Landcare Research
Manaaki Whenua

Guidelines for Monitoring Land Fragmentation

Guideline Overview

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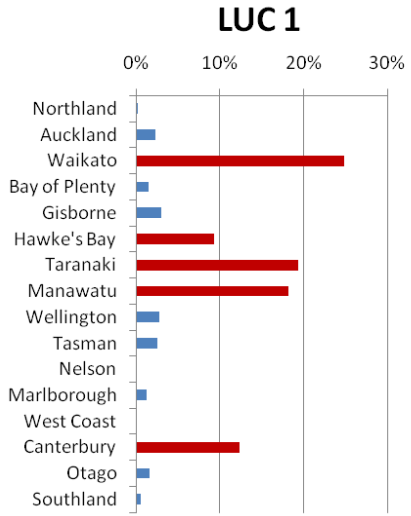
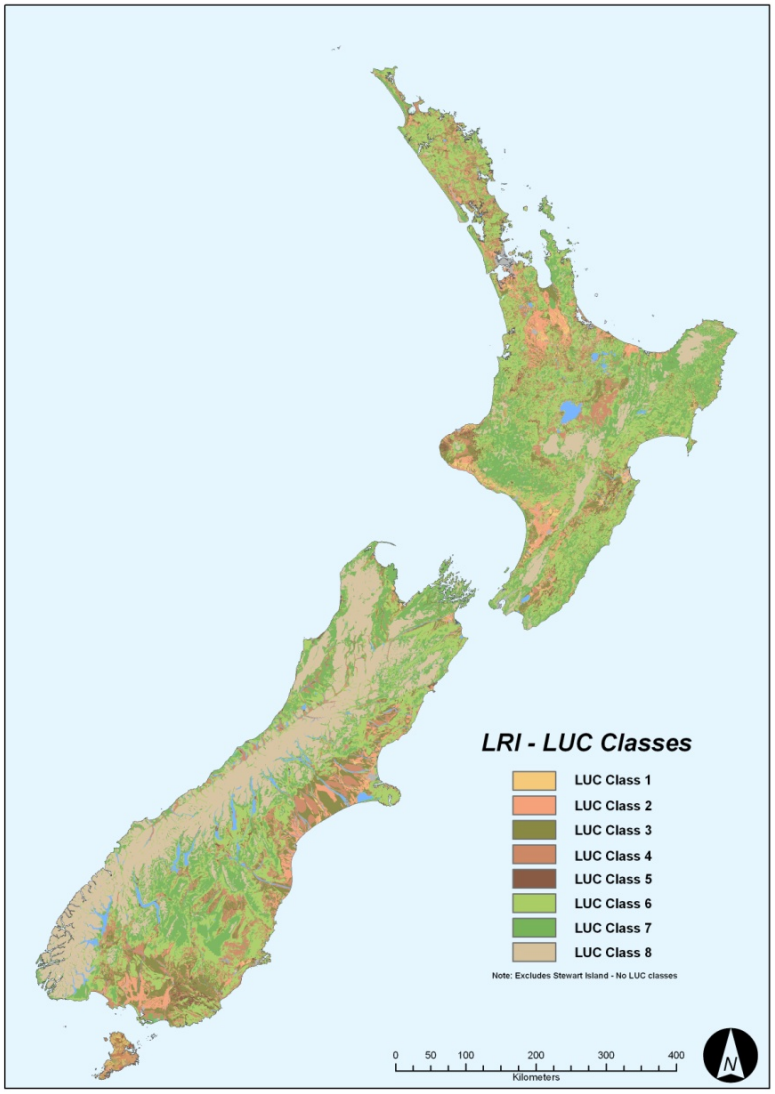
Landcare Research SLT Presentation

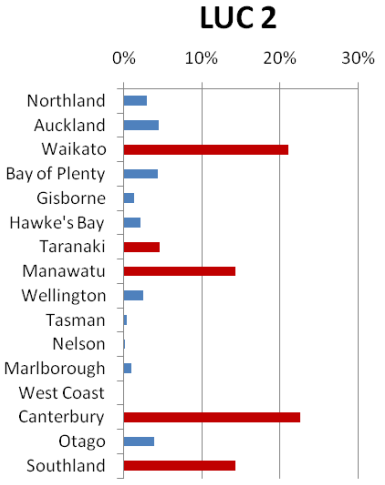
21 July 2014

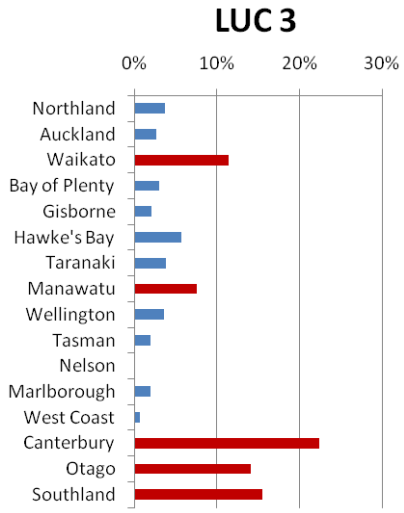
SOIL RESOURCE URBANISATION TRENDS – QUICK UPDATE

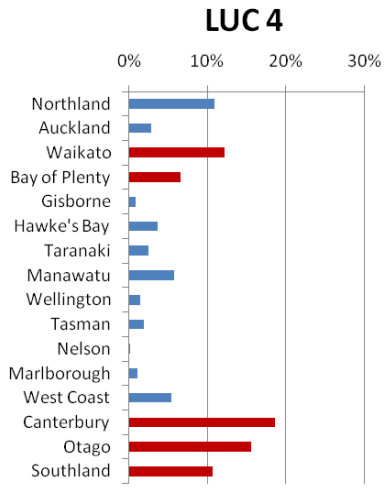
Distribution of soil resources across New Zealand is heterogeneous











Land Fragmentation: Why do we care?

Land and soils are a finite resource both globally and within New Zealand

LRI Class	Area (1,000 ha)	Total Area (%)	Cumulative Area (%)
LUC Class 1	186.91	0.7	0.7
LUC Class 2	1,199.77	4.5	5.2
LUC Class 3	2,438.94	9.2	14.4
LUC Class 4	2,771.92	10.5	24.9
LUC Class 5	209.07	0.8	25.7
LUC Class 6	7,452.62	28.1	53.8
LUC Class 7	5,673.07	21.4	75.2
LUC Class 8	5,781.63	21.8	77.0
Other*	774.74	2.9	99.9

Rutledge et al. 2010. Thought for food: Impacts of urbanisation trends on soil resource availability in New Zealand. Proceedings of the New Zealand Grasslands Association 72: 241-246.

Land Fragmentation Background: Why do we care?

- Conversion to urban and (rural) residential land uses reduces the potential available stock of productive land

	TO (% Converted from Original Area)					
FROM	LUCAS Settlements 1990	LCDB1 Urban 1996/1997	LCDB2 Urban 2001/2002	LUCAS Settlements 2008	Agribase Lifestyle Blocks 2008	Total Agribase + LCDB2
LUC 1	**2.2**	**1.6**	**2.3**	**2.2**	**3.3**	**5.6**
LUC 2	**1.5**	**0.9**	**1.7**	**1.6**	**2.2**	**4.0**
LUC 3	0.9	0.5	1.0	0.9	1.4	2.4
LUC 4	0.5	0.3	0.7	0.5	1.0	1.7
LUC 5	0.4	0.2	0.4	0.4	0.9	1.3
LUC 6	0.2	0.1	0.2	0.2	0.5	0.7
LUC 7	0.1	0.1	0.1	0.1	0.2	0.3
LUC 8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

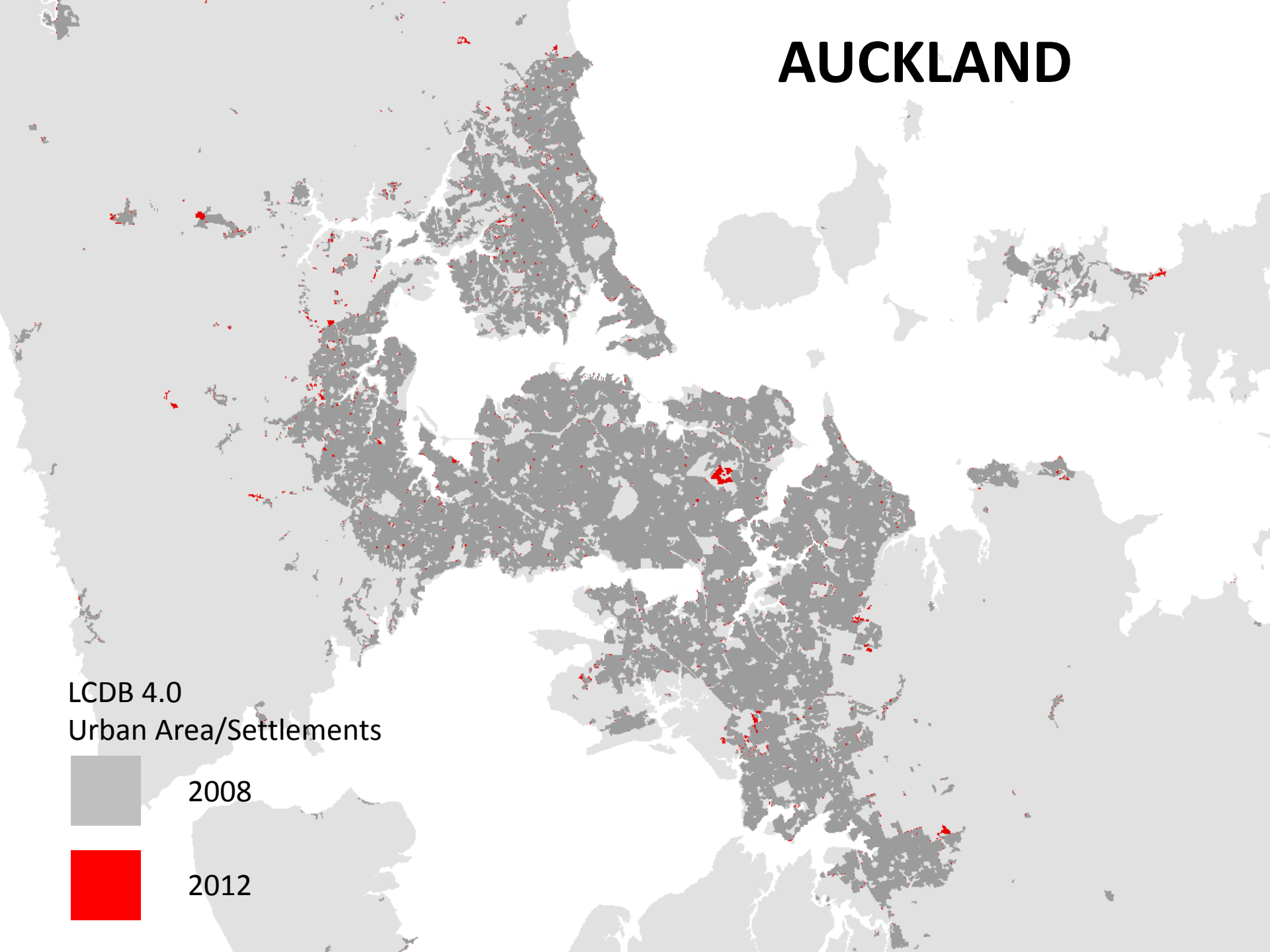
Rutledge et al. 2010. Thought for food: Impacts of urbanisation trends on soil resource availability in New Zealand. Proceedings of the New Zealand Grasslands Association 72: 241-246.

