BEFORE THE PROPOSED NATURAL RESOURCES PLAN HEARINGS PANEL

IN THE MATTER	of the Resource Management Act 1991
AND	
IN THE MATTER	of Projections of land use in the Wellington Region
AND	
IN THE MATTER	of the submissions and further submissions set out in the S42A Officer Report

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STATEMENT OF PRIMARY EVIDENCE OF DAVE MICHAEL BETHAM GRIMMOND ON BEHALF OF WELLINGTON REGIONAL COUNCIL

TECHNICAL – Projections of land use in the Wellington Region

12 January 2018

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1. SUMMARY

1.1 My name is David Michael Betham Grimmond. I have been the Greater Wellington Regional Council Economist since July 2016. I obtained a Bachelor of Arts Honours degree in economics from the University of Otago in 1982. A full copy of my qualifications and experience is available in **Attachment A** of my evidence.

1.2 I do not refer here to evidence of other experts.

1.3 I have been asked to provide evidence to aid in the response to submissions received coded to topic water quality.

1.4 The scope of my evidence includes an assessment of regional land use change and intensification in the Wellington region.

2. INTRODUCTION

2.1 My name is David Michael Betham Grimmond. I have been the Greater Wellington Regional Council Economist since July 2016. I obtained a Bachelor of Arts Honours degree in economics from the University of Otago in 1982. I have over thirty years of experience as a New Zealand based economist working for private sector economic consultants (New Zealand Institute of Economic Research, Infometrics) and in the public sector (Treasury, Department of Labour). I have spent considerable amounts of time involved in the preparation of economic forecasts and in the development of forecast models. A full copy of my qualifications and experience is available in **Attachment A** to my evidence.

2.2 I have been engaged by Wellington Regional Council to provide evidence relating to land use change and intensification within the Wellington region.

3. CODE OF CONDUCT

3.1 I confirm that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note and that I agree to comply with the code. My evidence in this statement is within my area of expertise. I have not omitted to consider material facts known to me that might alter to detract from the opinions which I express.

4. SCOPE

(a) I have been asked to provide evidence relating to land use change and intensification

5. METHODOLOGY

5.1 The methodology for assessing land use change and intensification involved analysing historical land use data for the Wellington region, the estimation of relevant forecast models, and the preparation of urban and farm land use forecasts for the Wellington region out to 2025. Details of methods used are presented in the Appendix in Section 11 below.

6. SUMMARY OF PROJECTIONS OF LAND USE IN THE WELLINGTON REGION

6.1 The projection methods used were deliberately simple, as more complex approaches often suggest a higher level of understanding than actually exists and potentially increase the sources of forecast error. The forecasts presented here primarily reflect the population projections for the region that underpin the supporting information for the 2018 Long Term Plan and a continuation of recent trends in land use in the region.

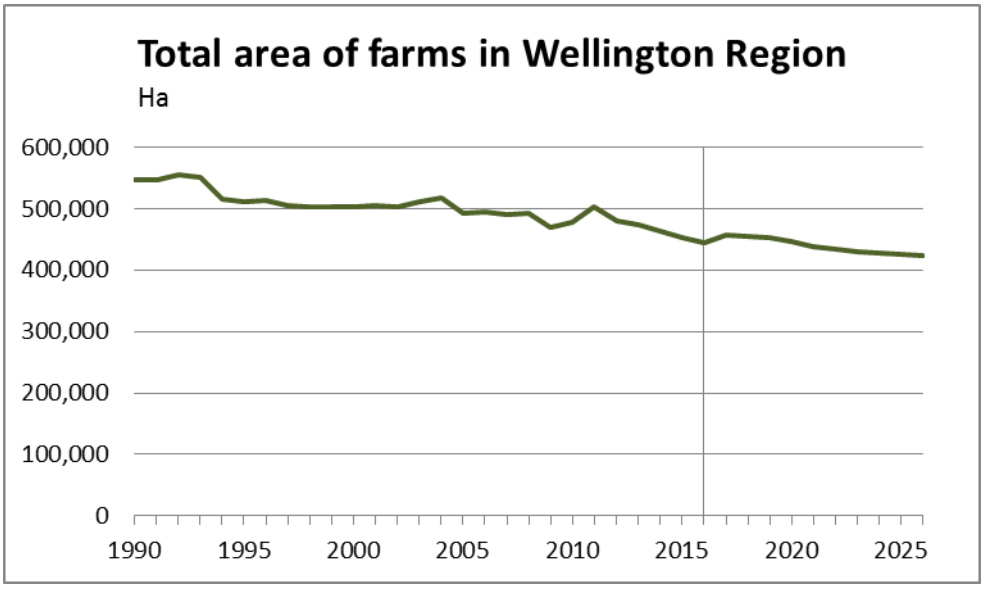
6.2 The summary is, with an expected population growth of 24,000 over the eight years to 2025 (at an average of 0.6%pa), that the region's urban land coverage is projected to increase by 1,180 Ha from an estimated 20,870 Ha in 2016 to 22,050 Ha in 2025 (ie at an average of 0.6% growth per year). In terms of absolute area, the largest projected increase in urban land cover is the 360 Ha increase expected in Wellington City. The 210 Ha expected increase in Kapiti Coast represents the largest relative increase, at 6.9%.

