



Landcare Research
Manaaki Whenua

National Guidelines for Monitoring the Effects of Land Fragmentation

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Landcare Research LINK Policy Seminar

Ministry for the Environment

06 October 2015



CONTEXT



Envirolink Tools Project

- Develop national guidelines for monitoring the effects of land fragmentation
- Champion: Regional Council Land Monitoring Forum
- January 2013 – February 2015
- \$200,000

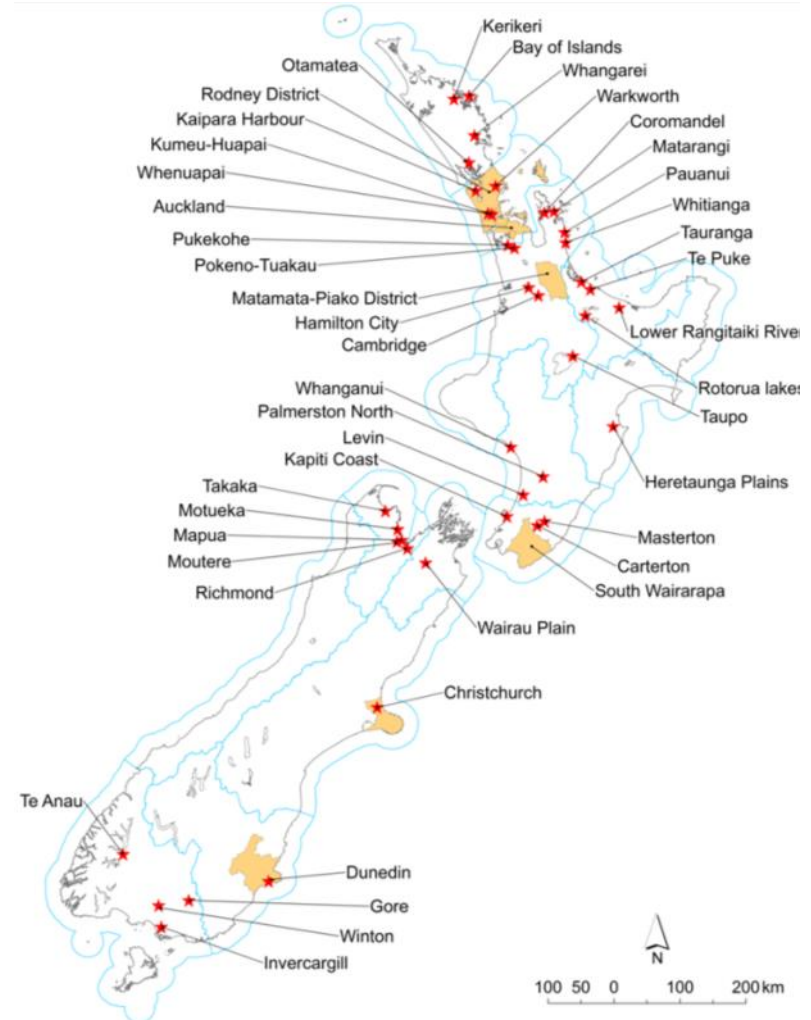
Regional Councils & Land Fragmentation: State of Play

Strengths

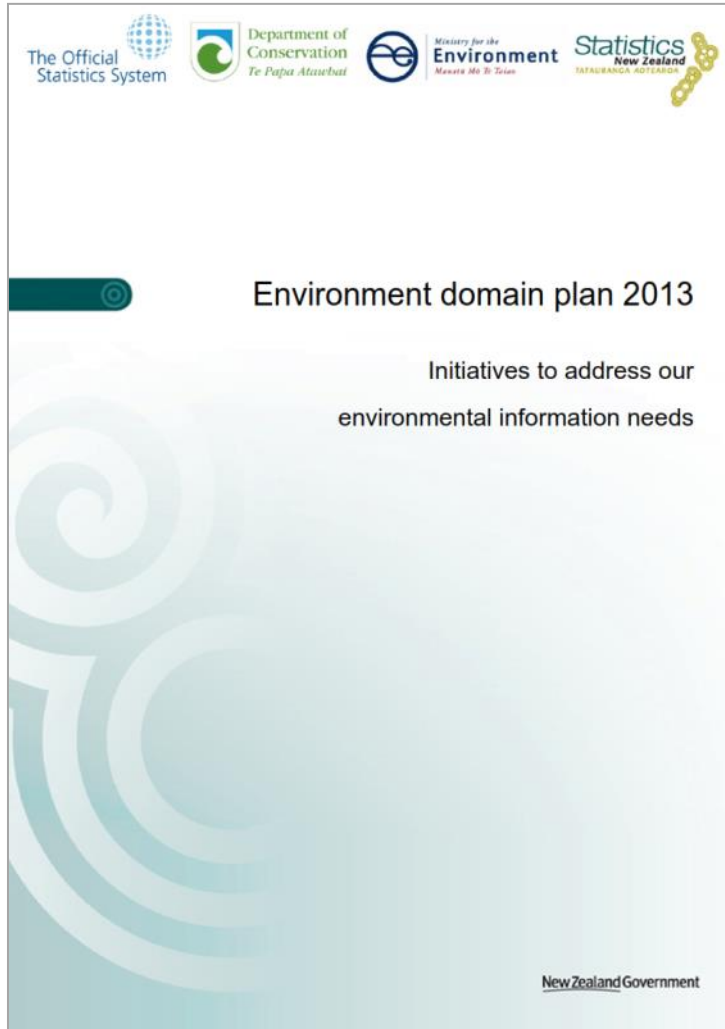
- Shared concern over long-term capacity for primary production via land use change
- Regional importance varies although most regions have **“hot spots”** ★
- 13 of 16 councils have existing or proposed policies

Limitations

- No common definition
- Only 3 councils (all unitary authorities) have rules (Auckland, Marlborough, Tasman)
- Only 3 councils undertake regular monitoring (Auckland, Waikato, Marlborough)



National Context: Environmental Reporting

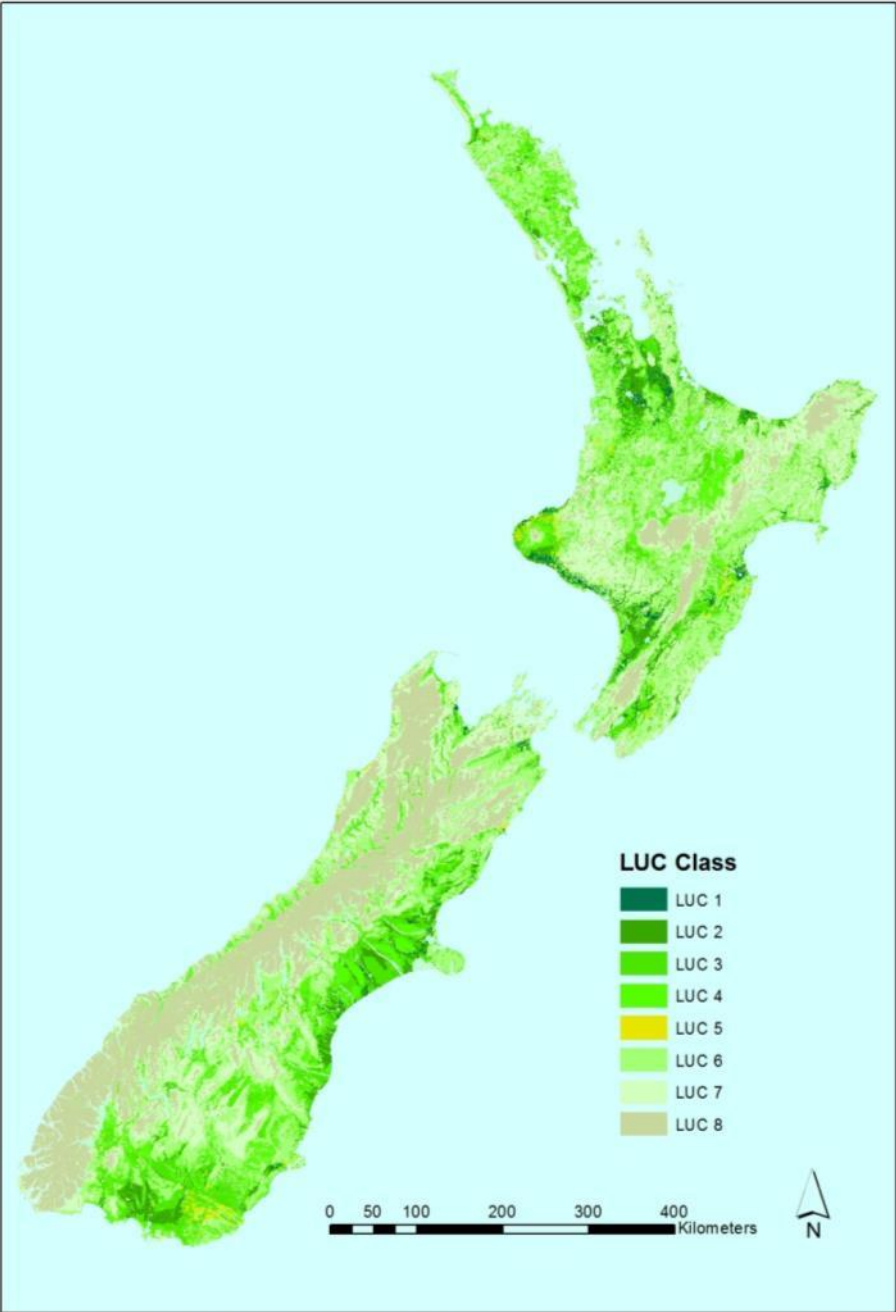


- Soils, landscapes & natural resources
 - Underpin natural & managed ecosystems
 - Provide essential ecosystem services
- Current land uses, intensification, and changing geographic pattern of land uses bring increasing pressure
- Understand state, trends, drivers, and impacts
 - Land use
 - Land cover
 - Soils

**BACKGROUND:
WHY ARE WE CONCERNED?**

Land & Soils: Finite & Unevenly Distributed

LRI Land Use Capability (LUC) Class	Total Area (1,000 ha)	Total Area (%)
1	187	0.7
2	1,200	4.5
3	2,439	9.2
4	2,772	10.5
5	209	0.8
6	7,453	28.1
7	5,673	21.4
8	5,782	21.8
Other	775	2.9



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.

Research Highlights

- Urbanisation & rural residential development disproportionately affect our most capable land & soils (i.e. LUC Classes 1, 2, 3)
- Rural Residential Development: Lifestylers vs. Smallfarmers
 - Lifestylers: most common with no or relatively little farm income
 - Smallfarmers: less common but higher farm income & productivity
- Both positive and negative effects of subdivision
 - Negative: reduction of land available for primary production
 - Positive: smaller enterprises can sometimes be more productive
- Future competition for land expected to intensify
 - Population & *household* growth
 - Increased affluence & desire for rural residential lifestyle
- Lack of comprehensive, consistent data & monitoring

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.

