

NIWA

POST CYCLONE GABRIELLE HAWKES BAY LiDAR

VOLUME: PRJ44793_02-04

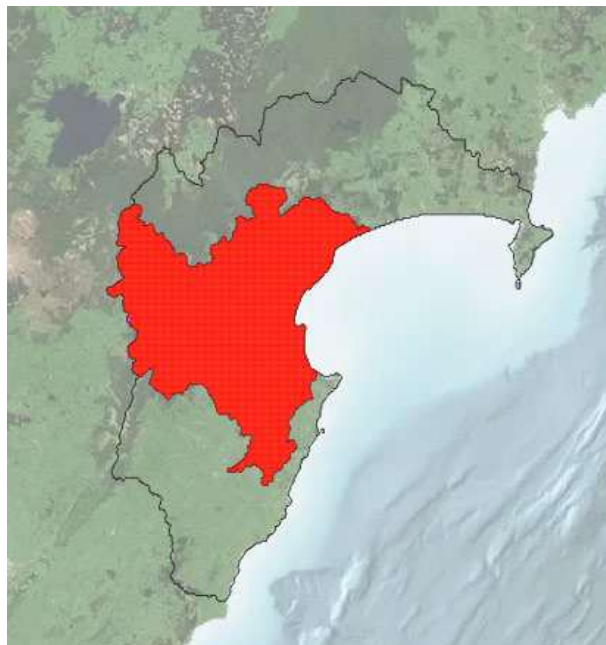
PROJECT SUMMARY

The National Institute of Water and Atmospheric Research Limited (NIWA) contracted Woolpert to capture and process LiDAR and concurrent imagery over Hawkes Bay, post Cyclone Gabrielle.

This report is for the products supplied for Priority One in volumes – PRJ44793_02, PRJ44793_03 & PRJ44793_04, approximately 5,519 km² in total. Resubmissions following LINZ QA were completed in May 2024.

The majority of this area was captured between the 20th of September 2023 – 21st of December 2023, and a small re-fly on the western edge was captured on 23 April 2024.

The survey was planned to achieve $\leq 20\text{cm}$ vertical accuracy (95% CI), $\leq 100\text{cm}$ horizontal accuracy (95% CI) with an emitted pulse density of 8ppsm, and ground classification to ICSM level 2.



DATA SUMMARY

This volume includes the following data in NZTM2000 projection, NZVD2016 vertical datum:

- 15,970 x NZTopo50 1:1000 tiles are included in Hawkes Bay Priority One
- 15,970 tiles of ICSM L2 Colourised Classified Point Cloud data in LAZ v1.4 format
- 15,964 tiles of 1m cell DEM in GeoTIFF format
- 15,964 tiles of 1m cell DSM in GeoTIFF format
- 15,964 tiles of 1m cell CHM in GeoTIFF format
- 15,970 tiles of 12.5cm gsd RGBI Imagery in GeoTIFF format
- Ancillary files in ESRI Shapefile format – Tile Index, Delivery Extent, Flightlines, Hydro Breaklines.
- File listing in text file format
- Metadata file: This document in PDF format

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1. DATA INFORMATION

Data supply: LINZ AWS
 Number of files: 130,416 data files, 1 file list, 1 survey report, 1 metadata file
 Data formatted on: 20/03/2024 - 09/04/2024, 14-22/05/2024
 Metadata Document: This file

Previous Deliveries	Date	Title	Contents
PRJ44793_01	22.12.2023	Post Cyclone Gabrielle Hawkes Bay LiDAR	Sample of deliverables from P1-SE
PRJ44793_02	08.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-SE
PRJ44793_03	05.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-N
PRJ44793_04	06.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-W
PRJ44793_04-02	14-22.05.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	Resubmissions for Priority 1 blocks SE, N, W

File Naming in this Delivery	Contents
CL2_BH36_2023_1000_3441.laz	Colourised classified point cloud in LAZ v1.4 format
DEM_BH36_2023_1000_3441.tif/tfw	1m grid DEM
DSM_BH36_2023_1000_3441.tif/tfw	1m grid DSM
CHM_BH36_2023_1000_3441.tif/tfw	1m grid CHM (canopy height above ground)
RGBI_BH36_2023_1000_3441.tif/tfw	12.5cm gsd RGBI imagery

<p>Ancillary files:</p> <p>PRJ44793_HB_P1-SE_HydroBreaklines_NZTM</p> <p>PRJ44793_HB_P1-SE_LiDAR_Extent_NZTM</p> <p>PRJ44793_HB_P1-SE_OceanClip_NZTM</p> <p>PRJ44793_HB_P1-SE_TileIndex_NZTM</p> <p>PRJ44793_HB_P1-SE_Trajectories_NZTM</p>	<p>ESRI Shapefile format:</p> <p>Volume 02 Hydro breaklines</p> <p>Volume 02 Extent</p> <p>Volume 02 Ocean clip boundary</p> <p>Volume 02 Tile Index</p> <p>Volume 02 Flight lines</p>
<p>Ancillary files:</p> <p>PRJ44793_HB_P1-N_HydroBreaklines_NZTM</p> <p>PRJ44793_HB_P1-N_LiDAR_Extent_NZTM</p> <p>PRJ44793_HB_P1-N_OceanClip_NZTM</p> <p>PRJ44793_HB_P1-N_TileIndex_NZTM</p> <p>PRJ44793_HB_P1-N_Trajectories_NZTM</p>	<p>ESRI Shapefile format:</p> <p>Volume 03 Hydro breaklines</p> <p>Volume 03 Extent</p> <p>Volume 03 Ocean clip boundary</p> <p>Volume 03 Tile Index</p> <p>Volume 03 Flight lines</p>
<p>Ancillary files:</p> <p>PRJ44793_HB_P1-W_HydroBreaklines_NZTM</p> <p>PRJ44793_HB_P1-W_LiDAR_Extent_NZTM</p> <p>PRJ44793_HB_P1-W_TileIndex_NZTM</p> <p>PRJ44793_HB_P1-W_Trajectories_NZTM</p>	<p>ESRI Shapefile format:</p> <p>Volume 04 Hydro breaklines</p> <p>Volume 04 Extent</p> <p>Volume 04 Tile Index</p> <p>Volume 04 Flight lines</p>
<p>Readme_PRJ44793_02-04.pdf</p>	<p>Metadata Report</p>
<p>PRJ44793_02-04_HawkesBay_P1_LiDAR_Report.pdf</p>	<p>Survey Report</p>
<p>PRJ44793_02-04_FileListing.txt</p>	<p>List of product files delivered in this volume</p>

2. METADATA

Source Data	Source	Description	Ref No	Date
LiDAR & Imagery	Woolpert	TerrainMapper2 - 527	FL020423	20.09.2023
		TerrainMapper2 – 527	FL020424	21.09.2023
		TerrainMapper2 – 527	FL020430	21.09.2023
		TerrainMapper2 – 527	FL020511	01.10.2023
		TerrainMapper2 – 527	FL020533	04.10.2023
		TerrainMapper2 – 527	FL020539	04.10.2023
		TerrainMapper2 – 527	FL020542	05.10.2023
		TerrainMapper2 – 527	FL020547	05.10.2023
		TerrainMapper2 – 527	FL020601	11.10.2023
		TerrainMapper2 – 527	FL020608	13.10.2023
		TerrainMapper2 – 527	FL020623	15.10.2023
		TerrainMapper2 – 527	FL020650	19.10.2023
		TerrainMapper2 – 527	FL020655	20.10.2023
		TerrainMapper2 – 527	FL020842	12.11.2023
		TerrainMapper2 – 527	FL020875	14.11.2023
		TerrainMapper2 – 527	FL021135	15.12.2023
		TerrainMapper2 – 527	FL021141	16.12.2023
		TerrainMapper2 – 527	FL021156	17.12.2023
		TerrainMapper2 – 527	FL021159	17.12.2023
		TerrainMapper2 – 527	FL021182	21.12.2023
TerrainMapper2 – 527	FL022290	23.04.2024		
GPS Base Data	GeoNET /LINZ	GeoNET CORS, LINZ GDB co-ordinates	As above	As above
Control	Sounds Surveying	RTK GNSS	PRJ44793	27/09/2023 – 8/10/2023

LiDAR Characteristics

Description

Format	LAZ 1.4
Emitted Density	8 ppm2
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
ICSM Classification	Level 2. Ground surface improvement
Capture Constraints	Napier Estuary and the coast line between Esk and Ngaruroro rivers captured within 1.5 hours of low tide. Remaining coastline captured within 3 hours of low tide.

