IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Proposed Canterbury Land and Water Regional Plan

STATEMENT OF EVIDENCE OF GEOFFREY BUTCHER FOR THE GROUP ONE HEARINGS

1. INTRODUCTION

1.1 My name is Geoffrey Vernon Butcher. I am director of Butcher Partners Ltd, an economic consultancy with office in Christchurch. I hold an MA (Hons) in Economics from Canterbury University. My experience includes**:**

(a) 30 years as a professional economist including periods of employment at the New Zealand Institute of Economic Research and Lincoln University, where I lectured in the areas of business economics, cost benefit analysis and economic impact analysis;

(b) I have published a manual on regional economic impact analysis in New Zealand and run workshops for government and council policy analysts on how to undertake analysis and interpret results;

(c) Over the last 20 years I have developed regional economic models for many New Zealand regions and these are used by various councils and other economic consultancies such as BERL and Infometrics;

(d) I have undertaken numerous economic impact analyses for a wide range of industries and in a large number of regions. Of particular relevance to the evidence I shall give is my analysis of two dairy factories and numerous irrigation schemes where I have looked at both on-farm and off-farm impacts.

(e) I have appeared as an expert witness on economic impacts and economic efficiency in a number of hearings before councils, commissioners and the Environment Court on Resource Management Act-related matters

1.2 I have read and am familiar with the Code of Conduct for Expert Witnesses outlined in the Environment Court's Practice Note 1 November 2011 and although this is a Regional Council hearing, I have complied with it in preparing this evidence. I also agree to follow the Code when presenting evidence to the Hearing Committee. I confirm that the issues addressed in this brief of evidence are within my area of expertise and I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

2. SCOPE OF EVIDENCE

2.1 I have been asked by Dairy New Zealand and Fonterra Cooperative Group Ltd ("Fonterra") to discuss:

(a) The significance of irrigated farming and dairy farming in particular to the Canterbury economy;

(b) Growth in dairy farming in Canterbury;

(c) The implications for economic efficiency and regional economic activity of rules or policies which may prevent dairy factories in the red zone from abstracting water or discharging water to waste;

(d) The economic costs and efficiency associated with rules that propose the surrender of 25 % - 50 % of water rights upon transfer in areas where allocation limits are exceeded; and

(e) The Canterbury Regional Council's ("Council") section 32 analysis from an economics perspective.

3. THE SIGNIFICANCE OF IRRIGATION AND DAIRYING IN CANTERBURY, AND THE ECONOMIC IMPACTS OF FARMING

3.1 Appendices 1 and 2 to this evidence contains details of my calculations which show the economic significance of irrigated farming and dairy farming specifically to Canterbury. In this section I summarise those results.

3.2 There is (very approximately) 550,000[1] Ha of irrigated land in Canterbury. Assuming a mix of land uses and applying dryland and irrigated farm budget figures[2] to this area, I estimate that irrigation in Canterbury increases farm production by approximately $3.0 billion per year, value added (GDP) by $1.5 billion per year, and on-farm employment by 8,000 jobs.

3.3 Farmers purchase inputs and farm households spend incomes, and these activities increase economic activity in the Region via a series of multiplier effects. There is also processing of milk and meat in the Region, and this also generates a series of multiplier effects. I estimate that once these activities are all taken into account, irrigation in Canterbury increases regional GDP by $3.3 billion per year and provides employment for 25,000 people.

3.4 These are very significant impacts which are equivalent to around 11 % of total regional employment and 15 % of regional GDP.

