

FIG Working Week 2016

CHRISTCHURCH, NEW ZEALAND 2-6 MAY 2016

Recovery

from disaster

Presented at the FIG Working Week 2016,
May 2-6, 2016 in Christchurch, New Zealand

Coastal Hazard and Climate-Change Risk Exposure in New Zealand: Comparing Regions and Urban Areas

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Paper: 8102

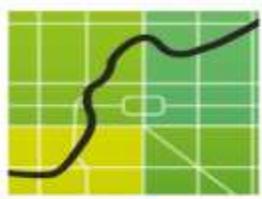


Platinum Partners:



Diamond Partner



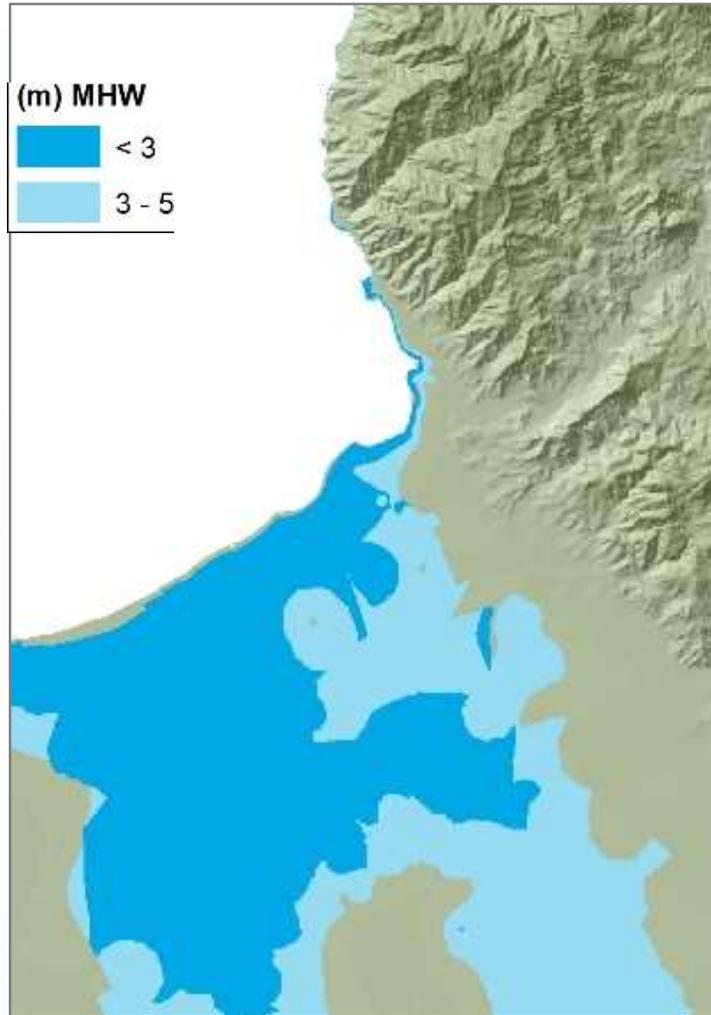


Background to the national coastal risk-exposure study

- No consistent national study has previously been undertaken in NZ:
 - Inaccurate national DEM (10-m contours + Shuttle Radar Topography)
 - National asset/building database only now available – but needed 11,300 more buildings added to coastal areas <10 m
 - Several regional vertical datums and no consistent definition of MHWS
 - In-consistent protocols and standards for LiDAR surveys between regions
- NZ Parliamentary Commissioner for the Environment commissioned NIWA to proceed with such a national study focused on sea-level rise exposure, using LiDAR DEMs where available
- Opportunity to assess current national DEM and other geospatial datasets

National DEM ($\sigma = 3-4$ m) vs LiDAR ($\sigma = 0.15$ m)