Urbanisation Trends 2008-2012 from LCDB4.0: Total Area = 1,896 ha

	LUC1	LUC2	LUC3	LUC4	LUC5	LUC6	LUC7	LUC8
Total Area (ha)	194.2	421.6	490.9	324.4	14.0	402.9	47.8	-
% 2008-2012 Urbanisation	10.2%	22.2%	25.9%	17.1%	0.7%	21.3%	2.5%	-
% Original LUC Area	0.10%	0.04%	0.02%	0.01%	0.01%	0.01%	0.001%	-



58.3% of new urban areas occur on LUC Class 1-3

Urban = Built-up Areas/Settlements + Mines & Dumps + Transport Infrastructure + Urban Parks/Open Spaces

Monitoring & Reporting Challenges: Patchy & Inconsistent Data

	Sanson et al. (2004)	Mackay et al (2011)	LCDB 4.0 V2012 (2014)	Andrews & Dymond (2012)	Agribase (March 2015)	LINZ (June 2015)
Urban Area (ha)		730,000	239,633			133,000
Transport (ha)		160,000	5,780			360,000
Urbanisation Rate (ha/yr)			~1500	~1400		
Lifestyle Blocks or Smallholdings (ha and #)	753,000 139,868			873,000 175,000	245,000 60,528	
“Rurbanisation” Rate (ha/yr)	~40,000			~21,000		

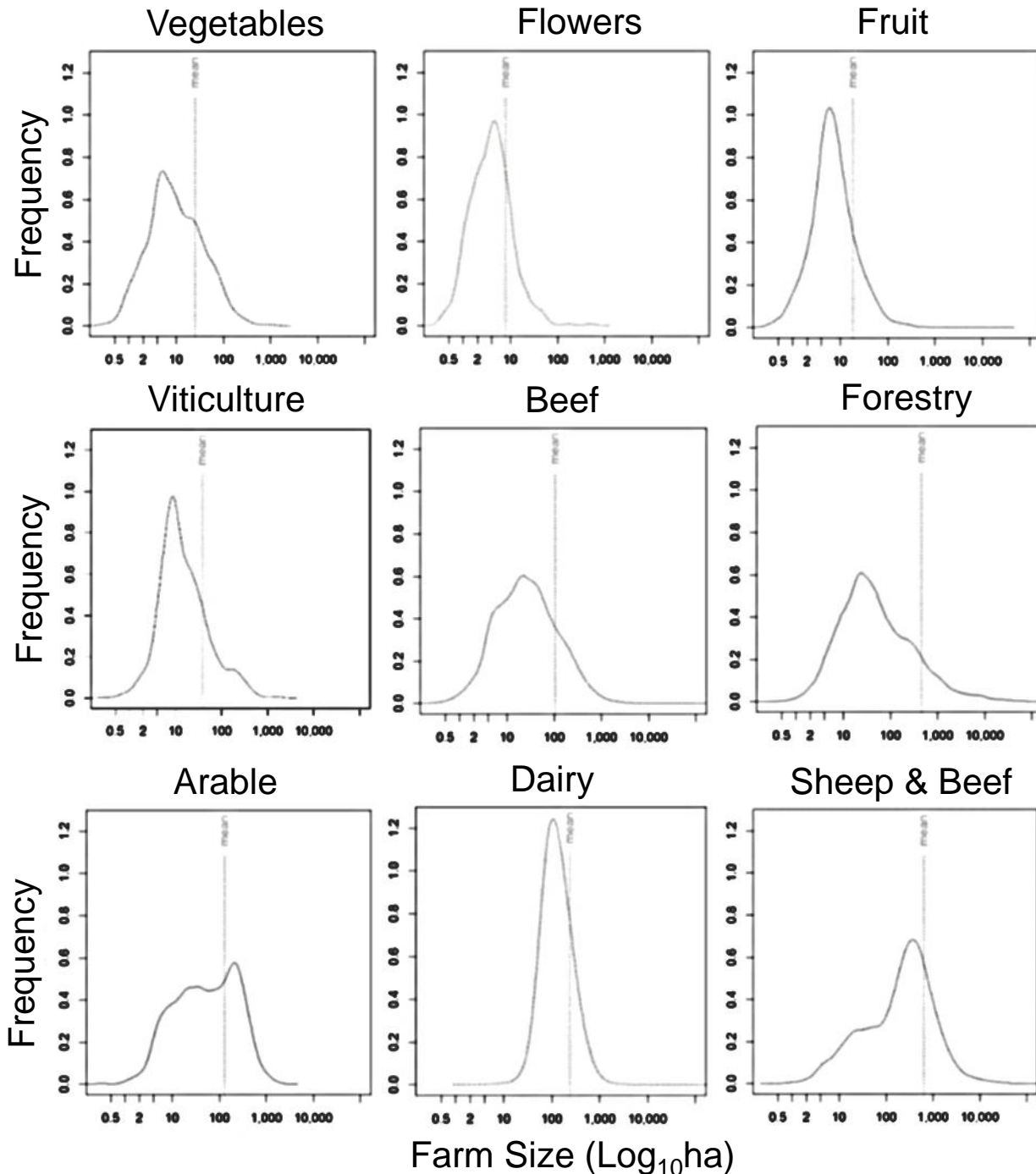
GUIDELINE DEVELOPMENT

Regional Council Priorities for National Guidelines

- Land Fragmentation Definition
- Indicators
 - Land Supply for Primary Production
 - Reverse Sensitivity
- Monitor and reporting
 - Historic trends
 - Possible future trends
 - Pressure points
 - Emerging issues
 - Support policy, planning & resource management

Indicator Considerations

- Land Supply
 - Total farm size
 - Operational requirements (e.g. minimum lot sizes)
- Reverse Sensitivity
 - Source
 - Recipient
 - Distance



Source: Farm size data from Agribase March 2014

Design Principles

- Complexity
 - Keep it simple to start
 - Add complexity as time/resources/needs warrant
- Avoid subjectivity
- Flexibility
- Underpinning data requirements: PAN Principle
 - **P**ublically available
 - **A**uthoritative (not the same as infallible)
 - **N**ationally consistent

Underpinning Data: PAN Principle

Dataset	Owner	Public	Authoritative	Nationally Consistent	Outcome
Agribase	AsureQuality	✘	Partly (Survey Based)	✓	✘
Cadastral Database	LINZ	✓	✓	✓	✓
Census	StatisticsNZ	✓	✓	✓	?
Land Cover Database	Landcare Research	✓	✓	✓	✓
Land Resource Inventory	Landcare Research	✓	✓	✓	✓
Topographic Information	LINZ	✓	✓	✓	✓
Valuation	Councils (via 3 rd parties)	✘	✓	✓	✘

Underpinning Data Strengths & Limitations

- Cadastral Database
 - Tells us how we have divided property rights
 - Does not tell us whether those rights have yet been exercised
 - Provides some land use information (roads, protected areas, etc.)
- Land Cover Database
 - Good at capturing urbanisation fronts
 - Variable at capturing diffuse peri-urban/rural residential development
- Land Resource Inventory
 - Key data source on land & soil quality & capability
 - Dated (eventually to be updated/replaced by S-Map)
- LINZ Topographic Data
 - Rich data set > 100 features
 - Variable in resolution & updates

GUIDELINES

Land Fragmentation Definition

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

Factors to consider

- Biophysical: *topography, river networks, transport networks*
- Property Rights: *ownership, rules, zones, overlays, etc.*
- Ownership: *one (easier) to many (harder) decision-making*

INDICATOR

METHOD

INTERPRETATION

LEVEL I: MAXIMUM
LAND SUPPLY



LEVEL II: KNOWN
LAND SUPPLY



LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY

Region Area –
Key Biophysical Networks
(Water & Transport)

Maximum Land Supply
– Urban Areas
– Protected Areas

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address Points

Known Land Supply –
Buffer Areas of
Specified Land Uses

Contiguous areas available for
primary production without
considering current land use or
land cover

Maximum land supply
excluding known urban/built-up
areas and protected areas

Known land supply
excluding likely areas of rural
residential/peri-urban development

Likely land supply
excluding potential indirect
effects (e.g. reverse sensitivity)

INDICATOR

LEVEL I: MAXIMUM
LAND SUPPLY



LEVEL II: KNOWN
LAND SUPPLY



LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY

METHOD

Region Area –
Biophysical Networks
(Water, Transport)

REGION	CLASS	POLYGON
Land Supply (hectares)	Land Supply (hectares)	Polygon Area (hectares)
# of Polygons (scalar)	# of Polygons (scalar)	Polygon Shape <i>(all optional)</i>
Polygon Size Distribution (Graph)	Polygon Size Distribution (Graph)	

Known Land Supply –
Buffer Areas of
Specified Land Uses

INTERPRETATION

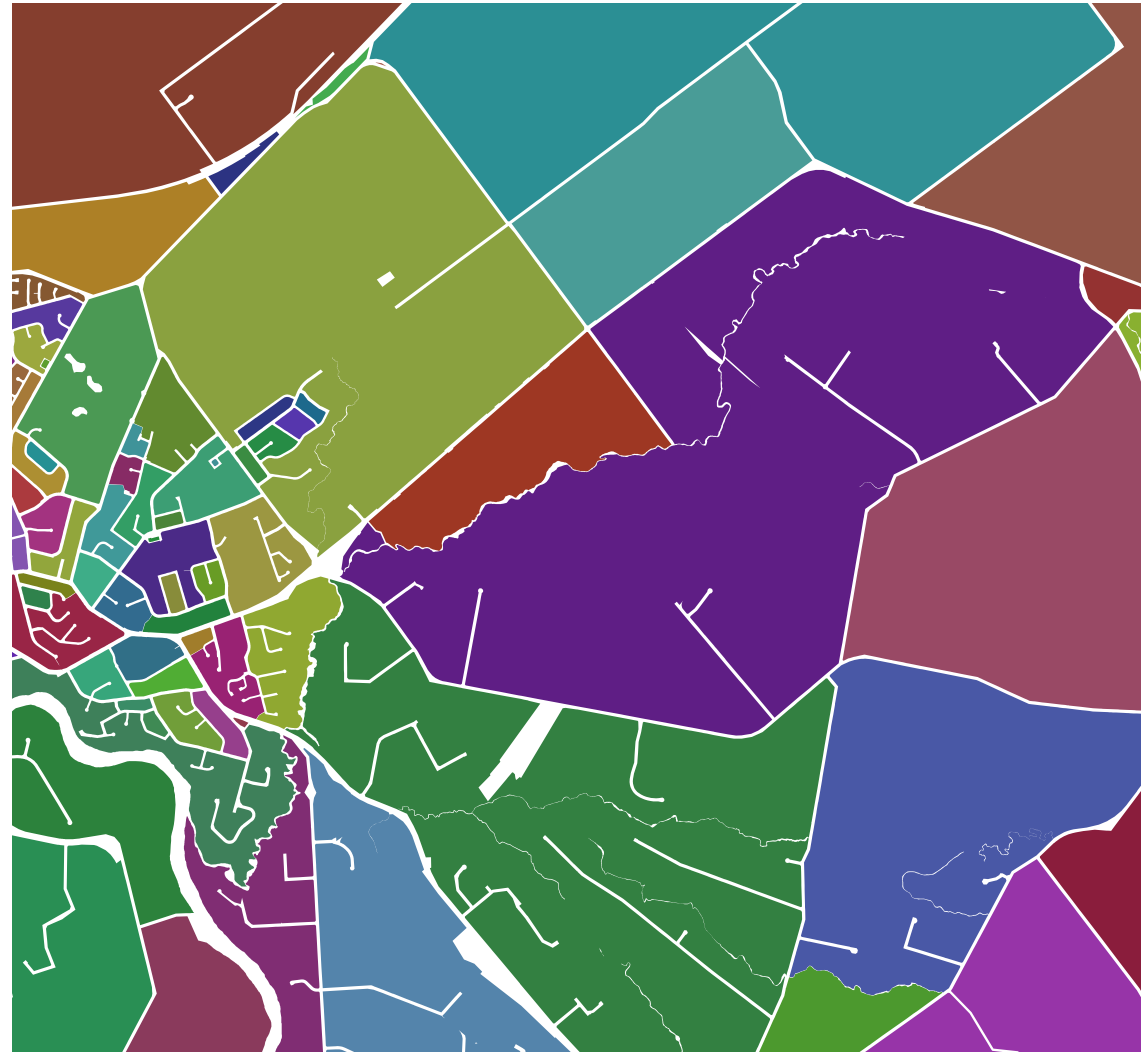
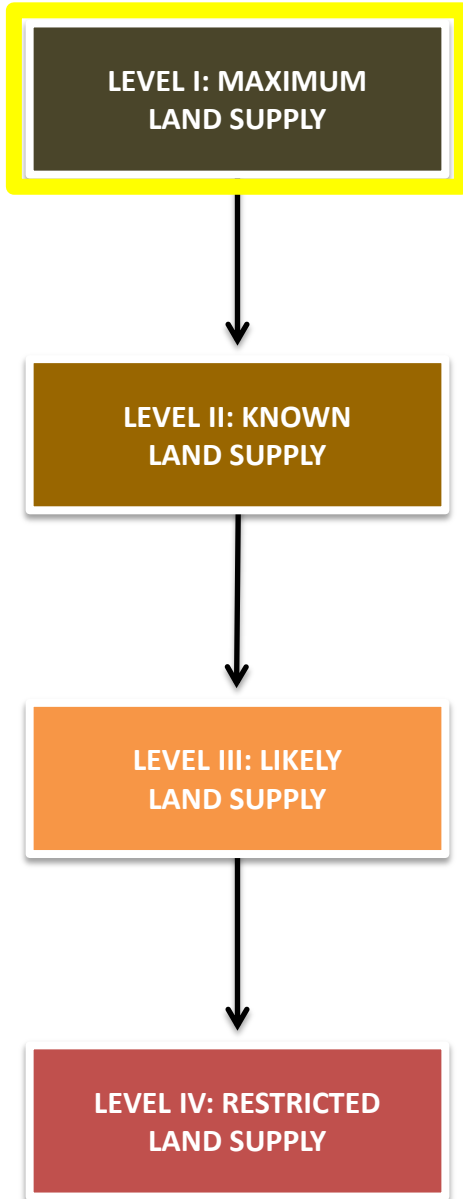
Contiguous areas available for
primary production without
considering current land use or
land cover

