

# Health and Air Pollution in New Zealand

## APPENDICES

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## Appendix 1 – Tables

Tables of the exposure and calculated effects for each of the 67 urban areas covered, for PM<sub>10</sub>, CO and benzene. Annual average NO<sub>2</sub> is also shown, but this is not used in the calculations.

Notes on the data:

1. The base data is from the year 2001, and should be interpreted for other years with caution.
2. The 2001 year was chosen as it is that latest year for which official census figures are available and these were required for the analysis.
3. The data given may not be consistent with other data sources, such as those from Regional Councils and the Ministry for the Environment, for the simple reason that some of the data may have been revised, updated, or is generated for different purposes.

The choice of the 67 urban areas was made for particular reasons (discussed in the main report text) and is not necessarily consistent with any other determination of 'urban' areas in New Zealand. Indeed it must be noted that 'urban' is defined differently by different departments such as Environment, Economic Development, Health, Education, Social Welfare etc.

Tables include:-

1. The basic annual concentrations of various pollutants used in the study, including a breakdown of PM<sub>10</sub> by source.
2. The annual pre-mature mortality calculations for PM<sub>10</sub>, by source including background.
3. The annual pre-mature mortality calculations for PM<sub>10</sub>, by source excluding background.  
*NB Both of these tables are include as they are both used in various types of policy analysis and further calculations. The user has to select the one more appropriate their particular purpose. For most of the conclusions in this report, the values excluding background have been used.*
4. The rates of heart failure associated with CO.
5. The combined pre-mature mortality effects for PM<sub>10</sub> and CO (excluding background).
6. Cancer case associated with benzene.
7. Morbidity (illness) associated with PM<sub>10</sub> and CO.
8. Number of restricted activity days.
9. Comparison of the mortality rates associated with air pollution, with the natural rates, for the major urban areas.

1. Annual concentrations

City	(all $\mu\text{g m}^{-3}$ , except CO in $\text{mg m}^{-3}$ )				Total PM10	Total CO	Total NO <sub>2</sub>	Total Benzene
	Domestic PM10	Vehicle PM10	Industrial PM10	Background PM10				
Alexandra	20.6	2.8	0.5	2.0	25.9	0.7	16.8	4.1
Arrowtown	14.8	2.2	0.5	2.0	19.5	0.5	12.7	2.2
Ashburton	13.1	3.5	0.9	2.0	19.5	0.5	12.7	2.5
Auckland	4.4	9.9	2.7	4.0	21.0	1.0	22.0	8.8
Balclutha	10.5	3.0	0.5	2.0	16.0	0.4	10.4	1.7
Blenheim	10.3	4.7	1.1	2.0	18.1	0.5	10.8	1.8
Cambridge	3.5	6.8	1.8	2.0	14.1	1.0	21.7	4.8
Christchurch Inner	13.6	5.5	1.6	4.0	24.7	0.7	16.1	3.2
Christchurch Outer	8.1	4.2	1.1	4.0	17.4	1.2	11.3	1.9
Clevedon	1.9	2.6	0.5	2.0	7.1	0.5	10.6	1.7
Cromwell	18.6	2.7	0.5	2.0	23.8	0.7	15.4	3.0
Dunedin	4.5	2.5	1.0	7.5	15.5	0.4	10.1	1.4
Fielding	5.6	3.5	1.1	2.0	12.3	0.8	18.4	3.9
Geraldine	9.7	2.9	0.5	4.0	17.2	0.5	11.2	1.9
Gisborne	4.6	3.2	0.9	2.0	10.7	0.7	16.0	2.0
Gore	13.4	3.1	0.6	2.0	19.1	0.5	12.4	2.2
Hamilton	5.0	5.7	2.0	2.0	14.7	0.9	19.6	5.1
Hastings	1.9	5.1	1.3	2.0	10.3	0.7	15.5	3.5
Hawera	2.5	4.5	1.0	2.0	10.0	0.7	15.0	2.9
Invercargill	13.3	3.5	0.9	2.0	19.7	0.5	12.8	2.3
Kaipoi	16.7	3.6	1.2	2.0	23.4	0.7	15.2	3.3
Kaikoura	1.0	3.3	0.5	16.0	20.9	0.6	13.6	2.5
Leamington	4.1	6.0	1.9	2.0	13.9	1.0	20.9	4.7
Levin	5.6	6.1	0.7	2.0	14.4	1.1	22.8	5.0
Lower Hutt	4.9	7.2	0.9	2.0	15.1	1.0	22.6	4.9
Manukau	2.4	6.3	2.6	3.3	14.6	0.9	20.1	5.4
Masterton	15.9	3.5	0.7	2.0	22.1	0.6	14.4	1.7
Matamata	5.5	7.0	1.7	2.0	16.2	1.1	24.3	5.9
Milton	14.2	3.0	0.5	2.0	19.6	0.5	12.8	2.3
Morrinsville	4.1	6.8	1.1	2.0	14.0	1.0	20.9	4.7
Mosgiel	16.2	1.9	1.3	2.0	21.4	0.6	13.9	2.6
Napier	2.0	5.1	1.3	2.0	10.3	0.7	15.5	3.4
Nelson	19.2	6.0	0.8	8.0	34.0	0.8	19.0	5.7
New Plymouth	0.5	2.2	1.0	8.0	11.7	0.8	17.6	3.7
North Shore	3.2	7.0	2.1	4.0	16.3	1.0	22.0	6.7
Oamaru	13.2	3.3	0.6	4.0	21.1	0.6	13.7	3.0
Opotiki	4.5	3.3	1.0	2.0	10.8	0.7	16.1	3.8
Orewa	3.6	5.4	1.2	2.0	12.1	0.8	18.2	2.5
Palmerston North	3.9	3.9	1.0	3.8	12.7	0.9	19.0	3.9
Papakura	4.6	3.8	2.0	2.2	12.6	0.8	18.3	4.5
Paraparaumu	2.9	3.4	0.8	8.0	15.1	1.0	22.6	4.1
Porirua	2.6	3.9	0.9	6.2	13.6	0.9	19.6	5.3
Pukekohe	4.4	4.4	1.7	2.0	12.5	0.9	18.7	4.6
Putaruru	7.0	4.6	1.1	2.0	14.7	1.0	22.0	4.0
Rangiora	13.5	3.3	0.9	2.0	19.7	0.5	12.8	5.1
Reefton	16.9	6.1	0.5	2.0	25.4	0.7	16.5	2.5
Richmond	10.3	5.2	0.6	2.0	18.1	0.5	11.8	3.3
Rotorua	5.9	4.7	1.3	4.0	15.9	1.1	23.8	2.8
Takanini	2.0	4.6	1.8	4.0	12.4	0.6	13.9	7.1
Taupo	6.0	6.0	1.0	2.0	15.1	1.0	22.5	4.0
Tauranga	2.6	4.2	1.1	6.7	14.6	1.0	21.2	6.7
Te Awamutu	4.8	4.5	1.5	4.0	14.8	1.0	22.2	6.2
Te Kuiti	6.7	5.8	0.8	2.0	15.3	1.1	22.9	5.2
Timaru	12.6	3.7	0.9	4.0	21.2	0.6	13.8	6.9
Tokoroa	15.7	2.3	1.5	2.0	21.5	1.5	32.5	3.0
Upper Hutt	6.4	7.2	1.0	4.0	18.6	1.3	27.8	8.2
Waiheke Island	2.6	5.6	0.4	8.0	16.6	1.1	23.9	7.3
Waimate	11.6	2.9	0.5	2.0	17.0	0.5	11.0	6.2
Wainuiomata	4.4	5.8	0.5	2.0	12.7	0.9	19.0	3.2
Waitakere	4.0	5.4	1.9	4.0	15.3	1.0	21.4	3.6
Waiuku	4.7	4.7	1.5	2.0	12.9	0.9	19.4	5.4
Wanganui	3.9	6.8	0.9	2.0	13.7	0.9	20.5	4.2
Wellington	1.4	2.5	1.2	6.7	11.8	0.8	17.2	4.6
Westport	8.5	7.2	0.5	4.0	20.1	0.6	13.1	6.8
Whakatane	4.3	3.4	0.8	2.0	10.5	0.7	15.7	2.3
Whangarei	7.3	5.9	0.9	4.0	18.1	1.2	24.9	3.8
Winton	21.5	3.0	0.5	2.0	27.0	0.8	17.5	7.0
<b>Average</b>	<b>7.7</b>	<b>4.5</b>	<b>1.1</b>	<b>3.3</b>	<b>16.6</b>	<b>0.8</b>	<b>17.6</b>	<b>4.1</b>
<b>Percentage</b>	<b>46%</b>	<b>27%</b>	<b>6%</b>	<b>20%</b>	<b>100%</b>			

City	2. Annual mortality (including Background)		PM <sub>10</sub> only Industrial Mortality	Background Mortality	Total Mortality	Per 1000 Pop
	Domestic Mortality	Vehicle Mortality				
Alexandra	2.8	0.4	0.1	0.3	3.6	0.81
Arrowtown	0.8	0.1	0.0	0.1	1.0	0.60
Ashburton	5.9	1.6	0.4	0.9	8.9	0.63
Auckland City	32.7	73.4	20.3	29.6	156.0	0.43
Balclutha	1.3	0.4	0.1	0.3	2.0	0.50
Blenheim	5.8	3.1	0.7	1.3	10.9	0.52
Cambridge	0.6	1.2	0.3	0.4	2.5	0.51
Christchurch Inner	53.2	26.9	7.6	22.9	110.6	0.83
Christchurch Outer	35.5	17.9	5.0	15.3	73.7	0.40
Clevedon	0.2	0.3	0.1	0.2	0.7	0.22
Cromwell	1.5	0.2	0.0	0.2	1.9	0.72
Dunedin	11.0	6.2	2.5	18.1	37.8	0.46
Fielding	2.1	1.3	0.4	0.7	4.5	0.36
Geraldine	0.7	0.2	0.0	0.3	1.3	0.57
Gisborne	3.6	2.6	0.7	1.6	8.5	0.29
Gore	3.8	0.9	0.2	0.6	5.4	0.71
Hamilton	10.5	17.5	6.2	6.2	40.4	0.35
Hastings	2.1	5.5	1.4	2.2	11.2	0.26
Hawera	0.6	1.0	0.2	0.5	2.3	0.30
Invercargill	15.9	4.4	1.1	2.5	23.9	0.57
Kaiapoi	4.5	1.0	0.3	0.6	6.4	0.69
Kaikoura	0.1	0.2	0.0	1.1	1.4	0.67
Leamington	0.8	1.1	0.4	0.4	2.6	0.41
Levin	2.1	2.5	0.3	0.8	5.7	0.47
Lower Hutt	13.4	19.5	2.5	5.5	41.0	0.52
Manukau	9.1	46.8	19.6	24.8	100.3	0.36
Masterton	8.0	1.9	0.4	1.1	11.4	0.65
Matamata	1.0	1.3	0.3	0.4	3.1	0.51
Milton	0.8	0.2	0.0	0.1	1.1	0.59
Morrinsville	0.7	1.2	0.2	0.4	2.5	0.69
Mosgiel	3.2	0.4	0.3	0.4	4.3	0.69
Napier	3.0	7.6	2.0	3.0	15.7	0.31
Nelson	9.0	3.9	0.5	5.1	18.5	1.23
New Plymouth	0.8	3.4	1.5	12.0	17.6	0.36
North Shore	8.9	38.3	11.7	22.1	81.1	0.44
Oamaru	4.6	1.2	0.2	1.4	7.4	0.67
Opotiki	0.5	0.3	0.1	0.2	1.1	0.28
Orewa	3.1	4.6	1.0	1.7	10.4	0.39
Palmerston North	8.0	8.0	2.1	7.8	25.9	0.37
Papakura	3.5	3.0	1.7	1.9	10.1	0.34
Paraparaumu	2.0	2.3	0.5	5.3	10.1	0.47
Porirua	3.1	4.8	1.0	7.7	16.5	0.35
Pukekohe	1.4	1.4	0.5	0.6	3.9	0.36
Putaruru	0.8	0.5	0.1	0.2	1.6	0.43
Rangiora	4.3	1.1	0.3	0.7	6.4	0.74
Reefton	0.5	0.2	0.0	0.1	0.8	0.77
Richmond	3.3	1.7	0.2	0.7	5.8	0.55
Rotorua	8.2	6.6	1.9	5.6	22.3	0.49
Takanini	0.3	1.2	0.4	0.5	2.4	0.26
Taupo	3.0	3.0	0.5	1.0	7.5	0.44
Tauranga	6.1	11.5	3.1	18.2	38.9	0.55
Te Awamutu	1.3	1.2	0.4	1.1	4.1	0.45
Te Kuiti	0.8	0.7	0.1	0.2	1.9	0.42
Timaru	9.4	2.9	0.7	3.1	16.1	0.65
Tokoroa	3.9	0.7	0.3	0.5	5.5	0.39
Upper Hutt	5.8	6.8	1.0	4.2	17.9	0.54
Waiheke Island	0.4	1.3	0.1	1.8	3.7	0.52
Waimate	1.1	0.3	0.0	0.2	1.6	0.57
Wainuiomata	2.1	2.8	0.2	1.0	6.1	0.36
Waitakere	19.2	25.7	9.1	19.2	73.1	0.41
Waiuku	0.7	0.7	0.2	0.3	2.0	0.36
Wanganui	4.1	7.0	1.0	2.1	14.1	0.39
Wellington	7.0	12.3	5.8	32.3	57.5	0.34
Westport	1.0	0.8	0.1	0.5	2.4	0.60
Whakatane	1.8	1.4	0.3	0.8	4.4	0.32
Whangarei	7.5	6.1	1.0	4.2	18.8	0.44
Winton	1.4	0.2	0.0	0.1	1.8	0.80
<b>Average/Total</b>	<b>356.5</b>	<b>414.4</b>	<b>130.6</b>	<b>320.7</b>	<b>1222.2</b>	<b>0.45</b>
<b>Percentage</b>	<b>29%</b>	<b>34%</b>	<b>11%</b>	<b>26%</b>	<b>100%</b>	

3. Annual mortality (excluding Background)			PM <sub>10</sub> only	Total	Per 1000
City	Domestic Mortality	Vehicle Mortality	Industrial Mortality		
Alexandra	2.8	0.4	0.1	3.3	0.74
Arrowtown	0.8	0.1	0.0	0.9	0.54
Ashburton	5.9	1.6	0.4	7.9	0.56
Auckland City	32.7	73.4	20.3	126.4	0.35
Balclutha	1.3	0.4	0.1	1.8	0.43
Blenheim	5.8	3.1	0.7	9.6	0.45
Cambridge	0.6	1.2	0.3	2.1	0.43
Christchurch Inner	53.2	26.9	7.6	87.7	0.66
Christchurch Outer	35.5	17.9	5.0	58.4	0.32
Clevedon	0.2	0.3	0.1	0.5	0.16
Cromwell	1.5	0.2	0.0	1.8	0.66
Dunedin	11.0	6.2	2.5	19.7	0.24
Fielding	2.1	1.3	0.4	3.8	0.30
Geraldine	0.7	0.2	0.0	1.0	0.44
Gisborne	3.6	2.6	0.7	6.9	0.24
Gore	3.8	0.9	0.2	4.8	0.63
Hamilton	10.5	17.5	6.2	34.2	0.30
Hastings	2.1	5.5	1.4	9.0	0.21
Hawera	0.6	1.0	0.2	1.9	0.24
Invercargill	15.9	4.4	1.1	21.4	0.51
Kaiapoi	4.5	1.0	0.3	5.8	0.63
Kaikoura	0.1	0.2	0.0	0.3	0.16
Leamington	0.8	1.1	0.4	2.2	0.35
Levin	2.1	2.5	0.3	5.0	0.40
Lower Hutt	13.4	19.5	2.5	35.4	0.45
Manukau	9.1	46.8	19.6	75.5	0.27
Masterton	8.0	1.9	0.4	10.3	0.59
Matamata	1.0	1.3	0.3	2.7	0.44
Milton	0.8	0.2	0.0	1.0	0.52
Morrinsville	0.7	1.2	0.2	2.2	0.59
Mosgiel	3.2	0.4	0.3	3.9	0.62
Napier	3.0	7.6	2.0	12.6	0.25
Nelson	9.0	3.9	0.5	13.4	0.89
New Plymouth	0.8	3.4	1.5	5.7	0.12
North Shore	8.9	38.3	11.7	58.9	0.32
Oamaru	4.6	1.2	0.2	6.0	0.54
Opotiki	0.5	0.3	0.1	0.9	0.23
Orewa	3.1	4.6	1.0	8.7	0.33
Palmerston North	8.0	8.0	2.1	18.1	0.26
Papakura	3.5	3.0	1.7	8.2	0.28
Paraparaumu	2.0	2.3	0.5	4.8	0.22
Porirua	3.1	4.8	1.0	8.9	0.19
Pukekohe	1.4	1.4	0.5	3.3	0.30
Putaruru	0.8	0.5	0.1	1.4	0.37
Rangiora	4.3	1.1	0.3	5.7	0.66
Reefton	0.5	0.2	0.0	0.7	0.71
Richmond	3.3	1.7	0.2	5.2	0.49
Rotorua	8.2	6.6	1.9	16.7	0.37
Takanini	0.3	1.2	0.4	1.9	0.20
Taupo	3.0	3.0	0.5	6.4	0.38
Tauranga	6.1	11.5	3.1	20.7	0.29
Te Awamutu	1.3	1.2	0.4	3.0	0.33
Te Kuiti	0.8	0.7	0.1	1.6	0.37
Timaru	9.4	2.9	0.7	13.0	0.53
Tokoroa	3.9	0.7	0.3	5.0	0.36
Upper Hutt	5.8	6.8	1.0	13.6	0.41
Waiheke Island	0.4	1.3	0.1	1.8	0.26
Waimate	1.1	0.3	0.0	1.4	0.50
Wainuiomata	2.1	2.8	0.2	5.1	0.31
Waitakere	19.2	25.7	9.1	53.9	0.32
Waiuku	0.7	0.7	0.2	1.7	0.31
Wanganui	4.1	7.0	1.0	12.0	0.35
Wellington	7.0	12.3	5.8	25.1	0.15
Westport	1.0	0.8	0.1	1.9	0.50
Whakatane	1.8	1.4	0.3	3.5	0.27
Whangarei	7.5	6.1	1.0	14.6	0.36
Winton	1.4	0.2	0.0	1.6	0.77
<b>Average/Total</b>	<b>356.5</b>	<b>414.4</b>	<b>130.6</b>	<b>914.6</b>	<b>0.34</b>
<b>Percentage</b>	<b>40%</b>	<b>45%</b>	<b>15%</b>	<b>100%</b>	