3.5 It needs to be acknowledged that if irrigation had not been established, then the range of resources currently used on farms and in supporting industries would have been available for use elsewhere, and had they been used elsewhere in Canterbury then they would also have generated employment and GDP. However, there is no guarantee that they would otherwise have been used in

---

1. There is considerable uncertainty as to the total area of irrigated land in Canterbury at present, and the types of farming that take place on that land. Saunders *et al* [Total Value of Irrigation Land in Canterbury; Caroline Saunders and John Saunders. AERU, Lincoln University. September 2012] quote estimates ranging from 364,000 in 2009 [Government National Infrastructure Plan 2011, quoted in Saunders p 5] to 500,000 in 2008 [Canterbury Water Management Strategy. Quoted in Saunders p5], and also estimate increases in per Ha farm production and value added. Lilburne, L. [Landcare Research, *pers comm* December 2012 quoted in ECan S 32 analysis Appendix 1 p 10] gives a figure of 586,000 in 2012.
2. Land use quoted in Saunders, p 19. Farm budgets provided by Stuart Ford (Agricultural Economist] are shown in Appendix 1. They represent typical budgets from MAF monitoring farms, but product prices are adjusted to 8 year moving average.

Canterbury[3] and in any case the point to be made here is that irrigation is enormously significant to the Canterbury economy.

3.6 Dairy farm production in Canterbury has grown at 12 % per annum during the period 1998-99 – 2011-12, and Statistics NZ estimates that there are now 4,540 people employed directly in dairy farming. I estimate a regional employment multiplier of 2.2 for dairy farming which implies that in total there are 9,990 people who work in dairy farming, or whose jobs are in some way dependent on dairy farming.

3.7 There are a further 1,310 employed in dairy processing. I estimate a regional employment multiplier for milk processing (excluding dairy farming-related impacts) of 2.6 which implies that in total there are 3,410 people in Canterbury whose jobs depend on milk processing.

3.8 Hence all told there are 13,400 jobs in Canterbury which depend on dairy farming and milk processing. This is equivalent to 5.2 % of all employment in Canterbury.

3.9 Economic impacts of different land uses vary significantly, as shown in Table 1. Total regional employment, including all multiplier effects (including those arising from processing), vary from 18 jobs / 000 Ha in dryland sheep and arable farming, to between 13 and 105 jobs in irrigated farming, with dairying being the highest of those shown at 105 jobs per 1,000 Ha, although this is partly offset by the very low employment on irrigated dairy support farms which require little labour on farm and generate comparatively minor off farm impacts, partly because they have very little impact on processing.

3. Since both labour and capital are free to go wherever they feel they can get the best return.

Table 1 Economic Impacts per 000 Ha

	On-Farm Impacts				Total Regional Impacts including Processing			
	Output $m/yr	Jobs FTE	Value Added $m/yr	Earned Income $m/yr	Output $m/yr	Jobs FTE	Value Added $m/yr	Earned Income $m/yr
Dryland								
Arable	1.7	8	0.4	0.5	3.8	18	1.4	1.0
Sheep	1.1	3	0.5	0.2	5.5	19	2.1	1.1
Irrigated								
Dairy	10.6	30	5.3	1.5	38	105	13	5.8
Arable	4.0	8	2.0	0.5	8.6	28	3.9	1.5
Sheep	5.9	7	2.3	0.3	21	57	7.7	3.3
Finishing	3.8	4	2.5	0.2	5.6	13	3.3	0.7
Dairy Support								

Source: On-farm impacts based on farm budgets from Ford. Total impacts estimated by incorporating these budgets into regional economic models developed by Butcher, using Statistics NZ national input-output tables as a base. See Appendix 2.

4. DAIRY FACTORIES BEING ABLE TO DRAW AND DISCHARGE WATER

4.1 A number of Land and Water Regional Plan ("Plan") policies may affect the certainty of water supply and water discharge for the dairy factory at Darfield, which is in the "red zone". Fonterra seeks various changes to the Plan to ensure that the factory will continue to be able to operate at its current site under a planning regime that does not create substantial risks to ongoing viability and that recognises the importance of this (and other) processing sites in the Region. I have been asked to comment on the economic efficiency and economic activity implications of the factory being unable to continue, or having to stop production for short periods during times of water restrictions.