Likely land supply
excluding potential indirect
effects (e.g. reverse sensitivity)

INDICATOR

METHOD

Region Area –
Biophysical Networks
(Water, Transport)

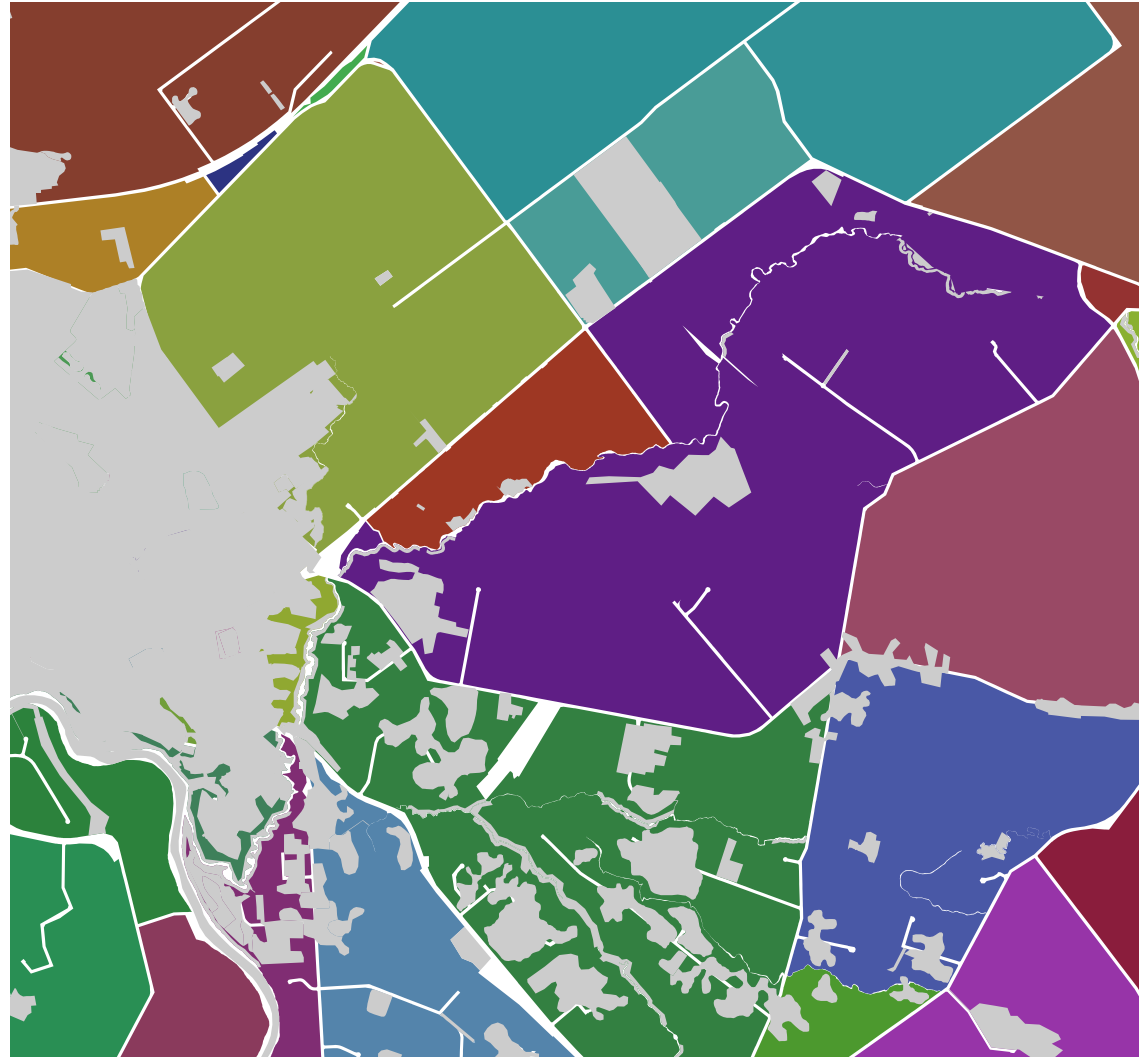
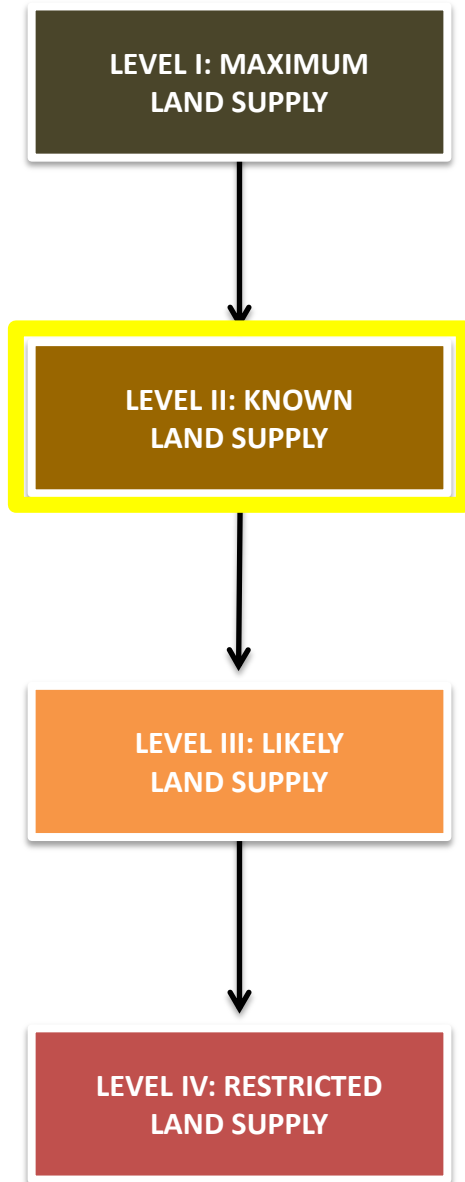


Note: Different colours represent different individual polygons

INDICATOR

METHOD

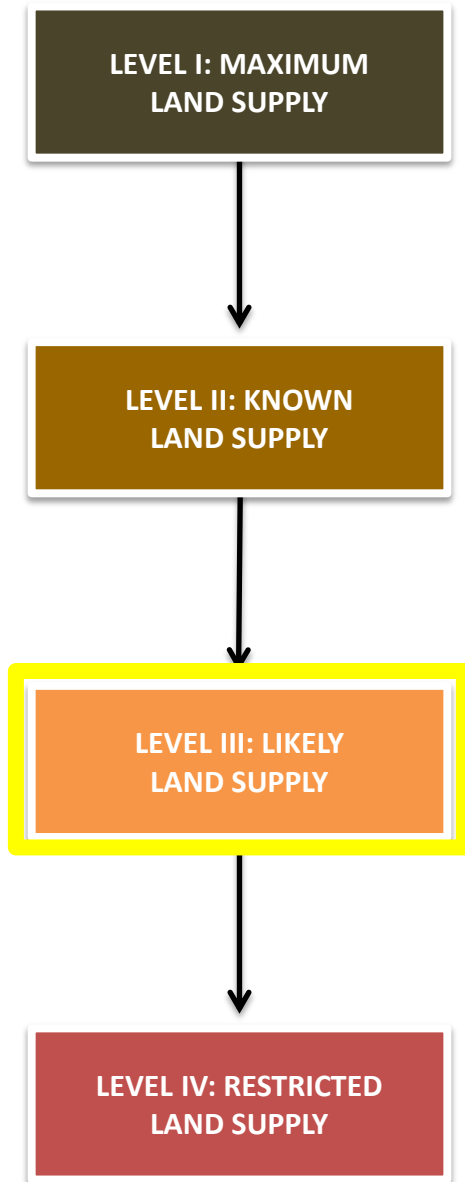
Maximum Land Supply
– Urban Areas
– Protected Areas



INDICATOR

METHOD

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address



INDICATOR

METHOD

Known Land Supply –
Buffer Areas of
Specified Land Uses

LEVEL I: MAXIMUM
LAND SUPPLY



LEVEL II: KNOWN
LAND SUPPLY



LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY



Likely Land Supply:

Why Parcels + Electoral Address Points?

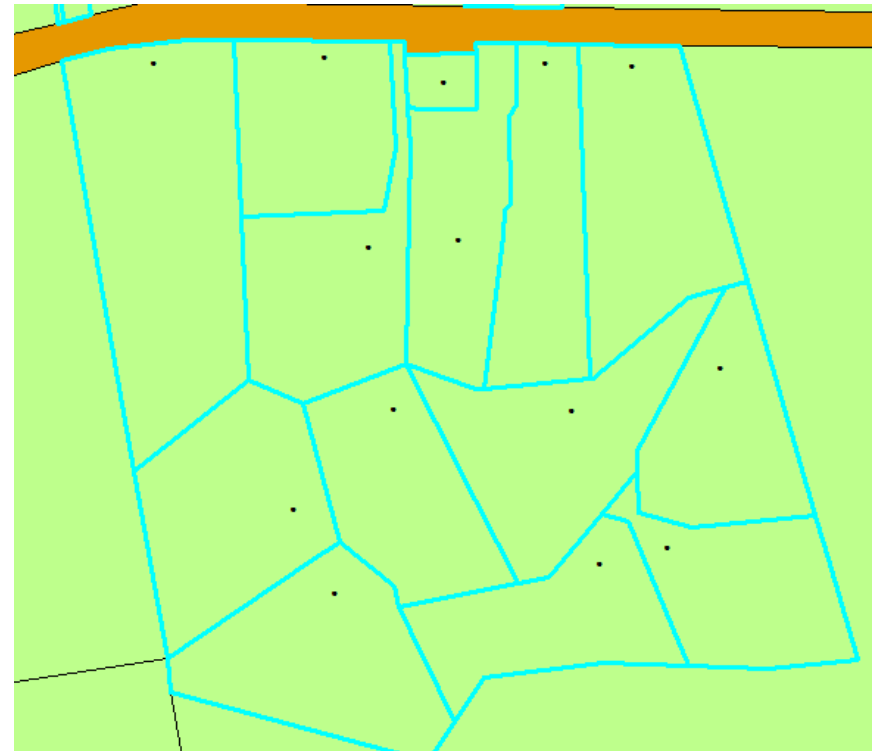
- Proxy for diffuse, rural residential/peri-urban development
- Satisfies PAN Principle
 - Public: via LINZ Data Service – data.linz.govt.nz
 - Authoritative: parcels & address points are legal entities
 - National: but fine-scale detail
- Regular updates: track change over time
- Flexible: set parcel size threshold based on the question