Table 1: Urban land coverage projections

				2016-2025 Change	
	2012	2016	2025	Ha	%
Kapiti Coast District	2,992	3,060	3,270	210	6.9%
Porirua City	2,319	2,380	2,530	150	6.3%
Upper Hutt City	2,306	2,340	2,460	120	5.1%
Lower Hutt City	4,416	4,520	4,710	190	4.2%
Wellington City	5,607	5,800	6,160	360	6.2%
Masterton District	1,636	1,660	1,760	100	6.0%
Carterton District	465	470	490	20	4.3%
South Wairarapa District	622	640	670	30	4.7%
Wellington Region	20,364	20,870	22,050	1,180	5.7%

6.3 In contrast the number of farm holdings in the Wellington Region is projected to decline by 170 from 1,887 in 2016 to 1,717 in 2025. With little change expected in the average size of farm holdings this implies a decline of almost 20,000 Ha from 445,321 in 2016 to 425,700 in 2025.

Figure 1



7. Urban land coverage

7.1 Historical urban land coverage data is sourced from the New Zealand Land Cover Database, version 4.1[1]. Data from this source was available for four years: 1996, 2001, 2008 and 2012. Population density estimates, measured as the population per Ha, were calculated using Statistics New Zealand sub-national population estimates for each of the region's territorial authority areas. Projections of population density were then calculated using simple trend analysis using STAMP (Koopman et al. 2007). See the Appendix for a technical explanation of the statistical methods used. The projections of urban population density are presented in Figure 2.

[1] See https://lris.scinfo.org.nz/layer/48423-lcdb-v41-land-cover-database-version-41-mainland-new-zealand/