4.2 If the factory is unable to process milk, then Mr Goldschmidt's evidence is that trucks would have to travel an additional 20,000 km per day to take the milk to Clandeboye, assuming that it had sufficient spare capacity to cope with the milk. In the opinion of Mr Goldschmidt (as stated in his evidence), the milk currently processed at Darfield would have to be disposed of, probably by being put into the effluent pond at each producer farm and then irrigated to land since in his opinion Clandeboye does not have sufficient capacity to process this extra milk and in any case there is insufficient spare milk tanker capacity to transport the milk to Clandeboye. At peak capacity of 6.6 million litres per day

the financial losses to farmers would be $3.7 million[4] per day. There would be further losses to the dairy factory which could increase the total to perhaps $5 million[5] per day. This demonstrates the enormous costs of short term restrictions on water supply to milk processing plants.

4.3 I understand that the Darfield factory, when complete, will have cost approximately $500 million. If the factory were unable to continue on its existing site, then a large part of that sunk cost would be unrecoverable and would represent a net national cost which is equivalent to around $50 million per year[6]. As set out above, the location of the factory at this site saves substantial travel compared to any likely alternative site, which would have to be outside the red zone to avoid the potential problems faced by the Darfield site under the current Plan policy. The additional transport costs would depend on where the alternative site is, but if it was at Clandeboye then the distance is 20,000 km / day during the peak of the season. It costs approximately $4 / km to run a truck and trailer unit and over the year the average throughput is about 60 % of peak. Hence the additional costs of transport could be around $17 million / year, plus of course the other costs such as congestion, accidents, emission of greenhouse gases and noise pollution. The $17 million per year has a net present value over 20 years of $170 million. Hence the total costs of closing the plant would be around $67 million per year or NPV $670 million.

4.4 Mr Goldschmidt's evidence is that Fonterra currently employs 60 people at the Darfield site and processes 2.2 million litre of milk per day, which is equivalent to around 190,000 kg of milk solids per day. The plant will eventually expand to processing up to 6.6 million litres per day at which point it is expected to employ 120 people. Mr Goldschmidt also states that the plant is a particularly efficient user of water.

4.5 Given the typical multipliers associated with dairy factories, I anticipate that loss of the dairy factory would eventually lead to the loss of around 500 jobs and $35 million per year of household income in the Region.

4. 6.6 M litres x 8.8 % milksolids: litres ratio x $6.40 / kg milk solids.
5. Value added in the dairy factory is approximately one third of raw milk costs.
6. Assuming an 8 % discount rate over a 20 year life.

4.6 I conclude that there would be very significant economic costs and social costs from closing the dairy factory.

4.7 The economic losses of NPV $67 million / year can be compared to the water used by the plant of approximately 1 litre of water per litre of milk. If the plant processes 6.6 million litres of milk per day at peak, then it consumes 6.6 million litres of water, or 6,600 m3 of water per day at peak, or very approximately 1.45 M m3 of water per year[7]. To compare that with the cost of closing the plant of $67 million per year implies that the value of water, including water disposal, to the dairy factory is around $48 / m3 for an on-going water right, which is vastly in excess of its value in alternative uses such as irrigation[8]. The implication is that to use available water take and water discharge capacity for the existing dairy plant at Fonterra is a very efficient use of the water resource. This point is heightened by Mr Goldschmidt's evidence that the Darfield plant is a particularly efficient user of water compared to other dairy plants.

4.8 The use of water by the dairy factory can be put into context by comparing it to the use of water for irrigation. Given that a farm being irrigated with 4.5 mm / day at peak consumes about 45 m^3 of water per Ha per day, the dairy factory peak demand of 6,500 m^3 per day at full development is equivalent to the water demands of 140 Ha of irrigated farm land. The annual demand of the factory averages possibly 3,900 m3 / day (assuming average use is 60 % of peak use), whereas the irrigation use is about 20 m3 per Ha per day, assuming a 5 month irrigation season. So averaged over a year the water use of the factory is equivalent to the irrigation demand of 200 Ha.