#### 4. Congestive heart failure associated with CO

City	pop	CO mean	Cases
Alexandra	4,407	0.7	0.4
Arrowtown	1,689	0.5	0.1
Ashburton	14,202	0.5	1.4
Auckland	359,454	1.0	28.8
Balclutha	4,104	0.4	0.3
Blenheim	21,195	0.5	1.7
Cambridge	4,995	1.0	0.4
Christchurch Inner	132,706	0.7	10.9
Christchurch Outer	183,512	1.2	15.3
Clevedon	3,297	0.5	0.4
Cromwell	2,667	0.7	0.2
Dunedin	82,284	0.4	3.5
Fielding	12,705	0.8	0.7
Geraldine	2,205	0.5	0.1
Gisborne	28,992	0.7	1.5
Gore	7,665	0.5	0.3
Hamilton	114,171	0.9	5.3
Hastings	42,297	0.7	2.7
Hawera	7,830	0.7	0.3
Invercargill	41,964	0.5	3.1
Kaiapoi	9,258	0.7	0.6
Kaikoura	2,106	0.6	0.1
Leamington	6,249	1.0	0.5
Levin	12,315	1.1	0.9
Lower Hutt	78,426	1.0	5.6
Manukau	279,906	0.9	22.2
Masterton	17,514	0.6	1.3
Matamata	6,078	1.1	0.5
Milton	1,920	0.5	0.1
Morrinsville	3,678	1.0	0.3
Mosgiel	6,342	0.6	0.6
Napier	49,851	0.7	4.0
Nelson	15,012	0.8	1.0
New Plymouth	49,047	0.8	3.4
North Shore	184,812	1.0	7.4
Oamaru	11,085	0.6	0.6
Opotiki	3,999	0.7	0.2
Orewa	26,559	0.8	0.9
Palmerston North	70,836	0.9	2.6
Papakura	29,328	0.8	1.5
Paraparaumu	21,372	1.0	0.7
Porirua	47,364	0.9	3.2
Pukekohe	11,076	0.9	0.4
Putaruru	3,783	1.0	0.2
Rangiora	8,607	0.5	0.4
Reefton	987	0.7	0.1
Richmond	10,578	0.5	0.6
Rotorua	45,597	1.1	2.0
Takanini	9,390	0.6	0.4
Taupo	16,935	1.0	1.4
Tauranga	70,854	1.0	3.1
Te Awamutu	9,165	1.0	0.4
Te Kuiti	4,374	1.1	0.2
Timaru	24,732	0.6	1.6
Tokoroa	14,019	1.5	0.7
Upper Hutt	32,904	1.3	1.9
Waiheke Island	7,137	1.1	0.5
Waimate	2,757	0.5	0.2
Wainuiomata	16,602	0.9	0.9
Waitakere	168,741	1.0	13.1
Waiuku	5,478	0.9	0.2
Wanganui	34,767	0.9	2.6
Wellington	162,978	0.8	7.2
Westport	3,783	0.6	0.2
Whakatane	13,113	0.7	1.2
Whangarei	40,824	1.2	2.4
Winton	2,100	0.8	0.1
<b>Total</b>	<b>2,726,679</b>	<b>0.8</b>	<b>178.0</b>

### 5. Total mortality (PM10 and CO)

City	Pop (2001)	Total PM10	Total PM mortality	Total CO	Total CO mortality	Total Mortality	Per 1000 Pop
Alexandra	4,407	25.9	3.3	1.0	0.4	3.6	0.83
Arrowtown	1,689	19.5	0.9	0.6	0.1	1.0	0.58
Ashburton	14,202	19.5	7.9	1.3	1.4	9.4	0.66
Auckland City	359,454	21.0	126.4	1.0	28.8	155.2	0.43
Balclutha	4,104	16.0	1.8	1.0	0.3	2.1	0.51
Blenheim	21,195	18.1	9.6	1.0	1.7	11.3	0.53
Cambridge	4,995	14.1	2.1	0.9	0.4	2.5	0.50
Christchurch Inner	132,706	24.7	87.7	1.0	10.9	98.6	0.74
Christchurch Outer	183,512	17.4	58.4	1.1	15.3	73.7	0.40
Clevedon	3,297	7.1	0.5	1.5	0.4	0.9	0.28
Cromwell	2,667	23.8	1.8	0.8	0.2	1.9	0.72
Dunedin	82,284	15.5	19.7	0.5	3.5	23.2	0.28
Fielding	12,705	12.3	3.8	0.7	0.7	4.5	0.35
Geraldine	2,205	17.2	1.0	0.5	0.1	1.0	0.47
Gisborne	28,992	10.7	6.9	0.7	1.5	8.4	0.29
Gore	7,665	19.1	4.8	0.5	0.3	5.2	0.68
Hamilton	114,171	14.7	34.2	0.6	5.3	39.6	0.35
Hastings	42,297	10.3	9.0	0.8	2.7	11.6	0.28
Hawera	7,830	10.0	1.9	0.5	0.3	2.2	0.28
Invercargill	41,964	19.7	21.4	0.9	3.1	24.5	0.58
Kaipoi	9,258	23.4	5.8	0.8	0.6	6.5	0.70
Kaikoura	2,106	20.9	0.3	0.6	0.1	0.4	0.21
Leamington	6,249	13.9	2.2	1.1	0.5	2.8	0.44
Levin	12,315	14.4	5.0	0.9	0.9	5.8	0.47
Lower Hutt	78,426	15.1	35.4	0.9	5.6	41.0	0.52
Manukau	279,906	14.6	75.5	1.0	22.2	97.7	0.35
Masterton	17,514	22.1	10.3	1.0	1.3	11.6	0.66
Matamata	6,078	16.2	2.7	1.1	0.5	3.2	0.53
Milton	1,920	19.6	1.0	1.0	0.1	1.2	0.60
Morrinsville	3,678	14.0	2.2	1.0	0.3	2.5	0.67
Mosgiel	6,342	21.4	3.9	1.1	0.6	4.5	0.71
Napier	49,851	10.3	12.6	1.0	4.0	16.7	0.33
Nelson	15,012	34.0	13.4	0.8	1.0	14.4	0.96
New Plymouth	49,047	11.7	5.7	0.9	3.4	9.0	0.18
North Shore	184,812	16.3	58.9	0.5	7.4	66.3	0.36
Oamaru	11,085	21.1	6.0	0.7	0.6	6.6	0.60
Opotiki	3,999	10.8	0.9	0.5	0.2	1.1	0.27
Orewa	26,559	12.1	8.7	0.4	0.9	9.7	0.36
Palmerston North	70,836	12.7	18.1	0.5	2.6	20.7	0.29
Papakura	29,328	12.6	8.2	0.7	1.5	9.7	0.33
Paraparaumu	21,372	15.1	4.8	0.4	0.7	5.5	0.26
Porirua	47,364	13.6	8.9	0.8	3.2	12.1	0.25
Pukekohe	11,076	12.5	3.3	0.5	0.4	3.7	0.34
Putaruru	3,783	14.7	1.4	0.7	0.2	1.6	0.43
Rangiora	8,607	19.7	5.7	0.5	0.4	6.0	0.70
Reefton	987	25.4	0.7	0.7	0.1	0.8	0.76
Richmond	10,578	18.1	5.2	0.7	0.6	5.8	0.54
Rotorua	45,597	15.9	16.7	0.5	2.0	18.7	0.41
Takanini	9,390	12.4	1.9	0.6	0.4	2.3	0.25
Taupo	16,935	15.1	6.4	1.1	1.4	7.9	0.46
Tauranga	70,854	14.6	20.7	0.5	3.1	23.8	0.34
Te Awamutu	9,165	14.8	3.0	0.6	0.4	3.4	0.37
Te Kuiti	4,374	15.3	1.6	0.7	0.2	1.9	0.42
Timaru	24,732	21.2	13.0	0.8	1.6	14.6	0.59
Tokoroa	14,019	21.5	5.0	0.6	0.7	5.6	0.40
Upper Hutt	32,904	18.6	13.6	0.7	1.9	15.6	0.47
Waiheke Island	7,137	16.6	1.8	0.9	0.5	2.3	0.33
Waimate	2,757	17.0	1.4	1.0	0.2	1.6	0.58
Wainuiomata	16,602	12.7	5.1	0.7	0.9	6.1	0.37
Waitakere	168,741	15.3	53.9	1.0	13.1	67.0	0.40
Waiuku	5,478	12.9	1.7	0.5	0.2	1.9	0.35
Wanganui	34,767	13.7	12.0	0.9	2.6	14.6	0.42
Wellington	162,978	11.8	25.1	0.6	7.2	32.4	0.20
Westport	3,783	20.1	1.9	0.7	0.2	2.1	0.56
Whakatane	13,113	10.5	3.5	1.2	1.2	4.7	0.36
Whangarei	40,824	18.1	14.6	0.8	2.4	17.1	0.42
Winton	2,100	27.0	1.6	0.9	0.1	1.8	0.84
<b>Average/Total</b>	<b>2,726,679</b>	<b>16.7</b>	<b>914.6</b>	<b>0.8</b>	<b>178.0</b>	<b>1092.6</b>	<b>0.40</b>

## 6. Benzene cancer cases

City	Pop	NO <sub>2</sub> mean	Benzene	Cancer cases per year	Cancer cases per 1000
Alexandra	4,407	16.8	2.4	0.06	0.015
Arrowtown	1,689	12.7	1.7	0.02	0.010
Ashburton	14,202	12.7	1.7	0.14	0.010
Auckland	359,454	22.0	3.5	7.63	0.021
Balclutha	4,104	10.4	1.3	0.03	0.008
Blenheim	21,195	10.8	1.3	0.17	0.008
Cambridge	4,995	21.7	3.5	0.10	0.021
Christchurch Inner	132,706	16.1	2.3	1.83	0.014
Christchurch Outer	183,512	11.3	1.4	1.57	0.009
Clevedon	3,297	10.6	1.3	0.03	0.008
Cromwell	2,667	15.4	2.2	0.03	0.013
Dunedin	82,284	10.1	1.2	0.60	0.007
Fielding	12,705	18.4	2.8	0.21	0.017
Geraldine	2,205	11.2	1.4	0.02	0.008
Gisborne	28,992	16.0	2.3	0.40	0.014
Gore	7,665	12.4	1.6	0.07	0.010
Hamilton	114,171	19.6	3.0	2.07	0.018
Hastings	42,297	15.5	2.2	0.55	0.013
Hawera	7,830	15.0	2.1	0.10	0.013
Invercargill	41,964	12.8	1.7	0.42	0.010
Kaiapoi	9,258	15.2	2.1	0.12	0.013
Kaikoura	2,106	13.6	1.8	0.02	0.011
Leamington	6,249	20.9	3.3	0.12	0.020
Levin	12,315	22.8	3.7	0.28	0.022
Lower Hutt	78,426	22.6	3.7	1.73	0.022
Manukau	279,906	20.1	3.1	5.25	0.019
Masterton	17,514	14.4	2.0	0.21	0.012
Matamata	6,078	24.3	4.1	0.15	0.024
Milton	1,920	12.8	1.7	0.02	0.010
Morrinsville	3,678	20.9	3.3	0.07	0.020
Mosgiel	6,342	13.9	1.9	0.07	0.011
Napier	49,851	15.5	2.2	0.65	0.013
Nelson	15,012	19.0	2.9	0.26	0.017
New Plymouth	49,047	17.6	2.6	0.77	0.016
North Shore	184,812	22.0	3.5	3.93	0.021
Oamaru	11,085	13.7	1.8	0.12	0.011
Opotiki	3,999	16.1	2.3	0.06	0.014
Orewa	26,559	18.2	2.7	0.43	0.016
Palmerston North	70,836	19.0	2.9	1.23	0.017
Papakura	29,328	18.3	2.8	0.49	0.017
Paraparaumu	21,372	22.6	3.7	0.47	0.022
Porirua	47,364	19.6	3.0	0.86	0.018
Pukekohe	11,076	18.7	2.8	0.19	0.017
Putaruru	3,783	22.0	3.5	0.08	0.021
Rangiora	8,607	12.8	1.7	0.09	0.010
Reefton	987	16.5	2.4	0.01	0.014
Richmond	10,578	11.8	1.5	0.09	0.009
Rotorua	45,597	23.8	4.0	1.08	0.024
Takanini	9,390	13.9	1.9	0.11	0.011
Taupo	16,935	22.5	3.7	0.37	0.022
Tauranga	70,854	21.2	3.4	1.43	0.020
Te Awamutu	9,165	22.2	3.6	0.20	0.022
Te Kuiti	4,374	22.9	3.7	0.10	0.022
Timaru	24,732	13.8	1.9	0.28	0.011
Tokoroa	14,019	32.5	6.1	0.51	0.036
Upper Hutt	32,904	27.8	4.9	0.97	0.029
Waiheke Island	7,137	23.9	4.0	0.17	0.024
Waimate	2,757	11.0	1.4	0.02	0.008
Wainuiomata	16,602	19.0	2.9	0.29	0.017
Waitakere	168,741	21.4	3.4	3.46	0.020
Waiuku	5,478	19.4	3.0	0.10	0.018
Wanganui	34,767	20.5	3.2	0.67	0.019
Wellington	162,978	17.2	2.5	2.48	0.015
Westport	3,783	13.1	1.7	0.04	0.010
Whakatane	13,113	15.7	2.2	0.18	0.013
Whangarei	40,824	24.9	4.2	1.03	0.025
Winton	2,100	17.5	2.6	0.03	0.016
<b>Total</b>	<b>2,726,679</b>			<b>47.33</b>	



## 7. Morbidity (all ages)

City	Pop	PM <sub>10</sub>	COPD	Cardiac	Respiratory
Alexandra	4,407	25.9	5	1	2
Arrowtown	1,689	19.5	1	0	0
Ashburton	14,202	19.5	12	2	4
Auckland	359,454	18.2	289	45	87
Balclutha	4,104	16.0	3	0	1
Blenheim	21,195	18.1	17	3	5
Cambridge	4,995	14.1	3	0	1
Christchurch Inner	132,706	24.7	145	22	43
Christchurch Outer	183,512	17.5	141	22	42
Clevedon	3,297	7.1	1	0	0
Cromwell	2,667	23.8	3	0	1
Dunedin	82,284	15.5	56	9	17
Fielding	12,705	12.3	7	1	2
Geraldine	2,205	17.2	2	0	1
Gisborne	28,992	10.7	14	2	4
Gore	7,665	19.1	6	1	2
Hamilton	114,171	14.7	74	11	22
Hastings	42,297	10.3	19	3	6
Hawera	7,830	10.0	3	1	1
Invercargill	41,964	19.7	36	6	11
Kaipoi	9,258	23.4	10	1	3
Kaikoura	2,106	20.9	2	0	1
Leamington	6,249	13.9	4	1	1
Levin	12,315	14.4	8	1	2
Lower Hutt	78,426	15.1	52	8	16
Manukau	279,906	14.6	180	28	54
Masterton	17,514	22.1	17	3	5
Matamata	6,078	16.2	4	1	1
Milton	1,920	19.6	2	0	1
Morrinsville	3,678	14.0	2	0	1
Mosgiel	6,342	21.4	6	1	2
Napier	49,851	10.3	23	3	7
Nelson	15,012	34.0	22	3	7
New Plymouth	49,047	11.7	25	4	8
North Shore	184,812	16.3	133	20	40
Oamaru	11,085	21.1	10	2	3
Opotiki	3,999	10.8	2	0	1
Orewa	26,559	12.1	14	2	4
Palmerston North	70,836	12.7	40	6	12
Papakura	29,328	12.6	16	3	5
Paraparaumu	21,372	15.1	14	2	4
Porirua	47,364	13.6	28	4	9
Pukekohe	11,076	12.5	6	1	2
Putaruru	3,783	14.7	2	0	1
Rangiora	8,607	19.7	7	1	2
Reefton	987	25.4	1	0	0
Richmond	10,578	18.1	8	1	3
Rotorua	45,597	15.9	32	5	10
Takanini	9,390	12.4	5	1	2
Taupo	16,935	15.1	11	2	3
Tauranga	70,854	14.6	46	7	14
Te Awamutu	9,165	14.8	6	1	2
Te Kuiti	4,374	15.3	3	0	1
Timaru	24,732	21.2	23	4	7
Tokoroa	14,019	21.5	13	2	4
Upper Hutt	32,904	18.6	27	4	8
Waiheke Island	7,137	16.6	5	1	2
Waimate	2,757	17.0	2	0	1
Wainuiomata	16,602	12.7	9	1	3
Waitakere	168,741	15.3	114	18	34
Waiuku	5,478	12.9	3	0	1
Wanganui	34,767	13.7	21	3	6
Wellington	162,978	11.8	85	13	26
Westport	3,783	20.1	3	1	1
Whakatane	13,113	10.5	6	1	2
Whangarei	40,824	18.1	33	5	10
Winton	2,100	27.0	2	0	1
<b>Total</b>	<b>2,726,679</b>		<b>1,928</b>	<b>297</b>	<b>580</b>