Figure 2

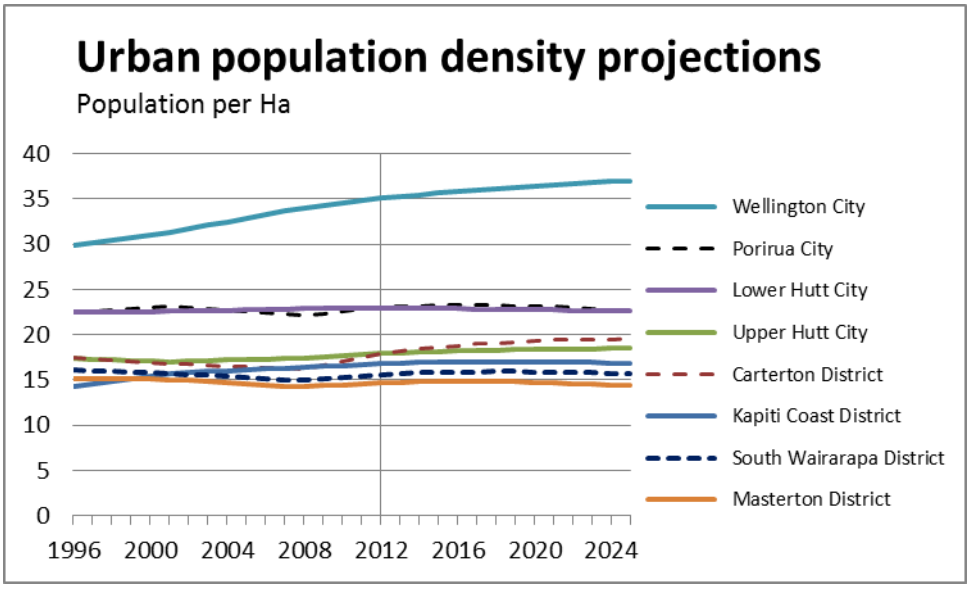
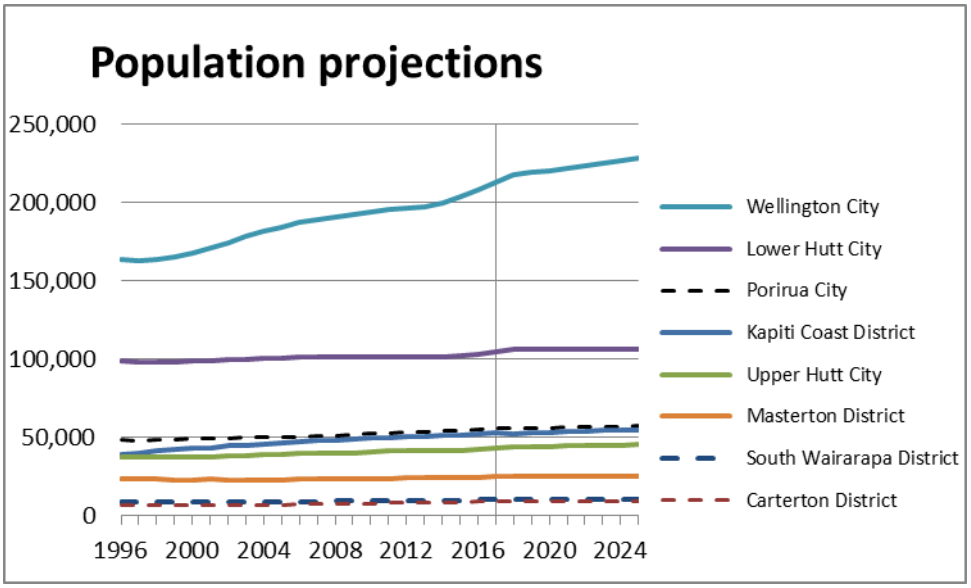
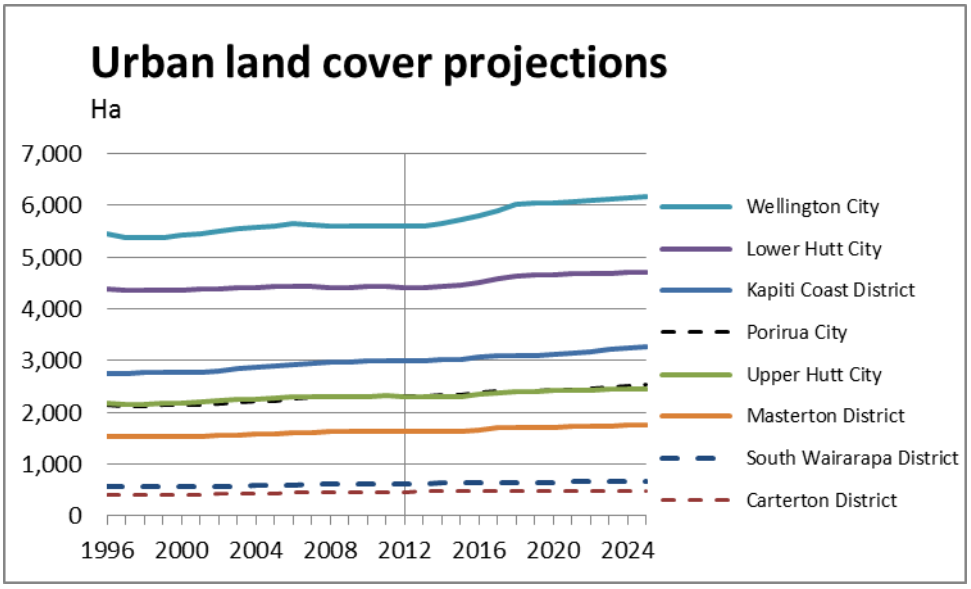


Figure 3



7.2 The population projections for each area that underpin the supporting information for the 2018 Long Term Plan (see Figure 3) are then applied to the projected urban population densities to generate projections of urban land coverage (see Figure 4).

Figure 4



8. Farm area

8.1 The historical farm area and stocking data was sourced from Statistics New Zealand Infoshare service[2]. An issue with this data is missing data points for various indicators in various years. These missing data points were interpolated using polynomial spline techniques (usually of order 6).

8.2 Projections of region farm area were based on an error correction model that related farm area to regional population (see Appendix). As expected the population variable entered the model with a negative sign, thus the projections of farm area are consistent with a theoretical model whereby population pressures compete for farm uses of land in the region. However, past and projected declines in farm land in the region exceed what can be explained purely from population pressures. Thus there is more behind the downward trend in farm activity in the region than simply urban population growth. Other factors that could be contributing include an expansion in rural lifestyle blocks, increases in non-farm rural industry land uses, and declines in farm returns. The land use projections presented here account for some continuation of such trends, but do not explicitly identify any influencing factors other than the population trends.