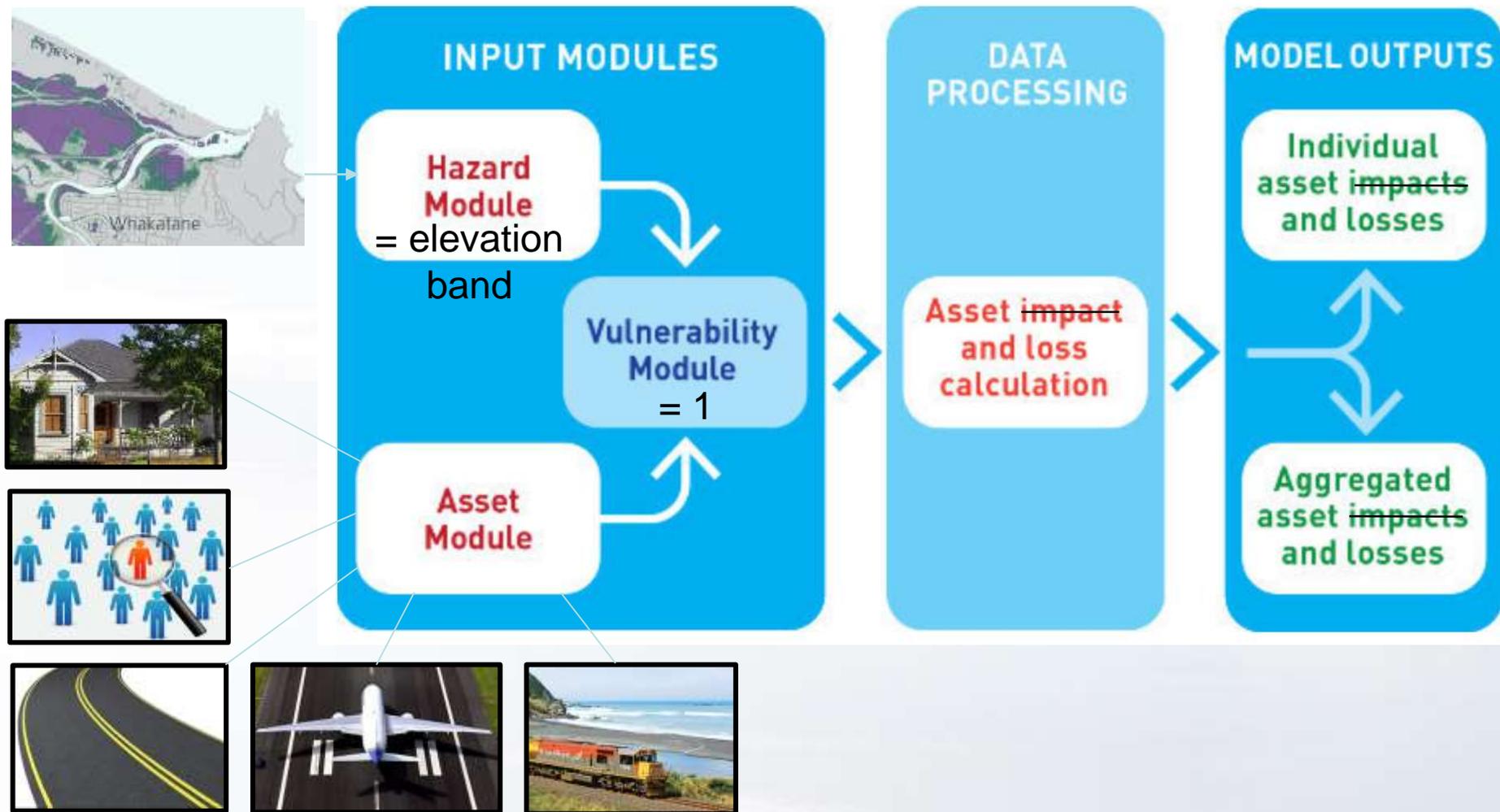
0–5 m

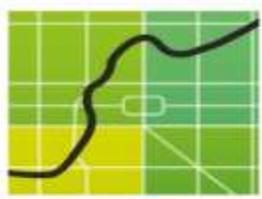


0–1.5 m



RiskScape: overlays hazard & assets = risk exposure





Methodology: national coastal risk-exposure study

- Set MHWS on a consistent national basis: MHWS-10 plus MSL offset
- Intersect Digital Elevation Models (DEMs) with surfaces in elevation bands e.g. 0.25, 0.5, 1, 1.5, 2, 2.5, 3 m above MHWS-10
- Clip polygons to land-water boundaries (coast, estuaries, rivers)
- Overlay elevation-band polygons on RiskScape assets (<10 m elevation), NZ LandCover Database (v4) & Stats NZ 2013 Census
- Enumerate point data & lengths of poly-lines
 - e.g. points = buildings, airports; lines = roads, railway
- Aggregate risk exposure (counts) to urban areas (UAs), council areas, regions and nationally

