



CHRISTCHURCH CITY COUNCIL

CHRISTCHURCH LIDAR SURVEY MAY 2011

VOLUME 18797A04NOB

Summary

Project

An Airborne Laser Scanning survey conducted over Christchurch and Lyttelton City that was designed to support the February 2011 earthquake recovery effort. The survey was flown from 20th May to 30th May 2011. The area covered is approximately 504 km².

Data

The deliverables for this dispatch contain the following:

2003 and 2011 Difference

- ASCII XYZ Clean – Contains removed noise around +/-0.2m
- ASCII XYZi Raw – Contains the noise around the +/-0.2m
- 2003:2011 Overlap boundary in DGN, DXF and ESRI Shape File format

2003 Dataset Resupply

- ASCII XYZ
- LAS 1.2

2011

- ASCII XYZi Vegetation Low
- ASCII XYZi Vegetation Medium
- ASCII XYZi Vegetation High

A 1km x 1km Tile layout is supplied in DGN, DXF and ESRI Shape File format.

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1. PROJECT REPORT

Safety: No safety Incidents were reported during the project

Acquisition: Airborne Laser Scanning (ALS) data was acquired from a fixed wing aircraft between May 20th and May 30th 2011.

Ground Support: GPS base station support was provided by GeoSystems NZ. The ground check points acquired by the Christchurch City Council allowed an assessment of the accuracy of the ALS data.

Data Processing: Reduction of the ALS data proceeded without any significant problems. 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 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

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2. DATA INSTALLATION

Data format : LAS, ASCII XYZi, SHP, DXF, DGN
 Number & type of media : One External HDD
 Number of files on media : 5,048 files, 1,757 ASCII XYZi, 534 LAS files, 1,148 ESRI
 ASCII files, 1,590 ASCII XYZ files, 2 DGN files, 2 DXF
 files, 8 SHP files and
 18797A04NOB_Christchurch_File_Listing.pdf
 Data formatted on : 03.10.2011
 Disk volume : 18797A04NOB

README FILE

This document (18797A04NOB_README.PDF) is provided as an Acrobat file in this volume.

To open the file, double click on the PDF file to activate Acrobat Reader Software.

Adobe Acrobat Reader may be downloaded from:

<http://www.adobe.com/products/acrobat/readstep2.html>

LOADING NOTES

Data may be copied using a file copy utility such as Windows Explorer or similar.

REVISION HISTORY

Volumes previously issued under this project include:

Volume	Date	Data Title	Contents
18797A01NOB	15.07.11	Christchurch	Bare Earth DEM
18797A02NOB	29.07.11	Christchurch	ASCII XYZi 1 st , Last, Only, Intermediate, Ground, Non-ground, Thinned Ground Returns, LAS All Returns Unclassified, ECW 1m Intensity Mosaic
18797A03NOB	17.08.11	Christchurch	Contour Samples

FILE SIZES AND NAMES

Data is provided in tiles 1km by 1km to the following file naming convention:

e1555n5182_ ALL_RETURNS.las

- e1555 - coordinate easting (in thousands) of south west tile corner.
- n5182 - coordinate northing (in thousands) of south west tile corner
- 03_11_Difference_Clean - Difference grid with +/-0.2m noise removed.
- 03_11_Difference_Raw - Difference grid with +/-0.2m noise kept.
- 2003 - 2003 resupply in NZTM
- _grd - 2011 Digital Elevation Model
- DSM - 2011 Digital Surface Model
- High_Veg - Laser strikes +2m classified as "high vegetation"
- Low_Veg - Laser strikes 0m to 0.2m classified as "low vegetation"
- Med_Veg - Laser strikes 0.2m to 2m classified as "medium vegetation"
- .xyz - Space delimited ASCII in X, Y, Z
- .asc - 1m ESRI ASCII Grid
- .veg - Space delimited ASCII in X, Y, Z and intensity
- .las - laser strikes "classified in accordance with ASPRS V1.2 LAS file standards" ground point class level.

Easting	Northing	RL	Intensity
1553334.240	5182503.480	71.790	144
1553334.530	5182497.730	72.000	130
1553332.160	5182491.590	72.030	112
1553334.390	5182474.580	71.920	119
1553332.820	5182479.850	71.980	122
1553328.210	5182476.970	71.850	138
1553334.730	5182448.810	71.580	115
1553334.570	5182440.700	71.670	126

LAS format is a binary format and cannot be listed. LAS file point classifications levels are formatted to comply with ASPRS Standard LiDAR Point Classes.