LCDB 4.0 Update: Urbanisation Trends

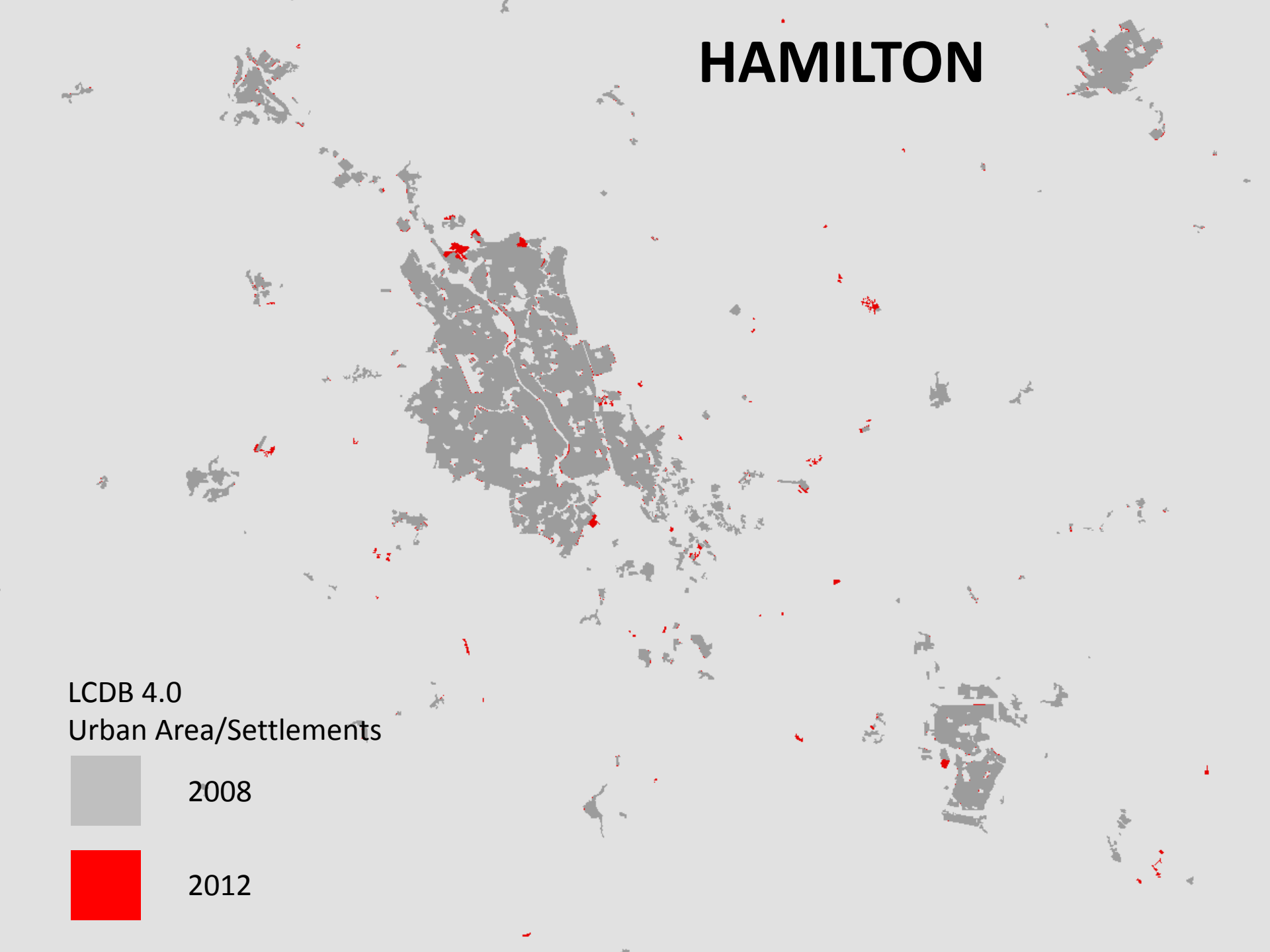
LCDB Class	1996	2001	2008	2012
Built-up Areas & Settlements	166,664	173,692 +7028 +1405	185,451 +11,371 +1680	187,539 +2089 +522
Surface Mines or Dumps	9,565	9,896 +332 +66	11,371 +1474 +210	12,300 +929 +232
Transport Infrastructure	5,354	5,463 +109 +22	5,680 +217 +31	5,780 +99 +25
Urban Parkland & Open Space	39,747	39,547 -201 -40	39,612 +65 +9	39,794 +181 +45
TOTAL	221,330	228,598 +7,268 +1,454	242,114 +13,516 +1,931	245,413 +3,299 +824

Urbanisation Trends by Region x LUC1C: 2008 to 2012 (preliminary)

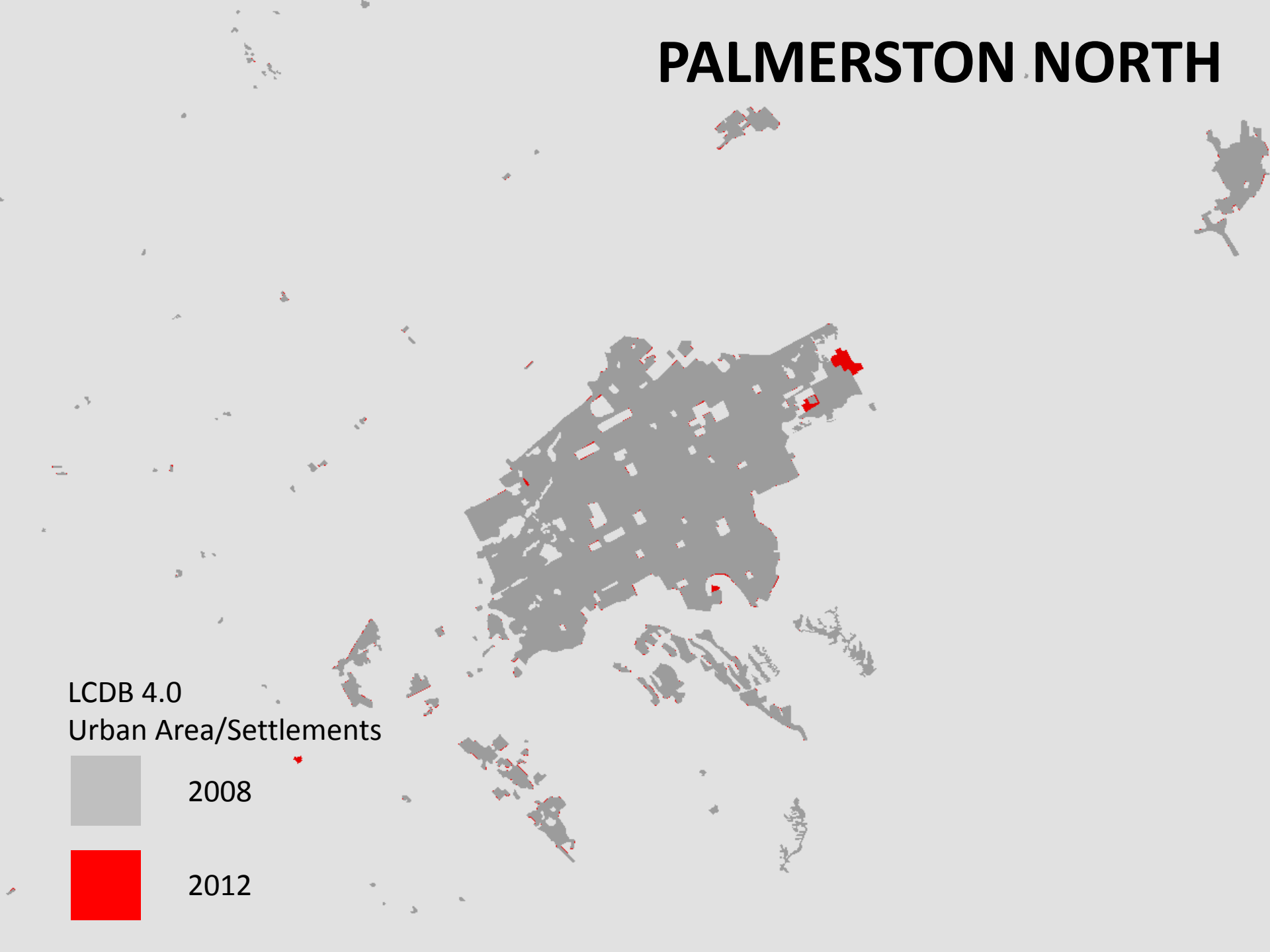
Region	LUC1	LUC2	LUC3	LUC4	LUC5	LUC6	LUC7	LUC8
Auckland Region		19.5	10.0	96.2		9.8		
Bay of Plenty Region		21.0	10.4	9.1		4.1	9.5	
Canterbury Region	49.3	251.9	277.5	42.4	0.1	228.7	2.3	
Gisborne Region	8.6		27.9	1.1		1.6		
Hawke's Bay Region	79.6	15.7	48.3			1.6	7.5	
Manawatu-Wanganui Region		30.2		5.9		7.2		
Marlborough Region	4.0	0.4	14.5					
Nelson Region		5.3	9.3			0.9		
Northland Region	6.9	16.9	21.8	4.1		6.0		
Otago Region	13.0	1.6	11.8	82.1	2.2	58.0		
Southland Region		2.5		16.5				
Taranaki Region	16.3	9.9	2.9	11.9	8.9	2.4		
Tasman Region			13.0			24.1	3.1	
Waikato Region	16.5	44.9	39.4	43.6		26.5	11.7	
Wellington Region		1.7	4.2			28.1	0.0	
West Coast Region				11.4	2.7	3.8	3.7	
TOTALS	194.2	421.6	490.9	324.4	14.0	402.9	47.8	
% of Total Urbanisation	10.2%	22.2%	25.9%	17.1%	0.7%	21.3%	2.5%	
% of Original Area	0.10%	0.04%	0.02%	0.01%	0.01%	0.01%	0.001%	-