National aggregates: < 0.5 m above MHWS-10

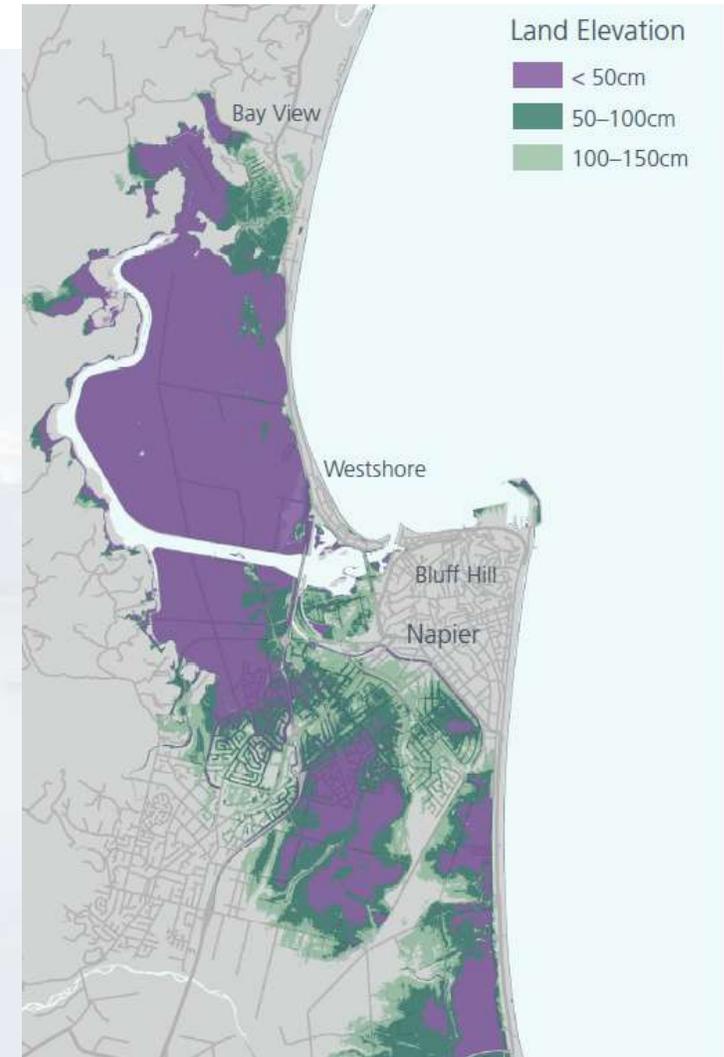
- Population (NZ Census 2013)
 - ~40,000 people
- Buildings
 - Residential: ~9,000
 - All types: ~13,000
 - Replacement cost NZ\$3B (2011)
- Jetties & wharves
 - ~1,500 structures



