PALMERSTON NORTH CITY COUNCIL

PNCC LIDAR 2018

VOLUME PRJ31260NOM01

<div align="center">__Summary__</div>

Project

AAM was engaged by Palmerston North City Council to undertake an airborne LiDAR survey over Palmerston North (the project extent is shown on maps towards the back of this report).

The data was captured between 29 August and 28 September 2018.

LiDAR data and other products supplied over the course of this project include:
1. Classified LiDAR point cloud – CL2
2. Ground LiDAR point cloud - DTM
3. Non Ground LiDAR point cloud - NG
4. Digital Elevation Model - DEM
5. Digital Surface Model -DSM
6. Contours – CON (NZVD2016) / CON2 (Moturiki 1953)
7. Imagery – IMG
8. Ancillary Files:
   - Trajectories as ESRI Shapefile
   - Tile Index Metadata as ESRI Shapefile
   - Project Extent as ESRI Shapefile
   - DEM Breaklines
   - Ground Control
   - Project Report

The project specification for point cloud accuracy is vertical +/- 0.10m @ 95% confidence, and horizontal +/- 0.50m @ 95% confidence. This dataset is supplied on NZTM map projection, all products are supplied in NZVD2016 vertical datum, with an additional set of contours supplied in Moturiki 1953.

(Ref: PRJ31260)

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1. PROJECT REPORT

Acquisition: AAM was engaged by Palmerston North City Council to undertake an airborne LiDAR survey over Palmerston North. The data was captured between 29 August and 28 September 2018. An Optech Orion H300 LiDAR sensor system was used for this project, coupled with a Phase One medium format camera.

Date	Flight #	Status	Sensor	Survey Start	Survey End
29/08/2018	1	Successful Capture	Sensor:Optech Orion H300 - 325	12:56 p.m.	5:17 p.m.
30/08/2018	2	Successful Capture	Sensor:Optech Orion H300 - 325	9:15 a.m.	3:25 p.m.
31/08/2018	3	Successful Capture	Sensor:Optech Orion H300 - 325	3:22 p.m.	5:55 p.m.
01/09/2018	4	Successful Capture	Sensor:Optech Orion H300 - 325	2:14 p.m.	5:58 p.m.
10/09/2018	5	Successful Capture	Sensor:Optech Orion H300 - 325	10:28 a.m.	10:58 a.m.
10/09/2018	6	Successful Capture	Sensor:Optech Orion H300 - 325	3:52 p.m.	5:15 p.m.
19/09/2018	7	Successful Capture	Sensor:Optech Orion H300 - 325	9:00 a.m.	1:43 p.m.
19/09/2018	8	Successful Capture	Sensor:Optech Orion H300 - 325	2:46 p.m.	4:41 p.m.
20/09/2018	9	Successful Capture	Sensor:Optech Orion H300 - 325	8:48 a.m.	10:24 a.m.
20/09/2018	10	Successful Capture	Sensor:Optech Orion H300 - 325	5:03 p.m.	5:39 p.m.
27/09/2018	11	Successful Capture	Sensor:Optech Orion H300 - 325	1:53 p.m.	2:40 p.m.
28/09/2018	12	Successful Capture	Sensor:Optech Orion H300 - 325	7:23 a.m.	8:14 a.m.

The acquisition design was planned on recording a minimum 8 pulses per square metre. Sensor system settings were adjusted to manage the terrain variation, with majority of the flown at 1,050m above ground level and a narrow field of view of 15 degrees. Target ground speed for the entire project was 140 knots, and minimum swath side overlap of 20%.

Ground Support: High precision GNSS positioning was utilized extensively for this project. Using the current version of WGS84 (based of ITRF08 on the date of acquisition) and NZGD2000 reference systems and networks. Heights in terms of LINZ NZVD2016 Standard, calculated using the New Zealand Quasigeoid 2016.

Base station support was sourced from GNS/LINZ Surveys Continuously Operating Reference Station data, which covers the full project extent.

Validation field surveying was performed by Sounds Surveying. To ensure independence, AAM requested that Sounds Surveying select the 25 vertical and 7 horizontal survey sites locations, with instruction to widely distribute the sites throughout the project extent. This data allowed an independent assessment of the accuracy of the point cloud data.

Site 7 returned slightly higher than expected vertical residuals thought to be due to surrounding vegetation corridor causing multipath interference. A secondary site, site 77 was surveyed nearby, but not within the vegetation corridor and this produced better results.

Data Processing: Reduction of the LiDAR data proceeded without any significant problems. Classification of the point clouds is to Level 3, with reference to *ICSM LiDAR Specifications for NZ*. Classification accuracy required: 99% for ground points.

The Classified point cloud product contains the following classes:

Number	Point class	Description
1	*Default*	*Unclassified*
2	*Ground*	*Bare ground*
3	*Low vegetation*	*0 – 0.3m (essentially sensor noise)*

4	Medium vegetation	0.3 – 2m
5	High vegetation	2m >
6	Buildings, structures	Buildings, houses, sheds, silos etc.
7	Low / high points	Spurious high/low point returns (unusable and/or noise)
9	Water	Any point in water
10	Bridge	Road bridge or overpass

The withheld flag was applied to the overage data (overlapping points between flight lines), this is an automated process using LASTools.

Further Processing: Further processing was required to generate NZVD2016 data producing Contours, DEM and DSM grid models, and a secondary set of contours in Moturiki 1953 vertical datum.

Grid models were derived using a point to TIN and TIN to Raster process, using Linear interpolation. Hydro flattening was undertaken over non-tidal water bodies with surface area greater than 10,000 sq m, and non-tidal water courses greater than 30m nominal width.

The 0.25m contours supplied on for this project are generated from contour key points extracted from the ground points. The aim was to supply a smooth appearance, without loss of integrity. Sample files were supplied to the client to approve the appearance.

The imagery supplied was georeferenced using direct referencing methods, and ortho-rectified using the LiDAR digital terrain model.

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 appropriate data presentation.

Project Contacts:

Client
Andre Kruger   andre.kruger@pncc.govt.nz

Company
Palmerston North City Council

AAM General Manager Mapping
Tim Farrier   t.farrier@aamgroup.com

AAM Account Manager
Chris Worts   c.worts@aamgroup.com

AAM Project Manager
Lorraine Claydon   l.claydon@aamgroup.com

2.   DATA INSTALLATION

Data formats	:	ESRI ASCII grid, ESRI Shapefile, LAS v1.3, GeoTIFF/TFW
Information files on media	:	Readme_PRJ31260NOM01.pdf
Data formatted on	:	8/01/2019
Disk volume	:	PRJ31260NOM01

README FILE

This document (Readme_PRJ31260NOM01.pdf) is provided as an Acrobat file in this volume.

FILE SIZES AND NAMES

The file naming convention follows the tile numbering system provided by Council. A year stamp (year of project capture commencement), and a product dataset code:

[Product ID]_[Topo50 Prime]_[YEAR]_[SCALE]_[Topo50 TILE].[format]

[ProductID] :
- CL2 – Raw Point Cloud
- DTM – Digital Terrain Point Cloud
- NG – Above Ground Point Cloud
- DEM – Digital Elevation Model (grid)
- DSM – Digital Surface Model (grid)
- CON – Contours in NZVD2016
- CON2 – Contours in Moturiki 1953 vertical datum
- IMG - Imagery

[format] - *.las, *.asc, *.shp, *.tif

e.g. CL2_BM34_2018_1000_3604.las

3. ADDITIONAL SERVICES

## Product Generation

AAM can perform the following additional services on the data contained on this volume if required:

Change horizontal datum	:	to another local grid
Alter geoid modeling	:	by transforming ALS data to fit orthometric survey heights
Improve data classification	:	by tailoring parameters to suit regional variations
Further classification	:	assist building identification by further classifying non-ground strikes
Further point cloud manipulation		by normalising point cloud to terrain, creating canopy height models etc
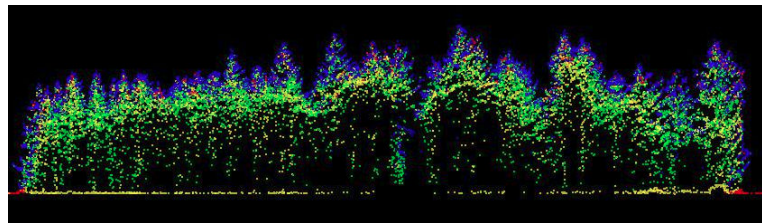
Data thinning	:	to remove superfluous points not adding to the terrain definition
Data subset	:	by dividing the data into different tiles or polygons
Data presentation	:	by creating additional contours, hill shade reliefs profiles, perspectives, flythrough, colour-coded height plots etc.
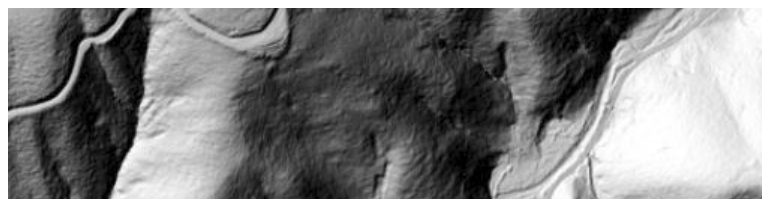
Ground truthing	:	by comparing the ALS terrain model with extra independent height data
Data gridding	:	to convert the measured spot heights into a regular grid
Intensity Image	:	greyscale image created from laser's intensity returns
3d Perspectives	:	image draping /slope models
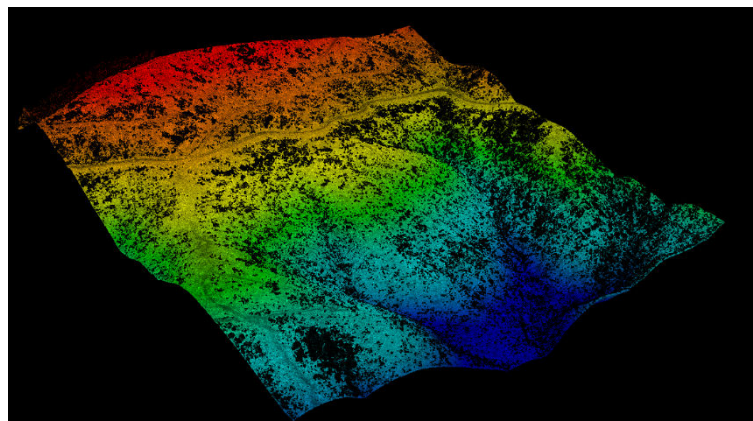
4. METADATA

SOURCE DATA

Item	Source	Description	Ref No	Date
Laser System	AAM	Orion H300	PRJ31260	29/08/2018 – 28/09/2018
Base Stn Coords	GeoNET	CORS	PRJ31260	" "
Field Survey Data	Sounds Surveying	RTK GPS	PRJ31260	13-16 Feb 2018 & 18 Nov 2018

LASER DATA CHARACTERISTICS

Characteristic	Description
Device Name:	Orion H300
Half Scan Angle:	15 degrees
Laser Pulse Rate:	250 kHz
Laser Pulse Mode:	Multipulse
Laser Return Types:	1st, 2nd, 3rd … 4th and last
File Format:	ESRI ASCII Grid, ESRI Shapefile, LAS 1.3, GeoTIF
Contour Interval:	0.25m
Horizontal Datum:	NZGD2000
Vertical Datum:	NZVD2016 (and Moturiki 1953)
Map Projection:	NZTM
Vertical Accuracy Specification:	±0.05m RMS
Horizontal Accuracy Specification:	±0.25m RMS

REFERENCE SYSTEMS

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

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	<= 0.05 m	Project Design
Horizontal data	<= 0.21 m	Project Design
Test points	0.05m	Survey methodology used

Notes on Expected Accuracy
- Accuracy estimates for terrain modeling refer to the terrain definition on clear ground, 1 sigma confidence level.
- 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.

DATA VALIDATION

- Ground data in this volume has been compared to test points obtained by field survey and assumed to be error-free. Comparison of the field test points with elevations interpolated from measured data resulted in:

Ref Point Site	No. of Points	Mean Difference (m)	Std Deviation (m)	RMS (m)	95% confidence
All 25 sites	1,308	-0.006	0.038	0.039	0.075

- Full vertical analysis is shown in PRJ31260_PNCC_LiDAR_Vertical Anaylsis.pdf
- Points at site 7 were excluded, new site 77 was included.
- Unreliable points have been removed from the above analysis, e.g. those in long grass, along fencelines, edge of ditch etc.
- Horizontal check sites were observed during the QA process.
- Data classification has been manually checked and edited against available imagery.

USE OF DATA

- Intended use   : Preliminary Design subject to final survey
- Intended use   : Planning, Conceptual Design
- Intended scale of use : 1:500

6.   CONDITIONS OF SUPPLY

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

The data in this volume is provided by AAM NZ Limited (AAM) to **PALMERSTON NORTH CITY COUNCIL** under **Contract No: 3526, dated 8 December 2017**, which provides **PALMERSTON NORTH CITY COUNCIL** and AAM NZ Limited with joint ownership of the digital mapping and other delivered data (Project IP), in accord with documented provisions, and subject to the following conditions:

1. This file (Readme_PRJ31260NOM01.PDF) is always stored with the unaltered data contained in this volume.

2. This volume of data is not altered in any way without the approval of AAM. The data may be copied from this file to another.

Any breach of these conditions will result in the immediate termination of the license issued by AAM, and PALMERSTON NORTH CITY COUNCIL will indemnify AAM from all resulting liabilities.

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 5 under the Project Report heading.
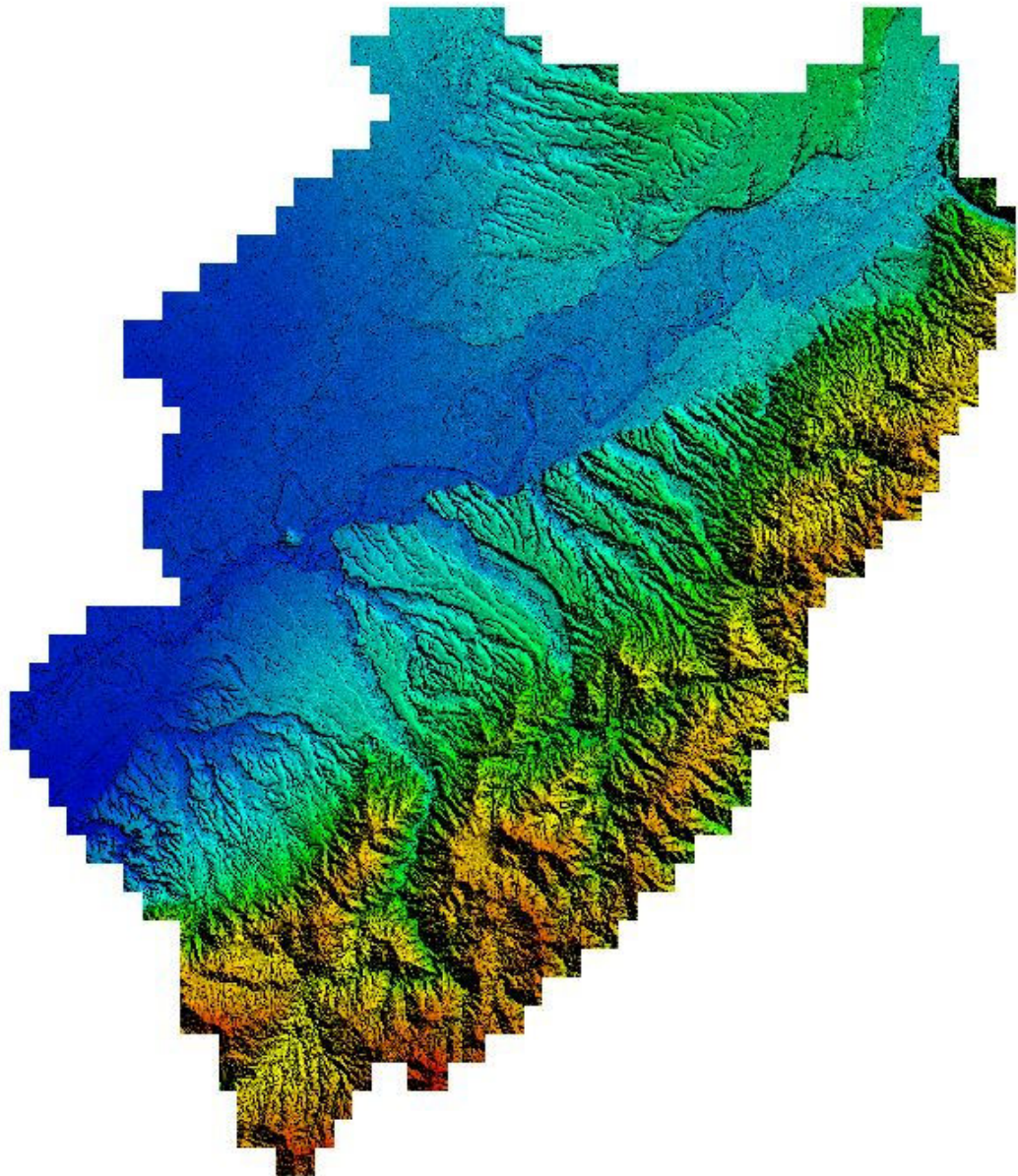
6 Ossian St,
NAPIER
New Zealand
Telephone   +64 296 030 382
Email info@aamgroup.com
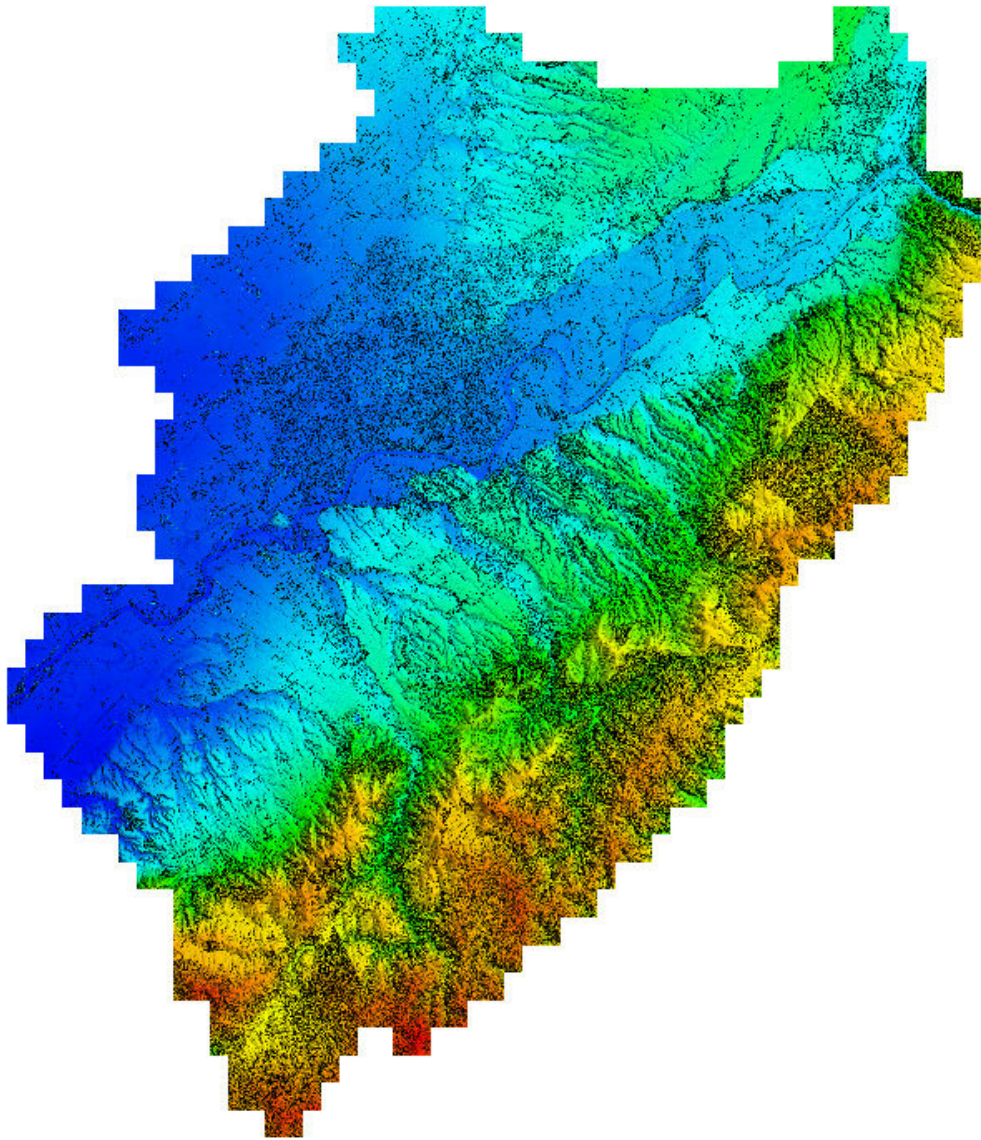Web www.aamgroup.com

7. PROJECT AREA
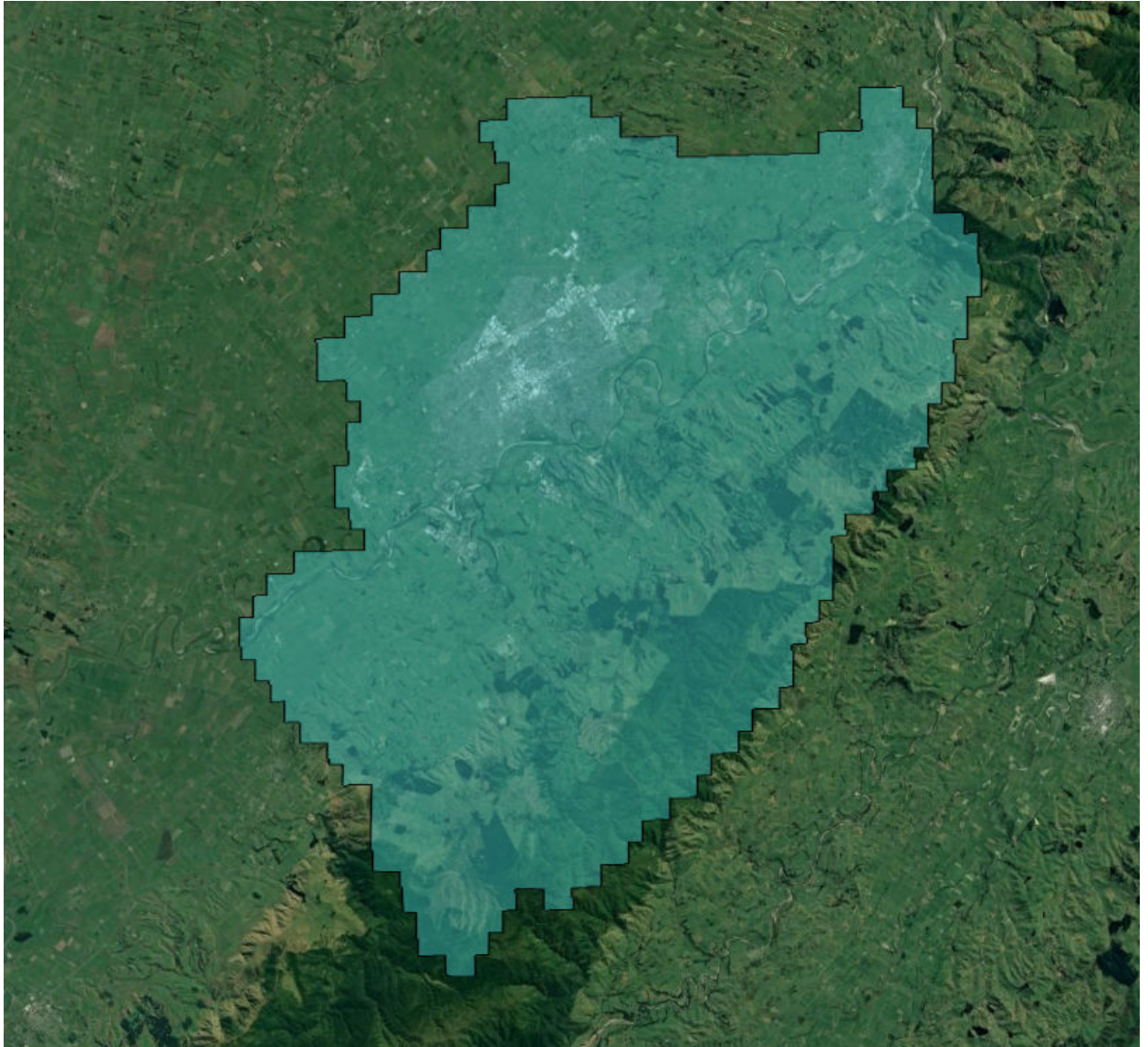
Extent of the project (background image from Google Earth)

8. **VALIDATION PLOTS**
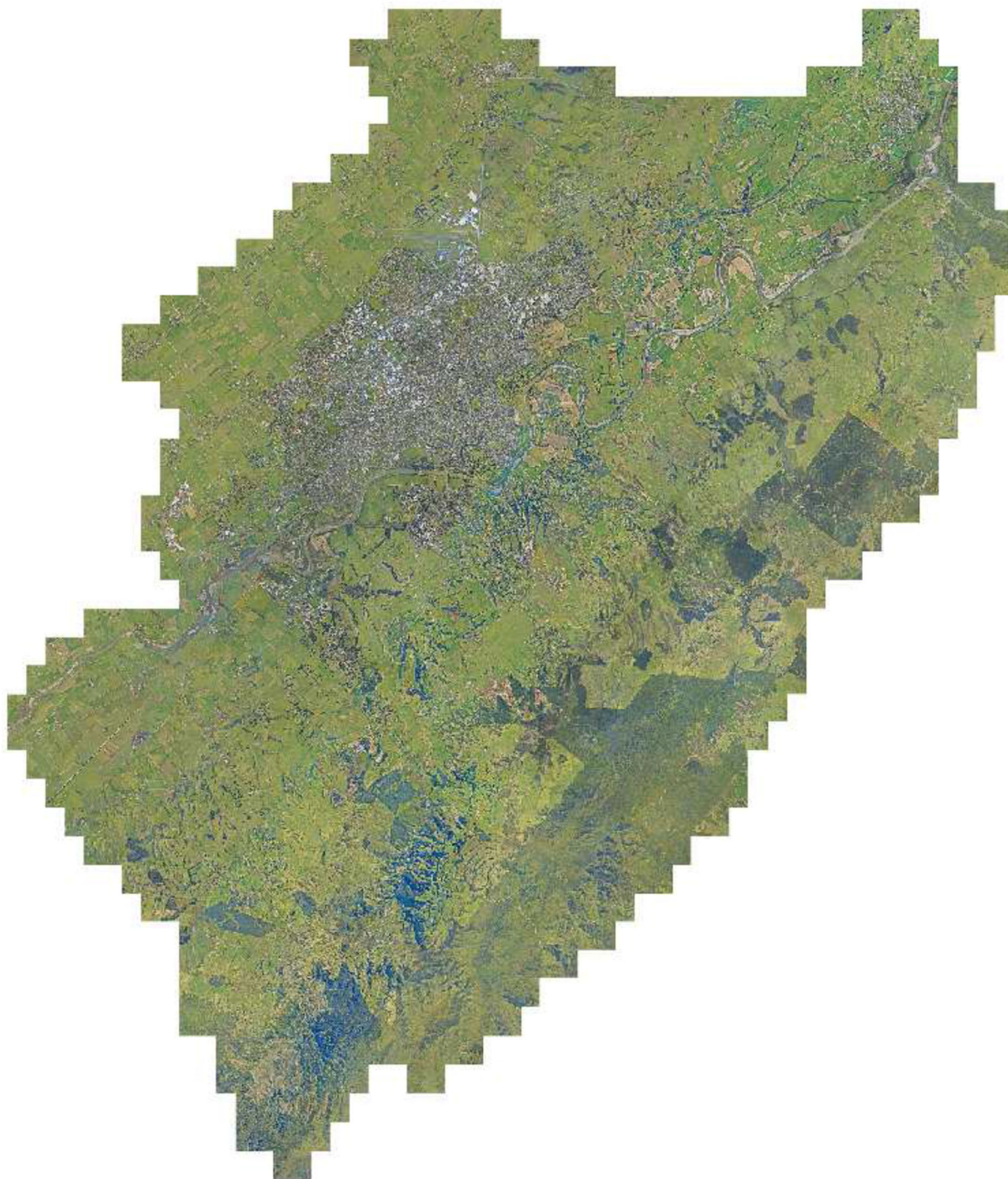

Terrain data coloured by elevation

Surface Model data coloured by elevation

Imagery