Pukekohe East Road, Pukekohe



Aerial image ©2014 DigitalGlobe via GoogleMaps

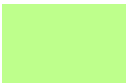



LCDB4.0 High-producing Exotic Grassland

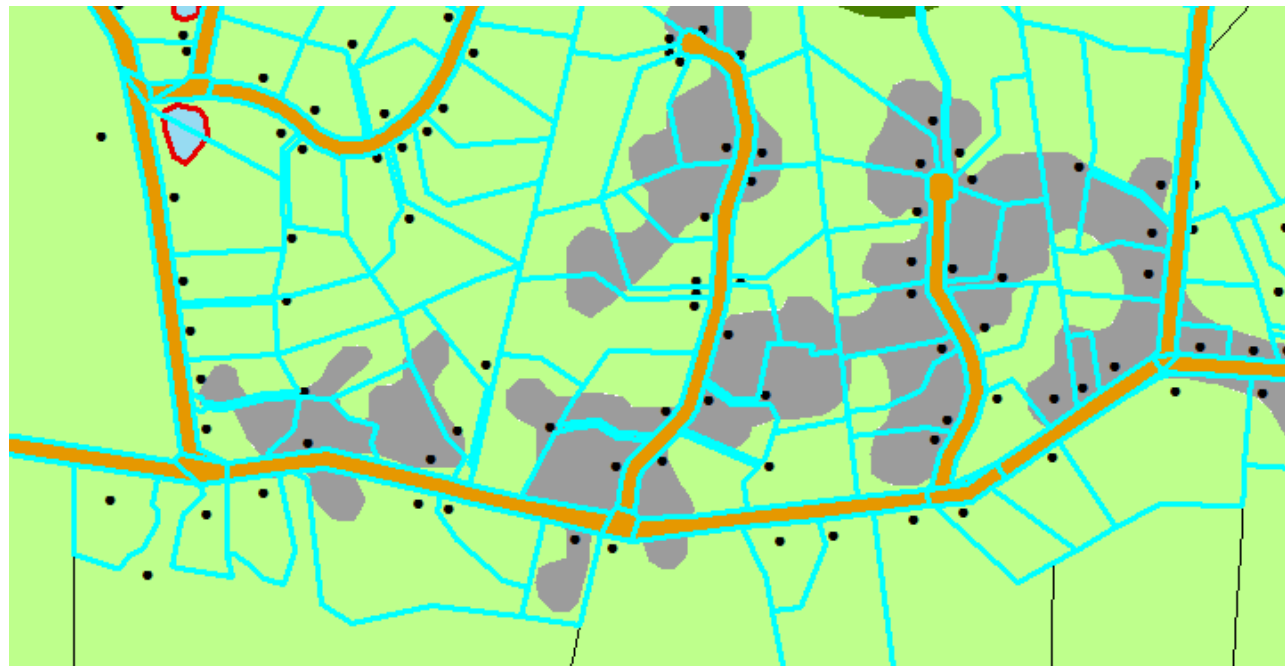


Aerial image ©2014 DigitalGlobe via GoogleMaps

Rotokauri Road, Hamilton

 LCDB4.0 High-producing
Exotic Grassland





 LCDB4.0 Built-up
Areas/Settlements





Aerial image ©2014 DigitalGlobe via GoogleMaps

Tram Road, Christchurch


-  LCDB4.0 High-producing Exotic Grassland
-  LCDB4.0 Built-up Areas/
Settlements
-  LCDB4.0 Orchard, Vineyard
and Other Perennial Crops
-  LCDB4.0 Short-rotation Cropland

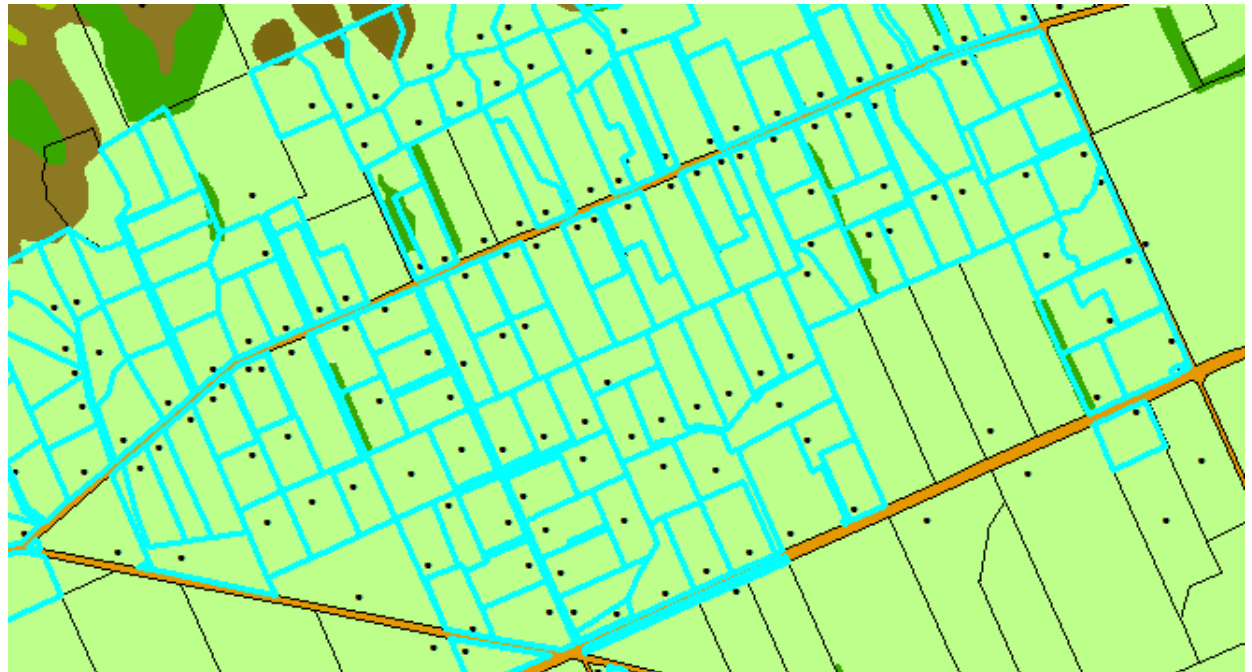




Aerial image ©2014 DigitalGlobe via GoogleMaps

Tirohanga Road, Otago

 LCDB4.0 High-producing Exotic Grassland



EXAMPLE: WELLINGTON REGION

INDICATOR

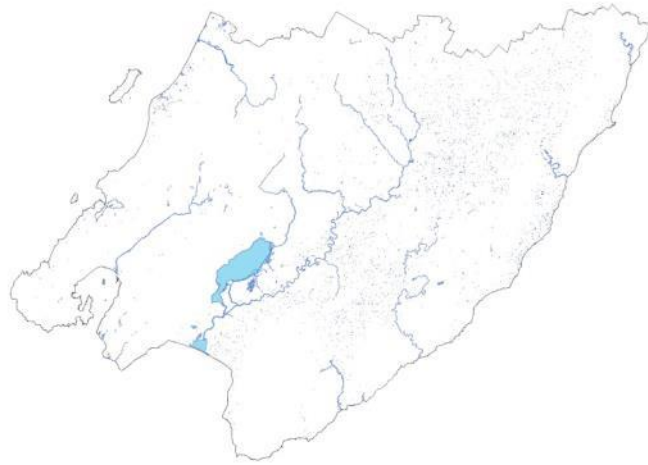
LEVEL I: MAXIMUM
LAND SUPPLY

LEVEL II: KNOWN
LAND SUPPLY

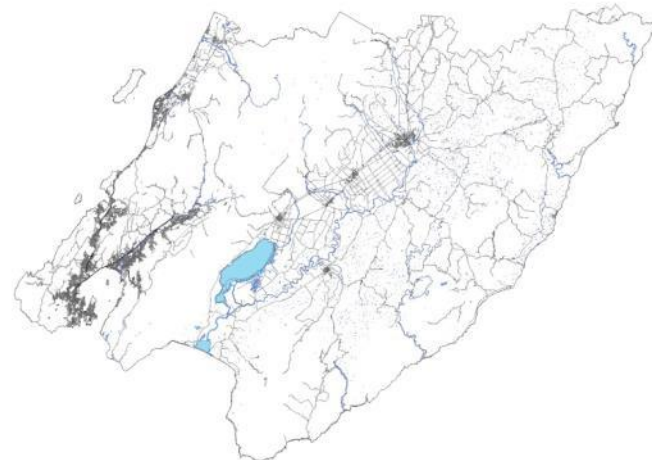
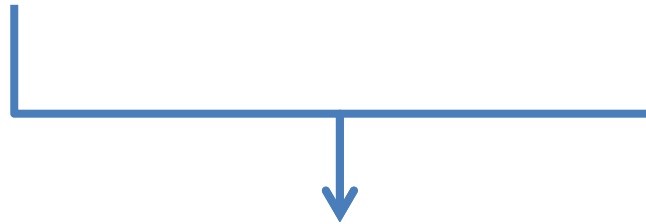
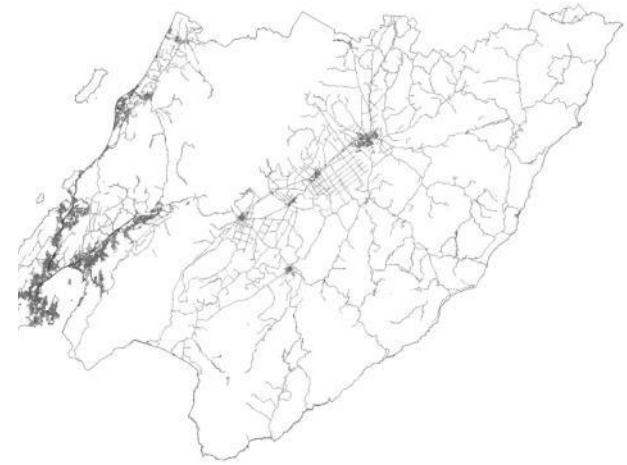
LEVEL III: LIKELY
LAND SUPPLY

LEVEL IV: RESTRICTED
LAND SUPPLY

Water Networks



Transport Networks

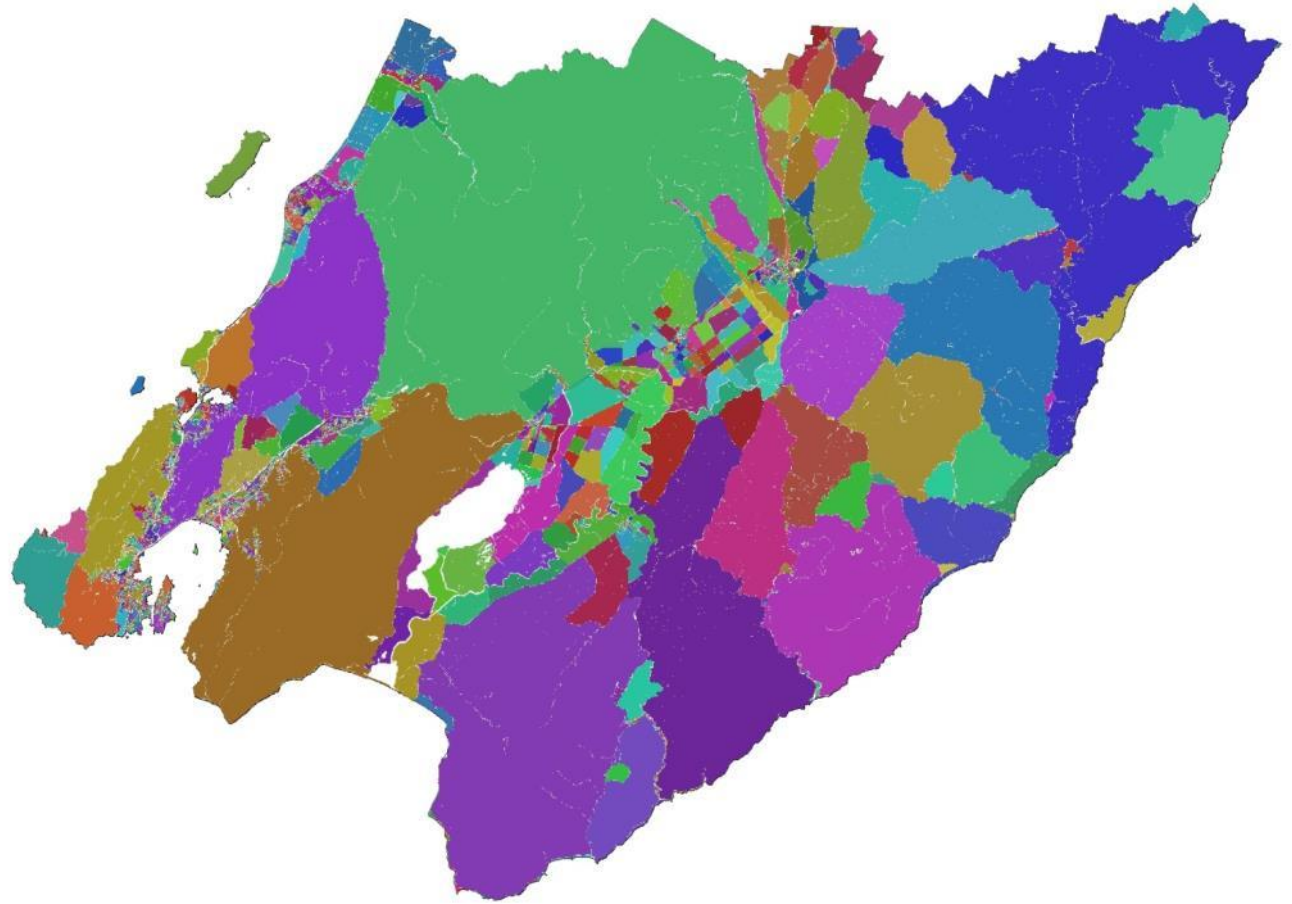


Water &
Transport
Networks

INDICATOR

METHOD

Region Area –
Biophysical Networks
(Water, Transport)