AUCKLAND
LCDB 4.0
Urban Area/Settlements
2008
2012

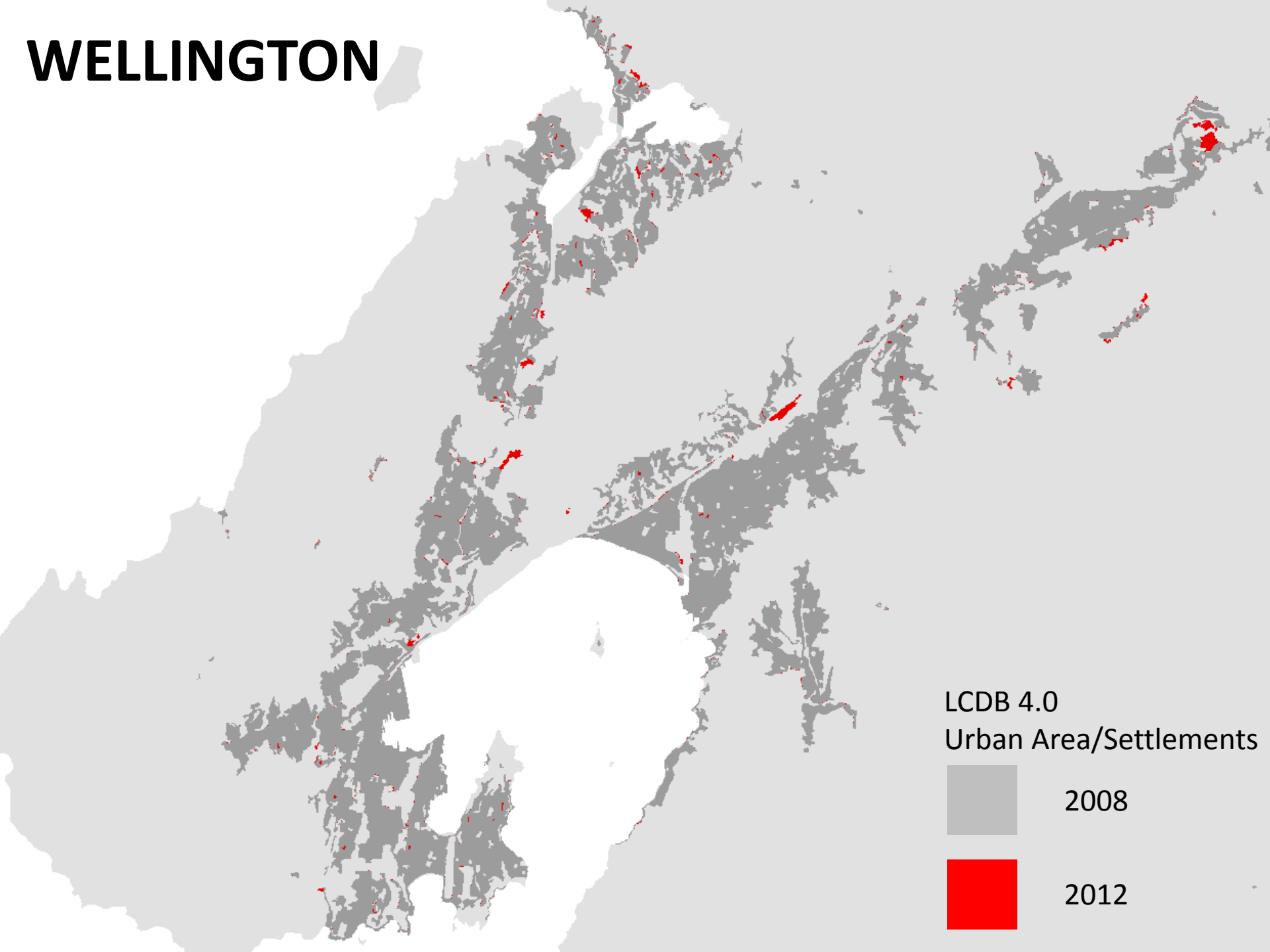
HAMILTON

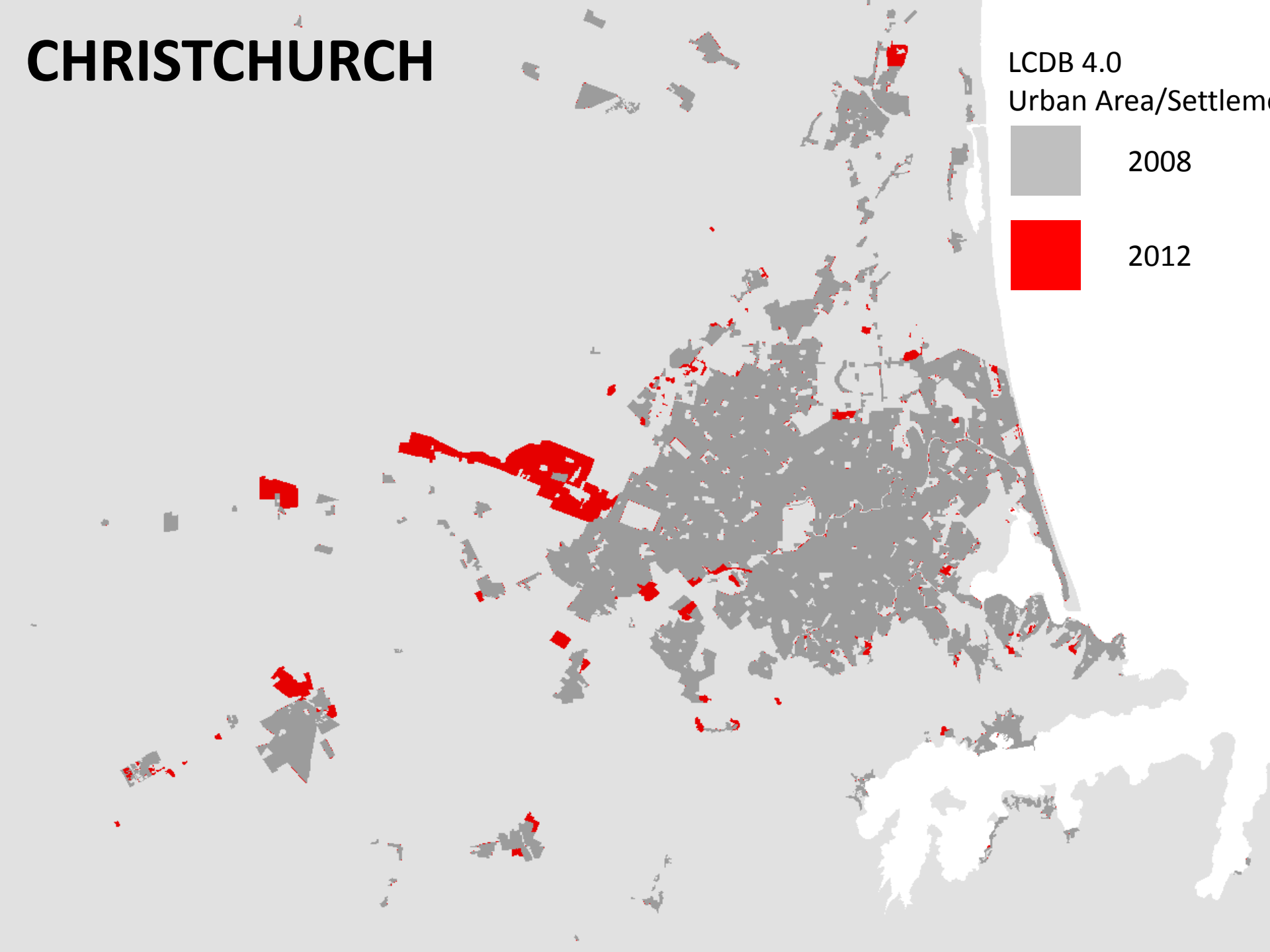


PALMERSTON NORTH

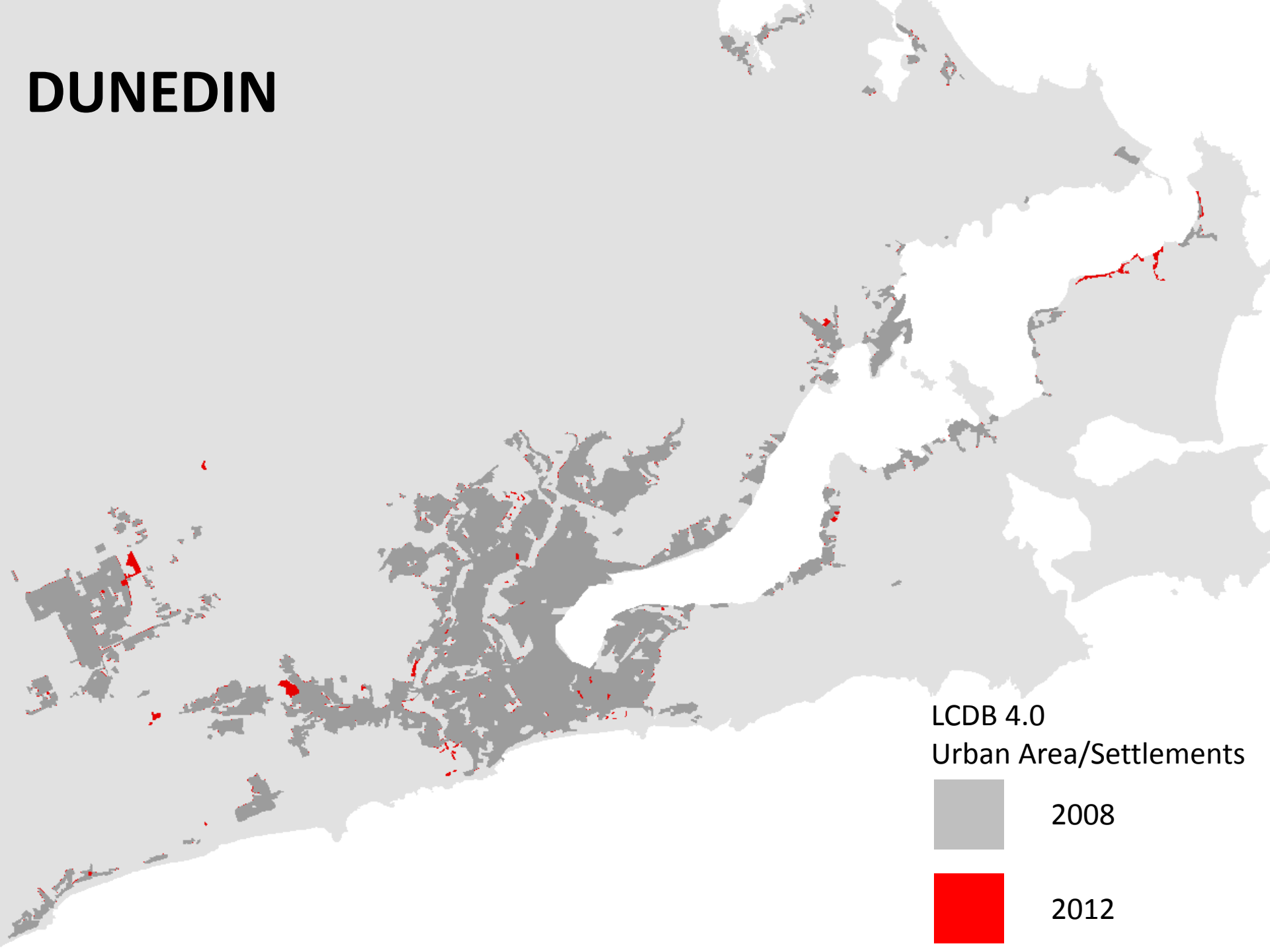


WELLINGTON

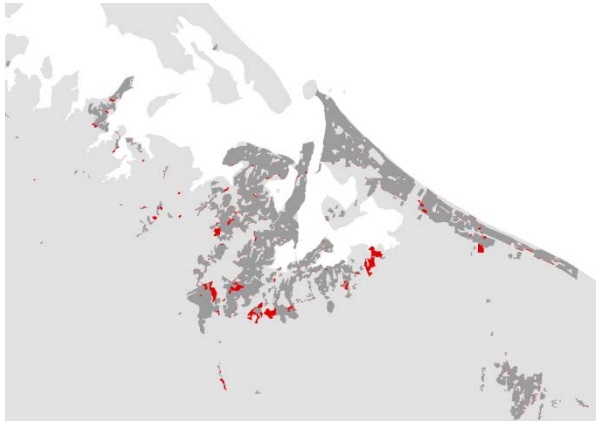



CHRISTCHURCH
LCDB 4.0
Urban Area/Settleme
2008
2012

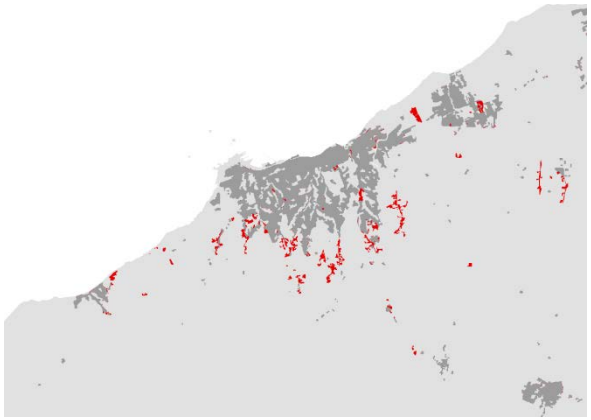
DUNEDIN



TAURANGA

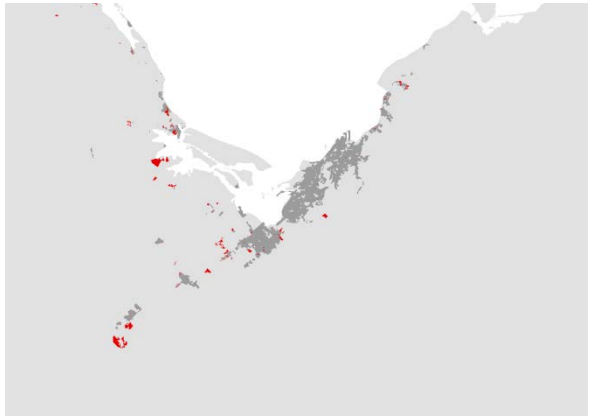


NEW PLYMOUTH

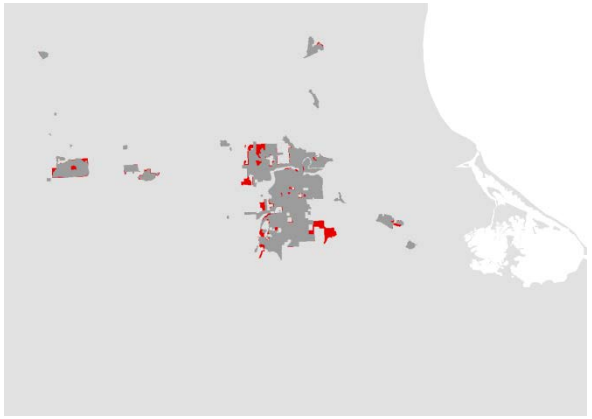


WHANGEREI

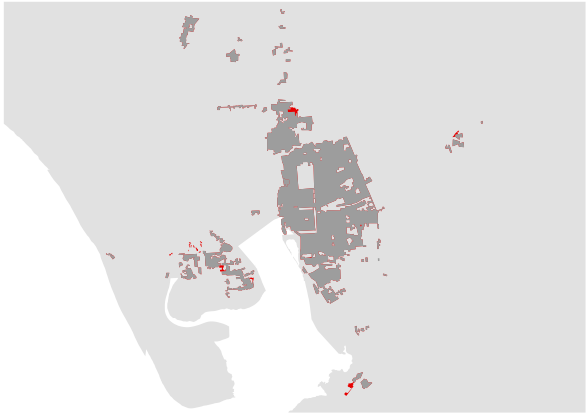
NELSON/ RICHMOND



BLENHEIM



INVERCARGILL



Population, Household and Dwelling Trends

REGION	Usually Resident Population		Total Households in Private Occupied Dwellings		Private Occupied Dwellings	
	2001 to 2006	2006 to 2013	2001 to 2006	2006 to 2013	2001 to 2006	2006 to 2013
Northland	1.16%	0.31%	1.45%	**1.14%**	1.47%	1.04%
Auckland	2.38%	**1.17%**	2.17%	**1.12%**	2.18%	1.06%
Waikato	1.34%	0.83%	1.68%	**1.24%**	1.67%	1.18%
Bay of Plenty	1.46%	0.57%	1.77%	**1.09%**	1.81%	0.99%
Gisborne	0.24%	-0.27%	0.38%	**0.46%****	0.33%	0.39%▲
Hawke's Bay	0.67%	0.33%	0.91%	**0.77%**	0.91%	0.70%
Taranaki	0.25%	0.74%▲	0.71%	**1.08%**▲	0.71%	1.01%▲
Manawatu-Wanganui	0.21%	0.02%	0.69%	**0.50%**	0.70%	0.44%
Wellington	1.16%	**0.70%**	1.39%	**0.77%**	1.43%	0.69%
Tasman	1.54%	0.79%	1.89%	**1.20%**	1.87%	1.06%
Nelson	0.63%	1.14%▲	1.19%	**1.31%**▲	1.28%	1.21%
Marlborough	1.47%	0.29%	1.85%	**1.05%**	1.91%	0.91%
West Coast	0.67%	0.37%	1.20%	**0.92%**	1.12%	0.83%
Canterbury	1.62%	**0.48%**	1.60%	0.35%	1.58%	0.37%
Otago	1.32%	0.63%	1.23%	**0.95%**	1.27%	0.87%
Southland	-0.03%	0.38%▲	0.33%	**0.84%**▲	0.32%	0.77%▲

GUIDELINE DEVELOPMENT

Priorities

- Land Fragmentation Definition
- Indicators
  - Land Supply for Primary Production
  - Reverse Sensitivity
- Monitor and reporting
  - Historic trends
  - Possible future trends or pressure points to help identify emerging issues to support policy and planning

Land Fragmentation Working Definition

Any division of a land resource that changes the current or future range of possible land uses.