Number	Point Class	Description	ICSM	CI %
1	Default	Unclassified	1	95
2	Ground	Ground	2	98
3	Low vegetation	< 2.0 m	1	95
4	Medium vegetation	2.0 – 8.0 m	1	95
5	High vegetation	> 8.0 m	1	95
6	Buildings, structures	Buildings, houses, sheds, silos etc.	1	95
7	Low Noise	Spurious low point returns (unusable)	2	98
9	Water	Any point in water	2	98
17	Bridge	Any bridge or overpass	2	98
18	High Noise	Spurious high point returns (unusable)	2	98

Ortho Characteristics	Description
Format	GeoTIFF & ECW
Ground Sample Distance	12.5cm
Terrain Model	Concurrent LiDAR
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
Sample Type	8-bit Integer
Image Bands	RGBI
Orientation/AT	Aero Triangulation/GPS-IMU
Capture Constraints	Nil specific to imagery – captured under LiDAR capture conditions above, in daylight hours

Reference Systems	Horizontal	Vertical
Datum	NZGD2000	NZVD2016
Projection	NZTM2000	N/A
Geoid Model	N/A	NZGeoid2016

Accuracy Specification	Measured Point	Derived Point	Basis of Estimation
Control Points	0.05m		Survey Methodology
LiDAR (Horizontal)	0.40m		Project design
LiDAR (Vertical)	0.10m		Project design
Orthophoto	0.30m		Project design

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 by LiDAR refer to the terrain definition on clear ground.
- 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.
- Buildings and vegetation have been classified automatically: ISCM Level 1, 95% confidence. These classes may contain artefacts such as powerlines, car’s, containers etc. Be aware when using the LAZ and CHM products.

Data Validation – LiDAR Data

- Vertical Accuracy Validation - Ground data in this volume has been compared to ~2800 test points obtained by field survey and assumed to be error-free. The test points were distributed in 62 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:

Mean difference: 0.006 m

Std Deviation: 0.034 m

Standard Error (RMS): 0.035 m or 0.068 m @ 95% CI

DEM comparisons were made between adjacent blocks to ensure consistency, blocks were found to align within 0.023m.

A shift of -0.127 was applied to the data before testing against the check points to produce the results shown above.

- Horizontal Accuracy – the LiDAR data was compared to visible horizontal control using the intensity imagery. The data was found to fit well. The expected horizontal accuracy at 95% CI is 38cm, within the specification of 100cm.
- Data classification has been manually checked and edited against available imagery.
- More information is available in the Survey Report: PRJ44793_02-04_HawkesBay_P1_LiDAR_Report.pdf

Data Validation – Orthophoto Image

- This data has not been field tested for accuracy. Spot checks comparing the orthophoto with horizontal check points supported the estimated horizontal accuracy of < 0.300 m. Full proof of accuracy achieved requires comparison to independent test points.

3. CONDITIONS OF SUPPLY

The data in this volume has been commissioned by the National Institute of water and Atmospheric Research Limited **NIWA**.

The data in this volume is provided by Woolpert to **NIWA** under the Terms of Engagement described in the **NIWA Woolpert Imagery Contract Agreement, dated 16th August 2023**. Which provides the client, **NIWA** (or its nominee) with ownership of the deliverables to fully protect, realise and use all delivered data and reports, allowing release of data for re-use with a Creative Commons license (CC BY) with attribution to the buyer in line with the New Zealand Government Open Access Licensing framework (NZGOAL). This specification places no restrictions on the rights of Woolpert to resell data or derivative products.

1. This file (Readme_PRJ44793_02-04_rev12wq.pdf) will always be stored with the unaltered data contained in this volume.

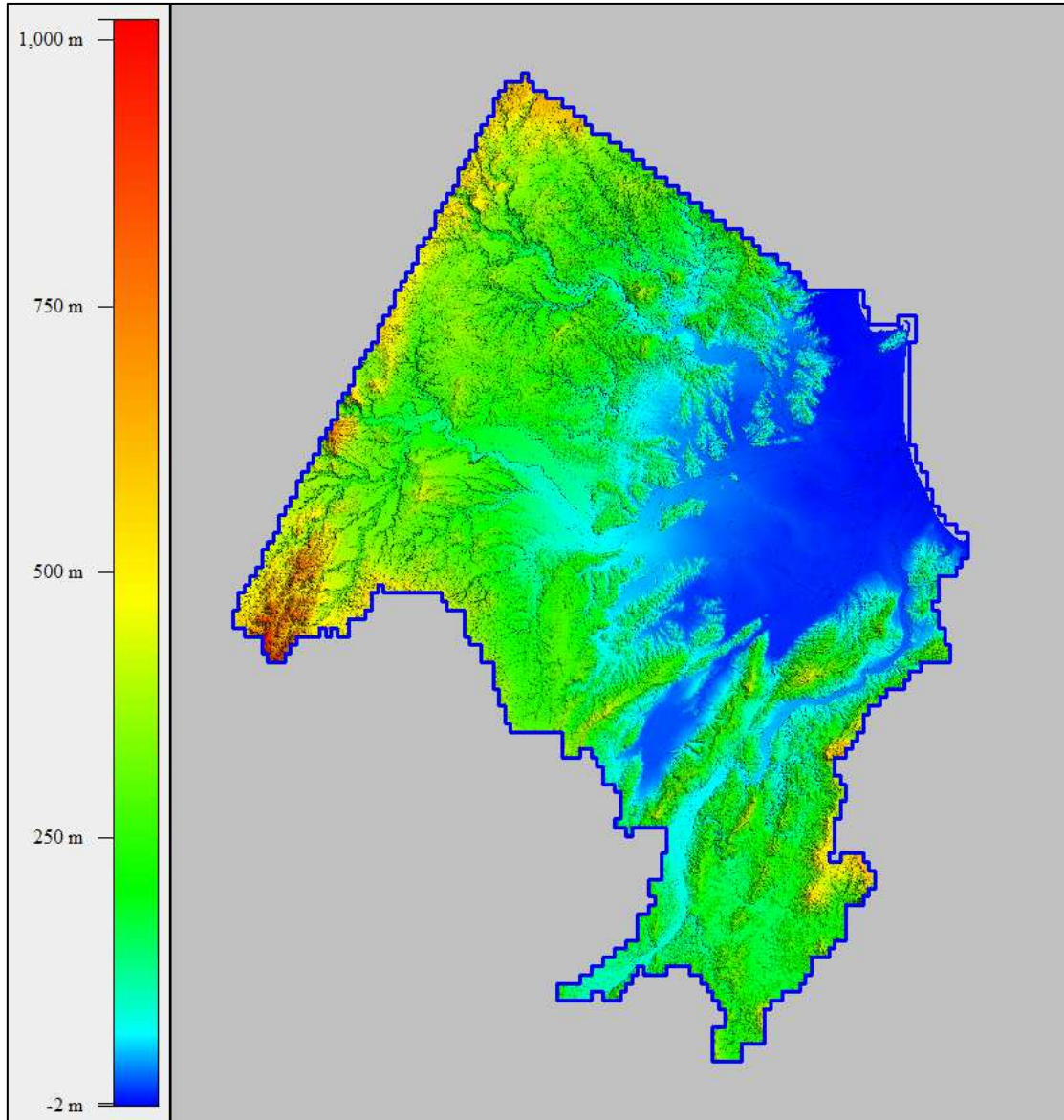
This data is provided in accordance with the specifications agreed with NIWA and Land Information NZ. Any problems associated with the information in the data files contained in this volume should be reported to Woolpert, Asia-Pacific.