INDICATOR

METHOD

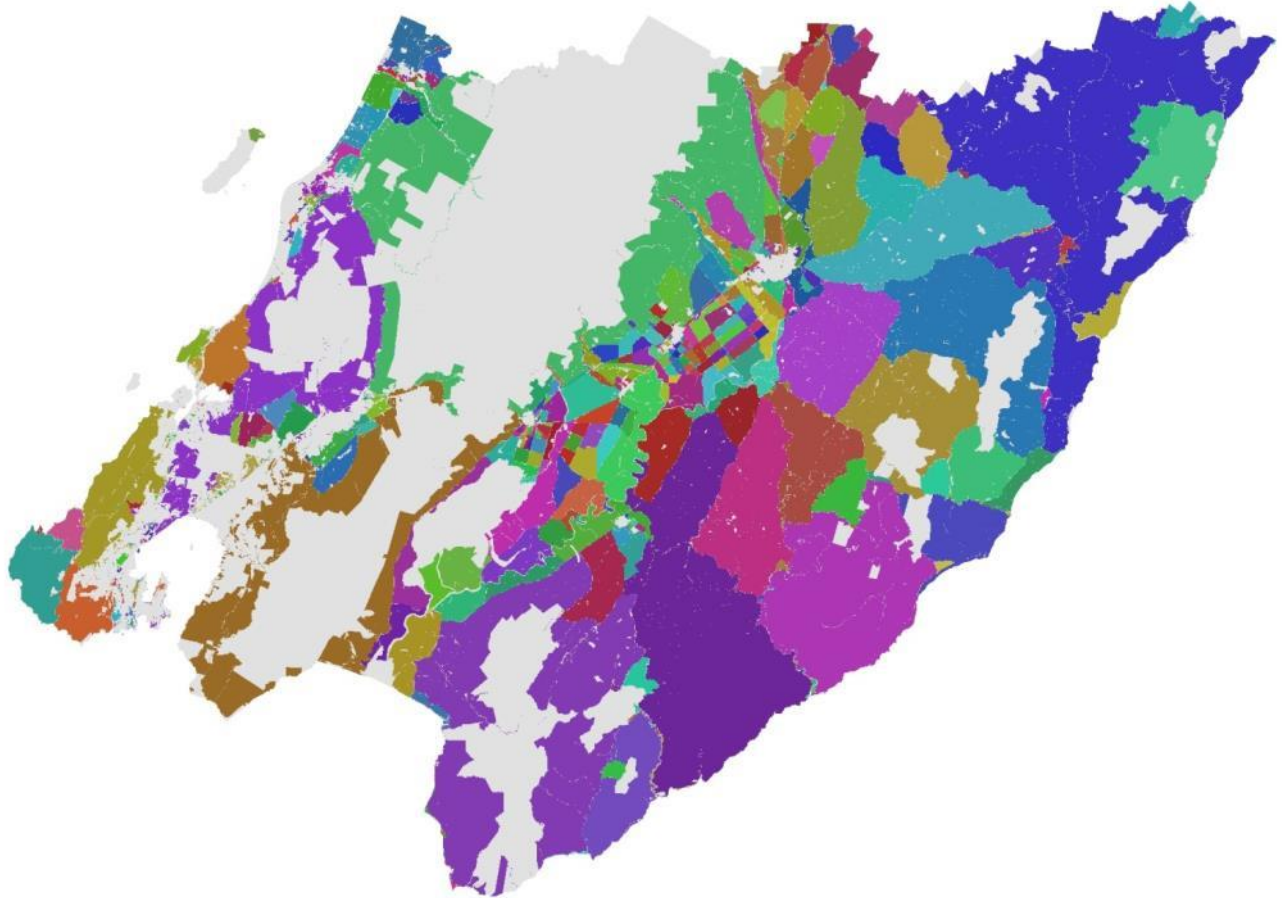
Maximum Land Supply
– Urban Areas
– Protected Areas

LEVEL I: MAXIMUM
LAND SUPPLY

LEVEL II: KNOWN
LAND SUPPLY

LEVEL III: LIKELY
LAND SUPPLY

LEVEL IV: RESTRICTED
LAND SUPPLY



INDICATOR

METHOD

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address

LEVEL I: MAXIMUM
LAND SUPPLY



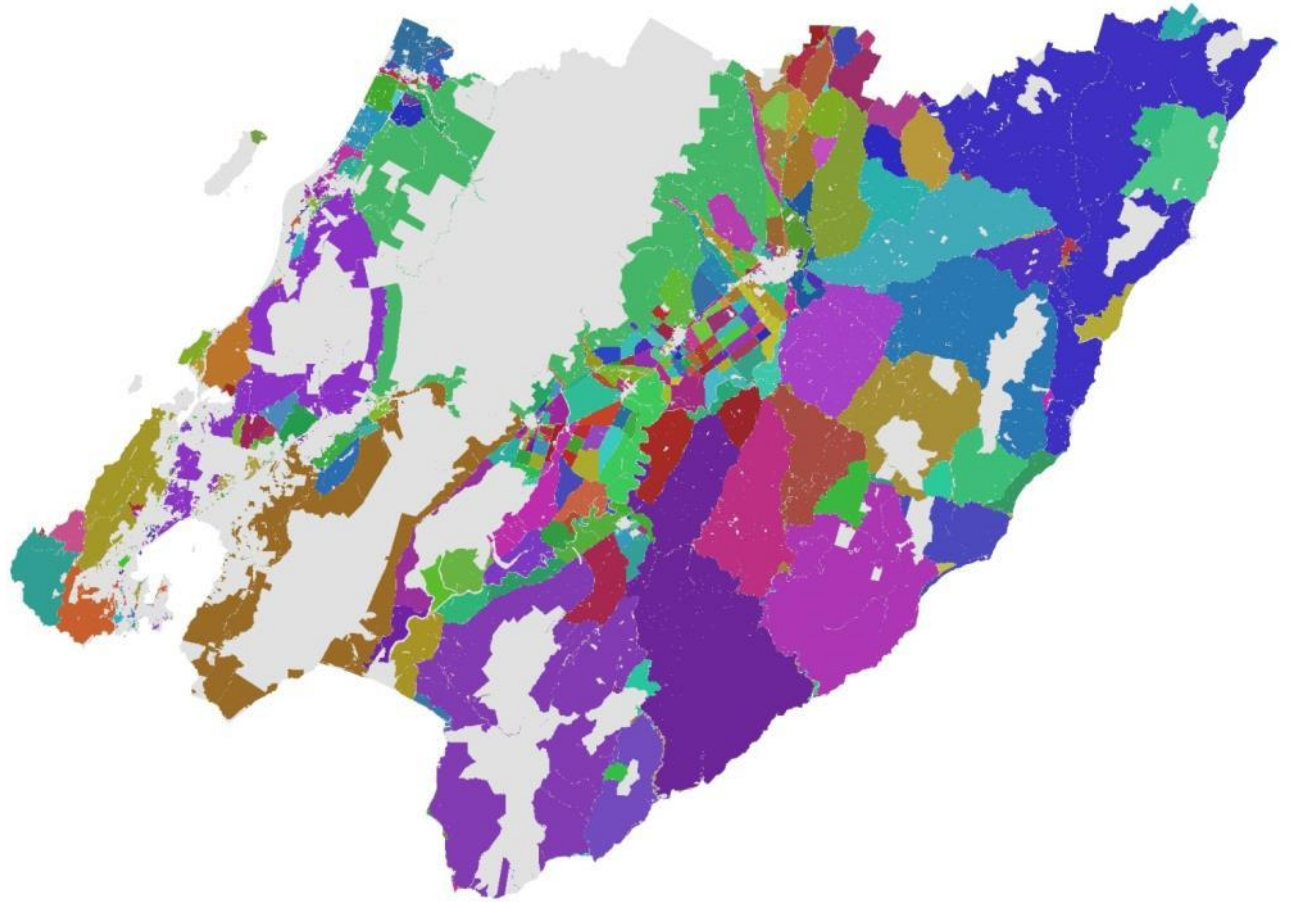
LEVEL II: KNOWN
LAND SUPPLY



LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY

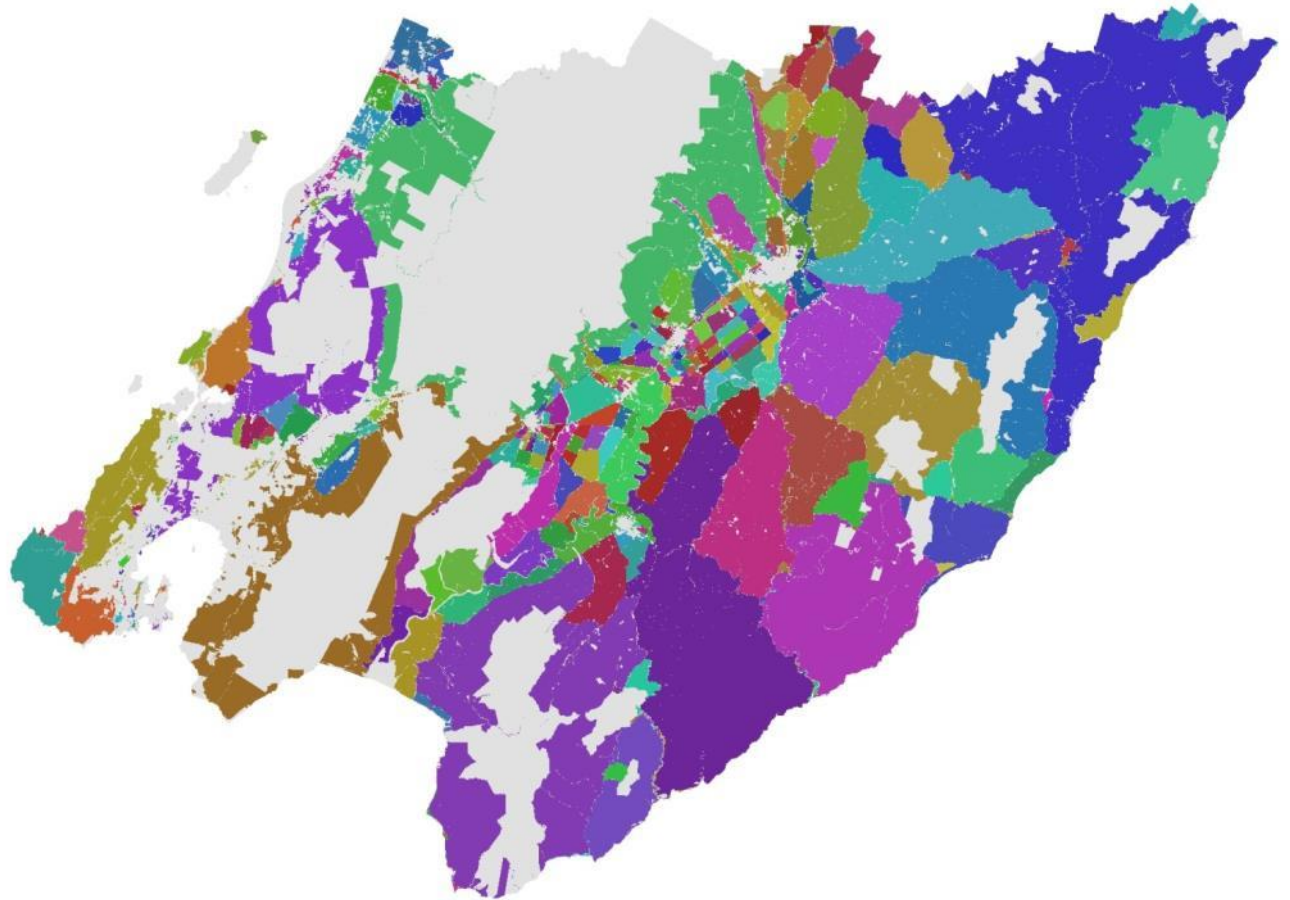
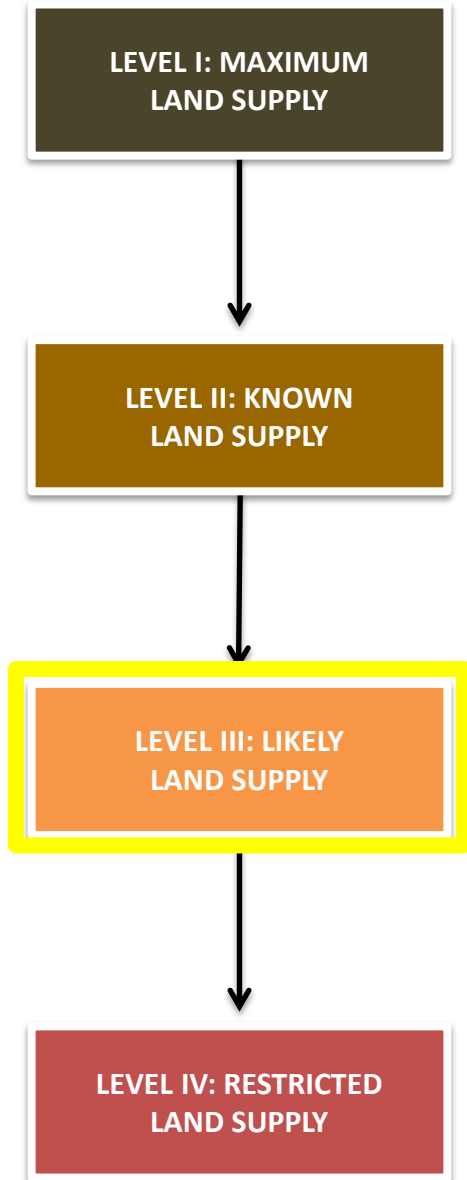