## 8. Restricted Activity Days

City	Pop	PM <sub>10</sub>	RAD
Alexandra	4,407	25.9	6,228
Arrowtown	1,689	19.5	1,799
Ashburton	14,202	19.5	15,157
Auckland	359,454	18.2	357,782
Balclutha	4,104	16.0	3,583
Blenheim	21,195	18.1	20,936
Cambridge	4,995	14.1	3,859
Christchurch Inner	132,706	25.0	181,144
Christchurch Outer	183,512	18.0	180,356
Clevedon	3,297	7.1	1,272
Cromwell	2,667	23.8	3,460
Dunedin	82,284	15.5	69,650
Fielding	12,705	12.3	8,500
Geraldine	2,205	17.2	2,068
Gisborne	28,992	10.7	16,888
Gore	7,665	19.1	7,979
Hamilton	114,171	14.7	91,486
Hastings	42,297	10.3	23,858
Hawera	7,830	10.0	4,284
Invercargill	41,964	19.7	45,162
Kaipoi	9,258	23.4	11,849
Kaikoura	2,106	20.9	2,399
Leamington	6,249	13.9	4,752
Levin	12,315	14.4	9,683
Lower Hutt	78,426	15.1	64,622
Manukau	279,906	14.6	222,842
Masterton	17,514	22.1	21,137
Matamata	6,078	16.2	5,383
Milton	1,920	19.6	2,059
Morrinsville	3,678	14.0	2,804
Mosgiel	6,342	21.4	7,418
Napier	49,851	10.3	28,091
Nelson	15,012	34.0	27,845
New Plymouth	49,047	11.7	31,431
North Shore	184,812	16.3	164,553
Oamaru	11,085	21.1	12,757
Opotiki	3,999	10.8	2,353
Orewa	26,559	12.1	17,616
Palmerston North	70,836	12.7	49,132
Papakura	29,328	12.6	20,170
Paraparaumu	21,372	15.1	17,594
Porirua	47,364	13.6	35,171
Pukekohe	11,076	12.5	7,546
Putaruru	3,783	14.7	3,033
Rangiora	8,607	19.7	9,245
Reefton	987	25.4	1,371
Richmond	10,578	18.1	10,467
Rotorua	45,597	15.9	39,571
Takanini	9,390	12.4	6,351
Taupo	16,935	15.1	13,917
Tauranga	70,854	14.6	56,365
Te Awamutu	9,165	14.8	7,411
Te Kuiti	4,374	15.3	3,645
Timaru	24,732	21.2	28,657
Tokoroa	14,019	21.5	16,457
Upper Hutt	32,904	18.6	33,339
Waiheke Island	7,137	16.6	6,474
Waimate	2,757	17.0	2,556
Wainuimata	16,602	12.7	11,484
Waitakere	168,741	15.3	140,755
Waiuku	5,478	12.9	3,870
Wanganui	34,767	13.7	25,950
Wellington	162,978	11.8	105,016
Westport	3,783	20.1	4,158
Whakatane	13,113	10.5	7,503
Whangarei	40,824	18.1	40,345
Winton	2,100	27.0	3,093
<b>Total</b>	<b>2,726,679</b>		<b>2,395,693</b>

### 9. Comparing air pollution mortality rate with natural rate

City	Population (2001)	Pollution Mortality Rate (per 1000)	Natural Mortality Rate (per 1000)	Fraction (pollution vs natural)
Auckland City	359,454	0.43	6.0	7.2%
Manukau	279,906	0.35	6.5	5.4%
North Shore	184,812	0.36	5.5	5.8%
Waitakere	168,741	0.40	6.1	6.5%
<b>Greater Auckland</b>	<b>992,913</b>	<b>0.38</b>	<b>6.0</b>	<b>6.2%</b>
Wellington	162,978	0.20	6.1	3.3%
Porirua	47,364	0.25	8.0	3.2%
Lower Hutt	78,426	0.52	6.8	7.7%
Upper Hutt	32,904	0.47	6.9	6.9%
<b>Greater Wellington</b>	<b>321,672</b>	<b>0.36</b>	<b>7.0</b>	<b>5.3%</b>
Christchurch Outer	183,512	0.40	6.3	6.4%
Christchurch Inner	132,706	0.74	6.3	11.8%
<b>Greater Christchurch</b>	<b>316,218</b>	<b>0.57</b>	<b>6.3</b>	<b>9.1%</b>
Hamilton	114,171	0.35	6.3	5.5%
Dunedin	82,284	0.28	6.8	4.1%
Tauranga	70,854	0.34	5.9	5.7%
Palmerston North	70,836	0.29	6.1	4.8%
Napier	49,851	0.33	6.9	4.8%
New Plymouth	49,047	0.18	6.4	2.9%
Rotorua	45,597	0.41	7.8	4.7%
Hastings	42,297	0.28	6.9	4.0%
Invercargill	41,964	0.58	8.1	7.2%
Whangarei	40,824	0.42	6.9	6.1%
Wanganui	34,767	0.42	7.5	5.6%
Nelson	15,012	0.96	6.4	14.9%
<b>Totals</b>	<b>2,273,295</b>	<b>0.32</b>	<b>6.7</b>	<b>4.8%</b>

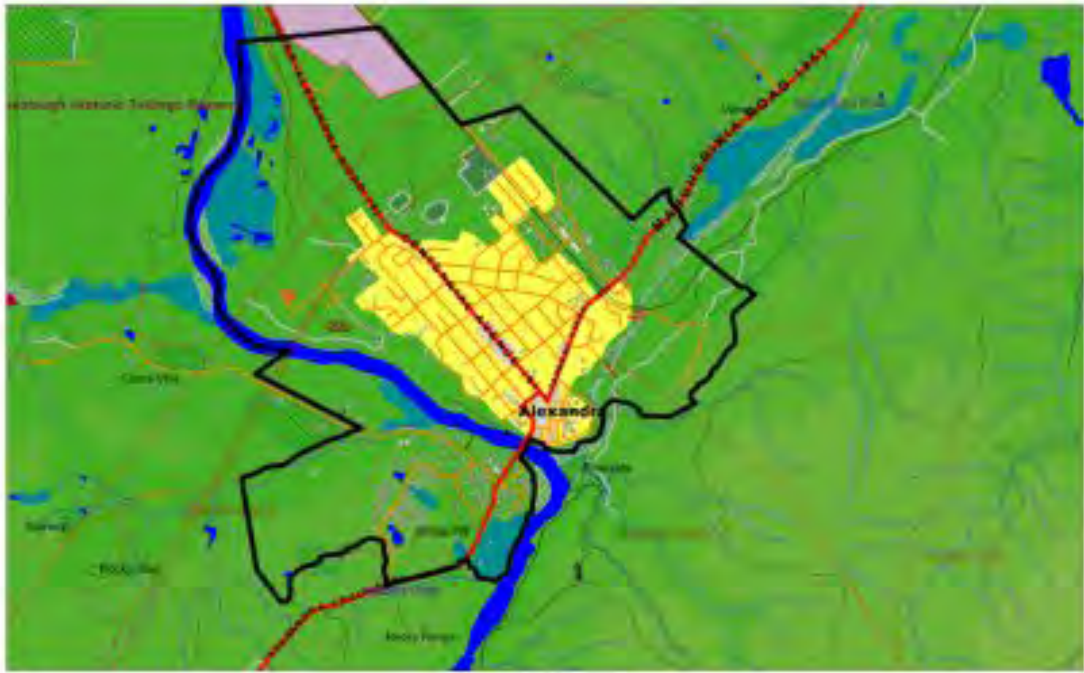
## Appendix 2 - Maps

This appendix contains plan view maps of the 67 urban areas covered in the exposure assessment (listed alphabetically). These are marked as CAU boundaries from which the original Statistics NZ data has been extracted.

In some cases the boundaries appear to extend beyond the obvious limits of the urban boundaries – particularly in some smaller centres. This is simply an artefact of the way the CAU units are defined. This does affect the exposure calculations slightly, but the consequence is not great since (a) there are very few people living in these areas, and (b) the pollution levels are generally low in these large area CAUs.

**Urban areas covered in the study (listed alphabetically).**

1. Alexandra	34. New Plymouth
2. Arrowtown	35. North Shore (Auckland)
3. Ashburton	36. Oamaru
4. Auckland	37. Opotiki
5. Balclutha	38. Orewa
6. Blenheim	39. Palmerston North
7. Cambridge	40. Papakura
8. Christchurch Inner suburbs	41. Paraparaumu
9. Christchurch Outer suburbs	42. Porirua
10. Clevedon	43. Pukekohe
11. Cromwell	44. Putaruru
12. Dunedin	45. Rangiora
13. Fielding	46. Reefton
14. Geraldine	47. Richmond
15. Gisborne	48. Rotorua
16. Gore	49. Takanini
17. Hamilton	50. Taupo
18. Hastings	51. Tauranga
19. Hawera	52. Te Awamutu
20. Invercargill	53. Te Kuiti
21. Kaiapoi	54. Timaru
22. Kaikoura	55. Tokoroa
23. Leamington	56. Upper Hutt
24. Levin	57. Waiheke Island
25. Lower Hutt	58. Waimate
26. Manukau	59. Wainuiomata
27. Masterton	60. Waitakere
28. Matamata	61. Waiuku
29. Milton	62. Wanganui
30. Morrinsville	63. Wellington
31. Mosgiel	64. Westport
32. Napier	65. Whakatane
33. Nelson	66. Whangarei
	67. Winton



Alexandra

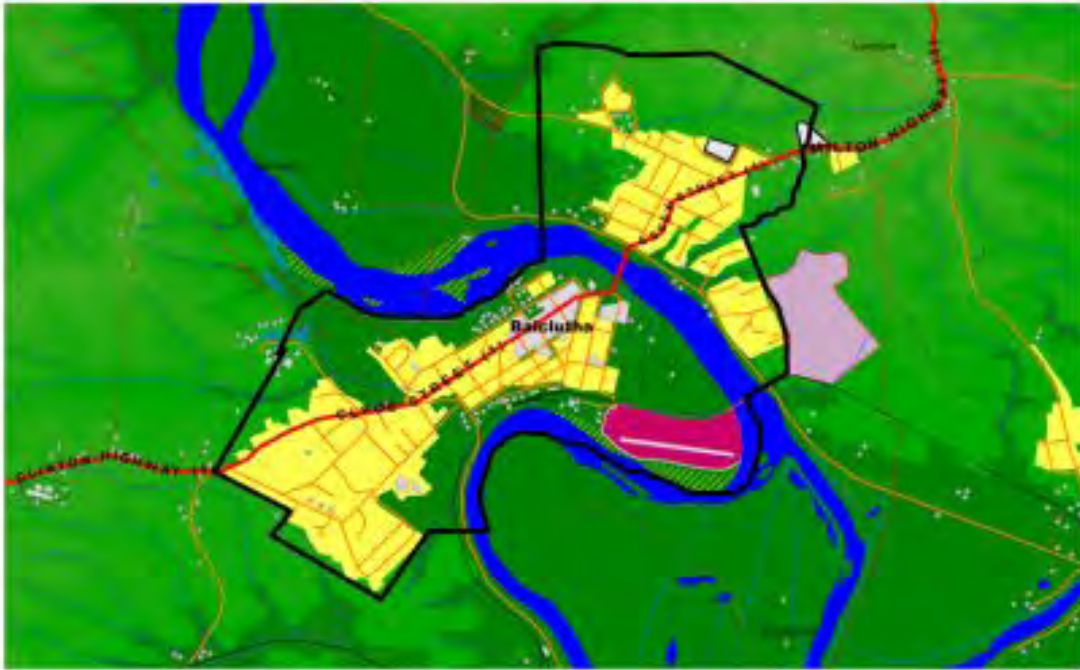




Ashburton



Auckland City

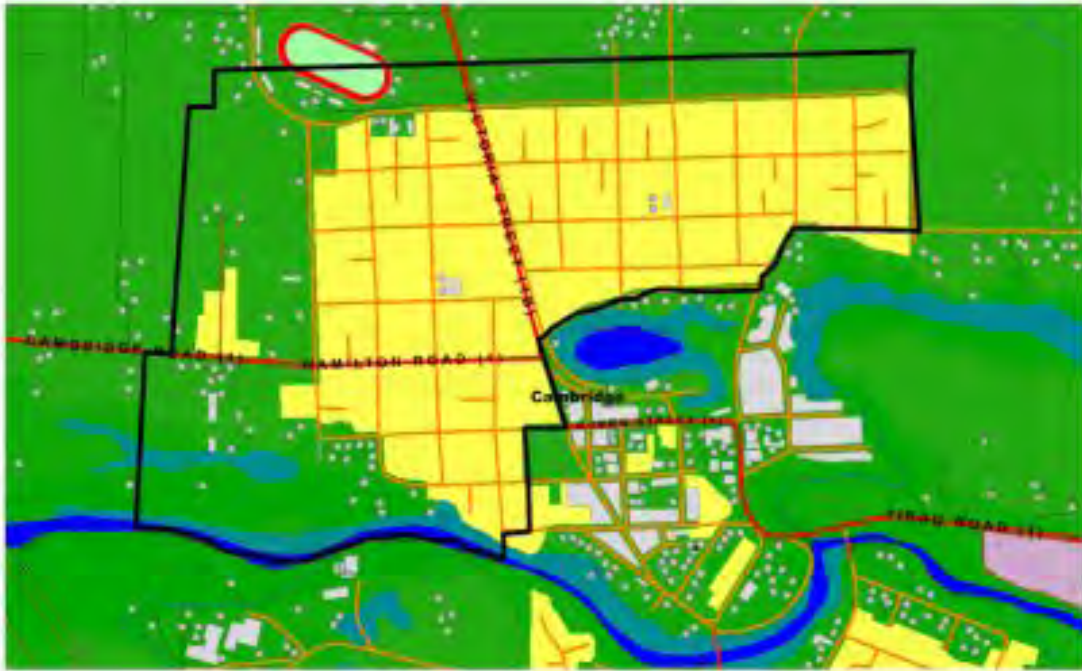


**Balclutha**

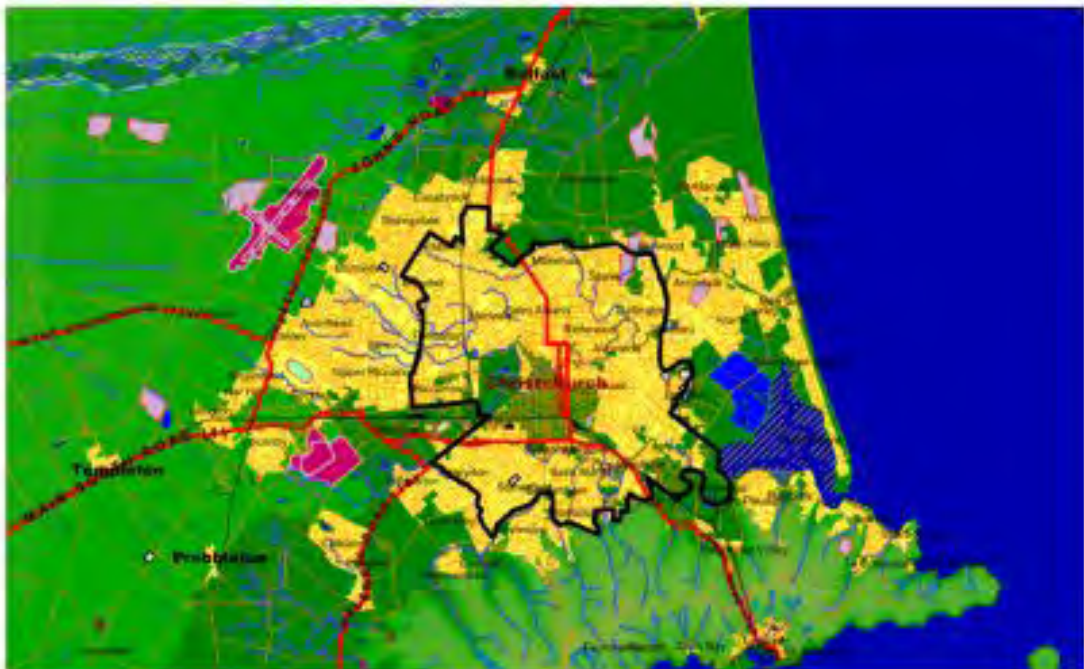


**Blenheim**

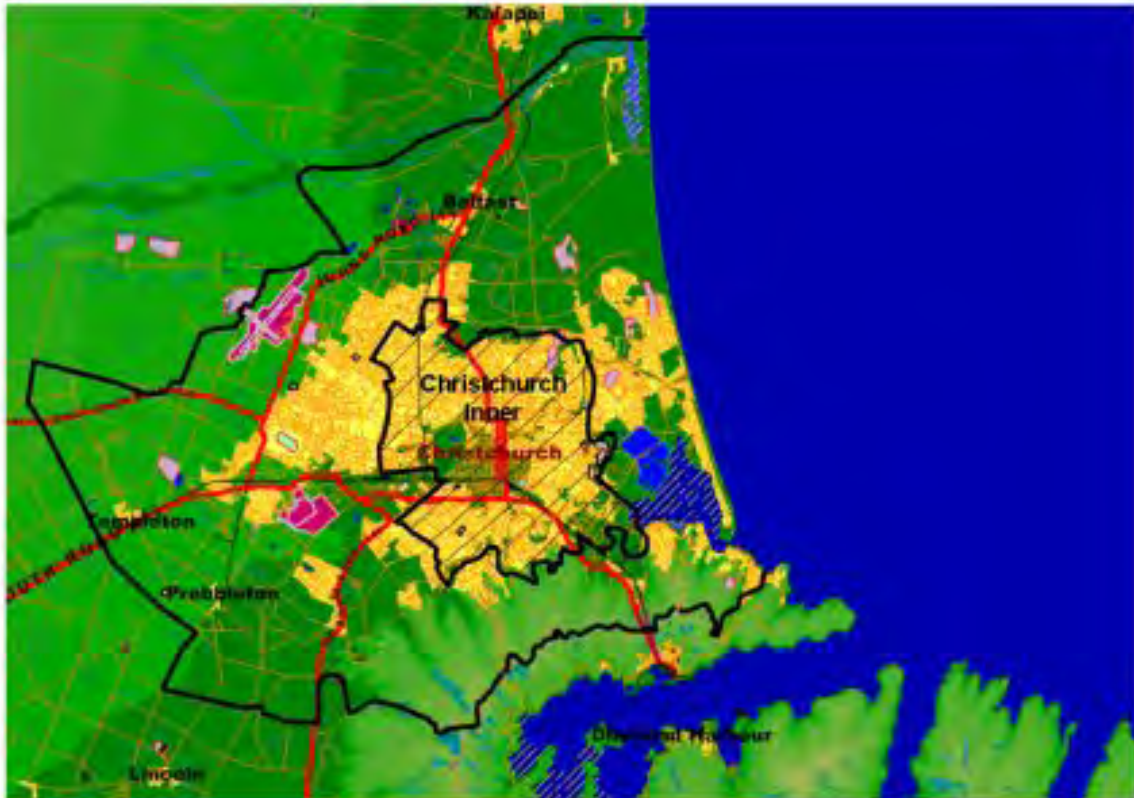




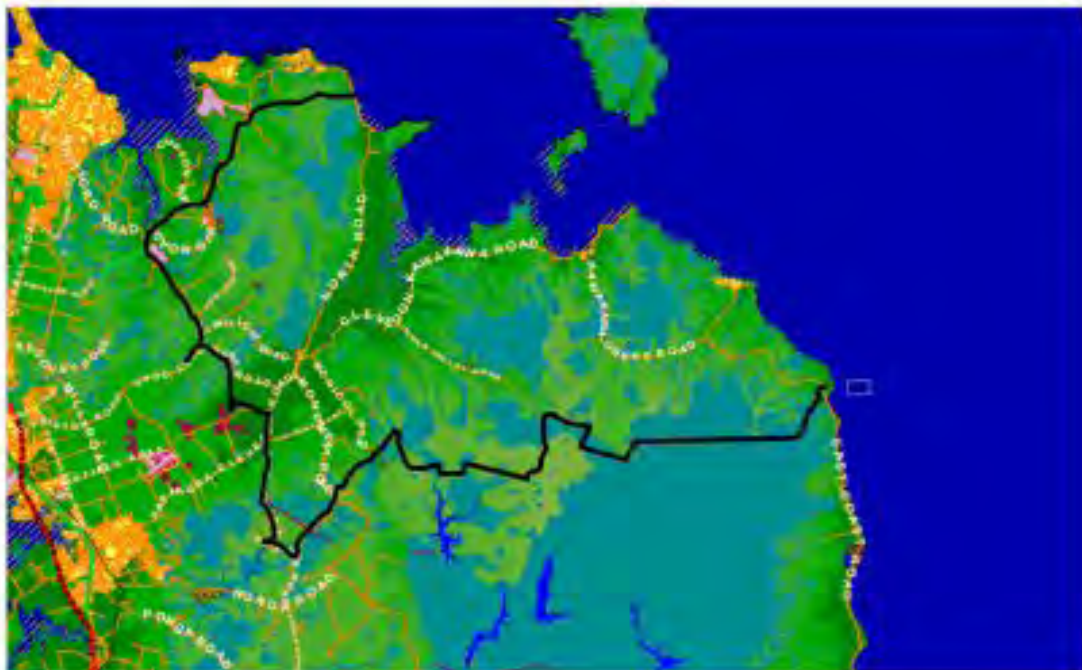
Cambridge



Christchurch Inner



Christchurch Outer



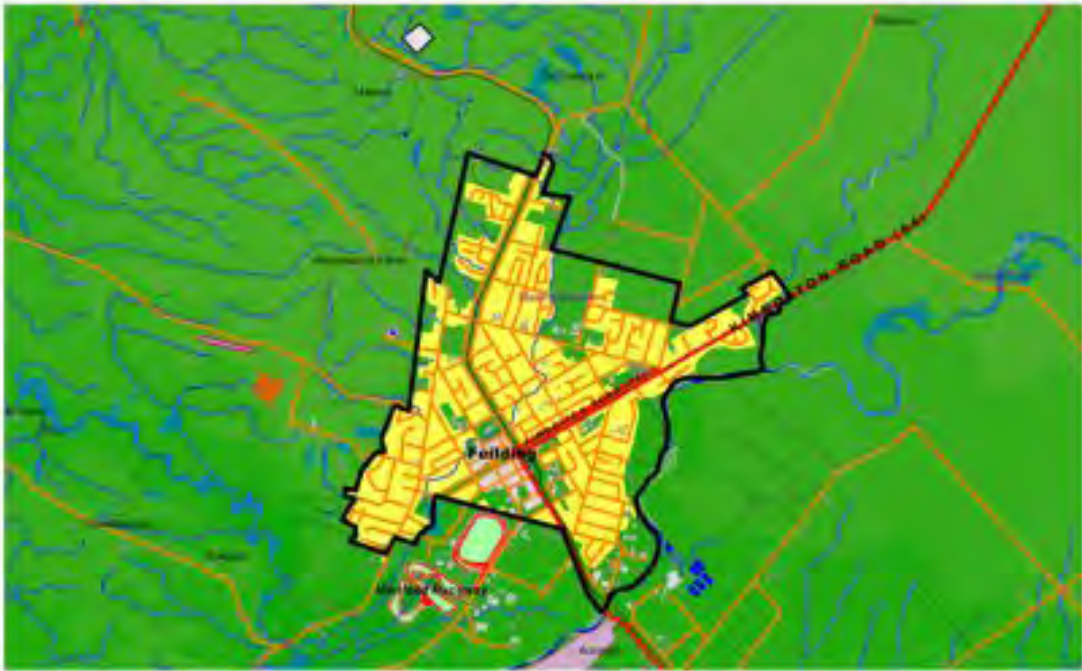
Clevedon



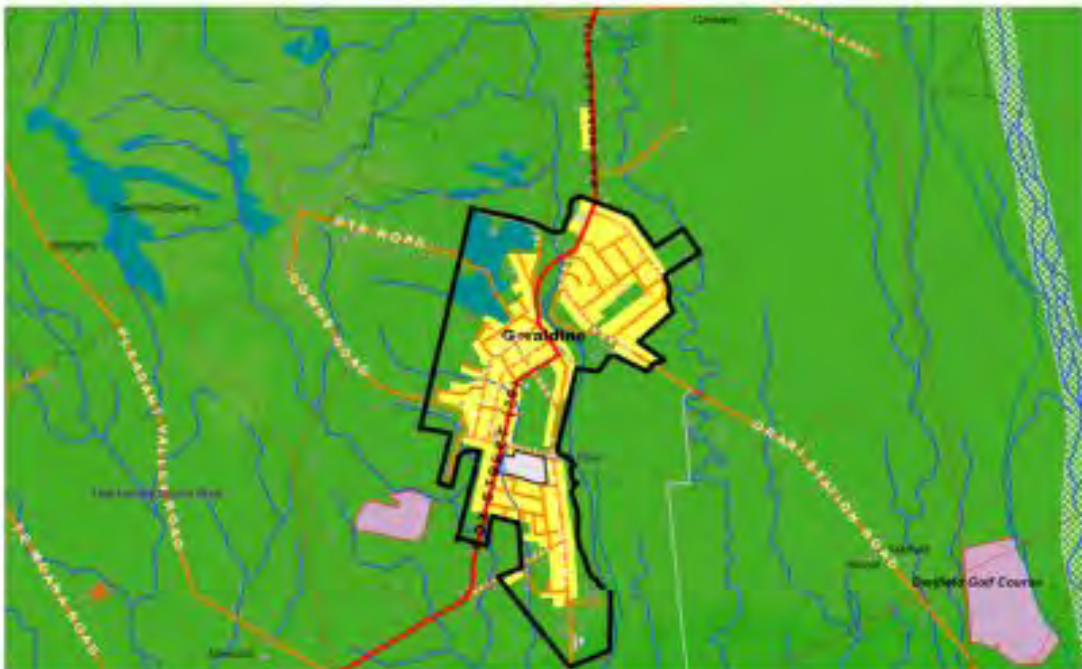
Cromwell



Dunedin



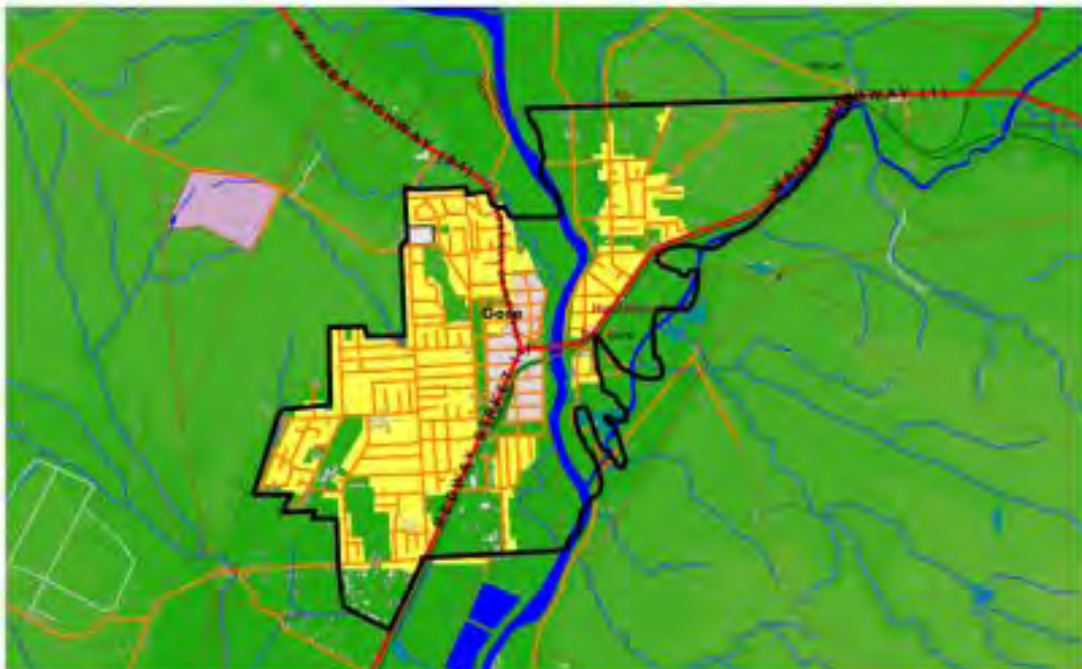
**Fellding**



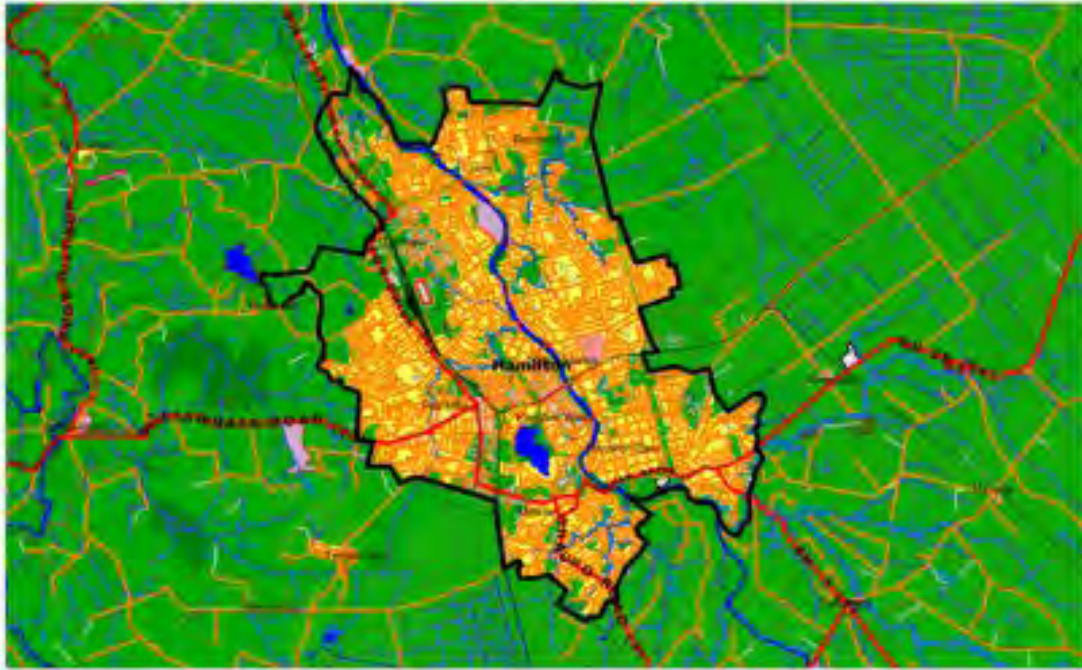
**Geraldine**



Gisborne



Gore



Hamilton



Hastings



Hawera



Invercargill

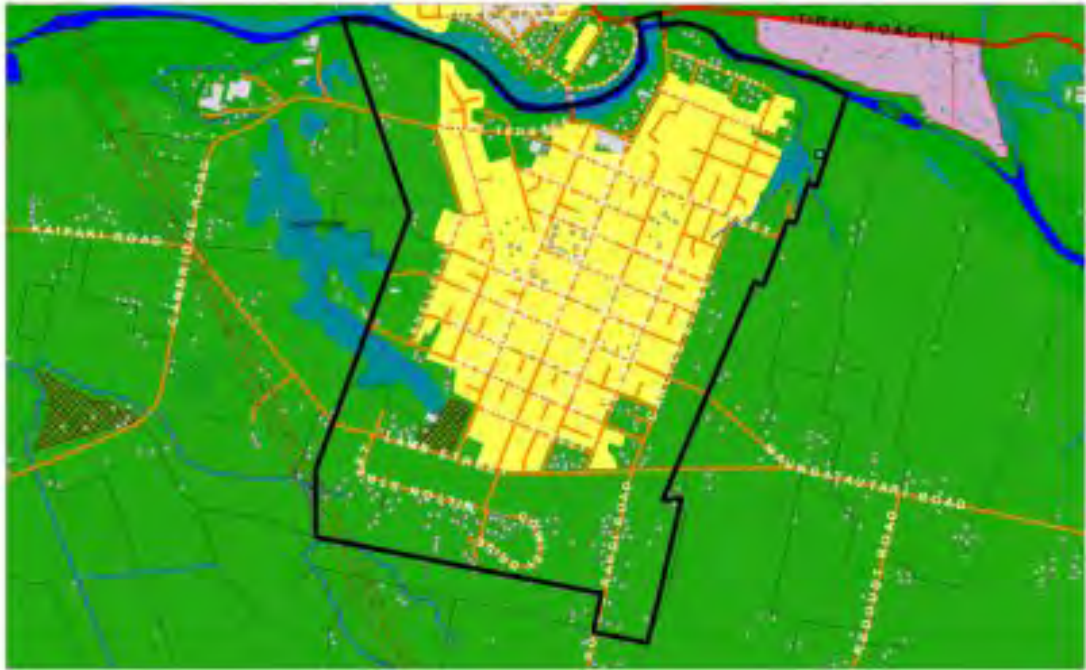


Kaiapoi

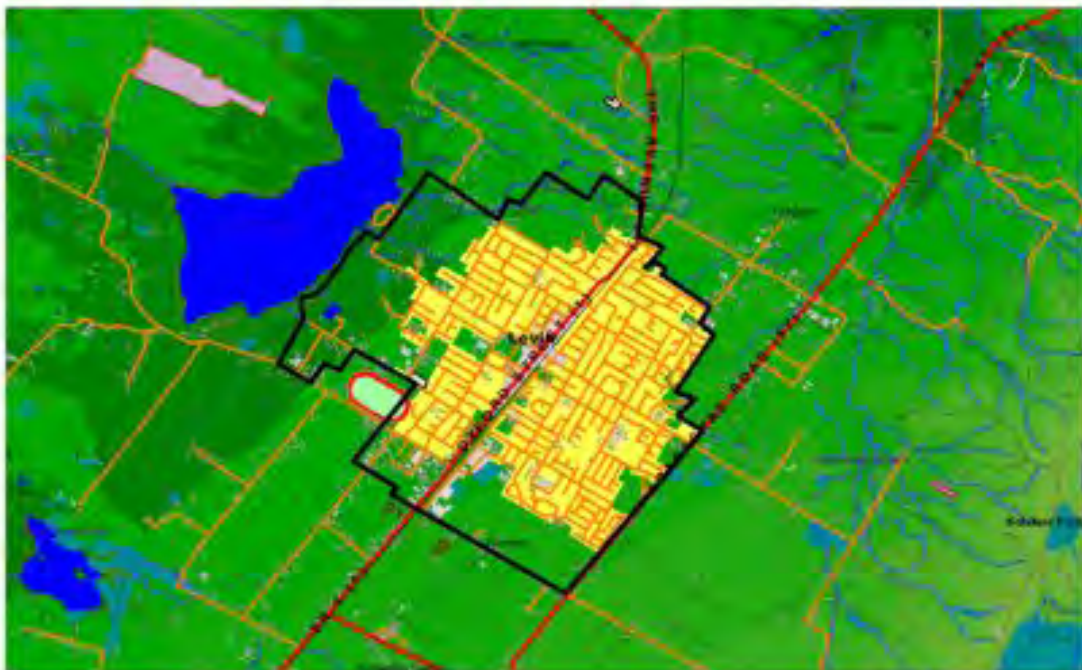


Kalkoura

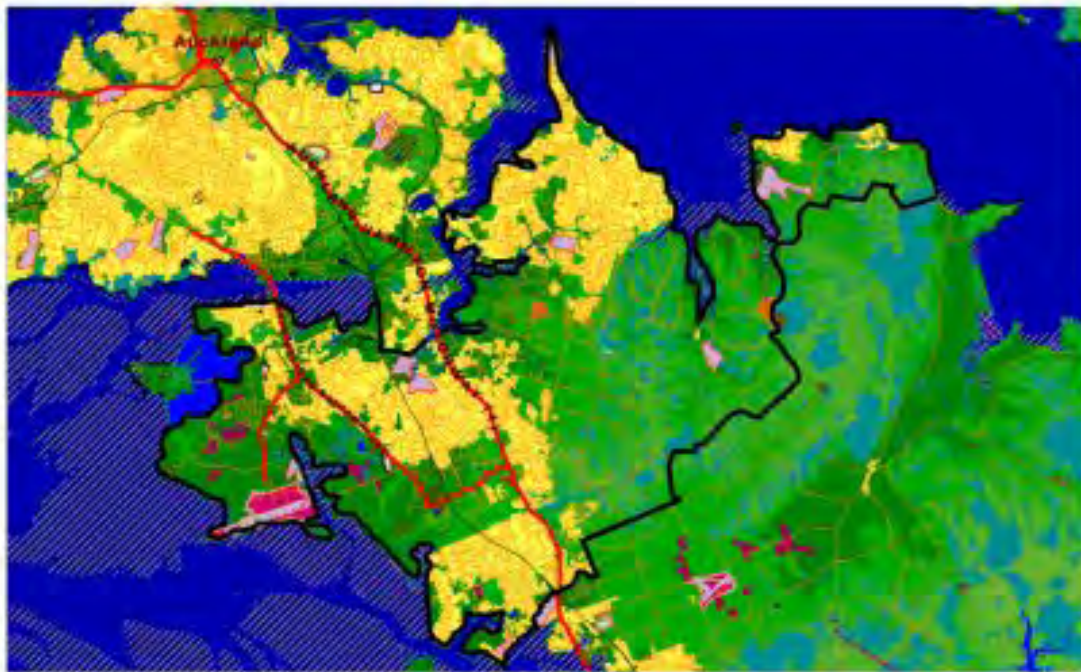
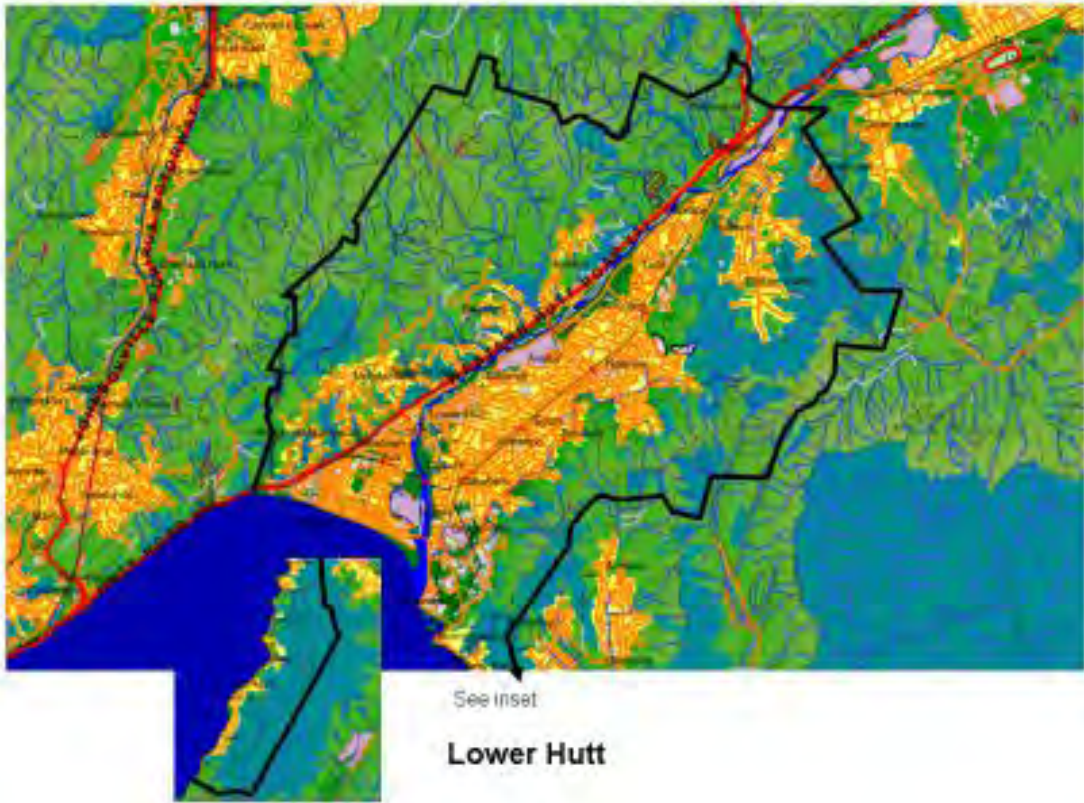


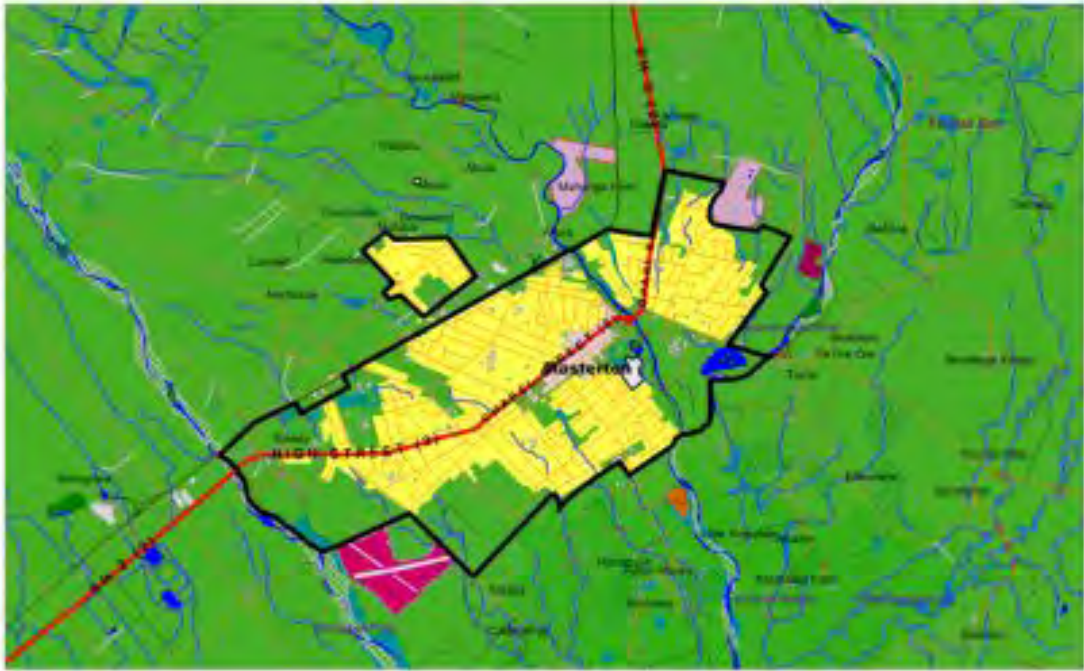


Leamington

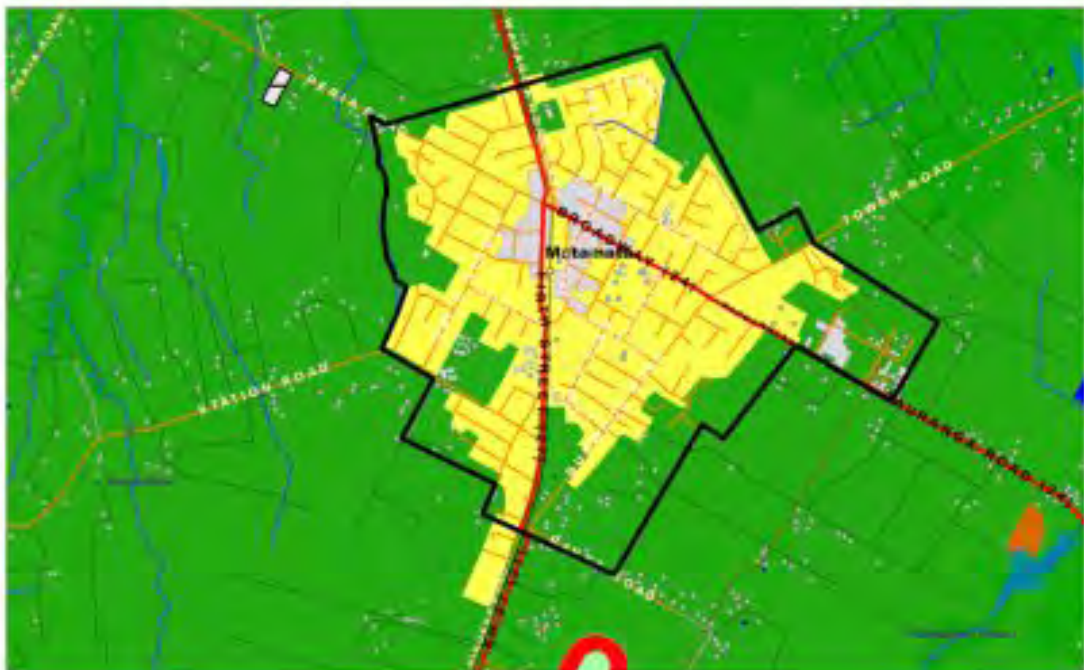


Levin





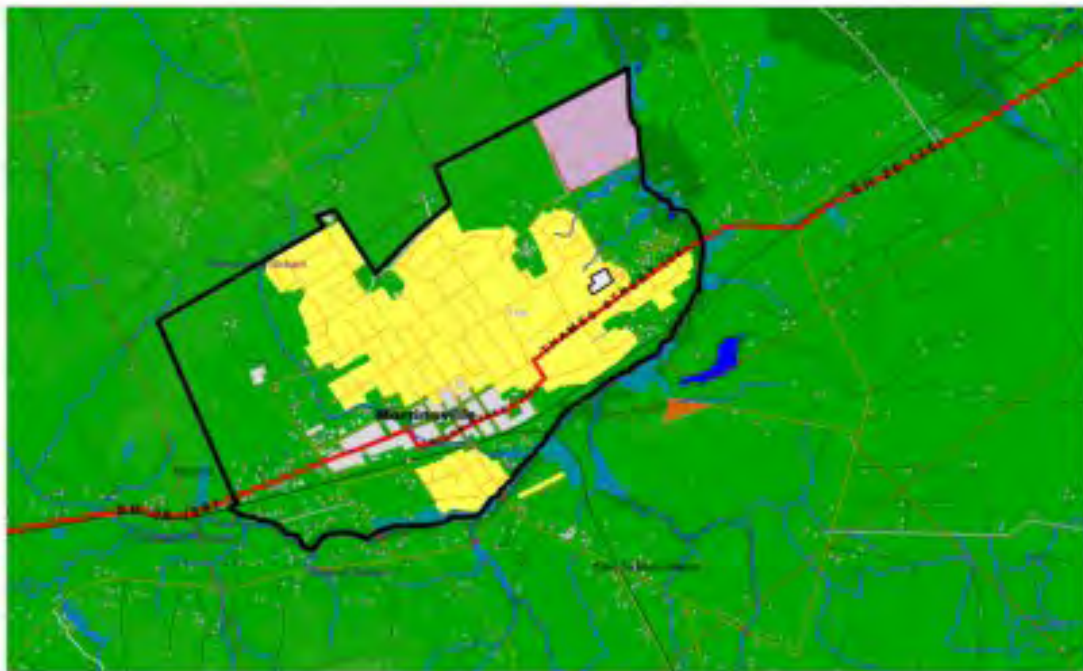
**Masterton**



**Matamata**



**Milton**



**Morrinsville**



Mosgiel



Napier



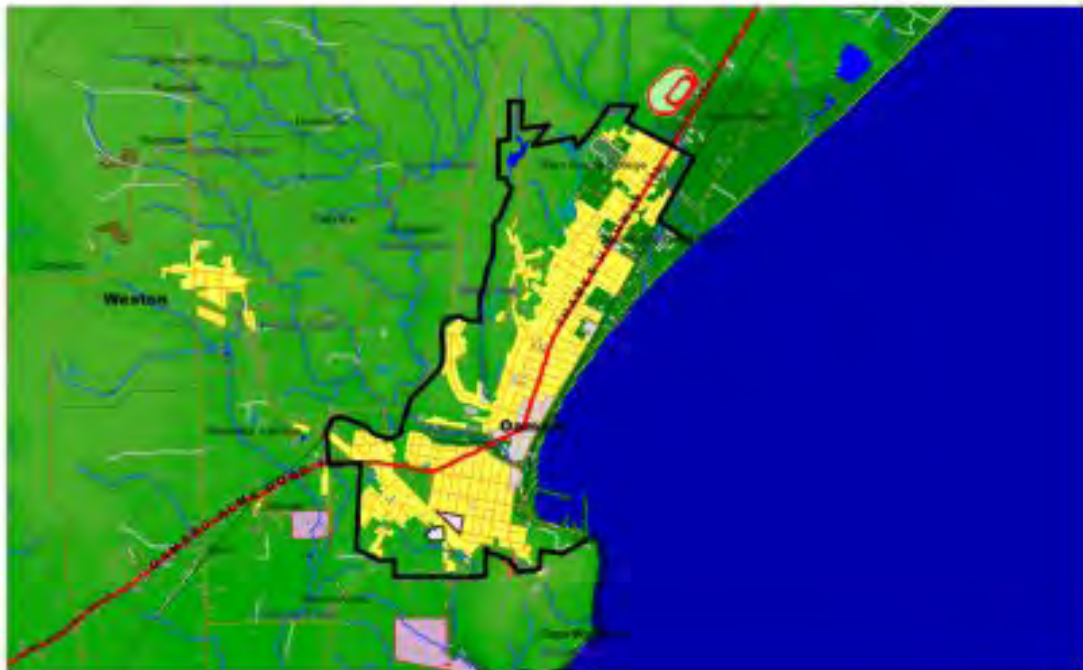
Nelson



New Plymouth



North Shore



Oamaru

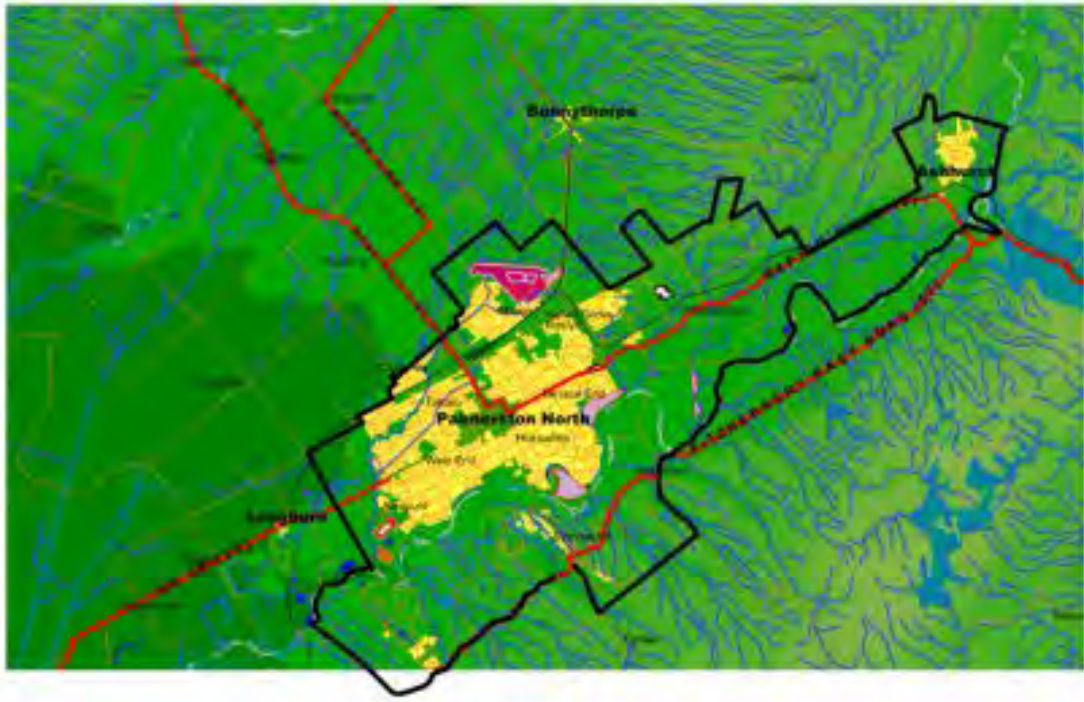


Opotiki

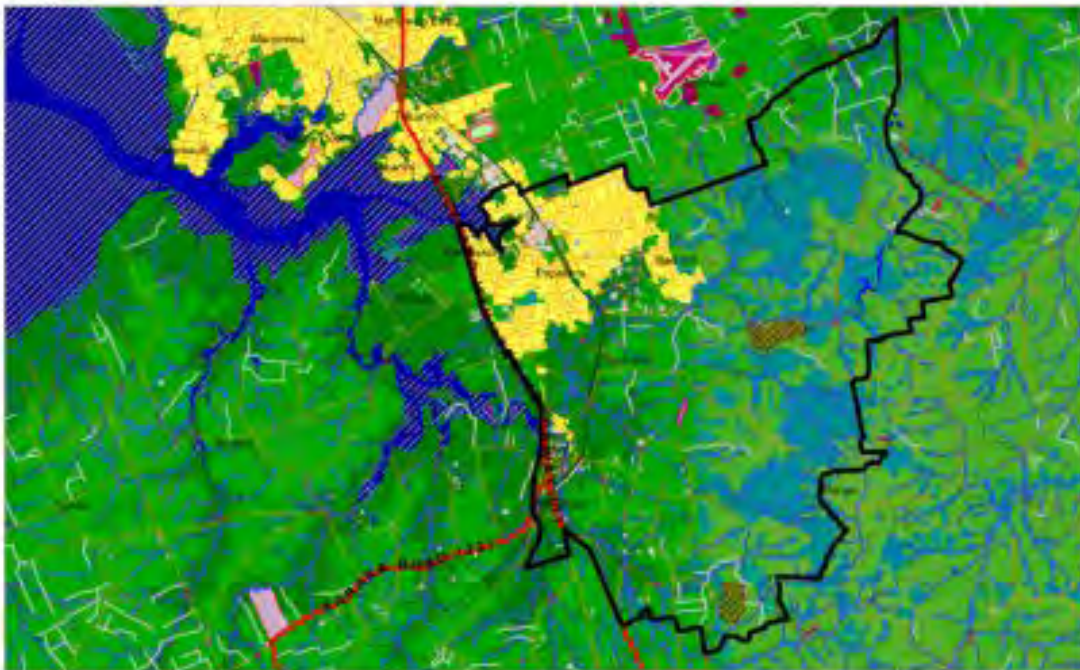


Orewa

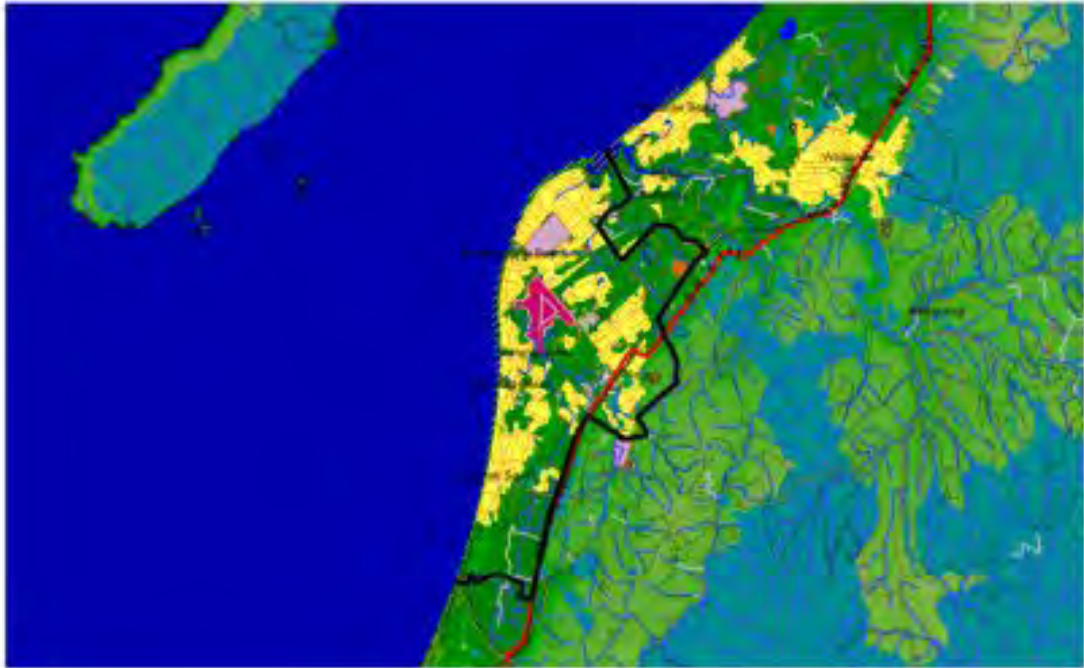




Palmerson North



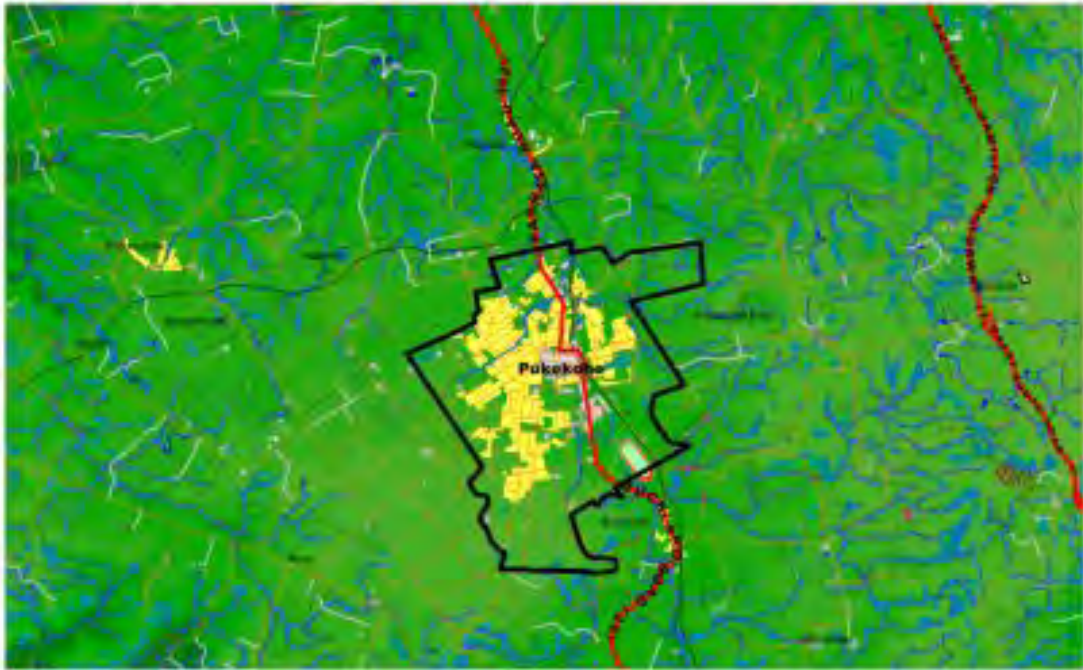
Papakura



Paraparaumu



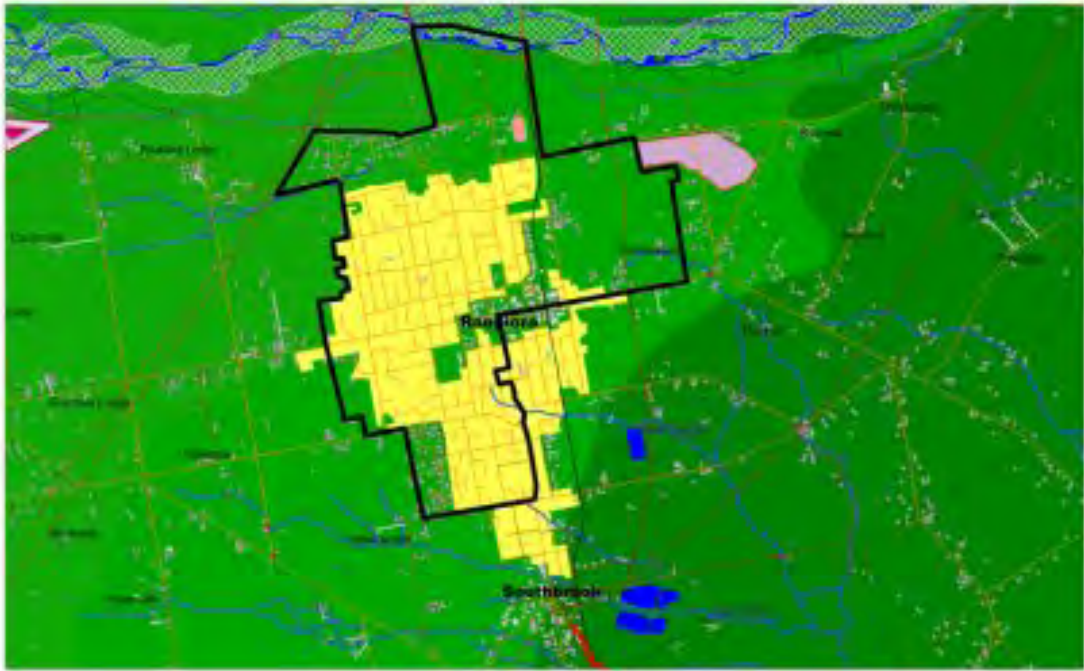
Porirua



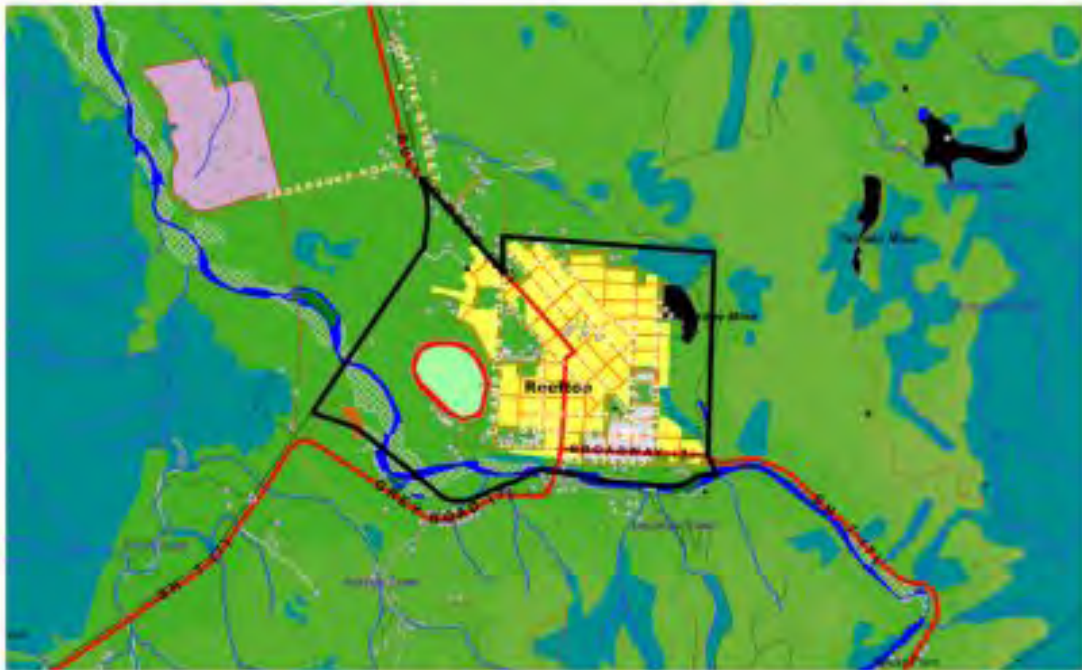
**Pukekohe**



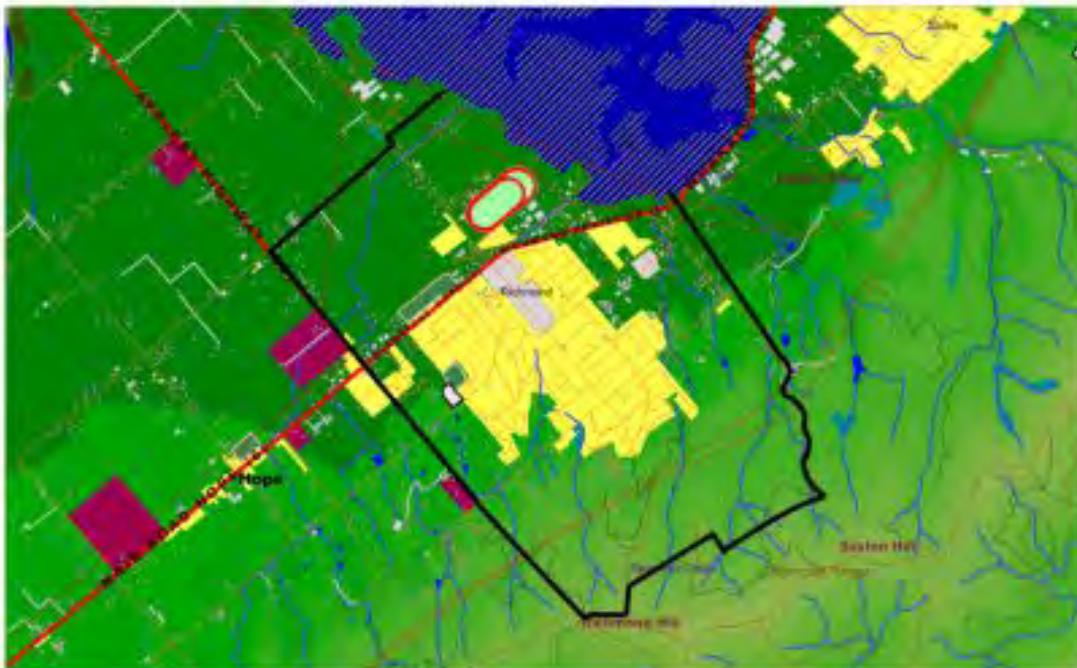
**Putaruru**



Rangiora



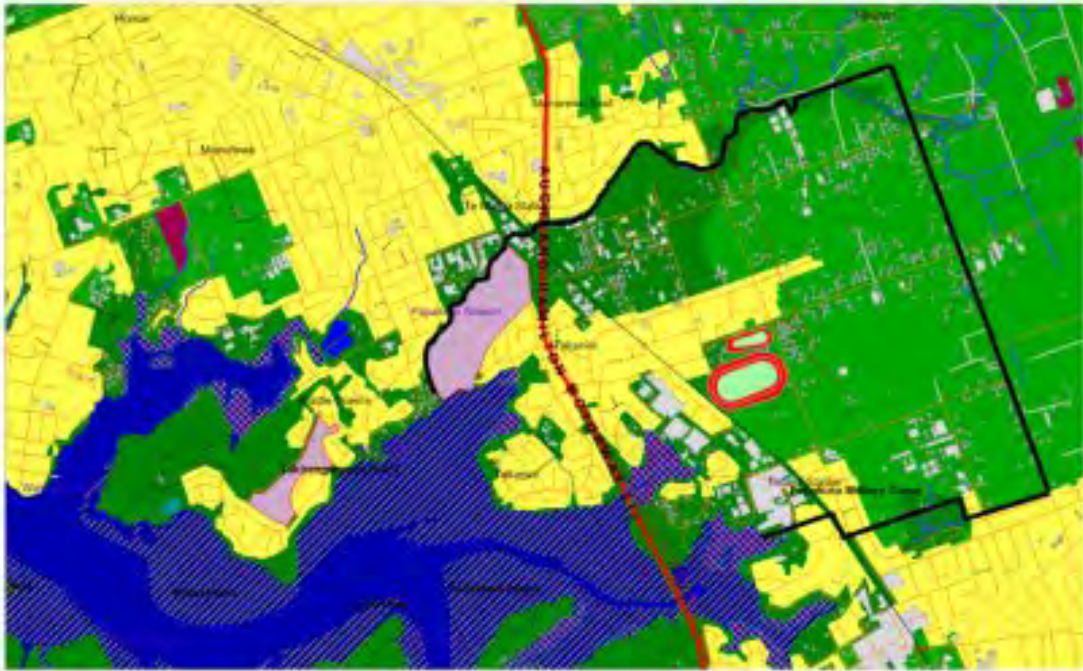
Reefton



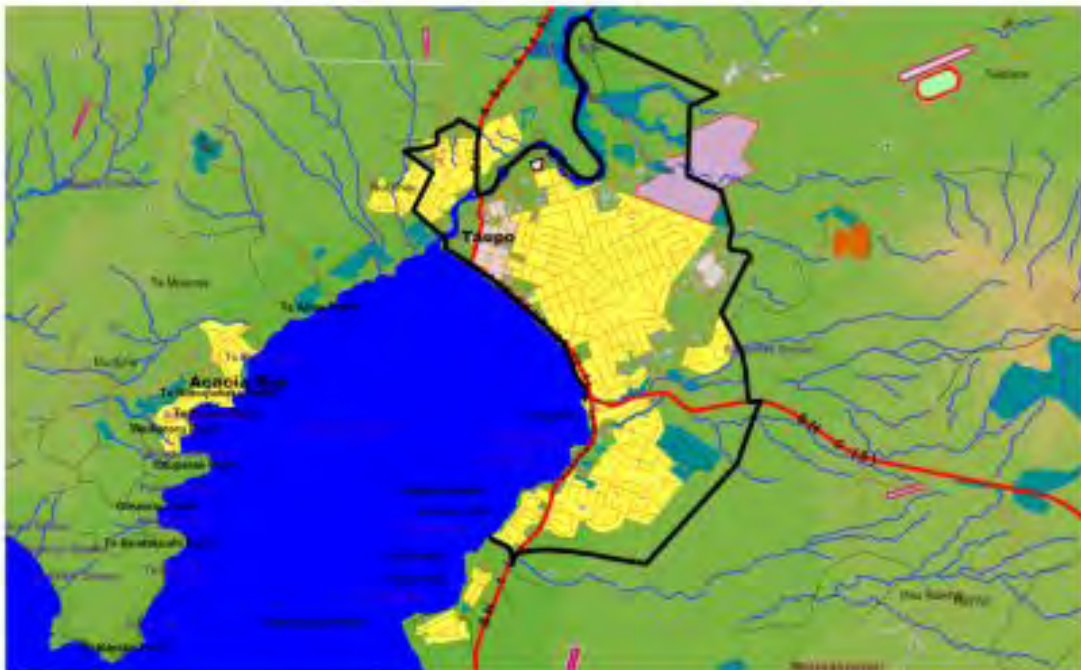
**Richmond**



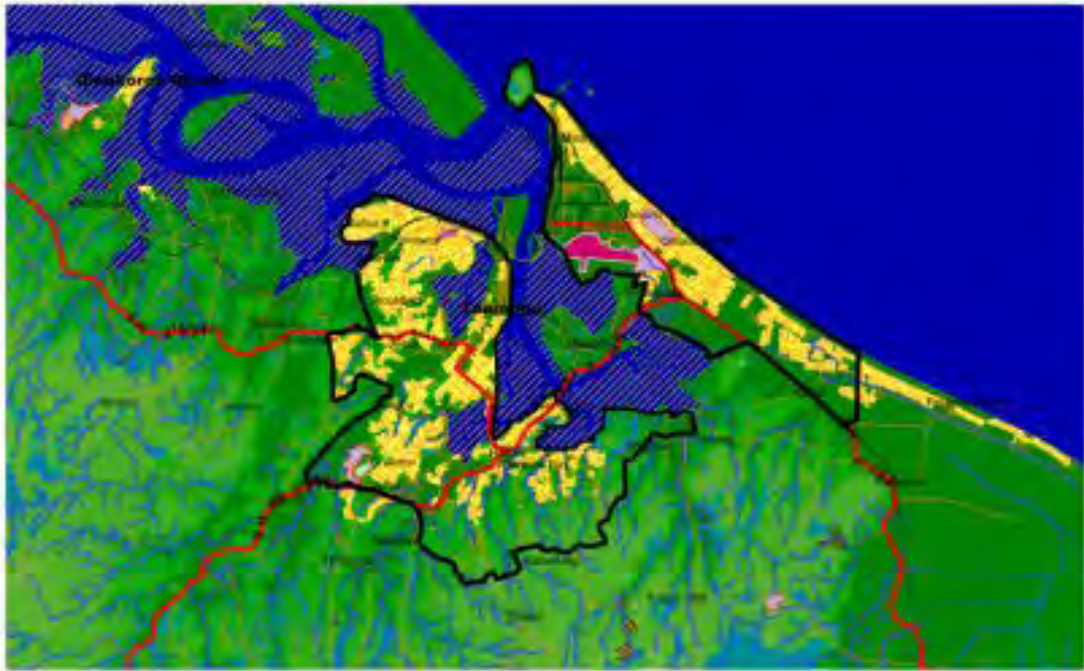
**Rotorua**



Takanini



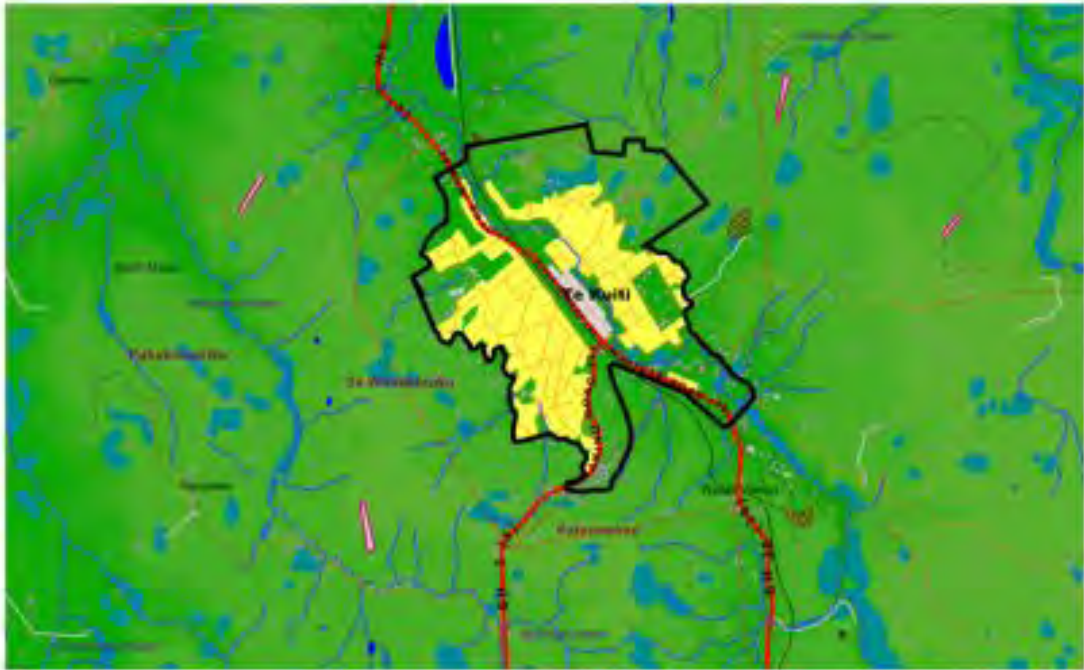
Taupo



Tauranga



Te Awamutu

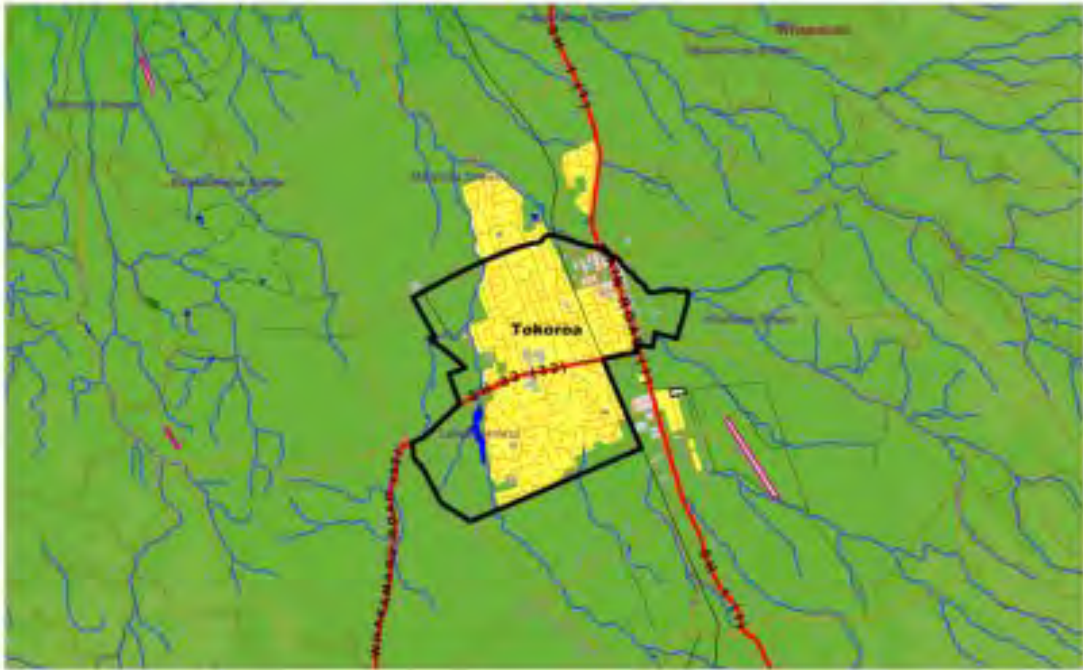


Te Kuiti

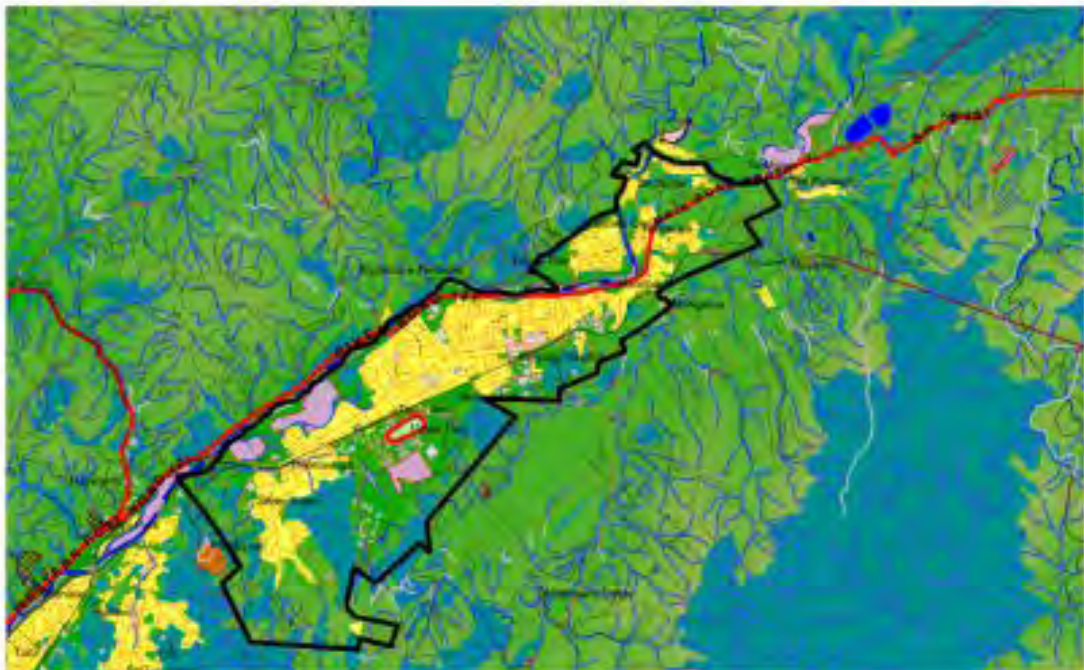


Timaru

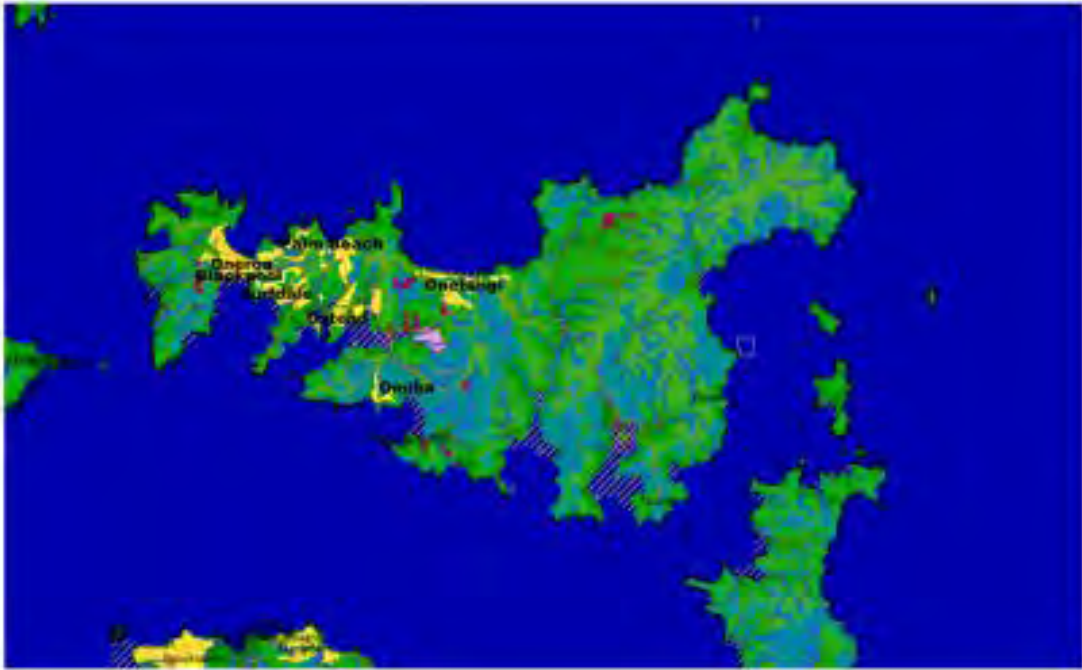




**Tokoroa**



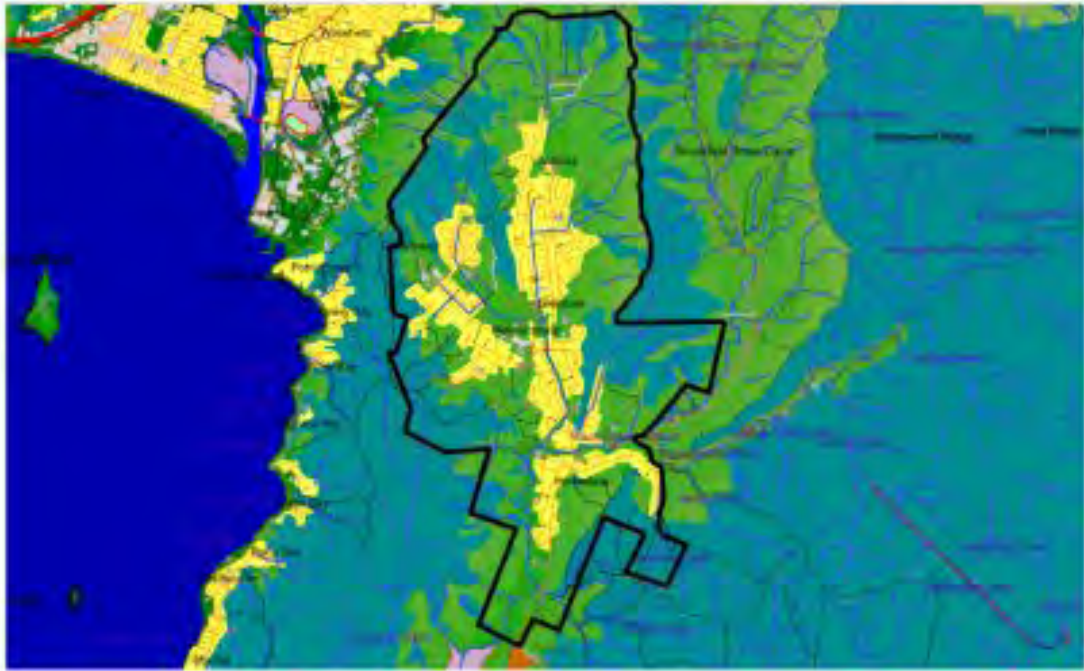
**Upper Hutt**



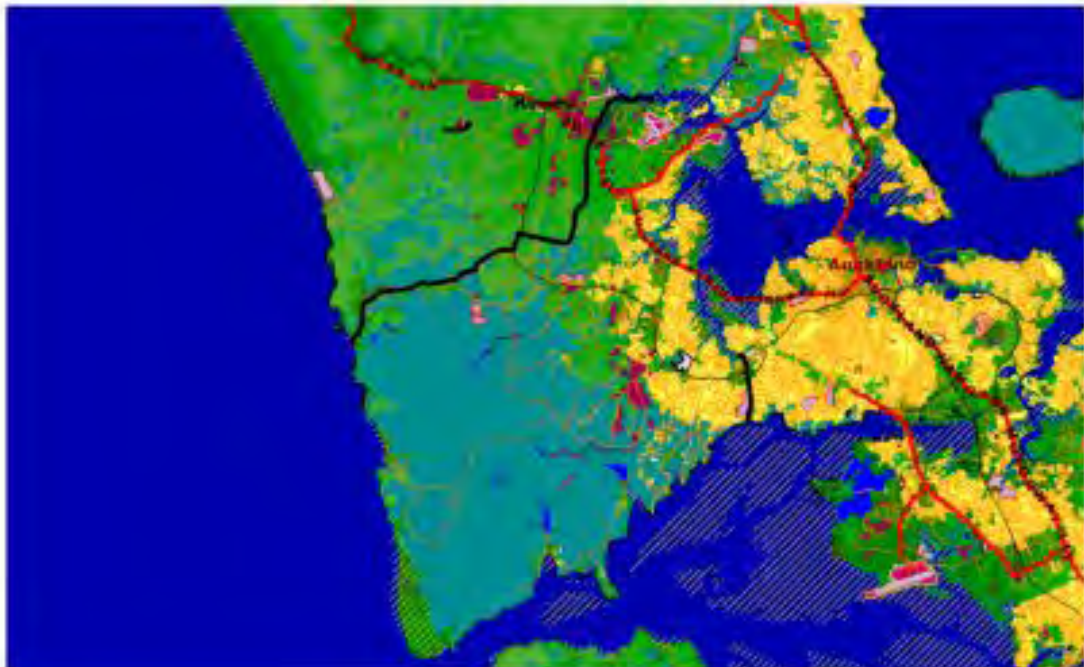
Waiheke Island



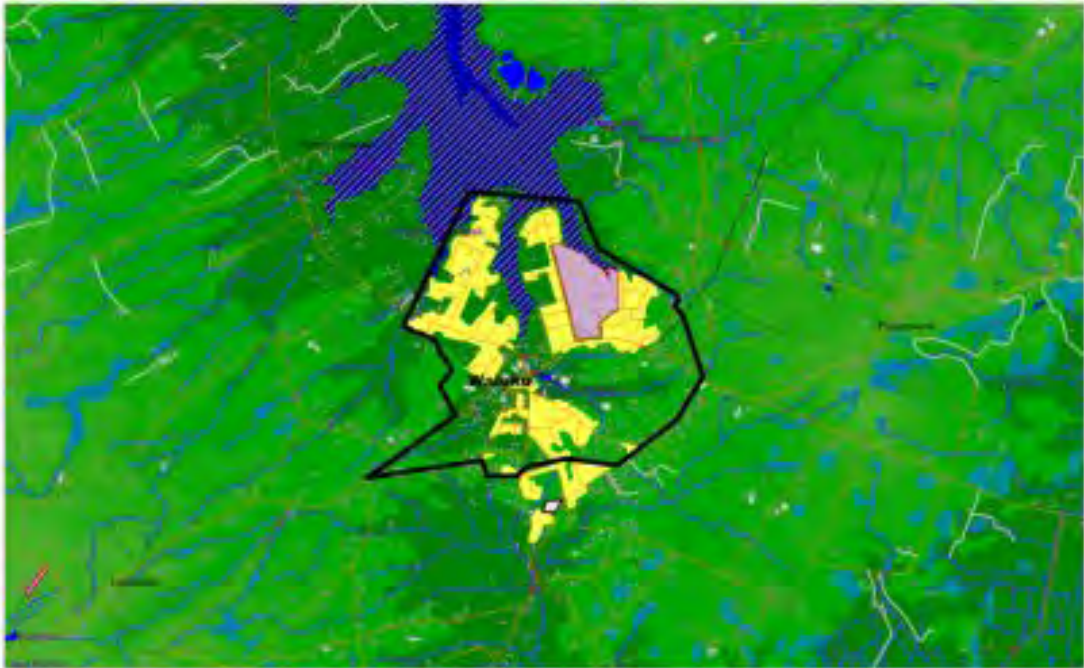
Waimate



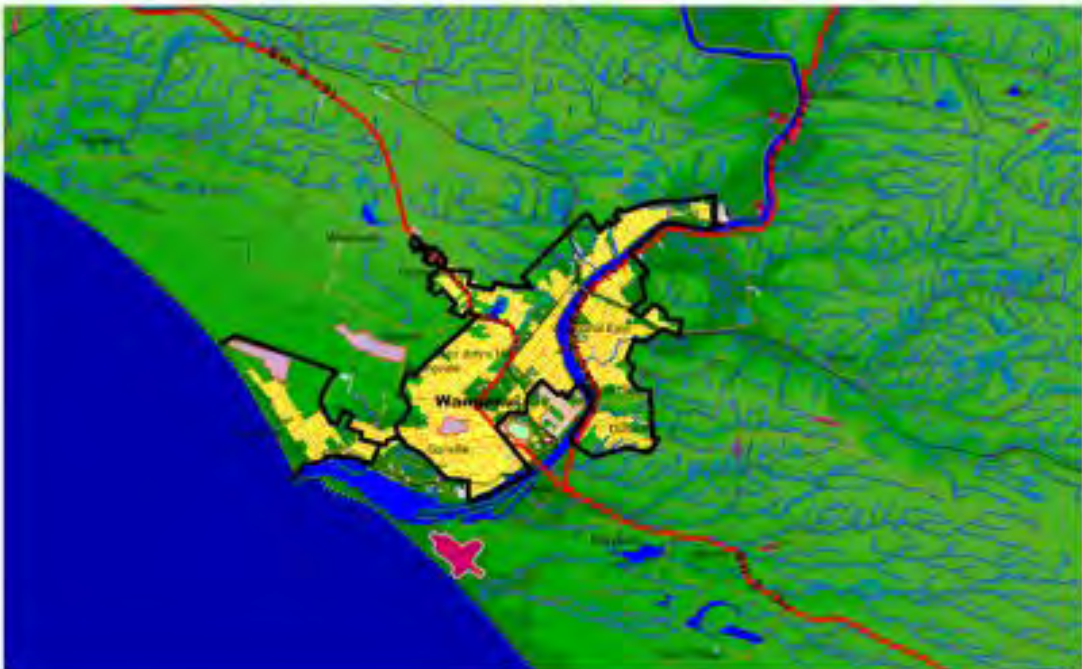
**Wainuiomata**



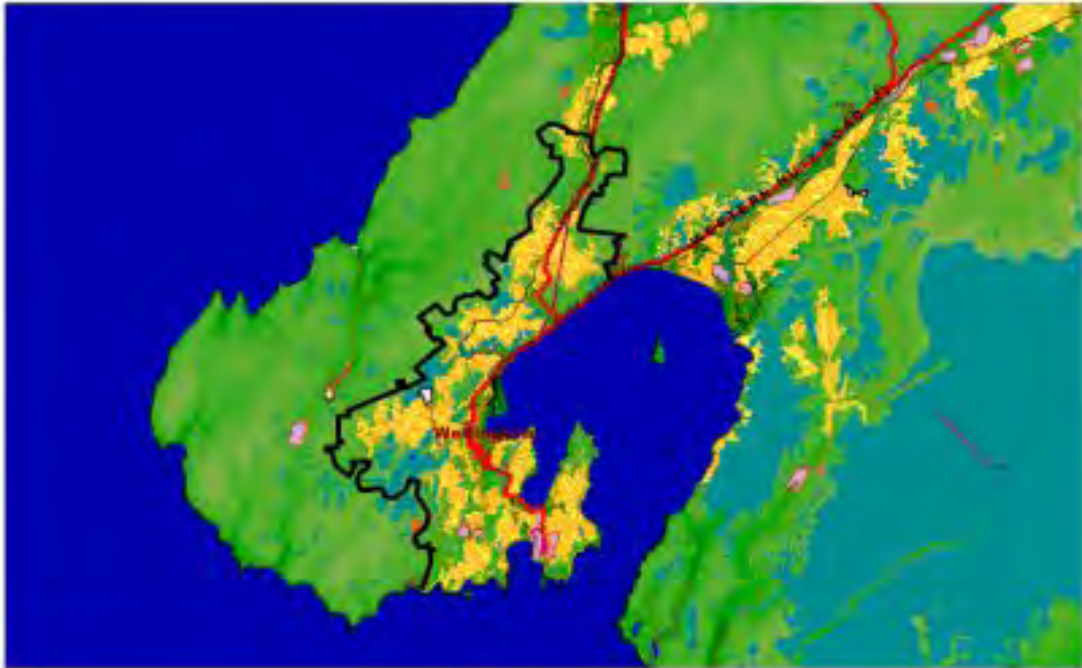
**Waitakere**



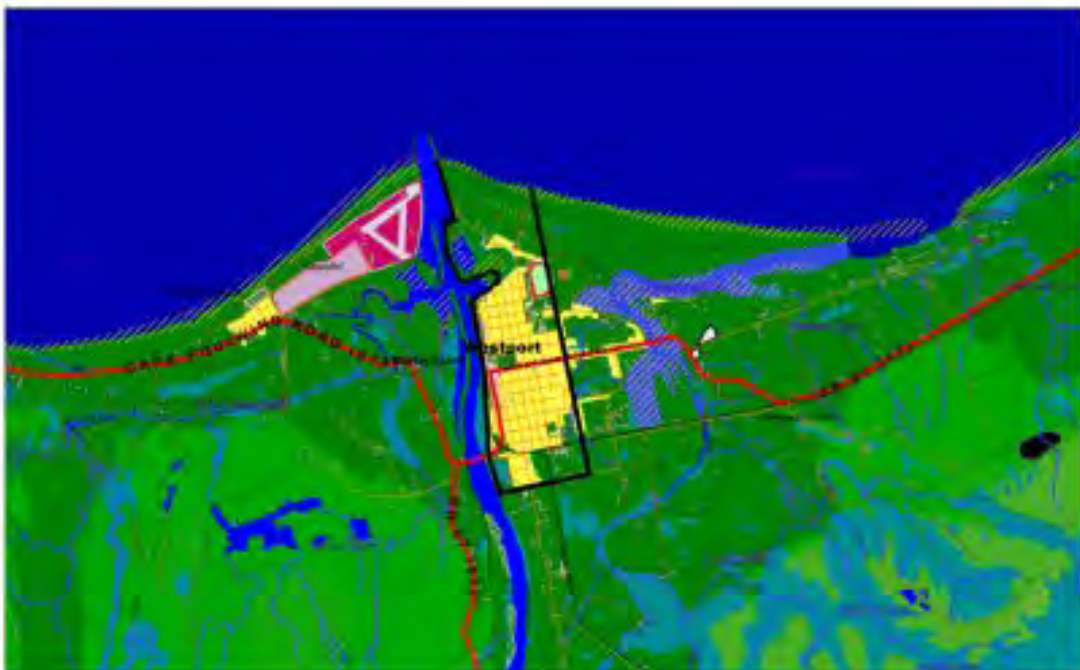
Waluku



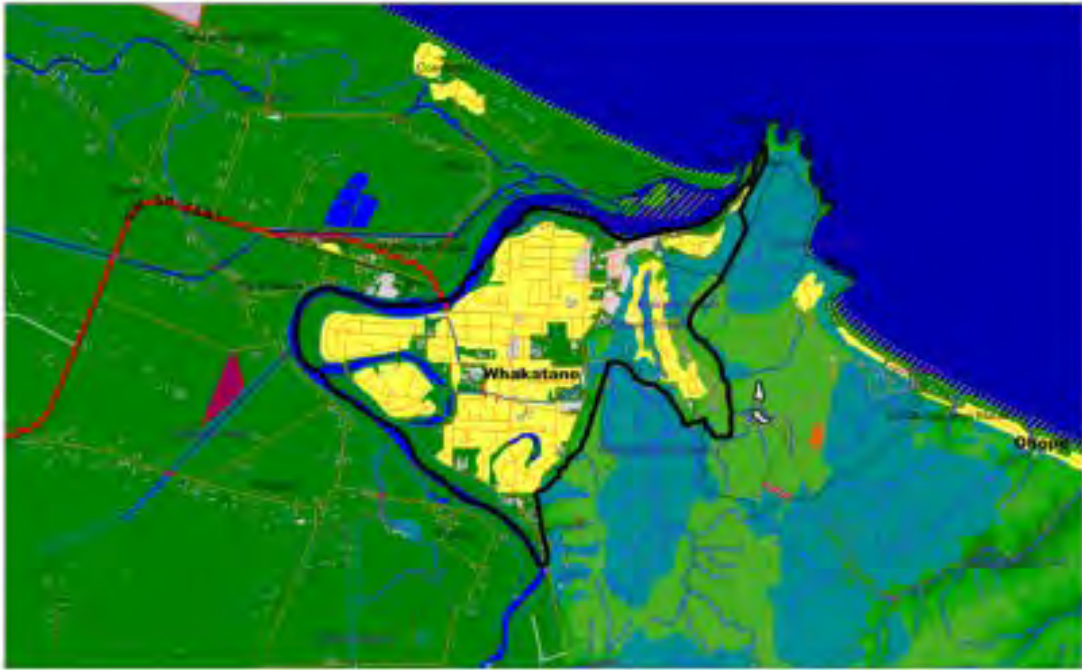
Wanganui



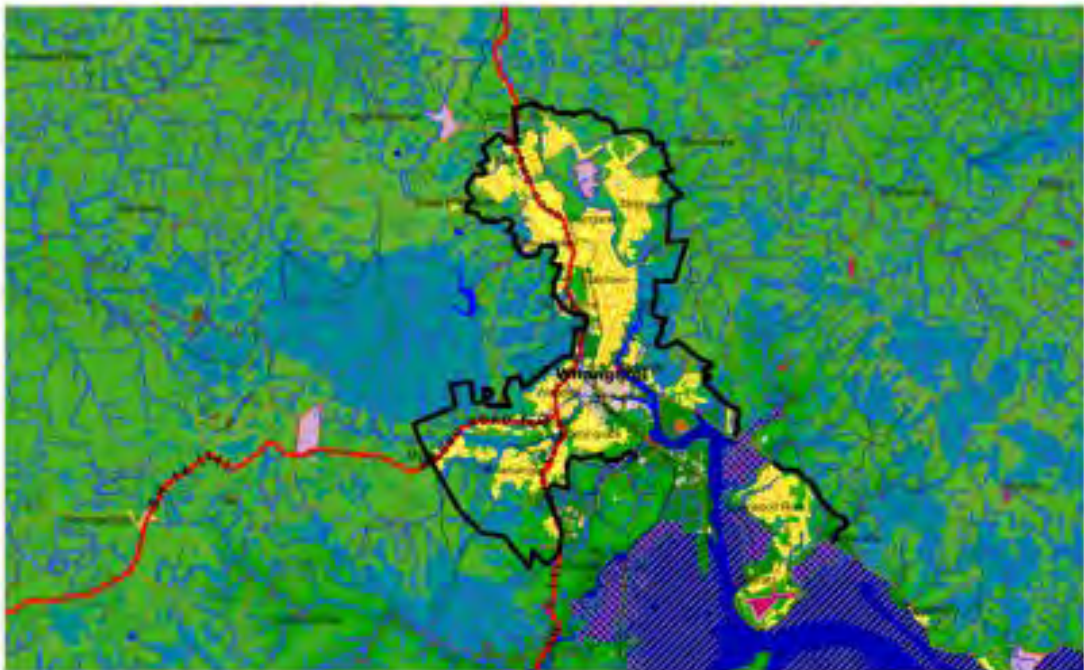
Wellington



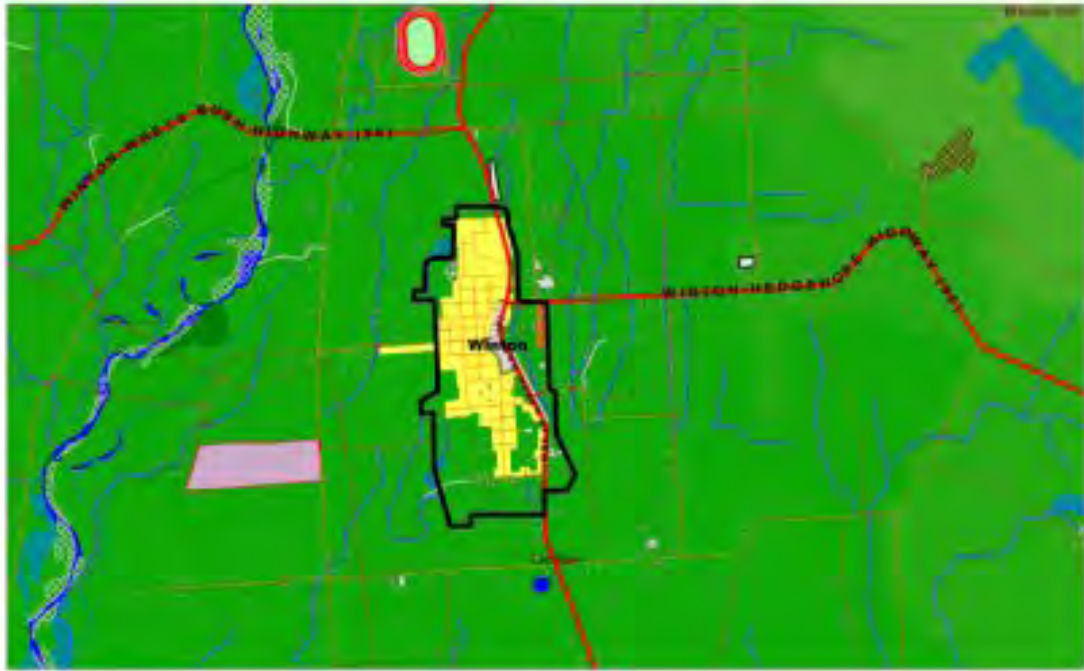
Westport



Whakatane



Whangarei



Winton