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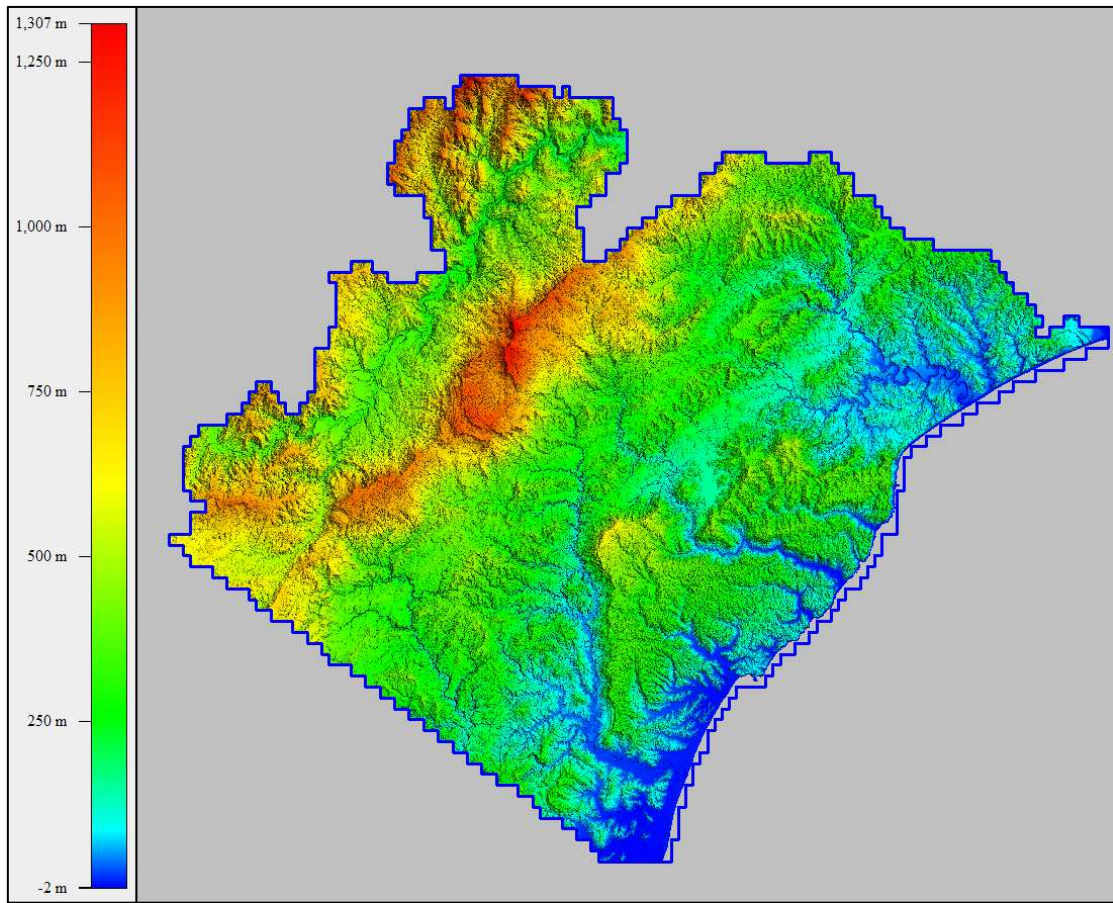
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4. VALIDATION

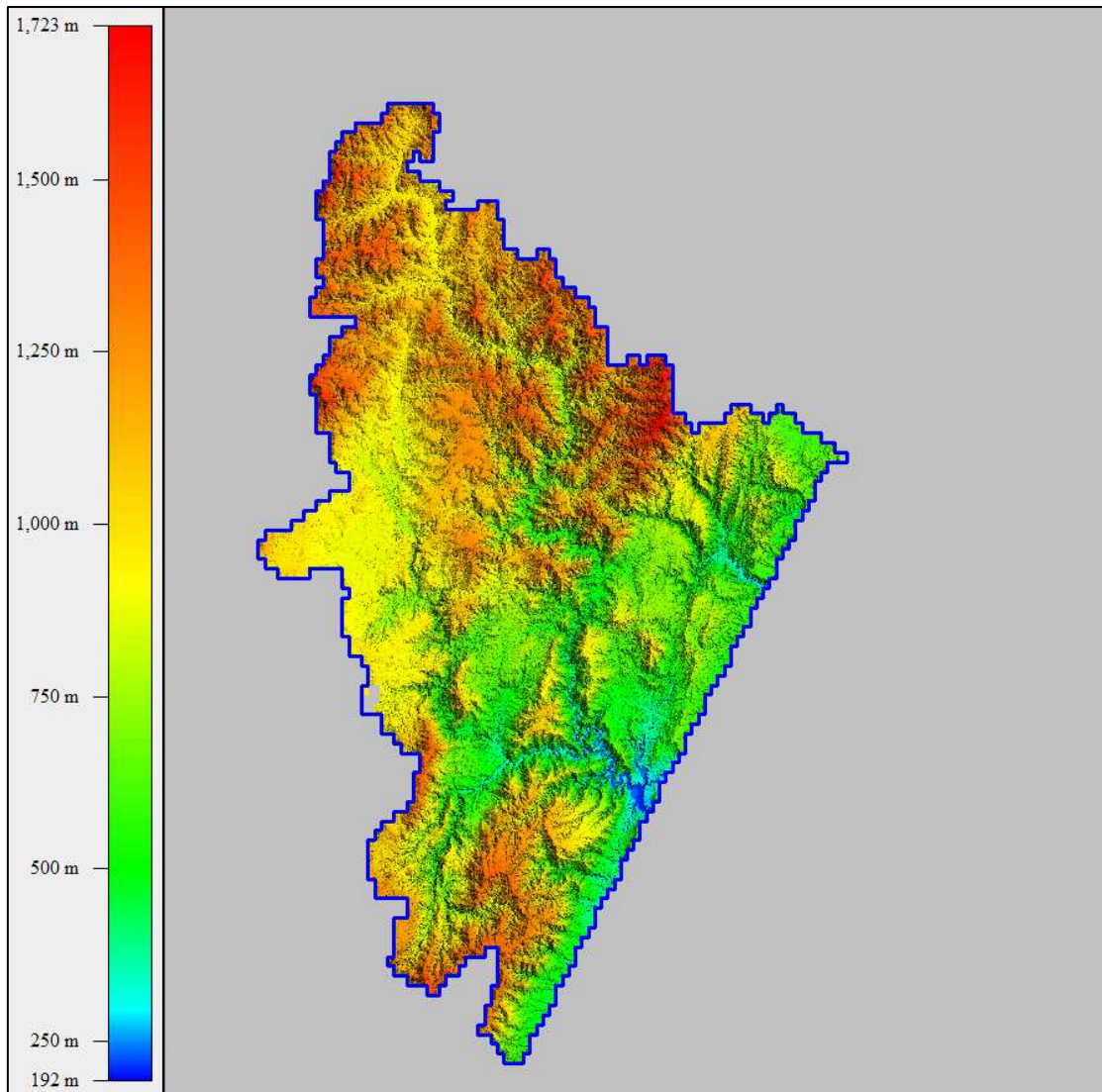
PRJ44793_02 – P1-SE



PRJ44793_03 – P1-N



PRJ44793_04 – P1-W



NIWA

POST CYCLONE GABRIELLE HAWKES BAY LiDAR

VOLUME: PRJ44793_05

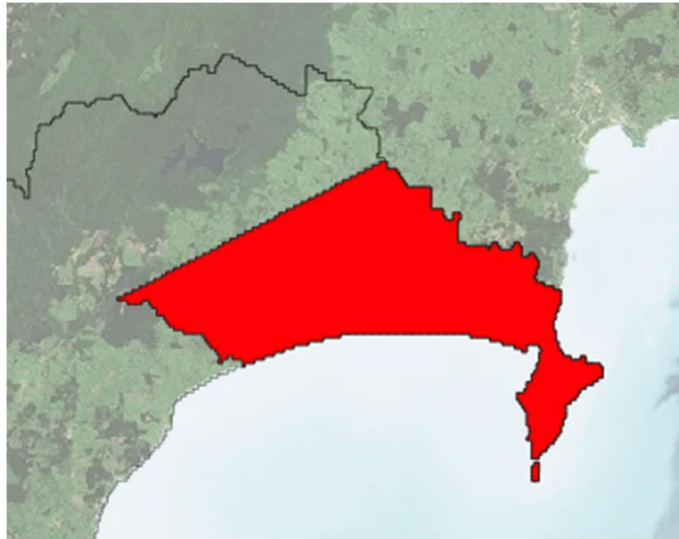
PROJECT SUMMARY

The National Institute of Water and Atmospheric Research Limited (NIWA) contracted Woolpert to capture and process LiDAR and concurrent imagery over Hawkes Bay, post Cyclone Gabrielle.

This report is for the products supplied for Priority Two in volume – PRJ44793_05, approximately 2,015 km². Resubmissions following LINZ QA were completed in August.

This area was captured between the 20th of September 2023 – 17th of December 2023.

The survey was planned to achieve $\leq 20\text{cm}$ vertical accuracy (95% CI), $\leq 100\text{cm}$ horizontal accuracy (95% CI) with an emitted pulse density of 8ppsm, and ground classification to ICSM level 2.