Parcel Size < 1 Hectare

INDICATOR

METHOD

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address

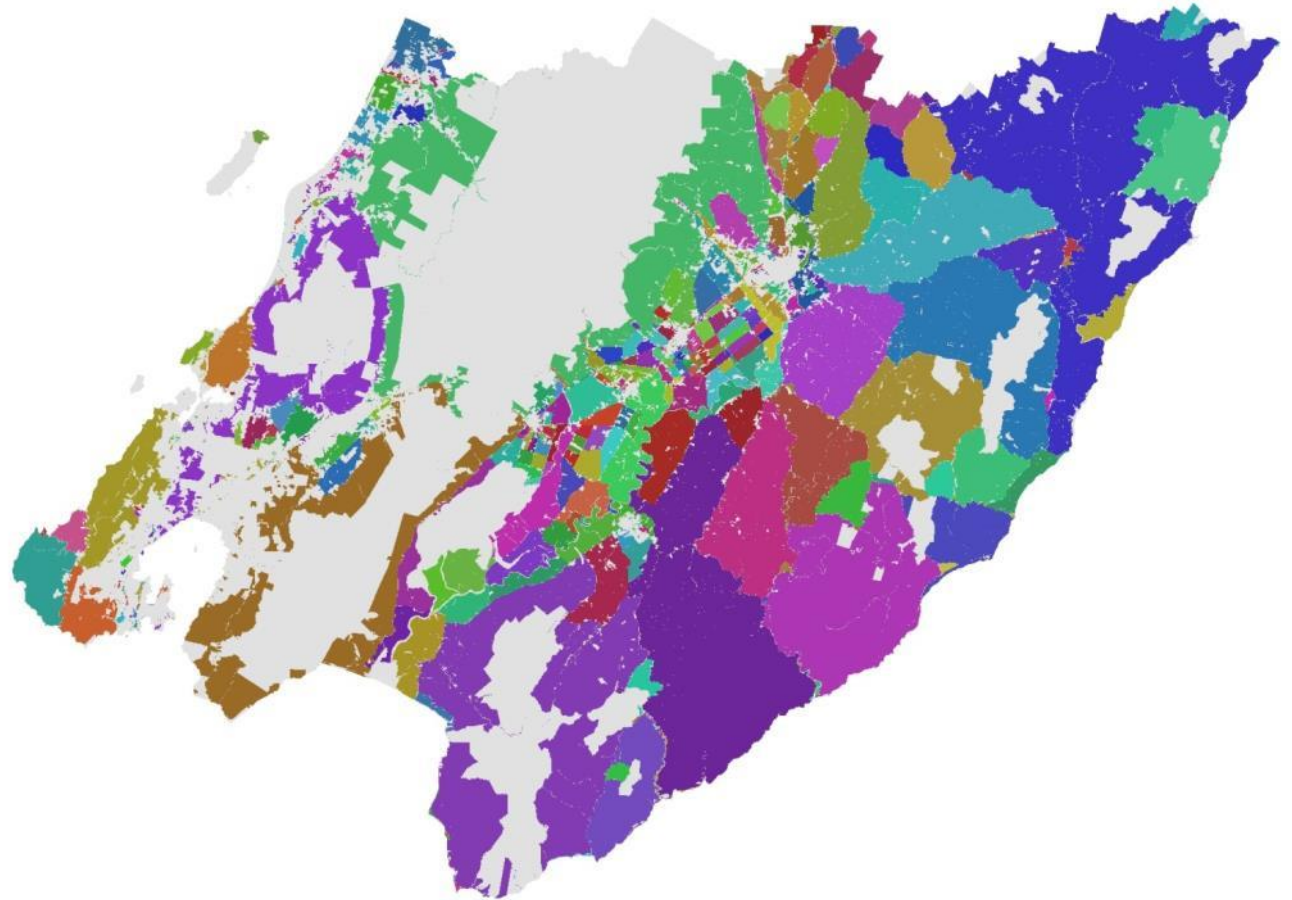
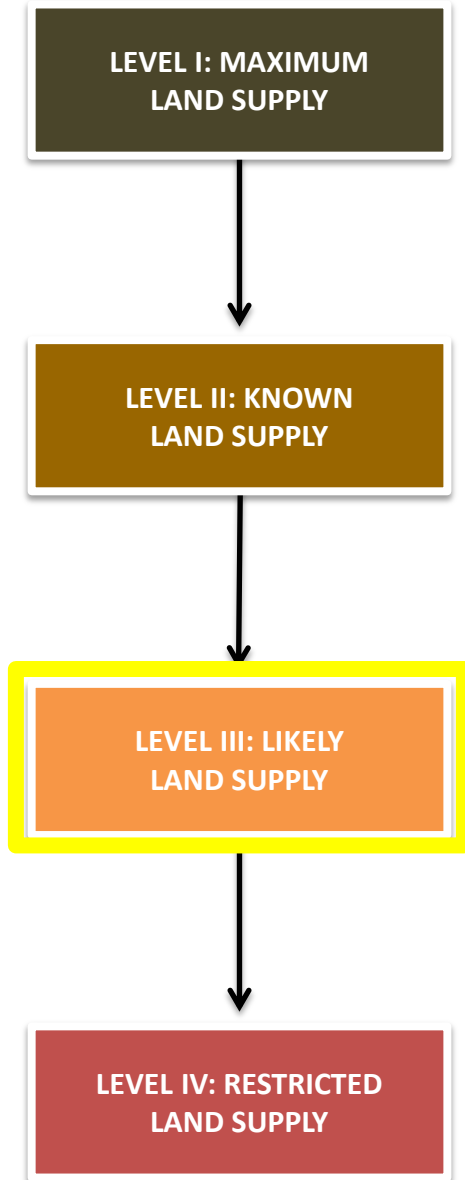


Parcel Size < 4 Hectares

INDICATOR

METHOD

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address



Parcel Size < 10 Hectare

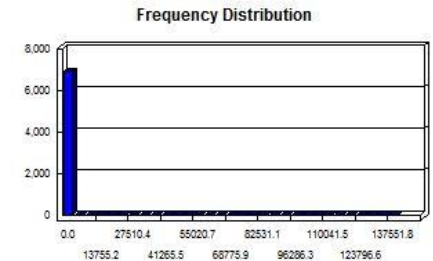
Wellington Region Indicators

Area (ha)	# of Polygons	Polygon Distribution
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LEVEL I: MAXIMUM LAND SUPPLY