4.9 The Council's s 32 Analysis of nutrient management notes that discharge to land from meat, milk and processing industries constitutes 60 % of the load from point sources[9]. However, the analysis also says that, "*outside urban areas, point source discharges are a relatively minor source of nutrients*". Given the location of the major dairy plants is outside urban areas, then

7. 6,600 m3 / day at peak x 365 days per year x 60 % average capacity = 1.45M m3 / year.
8. Conversion from dryland sheep to irrigated dairy farming, water provides an additional profit of $1,200 / Ha / yr (see Table 5) and uses 9,000 m3 of water / year (180 days at 5mm / day). Value per m3 of water = $0.16 c / m3 / yr. The NPV of this at an 8 % discount rate is $1.90
9. S32 report p 64.

presumably the dairy factory nutrient impact is relatively minor in the bigger picture.

5. THE ECONOMIC COSTS AND EFFICIENCY ASSOCIATED WITH RULES THAT PROPOSE THE SURRENDER OF 25 % - 50 % OF WATER RIGHTS UPON TRANSFER IN AREAS WHERE ALLOCATION LIMITS ARE EXCEEDED.

5.1 Policy 4.73 seeks to "*enable the transfer of water provided there is a surrender of a proportion of the allocated water to the water body and it is not re-allocated*." Rule 5.107 implements this policy and proposes that where a water right is transferred, 25 % of that right is surrendered if the transfer is of groundwater from down-plains to up-plains or surface water from up-plains to down-plains, and 50 % in other cases. In addition the Regional Council will consider various other matters including the efficiency of the exercise of the resource consent, and the new consent will require records of use to be telemetered to the Council. The Plan's objective is to reduce water use in over-allocated catchments and improve the efficiency of water use.

5.2 From an economics perspective this rule creates a huge incentive not to transfer water, and is almost bound to significantly reduce the transfer of water rights to more efficient uses because of the loss involved. With 0 % surrender, water is likely to be transferred if the increased benefits of water use at the new site are greater than the minor transactions costs of transferring the rights. Under the proposed rule, water is unlikely to be transferred unless the value of the water in the new use is at least 33% greater than the existing use in situations where the surrender is 25 %, or at least 100 % greater than the existing use in situations where the surrender is 50 %.[10]

5.3 Farm budgets (Appendix 1 and Table A.4 in Appendix 2) show that changing land use to irrigated dairying from irrigated sheep has a net benefit of $527 / ha / year, assuming that water at the farm gate costs $535 / Ha / yr. Given that

10. Assume a current user gets $1 / m3 from the use of 100 m3 of water. A new user to whom a right of say 100m3 is transferred will have to pay at least $100 but will get only 75 m3 or 50 m^3, depending on the surrender ratio. The new user will thus have to be willing to pay $1.33 or $2 per m3 given up by the current user.

water consents have been transferring for around $550[11] / Ha / year, a doubling of the effective cost of transferred water would effectively negate the benefits of that transfer and it would not occur. The same conclusion occurs with regard to conversion of irrigated arable to irrigated sheep finishing. There may of course be other cases in which the difference in water values is still sufficient for the transfer to occur, and this is true in particular for existing consents, or parts of consents that are unused and where the current value of the water is zero.

5.4 Reducing the transfer of water will reduce the efficiency with which water is used and is hence inconsistent with section 7 (b) of the RMA, and indirectly section 5 of the RMA since more efficient use generally creates more benefits such as employment.

5.5 In a situation where consented water is not required in the short term by the consent holder (as in the case of Fonterra's plant at Darfield[12]), the effects are even more perverse. The existing situation provides an incentive for Fonterra to transfer the water to another user in the short term and then to have it transferred back when it needs it for operation of the dairy factory. This will be an efficient use of water.

