NIWA
Taihoro Nukurangi

National and regional risk exposure in low-lying coastal areas

Areal extent, population, buildings and infrastructure

Prepared for the Parliamentary Commissioner for the Environment

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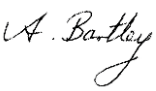	Formatting checked by:	Alison Bartley
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Contents

Tables

Figures

Executive summary

What is the context and purpose of this Report?

The mean level of the sea is rising globally due to climate change from a warming atmosphere. Over the past century up to present, New Zealand's average rise in mean sea level has been similar to the global-average rate – therefore future projections of global-average sea-level rise are generally applicable to Aotearoa–New Zealand (A-NZ). In tandem with this rise in sea level, the frequency of coastal storm inundation has increased (Stephens, 2015), as evident in Auckland such as Tamaki Drive, with the occurrence of these events set to escalate as sea-level rise accelerates. Planning for both coastal erosion and inundation and climate-change effects is a hotly-contested space for vulnerable communities and their councils and requires a sound evidence base built around the time-varying risk exposure.

Against this backdrop, NIWA was commissioned by the Parliamentary Commissioner for the Environment (PCE) to provide a nationally-consistent coastal risk exposure as a first pass assessment at the national level, aggregated up from a comparison of results at the regional level.

The analysis in this Report is the first consistent attempt at quantifying the risk exposure in low-lying coastal areas across A-NZ and enabling a comparison between different regions and urban areas to assist in prioritising national and regional effort in adaptation to more frequent coastal hazard impacts. Risk exposure is expressed as counts of normally-resident population, land-cover, land parcels and built assets (e.g., buildings, roads, railways, coastal structures) present within various elevation bands up to 3 metres above the present-day mean high water spring (MHWS) tide mark, along with replacement costs for buildings in New Zealand dollars as of 2011 (extracted from the NIWA/GNS Science RiskScape asset database – see Chapter 5). Data on these risk receptors have been have been extracted from Statistics NZ (2013 Census), Landcare Research Landcover Database, Land Information NZ Data Service and RiskScape (NIWA and GNS Science).

What approach was used to determine the national coastal-risk exposure?

Inundation of lower-lying coastal areas usually occurs from a complex combination of coastal and weather processes (e.g., tides, storm surge, wave runup) modulated by climate variability from annual to inter-decadal climate cycles up to longer-term trends from climate change, particularly sea-level rise. Assessment of the coastal inundation risk is usually undertaken for various likelihood (return-period) scenarios for the present-day situation and extended out to one or more planning timeframes, particularly for "at least 100 years" as required under the 2010 New Zealand Coastal Policy Statement. Tsunami is also a coastal inundation hazard to be considered when giving effect to the statement.

The exposure to coastal-inundation hazards also varies markedly between open coastal situations around different regions (e.g., Southland, Otago, west coasts and the south Wellington coast have a high wave exposure compared with the Hauraki Gulf/Firth of Thames) and then between open coasts and more quiescent estuary, lowland river, fjord and harbour environments.

One approach would be to apply a generic storm-surge scenario across all coastal and estuarine areas of A-NZ, with various increments of sea-level rise. However, because of the spatial variability in exposure to coastal-inundation hazards between and within regions, and the additional local effect of wave runup, this study instead explores the coastal-risk exposure over a common set of land-elevation bands relative to the local spring high-water.

Focusing on a stocktake of residents and assets (buildings and some infrastructure types) in various elevation bands, provides a first pass for the level of risk exposure nationally and a comparison between regions. Lower elevation bands, up to 1–1.5 m above MHWS, have a higher exposure in the present and in the future when compared to higher elevation bands, up to 3 m above MHWS. Higher elevation bands will be increasingly exposed to coastal hazards as sea level rises. The enumerated risk-exposure values here are only elevation based with no modulation for existing coastal defences/stopbanks or consideration of sea-inundation volumes being able to fully spread inland over wider low-lying coastal plains during storm-tides (or small tsunami).

What digital-elevation datasets were used and what is the difference?

The risk-exposure study was undertaken within the context that currently there is no nation-wide high-resolution topography or digital elevation model (DEM)[1] of A-NZ at sub-metre vertical accuracy. Yet, the accuracy of land elevation is paramount when dealing with combined coastal inundation and sea-level rise that may reach combined levels of up to 3 metres.

While there are substantial areas of high-resolution elevation coverage across coastal areas (mainly from LiDAR[2] surveys which typically can achieve vertical accuracies of ±0.15 m or better), there is by no means full national coverage for areas below 10 m. Therefore, to undertake a national appraisal of coastal risk exposure that includes all coastal plains a national coastal DEM is for now a necessity.

The modified enhanced national DEM at 25 m grid spacing (referred to from here as "the national DEM"), has been modified from the Landcare Research enhanced DEM generated from the Land Information New Zealand topographic contour data blended with NASA global terrain data. The absolute height accuracy for the national DEM for A-NZ is not specifically stated in the metadata, but the accuracy of elevations across the relatively flat coastal plains are likely to be of the order of 3–4 m.

This Report covers the findings from using both the national DEM, for a 0–3 m height coastal zone, and those areas where more-accurate LiDAR surveys, at accuracies typically down to 0.15 m, were available. Where LiDAR data was available the results were able to be reported for smaller elevation bands or increments of 0, 0.25, 0.5, 1, 1.5, 2, 2.5 up to 3 m height above MHWS (being the zero baseline).

How did the results compare for the two different elevation datasets?

The clear and most obvious finding is that the best-available national modified DEM is inadequate, with insufficient accuracy, to rely on for the detailed risk-exposure analyses being attempted here in this Report. While there is not full LiDAR coverage available for A-NZ coastal areas (see Figure ES-1.), the total land-cover area and population within the cumulative 0–3 m coastal zone derived from LiDAR DEMs is nearly double those enumerated from the national modified DEM for the same elevation range. The national DEM also substantially underestimates the risk exposure (buildings and infrastructure) by around half when compared with the available LiDAR elevation datasets for the same elevation zone (0–3 m). As an example, using the 0–3 m elevation zone for the areas where LiDAR was available there are 89,780 buildings based on the national DEM and 166,750 based on LiDAR. There is an even greater underestimate for total replacement building costs of $24B (2011)

[1] a matrix of ground elevations gridded on a regular array of north and east directions at typically 1–5 m grid spacing for LiDAR and 25 m for the national DEM

[2] Light Detection And Ranging, which is a laser-based aerial scanning method for measuring elevations

compared to $52B (2011) for areas where LiDAR was available, with land area containing higher-cost commercial buildings in central business areas substantially underestimated.

Figure ES-1: Coverage of LiDAR DEMs across A-NZ used in this Project. Source: DEMs sourced from LINZ or directly with councils.

A key finding of this Project is the only defensible and robust approach to coastal risk assessments is to use high-resolution and accurate LiDAR DEMs. While these were available in the majority of regions (apart from five), surveys in most regions outside of Auckland and Wellington are composed of a mix of surveys undertaken at different times with varying accuracies. On the positive side, the coastal margin for most developed areas has generally been covered by LiDAR surveys. In this Report, the national DEM is used to provide a lower bound estimate of the relative coastal risk exposure for the five regions where LiDAR data was not available.

What is the area and type of coastal land in these zones and where are the largest tracts?

Nationally, for those areas where LiDAR datasets were available, the total land-cover area for the 0–1.5 m elevation zone is 1,290 km^2 (0.5% of the land area of A-NZ), rising to around 2,000 km^2 (0.7% of A-NZ land area) for the wider 0–3 m elevation zone. The latter is nearly twice the land area extracted from the analysis using the national modified DEM for the 0–3 m elevation zone, and hence explains the substantial underestimate by around half for coastal risk exposure by way of counts of residents and assets.

Waikato has the largest land-cover area nationally for both elevation zones, followed by Bay of Plenty and Canterbury. Primary production (e.g., dairy farming, horticulture, forestry) is the most extensive land-cover type, estimated to occupy 77% of land within 0–1.5 m elevation zone and 75% of land within 0–3 m zone. Waikato, primarily the Hauraki Plains, accounts for over one third of New Zealand's primary production land in both coastal elevation zones.

The built-environment land cover is estimated to cover 64 km^2 within the 0–1.5 m elevation zone, which more than doubles to 154 km^2 (+240%) for 0–3 m. Canterbury has the most extensive built-land cover with an area of just under 39 km^2 (although this has decreased with the formation of the residential Red Zone in Christchurch). The built environments of Auckland, Waikato, Bay of Plenty, Hawke's Bay and Wellington all occupy between 14–19 km^2 of land within the 0–3 m elevation zone.

Summary of the overall results based on the LiDAR elevation datasets

A summary of the coastal risk exposure is shown in the infographics below, with regional entries for just the highest regional counts of assets or population (i.e., not all results shown) and national totals. The results, based on the LiDAR DEM analyses, have been aggregated for the lower 0–1.5 m elevation zone and the wider 0–3 m elevation zone (relative to present local MHWS).

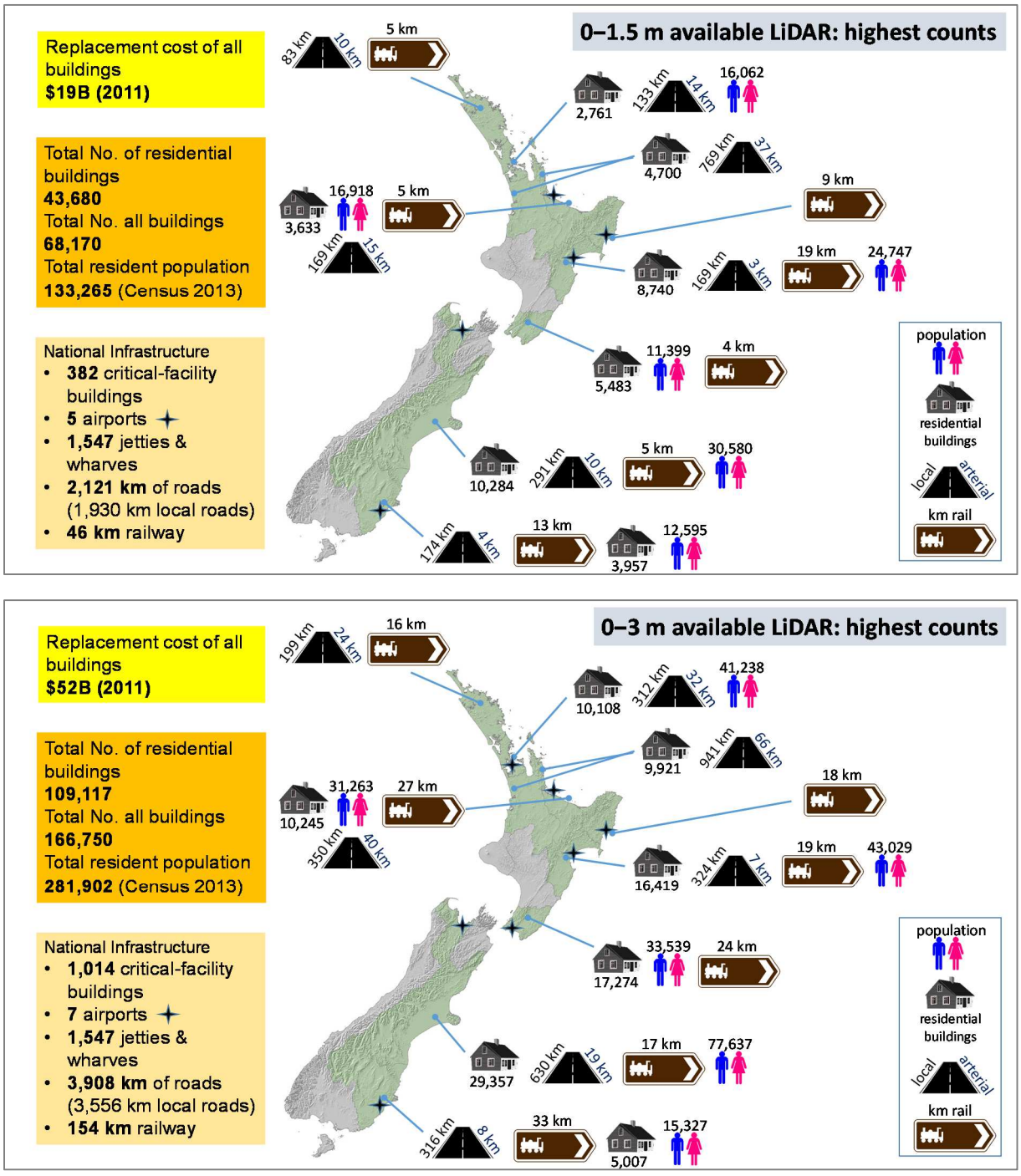


Figure ES-2: Summary of regions with the highest counts of assets or populations and national totals for coastal risk exposure across regions with LiDAR available (excl. grey-shaded areas) for the 0–1.5 m and 0–3 m elevation zones. *Notes*: Population (all ages) from 2013 Census (normally-resident); regional building counts only include residential-type buildings (from RiskScape) and excl. the Residential Red Zone in Christchurch; roads subdivided into "local" (includes local and feeder roads) and "arterial" (includes arterial and motorways), stars show airports that partially or wholly occupy the elevation zone. Replacement costs from RiskScape based on 2011 NZ$. Critical-facility buildings include those for engineering lifelines and utilities, emergency services, government and education.

The percentages of the A-NZ population normally resident in the 0–1.5 m and 0–3 m elevation zones (3.1% and 6.6% respectively) and the total A-NZ building replacement costs (1.6% and 4.4% respectively for residential and 2.5% and 6.9% for non-residential buildings) are substantially higher than the 0.5–0.7% of land-cover area of A-NZ for these same coastal elevation zones, highlighting that land area is not a reliable proxy for coastal risk exposure.

For the wider 0–3 m coastal elevation zone where LiDAR DEMs were available, the national totals are:

- normally resident population is 281,902
- nearly 294,000 land parcels (i.e., legal properties)
- total number of buildings is 166,750 with a replacement cost of $52B in 2011 $NZ
- nearly 92% of the coastal risk exposure (using building replacement costs as a measure) is derived from urbanised areas compared with rural areas
- 1,014 critical-facility or government buildings
- over 3,900 km of road, with nearly 91% designated as local roads
- 154 km of railway lines identified
- over 1500 jetty or wharf structures
- 7 or more airports and 25 airstrips or aerodromes.

What is the normally-resident population in low-lying coastal zones and where are they concentrated?

Aggregated nationally across areas with LiDAR datasets available, the total resident population from the 2013 Census in the 0–1.5 m elevation zone was 133,265 (3.1% of A-NZ population), rising to 281,902 across the wider 0–3 m elevation zone (6.6% of A-NZ population).

Of the regions with LiDAR datasets available, two-thirds of the people resident in the more exposed 0–1.5 m coastal elevation zone lived in either Canterbury (~23%), Hawke's Bay (~19%), Bay of Plenty (~13%) or Auckland (~12%), with these four regions accounting for around 68% of all people who were resident in the wider 0–3 m elevation zone in the 2013 Census. For Canterbury and the Christchurch urban area, following the 2010/2011 earthquakes, there was a 36% decrease in the population of the most damaged Red Zone areas in the east of Christchurch city, with these reductions already present in the Census 2013 dataset used for this Project, but the analysis does not include any further changes following Census night.

Across any particular region, the resident population in the 0–3 m coastal zone (based on areas with available LiDAR surveys) is generally quite a small proportion at < 10% of a region's population. Exceptions include Hawke's Bay, with 28% of the region's population, followed by Tasman with 16% and Canterbury and Nelson at 14%. Otago has a high proportion of people residing in the lower 0–1.5 m coastal elevation zone compared to the 1.5–3 m zone, due to the low-lying nature of coastal plains in Otago (including Dunedin) adjacent to steeply rising topography.

Apart from Northland and Waikato and to a lesser extent Tasman, the main concentration of populations in these low-lying elevation zones are essentially in urban areas or settlements. For example, Christchurch City makes up 96–97% of the Canterbury region population in the coastal elevation zones, and similarly Dunedin City makes up 87–89% of the Otago total. In the Wellington region, Lower Hutt has a substantially higher population in the 0–3 m elevation zone (47% of the regional total) than Wellington City (31%), followed by Kāpiti Coast (14%). Likewise in Hawke's Bay, the population count is dominated by Napier City (~90% of the regional total) compared with Hastings.

While the national modified DEM results proved to be underestimates, they demonstrate national relativity across all regions by including five regions where LiDAR datasets were unavailable (Taranaki, Manawatu-Wanganui, Marlborough, West Coast, Southland). Nearly 6,900 people were resident in these five regions within the 0–3 m elevation zone of the national DEM, with 73% from two regions West Coast (2,577) and Southland (2,486), which are very likely to be underestimates.

An important caveat with this demographic overview is that the populations are based on people normally resident in these areas and were present in A-NZ on census night. Therefore, there will be a significant underestimate of people who would be temporarily resident in coastal settlements and towns, particularly in the peak summer season of December–January and occasionally through the year.

What are the number of buildings of different types, their replacement costs and what regions have the highest counts?

Nationally, there are over 68,000 buildings in the lower-lying 0–1.5 m elevation zone (excluding areas and regions where LiDAR datasets were unavailable), which rises to a total of 166,750 buildings for the wider 0–3 m elevation zone.

Canterbury and Hawke's Bay, followed by Waikato, have the most buildings of all types in the 0–1.5 m elevation zone, but the Wellington and Bay of Plenty regions join this group with the highest building counts across the 0–3 m elevation zone. The building count for the latter in the Wellington region is boosted by a higher proportionate number of commercial buildings (predominantly Wellington and Lower Hutt), which is reflected in the higher building replacement costs.

Nationally, in areas with LiDAR datasets available, the total replacement costs for enumerated buildings of all classes accumulates to NZD$19.3B (2011) for the lower-lying 0–1.5 m elevation zone rising to around NZD$52B (2011) across the wider 0–3 m elevation zone.

The total building replacement costs across the 0–1.5 m coastal elevation zone (where LiDAR datasets were available) amounts to around 1.6% and 2.5% of the national building stock for residential and non-residential buildings respectively, rising to 4.4% and 6.9% respectively for the 0–3 m elevation zone. These percentages would be slightly higher if LiDAR DEMs were available for all coastal areas

Canterbury, Auckland, Wellington and Hawke's Bay dominate the building replacement cost national totals, with Auckland ($11B) and the Wellington region ($9.8B) returning the highest regional replacement cost totals for the 0–3 m elevation zone.

Based on results for buildings from the incremental elevation bands (0.25, 0.5, 1, 1.5, … 3 m) where LiDAR surveys were available, three different elevation profiles of coastal risk exposure were revealed:

- Highest proportion of risk exposure for a region in the lowest-lying elevation band (0-0.25 m) occurs in Waikato and Otago regions.
- A rapid increase in risk exposure between 0.5–1 to 1.5–2 m (majority of regions).
- A steady increase in risk exposure up to the 3 m upper limit assessed e.g., Auckland and especially Gisborne.

Which urban areas have the highest counts for buildings and replacement costs?

Urban areas, as defined by Stats NZ, mostly centre on a single city or town and the surrounding peri-urban area, but Auckland City/Region is divided into four urban zones (North, West, Central and Southern Auckland Zones) and Wellington also into 4 zones –Wellington, Lower Hutt, Upper Hutt and Porirua.

Distributions of building numbers for urban areas in descending order across the 0–3 m elevation zone for areas with LiDAR datasets available, were compared with the counts for the lower-lying 0–1.5 m elevation zone. The highest numbers of all types of buildings identified for urban areas nationally are dominated by Christchurch – excluding the Red Zone (45,833 – up from 15,556 for 0–1.5 m), Napier (25,046 up from 14,207 for 0–1.5 m) and Lower Hutt (10,199 up from 4,635 for 0–1.5 m). These urban areas are followed by Dunedin (5,845 buildings) and Whakatane (5,580 buildings) for the 0–3 m zone. A group comprising urban areas of Tauranga, Nelson, North Auckland Zone and Wellington, each accounted for total numbers of buildings in the range 4,000 to 5,000 for the same coastal elevation zone.

The highest accumulated replacement costs (NZ$–2011) for buildings identified are dominated by those from Christchurch- excluding the Red Zone ($8.7B – up from $3.2B for 0–1.5 m), Central Auckland Zone ($5.9B – up from $0.9B), Napier ($5.1B – up from $2.6B), Wellington ($5.0B – up from $2.2B) and Lower Hutt ($3.5B – up from $1.5B). Together, these 5 urban areas account for $28.3B or nearly 60% of the replacement cost total ($47.6B) across all urban areas where LiDAR DEMs were available. North Auckland Zone, Dunedin and Tauranga also accounted for total replacement costs of over $2B each, followed by Nelson at $1.8B.

For areas where LiDAR DEMs were available, the difference between the national total replacement costs of nearly $52B (2011$NZD) and the total for all urban areas ($47.6B), indicates that nearly 92% of the coastal risk exposure (using replacement costs as a risk-exposure measure) is derived from urbanised areas compared with rural areas.

For those urban centres not covered by available LiDAR DEMs, the national 0–3 m DEM results provide an indication (likely an underestimate) of the additional replacement costs in these regions, the highest of these being Invercargill ($0.44B) and Westport ($0.21B).

How many kilometres of road and railway are in these coastal zones?

All regions with LiDAR coverage contain a range of road types located within both the 0–1.5 m and 0–3 m coastal elevation zones, although the regional and national totals for road length are dominated by “local” roads and streets (91%). The total length of all types of road is highest in the Waikato for both coastal zones, with just over 800 km and 1,000 km respectively, followed by Canterbury.

An estimated 2,100 km of road network in A-NZ (for regions with available LiDAR coverage) is located within the lower-lying 0–1.5 m elevation zone, rising to 3,900 km within the wider 0–3 m coastal elevation zone. The latter is a considerable increase of more than twice that identified from the national DEM for the same areas (~1,700 km). The largest underestimations from the national DEM were for Waikato, where the road length estimate moves from 195 km (using the national DEM) to 1,006 km, while in Otago there is an increase from 52 km (national DEM) to 323 km.

Nationally there are around 192 km of arterial roads within the 0–3 m coastal elevation zone, with the most extensive networks located in Waikato, Bay of Plenty and Northland. Expressway or motorway networks located within the four major urban areas all contain segments within both the

0–1.5 m and 0–3 m elevation zones. Auckland's State Highway network occupies the greatest extent in each of these cumulative elevation zones with 5 km and 18 km respectively.

In the lowest-lying 0–0.25 m elevation band, 720 km of road network (mostly local roads) was identified nationally. Approximately 77% (561 km) of these roads are located in the Waikato. This cumulative road length accounts for over half of all Waikato roads within the wider 0–3 m elevation zone, emphasising that most roads in this region hug the coast. Otago has around 40 km and Auckland nearly 30 km in this lowest elevation band. No other region exceeds 25 km of roads in the lowest 0–0.25 m elevation band. Nationally, the aggregated road length increases by almost three times between the 0–0.25 m and 1–1.5 m elevation bands from 720 km to 2,121 km (for those areas with available LiDAR coverage).

Nationally, railway-track length triples between 0–1.5 m and 0–3 m elevation zones from 46 km to 154 km. Otago has the most extensive railway track in both elevation zones with 13 km and nearly 33 km respectively. Railway networks associated with major ports in the Bay of Plenty (27 km) and Wellington (24 km) means these regions also contain relatively extensive track networks in the 0–3 m elevation zone. Auckland has less than 5 km of railway track located below the 3 m elevation (mostly >1.5 m elevation).

For the five regions where LiDAR surveys were not available, an additional railway length of 11.5 km lies in the 0–3 m elevation zone, which is 16% of the national total.

What were the counts for other types of infrastructure, such as airports and wharves and jetties?

A total of seven airports were identified in the 0–3 m elevation zone for areas with LiDAR datasets available. Nine airports were identified from the 0–3 m national DEM analysis. The difference arises from the unavailability of LiDAR data for West Coast and Southland, which means 3 airports (Westport, Greymouth and Invercargill) in these regions were not identified, however the LiDAR analysis for Otago has included Dunedin Airport at Momona on low-lying land connected to the sea via the Taieri River. Two international airports were identified at Auckland and Wellington (both of which have some parts of the airport runway towards the upper end of the 0–3 m coastal elevation zone) and regional airports at Tauranga, Gisborne, Napier/Hastings, Wellington, Nelson and Dunedin from the areas with LiDAR available.

A number of airfields and aerodromes (25) are also located in the 0–3 m elevation zone from the LiDAR analysis, which are predominantly in regions with relatively large areas of primary production land or coastal resorts such as Waikato.

Nationally, there are over 1,500 jetty and wharf structures, with a combined length of 100 km around the A-NZ coast adjacent to the low-lying areas that were delineated in the 0–3 m national modified DEM (not repeated for the LiDAR analysis). The highest number of coastal maritime structures are in Otago and Auckland (61% of the national total), with both regions together accounting for 57% of the total cumulative length, with Auckland having the highest cumulative length at nearly 30 km. Northland has the third highest counts for jetties and wharves.

What are the critical recommendations to improve a national coastal-risk assessment?

To enable a true national appraisal of coastal risk exposure to coastal hazards and sea-level rise, including consideration of high-magnitude low-frequency tsunami inundation events, all coastal-plain areas with elevations below 15 m throughout A-NZ should be covered by high-resolution LiDAR

surveys. This data should then be processed to produce bare-earth DEMs, which if processed to standard protocols and rectified to a common vertical datum, could be coalesced into a national high-resolution coastal DEM for New Zealand. Similar national DEMs for river flood plains upstream would be a useful adjunct, as they usually transition into a coastal plain or river mouth at the coast.

An adjunct recommendation is the development of an accurate and high-resolution present-day shoreline (or water-land boundary) for coastlines, estuaries, wetlands, rivers and lakes and converted to GIS polygons for the entire New Zealand coastline. The existing GIS resources, such as the NZ Coastlines, NZ Lake and the NZ River Polygons available on the Land Information NZ Data Service, have insufficient accuracy for clipping land elevation bands in LiDAR DEMs to remove water bodies or wetland areas. Such high-resolution land-water boundary polygons would also need to be regularly updated to track geomorphic and anthropogenic changes in coastal land-water boundaries, which will become more frequent as sea level rises.

Applicability of results for regional and local studies

The results presented in this report provide a first pass for what is exposed regionally and aggregated nationally for the coastal margin of A-NZ.

More detailed testing and assessment of appropriate coastal-hazard and climate-change scenarios on LiDAR DEMs should be (or have already been) undertaken at the regional or local scale by the relevant local-government agencies to derive a more accurate risk profile to inform their priority responses to managing coastal development under the NZ Coastal Policy Statement 2010 and the Resource Management Act 1991.

Disclaimer: The material in this Report is therefore not suitable to be applied directly for district or regional planning purposes (including hazard lines or setback zones) under these statutory processes.

1 Introduction

1.1 Backdrop

The mean level of the sea is rising globally due to climate change from a warming atmosphere.

Over the past century up to present, New Zealand's average rise in mean sea level has been similar to the global-average rate - therefore projections of global-average sea-level rise (SLR) are generally applicable to Aotearoa–New Zealand (A-NZ).

Credible projections of sea-level rise by 2100 range from 0.5 to 1 m (Church et al. 2013; IPCC, 2013). However, rises well above 1 m by 2100 are still possible (e.g., Jevrejeva et al. 2014; Horton et al. 2014; de Vries & van der Wal, 2015; Royal Society of NZ, 2010), particularly if the acceleration in losses from polar ice sheets continues (Pollard et al. 2015; Rignot et al. 2014; Joughin et al. 2014). Next century and beyond, sea level will continue rising, possibly for several centuries or more, with the rate of increase and the ultimate SLR determined by the time-trajectory of mitigation of greenhouse gas emissions (Church et al. 2013).

Sea-level rise (SLR) acting alone, would simply raise the upper tide mark, such as the Mean High Water Springs (MHWS), by the equivalent amount on the open coast, assuming no change in tidal characteristics. However, the main threat arises from coastal hazards (e.g., storm-tide, river floods, tsunami, waves, coastal erosion) riding on the back of this rising sea level, with the frequency of damaging events escalating in coming decades. In tandem with this rise in sea level, the frequency of coastal storm inundation has increased, as evident in Auckland such as along Tamaki Drive, with the occurrence of these events set to escalate as sea-level rise accelerates. This is a subject of a separate report to the Parliamentary Commissioner for the Environment (Stephens, 2015).

The Parliamentary Commissioner for the Environment (PCE) produced an initial report in November 2014 entitled *Changing climate and rising seas: Understanding the science* (PCE, 2014), which outlined the science behind rising sea levels and drew out some of the implications for Aotearoa–New Zealand, including the non-linear rise in frequency of occurrence of coastal inundation events.

This Report follows on from this initial science report to quantify the potential risk exposure for the coastal zone around A-NZ from the impacts of coastal hazards and rising sea levels, which will affect increasingly higher land elevations above present-day MHWS. For this report covering the national scale, aggregated up from the regions, elevation above MHWS is adapted as a first pass for what is exposed nationally, given there is insufficient or inconsistent coverage across A-NZ of high-resolution topography and reliable or known extreme coastal/river-storm water levels to overlay on the topography. The enumerated risk-exposure values presented in this Report are only elevation based with no modulation for existing coastal defences/stopbanks or consideration of sea-inundation volumes being able to fully spread inland over wider low-lying coastal plains during storm-tides (or small tsunami).

The Report determines the overall risk exposure to people, assets and land-use within an elevation zone up to 3 metres above mean high water (MHW) throughout A-NZ. Where higher-resolution and more accurate coastal topography from Light Detection And Ranging (LiDAR) surveys are available, the coastal-risk exposure is enumerated in smaller coastal elevation bands (e.g., 0.25 m increments initially to 0.5 m, then 0.5 m increments up to 3 m above MHWS). To summarise the main findings, enumerations of people and assets were aggregated over two main coastal elevation zones for 0–

1.5 m and 0–3 m above MHWS, but the distributions across the narrower elevation bands are also presented for buildings and population.

1.2 The purpose of the report

The PCE engaged NIWA to undertake a regional and national-level enumeration of demographics and available built-environment assets in A-NZ coastal plains below 3 m above mean high water that could be exposed to ongoing SLR and coastal/river storm hazards. The project included the following four components:

- Collate available LiDAR Digital Elevation Model (DEM) datasets where available, derive 0–3 m coastal elevation zone polygons from the best-available national DEM and finer elevation zones for areas with gridded LiDAR DEM coverage and enumerate demographics in each region.
- Additional GIS analysis to determine overlays for finer elevation zones based on present-day MHWS plus seven elevation increments (0.25, 0.5, 1, 1.5, 2.0, 2.5, 3.0 m) within areas with LiDAR coverage.
- Enumeration of available regional and national assets (e.g., dwellings, buildings, km of road/rail, broad land-use categories) in each elevation band. Initially, undertake a national-level check using aerial photographs to generally verify the number and location of built assets currently resident in the RiskScape[3] national asset databases.
- Production of a NIWA technical report to the PCE to describe the methodology behind the analyses and present the main findings on risk exposure in the coastal zone at regional and national scales.

1.3 General assumptions and scope

This Report is the first known attempt nationally to quantify both the demographics and assets within coastal plains in A-NZ, building on an earlier assessment of coastal demographics (2006 Census) and area of extent of coastal zones up to 3 m above MHW (Bell & Wadwha, 2014).

The study is undertaken on the basis that currently there is no nation-wide high-resolution topography or DEM of A-NZ, nor a complete national inventory of all types of assets of the built environment.

A 25-m grid national DEM, based on 10–20 m elevation contours and spot-heights from photogrammetry, was developed by Landcare Research in 2002 (referred to as the enhanced NZ DEM) and further developed by SKM in 2008 (modified enhanced national DEM) to support the KiwImage project for acquiring high-resolution satellite images across A-NZ (SKM, 2008). The more recent national DEM incorporates elevation data at 30-m (1 arc-sec) grid spacing from the NASA Shuttle Radar Topography Mission (SRTM)[4] in 2000 to splice with the 25-m enhanced DEM by Landcare (SKM, 2008). So while improvements have been made, the vertical accuracy of the modified enhanced national DEM is not specifically stated (as it varies depending on land slope and topographic features), but is likely to be within a few metres. Aspects and limitations of the modified enhanced national DEM are discussed further in Section 3.1.

[3] www.riskscape.org.nz
[4] http://www2.jpl.nasa.gov/srtm/index.html

In comparison, LiDAR topography surveys can achieve a sub-metre vertical elevation accuracy of down to ±0.15 m, which makes these topography products much more amenable to analysing the impacts of SLR and coastal hazards. Unfortunately, LiDAR coverage of the coastal zone around A-NZ is patchy and at different elevation accuracies (e.g., rural areas usually at 0.5 m accuracy), driven entirely by requirements of individual regional or local government agencies. Therefore, while locally some comparisons can be made between the risk-exposure results using the modified enhanced national DEM and LiDAR DEMs, the national-overview component of this study will still need to rely on the less-accurate national DEM.

Population within coastal areas is also similar constrained to the enumeration on the mid-week Census day (Tuesday 5 March, 2013) of the normally-resident population, and as such is not necessarily truly representative of the temporary occupation of dwellings in coastal areas, especially the well-known increases that occur during summer and on holidays or weekends. However, it provides an indication of the number of normally-resident residents exposed at different elevations. Hence the coastal risk exposure population figures are complemented by enumerating buildings or dwellings in the coastal environment besides calculating the risk exposure of the built environment.

RiskScape is a quantitative risk analysis platform developed by a joint venture between NIWA and GNS Science to assess direct and indirect impacts of natural-hazard perils. Fundamental to a quantitative assessment of risk is the requirement for a database of assets (buildings, houses, cars, critical facilities and infrastructure) and demographics exposed to any particular peril. Consequently, a concerted effort has been made by the RiskScape project to coalesce available asset databases or determine asset attributes from proxies (e.g., floor heights above the ground to assess inundation/flood exposure based on the age class of the building or contents based on floor area of building). While every effort has been made to include most of the buildings in A-NZ, only a limited set of infrastructure assets is available, such as roads, rail, ports, airports and a range of other critical facilities – but not other horizontal infrastructure such as those servicing the “3-waters” sector. RiskScape also contains an attribute attached to buildings that estimates the replacement cost (to replace like-with-like if written off), which is set to 2011 NZ$. This cost is not related to capital and land market values, which are not considered in this Report. This Project does not include the replacement costs for linear infrastructure assets (i.e., roads, railways), but could be calculated by the reader if a unit construction cost per kilometre is known.

1.4 Scenarios versus elevation bands

The exposure to coastal-inundation hazards in A-NZ varies markedly between open coastal situations around different regions and then between open coasts and more quiescent estuary, lowland river, fjord and harbour environments.

One approach would be to apply a generic suite of coastal-hazard and SLR scenarios across all coastal and estuarine areas of A-NZ. However, because of the spatial variability in exposure to coastal-inundation hazards between and within regions, this national-scale study instead explores the coastal-risk exposure over a common set of land-elevation bands relative to the local MHWS (where LiDAR datasets were available) or MHW (for the national modified DEM). See Chapter 2 for further details.

More detailed testing of appropriate coastal-hazard and climate-change scenarios on LiDAR DEMs should be (or have already been) undertaken at the regional or local scale by the relevant local-government agencies to derive more accurate risk information to inform their priority responses to

managing coastal development under the NZ Coastal Policy Statement 2010 (NZCPS) and the Resource Management Act 1991 (RMA).

Disclaimer: The material in this Report is therefore not suitable to be applied directly for district or regional planning purposes (including hazard lines or setback zones) under these statutory processes.

1.5 Report structure

Chapter 1 outlines the rationale and approach adopted for this Report. Chapter 2 provides a succinct snapshot of the main results as infographics. While specific coastal hazard scenarios for various sea-level rise (SLR) values were not used to assess the coastal risk exposure nationally, Chapter 3 provides an outline of the types and combinations of coastal hazards and their magnitudes, including a summary of SLR projections to raise awareness of how high these combinations could reach in the context of the land-elevation bands used.

Chapter 4 describes the topographic datasets that were available to the project team and processing required, with details and metadata contained in Appendices. Chapter 5 outlines the process of extracting data on receptors (people, assets and infrastructure) from the RiskScape databases and how it was processed for each elevation band.

Chapters 6 (national DEM) and Chapter 7 (LiDAR DEMs) provide the detailed findings of the coastal risk-exposure analysis for each region and nationally, mainly by way of graphs and maps.

Chapter 8 provides a summary and recommendations for further work and spatial-data infrastructure.

A Glossary of terms and acronyms used in the Report can be found at the back just before the References.

Appendices A and B outline the local MHWS values and mean sea level offsets respectively used in the GIS analyses to set the zero baseline for the elevation bands. Detailed results for regional, and in some cases urban areas, are listed in the remaining Appendices.

2 Counting the risk exposure: snapshot of the main results

2.1 Coastal risk exposure

Sea level has already risen 0.16–0.2 m over the past 100 years in A-NZ and will continues to rise and accelerate due to climate change. Climate change is already exacerbating coastal inundation from storm-tides and wave overtopping, as storms and waves ride on the back of a higher sea level. Similarly, coastal areas will also face an increase in tsunami exposure, with the waves raised by the higher sea level.

Climate change will also cause an increase in the frequency and extent of coastal erosion.

For this national overview of risk exposure to coastal areas, this Report only explores the potential exposure of people and assets in various elevation bands above mean high water spring (MHWS), rather than analyse a number of scenarios of coastal hazards combined with SLR. The two main reasons for this simplified approach, where coastal elevation is a proxy of the present and future risk exposure, are:

- high-resolution topography datasets (e.g., from airborne LiDAR laser surveys) are of variable quality and only cover a proportion of all coastal areas that are populated or contain infrastructure such as roads and railways
- coastal-hazard exposure varies significantly around A-NZ, particularly when comparing sheltered water bodies like tidal creeks and lowland rivers with open coastlines exposed to ocean swell. Scenario-specific analysis is really only feasible at the regional or local scale – whereas the focus here is on a national overview on how large is the exposure?

2.2 Results using the national topographic coverage

For the national overview, including all low-lying coastal plains, the national digital elevation model (DEM) developed by Landcare Research and enhanced by SKM (now Jacobs) was used to extract areas with a land elevation between 0 and 3 m above MHW. Unlike the more accurate LiDAR survey datasets, this DEM covers all of A-NZ, and although is less accurate in vertical land elevation, it provides a consistent base to compare relativity between regions. In most cases the national DEM underestimates the land area below a given land contour height, so the regional and aggregated national results are likely to yield a significantly underestimate in coastal risk exposure.

A summary of the main results for regions with the higher counts is shown in Figure 2-1. The results for each region are discussed in more detail in Section 6 and results listed in Appendices C–E.

The key findings from the national overview of coastal risk exposure show that the regions of Canterbury[5] and Hawke's Bay have the highest counts of population, residential buildings and kilometres of road in the 0–3 m elevation zone, with Auckland, Bay of Plenty and Wellington also with considerable number of people resident in this zone (Figure 2-1). Waikato has the 3rd highest length of roads occupying the elevation band. While the Waikato region (east and west coasts) has less people resident in this coastal zone (based on Census night values), the number of residential

[5] Canterbury totals exclude the Red Zone buildings

buildings is the 5th highest count (likely due to coastal properties in areas like the Coromandel that are mostly unoccupied outside holiday periods).

Nationally, there are nearly 90,000 buildings in the 0–3 m elevation band (of which nearly 61,000 are residential buildings), with a combined replacement cost of $24B (2011), derived using the method described by Cousins (2009) and assigned to the building attributes in the RiskScape inventory.

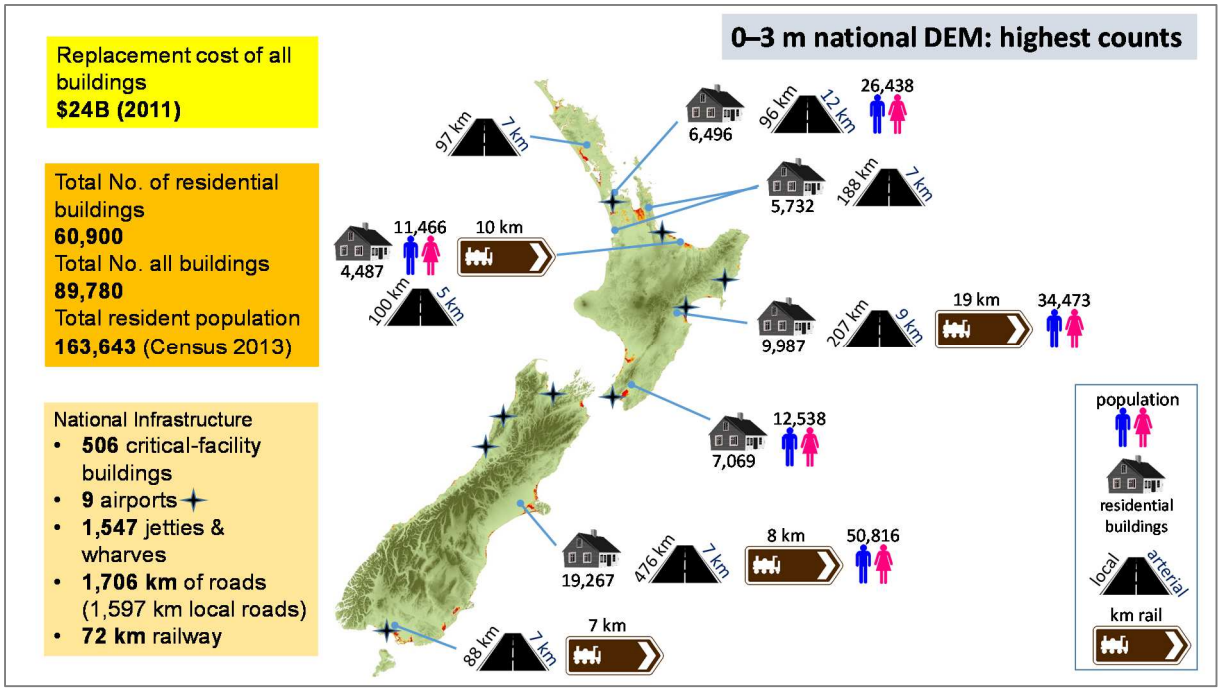


Figure 2-1: Regions with highest counts and national summary for risk exposure in the 0–3 m elevation zone (national DEM). *Notes*: Population (all ages) from 2013 Census (normally-resident); regional building counts only include residential buildings (from RiskScape) and excl. the Red Zone in Christchurch; roads subdivided into "local" (includes local and feeder roads) and "arterial" (includes arterial and motorways), stars show airports that partially or wholly occupy the elevation zone. Replacement costs from RiskScape based on 2011 NZ$. Critical-facility buildings include those for engineering lifelines and utilities, emergency services, government and education.

A summary of the national infrastructure within the 0–3 m coastal elevation zone (Figure 2-1) shows 9 airports are located (or partially) in this zone comprising international airports at Auckland and Wellington (both of which are at the upper end of the elevation band for parts of the runway) and regional airports at Tauranga, Gisborne, Napier/Hastings, Wellington, Nelson, Westport, Greymouth and Invercargill.

Over 500 critical-facility buildings, covering police and fire stations, hospitals, schools and other engineering lifeline facilities, are in this zone nationally. Figure 2-1 also shows counts of the length of roads and rail in kilometres, with roads dominated by nearly 1,600 km of local or feeder roads. Over 1,500 jetties, wharf and other maritime structures occupy the coastline.

Note that in most cases the national DEM underestimates the land area (compared to LiDAR DEMs) below a given land elevation, so the regional and aggregated national results result in a substantial underestimation in coastal risk exposure.

2.3 Results using high-resolution LiDAR topography where available

A more accurate analysis of coastal risk exposure was undertaken for coastal areas where LiDAR digital topographic datasets were available. Because of the higher resolution and accuracy, smaller elevation bands were extracted for 0, 0.25, 0.5, 1, 1.5, 2, 2.5, 3 m above MHWS to explore the risk exposure in terms of elevation above the present-day shoreline.

LiDAR topographic datasets were obtained, where available, from councils who have flown aerial surveys or via Land Information NZ, who have embarked on a national elevation dataset collation project (ElevatioNZ). Regions where no LiDAR datasets was available to the Project were: Taranaki, Manawatu-Wanganui, West Coast, Marlborough and Southland.[6]

A summary of the main results for regions with the higher counts is shown in Figure 2-2. The results for each region are discussed in more detail in Section 7 and results listed in Appendices F–H (0–1.5 m LiDAR) and Appendices I–K (0–3 m LiDAR).

The key findings from the national overview of coastal risk exposure show that the regions of Canterbury[7] and Hawke's Bay have the highest counts of population and residential buildings in both the 0–1.5 m and 0–3 m elevation bands, with Auckland, Wellington and Bay of Plenty also with considerable number of buildings and people resident in this zone, followed by Otago (Figure 2-2). While the Waikato region (east and west coasts) ranks only 7th for number of people resident in this coastal zone (based on Census night 2013 values), the number of residential buildings is the 4th highest count for the 0–1.5 m elevation zone (likely due to coastal properties in areas like the Coromandel Peninsula that are mostly unoccupied outside holiday periods). However, for the wider 0–3 m elevation zone, Auckland and Bay of Plenty have more residential buildings than Waikato, with a greater proportion or buildings in the higher 1.5–3 m zone.

Nationally, Waikato has by far the highest length of roads occupying these two elevation zones (769 km of local roads and 37 km of arterial roads for 0–1.5 m elevation zone rising to 941 km and 66 km respectively across the wider 0–3 m elevation zone). Canterbury, Bay of Plenty, Otago, Hawke's Bay and Auckland have the next highest totals of road length in the two cumulative elevation zones (Figure 2-2).

Nationally, there are over 68,000 buildings in the 0–1.5 m elevation band for areas with LiDAR available (of which nearly 44,000 are residential buildings), with a combined replacement cost of $19B (2011). Considering the wider 0–3 m elevation zone, there are a total of 166,750 buildings (109,000 residential) with a combined replacement cost of $52B (2011). Despite not having full LiDAR coverage of coastal plains in all regions (including some urban areas e.g., Invercargill, Wanganui, Blenheim and others), this estimate of total replacement cost is more than double the estimate using the 0–3m national DEM (Figure 2-1), because the area below 3 m above MHW is substantially under-represented in the national DEM.

Cumulative replacement costs for commercial buildings is highest for the Wellington region which include Lower Hutt ($1.6B for 0–1.5 m elevation band and $3.5B for 0–3 m). For the wider 0–3 m elevation bands, Auckland has the second highest count for replacement costs for commercial buildings ($2.4B) followed by Otago ($0.7B).

[6] Waituna catchment was the only available LiDAR for Southland from the Southland Regional Council, but was not used as it only covers a small subset of the assets and infrastructure of Southland.
[7] Excludes the buildings in the Christchurch Red Zone

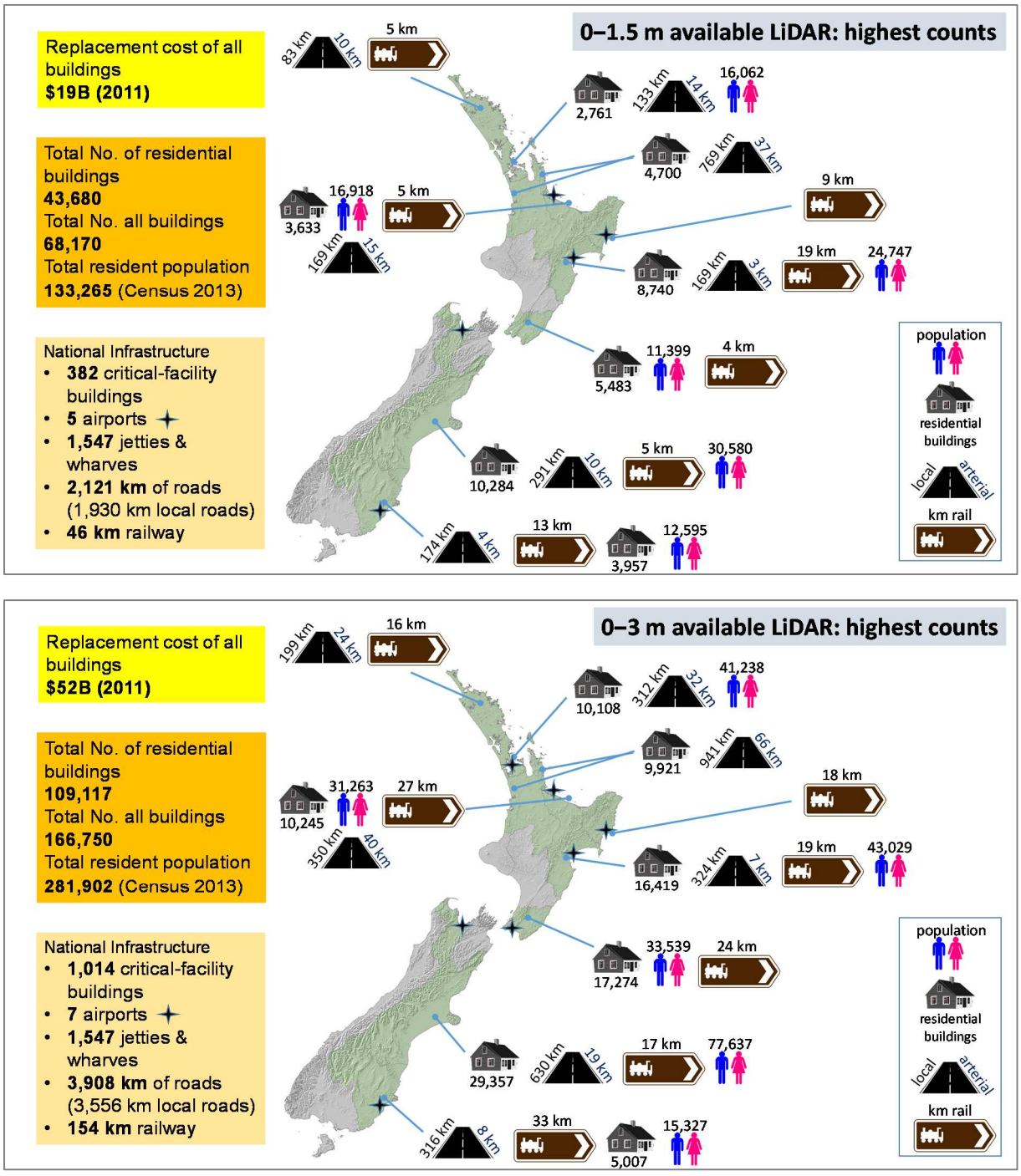


Figure 2-2: Regions with the highest counts for assets or population and the national summary for coastal risk exposure in areas with LiDAR available: (top) 0–1.5 m elevation zone; (bottom) 0–3 m elevation zone (excl. grey-shaded areas). *Notes*: Population (all ages) from 2013 Census (normally-resident); regional building counts only include residential buildings (from RiskScape) and excl. the residential Red Zone in Christchurch; roads subdivided into "local" (includes local and feeder roads) and "arterial" (includes arterial and motorways), stars show airports that partially or wholly occupy the elevation zone. Replacement costs from RiskScape based on 2011 NZ$. Critical-facility buildings include those for engineering lifelines and utilities, emergency services, government and education.

Over 1,000 critical-facility buildings, covering police and fire stations, hospitals, schools and other engineering lifeline facilities, are in the 0–3 m zone nationally where LiDAR is available (380 in the lower 0–1.5 m elevation band). Figure 2-2 also shows counts of the length of roads and rail in kilometres, with nearly 4,000 km of roads in the 0–3 m elevation band where LiDAR was available, dominated (91%) by local roads.

The number of airports within the 0–3 m elevation zone is slightly different, given LiDAR DEMs were not available for some regions, however the national total rise to 10 airports report for the national DEM, with Dunedin Airport showing up in the Otago LiDAR analysis. Over 1,500 jetties, wharf and other maritime structures occupy the coastline, and while they have an obvious functional need to be at the coast, many of these structures will need to be progressively raised as sea levels continue to rise.

Otago and Waikato coastal areas have the highest proportion of their building stock in the lowest elevation band (0–0.25 m) compared with the other regions which generally show a rapid increase in building exposure from about the 0.75–1 m elevation band and above.

3 Coastal hazards and climate-change: scenarios or elevation bands?

3.1 Introduction

Inundation of lower-lying coastal areas usually occurs from a complex combination of coastal and weather processes modulated by climate variability from annual to inter-decadal climate cycles up to longer-term trends from climate change, particularly sea-level rise (SLR). Assessment of the coastal inundation risk is usually undertaken for the present-day situation and extended out to one or more planning timeframes, particularly for "at least 100 years" as required under the 2010 New Zealand Coastal Policy Statement (NZCPS).[8]

Tsunamis are also an infrequent coastal-inundation hazard, but potentially with large wave heights of over 10 m in places around A-NZ (Power et al. 2013). Tsunami hazard exposure is also required to be considered by the NZCPS[9] in identifying risks to coastal areas.

The exposure to coastal-inundation hazards also varies markedly between open coastal situations around different regions (e.g., Southland, Otago, west coasts and the south Wellington coast have a high wave exposure compared with the Hauraki Gulf/Firth of Thames) and then between open coasts and more quiescent estuary, lowland river, fjord and harbour environments.

One approach would be to apply a generic storm-surge scenario across all coastal and estuarine areas of A-NZ, with various increments of SLR say from 0.25 m (by 2040) up to 2 m (100+ years). However, because of the spatial variability in exposure to coastal-inundation hazards between and within regions, this study instead explores the coastal-risk exposure over a common set of land-elevation bands relative to the local MHWS (where LiDAR DEMs were available) or MHW (for the national modified DEM).

This Chapter describes the various coastal and climate processes that potentially contribute to coastal inundation (present and future) and provides some examples of various combinations of these processes that could apply to the different land-elevation bands.

This information on coastal hazards is provided to illustrate the complexities and magnitude of water levels that contribute to the coastal-risk exposure locally. However, for this national overview, risk exposure is derived only from elevation bands above MHWS, as a first pass for the level of risk exposure nationally, where lower elevation bands up to 1–1.5 m above MHWS have a higher exposure (present and in the future) than higher elevation bands (which will be increasingly exposed as sea level rises). A number of overseas studies have adopted a definition of the low-elevation coastal zone (LECZ) as the contiguous and hydrologically connected zone of land along the coast and below 10 m of elevation for coastal risk exposure studies (e.g., Neumann et al. 2015; Lichter et al. 2011). The sections below on hazards associated with the coast and estuaries of A-NZ, and projected sea-level rise out to at least 100 years, indicate that the 0–3 m elevation band around the coastal and estuarine margins would be subject to potential hazard risk either present day at lower elevations or towards 3 m elevations (excluding moderate to large tsunamis).

More detailed hazard-exposure and risk analyses and mapping covering the coastal-hazard processes below will be required to be undertaken by councils at the regional and local scales to inform

[8] e.g., Policies 24, 25, 27 of the NZCPS
[9] Policies 24 and 25(f), NZCPS

local/regional land-use planning and climate-change adaptation plans to give effect to Policy 24, NZCPS.

3.2 Coastal-inundation hazard processes

3.2.1 Sea level (excluding waves)

There are a number of meteorological and astronomical phenomena involved in the development of extreme sea-level events. These processes can combine to inundate low-lying coastal margins. The processes involved are:

- Astronomical tides.
- Storm surge– a temporary elevation in sea level, as the ocean surfaces "relaxes" due to low barometric pressure in a storm system, combined with water-level setup from winds.
- Monthly mean sea level anomaly (MSLA), which is the variation of the non-tidal sea level about the longer-term mean sea level on time scales ranging from a monthly or seasonal basis to decades, due to climate variability. This includes ENSO and IPO patterns on sea level, winds and sea temperatures, and warming/cooling seasonal effects.
- Climate-change effects including SLR and changes in wave heights and storm surges due to changes in storms (winds and atmospheric pressure). SLR is projected to be in the range 0. 5–1 m by 2100 (Church et al. 2013) but rises above 1 m by 2100 are possible if polar ice-sheet melt continues to accelerate.
- Tsunami – generated by geological or atmospheric disturbance e.g., under-sea fault rupture, submarine landslides or volcanoes. Documented historic events in A-NZ have generated maximum wave run-up heights of 10–12 m from local tsunami sources (King, 2015; Table 2).

Tides

The astronomical tides are caused by the gravitational attraction of solar-system bodies, primarily the Sun and the Earth's moon. These tidal forces on the Earth's deep oceans generate waves which then propagate as forced long waves interacting in a complex way with continental shelves through to shallow estuaries.

In A-NZ, the tide we typically observe is dominated by the twice-daily (semi-diurnal) lunar tide (de Lange et al. 2003), with an average tidal cycle of 12 hours 25 minutes. The largest tides occur when the gravitational pull of the Sun and Moon are aligned (New or Full Moon) coincides with the Moon being closest to the Earth in its elliptical orbit, known as the *perigee*. These larger tides peak about every 7 months and are called perigean-spring tides or more colloquially "king tides".[10]

Astronomical tides have by far the largest influence on present-day sea level around A-NZ, followed by storm surge (in most locations). Some of the largest tidal ranges are in Golden Bay (up to 4.5 m), Nelson (3.8 m) and the upper reaches of the Manukau and Kaipara Harbour (3.7 m), while the south

[10] NIWA red-alert tide days web page: http://www.niwa.co.nz/our-science/coasts/tools-and-resources/tide-resources

Wellington coast has the smallest tide range (<1.3 m). Consequently, in most areas of A-NZ, tides form a large component of extreme sea levels in a region.

The variability in tide range around A-NZ also requires a consistent approach to setting MHWS levels, which then become the spatially-variable baseline for extracting elevation bands from LiDAR DEMs or the modified national DEM. This aspect is described in Section 4.4.

Storm surges and storm-tide

Low-pressure weather systems and/or adverse winds cause a rise in water level known as storm surge.

Storm surge results from two processes:

- low-atmospheric pressure relaxes the pressure on the ocean surface causing a temporary rise in sea-level, and
- wind stress on the ocean surface from a persistent wind field pushes water down-wind for an onshore wind, or alternatively, to the left of an alongshore wind along the coast (in the southern hemisphere), piling water up against any adjacent coast e.g., for the Otago/Canterbury coastline, wind set-up would occur for alongshore winds offshore from the south or south-west, where the coast is on the left.

The highest recorded storm-surge height was in Tauranga Harbour during extra-tropical cyclone *Gisele* ("Wahine storm") in April 1968, reaching 0.88 m (de Lange & Gibb, 2000). The analysis of Bell et al. (2000), based on the 1968 event estimated that the probable maximum storm surge in A-NZ is approximately 1 m. Storm surges could be somewhat higher than 1 m for strong persistent winds in estuaries with reasonable wind fetches, where internal wind-set-up can compound forcing at the entrance by elevated coastal storm-tide levels.

Storm-tide is defined as the sea-level peak reached during a storm event, from a combination of *MSLA* + *high tide* + *storm surge* (see below for description of MSLA) as shown in Figure 3-1. It is the storm-tide that is primarily measured by sea-level or tide gauges. Storm-tide is the sea-level quantity relevant to coastal-storm inundation before wave setup and runup are applied.

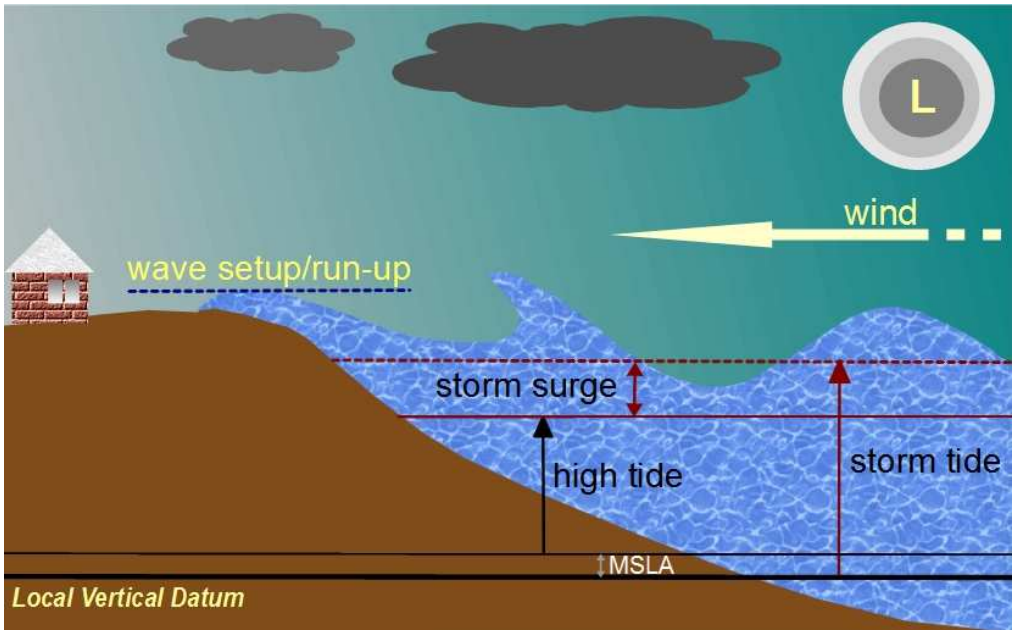


Figure 3-1: Components leading to storm-driven inundation at the coast. MSLA = MSL anomaly

Storm-tide levels around A-NZ vary considerably, as the height of the high tide (a function of the tide range) usually is the main contributor to extreme storm-tide levels (Bell, 2010)). Besides the storm surge contribution, the storm-tide level can exceed the local MHWS by a few decimetres if the storm coincides with a high perigean-spring tide and the MSLA, as shown below, can be up to 0.2–0.25 m above the normal MSL.

Climate change effects on storm surge in A-NZ is likely to be small in comparison to SLR, with increases of 1–5% in storm-surge heights predicted based on two climate-change scenarios from the IPCC 4th Assessment Report (A1B and B2) [unpublished data; NIWA Waves & Storm Surge Projections project].

MSL anomaly

The mean sea level anomaly (MSLA) describes the variation of the non-tidal sea level on longer time scales ranging from a monthly basis (e.g., stormy or calm months), through an annual sea-level cycle, up to decades due to climate variability, including the effects of El Niño–Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO) patterns on sea level, winds and sea temperatures, and seasonal effects.

In general, the seasonal (annual) fluctuation in MSLA is ±0.04–0.08 m, at interannual 3-4 year ENSO timescale, the variability is up to ±0.12 m on both east and west coasts, and for the longer inter-decadal 20–30 year IPO cycle, the variability is ±0.05 m (MfE, 2008; Appendix 9). The total variability range for MSLA in A-NZ is around ±0.25 m, with the highest MSLA likely to be achieved during late summer/early autumn during an intense La Niña episode coinciding with the IPO in its negative phase (as it has been since ~1999).

Sea-level rise – a changing state

Climate change will also cause acceleration in long-term trends of sea-level rise (MfE, 2008; IPCC, 2013, Church et al. 2013). This changing or time-variant state along the world's shorelines means that not only should the present-day coastal-hazard risk be appraised for the above coastal

processes, but also for future planning and design timeframes – more so for higher risks and enduring coastal development. While more definitive SLR projections from IPCC are available out to 2100 ranging from 0.3 to 1.0 m, sea level is projected to continue rising for several centuries, with the extent of future controls on greenhouse gases determining the rate of rise and ultimately the long-term SLR that will be reached (Church et al. 2013).

The national guidance manual for coastal hazards and climate change (MfE, 2008) recommends a risk-based approach considering the consequences of a range of higher sea levels, starting the analysis with 0.5 m and at least consider 0.8 m by the 2090s. The equivalent "gate-values" extended out to 100 years to align with Policy 24 of the NZCPS, are 0.7 m and 1.0 m by 2115.

Based on current understanding, only the collapse of marine-based sectors of the Antarctic ice sheet, if initiated, could cause global mean sea level to rise substantially above the likely range of projections during this century (Church et al. 2013). However, there is *medium confidence* by IPCC that this additional contribution from ice sheets would not exceed several decimetres (tenths of a metre) of SLR during this century (Church et al. 2013; IPCC, 2013), which could lead to SLR pushing considerably above 1 m by 2100.

In considering SLR projections beyond 2100, the uncertainties are largely one-sided, with the upper end of plausible values that could be reached within a given timeframe highly uncertain. Some recent papers (see Section 1.1) have indicated the upper range projections produced by IPCC (2013) may be too low, due to one-sided upper uncertainty in estimating the SLR rate that could arise from accelerated collapse of the polar ice sheets, which store vast quantities of ice (many 10's metres of SLR equivalent). If a 1.5 m SLR was reached by 2100, then because of the high rate of change towards that juncture, a 2 m SLR would be reached soon after around 2120. Extrapolating the SLR trajectory passing through 0.8 m by the 2090s and 1 m by 2115 derived from MfE (2008), would reach 2 m by around 2200. So the plausible time frame for a 2 m SLR to be reached, based on the "business-as-usual" RCP8.5 pathway or higher, taking into account the IPCC (2013) ice-sheet caveat and recent ice-sheet observations and modelling, would be at the earliest around 2120 (just over 100 years from now) through to approximately 2200.

The consequence of sea-level rise is that both storm-inundation levels and tsunami wave heights (next sub-section) will be lifted higher as mean sea level rises. In particular, storm-tide and wave inundation will become much more frequent as sea level rises e.g., present-day 1% Annual Exceedance Probability (AEP) storm-tide events (100-year recurrence interval) will become an annual occurrence on average with only a 0.4 m SLR (based on an analysis for Auckland and Nelson).

Tsunami

Unlike present-day storm-generated inundation, tsunami waves have the potential to inundate large areas of low-lying coastal plains in New Zealand, due to both the wave height (could be up to or above 10 m for large magnitude earthquakes) and the long period of the waves (5–20 minute period for tsunami surges over land). Figure 3-2 shows the predicted tsunami wave heights for the New Zealand coastline at 100-year and 500-year average recurrence intervals that were determined in a recent revision of the tsunami hazard exposure for New Zealand (Power et al. 2013). Such wave heights could be elevated further above MHW if the peak tsunami waves coincided with high tide. Large tsunami events are therefore likely to inundate a substantial proportion of the 0–3 m coastal elevation zone to which most of the tsunami energy is directed and beyond into higher elevation zones depending on the hinterland topographic profile.

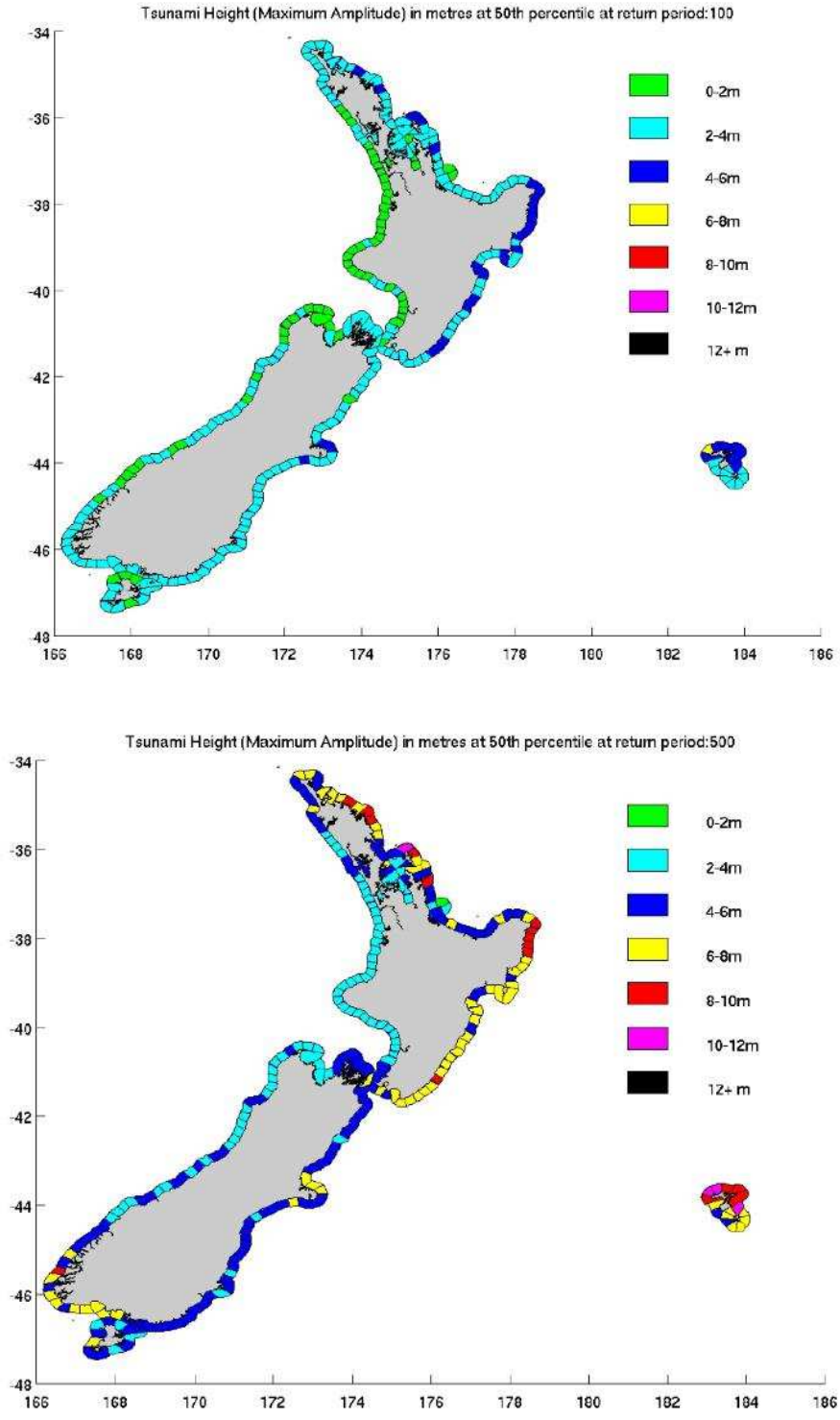


Figure 3-2: Tsunami wave heights (m) around NZ for average recurrence intervals of: (top) 100 years, (bottom) 500 years. Note: these are the median estimates [*Source*: Power et al. (2013)].

3.2.2 Wave setup and runup

Waves also temporarily raise the effective sea level at the coastline (Figure 3-3).

Wave setup describes an average raised temporary elevation of sea level shoreward of the wave-breaking zone in the surf zone. Wave runup is the maximum vertical extent of wave "up-rush" on a

beach or structure above the instantaneous still-water or storm-tide level (that would occur without waves present). Therefore runup constitutes a short-term fluctuation in water level relative to wave setup, tidal and storm-surge time scales, although can still contribute significant inundation volumes as occurred in Tamaki Drive in Auckland on 17 April 2014 during ex-tropical cycle *Ita* (Figure 3-4).

Wave runup usually includes the wave setup component in algorithms and models for calculating wave overtopping. When offshore waves are large, wave setup and runup can raise the water level on open-coast beaches substantially by 1 or 2 metres, especially on beaches with steeper slopes or steep-faced artificial structures such as rock revetments or seawalls. Conversely in sheltered estuaries with short wind fetches, wave runup is usually minor compared to the other processes.

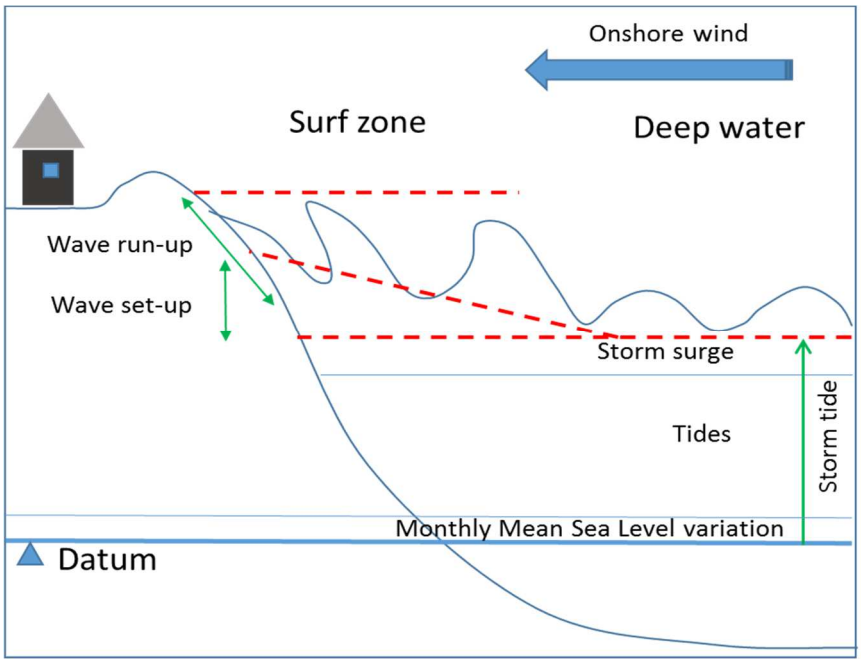


Figure 3-3: Schematic illustrating the various processes that contribute to coastal inundation including wave setup in the surf zone and wave runup.

Figure 3-4: Coastal inundation by wave overtopping along Tamaki Drive, Auckland during ex-TC *Ita* (~0900 hrs 17 April 2014). (Left) Credit: Leila Robinson (Right) Credit: Nicola Giles.

Which of wave setup or wave runup is most important to widespread inundation of the coastal margin?

Wave runup elevations are usually considerably higher than wave setup elevations. The two processes are important for different reasons:

- Wave setup is an integral component of the total water level that potentially could cause direct or near-continuous inundation of "green water" onto coastal margins or roads (Figure 3-4. The combined storm-tide plus wave setup level is therefore important for large-scale coastal inundation.
- Wave runup and overtopping involves "wave splash", "wind spray" and sporadic shallow overwash of "green water" (depending how high up the wave setup level is). This may not necessarily cause substantial flood impacts compared to more direct inundation from wave setup, but this also depends on the capacity of the drainage system behind the overtopped barrier, and the safety requirements of vehicles and pedestrians if close to a road. The combined storm-tide plus wave runup level is important to any overtopping of dunes and seawalls, beach erosion and wave impact on seawalls (left panel; Figure 3-4).
- For seawalls, formulae exist (e.g., EurOtop, 2008) to calculate the number of waves overtopping in one hour, the probability of overtopping per wave, and the mean overtopping discharge per metre of coastline that enables estimates of damage to buildings and seawalls, but tends to be very location-specific.

Wave setup and wave runup are highly sensitive to the beach profile shape and the beach-slope parameter (Stephens et al. 2011). Thus there is considerable uncertainty around the use of empirical wave setup/runup calculations, because beach profiles are in a constant state of evolution, and it is often difficult to pick a representative beach slope from a profile. Wave runup is similarly highly sensitive to the beach profile shape. These complexities at the local scale generally work against developing a generic scenario to consistently apply across A-NZ in combination with a storm-tide level.

3.3 Scenarios versus elevation bands

As described in the section above, there is a complex array of possible combinations of coastal–inundation hazards and across various timeframes with SLR and the secondary effects of climate-change on storm surges and wave heights.

Developing worst-case or near-maximum scenarios for coastal inundation, as traditionally done, by using an additive "building-block" approach combining the near-maximum contributions for tide, storm surge, waves etc., is not very definitive. The average recurrence interval for such a combined near-maximum event is usually unknown and has been demonstrated to be a very rare occurrence (very low AEP by 2 orders of magnitude) in a study for Auckland region by Stephens et al. (2011). This was compared with a more rigorous joint-probability approach that takes into account dependence or otherwise between the various coastal inundation processes. The joint-probability approach (Goring et al. 2010) was developed for New Zealand situations, producing robust results with fairly short sea-level records and quantifies the joint-AEP or recurrence interval for the combined water-level (e.g., storm tide level from tide and storm surge, or the joint occurrence of offshore wave heights and storm-tide for wave runup).

However, the key point in relation to this national overview study, is that the joint-probability method requires local or regional data to work with, as the combinations of coastal processes are unique to each coastal area. As described in the previous section, the magnitude of these coastal processes also varies substantially around A-NZ, particularly tides and waves, with wave runup strongly influenced by beach slopes and shoreline type. Therefore, it is not possible at this stage to define a consistent suite of storm-tide or wave runup levels around A-NZ on say a common 1% joint AEP basis – this would be a major undertaking.

On the other hand, historic relative SLR and inter-decal sea-level variability around A-NZ is reasonably similar in magnitude as shown by Hannah & Bell (2012). One caveat is that regionally or locally there are areas, such as the lower North Island that is currently exhibiting downward land movements of 1–3 mm/yr (Beavan & Litchfield, 2012). If such subsidence or downward movement continues, without a major tectonic event, then it will exacerbate the absolute (eustatic) SLR. Again such complexities have not been considered for this national overview, but should be considered where necessary in regional or local studies or coastal-hazard risk assessments.

There are two approaches that could be taken to determine the national coastal risk exposure for A-NZ, either:

- selecting and applying specific coastal hazard and/or climate-change scenarios uniformly across the coastal assets, land and demographics e.g., the national study undertaken for Australia (Steffen et al. 2014) used specific coastal erosion and inundation scenarios for a 1.1 m SLR, or a study for Florida Keys in USA used SLR scenarios at 0.3 m increments from 0.3–1.8 m without storm-tide or wave effects (Zhang et al. 2011), or

- a generic approach that enumerates the assets (and their value where known) and population present in various elevation bands above an upper-tide baseline, with lower elevation bands being more highly exposed (presently and the near future) than higher elevation bands (which could be impacted up to and beyond a 100 years by coastal hazards).

  This latter approach was undertaken by Lichter et al. (2011) and Neumann et al. (2015) for a global risk exposure of each country's population within the low-elevation coastal zone (LECZ), for land below 10 m of elevation. The latter study also assessed population exposure in a nominal 1-in-100 year coastal inundation zone based on four different sea-level rise and socio-economic scenarios. A similar approach to enumerate infrastructure assets, using distance from the shoreline (in lieu of LiDAR data) and replacement costs as proxies for risk exposure, was undertaken by Kumar & Taylor (2015) for the Pacific Islands.

In A-NZ, a generic storm-surge scenario could have been applied across all coastal and estuarine areas comprising a near-maximum 1 metre storm surge on open coasts (from Bell et al. 2000) without any wave contributions, on the back of various increments of SLR from say 0.25 m up to 2 m. However, there is substantial spatial variability in exposure to coastal-inundation hazards (singularly and jointly with contributing processes) between and within regions, and estuaries can be exposed to higher water-level setups than the open coast, but with a much lower wave climate. This regional and local variability, which could be of the order of >1 m across different coastal and estuarine environments in A-NZ, would need to be explicitly taken into account to produce a robust and

consistent national assessment when using a scenario-based approach, along with a selection of a range of credible SLR values. Detailed information of the frequency and magnitude of coastal inundation (e.g., say a 1% joint AEP for storm-tide and wave runup) is known for some parts of A-NZ (e.g., Tasman, Nelson, Auckland, Bay of Plenty, Wellington), but inundation exposure in estuaries and harbour, even in these regions, is quite limited, except for the Manukau and Waitemata Harbours (Stephens et al. 2013). A further constraint on using a scenario-based approach is that high-resolution topographic datasets (e.g., LiDAR) are not available for parts of the coastal environment), so instead the national enhanced DEM of lower accuracy and extent, has to be relied on at this stage for a national-level assessment. These factors currently preclude any approach that is too prescriptive with scenarios of inundation levels across A-NZ, which ideally would be required to the nearest decimetre or centimetre to be defensible for planning purposes.

Therefore, this national-level assessment instead explores the coastal-risk exposure over a common set of land-elevation bands relative to the local MHWS (where accurate LiDAR DEMs were available) or for a single elevation zone of 0–3 m above MHW (for the modified enhanced national DEM). At least, for the regional LiDAR analyses, a local MHWS level, derived from a consistent methodology, was used for the baseline for the elevation bands, which incorporates the spatial variability of the tide-range – given that storm-tide levels in A-NZ are dominated by the tidal component compared to the storm surge.

Each elevation band extracted from the LiDAR DEMs provides generic information on the assets and population exposed in those bands, and can be interpreted at the national or regional level by the reader as being exposed presently, or over time, to different combinations of coastal-hazard processes and SLR. For example:

- 0–0.25 m band – MHWS + 0.25 m SLR (e.g., by 2040–50), which is equivalent to a permanent change in MHWS levels reached on a fortnightly to monthly basis
- 0.25–0.5 m band – MHWS + 0.5 m storm surge, or MHWS + 0.5 m SLR
- 0.5–1 m band – MHWS + 1 m storm surge/wave runup, or MHWS + 1 m SLR
- 1–1.5 m band – MHWS + 1 m storm surge/wave runup + 0.5 m SLR
- 2.5–3 m band – MHWS + 1 m storm surge + 2 m SLR, or MHWS + 1 m storm surge + 1 m wave runup + 1 m SLR, or a small to moderate tsunami wave height which may or may not include SLR.

These examples show that the choice of a 0–3 m coastal elevation zone above MHWS is relevant to potential coastal hazards and climate-change impacts for present day exposure (the lower elevation bands) or in at least 100 years (the higher elevation bands).

The assets and people enumerated in each of the elevation bands up to 3 m above MHWS then form a set of varying risk exposures, with lower elevation bands at higher-more immediate exposure while the risk exposure for higher elevation bands will be increasingly realised for longer timeframes (100+ years), or for infrequent tsunami events. So essentially, the coastal elevation bands are proxy measures of the potential risk (or consequences) that will be realised in the short-term or the foreseeable future with respect to coastal hazards and plausible SLR projections.

In some areas, the actual exposure to coastal-hazard risk may be minimal, but the degree of exposure needs to be determined through more definitive risk-assessments at the local community

or regional scale to give effect to Policy 24 of the NZCPS. These assessments will need to engage with communities and stakeholders to determine appropriate tipping-points and timeframes for SLR and intolerable frequency of coastal inundation events, when alternative adaptation options will need to be implemented (Britton et al. 2011).

4 Topography dataset processing

4.1 Background to land elevation DEMs available nationally

The study is undertaken on the basis that currently there is no nation-wide high-resolution topography or digital elevation model (DEM) of A-NZ at sub-metre vertical accuracy. While there are substantial areas of high-resolution elevation coverage across coastal areas (mainly LiDAR), there is by no means full national coverage for say areas below 10 m, which is the land contour spacing in the national topography datasets. Therefore, to undertake a national appraisal of coastal risk exposure that includes all coastal plains, for now must be based on the best–available, but lower-accuracy national DEM, but can be compared with the considerable areas already flown by LiDAR surveys contracted by local government agencies.

Previously, for many years, the national DEM in A-NZ was based on land-elevation contours at 10 or 20 m intervals digitised from the 1:50,000 series Land Information NZ (LINZ) topography maps. However, such large increments between contours is insufficient to resolve sea-level rise and coastal-hazard risk impacts on low-lying coastal zones, especially assessing risk exposure below 3 m above MHW.

A more accurate 25-m resolution national DEM was developed by Landcare Research in 2002 (Barringer et al. 2002), referred to here as the enhanced NZ DEM. This 25-m DEM was further modified by SKM[11] in 2008 using NASA global terrain data, referred to as the modified enhanced national DEM, to support the KiwImage project for acquiring high-resolution satellite images across A-NZ (SKM, 2008).

Both these more recent national DEM's incorporated elevation data at 30-m grid (1 arc-second) spacing from the NASA Shuttle Radar Topography Mission (SRTM)[12] flown globally during eleven days in February 2000 by Space Shuttle Endeavour, based on the C-RADAR data-stream (Farr et al. 2007). Originally, only 90-m (3 arc-second) SRTM data was freely available, as used to denote areas in A-NZ under 10 m and 5 m above MHW in Figure 3.1 of the Ministry for the Environment's *Coastal hazards and Climate Change* guidance manual (MfE, 2008). The higher-resolution SRTM dataset was released by NASA for use in the KiwImage project (SKM, 2008).

For the modified enhanced national DEM, SRTM elevation data were spliced with the existing 20 m increments in land contours and spot heights from the Landcare 25-m grid DEM, originally extracted from photogrammetry by Landcare (SKM, 2008).

The stated accuracy of the SRTM gridded data alone for A-NZ, based on a comparison with kinematic GPS transects is 5.9 m for the standard deviation, while 90% of elevations are within 10 m (Rodriguez et al. 2005; Table 2.1). Most of the rest of the world's regions returned a lower standard deviation of 3.5–4 m and a lower 90-percentile of 6–7 m. However, it was noted by Rodriguez et al. (2005) that New Zealand was an exception, based on many fewer points of comparison, where the discrepancy may be due to the rugged terrain encountered by the New Zealand GPS transect. In much of the clear flat areas of Australia, the height errors for the 30-m SRTM are less than 3 m, although there are some areas where the errors are much larger, and the bias is towards higher elevations than actual (Geoscience Australia, 2011). In general, the higher anomalies tend to occur over steep or high topography including river valley floors, as noted by SKM (2008) in the Milford Sound area. So

[11] now Jacobs
[12] http://www2.jpl.nasa.gov/srtm/

vertical accuracy of the SRTM dataset depends considerably on location and characteristics of the terrain and surface features, including at the coast e.g., our comparison of the modified enhanced national DEM with high-resolution LiDAR in Napier City,[13] revealed a higher "shadow zone" in the national DEM to the south of Bluff Hill, a prominent feature standing proud of the surrounding flat land.[14] . Therefore, the absolute height accuracy of relatively flat coastal plains in the SRTM gridded DEM for A-NZ is likely to be more aligned with the global and Australia ranges for the standard deviation of 3–4 m, rather than towards the higher errors at the 90-percentile level reported by Rodriguez et al. (2005).

While improvements have been made to the national DEM by Landcare Research (Barringer et al. 2002) and subsequently modified by SKM splicing the 30-m gridded SRTM DEM with land contours and spot heights, the vertical accuracy of the modified enhanced national DEM is not specifically stated (SKM, 2008). However, it is likely that the accuracy for coastal plains is similar (or slightly better) than the 30-m SRTM DEM, as the blended contour data was only at 20 m increments, although spot heights at a 25-m grid were also assimilated from the Landcare DEM. The vertical accuracy for the modified enhanced DEM of at least a few metres for coastal plains (e.g., likely to be 3–4 m or above) was a key reason for not further sub-dividing the coastal elevation band of 0–3 m above MHW for the national overview in this study.

In comparison, LiDAR topography surveys can achieve a sub-metre vertical elevation accuracy of down to 0.10–0.15 m, which makes these topography products much more amenable to analysing the impacts of SLR and coastal hazards. Unfortunately, LiDAR coverage of the coastal zone around A-NZ is patchy (although does cover some substantial coastal areas) or not accessible, driven entirely by requirements of individual regional or local government agencies. This means for a national overview of coastal risk exposure in A-NZ, a reliance at this stage on the use of the less-accurate modified enhanced DEM.

Some overseas studies have assessed the suitability of the SRTM DEM (on which the NZ DEM is largely based), compared with LiDAR, for flood inundation modelling across floodplain topographies more akin to coastal plains and have found the areas inundated are significantly lower e.g., Ali et al. (2015) who found the inundation area was 36% less using the coarser 90-m SRTM DEM compared with a LiDAR DEM for the same 90-m horizontal resolution. The SRTM DEM therefore tends to overestimate the topography elevation.

Interestingly, a recent similar global study assessing coastal risk exposure to SLR (Strauss & Kulp, 2014), found the use of the SRTM DEM alone significantly underestimated the coastal land area likely to be exposed. Comparing results for U.S. vulnerability using SRTM global data and state-of-the-art domestic LiDAR data, they found that global elevation data led to major underestimates of area exposed compared to modern LiDAR elevation data (by a factor of 3 to 4) as shown in Figure 4-1. They concluded that higher-quality global data — and in particular, elevation data — is needed to help resolve sea-level rise sensitivity, but that their unadjusted results still give an indication of how nations compare in the threats they face from rising seas.

[13] LiDAR supplied by Hawke's Bay Regional Council

[14] This anomaly that was picked up early in the analysis was rectified in the version of the modified enhanced national DEM we used

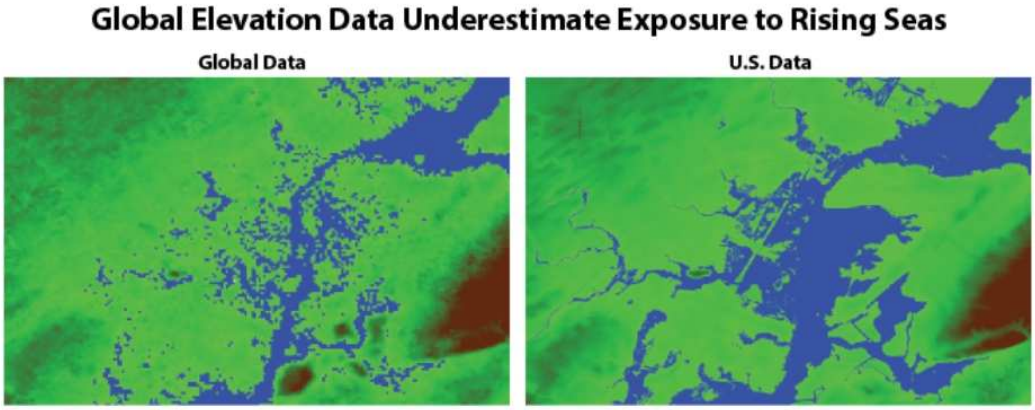


Figure 4-1: Identical sections of northern New Jersey (USA) at 1.8 m coastal inundation illustrates the differences between the global SRTM elevation data (left) and the more granular LiDAR data (right). [*Source*: Strauss & Kulp, 2014].

These comparison studies on flood or coastal plains also confirm our approach of not further subdividing the 0–3 m elevation zone to smaller bands for the national-overview component of the PCE study – and also that the areas in the 0–3 m zone from modified enhanced national DEM are likely to be underestimates of the true area in that elevation band across NZ.

The rest of this Section describes the processing undertaken to derive GIS overlays for the relevant elevation bands for both the modified enhanced national DEM and where available, the considerably-more accurate regional LIDAR DEMs.

4.2 National DEM

4.2.1 Access to the national DEM

The modified enhanced national DEM (referred to from here as "the national DEM"), has been merged from the Landcare Research enhanced DEM generated from the LINZ topographic contour data and blended with the SRTM DEM. Under the licensing arrangements, it was available for use by NIWA as a Government agency and NIWA was also a partner in the KiwImage Quickbird imagery project, for which the national DEM was modified (SKM, 2008).

4.2.2 Processing

The national DEM was used by Bell & Wadhwa (2013) for an initial national overview of coastal land areas and population in three elevation bands (0–3, 3–5, 5–10 m) above MHW. The 0–3 m elevation band from this previous analysis was used as the starting base for the Project.

After a high-level comparison, overlaying this initial polygons with Google Earth imagery around A-NZ, two obvious areas requiring modification in developed urban areas were as follows:

- the low-lying land in the Dargaville area was missing from the national DEM (so a polygon for areas up to 3 m height was added, approximating the LiDAR coverage (sourced early from Northland Regional Council)
- for the northern side of Napier, there was a shadow zone of higher land adjacent to Bluff Hill – the existing 0–3 m national DEM polygon was adjusted to better approximate the areal extent of the 3 m height shown in Figure 1 of Fraser et al.

(2014), which was derived from LiDAR (which was subsequently obtained from Hawke's Bay Regional Council for the Project).

Otherwise, the polygons extracted from the national DEM was the same as used in the earlier study.

The 0–3 m polygons were determined, by intersecting the relevant lower and upper elevation in metres above MHW with the national DEM. A further polygon below 0 m was also added for the nearshore coastal waters to ensure any assets or infrastructure were not missed due to inaccuracies in the MHW line in the national DEM.

Areas with topography within those elevation limits that did not have a direct link to the coastline (for the 0–3 m zone) i.e., isolated areas, were removed from the polygons by Bell & Wadhwa (2014) and not included in any further analysis. The rationale for this was that these areas were clearly not exposed to coastal inundation below the 3 m height and out of a direct overland flowpath inland from the coastline.

The national DEM resolution is insufficient to resolve most coastal stopbanks and narrow dune-barriers, so there remains within the processed 0-3 m DEM polygons of land behind these barriers as they appear to be connected to the coastline in the DEM e.g., considerable areas of the northern Hauraki Plains (Waikato) are still included in the 0–3 m polygons.

The 0–3 m national DEM polygons were then used to overlay census meshblocks (for population counts) and the geo-referenced asset datasets (points, lines, polygons) from the national inventory in RiskScape. Population counts were obtained by applying the ratio of the area of the 0–3 m elevation-band overlay to the total area of each meshblock to the total population count (normally-resident) in that meshblock i.e., if the 0–3 m overlay occupied 75% of the meshblock, then the population count would be 75% of the total population in that meshblock. Regionally, this could be improved by incorporating the spatial distribution of building footprints into the analysis, but the pro-rata approach based on land area is deemed sufficient for a national overview.

4.3 Regional LiDAR datasets

4.3.1 Derivation of DEMs from LiDAR point cloud data

Light detection and ranging (LiDAR), sometimes called laser altimetry, involves a rotary-scanning laser (usually mounted under an aircraft) emitting pulses of laser light (in the near-infrared spectral band) and capturing the reflection through a sensor to measure distances to the surface. High sampling rates (e.g., typically in the range of 1 ping per 0.5–1.0 m^2 (urban areas) to 1 ping per 4–25 m^2 in rural areas) produce high-spatial resolution 3-D "point clouds", which include a mix of the 1st return reflection (e.g., off building roofs or tops of trees or vegetation) and last-return reflection of the ground surface.

A Digital Elevation Model (DEM) normally refers to the ground or "bare-earth" surface, which is derived from using last-return or ground points and spatially interpolating a surface across areas where no bare earth points are found, and can be enhanced using landform break-lines (e.g., ridges, river banks, cliffs) from photogrammetry, and filters on outliers. A DEM is then extracted from the interpolated ground surface as a gridded dataset (raster) at a specified horizontal spacing e.g., 5-m or 10-m grid, not to be confused with the vertical accuracy.

4.3.2 LiDAR datasets available to the Project

Various LiDAR DEMs or point-cloud data were obtained from regional, unitary or district councils either directly or through LINZ, who have recently coordinated a stocktake of LiDAR holdings in New Zealand, as part of the ElevatioNZ Scoping Investigation in 2013/14 (Bjorn Johns, LINZ, pers. com.).

Waikato Regional Council performed their own processing of LiDAR DEMs, and supplied NIWA with the GIS shapefiles for the required elevation bands relative to the MHWS-10 baseline and MSL offsets supplied by NIWA (see Section 4.4).

Southland Regional Council supplied LiDAR DEM for the Waituna River/Lagoon catchment, but as the coastal plain, comprising largely rural development, was only a small proportion of the region, no risk-exposure analysis was undertaken for the Southland region.

Figure 4-2 shows the coverage of the LiDAR DEMs or point-cloud datasets supplied for this Project.

Limited quality control was applied to the supplied DEMs (due to the size and extent of datasets nationally), mostly for any obvious issues such as checking whether a residual of building footprints remain in bare-earth DEMs (as was the case in Wellington), registration of water-land boundaries overlain on aerial imagery or the need to remove overlapping surveys to the more relevant or most recent survey.

In the case of the 2013 LiDAR survey of the Wellington region, the supplied "bare-earth" DEM still had the surfaces of building roofs over 3–4 m high embedded. In areas such as Petone and Wellington CBD, where there is a high density of industrial or commercial buildings, the DEM was unworkable with a high proportion of elevations at the building-roof level. Consequently, the LiDAR from earlier surveys was then processed, but comprised several different surveys and didn't cover the whole region. Finally, a revised bare-earth DEM was developed from the 2013 DEM (several days' work) applying masks based on building footprints from a Wellington region building inventory (supplied by GWRC) and extending 3.5 m beyond the footprint to ensure only minimal residuals of any building roof height remained. These masked areas were then spatially interpolated in GIS to create bare-earth gridded elevations across these areas.

The regional LiDAR DEMs or cloud point data were supplied with a variety of resolutions and accuracies, and an amalgam of different surveys. Table 4-1 outlines the main attributes of the various LiDAR DEMs or point-cloud data that were made available to the Project. The available metadata listed were extracted from documents as supplied by the various agencies – the Table while not fully completed shows the indicative range of variability in the dataset attributes.

Figure 4-2: Coverage of LiDAR DEMs or point-cloud datasets across A-NZ used in this Project. Source: DEMs sourced from LINZ or directly with councils (see Table 4-1).

Table 4-1: Metadata, where available, on regional LiDAR DEMs or point cloud datasets supplied and used for this Project. Metadata obtained from various aerial-survey company reports or files supplied by the relevant council.

Region	Agency	Area (rural, urban)	DEM grid (m)	Accuracy[15] (vertical) (m)	Datum (vertical)	Years for surveys	Pings	Notes
Northland	Northland Regional Council	Pockets (urban & rural)	1 m	±0.15 m	One Tree Point-1964	2003, 2006-2008, 2009, 2014	1–1.6 per m^2	Point cloud ESRI Terrain
Auckland	Auckland Council	Urban & Intertidal	1 m	±0.25 m (@68%)	Auckland Vertical Datum-1946	Mainly 2006, also 2008/2011	1 per 2 m^2 (urban and intertidal)	
	North Shore City Council	Urban	1 m	±0.1 m (@95%)	AVD–46	Oct-Nov 2009 (North Shore)	1 per m^2	Previous North Shore City Council area
	Auckland Council	Rural	1 m	±0.5 m (@95%)	AVD–46	Mainly 2006, also 2008/2011	1 per 25 m^2	
Waikato	Waikato Regional Council	Urban + rural	1 m	±0.15 m	Auckland Vertical Datum-1946, Tararu-1952	2008, 2011, 2013		Elevation-band shapefiles derived from DEMs directly by WRC
Bay of Plenty	Bay of Plenty Regional Council	Urban + rural	2 m	±0.25 m (@68%)	Moturiki Vertical Datum–1953	Feb 2011–Sept 2011		
	BOPLASS Ltd.	Urban + rural (Kaituna to Opotiki)		±0.5 m (@68%)	Moturiki Vertical Datum–1953	Feb 2011–Jan 2012		BOPLASS Ltd is a company owned by regional/unitary councils and territorial local authorities in the Bay of Plenty and Gisborne areas

[15] vertical accuracy is normally quoted at ± 1 standard deviation (or @68% or 1 -sigma), but sometimes at a 95% confidence interval (or ± 2 standard deviations)

Region	Agency	Area (rural, urban)	DEM grid (m)	Accuracy[15] (vertical) (m)	Datum (vertical)	Years for surveys	Pings	Notes
Gisborne	Gisborne District Council	Pockets (urban & rural)	1 m	±0.05 - ±0.10 m (@68%)	Gisborne-1926	Nov-Dec 2014	2.04 to 2.33 per m^2	Supplied 1 m Gridded DEM for Gisborne and contours for small rural areas
Hawke's Bay	Hawke's Bay Regional Council		1 m	±0.15 m (@68%)	Napier Vertical Datum-1962	2003-2012	1 per m^2	Point cloud and ESRI Terrain
Wellington	Greater Wellington Regional Council	Urban & rural	1 m	±0.1–0.15 m (@68%)	Wellington Vertical Datum 1953	2013-2014	1 per 0.8 m^2	DTM produced by Landcare Research for GWRC
Nelson	Nelson City Council		1 m	±0.06 m (@68%)	NZVD2009, and Nelson City Council Vertical Datum (NCCVD)	2014-2015		Supplied point cloud data
Tasman	Tasman District Council	Urban & rural	1 m	±0.07 m (@90%)	Nelson Vertical Datum 1955	2008-2014		Supplied point cloud and terrain
Canterbury	Environment Canterbury	North Canterbury	1 m	±0.1 m (@68%)	Lyttelton Vertical Datum 1937	July 2003 July 2012		Where available, DEMs from surveys post-earthquake were used (e.g., Sept 2011, Feb 2012)
	Environment Canterbury	Ellesmere to South Canterbury	1 m	±0.1 m (@68%)		Feb 2008 March-Apr, Sept 2010	1 per 12 m^2	Where available, DEMs from surveys post-earthquake were used (e.g., Sept 2011, Feb 2012)
Canterbury	LINZ	Christchurch & Kaiapoi	1 m			2010-2012		Post Canterbury Earthquake series coordinated by LINZ

Region	Agency	Area (rural, urban)	DEM grid (m)	Accuracy[15] (vertical) (m)	Datum (vertical)	Years for surveys	Pings	Notes
Otago	Otago Regional Council	Coastal & river mouths	1 m	±0.13 m (@68%)	Dunedin Vertical Datum 1958	Sept 2004	1.7 m density	Supplied point cloud data
	Dunedin City Council	Dunedin	1 m	±0.06 m	Dunedin Vertical Datum 1958	Sept 2009		
	Otago Regional Council	Molyneaux Bay, Taieri	1 m		Dunedin Vertical Datum 1958	2004/2005		Supplied point cloud data

4.3.3 LiDAR processing and GIS mapping

Prior to the mapping in each region, pre-processing involved two steps:

1. A study area polygon was created from approximately the + 20 m height contour inland and to ~ 1 km offshore, to be used as the analysis area. This study area polygon can be described as a "window" within which the GIS looks for the intersection of the coastal land elevations with the relevant LiDAR DEM.

2. The LiDAR DEM coverage within the "window" in each region was manually sub-divided into watershed "masks" or compartments to which a particular MHWS-10 heights along the coast would apply (Appendix A). The relevant MHWS-10 and MSL offset (matching the datum of the LiDAR DEM) were then added and assigned to these coastal area masks as the "zero baseline" level above the local vertical datum before applying the overlays for elevation bands in Table 4-2. For the Auckland region, for which the LiDAR DEM was previously intersected to derive inundation planning maps by Stephens et al. (2013), the same MHWS-10 values from that study were applied around the Waitemata, Manukau and southern Kaipara Harbour coastlines (but generally elsewhere in A-NZ, MHWS was not readily available inside estuaries).

Maps of coastal areas above the relevant MHWS-10 were created within GIS by intersecting the levels separating each elevation band (outlined in Table 4-2) with the LiDAR DEM. These intersections of the land topography were then used to create GIS polygons that map the areas where the terrain is between the lower and upper levels of the elevation band.

The GIS polygons for each elevation band, in each region where LiDAR DEMs were available, were then input to the risk-exposure analysis in GIS to enumerate assets, such as buildings, roads, rail, jetties and airports (Chapter 5).

It became clear during the Project that the GIS elevation polygons would need to be clipped to remove waterbodies such as the coast, estuaries, rivers and coastal lakes, in order to enumerate areas of land and thereby resident population (which relies on the ratio of land area in the elevation band to the total meshblock area). Accurate clipping of LiDAR polygons to waterbody shorelines proved a challenging exercise.

The NZ Coastlines, NZ Lake and the NZ River Polygons published by LINZ / National Topographic Office (2011), are a coastline relative to MHW and river or lake land-boundaries respectively, which have been extracted from Topographic Map series at 1:50,000 scales. Estuary polygons extracted from these same 1:50,000 scale databases by NIWA in developing the Estuary Environment Classification.[16] However, at the much higher resolution of the LiDAR surveys, these boundary polylines proved too inaccurate for clipping the derived elevation polygons from the LiDAR processing. There were also numerous locations where the geomorphology of the water body had changed in the interim, particularly estuary and river mouths, which are well known for altering their geographical size and shape.

Two examples are shown in Figure 4-3 for Nelson, where the NZ Coastline (LINZ) actually cuts across some buildings and illustrates more recent change in the geomorphology (top panel) and the river

[16] https://www.niwa.co.nz/coasts-and-oceans/nz-coast/learn-about-coastal-environments/estuary-types

and estuary polygons don't adequately delineate the water bodies within Maitai River (bottom panel).

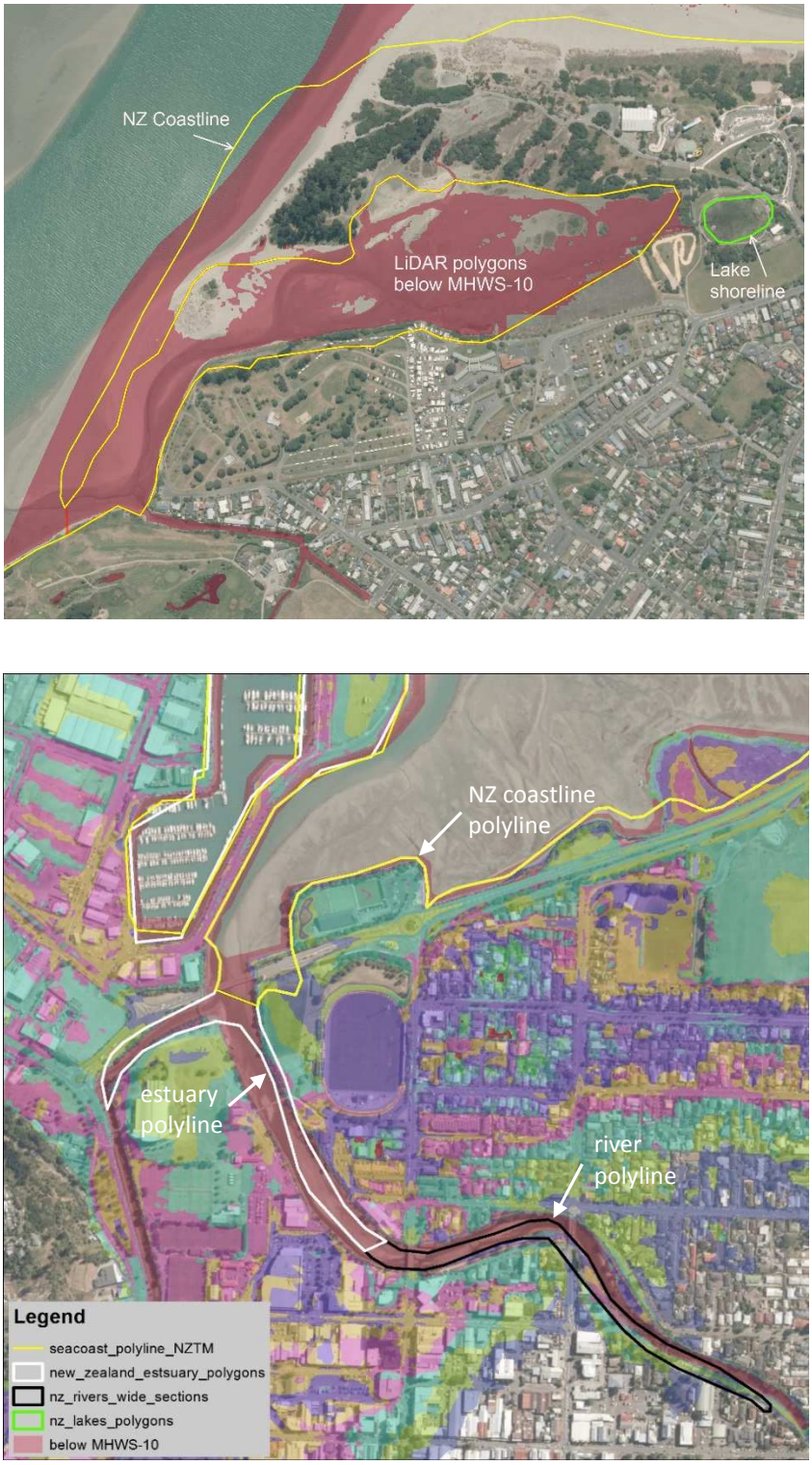


Figure 4-3: Example comparisons of the LiDAR polygons below MHWS-10 (pink-red colour) with the NZ Coastlines, NZ River, NZ Lake and NZ Estuary Shorelines in Nelson. *Source*: Lines from LINZ/Topographic Authority 1:50,000 Coastline, River and Lake Polygons, NIWA Estuary Environment Classification; background aerial image from Esri Baseline Maps (NZ Imagery).

These examples are replicated in many other situations around the NZ coast where LiDAR surveys were available, highlighting the limitation of the NZ Coastline polygons for clipping the higher spatial resolution of the LiDAR polygons to waterbody boundaries (rather than the intended original purpose of resolving a NZ shoreline at 1:50,000 scale mapping). Consequently, a manual method was required to more accurately remove LiDAR polygons with elevation less than MHWS-10, firstly from offshore of the open coast, then the more complicated exercise of removing either entire polygons occupying a water body (e.g., estuary, river) or manually splitting a polygon, where a portion was clearly on land or an island.

The manual approach was a resourcing balance between removing the more obvious polygons overlying water bodies or coastal waters for a national-scale study, but not the finer local detail, which is a more thorough exercise the regional, unitary or local authorities can undertake. The manual approach consisted of overlying all the various NZ shoreline polygons and the derived LiDAR elevation bands over recent aerial images provided by Esri as Baseline Maps (NZ Imagery), and making visual judgements on which polygons below MHWS-10 should be removed from the LiDAR analysis or which ones should be cut, to remove most of the waterbodies. This approach was trialled around the coastline of the Otago, Tasman and Nelson regions by two of the authors working together, before the GIS analysts proceeded with the remaining regions. Note: the Bay of Plenty LiDAR DEM, as supplied, was already clipped to the NZ Coastline, so will contain some overs and unders in relation to separating land and water.

The re-processed GIS polygons, arising from the manual approach, were provided to the PCE for mapping the various elevation bands where LiDAR coverage around A-NZ is available, and also used as input to the population and areal extent analysis.

Table 4-2: Elevation bands for which GIS polygons were extracted and identifiers used for plotting results (by band or the cumulative elevation zones).

Elevation band (above MHWS-10)	Plotting mark (upper level of band)	Cumulative zones used
0–0.25 m	0.25 m	
0.25–0.5 m	0.5 m	0–0.5 m
0.5–1 m	1.0 m	
1–1.5 m	1.5 m	0–1.5 m
1.5–2 m	2.0 m	
2–2.5 m	2.5 m	
2.5–3 m	3.0 m	0–3 m

4.3.4 LiDAR DEM processing notes

- In some coastal areas of A-NZ there are low-lying land areas that are below the 0 m elevation (i.e., below MHWS-10) that are either directly connected to the sea or indirectly via somewhat higher (< 3 m) near-shore land or a natural sand barrier or stopbank. These areas below MHWS-10 were included in 0 m surface relative to MHWS-10 for assessing risk exposure.

- Areas below 3 m in height above MHWS-10 that were not connected to the sea by rivers, estuaries, wetlands or drains, where intervening land was above 3 m (i.e., isolated from the coast), were not removed from the elevation band polygons in any region. Removal of these hydraulically-isolated areas is a complex and time-consuming manual process of establishing hydraulic connectivity (e.g., drains, tide flapgates, culverts) or otherwise, as undertaken previously for mapping coastal inundation in Auckland (Stephens et al. 2013). This requires more detailed local or regional information, including drainage and stormwater assets inventories, than was available to this national-overview Project and which could not be undertaken within the resources assigned.

  The implication of the inclusion of these isolated basins or depressions, usually relatively small, will be to slightly over-estimate the area of the coastal margin in that elevation band that may be potentially exposed to coastal inundation hazards and sea-level rise, and hence additional assets and resident population. However, this overestimation in areal extent of some elevation bands (which will vary between regions depending on terrain characteristics) is likely to be more than offset by areas of A-NZ where LiDAR DEM's were not available or of limited coverage (e.g., Southland, Manawatu-Wanganui, Taranaki, Marlborough, West Coast) and for other regions where full coastal LiDAR coverage was not available (e.g., Northland, Gisborne, Otago, Waikato, Canterbury), but covered most of the developed coastal areas.

4.4 MHWS and MSL offsets around A-NZ

A key ingredient in using elevation bands as proxies for coastal-risk exposure is setting a consistently-applied baseline (or zero "datum") before adding on the elevation increments (0.25, 0.5, 1.0, …. 3 m). This involved a two-step process:

- Determine a consistent MHWS around A-NZ relative to an assumed datum of MSL=0 (i.e., the still-water level without any tide is set to zero to leave aside geographic variations in vertical survey datums).

- Apply a MSL offset to that initially-assumed zero datum, that is the vertical offset between the present-day MSL (averaged over several years) and the local vertical datum (LVD) for the region that the LiDAR DEM is relative to e.g., in Bay of Plenty, the LVD is Moturiki Vertical Datum-1953.

4.4.1 MHWS levels around A-NZ

Given that MHWS is used as the landward boundary of the coastal marine area (CMA), defined in the RMA as a jurisdictional boundary between regional and district resource-management responsibilities, this was chosen as the zero baseline for the elevation zones. While MHWS is reliably known at the 16 Standard Ports and a number of Secondary Port sites in A-NZ (LINZ, 2015), it still

leaves large tracts of coastline including estuaries without definitive values for MHWS (other than interpolating values). Also in many cases, MHWS at Secondary Ports are based on limited measurements of water levels and varying definitions or accuracy of MHWS. There are also several variants on the definition of MHWS (Bell, 2010; Stephens & Wadhwa, 2012; Auckland Council, 2014), including mathematical definitions (from nautical and surveying perspectives) or local visual observations (e.g., edge of strand line or saline vegetation). The RMA simply defines the landward boundary of the CMA as "the line of mean high water springs" [s2, RMA], but case law indicates one has to take a pragmatic approach to defining MHWS locally.[17]

To provide a nationally-consistent baseline for the LiDAR DEMs, a MHWS-10 level was adopted (Bell, 2010; Stephens & Wadhwa, 2012), which is the MHWS level at which only 10% of all high waters (HW) exceed this (excluding weather effects such as storm surges and waves). An example of how the MHWS-10 level is derived from the high-tide exceedance curve is shown in Figure 4-4 for Moturiki Island (Mount Maunganui), based on tidal constituents analysed from the tide gauge record (same curves can be derived from tidal-model output).

Such a definition straddles the variations in the type of tides experienced e.g., fortnightly spring-neap tides on the west coast and the monthly perigean-apogean tides that are more dominant[18] on the east coast. This is why the perigean-spring (MHWPS) mark is well above the MHWSn (average fortnightly-spring) level for Moturiki in Figure 4-4, whereas on the west coasts these two levels are closer together. This geographical variation illustrates the need for a consistent definition of MHWS for all sites, such as MHWS-10, which was also adopted for delineating the CMA in the Auckland region in tandem with LiDAR DEM and aerial photographs (Stephens & Wadhwa, 2012).

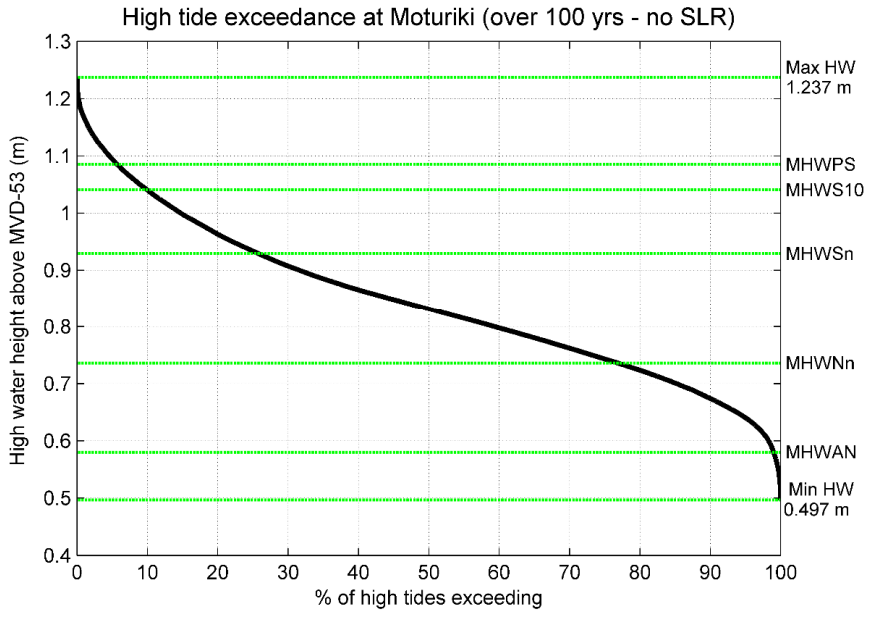


Figure 4-4: High-water (HW) exceedance distribution for all predicted high tides spanning a 100 years (*n*=70,780 high tides) for Moturiki Island (Mount Maunganui) relative to the LVD. Note: tide only, and excludes weather, climate and SLR effects. *Abbrev.*: MHWPS = mean high water perigean-spring; MHWS10 = MHWS exceeded by only 10% of high waters, MHWSn, MHWNn= nautical definition of MHWS and mean high-water neap (principal lunar + solar tides); MHWAN= mean high water apogean-neap.

[17] Planning Tribunal: Falkner *vs* Gisborne District Council (A82/1994); AV Hastings *vs* Auckland Regional Council (EnvC A130/2000)
[18] where a larger set of spring tides occur each month with the preceding spring tides being smaller a fortnight earlier

The use of an upper tidal limit as the baseline for this Project, such as Max HW, which rarely occurs (excluding weather and wave effects), can pose problems for sheltered, semi-enclosed water bodies such as estuaries, where such levels may be partially-vegetated "land" or the land behind natural or artificial coastal barriers such as dunes or stopbanks may often be below this level. MHWS-10 is also about the level that coastal dwellers would observe on a regular fortnightly-to-monthly basis in sheltered waters.

To provide national open-coast coverage, particularly to fill the gaps between tide gauge locations, we used output from NIWA's tidal model that covers the Exclusive Economic Zone (EEZ) of A-NZ (Walters et al. 2001). 290 locations were established around the A-NZ coast to cover the main littoral cells (pocket beaches, bays) and headlands, with several points covering the larger bights (e.g., Canterbury and Taranaki Bights) – see Appendix A.

At each location, 13 tidal constituents, which combined make up nearly all the observable tide in A-NZ, were extracted from the NIWA EEZ tidal model. These tidal constituents were then used to predict all high tides for a 100-year period, relative to MSL=0, to produce high-tide exceedance curves like Figure 4-4, and the MHWS-10 (and also MHWPS) levels extracted.

A quality-control process was applied to the model-derived MHWS-10 values by comparing MHWS-10 processed from datasets for sites near Standard Ports, other tide-gauge locations with reasonably-long records (> 1 year) or from MHWS estimates for Secondary Ports in (LINZ, 2015). For the majority of sites, the model-derived values were within a few cm of the MHWS-10 generated from the tide-level data or a decimetre of the MHWS estimate for Secondary Ports, and were left unaltered. Where a larger offset occurred in between the modelled MHWS-10 and that derived from datasets, the former values were adjusted to match at those specific sites. Values for intervening model-output sites between locations near gauges, where adjustments were made, were adjusted on a pro-rata basis using linear interpolation, in order to preserve the relative spatial variability between the model output sites. For example, if MHWS-10 at site X (gauge site) required no adjustment and site Z (gauge site) needed an adjustment of +0.04 m, then at an intermediate model-output site which had say a predicted value of 50% of the difference between X and Z from the model, an adjustment of +0.02 m was made.

Most of the adjustments required were less than 0.05 m, with the largest bias in the MHWS-10, derived from the EEZ tide model, found for the southern Firth of Thames where a reduction of 0.10 m was required. The shoaling bathymetry in this relatively shallow area is not well-represented at the model grid-cell resolution of the broad-scale tidal model, so it is over-amplifying the high tides as frictional effects increase.

The EEZ tide model also doesn't include estuaries and harbours, and given the general paucity of tide data or local-area models within these water bodies, it is assumed for this national-scale Project that MHWS-10 level at the open-coast entrance applies up estuaries and harbours (unless otherwise known or tide data was readily available e.g., Waitemata, Manukau and Kaipara Harbours from Stephens & Wadhwa (2012) and Stephens et al. (2013) and for the Whitianga Estuary (NIWA gauge deployments inside and outside the inlet entrance). For Dargaville, at the northern end of the Kaipara harbour, an additional 0.38 m was added to the MHWS-10 height at the entrance to Kaipara Harbour, based on limited gauge data in the northern Harbour.

The full set of adjusted MHWS-10 values relative to present MSL=0 for sites around A-NZ are provided in Appendix A in the form of annotated maps. A ribbon plot of the spatial variability in

MHWS-10 is shown in Figure 4-5. This is the first known national derivation of a consistent and quality-checked MHWS height around the open coast. The highest MHWS-10 levels, in the band 1.91-2.0 m, occur in northern Golden Bay near Farewell Spit, which contrasts with the lowest MHWS-10 (0.28-0.3 m) off Makara to the west of Wellington (Figure 4-5 and Figure B-4).

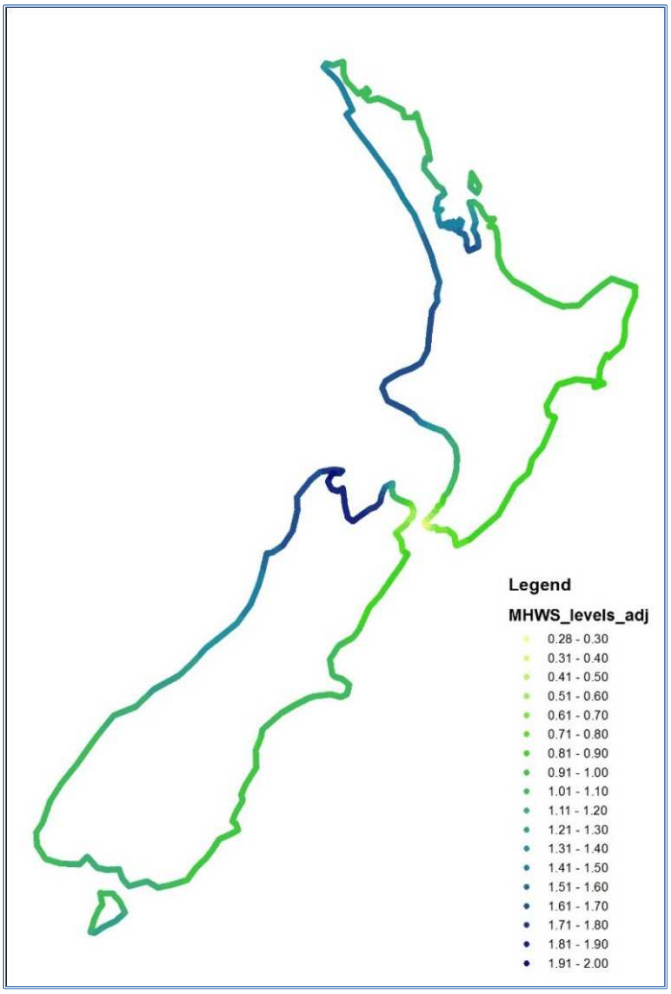


Figure 4-5: Ribbon-plot of MHWS-10 (m) above MSL=0 connecting 290 model-output sites around A-NZ.
Source: derived from adjusted output from the NIWA EEZ tide model (Walters et al. 2001).

Limitations of the national coastal MHWS-10 dataset are:

- Tides in estuaries: Tides generally amplify in range as they travel up inside estuaries and harbours, before gradually diminishing further upstream in tidal creeks and the transition with lowland rivers. There are also some estuaries with shallow entrances where the tide range is reduced once inside the water body e.g., Whitianga MHWS-10 drops by 0.12 m, which is known from tide gauges and was factored into the MHWS-10 level used. Mostly, the tide range inside many estuaries or upper reaches of harbours away from ports or marinas, is not known. This would require detailed modelling of each estuary or harbour or alternatively short-term tide-gauge deployments. Such a paucity of data inside the east-coast estuaries of the Auckland region required some work-around assumptions where modelling or gauge data were not available (Stephens et al. 2013). This exercise was not undertaken for this national-scale project – rather it is assumed that the open-coast MHWS-10 (tide only with no weather or

wave effects) applies inside the adjacent estuaries and harbours. From our knowledge and experience with estuarine tides, the uncertainty level relative to the open-coast MHWS-10 of this assumption inside estuaries would usually be around ±0.1–0.2 m. Note: if the actual tide range is higher in parts of the estuary than the open-coast MHWS-10 assigned, then the risk exposure e.g., number of buildings, will be underestimated for the lower elevation bands, especially *MHWS-10 + 0.25 m*. More detailed regional assessments and mapping of coastal inundation and SLR by councils can factor in these spatial variations in high water up inside estuaries.

- Open-coast wave effects on defining the shoreline: The derived MHWS-10 is based on tides only for all regions, and doesn't include the wave setup component that is invariably present most of the time on open-coast shorelines with a surf zone (leaving aside storm conditions). An Auckland regional study by Stephens & Wadhwa (2012) determined that a wave component needed to be added to MHWS-10 for different coastal compartments in the Auckland region to better match with the natural shoreline (e.g., edge of vegetation or toe of dune). However, it required careful analysis, checking and matching with aerial photographs and ground-truthing on beach profiles to obtain realistic modified MHWS-10 levels for the CMA (land-sea) boundary. This type of detailed analysis is highly dependent on local exposure to both wind-waves and swell, and therefore such additional adjustments to MHWS-10 across A-NZ for wave setup are beyond the scope and resources of the Project. For consistency in this national study, only a tide-derived MHWS-10 was used for the Auckland region (to match the approach in regions elsewhere).

  Excluding persistent wave setup for any location will result in an underestimate of risk exposure for the lower elevation bands, although wave-exposed coasts are unlikely to contain buildings in these lower-elevation bands, unless the land is behind a dune or barrier system.

4.4.2 MSL offsets around A-NZ

Regional or local MSL offsets were derived, to apply to the MHWS-10 heights to convert this baseline to the local vertical datum (LVD)[19] that matched the datum of the relevant LiDAR DEM supplied. Sea-level gauge data, mostly during the early half of last century, were used to derive the local vertical datums, such as *Moturiki Vertical Datum-1953*, around A-NZ (Amos, 2010; Hannah & Bell, 2012).

MSL has risen since those historic measurements, so MSL offsets are now required to add to these LVDs to represent the present-day MSL over the recent epoch e.g., past decade or so. The period used varies somewhat depending on availability of data, but generally will be within an accuracy of 0.01–0.02 m.

The MSL offsets were calculated from recent epochs of the last 6–18 years from available sea-level gauge records or derived from Standard Port levels for MSL in the Nautical Almanac (LINZ, 2015).

The list of MSL offsets for compartment of the A-NZ coast are listed in Appendix B.

Adding the MSL offset then converts the MHWS-10 height into a level relative to the local vertical datum matching the same datum used for the LiDAR DEMs.

[19] http://www.linz.govt.nz/data/geodetic-system/datums-projections-and-heights/vertical-datums/local-mean-sea-level-datums

5 Asset exposure and demographic processing

5.1 Asset data

Building, infrastructure and land assets, within 0 to 3 m elevation of MHW or the smaller elevation bands relative to MHWS-10 from LiDAR DEMs, were identified from a range of readily accessible geospatial databases. Building assets were geo-located using the national building asset inventory from RiskScape (Schmidt et al. 2011). This inventory contains structural and non-structural attribute information for over 2.1 million buildings in New Zealand, sourced primarily from QV Property Valuation datasets enhanced by additional building attributes (e.g., construction, cladding) from work undertaken by the NZ Earthquake Commission, limited field surveys and proxy attributes such as floor level, derived from the age of the building (in relation to foundation styles).

For this Project, attributes to report from this inventory for buildings located in the area of interest included use category and replacement costs. Building use category types reported include; residential, commercial, industrial/primary production, critical facility, community and other (e.g., out-buildings, garages).

Additional building identification was performed where georeferenced aerial photography and building footprint shapefiles were available. A vector polygon representing land area up to 10 m above MHW was initially overlaid on a building point dataset from the RiskScape national building asset inventory to identify buildings either missing in aerial photography or building foot print shapefiles. Missing buildings were added as vector points with RiskScape type standard use category (summary in Table 5-1 by region) and NZD$2011 replacement cost attribute fields.

Table 5-1: RiskScape building inventory count and additional buildings identified within 10 m above MHW.

Region	RiskScape Building Inventory Count up to 10m above MHW Before Aerial Photography Reviewed	RiskScape Building Inventory Count up to 10m above MHW After Aerial Photography Reviewed	Number of Buildings Added to RiskScape Building Inventory
Northland	12,177	12,342	165
Auckland	46,919	50,717	3,798
Waikato	27,356	27,403	47
Bay of Plenty	49,722	50,516	794
Gisborne	12,295	12,895	600
Hawke's Bay	50,460	50,675	215
Taranaki	2,804	2,854	50
Manawatu-Wanganui	16,638	16,888	250
Wellington	37,263	37,580	317
West Coast	5,664	6,778	1,114
Canterbury	98,250	101,576	3,326
Otago	8,678	8,740	62
Southland	12,477	12,520	43
Tasman	7,230	7,440	210
Nelson	4,786	4,906	120
Marlborough	10,480	10,675	195
NZ total	**403,199**	**414,505**	**11,306**

Use category was identified from aerial photography or Google Street View, while replacement costs were assigned using the methods described by Cousins (2007) in order to be consistent with other building replacement costs in the inventory. In Christchurch City, buildings cleared following the Christchurch 2011 earthquake up to around 2012 were removed from the building inventory where these could be clearly identified.

Replacement costs were extracted for both the building structure and its contents, although only the former is reported as being applicable to slower-onset climate-change effects. All costs are reported in 2011 New Zealand dollars and were derived using the method described by Cousins (2009). The author used published construction cost data for New Zealand (Giddens, 2007) per square metre (m^2) construction cost rates for buildings based on use, footprint and storeys. These rates were updated to NDZ$2011 values based on 2011 Rawlinsons Construction Handbook[20] guidelines during the development of the national building inventory in RiskScape.

Infrastructure assets used for this analysis were limited to roads, railway, airports and airfields and wharves due to data accessibility. Similar to buildings, a national road inventory available from RiskScape was used to locate road sections within each coastal elevation band. Road type and length (km) attributes could only be identified from this inventory. In addition to roads, Land Information New Zealand (LINZ) provides geospatial data for railways, airports, airfields and wharves at a national level. Railways and wharves were represented as vector lines while airport and airfield locations are provided as vector points. No database provided by LINZ contained data tables of the structural or engineering attributes associated with the infrastructure.

The New Zealand Land Cover Database Version 4 (LCDBv4) was used for land cover and land parcel use identification. The database developed by Landcare Research NZ Ltd provides a multi-temporal digital thematic map of land cover. Maps are created using satellite imagery and contain detailed information on how land cover and land use boundaries change over time. LCDBv4 is the fourth version representing land cover and land use during the 2012–2013 period. LCDBv4 contains 33 land cover types represented as vector polygon features containing the type code and boundary for the time period.

5.2 Asset exposure processing and outputs

Asset location and attribute information was derived from a range of geospatial processing techniques. In ArcGIS 10.1 the national 0–3 m elevation polygon (relative to MHWS) was initially clipped for each region and exported as separate vector polygons. This would enable point feature assets (e.g., buildings, airports, airfields) to be selected by location with attribute fields exported as comma-separated delimited files for extraction of summary statistics. In addition, the 0–3 m elevation polygon was used to clip vector point (e.g., airports) line (e.g., roads, railway, wharves, airstrips) and polygon features (e.g., land cover, land parcel use) prior to attribute field export. A similar process was undertaken for the incremental elevation bands from the LiDAR DEM processing.

Building, airport and airfield point features and wharves line features were regionally selected by location within the 0–3 m elevation polygon (or LiDAR elevation bands). Airport and airfield points and wharves lines were summed for each region while for all selected building point features, attribute fields “Use Category”, “Contents Value” and “Replacement Cost” were exported to MS Excel and total values summed. “Use Category” attribute field codes represent 22 building types

[20] Web site: http://www.rawlinsons.co.nz/construction-handbooks/. In 2014, QV bought the rights to the Rawlinsons NZ Construction Handbook : http://qvgroup.qv.co.nz/qv-costbuilder

based on RiskScape type standards. In some instances, multiple RiskScape defined building use category types were aggregated to report general categories where additional detail was not considered necessary (Table 5-2). The total number of buildings was summed for residential, commercial, industrial/primary production, critical facility, community and other use categories.

Table 5-2: Outline of procedure for aggregating various RiskScape building types into more general building use categories used for this Project.

RiskScape Building "Use Category"	Reported Building Use Category
1: Residential Dwellings; 3: Commercial – Accommodation; 15: Resthome; 19: Lifestyle	Residential
2: Commercial – Business; 6: Fast Moving Consumer Goods	Commercial
4: Industrial - Manufacturing, Storage; 5: Industrial - Chemical, Energy, Hazardous; 17: Forestry, Mining; 18: Farm	Industrial/Primary Production
7: Government; 8: Territorial Authority/Civil Defence; 9: Lifeline Utilities; 10: Police; 11: Hospital, Clinic; 12: Fire Station; 14: Education	Critical Facility
13: Community; 16: Religious	Community
20: Parking; 21: Clear Site; 22: Other	Other

Road and railway asset vector line features were initially clipped to extract only the line segments located within the 0–3 m elevation (or LiDAR elevation) polygon in each region. For both assets line length geometry was then calculated in kilometres for the extracted features then summed for each region to derive total asset length. Road lines contained additional use information indicating whether they were local, collector, arterial or expressway/motorway therefore, road length was summed for these attributes. The road and railway databases used for this analysis did not contain asset replacement cost information therefore, this information has not been provided. However, this information could be derived by the relevant network agencies based on replacement or repair costs for highways/railways per kilometre in the various locations that could simply be multiplied by the length of the network exposed.

Similar to buildings, Land Cover Database Version 4 (LCDBv4) developed by Landcare Research (Landcare Research, 2015) provided an attribute field with land cover type codes which required type aggregation. Three general categories representing land cover and use were identified (Table 5-3).

Polygons within each category were selected by land cover type attributes, exported as a vector polygon shapefile then merged to form a single polygon feature. An additional attribute field for land area in square kilometres was added to each polygon with the geometry calculated. Polygons were then clipped with the 0–3 m elevation polygon (or LiDAR elevation band polygon) for each region with land cover area summed for the elevation area. The elevation land-cover polygons were further used to clip the 2014 LINZ New Zealand land parcel vector polygons to assign land use types to individual land parcel polygons. The total number of land parcels for each land use type were then summed for each region.

Table 5-3: Outline of aggregation of various land cover types into the three general categories used in this Report.

Land Cover Database Version 4 Land Cover Code	Reported Land Cover and Use Type
3: Built-up area; 33: Transport infrastructure	Built-Environment
7: Exotic forest; 10: Forest – harvested; 15: High producing exotic grassland; 20: Low producing exotic grassland; 25: Orchard vineyard and other perennial crops; 29: Short-rotation crop; 31: Surface mines and dumps	Primary Production
1: Alpine grassland/herbfield; 2: Broadleaved indigenous hardwoods; 4: Deciduous hardwoods; 5: Depleted grassland; 6: Estuarine open water; 7: Exotic forest; 8: Fernland; 9: Flaxland; 10: Forest – harvested; 11: Gorse and/or broom; 12: Gravel and rock; 13: Herbaceous freshwater vegetation; 14: Herbaceous saline vegetation; 16: Indigenous forest; 17: Lake or pond; 18: Land Cover; 19: Landslide; 21: Mangrove; 22: Manuka and/or Kanuka; 23: Matagouri or grey scrub; 24: Mixed exotic shrubland; 26: Permanent snow and ice; 27: River; 28: Sand and gravel; 30: Sub alpine shrubland; 32: Tall tussock grassland; 34: Urban parkland/open space 35: Vegetation; 36: Wetlands	Natural Environment

5.3 Demographic processing from the 2013 Census

Census 2013 data (5 March 2013) for the normally-resident population was obtained from the Stats NZ web site, subdivided into three main age brackets (of which only 0–65 years old and >65 years old) were used. New Zealand residents who are away from their usual address on census night are allocated back to the area where they usually live and form part of the census "usually resident" population count of that area (Stats NZ, 2014).

The 2013 Census meshblocks (MB2013 – High Definition Clipped) were downloaded from the Stats NZ web site as an ESRI shapefile.[21]

To obtain an estimate of the population in any meshblock where the elevation-band polygons only partially cover the meshblock, the total population of the meshblock was pro-rata'ed (linear interpolation) according to the ratio of the area of either the 0–3 m coastal elevation band from the national DEM or LiDAR elevation-band overlay, relative to the entire area within the high-definition clipped mesh block. This approach tended to over-estimate the normally resident population in lower-lying areas near MHWS, whereas people mostly live towards the higher end of any coastal meshblock. For this reason, results for population counts from the lower LiDAR elevation bands were aggregated into a single count for elevation ≤ 0.5 m above MHWS-10. On the other hand, for elongated meshblocks that extend well inland, there will be cases where most people are living in a coastal settlement within a close distance to the coast with a largely rural hinterland, in which case the pro rata approach based on areas may be a substantial under-estimate.

Short of developing a complex schema for allocating population counts to different-size buildings and their geo-referenced footprint, the above approach, including aggregating population for the lower elevation bands, should suffice for a regional and national overview.

[21] http://www.stats.govt.nz/browse_for_stats/Maps_and_geography/Geographic-areas/digital-boundary-files.aspx

6 Results for coastal-risk exposure: national DEM (0–3 m)

6.1 Introduction

Enumeration of various asset and demographics from the intersection of GIS polygons derived from the 0–3 m national DEM were aggregated to territorial-authority areas, urban areas and regions as defined by Stats NZ and LINZ, and finally aggregated to a national value.

Coastal risk exposure is enumerated for the following categories across the 0–3 m elevation band from the national DEM:

- National DEM polygon coverage [km^2].
- Normally-resident population from 2013 Census (<65 years, 65+ years, total) [#].
- Land-use categories and total land area [km^2].
- No. of land parcels [#].
- No. of buildings for categories: residential, commercial, industrial/primary production, critical facility, community and other. [#]
- Replacement cost of buildings for each category in 2011 dollars[22] [NZD$B].
- Length of roads for different categories: local, collector, arterial and expressway/motorway [km].
- Length of railway [km].
- Number of wharves & jetties and airports [#].

6.2 Areal coverage of 0–3 m coastal elevation zone

The total coverage area for each region encompassed by the 0–3 m coastal elevation zone is shown in Figure 6-1. Table 6-1 lists the polygon area in km^2 covered by the 0–3 m coastal elevation zone for each region, which also includes the upper-intertidal areas, and river/estuary waterbodies. For the national DEM, no further analysis was undertaken to clip the 0–3 m polygons to water-land boundaries. The regional coverage was aggregated up to the national totals, along with percentages relative to the total region area and the distribution of the A-NZ total area within the coastal band.

The largest areas within the 0–3 m coastal elevation zone across A-NZ are in Canterbury (450 km^2) followed by Southland, Northland, Waikato (mainly Hauraki Plains), and Auckland with coverage from 140–170 km^2.

[22] Based on the costing method outlined in Section 5.1 to re-construct the building – bears no relationship to market value.

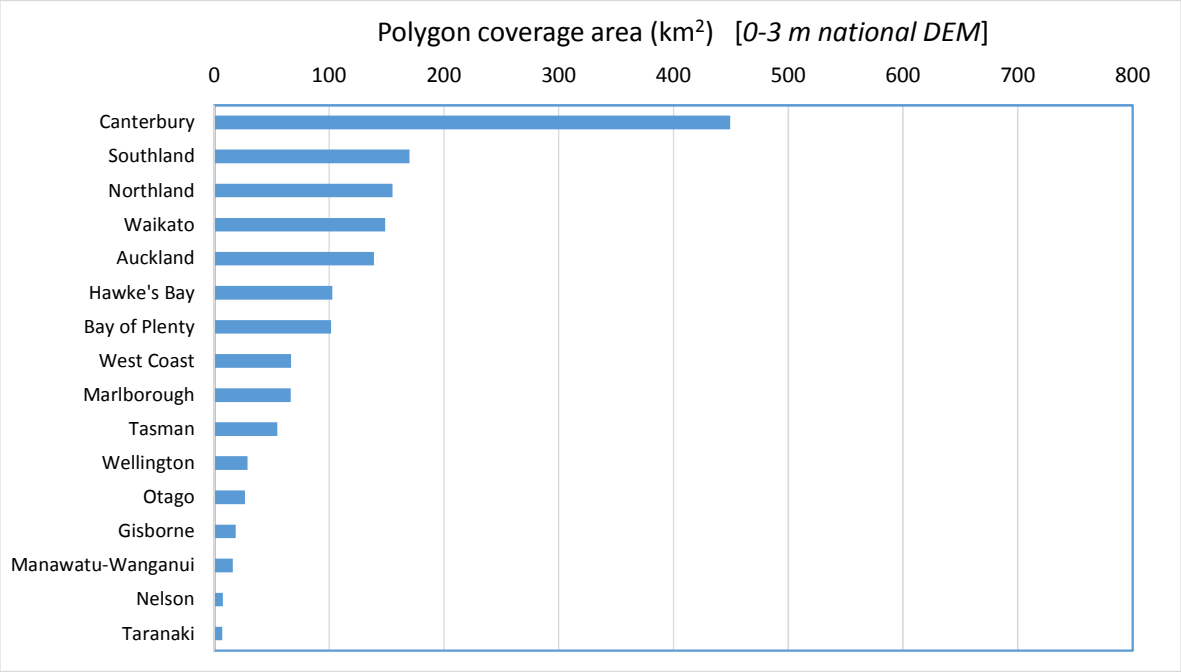


Figure 6-1: Regional distributions of total coverage area within the 0–3 m national DEM. Source: GIS polygon areas.

Table 6-1: Regional distribution of coverage of the 0-3 m national DEM elevation-band polygons. Source: Area of polygons from GIS analysis. Columns may not add up to totals due to numerical rounding.

Region	0–3 m zone area per region (km²)	% of NZ area in 0-3 m national DEM
Northland	155.4	10.0
Auckland	139.1	8.9
Waikato	148.7	9.5
Bay of Plenty	101.6	6.5
Gisborne	18.6	1.2
Hawke's Bay	102.6	6.6
Taranaki	6.9	0.4
Manawatu-Wanganui	15.9	1.0
Wellington	28.8	1.9
West Coast	66.8	4.3
Canterbury	449.5	28.8
Otago	26.7	1.7
Southland	170.0	10.9
Tasman	54.9	3.5
Nelson	7.5	0.5
Marlborough	66.6	4.3
NZ total coverage	**1,559**	**100%**

6.3 Population normally resident in 0–3 m coastal elevation zone

The results from enumerating the resident population within the 2013 Census meshblocks overlapping the 0–3 m coastal elevation zone from the national DEM are provided in Figure 6-2 and Table 6-2. The results have been aggregated up to the regional level and the table ends with a national summary. Table 6-2 also lists the % of the region's resident population located within the 0–3 m elevation zone.

For all ages, most of the people resident in the 0–3 m coastal elevation zone in A-NZ (based on the national DEM) lived in either Canterbury (31%), Hawke's Bay (21%) or Auckland (16%), with these three regions accounting for nearly 70% of all people who were resident in this zone in the 2013 Census.

For Canterbury, following the 2010/2011 earthquakes, the reductions in population of the red zones will already be present in the Census 2013 dataset used for this Project, but do not include any further reductions following Census night.

Across any particular region, the resident population in the low-lying coastal zone (based on the national DEM) is generally quite a small proportion of < 5% (Table 6-2), but Hawke's Bay has by far the highest proportion (~23% of the region's population), followed by Canterbury (9%), West Coast (8%) and Tasman (7%).

An important caveat with this demographic overview is that the populations in each meshblock are based on people normally resident in these area units and were present in A-NZ on census night (a Tuesday in March 2013). New Zealand residents who are away from their usual address on census night are allocated back to the area where they usually live and form part of the census usually resident population count of that area (Stats NZ, 2014). Therefore, there will be a significant underestimate of people who would be temporarily resident in coastal settlements and towns, particularly in the peak summer season of December–January and occasionally through the year. Consequently for these holiday destinations, the number of dwellings in these coastal elevation zones is a more accurate proxy for coastal risk susceptibility, with many buildings only occupied for part of the year (typically summer).

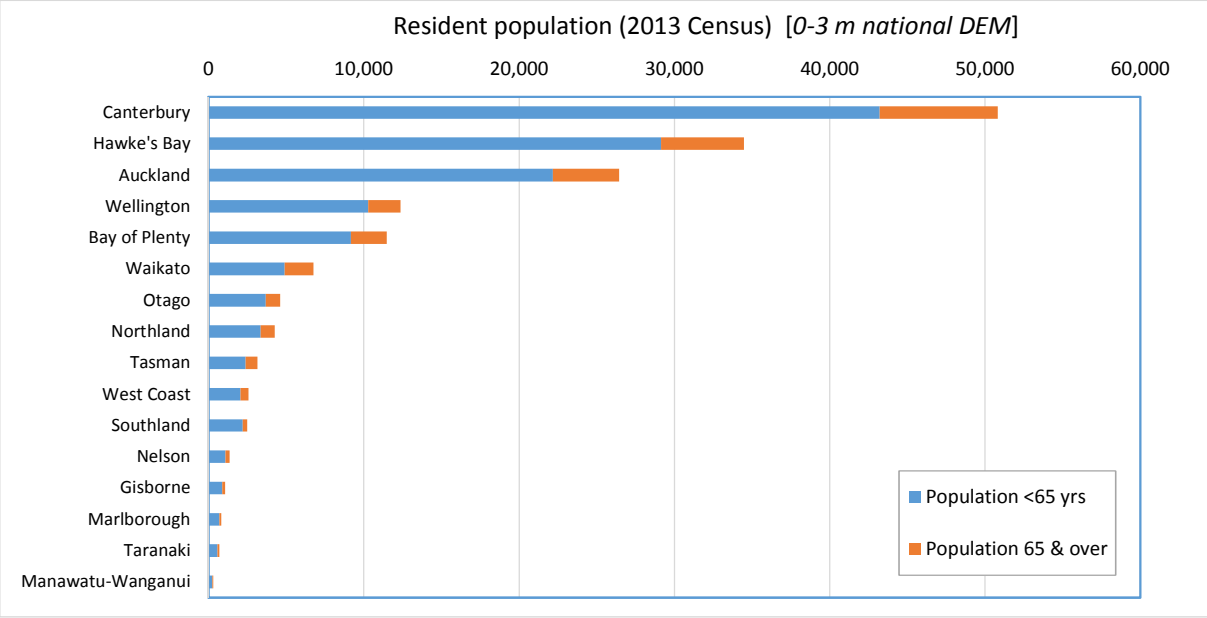


Figure 6-2: Regional distributions of resident population within the 0-3 m elevation zone of the national DEM. Source: Stats NZ Census 2013 meshblock data.

Table 6-2: Regional distribution of resident population in the 0-3 m elevation zone of the national DEM. Source: NZ Stats Census 2013 meshblock data.

Region	Total resident population	< 65 years old	65+ years old	% of regional population in-zone
Northland	4,247	3,351	896	2.8
Auckland	26,438	22,170	4,268	1.9
Waikato	6,762	4,913	1,849	1.7
Bay of Plenty	11,466	9,169	2,297	4.3
Gisborne	1066	881	185	2.4
Hawke's Bay	34,473	29,131	5,342	22.8
Taranaki	693	572	121	0.6
Manawatu-Wanganui	303	250	53	0.1
Wellington	12,358	10,286	2,072	2.6
West Coast	2,577	2057	520	8.0
Canterbury	50,816	43,222	7,594	9.4
Otago	4,616	3,668	948	2.3
Southland	2,486	2,185	301	2.7
Tasman	3,158	2,383	775	6.7
Nelson	1,363	1,076	287	2.9
Marlborough	821	690	131	1.9
NZ total	163,643	136,004	27,639	

6.4 Land-use and parcels in 0–3 m coastal elevation zone

The distribution of land-use within the 0–3 m coastal elevation zone, categorized by urban, primary production or natural environment from the Land-Cover database V4, is shown in Figure 6-3 and listed in Table 6-3. The total land-cover areas are likely to be a closer estimate of the actual land areas in each region that are below 3 m (relative to MHW), than the national DEM polygon coverage in Section 6.2 (which also includes waterbodies and wetlands).

Canterbury has by far the largest land area within the 0–3 m elevation zone (national DEM) at around 430 km^2, followed by Waikato (131 km^2), then similar land areas for Southland, Northland, Bay of Plenty and Hawke's Bay (range 69–78 km^2). Auckland has the highest proportion of land area within a region that lies in the 0–3 m elevation band – but at only 1.3% of the total land area of the region, followed by Canterbury (1% of the region's land area).

Overall in New Zealand, the areal extent of the 0–3 m coastal elevation zone from the national DEM is quite small at around 0.4% of the total land area of 272,900 km^2 – however, it is these low-lying areas which are more likely to be developed and populated as shown below. The Nelson region is such an example where the area of low-lying coastal land is small at only just over 3 km^2 (bottom of Figure 6-3; Table 6-3), but it is where much of the seaward part of the Nelson City CBD and adjoining suburbs are located.

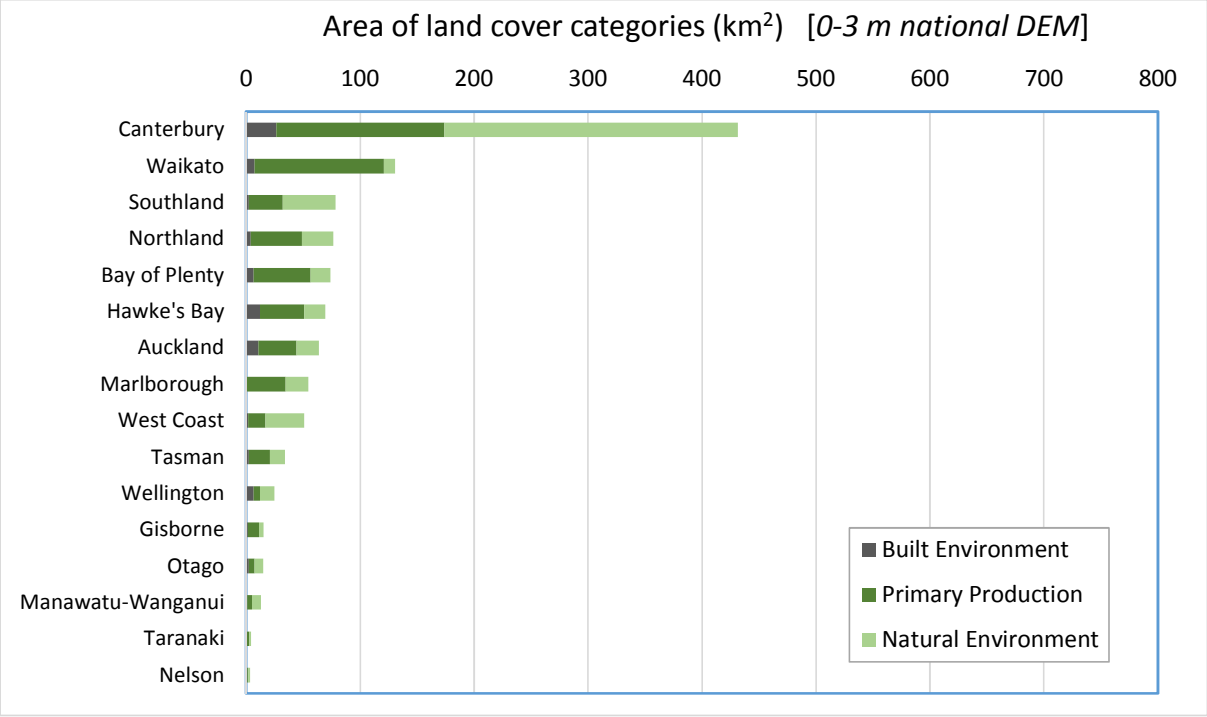


Figure 6-3: Regional distributions of three aggregated land-use types in the 0–3 m national DEM elevation zone. Source: Land Cover Database (LCDBv4).

Table 6-3: Distribution by region of land-use by areas (0-3 m national DEM). Source: Landcare Research Land-Cover database V4.

Region	Built-Environment Land Area (km²)	Primary Production Land Area (km²)	Natural Environment Land Area (km²)	Total Land Area (km²)
Northland	3.8	45.0	27.7	76.5
Auckland	10.7	33.5	19.7	63.8
Waikato	7.3	113.6	9.8	130.8
Bay of Plenty	6.6	50.1	17.3	73.9
Gisborne	1.4	9.9	3.9	15.2
Hawke's Bay	12.2	38.6	18.6	69.4
Taranaki	0.3	2.2	1.9	4.4
Manawatu-Wanganui	0.8	4.3	7.7	12.8
Wellington	6.5	5.8	12.5	24.8
West Coast	1.7	15.0	34.0	50.8
Canterbury	26.4	147.4	257.7	431.5
Otago	2.3	5.1	7.6	14.9
Southland	2.5	29.5	46.4	78.3
Tasman	2.3	18.5	13.1	33.9
Nelson	0.8	0.8	1.7	3.3
Marlborough	0.7	33.8	20.2	54.7
NZ Total	86.3	553.0	500	1,139

The coastal-risk exposure results further below emphasise that the proportion of land area within the coastal elevation zone relative to the region or NZ-wide land area, is a poor proxy by itself as a national measure of the susceptibility – it needs to include demographic information and enumeration of built environment assets within these coastal areas to identify the socio-economic composition of areas potentially susceptible to coastal hazard and SLR risks.

Land cover identified as primary production occupies ~50% of New Zealand's land within 0–3 m elevation band from the national DEM. Canterbury and Waikato account for a considerable proportion nationally of primary-production land in the coastal zone with 27% and 21% respectively.

Canterbury also has the most extensive land identified with built environments (e.g., urban land cover) covering an area just over 26 km^2 (although some of this area includes the residential Red Zone in Christchurch and also Kaiapoi). The built environments of other regions such as Auckland and Hawke's Bay occupy over 10 km^2 of land within the elevation zone of the national DEM. Taranaki has the least built environment cover with less 0.3 km^2. Land cover classified as natural environments comprise almost 44% of New Zealand's land in the 0–3 m elevation zone. The majority of this natural-environment land is located in Canterbury and Southland.

The regional distribution of land parcels within the 0–3 m elevation zone of the national DEM is shown in Figure 6-4. Overall, the number of land parcels contained is highest in Canterbury (23%), then Auckland (15%), followed by Northland (11%) and Hawke's Bay (10%) (Figure 6-4). Taranaki, Manawatu-Wanganui and Nelson have the fewest number of parcels (2% combined of the national number of parcels in the 0–3 m coastal zone).

Land parcels identified for use as built environments (e.g., urban development, transport infrastructure) account for 52% of the total number of land parcels identified within 0–3 m elevation of MHW in A-NZ. A considerable proportion of these are located in Canterbury with relatively high parcel occupancy also occurring in Hawke's Bay and Auckland.

Primary production has the least number of land parcels in the elevation zone overall, which is reflected in the land area of parcels being generally much greater (e.g., farms) as previously mentioned. Again, the majority of primary-production parcels are located in Canterbury followed by Waikato (e.g., Hauraki Plains).

Land parcels occupied by natural environments are most commonly located in the northern regions. Northland and Auckland respectively account for 21% and 20% of all parcels for this land use type. Despite the high number of parcels the land extent for these regions is considerably less than some regions with fewer parcels such as Canterbury, Southland and West Coast.

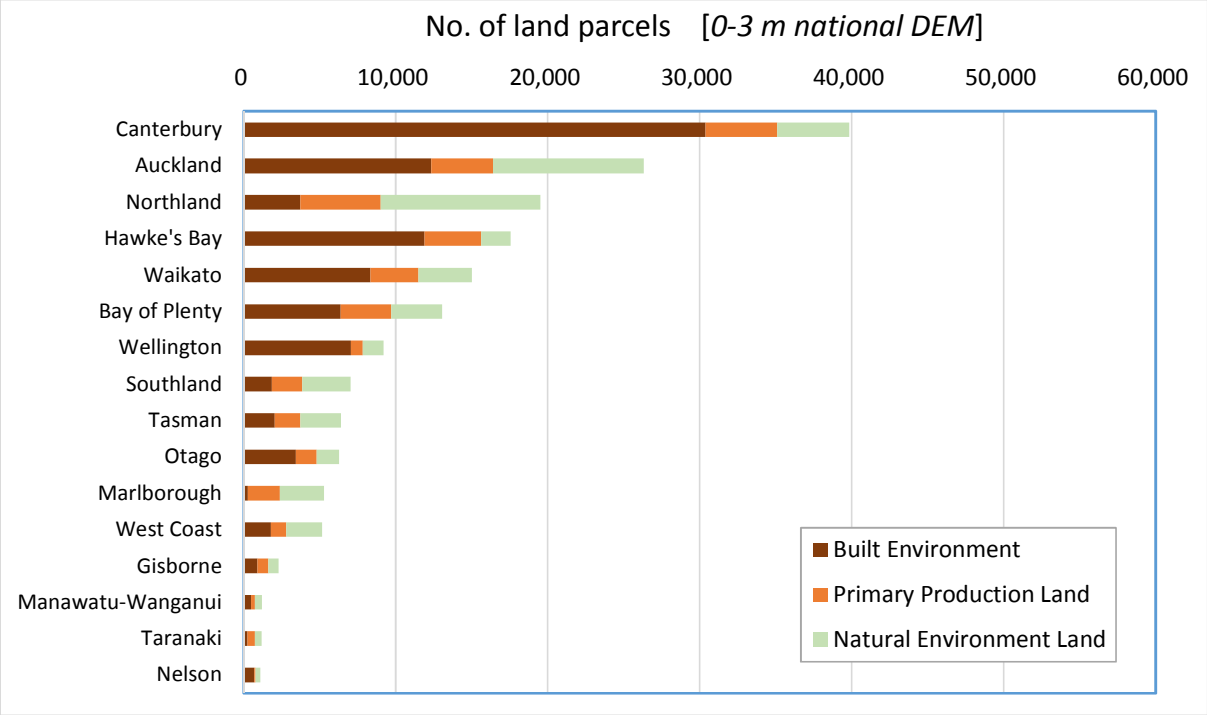


Figure 6-4: Regional distribution of the number of land parcels in the 0-3 m coastal elevation band from the national DEM. Source: Land Cover DB v4.

Table 6-4: Distribution of No. of land parcels for different land-cover types (0–3 m national DEM).
Source: Land Cover Database v4.

Region	Built-Environment (No.)	Primary Production (No.)	Natural Environment (No.)	Total Land Parcels (No.)
Northland	3,736	5,287	10,507	19,530
Auckland	12,341	4,051	9,942	26,334
Waikato	8,347	3,152	3,533	15,032
Bay of Plenty	6,377	3,336	3,347	13,060
Gisborne	913	697	689	2,299
Hawke's Bay	11,898	3,741	1,934	17,573
Taranaki	258	483	434	1,175
Manawatu-Wanganui	473	255	476	1,204
Wellington	7,050	783	1,372	9,205
West Coast	1,797	1,011	2,359	5,167
Canterbury	30,394	4,713	4,751	39,858
Otago	3,429	1,375	1,455	6,259
Southland	1,847	1,998	3,192	7,037
Tasman	2,033	1,694	2,670	6,397
Nelson	695	99	302	1,096
Marlborough	281	2,099	2,920	5,300
NZ Total	**91,869**	**34,774**	**49,883**	**176,526**

6.5 Built and infrastructure assets in 0–3 m coastal elevation zone

6.5.1 Buildings

Buildings types and replacement costs ($2011 NZD) were enumerated for the 0–3 m coastal elevation zone (national DEM) in each region and are presented by region in descending order in Figure 6-5 and Figure 6-6 and then listed in Table 6-5 and Table 6-6.

Residential is the most prevalent building type identified nationally (60,900 excluding the Red Zone in Christchurch) within the 0–3 m elevation zone, accounting for 68% of all types of buildings in the RiskScape inventory within the elevation zone. The largest proportion of residential buildings in this elevation zone are located in Canterbury and Hawke's Bay, followed by 5,000–7,000 in each of Wellington, Auckland, Bay of Plenty and Waikato (mostly in the Coromandel).

Similarly, the highest proportions of buildings used for industrial or primary production purposes are located in Canterbury and Hawke's Bay while the greatest number of commercial and community buildings are located in Canterbury (based on the national DEM). Nationally there are 506 critical facility buildings (e.g., hospitals, police/fire stations, government buildings), with Hawke's Bay and Auckland accounting for just under 60% of all critical facilities in the 0–3 m elevation zone.

Fewer than 450 buildings of any type were each identified in Taranaki, Manawatu-Wanganui, Nelson and Marlborough in the 0–3 m elevation zone of the national DEM (Figure 6-5) and similarly reflected in the lowest replacement costs nationally (Figure 6-6). The five regions not covered by available LiDAR surveys (Chapter 7) contained ~3,900 buildings within the 0–3 m elevation zone of the national DEM, with 70% from two regions or around 1,360 buildings in each of West Coast and Southland.

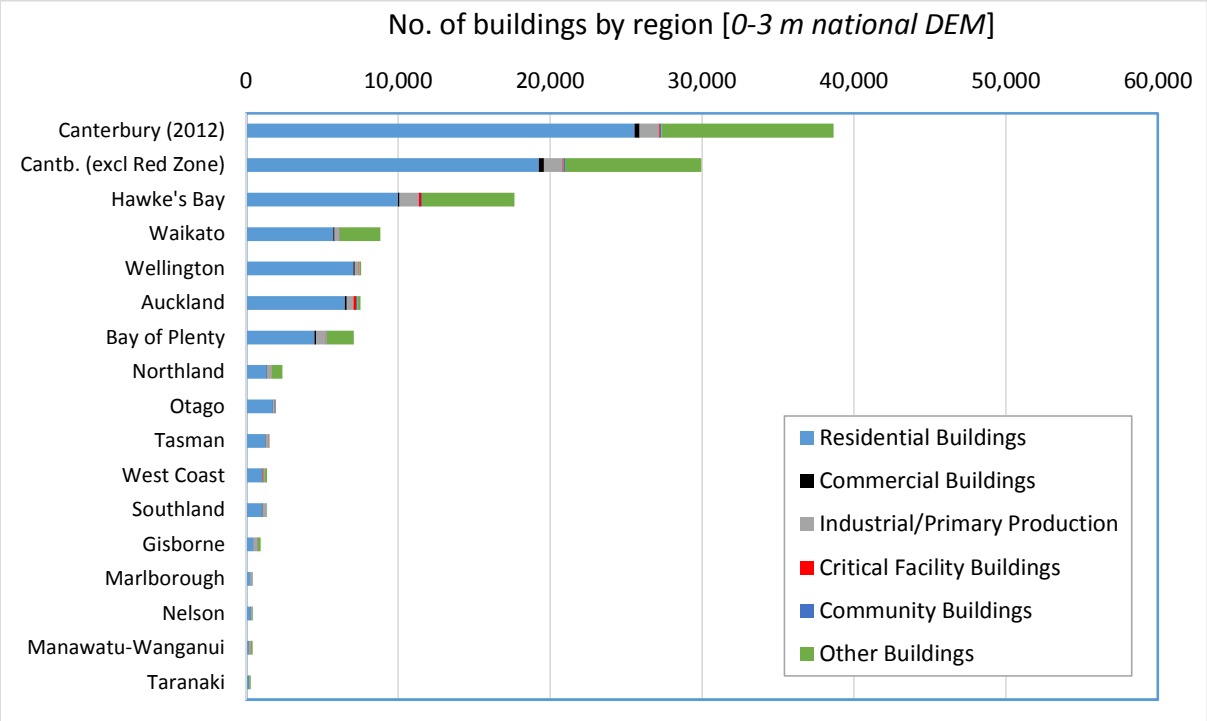


Figure 6-5: Regional distribution of No. of buildings in different classes in 0-3 m national DEM. Source: RiskScape buildings inventory (Section 5.1). Building counts for Canterbury shown both for 2012 and also excluding all buildings in the Christchurch Residential Red Zone.

The higher number of all types of buildings found in Canterbury that are located in the 0–3 m coastal elevation zone (Figure 6-5) is reflected in the region also having the highest building replacement-cost values (with the Red Zone excluded), followed by Auckland, Hawke's Bay and then Wellington (Figure 6-6). The average total replacement cost value per building for Canterbury is estimated at nearly $190,500 (Table 6-6).

Hawke's Bay also has a high number of buildings within the 0–3 m elevation zone relative to Auckland (Figure 6-5). However, the total replacement cost of Auckland buildings is close to $2B higher despite Auckland having only about 50% of the total number of buildings in Hawke's Bay in this coastal elevation zone. Commercial and critical-facility buildings contribute to the higher replacement cost total in Auckland.

The average total replacement cost per building structure (all building types) in the 0–3 m elevation band in Auckland is around $676,000, with the next highest regions being Southland ($640,000) and Nelson ($489,000). For New Zealand, the average total replacement cost value per building in the 0–3 m elevation band is $266,500 (2011). This includes all building types – not just residential.

The five regions not covered by available LiDAR surveys (Chapter 7) contained a total building replacement cost around $1.5B (2011) within the 0–3 m elevation zone of the national DEM, with nearly 60% arising from Southland ($0.87B).

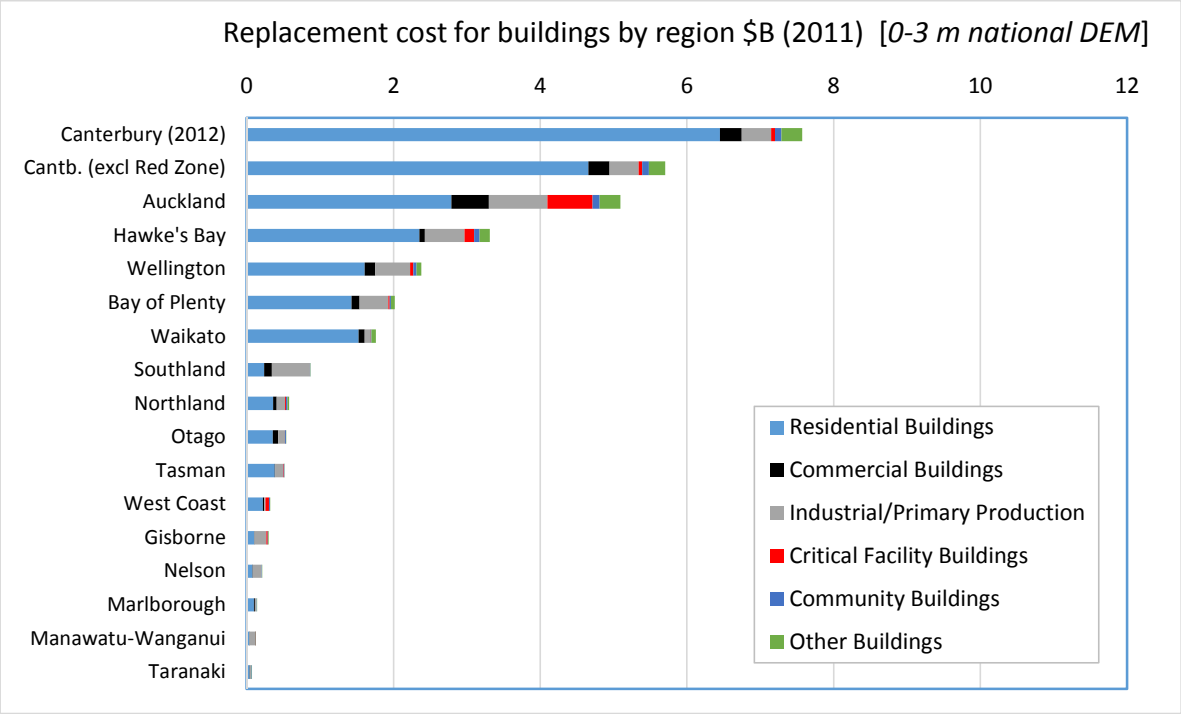


Figure 6-6: Regional distribution of replacement costs (2011 $B) aggregated from the various building classes for the 0-3 m national DEM. Source: calculated in RiskScape (see Section 5.1). Building counts for Canterbury shown both for 2012 and also excluding all buildings in the Christchurch Residential Red Zone.

Table 6-5: Distribution by region of the No. of buildings for different classes. Source: RiskScape buildings inventory, but excludes the Christchurch Red Zone.

Region	Residential Buildings	Commercial Buildings	Industrial/Primary Production Buildings	Critical Facility Buildings	Community Buildings	Other Buildings	Total Buildings
Northland	1,352	39	244	14	17	721	2,387
Auckland	6,496	121	454	155	94	214	7,534
Waikato	5,732	74	325	3	18	2,679	8,831
Bay of Plenty	4,487	133	604	30	47	1,777	7,078
Gisborne	469	7	273	22	4	186	961
Hawke's Bay	9,987	101	1,275	143	71	6,097	17,674
Taranaki	190	2	19	0	4	87	302
Manawatu-Wanganui	181	2	131	2	2	105	423
Wellington	7,069	62	280	27	21	113	7,572
West Coast	1,042	19	86	48	14	169	1,378
Canterbury*	19,267	325	1,239	47	102	8,966	29,946
Otago	1,743	34	111	2	49	5	1,944
Southland	1,038	32	274	0	10	5	1,359
Tasman	1,274	9	191	13	14	32	1,533
Nelson	301	2	85	0	9	28	425
Marlborough	268	2	135	0	5	22	432
NZ Total*	**60,896**	**964**	**5,726**	**506**	**481**	**21,206**	**89,779**

* excludes Christchurch Residential Red Zone.

Table 6-6: Regional distribution of replacement costs for residential and all building types and mean unit costs within the 0-3 m national DEM (2011 NZ$B). Source: RiskScape buildings inventory, but excludes the Christchurch Red Zone.

Region	Replacement Costs (2011 $)			
	Residential Buildings ($B)	Mean Residential ($)	All buildings ($B)	Mean all buildings ($)
Northland	0.359	265,340	0.580	242,831
Auckland	2.790	429,418	5.095	676,221
Waikato	1.524	265,882	1.760	199,286
Bay of Plenty	1.430	318,646	2.014	284,613
Gisborne	0.104	221,673	0.299	311,399
Hawke's Bay	2.355	235,855	3.312	187,366
Taranaki	0.042	219,502	0.071	235,629
Manawatu-Wanganui	0.034	189,572	0.126	296,858
Wellington	1.608	227,510	2.379	314,121
West Coast	0.222	212,946	0.318	230,735
Canterbury*	4.658	241,735	5.704	190,472
Otago	0.354	203,155	0.539	277,520
Southland	0.237	228,026	0.870	640,240
Tasman	0.382	299,600	0.514	335,246
Nelson	0.084	277,753	0.208	489,152
Marlborough	0.096	358,003	0.139	321,787
NZ Total*	**$16.277B**	267,295	**$23.927B**	266,509

* excludes Christchurch Residential Red Zone

6.5.2 Roads and Railways

All regions contain a range of road types located within the 0–3 m coastal elevation zone (national DEM), although is dominated by "local" roads and streets (Figure 6-7). Around 33% of the national total road length is in Canterbury[23] (483 km), followed by Hawke's Bay and Waikato having the most extensive roading networks located in this zone with 216 km and 195 km respectively (Figure 6-7 and Table 6-7). Taranaki (8 km) and Manawatu-Wanganui (12 km) have the least extensive road networks in low lying coastal areas.

The majority of roads in the coastal elevation band are "local", accounting for almost 94% of the total road network present. These are predominantly streets or minor roads located in urban or peri-urban areas. Nationally there is around 50 km of arterial roads, with the highest cumulative lengths in Hawke's Bay (9 km) and Waikato and Northland regions (at ~7 km each).

Expressway and motorway networks located in some urban sectors contain segments within the 0–3 m coastal elevation zone, with 11 km cumulative length nationally in the 0–3 m DEM. Auckland's State Highway network occupies the greatest extent of around 9 km (some of which is currently being upgraded and raised e.g., SH16 North-western Motorway causeway at Waterview).

For the five regions where LiDAR surveys were not available, the total road length (224 km) in the 0–3 m elevation zone was 13% of the national total, with West Coast, Marlborough and Southland containing 91% (~200 km) of the road length enumerated over the 5 regions.

[23] Includes road in the Christchurch Residential Red Zone, as it is unclear how many roads will be closed permanently.

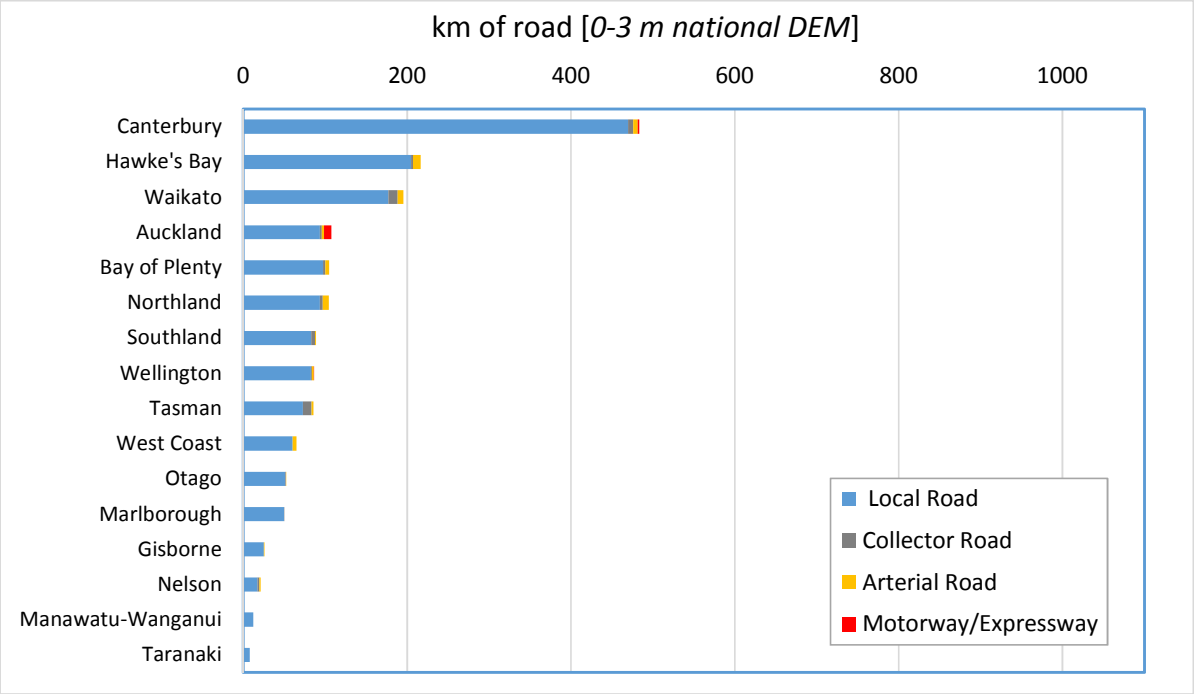


Figure 6-7: Regional distribution of length (km) of different classes of road. Source: LINZ GIS road network.

Table 6-7: Regional distribution of length (km) of different classes of road (0-3 m national DEM). Source: LINZ GIS road network.

Region	Road Length (km)				Total Road Length (km)
	Local	Collector	Arterial	Expressway/ Motorway	
Northland	93.2	3.8	7.3	0.0	104
Auckland	93.2	2.5	2.7	9.1	107
Waikato	177.0	11.4	6.9	0.0	195
Bay of Plenty	97.5	2.5	4.7	0.0	105
Gisborne	25.1	0.0	0.6	0.0	26
Hawke's Bay	204.8	2.5	9.2	0.0	216
Taranaki	7.8	0.0	0.0	0.0	8
Manawatu-Wanganui	12.1	0.0	0.0	0.0	12
Wellington	82.7	0.9	2.4	0.1	86
West Coast	60.0	0.0	5.1	0.0	65
Canterbury	469.8	6.1	5.5	1.8	483
Otago	51.3	0.6	0.0	0.0	52
Southland	82.8	4.8	1.3	0.0	89
Tasman	72.7	10.7	2.3	0.0	86
Nelson	17.4	2.3	1.4	0.0	21
Marlborough	49.6	0.1	0.0	0.0	50
NZ Total	**1,597**	**48**	**50**	**11**	**1,706**

Railway track segments in all regions that are located within 0-3 m elevation of MHW are listed in Table 6-8, with a national total of nearly 73 km exposed in lower-lying coastal areas. Hawke's Bay has the longest length of railway tracks in the coastal elevation zone (~19 km) followed by Bay of Plenty (~10 km) and Canterbury (~8 km) respectively. West Coast and Nelson have less the 1 km of railway tracks located within 0–3m elevation of MHW, while there is no rail network in Waikato and Tasman coastal areas.

For the five regions where LiDAR surveys were not available, the total railway length (11.5 km) in the 0–3 m elevation zone was 16% of the national total, with Southland containing 64% (7.4 km) of the railway length enumerated over the 5 regions.

Table 6-8: Regional distribution of railway length (km) in the 0-3 m national DEM. Source: LINZ GIS railway network.

Region	Total Railway Length (km)
Northland	3.5
Auckland	5.0
Waikato	0.0
Bay of Plenty	9.9
Gisborne	6.0
Hawke's Bay	19.3
Taranaki	1.2
Manawatu-Wanganui	1.5
Wellington	4.8
West Coast	0.3
Canterbury	7.9
Otago	4.1
Southland	7.4
Tasman	0.0
Nelson	0.5
Marlborough	1.1
NZ Total	72.5

6.5.3 Airports and Airfields

Nationally, there are 9 airports located in the 0–3 m coastal elevation zone (Table 6-9). Two are the international airports at Auckland and Wellington (both of which have parts towards the upper end of the 3 m elevation band) and regional airports at Tauranga, Gisborne, Napier/Hastings, Wellington, Nelson, Westport, Greymouth and Invercargill.

A number of airfields and aerodromes (37) are also located in the elevation zone, predominantly in regions with relatively large areas of primary production land and coastal resorts such as Waikato.

Table 6-9: Regional distribution for No. of airports and airfields located in the 0–3 m national DEM zone.
Source: RiskScape asset inventory.

Region	Airports (No.)	Airfields and Aerodromes (No.)	Total
Northland	0	2	2
Auckland	1	1	2
Waikato	0	8	8
Bay of Plenty	1	2	3
Gisborne	1	1	2
Hawke's Bay	1	1	2
Taranaki	0	0	0
Manawatu-Wanganui	0	0	0
Wellington	1	0	1
West Coast	2	4	6
Canterbury	0	1	1
Otago	0	0	0
Southland	1	1	2
Tasman	0	4	4
Nelson	1	0	1
Marlborough	0	3	3
NZ Total	9	28	37

6.5.4 Jetties and wharves

Table 6-10 lists the regional distribution of counts of wharves and jetties and estimate cumulative length adjacent to the coastlines associated with the 0–3 m national DEM.

Nationally, there are over 1,500 jetty and wharf structures, with a combined length of 100 km around the A-NZ coast adjacent to the low-lying areas delineated in the 0–3 m national DEM. The highest number of coastal maritime structures are in Otago and Auckland (61% of the national total), with both regions accounting for 57% of the total cumulative length, with Auckland having the highest count at nearly 30 km. Northland has the third highest counts for jetties and wharves.

Table 6-10: Regional distribution of wharves and jetties adjacent to the coastline of the 0–3 m national DEM. Source: RiskScape inventory.

Region	Jetties and wharves (No.)	Total cumulative length (km)
Northland	146	10.6
Auckland	327	29.6
Waikato	60	3.6
Bay of Plenty	97	7.5
Gisborne	2	0.3
Hawke's Bay	4	1.2
Taranaki	14	0.8
Manawatu-Wanganui	1	0.1
Wellington	43	5.2
West Coast	18	1.0
Canterbury	14	1.0
Otago	614	27.4
Southland	46	3.2
Tasman	18	1.0
Nelson	79	4.2
Marlborough	64	3.7
NZ Total	1547	100.4

6.6 Summary

For each attribute, there are different regional distributions of where the highest coastal-risk exposure is concentrated, but overall Canterbury, followed by Hawke's Bay and Auckland show the highest exposure in terms of population, number of buildings, building replacement costs and length of road.

These results are based on the 0–3 m coastal elevation band extracted from the national DEM. As shown in the next Chapter, the regional and national exposure and population are substantially underestimated using this best-available national modified DEM. Therefore only limited analysis was undertaken within this Chapter.

However, the national DEM results demonstrate the national relativity across all regions for five regions where LiDAR was not available (Taranaki, Manawatu-Wanganui, Marlborough, West Coast, Southland). These five regions contained ~3,900 buildings within the 0–3 m elevation zone of the national DEM, with 70% from two regions or around 1,360 buildings in each of West Coast and Southland, and a total building replacement cost around $1.5B (2011), with nearly 60% arising from Southland ($0.87B).

For the 5 regions where LiDAR surveys were not available, the total road and railway length (224 km and 11.5 km respectively) in the 0–3 m elevation zone was 13% and 16% respectively of the national total. Of these regions, Southland, West Coast and Marlborough had the highest proportion of the combined road length (91%). While regional and national exposure is substantially underestimated using the national DEM, nevertheless, these results for the five regions provide a broad estimate of the coastal-risk exposure in regions where LiDAR DEMs were not available for the study.

7 Results for coastal-risk exposure: LiDAR DEM elevation bands

7.1 Introduction

Counts of people and assets for the built environment in this Chapter only includes those areas and regions where LiDAR DEM's were available (see national coverage in Figure 4-2).

The stocktakes were enumerated for elevation bands between surfaces for 0, 0.25, 0.5, 1, 1.5, 2, 2.5 and 3 m above the local MHWS-10 baseline (and for most regions also included extra analyses for 1.25 m apart from Waikato). Land that was below MHWS-10 (e.g., land behind coastal stopbanks or dunes or adjacent to estuaries) was included in the 0–0.25 m band in terms of asset and land area enumeration. Demographic results for lower elevation bands are only reported as an aggregate number of people at or below 0.5 m, as the pro rata approach to assigning residents by the areal proportion of an elevation band to the meshblock area tends to overestimate the number living in the lowest elevations. Note: A more accurate distribution of people could be done by apportioning the population to building footprints within each meshblock across A-NZ, but was beyond the resources for this project.

As described in Section 4.3, elevation polygons that were essentially over were removed manually or cut to better fit water-land boundaries in recent aerial imagery. Nevertheless, there remains areas of marsh or upper intertidal areas above MHWS-10 in the low-elevation polygons, especially the 0 m surface, which will contain a larger area than the actual land cadastre. These post-processed LiDAR shapefiles were used to calculate areal extent of the polygons and normally-resident population.

Results are reported graphically in two main forms:

- Horizontal bar chart (in descending order) for the 0–1.5 m and the 0–3 m) coastal elevation zones (aggregated from the relevant combined elevation bands), similar to the graphs for the 0–3 m national DEM results, mainly covering the regions, but with some graphs for urban areas.
- Vertical bar chart and cumulative distributions as a function of elevation bands above MHWS-10 to appraise the relative degree of exposure in terms of the land-elevation profile.

These graphs are supported by lists of the main results in tables in Appendices C onwards.

7.2 Population normally resident in coastal-elevation bands (LiDAR)

7.2.1 Aggregated regional populations for 0–1.5 m and 0–3 m elevation zones

The regional distributions of residents from the 2013 Census, within the 0–1.5 m, 1.5–3 m and the 0–3 m coastal elevation zones are shown in Figure 7-1 and listed in Table 7-1 for regions where LiDAR was available. The results have been aggregated up to the regional level and the table ends with a national summary across the areas where LiDAR DEMs were available. Table 7-1 also lists the % of the region's resident population located within the wider 0–3 m elevation zone.

Of the regions with LiDAR DEMs available, two-thirds of the people resident in the more exposed 0–1.5 m coastal elevation zone lived in either Canterbury (~23%), Hawke's Bay (~19%), Bay of Plenty (~13%) or Auckland (12%), with these four regions accounting for around 68% of all people who were resident in the wider 0–3 m elevation zone in the 2013 Census.

Aggregated nationally across areas with LiDAR DEMs available, the total resident population from the 2013 Census in the 0–1.5 m elevation band was 133,265 (3.1% of A-NZ population[24]), rising to 281,902 across the wider 0–3 m elevation zone (6.6% of A-NZ population). The latter population count is substantially higher than the value of 163,643 derived from the 0–3 m national DEM (Chapter 6), but is in line with the substantial under-estimate of land area and risk exposure using the national modified DEM.

For Canterbury, following the 2010/2011 earthquakes, there was a 36% decrease in the population of the most damaged Red Zone areas in the east of Christchurch city (down from 33,255 in the 2006 Census to 21,195 in the 2013 Census).[22] A best estimate for the Residential Red Zone (Christchurch City Council, David Price, pers. comm.) for the usually-resident population in the Red Zone is somewhere between 3,000 and 3,500 people at the 2013 Census, down from around 14,000 in 2006. There was also a 59% decrease in the number of residents usually living in Kaiapoi East (part of the Waimakariri district), down from 2,256 to 918.[25] Both these areas would be mostly below 3 m in elevation. These reductions are already present in the Census 2013 dataset used for this Project, but our analysis does not include any further reductions following Census night.

Across any particular region, the resident population in the low-lying 0–3 m coastal zone (based on areas with available LiDAR surveys) is generally quite a small proportion at < 10% of the region's population (Table 7-1), but Hawke's Bay has by far the highest proportion living in this zone (over 28% of the region's population), followed by Tasman (16%) and Canterbury and Nelson at 14% of the region's population. Otago has a high proportion of people residing in the lower 0–1.5 m elevation band compared to the 1.5–3 m band (Figure 7-1), due to the low-lying nature of coastal plains in Otago (including Dunedin) adjacent to steeply rising topography.

An important caveat with this demographic overview is that the populations in each meshblock are based on people normally resident in these area units and were present in A-NZ on census night (a Tuesday in March 2013). New Zealand residents who are away from their usual address on census night are allocated back to the area where they usually live and form part of the census usually resident population count of that area (Stats NZ, 2014). Therefore, there will be a significant underestimate of people who would be temporarily resident in coastal settlements and towns, particularly in the peak summer season of December–January and occasionally through the year. Consequently for these holiday centres, the number of dwellings in these coastal elevation zones is a more accurate proxy for coastal risk susceptibility, with many buildings only occupied for part of the year (typically summer).

[24] Normally-resident population of A-NZ from Census 2013 was 4,242,048
[25] http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-greater-chch/population-movement.aspx

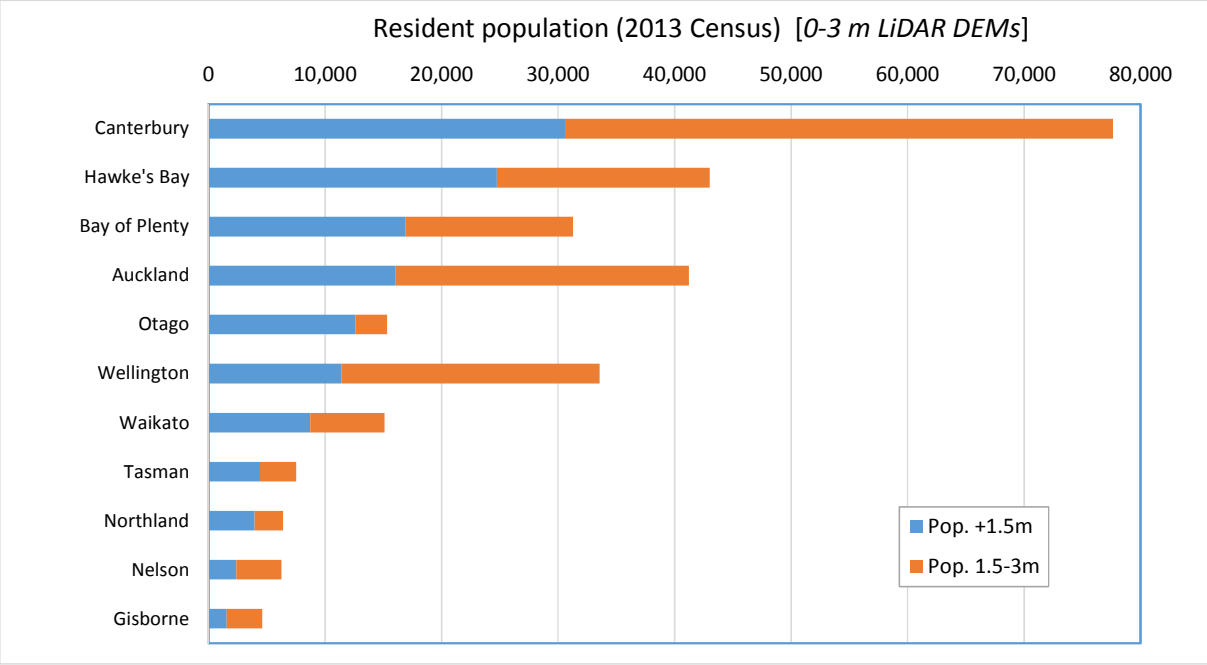


Figure 7-1: Regional distributions of normally-resident population in 0–1.5 m (+1.5m) and 1.5–3 m coastal elevation zones where LiDAR was available. Note: Regions are plotted in descending order based on the population in the lower 0–1.5 m elevation zone. Source: Stats NZ, Census 2013.

Table 7-1: Regional distributions of normally-resident population in the 0–1.5, 1.5–3 and 0–3 m coastal elevation zones (LiDAR areas overlying meshblocks). Source: Stats NZ Census 2013.

Region	Total resident population (0–1.5 m)	Total resident population (1.5–3 m)	Total resident population (0–3 m)	% of total regional population in 0–3 m zone
Northland	3,920	2,482	6,402	4.2
Auckland	16,062	25,176	41,238	2.9
Waikato	8,722	6,376	15,098	3.7
Bay of Plenty	16,918	14,345	31,263	11.7
Gisborne	1,554	3,043	4,597	10.5
Hawke's Bay	24,747	18,282	43,029	28.5
Taranaki	–	–	–	–
Manawatu-Wanganui	–	–	–	–
Wellington	11,399	22,140	33,539	7.1
West Coast	–	–	–	–
Canterbury	30,580	47,057	77,637	14.4
Otago	12,595	2,732	15,327	7.6
Southland	–	–	–	–
Tasman	4,397	3,118	7,515	15.9
Nelson	2,371	3,886	6,257	13.5
Marlborough	–	–	–	–
NZ total (LiDAR areas)	133,265	148,637	281,902	

7.2.2 Population distributions in relation to urban areas

The population results of the previous sub-section were aggregated up to the regional scale. This sub-section outlines the main urban areas within each region where most the population in the 0–1.5 m and0–3 m coastal elevation zones are located. Table 7-2 lists the urban areas from which the main proportions of regional population counts are sourced.

Table 7-2: Urban area distributions of normally-resident population in the 0–1.5 and 0–3 m coastal elevation zones (LiDAR areas overlying meshblocks). Source: Stats NZ Census 2013.

Region/*Urban Area*	Resident population (0–1.5 m)	% of population in-0–1.5 m zone	Resident population (0–3 m)	% of population in-0–3 m zone
Northland (total)	3,920	100	6,402	100
Whangarei	*883*	*23*	*1,379*	*22*
Dargaville	*559*	*14*	*737*	*12*
Auckland	16,062	100	41,238	100
Northern Zone	*4,309*	*27*	*12,756*	*31*
Central Zone	*2,879*	*18*	*10,616*	*26*
Southern Zone	*3,282*	*20*	*9,137*	*22*
Waikato	8,722	100	15,098	100
Whitianga	*842*	*10*	*3,467*	*23*
Thames	*1,568*	*18*	*2,402*	*16*
Bay of Plenty	16,918	100	31,263	100
Tauranga	*6,693*	*40*	*12,180*	*39*
Whakatane	*4,620*	*27*	*8,650*	*28*
Gisborne	1,554	100	4,597	100
Hawke's Bay	24,747	100	43,029	100
Napier	*22,491*	*91*	*38,426*	*89*
Hastings	*2,134*	*9*	*3,913*	*9*
Wellington	11,399	100	33,539	100
Lower Hutt	*7,432*	*65*	*15,873*	*47*
Wellington	*2,455*	*22*	*10,355*	*31*
Kāpiti Coast	*671*	*6*	*4,662*	*14*
Canterbury	30,580	100	77,637	100
Christchurch	*29,422*	*96*	*75,106*	*97*
Otago	12,595	100	15,327	100
Dunedin	*11,204*	*89*	*13,362*	*87*
Tasman	4,397	100	7,515	100
Motueka	*2,750*	*63*	*4,600*	*61*
Nelson	2,371	100	6,257	100
NZ total (LiDAR areas)	133,265		281,902	

Apart from Northland and Waikato and to a lesser extent Tasman, the main concentration of populations in these low-lying elevation bands are essentially in urban or peri-urban areas. For example, Christchurch City makes up 96–97% of the Canterbury region population in the coastal elevation zones, and similarly Dunedin City makes up 87–89% of the Otago total. In the Wellington region, Lower Hutt has a substantially higher population in the 0–3 m elevation zone than Wellington City, followed by Kāpiti Coast. Likewise in Hawke's Bay, the population count is dominated by Napier City (~90% of the regional total) compared with Hastings.

7.2.3 Regional population distribution by elevation band

Regional population estimates, based on an area-weighted approach for each elevation-band to apportioning each meshblock population, were generated for individual LiDAR derived elevation bands of ≤0.5, 1, 1.5, 2, 2.5 and 3 m above the local MHWS-10 baseline. North Island and South Island region population counts per elevation band for the area within 3 m above MHWS-10 elevation are presented in Figure 7-2 and Figure 7-3.

Canterbury, with the most population within the 0–3 m elevation range, along with Wellington peak at the 2 m elevation, before the population count per elevation band decreases, whereas most other regions show a fairly uniform distribution across the elevation bands. The exception is Otago, which exhibits a high number of people resident in land areas between 0–0.5 m elevations (upper-right; Figure 7-3).

These distributions of population per elevation band are only approximate, as population data is only geo-referenced to a wider meshblock area unit. The aggregated results for the 0–1.5 m and 0–3 m coastal elevation zones are likely to be more robust measures of population in broader zones. A more sharply-focused measure of coastal risk exposure as a function of elevation above MHWS-10 is available from the spatial analysis of buildings, for which their individual footprints are geo-referenced.

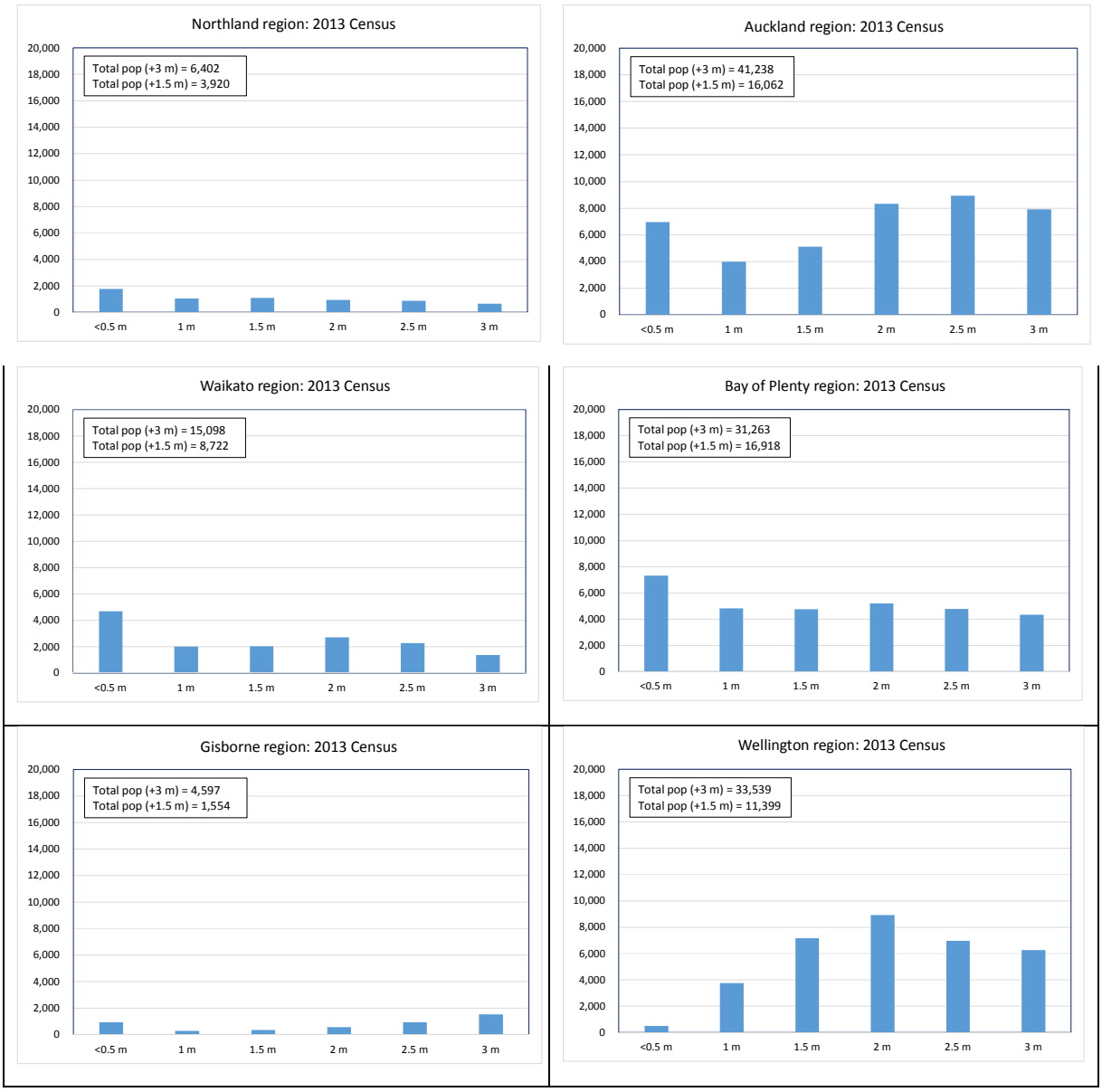


Figure 7-2: Distribution of population by elevation band within North Island regions where LiDAR DEMs were available. Source: Stats NZ Census 2013 processed by area-weighted proportions of elevation band polygons relative to the meshblock area.

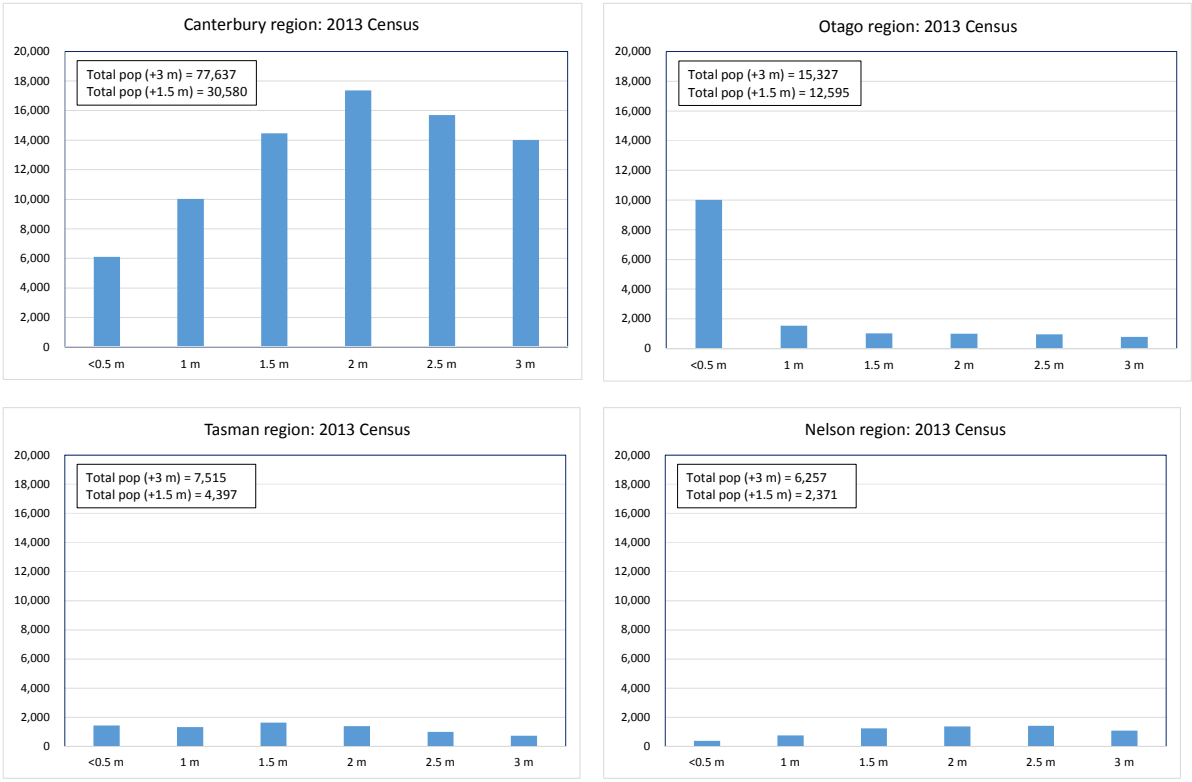


Figure 7-3: Distribution of population by elevation band within South Island regions where LiDAR DEMs were available. Source: Stats NZ Census 2013 processed by area-weighted proportions of elevation band polygons relative to the meshblock area.

7.3 Land-cover and parcels for the incremental coastal-elevation bands (LiDAR)

The distribution of land-use within the 0–1.5 m and the 0–3 m coastal elevation zones in regions where LiDAR was available, categorized by urban, primary production or natural environment, is shown in Figure 7-4 and listed in Table 7-3 and Table 7-4.

Nationally, for those areas where a LiDAR DEM was available, the total land-cover area for the 0–1.5 m coastal elevation zone is 1,290 km^2 (0.5% of the land area of A-NZ[26]), rising to around 2,000 km^2 (0.7% of A-NZ land area). The latter is nearly twice the land area extracted from the analysis using the national modified DEM for the wider 0–3 m elevation zone.

Waikato has the largest area nationally for both 0–1.5 m and 0–3 m coastal elevation zones (Figure 7-4), followed by Bay of Plenty and Canterbury. This is quite a different distribution that that shown for the national DEM, comparing Figure 6-3 with the bottom panel of Figure 7-4, which are to the same horizontal scale. The main differences are the substantial increase in areas in the Waikato and Otago, along with an increase in all other areas when LiDAR analysis is applied. While there is not full LiDAR coverage of A-NZ coastal areas, the total land area for 0–3 m zone is nearly double the area enumerated for the national modified DEM.

[26] Based on total land area of 272,900 km^2 for A-NZ

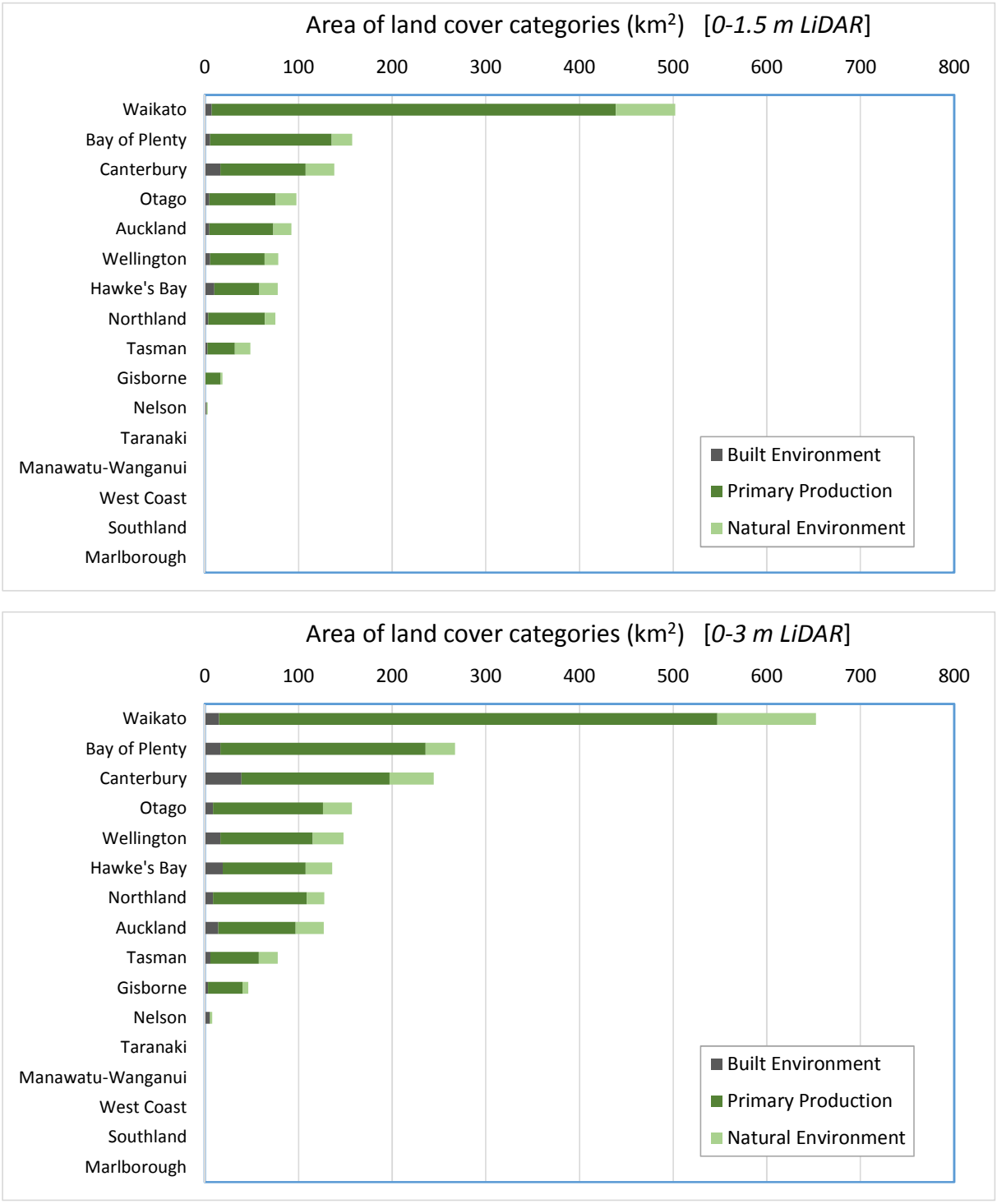


Figure 7-4: Regional distributions of land-cover where LiDAR was available: (top) 0-1.5 m; (bottom) 0-3 m.
Source: Landcare Research Land Cover Database V4.

Primary production is the most extensive land cover type within the 0–3 m area above MHWS-10, where LiDAR was available. This land cover is estimated to occupy 77% of land within 0–1.5 m elevation of MHWS-10 and 75% of land within 0–3 m. Waikato, primarily the Hauraki Plains, accounts for over one third of New Zealand's primary production land in both elevation bands. Primary production land cover also occupies over 80% of all land in this region for both elevation zones though most (81%) of all primary production land below 3 m is within the 0–1.5 m elevation zone.

Northland, Bay of Plenty, Gisborne and Otago also have over 70% primary production land cover within both LiDAR elevation zones.

The built-environment is estimated to cover 64 km^2 within 0–1.5 m elevation zone above MHWS-10, which more than doubles to 154 km^2 (+240%) over the 0–3 m elevation zone. Canterbury has the most extensive built-land cover with an area of just under 39 km^2 (although this has decreased with the formation of the residential Red Zone in Christchurch). The built environments of Auckland, Waikato, Bay of Plenty, Hawke's Bay and Wellington all occupy between 14–19 km^2 of land within the cumulative 0–3 m elevation zone. Gisborne has the least built land covering 3.42 km^2, of those regions with LiDAR available.

Land cover classified as natural environments comprises 17% of New Zealand's land (within 0–3 m of MHWS-10) covered by an available LiDAR DEM. Waikato, Canterbury and the Bay of Plenty account for just over 50% of all natural environment land cover identified in this elevation zone. Nelson's relatively small land area coupled by extensive built-environment land cover reflects the lowest natural environment land cover extent observed across all regions.

Table 7-3: Regional distributions of three aggregated land-cover types in the 0–1.5 m coastal elevation band (LiDAR). Source: Landcare Research Land-Cover Database Version 4 (LCBDv4).

Region	Built-Environment Land Area (km^2)	Primary Production Land Area (km^2)	Natural Environment Land Area (km^2)	Total Land Area (km^2)
Northland Region	3.61	60.26	11.66	75.5
Auckland Region	4.75	68.24	19.45	92.4
Waikato Region	7.33	431.38	63.45	502.1
Bay of Plenty Region	5.72	129.52	21.99	157.2
Gisborne Region	0.74	15.94	2.35	19
Hawke's Bay Region	10.27	48.08	19.51	77.8
Taranaki Region	–	–	–	–
Manawatu-Wanganui	–	–	–	–
Wellington Region	5.73	57.91	14.70	78.3
West Coast Region	–	–	–	–
Canterbury Region	16.52	91.14	30.56	138.2
Otago Region	4.81	70.95	22.05	97.8
Southland Region	–	–	–	–
Tasman Region	2.84	29.29	16.32	48.4
Nelson Region	1.83	0.18	1.19	3.2
Marlborough Region	–	–	–	–
NZ Total	**64**	**1,003**	**223**	**1,290**

Table 7-4: Regional distributions of three aggregated land-cover types in the 0-3 m coastal elevation band (LiDAR). Source: Landcare Research Land-Cover Database Version 4 (LCBDv4).

Region	Built-Environment Land Area (km²)	Primary Production Land Area (km²)	Natural Environment Land Area (km²)	Total Land Area (km²)
Northland Region	8.68	100.05	18.73	127.4
Auckland Region	14.32	82.63	29.93	126.8
Waikato Region	15.13	532.17	105.24	652.5
Bay of Plenty Region	16.45	219.37	31.47	267.2
Gisborne Region	3.42	36.89	5.96	46.2
Hawke's Bay Region	19.13	88.62	28.24	136
Taranaki Region	–	–	–	–
Manawatu-Wanganui	–	–	–	–
Wellington Region	17.16	114.17	24.00	155.3
West Coast Region	–	–	–	–
Canterbury Region	38.93	158.46	47.21	244.6
Otago Region	8.64	117.55	30.91	157.1
Southland Region	–	–	–	–
Tasman Region	6.07	51.56	20.33	77.9
Nelson Region	5.12	0.38	2.54	8
Marlborough Region	–	–	–	–
NZ Total	**153**	**1,502**	**345**	**1,999**

Overall, the number of cadastral land parcels contained within the 0–1.5 m coastal elevation zones of the LiDAR-surveyed regions is highest in Canterbury (18%), then Waikato, Auckland and Bay of Plenty (12–13%), with a similar distribution for the 0–3 m LiDAR elevation zone (Figure 7-5, Table 7-5 and Table 7-6). Otago has proportionately more land parcels in the lower 0–1.5 m elevation zone. Gisborne and Nelson have the fewest number of parcels of the regions with LiDAR DEMs available.

Land parcels identified as used for built environments (e.g., urban development, transport infrastructure) account for 58% of the 293,897 parcels identified within the 0–3 m coastal elevation zone. A little over a quarter of these land parcels are located in Canterbury. Auckland, Waikato, Bay of Plenty, Hawke's Bay and Wellington each have over 16,000 built land parcels while Gisborne and Nelson have the fewest in the elevation band with less than 5,000 in each region. For all built-environment parcels, 54% are located between 0–1.5 m above MHWS-10.

Land parcels used for primary production are identified for just under one quarter of all land parcels between 0–3 m above MHWS-10. Waikato and Bay of Plenty have the highest concentrations of these parcels for this elevation zone, which is consistent with primary production land cover extent estimates. Other regions such as Hawke's Bay and Otago also have relatively high numbers of primary production parcels in the 0–3 m elevation zone with over 7,800 land parcels identified in each region.

Land parcels occupied by natural environment land parcels for the 0–3 m coastal elevation zone are mostly located in regions north of Bay of Plenty. These northern regions account for 59% of the 53,196 land parcels identified as used for natural environments. Just over one third of these parcels

are located in Auckland. Regions with the lowest number of natural environment parcels in both the 0–1.5 m and 0–3 m coastal elevation zones (e.g., Gisborne and Nelson) correspond with the lowest land area extents in these bands.

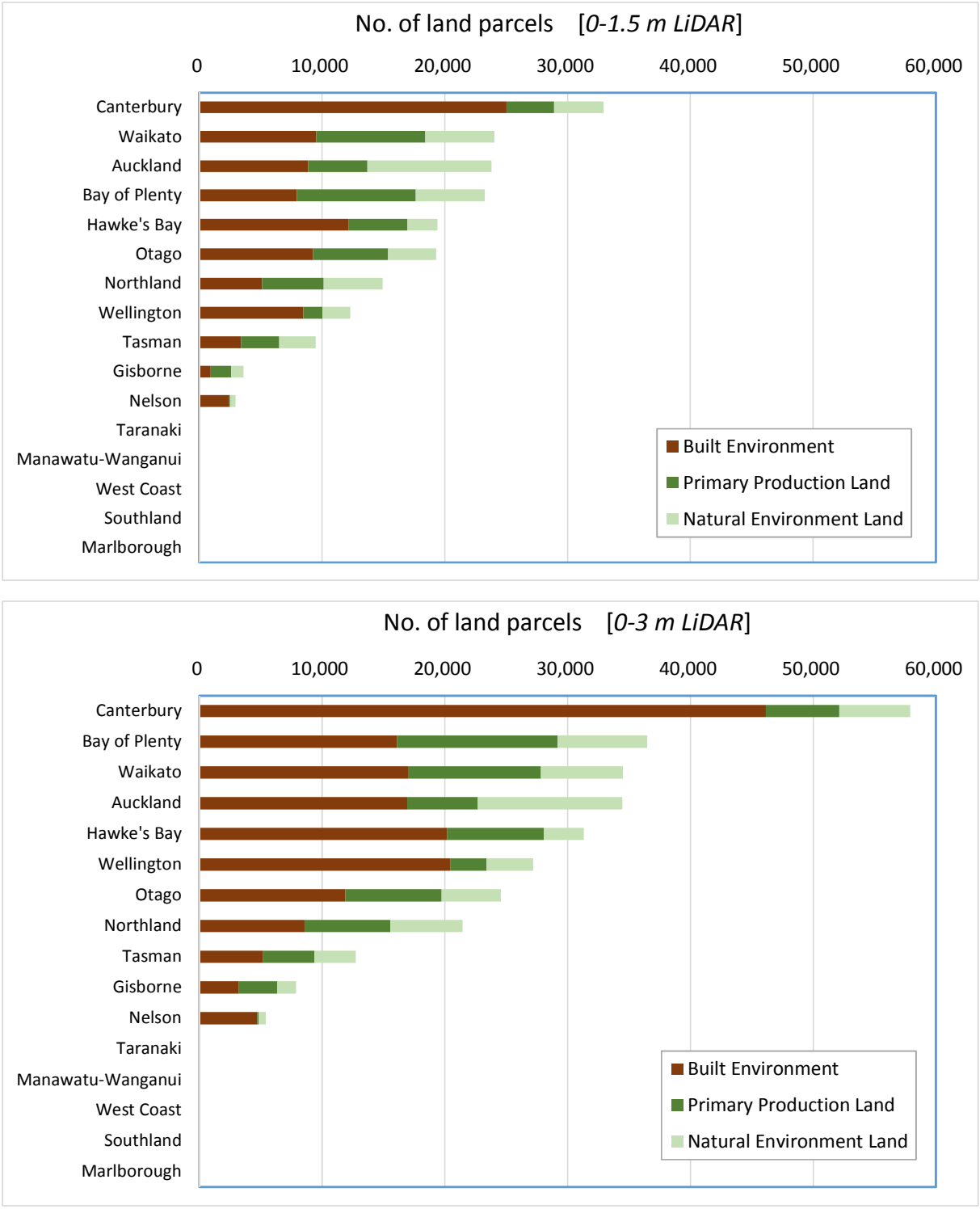


Figure 7-5: Regional distribution of the No. of land parcels for different land-cover categories for the cumulative LiDAR elevation bands: (top) 0–1.5 m; (bottom) 0–3 m coastal elevation zones. Source: LINZ database and Landcare Research Land-Cover Database v4.

Table 7-5: Regional distributions land parcels nos. for different land-cover types in the 0-1.5 m coastal elevation band (LiDAR). Source: LINZ database and Landcare Research Land-Cover Database Version 4 (LCBDv4).

Region	Built-Environment (No.)	Primary Production (No.)	Natural Environment (No.)	Total Land Parcels (No.)
Northland Region	5,118	5,004	4,803	14,925
Auckland Region	8,853	4,823	10,125	23,801
Waikato Region	9,525	8,878	5,625	24,028
Bay of Plenty Region	7,946	9,667	5,633	23,246
Gisborne Region	926	1,669	1,004	3,599
Hawke's Bay Region	12,181	4,787	2,427	19,395
Taranaki Region	–	–	–	–
Manawatu-Wanganui Region	–	–	–	–
Wellington Region	8,449	1,574	2,282	12,305
West Coast Region	–	–	–	–
Canterbury Region	25,022	3,861	4,038	32,921
Otago Region	9,269	6,100	3,916	19,285
Southland Region	–	–	–	–
Tasman Region	3,414	3,108	2,971	9,493
Nelson Region	2,440	59	439	2,938
Marlborough Region	–	–	–	–
NZ Total	**93,143**	**49,530**	**43,263**	**185,936**

Table 7-6: Regional distributions land parcels nos. for different land-cover types in the 0-3 m coastal elevation band (LiDAR). Source: LINZ database and Landcare Research Land-Cover Database Version 4 (LCBDv4).

Region	Built-Environment (No.)	Primary Production (No.)	Natural Environment (No.)	Total Land Parcels (No.)
Northland Region	8,583	6,973	5,887	21,443
Auckland Region	16,941	5,755	11,748	34,444
Waikato Region	17,007	10,808	6,685	34,500
Bay of Plenty Region	16,096	13,106	7,289	36,491
Gisborne Region	3,224	3,117	1,543	7,884
Hawke's Bay Region	20,193	7,858	3,274	31,325
Taranaki Region	–	–	–	–
Manawatu-Wanganui Region	–	–	–	–
Wellington Region	20,436	2,967	3,788	27,191
West Coast Region	–	–	–	–
Canterbury Region	46,150	5,975	5,776	57,901
Otago Region	11,899	7,836	4,825	24,560
Southland Region	–	–	–	–
Tasman Region	5,173	4,209	3,365	12,747
Nelson Region	4,738	102	571	5,411
Marlborough Region	–	–	–	–
NZ Total	**170,440**	**68,706**	**54,751**	**293,897**

7.4 Built and infrastructure assets in coastal elevation bands (LiDAR)

7.4.1 Buildings (regional)

Counts of building use types and associated replacement costs ($2011 NZD) were enumerated for 0–1.5 m and 0–3 m coastal elevation zones in each region where LiDAR datasets were available and are presented by region in descending order in Figure 7-6 and Figure 7-7 and listed in (Table 7-7 to Table 7-10). Results are given for Canterbury for both the 2012 situation as represented in the updated RiskScape building inventory and excluding the Christchurch Residential Red Zone, with the national total counts using the latter.

Nationally (excluding areas and regions without LiDAR coverage), there are over 68,000 buildings in the 0–1.5 m coastal elevation zone, which rises to a total of 166,750 buildings for the 0–3 m elevation zone (Table 7-7 and Table 7-8).

Canterbury and Hawke's Bay, followed by Waikato have the most buildings in the lower-lying 0–1.5 m coastal elevation zone (Figure 7-6), but Wellington and Bay of Plenty join this group with the highest building counts of all types across the 0–3 m coastal elevation zone (Figure 7-7). The building count for the Wellington region is boosted by a higher proportionate number of commercial buildings (predominantly Wellington and Lower Hutt), which is reflected in the building replacement costs (bottom panel of Figure 7-7).

Nationally, in areas surveyed by LiDAR, the total replacement costs for enumerated buildings of all classes accumulates to NZD$19.3B (2011) for the 0–1.5 m coastal elevation zone rising to around NZD$52B (2011) across the wider 0–3 m coastal elevation zone (Table 7-9 and Table 7-10). The latter value for areas with LiDAR surveys is over twice the NZD$24B (2011) enumerated for building replacement costs from the 0–3 m national DEM, which covered all regions. Canterbury, Auckland, Wellington and Hawke's Bay dominate the replacement cost national totals (bottom panels of Figure 7-6 and Figure 7-7), with Auckland (2011 $11B) and the Wellington region (2011 $9.8B) returning the highest replacement cost totals for the 0–3 m elevation zone.

Building counts

Despite the limited LiDAR coverage across New Zealand, a considerable increase in buildings counts was identified in the LiDAR 0–3 m elevation band relative to the 0–3 m elevation zone from the national DEM, using the same building inventory dataset. The 0–3 m LiDAR elevation zone yielded a 94% increase in building counts across LiDAR surveyed areas in A-NZ from 85,885 to 166,755 buildings (excluding the Christchurch Red Zone), translating to an additional 80,870 buildings than enumerated from the national DEM for supposedly the same 0–3 m elevation zone. Proportionately, Nelson has the greatest increase in building count compared to the national DEM (~4,600 buildings versus 425) while the 0–3 m elevation zone from the LiDAR analysis for Canterbury includes a further 17,232 buildings (excluding the Christchurch Red Zone). Counts of buildings also increased in Bay of Plenty, Wellington and Hawke's Bay by over 10,000 buildings. Tasman and Gisborne show the smallest numerical increase in building counts compared to the national DEM, however, proportionately the number of buildings increased by 170% in these regions using the LiDAR datasets.

Similar to the 0–3 m elevation band from the national DEM, residential buildings are the most common type identified in the 0–1.5 m and 0–3 m LiDAR coastal elevation zones (Table 7-7 and Table 7-8). Residential buildings represent two-thirds (65%) of all buildings in both these cumulative

elevation zones where LiDAR DEMs were available. For replacement costs, the ratio of residential building costs within the overall building portfolio dropped to 56–57% for both elevation zones.

For regions with LiDAR DEMs available, only 58,177 residential buildings were identified within the 0–3 m national DEM, while the LiDAR polygons over the same 0–3 m elevation band returned nearly 51,000 (+88%) more residential buildings. Over half of these additional buildings enumerated are located in Canterbury (10,090), Wellington (10,205) and Hawke's Bay (6.432).

A smaller number of buildings (3,900), at a total replacement cost of $1.5B, were identified within the 0–3 m national DEM across the five regions where LiDAR DEMs were not available.

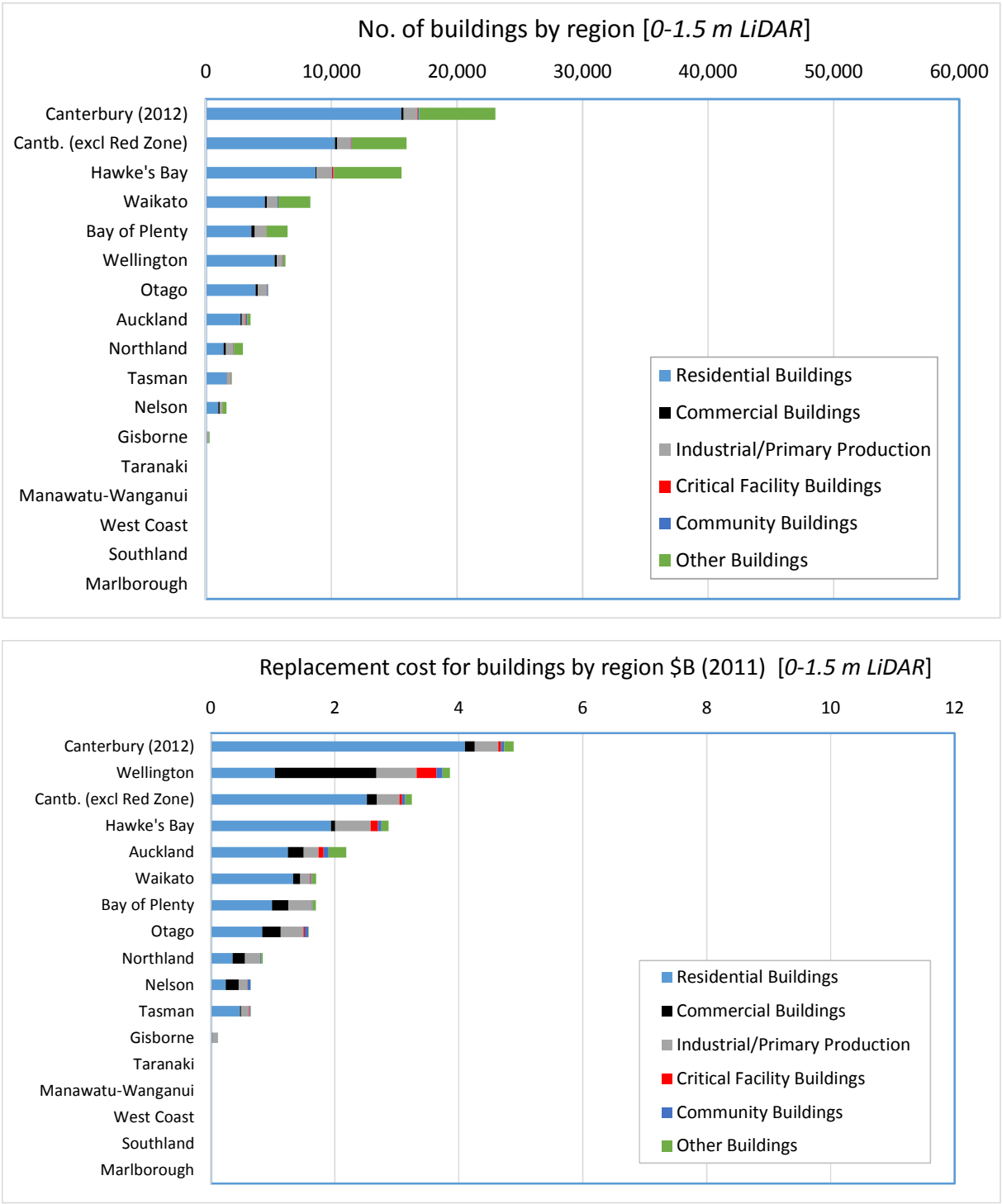


Figure 7-6: Regional distributions for the 0–1.5 m LiDAR coastal elevation zone for: (top) No. of buildings; (bottom) replacement cost in NZ$B (2011). Source: RiskScape building inventory, with a bar also shown for Canterbury excl. the Red Zone. No LiDAR DEMs were available for the last 5 regions.

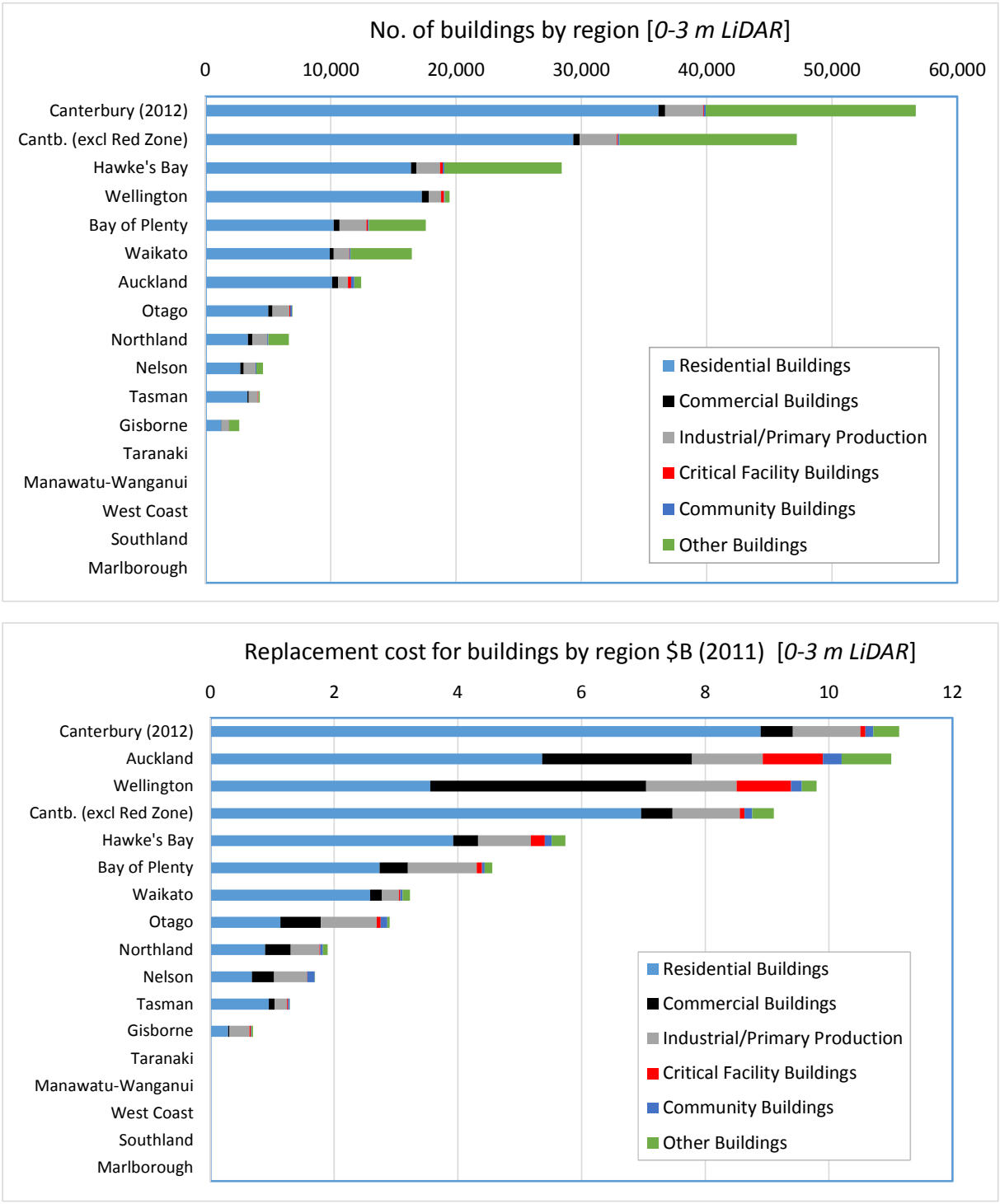


Figure 7-7: Regional distributions for the 0–3 m LiDAR coastal elevation zone for: (top) No. of buildings; (bottom) replacement cost in NZ$B (2011). Source: RiskScape building inventory, with a bar also shown for Canterbury excl. the Red Zone. No LiDAR DEMs were available for the last 5 regions.

Table 7-7: Distribution by region of the No. of buildings for different classes in the 0-1.5 m coastal elevation band (LiDAR). Source: RiskScape building inventory, with the entry for Canterbury excl. the Red Zone. No LiDAR DEMs were available for the 5 regions with dashes.

Region	Residential	Commercial	Industrial/Primary Production	Critical Facility	Community	Other	Total
Northland	1,412	173	610	4	27	724	2,950
Auckland	2,761	87	261	81	106	247	3,543
Waikato	4,700	167	839	12	48	2,555	8,321
Bay of Plenty	3,633	258	892	10	20	1,683	6,496
Gisborne	70	1	163	0	3	50	287
Hawke's Bay	8,740	88	1,201	124	51	5,382	15,586
Taranaki	–	–	–	–	–	–	–
Manawatu-Wanganui	–	–	–	–	–	–	–
Wellington	5,483	160	435	54	38	165	6,335
West Coast	–	–	–	–	–	–	–
Canterbury*	10,284	194	1,057	43	59	4,342	15,979
Otago	3,957	187	702	27	63	21	4,957
Southland	–	–	–	–	–	–	–
Tasman	1,656	16	313	22	14	41	2,062
Nelson	987	117	208	5	21	315	1,653
Marlborough	–	–	–	–	–	–	–
NZ Total*	**43,683**	**1,448**	**6,681**	**382**	**450**	**15,525**	**68,169**

* excludes the Christchurch Residential Red Zone

A total of nearly 3,800 commercial buildings were identified in the 0–3 m above MHWS-10 elevation band for all regions (Table 7-8), compared to only just over 900 commercial buildings from the 0–3 m national DEM for those areas with LiDAR DEMs available (Table 6-5) – a substantial 320% increase.

Wellington, which has around 540 commercial buildings for the 0–3 m LiDAR elevation zone, is the highest regional count, followed by Canterbury, Auckland and the Bay of Plenty (all > 450 commercial buildings). Bay of Plenty records the highest number of commercial buildings (258) in the 0–1.5 m coastal elevation zone, followed by Canterbury and Otago (>180 commercial buildings), while Gisborne has the lowest.

Table 7-8: Distribution by region of the No. of buildings for different classes in the 0-3 m coastal elevation band (LiDAR). Source: RiskScape buildings inventory, with the entry for Canterbury excl. the Red Zone. No LiDAR DEMs were available for the 5 regions with dashes.

Region	Residential	Commercial	Industrial/Primary Production	Critical Facility	Community	Other	Total
Northland	3,401	348	1,168	22	67	1,655	6,661
Auckland	10,108	472	787	253	258	544	12,422
Waikato	9,921	298	1,261	20	84	4,875	16,459
Bay of Plenty	10,245	453	2,156	88	85	4,556	17,583
Gisborne	1,252	26	558	11	10	830	2,687
Hawke's Bay	16,419	405	1,896	218	109	9,367	28,414
Taranaki	–	–	–	–	–	–	–
Manawatu-Wanganui	–	–	–	–	–	–	–
Wellington	17,274	538	987	233	77	374	19,486†
West Coast	–	–	–	–	–	–	–
Canterbury*	29,357	503	2,982	69	131	14,136	47,178
Otago	5,007	340	1,357	55	141	46	6,946
Southland	–	–	–	–	–	–	–
Tasman	3,351	113	701	37	37	86	4,325
Nelson	2,782	282	944	8	49	529	4,594
Marlborough	–	–	–	–	–	–	–
NZ Total*	**109,117**	**3,781**	**14,797**	**1,014**	**1,048**	**36,998**	**166,755**

† Includes three commercial buildings (2 in Wellington, one in Lower Hutt) not captured by the masking process during LiDAR processing
* excludes the Christchurch Residential Red Zone.

The highest proportions of industrial or primary production buildings in the 0–3 m coastal elevation zone are located in Canterbury and Bay of Plenty (> 2,100) while Hawke's Bay followed by Canterbury has the most industrial or primary production buildings in the lower-lying 0–1.5 m coastal elevation zone in available LiDAR-surveyed areas. Combined, Canterbury–excluding the red zone (2,982) and Bay of Plenty (2,156) account for around 35% of all industrial or primary production buildings in the 0–3 m elevation zone from the LiDAR-derived polygons. Otago and Nelson has the greatest proportional increase in industrial or primary production buildings counted relative to the 0–3 m national DEM.

Nationally, an estimated 1,014 critical facilities were identified from within the wider 0–3 m LiDAR elevation zone (Table 7-8).

In the 0–1.5 m coastal elevation zone around 380 were identified with most in Hawke's Bay, followed by Auckland. Conversely, Auckland has the highest critical facility building count in 0–3 m elevation zone with around 250 buildings, followed by the Wellington region. Auckland also has a similar number of community buildings in the 0–3 m elevation zone.

'Other' buildings, which include garages and detached rooms, nationally account for just over 22% of all buildings identified in the 0–3 m elevation zone area. Around 38% of these 'other' buildings were identified in Canterbury while Hawke's Bay also accounts for almost 25%. Note: some of these 'other' buildings may have not been yet classified in the RiskScape inventory to one of the specific building types, nevertheless they are still included in the total count and replacement costs.

Building replacement costs

It is estimated that the cumulative replacement cost for buildings identified within in the 0–1.5 m LiDAR elevation zone is NZD$19.4B (2011) as listed in Table 7-9. The Canterbury region (including the Red Zone) would have had the highest count of buildings located within this elevation zone, but excluding all Christchurch Residential Red Zone buildings means that the Wellington region becomes the region with the highest building replacement costs of $3.9B (bottom panel; Figure 7-6). Other regions with major urban centres, Canterbury, Auckland and Hawke's Bay also record replacement costs of greater than $2B, with Canterbury at $3.2B. Overall, these four regions account for 63% of the total replacement costs for areas with LiDAR DEM available.

However, the average building replacement cost in Canterbury of nearly $203,000, is considerably lower than other regions with major urban areas such as Auckland and Wellington which average $616,649 and $608,761 respectively, due to the higher number of non-residential buildings, particularly commercial.

For the wider 0–3 m LiDAR elevation zone, the highest regional total replacement cost is Auckland at $11B (2011), followed by the Wellington region ($9.8B), Canterbury, excluding the Red Zone, ($9.1B) and Hawke's Bay ($5.7B) as shown in the lower panel of Figure 7-7. These four regions account for around 69% of the total building replacement costs of nearly $52B across all regions with LiDAR DEMs available. Interestingly, the eventual removal of all buildings from the Christchurch Residential Red Zone has reduced the risk exposure in the wider 0–3 m elevation zone by around $2B (2011), or 4% of the national total replacement costs.

Total replacement costs for the 0–1.5 m and 0–3 m coastal elevation zones increases from $19.3B to nearly $52B, with an additional $32.6B for the second 1.5 m elevation band (1.5–3 m) above MHWS-10, a factor of 1.7 times (Table 7-9 and Table 7-10). Similarly, Auckland and Wellington region replacement costs in the coastal zone increased by nearly $9B and $6B respectively, relative to the 0–1.5 m elevation zone. This highlights the substantially increased exposure above 1.5 m, which is expected as they are fewer buildings located in the 0–1.5 m zone due to present-day exposure to coastal hazards, especially on the open coast or around larger harbours.

A recent national risk-exposure study for tsunami (Horspool et al. 2015) provides an updated estimate of the replacement costs in A-NZ for all buildings in the RiskScape database, with total estimates of $725B and $358B for residential and non-residential buildings in 2015 NZ$ terms. An increase in replacement costs of 5% and 4% respectively were calculated from 2013 for the tsunami study. Applying the same cost increases from the 2011 base to 2013 used for the present Project, the total estimates of $665B and $331B would apply for residential and non-residential buildings in $NZ 2011 terms. Based on these estimates, the total building replacement costs across the 0–1.5 m coastal elevation zone amounts to around 1.6% and 2.5% of the national building stock for residential and non-residential buildings respectively, rising to 4.4% and 6.9% respectively for the 0–3 m coastal elevation zone. These percentages would be slightly higher if LiDAR DEMs were available for all coastal areas.

Residential buildings account for $5.4B (~50%) of Auckland's total building replacement costs for the 0–3 m elevation zone, whereas in the Wellington region, residential buildings only account for 36% of the total replacement costs, where commercial and industrial building replacement costs account for a higher proportion than Auckland. Auckland's average building replacement cost also increases by $616,649 (0–1.5 m elevation zone) to $886,035 for the 0–3 m elevation zone, with the latter just under 3 times the $311,898 national average (Table 7-10). Outside of Canterbury, Auckland,

Wellington and Hawke's Bay regions, the building replacement-costs in the 0–3 m coastal elevation zone range between $0.7B (Gisborne) to $4.6B (Bay of Plenty), accounting for just over $16B total. (Figure 7-7).

Table 7-9: Regional distribution of replacement costs for residential and all building types and mean unit costs in the 0–1.5 m coastal elevation band (LiDAR) (2011 NZD$). Source: RiskScape buildings inventory, with the entry for Canterbury excl. the Red Zone. No LiDAR DEMs were available for the 5 regions with dashes.

Region	Replacement Costs (2011 NZD$)			
	Residential Buildings ($B)	Mean Residential ($)	All buildings ($B)	Mean all buildings ($)
Northland	0.348	246,732	0.836	283,466
Auckland	1.240	449,042	2.185	616,649
Waikato	1.328	282,580	1.700	204,283
Bay of Plenty	0.986	271,525	1.697	261,197
Gisborne	0.022	313,711	0.115	399,934
Hawke's Bay	1.936	221,560	2.868	183,984
Taranaki	–	–	–	–
Manawatu-Wanganui	–	–	–	–
Wellington	1.033	188,401	3.856	608,761
West Coast	–	–	–	–
Canterbury*	2.521	245,094	3.243	202,978
Otago	0.830	209,630	1.577	318,212
Southland	–	–	–	–
Tasman	0.469	283,356	0.642	311,339
Nelson	0.240	243,129	0.643	389,144
Marlborough	–	–	–	–
NZ Total*	**$10.953B**	**$250,748**	**$19.362B**	**$284,036**

* excludes the Christchurch Residential Red Zone

Table 7-10: Regional distribution of replacement costs for residential and all building types and mean unit costs in the 0–3 m coastal elevation band (LiDAR) (2011 NZD$). Source: RiskScape buildings inventory, with the entry for Canterbury excl. the Red Zone. No LiDAR DEMs were available for the 5 regions with dashes.

Region	Replacement Costs (2011 NZD$)			
	Residential Buildings ($B)	Mean Residential ($)	All buildings ($B)	Mean all buildings ($)
Northland	0.883	259,720	1.893	284,182
Auckland	5.362	530,445	11.006	886,035
Waikato	2.581	260,166	3.227	196,044
Bay of Plenty	2.738	267,275	4.559	259,264
Gisborne	0.288	230,252	0.688	255,992
Hawke's Bay	3.923	238,929	5.739	201,977
Taranaki	–	–	–	–
Manawatu-Wanganui	–	–	–	–
Wellington	3.551	205,588	9.802†	503,036
West Coast	–	–	–	–
Canterbury*	6.962	237,151	9.111	193,122
Otago	1.132	226,069	2.899	417,370
Southland	–	–	–	–
Tasman	0.946	282,418	1.286	297,329
Nelson	0.671	241,357	1.692	368,349
Marlborough	–	–	–	–
NZ Total*	**$29.039B**	**$266,125**	**$51.902B**	**$311,246**

† Note: In Wellington region, three commercial buildings (one in Lower Hutt) totalling an additional NZ$190M were not clipped by the LiDAR auto-masking process to generate a bare-earth DEM, but have now been included in the Wellington region total.

* excludes the Christchurch Residential Red Zone

Distribution of building counts and replacement costs by elevation band

Total building counts and replacement costs were aggregated over each region from the LiDAR-derived elevation bands of 0.25, 0.5, 1, 1.5, 2, 2.5 and 3 m above the local MHWS-10 baseline. The building counts from the individual elevation bands and cumulative variations with land elevation for the North Island and South Island are presented in Figure 7-8 to Figure 7-10. Similarly, the variation of North Island and South Island region aggregated building-replacement costs per-elevation band and cumulative replacement cost with land elevation up to 3 m above MHWS-10 are presented in Figure 7-11 to Figure 7-13. These plots illustrate the distribution of buildings and associated replacement costs across the coastal elevation bands, with the lowest elevation bands a proxy for the highest exposure to coastal hazards and SLR. The results for the Canterbury region exclude buildings in the Christchurch Red Zone (but not the Kaiapoi red zones).

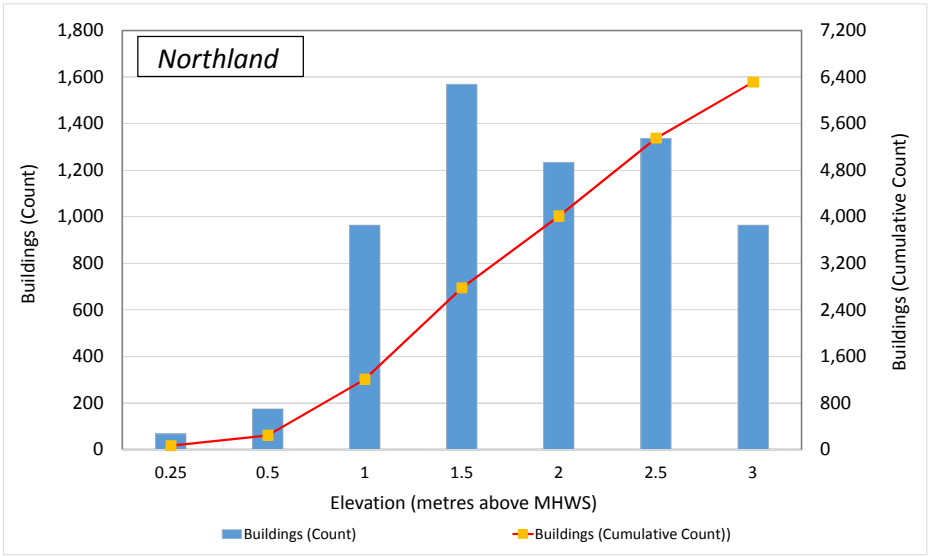
Across A-NZ in areas where LiDAR DEMs were available, nearly 7,500 buildings were identified in the lowest 0–0.25 m elevation band at a replacement cost of NZD$1.6B. Over half of these low-lying buildings are located in the Waikato and Otago (62%). These regions account for 2,851 and 2,319 buildings respectively with combined replacement cost of nearly $1.1B. Residential is the most prominent use type in the 0–0.25 m elevation band representing 68% of all building types. Given the extensive areas of Waikato and Otago primary production land in this lowest elevation band, most of

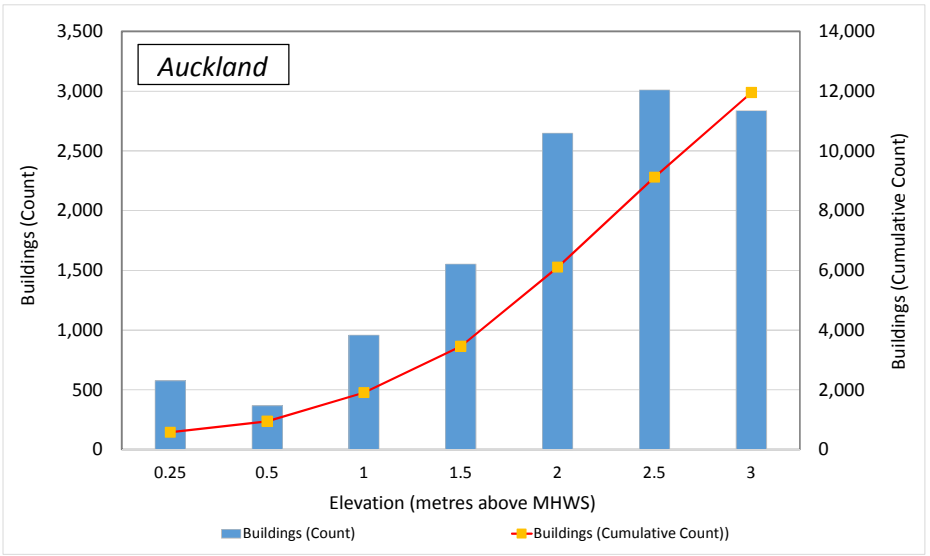
the 756 industrial or primary production buildings identified nationally in LiDAR surveyed areas (77%) from the 0–0.25 m elevation band are also located in these two regions.

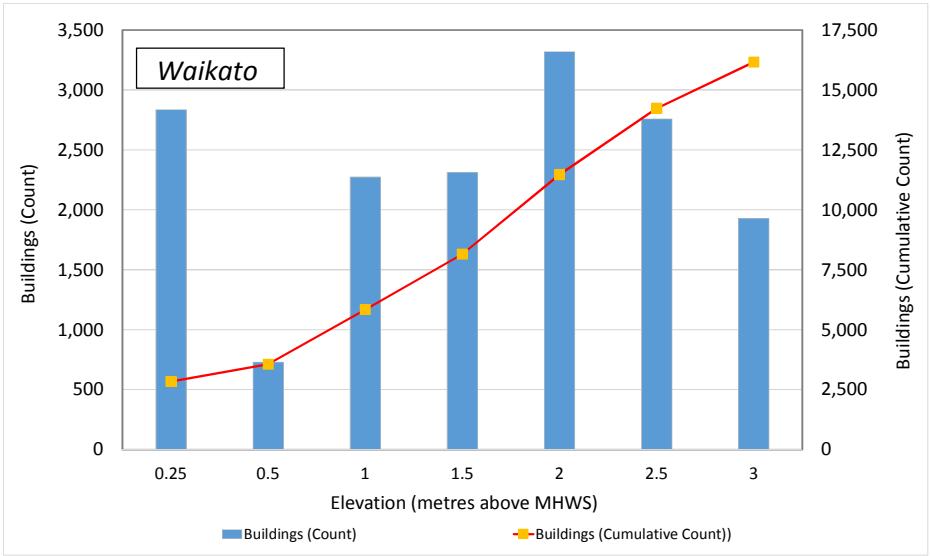
National building counts increase between 0–0.25 m and 1–1.5 m elevation bands by 60,028 to 67,777. Over these elevation bands, total replacement costs also increases by just over NZD$19.1B (2011). On average the total replacement cost increase per elevation band is 227% with the greatest proportional increase experienced between 0.5 m and 1 m (288%). Building counts show a similar but slight higher proportional increase (273%) per elevation band.

For all regions, residential and industrial/primary production building counts increase by five times between 0.25 m and 1 m, while replacement costs increase by 10 times for the latter building use. Canterbury (6,527) and Hawke's Bay (6,226) have the highest building counts for the 0.5–1 m elevation band corresponding with replacement costs of $1.4B and $1.5B. These two regions also experience the highest building counts (15,979 and 8,740) for the 1–1.5 m elevation band while Wellington records the highest building replacement cost of $2.9B. Wellington commercial building replacement cost value increases between 0.5–1 m and 1–1.5 m by almost 10 times from $0.2B to $1.6B.

The distribution of elevation band building counts and replacement costs peak in most regions at either 1.5 m or 2 m above MHWS-10 for most regions then decreases somewhat thereafter for higher elevations. As mentioned, the Waikato and Otago regions show proportionately more buildings in the lowest-lying elevation band. Cumulative curve slopes for both building counts and replacement costs show a steeper linear trend in most regions for all elevation bands above 0.5 m. This indicates overall building counts and replacement costs are relatively low in the lower elevation bands up to 0.5 m (mainly Otago and Waikato), then increase rapidly between 0.5 m and 2 m above MHWS-10. For some regions, cumulative building count (e.g., Northland, Waikato, Hawke's Bay, Wellington, Tasman) and/or cumulative replacement cost (e.g., Waikato, Wellington, Tasman, Otago) curve slopes decrease slightly beyond 2 m or 2.5 m which reflects relatively lower values in the higher elevation bands up to 3 m. The Gisborne region shows a very low risk exposure (building counts and replacement costs) at lower elevation bands that continues to rise up to 3 m, with a sharp increase at 2–2.5 m.







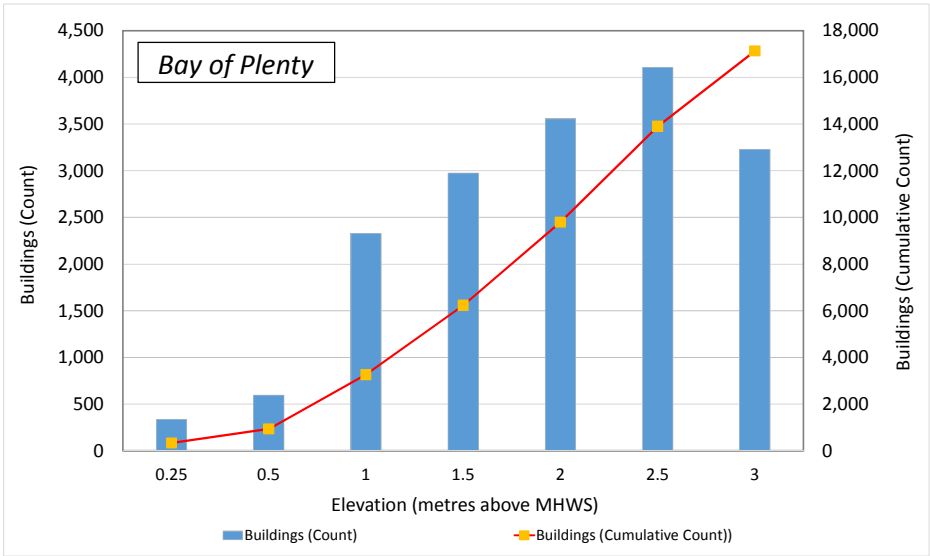
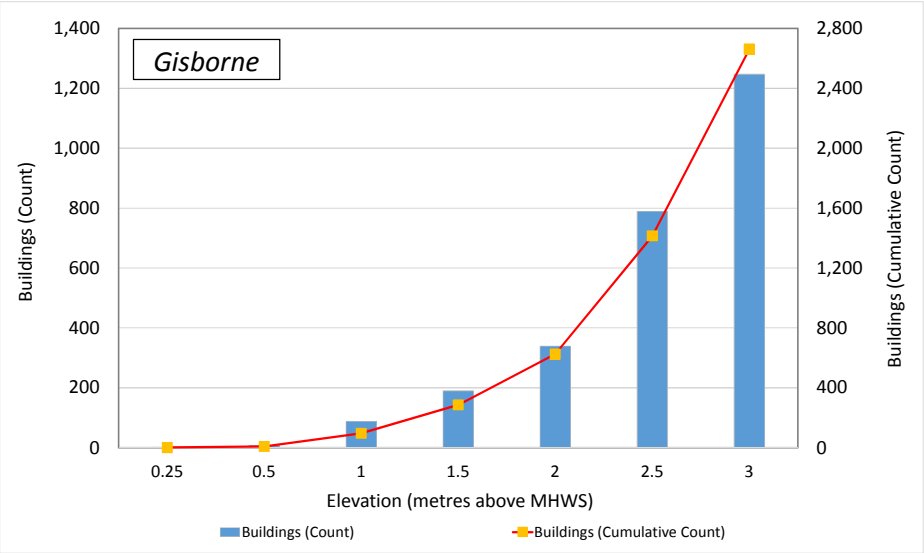
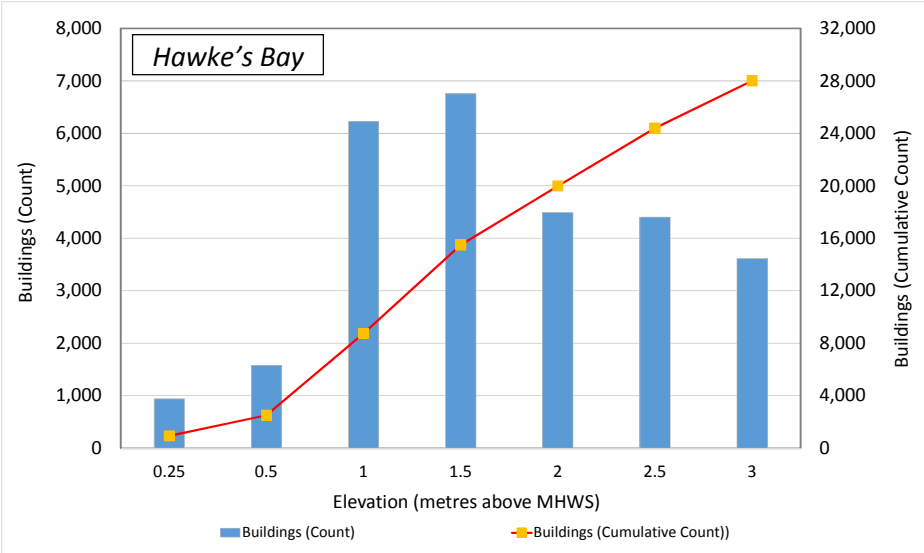


Figure 7-8: Building count variation with elevation band for upper North Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.





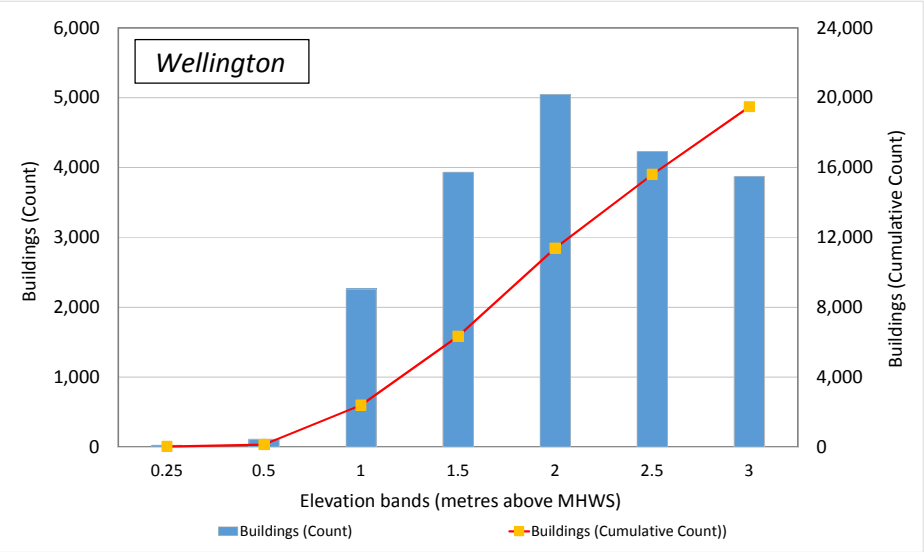
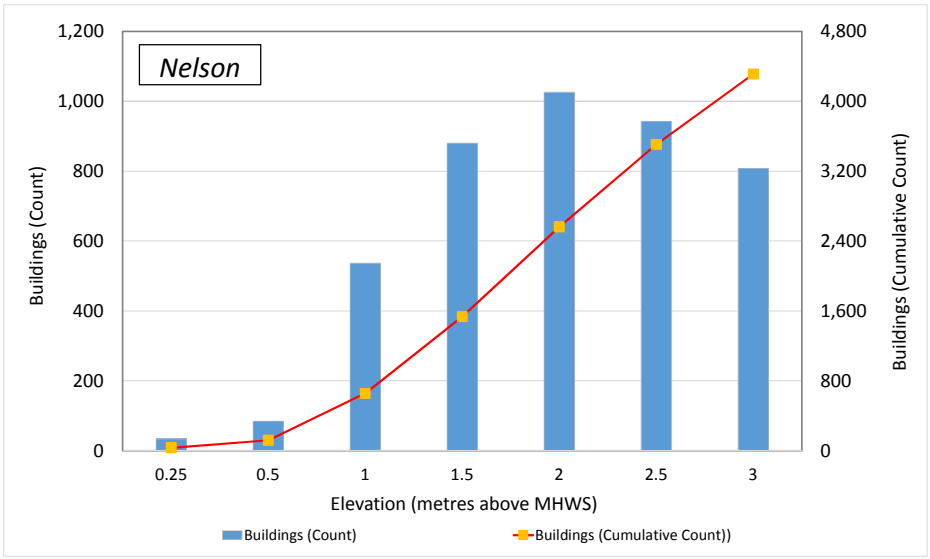
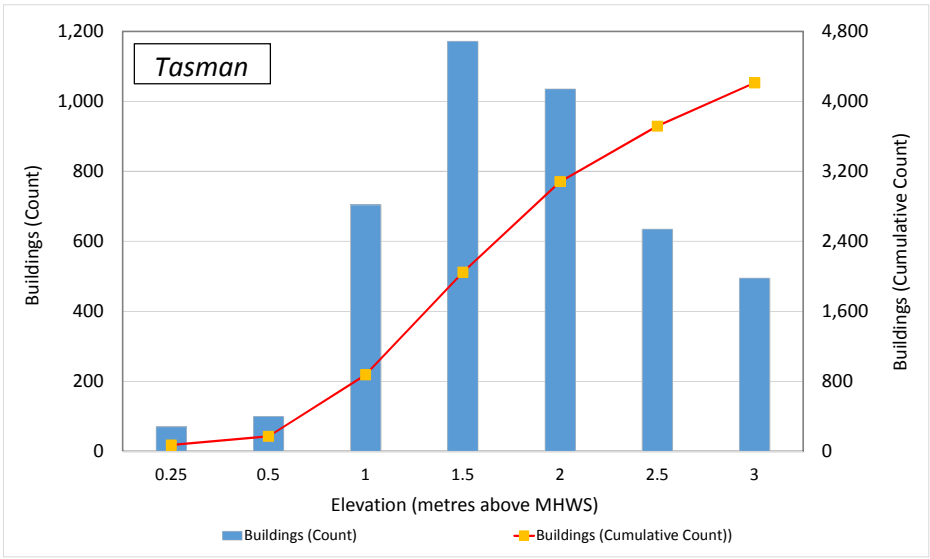
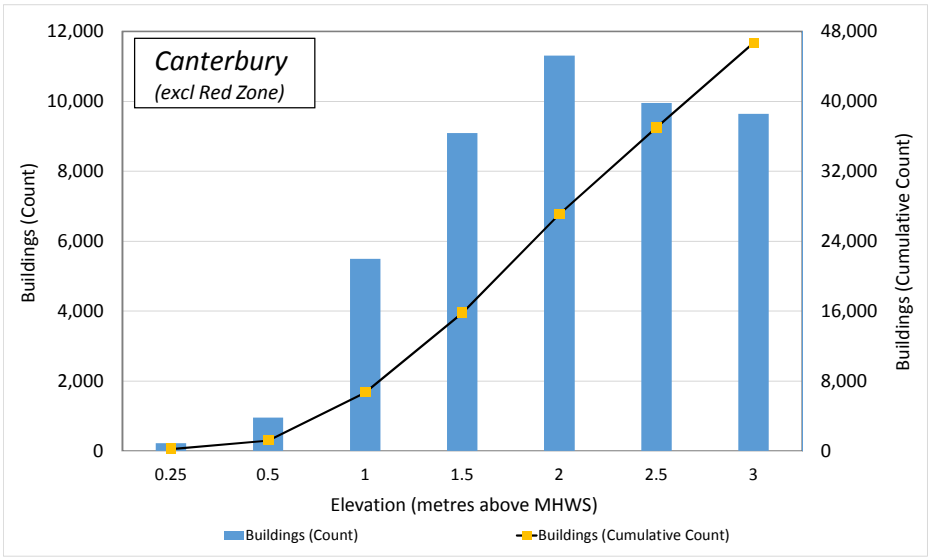


Figure 7-9: Building count variation with elevation band for lower North Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.







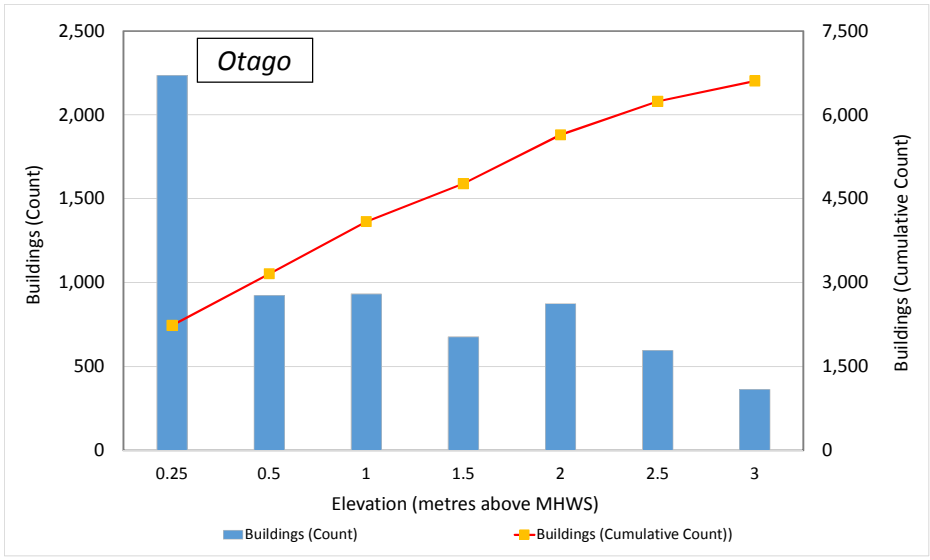
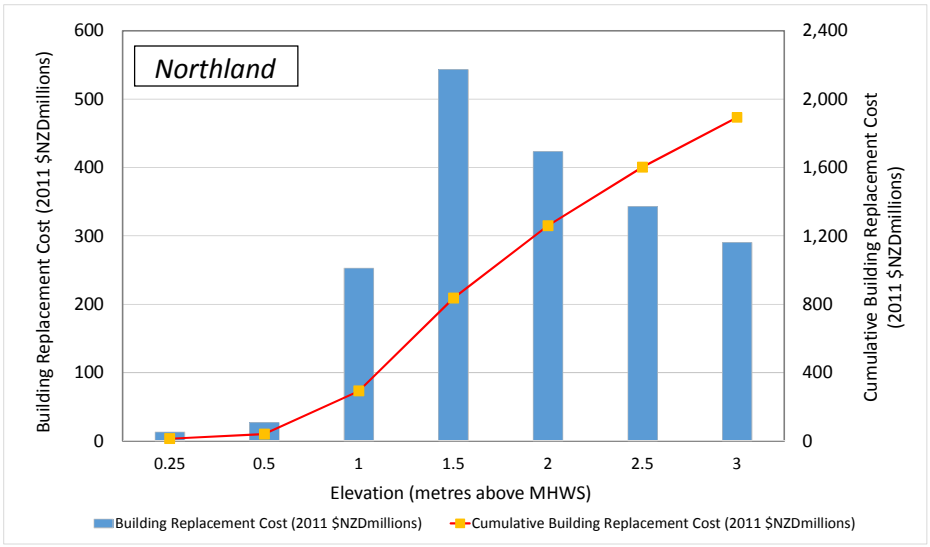
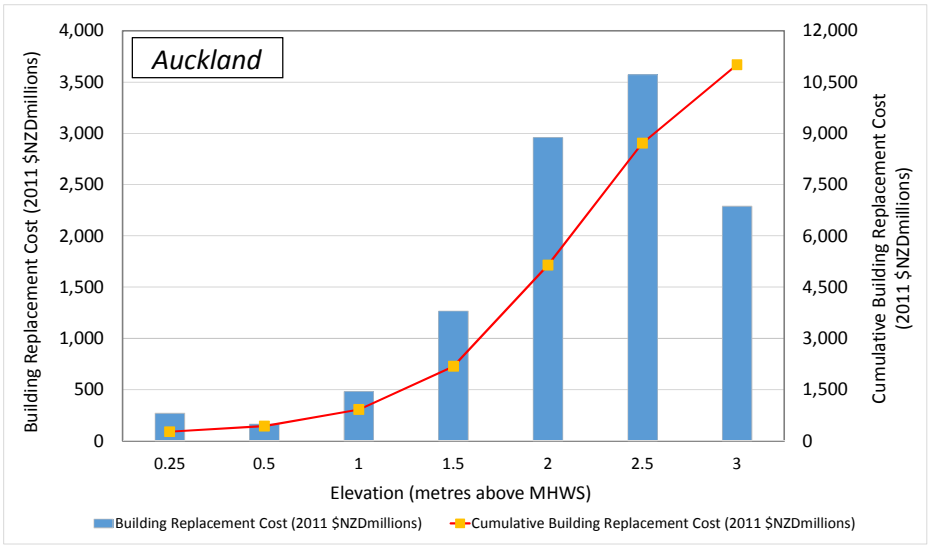
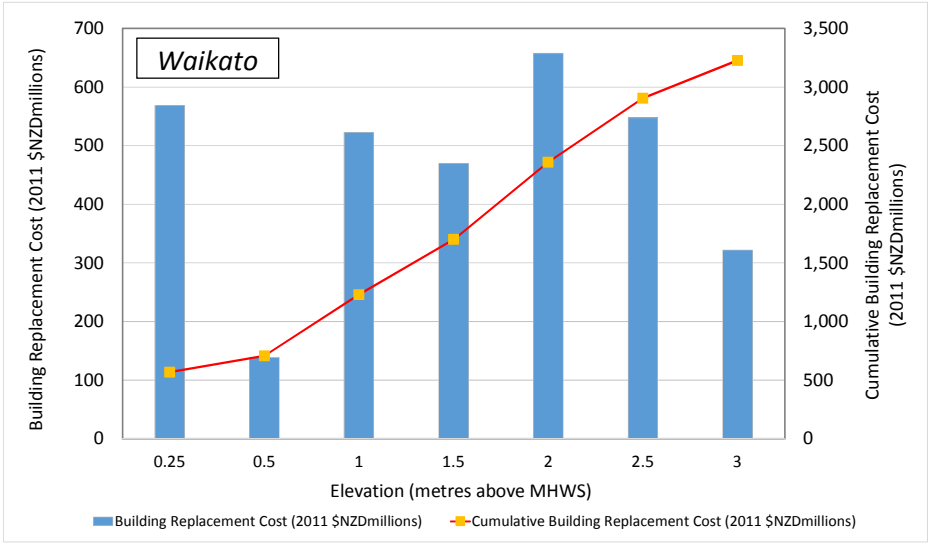


Figure 7-10: Building count variation with elevation band for South Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.







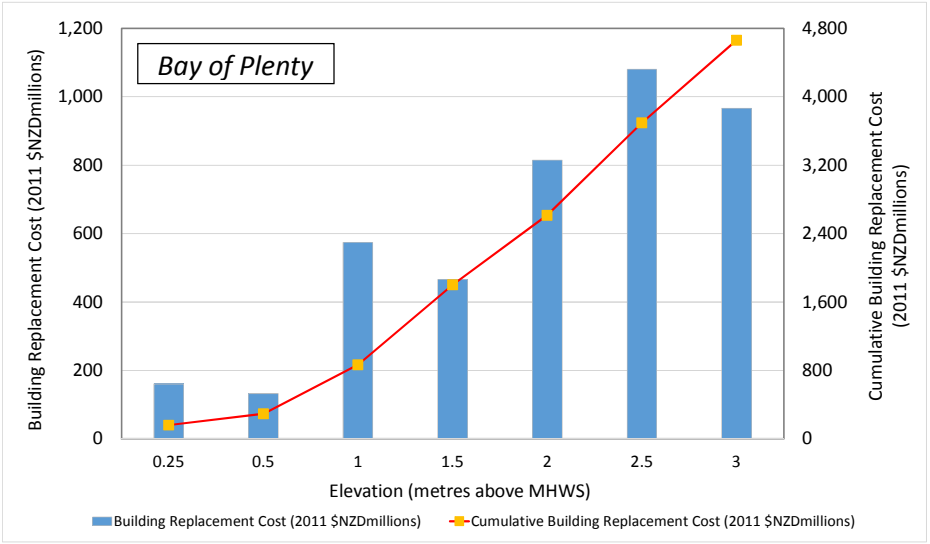
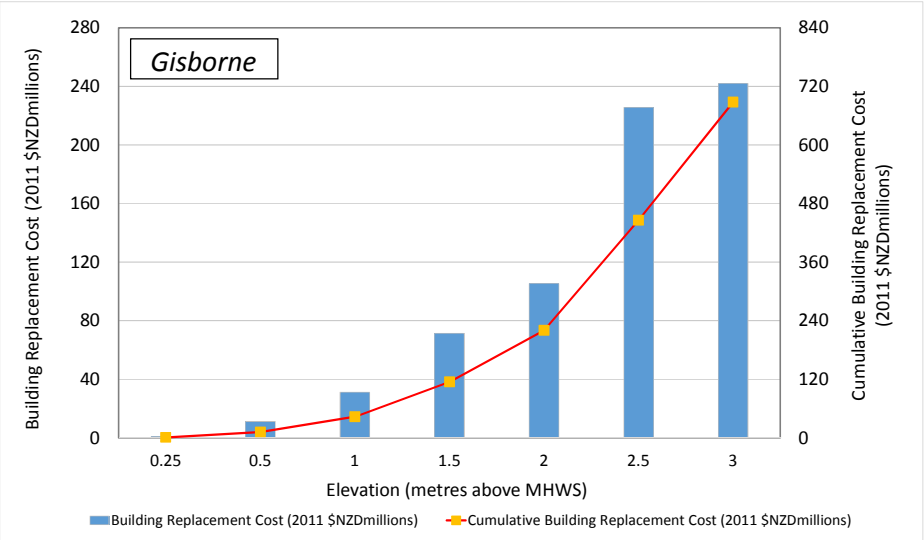
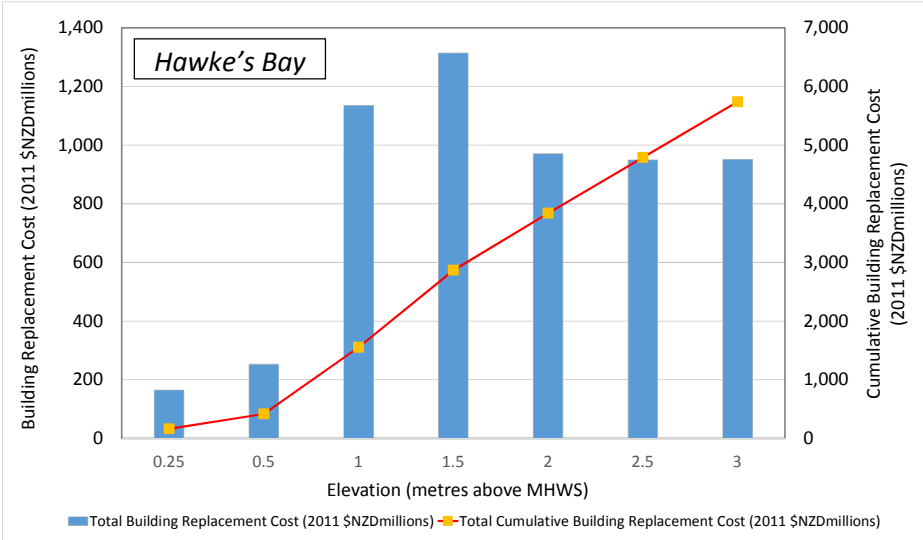


Figure 7-11: Total building replacement cost variation with coastal elevation band for upper North Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.





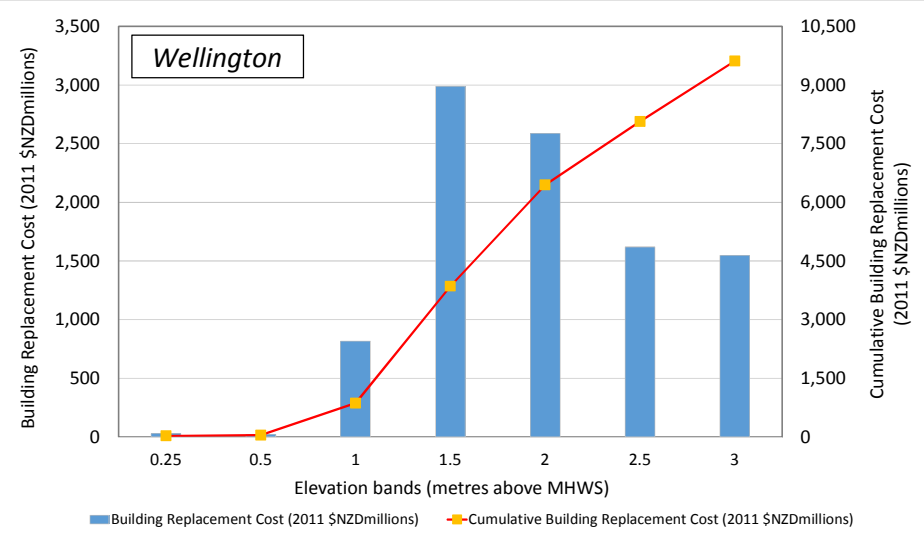
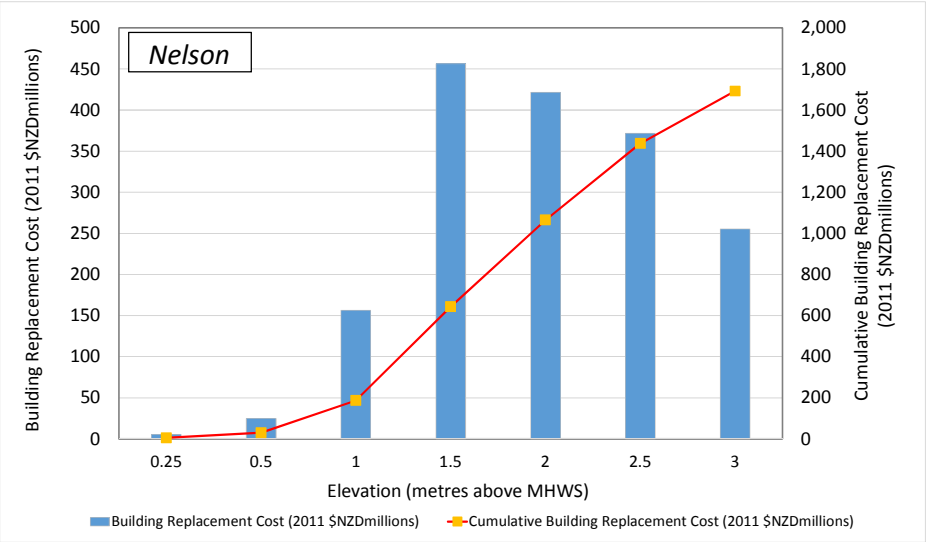
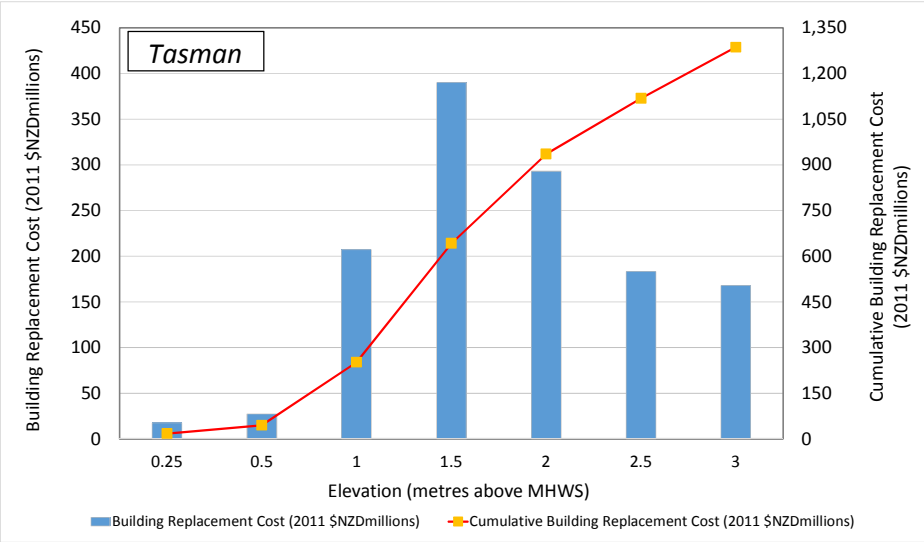
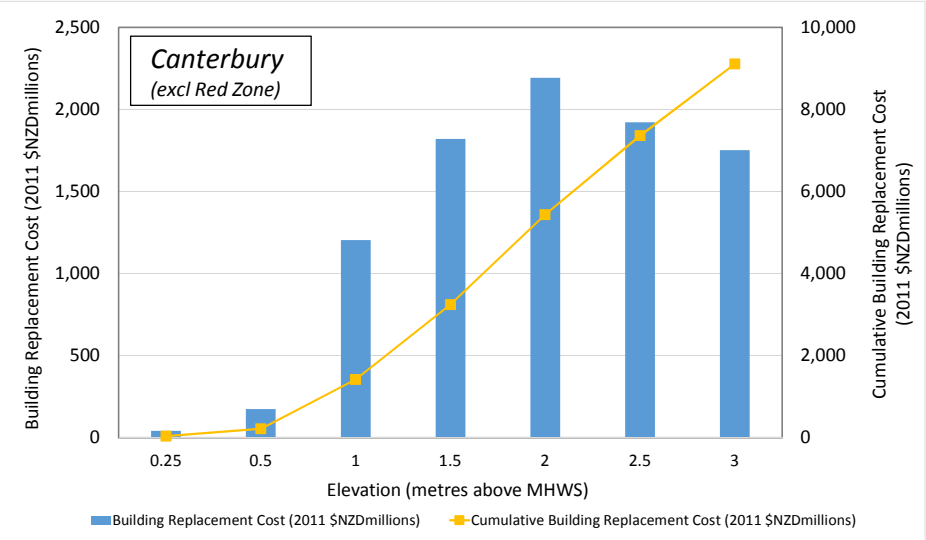


Figure 7-12: Total building replacement cost variation with coastal elevation band for lower North Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.







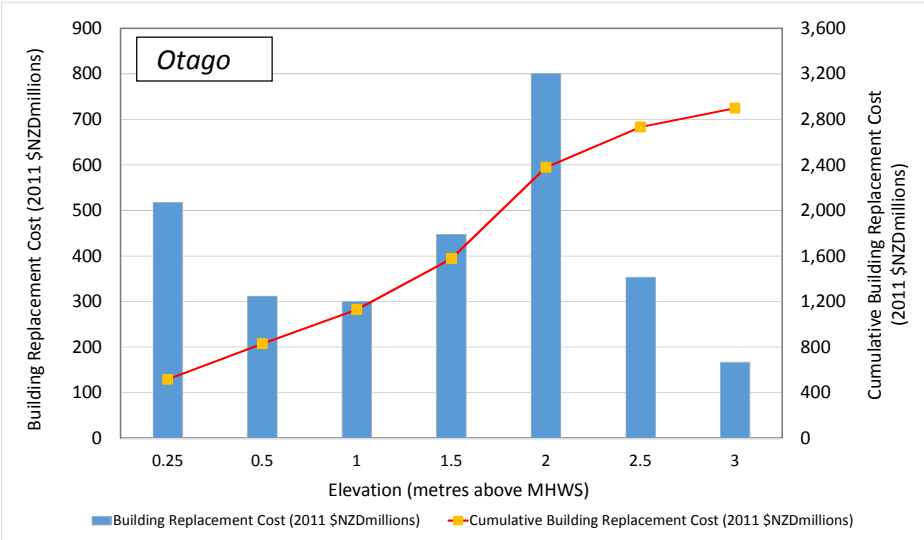


Figure 7-13: Total building replacement cost variation with elevation band for South Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.

7.4.2 Building counts and replacement costs for urban areas

The previous section provides a regional comparison in the context of a national overview. This section describes the results (mainly graphically) comparing urban areas (as defined by Stats NZ GIS shapefiles as a UA code) for buildings and their replacement costs. Urban areas mostly centre on a city or town and the surrounding peri-urban area, but Auckland City/Region is divided into four urban zones (North, West, Central and Southern Auckland Zones) and also the wider Wellington urban area into 4 zones – Wellington, Lower Hutt, Upper Hutt and Porirua. The horizontal scales of the bar graphs have fixed to the same limits as horizontal bar graphs in the previous section to maintain comparability.

Figure 7-14 provides the distributions of building numbers for urban areas in descending order across the lower-lying 0–1.5 m coastal elevation zone for areas with LiDAR DEMs available. The highest numbers of buildings identified are dominated by those from Christchurch–excluding the Red Zone (15,556) and Napier (14,207), followed by Lower Hutt (4,635) and Dunedin (4,436). However for Dunedin, around 70% of those buildings (3,094) are located on low-lying land below 0.5 m above MHWS, with 1,935 residential houses/apartments located in the lowest 0–0.25 m elevation band and an aggregate of 2,683 residential buildings across the two lowest elevation bands (0–0.5 m).

All other urban areas (with LiDAR DEMs available) had building counts of <2,300 within the 0–1.5 m coastal elevation zone.

Figure 7-15 shows the accumulated replacement costs for various types of building in urban areas across the lower-lying 0–1.5 m elevation zone for areas with LiDAR DEMs available. The four urban areas with the highest building count are joined by Wellington City as the five centres with the highest total replacement costs ($1.45–$3.17B), with Wellington's commercial buildings providing a substantial proportion (73%) of the total replacement costs. Central Auckland, Tauranga and Nelson follow, with total replacement costs in the range $0.7–$0.9B.

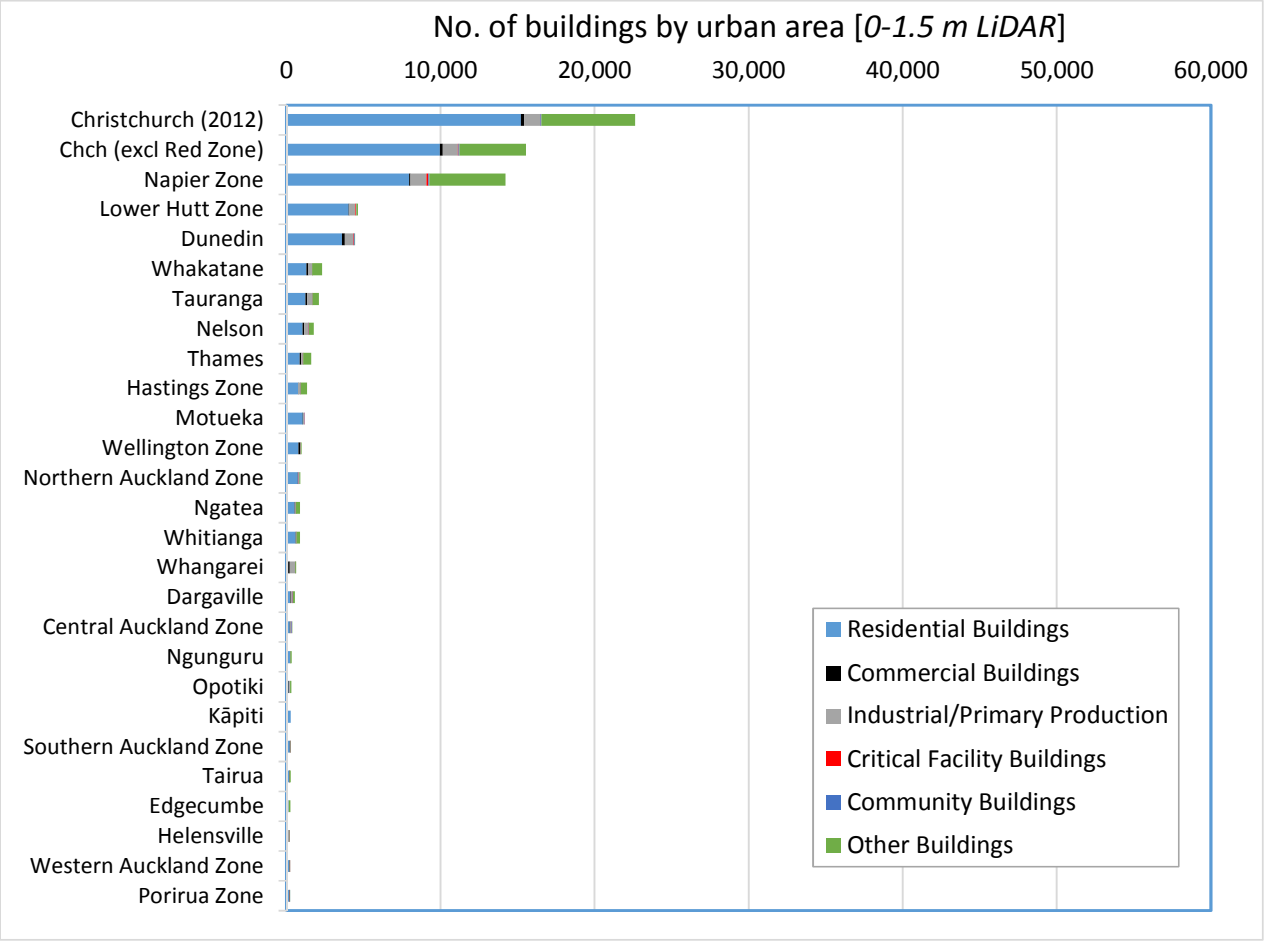


Figure 7-14: Regional distributions for the 0–1.5 m LiDAR coastal elevation zone for No. of buildings.
Source: RiskScape building inventory, with a bar also shown for Christchurch excl. the Red Zone. The lower cut-off was < 200 buildings identified.

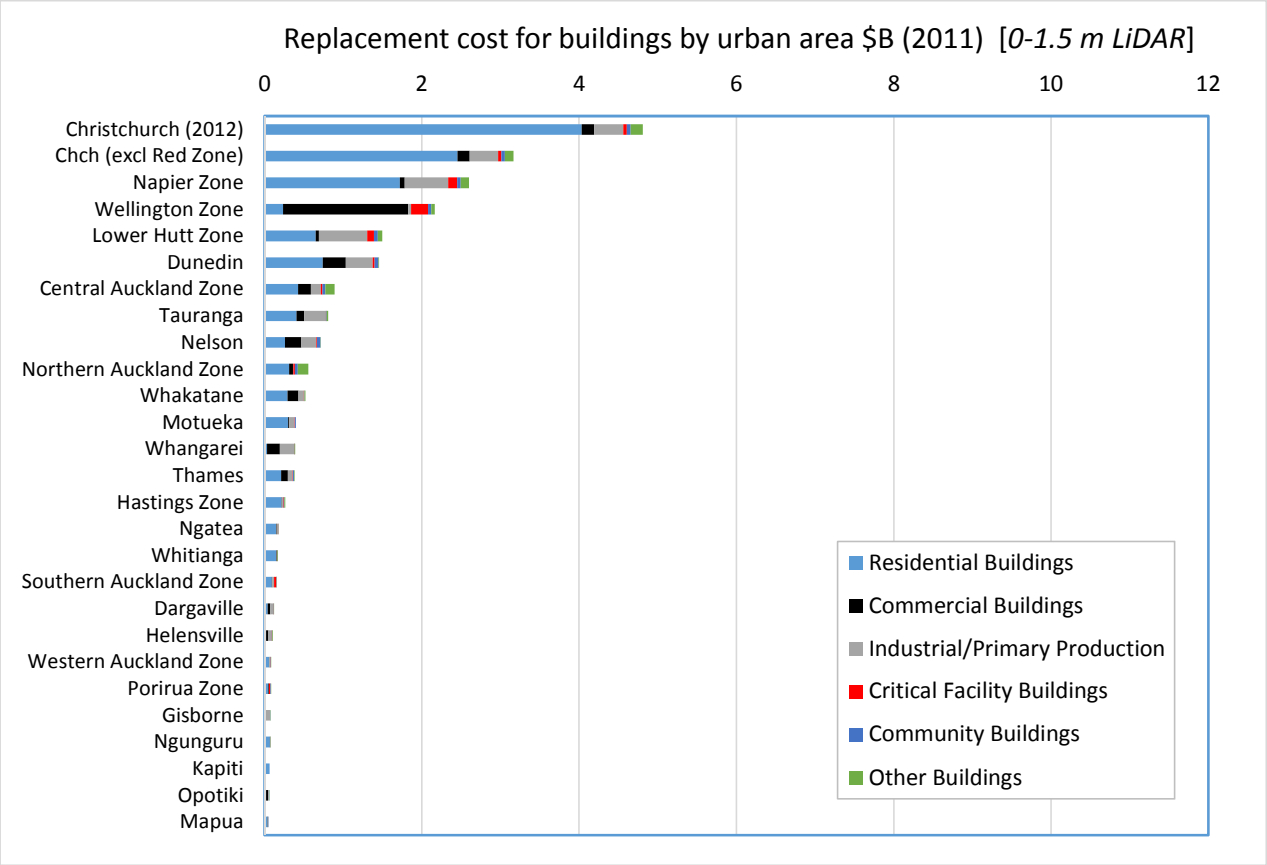


Figure 7-15: Regional distributions for the 0–1.5 m LiDAR coastal elevation zone for the total replacement costs for buildings (2011 NZ$B). Source: RiskScape building inventory, with a bar also shown for Christchurch excl. the Red Zone. The lower cut-off set to $50M (2011) in total building replacement costs identified.

Figure 7-16 provides the distributions of building numbers for urban areas in descending order across the 0–3 m coastal elevation zone for areas with LiDAR DEMs available, and compared with the 0–1.5 m elevation-zone counts. The highest numbers of buildings identified are dominated by those from Christchurch- excluding the Red Zone (45,833 – up from 15,556 for 0–1.5 m elevation zone), Napier (25,046 up from 14,207 for 0–1.5 m elevation zone) and Lower Hutt (10,199 up from 4,635 for 0–1.5 m elevation zone). These urban areas are followed by Dunedin (5,845) and Whakatane (5,580). A group comprising urban areas of Tauranga, Nelson, North Auckland Zone and Wellington accounted for total numbers of buildings in the range 4,000 to 5,000.

Figure 7-17 shows the accumulated replacement costs (2011 $B) for various types of building in urban areas across the entire 0–3 m coastal elevation zone for areas with LiDAR DEMs available and compared with the 0–1.5 m elevation-zone counts. The highest accumulated replacement costs for buildings identified are dominated by those from Christchurch- excluding the Red Zone ($8.7B – up from $3.2B for 0–1.5 m elevation zone), Central Auckland Zone ($5.9B – up from $0.9B), Napier ($5.1B – up from $2.6B), Wellington ($5.0B – up from $2.2B) and Lower Hutt ($3.5B – up from $1.5B). Together, these 5 urban areas account for $28.3B or nearly 60% of the replacement cost total ($47.6B) of all urban areas where LiDAR DEMs were available. North Auckland Zone, Dunedin and Tauranga also accounted for total replacement costs of over $2B, followed by Nelson at $1.8B.

For areas where LiDAR DEMs were available, the difference between the national total replacement costs of $51.9B and the total for all urban areas ($47.6B), indicates that nearly 92% of the coastal risk exposure (using replacement costs as a proxy) is derived from urbanised areas compared with rural areas.

For those urban centres not covered by available LiDAR DEMs, the national 0–3 m DEM results provide an indication (probably an underestimate) of the additional replacement costs nationally, with an extra $1B identified across urban areas. The highest of these was Invercargill ($0.44B) and Westport ($0.21B), followed in descending order by Bluff and Wanganui with replacement costs above a $50M cut-off.

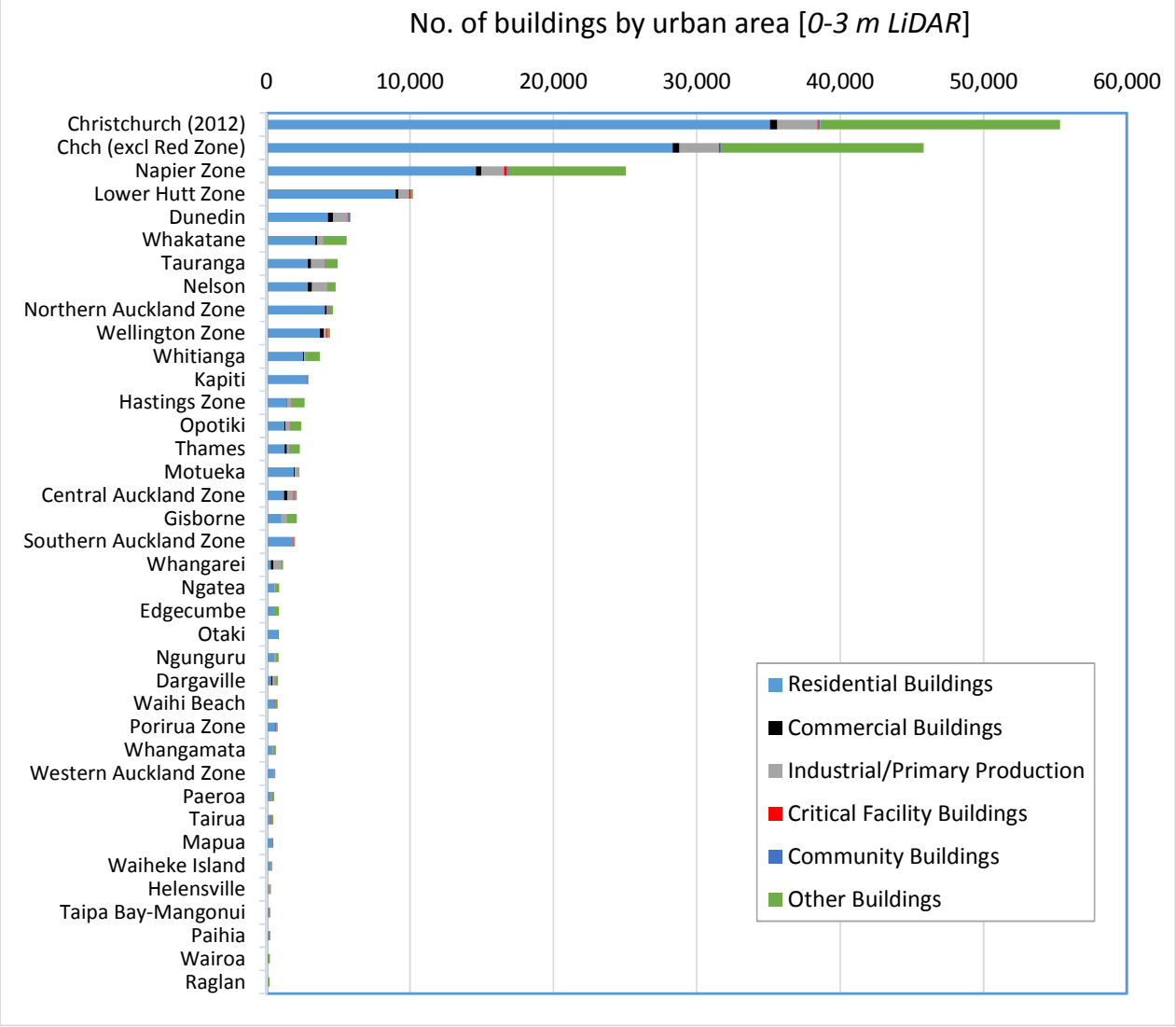


Figure 7-16: Regional distributions for the 0–1.5 m LiDAR coastal elevation zone for No. of buildings.
Source: RiskScape building inventory, with a bar also shown for Christchurch excl. the Red Zone. The lower cut-off was < 200 buildings identified.

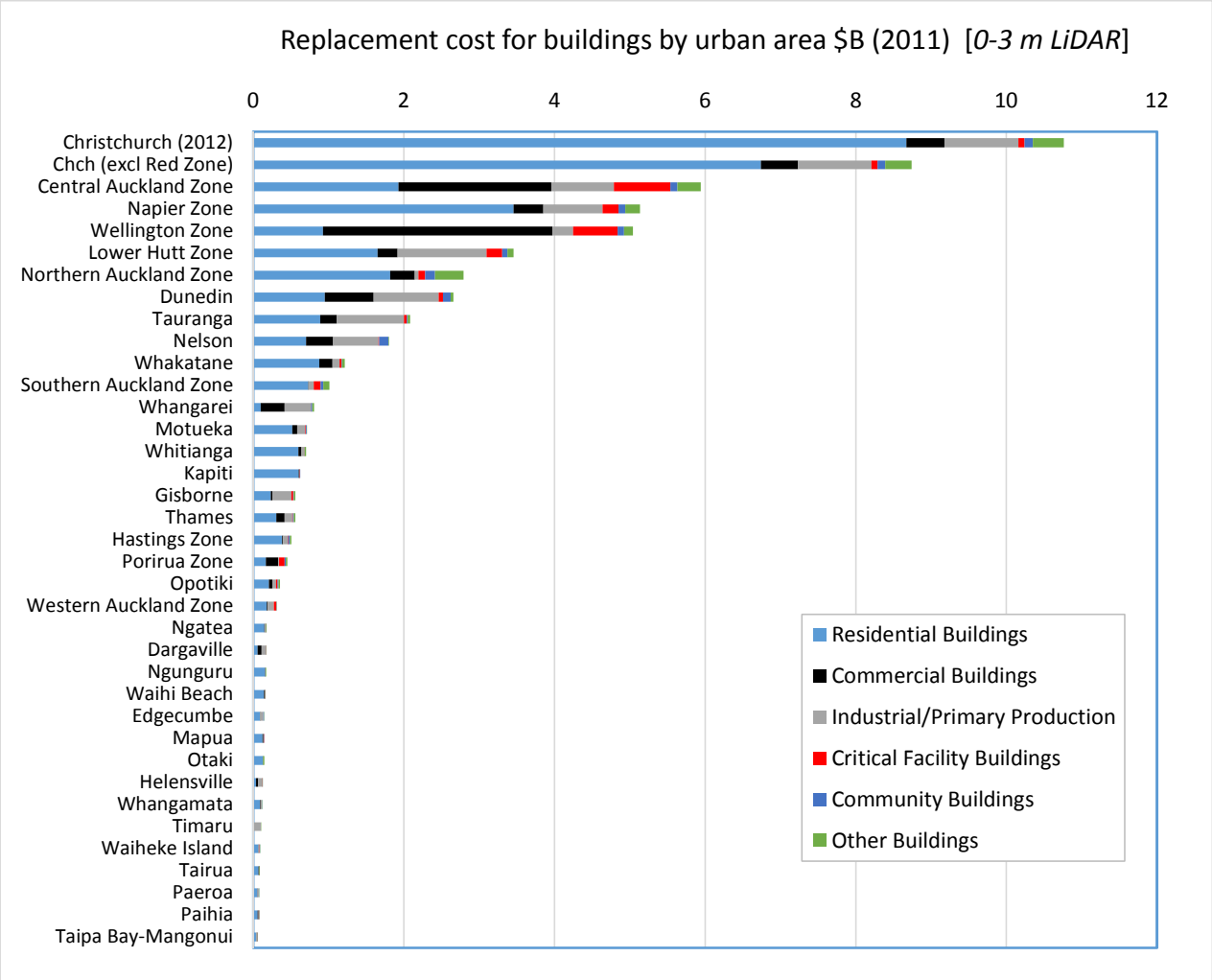


Figure 7-17: Regional distributions for the 0–1.5 m LiDAR coastal elevation zone for the total replacement costs for buildings (2011 NZ$B). Source: RiskScape building inventory, with a bar also shown for Christchurch excl. the Red Zone. The lower cut-off set to $50M (2011) in total building replacement costs identified.

7.4.3 Roads (by region)

The regional distribution of lengths of various types of roads within the 0–1.5 m and 0–3 m cumulative elevation zones for regions with LiDAR coverage are shown in Figure 7-18 and Table 7-11 to Table 7-12.

All regions with LiDAR coverage contain a range of road types located within both the 0–1.5 m and 0–3 m coastal elevation zones, although the regional and national totals are dominated by “local” roads and streets. The total length of all types of road is highest in the Waikato for both cumulative elevation bands, with just over 800 km and 1,000 km respectively, followed by Canterbury (Figure 7-18).

An estimated 2,100 km of road network in A-NZ (for regions with LiDAR coverage) is located within 0–1.5 m coastal elevation zone above MHWS-10, rising to 3,900 km within the 0–3 m coastal elevation zone (Table 7-11 and Table 7-12), where LiDAR DEMs were available. The latter is considerable increase of over twice the aggregated road length identified from the LiDAR DEMs

relative to the ~1,700 km of road extracted from national DEM polygons for the cumulative 0–3 m elevations bands.

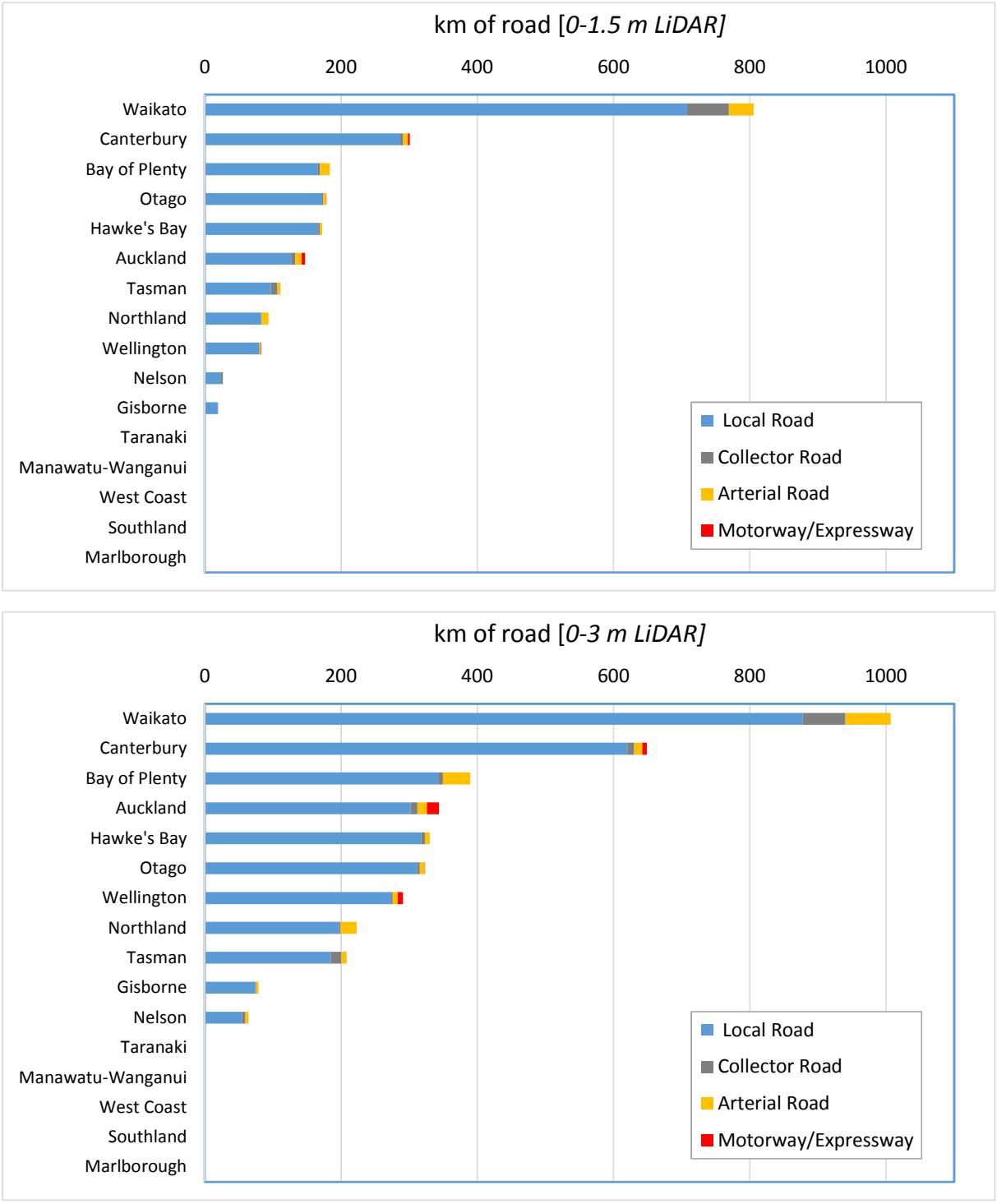


Figure 7-18: Regional distributions for lengths of various road categories for: (top) 0–1.5 m LiDAR coastal elevation zone; (bottom) 0–3 m LiDAR elevation zone. Source: LINZ road network GIS layer and RiskScape asset inventory.

In the 0–3 m LiDAR-derived coastal elevation zone, regional road length estimates vary considerably with respect to corresponding national DEM counts. The Waikato road length moves from 195 km (from the national DEM) to 1,006 km, while in Otago there is an increase from 52 km to 323 km. In other regions, with the exception of Canterbury and Hawke's Bay, the enumerated road length exceeds the national 0–3 m DEM value by 2 or 3 times.

"Local" roads comprise 90% of the entire road network within the 0–3 m LiDAR elevation zone at an estimated 3,556 km (Table 7-12). Approximately 38% of local roads in this elevation band are located in Waikato (877 km) and Canterbury (620 km). Auckland, Bay of Plenty, Hawke's Bay and Otago local roading networks located within 0–3 m of MHWS-10 also each exceed regional totals of 300 km. Nelson and Gisborne have the least extensive networks at 54 km and 74 km respectively.

Nationally there is around 192 km of arterial roads within 0–3 m of MHWS-10, with the most extensive networks located in Waikato, Bay of Plenty and Northland (Table 7-12). Expressway or motorway networks located within the four major urban areas all contain segments within the both the 0–1.5 m and 0–3 m coastal elevation zones. Auckland's State Highway network occupies the greatest extent in each of these cumulative elevation zones with 5 km and 18 km respectively.

From the national DEM results for the 0–3 m coastal elevation zone (Chapter 6), there were a further 224 km of roads in regions where LiDAR DEMs were not available, mainly in Southland (89 km) and the West Coast (65 km).

Table 7-11: Regional distribution of road length (km) for road classes identified in the 0-1.5 m coastal elevation band (LiDAR). Source: LINZ GIS road network and RiskScape asset inventory.

Region	Road Length (km)				Total Road Length (km)
	Local	Collector	Arterial	Expressway/ Motorway	
Northland	82.5	0.8	10.2	0	93.4
Auckland	126.8	6.3	9.2	4.9	147.1
Waikato	708.1	61.1	36.7	0	805.8
Bay of Plenty	166.2	2.6	14.5	0	183.2
Gisborne	18.9	0.0	0.6	0	19.5
Hawke's Bay	166.6	2.2	3.3	0	172.1
Taranaki	–	–	–	–	–
Manawatu-Wanganui	–	–	–	–	–
Wellington	80.3	0.3	1.4	0.9	82.8
West Coast	–	–	–	–	–
Canterbury	287.1	4.2	7.0	2.7	300.9
Otago	172.1	1.9	4.3	0.2	178.4
Southland	–	–	–	–	–
Tasman	96.9	9.9	4.2	0	110.9
Nelson	24.2	2.2	0.0	0	26.4
Marlborough	–	–	–	–	–
NZ Total	**1,929.6**	**91.5**	**91.2**	**8.6**	**2,121.1**

Table 7-12: Regional distribution of road length (km) for road classes identified in the 0-3 m coastal elevation band (LiDAR). Source: LINZ GIS road network and RiskScape asset inventory.

Region	Road Length (km)				Total Road Length (km)
	Local	Collector	Arterial	Expressway/ Motorway	
Northland	197.6	1.8	23.6	0	222.9
Auckland	302.0	10.1	14.2	17.6	343.8
Waikato	877.6	62.9	66.4	0	1,006.8
Bay of Plenty	342.5	7.3	39.8	0	389.5
Gisborne	73.8	1.7	3.4	0	78.9
Hawke's Bay	317.6	6	6.6	0	330.1
Taranaki	–	–	–	–	–
Manawatu-Wanganui	–	–	–	–	–
Wellington	273.4	2.4	7.3	7.7	290.8
West Coast	–	–	–	–	–
Canterbury	620.5	9.9	12.0	6.7	649
Otago	312.1	3.6	7.5	0.3	323.4
Southland	–	–	–	–	–
Tasman	184.9	15.6	7.8	0	208.3
Nelson	54.4	5.5	4.4	0	64.2
Marlborough	–	–	–	–	–
NZ Total	**3,556.2**	**126.6**	**192.9**	**32.3**	**3,908.3**

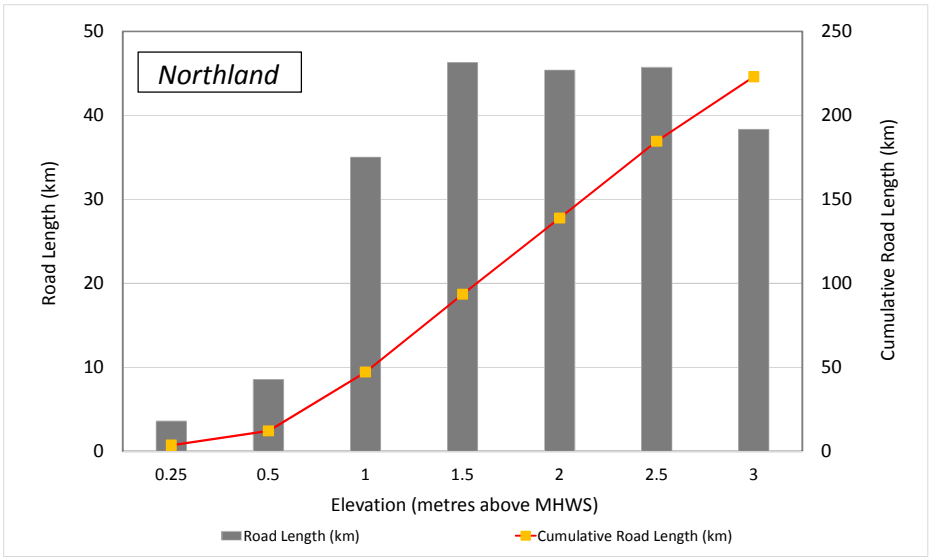
Regional road length estimates combining all types were also aggregated for individual LiDAR derived elevation bands of 0.25, 0.5, 1, 1.5, 2, 2.5 and 3 m above the local MHWS-10 baseline. North Island and South Island region road lengths per elevation band and cumulative-count curves for coastal areas within 3 m above MHWS-10 are presented in Figure 7-19 to Figure 7-21.

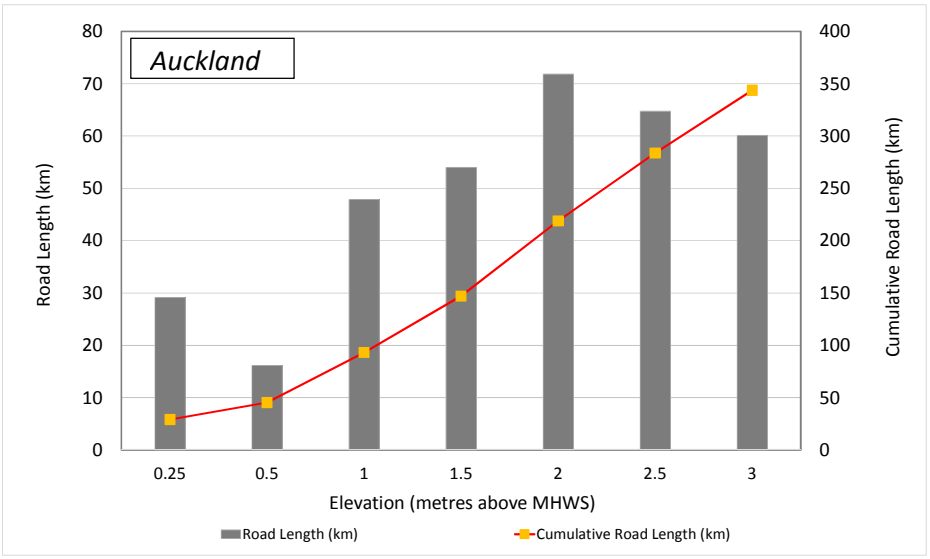
In the lowest-lying 0–0.25 m elevation band, 720 km of road network (mostly local roads) was identified. Approximately 77% (561 km) of these roads are located in the Waikato. This cumulative road length accounts for over half of all Waikato roads within the wider 0–3 m elevation zone. Otago has around 40 km and Auckland nearly 30 km in this lowest 0–0.25 m elevation band. No other region exceeds 25 km of roading in the lowest 0–0.25 m elevation band.

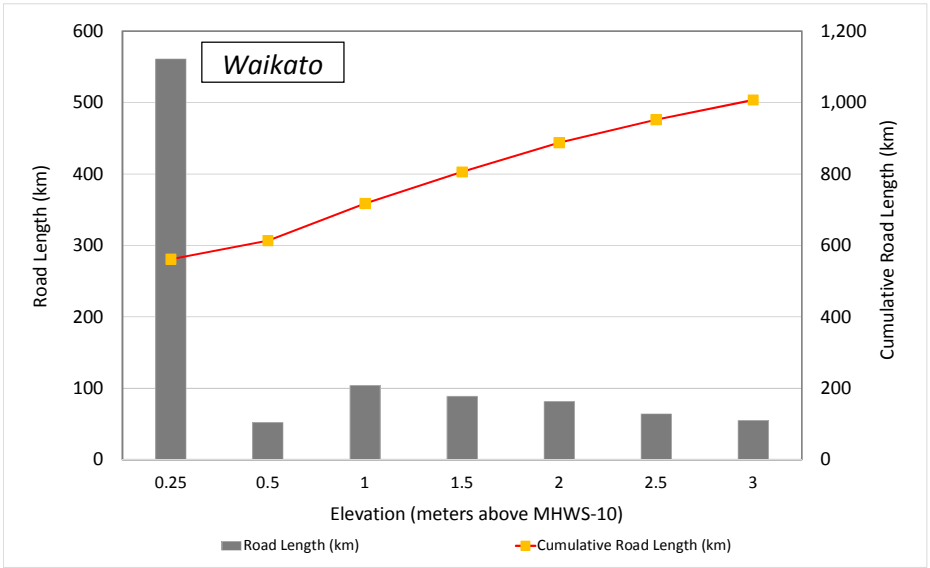
Nationally, the aggregated road length increases by almost three times between 0–0.25 m and 1–1.5 m elevation bands from 720 km to 2,121 km (for those area with LiDAR coverage). Proportionately this is a greater increase than the next elevation bands between 1.5 m and 3 m elevation. Canterbury (275 km) and Waikato (245 km) contain the most road length between 0.25 m and 1.5 m. Road length in Northland, Gisborne, Wellington and Nelson increased by 20 to 58 times between 0.25 m and 1.5 m. Waikato region exhibits a highly-skewed distribution of road-length counts towards the lower-lying elevations (Figure 7-19), with the lowest proportional increase in regional road length for the higher elevations.

The distribution of road lengths across the elevation bands resembles a similar trend to building counts and replacement cost observed in Figure 7-8 to Figure 7-13. Road length peaks between the 1.5 m or 2 m elevation band for most regions then decreases thereafter. Some regions however show a steadily rising count in road length with land elevation, such as Gisborne and Wellington.

Cumulative curve slopes display a steeper trend in most regions for all elevation bands above 0.5 m. This suggests road-length counts are relatively small below this elevation (with the exception of Waikato, see Figure 7-19) then increase rapidly between 0.5 m and 2 m. The slopes of cumulative road length curves (e.g., Nelson, Tasman, Otago) reduce slightly beyond 2 m or 2.5 m for some South Island regions (e.g., Nelson, Tasman, Otago) in response to relatively lower road length in the higher elevation bands toward 3 m. North Island regions and Canterbury cumulative curves generally maintain their steepness through higher elevation bands indicating road length estimates values are relatively consistent beyond 2 m elevations above MHWS-10.







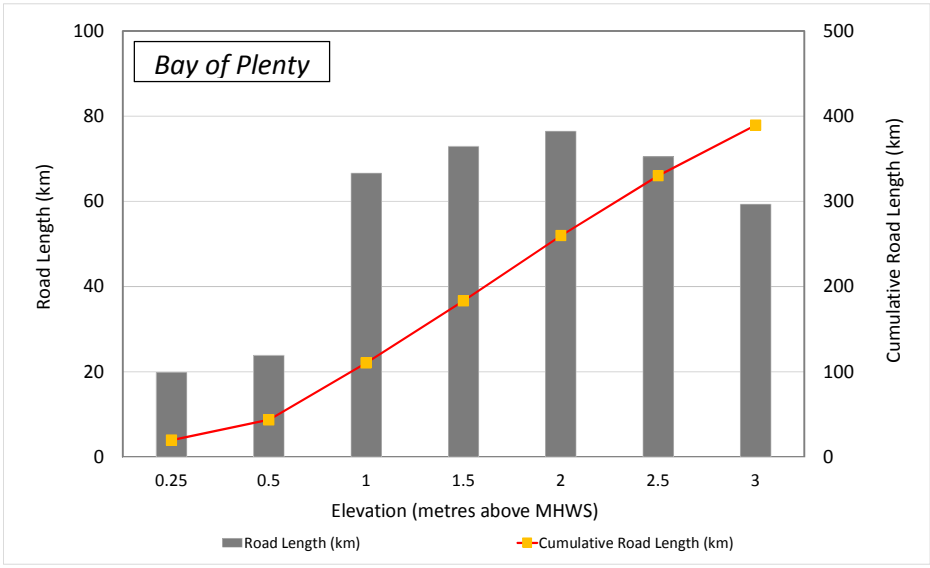
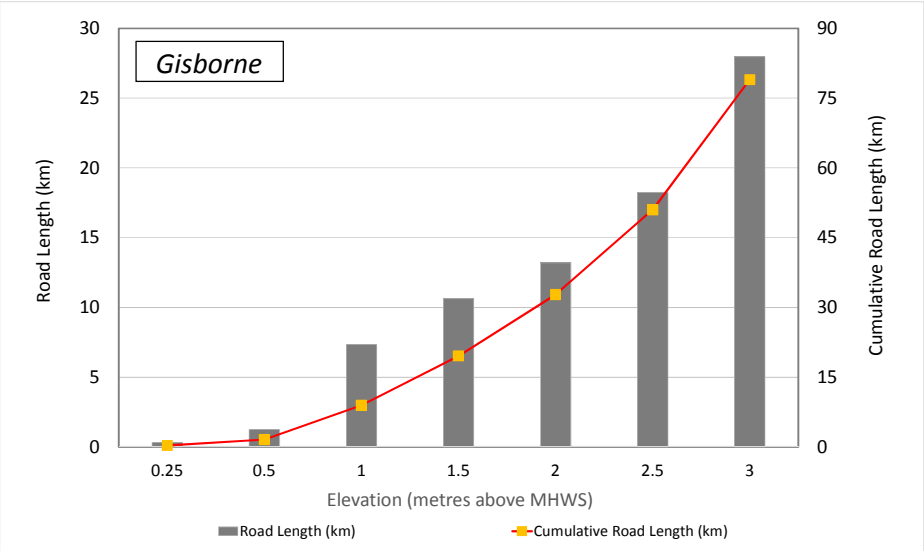
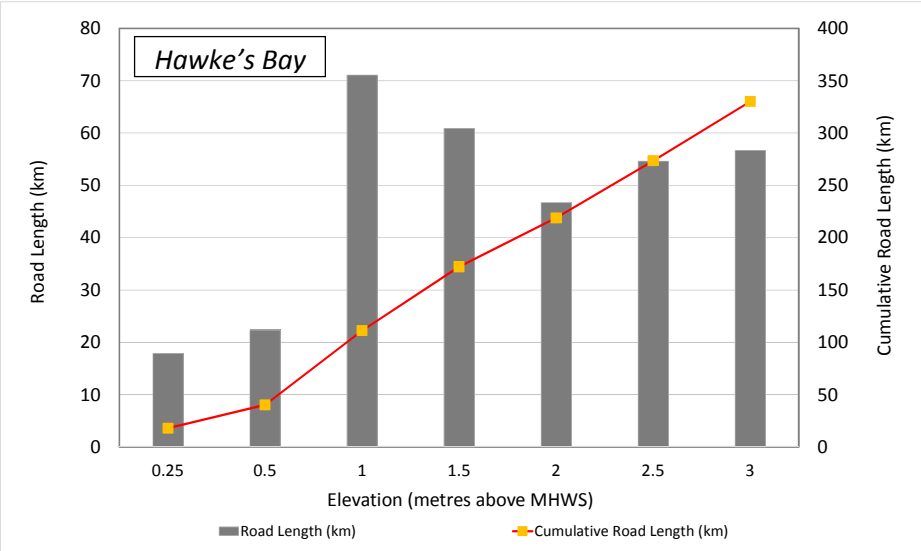


Figure 7-19: Total road lengths (km) for all road types for upper North Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.





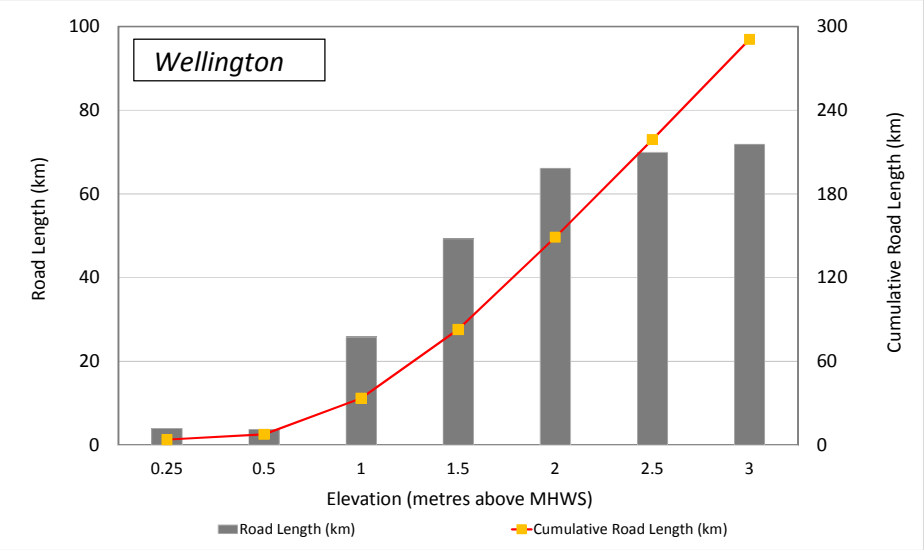
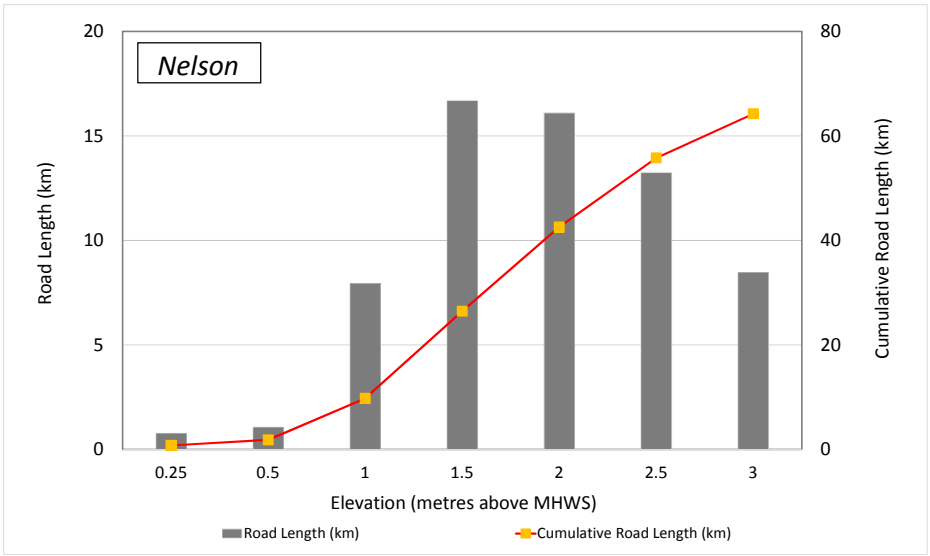
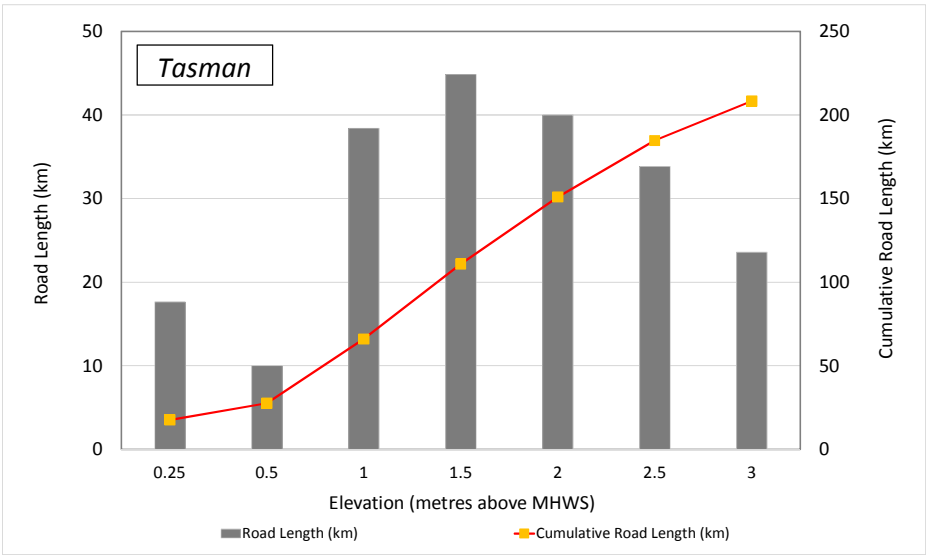
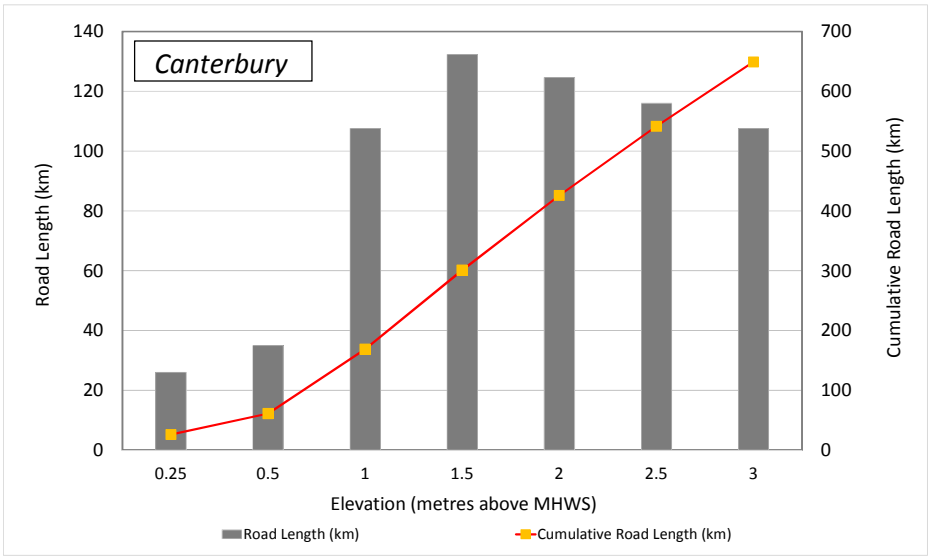


Figure 7-20: Total road lengths (km) for all road types for lower North Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.







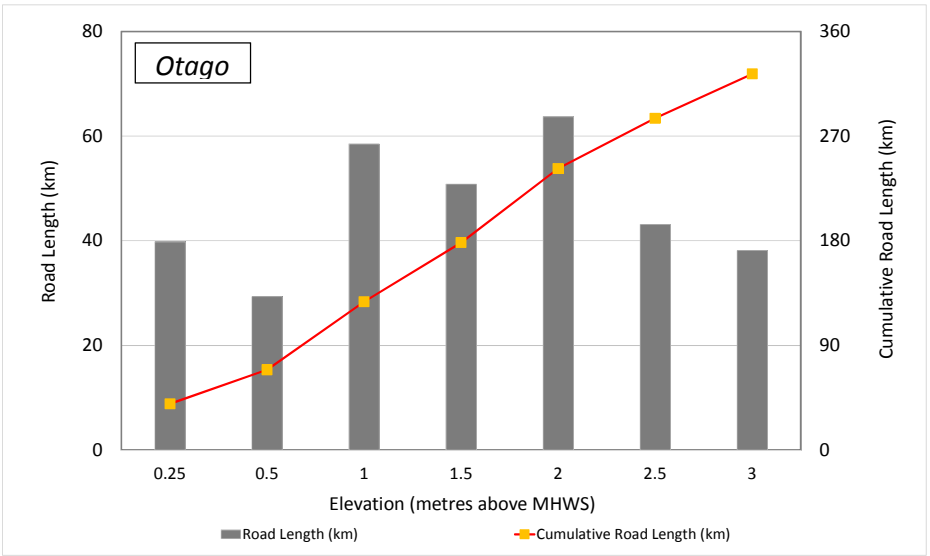


Figure 7-21: Total road lengths (km) for all road types for South Island regions with LiDAR coverage. Vertical bars are counts for individual coastal elevation bands for the increment up to the elevation marked (m) and the curve with square symbols is the cumulative counts of successive elevation bands.

7.4.4 Railways

Railway track lengths measured in all regions for the 0–1.5 m and 0–3 m coastal elevation zones are shown in Figure 7-22 and listed in Table 7-13.

Nationally, railway-track length triples between 0–1.5 m elevation zone and the wider 0–3 m elevation zone from 46 km to 154 km. Otago has the most extensive railway track in both elevation zones with 13 km and nearly 33 km respectively (Figure 7-22). Railway networks associated with major ports in the Bay of Plenty (27 km) and Wellington (24 km) means these regions also contain relatively extensive track networks in the 0–3 m coastal elevation zone. Auckland and Nelson have less than 5 km of railway track located below the 3 m elevation (mostly >1.5 m elevation as shown in Figure 7-22) while no railway tracks were identified in coastal areas of the Waikato and Tasman regions (of those regions with LiDAR coverage).

From the national DEM results for the 0–3 m elevation zone (Chapter 6), there were a further 11-12 km of railway in regions where LiDAR DEMs were not available, mainly in Southland (7.4 km).

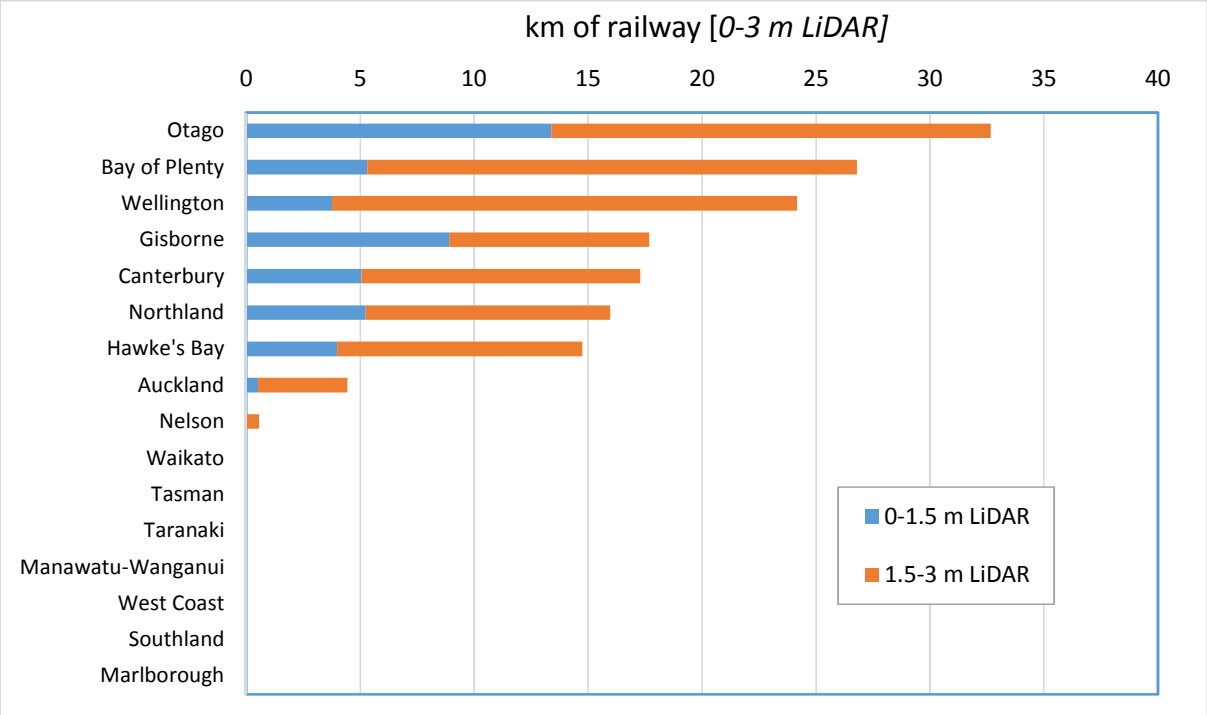


Figure 7-22: Regional distribution of railway track (km) for the lower 0–1.5 m and higher 1.5–3 m LiDAR elevation bands. Source: LINZ GIS railway database. Note: Nelson railway network no longer in use (closed 1955).

Table 7-13: Regional distributions of railway length (km) in the 0–1.5 m and 0–3 m coastal elevation zones (LiDAR). Source: LINZ GIS railway network.

Region	Railway track length (km) in 0-1.5 m coastal elevation band	Railway track length (km) in 0-3 m coastal elevation band
Northland	5.2	16.0
Auckland	0.5	4.4
Waikato	0	0
Bay of Plenty	5.3	26.8
Gisborne	8.9	17.7
Hawke's Bay	4.0	14.7
Taranaki	–	–
Manawatu-Wanganui	–	–
Wellington	3.8	24.2
West Coast	–	–
Canterbury	5.1	17.3
Otago	13.4	32.7
Southland	–	–
Tasman	0	0
Nelson	0	0.6
Marlborough	–	–
NZ Total	**46.19**	**154.33**

7.4.5 Airports and airfields

A total of seven airports were identified in the 0–3 m coastal elevation zones for areas with LiDAR surveys (Table 7-14). Nine airports were identified from the 0–3 m national DEM analysis (Section 6.5.3). The difference is the absence of LiDAR survey data for West Coast and Southland means 3 airports (Westport, Greymouth and Invercargill) in these regions were not identified, however the LiDAR analysis for Otago has included Dunedin Airport at Momona on low-lying land connected to the sea via the Taieri River. Two international airports were identified at Auckland and Wellington (both of which have some parts of the airport runway towards the upper end of the 0–3 m elevation band) and regional airports at Tauranga, Gisborne, Napier/Hastings, Wellington, Nelson and Dunedin from the areas with LiDAR available.

A number of airfields and aerodromes (25) are also located in the 0–3 m elevation band from the LiDAR analysis. Similar to the 0–3 m national DEM analysis, these are predominantly in regions with relatively large areas of primary production land or coastal resorts such as Waikato.

Table 7-14: Regional distribution for No. of airports and airfields located in the 0–3 m coastal elevation band (LiDAR). Source: RiskScape asset inventory.

Region	Airports (No.)	Airfields and Aerodromes (No.)	Total
Northland	0	1	1
Auckland	1	3	4
Waikato	0	7	7
Bay of Plenty	1	1	2
Gisborne	1	2	3
Hawke's Bay	1	0	1
Taranaki	–	–	–
Manawatu-Wanganui	–	–	–
Wellington	1	1	2
West Coast	–	–	–
Canterbury	0	1	1
Otago	1	0	1
Southland	–	–	–
Tasman	0	2	2
Nelson	1	0	1
Marlborough	–	–	–
NZ Total	**7**	**18**	**25**

7.4.6 Jetties and wharves

The analysis for coastal jetties and wharves undertaken for the national DEM in Section 6.5.4 was not repeated for the areas with LiDAR coverage as these structures lie adjacent to the coastline, so the former analysis is more representative of the national count of maritime structures at the coast in A-NZ.

8 Conclusions and gaps

The analysis in this Report is the first consistent attempt at nationally quantifying the risk exposure in low-lying coastal areas across Aotearoa-New Zealand (A-NZ) and enabling a comparison between different regions and urban areas. Risk exposure is expressed as counts of various demographic, land-cover and built assets (e.g., buildings, roads, airports, jetties and wharves) present within various elevation bands for areas with available LiDAR survey DEMs, or in the 0–3 m national modified DEM that covers all regions.

8.1 Findings

8.1.1 Topographic DEMs

Summaries of the highest counts for both the 0–3 m national DEM and the LiDAR (0–1.5 m and 0–3 m) elevation-zone assessments are shown in Chapter 2 including summary graphics.

The clear and most obvious finding is that the best-available national modified DEM is not accurate enough with insufficient resolution to rely on for the detailed risk-exposure analyses being attempted here. While there is not full LiDAR coverage available for A-NZ coastal areas, the total land-cover area and population for the 0–3 m elevation zone is nearly double those enumerated from the national modified DEM. The national DEM also substantially underestimates the risk exposure (buildings and infrastructure) by around half overall when compared with the available LiDAR DEMs for the same elevation zone (0–3 m).

The only defensible and robust approach is to use high-resolution and accurate LiDAR DEMs. These were available in the majority of regions (except for 5 regions), but even so the surveys in most regions outside Auckland and Wellington are patchy with a mix of surveys undertaken at different times with varying accuracies and non-uniform laser pings per square metre (or point density).

The summary of results below focuses on the LiDAR DEM analyses, with some comparison to the national modified DEM to highlight the underestimates of the latter.

8.1.2 Coastal land-cover areas

Nationally, for those areas where a LiDAR DEM was available, the total land-cover area for the 0–1.5 m coastal elevation zone is 1,290 km^2 (0.5% of the land area of A-NZ), rising to around 2,000 km^2 (0.7% of A-NZ land area) for the wider 0–3 m elevation zone. The latter is nearly twice the land area extracted from the analysis using the national modified DEM for the 0–3 m elevation zone, and hence explains the substantial underestimate by around half for coastal risk exposure by way of counts of residents and assets.

Waikato has the largest land-cover area nationally for both 0–1.5 m and 0–3 m coastal elevation zones, followed by Bay of Plenty and Canterbury. Primary production is the most extensive land-cover type within the 0–3 m elevation zone above MHWS-10, where LiDAR was available. This land cover is estimated to occupy 77% of land within the 0–1.5 m coastal elevation zone and 75% of land within the 0–3 m elevation zone. Waikato, primarily the Hauraki Plains, accounts for over one third of New Zealand's primary production land in both elevation bands.

The built-environment land cover is estimated to cover 64 km^2 within the 0–1.5 m elevation zone, which more than doubles to 154 km^2 (+240%) for the wider 0–3 m coastal elevation zone. Canterbury has the most extensive built-land cover with an area of just under 39 km^2 (although this has

decreased with the formation of the residential Red Zone in Christchurch). The built environments of Auckland, Waikato, Bay of Plenty, Hawke's Bay and Wellington all occupy between 14–19 km^2 of land within the 0–3 m coastal elevation zone.

8.1.3 Coastal normally-resident demographics

While the national modified DEM results proved to be underestimates, they demonstrate national relativity across all regions by including five regions where no LiDAR surveys were available (Taranaki, Manawatu-Wanganui, Marlborough, West Coast, Southland). Nearly 6,900 people were resident in these five regions within the 0–3 m elevation zone of the national DEM, with 73% from two regions West Coast (2,577) and Southland (2,486).

Of the regions with LiDAR DEMs available, two-thirds of the people resident in the more exposed 0–1.5 m coastal elevation zone lived in either Canterbury (~23%), Hawke's Bay (~19%), Bay of Plenty (~13%) or Auckland (~12%), with these four regions accounting for around 68% of all people who were resident in the wider 0–3 m elevation zone in the 2013 Census. For Canterbury and the Christchurch urban area, following the 2010/2011 earthquakes, there was a 36% decrease in the population of the most damaged red zone areas in the east of Christchurch City, with these reductions already present in the Census 2013 dataset used for this Project, but the analysis does not include any further reductions following Census night.

Aggregated nationally across areas with LiDAR DEMs available, the total resident population from the 2013 Census in the 0–1.5 m elevation band was 133,265 (3.1% of A-NZ population), rising to 281,902 across the wider 0–3 m elevation zone (6.6% of A-NZ population). The latter population count is substantially higher than the value of 163,643 derived from the 0–3 m national modified DEM, but is in line with the substantial underestimate of land area and risk exposure using the national modified DEM.

Across any particular region, the resident population in the low-lying 0–3 m coastal zone (based on areas with available LiDAR surveys) is generally quite a small proportion at < 10% of a region's population, but Hawke's Bay has by far the highest proportion living in this zone (over 28% of the region's population), followed by Tasman (16%) and Canterbury and Nelson each at 14%. Otago has a high proportion of people residing in the lower 0–1.5 m elevation zone compared to the 1.5–3 m zone, due to the low-lying nature of coastal plains in Otago (including Dunedin) adjacent to steeply rising topography.

Apart from Northland and Waikato and to a lesser extent Tasman, the main concentration of populations in these low-lying elevation zones are essentially in urban or peri-urban areas. For example, Christchurch City makes up 96–97% of the Canterbury region population in the coastal elevation zones, and similarly Dunedin City makes up 87–89% of the Otago total. In the Wellington region, Lower Hutt has a substantially higher population in the 0–3 m elevation zone (47% of the regional total) than Wellington City (31%), followed by Kāpiti Coast (14%). Likewise in Hawke's Bay, the population count is dominated by Napier City (~90% of the regional total) compared with Hastings.

An important caveat with this demographic overview is that the populations in each meshblock are based on people normally resident in these area units and were present in A-NZ on census night (e.g., a Tuesday in March 2013). Therefore, there will be a significant underestimate of people who would be temporarily resident in coastal settlements and towns, particularly in the peak summer season of December–January and occasionally through the year. Consequently for these holiday

centres (e.g., Coromandel Peninsula), the number of dwellings in these coastal elevation zones is a more accurate proxy for coastal risk susceptibility, with many buildings only occupied for part of the year (typically summer).

8.1.4 Coastal assets, buildings and infrastructure

0–3 m national DEM

For each asset attribute, results based on the 0–3 m coastal elevation band extracted from the national modified DEM, substantially underestimated the regional and aggregated national exposure. Therefore only limited analysis was undertaken using the national DEM.

However, the national DEM results demonstrate the national relativity across all regions by including five regions where no LiDAR surveys were available (Taranaki, Manawatu-Wanganui, Marlborough, West Coast, Southland). These five regions contained ~3,900 buildings within the 0–3 m elevation zone of the national DEM, with 70% from two regions or around 1,360 buildings in each of West Coast and Southland, and a total building replacement cost around $1.5B (2011), with nearly 60% of that total arising from Southland ($0.87B).

For the five regions where LiDAR surveys were not available, the total road and railway length (224 km and 11.5 km respectively) in the 0–3 m elevation zone was 13% and 16% respectively of the national total. Of these regions, Southland, West Coast and Marlborough had the highest proportion of the combined road length (91%). While the aggregated national coastal exposure is substantially underestimated using the national DEM, nevertheless results for these five regions provide a broad estimate of the coastal-risk exposure in regions where LiDAR DEMs were not available for the study.

LiDAR DEM elevation zones up to 3 m (regional)

Buildings

Nationally (excluding areas and regions without LiDAR coverage), there are over 68,000 buildings in the 0–1.5 m coastal elevation zone, which rises to a total of 166,750 buildings for the 0–3 m elevation zone.

Canterbury and Hawke's Bay, followed by Waikato, have the most buildings in the lower-lying 0–1.5 m coastal elevation zone, but the Wellington and Bay of Plenty regions join this group with the highest building counts of all types across the wider 0–3 m coastal elevation zone. The building count for the Wellington region is boosted by a higher proportionate number of commercial buildings (predominantly Wellington and Lower Hutt), which is reflected in the higher building replacement costs.

In all the areas surveyed by LiDAR, the total replacement costs for enumerated buildings of all classes accumulates to NZD$19.3B (2011) for the 0–1.5 m coastal elevation zone rising to around NZD$52B (2011) across the wider 0–3 m elevation zone. The latter value for areas with LiDAR surveys is over twice the NZD$24B (2011) enumerated for building replacement costs from the 0–3 m coastal elevation zone based on the national DEM, which covered all regions.

The total building replacement costs across the 0–1.5 m coastal elevation zone amounts to around 1.6% and 2.5% of the national building stock for residential and non-residential buildings respectively, rising to 4.4% and 6.9% respectively for the wider 0–3 m elevation zone. These percentages would be slightly higher if the more accurate LiDAR DEMs were available for all coastal

areas (e.g., NZ$1.5–3B (2011) based on the national DEM results for the extra 5 regions, up to doubling these estimates).

Canterbury, Auckland, Wellington and Hawke's Bay dominate the building replacement cost national totals, with Auckland ($11B) and the Wellington region ($9.8B) returning the highest regional replacement cost totals for the 0–3 m coastal elevation zone.

Based on results for buildings from the incremental elevation bands (0.25, 0.5, 1, 1.5, … 3 m) where LiDAR surveys were available, three different elevation profiles of coastal risk exposure were revealed:

- Highest proportion of risk exposure for a region in the lowest-lying elevation band (0-0.25 m) occurs in Waikato and Otago regions.
- A rapid increase in risk exposure between 0.5–1 to 1.5–2 m above MHWS-10 (for the majority of regions).
- A steady increase in risk exposure up to the 3 m upper limit assessed e.g., Auckland and especially Gisborne (which has low overall risk exposure at lower elevation bands).

Roads and other infrastructure (railways, airports, jetties/wharves)

All regions with LiDAR coverage contain a range of road types located within both the 0–1.5 m and 0–3 m coastal elevation zones, although the regional and national totals are dominated by "local" roads and streets (91%). The total length of all types of road is highest in the Waikato for both the 0–1.5 and 0–3 m coastal elevation zones, with just over 800 km and 1,000 km respectively, followed by Canterbury.

An estimated 2,100 km of road network in A-NZ (for regions with LiDAR coverage) is located within the 0–1.5 m elevation zone, rising to 3,900 km within the wider 0–3 m elevation zone. The latter is a considerable increase of over twice the aggregated road length identified from the available LiDAR DEMs relative to the ~1,700 km of road extracted from national DEM polygons for the 0–3 m elevation zone. The largest underestimations from the national DEM were for Waikato, where the road length estimate moves from 195 km (national DEM) to 1,006 km, while in Otago there is an increase from 52 km (national DEM) to 323 km.

Nationally there are around 192 km of arterial roads within the 0–3 m coastal elevation zone, with the most extensive networks located in Waikato, Bay of Plenty and Northland. Expressway or motorway networks located within the four major urban areas all contain segments within both the 0–1.5 m and 0–3 m elevation zones. Auckland's State Highway network occupies the greatest extent in each of these cumulative elevation bands with 5 km and 18 km respectively.

In the lowest-lying 0–0.25 m elevation band, 720 km of road network (mostly local roads) was identified nationally. Approximately 77% (561 km) of these roads are located in the Waikato. This cumulative road length accounts for over half of all Waikato roads within the wider 0–3 m elevation zone. Otago has around 40 km and Auckland nearly 30 km in this lowest 0–0.25 m elevation band. No other region exceeds 25 km of roads in the lowest 0–0.25 m elevation band. Nationally, the aggregated road length increases by almost three times between 0–0.25 m and 1–1.5 m elevation bands from 720 km to 2,121 km (for those areas with available LiDAR coverage).

Nationally, railway-track length triples between 0–1.5 m and 0–3 m coastal elevation zones from 46 km to 154 km. Otago has the most extensive railway track in both elevation zones with 13 km and nearly 33 km respectively. Railway networks associated with major ports in the Bay of Plenty (27 km) and Wellington (24 km) means these regions also contain relatively extensive track networks in the wider 0–3 m coastal elevation zone. Auckland has less than 5 km of railway track located below the 3 m elevation (mostly >1.5 m elevation).

A total of seven airports were identified in the 0–3 m coastal zone for areas with LiDAR surveys available. Nine airports were identified from the 0–3 m national DEM analysis. The difference is the unavailability of LiDAR survey data for West Coast and Southland means 3 airports (Westport, Greymouth and Invercargill) in these regions were not identified, however the LiDAR analysis for Otago has included Dunedin Airport at Momona on low-lying land connected to the sea via the Taieri River. Two international airports were identified at Auckland and Wellington (both of which have some parts of the airport runway towards the upper end of the 0–3 m coastal elevation zone) and regional airports at Tauranga, Gisborne, Napier/Hastings, Wellington, Nelson and Dunedin from the areas with LiDAR available.

A number of airfields and aerodromes (25) are also located in the 0–3 m elevation band from the LiDAR analysis, which are predominantly in regions with relatively large areas of primary production land or coastal resorts such as Waikato.

Nationally, there are over 1,500 jetty and wharf structures, with a combined length of 100 km around the A-NZ coast adjacent to the low-lying areas that were delineated in the 0–3 m national modified DEM (not repeated for the LiDAR analysis). The highest number of coastal maritime structures are in Otago and Auckland (61% of the national total), with both regions together accounting for 57% of the total cumulative length, with Auckland having the highest cumulative length at nearly 30 km. Northland has the third highest counts for jetties and wharves.

LiDAR DEM elevation zone up to 3 m (urban)

Urban areas, as defined by Stats NZ, mostly centre on a city or town and the surrounding peri-urban area, but Auckland City/Region is divided into four urban zones (North, West, Central and Southern Auckland Zones) and also Wellington area into 4 zones – Wellington, Lower Hutt, Upper Hutt and Porirua.

Distributions of building numbers for urban areas, in descending order across the 0–3 m coastal elevation zone for areas with LiDAR DEMs available, were compared with the counts for the lower-lying 0–1.5 m elevation zone. The highest numbers of buildings identified for urban areas are dominated by those from Christchurch - excluding the Red Zone (45,833 – up from 15,556 for 0–1.5 m zone), Napier (25,046 up from 14,207 for 0–1.5 m zone) and Lower Hutt (10,199 up from 4,635 for 0–1.5 m zone). These urban areas are followed by Dunedin (5,845 buildings) and Whakatane (5,580 buildings) for the 0–3 m elevation zone. A group comprising urban areas of Tauranga, Nelson, North Auckland Zone and Wellington, each accounted for total numbers of buildings in the range 4,000 to 5,000.

The highest accumulated replacement costs (NZ$–2011) for buildings identified are dominated by those from Christchurch - excluding the Red Zone ($8.7B – up from $3.2B for 0–1.5 m elevation zone), Central Auckland Zone ($5.9B – up from $0.9B), Napier ($5.1B – up from $2.6B), Wellington ($5.0B – up from $2.2B) and Lower Hutt ($3.5B – up from $1.5B). Together, these 5 urban areas account for $28.3B or nearly 60% of the replacement cost total ($47.6B) of all urban areas where

LiDAR DEMs were available. North Auckland Zone, Dunedin and Tauranga also accounted for total replacement costs of over $2B each, followed by Nelson at $1.8B.

For areas where LiDAR DEMs were available, the difference between the national total replacement costs of nearly $52B and the total for all urban areas ($47.6B), indicates that nearly 92% of the coastal risk exposure (using replacement costs as a risk-exposure measure) is derived from urbanised areas compared with rural areas.

For those urban centres not covered by available LiDAR DEMs, the 0–3 m national DEM results provide an indication (probably an underestimate) of the additional replacement costs nationally, with an extra $1B identified across urban areas. The highest of these was Invercargill ($0.44B) and Westport ($0.21B), followed in descending order by Bluff and Wanganui with replacement costs above a $50M cut-off.

8.1.5 Overall coastal risk exposure

The percentages of the A-NZ population normally resident in the 0–1.5 m and the wider 0–3 m coastal elevation zones (3.1% and 6.6% respectively) and the total A-NZ building replacement costs (1.6% and 4.4% respectively for residential and 2.5% and 6.9% for non-residential buildings) are substantially higher than the 0.5–0.7% of land-cover area of A-NZ for these same coastal elevation bands, highlighting that land area is not a reliable proxy for coastal risk exposure.

For the wider 0–3 m coastal elevation zone for areas where LiDAR DEMs were available, the national totals are:

- normally resident population is 281,902
- nearly 294,000 cadastral land parcels (i.e., legal properties)
- total number of buildings is 166,750 with a replacement cost of $52B in 2011 $NZ
- nearly 92% of the coastal risk exposure (using building replacement costs as a proxy) is derived from urbanised areas compared with rural areas
- 1,014 critical-facility or government buildings
- over 3,900 km of road, with nearly 91% designated as local roads
- 154 km of railway lines identified
- over 1500 jetty or wharf structures
- 7 or more airports and 25 airstrips or aerodromes.

8.2 Gaps and recommendations

It is important to acknowledge that the datasets and methods employed in this analysis of coastal risk exposure can be improved, being particularly sensitive to the accuracy of the DEM being used, as has been found previously by Lichter et al. (2011) and also this Project, where a comparison between DEMs has highlighted the benefits of using sub-metre accuracy LiDAR datasets.

Considerable extra staff resources and delays (2–3 months) were required to collate and process the various regional LiDAR datasets, with considerable variability in formats, accuracy, datums, processing of DEMs including bare-earth versions, density of points, prior clipping to inaccurate

water-land boundaries and dealing with multiple overlapping surveys (e.g., alignment with vertical datum). To better enable national-scale analyses, such as coastal risk exposure (or could be for river flood plains in A-NZ), to be undertaken efficiently and with consistent elevation datasets, there is an urgent need for standardisation of LiDAR processing protocols (point clouds and types of DEMs), formats, datums and metadata information, and eventually to produce a nationally-consistent LiDAR DEM for the coastal margin of A-NZ.

The uptake of a common vertical datum for use throughout A-NZ (e.g., the NZ Vertical Datum 2009 is seldom used) would provide further national consistency including across the nearshore seabed bathymetry, whereas the various local vertical datums used for the LiDAR DEMs in this Project contain slight vertical step-changes in apparent elevation across regional boundaries. This was handled in this Project by specifying present-day MSL offsets relative to the relevant local vertical datum to account for this shift regionally, but when polygons are plotted nationally or across region boundaries, the step-change will be present. A common national vertical datum, as used in most developed countries, would engender further consistency and ease for undertaking national risk assessments.

An allied issue is the determination of an accurate and high-resolution present-day shoreline (or water-land boundary) for coastlines, estuaries, wetlands, rivers and lakes and converted to GIS polygons. The existing GIS resources, such as the NZ Coastlines, NZ Lakes and the NZ River Polygons published by LINZ / National Topographic Office (2011), have been extracted from Topographic Map series at 1:50,000 scales. However, at the high spatial resolution of modern LiDAR surveys, these land-water boundaries are no longer suitable for clipping coastal elevation polygons or surfaces (or comparing with high-resolution aerial imagery). There were also numerous locations where the geomorphology of the water body has changed in the interim since 2011, particularly estuary and river mouths, which are well known for altering their geographical size and shape. Therefore there is a national need to develop, and regularly update, a set of high-resolution land-water boundary polygons, which can be used to accurately clip LiDAR coastal or river-plain DEMs for A-NZ. This would provide a much-needed resource for central and local government to underpin more detailed planning for adaptation to climate-change in our coastal margins and where the regional and national priorities lie in reducing risk exposure.

Tide elevations up most estuaries in A-NZ were not readily available (other than the Auckland region and Whitianga), which led to a degree of uncertainty in vertically locating the MHWS baseline. In this Project we erred on lower side (e.g., used open-coast MHWS if not known up estuaries), which exposes lower numbers of assets than if MHWS is higher (could be up to 0.1–0.3 m difference) but in some instances MHWS could also be lower inside estuaries (e.g., as used for adjustment inside Whitianga Harbour). To plug this gap, there is a need for tidal measurements and/or hydrodynamic modelling inside estuaries and up lowland rivers to establish MHWS to a survey datum.

For national asset databases there is a need for more checking of the assignment of building types and attributes within RiskScape, in the coastal zone (or river flood plains), to provide more accurate replacement cost estimates and counts on the number of buildings of each type. Building replacement costs should also be updated to the present. Also, only a limited sub-set of infrastructure types could be analysed in this Project where national asset databases exist, so there is a need to develop national databases for other types to improve risk exposure analyses, particularly for “3-waters” and telecommunication assets.

Population in A-NZ is enumerated every few years on a national Census on a week-day in March. This leads to some distortion in population counts for coastal areas, mostly for settlements where summer-time populations temporarily swell. However, undertaking building counts provides a complementary approach to assessing coastal risk exposure, covering the situations where population count may be lower in March.

Distributions of population per elevation band are also only approximate, as population data is only geo-referenced to a wider meshblock area unit. The aggregated results for 0–1.5 m and 0–3 m coastal zones are likely to be more robust measures of population than within individual narrower coastal elevation bands. More detailed matching is required of the number of people normally-resident in coastal areas to where they are physically located in the meshblocks (e.g., apportioning population to building clusters) to improve the population counts in coastal areas. As used in this project, a more sharply-focused measure of coastal risk exposure as a function of elevation above MHWS-10 is available from the spatial analysis of buildings, for which their individual footprints are geo-referenced in the RiskScape asset database.

To enable a true national appraisal of coastal risk exposure to coastal hazards and sea-level rise, including consideration of high-magnitude low-frequency tsunami inundation events, all coastal-plain areas with elevations below 10–15 m throughout A-NZ should be covered by high-resolution LiDAR surveys. This data should then be processed to produce bare-earth DEMs, which if processed to standard protocols and rectified to a common vertical datum, could be coalesced into a national high-resolution coastal DEM for New Zealand. Similar national DEMs for river flood plains upstream would be a useful adjunct, as they usually transition into a coastal plain or river mouth at the coast.

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- Nelson City Council
- Tasman District Council

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10 Glossary of abbreviations and terms

A-NZ	Aotearoa–New Zealand.
AEP	Annual Exceedance Probability: The probability of a given (usually extreme) sea level being equalled or exceeded in elevation, in any calendar year. AEP can be specified as a fraction of 1 (e.g., 0.01) or a percentage (e.g., 1%).
DEM	Digital elevation model of the ground surface or bare-earth topography above a given vertical datum.
LiDAR	Light Detection And Ranging – a laser scanning system, usually on an aircraft platform, that rapidly scans swathes of the land below the sensor and can be processed to vertical accuracies down to ±0.15 m.
LINZ	Land Information NZ.
LVD	Local Vertical Datum: A set of regional datums determined at varying times several decades ago based on historic measurements from a particular tide gauge in the relevant region. http://www.linz.govt.nz/data/geodetic-system/datums-projections-and-heights/vertical-datums/local-mean-sea-level-datums
MHW	Mean High Water – an average high water level (nominal datum for the national modified Landcare/SKM DEM).
MHWS	Mean High Water Springs – a measure of the average of the upper high tides during spring tides.
MHWS-10	A nationally-consistent definition of MHWS, which is the tidal water level that is only exceeded by 10% of all predicted high tides at any location calculated over a 50 or 100-year period. Excludes weather and wave-run-up influences and SLR.
MSL	Mean Sea Level: The mean level of the sea relative to a vertical datum over a defined epoch of at least several years.
MSLA	MSL anomaly: The variability of monthly average sea level about MSL.
NZCPS	NZ Coastal Policy Statement (2010).
PCE	Parliamentary Commissioner for the Environment.
RMA	Resource Management Act 1991 and subsequent amendments.
Storm surge	The temporary rise in sea level due to storm meteorological effects. Low-atmospheric pressure causes the sea level to rise above predicted tide levels, and wind stress on the ocean surface pushes water down-wind and to the left up against any adjacent coast.
Storm-tide	Storm-tide is defined as the sea-level peak elevation around high tide reached during a storm event, resulting from a combination of MSLA + tide + storm surge relative to a vertical datum.

SLR	Sea-level rise.
Wave setup	The increase in mean still-water sea level at the coast, resulting from the release of wave energy in the surf zone as waves break.
Wave runup	The maximum vertical extent of wave “up-rush” or flowing water (“green water”) on a beach or structure above the still water or storm-tide level, and constitutes a short-term upper-bound fluctuation in water level compared to the more persistent and slowly-varying wave setup.

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Appendix A MHWS-10 heights around A-NZ

The following Figures show the MHWS-10 heights at nearly 290 coastal sites around A-NZ (a few not shown for clarity of reading values), where the MHWS-10 values were used as the baseline for the elevation bands analysed from the LiDAR digital elevation models. These values, derived from the NIWA EEZ tide model, have been adjusted, where required, to match with local gauge measurements. In some of the larger estuaries or harbours where MHWS-10 was available or known (e.g., Waitemata, Manukau, Kaipara Harbours), local MHWS-10 values were spatially applied to the LiDAR DEM around the harbour shoreline).

The datum is set to local MSL=0, but a present-day MSL offset is applied for each region (Appendix B) to relate the MHWS-10 heights to the same datum used for the LiDAR DEM.

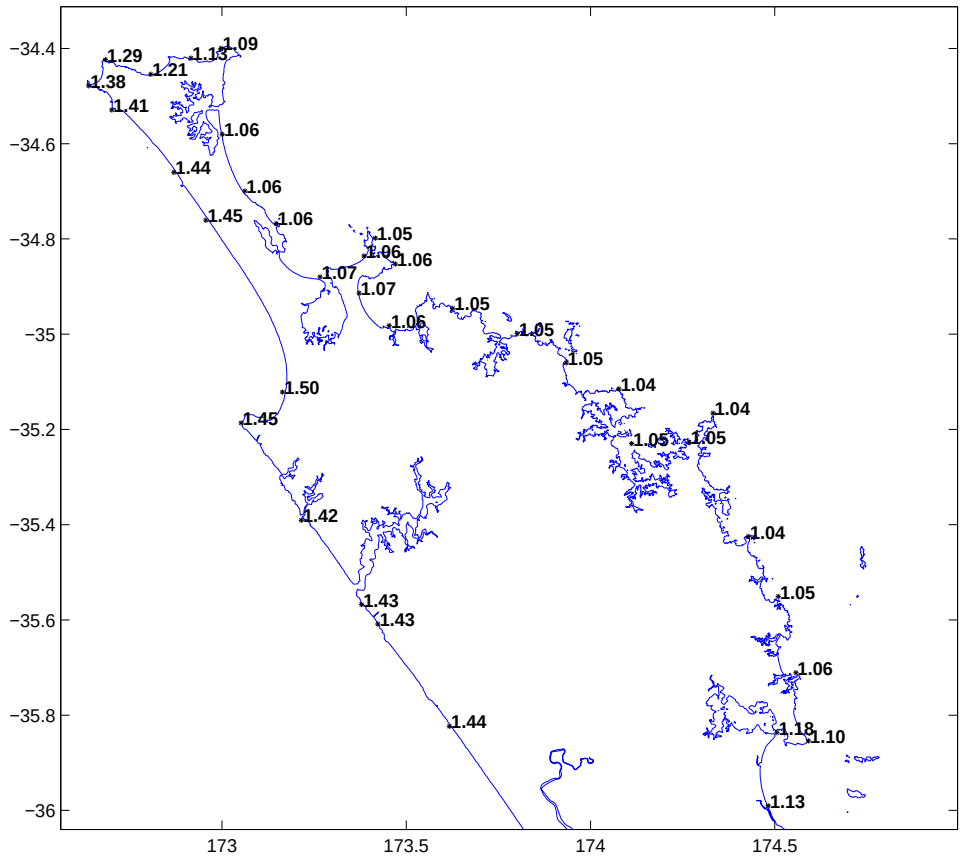

Figure A-1: MHWS-10 heights (relative to MSL=0) for Northland. Source: NIWA EEZ tide model, on latitude/longitude coordinate system.

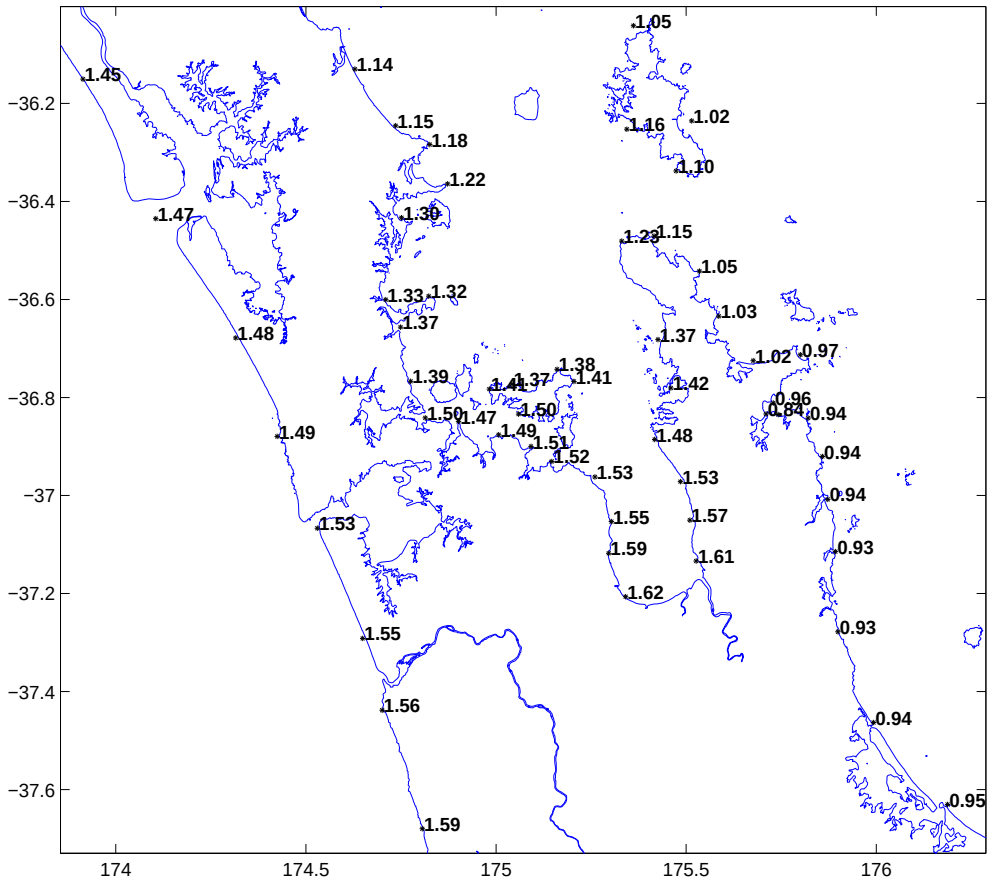

Figure A-2: MHWS-10 heights (relative to MSL=0) for Auckland and Waikato. Source: NIWA EEZ tide model, on latitude/longitude coordinate system.

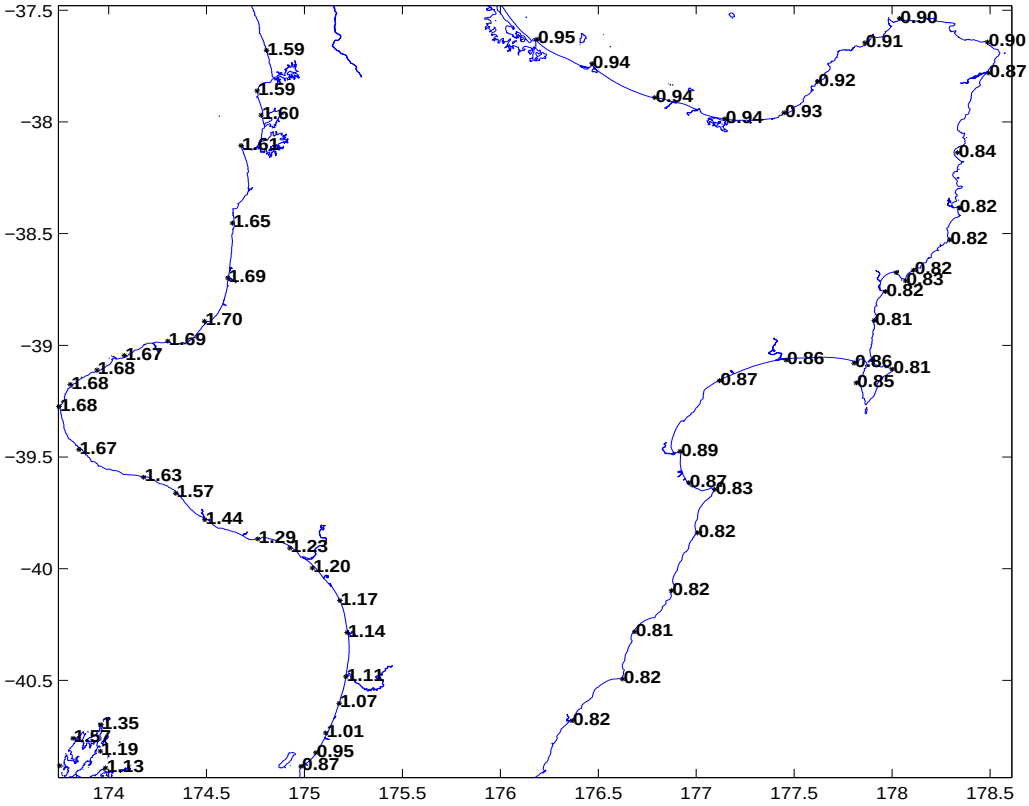

Figure A-3: MHWS-10 heights (relative to MSL=0) for Lower North Island. Source: NIWA EEZ tide model.

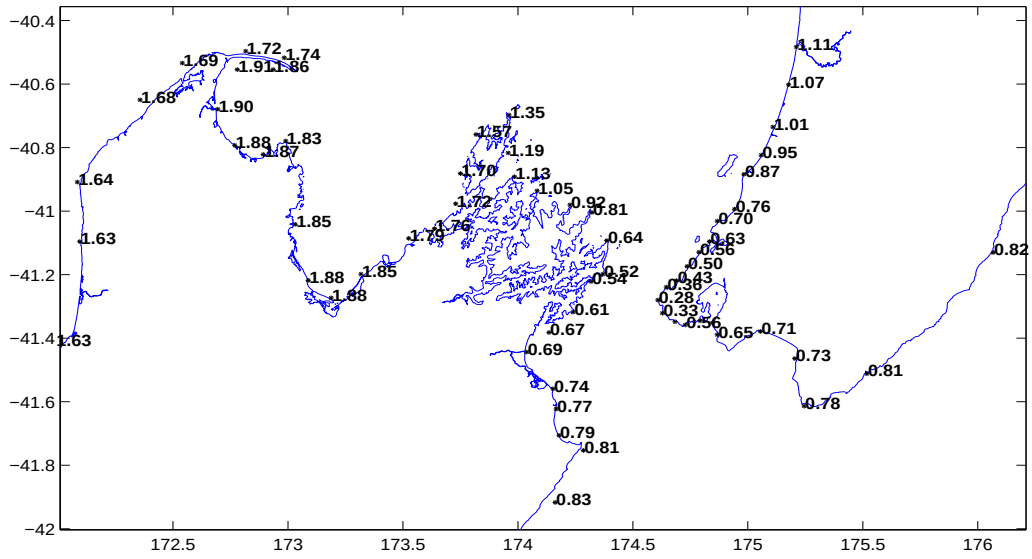

Figure A-4: MHWS-10 heights (relative to MSL=0) for Greater Cook Strait area. Source: NIWA EEZ tide model, on latitude/longitude coordinate system.

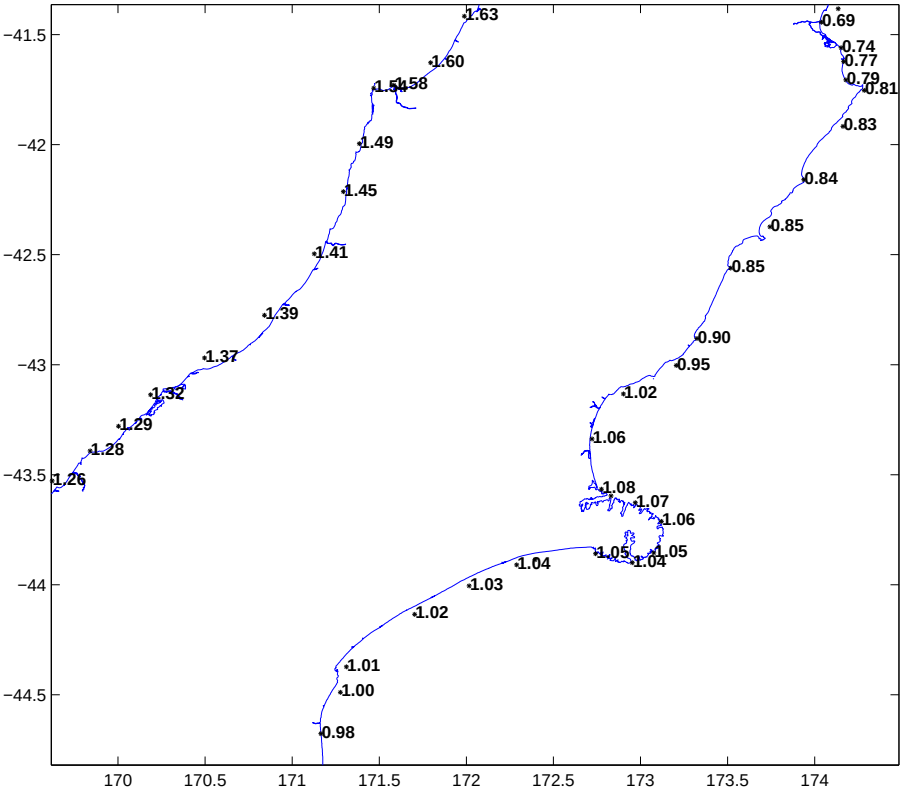

Figure A-5: MHWS-10 heights (relative to MSL=0) for Central South Island. Source: NIWA EEZ tide model, on latitude/longitude coordinate system.

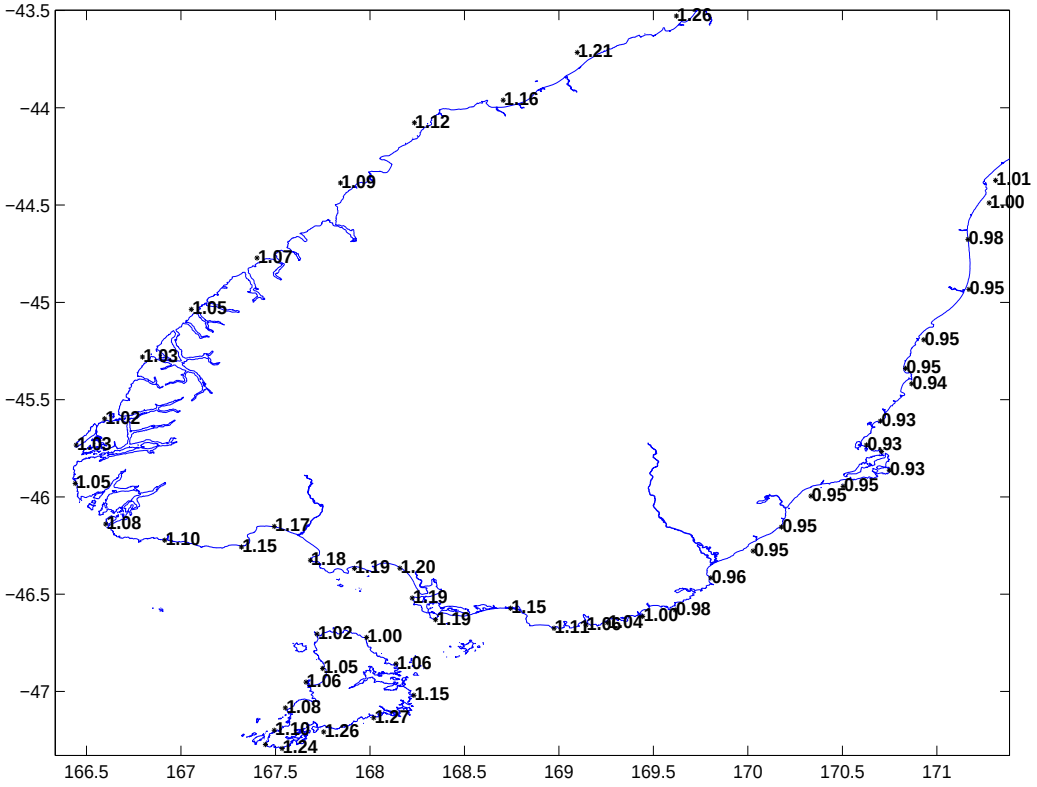

Figure A-6: MHWS-10 heights (relative to MSL=0) for Southland & Otago. Source: NIWA EEZ tide model, on latitude/longitude coordinate system.

Appendix B Local MSL offsets

The Table below lists the local MSL offsets that were applied to the MHWS-10 heights to convert to the local vertical datum (LVD) used for the relevant LiDAR DEM supplied. These offsets are required as MSL has risen since the years for which data was used to derive the local vertical datum. The MSL offsets were calculated from recent epochs mostly covering between 7–8 years up to the 18-year nodal-tide cycle from available sea-level gauge records, derived from Standard Port levels for MSL in the Nautical Almanac (LINZ, 2015) or interpolated where needed (in absence of gauge data).

Table B-1: Estimated MSL offsets for various coastal regions relative to the relevant local vertical datum. Notes: i) these offsets are estimates at one location in the wider "coastal region" from a variety of gauge record lengths and LINZ Standard Port MSL values - *offsets not intended to be used locally for engineering design or cadastral purposes*; ii) offsets for Northland sites are mostly negative as One Tree Point datum is currently higher than present-day MSL.

Coastal region	Local Vertical Datum	MSL offset (m)	Notes (or epoch)
Dargaville (Northland)	One Tree Pt (1964)	0.27	Hoods Landing vs Anawhata
Open west coast (Northland)	One Tree Pt (1964)	-0.11	Assumed same as east coast
Northland- open east coast	One Tree Pt (1964)	-0.11	Marsden Pt (2004-12)
Whangarei - Northland	One Tree Pt (1964)	-0.08	Whangarei (1999-2006)
Marsden Pt - Northland	One Tree Pt (1964)	-0.11	Marsden Pt (2004-12)
Opua - Bay of Islands (Northland)	One Tree Pt (1964)	-0.09	0.01 m less than Whangarei
Auckland - east coast	Auckland (1946)	0.15	Auckland (1999-2008)
Auckland - west coast (Onehunga)	Auckland (1946)	0.22	Onehunga (2001-2013)
Auckland -west open coast	Auckland (1946)	0.16	Table 2.2 (Stephens et al. 2013)
Coromandel- east open coast	Moturiki (1953)	0.10	Based on Moturiki gauge
Whitianga Harbour	Moturiki (1953)	0.05	0.05 m lower (Wharf gauge)
Inner Firth of Thames - Tararu	Moturiki (1953)	0.22	Tararu gauge (1998-2014)
Outer Firth of Thames, Coromandel town	Moturiki (1953)	0.18	Interpolated: Moturiki-Auckland
Moturiki - all of Bay of Plenty	Moturiki (1953)	0.10	Moturiki gauge (1998-2014)
Waikato - west coast	Moturiki (1953)	0.06	MSL: Port Taranaki, Manukau Entr
Waikato - Kawhia/Raglan Harbours	Moturiki (1953)	0.06	Same value as Taranaki, needs longer gauge record
New Plymouth - Taranaki	Taranaki (1970)	0.14	Port Taranaki (1995-2013)
Gisborne - East Cape	Gisborne (1926)	0.22	Gisborne (2004-2013)
Napier – Hawke's Bay	Napier (1962)	0.03	Napier (1999-2013)
Wairarapa Coast- Wellington region	Wellington 1953)	0.24	Interpolated: Napier-Wellington
Wellington	Wellington (1953)	0.19	Wellington (1995-2013)
Kāpiti Coast - Wellington region	Wellington (1953)	0.21	Interpolated: Taranaki-Wellington
Nelson-Tasman region	Nelson (1955)	0.08	Nelson (1999-2008)
Picton	Nelson (1955)	0.01	Picton (2005-2008)
Kaikoura - Canterbury region	Lyttelton (1937)	0.15	Same as Lyttelton
Lyttleton - Christchurch area	Lyttelton (1937)	0.15	Lyttelton (1999-2008)
Timaru	Lyttelton (1937)	0.15	Timaru (2002-2008)
Dunedin	Dunedin (1958)	0.11	Dunedin (1999-2013)
Port Chalmers	Dunedin (1958)	0.10	Port Chalmers (2000-2013)
Oamaru- North Otago	Dunedin (1958)	0.13	Interpolated: Timaru-Otago
Open Otago coast - Green Island	Dunedin (1958)	0.09	0.01 m lower than Port Chalmers
Bluff	Bluff (1955)	0.12	Bluff (1998-2013)

Appendix C Result tables: buildings for the 0–3 m national DEM (regional, TLA and urban areas)

Table 1: Building use count by regional council

REGC2014_N	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Northland Region	2,387	1,352	39	244	14	17	721
Auckland Region	7,534	6,496	121	454	155	94	214
Waikato Region	8,831	5,732	74	325	3	18	2,679
Bay of Plenty Region	7,078	4,487	133	604	30	47	1,777
Gisborne Region	961	469	7	273	22	4	186
Hawke's Bay Region	17,674	9,987	101	1,275	143	71	6,097
Taranaki Region	302	190	2	19	0	4	87
Manawatu-Wanganui Region	423	181	2	131	2	2	105
Wellington Region	7,572	7,069	62	280	27	21	113
West Coast Region	1,378	1,042	19	86	48	14	169
Canterbury (2012)	38,668	25,539	342	1,287	47	109	11,344
Cant. (excl. Red Zone)	29,946	19,267	325	1,239	47	102	8,966
Otago Region	1,944	1,743	34	111	2	49	5
Southland Region	1,359	1,038	32	274	0	10	5
Tasman Region	1,533	1,274	9	191	13	14	32
Nelson Region	425	301	2	85	0	9	28
Marlborough Region	432	268	2	135	0	5	22
New Zealand Total	98,501	67,168	981	5,774	506	488	23,584
New Zealand Total*	89,779	60,896	964	5,726	506	481	21,206

* excludes Red Zone in Christchurch

Table 2: Building use count by territorial authority

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Far North District	626	372	26	59	2	6	161
Whangarei District	1,076	633	3	80	0	5	355
Kaipara District	685	347	10	105	12	6	205
Thames-Coromandel District	6,498	4,401	55	86	1	9	1,946
Hauraki District	2,202	1,248	19	233	2	5	695
Waikato District	127	82	0	6	0	4	35
Matamata-Piako District	0	0	0	0	0	0	0

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	1	0	0	0	0	0	1
South Waikato District	0	0	0	0	0	0	0
Waitomo District	3	1	0	0	0	0	2
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	1,424	901	6	39	6	10	462
Tauranga City	2,784	1,974	53	232	3	6	516
Rotorua District	0	0	0	0	0	0	0
Whakatane District	1,412	918	7	75	0	3	409
Kawerau District	0	0	0	0	0	0	0
Opotiki District	1,458	694	67	258	21	28	390
Gisborne District	961	469	7	273	22	4	186
Wairoa District	0	0	0	0	0	0	0
Hastings District	2,236	1,239	12	186	10	16	773
Napier City	15,410	8,733	89	1,089	133	55	5,311
Central Hawke's Bay District	28	15	0	0	0	0	13
New Plymouth District	282	177	2	17	0	4	82
Stratford District	0	0	0	0	0	0	0
South Taranaki District	20	13	0	2	0	0	5
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	139	16	0	110	0	2	11
Rangitikei District	0	0	0	0	0	0	0
Manawatu District	260	145	2	21	2	0	90
Palmerston North City	0	0	0	0	0	0	0
Tararua District	17	14	0	0	0	0	3
Horowhenua District	7	6	0	0	0	0	1
Kapiti Coast District	3,625	3,582	11	0	1	4	27
Porirua City	242	186	12	4	9	3	28
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	3,486	3,132	27	258	17	13	39
Wellington City	210	165	12	13	0	1	19
Masterton District	7	3	0	4	0	0	0
Carterton District	0	0	0	0	0	0	0
South Wairarapa District	2	1	0	1	0	0	0
Tasman District	1,533	1,274	9	191	13	14	32
Nelson City	425	301	2	85	0	9	28
Marlborough District	432	268	2	135	0	5	22

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Kaikoura District	44	38	1	2	0	3	0
Buller District	959	819	4	56	45	10	25
Grey District	224	109	0	7	1	2	105
Westland District	195	114	15	23	2	2	39
Hurunui District	195	187	0	4	0	4	0
Waimakariri District	4,864	4,334	99	314	45	43	29
Christchurch CC (2012)	32,875	20,480	240	788	2	54	11,311
Chch (excl. Red Zone)	24,153	14,208	223	740	2	47	8,933
Selwyn District	417	334	0	76	0	5	2
Ashburton District	15	11	0	4	0	0	0
Timaru District	220	143	2	73	0	0	2
Mackenzie District	0	0	0	0	0	0	0
Waimate District	38	12	0	26	0	0	0
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	11	2	1	7	0	1	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	1,904	1,716	33	100	2	48	5
Clutha District	29	25	0	4	0	0	0
Southland District	97	68	4	21	0	3	1
Gore District	0	0	0	0	0	0	0
Invercargill City	1,262	970	28	253	0	7	4
Auckland	7,534	6,496	121	454	155	94	214
New Zealand Total	98,501	67,168	981	5,774	506	488	23,584
New Zealand Total*	89,779	60,896	964	5,726	506	481	21,206

* excludes Red Zone in Christchurch

Table 3: Building use count by urban area

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangarei	48	14	1	27	0	0	6
Northern Auckland Zone	2,064	1,857	51	35	41	25	55
Western Auckland Zone	633	549	2	34	14	5	29
Central Auckland Zone	1,386	996	24	238	30	29	69
Southern Auckland Zone	2,357	2,105	19	114	70	18	31
Hamilton Zone	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	2,846	2,011	54	233	3	7	538
Rotorua	0	0	0	0	0	0	0
Gisborne	864	440	7	238	2	4	173
Napier Zone	15,448	8,756	89	1,089	133	55	5,326
Hastings Zone	2,158	1,194	12	183	10	15	744
New Plymouth	117	81	2	15	0	3	16
Wanganui	139	16	0	110	0	2	11
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	3,486	3,132	27	258	17	13	39
Porirua Zone	242	186	12	4	9	3	28
Wellington Zone	210	165	12	13	0	1	19
Nelson	545	334	2	160	7	12	30
Christchurch (2012)	37,125	24,308	335	1,035	47	92	11,308
Chch (excl. Red Zone)	28,403	18,036	318	987	47	85	8,930
Dunedin	1,745	1,574	31	91	2	42	5
Invercargill	1,170	917	25	224	0	3	1
Kapiti	2,862	2,845	11	0	1	3	2
Blenheim	168	77	0	86	0	3	2
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	1,354	894	7	52	0	3	398
Hawera	0	0	0	0	0	0	0
Feilding	0	0	0	0	0	0	0
Levin	7	6	0	0	0	0	1
Masterton	0	0	0	0	0	0	0
Greymouth	219	106	0	5	1	2	105
Ashburton	0	0	0	0	0	0	0
Timaru	53	1	2	49	0	0	1
Oamaru	8	0	0	7	0	1	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	152	99	5	16	1	2	29
Kaitaia	0	0	0	0	0	0	0
Kerikeri	24	20	0	0	0	0	4
Paihia	20	13	3	0	0	0	4
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Dargaville	0	0	0	0	0	0	0
Wellsford	0	0	0	0	0	0	0
Warkworth	0	0	0	0	0	0	0
Snells Beach	23	9	0	0	0	5	9
Helensville	0	0	0	0	0	0	0
Waiheke Island	45	34	0	8	0	2	1
Waiuku	205	205	0	0	0	0	0
Raglan	119	78	0	6	0	4	31
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	2,154	1,517	37	0	1	1	598
Coromandel	0	0	0	0	0	0	0
Whangamata	1,647	1,106	11	60	0	4	466
Tairua	164	98	4	5	0	1	56
Thames	227	148	1	11	0	1	66
Waihi Beach	237	170	0	7	1	0	59
Paeroa	0	0	0	0	0	0	0
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	62	39	0	0	0	2	21
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	0	0	0	0	0	0	0
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	1,408	662	67	258	21	27	373
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	164	95	0	2	0	1	66
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	0	0	0	0	0	0	0
Eltham	0	0	0	0	0	0	0
Patea	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	0	0	0	0	0	0	0
Shannon	0	0	0	0	0	0	0
Otaki	481	456	0	0	0	0	25
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	19	16	0	2	0	1	0
Kaikoura	42	36	1	2	0	3	0
Takaka	0	0	0	0	0	0	0
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	804	760	0	39	1	4	0
Westport	754	670	3	28	45	8	0
Reefton	0	0	0	0	0	0	0
Hokitika	55	30	15	10	0	0	0
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	58	34	3	17	0	4	0
Te Anau	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Riverton	5	4	1	0	0	0	0
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	179	107	2	6	0	0	64
Mangawhai Heads	2	2	0	0	0	0	0
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	886	530	16	53	1	3	283
Mapua	101	89	1	9	0	1	1
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	123	113	1	4	0	5	0
Rural Centre	3,643	2,486	41	167	29	16	904
Rural (Incl.some Off Shore Islands)	2,086	1,587	11	336	2	23	127
Rural (Incl.some Off Shore Islands)	3,355	2,033	24	287	4	13	994
Rural (Incl.some Off Shore Islands)	2,002	1,358	9	139	13	16	467
New Zealand Total	98,500	67,168	981	5,772	506	488	23,585
New Zealand Total*	89,778	60,896	964	5,724	506	481	21,207

* excludes Red Zone in Christchurch

Table 4: Building replacement cost (NZD$ 2011) by regional council

REGC2014_N	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
Northland Region	579,638,350	358,739,067	49,978,057	113,198,237	15,460,180	16,992,049	25,270,760
Auckland Region	5,094,648,260	2,789,500,515	507,635,127	801,879,066	612,499,311	97,759,370	285,374,871
Waikato Region	1,759,892,952	1,524,034,175	83,547,148	79,584,794	709,703	10,255,493	61,761,639
Bay of Plenty Region	2,014,493,141	1,429,764,135	109,971,241	390,252,903	17,469,150	15,723,370	51,312,342
Gisborne Region	299,254,497	103,964,796	5,091,311	160,039,503	16,050,663	3,903,138	10,205,086
Hawke's Bay Region	3,311,509,499	2,355,486,140	71,347,880	542,743,730	130,825,053	71,402,107	139,704,589
Taranaki Region	71,160,005	41,705,304	1,821,040	13,990,384	0	11,655,382	1,987,895
Manawatu-Wanganui Region	125,571,140	34,312,504	921,106	85,303,182	684,935	1,759,560	2,589,853
Wellington Region	2,378,525,379	1,608,271,678	141,248,977	476,988,874	44,459,744	42,078,382	65,477,724
West Coast Region	317,953,299	221,889,393	14,869,807	15,249,720	50,131,648	11,121,823	4,690,908
Canterbury (2012)	7,573,197,345	6,449,340,138	296,571,778	402,753,568	49,053,125	92,476,310	283,002,426
Cant (excl Red Zone)	5,703,877,931	4,657,510,307	288,688,713	393,784,870	49,053,125	89,285,677	225,555,239
Otago Region	539,498,073	354,099,250	76,044,682	90,204,810	673,192	16,618,352	1,857,787
Southland Region	870,086,820	236,691,489	105,489,853	520,585,529	0	4,755,166	2,564,783
Tasman Region	513,932,230	381,690,329	4,890,302	108,476,062	7,556,560	8,290,010	3,028,967
Nelson Region	207,889,723	83,603,637	407,434	118,502,236	0	3,636,404	1,740,012
Marlborough Region	139,011,885	95,944,850	13,817,348	22,079,660	0	3,410,637	3,759,390
New Zealand Total	25,796,262,598	18,069,037,400	1,483,653,091	3,941,832,258	945,573,264	411,837,553	944,329,032
New Zealand Total*	23,926,943,184	16,277,207,569	1,475,770,026	3,932,863,560	945,573,264	408,646,920	886,881,845

* excludes Red Zone in Christchurch as at 2012

Table 5: Building replacement cost (NZD$2011) by territorial authority

TA2014_NAM	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
Far North District	133,661,028	87,295,566	17,139,759	17,535,479	1,061,692	4,285,629	6,342,903
Whangarei District	331,025,305	203,426,535	26,449,228	79,746,319	0	8,497,149	12,906,074
Kaipara District	114,952,017	68,016,966	6,389,070	15,916,439	14,398,488	4,209,271	6,021,783
Thames-Coromandel District	1,289,572,539	1,110,801,223	73,397,158	57,686,161	167,265	6,294,043	41,226,689
Hauraki District	445,156,124	391,974,537	10,149,990	20,992,092	542,438	2,312,391	19,184,676

TA2014_NAM	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
Waikato District	24,252,065	21,048,040	0	906,541	0	1,649,059	648,425
Matamata-Piako District	0	0	0	0	0	0	0
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	40,860	0	0	0	0	0	40,860
South Waikato District	0	0	0	0	0	0	0
Waitomo District	871,364	210,375	0	0	0	0	660,989
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	302,325,711	279,981,805	1,964,945	4,407,476	1,242,331	3,890,715	10,838,439
Tauranga City	1,186,554,447	779,914,984	58,512,517	320,441,111	8,285,431	1,494,850	17,905,554
Rotorua District	0	0	0	0	0	0	0
Whakatane District	286,493,111	253,099,378	5,331,507	17,181,505	0	1,484,230	9,396,491
Kawerau District	0	0	0	0	0	0	0
Opotiki District	239,119,872	116,767,968	44,162,272	48,222,811	7,941,388	8,853,575	13,171,858
Gisborne District	299,254,497	103,964,796	5,091,311	160,039,503	16,050,663	3,903,138	10,205,086
Wairoa District	0	0	0	0	0	0	0
Hastings District	434,542,392	337,262,469	6,440,362	46,245,127	10,091,170	14,193,400	20,309,864
Napier City	2,872,270,374	2,013,835,193	64,907,518	496,498,603	120,733,883	57,208,707	119,086,470
Central Hawke's Bay District	4,696,733	4,388,478	0	0	0	0	308,255
New Plymouth District	66,359,857	37,086,405	1,821,040	13,980,776	0	11,655,382	1,816,254
Stratford District	0	0	0	0	0	0	0
South Taranaki District	4,800,148	4,618,899	0	9,608	0	0	171,641
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	89,460,606	2,552,711	0	84,967,588	0	1,759,560	180,747
Rangitikei District	0	0	0	0	0	0	0
Manawatu District	30,649,515	26,344,799	921,106	335,594	684,935	0	2,363,081
Palmerston North City	0	0	0	0	0	0	0
Tararua District	2,561,584	2,525,202	0	0	0	0	36,382
Horowhenua District	2,899,435	2,889,792	0	0	0	0	9,643
Kāpiti Coast District	900,312,627	868,802,663	13,037,146	0	1,023,412	4,503,188	12,946,218
Porirua City	115,627,364	58,842,453	24,142,261	2,970,522	12,508,609	3,453,758	13,709,761
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	1,155,591,289	589,131,798	29,162,811	444,320,189	30,927,723	32,006,356	30,042,412
Wellington City	205,734,786	90,363,839	74,906,759	29,569,775	0	2,115,080	8,779,333
Masterton District	981,885	863,445	0	118,440	0	0	0
Carterton District	0	0	0	0	0	0	0

TA2014_NAM	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
South Wairarapa District	277,428	267,480	0	9,948	0	0	0
Tasman District	513,932,230	381,690,329	4,890,302	108,476,062	7,556,560	8,290,010	3,028,967
Nelson City	207,889,723	83,603,637	407,434	118,502,236	0	3,636,404	1,740,012
Marlborough District	139,011,885	95,944,850	13,817,348	22,079,660	0	3,410,637	3,759,390
Kaikoura District	16,738,792	10,206,244	1,071,130	1,615,985	0	3,845,433	0
Buller District	246,617,455	174,430,281	1,636,576	11,272,556	46,887,849	9,919,793	2,470,400
Grey District	29,079,803	24,308,775	0	1,324,023	1,607,815	183,870	1,655,320
Westland District	42,256,041	23,150,337	13,233,231	2,653,141	1,635,984	1,018,160	565,188
Hurunui District	33,183,942	31,438,885	0	571,567	0	1,173,490	0
Waimakariri District	1,377,081,257	1,153,016,045	56,215,653	81,974,125	48,192,433	26,278,889	11,404,112
Christchurch (2012)	5,920,498,043	5,126,734,632	237,211,331	225,641,658	860,692	59,605,541	270,444,189
Chch (excl Red Zone)	4,051,178,629	3,334,904,801	229,328,266	216,672,960	860,692	56,414,908	212,997,002
Selwyn District	95,150,628	84,762,356	0	8,684,760	0	1,572,957	130,555
Ashburton District	10,756,781	9,463,989	0	1,292,792	0	0	0
Timaru District	113,959,870	28,450,339	2,073,664	82,412,297	0	0	1,023,570
Mackenzie District	0	0	0	0	0	0	0
Waimate District	5,828,032	5,267,648	0	560,384	0	0	0
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	2,425,582	506,994	264,005	1,598,120	0	56,463	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	532,736,080	349,284,277	75,780,677	88,578,258	673,192	16,561,889	1,857,787
Clutha District	4,336,411	4,307,979	0	28,432	0	0	0
Southland District	18,319,757	14,071,729	1,811,539	959,619	0	1,365,401	111,469
Gore District	0	0	0	0	0	0	0
Invercargill City	851,767,063	222,619,760	103,678,314	519,625,910	0	3,389,765	2,453,314
Auckland	5,094,648,260	2,789,500,515	507,635,127	801,879,066	612,499,311	97,759,370	285,374,871
New Zealand Total	25,796,262,598	18,069,037,400	1,483,653,091	3,941,832,258	945,573,264	411,837,553	944,329,032
New Zealand Total*	23,926,943,184	16,277,207,569	1,475,770,026	3,932,863,560	945,573,264	408,646,920	886,881,845

* excludes Red Zone in Christchurch as at 2012

Table 6: Building replacement cost (NZD$2011) by urban area

UA2014_NAM	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
Whangarei	84,789,262	20,151,557	25,721,250	38,732,175	0	0	184,280
Northern Auckland Zone	1,075,078,721	830,597,120	107,356,445	20,980,462	48,699,647	30,328,667	37,116,380
Western Auckland Zone	346,369,621	248,802,283	5,837,738	68,400,570	9,905,320	3,585,850	9,837,860
Central Auckland Zone	1,997,234,145	563,150,862	366,375,982	461,599,342	377,866,559	39,140,862	189,100,538
Southern Auckland Zone	1,293,053,224	787,324,137	22,586,523	241,411,236	176,027,785	18,868,287	46,835,256
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	1,205,120,131	796,535,356	58,942,468	320,449,868	8,285,431	2,379,250	18,527,758
Rotorua	0	0	0	0	0	0	0
Gisborne	267,191,626	96,205,968	5,091,311	151,851,583	1,090,718	3,903,138	9,048,908
Napier Zone	2,881,791,825	2,022,948,104	64,907,518	496,498,603	120,733,883	57,208,707	119,495,010
Hastings Zone	416,372,466	320,997,889	6,440,362	46,173,612	10,091,170	13,190,436	19,478,997
New Plymouth	47,774,563	19,989,368	1,821,040	13,906,176	0	11,643,500	414,479
Wanganui	89,460,606	2,552,711	0	84,967,588	0	1,759,560	180,747
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	1,155,591,289	589,131,798	29,162,811	444,320,189	30,927,723	32,006,356	30,042,412
Porirua Zone	115,627,364	58,842,453	24,142,261	2,970,522	12,508,609	3,453,758	13,709,761
Wellington Zone	205,734,786	90,363,839	74,906,759	29,569,775	0	2,115,080	8,779,333
Nelson	313,863,108	96,848,995	407,434	201,625,601	4,176,560	6,672,006	4,132,512
Christchurch (2012)	7,177,587,661	6,168,225,205	291,844,191	303,992,573	49,053,125	85,111,973	279,360,594
Chch (excl Red Zone)	5,308,268,247	4,376,395,374	283,961,126	295,023,875	49,053,125	81,921,340	221,913,407
Dunedin	478,008,336	320,009,549	75,231,176	65,752,748	673,192	14,483,884	1,857,787
Invercargill	443,075,234	210,917,261	41,121,089	189,178,347	0	1,560,197	298,340
Kapiti	766,195,270	748,193,546	13,037,146	0	1,023,412	3,656,196	284,970
Blenheim	43,881,498	26,441,695	0	12,334,943	0	3,226,560	1,878,300
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	275,336,177	242,784,224	5,331,507	16,792,762	0	1,484,230	8,943,454
Hawera	0	0	0	0	0	0	0
Feilding	0	0	0	0	0	0	0
Levin	2,899,435	2,889,792	0	0	0	0	9,643

UA2014_NAM	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
Masterton	0	0	0	0	0	0	0
Greymouth	28,427,049	23,678,931	0	1,301,113	1,607,815	183,870	1,655,320
Ashburton	0	0	0	0	0	0	0
Timaru	84,716,915	1,154,307	2,073,664	80,477,094	0	0	1,011,850
Oamaru	1,654,583	0	0	1,598,120	0	56,463	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	38,774,940	19,431,491	2,274,618	11,723,596	297,000	2,434,642	2,613,593
Kaitaia	0	0	0	0	0	0	0
Kerikeri	9,389,749	9,341,490	0	0	0	0	48,259
Paihia	7,829,088	4,033,758	3,699,162	0	0	0	96,168
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	0	0	0	0	0	0	0
Wellsford	0	0	0	0	0	0	0
Warkworth	0	0	0	0	0	0	0
Snells Beach	4,193,567	2,816,423	0	0	0	1,377,144	0
Helensville	0	0	0	0	0	0	0
Waiheke Island	10,266,582	7,971,817	0	1,375,091	0	635,536	284,138
Waiuku	75,130,678	75,130,678	0	0	0	0	0
Raglan	23,255,887	20,117,401	0	906,541	0	1,649,059	582,886
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	387,770,104	329,951,797	43,449,866	0	167,265	1,648,588	12,552,588
Coromandel	0	0	0	0	0	0	0
Whangamata	341,467,138	289,596,858	11,807,810	27,611,844	0	3,010,029	9,440,597
Tairua	30,625,064	25,290,922	3,749,000	134,593	0	106,138	1,344,411
Thames	93,629,962	53,235,500	9,960,438	27,623,862	0	1,507,000	1,303,162
Waihi Beach	64,054,390	60,755,646	0	1,783,761	81,720	0	1,433,263
Paeroa	0	0	0	0	0	0	0
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	18,979,545	17,414,267	0	0	0	919,908	645,370
Te Puke Community	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
Turangi	0	0	0	0	0	0	0
Edgecumbe	0	0	0	0	0	0	0
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	231,436,453	109,420,832	44,162,272	48,222,811	7,941,388	8,806,047	12,883,103
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	18,303,999	16,815,742	0	74,600	0	11,882	1,401,775
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	0	0	0	0	0	0	0
Eltham	0	0	0	0	0	0	0
Patea	0	0	0	0	0	0	0
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	0	0	0	0	0	0	0
Shannon	0	0	0	0	0	0	0
Otaki	94,049,564	81,388,316	0	0	0	0	12,661,248
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	3,527,279	3,492,774	0	8,008	0	26,497	0
Kaikoura	15,994,513	9,461,965	1,071,130	1,615,985	0	3,845,433	0
Takaka	0	0	0	0	0	0	0
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	264,668,835	244,434,600	0	17,383,777	463,856	2,386,602	0
Westport	207,091,503	140,643,881	1,171,622	9,017,613	46,887,849	9,370,538	0
Reefton	0	0	0	0	0	0	0
Hokitika	20,618,642	6,302,221	13,233,231	1,083,190	0	0	0
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Value	Residential Building Replacement Value	Commercial Building Replacement Value	Industrial/Primary Production Building Replacement Value	Critical Facility Building Replacement Value	Community Building Replacement Value	Other Building Replacement Value
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	126,705,506	6,446,760	62,557,225	55,871,953	0	1,829,568	0
Te Anau	0	0	0	0	0	0	0
Riverton	880,208	599,190	281,018	0	0	0	0
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	40,659,333	33,813,611	727,978	97,132	0	0	6,020,612
Mangawhai Heads	624,435	624,435	0	0	0	0	0
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	177,123,026	145,202,194	9,762,430	13,759,207	195,278	1,340,973	6,862,944
Mapua	30,779,701	24,442,278	1,870,830	3,164,643	0	1,248,624	53,326
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	24,671,849	21,885,824	345,576	387,282	0	2,053,167	0
Rural Centre	697,605,167	600,708,568	33,909,609	17,679,444	18,282,833	4,985,761	22,038,952
Rural (Incl.some Off Shore Islands)	738,151,848	387,026,747	4,887,416	328,559,405	1,635,984	7,045,588	8,996,708
Rural (Incl.some Off Shore Islands)	687,488,700	627,454,429	4,120,880	20,562,067	1,785,962	4,569,694	28,995,668
Rural (Incl.some Off Shore Islands)	513,618,584	405,048,035	8,272,305	58,238,987	15,163,180	15,010,305	11,885,772
New Zealand Total	25,796,200,734	18,069,037,400	1,483,653,091	3,941,770,394	945,573,264	411,837,553	944,329,032
New Zealand Total*	23,926,881,320	16,277,207,569	1,475,770,026	3,932,801,696	945,573,264	408,646,920	886,881,845

* excludes Red Zone in Christchurch as at 2012

Appendix D Result tables: infrastructure assets for the 0–3 m national DEM (regional, TLA and urban areas)

Roads

Table 1: Road type and length by regional council.

REGC2014_N	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Northland Region	104	93.2	4	7.3	0.0
Auckland Region	107	93.2	3	2.7	9.1
Waikato Region	195	177.0	11	6.9	0.0
Bay of Plenty Region	105	97.5	3	4.7	0.0
Gisborne Region	26	25.1	0	0.6	0.0
Hawke's Bay Region	216	204.8	3	9.2	0.0
Taranaki Region	8	7.8	0	0.0	0.0
Manawatu-Wanganui Region	12	12.1	0	0.0	0.0
Wellington Region	86	82.7	1	2.4	0.1
West Coast Region	65	60.0	0	5.1	0.0
Canterbury Region	483	469.8	6	5.5	1.8
Otago Region	52	51.3	1	0.0	0.0
Southland Region	89	82.8	5	1.3	0.0
Tasman Region	86	72.7	11	2.3	0.0
Nelson Region	21	17.4	2	1.4	0.0
Marlborough Region	50	49.6	0	0.0	0.0
New Zealand Total	1,706	1,596.9	48	49.5	11.0

Table 2: Road type and length by territorial authority.

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Far North District	52	44.8	2	4.5	0.0
Whangarei District	34	33.3	0	0.9	0.0
Kaipara District	18	15.1	1	1.9	0.0
Thames-Coromandel District	64	62.1	0	2.3	0.0
Hauraki District	127	111.1	11	4.6	0.0
Waikato District	3	2.9	0	0.0	0.0
Matamata-Piako District	0	0.0	0	0.0	0.0
Hamilton City	0	0.0	0	0.0	0.0
Waipa District	0	0.0	0	0.0	0.0

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Otorohanga District	1	0.6	0	0.0	0.0
South Waikato District	0	0.0	0	0.0	0.0
Waitomo District	0	0.2	0	0.0	0.0
Taupo District	0	0.0	0	0.0	0.0
Western Bay of Plenty District	35	34.9	0	0.0	0.0
Tauranga City	32	28.1	2	2.0	0.0
Rotorua District	0	0.0	0	0.0	0.0
Whakatane District	21	20.7	0	0.0	0.0
Kawerau District	0	0.0	0	0.0	0.0
Opotiki District	17	13.8	0	2.7	0.0
Gisborne District	26	25.1	0	0.6	0.0
Wairoa District	0	0.5	0	0.0	0.0
Hastings District	45	43.1	0	1.4	0.0
Napier City	172	161.4	3	7.8	0.0
Central Hawke's Bay District	1	0.6	0	0.0	0.0
New Plymouth District	4	4.1	0	0.0	0.0
Stratford District	0	0.0	0	0.0	0.0
South Taranaki District	4	3.8	0	0.0	0.0
Ruapehu District	0	0.0	0	0.0	0.0
Wanganui District	4	4.0	0	0.0	0.0
Rangitikei District	0	0.3	0	0.0	0.0
Manawatu District	3	3.0	0	0.0	0.0
Palmerston North City	0	0.0	0	0.0	0.0
Tararua District	1	1.3	0	0.0	0.0
Horowhenua District	4	3.6	0	0.0	0.0
Kapiti Coast District	37	35.8	0	1.3	0.0
Porirua City	7	6.2	0	0.4	0.0
Upper Hutt City	0	0.0	0	0.0	0.0
Lower Hutt City	34	33.7	0	0.2	0.0
Wellington City	8	6.5	1	0.3	0.1
Masterton District	0	0.2	0	0.0	0.0
Carterton District	0	0.0	0	0.0	0.0
South Wairarapa District	1	0.4	0	0.2	0.0
Tasman District	86	72.7	11	2.3	0.0
Nelson City	21	17.4	2	1.4	0.0
Marlborough District	50	49.6	0	0.0	0.0
Kaikoura District	3	3.3	0	0.0	0.0
Buller District	36	35.7	0	0.4	0.0
Grey District	5	5.2	0	0.1	0.0

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Westland District	24	19.1	0	4.6	0.0
Hurunui District	6	6.1	0	0.0	0.0
Waimakariri District	89	83.4	4	0.0	1.8
Christchurch City	270	262.0	2	5.5	0.0
Selwyn District	76	75.9	0	0.0	0.0
Ashburton District	6	5.7	0	0.0	0.0
Timaru District	21	21.3	0	0.0	0.0
Mackenzie District	0	0.0	0	0.0	0.0
Waimate District	12	12.1	0	0.0	0.0
Chatham Islands Territory	0	0.0	0	0.0	0.0
Waitaki District	5	4.5	0	0.0	0.0
Central Otago District	0	0.0	0	0.0	0.0
Queenstown-Lakes District	0	0.0	0	0.0	0.0
Dunedin City	45	44.2	1	0.0	0.0
Clutha District	3	2.5	0	0.0	0.0
Southland District	22	21.9	0	0.1	0.0
Gore District	0	0.0	0	0.0	0.0
Invercargill City	67	60.9	5	1.2	0.0
Auckland	107	93.2	3	2.7	9.1
New Zealand Total	1,707	1,597.8	48	49.5	11.0

Table 3: Road type and length by urban area

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Whangarei	7	6.6	0	0.0	0.0
Northern Auckland Zone	21	19.3	0	0.3	1.8
Western Auckland Zone	5	3.6	0	0.0	0.9
Central Auckland Zone	20	12.0	2	0.8	6.0
Southern Auckland Zone	30	27.9	1	0.8	1.0
Hamilton Zone	0	0.0	0	0.0	0.0
Cambridge Zone	0	0.0	0	0.0	0.0
Te Awamutu Zone	0	0.0	0	0.0	0.0
Tauranga	33	29.6	2	1.6	0.0
Rotorua	0	0.0	0	0.0	0.0
Gisborne	18	17.3	0	0.6	0.0
Napier Zone	174	163.3	3	7.9	0.0
Hastings Zone	42	40.3	0	1.3	0.0

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
New Plymouth	1	1.3	0	0.0	0.0
Wanganui	4	4.0	0	0.0	0.0
Palmerston North	0	0.0	0	0.0	0.0
Upper Hutt Zone	0	0.0	0	0.0	0.0
Lower Hutt Zone	34	33.5	0	0.2	0.0
Porirua Zone	6	6.0	0	0.4	0.0
Wellington Zone	7	5.6	1	0.3	0.1
Nelson	29	22.5	5	1.4	0.0
Christchurch	325	312.1	6	5.5	1.7
Dunedin	38	37.1	1	0.0	0.0
Invercargill	34	33.0	0	0.8	0.0
Kapiti	23	22.6	0	0.0	0.0
Blenheim	21	21.3	0	0.0	0.0
Pukekohe	0	0.0	0	0.0	0.0
Tokoroa	0	0.0	0	0.0	0.0
Taupo	0	0.0	0	0.0	0.0
Whakatane	13	12.4	0	0.0	0.0
Hawera	0	0.0	0	0.0	0.0
Feilding	0	0.0	0	0.0	0.0
Levin	0	0.1	0	0.0	0.0
Masterton	0	0.0	0	0.0	0.0
Greymouth	4	4.3	0	0.0	0.0
Ashburton	0	0.0	0	0.0	0.0
Timaru	4	4.2	0	0.0	0.0
Oamaru	0	0.0	0	0.0	0.0
Rangiora	0	0.0	0	0.0	0.0
Queenstown	0	0.0	0	0.0	0.0
Taipa Bay-Mangonui	3	2.9	0	0.3	0.0
Kaitaia	0	0.0	0	0.0	0.0
Kerikeri	0	0.4	0	0.0	0.0
Paihia	1	0.7	0	0.5	0.0
Kawakawa	0	0.0	0	0.0	0.0
Moerewa	0	0.0	0	0.0	0.0
Kaikohe	0	0.0	0	0.0	0.0
Dargaville	0	0.0	0	0.0	0.0
Wellsford	0	0.0	0	0.0	0.0
Warkworth	0	0.0	0	0.0	0.0
Snells Beach	0	0.4	0	0.0	0.0
Helensville	0	0.0	0	0.0	0.0
Waiheke Island	2	1.6	0	0.0	0.0
Waiuku	2	1.5	0	0.0	0.0
Raglan	2	2.1	0	0.0	0.0

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Huntly	0	0.0	0	0.0	0.0
Otorohanga	0	0.0	0	0.0	0.0
Te Kuiti	0	0.0	0	0.0	0.0
Taumarunui	0	0.0	0	0.0	0.0
Whitianga	19	18.7	0	0.0	0.0
Coromandel	0	0.4	0	0.0	0.0
Whangamata	14	13.6	0	0.2	0.0
Tairua	2	1.4	0	0.1	0.0
Thames	3	2.5	0	0.0	0.0
Waihi Beach	2	1.8	0	0.0	0.0
Paeroa	0	0.0	0	0.0	0.0
Waihi	0	0.0	0	0.0	0.0
Te Aroha	0	0.0	0	0.0	0.0
Morrinsville	0	0.0	0	0.0	0.0
Matamata	0	0.0	0	0.0	0.0
Putaruru	0	0.0	0	0.0	0.0
Katikati Community	1	0.7	0	0.0	0.0
Te Puke Community	0	0.0	0	0.0	0.0
Turangi	0	0.0	0	0.0	0.0
Edgecumbe	0	0.0	0	0.0	0.0
Kawerau	0	0.0	0	0.0	0.0
Murupara	0	0.0	0	0.0	0.0
Opotiki	11	10.8	0	0.0	0.0
Wairoa	0	0.0	0	0.0	0.0
Waipawa	0	0.0	0	0.0	0.0
Waipukurau	0	0.0	0	0.0	0.0
Dannevirke	0	0.0	0	0.0	0.0
Woodville	0	0.0	0	0.0	0.0
Waitara	3	2.8	0	0.0	0.0
Inglewood	0	0.0	0	0.0	0.0
Stratford	0	0.0	0	0.0	0.0
Opunake	0	0.2	0	0.0	0.0
Eltham	0	0.0	0	0.0	0.0
Patea	0	0.0	0	0.0	0.0
Ohakune	0	0.0	0	0.0	0.0
Raetihi	0	0.0	0	0.0	0.0
Waiouru	0	0.0	0	0.0	0.0
Bulls	0	0.0	0	0.0	0.0
Taihape	0	0.0	0	0.0	0.0
Marton	0	0.0	0	0.0	0.0
Foxton Community	0	0.0	0	0.0	0.0
Shannon	0	0.0	0	0.0	0.0

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Otaki	7	7.3	0	0.0	0.0
Pahiatua	0	0.0	0	0.0	0.0
Carterton	0	0.0	0	0.0	0.0
Greytown	0	0.0	0	0.0	0.0
Featherston	0	0.0	0	0.0	0.0
Martinborough	0	0.0	0	0.0	0.0
Picton	0	0.1	0	0.0	0.0
Kaikoura	1	1.1	0	0.0	0.0
Takaka	1	0.5	0	0.0	0.0
Brightwater	0	0.0	0	0.0	0.0
Wakefield	0	0.0	0	0.0	0.0
Motueka	15	14.6	1	0.0	0.0
Westport	15	15.1	0	0.0	0.0
Reefton	0	0.0	0	0.0	0.0
Hokitika	1	1.3	0	0.0	0.0
Woodend	0	0.0	0	0.0	0.0
Oxford	0	0.0	0	0.0	0.0
Darfield	0	0.0	0	0.0	0.0
Lincoln	0	0.0	0	0.0	0.0
Leeston	0	0.0	0	0.0	0.0
Pleasant Point	0	0.0	0	0.0	0.0
Geraldine	0	0.0	0	0.0	0.0
Temuka	0	0.0	0	0.0	0.0
Twizel Community	0	0.0	0	0.0	0.0
Waimate	0	0.0	0	0.0	0.0
Milton	0	0.0	0	0.0	0.0
Balclutha	0	0.0	0	0.0	0.0
Alexandra	0	0.0	0	0.0	0.0
Cromwell	0	0.0	0	0.0	0.0
Wanaka	0	0.0	0	0.0	0.0
Arrowtown	0	0.0	0	0.0	0.0
Winton	0	0.0	0	0.0	0.0
Bluff	2	1.5	0	0.5	0.0
Te Anau	0	0.0	0	0.0	0.0
Riverton	1	0.6	0	0.0	0.0
Rolleston	0	0.0	0	0.0	0.0
Gore	0	0.0	0	0.0	0.0
Ngunguru	2	1.8	0	0.0	0.0
Mangawhai Heads	0	0.0	0	0.0	0.0
Te Kauwhata	0	0.0	0	0.0	0.0
Ngatea	15	12.8	0	2.6	0.0
Mapua	2	2.0	0	0.0	0.0

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Amberley	0	0.0	0	0.0	0.0
Methven	0	0.0	0	0.0	0.0
Rakaia	0	0.0	0	0.0	0.0
Waikouaiti	4	4.1	0	0.0	0.0
Rural Centre	69	66.5	0	2.3	0.0
Rural (Incl.some Off Shore Islands)	333	313.7	12	8.1	0.1
Rural (Incl.some Off Shore Islands)	216	192.6	12	11.5	0.0
Rural (Incl.some Off Shore Islands)	102	92.9	4	5.0	0.0
New Zealand Total	1,744	1,630.6	48	52.9	11.6

Railway

Table 4: Railway track length by regional council.

REGC2014_N	Railway Track Length (km)
Northland Region	3.49
Auckland Region	4.96
Waikato Region	0.00
Bay of Plenty Region	9.93
Gisborne Region	5.98
Hawke's Bay Region	19.34
Taranaki Region	1.19
Manawatu-Wanganui Region	1.50
Wellington Region	4.80
West Coast Region	0.33
Canterbury Region	7.91
Otago Region	4.06
Southland Region	7.40
Tasman Region	0.00
Nelson Region	0.46
Marlborough Region	1.11
New Zealand Total	72.48

Airports and Airstrips

Table 5: Airport and airstrip counts by regional council.

REGC2014_N	Total	Airport Count	Airstrip and Aerodrome Count
Northland Region	2	0	2
Auckland Region	2	1	1
Waikato Region	8	0	8
Bay of Plenty Region	3	1	2
Gisborne Region	2	1	1
Hawke's Bay Region	2	1	1
Taranaki Region	0	0	0
Manawatu-Wanganui Region	0	0	0
Wellington Region	1	1	0
West Coast Region	6	2	4
Canterbury Region	1	0	1
Otago Region	0	0	0
Southland Region	2	1	1
Tasman Region	4	0	4
Nelson Region	1	1	0
Marlborough Region	3	0	3
New Zealand Total	37	9	28

Wharf and Jetties

Table 6: Wharf and jetty count and lengths by regional council.

REGC2014_N	Wharf & Jetty Count	Wharf & Jetty Length (km)
Northland Region	146	10.58
Auckland Region	327	29.64
Waikato Region	60	3.62
Bay of Plenty Region	97	7.49
Gisborne Region	2	0.26
Hawke's Bay Region	4	1.16
Taranaki Region	14	0.82
Manawatu-Wanganui Region	1	0.06
Wellington Region	43	5.22
West Coast Region	18	1.03
Canterbury Region	14	1.04
Otago Region	614	27.43
Southland Region	46	3.16
Tasman Region	18	1.02
Nelson Region	79	4.23
Marlborough Region	64	3.66
New Zealand Total	1547	100.42

Appendix E Result tables: land assets for the 0–3 m national DEM (regional and TLA areas)

Land Cover

Table 1: Land cover type area by regional council.

REGC2014_N	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Northland Region	76	4	45	27.7
Auckland Region	64	11	34	19.7
Waikato Region	131	7	114	9.8
Bay of Plenty Region	74	7	50	17.3
Gisborne Region	15	1	10	3.9
Hawke's Bay Region	69	12	39	18.6
Taranaki Region	4	0	2	1.9
Manawatu-Wanganui Region	13	1	4	7.7
Wellington Region	25	6	6	12.5
West Coast Region	51	2	15	34.0
Canterbury Region	431	26	147	257.7
Otago Region	15	2	5	7.6
Southland Region	78	2	29	46.4
Tasman Region	34	2	18	13.1
Nelson Region	3	1	1	1.7
Marlborough Region	55	1	34	20.2
New Zealand Total	1,139	86	553	500

Table 2: Land cover type area by territorial authority.

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Far North District	40	1	23	17.1
Whangarei District	12	3	5	5.0
Kaipara District	23	1	18	5.4
Thames-Coromandel District	14	6	5	4.1
Hauraki District	112	2	107	3.5
Waikato District	2	0	1	1.2
Matamata-Piako District	0	0	0	0.0
Hamilton City	0	0	0	0.0
Waipa District	0	0	0	0.0
Otorohanga District	1	0	1	0.6

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
South Waikato District	0	0	0	0.0
Waitomo District	1	0	0	0.4
Taupo District	0	0	0	0.0
Western Bay of Plenty District	40	1	31	7.4
Tauranga City	12	3	6	2.8
Rotorua District	0	0	0	0.0
Whakatane District	16	1	10	4.8
Kawerau District	0	0	0	0.0
Opotiki District	6	1	3	2.0
Gisborne District	15	1	10	3.9
Wairoa District	9	0	1	7.9
Hastings District	20	1	16	3.0
Napier City	39	11	21	6.7
Central Hawke's Bay District	1	0	0	1.0
New Plymouth District	1	0	0	0.8
Stratford District	0	0	0	0.0
South Taranaki District	3	0	2	1.2
Ruapehu District	0	0	0	0.0
Wanganui District	3	1	0	1.5
Rangitikei District	5	0	2	3.8
Manawatu District	3	0	1	1.4
Palmerston North City	0	0	0	0.0
Tararua District	1	0	0	0.1
Horowhenua District	2	0	1	0.9
Kapiti Coast District	7	3	3	1.4
Porirua City	1	0	0	0.2
Upper Hutt City	0	0	0	0.0
Lower Hutt City	4	3	0	1.1
Wellington City	1	1	0	0.2
Masterton District	1	0	0	0.4
Carterton District	1	0	1	0.2
South Wairarapa District	10	0	1	8.9
Tasman District	34	2	18	13.1
Nelson City	3	1	1	1.6
Marlborough District	55	1	34	20.2
Kaikoura District	1	0	0	0.7
Buller District	17	1	9	6.7
Grey District	3	0	1	1.7

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Westland District	31	0	5	25.5
Hurunui District	4	0	2	1.6
Waimakariri District	36	6	23	6.2
Christchurch City	130	19	28	82.3
Selwyn District	211	0	57	153.6
Ashburton District	5	0	3	1.3
Timaru District	21	1	16	4.3
Mackenzie District	0	0	0	0.0
Waimate District	24	0	16	7.6
Chatham Islands Territory	0	0	0	0.0
Waitaki District	1	0	1	0.4
Central Otago District	0	0	0	0.0
Queenstown-Lakes District	0	0	0	0.0
Dunedin City	9	2	3	4.1
Clutha District	4	0	1	3.0
Southland District	37	0	9	27.3
Gore District	0	0	0	0.0
Invercargill City	41	2	20	18.7
Auckland	63	11	34	18.9
New Zealand Total	1,137	86	553	498

Land Parcels

Table 3: Land parcel use count by regional council.

REGC2014_N	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Northland Region	19,530	3,736	5,287	10,507
Auckland Region	26,334	12,341	4,051	9,942
Waikato Region	15,032	8,347	3,152	3,533
Bay of Plenty Region	13,060	6,377	3,336	3,347
Gisborne Region	2,299	913	697	689
Hawke's Bay Region	17,573	11,898	3,741	1,934
Taranaki Region	1,175	258	483	434
Manawatu-Wanganui Region	1,204	473	255	476
Wellington Region	9,205	7,050	783	1,372
West Coast Region	5,167	1,797	1,011	2,359
Canterbury Region	39,858	30,394	4,713	4,751
Otago Region	6,259	3,429	1,375	1,455
Southland Region	7,037	1,847	1,998	3,192

REGC2014_N	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Tasman Region	6,397	2,033	1,694	2,670
Nelson Region	1,096	695	99	302
Marlborough Region	5,300	281	2,099	2,920
New Zealand Total	176,526	91,869	34,774	49,883

Table 4: Land parcel use count by territorial authority.

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Far North District	9,351	1,190	2,607	5,554
Whangarei District	5,838	1,963	1,273	2,602
Kaipara District	4,341	583	1,407	2,351
Thames-Coromandel District	10,227	6,739	998	2,490
Hauraki District	3,279	1,311	1,640	328
Waikato District	854	216	288	350
Matamata-Piako District	0	0	0	0
Hamilton City	0	0	0	0
Waipa District	0	0	0	0
Otorohanga District	405	62	138	205
South Waikato District	0	0	0	0
Waitomo District	267	19	88	160
Taupo District	0	0	0	0
Western Bay of Plenty District	4,227	1,450	1,713	1,064
Tauranga City	3,944	2,787	347	810
Rotorua District	0	0	0	0
Whakatane District	2,349	1,238	446	665
Kawerau District	0	0	0	0
Opotiki District	2,490	902	814	774
Gisborne District	2,299	913	697	689
Wairoa District	352	7	144	201
Hastings District	3,871	1,472	1,846	553
Napier City	13,150	10,418	1,647	1,085
Central Hawke's Bay District	197	1	104	92
New Plymouth District	742	255	158	329
Stratford District	0	0	0	0
South Taranaki District	433	3	325	105
Ruapehu District	2	0	0	2
Wanganui District	293	199	24	70

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Rangitikei District	224	0	38	186
Manawatu District	445	234	107	104
Palmerston North City	0	0	0	0
Tararua District	118	0	61	57
Horowhenua District	130	40	26	64
Kapiti Coast District	3,836	3,054	411	371
Porirua City	725	475	47	203
Upper Hutt City	0	0	0	0
Lower Hutt City	3,259	2,969	12	278
Wellington City	690	490	27	173
Masterton District	297	60	89	148
Carterton District	111	0	62	49
South Wairarapa District	279	2	134	143
Tasman District	6,397	2,033	1,694	2,670
Nelson City	1,096	695	99	302
Marlborough District	5,300	281	2,099	2,920
Kaikoura District	275	67	68	140
Buller District	2,650	1,222	584	844
Grey District	576	211	105	260
Westland District	1,941	364	322	1,255
Hurunui District	707	276	190	241
Waimakariri District	8,110	6,133	1,310	667
Christchurch City	27,567	23,508	1,460	2,599
Selwyn District	1,371	146	837	388
Ashburton District	293	8	126	159
Timaru District	1,087	256	474	357
Mackenzie District	0	0	0	0
Waimate District	448	0	248	200
Chatham Islands Territory	0	0	0	0
Waitaki District	443	74	212	157
Central Otago District	0	0	0	0
Queenstown-Lakes District	0	0	0	0
Dunedin City	5,176	3,299	935	942
Clutha District	640	56	228	356
Southland District	3,760	167	1,071	2,522
Gore District	0	0	0	0
Invercargill City	3,277	1,680	927	670
Auckland	26,334	12,341	4,051	9,942
New Zealand Total	53	0	16	37

Appendix F Result tables using LiDAR: Buildings for the 0–0.5 m, 0.5–1 m, 1–1.5 m elevation bands and aggregated 0–1.5 m zones (regional, TLA and urban areas)

Table 1: Building use count by regional council for the 0–0.5 m LiDAR elevation band

REGC2014_N	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Northland Region	245	133	1	27	0	3	81
Auckland Region	965	775	20	81	12	17	60
Waikato Region	3,588	1,983	22	437	2	11	1,133
Bay of Plenty Region	942	508	8	134	0	4	288
Gisborne Region	9	1	0	5	0	0	3
Hawke's Bay Region	2,530	1,439	13	89	16	5	968
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	139	117	1	15	2	1	3
West Coast Region	0	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury*	1,190	904	5	41	7	8	225
Otago Region	3,276	2,772	116	339	14	27	8
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	170	110	0	41	0	5	14
Nelson Region	123	64	4	3	0	1	51
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	15,322	10,419	195	1,226	53	87	3,342
New Zealand Total*	13,177	8,806	190	1,212	53	82	2,834

* excludes Red Zone in Christchurch

Table 2: Building use count by regional council for the 0.5–1 m LiDAR elevation band

REGC2014_N	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Northland Region	1,019	497	55	192	1	6	268
Auckland Region	980	731	21	75	20	32	101
Waikato Region	2,327	1,352	53	211	6	14	691
Bay of Plenty Region	2,401	1,336	73	311	5	10	666
Gisborne Region	88	18	1	52	0	2	15
Hawke's Bay Region	6,263	3,354	37	644	52	14	2,162
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	2,260	2,022	20	157	8	13	40
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury *	5,562	3,693	58	260	18	22	1,511
Otago Region	963	770	30	131	9	19	4
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	712	568	8	112	5	4	15
Nelson Region	559	333	22	47	2	8	147
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	28,768	18,924	393	2,234	126	151	6,940
New Zealand Total*	23,134	14,674	378	2,192	126	144	5,620

* excludes Red Zone in Christchurch

Table 3: Building use count by regional council for the 1–1.5 m LiDAR elevation band

REGC2014_N	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Northland Region	1,686	782	117	391	3	18	375
Auckland Region	1,598	1,255	46	105	49	57	86
Waikato Region	2,406	1,365	92	191	4	23	731
Bay of Plenty Region	3,153	1,789	177	447	5	6	729
Gisborne Region	190	51	0	106	0	1	32
Hawke's Bay Region	6,793	3,947	38	468	56	32	2,252
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	3,936	3,344	139	263	44	24	122
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury*	9,227	5,687	131	756	18	29	2,606
Otago Region	718	415	41	232	4	17	9
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	1,180	978	8	160	17	5	12
Nelson Region	971	590	91	158	3	12	117
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	33,303	21,212	881	3,278	203	225	7,504
New Zealand Total*	31,858	20,203	880	3,277	203	224	7,071

* excludes Red Zone in Christchurch

Table 4: Building use count by regional council for the aggregated 0–1.5 m LiDAR elevation zone

REGC2014_N	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Northland Region	2,950	1,412	173	610	4	27	724
Auckland Region	3,543	2,761	87	261	81	106	247
Waikato Region	8,321	4,700	167	839	12	48	2,555
Bay of Plenty Region	6,496	3,633	258	892	10	20	1,683
Gisborne Region	287	70	1	163	0	3	50
Hawke's Bay Region	15,586	8,740	88	1,201	124	51	5,382
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	6,335	5,483	160	435	54	38	165
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury (2012)	23,058	15,543	210	1,100	43	67	6,095
Cant (excl Red Zone)	15,979	10,284	194	1,057	43	59	4,342
Otago Region	4,957	3,957	187	702	27	63	21
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	2,062	1,656	16	313	22	14	41
Nelson Region	1,653	987	117	208	5	21	315
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	75,248	48,942	1,464	6,724	382	458	17,278
New Zealand Total*	68,169	43,683	1,448	6,681	382	450	15,525

* excludes Red Zone in Christchurch

Table 5: Building use count by territorial authority for the 0–0.5 m LiDAR elevation band

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Far North District	71	37	1	14	0	1	18
Whangarei District	154	85	0	10	0	2	57
Kaipara District	20	11	0	3	0	0	6
Thames-Coromandel District	560	311	2	52	0	5	190
Hauraki District	2,969	1,642	20	382	2	6	917
Waikato District	41	21	0	1	0	0	19
Matamata-Piako District	3	1	0	1	0	0	1
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	15	8	0	1	0	0	6
South Waikato District	0	0	0	0	0	0	0
Waitomo District	0	0	0	0	0	0	0
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	106	55	0	10	0	0	41
Tauranga City	132	73	4	21	0	1	33
Rotorua District	0	0	0	0	0	0	0
Whakatane District	679	363	4	103	0	3	206
Kawerau District	0	0	0	0	0	0	0
Opotiki District	25	17	0	0	0	0	8
Gisborne District	9	1	0	5	0	0	3
Wairoa District	0	0	0	0	0	0	0
Hastings District	210	118	1	23	1	0	67
Napier City	2,320	1,321	12	66	15	5	901
Central Hawke's Bay District	0	0	0	0	0	0	0
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	5	5	0	0	0	0	0
Porirua City	9	9	0	0	0	0	0
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	102	92	1	4	2	1	2
Wellington City	3	2	0	0	0	0	1
Masterton District	0	0	0	0	0	0	0
Carterton District	0	0	0	0	0	0	0
South Wairarapa District	20	9	0	11	0	0	0
Tasman District	170	110	0	41	0	5	14
Nelson City	123	64	4	3	0	1	51
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	0	0	0	0	0	0	0
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	0	0	0	0	0	0	0
Waimakariri District	466	442	1	9	7	3	4
Christchurch City*	716	459	4	28	0	4	221
Selwyn District	7	3	0	3	0	1	0
Ashburton District	0	0	0	0	0	0	0
Timaru District	1	0	0	1	0	0	0
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	0	0	0	0	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	3,177	2,723	116	292	14	24	8

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Clutha District	99	49	0	47	0	3	0
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	965	775	20	81	12	17	60
New Zealand Total	15,322	10,419	195	1,226	53	87	3,342
New Zealand Total*	13,177	8,806	190	1,212	53	82	2,834

* excludes Red Zone in Christchurch

Table 6: Building use count by territorial authority for the 0.5–1 m LiDAR elevation band

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Far North District	306	187	3	40	1	1	74
Whangarei District	545	235	39	122	0	2	147
Kaipara District	168	75	13	30	0	3	47
Thames-Coromandel District	1,541	920	51	113	6	13	438
Hauraki District	650	344	2	95	0	1	208
Waikato District	107	70	0	2	0	0	35
Matamata-Piako District	2	2	0	0	0	0	0
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	26	15	0	1	0	0	10
South Waikato District	0	0	0	0	0	0	0
Waitomo District	1	1	0	0	0	0	0
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	287	177	2	20	2	1	85
Tauranga City	669	381	21	135	1	6	125
Rotorua District	0	0	0	0	0	0	0
Whakatane District	1,317	711	48	141	2	0	415
Kawerau District	0	0	0	0	0	0	0
Opotiki District	128	67	2	15	0	3	41

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Gisborne District	88	18	1	52	0	2	15
Wairoa District	4	2	0	0	0	0	2
Hastings District	675	394	5	55	3	2	216
Napier City	5,584	2,958	32	589	49	12	1,944
Central Hawke's Bay District	0	0	0	0	0	0	0
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	112	100	0	0	0	0	12
Porirua City	68	62	2	0	0	1	3
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	1,990	1,788	10	153	7	10	22
Wellington City	87	70	8	3	1	2	3
Masterton District	0	0	0	0	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	3	2	0	1	0	0	0
Tasman District	712	568	8	112	5	4	15
Nelson City	559	333	22	47	2	8	147
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	3	1	0	2	0	0	0
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	6	1	0	5	0	0	0
Waimakariri District	921	826	22	41	18	6	8

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Christchurch City*	4,552	2,804	36	194	0	15	1,503
Selwyn District	77	58	0	18	0	1	0
Ashburton District	0	0	0	0	0	0	0
Timaru District	3	3	0	0	0	0	0
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	4	1	0	3	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	884	710	30	113	9	19	3
Clutha District	75	59	0	15	0	0	1
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	980	731	21	75	20	32	101
New Zealand Total	28,768	18,924	393	2,234	126	151	6,940
New Zealand Total*	23,134	14,674	378	2,192	126	144	5,620

* excludes Red Zone in Christchurch

Table 7: Building use count by territorial authority for the 1–1.5 m LiDAR elevation band.

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Far North District	303	161	15	40	1	2	84
Whangarei District	913	420	60	248	1	9	175
Kaipara District	470	201	42	103	1	7	116
Thames-Coromandel District	1,858	1,083	89	113	4	17	552
Hauraki District	332	166	3	55	0	1	107
Waikato District	174	102	0	6	0	4	62
Matamata-Piako District	3	0	0	3	0	0	0
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	38	14	0	14	0	1	9
South Waikato District	0	0	0	0	0	0	0
Waitomo District	1	0	0	0	0	0	1
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	390	248	5	26	3	3	105
Tauranga City	1,199	709	81	187	1	1	220
Rotorua District	0	0	0	0	0	0	0
Whakatane District	1,272	714	54	171	1	1	331
Kawerau District	0	0	0	0	0	0	0
Opotiki District	292	118	37	63	0	1	73
Gisborne District	190	51	0	106	0	1	32
Wairoa District	10	3	0	2	0	0	5
Hastings District	487	252	6	74	6	4	145
Napier City	6,296	3,692	32	392	50	28	2,102
Central Hawke's Bay District	0	0	0	0	0	0	0
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	361	354	0	0	0	0	7
Porirua City	139	117	2	0	11	6	3
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	2,543	2,159	43	236	21	10	74
Wellington City	884	709	94	23	12	8	38
Masterton District	1	1	0	0	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	8	4	0	4	0	0	0
Tasman District	1,180	978	8	160	17	5	12
Nelson City	971	590	91	158	3	12	117
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	19	12	1	5	0	0	1
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	64	62	0	2	0	0	0
Waimakariri District	648	509	41	66	17	14	1
Christchurch City*	8,271	4,923	89	645	1	13	2,600
Selwyn District	209	171	0	34	0	2	2
Ashburton District	0	0	0	0	0	0	0
Timaru District	16	10	0	4	0	0	2
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	1	0	0	1	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	651	367	41	215	3	16	9

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/ Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Clutha District	66	48	0	16	1	1	0
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	1,598	1,255	46	105	49	57	86
New Zealand Total	33,303	21,212	881	3,278	203	225	7,504
New Zealand Total*	31,858	20,203	880	3,277	203	224	7,071

* excludes Red Zone in Christchurch

Table 8: Building use count by territorial authority for the aggregated 0–1.5 m LIDAR elevation zone

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Far North District	680	385	19	94	2	4	176
Whangarei District	1,612	740	99	380	1	13	379
Kaipara District	658	287	55	136	1	10	169
Thames-Coromandel District	3,959	2,314	142	278	10	35	1,180
Hauraki District	3,951	2,152	25	532	2	8	1,232
Waikato District	322	193	0	9	0	4	116
Matamata-Piako District	8	3	0	4	0	0	1
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	79	37	0	16	0	1	25
South Waikato District	0	0	0	0	0	0	0
Waitomo District	2	1	0	0	0	0	1
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	783	480	7	56	5	4	231
Tauranga City	2,000	1,163	106	343	2	8	378
Rotorua District	0	0	0	0	0	0	0
Whakatane District	3,268	1,788	106	415	3	4	952
Kawerau District	0	0	0	0	0	0	0
Opotiki District	445	202	39	78	0	4	122
Gisborne District	287	70	1	163	0	3	50
Wairoa District	14	5	0	2	0	0	7
Hastings District	1,372	764	12	152	10	6	428
Napier City	14,200	7,971	76	1,047	114	45	4,947
Central Hawke's Bay District	0	0	0	0	0	0	0

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	478	459	0	0	0	0	19
Porirua City	216	188	4	0	11	7	6
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	4,635	4,039	54	393	30	21	98
Wellington City	974	781	102	26	13	10	42
Masterton District	1	1	0	0	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	31	15	0	16	0	0	0
Tasman District	2,062	1,656	16	313	22	14	41
Nelson City	1,653	987	117	208	5	21	315
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	22	13	1	7	0	0	1
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	70	63	0	7	0	0	0
Waimakariri District	2,852	2,580	67	125	42	24	14
Christchurch (2012)	19,801	12,642	142	901	1	39	6,076
Chch (excl Red Zone)	12,722	7,383	126	858	1	31	4,323
Selwyn District	293	232	0	55	0	4	2
Ashburton District	0	0	0	0	0	0	0
Timaru District	20	13	0	5	0	0	2
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	5	1	0	4	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Dunedin City	4,712	3,800	187	620	26	59	20
Clutha District	240	156	0	78	1	4	1
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	3,543	2,761	87	261	81	106	247
New Zealand Total	75,248	48,942	1,464	6,724	382	458	17,278
New Zealand Total*	68,169	43,683	1,448	6,681	382	450	15,525

* excludes Red Zone in Christchurch

Table 9: Building use count by urban area for the 0–0.5 m LiDAR elevation band

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangarei	18	6	0	8	0	2	2
Northern Auckland Zone	75	47	1	1	1	5	20
Western Auckland Zone	47	45	0	0	0	1	1
Central Auckland Zone	23	8	2	1	4	6	2
Southern Auckland Zone	12	8	1	1	1	1	0
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	141	77	4	21	0	1	38
Rotorua	0	0	0	0	0	0	0
Gisborne	0	0	0	0	0	0	0
Napier Zone	2,320	1,321	12	66	15	5	901
Hastings Zone	210	118	1	23	1	0	67
New Plymouth	0	0	0	0	0	0	0
Wanganui	0	0	0	0	0	0	0
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	102	92	1	4	2	1	2
Porirua Zone	9	9	0	0	0	0	0
Wellington Zone	3	2	0	0	0	0	1
Nelson	125	64	4	5	0	1	51
Christchurch	1,180	901	5	36	7	7	224
Dunedin	3,094	2,683	116	249	14	24	8

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	1	1	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	495	276	4	52	0	3	160
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	1	0	0	1	0	0	0
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	0	0	0	0	0	0	0
Kaitaia	0	0	0	0	0	0	0
Kerikeri	0	0	0	0	0	0	0
Paihia	7	7	0	0	0	0	0
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	8	3	0	3	0	0	2
Wellsford	0	0	0	0	0	0	0
Warkworth	0	0	0	0	0	0	0
Snells Beach	3	0	0	0	0	0	3
Helensville	82	34	1	34	1	1	11
Waiheke Island	9	4	0	2	0	1	2
Waiuku	0	0	0	0	0	0	0
Raglan	27	16	0	0	0	0	11
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	0	0	0	0	0	0	0
Coromandel	27	13	0	1	0	0	13
Whangamata	0	0	0	0	0	0	0
Tairua	6	5	0	0	0	1	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Thames	302	176	1	16	0	2	107
Waihi Beach	5	2	0	1	0	0	2
Paeroa	0	0	0	0	0	0	0
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	7	4	0	0	0	0	3
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	0	0	0	0	0	0	0
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	1	1	0	0	0	0	0
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	4	4	0	0	0	0	0
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	0	0	0	0	0	0	0
Takaka	1	0	0	0	0	0	1
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	61	45	0	14	0	2	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	19	13	0	0	0	0	6
Mangawhai Heads	12	8	0	0	0	0	4
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	878	527	16	50	1	3	281
Mapua	15	12	0	2	0	1	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Rural Centre	665	557	16	13	5	3	71
Rural (Incl.some Off Shore Islands)	251	120	0	112	0	5	14
Rural (Incl.some Off Shore Islands)	2,551	1,340	5	441	1	4	760
Rural (Incl.some Off Shore Islands)	385	255	0	54	0	2	74
New Zealand Total	15,327	10,417	195	1,225	53	87	3,350
New Zealand Total*	13,182	8,804	190	1,211	53	82	2,842

* excludes Red Zone in Christchurch

Table 10: Building use count by urban area for the 0.5–1 m LiDAR elevation band

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangarei	212	31	36	115	0	1	29
Northern Auckland Zone	319	259	1	4	7	9	39
Western Auckland Zone	90	79	3	4	0	2	2
Central Auckland Zone	83	38	5	15	4	10	11
Southern Auckland Zone	96	81	4	3	5	0	3
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	733	419	22	136	1	7	148
Rotorua	0	0	0	0	0	0	0
Gisborne	42	5	1	26	0	2	8
Napier Zone	5,584	2,958	32	589	49	12	1,944
Hastings Zone	669	391	5	53	3	2	215
New Plymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	1,990	1,788	10	153	7	10	22
Porirua Zone	68	62	2	0	0	1	3
Wellington Zone	87	70	8	3	1	2	3
Nelson	605	351	22	75	2	8	147

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Christchurch	5,466	3,629	58	233	18	21	1,507
Dunedin	757	604	29	98	9	15	2
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	25	25	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	1,028	563	48	86	2	0	329
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	0	0	0	0	0	0	0
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	1	1	0	0	0	0	0
Kaitaia	0	0	0	0	0	0	0
Kerikeri	3	3	0	0	0	0	0
Paihia	65	52	1	2	0	0	10
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	131	57	13	21	0	3	37
Wellsford	0	0	0	0	0	0	0
Warkworth	1	0	0	0	0	1	0
Snells Beach	11	0	0	0	0	6	5
Helensville	84	26	7	35	2	1	13
Waiheke Island	39	31	0	5	1	1	1
Waiuku	0	0	0	0	0	0	0
Raglan	22	13	0	1	0	0	8
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	233	171	4	7	2	0	49
Coromandel	54	33	1	7	0	1	12

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangamata	55	33	0	0	0	0	22
Tairua	171	110	2	3	0	1	55
Thames	675	369	42	36	4	8	216
Waihi Beach	27	20	0	4	0	0	3
Paeroa	0	0	0	0	0	0	0
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	1	0	0	1	0	0	0
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	20	11	0	0	0	0	9
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	76	39	2	8	0	3	24
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	86	75	0	0	0	0	11
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	3	1	0	2	0	0	0
Takaka	6	1	0	3	0	0	2
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	426	390	3	31	0	2	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	107	67	1	3	0	0	36
Mangawhai Heads	14	8	0	0	0	0	6
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	6	2	0	3	0	0	1
Mapua	39	32	1	6	0	0	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Rakaia	0	0	0	0	0	0	0
Waikouaiti	12	12	0	0	0	0	0
Rural Centre	381	240	7	38	8	2	86
Rural (Incl.some Off Shore Islands)	402	287	2	88	0	6	19
Rural (Incl.some Off Shore Islands)	1,545	873	4	238	0	4	426
Rural (Incl.some Off Shore Islands)	600	377	2	57	1	6	157
New Zealand Total	28,784	18,937	393	2,234	126	154	6,940
New Zealand Total*	23,150	14,687	378	2,192	126	147	5,620

* excludes Red Zone in Christchurch

Table 11: Building use count by urban area for the 1–1.5 m LiDAR elevation band

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangarei	398	84	60	226	1	5	22
Northern Auckland Zone	515	439	10	5	16	22	23
Western Auckland Zone	79	64	1	7	4	2	1
Central Auckland Zone	281	164	27	45	13	11	21
Southern Auckland Zone	162	128	5	5	12	1	11
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	1,240	735	81	187	1	1	235
Rotorua	0	0	0	0	0	0	0
Gisborne	113	34	0	65	0	1	13
Napier Zone	6,303	3,694	32	396	50	28	2,103
Hastings Zone	470	245	6	67	6	4	142
New Plymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	2,543	2,159	43	236	21	10	74
Porirua Zone	139	117	2	0	11	6	3
Wellington Zone	884	709	94	23	12	8	38
Nelson	1,051	628	91	193	10	12	117

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Christchurch	8,910	5,427	130	708	18	27	2,600
Dunedin	585	317	40	205	3	13	7
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	250	250	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	790	470	54	104	1	1	160
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	4	0	0	3	0	0	1
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	16	6	2	2	0	0	6
Kaitaia	0	0	0	0	0	0	0
Kerikeri	1	1	0	0	0	0	0
Paihia	21	15	0	0	0	0	6
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	415	169	42	97	1	7	99
Wellsford	0	0	0	0	0	0	0
Warkworth	6	0	0	0	2	1	3
Snells Beach	43	23	0	1	0	7	12
Helensville	53	35	2	11	0	4	1
Waiheke Island	121	108	0	7	0	4	2
Waiuku	3	2	0	0	1	0	0
Raglan	24	12	0	5	0	2	5
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	648	414	15	19	0	5	195
Coromandel	31	14	1	4	0	1	11

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangamata	90	50	0	13	0	2	25
Tairua	87	57	7	1	1	0	21
Thames	619	318	65	50	3	7	176
Waihi Beach	55	41	0	5	0	0	9
Paeroa	2	0	0	0	0	0	2
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	3	1	1	1	0	0	0
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	234	128	0	12	0	0	94
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	243	89	37	59	0	1	57
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	98	91	0	0	0	0	7
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	19	12	1	5	0	0	1
Takaka	4	2	0	1	0	0	1
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	674	618	0	44	10	2	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	209	153	0	9	0	0	47
Mangawhai Heads	31	21	0	0	0	0	10
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	0	0	0	0	0	0	0
Mapua	104	89	1	13	0	1	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Rakaia	0	0	0	0	0	0	0
Waikouaiti	15	13	0	0	0	2	0
Rural Centre	500	297	17	55	4	7	120
Rural (Incl.some Off Shore Islands)	654	502	8	122	1	4	17
Rural (Incl.some Off Shore Islands)	1,425	810	4	202	0	8	401
Rural (Incl.some Off Shore Islands)	703	457	1	65	1	7	172
New Zealand Total	33,313	21,221	881	3,279	203	225	7,504
New Zealand Total*	31,868	20,212	880	3,278	203	224	7,071

* excludes Red Zone in Christchurch

Table 12: Building use count by urban area for the 0–1.5 m LiDAR elevation zone

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangarei	628	121	96	349	1	8	53
Northern Auckland Zone	909	745	12	10	24	36	82
Western Auckland Zone	216	188	4	11	4	5	4
Central Auckland Zone	387	210	34	61	21	27	34
Southern Auckland Zone	270	217	10	9	18	2	14
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	2,114	1,231	107	344	2	9	421
Rotorua	0	0	0	0	0	0	0
Gisborne	155	39	1	91	0	3	21
Napier Zone	14,207	7,973	76	1,051	114	45	4,948
Hastings Zone	1,349	754	12	143	10	6	424
New Plymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	4,635	4,039	54	393	30	21	98
Porirua Zone	216	188	4	0	11	7	6
Wellington Zone	974	781	102	26	13	10	42
Nelson	1,781	1,043	117	273	12	21	315
Christchurch (2012)	22,635	15,216	209	1,020	43	63	6,084

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Chch (excl Red Zone)	15,556	9,957	193	977	43	55	4,331
Dunedin	4,436	3,604	185	552	26	52	17
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	276	276	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	2,313	1,309	106	242	3	4	649
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	5	0	0	4	0	0	1
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	17	7	2	2	0	0	6
Kaitaia	0	0	0	0	0	0	0
Kerikeri	4	4	0	0	0	0	0
Paihia	93	74	1	2	0	0	16
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	554	229	55	121	1	10	138
Wellsford	0	0	0	0	0	0	0
Warkworth	7	0	0	0	2	2	3
Snells Beach	57	23	0	1	0	13	20
Helensville	219	95	10	80	3	6	25
Waiheke Island	169	143	0	14	1	6	5
Waiuku	3	2	0	0	1	0	0
Raglan	73	41	0	6	0	2	24
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	881	585	19	26	2	5	244
Coromandel	112	60	2	12	0	2	36
Whangamata	145	83	0	13	0	2	47
Tairua	264	172	9	4	1	2	76

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Thames	1,596	863	108	102	7	17	499
Waihi Beach	87	63	0	10	0	0	14
Paeroa	2	0	0	0	0	0	2
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	11	5	1	2	0	0	3
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	254	139	0	12	0	0	103
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	320	129	39	67	0	4	81
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	188	170	0	0	0	0	18
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	22	13	1	7	0	0	1

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Takaka	11	3	0	4	0	0	4
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	1,161	1,053	3	89	10	6	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	335	233	1	12	0	0	89
Mangawhai Heads	57	37	0	0	0	0	20
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	884	529	16	53	1	3	282
Mapua	158	133	2	21	0	2	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	27	25	0	0	0	2	0
Rural Centre	1,546	1,094	40	106	17	12	277
Rural (Incl.some Off Shore Islands)	1,307	909	10	322	1	15	50
Rural (Incl.some Off Shore Islands)	5,521	3,023	13	881	1	16	1,587

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Rural (Incl.some Off Shore Islands)	1,688	1,089	3	176	2	15	403
New Zealand Total	75,279	48,962	1,464	6,724	382	461	17,286
New Zealand Total*	68,200	43,703	1,448	6,681	382	453	15,533

* excludes Red Zone in Christchurch

Table 13: Building replacement cost (NZ$2011) regional council for the 0–0.5 m LIDAR elevation band.

REGC2014_N	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Northland Region	40,001,821	29,555,311	356,090	7,283,408	0	1,052,052	1,754,960
Auckland Region	435,930,466	296,074,012	53,737,055	28,062,624	11,929,980	25,301,388	20,825,407
Waikato Region	707,398,236	614,600,999	12,035,847	42,717,097	354,476	5,426,178	32,263,639
Bay of Plenty Region	191,365,603	142,424,373	4,280,009	28,830,431	0	1,498,597	14,332,193
Gisborne Region	12,111,586	104,381	0	10,996,098	0	0	1,011,107
Hawke's Bay Region	418,305,216	326,798,738	4,605,887	41,671,080	16,310,524	6,370,652	22,548,335
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	50,747,229	19,240,609	1,211,612	1,611,008	15,076,565	2,658,370	10,949,065
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury *	217,996,083	201,283,576	2,358,572	3,194,284	4,917,561	1,699,346	4,542,744
Otago Region	829,441,423	539,737,600	117,781,412	138,712,331	11,136,113	19,101,527	2,972,440
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	44,942,772	33,451,556	0	8,248,065	0	3,102,616	140,535
Nelson Region	30,643,300	14,080,348	1,035,318	1,256,091	0	13,684,786	586,757
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	3,409,784,007	2,630,482,213	198,289,847	313,458,647	59,725,219	83,488,025	124,340,056
New Zealand Total*	2,978,883,735	2,217,351,503	197,401,802	312,582,517	59,725,219	79,895,512	111,927,182

* excludes Red Zone in Christchurch

Table 14: Building replacement cost (NZ$2011) by regional council for the 0.5–1 m LIDAR elevation band

REGC2014_N	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Northland Region	253,050,493	116,408,186	58,748,977	66,284,309	1,229,209	1,704,543	8,675,269
Auckland Region	481,027,490	265,952,067	26,167,649	68,725,677	11,813,718	21,874,085	86,494,294
Waikato Region	522,494,959	369,195,731	49,739,075	76,365,981	5,348,235	5,149,666	16,696,271
Bay of Plenty Region	572,434,691	350,009,927	88,036,629	111,342,337	1,813,747	4,766,813	16,465,238
Gisborne Region	31,245,963	5,509,853	1,074,500	22,416,717	0	1,856,984	387,909
Hawke's Bay Region	1,135,435,713	692,496,317	48,851,724	284,566,786	49,745,316	12,184,102	47,591,468
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	818,277,266	320,178,285	181,004,402	241,472,891	8,563,288	41,904,462	25,153,938
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury *	1,204,272,012	948,168,283	84,060,202	96,520,582	17,736,428	18,304,753	39,481,764
Otago Region	300,344,134	180,570,792	26,748,658	61,604,028	9,263,873	20,947,453	1,209,330
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	207,188,886	159,156,410	13,357,142	22,986,588	2,916,144	8,488,952	283,650
Nelson Region	156,454,251	70,962,729	32,668,407	28,212,915	745,084	21,966,189	1,898,927
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	6,579,029,028	4,344,825,034	615,434,603	1,084,582,692	109,175,042	160,202,464	264,809,193
New Zealand Total*	5,682,225,858	3,478,608,580	610,457,365	1,080,498,811	109,175,042	159,148,002	244,338,058

* excludes Red Zone in Christchurch

Table 15: Building replacement cost (NZ$2011) by regional council for 1–1.5 m LIDAR elevation band

REGC2014_N	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Northland Region	543,173,671	202,422,531	143,434,755	172,902,358	582,509	11,179,417	12,652,101
Auckland Region	1,267,830,976	677,779,043	180,315,659	141,936,870	56,341,565	35,645,131	175,812,708
Waikato Region	469,945,988	344,327,162	53,179,642	40,174,551	3,008,288	9,772,836	19,483,509
Bay of Plenty Region	932,936,385	494,016,505	170,902,774	235,862,696	4,329,851	4,343,217	23,481,342
Gisborne Region	71,423,621	16,345,555	0	52,360,537	0	1,806,045	911,484
Hawke's Bay Region	1,313,841,008	917,140,870	16,578,217	243,024,648	53,831,505	34,759,311	48,506,457
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data

REGC2014_N	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Wellington Region	2,987,474,845	693,586,425	1,456,079,646	405,612,763	294,695,468	53,212,715	84,287,828
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury *	1,821,116,487	1,371,097,077	69,143,295	268,258,125	20,702,139	26,767,103	65,148,748
Otago Region	447,591,238	109,199,436	149,502,225	168,469,626	4,621,323	12,042,341	3,756,287
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	389,849,136	276,630,103	3,992,751	98,570,972	9,425,432	1,069,642	160,236
Nelson Region	456,157,520	154,925,654	174,786,736	115,685,749	1,562,219	6,736,226	2,460,936
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	11,014,883,767	5,556,347,165	2,418,831,032	1,945,529,541	449,100,299	197,752,166	447,323,564
New Zealand Total*	10,701,340,875	5,257,470,361	2,417,915,700	1,942,858,895	449,100,299	197,333,984	436,661,636

* excludes Red Zone in Christchurch

Table 16: Building replacement cost (NZ$2011) by regional council for aggregated 0–1.5 m LIDAR zone

REGC2014_N	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Northland Region	836,225,985	348,386,028	202,539,822	246,470,075	1,811,718	13,936,012	23,082,330
Auckland Region	2,184,788,932	1,239,805,122	260,220,363	238,725,171	80,085,263	82,820,604	283,132,409
Waikato Region	1,699,839,183	1,328,123,892	114,954,564	159,257,629	8,710,999	20,348,680	68,443,419
Bay of Plenty Region	1,696,736,679	986,450,805	263,219,412	376,035,464	6,143,598	10,608,627	54,278,773
Gisborne Region	114,781,170	21,959,789	1,074,500	85,773,352	0	3,663,029	2,310,500
Hawke's Bay Region	2,867,581,937	1,936,435,925	70,035,828	569,262,514	119,887,345	53,314,065	118,646,260
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	3,856,499,340	1,033,005,319	1,638,295,660	648,696,662	318,335,321	97,775,547	120,390,831
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury (2012)	4,884,630,916	4,098,772,904	162,342,684	375,603,648	43,356,128	51,836,359	152,719,193
Cant (excl Red Zone)	3,243,384,582	2,520,548,936	155,562,069	367,972,991	43,356,128	46,771,202	109,173,256
Otago Region	1,577,376,795	829,507,828	294,032,295	368,785,985	25,021,309	52,091,321	7,938,057
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	641,980,794	469,238,069	17,349,893	129,805,625	12,341,576	12,661,210	584,421

REGC2014_N	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Nelson Region	643,255,071	239,968,731	208,490,461	145,154,755	2,307,303	42,387,201	4,946,620
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	21,003,696,802	12,531,654,412	3,232,555,482	3,343,570,880	618,000,560	441,442,655	836,472,813
New Zealand Total*	19,362,450,468	10,953,430,444	3,225,774,867	3,335,940,223	618,000,560	436,377,498	792,926,876

* excludes Red Zone in Christchurch

Table 17: Building replacement cost (NZ$2011) by territorial authority for the 0–0.5 m LIDAR elevation band

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Far North District	13,790,495	7,821,166	356,090	5,012,712	0	165,712	434,815
Whangarei District	22,016,344	18,165,555	0	1,788,448	0	886,340	1,176,001
Kaipara District	4,194,982	3,568,590	0	482,248	0	0	144,144
Thames-Coromandel District	95,438,040	73,758,290	1,418,906	13,837,037	0	2,062,761	4,361,046
Hauraki District	603,706,077	533,401,564	10,616,941	28,761,712	354,476	3,363,417	27,207,967
Waikato District	5,548,607	5,080,281	0	45,497	0	0	422,829
Matamata-Piako District	706,285	579,134	0	7,526	0	0	119,625
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	1,999,227	1,781,730	0	65,325	0	0	152,172
South Waikato District	0	0	0	0	0	0	0
Waitomo District	0	0	0	0	0	0	0
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	18,075,642	16,035,682	0	881,913	0	0	1,158,047
Tauranga City	53,176,815	33,403,947	875,173	11,031,675	0	14,367	7,851,653
Rotorua District	0	0	0	0	0	0	0
Whakatane District	116,495,300	89,528,228	3,404,836	16,916,843	0	1,484,230	5,161,163
Kawerau District	0	0	0	0	0	0	0
Opotiki District	3,617,846	3,456,516	0	0	0	0	161,330
Gisborne District	12,111,586	104,381	0	10,996,098	0	0	1,011,107
Wairoa District	0	0	0	0	0	0	0
Hastings District	42,677,468	35,716,837	1,056,020	2,102,239	1,713,682	0	2,088,690

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Napier City	375,627,748	291,081,901	3,549,867	39,568,841	14,596,842	6,370,652	20,459,645
Central Hawke's Bay District	0	0	0	0	0	0	0
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	412,332	412,332	0	0	0	0	0
Porirua City	999,306	999,306	0	0	0	0	0
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	40,200,236	12,896,523	1,211,612	1,330,841	15,076,565	2,658,370	7,026,325
Wellington City	4,935,876	1,013,136	0	0	0	0	3,922,740
Masterton District	0	0	0	0	0	0	0
Carterton District	0	0	0	0	0	0	0
South Wairarapa District	4,199,479	3,919,312	0	280,167	0	0	0
Tasman District	44,942,772	33,451,556	0	8,248,065	0	3,102,616	140,535
Nelson City	30,643,300	14,080,348	1,035,318	1,256,091	0	13,684,786	586,757
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	0	0	0	0	0	0	0
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	0	0	0	0	0	0	0
Waimakariri District	99,876,034	93,919,665	42,758	129,488	4,917,561	797,783	68,779
Christchurch City	116,190,842	106,200,799	2,315,814	2,571,281	0	628,983	4,473,965
Selwyn District	1,501,857	1,163,112	0	66,165	0	272,580	0
Ashburton District	0	0	0	0	0	0	0
Timaru District	427,350	0	0	427,350	0	0	0
Mackenzie District	0	0	0	0	0	0	0

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	0	0	0	0	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	812,828,759	525,727,337	117,781,412	136,628,762	11,136,113	18,582,695	2,972,440
Clutha District	16,612,664	14,010,263	0	2,083,569	0	518,832	0
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	435,930,466	296,074,012	53,737,055	28,062,624	11,929,980	25,301,388	20,825,407
New Zealand Total	3,409,784,007	2,630,482,213	198,289,847	313,458,647	59,725,219	83,488,025	124,340,056
New Zealand Total*	2,978,883,735	2,217,351,503	197,401,802	312,582,517	59,725,219	79,895,512	111,927,182

* excludes Red Zone in Christchurch

Table 18: Building replacement cost (NZ$2011) territorial authority for the 0.5–1 m LIDAR elevation band

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Far North District	49,251,463	40,190,101	1,075,122	4,161,374	1,229,209	185,900	2,409,757
Whangarei District	170,037,560	60,739,643	51,380,523	52,178,396	0	542,233	5,196,765
Kaipara District	33,761,470	15,478,442	6,293,332	9,944,539	0	976,410	1,068,747
Thames-Coromandel District	378,966,468	238,879,463	49,524,496	70,834,100	5,348,235	4,541,174	9,839,000
Hauraki District	127,662,881	115,572,715	214,579	5,467,064	0	608,492	5,800,031
Waikato District	12,187,967	11,625,467	0	56,715	0	0	505,785
Matamata-Piako District	938,076	938,076	0	0	0	0	0
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	2,643,636	2,084,079	0	8,102	0	0	551,455
South Waikato District	0	0	0	0	0	0	0

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Waitomo District	95,931	95,931	0	0	0	0	0
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	54,815,869	48,778,459	545,396	1,962,823	573,248	884,400	2,071,543
Tauranga City	233,333,180	119,090,761	29,838,543	79,036,973	80,840	2,454,648	2,831,415
Rotorua District	0	0	0	0	0	0	0
Whakatane District	264,866,190	168,261,475	56,609,855	28,944,190	1,159,659	0	9,891,011
Kawerau District	0	0	0	0	0	0	0
Opotiki District	19,419,452	13,879,232	1,042,835	1,398,351	0	1,427,765	1,671,269
Gisborne District	31,245,963	5,509,853	1,074,500	22,416,717	0	1,856,984	387,909
Wairoa District	287,005	260,820	0	0	0	0	26,185
Hastings District	127,323,600	110,821,136	3,631,770	4,774,089	915,464	802,235	6,378,906
Napier City	1,007,825,108	581,414,361	45,219,954	279,792,697	48,829,852	11,381,867	41,186,377
Central Hawke's Bay District	0	0	0	0	0	0	0
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	32,145,386	29,016,297	0	0	0	0	3,129,089
Porirua City	18,392,827	12,915,526	3,825,708	0	0	1,193,940	457,653
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	573,638,884	264,243,198	9,921,614	240,498,004	7,007,118	33,929,088	18,039,862
Wellington City	193,836,614	13,798,988	167,257,080	915,608	1,556,170	6,781,434	3,527,334
Masterton District	0	0	0	0	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	263,555	204,276	0	59,279	0	0	0
Tasman District	207,188,886	159,156,410	13,357,142	22,986,588	2,916,144	8,488,952	283,650
Nelson City	156,454,251	70,962,729	32,668,407	28,212,915	745,084	21,966,189	1,898,927
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Kaikoura District	86,838	80,250	0	6,588	0	0	0
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	1,605,710	832,362	0	773,348	0	0	0
Waimakariri District	233,476,410	185,742,971	14,904,842	4,940,406	17,736,428	7,698,081	2,453,682
Christchurch City	954,370,119	747,876,068	69,155,360	89,820,757	0	10,489,852	37,028,082
Selwyn District	14,346,745	13,250,442	0	979,483	0	116,820	0
Ashburton District	0	0	0	0	0	0	0
Timaru District	386,190	386,190	0	0	0	0	0
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	240,154	205,966	0	34,188	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	285,163,394	167,094,811	26,748,658	59,984,509	9,263,873	20,947,453	1,124,090
Clutha District	14,940,586	13,270,015	0	1,585,331	0	0	85,240
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	481,027,490	265,952,067	26,167,649	68,725,677	11,813,718	21,874,085	86,494,294
New Zealand Total	6,579,029,028	4,344,825,034	615,434,603	1,084,582,692	109,175,042	160,202,464	264,809,193
New Zealand Total*	5,682,225,858	3,478,608,580	610,457,365	1,080,498,811	109,175,042	159,148,002	244,338,058

* excludes Red Zone in Christchurch

Table 19: Building replacement cost (NZ$2011) by territorial authority for the 1–1.5 m LIDAR elevation band

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Far North District	58,554,231	47,532,873	4,620,811	2,991,105	192,692	1,022,300	2,194,450
Whangarei District	378,658,845	112,265,797	112,644,026	140,570,865	241,565	6,170,604	6,765,988
Kaipara District	105,960,595	42,623,861	26,169,918	29,340,388	148,252	3,986,513	3,691,663
Thames-Coromandel District	382,632,214	272,217,234	52,350,501	33,010,983	3,008,288	8,533,170	13,512,038
Hauraki District	61,777,190	55,705,600	829,141	2,054,573	0	15,212	3,172,664
Waikato District	18,067,108	13,939,983	0	1,885,458	0	1,212,037	1,029,630
Matamata-Piako District	18,044	0	0	18,044	0	0	0
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	6,804,462	2,464,345	0	3,205,493	0	12,417	1,122,207
South Waikato District	0	0	0	0	0	0	0
Waitomo District	646,970	0	0	0	0	0	646,970
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	77,974,882	63,312,237	1,712,051	7,659,801	201,236	1,202,662	3,886,895
Tauranga City	491,563,517	226,167,153	65,903,890	186,657,143	1,010,500	2,169,200	9,655,631
Rotorua District	0	0	0	0	0	0	0
Whakatane District	304,121,282	182,621,027	81,853,789	27,370,762	3,118,115	900,405	8,257,184
Kawerau District	0	0	0	0	0	0	0
Opotiki District	59,276,704	21,916,088	21,433,044	14,174,990	0	70,950	1,681,632
Gisborne District	71,423,621	16,345,555	0	52,360,537	0	1,806,045	911,484
Wairoa District	399,816	270,180	0	6,588	0	0	123,048
Hastings District	97,972,641	70,332,381	2,172,816	8,465,866	7,462,024	5,610,556	3,928,998
Napier City	1,215,468,551	846,538,309	14,405,401	234,552,194	46,369,481	29,148,755	44,454,411
Central Hawke's Bay District	0	0	0	0	0	0	0
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	71,190,371	62,688,835	0	0	0	0	8,501,536
Porirua City	63,258,625	31,985,557	6,080,498	0	15,975,788	7,175,666	2,041,116
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	882,992,165	376,677,694	26,465,266	371,399,020	63,161,131	13,498,730	31,790,324
Wellington City	1,968,491,054	220,765,655	1,423,533,882	34,139,797	215,558,549	32,538,319	41,954,852
Masterton District	179,550	179,550	0	0	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	1,363,080	1,289,134	0	73,946	0	0	0
Tasman District	389,849,136	276,630,103	3,992,751	98,570,972	9,425,432	1,069,642	160,236
Nelson City	456,157,520	154,925,654	174,786,736	115,685,749	1,562,219	6,736,226	2,460,936
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	3,029,208	1,535,985	691,528	595,195	0	0	206,500
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	8,293,912	8,115,399	0	178,513	0	0	0
Waimakariri District	219,207,894	136,762,129	19,705,349	33,865,766	20,690,265	7,998,642	185,743
Christchurch City	1,546,133,001	1,184,906,239	48,746,418	229,834,963	11,874	18,012,538	64,620,969
Selwyn District	40,709,315	38,232,565	0	1,639,631	0	755,923	81,196
Ashburton District	0	0	0	0	0	0	0
Timaru District	3,743,157	1,544,760	0	2,144,057	0	0	54,340
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	5,108	0	0	5,108	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	431,913,611	97,100,739	149,502,225	166,814,156	3,379,698	11,360,506	3,756,287
Clutha District	15,672,519	12,098,697	0	1,650,362	1,241,625	681,835	0
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	1,267,830,976	677,779,043	180,315,659	141,936,870	56,341,565	35,645,131	175,812,708
New Zealand Total	11,014,883,767	5,556,347,165	2,418,831,032	1,945,529,541	449,100,299	197,752,166	447,323,564
New Zealand Total*	10,701,340,875	5,257,470,361	2,417,915,700	1,942,858,895	449,100,299	197,333,984	436,661,636

* excludes Red Zone in Christchurch

Table 20: Building replacement cost (NZ$2011) by territorial authority for the aggregated 0–1.5 m LIDAR zone.

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Far North District	121,596,189	95,544,140	6,052,023	12,165,191	1,421,901	1,373,912	5,039,022
Whangarei District	570,712,749	191,170,995	164,024,549	194,537,709	241,565	7,599,177	13,138,754
Kaipara District	143,917,047	61,670,893	32,463,250	39,767,175	148,252	4,962,923	4,904,554
Thames-Coromandel District	857,036,722	584,854,987	103,293,903	117,682,120	8,356,523	15,137,105	27,712,084
Hauraki District	793,146,148	704,679,879	11,660,661	36,283,349	354,476	3,987,121	36,180,662
Waikato District	35,803,682	30,645,731	0	1,987,670	0	1,212,037	1,958,244
Matamata-Piako District	1,662,405	1,517,210	0	25,570	0	0	119,625
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	11,447,325	6,330,154	0	3,278,920	0	12,417	1,825,834
South Waikato District	0	0	0	0	0	0	0
Waitomo District	742,901	95,931	0	0	0	0	646,970
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	150,866,393	128,126,378	2,257,447	10,504,537	774,484	2,087,062	7,116,485
Tauranga City	778,073,512	378,661,861	96,617,606	276,725,791	1,091,340	4,638,215	20,338,699
Rotorua District	0	0	0	0	0	0	0
Whakatane District	685,482,772	440,410,730	141,868,480	73,231,795	4,277,774	2,384,635	23,309,358
Kawerau District	0	0	0	0	0	0	0
Opotiki District	82,314,002	39,251,836	22,475,879	15,573,341	0	1,498,715	3,514,231
Gisborne District	114,781,170	21,959,789	1,074,500	85,773,352	0	3,663,029	2,310,500
Wairoa District	686,821	531,000	0	6,588	0	0	149,233
Hastings District	267,973,709	216,870,354	6,860,606	15,342,194	10,091,170	6,412,791	12,396,594

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Napier City	2,598,921,407	1,719,034,571	63,175,222	553,913,732	109,796,175	46,901,274	106,100,433
Central Hawke's Bay District	0	0	0	0	0	0	0
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kāpiti Coast District	103,748,089	92,117,464	0	0	0	0	11,630,625
Porirua City	82,650,758	45,900,389	9,906,206	0	15,975,788	8,369,606	2,498,769
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	1,496,831,285	653,817,415	37,598,492	613,227,865	85,244,814	50,086,188	56,856,511
Wellington City	2,167,263,544	235,577,779	1,590,790,962	35,055,405	217,114,719	39,319,753	49,404,926
Masterton District	179,550	179,550	0	0	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	5,826,114	5,412,722	0	413,392	0	0	0
Tasman District	641,980,794	469,238,069	17,349,893	129,805,625	12,341,576	12,661,210	584,421
Nelson City	643,255,071	239,968,731	208,490,461	145,154,755	2,307,303	42,387,201	4,946,620
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	3,116,046	1,616,235	691,528	601,783	0	0	206,500
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	9,899,622	8,947,761	0	951,861	0	0	0
Waimakariri District	769,326,118	630,915,447	35,338,318	39,981,557	43,344,254	17,026,338	2,720,204
Christchurch (2012)	4,041,174,516	3,402,716,392	126,312,838	328,811,761	11,874	33,664,698	149,656,953
Chch (excl Red Zone)	2,399,928,182	1,824,492,424	119,532,223	321,181,104	11,874	28,599,541	106,111,016
Selwyn District	56,557,917	52,646,119	0	2,685,279	0	1,145,323	81,196
Ashburton District	0	0	0	0	0	0	0
Timaru District	4,556,697	1,930,950	0	2,571,407	0	0	54,340

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	245,262	205,966	0	39,296	0	0	0
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	1,529,905,764	789,922,887	294,032,295	363,427,427	23,779,684	50,890,654	7,852,817
Clutha District	47,225,769	39,378,975	0	5,319,262	1,241,625	1,200,667	85,240
Southland District	0	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	0	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	2,184,788,932	1,239,805,122	260,220,363	238,725,171	80,085,263	82,820,604	283,132,409
New Zealand Total	21,003,696,802	12,531,654,412	3,232,555,482	3,343,570,880	618,000,560	441,442,655	836,472,813
New Zealand Total*	19,362,450,468	10,953,430,444	3,225,774,867	3,335,940,223	618,000,560	436,377,498	792,926,876

* excludes Red Zone in Christchurch

Table 21: Building replacement cost (NZ$2011) by urban area for the 0–0.5 m LIDAR elevation band

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Whangarei	3,953,464	1,251,162	0	1,782,216	0	886,340	33,746
Northern Auckland Zone	59,492,516	25,522,817	15,042,657	648,941	182,253	10,323,017	7,772,831
Western Auckland Zone	14,305,222	13,891,827	0	0	0	86,936	326,459
Central Auckland Zone	135,706,217	92,173,562	24,150,103	72,150	5,354,559	13,679,423	276,420
Southern Auckland Zone	7,535,412	4,706,256	320,754	1,015,483	1,317,703	175,216	0
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	55,703,672	35,762,403	875,173	11,031,675	0	14,367	8,020,054
Rotorua	0	0	0	0	0	0	0
Gisborne	0	0	0	0	0	0	0
Napier Zone	375,627,748	291,081,901	3,549,867	39,568,841	14,596,842	6,370,652	20,459,645
Hastings Zone	42,677,468	35,716,837	1,056,020	2,102,239	1,713,682	0	2,088,690

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
New Plymouth	0	0	0	0	0	0	0
Wanganui	0	0	0	0	0	0	0
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	40,200,236	12,896,523	1,211,612	1,330,841	15,076,565	2,658,370	7,026,325
Porirua Zone	999,306	999,306	0	0	0	0	0
Wellington Zone	4,935,876	1,013,136	0	0	0	0	3,922,740
Nelson	30,869,626	14,080,348	1,035,318	1,482,417	0	13,684,786	586,757
Christchurch	216,047,062	200,120,464	2,358,572	2,693,895	4,917,561	1,426,766	4,529,804
Dunedin	777,713,057	511,748,330	117,781,412	115,492,067	11,136,113	18,582,695	2,972,440
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	24,736	24,736	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	80,094,541	56,194,803	3,404,836	15,444,682	0	1,484,230	3,565,990
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	427,350	0	0	427,350	0	0	0
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	0	0	0	0	0	0	0
Kaitaia	0	0	0	0	0	0	0
Kerikeri	0	0	0	0	0	0	0
Paihia	947,961	947,961	0	0	0	0	0
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	1,401,868	863,055	0	482,248	0	0	56,565
Wellsford	0	0	0	0	0	0	0
Warkworth	0	0	0	0	0	0	0
Snells Beach	1,546,593	0	0	0	0	0	1,546,593
Helensville	28,795,868	6,770,226	4,020,983	15,377,914	478,117	89,001	2,059,627
Waiheke Island	1,386,784	703,303	0	100,765	0	163,591	419,125

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Waiuku	0	0	0	0	0	0	0
Raglan	3,147,054	2,874,789	0	0	0	0	272,265
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	0	0	0	0	0	0	0
Coromandel	4,042,455	2,886,048	0	780,812	0	0	375,595
Whangamata	0	0	0	0	0	0	0
Tairua	837,788	774,840	0	0	0	62,948	0
Thames	43,868,520	34,902,956	598,605	4,387,712	0	1,949,692	2,029,555
Waihi Beach	766,012	731,679	0	14,750	0	0	19,583
Paeroa	0	0	0	0	0	0	0
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	1,741,499	1,624,857	0	0	0	0	116,642
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	0	0	0	0	0	0	0
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	144,900	144,900	0	0	0	0	0
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	387,596	387,596	0	0	0	0	0
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	0	0	0	0	0	0	0
Takaka	6,425	0	0	0	0	0	6,425
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	20,794,913	13,080,599	0	6,611,072	0	1,103,242	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	3,880,887	3,740,947	0	0	0	0	139,940
Mangawhai Heads	2,793,114	2,705,535	0	0	0	0	87,579
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	175,951,866	144,326,487	9,762,430	13,500,877	195,278	1,340,973	6,825,821
Mapua	6,482,617	4,836,821	0	397,172	0	1,248,624	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	0	0	0	0	0	0	0
Rural Centre	160,614,134	133,414,947	10,558,648	1,433,968	4,597,348	846,592	9,762,631
Rural (Incl.some Off Shore Islands)	61,548,137	36,293,791	0	24,085,654	0	1,021,642	147,050
Rural (Incl.some Off Shore Islands)	532,173,614	466,039,229	1,674,812	37,058,955	159,198	2,059,269	25,182,151
Rural (Incl.some Off Shore Islands)	80,127,883	61,648,450	0	15,244,745	0	637,140	2,597,548
New Zealand Total	3,410,602,269	2,630,014,137	198,289,847	313,445,571	59,725,219	83,488,025	125,639,470
New Zealand Total*	2,979,701,997	2,216,883,427	197,401,802	312,569,441	59,725,219	79,895,512	113,226,596

* excludes Red Zone in Christchurch

Table 22: Building replacement cost (NZ$2011) by urban area for the 0.5–1 m LIDAR elevation band

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Whangarei	110,896,105	6,122,075	50,326,897	51,870,626	0	522,802	2,053,705
Northern Auckland Zone	150,403,380	79,022,113	1,582,906	2,769,871	1,276,228	7,282,935	58,469,327
Western Auckland Zone	31,606,692	26,950,486	543,769	870,467	0	2,556,876	685,094
Central Auckland Zone	137,558,179	62,663,679	2,370,102	38,837,081	1,699,872	9,561,609	22,425,836
Southern Auckland Zone	41,894,329	32,046,708	810,392	358,253	7,507,295	0	1,171,681
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	248,704,258	132,574,076	30,268,494	79,045,730	80,840	3,339,048	3,396,070
Rotorua	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Gisborne	18,968,363	1,104,021	1,074,500	14,733,724	0	1,856,984	199,134
Napier Zone	1,007,825,108	581,414,361	45,219,954	279,792,697	48,829,852	11,381,867	41,186,377
Hastings Zone	125,485,702	109,091,776	3,631,770	4,715,551	915,464	802,235	6,328,906
New Plymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	573,638,884	264,243,198	9,921,614	240,498,004	7,007,118	33,929,088	18,039,862
Porirua Zone	18,392,827	12,915,526	3,825,708	0	0	1,193,940	457,653
Wellington Zone	193,836,614	13,798,988	167,257,080	915,608	1,556,170	6,781,434	3,527,334
Nelson	170,306,851	77,988,233	32,668,407	35,040,011	745,084	21,966,189	1,898,927
Christchurch	1,187,446,051	933,339,184	84,060,202	94,752,445	17,736,428	18,187,933	39,369,859
Dunedin	261,507,897	144,848,160	26,544,733	59,715,121	9,263,873	20,032,350	1,103,660
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	16,905,022	16,905,022	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	210,039,846	117,489,738	56,609,855	27,825,655	1,159,659	0	6,954,939
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	0	0	0	0	0	0	0
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	240,750	240,750	0	0	0	0	0
Kaitaia	0	0	0	0	0	0	0
Kerikeri	379,050	379,050	0	0	0	0	0
Paihia	13,394,642	12,195,174	571,642	423,492	0	0	204,334
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	28,019,486	10,094,005	6,293,332	9,807,019	0	976,410	848,720
Wellsford	0	0	0	0	0	0	0
Warkworth	112,512	0	0	0	0	112,512	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Snells Beach	1,478,742	0	0	0	0	1,122,970	355,772
Helensville	52,617,524	6,349,640	20,345,051	21,995,781	867,683	654,462	2,404,907
Waiheke Island	10,739,156	8,133,227	0	1,924,328	382,795	298,806	0
Waiuku	0	0	0	0	0	0	0
Raglan	2,802,165	2,647,640	0	11,218	0	0	143,307
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	48,925,071	45,481,259	1,278,327	335,834	845,626	0	984,025
Coromandel	10,609,389	9,411,868	252,600	599,273	0	28,260	317,388
Whangamata	9,571,103	9,179,659	0	0	0	0	391,444
Tairua	30,092,163	27,879,128	396,072	38,211	0	504,900	1,273,852
Thames	192,707,219	87,369,354	46,771,817	45,915,906	4,502,609	3,346,806	4,800,727
Waihi Beach	5,913,378	4,306,261	0	1,544,681	0	0	62,436
Paeroa	0	0	0	0	0	0	0
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	187,245	0	0	187,245	0	0	0
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	1,966,280	1,764,180	0	0	0	0	202,100
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	10,086,269	5,671,386	1,042,835	799,603	0	1,427,765	1,144,680
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	14,434,065	12,111,275	0	0	0	0	2,322,790
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	86,838	80,250	0	6,588	0	0	0
Takaka	397,602	235,620	0	109,132	0	0	52,850
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	142,590,166	112,634,470	10,657,288	11,198,620	0	8,099,788	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	19,576,093	17,512,312	441,300	289,042	0	0	1,333,439
Mangawhai Heads	2,940,667	2,803,709	0	0	0	0	136,958
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	850,691	569,152	0	258,330	0	0	23,209
Mapua	13,754,628	9,015,447	1,870,830	2,868,351	0	0	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	2,339,823	2,339,823	0	0	0	0	0
Rural Centre	65,009,149	53,712,716	1,729,815	2,216,489	4,718,601	334,620	2,296,908
Rural (Incl.some Off Shore Islands)	70,316,803	63,036,767	437,488	5,121,806	0	1,272,367	448,375
Rural (Incl.some Off Shore Islands)	322,512,909	269,678,447	1,040,259	38,004,136	0	1,269,700	12,520,367
Rural (Incl.some Off Shore Islands)	105,037,440	93,628,778	612,326	5,102,882	79,845	1,540,951	4,072,658
New Zealand Total	6,581,908,296	4,347,195,145	615,434,603	1,084,582,692	109,175,042	161,440,069	264,080,745
New Zealand Total*	5,685,105,126	3,480,978,691	610,457,365	1,080,498,811	109,175,042	160,385,607	243,609,610

* excludes Red Zone in Christchurch

Table 23: Building replacement cost (NZ$2011) by urban area for the 1–1.5 m LIDAR elevation band

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Whangarei	275,768,503	23,655,117	112,644,026	133,023,861	241,565	3,032,306	3,171,628
Northern Auckland Zone	346,509,490	207,805,376	30,555,754	2,524,765	19,047,919	16,167,550	70,408,126
Western Auckland Zone	37,661,759	15,243,353	5,758,579	14,407,431	930,371	573,194	748,831
Central Auckland Zone	617,763,555	271,703,798	139,063,660	83,679,681	14,396,879	10,945,293	97,974,244
Southern Auckland Zone	106,271,113	59,831,509	2,051,763	22,179,452	18,779,447	85,298	3,343,644
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	505,027,940	239,169,910	65,903,890	186,657,143	1,010,500	2,169,200	10,117,297
Rotorua	0	0	0	0	0	0	0
Gisborne	54,872,070	9,862,416	0	42,968,312	0	1,806,045	235,297
Napier Zone	1,215,984,843	846,979,736	14,405,401	234,598,638	46,369,481	29,148,755	44,482,832
Hastings Zone	95,532,956	68,233,137	2,172,816	8,253,846	7,462,024	5,610,556	3,800,577
New Plymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	882,992,165	376,677,694	26,465,266	371,399,020	63,161,131	13,498,730	31,790,324
Porirua Zone	63,258,625	31,985,557	6,080,498	0	15,975,788	7,175,666	2,041,116
Wellington Zone	1,968,491,054	220,765,655	1,423,533,882	34,139,797	215,558,549	32,538,319	41,954,852
Nelson	512,668,524	168,381,652	174,786,736	154,564,195	5,738,779	6,736,226	2,460,936
Christchurch	1,762,981,252	1,319,420,445	68,451,767	263,623,857	20,702,139	26,011,180	64,771,864
Dunedin	414,887,146	84,109,615	149,199,225	166,609,363	3,379,698	9,423,978	2,165,267
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	47,246,202	47,246,202	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	229,610,515	117,059,417	81,853,789	23,165,651	3,118,115	900,405	3,513,138
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Timaru	758,922	0	0	716,302	0	0	42,620
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	3,515,870	1,629,022	1,708,875	47,368	0	0	130,605
Kaitaia	0	0	0	0	0	0	0
Kerikeri	538,650	538,650	0	0	0	0	0
Paihia	11,566,375	11,430,505	0	0	0	0	135,870
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	91,714,768	30,927,562	26,169,918	27,348,964	148,252	3,986,513	3,133,559
Wellsford	0	0	0	0	0	0	0
Warkworth	3,620,736	0	0	0	2,156,364	654,305	810,067
Snells Beach	6,410,457	4,632,895	0	88,031	0	849,769	839,762
Helensville	22,589,492	7,516,679	1,650,588	11,150,582	0	2,153,624	118,019
Waiheke Island	28,329,204	25,473,611	0	1,836,384	0	741,942	277,267
Waiuku	877,777	66,021	0	0	811,756	0	0
Raglan	5,396,622	2,352,351	0	1,882,342	0	1,074,161	87,768
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	121,036,349	98,741,676	10,081,913	4,964,025	0	2,349,095	4,899,640
Coromandel	5,884,399	3,456,967	242,292	1,220,259	0	155,125	809,756
Whangamata	17,103,083	12,950,500	0	3,502,158	0	180,118	470,307
Tairua	15,749,689	11,805,544	3,137,333	10,295	335,288	0	461,229
Thames	148,177,225	86,574,926	38,186,209	11,622,482	2,673,000	5,260,885	3,859,723
Waihi Beach	11,133,396	8,564,626	0	2,389,027	0	0	179,743
Paeroa	21,916	0	0	0	0	0	21,916
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	1,179,339	640,462	292,502	246,375	0	0	0
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	28,003,972	23,835,789	0	1,924,033	0	0	2,244,150

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	52,405,498	15,498,563	21,433,044	14,104,275	0	70,950	1,298,666
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	22,156,314	13,654,778	0	0	0	0	8,501,536
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	3,029,208	1,535,985	691,528	595,195	0	0	206,500
Takaka	835,242	725,373	0	83,444	0	0	26,425
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	234,734,913	176,109,941	0	53,019,799	5,248,872	356,301	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Lincoln	0	0	0	0	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	48,815,114	45,421,052	0	2,455,425	0	0	938,637
Mangawhai Heads	8,633,375	8,302,282	0	0	0	0	331,093
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	0	0	0	0	0	0	0
Mapua	29,001,997	25,505,788	751,608	2,212,769	0	531,832	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	5,112,968	3,610,890	0	0	0	1,502,078	0
Rural Centre	95,140,311	77,058,273	5,350,602	3,836,326	393,928	3,121,064	5,380,118
Rural (Incl.some Off Shore Islands)	132,601,576	115,520,815	3,544,143	9,233,435	1,241,625	1,208,963	1,852,595
Rural (Incl.some Off Shore Islands)	263,275,685	214,815,223	1,531,895	32,025,532	0	2,784,282	12,118,753
Rural (Incl.some Off Shore Islands)	144,670,703	120,637,929	216,198	14,562,132	218,829	4,530,276	4,505,339
New Zealand Total	11,014,883,767	5,556,347,165	2,418,831,032	1,945,529,541	449,100,299	197,752,166	447,323,564
New Zealand Total*	10,701,548,857	5,257,665,267	2,417,915,700	1,942,871,971	449,100,299	197,333,984	436,661,636

* excludes Red Zone in Christchurch

Table 24: Building replacement cost (NZ$2011) by urban area for the aggregated 0–1.5m LIDAR zone

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Whangarei	390,618,072	31,028,354	162,970,923	186,676,703	241,565	4,441,448	5,259,079
Northern Auckland Zone	556,405,386	312,350,306	47,181,317	5,943,577	20,506,400	33,773,502	136,650,284
Western Auckland Zone	83,573,673	56,085,666	6,302,348	15,277,898	930,371	3,217,006	1,760,384
Central Auckland Zone	891,027,951	426,541,039	165,583,865	122,588,912	21,451,310	34,186,325	120,676,500
Southern Auckland Zone	155,700,854	96,584,473	3,182,909	23,553,188	27,604,445	260,514	4,515,325
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	809,435,870	407,506,389	97,047,557	276,734,548	1,091,340	5,522,615	21,533,421
Rotorua	0	0	0	0	0	0	0
Gisborne	73,840,433	10,966,437	1,074,500	57,702,036	0	3,663,029	434,431
Napier Zone	2,599,437,699	1,719,475,998	63,175,222	553,960,176	109,796,175	46,901,274	106,128,854
Hastings Zone	263,696,126	213,041,750	6,860,606	15,071,636	10,091,170	6,412,791	12,218,173
New Plymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	1,496,831,285	653,817,415	37,598,492	613,227,865	85,244,814	50,086,188	56,856,511
Porirua Zone	82,650,758	45,900,389	9,906,206	0	15,975,788	8,369,606	2,498,769
Wellington Zone	2,167,263,544	235,577,779	1,590,790,962	35,055,405	217,114,719	39,319,753	49,404,926
Nelson	713,845,001	260,450,233	208,490,461	191,086,623	6,483,863	42,387,201	4,946,620
Christchurch (2012)	4,807,720,699	4,031,104,061	161,651,156	368,700,854	43,356,128	50,691,036	152,217,464
Chch (excl Red Zone)	3,166,474,365	2,452,880,093	154,870,541	361,070,197	43,356,128	45,625,879	108,671,527
Dunedin	1,454,108,100	740,706,105	293,525,370	341,816,551	23,779,684	48,039,023	6,241,367
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	64,175,960	64,175,960	0	0	0	0	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	519,744,902	290,743,958	141,868,480	66,435,988	4,277,774	2,384,635	14,034,067
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Ashburton	0	0	0	0	0	0	0
Timaru	1,186,272	0	0	1,143,652	0	0	42,620
Oamaru	0	0	0	0	0	0	0
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	3,756,620	1,869,772	1,708,875	47,368	0	0	130,605
Kaitaia	0	0	0	0	0	0	0
Kerikeri	917,700	917,700	0	0	0	0	0
Paihia	25,908,978	24,573,640	571,642	423,492	0	0	340,204
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	121,136,122	41,884,622	32,463,250	37,638,231	148,252	4,962,923	4,038,844
Wellsford	0	0	0	0	0	0	0
Warkworth	3,733,248	0	0	0	2,156,364	766,817	810,067
Snells Beach	9,435,792	4,632,895	0	88,031	0	1,972,739	2,742,127
Helensville	104,002,884	20,636,545	26,016,622	48,524,277	1,345,800	2,897,087	4,582,553
Waiheke Island	40,455,144	34,310,141	0	3,861,477	382,795	1,204,339	696,392
Waiuku	877,777	66,021	0	0	811,756	0	0
Raglan	11,345,841	7,874,780	0	1,893,560	0	1,074,161	503,340
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	169,961,420	144,222,935	11,360,240	5,299,859	845,626	2,349,095	5,883,665
Coromandel	20,536,243	15,754,883	494,892	2,600,344	0	183,385	1,502,739
Whangamata	26,674,186	22,130,159	0	3,502,158	0	180,118	861,751
Tairua	46,679,640	40,459,512	3,533,405	48,506	335,288	567,848	1,735,081
Thames	384,752,964	208,847,236	85,556,631	61,926,100	7,175,609	10,557,383	10,690,005
Waihi Beach	17,812,786	13,602,566	0	3,948,458	0	0	261,762
Paeroa	21,916	0	0	0	0	0	21,916
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	3,108,083	2,265,319	292,502	433,620	0	0	116,642
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	29,970,252	25,599,969	0	1,924,033	0	0	2,446,250

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	62,636,667	21,314,849	22,475,879	14,903,878	0	1,498,715	2,443,346
Wairoa	0	0	0	0	0	0	0
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	36,977,975	26,153,649	0	0	0	0	10,824,326
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	3,116,046	1,616,235	691,528	601,783	0	0	206,500
Takaka	1,239,269	960,993	0	192,576	0	0	85,700
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	398,119,992	301,825,010	10,657,288	70,829,491	5,248,872	9,559,331	0
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	0	0	0	0	0	0	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	72,272,094	66,674,311	441,300	2,744,467	0	0	2,412,016
Mangawhai Heads	14,367,156	13,811,526	0	0	0	0	555,630
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	176,802,557	144,895,639	9,762,430	13,759,207	195,278	1,340,973	6,849,030
Mapua	49,239,242	39,358,056	2,622,438	5,478,292	0	1,780,456	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	7,452,791	5,950,713	0	0	0	1,502,078	0
Rural Centre	320,763,594	264,185,936	17,639,065	7,486,783	9,709,877	4,302,276	17,439,657
Rural (Incl.some Off Shore Islands)	264,466,516	214,851,373	3,981,631	38,440,895	1,241,625	3,502,972	2,448,020
Rural (Incl.some Off Shore Islands)	1,117,962,208	950,532,899	4,246,966	107,088,623	159,198	6,113,251	49,821,271
Rural (Incl.some Off Shore Islands)	329,836,026	275,915,157	828,524	34,909,759	298,674	6,708,367	11,175,545
New Zealand Total	21,007,602,314	12,533,751,353	3,232,555,482	3,343,570,880	618,000,560	442,680,260	837,043,779
New Zealand Total*	19,366,355,980	10,955,527,385	3,225,774,867	3,335,940,223	618,000,560	437,615,103	793,497,842

* excludes Red Zone in Christchurch

Appendix G Result tables: infrastructure assets for the aggregated 0–1.5 m LIDAR zone (regional, TLA and urban areas)

Roads

Table 1: Road type and length by regional council.

REGC2014_N	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Northland Region	93.5	82.45	0.82	10.22	0.00
Auckland Region	147.1	126.77	6.29	9.17	4.89
Waikato Region	805.9	708.09	61.10	36.68	0.00
Bay of Plenty Region	183.2	166.15	2.61	14.48	0.00
Gisborne Region	19.6	18.94	0.02	0.62	0.00
Hawke's Bay Region	172.2	166.63	2.23	3.31	0.00
Taranaki Region	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data
Wellington Region	82.9	80.28	0.33	1.37	0.88
West Coast Region	No Data	No Data	No Data	No Data	No Data
Canterbury Region	301.0	287.10	4.19	6.99	2.70
Otago Region	178.5	172.12	1.92	4.28	0.15
Southland Region	No Data	No Data	No Data	No Data	No Data
Tasman Region	110.9	96.90	9.87	4.15	0.00
Nelson Region	26.5	24.24	2.21	0.01	0.00
Marlborough Region	No Data	No Data	No Data	No Data	No Data
New Zealand Total	2121.2	1929.67	91.59	91.28	8.62

Table 2: Road type and length by territorial authority.

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Far North District	45.0	35.09	0.64	9.30	0.00
Whangarei District	37.3	36.87	0.18	0.24	0.00
Kaipara District	11.2	10.49	0.00	0.68	0.00
Thames-Coromandel District	102.6	86.92	0.00	15.64	0.00
Hauraki District	685.6	605.14	59.95	20.49	0.00
Waikato District	13.6	11.42	1.89	0.29	0.00
Matamata-Piako District	4.3	4.01	0.00	0.27	0.00
Hamilton City	0.0	0.00	0.00	0.00	0.00
Waipa District	0.0	0.00	0.00	0.00	0.00

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Otorohanga District	3.4	3.40	0.00	0.01	0.00
South Waikato District	0.0	0.00	0.00	0.00	0.00
Waitomo District	0.4	0.37	0.00	0.00	0.00
Taupo District	0.0	0.00	0.00	0.00	0.00
Western Bay of Plenty District	39.2	38.45	0.46	0.28	0.00
Tauranga City	30.0	25.03	0.74	4.28	0.00
Rotorua District	0.0	0.00	0.00	0.00	0.00
Whakatane District	89.3	83.77	1.42	4.16	0.00
Kawerau District	0.0	0.00	0.00	0.00	0.00
Opotiki District	24.8	19.28	0.00	5.50	0.00
Gisborne District	19.6	18.94	0.02	0.62	0.00
Wairoa District	6.8	6.70	0.00	0.10	0.00
Hastings District	21.0	20.11	0.00	0.89	0.00
Napier City	144.3	139.73	2.23	2.32	0.00
Central Hawke's Bay District	0.1	0.12	0.00	0.00	0.00
New Plymouth District	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0.0	0.00	0.00	0.00	0.00
Wanganui District	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0.0	0.00	0.00	0.00	0.00
Tararua District	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	7.0	6.99	0.02	0.03	0.00
Porirua City	7.4	6.29	0.01	0.40	0.73
Upper Hutt City	0.0	0.00	0.00	0.00	0.00
Lower Hutt City	39.8	39.65	0.00	0.13	0.00
Wellington City	12.6	11.39	0.30	0.79	0.14
Masterton District	0.6	0.59	0.00	0.00	0.00
Carterton District	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	15.4	15.37	0.00	0.02	0.00
Tasman District	110.9	96.92	9.87	4.15	0.00
Nelson City	26.5	24.24	2.21	0.01	0.00
Marlborough District	No Data	No Data	No Data	No Data	No Data
Kaikoura District	1.3	1.32	0.00	0.00	0.00
Buller District	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Westland District	No Data	No Data	No Data	No Data	No Data
Hurunui District	5.3	5.29	0.00	0.00	0.00
Waimakariri District	43.3	38.18	2.15	0.91	2.01
Christchurch City	175.1	166.79	2.04	5.52	0.74
Selwyn District	66.8	66.28	0.00	0.56	0.00
Ashburton District	0.5	0.50	0.00	0.00	0.00
Timaru District	9.7	9.68	0.00	0.00	0.00
Mackenzie District	0.0	0.00	0.00	0.00	0.00
Waimate District	0.2	0.17	0.00	0.00	0.00
Chatham Islands Territory	0.0	0.00	0.00	0.00	0.00
Waitaki District	2.0	1.93	0.06	0.00	0.00
Central Otago District	0.0	0.00	0.00	0.00	0.00
Queenstown-Lakes District	0.0	0.00	0.00	0.00	0.00
Dunedin City	116.0	109.93	1.87	4.07	0.15
Clutha District	60.7	60.51	0.00	0.21	0.00
Southland District	No Data	No Data	No Data	No Data	No Data
Gore District	0.0	0.00	0.00	0.00	0.00
Invercargill City	No Data	No Data	No Data	No Data	No Data
Auckland	147.1	126.77	6.29	9.17	4.89
New Zealand Total	2126.6	1934.61	92.33	91.03	8.66

Table 3: Road type and length by urban area

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Whangarei	18.8	18.74	0.00	0.01	0.00
Northern Auckland Zone	18.2	15.77	0.62	0.03	1.73
Western Auckland Zone	2.6	2.37	0.00	0.00	0.21
Central Auckland Zone	15.2	11.71	0.32	0.54	2.64
Southern Auckland Zone	19.8	19.35	0.06	0.12	0.24
Hamilton Zone	0.0	0.00	0.00	0.00	0.00
Cambridge Zone	0.0	0.00	0.00	0.00	0.00
Te Awamutu Zone	0.0	0.00	0.00	0.00	0.00
Tauranga	34.5	29.51	0.74	4.28	0.00
Rotorua	0.0	0.00	0.00	0.00	0.00
Gisborne	4.3	4.26	0.02	0.05	0.00
Napier Zone	144.8	139.79	2.23	2.81	0.00
Hastings Zone	20.1	19.73	0.00	0.41	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
New Plymouth	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data
Palmerston North	0.0	0.00	0.00	0.00	0.00
Upper Hutt Zone	0.0	0.00	0.00	0.00	0.00
Lower Hutt Zone	39.8	39.64	0.00	0.13	0.00
Porirua Zone	7.2	6.03	0.01	0.40	0.73
Wellington Zone	12.5	11.30	0.30	0.79	0.14
Nelson	40.6	35.28	5.36	0.01	0.00
Christchurch	200.6	188.62	4.19	5.07	2.70
Dunedin	72.0	68.92	1.87	1.10	0.15
Invercargill	No Data	No Data	No Data	No Data	No Data
Kapiti	3.6	3.62	0.02	0.00	0.00
Blenheim	No Data	No Data	No Data	No Data	No Data
Pukekohe	0.0	0.00	0.00	0.00	0.00
Tokoroa	0.0	0.00	0.00	0.00	0.00
Taupo	0.0	0.00	0.00	0.00	0.00
Whakatane	38.0	34.42	1.18	2.44	0.00
Hawera	No Data	No Data	No Data	No Data	No Data
Feilding	0.0	0.00	0.00	0.00	0.00
Levin	No Data	No Data	No Data	No Data	No Data
Masterton	0.0	0.00	0.00	0.00	0.00
Greymouth	No Data	No Data	No Data	No Data	No Data
Ashburton	0.0	0.00	0.00	0.00	0.00
Timaru	5.6	5.56	0.00	0.00	0.00
Oamaru	0.0	0.02	0.00	0.00	0.00
Rangiora	0.0	0.00	0.00	0.00	0.00
Queenstown	0.0	0.00	0.00	0.00	0.00
Taipa Bay-Mangonui	1.4	1.37	0.00	0.01	0.00
Kaitaia	0.0	0.00	0.00	0.00	0.00
Kerikeri	0.1	0.15	0.00	0.00	0.00
Paihia	1.0	0.45	0.00	0.58	0.00
Kawakawa	0.0	0.00	0.00	0.02	0.00
Moerewa	0.0	0.00	0.00	0.00	0.00
Kaikohe	0.0	0.00	0.00	0.00	0.00
Dargaville	10.0	9.33	0.00	0.68	0.00
Wellsford	0.0	0.00	0.00	0.00	0.00
Warkworth	0.2	0.20	0.00	0.00	0.00
Snells Beach	0.7	0.72	0.00	0.00	0.00
Helensville	3.4	3.00	0.00	0.43	0.00
Waiheke Island	5.7	5.06	0.67	0.00	0.00
Waiuku	0.0	0.00	0.00	0.00	0.00
Raglan	2.9	2.94	0.00	0.00	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Huntly	0.0	0.00	0.00	0.00	0.00
Otorohanga	0.0	0.00	0.00	0.00	0.00
Te Kuiti	0.0	0.00	0.00	0.00	0.00
Taumarunui	0.0	0.00	0.00	0.00	0.00
Whitianga	10.9	10.64	0.00	0.23	0.00
Coromandel	2.6	1.87	0.00	0.73	0.00
Whangamata	2.0	1.69	0.00	0.30	0.00
Tairua	3.5	3.25	0.00	0.29	0.00
Thames	18.7	16.95	0.00	1.77	0.00
Waihi Beach	0.7	0.63	0.05	0.00	0.00
Paeroa	1.0	0.62	0.13	0.25	0.00
Waihi	0.0	0.00	0.00	0.00	0.00
Te Aroha	0.0	0.00	0.00	0.00	0.00
Morrinsville	0.0	0.00	0.00	0.00	0.00
Matamata	0.0	0.00	0.00	0.00	0.00
Putaruru	0.0	0.00	0.00	0.00	0.00
Katikati Community	0.4	0.40	0.00	0.00	0.00
Te Puke Community	0.0	0.01	0.00	0.00	0.00
Turangi	0.0	0.00	0.00	0.00	0.00
Edgecumbe	2.1	2.07	0.00	0.00	0.00
Kawerau	0.0	0.00	0.00	0.00	0.00
Murupara	0.0	0.00	0.00	0.00	0.00
Opotiki	6.1	6.05	0.00	0.03	0.00
Wairoa	0.0	0.00	0.00	0.02	0.00
Waipawa	0.0	0.00	0.00	0.00	0.00
Waipukurau	0.0	0.00	0.00	0.00	0.00
Dannevirke	0.0	0.00	0.00	0.00	0.00
Woodville	0.0	0.00	0.00	0.00	0.00
Waitara	No Data	No Data	No Data	No Data	No Data
Inglewood	0.0	0.00	0.00	0.00	0.00
Stratford	0.0	0.00	0.00	0.00	0.00
Opunake	No Data	No Data	No Data	No Data	No Data
Eltham	0.0	0.00	0.00	0.00	0.00
Patea	No Data	No Data	No Data	No Data	No Data
Ohakune	0.0	0.00	0.00	0.00	0.00
Raetihi	0.0	0.00	0.00	0.00	0.00
Waiouru	0.0	0.00	0.00	0.00	0.00
Bulls	0.0	0.00	0.00	0.00	0.00
Taihape	0.0	0.00	0.00	0.00	0.00
Marton	0.0	0.00	0.00	0.00	0.00
Foxton Community	No Data	No Data	No Data	No Data	No Data
Shannon	0.0	0.00	0.00	0.00	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Otaki	2.6	2.58	0.00	0.00	0.00
Pahiatua	0.0	0.00	0.00	0.00	0.00
Carterton	0.0	0.00	0.00	0.00	0.00
Greytown	0.0	0.00	0.00	0.00	0.00
Featherston	0.0	0.00	0.00	0.00	0.00
Martinborough	0.0	0.00	0.00	0.00	0.00
Picton	No Data	No Data	No Data	No Data	No Data
Kaikoura	0.3	0.28	0.00	0.00	0.00
Takaka	2.4	2.41	0.00	0.00	0.00
Brightwater	0.0	0.00	0.00	0.00	0.00
Wakefield	0.0	0.00	0.00	0.00	0.00
Motueka	18.6	17.59	0.84	0.17	0.00
Westport	No Data	No Data	No Data	No Data	No Data
Reefton	0.0	0.00	0.00	0.00	0.00
Hokitika	No Data	No Data	No Data	No Data	No Data
Woodend	0.0	0.00	0.00	0.00	0.00
Oxford	0.0	0.00	0.00	0.00	0.00
Darfield	0.0	0.00	0.00	0.00	0.00
Lincoln	0.0	0.00	0.00	0.00	0.00
Leeston	0.0	0.00	0.00	0.00	0.00
Pleasant Point	0.0	0.00	0.00	0.00	0.00
Geraldine	0.0	0.00	0.00	0.00	0.00
Temuka	0.0	0.00	0.00	0.00	0.00
Twizel Community	0.0	0.00	0.00	0.00	0.00
Waimate	0.0	0.00	0.00	0.00	0.00
Milton	0.0	0.00	0.00	0.00	0.00
Balclutha	0.0	0.00	0.00	0.00	0.00
Alexandra	0.0	0.00	0.00	0.00	0.00
Cromwell	0.0	0.00	0.00	0.00	0.00
Wanaka	0.0	0.00	0.00	0.00	0.00
Arrowtown	0.0	0.00	0.00	0.00	0.00
Winton	0.0	0.00	0.00	0.00	0.00
Bluff	No Data	No Data	No Data	No Data	No Data
Te Anau	0.0	0.00	0.00	0.00	0.00
Riverton	No Data	No Data	No Data	No Data	No Data
Rolleston	0.0	0.00	0.00	0.00	0.00
Gore	0.0	0.00	0.00	0.00	0.00
Ngunguru	4.0	4.01	0.00	0.02	0.00
Mangawhai Heads	0.4	0.42	0.00	0.00	0.00
Te Kauwhata	0.0	0.00	0.00	0.00	0.00
Ngatea	32.3	25.71	0.00	6.61	0.00
Mapua	4.1	3.79	0.00	0.29	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Amberley	0.0	0.00	0.00	0.00	0.00
Methven	0.0	0.00	0.00	0.00	0.00
Rakaia	0.0	0.00	0.00	0.00	0.00
Waikouaiti	1.1	1.05	0.00	0.00	0.00
Rural Centre	46.1	41.74	0.97	3.41	0.00
Rural (Incl.some Off Shore Islands)	262.1	247.02	6.64	8.44	0.00
Rural (Incl.some Off Shore Islands)	876.6	775.55	61.59	39.45	0.00
Rural (Incl.some Off Shore Islands)	115.0	94.16	4.91	15.87	0.09
New Zealand Total	2137.5	1938.37	92.71	97.81	8.64

Table 4: Road lengths for selected urban areas for the 0–0.5 m, 0.5–1 m and 1–1.5 m elevation bands

UA2014_NAM	Road Length for all types (km)		
	0–0.5 m band	0.5–1 m band	1–1.5 m band
Northern Auckland Zone	3.8	4.6	9.8
Western Auckland Zone	0.4	1.2	1.0
Central Auckland Zone	0.7	3.7	10.8
Southern Auckland Zone	4.1	8.3	7.4
Tauranga	3.2	13.5	17.8
Napier Zone	37.2	59.0	48.6
Lower Hutt Zone	2.1	17.0	22.6
Porirua Zone	0.0	0.2	0.3
Wellington Zone	0.0	3.8	11.6
Nelson	5.6	12.5	22.6
Christchurch	39.7	77.0	83.9
Dunedin	35.1	17.0	19.9
Whakatane	9.0	15.0	14.1
Motueka	3.7	7.3	7.5

Railway

Table 5: Railway track length by regional council.

REGC2014_N	Railway Track Length (km)
Northland Region	5.24
Auckland Region	0.53
Waikato Region	0.00
Bay of Plenty Region	5.31
Gisborne Region	8.90
Hawke's Bay Region	3.99
Taranaki Region	No Data
Manawatu-Wanganui Region	No Data
Wellington Region	3.76
West Coast Region	No Data
Canterbury Region	5.05
Otago Region	13.39
Southland Region	No Data
Tasman Region	0.00
Nelson Region	0.00
Marlborough Region	No Data
New Zealand Total	46.19

Airports and Airstrips

Table 6: Airport and airstrip counts by regional council.

REGC2014_N	Total	Airport Count	Airstrip and Aerodrome Count
Northland Region	1	0	1
Auckland Region	3	1	2
Waikato Region	6	0	6
Bay of Plenty Region	2	1	1
Gisborne Region	3	1	2
Hawke's Bay Region	1	1	0
Taranaki Region	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data
Wellington Region	0	0	0
West Coast Region	No Data	No Data	No Data
Canterbury Region	0	0	0

REGC2014_N	Total	Airport Count	Airstrip and Aerodrome Count
Otago Region	1	1	0
Southland Region	No Data	No Data	No Data
Tasman Region	2	0	2
Nelson Region	1	1	0
Marlborough Region	No Data	No Data	No Data
New Zealand Total	20	6	14

Wharf and Jetties

See Appendix D Table 6.

Appendix H Result tables: land assets for the aggregated 0–1.5 m LiDAR zone (regional, TLA and urban areas)

Land Cover

Table 1: Land cover type area by regional council.

REGC2014_N	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Northland Region	75.53	3.61	60.26	11.66
Auckland Region	92.44	4.75	68.24	19.45
Waikato Region	502.16	7.33	431.38	63.45
Bay of Plenty Region	157.23	5.72	129.52	21.99
Gisborne Region	19.04	0.74	15.94	2.35
Hawke's Bay Region	77.87	10.27	48.08	19.51
Taranaki Region	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data
Wellington Region	78.34	5.73	57.91	14.70
West Coast Region	No Data	No Data	No Data	No Data
Canterbury Region	138.23	16.52	91.14	30.56
Otago Region	97.81	4.81	70.95	22.05
Southland Region	No Data	No Data	No Data	No Data
Tasman Region	48.45	2.84	29.29	16.32
Nelson Region	3.20	1.83	0.18	1.19
Marlborough Region	No Data	No Data	No Data	No Data
New Zealand Total	1,290	64	1,003	223

Table 2: Land cover type area by territorial authority.

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Far North District	43.84	0.56	35.80	7.49
Whangarei District	12.72	2.28	7.65	2.79
Kaipara District	18.97	0.77	16.82	1.38
Thames-Coromandel District	75.67	4.84	53.69	17.15
Hauraki District	387.21	2.03	356.38	28.80
Waikato District	6.85	0.32	2.44	4.09
Matamata-Piako District	25.82	0.00	15.06	10.76
Hamilton City	0.00	0.00	0.00	0.00
Waipa District	0.00	0.00	0.00	0.00
Otorohanga District	6.32	0.12	3.64	2.56
South Waikato District	0.00	0.00	0.00	0.00
Waitomo District	0.54	0.01	0.16	0.38
Taupo District	0.00	0.00	0.00	0.00
Western Bay of Plenty District	61.92	0.74	51.94	9.24
Tauranga City	11.27	2.65	4.33	4.29
Rotorua District	0.00	0.00	0.00	0.00
Whakatane District	68.39	1.83	61.18	5.37
Kawerau District	0.00	0.00	0.00	0.00
Opotiki District	14.64	0.43	11.72	2.50
Gisborne District	18.82	0.73	15.86	2.23
Wairoa District	25.13	0.04	13.74	11.35
Hastings District	15.84	0.69	13.37	1.78
Napier City	31.15	9.52	18.17	3.46
Central Hawke's Bay District	5.35	0.00	2.54	2.81
New Plymouth District	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data
Ruapehu District	0.00	0.00	0.00	0.00
Wanganui District	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data
Palmerston North City	0.00	0.00	0.00	0.00
Tararua District	0.03	0.00	0.00	0.03
Horowhenua District	No Data	No Data	No Data	No Data
Kapiti Coast District	3.86	0.45	2.28	1.14
Porirua City	1.45	0.28	0.44	0.72

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Upper Hutt City	0.00	0.00	0.00	0.00
Lower Hutt City	5.08	3.97	0.05	1.06
Wellington City	1.49	1.03	0.17	0.29
Masterton District	0.66	0.00	0.08	0.58
Carterton District	0.39	0.00	0.30	0.09
South Wairarapa District	65.39	0.00	54.60	10.79
Tasman District	48.34	2.83	28.60	16.91
Nelson City	3.22	1.83	0.18	1.21
Marlborough District	No Data	No Data	No Data	No Data
Kaikoura District	0.50	0.05	0.21	0.24
Buller District	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data
Hurunui District	5.89	0.08	3.77	2.04
Waimakariri District	11.61	3.00	6.34	2.28
Christchurch City	46.12	13.04	21.87	11.22
Selwyn District	64.37	0.07	53.08	11.22
Ashburton District	1.04	0.00	0.17	0.86
Timaru District	7.47	0.27	4.93	2.28
Mackenzie District	0.00	0.00	0.00	0.00
Waimate District	1.39	0.00	0.65	0.74
Chatham Islands Territory	0.00	0.00	0.00	0.00
Waitaki District	3.55	0.03	2.05	1.47
Central Otago District	0.00	0.00	0.00	0.00
Queenstown-Lakes District	0.00	0.00	0.00	0.00
Dunedin City	35.43	4.44	24.83	6.15
Clutha District	58.60	0.30	43.70	14.60
Southland District	0.00	No Data	No Data	No Data
Gore District	0.00	0.00	0.00	0.00
Invercargill City	0.00	No Data	No Data	No Data
Auckland	92.44	4.75	68.24	19.45
New Zealand Total	1,289	64	1,001	224

Land Parcels

Table 3: Land parcel use count by regional council.

REGC2014_N	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Northland Region	14,925	5,118	5,004	4,803
Auckland Region	23,801	8,853	4,823	10,125
Waikato Region	24,028	9,525	8,878	5,625
Bay of Plenty Region	23,246	7,946	9,667	5,633
Gisborne Region	3,599	926	1,669	1,004
Hawke's Bay Region	19,395	12,181	4,787	2,427
Taranaki Region	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data
Wellington Region	12,305	8,449	1,574	2,282
West Coast Region	No Data	No Data	No Data	No Data
Canterbury Region	32,921	25,022	3,861	4,038
Otago Region	19,285	9,269	6,100	3,916
Southland Region	No Data	No Data	No Data	No Data
Tasman Region	9,493	3,414	3,108	2,971
Nelson Region	2,938	2,440	59	439
Marlborough Region	No Data	No Data	No Data	No Data
New Zealand Total	185,936	93,143	49,530	43,263

Table 4: Land parcel use count by territorial authority.

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Far North District	5,842	1,222	2,504	2,116
Whangarei District	6,937	3,003	1,674	2,260
Kaipara District	2,146	893	826	427
Thames-Coromandel District	12,666	6,690	2,796	3,180
Hauraki District	7,926	2,060	4,735	1,131
Waikato District	1,638	561	509	568
Matamata-Piako District	498	0	338	160
Hamilton City	0	0	0	0
Waipa District	0	0	0	0
Otorohanga District	994	189	382	423
South Waikato District	0	0	0	0
Waitomo District	306	25	118	163
Taupo District	0	0	0	0

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Western Bay of Plenty District	7,025	1,370	3,850	1,805
Tauranga City	5,345	3,136	843	1,366
Rotorua District	0	0	0	0
Whakatane District	7,118	2,732	3,102	1,284
Kawerau District	0	0	0	0
Opotiki District	3,758	708	1,872	1,178
Gisborne District	3,599	926	1,669	1,004
Wairoa District	1,709	100	981	628
Hastings District	3,404	967	1,941	496
Napier City	13,917	11,112	1,682	1,123
Central Hawke's Bay District	365	2	183	180
New Plymouth District	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0
Tararua District	11	0	3	8
Horowhenua District	0	No Data	No Data	No Data
Kapiti Coast District	2,159	1176	515	468
Porirua City	1,118	617	142	359
Upper Hutt City	0	0	0	0
Lower Hutt City	5,462	4914	26	522
Wellington City	1,917	1707	42	168
Masterton District	361	34	173	154
Carterton District	88	0	47	41
South Wairarapa District	1,189	1	626	562
Tasman District	9,493	3,414	3,108	2,971
Nelson City	2,938	2,440	59	439
Marlborough District	No Data	No Data	No Data	No Data
Kaikoura District	359	119	112	128
Buller District	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data
Hurunui District	850	265	305	280
Waimakariri District	5,876	4,518	960	398
Christchurch City	23,460	19,894	1,211	2,355

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Selwyn District	1,319	82	874	363
Ashburton District	199	5	70	124
Timaru District	772	139	306	327
Mackenzie District	0	0	0	0
Waimate District	86	0	23	63
Chatham Islands Territory	0	0	0	0
Waitaki District	1,002	80	535	387
Central Otago District	0	0	0	0
Queenstown-Lakes District	0	0	0	0
Dunedin City	13,479	8,696	2,885	1,898
Clutha District	4,804	493	2,680	1,631
Southland District	No Data	No Data	No Data	No Data
Gore District	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data
Auckland	23,801	8,853	4,823	10,125
New Zealand Total	185,936	93,143	49,530	43,263

Appendix I Result tables: buildings for the aggregated 0–3 m LiDAR zone (regional, TLA and urban areas)

Table 1: Building use count by regional council

REGC2014_N	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Northland Region	6,661	3,401	348	1,168	22	67	1,655
Auckland Region	12,422	10,108	472	787	253	258	544
Waikato Region	16,459	9,921	298	1,261	20	84	4,875
Bay of Plenty Region	17,583	10,245	453	2,156	88	85	4,556
Gisborne Region	2,687	1,252	26	558	11	10	830
Hawke's Bay Region	28,414	16,419	405	1,896	218	109	9,367
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	19,486	17,274	541	987	233	77	374
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury (2012)	56,681	36,156	521	3,036	69	141	16,758
Cant (excl Red Zone)	47,178	29,357	503	2,982	69	131	14,136
Otago Region	6,946	5,007	340	1,357	55	141	46
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	4,325	3,351	113	701	37	37	86
Nelson Region	4,594	2,782	282	944	8	49	529
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	176,258	115,916	3,799	14,851	1,014	1,058	39,620
New Zealand Total*	166,755	109,117	3,781	14,797	1,014	1,048	36,998

* excludes Red Zone in Christchurch

Table 2: Building use count by territorial authority

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Far North District	2,194	1,256	68	271	12	31	556
Whangarei District	3,450	1,696	199	686	7	21	841
Kaipara District	1,017	449	81	211	3	15	258
Thames-Coromandel District	10,395	6,553	259	530	17	58	2,978
Hauraki District	5,111	2,835	33	633	3	15	1,592
Waikato District	659	397	2	18	0	10	232
Matamata-Piako District	117	47	0	47	0	0	23
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	171	85	4	33	0	1	48
South Waikato District	0	0	0	0	0	0	0
Waitomo District	6	4	0	0	0	0	2
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	2,468	1,596	25	127	6	8	706
Tauranga City	4,789	2,785	214	987	9	21	773
Rotorua District	0	0	0	0	0	0	0
Whakatane District	7,606	4,439	140	695	32	25	2,275
Kawerau District	0	0	0	0	0	0	0
Opotiki District	2,720	1,425	74	347	41	31	802
Gisborne District	2,687	1,252	26	558	11	10	830
Wairoa District	616	351	1	22	1	4	237
Hastings District	2,707	1,448	15	312	10	18	904
Napier City	25,033	14,587	389	1,561	207	86	8,203
Central Hawke's Bay District	58	33	0	1	0	1	23
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	3,840	3,786	11	1	4	5	33
Porirua City	776	577	52	29	46	11	61

TA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	10,199	9,001	210	736	102	32	118
Wellington City	4,418	3,712	268	168	81	27	162
Masterton District	142	138	0	4	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	111	60	0	49	0	2	0
Tasman District	4,325	3,351	113	701	37	37	86
Nelson City	4,594	2,782	282	944	8	49	529
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	162	106	25	28	0	1	2
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	355	334	0	16	0	5	0
Waimakariri District	4,784	4,271	97	301	55	36	24
Christchurch City (2012)	50,595	30,856	394	2,515	14	90	16,726
Chch (excl Red Zone)	41,092	24,057	376	2,461	14	80	14,104
Selwyn District	468	362	0	94	0	9	3
Ashburton District	173	170	0	3	0	0	0
Timaru District	144	57	5	79	0	0	3
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	60	23	2	31	0	3	1
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	6,320	4,619	336	1,145	54	127	39
Clutha District	566	365	2	181	1	11	6
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	12,422	10,108	472	787	253	258	544
New Zealand Total	176,258	115,916	3,799	14,851	1,014	1,058	39,620
New Zealand Total*	166,755	109,117	3,781	14,797	1,014	1,048	36,998

* excludes Red Zone in Christchurch

Table 3: Building use count by urban area

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Whangarei	1,139	278	184	552	7	14	104
Northern Auckland Zone	4,615	4,050	158	58	62	92	195
Western Auckland Zone	596	498	9	50	17	11	11
Central Auckland Zone	2,115	1,214	240	396	85	66	114
Southern Auckland Zone	1,993	1,805	15	33	60	20	60
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	4,955	2,886	215	990	9	22	833
Rotorua	0	0	0	0	0	0	0
Gisborne	2,115	1,007	21	400	11	9	667
Napier Zone	25,046	14,592	389	1,566	207	86	8,206
Hastings Zone	2,654	1,425	15	296	10	17	891
New Plymouth	0	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	0	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	10,199	9,001	210	736	102	32	118
Porirua Zone	776	577	52	29	46	11	61
Wellington Zone	4,416	3,710	268	168	81	27	162
Nelson	4,822	2,879	282	1,063	15	53	530
Christchurch (2012)	55,336	35,117	491	2,804	69	126	16,729
Chch (excl Red Zone)	45,833	28,318	473	2,750	69	116	14,107
Dunedin	5,845	4,285	334	1,020	54	116	36
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	2,878	2,858	10	1	4	5	0
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	5,580	3,405	137	377	29	20	1,612
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	87	11	5	69	0	0	2
Oamaru	20	0	1	15	0	3	1

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	257	161	11	25	1	3	56
Kaitaia	0	0	0	0	0	0	0
Kerikeri	4	4	0	0	0	0	0
Paihia	253	169	15	25	5	5	34
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	791	326	81	179	3	14	188
Wellsford	0	0	0	0	0	0	0
Warkworth	9	0	0	0	3	2	4
Snells Beach	147	88	0	3	0	14	42
Helensville	289	153	11	85	7	6	27
Waiheke Island	361	288	8	40	1	13	11
Waiuku	56	48	5	0	1	1	1
Raglan	211	123	0	10	0	7	71
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	3,701	2,552	63	113	5	12	956
Coromandel	173	85	8	23	0	2	55
Whangamata	663	397	6	61	0	4	195
Tairua	475	311	13	7	1	3	140
Thames	2,323	1,264	156	151	10	24	718
Waihi Beach	777	523	16	33	1	2	202
Paeroa	525	302	8	36	0	3	176
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	36	20	3	3	0	0	10
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	868	478	2	36	0	5	347
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	2,407	1,246	73	304	41	29	714
Wairoa	222	125	0	0	1	1	95
Waipawa	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	855	822	1	0	0	0	32
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	0	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	160	104	25	28	0	1	2
Takaka	23	6	0	11	0	0	6
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	2,258	1,891	78	253	14	16	6
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	5	4	0	1	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0

UA2014_NAM	Total Buildings	Residential Building Count	Commercial Building Count	Industrial/Primary Production Building Count	Critical Facility Building Count	Community Building Count	Other Building Count
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	830	534	3	62	0	0	231
Mangawhai Heads	127	78	0	3	0	1	45
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	886	530	16	53	1	3	283
Mapua	459	390	10	46	7	6	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	61	57	0	2	0	2	0
Rural Centre	3,722	2,501	74	284	23	32	808
Rural (Incl.some Off Shore Islands)	3,095	2,268	23	657	4	36	107
Rural (Incl.some Off Shore Islands)	10,078	5,788	28	1,353	6	36	2,867
Rural (Incl.some Off Shore Islands)	3,853	2,554	27	340	11	49	872
New Zealand Total	176,147	115,788	3,800	14,850	1,014	1,062	39,633
New Zealand Total*	166,644	108,989	3,782	14,796	1,014	1,052	37,011

* excludes Red Zone in Christchurch

Table 4: Building replacement cost (NZ$2011) by regional council

REGC2014_N	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Northland Region	1,892,935,824	883,307,608	414,942,707	461,739,706	15,502,415	41,772,437	75,670,951
Auckland Region	11,006,324,569	5,361,734,324	2,425,226,487	1,141,851,151	974,647,762	302,797,592	800,067,253
Waikato Region	3,226,691,736	2,581,105,213	193,951,639	274,535,466	16,782,030	39,389,303	120,928,085
Bay of Plenty Region	4,558,632,241	2,738,236,220	454,401,404	1,111,978,403	86,109,991	39,269,265	128,636,958
Gisborne Region	687,849,801	288,275,801	20,915,582	321,372,805	24,111,140	5,803,089	27,371,384
Hawke's Bay Region	5,738,971,887	3,922,980,022	404,847,559	851,878,816	223,320,199	112,222,768	223,722,523
Taranaki Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Wellington Region	9,802,158,862	3,551,335,439	3,491,808,953	1,466,093,373	880,032,320	171,901,008	240,987,769
West Coast Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Canterbury (2012)	11,133,536,445	8,895,763,532	520,421,080	1,092,538,463	78,698,957	129,549,594	416,564,819
Cant (excl Red Zone)	9,111,101,264	6,962,053,358	511,622,683	1,083,017,803	78,698,957	122,477,427	353,231,036
Otago Region	2,899,055,127	1,131,929,967	652,091,573	905,729,758	60,971,395	108,754,087	39,578,347
Southland Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Tasman Region	1,285,948,697	946,382,456	89,957,817	199,658,841	19,218,475	25,811,073	4,920,035
Nelson Region	1,692,193,888	671,453,935	357,117,608	535,973,524	3,652,547	116,155,850	7,840,424
Marlborough Region	No Data	No Data	No Data	No Data	No Data	No Data	No Data
New Zealand Total	53,924,299,077	30,972,504,517	9,025,682,409	8,363,350,306	2,383,047,231	1,093,426,066	2,086,288,548
New Zealand Total*	51,901,863,896	29,038,794,343	9,016,884,012	8,353,829,646	2,383,047,231	1,086,353,899	2,022,954,765

* excludes Red Zone in Christchurch

Table 5: Building replacement cost (NZ$2011) by territorial authority.

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Far North District	440,919,674	306,713,351	37,573,701	49,876,968	11,539,939	16,640,366	18,575,349
Whangarei District	1,230,016,499	475,557,589	325,027,739	357,211,962	3,263,070	18,852,926	50,103,213
Kaipara District	221,999,651	101,036,668	52,341,267	54,650,776	699,406	6,279,145	6,992,389
Thames-Coromandel District	2,105,893,292	1,610,898,766	176,268,056	208,585,285	16,080,394	26,043,823	68,016,968
Hauraki District	991,664,747	866,137,144	15,776,698	57,445,508	701,636	7,255,904	44,347,857
Waikato District	79,829,704	66,077,523	267,573	3,202,119	0	6,077,159	4,205,330
Matamata-Piako District	25,243,470	23,558,674	0	853,365	0	0	831,431
Hamilton City	0	0	0	0	0	0	0
Waipa District	0	0	0	0	0	0	0
Otorohanga District	22,980,459	14,020,771	1,639,312	4,449,189	0	12,417	2,858,770
South Waikato District	0	0	0	0	0	0	0
Waitomo District	1,080,064	412,335	0	0	0	0	667,729
Taupo District	0	0	0	0	0	0	0
Western Bay of Plenty District	520,268,776	467,501,940	13,658,257	15,881,753	944,964	3,204,452	19,077,410
Tauranga City	2,037,571,755	846,039,199	218,289,831	895,419,876	35,523,870	10,977,549	31,321,430
Rotorua District	0	0	0	0	0	0	0
Whakatane District	1,594,276,582	1,172,662,625	175,931,002	148,294,858	26,365,022	14,741,837	56,281,238
Kawerau District	0	0	0	0	0	0	0
Opotiki District	406,515,128	252,032,456	46,522,314	52,381,916	23,276,135	10,345,427	21,956,880
Gisborne District	687,849,801	288,275,801	20,915,582	321,372,805	24,111,140	5,803,089	27,371,384
Wairoa District	78,346,143	67,343,850	150,706	1,285,084	1,874,400	2,027,170	5,664,933
Hastings District	518,718,484	394,160,162	8,262,677	63,531,045	10,091,170	18,526,848	24,146,582
Napier City	5,133,252,672	3,453,569,393	396,434,176	787,018,366	211,354,629	91,512,878	193,363,230
Central Hawke's Bay District	8,654,588	7,906,617	0	44,321	0	155,872	547,778
New Plymouth District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0	0	0	0
Tararua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Horowhenua District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kāpiti Coast District	787,482,496	748,111,506	13,631,974	283,819	3,398,001	6,733,548	15,323,648
Porirua City	452,907,788	165,147,784	164,066,173	14,094,629	76,274,772	13,158,373	20,166,057
Upper Hutt City	0	0	0	0	0	0	0
Lower Hutt City	3,457,728,720	1,653,507,925	265,080,020	1,177,993,686	207,833,061	67,702,452	85,611,576
Wellington City	5,043,473,450	925,747,891	3,049,030,786	272,068,734	592,526,486	84,213,065	119,886,488
Masterton District	35,565,223	35,436,441	0	128,782	0	0	0
Carterton District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	25,001,185	23,383,892	0	1,523,723	0	93,570	0
Tasman District	1,285,948,697	946,382,456	89,957,817	199,658,841	19,218,475	25,811,073	4,920,035
Nelson City	1,692,193,888	671,453,935	357,117,608	535,973,524	3,652,547	116,155,850	7,840,424
Marlborough District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura District	41,367,868	24,465,988	8,303,521	6,094,366	0	2,128,773	375,220
Buller District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Hurunui District	61,030,378	57,971,621	0	1,864,809	0	1,193,948	0
Waimakariri District	1,417,584,576	1,187,546,737	55,638,497	84,204,504	55,793,773	25,823,577	8,577,488
Christchurch (2012)	9,352,132,313	7,490,800,043	448,134,971	899,857,573	22,905,184	84,038,473	406,396,069
Chch (excl Red Zone)	7,329,697,132	5,557,089,869	439,336,574	890,336,913	22,905,184	76,966,306	343,062,286
Selwyn District	126,253,339	101,357,586	0	8,381,078	0	16,364,823	149,852
Ashburton District	24,004,939	22,790,583	0	1,214,356	0	0	0
Timaru District	111,163,032	10,830,974	8,344,091	90,921,777	0	0	1,066,190
Mackenzie District	0	0	0	0	0	0	0
Waimate District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Chatham Islands Territory	0	0	0	0	0	0	0
Waitaki District	20,077,010	11,337,180	294,811	6,806,005	0	1,633,376	5,638
Central Otago District	0	0	0	0	0	0	0
Queenstown-Lakes District	0	0	0	0	0	0	0
Dunedin City	2,774,666,432	1,033,776,314	650,884,472	886,397,371	59,729,770	104,710,686	39,167,819
Clutha District	104,311,685	86,816,473	912,290	12,526,382	1,241,625	2,410,025	404,890
Southland District	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Gore District	0	0	0	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Auckland	11,006,324,569	5,361,734,324	2,425,226,487	1,141,851,151	974,647,762	302,797,592	800,067,253

TA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
New Zealand Total	53,924,299,077	30,972,504,517	9,025,682,409	8,363,350,306	2,383,047,231	1,093,426,066	2,086,288,548
New Zealand Total*	51,901,863,896	29,038,794,343	9,016,884,012	8,353,829,646	2,383,047,231	1,086,353,899	2,022,954,765

* excludes Red Zone in Christchurch

Table 6: Building replacement cost (NZ$2011) by urban area

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Whangarei	808,495,151	96,791,958	320,911,315	344,774,958	3,263,070	15,192,039	27,561,811
Northern Auckland Zone	2,791,635,801	1,818,962,370	327,437,732	46,043,630	87,578,172	133,627,562	377,986,335
Western Auckland Zone	315,510,480	179,535,365	13,810,826	83,261,830	28,727,514	4,994,352	5,180,593
Central Auckland Zone	5,943,690,346	1,926,763,211	2,030,332,134	828,914,161	751,390,872	94,402,539	311,887,429
Southern Auckland Zone	1,008,901,399	730,353,660	4,763,365	65,638,717	93,099,024	35,890,588	79,156,045
Hamilton Zone	0	0	0	0	0	0	0
Cambridge Zone	0	0	0	0	0	0	0
Te Awamutu Zone	0	0	0	0	0	0	0
Tauranga	2,084,320,061	889,695,306	218,719,782	895,550,726	35,523,870	11,861,949	32,968,428
Rotorua	0	0	0	0	0	0	0
Gisborne	558,301,515	231,912,491	19,809,582	255,700,157	24,111,140	5,646,999	21,121,146
Napier Zone	5,135,053,151	3,455,220,447	396,434,176	787,085,732	211,354,629	91,512,878	193,445,289
Hastings Zone	507,981,747	385,405,111	8,262,677	63,011,900	10,091,170	17,523,884	23,687,005
New Plymouth	0	No Data	No Data	No Data	No Data	No Data	No Data
Wanganui	0	No Data	No Data	No Data	No Data	No Data	No Data
Palmerston North	0	0	0	0	0	0	0
Upper Hutt Zone	0	0	0	0	0	0	0
Lower Hutt Zone	3,457,728,720	1,653,507,925	265,080,020	1,177,993,686	207,833,061	67,702,452	85,611,576
Porirua Zone	452,907,788	165,147,784	164,066,173	14,094,629	76,274,772	13,158,373	20,166,057
Wellington Zone	5,042,944,370	925,218,811	3,049,030,786	272,068,734	592,526,486	84,213,065	119,886,488
Nelson	1,800,801,711	704,209,008	357,117,608	602,070,044	7,829,107	120,539,270	9,036,674
Christchurch (2012)	10,764,421,931	8,673,912,544	503,773,468	983,631,120	78,698,957	109,862,050	414,543,792
Chch (excl Red Zone)	8,741,986,750	6,740,202,370	494,975,071	974,110,460	78,698,957	102,789,883	351,210,009
Dunedin	2,657,238,498	948,892,418	650,377,547	860,642,071	59,729,770	100,040,323	37,556,369
Invercargill	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Kapiti	625,734,230	603,447,526	11,871,336	283,819	3,398,001	6,733,548	0

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Blenheim	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Pukekohe	0	0	0	0	0	0	0
Tokoroa	0	0	0	0	0	0	0
Taupo	0	0	0	0	0	0	0
Whakatane	1,215,667,750	876,989,122	173,664,217	93,473,002	24,500,082	9,991,655	37,049,672
Hawera	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Feilding	0	0	0	0	0	0	0
Levin	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Masterton	0	0	0	0	0	0	0
Greymouth	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ashburton	0	0	0	0	0	0	0
Timaru	101,849,356	3,212,997	8,344,091	89,237,798	0	0	1,054,470
Oamaru	6,478,788	0	30,806	4,808,968	0	1,633,376	5,638
Rangiora	0	0	0	0	0	0	0
Queenstown	0	0	0	0	0	0	0
Taipa Bay-Mangonui	60,114,044	35,565,563	5,040,003	12,952,694	297,000	2,724,897	3,533,887
Kaitaia	0	0	0	0	0	0	0
Kerikeri	917,700	917,700	0	0	0	0	0
Paihia	80,895,965	56,141,347	14,874,446	3,299,265	1,976,701	3,776,141	828,065
Kawakawa	0	0	0	0	0	0	0
Moerewa	0	0	0	0	0	0	0
Kaikohe	0	0	0	0	0	0	0
Dargaville	174,178,714	57,888,090	52,341,267	51,896,842	699,406	6,256,877	5,096,232
Wellsford	0	0	0	0	0	0	0
Warkworth	4,099,860	0	0	0	2,234,230	766,817	1,098,813
Snells Beach	28,329,078	22,663,911	0	192,770	0	2,730,270	2,742,127
Helensville	128,326,823	37,825,916	28,240,805	51,829,161	2,767,774	2,897,087	4,766,080
Waiheke Island	95,512,615	69,224,104	2,986,945	10,891,686	382,795	8,601,676	3,425,409
Waiuku	25,156,929	20,655,851	3,227,552	0	811,756	461,770	0
Raglan	33,770,818	23,249,193	0	3,069,564	0	5,927,507	1,524,554
Huntly	0	0	0	0	0	0	0
Otorohanga	0	0	0	0	0	0	0
Te Kuiti	0	0	0	0	0	0	0
Taumarunui	0	0	0	0	0	0	0
Whitianga	702,300,380	602,505,185	39,217,793	29,553,270	4,060,020	5,557,444	21,406,668
Coromandel	31,685,642	21,999,081	2,759,800	4,868,807	0	183,385	1,874,569
Whangamata	118,951,188	91,224,841	7,530,511	15,739,339	0	829,824	3,626,673
Tairua	83,222,516	70,222,307	7,000,288	677,645	335,288	1,189,823	3,797,165
Thames	557,533,142	304,615,088	114,305,967	96,218,256	11,242,144	14,818,621	16,333,066
Waihi Beach	163,890,443	142,499,782	9,942,560	5,859,501	170,480	986,803	4,431,317
Paeroa	81,065,949	54,504,992	4,116,037	17,053,790	0	1,781,469	3,609,661

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Waihi	0	0	0	0	0	0	0
Te Aroha	0	0	0	0	0	0	0
Morrinsville	0	0	0	0	0	0	0
Matamata	0	0	0	0	0	0	0
Putaruru	0	0	0	0	0	0	0
Katikati Community	10,760,226	7,814,398	1,750,752	466,534	0	0	728,542
Te Puke Community	0	0	0	0	0	0	0
Turangi	0	0	0	0	0	0	0
Edgecumbe	149,401,762	90,688,912	1,453,045	44,874,694	0	4,750,182	7,634,929
Kawerau	0	0	0	0	0	0	0
Murupara	0	0	0	0	0	0	0
Opotiki	354,196,628	206,150,987	46,308,754	48,500,396	23,276,135	10,201,661	19,758,695
Wairoa	27,649,044	22,779,387	0	0	1,874,400	318,412	2,676,845
Waipawa	0	0	0	0	0	0	0
Waipukurau	0	0	0	0	0	0	0
Dannevirke	0	0	0	0	0	0	0
Woodville	0	0	0	0	0	0	0
Waitara	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Inglewood	0	0	0	0	0	0	0
Stratford	0	0	0	0	0	0	0
Opunake	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Eltham	0	0	0	0	0	0	0
Patea	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Ohakune	0	0	0	0	0	0	0
Raetihi	0	0	0	0	0	0	0
Waiouru	0	0	0	0	0	0	0
Bulls	0	0	0	0	0	0	0
Taihape	0	0	0	0	0	0	0
Marton	0	0	0	0	0	0	0
Foxton Community	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Shannon	0	0	0	0	0	0	0
Otaki	146,404,276	130,126,289	1,760,638	0	0	0	14,517,349
Pahiatua	0	0	0	0	0	0	0
Carterton	0	0	0	0	0	0	0
Greytown	0	0	0	0	0	0	0
Featherston	0	0	0	0	0	0	0
Martinborough	0	0	0	0	0	0	0
Picton	0	No Data	No Data	No Data	No Data	No Data	No Data
Kaikoura	40,864,108	23,962,228	8,303,521	6,094,366	0	2,128,773	375,220
Takaka	2,374,567	1,891,487	0	384,530	0	0	98,550

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Brightwater	0	0	0	0	0	0	0
Wakefield	0	0	0	0	0	0	0
Motueka	712,123,626	519,603,788	65,141,246	103,982,781	6,386,290	14,383,984	2,625,537
Westport	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Reefton	0	0	0	0	0	0	0
Hokitika	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Woodend	0	0	0	0	0	0	0
Oxford	0	0	0	0	0	0	0
Darfield	0	0	0	0	0	0	0
Lincoln	759,097	746,088	0	13,009	0	0	0
Leeston	0	0	0	0	0	0	0
Pleasant Point	0	0	0	0	0	0	0
Geraldine	0	0	0	0	0	0	0
Temuka	0	0	0	0	0	0	0
Twizel Community	0	0	0	0	0	0	0
Waimate	0	0	0	0	0	0	0
Milton	0	0	0	0	0	0	0
Balclutha	0	0	0	0	0	0	0
Alexandra	0	0	0	0	0	0	0
Cromwell	0	0	0	0	0	0	0
Wanaka	0	0	0	0	0	0	0
Arrowtown	0	0	0	0	0	0	0
Winton	0	0	0	0	0	0	0
Bluff	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Te Anau	0	0	0	0	0	0	0
Riverton	No Data	No Data	No Data	No Data	No Data	No Data	No Data
Rolleston	0	0	0	0	0	0	0
Gore	0	0	0	0	0	0	0
Ngunguru	173,250,739	158,090,844	1,169,278	3,523,544	0	0	10,467,073
Mangawhai Heads	29,025,323	27,648,220	0	209,616	0	22,268	1,145,219
Te Kauwhata	0	0	0	0	0	0	0
Ngatea	177,123,026	145,202,194	9,762,430	13,759,207	195,278	1,340,973	6,862,944
Mapua	149,138,346	123,722,152	10,851,422	7,197,146	3,812,270	3,555,356	0
Amberley	0	0	0	0	0	0	0
Methven	0	0	0	0	0	0	0
Rakaia	0	0	0	0	0	0	0
Waikouaiti	13,563,597	11,700,509	0	361,010	0	1,502,078	0
Rural Centre	781,402,169	648,873,667	35,438,983	31,622,457	18,881,508	13,634,446	32,951,108
Rural (Incl.some Off Shore Islands)	672,522,325	557,836,677	12,363,235	72,418,352	2,951,861	23,344,825	3,607,375

UA2014_NAM	Total Building Replacement Cost	Residential Building Replacement Cost	Commercial Building Replacement Cost	Industrial/Primary Production Building Replacement Cost	Critical Facility Building Replacement Cost	Community Building Replacement Cost	Other Building Replacement Cost
Rural (Incl.some Off Shore Islands)	1,978,166,264	1,692,391,851	8,473,636	179,169,596	2,814,240	12,730,704	82,586,237
Rural (Incl.some Off Shore Islands)	827,716,344	690,302,139	7,905,899	78,600,811	1,947,958	23,245,225	25,714,312
New Zealand Total	53,896,056,066	30,940,412,822	9,026,104,454	8,363,566,321	2,383,047,231	1,095,176,200	2,087,749,038
New Zealand Total*	51,873,620,885	29,006,702,648	9,017,306,057	8,354,045,661	2,383,047,231	1,088,104,033	2,024,415,255

* excludes Red Zone in Christchurch

Appendix J Result tables: infrastructure assets for the aggregated 0–3 m LiDAR zone (regional, TLA and urban areas)

Roads

Table 1: Road type and length by regional council.

REGC2014_N	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Northland Region	223.0	197.59	1.75	23.61	0.00
Auckland Region	343.9	301.97	10.10	14.17	17.62
Waikato Region	1006.9	877.61	62.85	66.42	0.00
Bay of Plenty Region	389.5	342.45	7.29	39.79	0.00
Gisborne Region	79.0	73.84	1.73	3.41	0.00
Hawke's Bay Region	330.2	317.57	6.00	6.59	0.00
Taranaki Region	No Data	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data	No Data
Wellington Region	290.8	273.36	2.43	7.32	7.71
West Coast Region	No Data	No Data	No Data	No Data	No Data
Canterbury Region	649.1	620.52	9.86	11.96	6.74
Otago Region	323.5	312.14	3.55	7.48	0.31
Southland Region	No Data	No Data	No Data	No Data	No Data
Tasman Region	208.3	184.87	15.63	7.82	0.00
Nelson Region	64.2	54.36	5.46	4.43	0.00
Marlborough Region	No Data	No Data	No Data	No Data	No Data
New Zealand Total	3908.3	3556.28	126.65	192.99	32.38

Table 2: Road type and length by territorial authority.

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Far North District	102.2	80.77	1.50	19.94	0.00
Whangarei District	92.8	90.22	0.25	2.37	0.00
Kaipara District	27.9	26.60	0.00	1.30	0.00
Thames-Coromandel District	206.8	171.15	0.00	35.64	0.00
Hauraki District	759.9	668.69	62.33	28.87	0.00
Waikato District	22.9	20.18	1.98	0.71	0.00
Matamata-Piako District	12.3	11.31	0.00	1.03	0.00
Hamilton City	0.0	0.00	0.00	0.00	0.00
Waipa District	0.0	0.00	0.00	0.00	0.00

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Otorohanga District	8.1	7.87	0.00	0.20	0.00
South Waikato District	0.0	0.00	0.00	0.00	0.00
Waitomo District	1.8	1.79	0.00	0.00	0.00
Taupo District	0.0	0.00	0.00	0.00	0.00
Western Bay of Plenty District	78.8	77.01	1.01	0.73	0.00
Tauranga City	76.2	61.56	2.81	11.87	0.00
Rotorua District	0.0	0.00	0.00	0.00	0.00
Whakatane District	176.4	162.38	3.46	10.58	0.00
Kawerau District	0.0	0.00	0.00	0.00	0.00
Opotiki District	58.5	41.89	0.00	16.60	0.00
Gisborne District	79.0	73.84	1.73	3.41	0.00
Wairoa District	31.3	30.93	0.12	0.25	0.00
Hastings District	54.4	51.19	0.00	3.21	0.00
Napier City	242.0	232.98	5.87	3.14	0.00
Central Hawke's Bay District	2.5	2.49	0.00	0.00	0.00
New Plymouth District	No Data	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data	No Data
Ruapehu District	0.0	0.00	0.00	0.00	0.00
Wanganui District	No Data	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data	No Data
Palmerston North City	0.0	0.00	0.00	0.00	0.00
Tararua District	No Data	No Data	No Data	No Data	No Data
Horowhenua District	No Data	No Data	No Data	No Data	No Data
Kapiti Coast District	51.8	51.34	0.40	0.10	0.00
Porirua City	28.7	22.97	0.61	1.96	3.19
Upper Hutt City	0.0	0.00	0.00	0.00	0.00
Lower Hutt City	92.8	90.56	0.15	1.00	1.13
Wellington City	65.4	56.87	1.28	3.88	3.40
Masterton District	4.5	4.46	0.00	0.00	0.00
Carterton District	No Data	No Data	No Data	No Data	No Data
South Wairarapa District	47.5	47.15	0.00	0.38	0.00
Tasman District	208.3	184.87	15.63	7.82	0.00
Nelson City	64.2	54.36	5.46	4.43	0.00
Marlborough District	No Data	No Data	No Data	No Data	No Data
Kaikoura District	4.9	4.93	0.00	0.00	0.00
Buller District	No Data	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data	No Data

TA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Westland District	No Data	No Data	No Data	No Data	No Data
Hurunui District	18.9	18.71	0.00	0.16	0.00
Waimakariri District	79.1	68.20	5.73	1.23	3.94
Christchurch City	400.3	383.90	4.14	9.43	2.82
Selwyn District	118.1	117.18	0.00	0.96	0.00
Ashburton District	2.2	2.18	0.00	0.00	0.00
Timaru District	26.1	25.93	0.00	0.17	0.00
Mackenzie District	0.0	0.00	0.00	0.00	0.00
Waimate District	1.4	1.38	0.00	0.00	0.00
Chatham Islands Territory	0.0	0.00	0.00	0.00	0.00
Waitaki District	8.0	7.86	0.10	0.00	0.00
Central Otago District	0.0	0.00	0.00	0.00	0.00
Queenstown-Lakes District	0.0	0.00	0.00	0.00	0.00
Dunedin City	205.3	194.52	3.45	7.06	0.31
Clutha District	110.2	109.77	0.00	0.43	0.00
Southland District	No Data	No Data	No Data	No Data	No Data
Gore District	0.0	0.00	0.00	0.00	0.00
Invercargill City	No Data	No Data	No Data	No Data	No Data
Auckland	343.9	301.97	10.10	14.17	17.62
New Zealand Total	3915.5	3561.97	128.10	193.01	32.40

Table 3: Road type and length by urban area

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Whangarei	34.4	33.58	0.00	0.85	0.00
Northern Auckland Zone	66.3	59.56	1.18	0.49	5.11
Western Auckland Zone	5.8	5.16	0.01	0.00	0.68
Central Auckland Zone	62.9	49.41	1.55	1.87	10.04
Southern Auckland Zone	47.7	44.43	0.65	0.87	1.72
Hamilton Zone	0.0	0.00	0.00	0.00	0.00
Cambridge Zone	0.0	0.00	0.00	0.00	0.00
Te Awamutu Zone	0.0	0.00	0.00	0.00	0.00
Tauranga	82.5	68.31	2.81	11.37	0.00
Rotorua	0.0	0.00	0.00	0.00	0.00
Gisborne	34.9	32.20	1.73	0.96	0.00
Napier Zone	243.6	233.72	5.87	4.03	0.00
Hastings Zone	49.7	47.75	0.00	1.99	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
New Plymouth	No Data	No Data	No Data	No Data	No Data
Wanganui	No Data	No Data	No Data	No Data	No Data
Palmerston North	0.0	0.00	0.00	0.00	0.00
Upper Hutt Zone	0.0	0.00	0.00	0.00	0.00
Lower Hutt Zone	89.3	87.01	0.15	1.00	1.13
Porirua Zone	29.0	23.26	0.61	1.96	3.19
Wellington Zone	63.3	54.78	1.28	3.88	3.40
Nelson	89.2	73.96	10.80	4.46	0.00
Christchurch	454.0	429.00	9.86	8.45	6.74
Dunedin	126.6	120.87	3.45	1.97	0.31
Invercargill	No Data	No Data	No Data	No Data	No Data
Kapiti	32.5	32.10	0.40	0.00	0.00
Blenheim	No Data	No Data	No Data	No Data	No Data
Pukekohe	0.0	0.00	0.00	0.00	0.00
Tokoroa	0.0	0.00	0.00	0.00	0.00
Taupo	0.0	0.00	0.00	0.00	0.00
Whakatane	76.3	68.34	1.40	6.51	0.00
Hawera	No Data	No Data	No Data	No Data	No Data
Feilding	0.0	0.00	0.00	0.00	0.00
Levin	No Data	No Data	No Data	No Data	No Data
Masterton	0.0	0.00	0.00	0.00	0.00
Greymouth	No Data	No Data	No Data	No Data	No Data
Ashburton	0.0	0.00	0.00	0.00	0.00
Timaru	12.9	12.75	0.00	0.17	0.00
Oamaru	0.6	0.63	0.00	0.00	0.00
Rangiora	0.0	0.00	0.00	0.00	0.00
Queenstown	0.0	0.00	0.00	0.00	0.00
Taipa Bay-Mangonui	6.2	4.87	0.00	1.33	0.00
Kaitaia	0.0	0.00	0.00	0.00	0.00
Kerikeri	0.4	0.40	0.00	0.00	0.00
Paihia	3.2	1.57	0.04	1.55	0.00
Kawakawa	0.1	0.00	0.00	0.06	0.00
Moerewa	0.0	0.00	0.00	0.00	0.00
Kaikohe	0.0	0.00	0.00	0.00	0.00
Dargaville	15.7	14.44	0.00	1.29	0.00
Wellsford	0.0	0.00	0.00	0.00	0.00
Warkworth	0.4	0.38	0.00	0.01	0.00
Snells Beach	1.8	1.78	0.04	0.00	0.00
Helensville	4.4	3.91	0.00	0.44	0.00
Waiheke Island	12.4	11.12	1.26	0.00	0.00
Waiuku	0.8	0.77	0.00	0.00	0.00
Raglan	4.4	4.44	0.00	0.00	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Huntly	0.0	0.00	0.00	0.00	0.00
Otorohanga	0.0	0.00	0.00	0.00	0.00
Te Kuiti	0.0	0.00	0.00	0.00	0.00
Taumarunui	0.0	0.00	0.00	0.00	0.00
Whitianga	41.8	39.29	0.00	2.51	0.00
Coromandel	6.3	3.48	0.00	2.82	0.00
Whangamata	8.8	7.89	0.00	0.91	0.00
Tairua	9.7	5.93	0.00	3.82	0.00
Thames	30.8	26.15	0.00	4.66	0.00
Waihi Beach	7.7	7.44	0.22	0.00	0.00
Paeroa	10.9	9.47	1.04	0.39	0.00
Waihi	0.0	0.00	0.00	0.00	0.00
Te Aroha	0.0	0.00	0.00	0.00	0.00
Morrinsville	0.0	0.00	0.00	0.00	0.00
Matamata	0.0	0.00	0.00	0.00	0.00
Putaruru	0.0	0.00	0.00	0.00	0.00
Katikati Community	1.6	1.62	0.00	0.00	0.00
Te Puke Community	0.0	0.01	0.00	0.00	0.00
Turangi	0.0	0.00	0.00	0.00	0.00
Edgecumbe	7.8	7.82	0.00	0.00	0.00
Kawerau	0.0	0.00	0.00	0.00	0.00
Murupara	0.0	0.00	0.00	0.00	0.00
Opotiki	19.7	18.24	0.00	1.48	0.00
Wairoa	5.3	5.31	0.00	0.03	0.00
Waipawa	0.0	0.00	0.00	0.00	0.00
Waipukurau	0.0	0.00	0.00	0.00	0.00
Dannevirke	0.0	0.00	0.00	0.00	0.00
Woodville	0.0	0.00	0.00	0.00	0.00
Waitara	No Data	No Data	No Data	No Data	No Data
Inglewood	0.0	0.00	0.00	0.00	0.00
Stratford	0.0	0.00	0.00	0.00	0.00
Opunake	No Data	No Data	No Data	No Data	No Data
Eltham	0.0	0.00	0.00	0.00	0.00
Patea	No Data	No Data	No Data	No Data	No Data
Ohakune	0.0	0.00	0.00	0.00	0.00
Raetihi	0.0	0.00	0.00	0.00	0.00
Waiouru	0.0	0.00	0.00	0.00	0.00
Bulls	0.0	0.00	0.00	0.00	0.00
Taihape	0.0	0.00	0.00	0.00	0.00
Marton	0.0	0.00	0.00	0.00	0.00
Foxton Community	No Data	No Data	No Data	No Data	No Data
Shannon	0.0	0.00	0.00	0.00	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Otaki	11.8	11.80	0.00	0.00	0.00
Pahiatua	0.0	0.00	0.00	0.00	0.00
Carterton	0.0	0.00	0.00	0.00	0.00
Greytown	0.0	0.00	0.00	0.00	0.00
Featherston	0.0	0.00	0.00	0.00	0.00
Martinborough	0.0	0.00	0.00	0.00	0.00
Picton	No Data	No Data	No Data	No Data	No Data
Kaikoura	1.5	1.50	0.00	0.00	0.00
Takaka	4.6	4.57	0.00	0.00	0.00
Brightwater	0.0	0.00	0.00	0.00	0.00
Wakefield	0.0	0.00	0.00	0.00	0.00
Motueka	34.1	31.93	1.49	0.72	0.00
Westport	No Data	No Data	No Data	No Data	No Data
Reefton	0.0	0.00	0.00	0.00	0.00
Hokitika	No Data	No Data	No Data	No Data	No Data
Woodend	0.0	0.00	0.00	0.00	0.00
Oxford	0.0	0.00	0.00	0.00	0.00
Darfield	0.0	0.00	0.00	0.00	0.00
Lincoln	0.0	0.00	0.00	0.00	0.00
Leeston	0.0	0.00	0.00	0.00	0.00
Pleasant Point	0.0	0.00	0.00	0.00	0.00
Geraldine	0.0	0.00	0.00	0.00	0.00
Temuka	0.0	0.00	0.00	0.00	0.00
Twizel Community	0.0	0.00	0.00	0.00	0.00
Waimate	0.0	0.00	0.00	0.00	0.00
Milton	0.0	0.00	0.00	0.00	0.00
Balclutha	0.0	0.00	0.00	0.00	0.00
Alexandra	0.0	0.00	0.00	0.00	0.00
Cromwell	0.0	0.00	0.00	0.00	0.00
Wanaka	0.0	0.00	0.00	0.00	0.00
Arrowtown	0.0	0.00	0.00	0.00	0.00
Winton	0.0	0.00	0.00	0.00	0.00
Bluff	No Data	No Data	No Data	No Data	No Data
Te Anau	0.0	0.00	0.00	0.00	0.00
Riverton	No Data	No Data	No Data	No Data	No Data
Rolleston	0.0	0.00	0.00	0.00	0.00
Gore	0.0	0.00	0.00	0.00	0.00
Ngunguru	10.5	10.50	0.00	0.03	0.00
Mangawhai Heads	1.3	1.27	0.00	0.00	0.00
Te Kauwhata	0.0	0.00	0.00	0.00	0.00
Ngatea	32.4	25.71	0.00	6.68	0.00
Mapua	10.5	10.07	0.00	0.43	0.00

UA2014_NAM	Road Length (km)	Local Road Length (km)	Collector Road Length (km)	Arterial Road Length (km)	Motorway Length (km)
Amberley	0.0	0.00	0.00	0.00	0.00
Methven	0.0	0.00	0.00	0.00	0.00
Rakaia	0.0	0.00	0.00	0.00	0.00
Waikouaiti	3.1	3.08	0.00	0.00	0.00
Rural Centre	110.5	98.20	1.40	10.93	0.00
Rural (Incl.some Off Shore Islands)	487.5	462.86	8.91	15.77	0.00
Rural (Incl.some Off Shore Islands)	1189.3	1043.65	64.43	81.18	0.00
Rural (Incl.some Off Shore Islands)	244.2	212.32	6.41	25.37	0.10
New Zealand Total	3943.3	3570.65	126.99	213.23	32.41

Railway

Table 4: Railway track length by regional council.

REGC2014_N	Railway Track Length (km)
Northland Region	15.98
Auckland Region	4.44
Waikato Region	0.00
Bay of Plenty Region	26.80
Gisborne Region	17.68
Hawke's Bay Region	14.74
Taranaki Region	No Data
Manawatu-Wanganui Region	No Data
Wellington Region	24.17
West Coast Region	No Data
Canterbury Region	17.29
Otago Region	32.66
Southland Region	No Data
Tasman Region	0.00
Nelson Region	0.58
Marlborough Region	No Data
New Zealand Total	154.33

Airports and Airstrips

Table 5: Airport and airstrip counts by regional council.

REGC2014_N	Total	Airport Count	Airstrip and Aerodrome Count
Northland Region	1	0	1
Auckland Region	4	1	3
Waikato Region	7	0	7
Bay of Plenty Region	2	1	1
Gisborne Region	3	1	2
Hawke's Bay Region	1	1	0
Taranaki Region	0	No Data	No Data
Manawatu-Wanganui Region	0	No Data	No Data
Wellington Region	2	1	1
West Coast Region	0	No Data	No Data
Canterbury Region	1	0	1
Otago Region	1	1	0
Southland Region	0	No Data	No Data
Tasman Region	2	0	2
Nelson Region	1	1	0
Marlborough Region	0	No Data	No Data
New Zealand Total	25	7	18

Wharf and Jetties

See Appendix D Table 6.

Appendix K Result tables: land assets for the aggregated 0–3 m LiDAR zone (regional, TLA and urban areas)

Land Cover

Table 1: Land cover type area by regional council.

REGC2014_N	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Northland Region	127.46	8.68	100.05	18.73
Auckland Region	126.87	14.32	82.63	29.93
Waikato Region	652.55	15.13	532.17	105.24
Bay of Plenty Region	267.29	16.45	219.37	31.47
Gisborne Region	46.28	3.42	36.89	5.96
Hawke's Bay Region	136.00	19.13	88.62	28.24
Taranaki Region	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data
Wellington Region	155.32	17.16	114.17	24.00
West Coast Region	No Data	No Data	No Data	No Data
Canterbury Region	244.60	38.93	158.46	47.21
Otago Region	157.10	8.64	117.55	30.91
Southland Region	No Data	No Data	No Data	No Data
Tasman Region	77.96	6.07	51.56	20.33
Nelson Region	8.04	5.12	0.38	2.54
Marlborough Region	No Data	No Data	No Data	No Data
New Zealand Total	1,999.47	153.05	1,501.86	344.56

Table 2: Land cover type area by territorial authority.

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Far North District	72.14	1.81	59.66	10.67
Whangarei District	27.21	5.63	16.41	5.18
Kaipara District	28.11	1.23	23.99	2.89
Thames-Coromandel District	105.92	10.99	74.28	20.65
Hauraki District	465.45	3.17	407.56	54.71
Waikato District	10.41	0.57	4.20	5.64
Matamata-Piako District	59.40	0.00	38.39	21.01
Hamilton City	0.00	0.00	0.00	0.00
Waipa District	0.00	0.00	0.00	0.00
Otorohanga District	10.16	0.20	6.34	3.62

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
South Waikato District	0.00	0.00	0.00	0.00
Waitomo District	0.86	0.02	0.29	0.55
Taupo District	0.00	0.00	0.00	0.00
Western Bay of Plenty District	101.03	2.11	87.66	11.26
Tauranga City	22.81	7.37	8.24	7.20
Rotorua District	0.00	0.00	0.00	0.00
Whakatane District	114.20	4.78	101.51	7.91
Kawerau District	0.00	0.00	0.00	0.00
Opotiki District	28.29	2.05	21.98	4.26
Gisborne District	46.11	3.42	36.89	5.80
Wairoa District	45.39	0.59	29.59	15.21
Hastings District	31.25	1.61	26.28	3.36
Napier City	47.49	16.86	25.92	4.71
Central Hawke's Bay District	12.25	0.02	6.35	5.88
New Plymouth District	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data
Ruapehu District	0.00	0.00	0.00	0.00
Wanganui District	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data
Palmerston North City	0.00	0.00	0.00	0.00
Tararua District	0.10	0.00	0.00	0.10
Horowhenua District	No Data	No Data	No Data	No Data
Kapiti Coast District	17.62	2.96	11.05	3.61
Porirua City	3.66	1.40	0.96	1.30
Upper Hutt City	0.00	0.00	0.00	0.00
Lower Hutt City	10.67	8.08	0.19	2.40
Wellington City	5.81	4.57	0.40	0.84
Masterton District	1.45	0.13	0.30	1.02
Carterton District	1.50	0.00	1.20	0.31
South Wairarapa District	114.51	0.02	100.07	14.42
Tasman District	77.02	5.89	50.74	20.39
Nelson City	8.01	5.12	0.38	2.51
Marlborough District	No Data	No Data	No Data	No Data
Kaikoura District	2.39	0.30	1.16	0.93
Buller District	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data

TA2014_NAM	Area (sq km)	Built Environment Area (sq km)	Primary Production Area (sq km)	Natural Environment Area (sq km)
Westland District	No Data	No Data	No Data	No Data
Hurunui District	15.49	0.45	10.44	4.60
Waimakariri District	19.53	5.41	10.70	3.42
Christchurch City	85.12	31.14	37.19	16.79
Selwyn District	93.23	0.12	80.10	13.02
Ashburton District	2.95	0.11	0.87	1.97
Timaru District	21.59	1.28	15.94	4.36
Mackenzie District	0.00	0.00	0.00	0.00
Waimate District	3.51	0.00	2.20	1.31
Chatham Islands Territory	0.00	0.00	0.00	0.00
Waitaki District	6.39	0.14	4.37	1.88
Central Otago District	0.00	0.00	0.00	0.00
Queenstown-Lakes District	0.00	0.00	0.00	0.00
Dunedin City	66.18	7.78	48.92	9.47
Clutha District	83.88	0.67	63.63	19.57
Southland District	No Data	No Data	No Data	No Data
Gore District	0.00	0.00	0.00	0.00
Invercargill City	No Data	No Data	No Data	No Data
Auckland	126.87	14.32	82.63	29.93
New Zealand Total	1,995.94	152.34	1,498.97	344.63

Land Parcels

Table 3: Land parcel use count by regional council.

REGC2014_N	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Northland Region	21,443	8,583	6,973	5,887
Auckland Region	34,444	16,941	5,755	11,748
Waikato Region	34,500	17,007	10,808	6,685
Bay of Plenty Region	36,491	16,096	13,106	7,289
Gisborne Region	7,884	3,224	3,117	1,543
Hawke's Bay Region	31,325	20,193	7,858	3,274
Taranaki Region	No Data	No Data	No Data	No Data
Manawatu-Wanganui Region	No Data	No Data	No Data	No Data
Wellington Region	27,191	20,436	2,967	3,788
West Coast Region	No Data	No Data	No Data	No Data
Canterbury Region	57,901	46,150	5,975	5,776
Otago Region	24,560	11,899	7,836	4,825
Southland Region	No Data	No Data	No Data	No Data
Tasman Region	12,747	5,173	4,209	3,365
Nelson Region	5,411	4,738	102	571
Marlborough Region	No Data	No Data	No Data	No Data
New Zealand Total	293,897	170,440	68,706	54,751

Table 4: Land parcel use count by territorial authority.

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Far North District	8,796	2,582	3,557	2,657
Whangarei District	9,840	4,740	2,385	2,715
Kaipara District	2,807	1,261	1,031	515
Thames-Coromandel District	20,316	12,737	3,677	3,902
Hauraki District	9,667	3,075	5,350	1,242
Waikato District	2,136	878	614	644
Matamata-Piako District	772	0	542	230
Hamilton City	0	0	0	0
Waipa District	0	0	0	0
Otorohanga District	1,243	292	469	482
South Waikato District	0	0	0	0
Waitomo District	366	25	156	185
Taupo District	0	0	0	0

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Western Bay of Plenty District	10,025	2,808	5,127	2,090
Tauranga City	9,041	5,813	1,375	1,853
Rotorua District	0	0	0	0
Whakatane District	11,532	5,599	4,103	1,830
Kawerau District	0	0	0	0
Opotiki District	5,893	1,876	2,501	1,516
Gisborne District	7,884	3,224	3,117	1,543
Wairoa District	3,508	793	1,918	797
Hastings District	5,676	1,791	3,098	787
Napier City	21,445	17,546	2,482	1,417
Central Hawke's Bay District	696	63	360	273
New Plymouth District	No Data	No Data	No Data	No Data
Stratford District	No Data	No Data	No Data	No Data
South Taranaki District	No Data	No Data	No Data	No Data
Ruapehu District	0	0	0	0
Wanganui District	No Data	No Data	No Data	No Data
Rangitikei District	No Data	No Data	No Data	No Data
Manawatu District	No Data	No Data	No Data	No Data
Palmerston North City	0	0	0	0
Tararua District	12	0	3	9
Horowhenua District	No Data	No Data	No Data	No Data
Kapiti Coast District	7,392	5090	1348	954
Porirua City	2,109	1370	226	513
Upper Hutt City	0	0	0	0
Lower Hutt City	9,647	8,799	48	800
Wellington City	5,512	4,901	76	535
Masterton District	818	257	316	245
Carterton District	122	0	65	57
South Wairarapa District	1,579	19	885	675
Tasman District	12,747	5,173	4,209	3,365
Nelson City	5,411	4,738	102	571
Marlborough District	No Data	No Data	No Data	No Data
Kaikoura District	817	357	254	206
Buller District	No Data	No Data	No Data	No Data
Grey District	No Data	No Data	No Data	No Data
Westland District	No Data	No Data	No Data	No Data
Hurunui District	1,319	439	495	385
Waimakariri District	7,877	5,810	1,471	596
Christchurch City	44,199	39,047	1,707	3,445

TA2014_NAM	Land Parcel Count	Built Environment Land Parcel Count	Primary Production Land Parcel Count	Natural Environment Land Parcel Count
Selwyn District	1,946	120	1,399	427
Ashburton District	346	8	145	193
Timaru District	1,271	369	467	435
Mackenzie District	0	0	0	0
Waimate District	126	0	37	89
Chatham Islands Territory	0	0	0	0
Waitaki District	1,323	175	708	440
Central Otago District	0	0	0	0
Queenstown-Lakes District	0	0	0	0
Dunedin City	16,947	10,898	3,662	2,387
Clutha District	6,290	826	3,466	1,998
Southland District	No Data	No Data	No Data	No Data
Gore District	0	0	0	0
Invercargill City	No Data	No Data	No Data	No Data
Auckland	34,444	16,941	5,755	11,748
New Zealand Total	293,897	170,440	68,706	54,751