Factors to consider

- Biophysical – natural or man-made division of landscapes
  - Topography
  - Hydrological networks
  - Infrastructure especially Transport Networks
- Property Rights – what can be done/not done & where
  - Primarily via Land Titles (Freehold, Covenants, etc.)
  - Also via planning and management (Policies, rules, etc. identifying restrictions or limitations)
- Ownership
  - One or few owners – likely easier to make decisions
  - Many owners – likely harder to maker decisions

Monitoring & Indictors: Key Design Principles

- Complexity
  - Keep it simple to start
  - Add complexity as time/resources/needs warrant
- Avoid subjectivity
- Underpinning Data Requirements
  - Nationally consistent
  - Publically available
  - Authoritative (not the same as infallible)

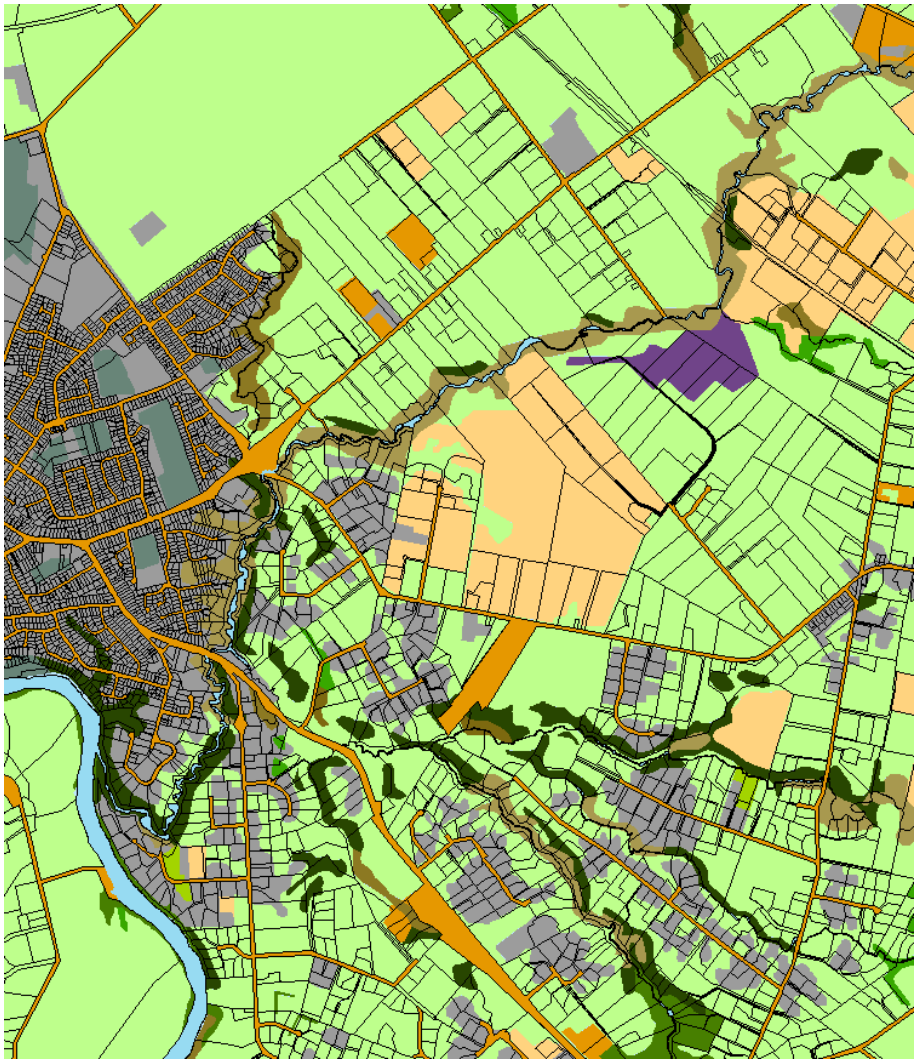
Underpinning Data: What do we have to work with?

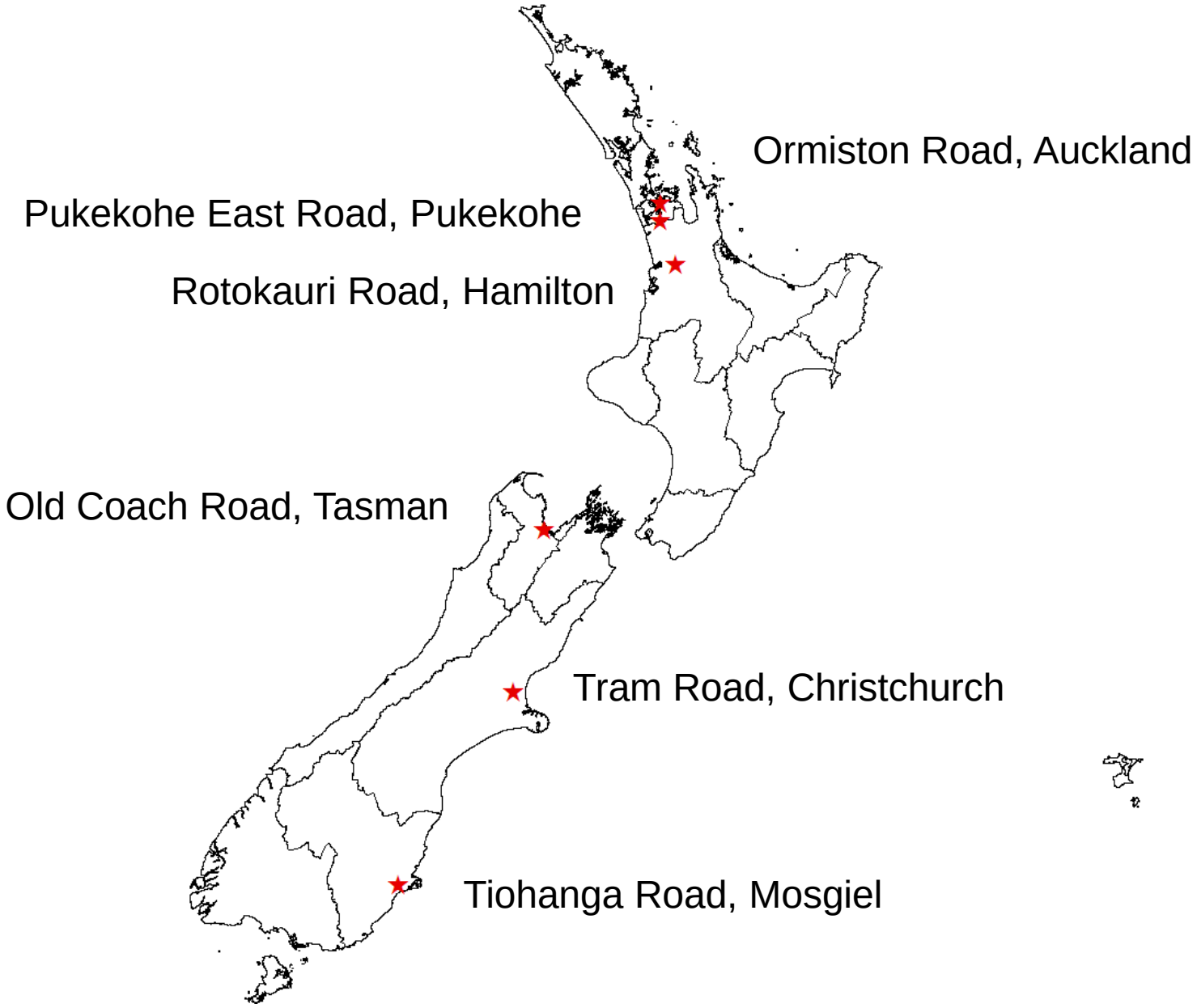
Dataset	Nationally Consistent	Public	Authoritative	Limitations	Use
Agribase (AssureQuality)	Yes	No	Partly (Survey Based)	Rolling updates Shows where respondent lives, not necessarily the farmed property	✗
Cadastral Database (LINZ)	Yes	Yes	Yes	Cadastral updates may lag real-world conditions	✓
Census (Statistics NZ)	Yes	Yes	Yes	Coarse resolution in rural areas (i.e. big meshblocks)	?
Land Cover Database (Landcare Research)	Yes	Yes	Yes	Speed of update Long-term viability Classification issues	✓
Land Resource Inventory (Landcare Research)	Yes	Yes	Yes	Somewhat dated but still very useful	✓
Topographic Information (LINZ)	Yes	Yes	Yes	Rate of update varies Variable quality of information	✓

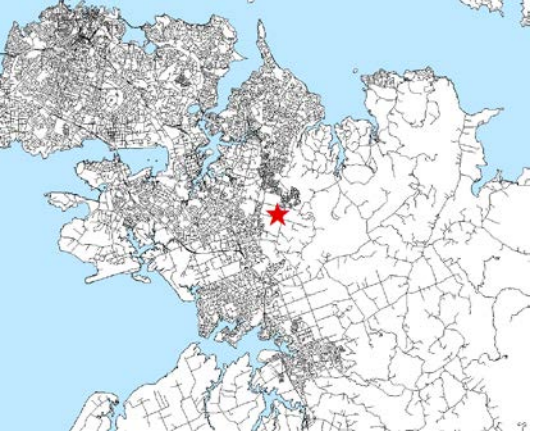
Data Exploration

- How does current data compare to real-world conditions (as assessed with GoogleMaps, which may not be current).

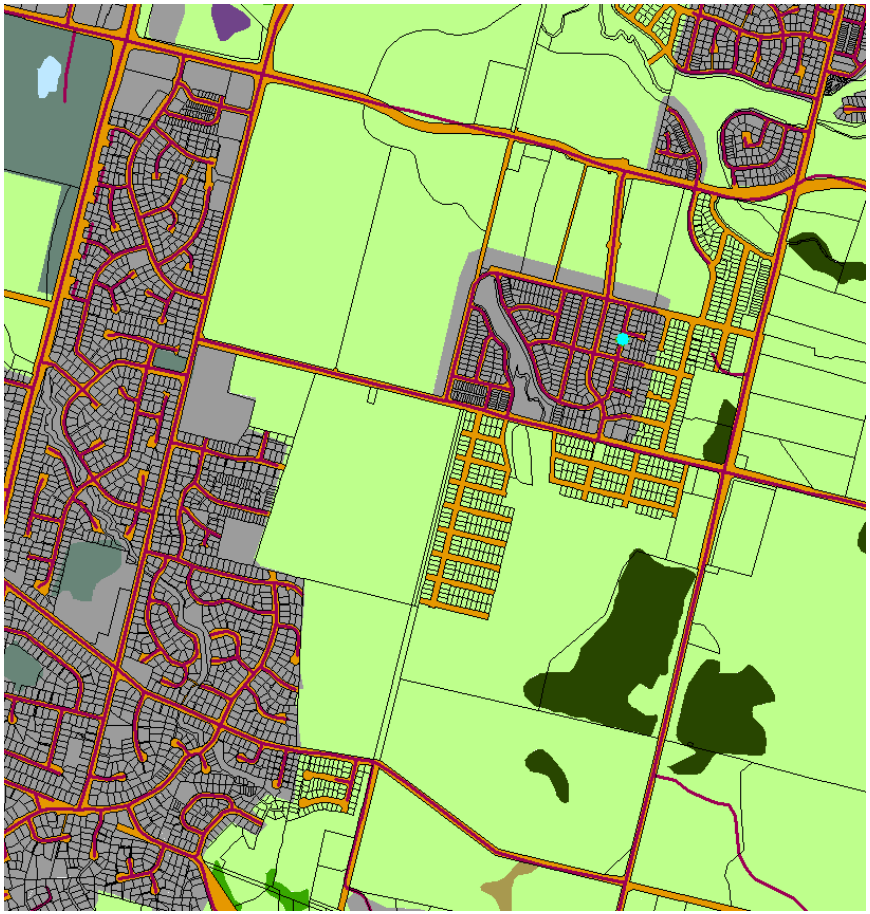
- Land Cover Database v4.0
- NZ Parcels (March 2014)
- NZ Hydro Parcels (March 2014)
  NZ Road Parcels (March 2014