- 0 Created, never classified
- 1 Unclassified1
- 2 Ground
- 3 Low Vegetation
- 4 Medium Vegetation
- 5 High Vegetation
- 6 Building
- 7 Low Point (noise)
- 8 Model Key-point (mass point)
- 9 Water
- 10 Reserved for ASPRS Definition
- 11 Reserved for ASPRS Definition
- 12 Overlap Points2
- 13-31 Reserved for ASPRS Definition

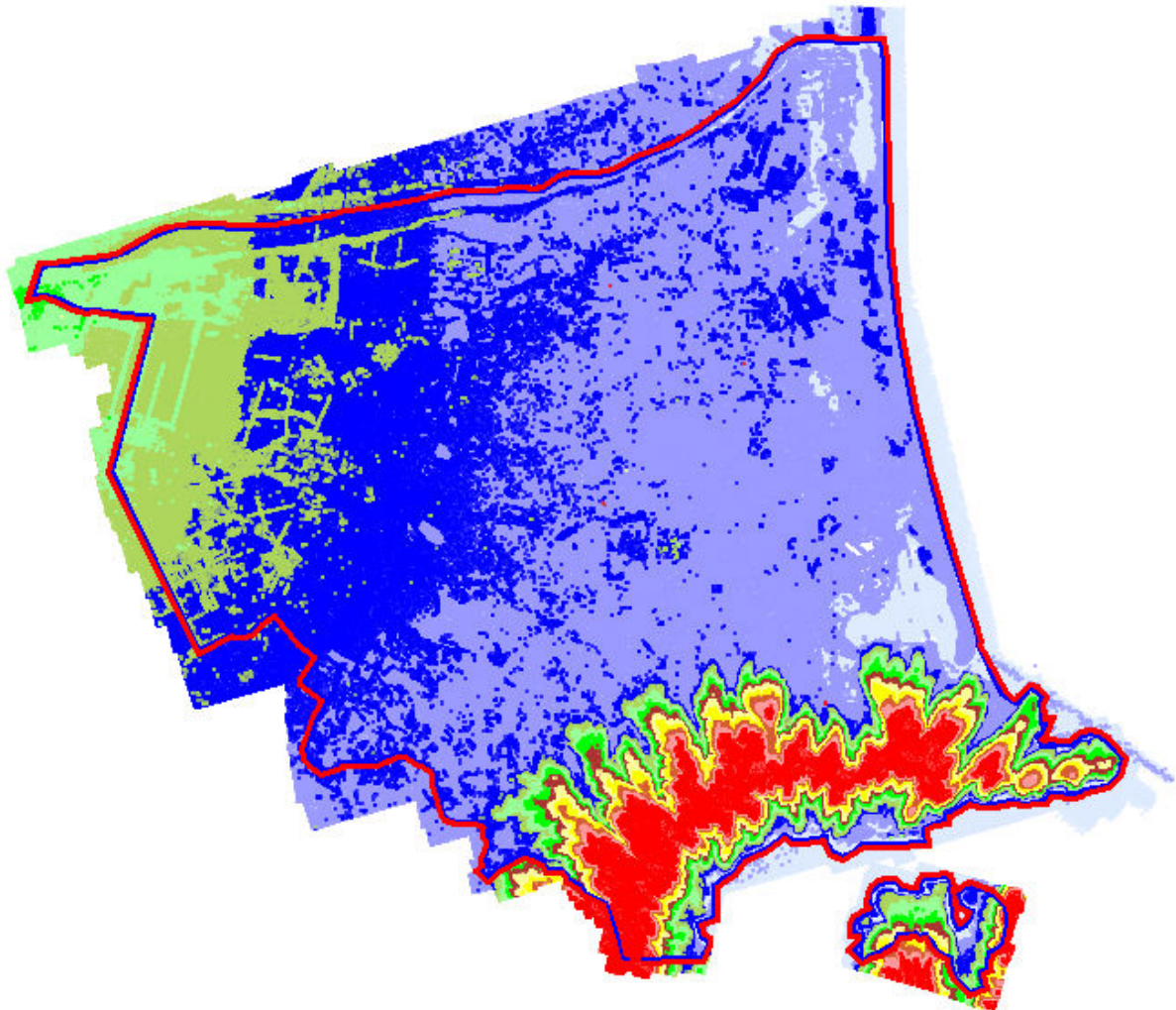
3. ADDITIONAL SERVICES AND EXTRA DATA

Product Generation

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

Change horizontal datum	:	to NZMG or other local grid
Data subset	:	by dividing the data into different tiles or polygons
Data presentation	:	by creating contours, profiles, perspectives, fly throughs, colour-coded height plots etc.
Extra data	:	extra data was collected beyond that supplied on this volume (see below)

Extra Data Captured



Laser Data shown in the above image outside the project boundary may be of a lower accuracy. It is not supplied within this volume and no manual classification editing has been undertaken.