[2] See http://archive.stats.govt.nz/infoshare/SelectVariables.aspx?pxID=bae23d64-b18e-410e-9212-278c883d699f

8.3 The number of farm holdings in the Wellington Region is projected to decline by 170 from 1,887 in 2016 to 1,717 in 2025 (see Figure 5). With little change expected in the average size of farm holdings (see Figure 6) this implies a decline of almost 20,000 Ha from 445,321 in 2016 to 425,700 in 2025 (see Figure 1).

Figure 5

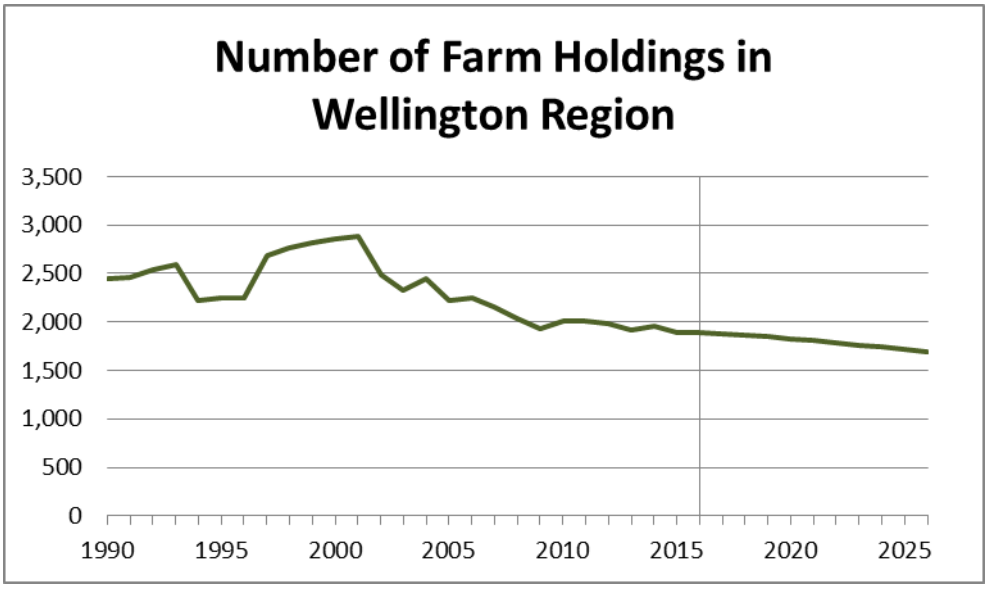
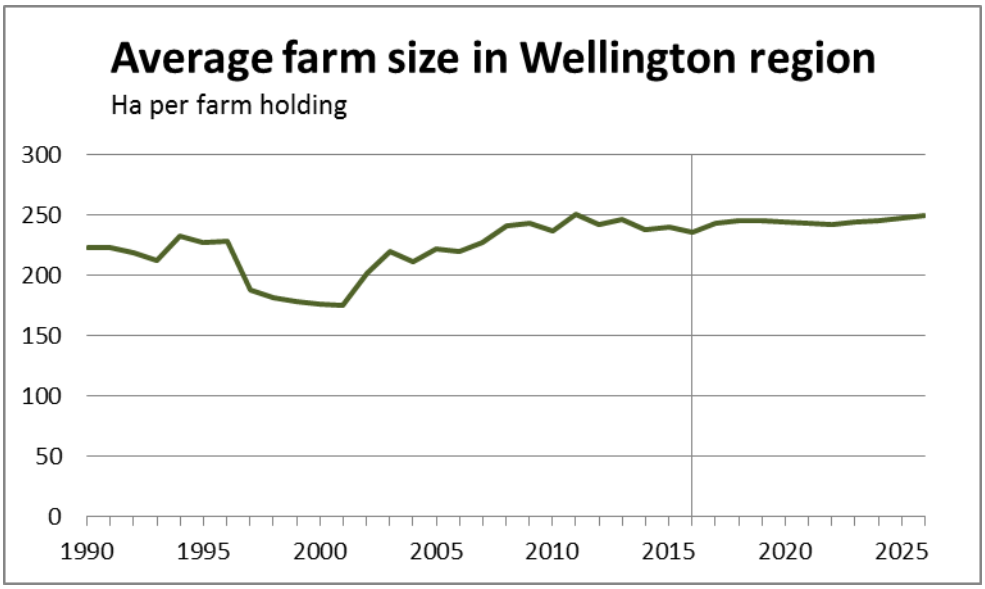


Figure 6



8.4 The decline in farm activity is expected to be primarily about further declines in sheep farming (see Figure 7), with static or perhaps slight declines in dairy and beef cattle numbers (see Figure 8 and Figure 9).