Ormiston Road, Auckland
Pukekohe East Road, Pukekohe
Rotokauri Road, Hamilton
Old Coach Road, Tasman
Tram Road, Christchurch
Tiohanga Road, Mosgiel



Ormiston Road, Auckland



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Pukekohe East Road, Pukekohe

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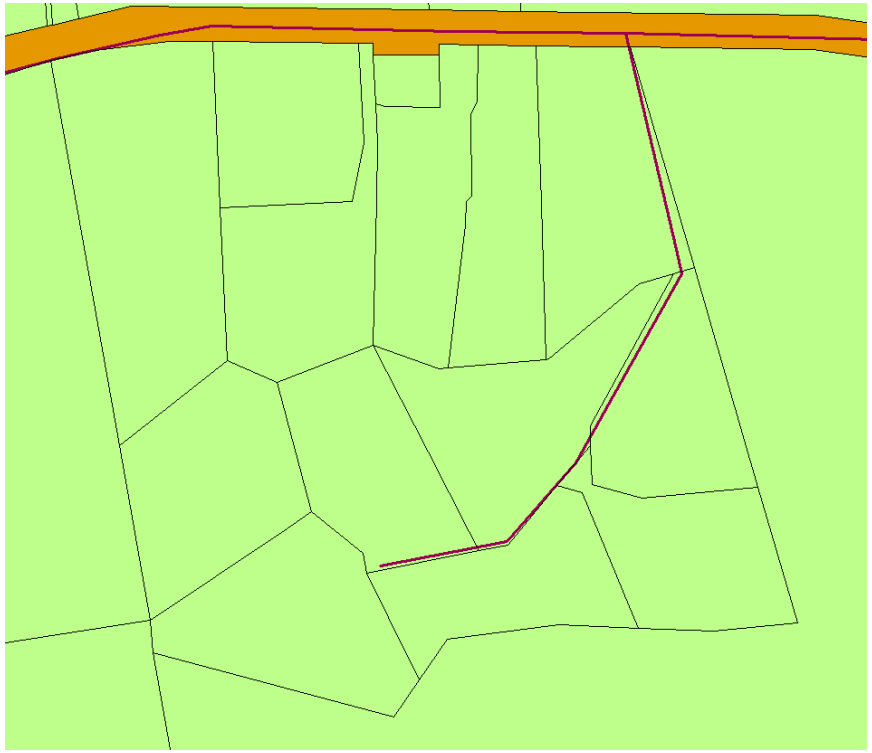

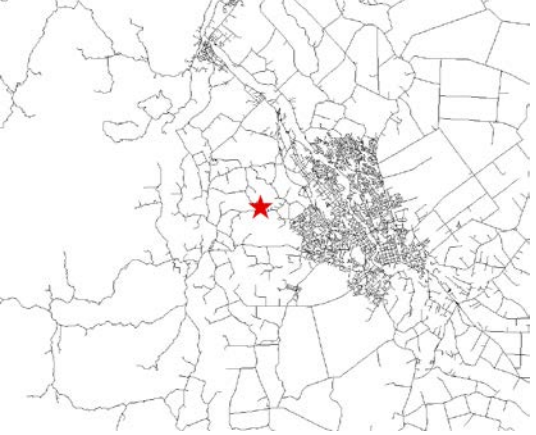

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Rotokauri Road, Hamilton

Old Coach Road, Tasman

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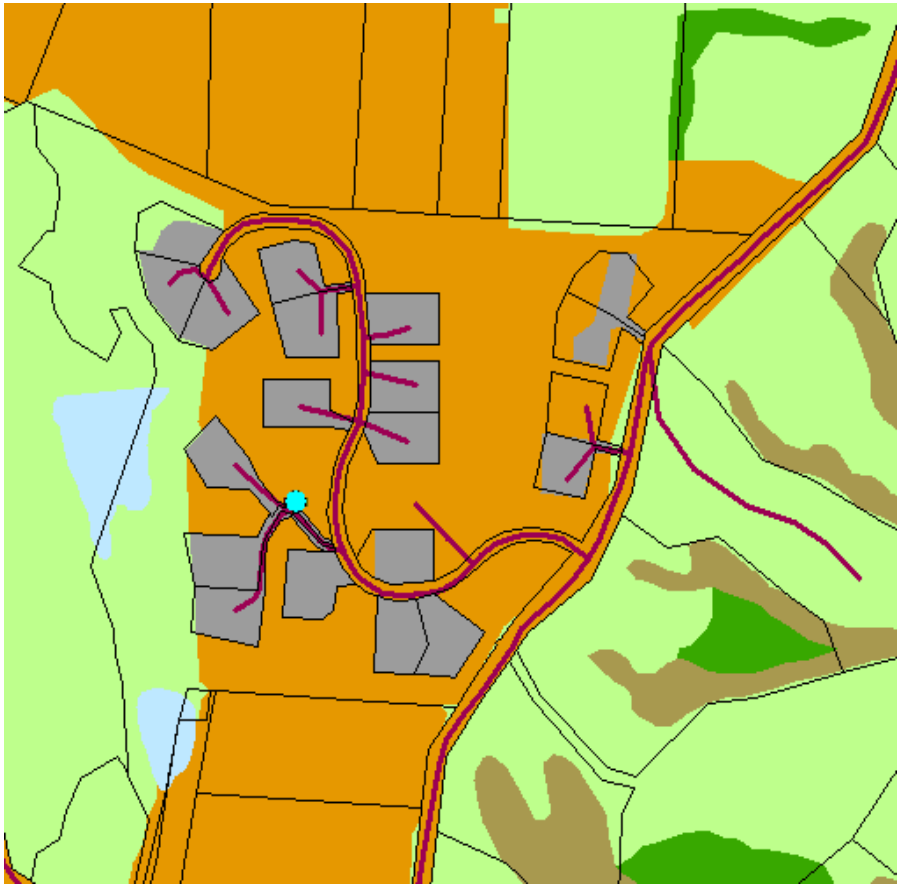

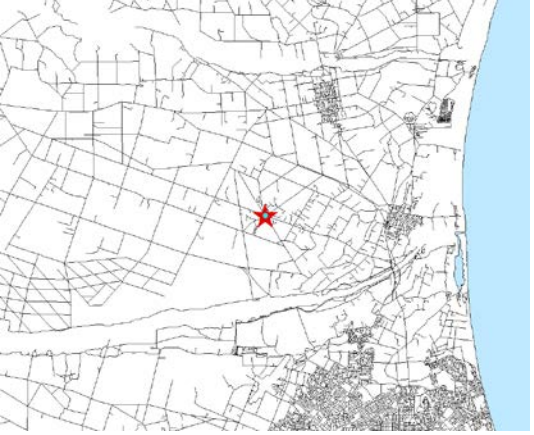

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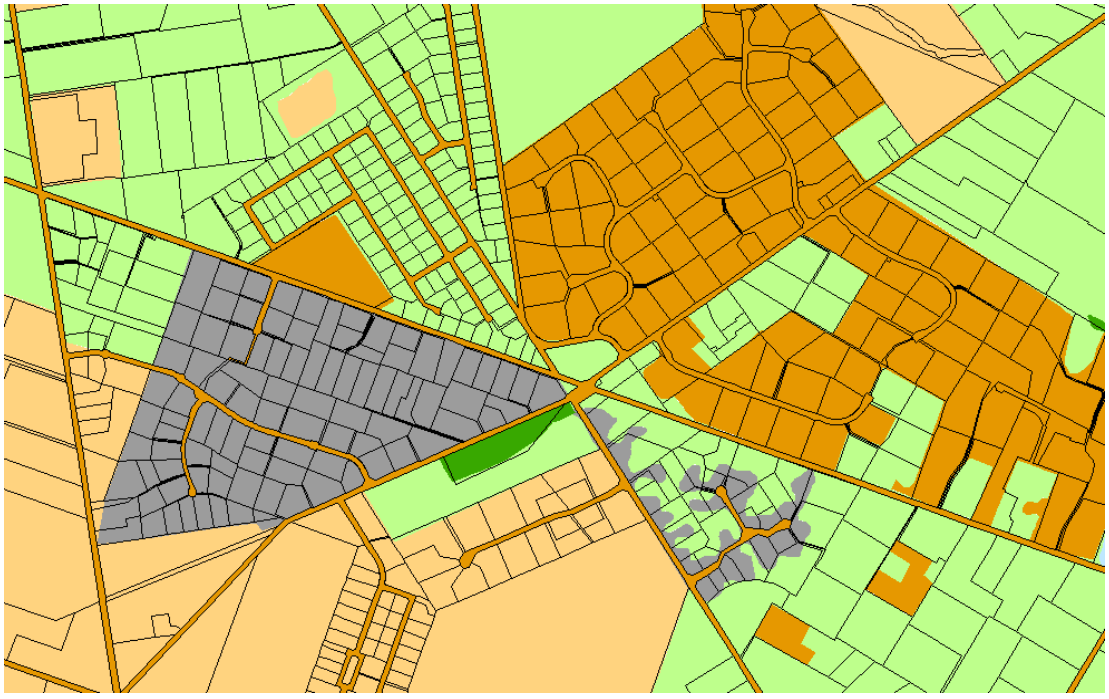
Tram Road, Christchurch



Tirohanga Road, Otago

Aerial image ©2014 DigitalGlobe via GoogleMaps

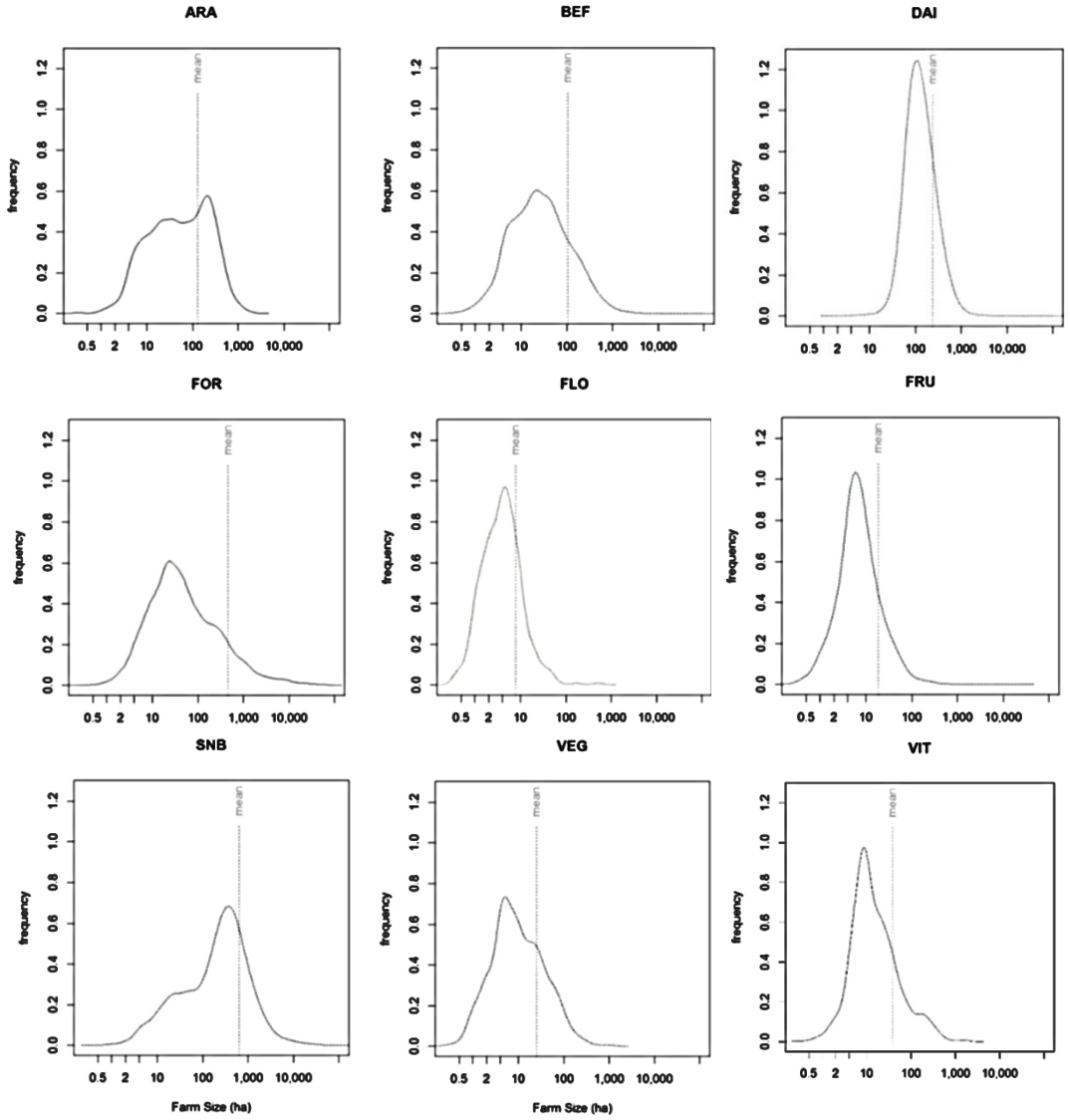
Observations

- Land Cover Database
  - Good at capturing urbanisation fronts
  - Variable at capturing more diffuse urban development (e.g. rural residential)
  - Can infer broad land use in some, but not all, cases

- NZ Parcel Database
  - Tells us how we have divided property rights
  - Does not tell us whether those rights have yet been exercised

Indicator Considerations

- Land Supply
  - Function of quantity and quality
  - Depends on the specific type of primary production
  - Farm sizes vary substantially
- Reverse Sensitivity
  - Type of sensitivity (e.g. odour, noise, visual) depends on (source, recipient)
  - Distance



Indicator Methodology

Step 1:
Characterise baseline level of regional land fragmentation created by hydrological networks

Indicators (Landscape):

- Number of Polygons (#)
- Size Distribution (graph)
- Largest Polygon (ha)

Interpretation/Use:
Provides an indicator of the baseline or natural degree of regional land fragmentation in the absence of human influence

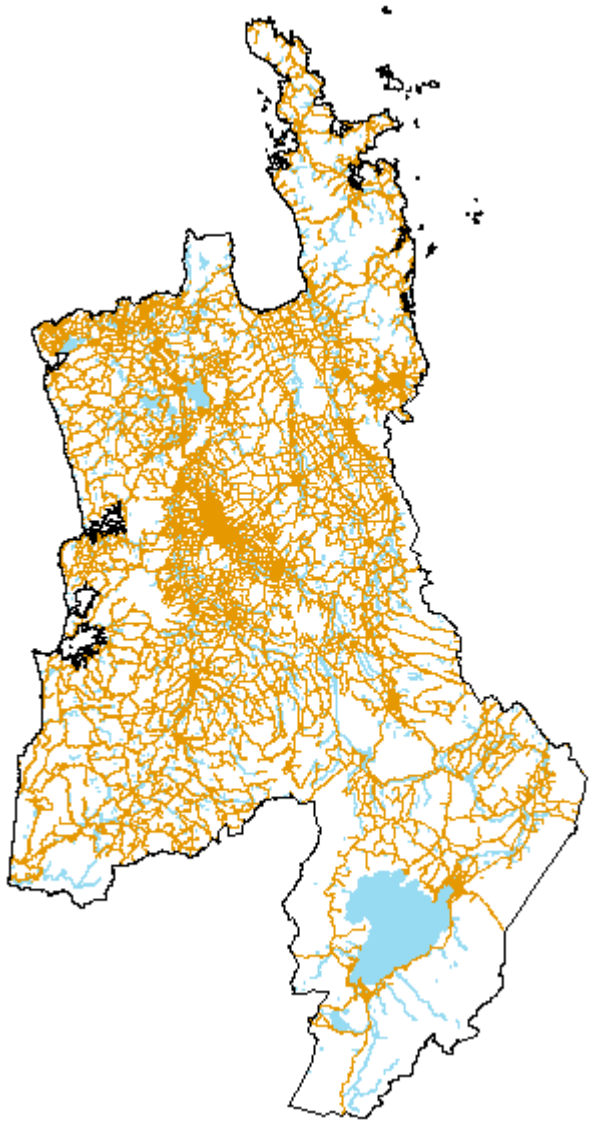
Indicator Methodology

Step 2:
Characterise modified level of regional land fragmentation created by man-made networks, principally transport

Indicators (Landscape & LUC):

- Number of Polygons (#)
- Size Distribution (Chart)
- Largest Polygon (ha)

Interpretation/Use:
Provides an indicator of the modified degree of regional land fragmentation



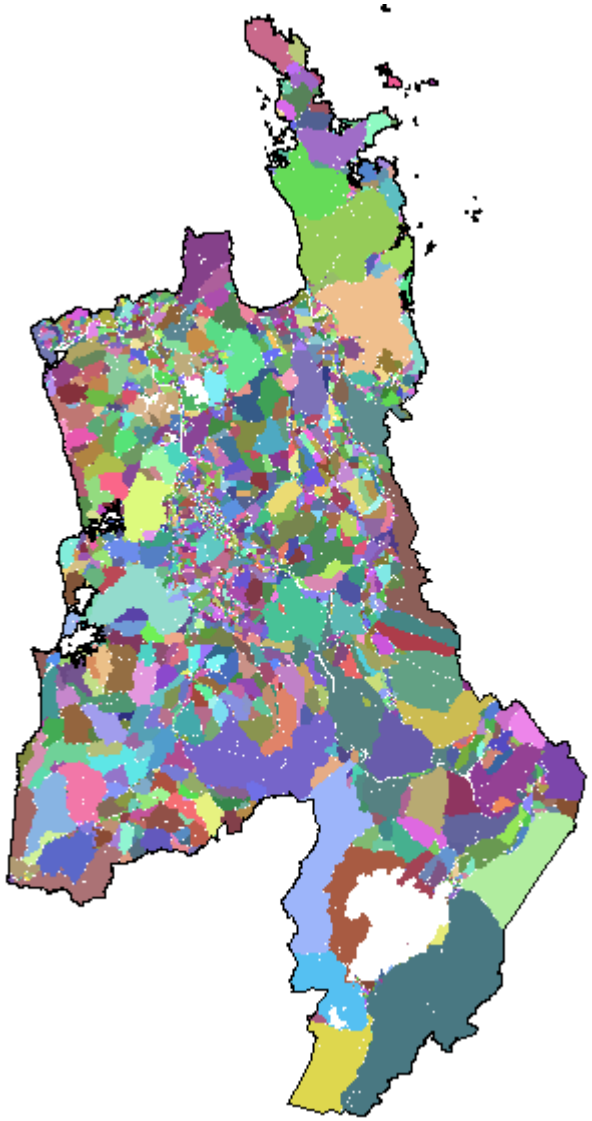
Indicator Methodology

Step 3:
Generate a mosaic characterising the Maximum Land Supply for Primary Production

Indicators:

None (intermediate step)

Interpretation/Use:
Each polygon has a unique ID to aid tracking of change over time



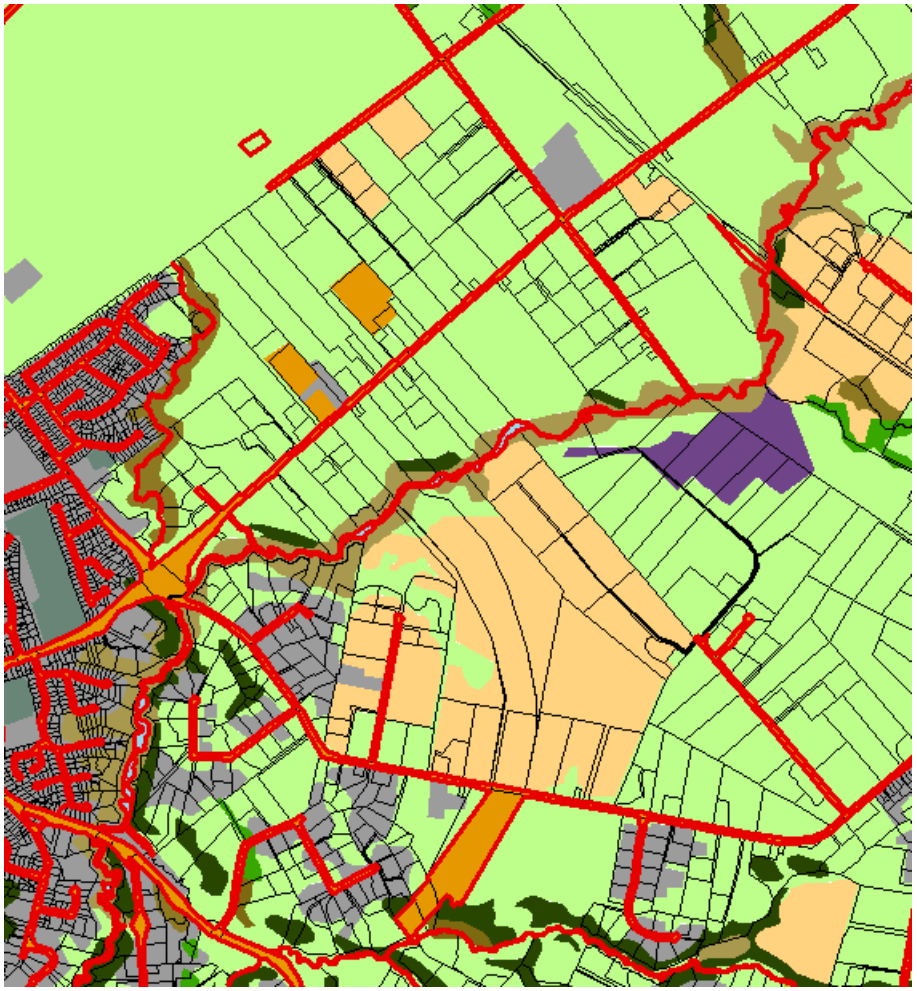
Indicator Methodology

Step 4:
Overlay Land Use, Land Cover, Parcels, LRI LUC1C, and Electoral Address points (explained later)

Indicators:

None (intermediate step)

Interpretation/Use:
Polygons become subregional units of analysis



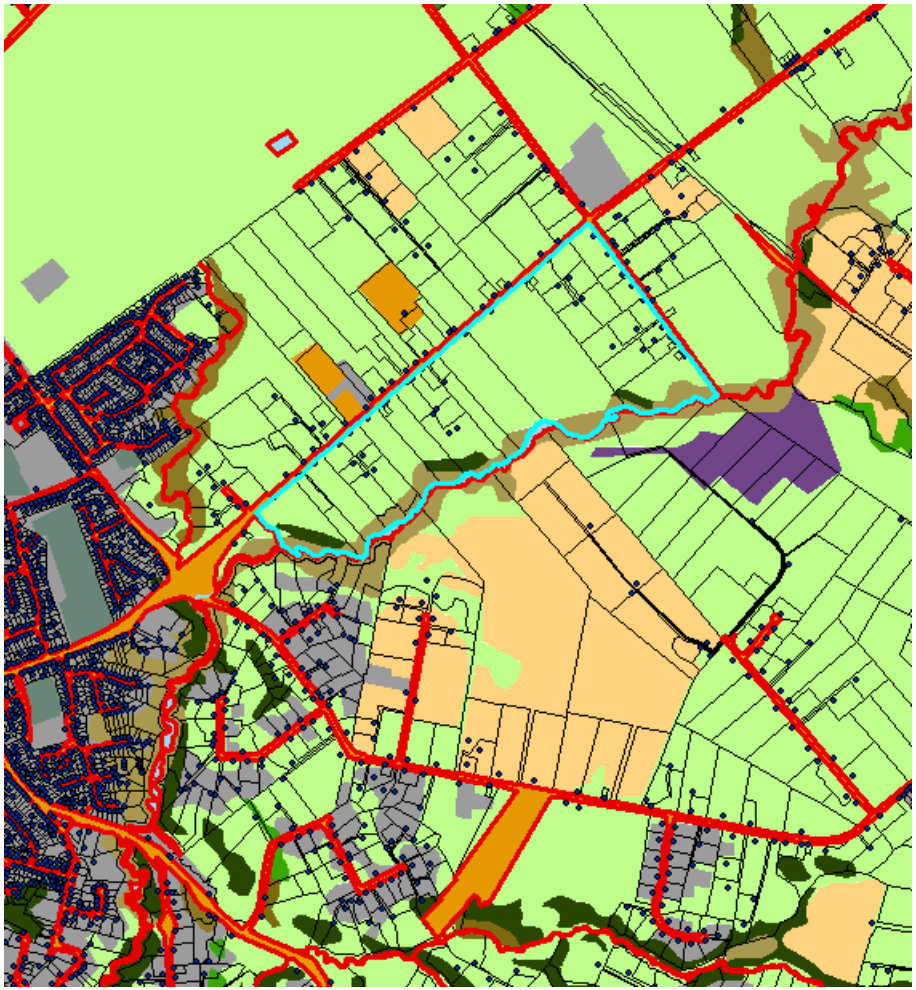
Indicator Methodology

Step 5:
Calculate Base Land Supply = Total Area – Urban – Protected Areas

Indicators (Polygon & LUC):

- Base Land Supply (ha)
- Polygon Shape (?)

Interpretation/Use:
Provides the maximum area of land available for primary production for each polygon & possibly LUC within a polygon



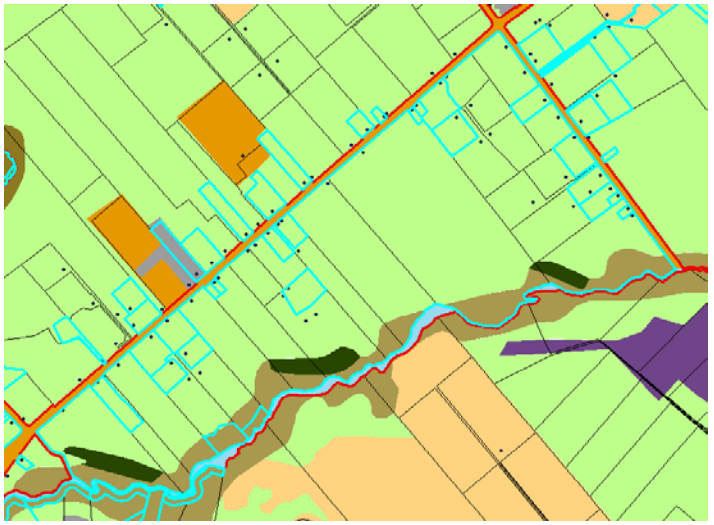
Indicator Methodology

Step 6:
Area – (Urban + Protected Areas + Parcels < Size Threshold with Electoral Address)

Indicators (Polygon & LUC):

- Effective Land Supply$_i$ (ha)
- Effective Number of Polygons (#)
- Patch Shape (?)

Interpretation/Use:
Provides a sliding scale of land supply based on size considerations & likely ownership/habitation and any further fragmentation caused by parcelisation/subdivision



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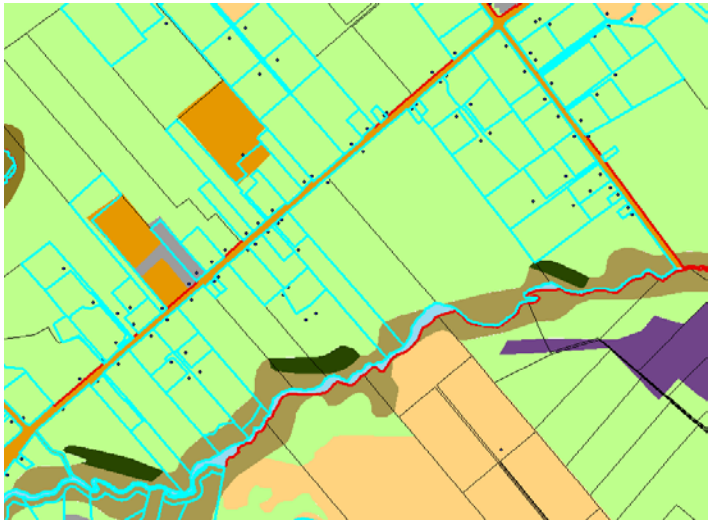


< 4 ha

Why Electoral Addresses?

- Originally explored using LINZ Building Points as a proxy for indicating occupation

- Electoral Addresses
  - Updated with the Parcel database
  - Represent a legally-defined location
  - Therefore a better choice as a proxy for indicating occupation/habitation (but not always)

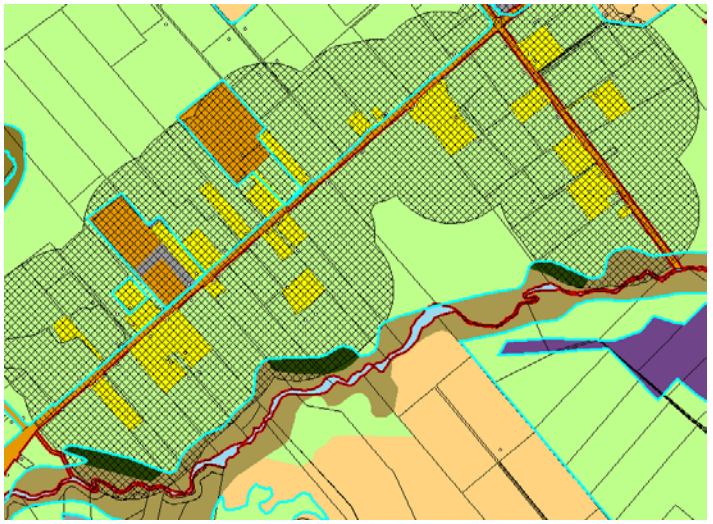
Indicator Methodology

Step 7:
Buffer Urban + Protected (+ Parcels < Size Thresold(s)) at specified distances

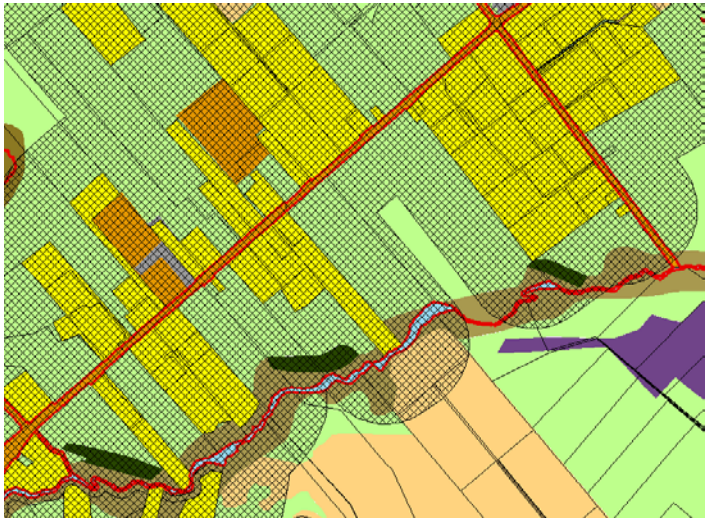
Indicators (Polygon and LUC):

Non-Sensitive Land Supply$_{i,D}$ (ha)
Distance Buffers (Maps)

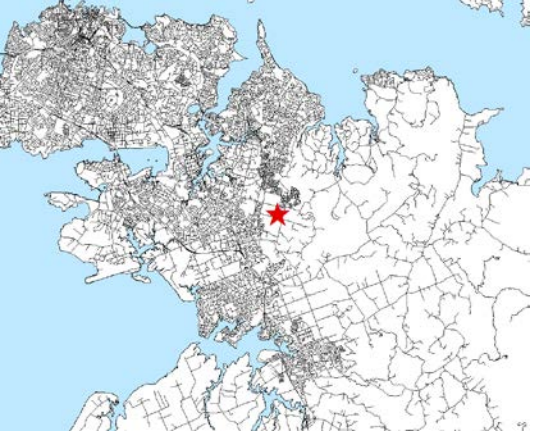
Interpretation/Use:
Provides a sliding scale for estimating potential for reverse sensitivity



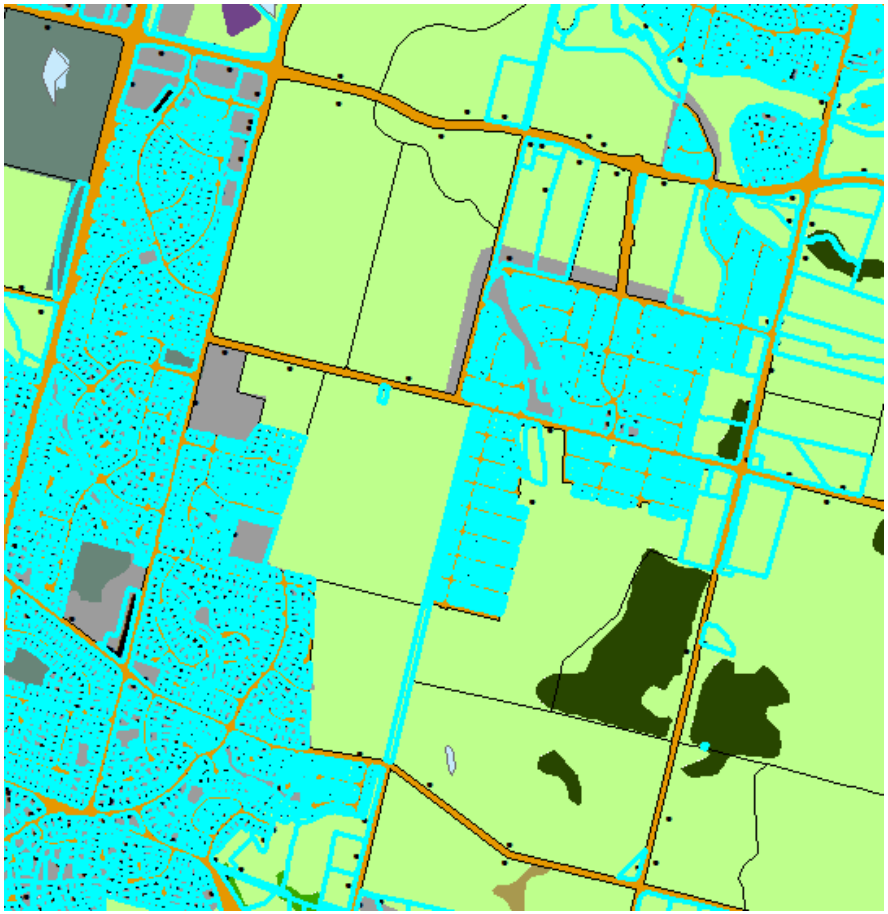
< 1 ha
200m
buffer



< 4 ha
200m
buffer

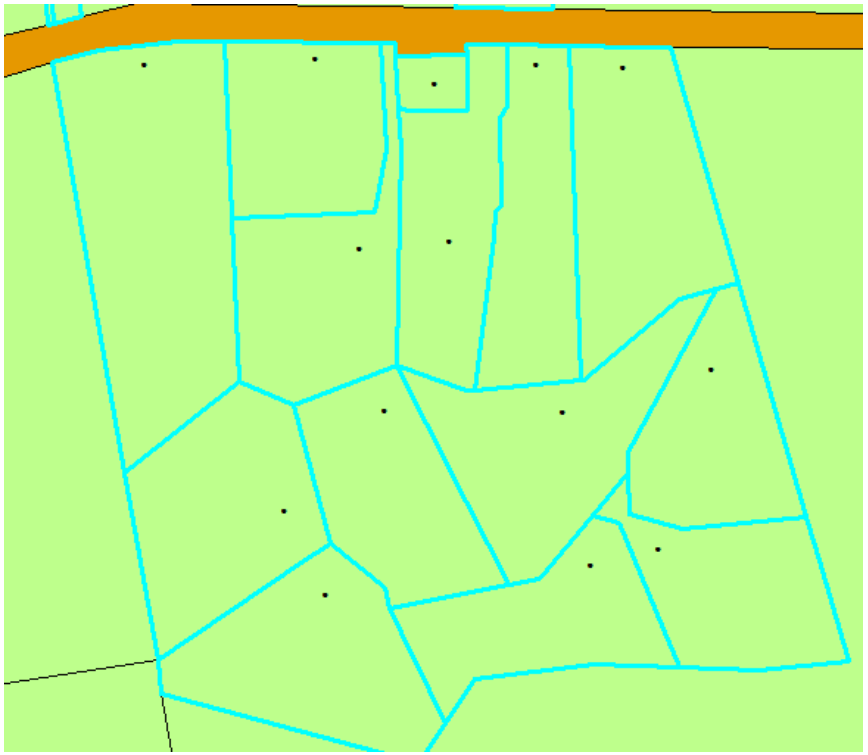


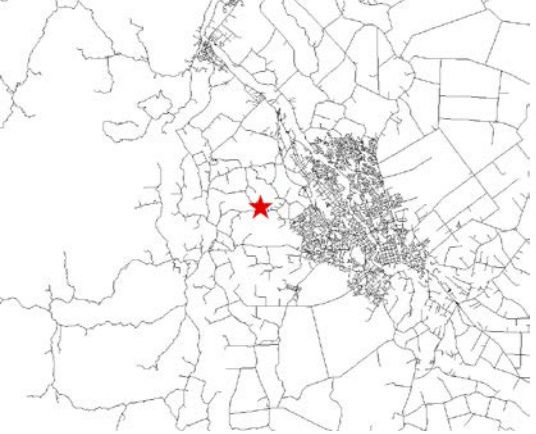
Ormiston Road, Auckland



Pukekohe East Road, Pukekohe

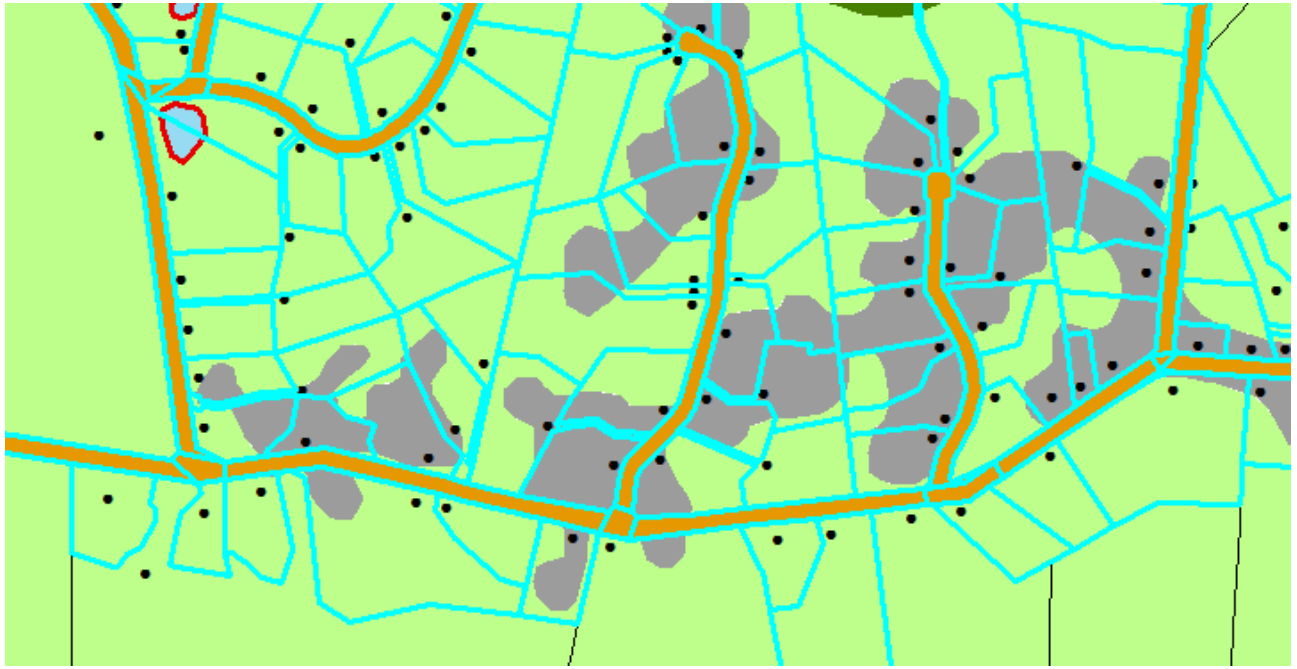
Aerial image ©2014 DigitalGlobe via GoogleMaps



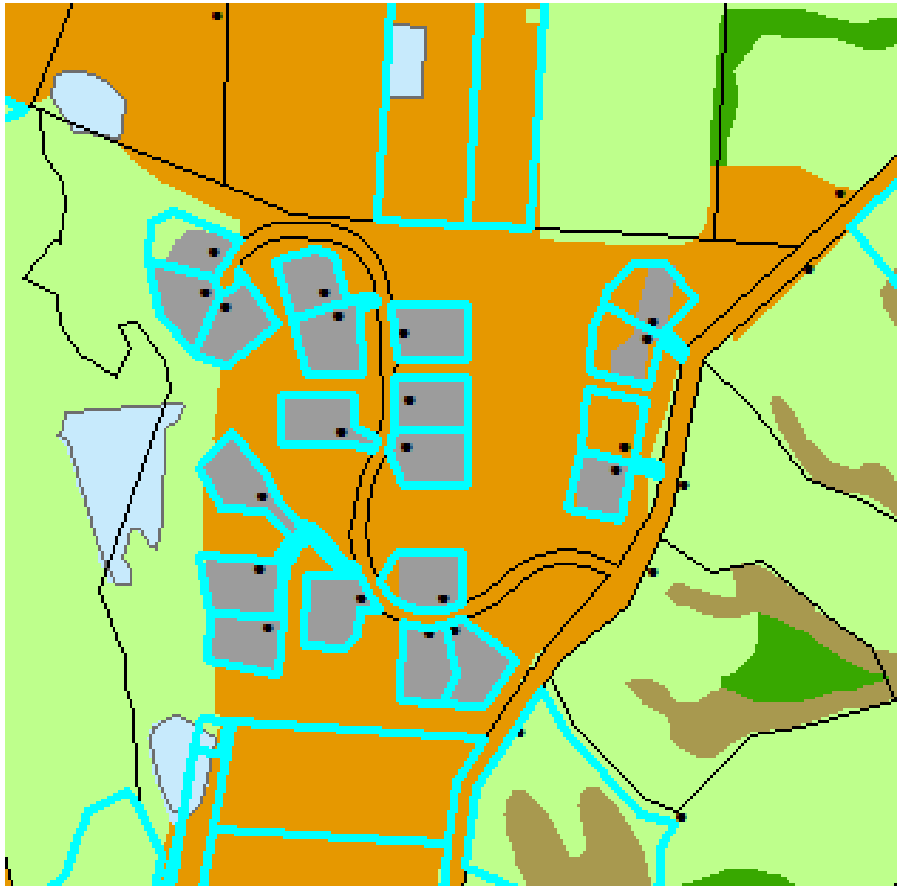


Aerial image ©2014 DigitalGlobe via GoogleMaps

Rotokauri Road, Hamilton



Old Coach Road, Tasman



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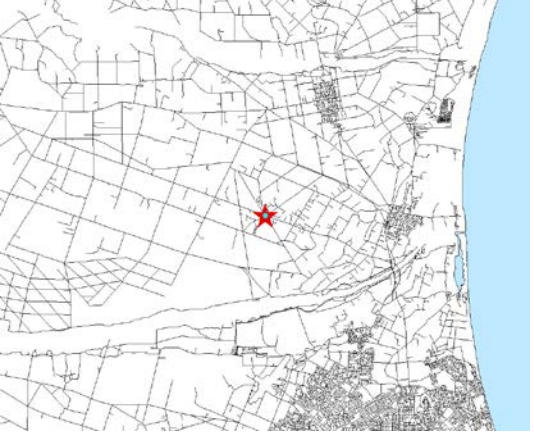

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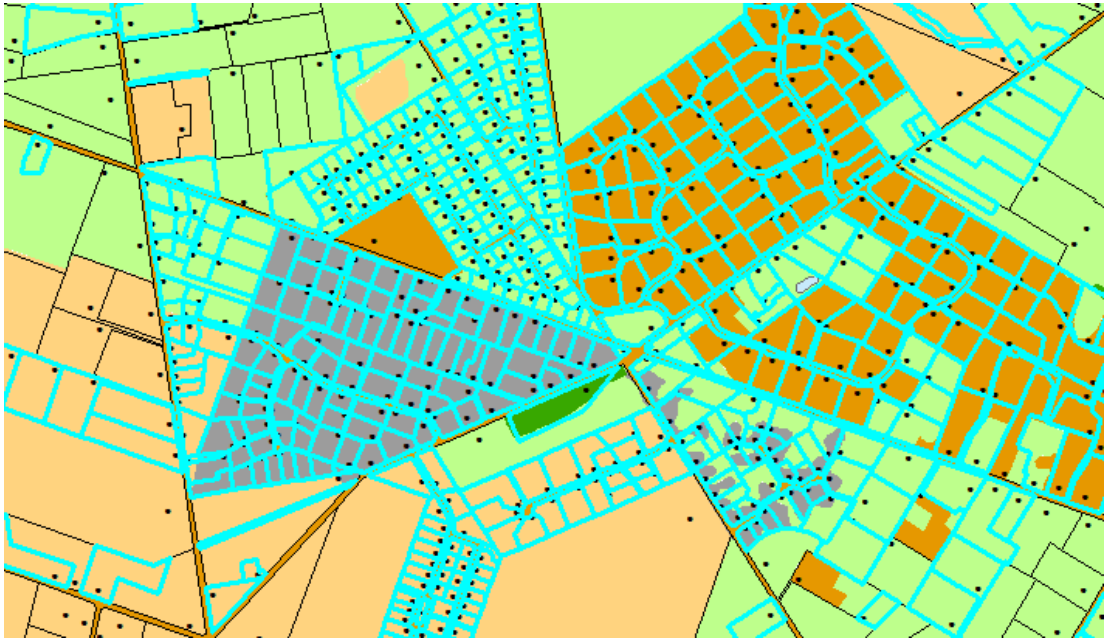
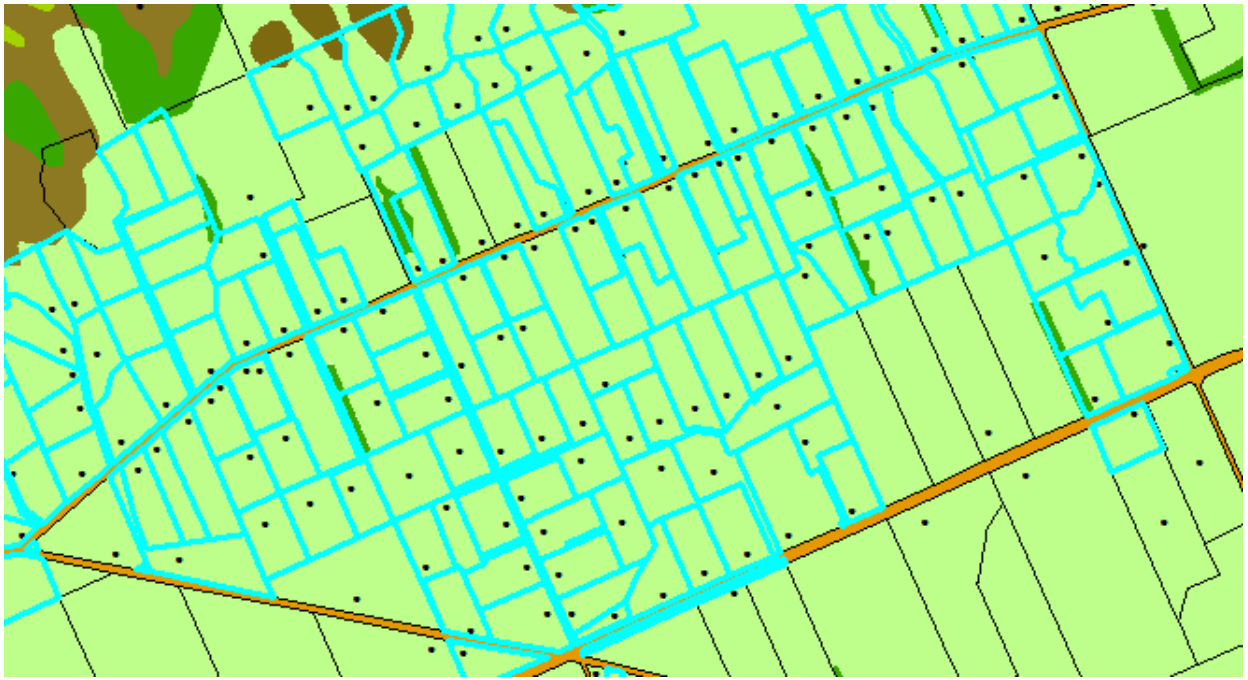
Tram Road, Christchurch



Tirohanga Road, Otago

Aerial image ©2014 DigitalGlobe via GoogleMaps



Indicator Summary

	Landscape	Class (LUC)	Polygon
Land Supply for Primary Production	Baseline Fragmentation		
	# of Polygons Size Distribution Largest Polygon	Total Area by LUC	Area (ha) Shape (?)
	Modified Fragmentation		
	# of Polygons Size Distribution Largest Polygon	Total Area by LUC	Area (ha) Shape (?)
	Base Land Supply (T – U – PA)	Base Land Supply (T – U – PA)	Base Land Supply (T – U – PA) Shape (?)
	Effective Land Supply ($T – U – PA – P_{i,EA}$)	Effective Land Supply ($T – U – PA – P_{i,EA}$)	Effective Land Supply ($T – U – PA – P_{i,EA}$) Shape (?)
Reverse Sensitivity	Non-Sensitive Land Supply Distance Buffer Maps	Non-Sensitive Land Supply Distance Buffer Maps	Non Sensitive Land Supply Shape (?)