4. METADATA

SOURCE DATA

Item	Source	Description	Ref No	Date
Laser System	AAM	ALS50-II	18797A	20.05.11 – 30.05.11
Pulse Rate Frequency	AAM	127.5 kHz	18797A	20.05.11 – 30.05.11
GPS Base Data	GeoSystems NZ	Static GPS	18797A	20.05.11 – 30.05.11
Base Stn Coords	GeoSystems NZ	Static GPS	18797A	Pre 12.09.10
Field Survey Data	Christchurch City Council	RTK	18797A	13.06.11 – 17.03.11

LASER DATA CHARACTERISTICS

Characteristic	Description
Format	LAS, ASCII
Size	2,137,800,268 data points
Captured terrain model	0.5m average point separation
Laser return	1 st , 2 nd 3 rd and last
Laser Intensity	Supplied on all returns
Laser footprint size	0.3m (0.2mrad beam divergence)
Laser mode	Multipulse
Data acquisition	4 hours either side of low tide

REFERENCE SYSTEMS

	Horizontal		Vertical
Datum	NZGD2000		LVD1937
Projection	NZTM2000		N/A
Geoid Model	N/A		NZGD09
Primary Reference Station WIG1	1,563,508.058 E	5,178,024.369 N	51.240 Ellipsoid
Additional Survey Control UBOLT	1,562,001.290 E	5,185,196.505 N	32.859 RL

5. ACCURACY

PROJECT DESIGN ACCURACY

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

	Measured Point	Derived Point	Basis of Estimation
Vertical data		0.1m	Project Design
Horizontal data	< 0.40m		System specifications ($1/2000$ flying height)
Test points	0.05m		Survey methodology used

Notes on Expected Accuracy

- Values shown represent standard error (68% confidence level or 1 sigma), in metres.
- “Derived points” are those interpolated from a terrain model.
- “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.

DATA VALIDATION

- Ground data in this volume has been compared to 1360 test points obtained by field survey and assumed to be error-free. The test points were distributed in 21 groups across the mapping area and located on open clear ground. 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)
Site 1	40	0.259	0.017	0.259
Site 2	46	0.246	0.018	0.246
Site 3	44	0.277	0.018	0.277
Site 4	42	0.235	0.017	0.236
Site 5	37	0.310	0.012	0.311
Site 6	44	0.270	0.021	0.271
Site 7	44	0.232	0.011	0.232
Site 8	43	0.272	0.016	0.272
Site 9	46	0.252	0.016	0.252
Site 10	45	0.299	0.016	0.299
Site 11	47	0.228	0.017	0.229
Site 12	51	0.219	0.011	0.219
Site 13	44	0.237	0.013	0.237
Site 14	42	0.231	0.022	0.232
Site 15	47	0.259	0.017	0.260
Site 16	31	0.234	0.01	0.234
Site 17	36	0.204	0.024	0.205
Site 18	44	0.253	0.016	0.253
Site 19	46	0.290	0.022	0.291
Site 20	36	0.280	0.016	0.280
Site 21	505	0.268	0.017	0.269

The mean difference of 0.255 has been removed from the data. Final accuracy estimates after removing the mean offset yielded:

Ref Point Site	No. of Points	Mean Difference (m)	Std Deviation (m)	RMS (m)
Site 1	40	-0.001	0.017	0.017
Site 2	46	-0.014	0.018	0.023
Site 3	44	0.017	0.018	0.024
Site 4	42	-0.025	0.017	0.030
Site 5	37	0.050	0.012	0.052
Site 6	44	0.010	0.021	0.023
Site 7	44	-0.028	0.011	0.030
Site 8	43	0.012	0.016	0.019
Site 9	46	-0.008	0.016	0.018
Site 10	45	0.039	0.019	0.043
Site 11	47	-0.032	0.017	0.036
Site 12	51	-0.041	0.011	0.042
Site 13	44	-0.023	0.013	0.027
Site 14	42	-0.029	0.022	0.036
Site 15	47	-0.001	0.017	0.017
Site 16	31	-0.026	0.01	0.028
Site 17	36	-0.056	0.024	0.061
Site 18	44	-0.007	0.016	0.018
Site 19	46	0.030	0.022	0.037
Site 20	36	0.020	0.016	0.026
Site 21	505	0.008	0.017	0.019

- Data classification has been manually checked and edited against any available imagery.

