804.659	5430970.208	87.915	87.905	-0.010
85	1762809.713	5430967.534	87.933	87.930	-0.003
86	1762814.747	5430965.008	87.913	87.912	-0.001
87	1762819.920	5430962.919	87.888	87.879	-0.009
88	1762824.790	5430960.901	87.824	87.804	-0.020
89	1762827.560	5430965.599	87.748	87.771	0.023
90	1762823.008	5430968.920	87.779	87.798	0.019

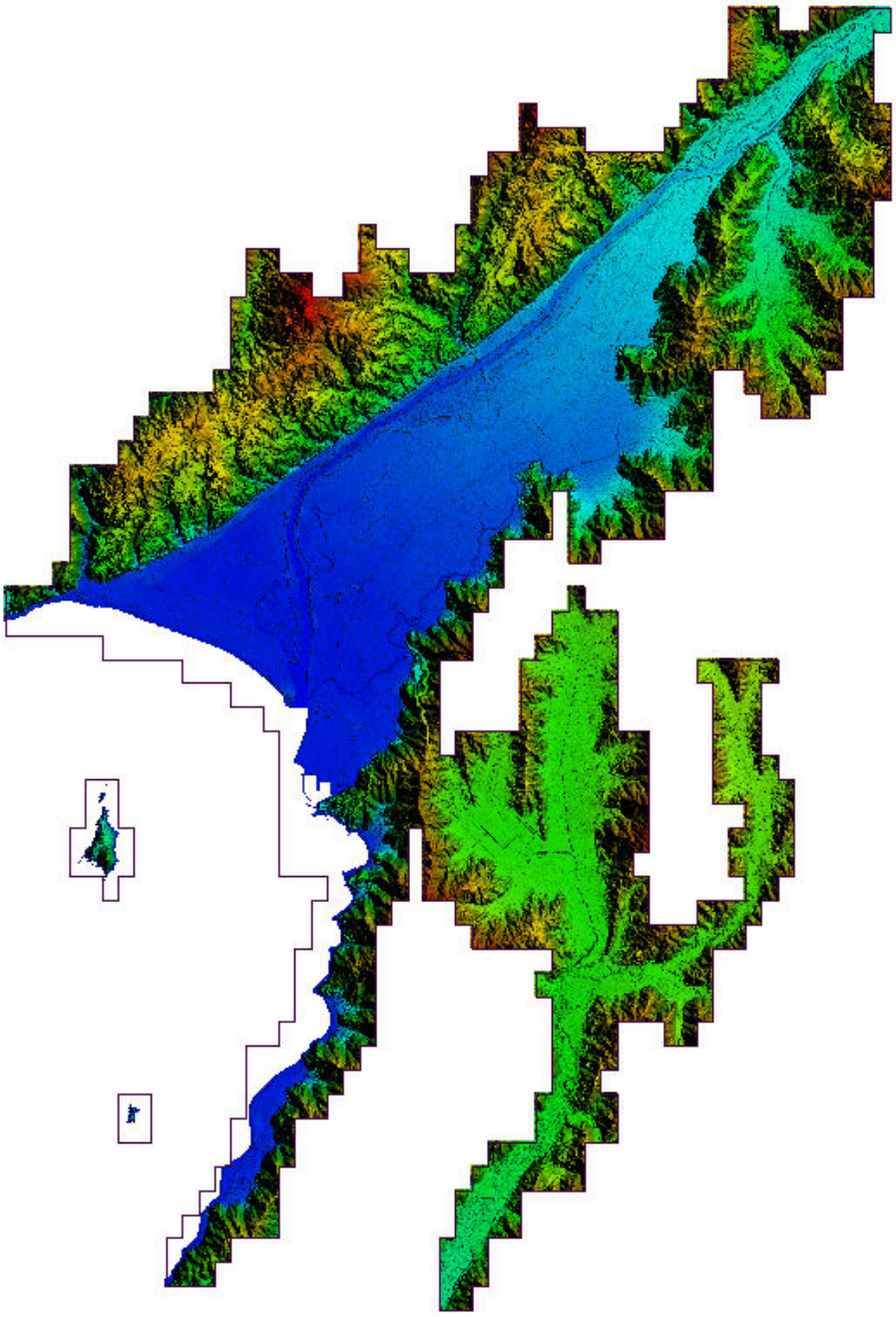
91	1762818.356	5430972.049	87.802	87.824	0.022
92	1762813.356	5430975.207	87.833	87.856	0.023
93	1762808.263	5430978.307	87.880	87.904	0.024
94	1768848.965	5442891.135	43.704	43.732	0.028
96	1768841.428	5442886.191	43.703	43.715	0.012
97	1768844.371	5442881.636	43.777	43.789	0.012
99	1768852.013	5442886.417	43.789	43.802	0.013
100	1768855.289	5442881.302	43.863	43.868	0.005
101	1768851.006	5442878.777	43.946	43.978	0.032
102	1768847.628	5442876.455	43.835	43.877	0.042
103	1768850.863	5442871.385	43.924	43.961	0.037
104	1768854.383	5442873.378	44.033	44.047	0.014
105	1768858.463	5442876.304	43.908	43.936	0.028
106	1768861.319	5442871.098	43.989	44.026	0.037
107	1768857.579	5442868.499	44.075	44.123	0.048
110	1768860.533	5442863.842	44.127	44.156	0.029
111	1768864.503	5442866.038	44.061	44.087	0.026
112	1768865.880	5442848.488	44.208	44.219	0.011
113	1768868.953	5442850.545	44.316	44.344	0.028
114	1768873.170	5442853.000	44.266	44.279	0.013
115	1768879.200	5442843.603	44.376	44.381	0.005
116	1768874.934	5442841.023	44.477	44.486	0.009
117	1768871.688	5442838.694	44.342	44.346	0.004
118	1768875.507	5442832.566	44.420	44.436	0.016
119	1768879.072	5442834.568	44.584	44.592	0.008
120	1768883.388	5442836.982	44.428	44.439	0.011
121	1768850.153	5442839.802	44.278	44.294	0.016
123	1768862.351	5442820.931	44.482	44.516	0.034
124	1768868.937	5442811.372	44.520	44.545	0.025
125	1768876.289	5442803.143	44.591	44.629	0.038
126	1776024.726	5448660.121	81.285	81.305	0.020
127	1776021.466	5448663.362	81.629	81.614	-0.015
128	1776019.521	5448665.534	81.776	81.777	0.001
129	1776015.136	5448662.783	81.732	81.704	-0.028
131	1776020.387	5448655.650	81.208	81.167	-0.041
132	1776016.527	5448652.753	81.230	81.218	-0.012
133	1776012.826	5448657.699	81.619	81.592	-0.027
134	1776013.125	5448661.723	81.708	81.717	0.009
135	1776007.445	5448656.546	81.772	81.732	-0.040
136	1776010.421	5448652.833	81.479	81.475	-0.004
137	1776013.313	5448649.819	81.264	81.249	-0.015
138	1776008.911	5448645.421	81.405	81.417	0.012
139	1776005.130	5448649.326	81.598	81.566	-0.032
142	1775998.997	5448646.915	81.713	81.663	-0.050
145	1775994.284	5448643.959	81.772	81.741	-0.031
146	1775990.696	5448648.694	81.668	81.639	-0.029
150	1775985.993	5448642.777	81.704	81.664	-0.040
151	1775988.525	5448639.424	81.913	81.870	-0.043
152	1775991.358	5448635.598	81.903	81.890	-0.013