Figure 7

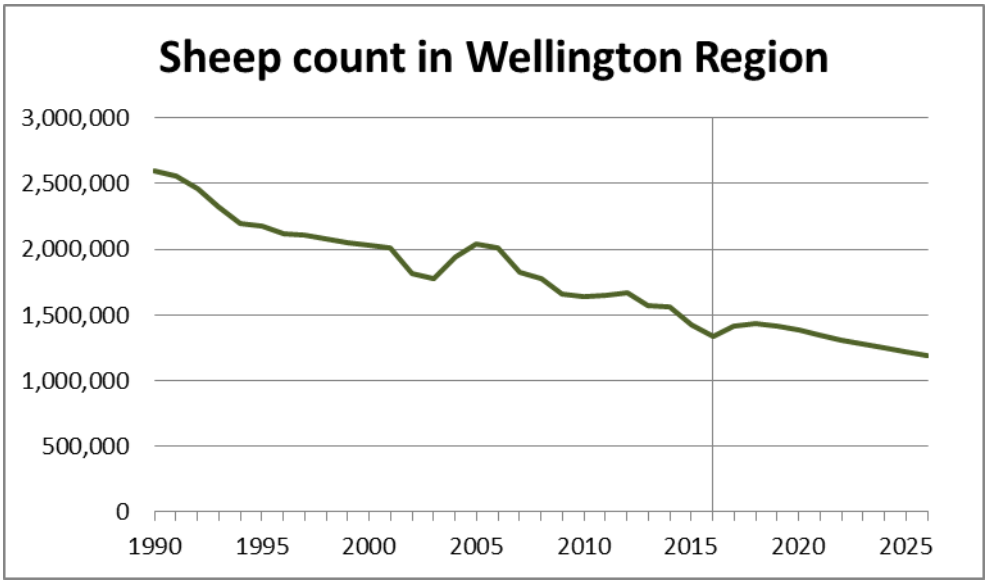


Figure 8

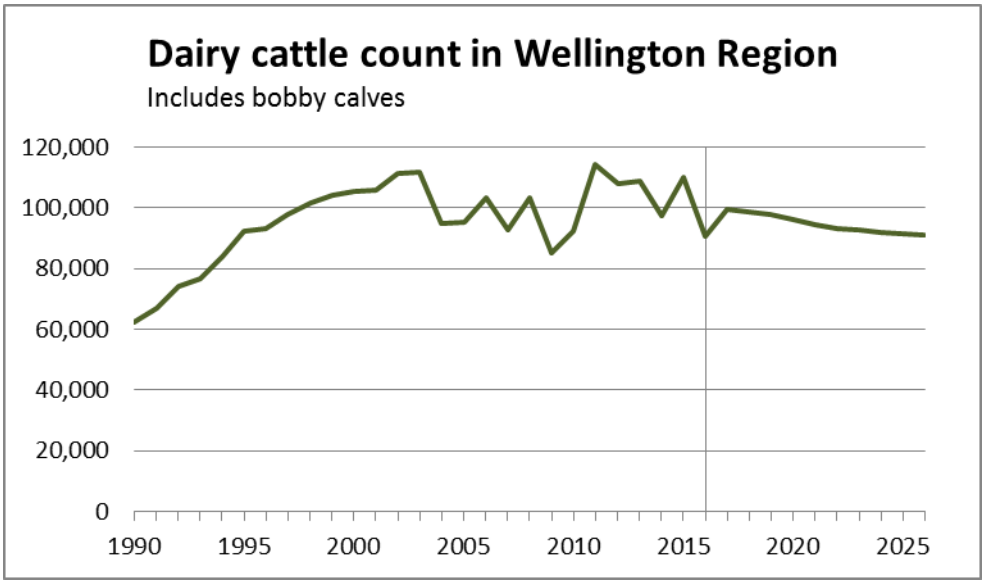
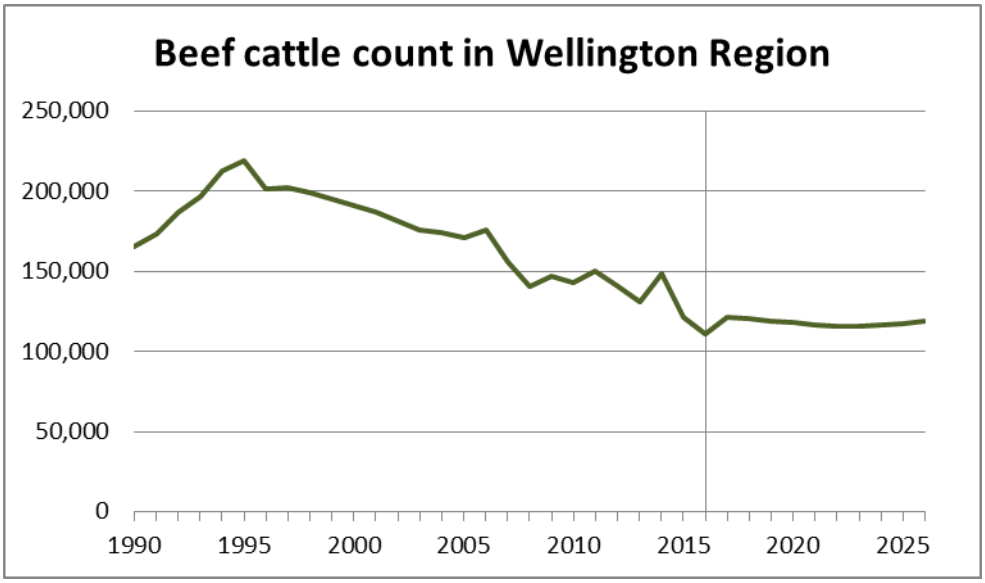


Figure 9



8.5 Despite the projected decline in farmland, increases in average per farm fertiliser applications (see Figure 10) means that fertiliser applications are projected to increase by 8,400 tonnes from 55,700 tonnes in 2017 to 64,100 tonnes in 2025 (i.e. by 15%, see Figure 11).

Figure 10

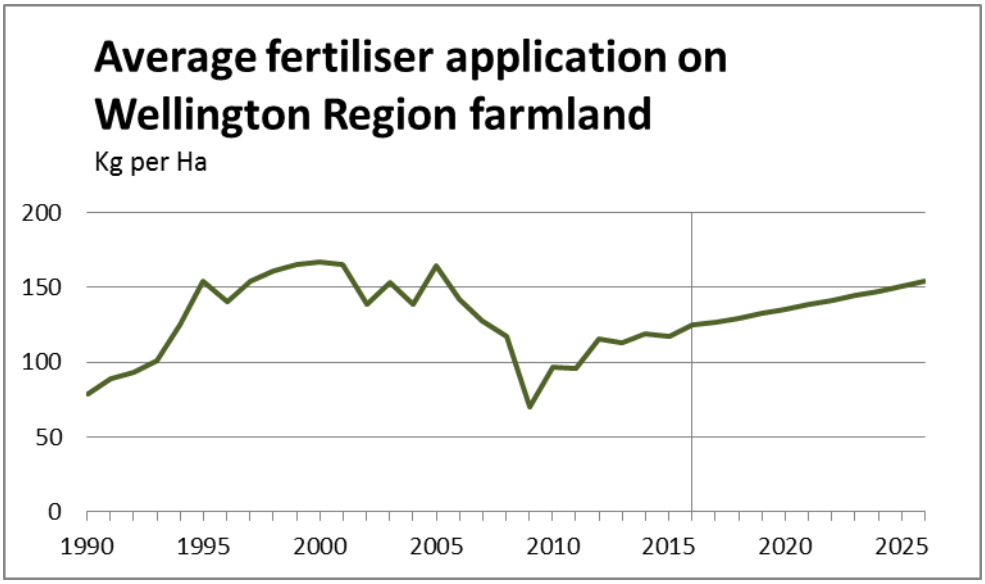
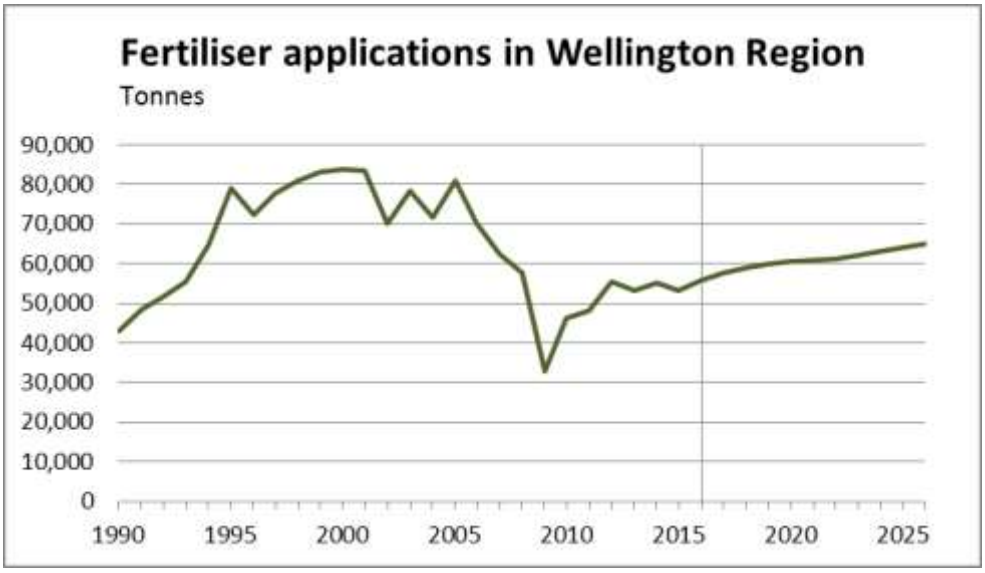


Figure 11



9. CONCLUSION

9.1 My evidence has provided a regional scale forecast for some land use activities to provide an indication of land use change and intensification across the region. The region's population is expected to grow by 24,000 over the eight years to 2025 (at an average of 0.6%pa). Further increases in urban population densities, especially in Wellington City, are expected to mitigate increases in urban land use coverage to an increase of 1,180 Ha from an estimated 20,870 Ha in 2016 to 22,050 Ha in 2025. The projections do not explicitly allow for transport changes like Transmission Gully and the Kapiti Expressway.

9.2 Farm land use projections are for a decline of almost 20,000 Ha from 445,321 in 2016 to 425,700 in 2025. This incorporates competition from urban land use, but there are also other forces at work, including perhaps an expansion in rural lifestyle blocks, increases in non-farm rural industry land uses, and declines in farm returns.

10. REFERENCES

Koopman, S J, A C Harvey, J A Doornik, and N Shephard. 2007. *Structural Time Series Analyser and Modeller and Predictor: STAMP 8*. London: Timberlake Consultants.

The New Zealand Land Cover Database, Version 4.1, https://lris.scinfo.org.nz/layer/48423-lcdb-v41-land-cover-database-version-41-mainland-new-zealand/

11. APPENDIX: ESTIMATION METHODS

11.1 The forecasts presented are largely trend based, with an underlying philosophy that by requiring fewer judgement calls, simple forecasting approaches can often outperform more complex structural forecast models.

11.2 Forecasts using STAMP Version 8 (Koopman et al. 2007) used univariate auto regressive estimation, ie:

$$y_t = \mu_t + \nu_t + \epsilon_t, \quad \epsilon_t \sim NID(0, \sigma_\epsilon^2), \quad t = 1, \dots, T$$

11.3 Where μ_t is the stochastic trend, ν_t is a first-order autoregressive component and ϵ_t is the irregular. The stochastic trend component is specified as

$$\begin{aligned} \mu_t &= \mu_{t-1} + \beta_{t-1} + \eta_t, \quad \eta_t \sim NID\left(0, \sigma_\eta^2\right) \\ \beta_t &= \beta_{t-1} + \zeta_t, \qquad\qquad \zeta_t \sim NID\left(0, \sigma_\zeta^2\right) \end{aligned}$$

11.4 Where β_t is the slope or gradient of the trend μ_t. The irregular ϵ_t, the level disturbance η_t, and the slope disturbance ζ_t, are mutually uncorrelated. Finally the first-order autoregressive, AR(1), process is given by

$$\nu_t = \rho_\nu \nu_{t-1} + \xi_t, \qquad \xi_t \sim NID\left(0, \sigma_\xi^2\right)$$

With ρ_ν in the 0 to 1 range.

11.5 The implication of this approach is that forecasts are generated based on historical trend analysis, with the stochastic trend process meaning that more recent data has a higher weighting in the trend analysis, while the AR(1) process acts to progressively dampen the trend impact in later forecasts.

11.6 Projections of total farm area in the region were based on an error correction forecast model that relates farm area (TFA) to Wellington Regional population (WRP) prospects. The derived forecast model (with standard errors in brackets) is:

$$\begin{aligned} \widehat{TFA} = \underset{}{656{,}828} &+ \underset{(0.087)}{0.241}\ TFA_{-1} - \underset{(0.037)}{0.633}\ WRP_{-4} \\ &\ (14{,}308) \end{aligned}$$

11.7 The model was estimated using error correction estimation techniques in PcGive, version 12 (Doornik and Hendry 2007). The

estimation used annual data from 2000 to 2016. Effectively this model accounts for the way that urban population growth competes for farm land.

11.8 The long run level equation estimated from 2000 to 2016 was:

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
Constant	868982	6.22E+04	14	0	0.9286
WRP_3	-0.833484	0.1356	-6.15	0	0.7159

11.9 The short run change equation estimated from 2001 to 2016 and the resulting diagnostic tests were:

	Coefficient	Std.Error	t-value	t-prob	Part.R^2
ztfa_1	-0.759067	0.2745	-2.77	0.0152	0.3533
Constant	-2787.81	2766	-1.01	0.3306	0.0677

sigma	10994.2	RSS	1.69221941e+009
R^2	0.353285	F(1,14) =	7.648 [0.015]*
log-likelihood	-170.517	DW	1.82
no. of observations	16	no. of parameters	2
mean(DTFA)	-3638.4	var(DTFA)	1.6354e+008

AR 1-2 test:	F(2,12) = 0.58037 [0.5747]
ARCH 1-1 test:	F(1,12) = 0.43176 [0.5235]
Normality test:	Chi^2(2) = 5.1620 [0.0757]
Hetero test:	F(2,11) = 0.28496 [0.7574]
Hetero-X test:	F(2,11) = 0.28496 [0.7574]
RESET test:	F(1,13) = 0.40440 [0.5359]

Attachment A
Qualifications and experience

Qualifications

BA Hons (Economics), University of Otago NZ, 1979-82

Experience:

SKILLS

Applied economist specialising in:

- Model development and forecasting
- Project assessment (cost benefit analysis, economic impact analysis, social return on investment)
- Macroeconomics
- Labour market
- Public policy (monetary policy, fiscal policy, social policy)

CAREER HISTORY

Greater Wellington Regional Council (July 2017 to Present)

Economist

Infometrics Economic Analysis Ltd (July 2014 to March 2016)

Director, Economist

Provision of project specific economic analysis for consulting clients.

Infometrics Ltd (May 2004 to June 2014)

Director, Senior Economist

Primarily responsible for consulting projects, many of which involved long-term forecasting, model development, policy advice, and cost-benefit analysis. Also involved with economic forecasts and developing retail and regional forecast products for Infometrics.

Department of Labour (October 2000 to May 2004)

Adviser, Labour Market Policy Group

Principal role to provide leadership on economic analysis for the Labour Market Policy Group. Also spent the year of 2001 operating as the Acting Manager of the Group's Research and Evaluation Team, from July 2002 to December 2003 heading the Department's Future of Work project, and from March 2003 to December 2003 as the Acting Manager of the Department's Labour Market Information Unit.

Infometrics Ltd (1997 to 2000)

Senior Economist

Involved in forecasting and consulting projects.

New Zealand Treasury (1992 – 1997)

Manager, Macroeconomic Policy (1995-97)

Responsible for overseeing the development of Treasury advice to financial ministers on the monetary policy framework and medium term fiscal strategy. Involved in developing Treasury advice on:

- monetary policy issues of the time (the breach of the Reserve Bank's inflation target, the merits of exchange rate intervention, the review of the CPI),
- the Reserve Bank's five-year funding agreement,
- the scope and timing of mid-1990s tax cuts,
- the fiscal consequences of an ageing population, and
- fiscal and economic management issues in the Treasury's 1996 Briefing to the Incoming Government.

Senior Analyst, Macroeconomic Forecasting (1992-94)

Forecast co-ordinator, responsible for overseeing the production of Treasury's economic forecasts.

New Zealand Institute of Economic Research (1983 – 1992)

Research Economist (1988-92)

Responsible for business sector, inflation, and monetary sector forecasts, assistant editor of Quarterly Predictions, contract research. Research projects undertaken during this time included studies into the impact of disinflation on New Zealand industry, the relationship between investment and growth, issues related to currency integration with Australia, labour market dynamics in New Zealand, and an empirical analysis of the relationship between inflation and growth in New Zealand.

Travel and work abroad (1985-88)

Assistant Research Economist (1983-85)

Responsible for agriculture sector and export forecasts; editor of Quarterly Survey of Business Opinion; contract research. Research included development of forecasting models for the producers price index and operating surplus.