USE OF DATA

- Intended use : Planning, Conceptual Design
- Intended scale of use : 1:500

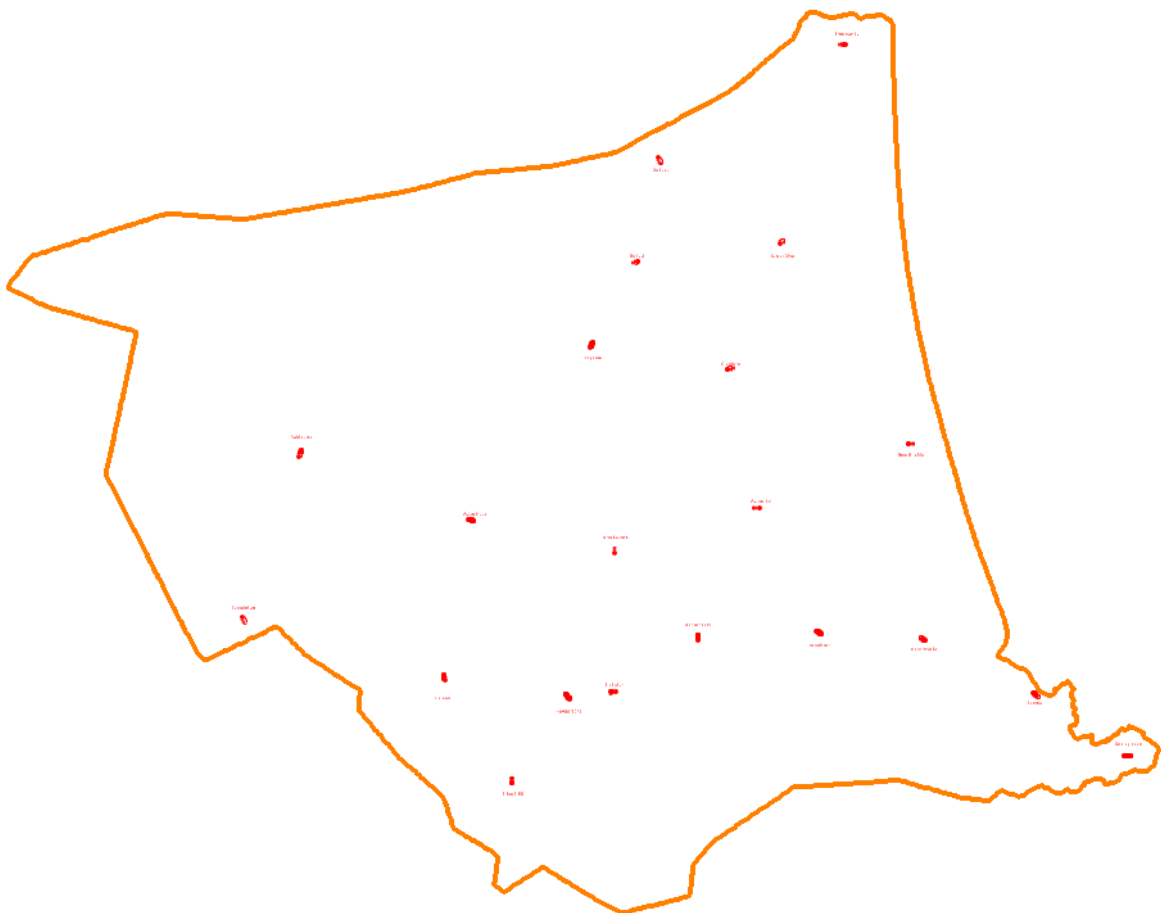
5. 2003 AND 2011 DIFFERENCE MODELLING

Acquisition: An airborne laser scanning survey was captured by AAM, previously known as AAMHatch, over the Christchurch and Waimakariri River area from the 6th to the 9th July 2003. Parts of the deliverables within this dispatch contain difference modelling between the 2003 survey and the 2011 survey.

Data Processing: The 2003 data was reprojected to NZTM and adjusted to the NZGD09 Geoid as it was originally presented in NZMG and adjusted to a Local Geoid. To get to NZGD09 the following steps were performed:

- Revert the data to the GRS80 Ellipsoid by reversing the local and EMG96 geoids.
- Adjust the data to the NZGD09 geoid

The 2003 data in this volume has been compared to 825 test points obtained by field survey captured in June 2010. The test points were distributed in 21 groups across the mapping area and located on open clear ground. Below is a screenshot showing the distribution of points.