787,207

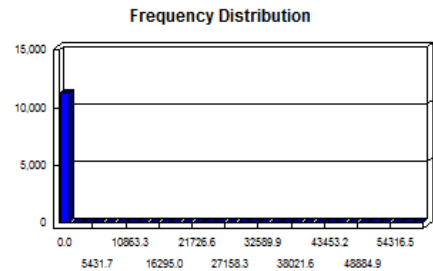
6,915



LEVEL II: KNOWN LAND SUPPLY

554,414

11,373



LEVEL III: LIKELY LAND SUPPLY

< 1 ha
< 4 ha
< 10 ha

552,360

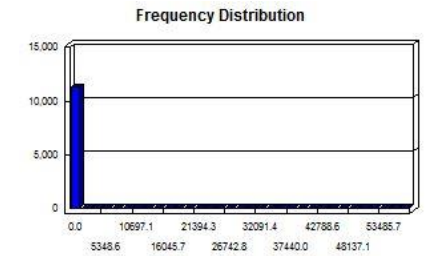
544,563

530,604

10,766

10,993

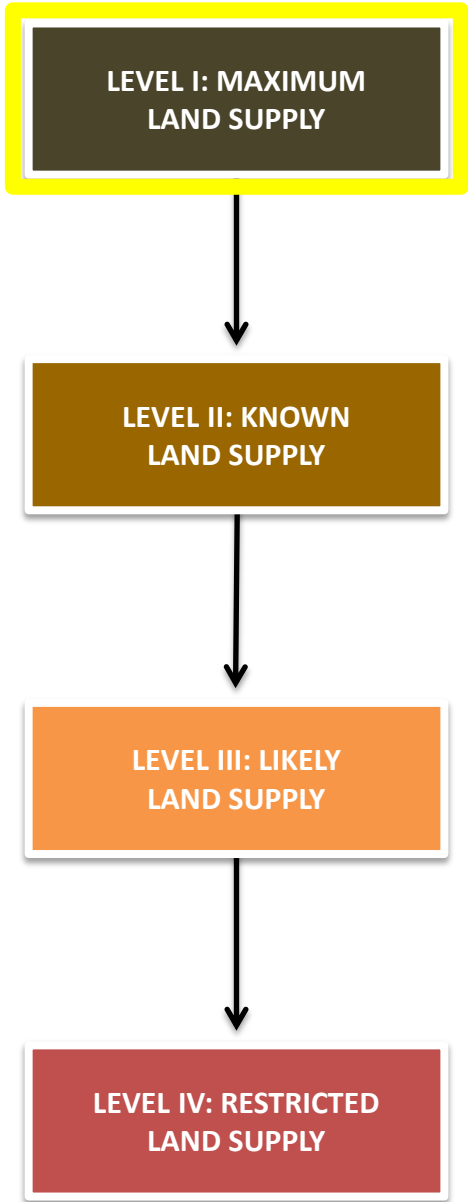
11,359



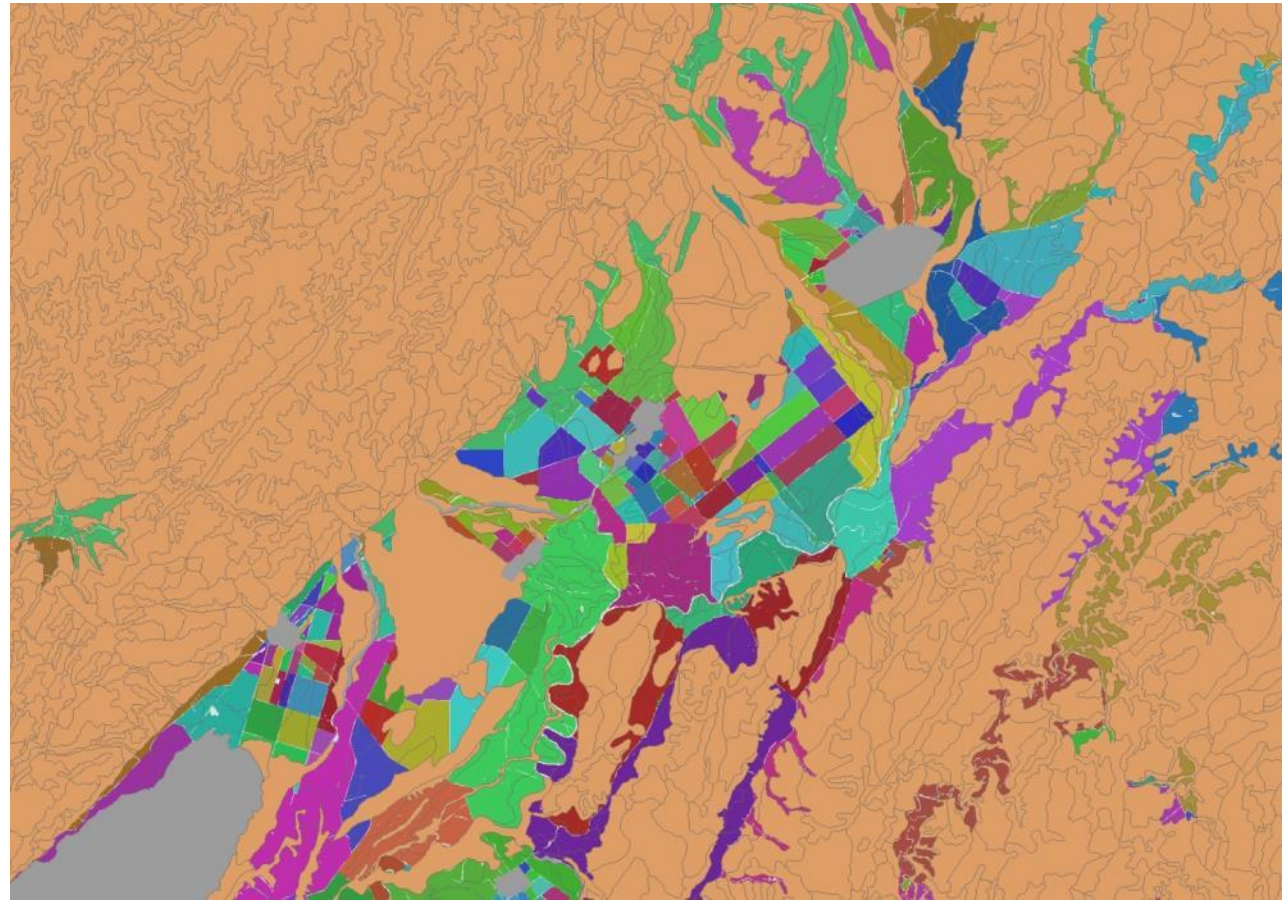
INDICATOR

METHOD

Region Area –
Biophysical Networks
(Water, Transport)



LUC Class 1-3 Land around Masterton-Carterton-Greytown Area



INDICATOR

METHOD

Maximum Land Supply
– Urban Areas
– Protected Areas

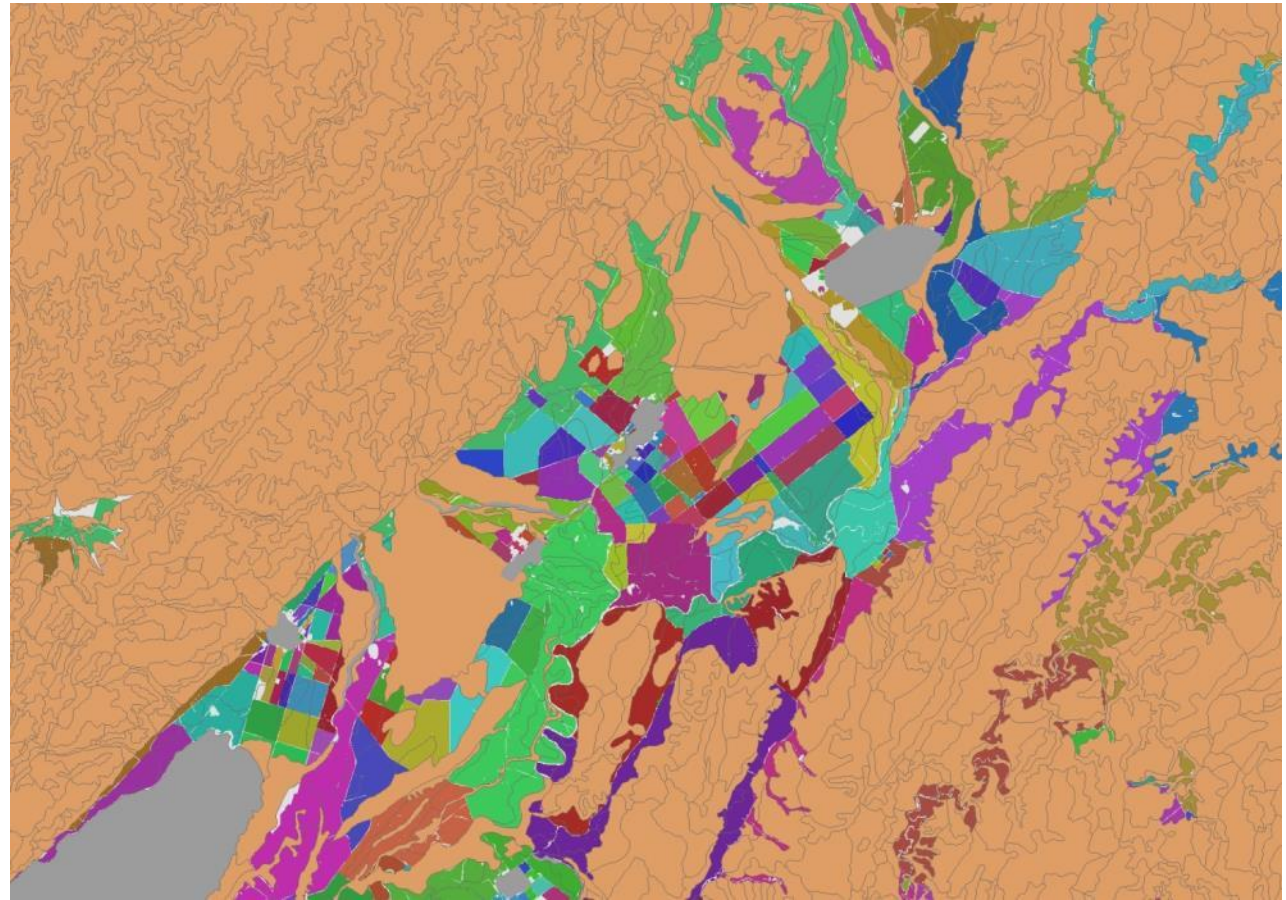
LEVEL I: MAXIMUM
LAND SUPPLY

LEVEL II: KNOWN
LAND SUPPLY

LEVEL III: LIKELY
LAND SUPPLY

LEVEL IV: RESTRICTED
LAND SUPPLY

LUC Class 1-3 Land around Masterton-Carterton-Greytown Area



INDICATOR

METHOD

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address

LEVEL I: MAXIMUM
LAND SUPPLY



LEVEL II: KNOWN
LAND SUPPLY

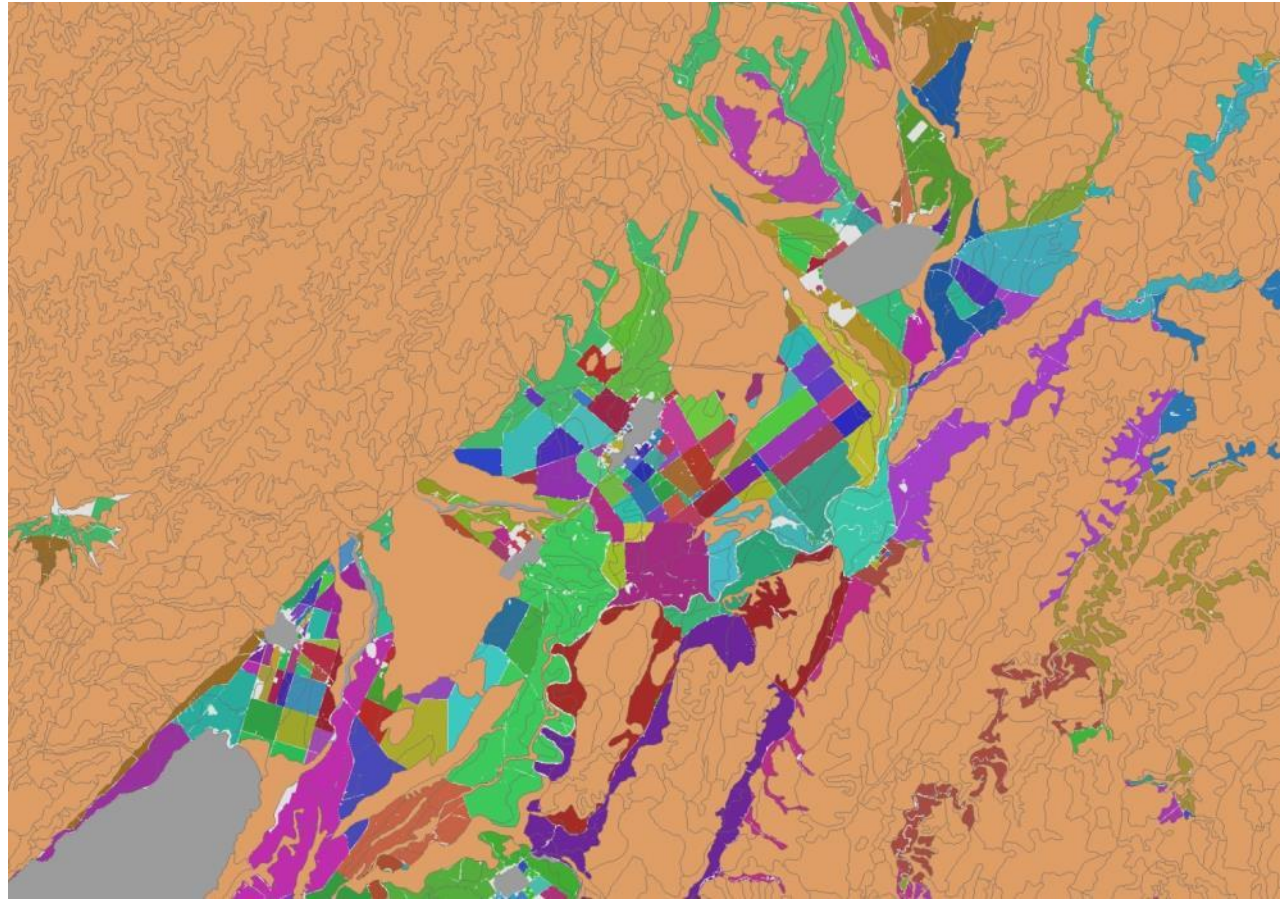


LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY

LUC Class 1-3 Land around Masterton-Carterton-Greytown Area



Parcel Size < 1 Hectare

INDICATOR

METHOD

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address

LEVEL I: MAXIMUM
LAND SUPPLY



LEVEL II: KNOWN
LAND SUPPLY

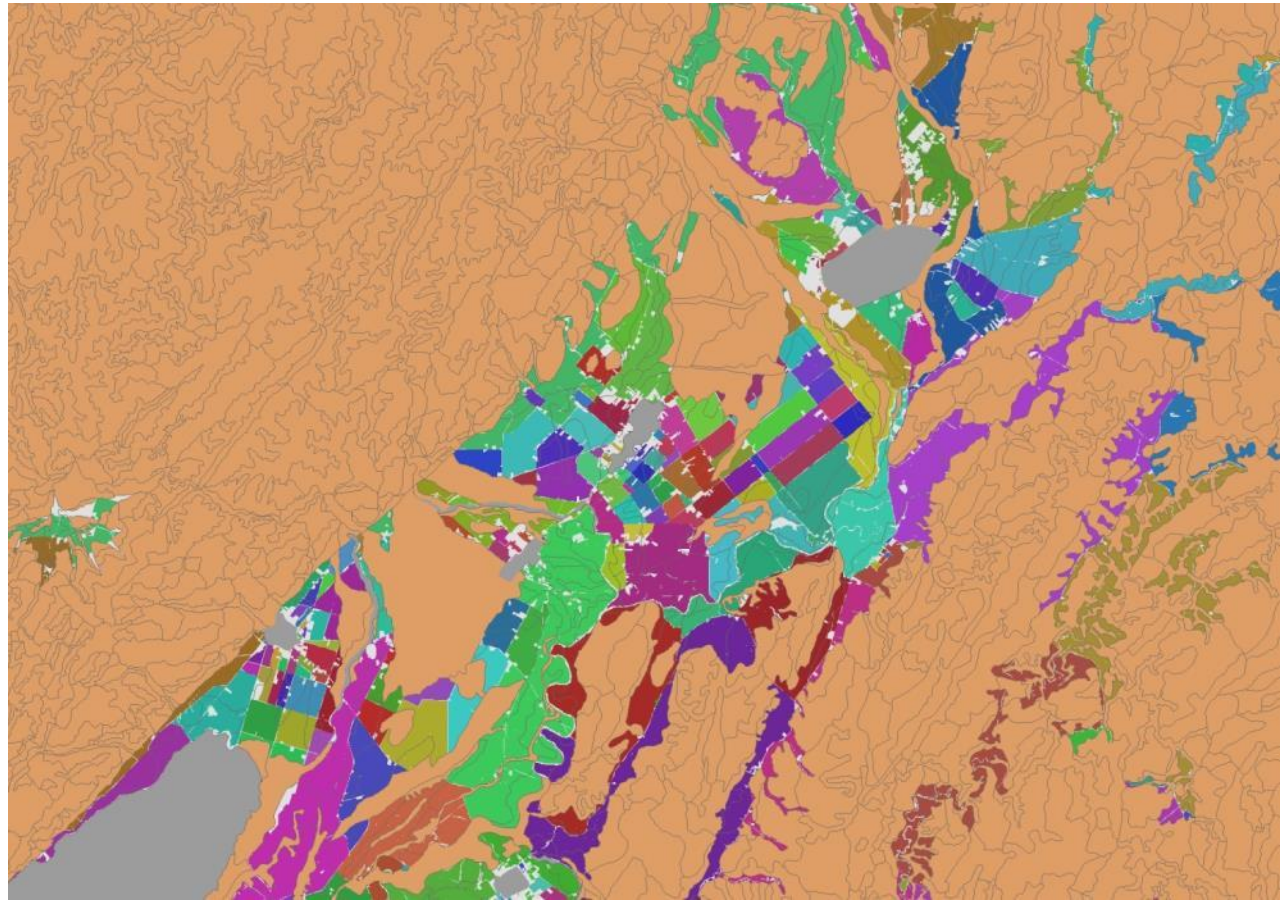


LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY

LUC Class 1-3 Land around Masterton-Carterton-Greytown Area



Parcel Size < 4 Hectares

INDICATOR

METHOD

Known Land Supply –
Parcels $\leq n$ ha
+ Electoral Address

LEVEL I: MAXIMUM
LAND SUPPLY



LEVEL II: KNOWN
LAND SUPPLY

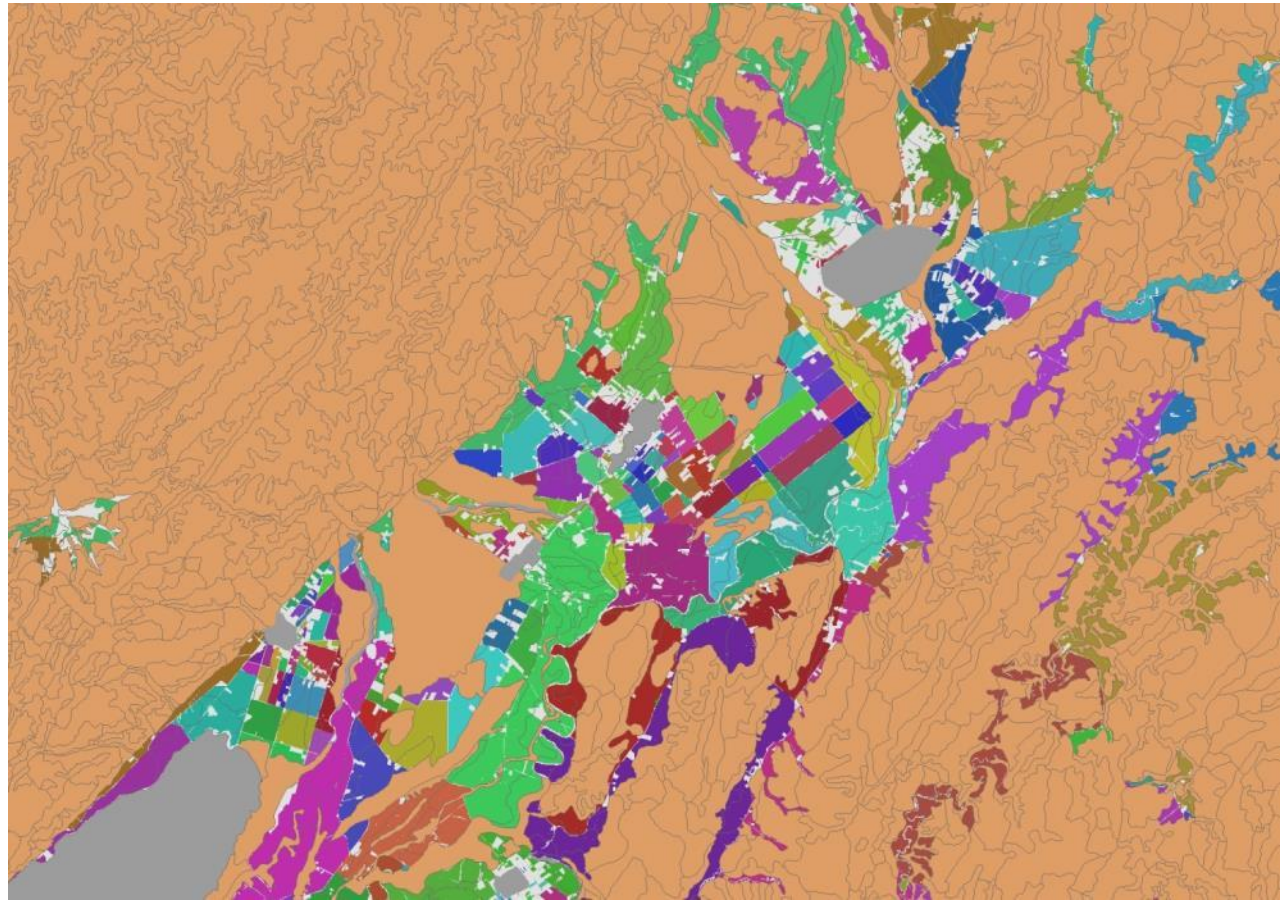


LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY

LUC Class 1-3 Land around Masterton-Carterton-Greytown Area



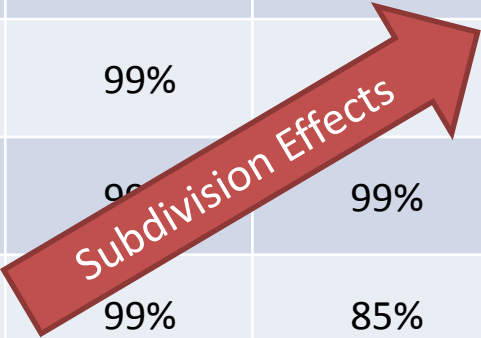
Parcel Size < 10 Hectare

LRI LUC Class Areas

LUC Class	Original	Maximum	Known	Likely < 1 ha	Likely < 4 ha	Likely < 10 ha
1	10,390	96%	93%	91%	86%	75%
2	59,693	96%	94%	93%	91%	85%
3	175,107	97%	93%	93%	90%	85%
4	81,719	99%	88%	88%	85%	81%
5	16,920	99%	99%	99%	99%	98%
6	546,551	99%	85%	85%	84%	82%
7	464,261	99%	65%	65%	65%	65%
8	204,242	100%	8%	8%	8%	8%

LRI LUC Class Areas

LUC Class	Original	Maximum	Known	Likely < 1 ha	Likely < 4 ha	Likely < 10 ha
1	10,390	96%	93%	91%	86%	75%
2	59,693	96%	94%	93%	91%	85%
3	175,107	97%	93%	93%	90%	85%
4	81,719	99%	99%	88%	85%	81%
5	16,920	99%	99%	99%	99%	98%
6	546,551	99%	85%	85%	84%	82%
7	164,111	99%	65%	65%	65%	65%
8	204,112	100%	8%	8%	8%	8%



INDICATOR

METHOD

Known Land Supply –
Buffer Areas of
Specified Land Uses

LEVEL I: MAXIMUM
LAND SUPPLY



LEVEL II: KNOWN
LAND SUPPLY



LEVEL III: LIKELY
LAND SUPPLY



LEVEL IV: RESTRICTED
LAND SUPPLY

Buffer Example: Masterton Area



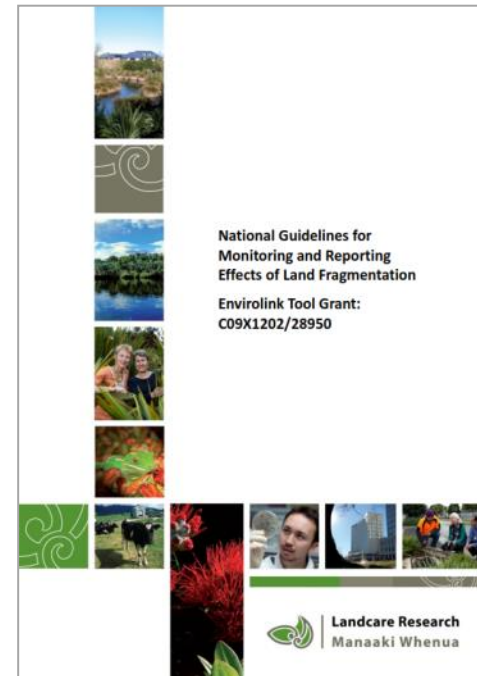
4 ha Parcels with 200m Buffer Zone

Summary

- Envirolink Tools Project developed 1st generation, nationally consistent guidelines for monitoring effects of land fragmentation
- Indicators can monitor trends in land supply for primary production and reverse sensitivity as prioritised by regional councils
- Monitoring & indicators derived solely from public, authoritative, and national data (PAN Principle)
- Flexible framework allows both standard & customised reporting + potential to develop additional tailored indicators
- Current guidelines & indicators do not consider proximity or spatial configuration of remaining areas of land supply

More Information

www.envirolink.govt.nz/PageFiles/31/R83%20Guidelines%20for%20monitoring%20land%20fragmentation.pdf



The screenshot shows the Landcare Research website. At the top left is the Landcare Research logo and name. To the right is a search bar with "The Whole Site" selected. Below the logo is a navigation menu with links for HOME, ABOUT US, OUR SCIENCE, PUBLICATIONS, and RESOURCES. Underneath is a secondary menu with links for Plants, animals & fungi, Greenhouse gases, Soils & landscapes, Sustainable business & living, E-science, and Research portfolios. The main content area shows the breadcrumb trail: Home > Our Science > Sustainable business & living > Sustainable futures > Monitoring land fragmentation. The title "GUIDELINES FOR MONITORING LAND FRAGMENTATION" is prominently displayed. Below the title is an "Overview" section with the text: "Land is a finite resource. Increasing competition among different land uses including urban, productive and conservation could fragment land such that the resulting units become unsuitable for certain types of activities. Of particular concern are the potential long-term impacts and implications of land fragmentation for New Zealand's soils resources and productive capacity." On the left side, there is a sidebar menu under "SUSTAINABLE BUSINESS & LIVING" with links for Cities, settlements & communities, Indigenous knowledge, Sustainable business, Sustainable futures, Future Scenarios, and Monitoring land fragmentation (which is highlighted).

www.landcareresearch.co.nz/science/living/sustainable-futures/monitoring-land-fragmentation