154	1775991.950	5448632.678	81.904	81.906	0.002
155	1775988.176	5448635.167	81.994	81.978	-0.016
156	1775985.268	5448638.506	81.775	81.782	0.007
158	1775984.486	5448624.930	82.436	82.395	-0.041
159	1775981.708	5448620.160	82.624	82.614	-0.010
162	1775969.554	5448595.234	83.206	83.234	0.028
163	1775972.673	5448593.965	83.164	83.121	-0.043
164	1775971.404	5448590.473	83.160	83.164	0.004
165	1775967.492	5448592.623	83.222	83.232	0.010

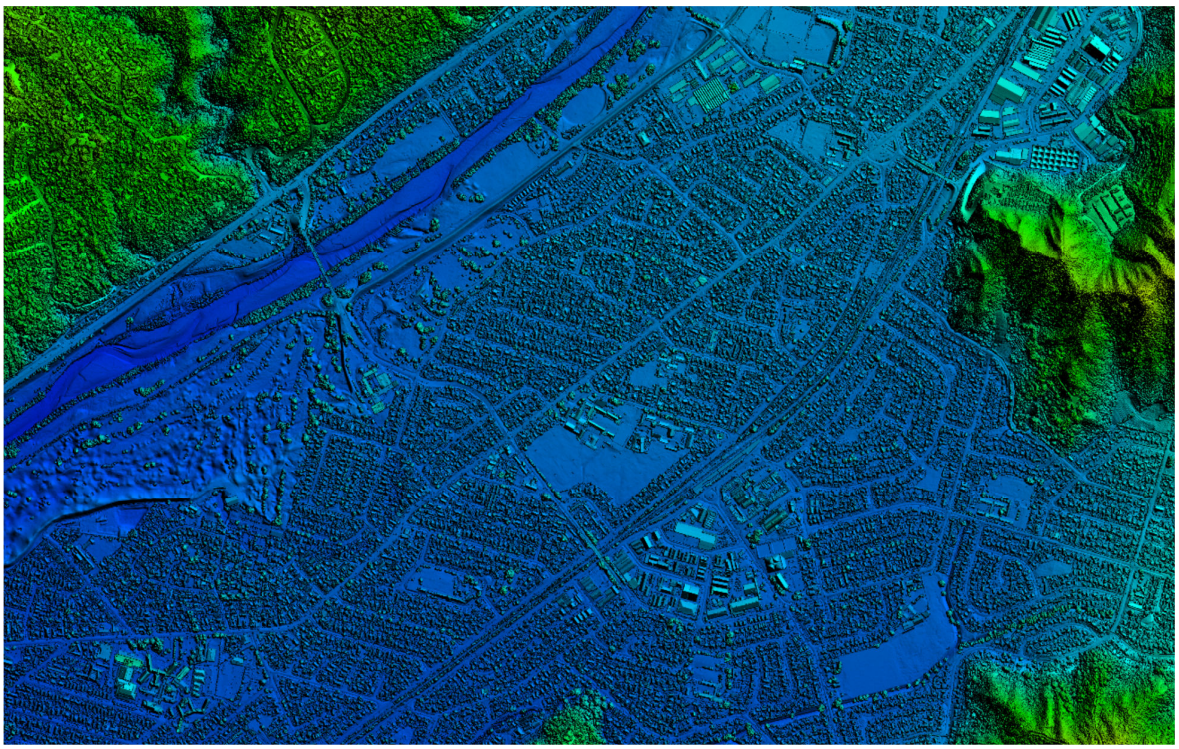
MIN	-0.050
MAX	0.048
Mean	0.000
STDEV	0.023
RMSE	0.023
95% confidence	0.045