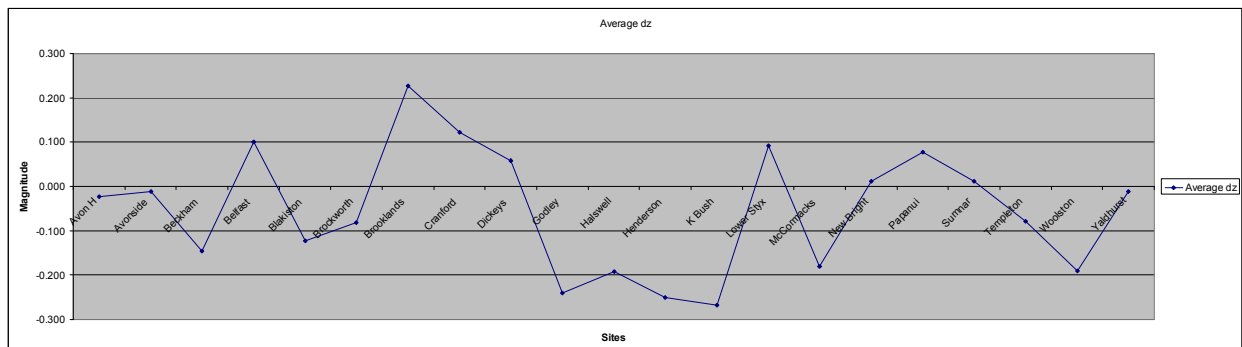


Comparison of the field test points were completed at three stages, data sitting with the local geoid, data adjusted to NZGD09 and final adjustment to test points. These results are shown below:

2003 Unadjusted Data Compared to 2010 Test Points

Ref Point Site	No. of Points	Mean Difference (m)	Std Deviation (m)	RMS (m)
Avon Head	32	-0.024	0.060	0.064
Avonside	40	-0.012	0.044	0.045
Beckenham	25	-0.146	0.061	0.158
Belfast	42	0.100	0.057	0.115
Blakiston	31	-0.123	0.060	0.136
Brockworth Place	37	-0.081	0.048	0.094
Brooklands	33	+0.227	0.070	0.237
Cranford	40	0.122	0.054	0.133
Dickeys Road	37	0.058	0.057	0.079
Godley Head	48	-0.240	0.059	0.247
Halswell	44	-0.192	0.063	0.202
Hendersons	51	-0.250	0.050	0.255
K Bush Road	39	-0.268	0.042	0.271
Lower Styx	34	0.092	0.067	0.113
McCormacks	31	-0.180	0.051	0.187
New Brighton	39	0.012	0.054	0.054
Papanui	42	0.077	0.056	0.095
Sumnar	38	0.012	0.046	0.047
Templeton	47	-0.078	0.059	0.098
Woolston	44	-0.191	0.062	0.200
Yaldhurst	51	-0.011	0.060	0.061

The average mean difference shows considerable variance with the 2003 data adjusted to the local geoid as shown with the below graph.

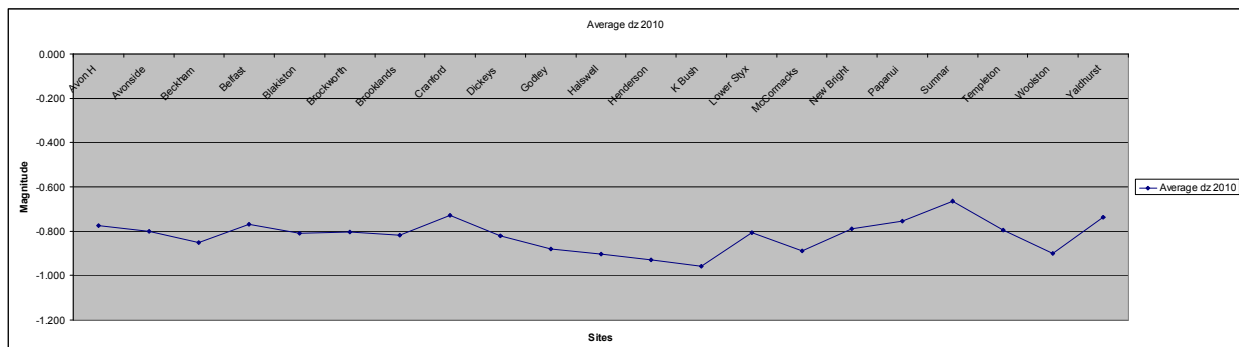


The next stage of analysis was a test point comparison to the NZGD09 Geoid.

2003 Adjusted Data to NZGD09 Compared to 2010 Test Points

Ref Point Site	No. of Points	Mean Difference (m)	Std Deviation (m)	RMS (m)
Avon Head	32	-0.774	0.060	0.777
Avonside	40	-0.802	0.044	0.803
Beckenham	25	-0.851	0.061	0.853
Belfast	42	-0.770	0.057	0.772
Blakiston	31	-0.809	0.060	0.811
Brockworth Place	37	-0.803	0.048	0.805
Brooklands	33	-0.818	0.070	0.821
Cranford	40	-0.728	0.054	0.730
Dickeys Road	37	-0.821	0.057	0.822
Godley Head	48	-0.880	0.059	0.882
Halswell	44	-0.902	0.063	0.904
Hendersons	51	-0.930	0.050	0.931
K Bush Road	39	-0.958	0.042	0.931
Lower Styx	34	-0.808	0.067	0.811
McCormacks	31	-0.889	0.051	0.891
New Brighton	39	-0.788	0.054	0.790
Papanui	42	-0.788	0.056	0.755
Sumnar	38	-0.664	0.046	0.666
Templeton	47	-0.795	0.059	0.797
Woolston	44	-0.901	0.062	0.903
Yaldhurst	51	-0.738	0.060	0.740

Once the local geoid model was removed the comparison with the test points resulted in a more consistent shift as shown below.