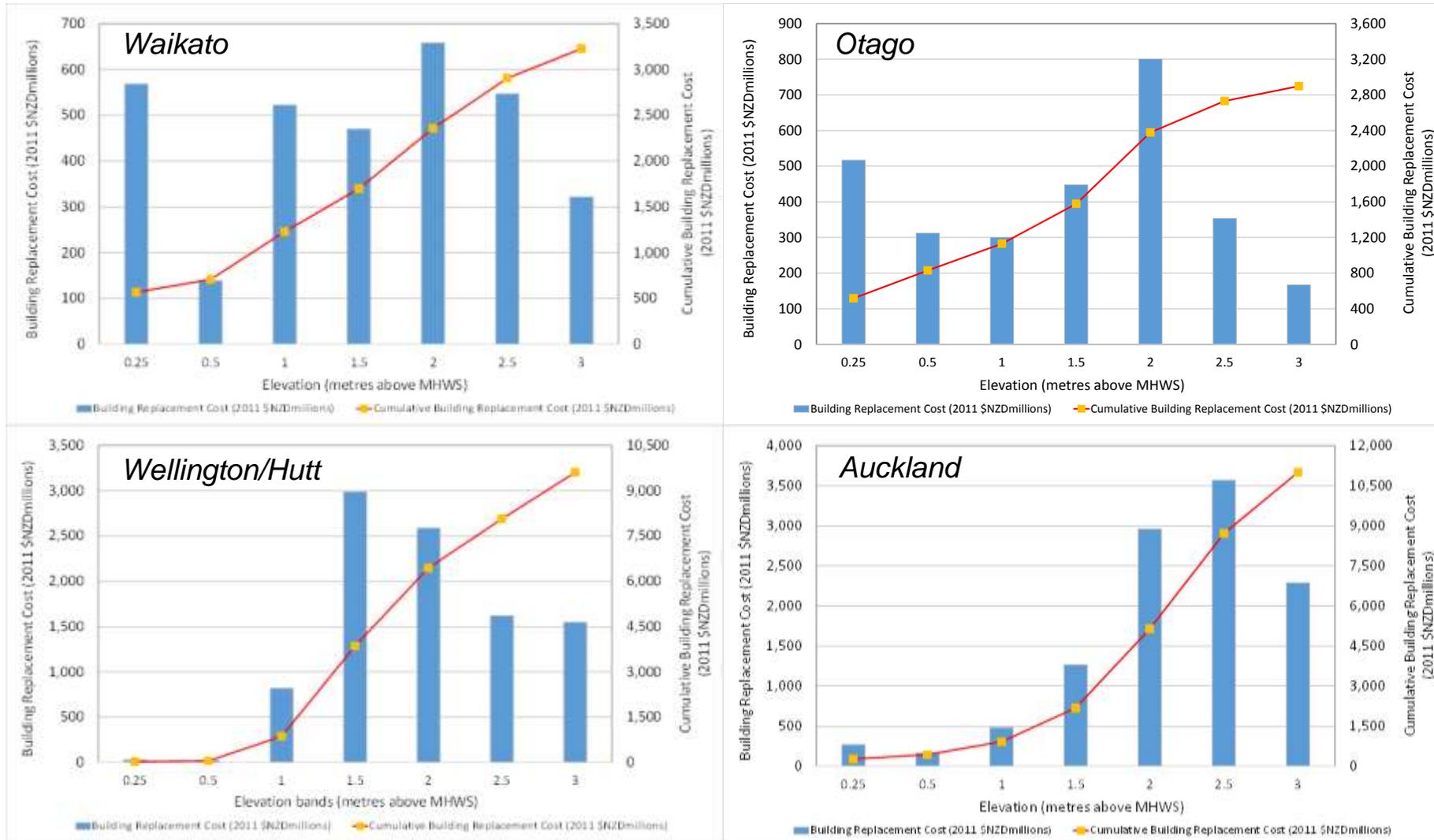
Main urban area: < 0.5 m above MHWS-10

Urban area	Houses	Roads (km)
Dunedin	2,683	35
Napier	1,321	37
Christchurch	901	40
Whakatane	276	9
Auckland	108	9
Wellington/Hutt	103	2
Tauranga	77	3
Nelson	64	6
Motueka	45	4

These urban areas ~63% of national house total
in elevation zone < 0.5 m



Building replacement cost (all types): by elevation band



Coastal risk exposure: 0–1.5 m above MHWS-10

BUILDINGS AFFECTED

\$19 billion
to replace all buildings (2011)

68,170
buildings total

43,680
homes

133,265
people in homes

NATIONAL INFRASTRUCTURE

382
critical-facility buildings

5
airports

1,547
jetties and wharves

2,121 km
of roads (1,930 km local)

46 km
of railway



KEY

- Population
- Residential buildings
- Local roads
- Arterial roads
- Rail
- Airport

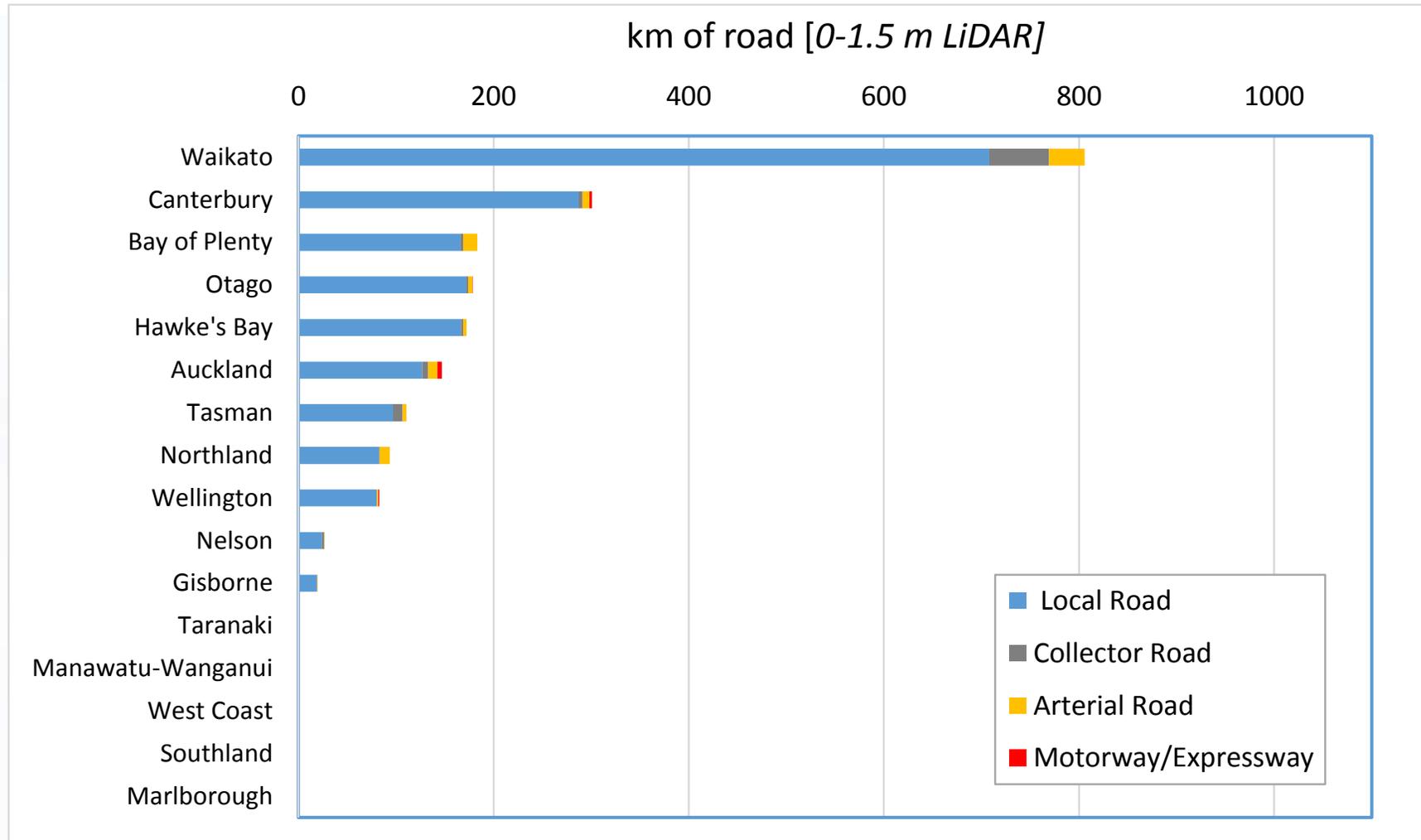
Source: Build Magazine/NIWA

Comparison using DEMs in 0–3 m coastal elevation band

Risk receptor	Existing national DEM	Available LiDAR DEMs*	Underestimate
Total No. of buildings	89,780	166,750	54%
Residential buildings	60,900	109,117	56%
Critical-facility buildings	506	1,014	50%
Total replacement cost	\$24B (2011)	\$52B (2011)	46%
Population (resident)	163,643	281,902	58%
Land parcels	176,526	293,900	60%
km of road (all types)	1,706	3,908	44%
km of railway	72	154	47%

* excludes Taranaki, Manawatu-Wanganui, Marlborough, West Coast, Southland (~10% of NZ risk exposure)

Coastal risk exposure: Roads (km) 0–1.5 m above MHWS-10



The rising challenge for NZ coastal areas

- Only 0.6% of NZ area below 3 m (MHWS-10)
- ~6% of NZ's building replacement cost (2011)
- 6.6% of NZ's resident population (2013)
- Increasing risk as sea levels rise by 0.5 to 1 m (or more) by 2100
- **0→1.5 m elevation zone in NZ:**
 - 68,000 buildings (\$19B, 2011) – 133,000 residents
 - 2,120 km road (~90% local roads) – 46 km railway
 - 185,900 land parcels
- **0→3 m elevation zone in NZ:**
 - 167,000 buildings [2.4×] (\$52B, 2011) [2.7×] – 282,000 residents [2.1×]
 - 3,900 km road [1.8×] – 154 km railway [3.3×]
 - 293,900 land parcels [1.6×]



NZTA: AMA

Key findings and gaps: geospatial datasets

- LiDAR (essential) – current national DEM underestimates risk by half or more
 - Land Information NZ project to develop a hi-res, accurate DEM
 - Procurement standards for LiDAR
- Land-water boundaries – need high-res plus as coastlines increasingly change incl. MHWS – updates more crucial
- Consistent methodology and measurements:
 - tide levels e.g. MHWS; need for high-tide data in estuaries, creeks
 - vertical datum (new national vertical datum later in 2016),
- Accurate asset/location data (infrastructure) with vulnerability attributes