8. VALIDATION PLOTS

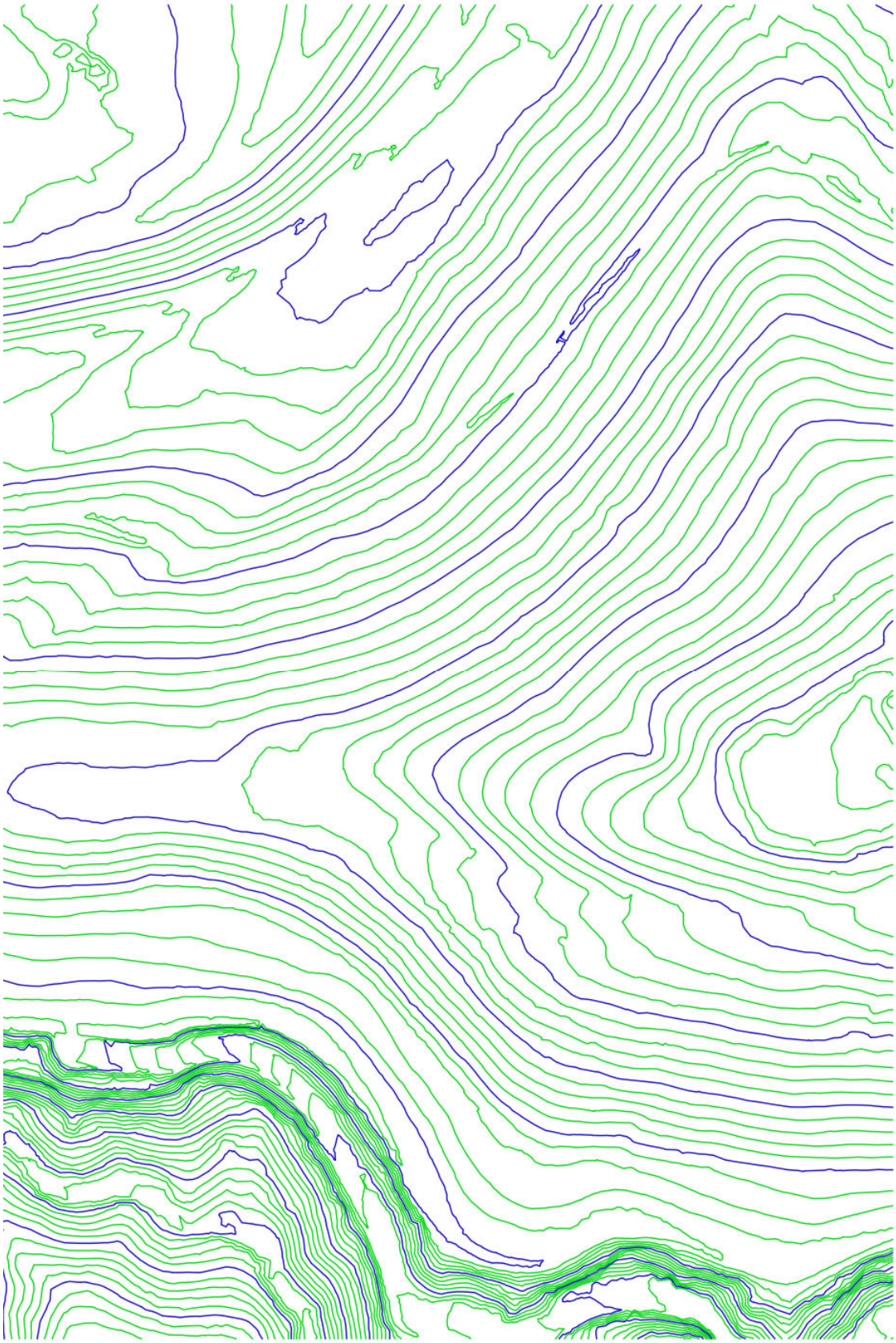
Overview of Ground data – colour elevation plot



Sample of the DSM:



Sample of the 1m Contours:



Sample of the 0.5m Contours: