



## AUCKLAND COUNCIL

### AUCKLAND COUNCIL LIDAR 2016-17

#### VOLUME 11286A01NOM

#### Summary

##### **Project**

AAM was engaged by Auckland Council to undertake an airborne LiDAR survey over the southern 1/3 of the Council's territory (the project extent is shown on maps towards the back of this report).

The data was captured between 9 September 2016 and 6 February 2017.

LiDAR data and other products supplied over the course of this project include:

1. Raw (Classified) LiDAR point cloud - RPC
2. DTM (Ground) LiDAR point cloud - DTM
3. Above Ground LiDAR point cloud - AG
4. Contours
5. Digital Elevation Model (DEM)
6. Digital Surface Model (DSM)
7. Digital Camera Imagery – supplied when lighting conditions allowed
8. Ancillary Files:
  - Trajectories as ESRI Shapefile
  - Tile Index Metadata as ESRI Shapefile
  - Project Extent as ESRI Shapefile

The project specification for point cloud accuracy is vertical  $\leq 0.10\text{m RMS}$ , and horizontal  $\leq 30\text{cm RMS}$ . This dataset is supplied on NZTM map projection, all products are supplied in Auckland 1946 vertical datum, point cloud products are also supplied in NZVD2016 vertical datum.

(Ref: PWNZ 11286A, PW 26933A)

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## 1. PROJECT REPORT

**Acquisition:** AAM was engaged by Auckland Council to undertake an airborne LiDAR survey over the southern part of Auckland Council territory. The data was captured between 9 September 2016 and 6 February 2017. A Riegl Q1560 LiDAR sensor system was used for this project; this sensor system contains a Trimble Aerial Imagery Camera (TAIC). The TAIC was used during flights undertaken during the day.

Date	Job No.	Flight Number or Daily Events	Sensors	Survey Begun	Survey Ended
09/Sep/16	11286A	Successful Capture - Flight 01	Riegl Q1560	7:56	10:44
10/Sep/16	11286A	Successful Capture - Flight 02	Riegl Q1560	7:31	11:10
11/Sep/16	11286A	Successful Capture - Flight 03	Riegl Q1560	6:33	10:16
11/Sep/16	11286A	Rejected Capture - Flight 04	Riegl Q1560	12:19	15:06
12/Sep/16	11286A	Successful Capture - Flight 05	Riegl Q1560	6:36	9:40
23/Oct/16	11286A	Successful Capture - Flight 06	Riegl Q1560	8:54	12:20
23/Oct/16	11286A	Successful Capture - Flight 07	Riegl Q1560	14:18	17:24
24/Oct/16	11286A	Successful Capture - Flight 08	Riegl Q1560	8:27	10:45
31/Oct/16	11286A	Successful Capture - Flight 09	Riegl Q1560	9:34	12:59
14/Jan/17	11286A	Successful Capture - Flight 10	Riegl Q1560	17:53	20:15
16/Jan/17	11286A	Successful Capture - Flight 11	Riegl Q1560	19:01	20:45
17/Jan/17	11286A	Successful Capture - Flight 12	Riegl Q1560	20:58	22:07
21/Jan/17	11286A	Successful Capture - Flight 13	Riegl Q1560	10:19	12:03
26/Jan/17	11286A	Successful Capture - Flight 14	Riegl Q1560	17:12	18:11
28/Jan/17	11286A	Successful Capture - Flight 15	Riegl Q1560	16:40	19:41
29/Jan/17	11286A	Successful Capture - Flight 16	Riegl Q1560	18:33	20:26
06/Feb/17	11286A	Successful Capture - Flight 17	Riegl Q1560	11:40	14:54

The acquisition design was planned on recording a minimum 4 pulses per square metre. Two sensor system settings were used on the project to manage the terrain variation. The urban central (flatter) portion of the project was flown at 1225m above sea level and a primary field of view of 40 degrees. The Manukau and Hunua parts of the project were flown at 1160m above sea level and a primary field of view of 58 degrees. Target ground speed for the entire project was 140 knots, and minimum swath side overlap of 25%.

Areas that Auckland Council identified as tidal were flown within 1.5 hours either side of predicted low tide. LINZ tide predictions were used for this purpose.

**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, which includes the New Zealand Quasigeoid 2016 and Auckland 1946 Relationship grid.

Base station support was sourced from Global Surveys Continuously Operating Reference Station data – the Global Surveys network covers the full project extent.

Validation field surveying was performed by Opus International Consultants. To ensure independence, AAM requested that Opus select the 70 vertical and 20 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.

**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.

Discussion and clarification on Classification was undertaken between Nathan Sykes as client representative, and the AAM Team during the client review of the data. , such as:

The pedestrian footbridges have been classed as structures, the intention was to use the bridge class for more substantial road bridges over water (unless it is a piped culvert)

Train carriages (temporary/moving objects) have been left in class 5, as assigned by classification routines.

The observation was made that the newer sensors, such as the Q1560, are very sensitive. They detect noticeably more atmospheric noise than older sensors (e.g. very light humidity that is not visible, can be detected). It's not a defect. With these returns included and classified in the dataset, the user gets a feel for the structure of the data, e.g. in open areas where there are no "only returns" because the "first of many returns" are in the noise class.

The Raw (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
12	Overlap points	Flight line overlap points (which were culled during the merging of overlapping flight lines). Expected in raw point clouds only.

**Further Processing:** Further processing was required for the Auckland 1946 data producing Contours, DEM and DSM grid models.

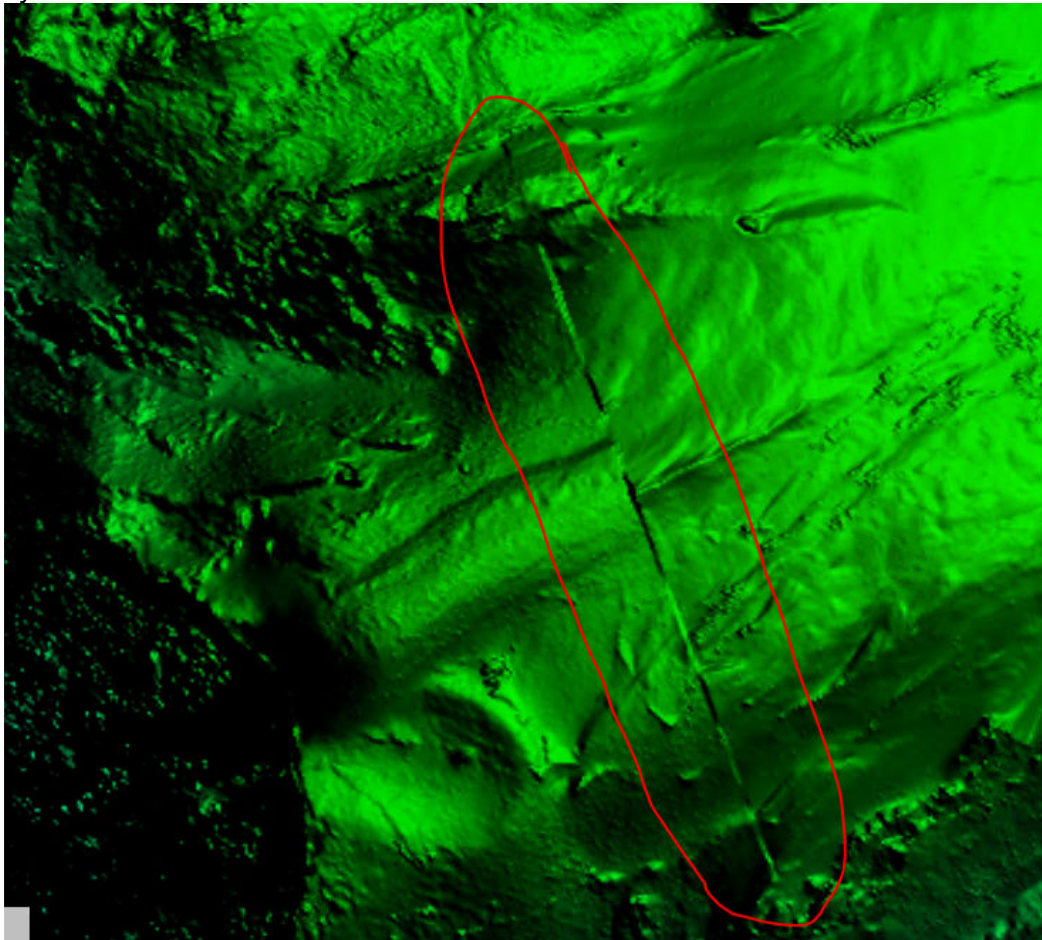
Grid models were derived using a point to TIN and TIN to Raster process, using Linear interpolation. Hydro flattening was undertaken over non-tidal water bodies with surface area greater than 625 sq m, to the client specifications.

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 fine tune settings.

Imagery supplied has been supplied where capture occurred in sufficient daylight, a plot of the imagery coverage can be seen in the validation plots on page13. Imagery 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.

**Points to Note:** It was noted in tiles BB31\_4425 and BB31\_4325, there was significant flight line stepping between flights 2 and 10. This was caused by shifting sand dunes, rather than a system error.



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## 2. DATA INSTALLATION

Data formats : ESRI ASCII , ESRI Shapefile, LAS v1.3, TIFF/TFW  
Information files on media : Readme\_11286A01NOM.pdf

Data formatted on : 30/04/2018  
Disk volume : 11286A01NOM

### **README FILE**

This document (Readme\_11286A01NOM.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]\_[Topo50 TILE]\_YEAR.[format]

[ProductID] :

- RPC – Raw Point Cloud
- DTM – Digital Terrain Point Cloud
- AG – Above Ground Point Cloud
- DEM – Digital Elevation Model (grid)
- DSM – Digital Surface Model (grid)
- Contour – Contours
- RGB - Imagery

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

e.g. RPC\_BA32\_3604\_2016.las

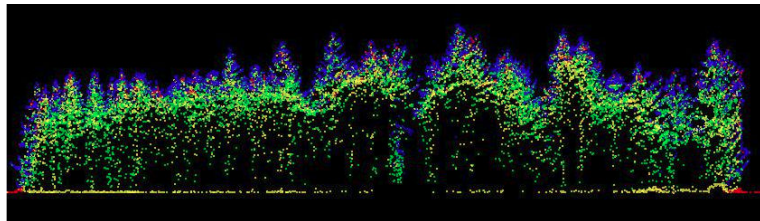


### 3. ADDITIONAL SERVICES

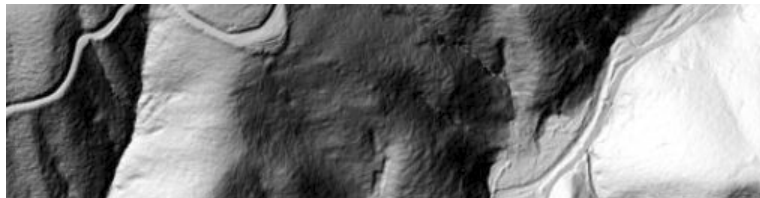
#### Product Generation

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

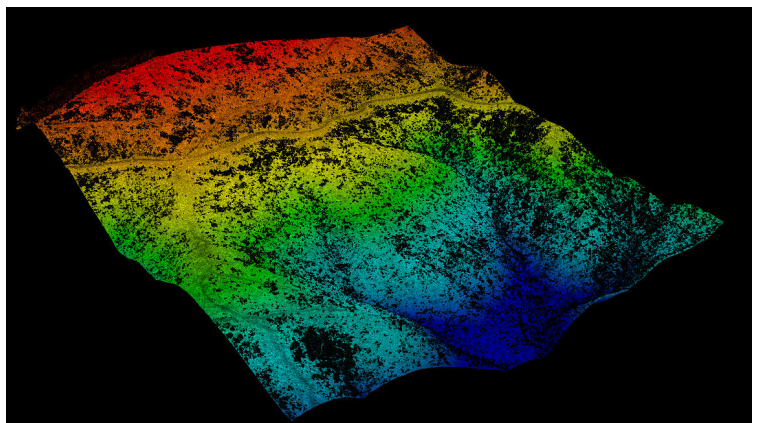
- Change horizontal datum : to another local grid
- Alter geoid modeling : by transforming ALS data to fit orthometric survey heights
- Improve data classification : by tailoring parameters to suit regional variations
- Further classification : assist building identification by further classifying non-ground 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	Riegl Q1560	11286A	09.09.2016 – 06.02.2017
Base Stn Coords	Global Surveys	CORS	11286A	09.09.2016 – 06.02.2017
Field Survey Data	Opus	RTK GPS	11286A	06.09.2016 – 16.09.2016

### LASER DATA CHARACTERISTICS

Characteristic	Description
Device Name:	Riegl Q1560 – 2 laser channel system
Half Scan Angle:	20 & 29 degrees
Laser Pulse Rate:	320 - 330 kHz
Laser Pulse Mode:	Multipulse
Laser Return Types:	1 <sup>st</sup> , 2 <sup>nd</sup> , 3 <sup>rd</sup> ... 7 <sup>th</sup> and last
File Format:	ESRI ASCII Grid, ESRI Shapefile, LAS 1.3, TIF
Contour Interval:	0.25m
Horizontal Datum:	NZGD2000
Vertical Datum:	NZVD2016 (and Auckland 1946)
Map Projection:	NZTM
Vertical Accuracy Specification:	±0.10m RMS
Horizontal Accuracy Specification:	±0.30m RMS

### REFERENCE SYSTEMS

	Horizontal	Vertical
Datum	NZGD2000	NZVD2016 (Auckland 1946)
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:

	<b>Measured Point</b>	<b>Basis of Estimation</b>
Vertical data	<= 0.10 m	Project Design
Horizontal data	<= 0.30 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:

<b>Ref Point Site</b>	<b>No. of Points</b>	<b>Mean Difference (m)</b>	<b>Std Deviation (m)</b>	<b>RMS (m)</b>
All sites	2,448	-0.005	0.04	0.04

- Points at site B23 were not used, the site had under gone development post survey
- Unreliable points have been removed from the above analysis, e.g. those in long grass, along fencelines, edge of ditch etc.
- Data classification has been manually checked and edited against any 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 **AUCKLAND COUNCIL**.

The data in this volume is provided by AAM NZ Limited (AAM) to **AUCKLAND COUNCIL** under **ACPN\_20055, dated 8 August 2016**, which provides **AUCKLAND COUNCIL** with a full and unrestricted license in perpetuity to use all reports, mapping and other delivered data (Project IP), in accord with documented provisions, and subject to the following conditions:

1. This file (Readme\_11286A01NOM.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 AUCKLAND 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 complete list of project related contacts is listed on page 5 under the Project Report heading.

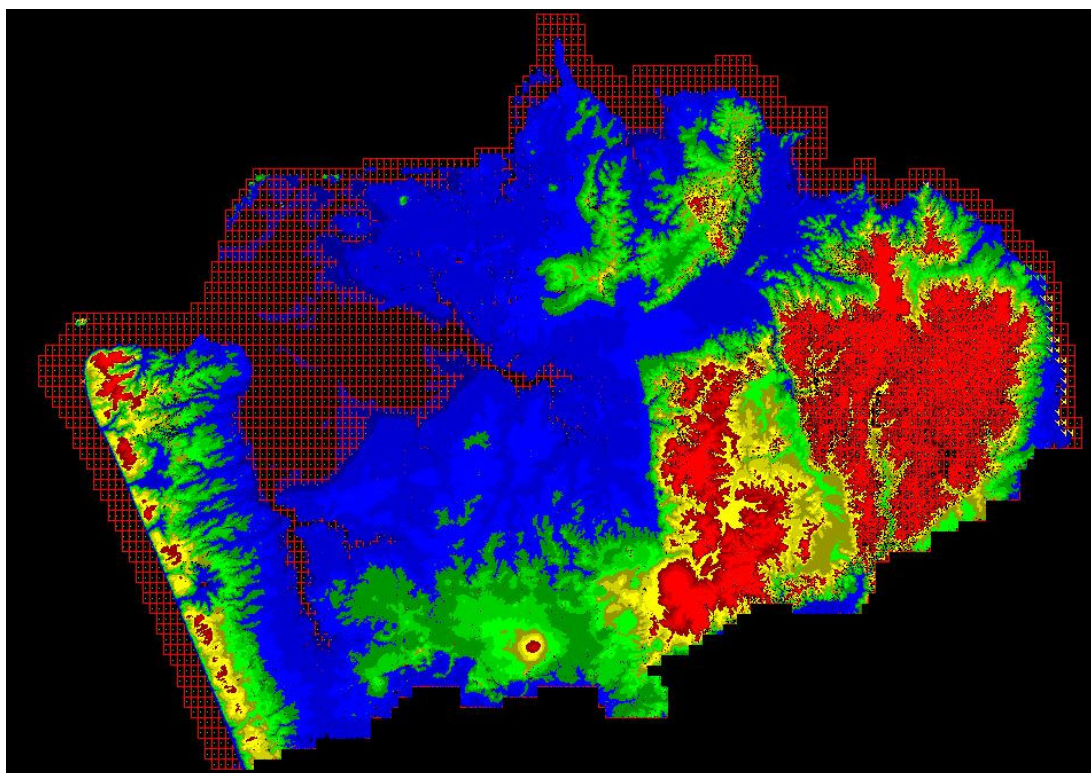
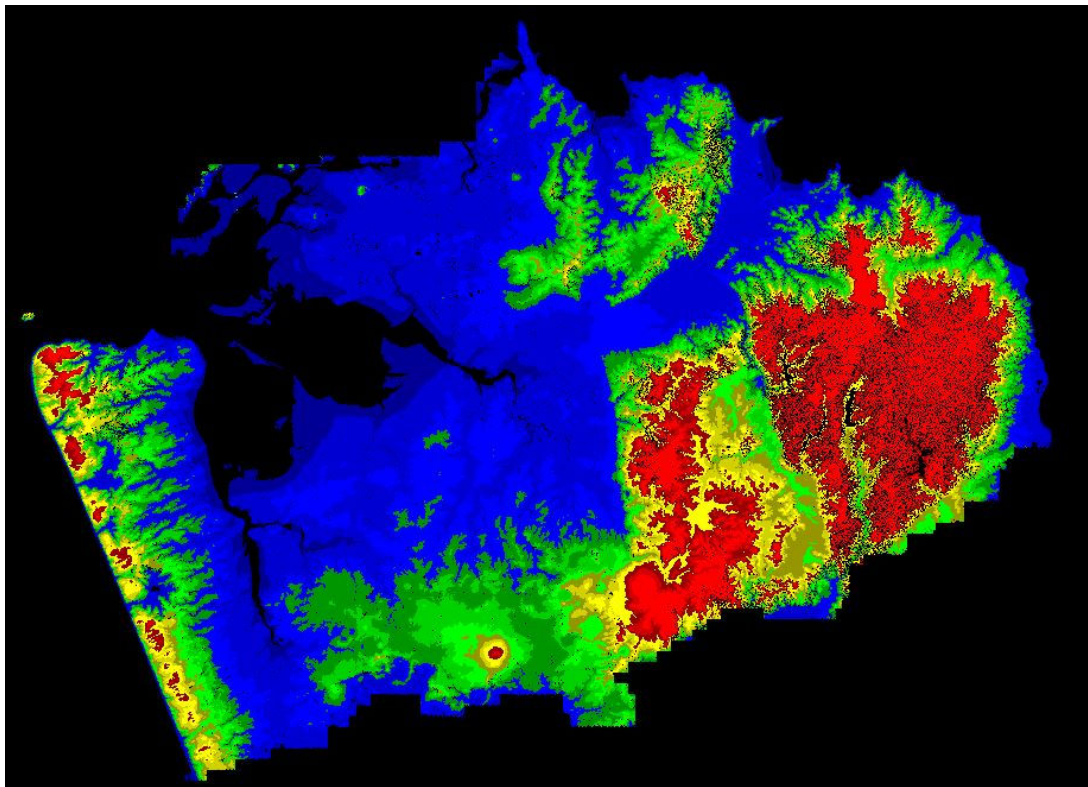
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Web [www.aamgroup.com](http://www.aamgroup.com)

## 7. PROJECT AREA



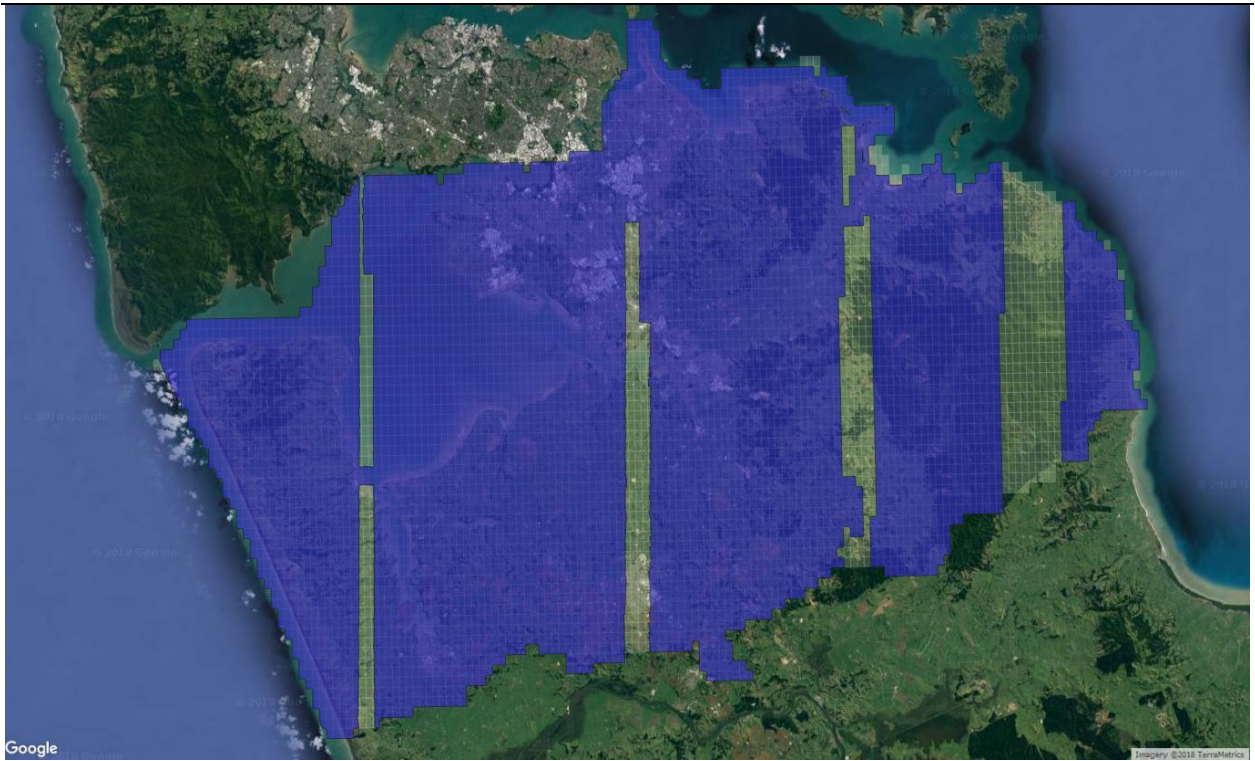
*Extent of the project as defined by Southern\_extent.shp*

## 8. VALIDATION PLOTS



*Terrain data coloured by elevation*





*Imagery has been provided over the blue shaded area*