DATA SUMMARY

This volume includes the following data in NZTM2000 projection, NZVD2016 vertical datum:

- 5,831 x NZTopo50 1:1000 tiles are included in PRJ44793_05
- 5,831 tiles of ICSM L2 Colourised Classified Point Cloud data in LAZ v1.4 format
- 5,814 tiles of 1m cell DEM in GeoTIFF format
- 5,814 tiles of 1m cell DSM in GeoTIFF format
- 5,814 tiles of 1m cell CHM in GeoTIFF format
- 5,831 tiles of 12.5cm gsd RGBI Imagery in GeoTIFF format
- Ancillary files in ESRI Shapefile format – Tile Index, Delivery Extent, Flightlines, Hydro Breaklines.
- File listing in text file format
- Metadata file: This document in PDF format

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1. DATA INFORMATION

Data supply: LINZ AWS
 Number of files: 52,397 data files, 1 file list, 1 survey report, 1 metadata file
 Data formatted on: 12-28/05/2024. Resubmissions: 13 & 23/08/2024
 Metadata Document: This file

Previous Deliveries	Date	Title	Contents
PRJ44793_01	22.12.2023	Post Cyclone Gabrielle Hawkes Bay LiDAR	Sample of deliverables from P1-SE
PRJ44793_02	08.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-SE
PRJ44793_03	05.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-N
PRJ44793_04	06.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-W
PRJ44793_04-02	14-22.05.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	Resubmissions for Priority 1 blocks SE, N, W
PRJ44793_05	12-28/05/2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P2-NE

File Naming in this Delivery	Contents
CL2_BG41_2023_1000_4237.laz	Colourised classified point cloud in LAZ v1.4 format
DEM_BG41_2023_1000_4237.tif/tfw	1m grid DEM
DSM_BG41_2023_1000_4237.tif/tfw	1m grid DSM
CHM_BG41_2023_1000_4237.tif/tfw	1m grid CHM (canopy height above ground)
RGBI_BG41_2023_1000_4237.tif/tfw	12.5cm gsd RGBI imagery

Ancillary files: PRJ44793_HB_P2-NE_HydroBreaklines_NZTM PRJ44793_HB_P2-NE_LiDAR_Extent_NZTM PRJ44793_HB_P2-NE_OceanClip_NZTM PRJ44793_HB_P2-NE_TileIndex_NZTM PRJ44793_HB_P2-NE_Trajectories_NZTM	ESRI Shapefile format: Volume 05 Hydro breaklines Volume 05 Extent Volume 05 Ocean clip boundary Volume 05 Tile Index Volume 05 Flight lines
Readme_PRJ44793_05.pdf	Metadata Report
PRJ44793_05_HawkesBay_LiDAR_Report.pdf	Survey Report
PRJ44793_05_FileListing.txt	List of product files delivered in this volume

2. METADATA

Source Data	Source	Description	Ref No	Date
LiDAR & Imagery	Woolpert	TerrainMapper2 - 527	FL020423	20.09.2023
		TerrainMapper2 – 527	FL020601	12.10.2023
		TerrainMapper2 – 527	FL020617	14.10.2023
		TerrainMapper2 – 527	FL020618	14.10.2023
		TerrainMapper2 – 527	FL020623	16.10.2023
		TerrainMapper2 – 527	FL020650	19.10.2023
		TerrainMapper2 – 527	FL020655	20.10.2023
		TerrainMapper2 – 527	FL020889	16.11.2023
		TerrainMapper2 – 527	FL020875	14.11.2023
		TerrainMapper2 – 527	FL021060	07.12.2023
		TerrainMapper2 – 527	FL021081	09.12.2023
		TerrainMapper2 – 527	FL021150	16.12.2023
		TerrainMapper2 – 527	FL021156	17.12.2023
		TerrainMapper2 – 527	FL021159	17.12.2023
GPS Base Data	GeoNET /LINZ	GeoNET CORS, LINZ GDB co-ordinates	As above	As above
Control	Sounds Surveying	RTK GNSS	PRJ44793	27/09/2023 – 8/10/2023 & 23- 28/11/2023

LiDAR Characteristics	Description
Format	LAZ 1.4
Emitted Density	8 ppm2
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
ICSM Classification	Level 2. Ground surface improvement
Capture Constraints	Coastline captured within 3 hours of low tide.

Number	Point Class	Description	ICSM	CI %
1	Default	Unclassified	1	95
2	Ground	Ground	2	98
3	Low vegetation	< 2.0 m	1	95
4	Medium vegetation	2.0 – 8.0 m	1	95
5	High vegetation	> 8.0 m	1	95
6	Buildings, structures	Buildings, houses, sheds, silos etc.	1	95
7	Low Noise	Spurious low point returns (unusable)	2	98
9	Water	Any point in water	2	98
17	Bridge	Any bridge or overpass	2	98
18	High Noise	Spurious high point returns (unusable)	2	98

Ortho Characteristics	Description
Format	GeoTIFF
Ground Sample Distance	12.5cm
Terrain Model	Concurrent LiDAR
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
Sample Type	8-bit Integer
Image Bands	RGBI
Orientation/AT	Aero Triangulation/GPS-IMU
Capture Constraints	Nil specific to imagery – captured under LiDAR capture conditions above, in daylight hours

Reference Systems	Horizontal	Vertical
Datum	NZGD2000	NZVD2016
Projection	NZTM2000	N/A
Geoid Model	N/A	NZGeoid2016

Accuracy Specification	Measured Point	Derived Point	Basis of Estimation
Control Points	0.05m		Survey Methodology
LiDAR (Horizontal)	0.40m		Project design
LiDAR (Vertical)	0.10m		Project design
Orthophoto	0.30m		Project design

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 by LiDAR refer to the terrain definition on clear ground.
- 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.
- Buildings and vegetation have been classified automatically: ISCM Level 1, 95% confidence. These classes may contain artefacts such as powerlines, car’s, containers etc. Be aware when using the LAZ and CHM products.

Data Validation – LiDAR Data

- Vertical Accuracy Validation - Ground data in this volume has been compared to ~1270 test points obtained by field survey and assumed to be error-free. The test points were distributed in 23 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:

Mean difference: -0.007 m

Std Deviation: 0.045 m

Standard Error (RMS): 0.046 m or 0.090 m @ 95% CI

DEM and control comparisons were made to the adjacent Priority One block to ensure consistency, these align within 0.01m.

A shift of -0.110 was applied to the data before testing against the check points to produce the results shown above.

- Horizontal Accuracy – the LiDAR data was compared to visible horizontal control using the intensity imagery. The data was found to fit well. The expected horizontal accuracy at 95% CI is 38cm, within the specification of 100cm.
- Data classification has been manually checked and edited against available imagery.
- More information is available in the Survey Report: PRJ44793_05-07_HawkesBay_P2_LiDAR_Report.pdf

Data Validation – Orthophoto Image

- This data has not been field tested for accuracy. Spot checks comparing the orthophoto with horizontal check points supported the estimated horizontal accuracy of < 0.300 m. Full proof of accuracy achieved requires comparison to independent test points.

3. CONDITIONS OF SUPPLY

The data in this volume has been commissioned by the National Institute of water and Atmospheric Research Limited **NIWA**.

The data in this volume is provided by Woolpert to **NIWA** under the Terms of Engagement described in the **NIWA Woolpert Imagery Contract Agreement, dated 16th August 2023**. Which provides the client, **NIWA** (or its nominee) with ownership of the deliverables to fully protect, realise and use all delivered data and reports, allowing release of data for re-use with a Creative Commons license (CC BY) with attribution to the buyer in line with the New Zealand Government Open Access Licensing framework (NZGOAL). This specification places no restrictions on the rights of Woolpert to resell data or derivative products.

1. This file (Readme_PRJ44793_05.pdf) will always be stored with the unaltered data contained in this volume.

This data is provided in accordance with the specifications agreed with NIWA and Land Information NZ. Any problems associated with the information in the data files contained in this volume should be reported to Woolpert, Asia-Pacific.

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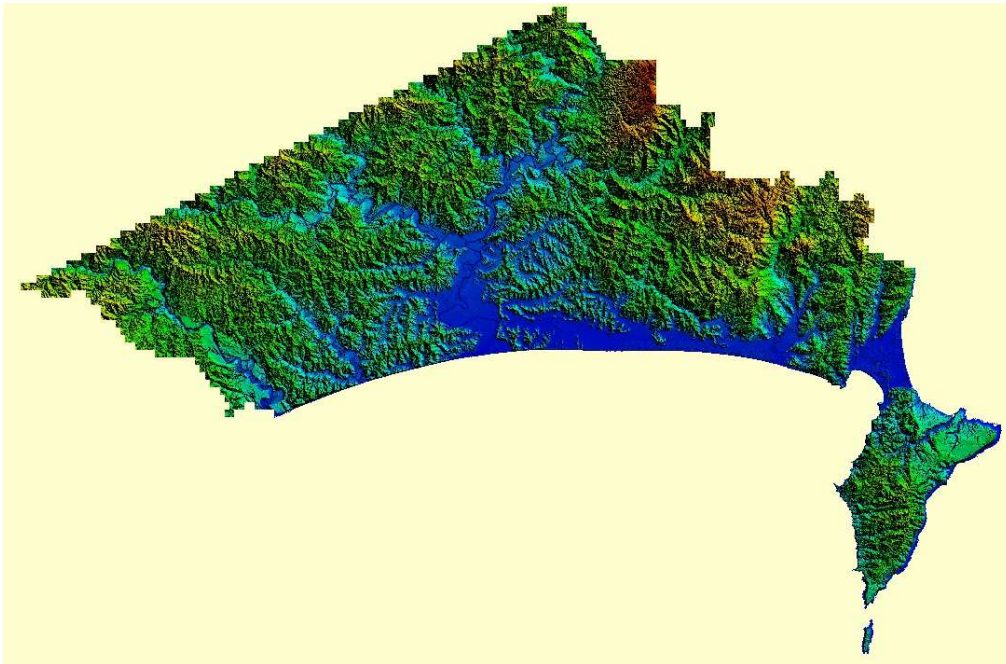
4. VALIDATION

PRJ44793_05 – P2-NE

Imagery



Colour Elevation



NIWA

POST CYCLONE GABRIELLE HAWKES BAY LiDAR

VOLUME: PRJ44793_06

PROJECT SUMMARY

The National Institute of Water and Atmospheric Research Limited (NIWA) contracted Woolpert to capture and process LiDAR and concurrent imagery over Hawkes Bay, post Cyclone Gabrielle.

This report is for the products supplied for Priority Two in volume – PRJ44793_06, approximately 3,548 km². Resubmission following LINZ QA were completed in August.

This area was captured between the 20th of September 2023 – 19th of April 2024.

The survey was planned to achieve $\leq 20\text{cm}$ vertical accuracy (95% CI), $\leq 100\text{cm}$ horizontal accuracy (95% CI) with an emitted pulse density of 8ppsm, and ground classification to ICSM level 2.



DATA SUMMARY

This volume includes the following data in NZTM2000 projection, NZVD2016 vertical datum:

- 10,267 x NZTopo50 1:1000 tiles are included in PRJ44793_06
- 10,267 tiles of ICSM L2 Colourised Classified Point Cloud data in LAZ v1.4 format
- 10,235 tiles of 1m cell DEM in GeoTIFF format
- 10,235 tiles of 1m cell DSM in GeoTIFF format
- 10,235 tiles of 1m cell CHM in GeoTIFF format
- 10,267 tiles of 12.5cm gsd RGBI Imagery in GeoTIFF format
- Ancillary files in ESRI Shapefile format – Tile Index, Delivery Extent, Flightlines, Hydro Breaklines.
- File listing in text file format
- Metadata file: This document in PDF format

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1. DATA INFORMATION

Data supply: LINZ AWS
 Number of files: 92,231 data files, 1 file list, 1 survey report, 1 metadata file
 Data formatted on: 19/06/2024 – 17/07/2024, resubmissions 30/08/2024
 Metadata Document: This file

Previous Deliveries	Date	Title	Contents
PRJ44793_01	22.12.2023	Post Cyclone Gabrielle Hawkes Bay LiDAR	Sample of deliverables from P1-SE
PRJ44793_02	08.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-SE
PRJ44793_03	05.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-N
PRJ44793_04	06.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-W
PRJ44793_04-02	14-22.05.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	Resubmissions for Priority 1 blocks SE, N, W
PRJ44793_05	12-28/05/2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P2-NE

File Naming in this Delivery	Contents
CL2_BM38_2023_1000_4509.laz	Colourised classified point cloud in LAZ v1.4 format
DEM_BM38_2023_1000_4509.tif/tfw	1m grid DEM
DSM_BM38_2023_1000_4509.tif/tfw	1m grid DSM
CHM_BM38_2023_1000_4509.tif/tfw	1m grid CHM (canopy height above ground)
RGBI_BM38_2023_1000_4509.tif/tfw	12.5cm gsd RGBI imagery

Ancillary files: PRJ44793_HB_P2-S_HydroBreaklines_NZTM PRJ44793_HB_P2-S_LiDAR_Extent_NZTM PRJ44793_HB_P2-S_OceanClip_NZTM PRJ44793_HB_P2-S_TileIndex_NZTM PRJ44793_HB_P2-S_Trajectories_NZTM	ESRI Shapefile format: Hydro breaklines Extent Ocean clip boundary Tile Index Flight lines
Readme_PRJ44793_06.pdf	Metadata Report
PRJ44793_06_FileListing.txt	List of product files delivered in this volume

2. METADATA

Source Data	Source	Description	Ref No	Date
LiDAR & Imagery	Woolpert	TerrainMapper2 - 527	FL020423	20.09.2023
		TerrainMapper2 - 527	FL020511	01.10.2023
		TerrainMapper2 - 527	FL020533	04.10.2023
		TerrainMapper2 - 527	FL020539	04.10.2023
		TerrainMapper2 - 527	FL020542	05.10.2023
		TerrainMapper2 - 527	FL020547	05.10.2023
		TerrainMapper2 - 527	FL020608	13.10.2023
		TerrainMapper2 - 527	FL020770	04.11.2023
		TerrainMapper2 - 527	FL020842	12.11.2023
		TerrainMapper2 - 527	FL020852	12.11.2023
		TerrainMapper2 - 527	FL020875	14.11.2023
		TerrainMapper2 - 527	FL021135	15.12.2023
		TerrainMapper2 - 527	FL021182	21.12.2023
		TerrainMapper2 - 527	FL021325	08.01.2024
		TerrainMapper2 - 527	FL021336	09.01.2024
		TerrainMapper2 - 527	FL021416	19.01.2024
		TerrainMapper2 - 527	FL021445	23.01.2024
		TerrainMapper2 - 527	FL021459	24.01.2024

		TerrainMapper2 – 527	FL021470	26.01.2024
		TerrainMapper2 – 527	FL021486	28.01.2024
		TerrainMapper2 – 527	FL021588	08.02.2024
		TerrainMapper2 – 527	FL021631	13.02.2024
		TerrainMapper2 – 527	FL021640	14.02.2024
		TerrainMapper2 – 527	FL021898	11.03.2024
		TerrainMapper2 – 527	FL022244	19.04.2024
GPS Base Data	GeoNET /LINZ	GeoNET CORS, LINZ GDB co-ordinates	As above	As above
Control	Sounds Surveying	RTK GNSS	PRJ44793	27/09/2023 – 8/10/2023 & 23-28/11/2023

LiDAR Characteristics	Description
Format	LAZ 1.4
Emitted Density	8 ppm2
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
ICSM Classification	Level 2. Ground surface improvement
Capture Constraints	Coastline captured within 3 hours of low tide.

Number	Point Class	Description	ICSM	CI %
1	Default	Unclassified	1	95
2	Ground	Ground	2	98
3	Low vegetation	< 2.0 m	1	95
4	Medium vegetation	2.0 – 8.0 m	1	95
5	High vegetation	> 8.0 m	1	95
6	Buildings, structures	Buildings, houses, sheds, silos etc.	1	95
7	Low / high points	Spurious low point returns (unusable)	2	98
9	Water	Any point in water	2	98
17	Bridge	Any bridge or overpass	2	98
18	High Noise	Spurious high point returns (unusable)	2	98

Ortho Characteristics	Description
Format	GeoTIFF
Ground Sample Distance	12.5cm
Terrain Model	Concurrent LiDAR
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
Sample Type	8-bit Integer
Image Bands	RGBI
Orientation/AT	Aero Triangulation/GPS-IMU
Capture Constraints	Nil specific to imagery – captured under LiDAR capture conditions above, in daylight hours

Reference Systems	Horizontal	Vertical
Datum	NZGD2000	NZVD2016
Projection	NZTM2000	N/A
Geoid Model	N/A	NZGeoid2016

Accuracy Specification	Measured Point	Derived Point	Basis of Estimation
Control Points	0.05m		Survey Methodology
LiDAR (Horizontal)	0.40m		Project design
LiDAR (Vertical)	0.10m		Project design
Orthophoto	0.30m		Project design

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 by LiDAR refer to the terrain definition on clear ground.
- 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.
- Buildings and vegetation have been classified automatically: ISCM Level 1, 95% confidence. These classes may contain artefacts such as powerlines, car's, containers etc. Be aware when using the LAZ and CHM products.

Data Validation – LiDAR Data

- Vertical Accuracy Validation - Ground data in this volume has been compared to ~1636 test points obtained by field survey and assumed to be error-free. The test points were distributed in 33 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:
 - Mean difference: 0.040 m
 - Std Deviation: 0.036 m
 - Standard Error (RMS): 0.053 m or 0.104 m @ 95% CIDEM and control comparisons were made to the adjacent Priority One block to ensure consistency, these align within 0.04m.
A shift of -0.076 was applied to the data before testing against the check points to produce the results shown above.
- Horizontal Accuracy – the LiDAR data was compared to visible horizontal control using the intensity imagery. The data was found to fit well. The expected horizontal accuracy at 95% CI is 38cm, within the specification of 100cm.
- Data classification has been manually checked and edited against available imagery.
- More information is available in the Survey Report: PRJ44793_05-07_HawkesBay_P2_LiDAR_Report.pdf

Data Validation – Orthophoto Image

- This data has not been field tested for accuracy. Spot checks comparing the orthophoto with horizontal check points supported the estimated horizontal accuracy of < 0.300 m. Full proof of accuracy achieved requires comparison to independent test points.

3. CONDITIONS OF SUPPLY

The data in this volume has been commissioned by the National Institute of water and Atmospheric Research Limited **NIWA**.

The data in this volume is provided by Woolpert to **NIWA** under the Terms of Engagement described in the **NIWA Woolpert Imagery Contract Agreement, dated 16th August 2023**. Which provides the client, **NIWA** (or its nominee) with ownership of the deliverables to fully protect, realise and use all delivered data and reports, allowing release of data for re-use with a Creative Commons license (CC BY) with attribution to the buyer in line with the New Zealand Government Open Access Licensing framework (NZGOAL). This specification places no restrictions on the rights of Woolpert to resell data or derivative products.

1. This file (Readme_PRJ44793_06.pdf) will always be stored with the unaltered data contained in this volume.

This data is provided in accordance with the specifications agreed with NIWA and Land Information NZ. Any problems associated with the information in the data files contained in this volume should be reported to Woolpert, Asia-Pacific.

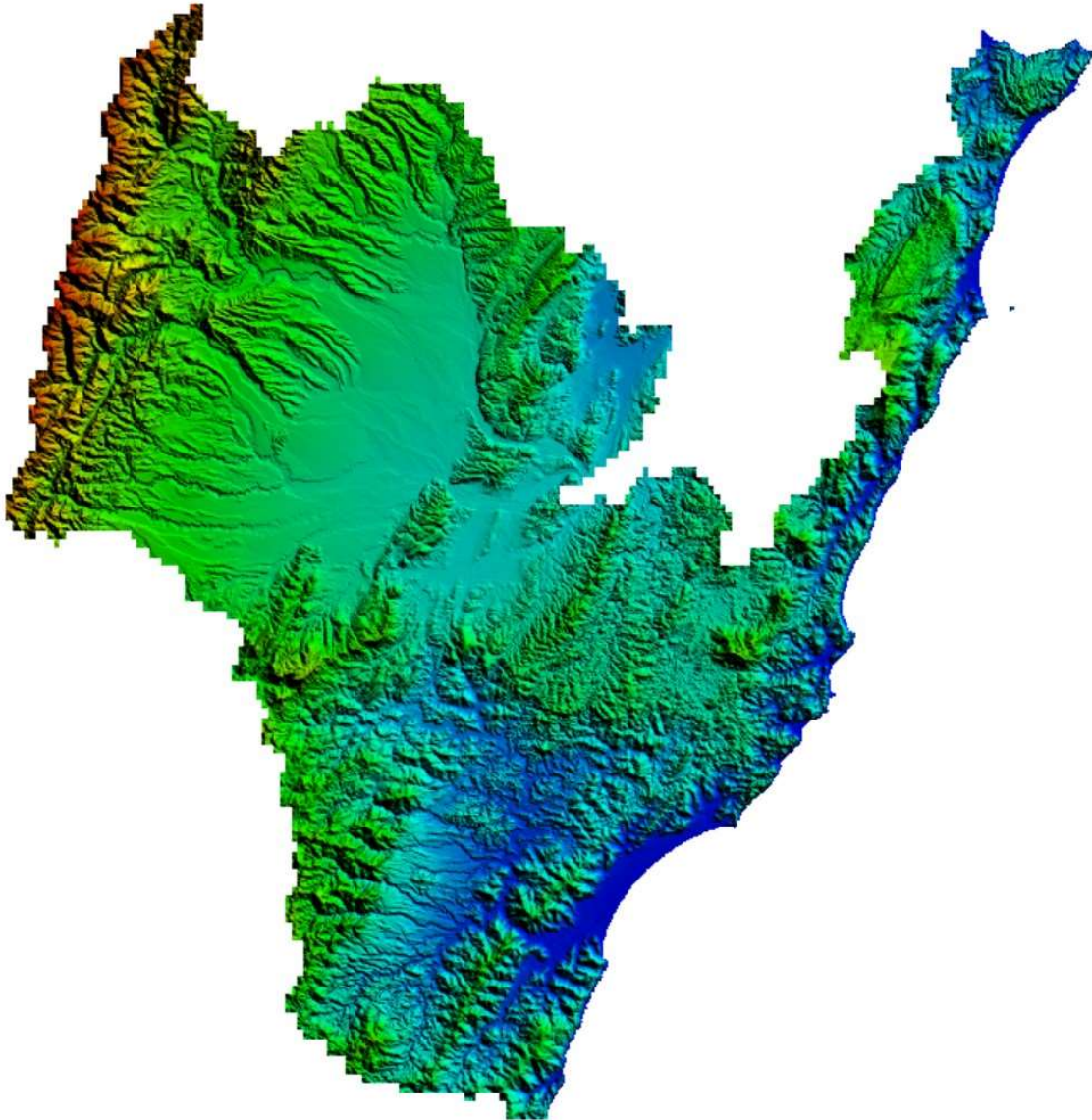
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4. VALIDATION

PRJ44793_06 – P2-S

Colour Elevation



NIWA

POST CYCLONE GABRIELLE HAWKES BAY LiDAR

VOLUME: PRJ44793_07

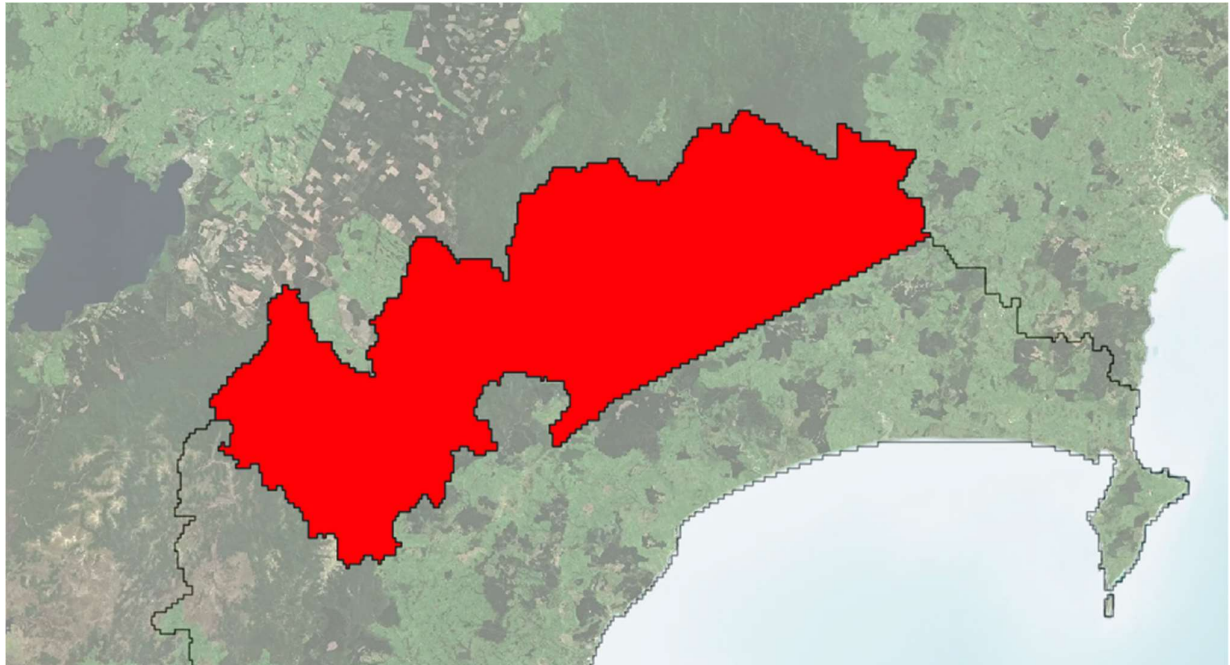
PROJECT SUMMARY

The National Institute of Water and Atmospheric Research Limited (NIWA) contracted Woolpert to capture and process LiDAR and concurrent imagery over Hawkes Bay, post Cyclone Gabrielle.