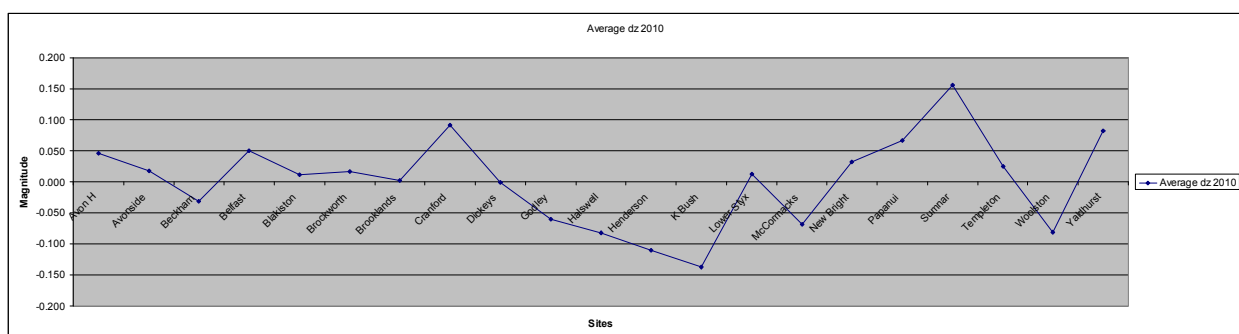


Please note that the large magnitude in the mean shift is due to the geoidal differences between EGM96 and NZGD09. The mean difference of 0.818m has been removed from the data.

2003 Adjusted Data to and Compared to 2010 Test Points

Ref Point Site	No. of Points	Mean Difference (m)	Std Deviation (m)	RMS (m)
Avon Head	32	0.046	0.060	0.075
Avonside	40	0.018	0.044	0.047
Beckenham	25	-0.031	0.061	0.067
Belfast	42	0.050	0.057	0.076
Blakiston	31	0.011	0.058	0.058
Brockworth Place	37	0.017	0.048	0.051
Brooklands	33	0.002	0.072	0.071
Cranford	40	0.092	0.054	0.106
Dickeys Road	37	-0.001	0.053	0.054
Godley Head	48	-0.06	0.059	0.084
Halswell	44	-0.082	0.063	0.103
Hendersons	51	-0.110	0.063	0.121
K Bush Road	39	-0.138	0.042	0.144
Lower Styx	34	0.012	0.067	0.067
McCormacks	31	-0.069	0.051	0.086
New Brighton	39	0.032	0.054	0.062
Papanui	42	0.067	0.056	0.087
Sumnar	38	0.156	0.046	0.162
Templeton	47	0.025	0.059	0.063
Woolston	44	-0.081	0.062	0.102
Yaldhurst	51	0.082	0.061	0.102

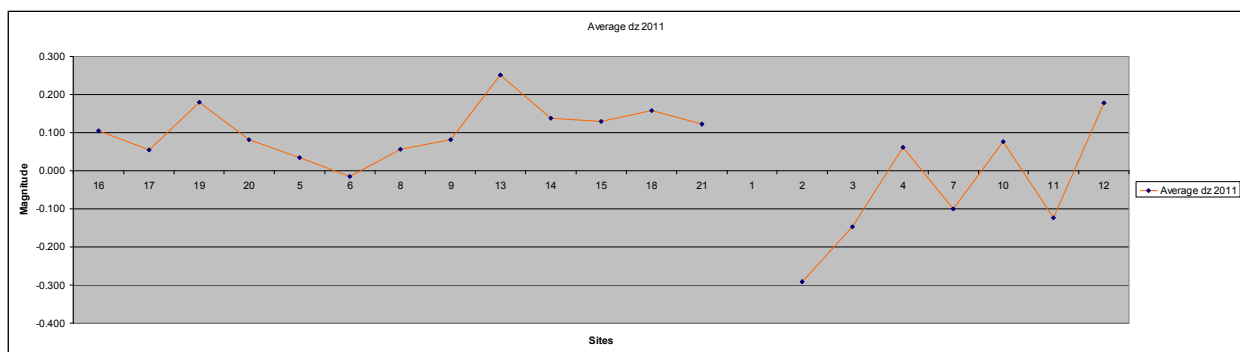
The graph below shows the mean difference over the area.



A comparison was conducted with the 2011 field test points with elevations interpolated from measured data:

Ref Point Site	No. of Points	Mean Difference (m)	Std Deviation (m)	RMS (m)
Site 1	40	Outside	Outside	Outside
Site 2	46	-0.292	0.064	0.299
Site 3	44	-0.148	0.065	0.162
Site 4	42	0.061	0.054	0.081
Site 5	37	0.034	0.055	0.064
Site 6	44	-0.015	0.062	0.063
Site 7	44	-0.100	0.054	0.114
Site 8	43	0.056	0.046	0.072
Site 9	46	0.081	0.053	0.097
Site 10	45	0.076	0.058	0.095
Site 11	47	-0.123	0.065	0.138
Site 12	51	0.178	0.047	0.184
Site 13	44	0.251	0.058	0.258
Site 14	42	0.138	0.059	0.150
Site 15	47	0.129	0.058	0.142
Site 16	31	0.105	0.047	0.115
Site 17	36	0.054	0.059	0.079
Site 18	44	0.158	0.065	0.170
Site 19	46	0.179	0.056	0.187
Site 20	36	0.082	0.064	0.104
Site 21	505	0.122	0.057	0.134

On average the 2011 test points sit 0.05m above the 2010 test points.



6. CONDITIONS OF SUPPLY

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

The data in this volume is provided by AAM Pty Limited (AAM) to **CHRISTCHURCH CITY COUNCIL** under the client's Terms of Engagement, which allow **CHRISTCHURCH CITY COUNCIL** to assume shared ownership with AAM, in accord with documented provisions, and subject to the following conditions:

1. This file (18797A04NOB_readme.PDF) is always stored with the unaltered data contained in this volume.
2. The data is not altered in any way without the approval of AAM. The data may be copied from this file to another.
3. The data is not used for purposes beyond that explicitly agreed in the description of the Services provided by AAM.

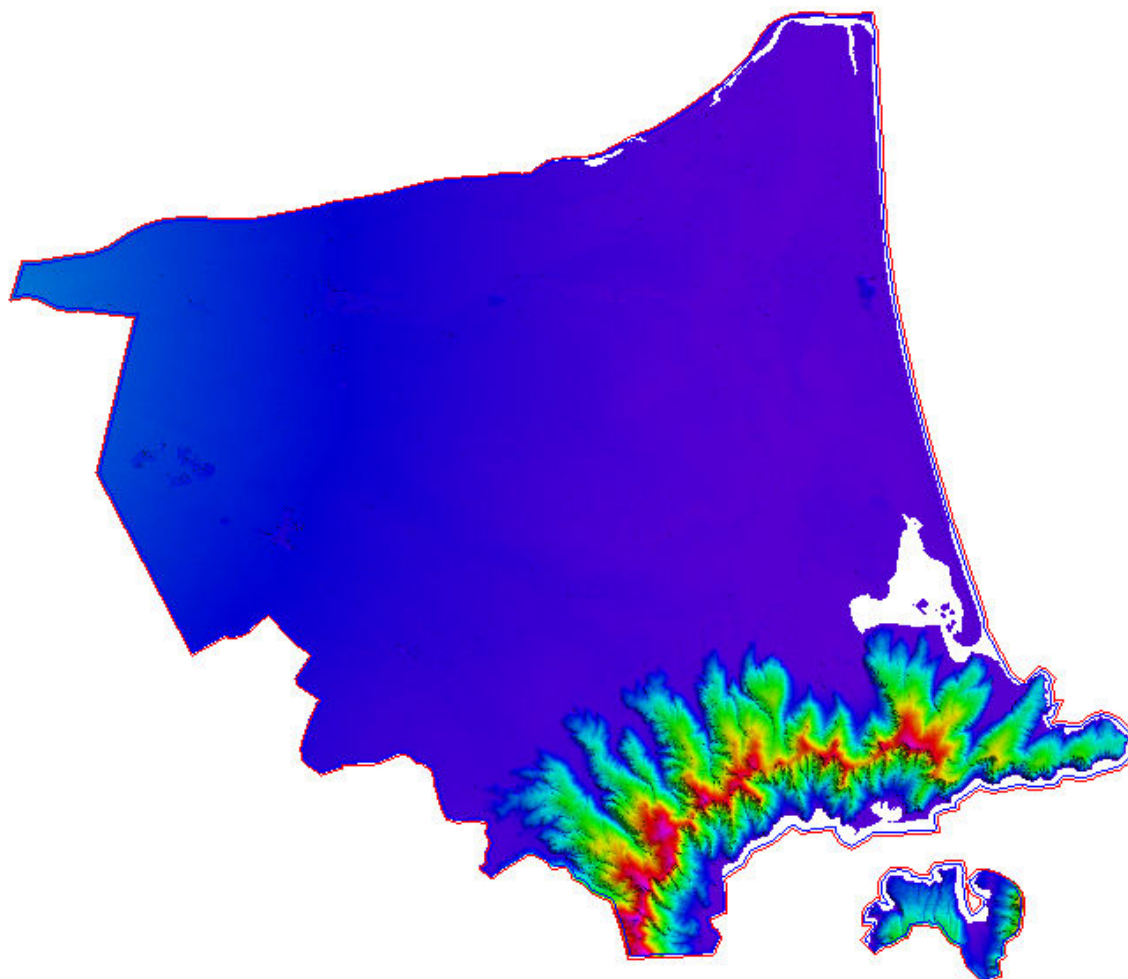
Any breach of these conditions will result in the immediate termination of the license issued by AAM, and **CHRISTCHURCH CITY COUNCIL** will indemnify AAM from all resulting liabilities.

Any problems associated with the information in the data files contained in this volume should be reported to AAM Pty Limited. A complete list of project related contacts is listed on page 2 under the Project Report heading.

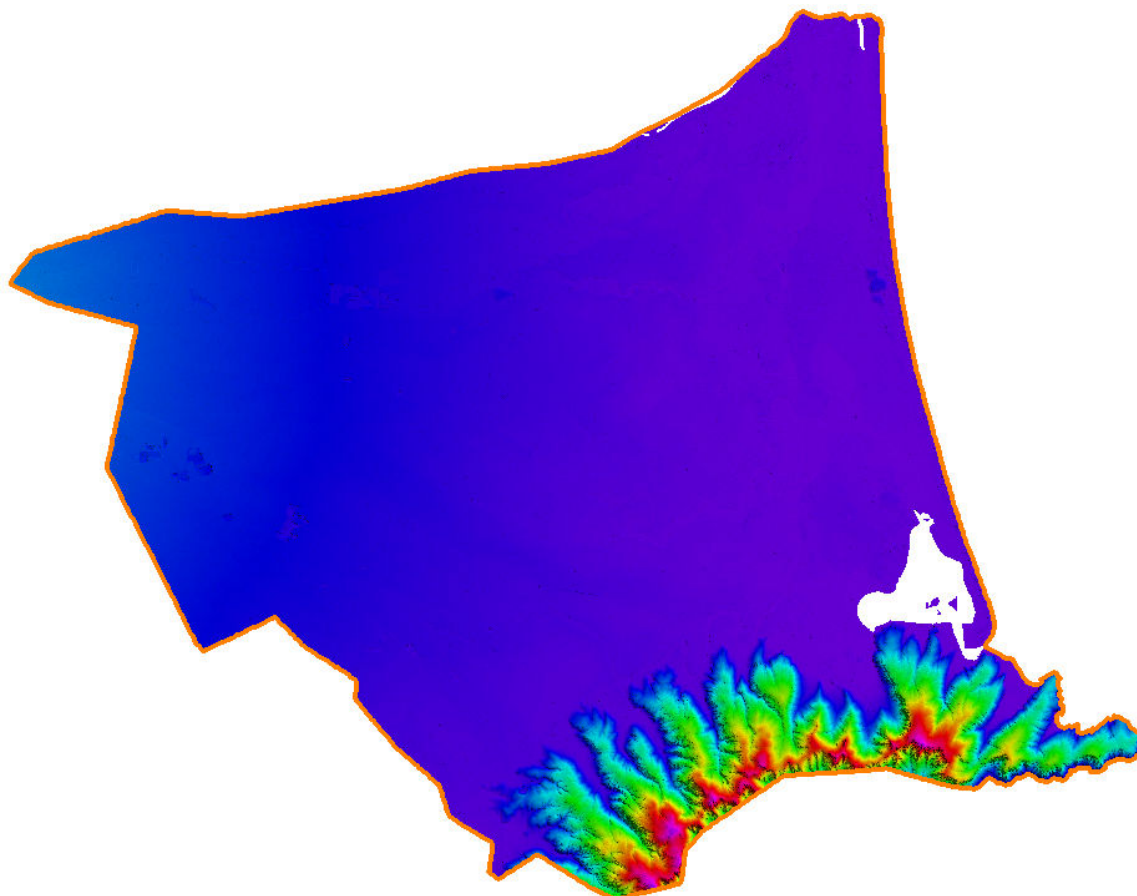
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Web www.aamgroup.com

7. VALIDATION PLOT

2011 Validation Plot



2003 Validation Plot



7. FILES SUPPLIED

Please see 18797A04NOB_Christchurch_File_Listing.pdf