This report is for the products supplied in Northern Hawkes Bay for Priority Two - volume PRJ44793_07, approximately 3,581 km².

This area was captured between the 21st of September 2023 – 27th of April 2024.

The survey was planned to achieve $\leq 20\text{cm}$ vertical accuracy (95% CI), $\leq 100\text{cm}$ horizontal accuracy (95% CI) with an emitted pulse density of 8ppsm, and ground classification to ICSM level 2.



DATA SUMMARY

This volume includes the following data in NZTM2000 projection, NZVD2016 vertical datum:

- 10,361 x NZTopo50 1:1000 tiles are included in PRJ44793_07
- 10,361 tiles of ICSM L2 Colourised Classified Point Cloud data in LAZ v1.4 format
- 10,361 tiles of 1m cell DEM in GeoTIFF format
- 10,361 tiles of 1m cell DSM in GeoTIFF format
- 10,361 tiles of 1m cell CHM in GeoTIFF format
- 10,361 tiles of 12.5cm gsd RGBI Imagery in GeoTIFF format
- Ancillary files in ESRI Shapefile format – Tile Index, Delivery Extent, Flightlines, Hydro Breaklines.
- File listing in text file format
- Metadata file: This document in PDF format

CONTENTS

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1. DATA INFORMATION

Data supply: LINZ AWS
 Number of files: 93,265 data files, 1 file list, 1 survey report, 1 metadata file
 Data formatted on: 31/07/2024- 28/08/2024
 Metadata Document: This file

Previous Deliveries	Date	Title	Contents
PRJ44793_01	22.12.2023	Post Cyclone Gabrielle Hawkes Bay LiDAR	Sample of deliverables from P1-SE
PRJ44793_02	08.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-SE
PRJ44793_03	05.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-N
PRJ44793_04	06.04.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P1-W
PRJ44793_04-02	14-22.05.2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	Resubmissions for Priority 1 blocks SE, N, W
PRJ44793_05	12-28/05/2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P2-NE
PRJ44793_06	19/06/2024 – 17/07/2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	P2-S
PRJ44793_05	13&23/08/2024	Post Cyclone Gabrielle Hawkes Bay LiDAR	Resubmissions P2-NE

File Naming in this Delivery	Contents
CL2_BG38_2023_1000_3248.laz	Colourised classified point cloud in LAZ v1.4 format
DEM_BG38_2023_1000_3248.tif/tfw	1m grid DEM
DSM_BG38_2023_1000_3248.tif/tfw	1m grid DSM
CHM_BG38_2023_1000_3248.tif/tfw	1m grid CHM (canopy height above ground)
RGBI_BG38_2023_1000_3248.tif/tfw	12.5cm gsd RGBI imagery
Ancillary files: PRJ44793_HB_P2-N_HydroBreaklines_NZTM PRJ44793_HB_P2-N_ProjectExtent_NZTM PRJ44793_HB_P2-N_TileIndex_NZTM PRJ44793_HB_P2-N_Trajectories_NZTM	ESRI Shapefile format: Volume 07 Hydro breaklines Volume 07 Extent Volume 07 Tile Index Volume 07 Flight lines
Readme_PRJ44793_07.pdf	Metadata Report
PRJ44793_07_FileListing.txt	List of product files delivered in this volume

2. METADATA

Source Data	Source	Description	Ref No	Date
LiDAR & Imagery	Woolpert	TerrainMapper2 - 527	FL020424	21.09.2023
		TerrainMapper2 - 527	FL020430	21.09.2023
		TerrainMapper2 – 527	FL020601	12.10.2023
		TerrainMapper2 – 527	FL020655	20.10.2023
		TerrainMapper2 – 527	FL020842	12.11.2023
		TerrainMapper2 – 527	FL020856	13.11.2023
		TerrainMapper2 – 527	FL020865	13.11.2023
		TerrainMapper2 – 527	FL020875	14.11.2023
		TerrainMapper2 – 527	FL021060	07.12.2023
		TerrainMapper2 – 527	FL021135	15.12.2023

		TerrainMapper2 – 527	FL021141	16.12.2023
		TerrainMapper2 – 527	FL021150	16.12.2023
		TerrainMapper2 – 527	FL021156	17.12.2023
		TerrainMapper2 – 527	FL021159	17.12.2023
		TerrainMapper2 – 527	FL021182	21/12/2023
		TerrainMapper2 – 527	FL021358	12/01/2024
		TerrainMapper2 – 527	FL021359	12/01/2024
		TerrainMapper2 – 527	FL021459	24/01/2024
		TerrainMapper2 – 527	FL021581	7/02/2024
		TerrainMapper2 – 527	FL021627	12/02/2024
		TerrainMapper2 – 527	FL021860	8/03/2024
		TerrainMapper2 – 527	FL021893	11/03/2024
		TerrainMapper2 – 527	FL021898	11/03/2024
		TerrainMapper2 – 527	FL022290	23/04/2024
		TerrainMapper2 – 527	FL022293	24/04/2024
		TerrainMapper2 – 527	FL022321	27/04/2024
GPS Base Data	GeoNET /LINZ	GeoNET CORS, LINZ GDB co-ordinates	As above	As above
Control	Sounds Surveying	RTK GNSS	PRJ44793	27/09/2023 – 8/10/2023 & 23-28/11/2023

LiDAR Characteristics	Description
Format	LAZ 1.4
Emitted Density	8 ppm2
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
ICSM Classification	Level 2. Ground surface improvement
Capture Constraints	Coastline captured within 3 hours of low tide.

Number	Point Class	Description	ICSM	CI %
1	Default	Unclassified	1	95
2	Ground	Ground	2	98
3	Low vegetation	< 2.0 m	1	95
4	Medium vegetation	2.0 – 8.0 m	1	95
5	High vegetation	> 8.0 m	1	95
6	Buildings, structures	Buildings, houses, sheds, silos etc.	1	95
7	Low Noise	Spurious low point returns (unusable)	2	98
9	Water	Any point in water	2	98
17	Bridge	Any bridge or overpass	2	98
18	High Noise	Spurious high point returns (unusable)	2	98

Ortho Characteristics	Description
Format	GeoTIFF
Ground Sample Distance	12.5cm
Terrain Model	Concurrent LiDAR
Tile size	480m x 720m (NZ Topo 50, 1:1000 tiles)
Sample Type	8-bit Integer
Image Bands	RGBI
Orientation/AT	Aero Triangulation/GPS-IMU
Capture Constraints	Nil specific to imagery – captured under LiDAR capture conditions above, in daylight hours

Reference Systems	Horizontal	Vertical
Datum	NZGD2000	NZVD2016
Projection	NZTM2000	N/A
Geoid Model	N/A	NZGeoid2016

Accuracy Specification	Measured Point	Derived Point	Basis of Estimation
Control Points	0.05m		Survey Methodology
LiDAR (Horizontal)	0.40m		Project design
LiDAR (Vertical)	0.10m		Project design
Orthophoto	0.30m		Project design

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 by LiDAR refer to the terrain definition on clear ground.
- 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.
- Buildings and vegetation have been classified automatically: ISCM Level 1, 95% confidence. These classes may contain artefacts such as powerlines, car’s, containers etc. Be aware when using the LAZ and CHM products.

Data Validation – LiDAR Data

- Vertical Accuracy Validation - Ground data in this volume has been compared to ~1043 test points obtained by field survey and assumed to be error-free. The test points were distributed in 19 groups across the mapping area and located on clear ground. Comparison of the test points with elevations interpolated from measured data resulted in:

Mean difference: 0.024 m
 Std Deviation: 0.058 m
 Standard Error (RMS): 0.063 m or 0.124 m @ 95% CI
 Comparison by site:

Site	Post dZ	Post RMS	Post SD
<i>Average</i>	<i>0.044</i>		
1028	0.128	0.130	0.023
1029	0.008	0.022	0.021
1049	-0.005	0.019	0.018
1050	0.085	0.087	0.020
1056	-0.004	0.013	0.012
1057	0.053	0.055	0.015

Site	Post dZ	Post RMS	Post SD
<i>Average</i>	<i>0.014</i>		
1004	0.063	0.067	0.024
1007	-0.006	0.020	0.020
1008	0.081	0.085	0.029
1009	-0.087	0.089	0.020
1010	0.022	0.027	0.017
1011	0.020	0.031	0.024
1012	0.045	0.049	0.021
1013	-0.031	0.036	0.019
1016	-0.025	0.033	0.022
1017	0.064	0.072	0.033
1027	0.064	0.071	0.032
1030	0.030	0.035	0.018
1123	-0.059	0.062	0.019

This volume is comprised for 2 blocks named P2-NW and P2-NN. DZ shifts were applied to each block following comparison to control and comparisons to the adjoining Priority One and Priority Two blocks.

Shifts applied were: -0.098m (P2-NW shift to P1-W and P1-N)
 -0.083m (P2-NN shift to P2-NW, P2-NE and P1-N)

These vertical shifts were applied to the data prior to comparison to the test points shown above.

- Horizontal Accuracy – the LiDAR data was compared to visible horizontal control using the intensity imagery. The data was found to fit well. The expected horizontal accuracy at 95% CI is 38cm, within the specification of 100cm.
- Data classification has been manually checked and edited against available imagery.

Data Validation – Orthophoto Image

- This data has not been field tested for accuracy. Spot checks comparing the orthophoto with horizontal check points supported the estimated horizontal accuracy of < 0.300 m. Full proof of accuracy achieved requires comparison to independent test points.

3. CONDITIONS OF SUPPLY

The data in this volume has been commissioned by the National Institute of water and Atmospheric Research Limited **NIWA**.

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1. This file (Readme_PRJ44793_07.pdf) will always be stored with the unaltered data contained in this volume.

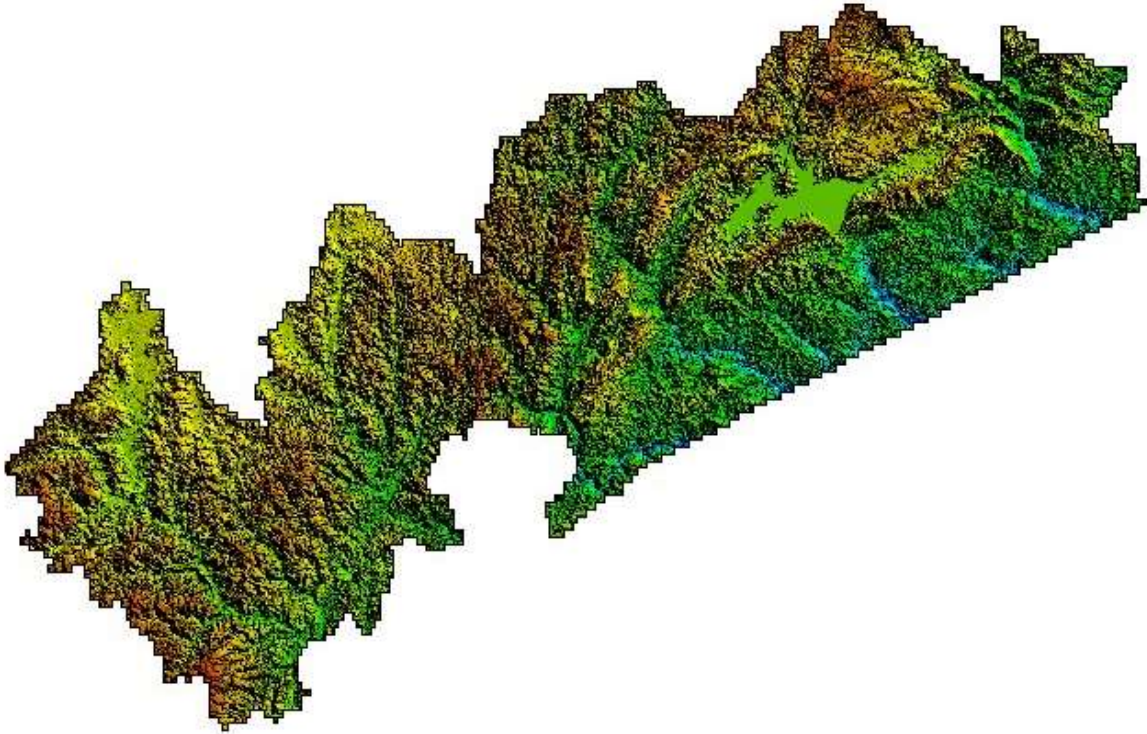
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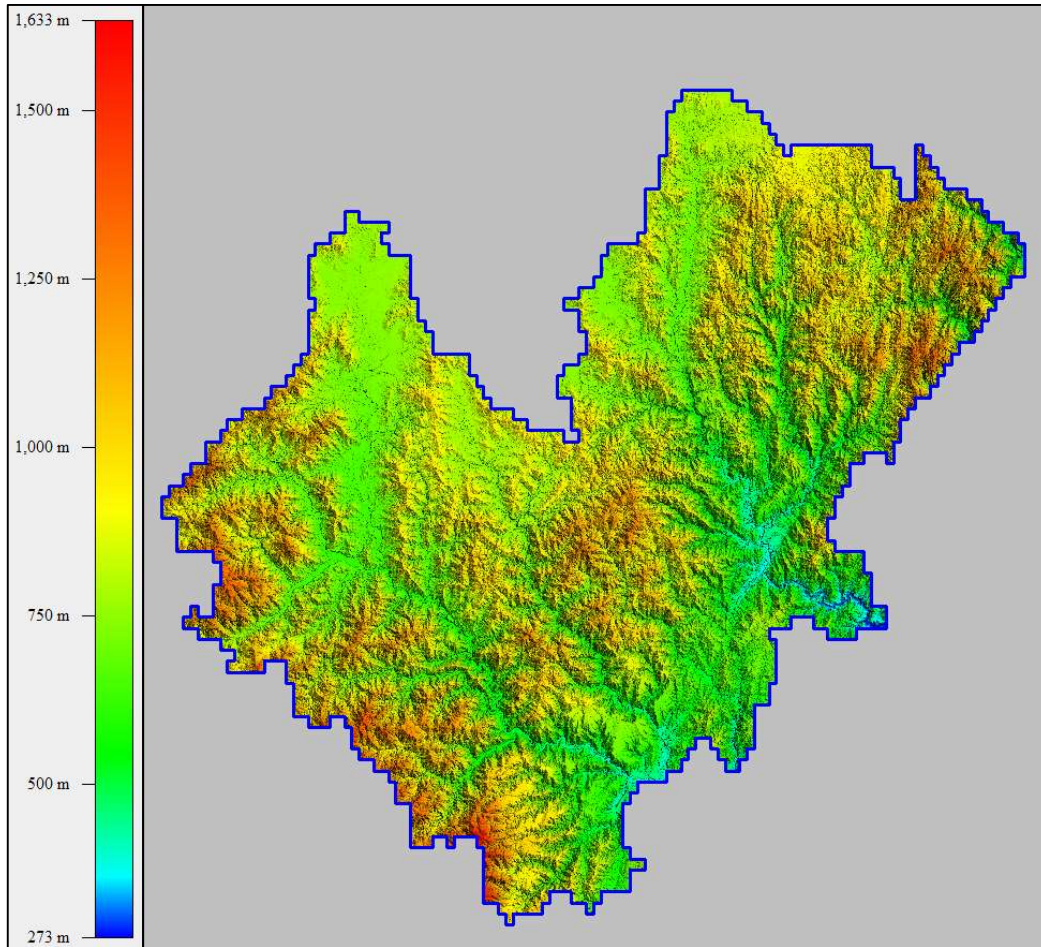
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4. VALIDATION

PRJ44793_07 – P2-N
Colour Elevation Overview



P2-NW



P2-NN