5.6 Under the proposed regime, Fonterra is unlikely to transfer the water since under Rule 5.107 it could be required to surrender half of the allocated amount of water in order to transfer it to an adjacent farm. Under the same rule the transfer back again could require the surrender of a further 50 % of the reduced take, or 25 % of the original take. Hence Fonterra in those scenarios would get back only 25 % of the original amount of water.

5.7 I note that Fonterra could apply under Rule 5.108 to transfer the water temporarily without any reduction in amount, but such an application would be a non-complying activity, with the higher statutory tests that that categorisation entails.

---

11. Analysis of HydroTrader data (Warwick Pascoe pers. comm.) suggests that the average consent transfer price was around $5,700 prior to notification of the pLWRP. The average consent duration was 23 years. Based on an 8 % discount rate this equates to around $550/ha/year.
12. See the evidence of Mr Goldschmidt.

5.8 The Council's s 32 analysis appears to justify the rule primarily on the grounds that it will be effective in reducing total water use, and says that "*without provisions of this nature, transfers would potentially undermine efforts to address over-allocation"*. With respect, I suggest that there will be potential measures[13] to reduce over-allocation that cannot be undermined by transfers. More importantly, I suggest that such high surrender percentages are likely to be less effective than lower percentages. Economics accepts that there is a relationship between costs and quantities which, in terms of the debate about rule 107, was most relevantly exemplified in the "Laffer Curve[14]" which related to total tax revenue. The Laffer curve expresses the commonsense proposition that at a 0 % tax rate no tax will be gathered, and that at a 100 % tax rate no tax will be gathered because of the disincentive effects. It pointed out that a tax rate between the two extremes will generate the highest total tax take, although there is huge academic debate as to what that rate is. The selection of an optimal rate is further complicated by the ability of people to avoid tax altogether by relocating, and will also have to take into account other matters such as political acceptability and public support. Consent surrender rates differ from tax rates in that not transferring a water consent is a perfectly viable option for most people, whereas not earning income is not a viable option for most people, because it comes at a very high cost. Hence one would expect the optimal surrender rate to be less than the optimal tax rate.

5.9 The first point I want to make is that no technical justification for the chosen surrender rate of 50 % is given, but it seems likely to me that it could well be less effective in terms of the total quantity of water surrendered than would be a lower rate. The S32 Analysis (p109) notes that various permutations of the policy were considered including the focus being on "unused water", but that this was considered unworkable in the absence of reliable metering. I would add that a focus on unused water could also lead to consent holders

13. For example, a simple percentage reduction in all takes. Provided that rights are tradable, then this should lead to the reallocation of water to its most efficient uses. See also the evidence of Andrew Curtis. In para 30 he outlines a logical approach to addressing any perceived over-allocation of water as discussed in the working papers of the Land and Water Forum.
14. The curve has a long history under various names. The term "Laffer Curve" was coined in a 1978 article by Jude Wanniski in *The Public Interest* entitled "Taxes, Revenues, and the 'Laffer Curve'". The name refers to Professor Arthur Laffer, University of Chicago.

assiduously using their consented water for no particular purpose other than to maintain their consent, and this could be particularly inefficient.

5.10 The s 32 Analysis contains very little discussion of the efficiency of the surrender rates contained in the rule, focussing instead on the benefits which might be achieved by other measures in the rule which encourage efficiency. From an economics perspective these other measures are likely to be unnecessary since commercial imperatives will in any case drive people to be efficient. The analysis notes the economic benefits of allowing transfers, and notes that the rule *"may discourage individual gains in efficiency if the water made available is less valuable"*, presumably from the perspective of the seller who will get up to 25 % - 50 % less for the water[15] they are selling. I did not find in the Council's s 32 report or s 42A report any discussion of alternative rules or policies to reduce the total consented water take.

5.11 It is my view that the surrender conditions in rule 107 and Policy 4.73 are inconsistent with a free market in transfers that encourages efficiency. In particular, the very high levels of surrender proposed (25 % and 50 %) are likely to significantly reduce the efficiency of water use, which is in conflict with policy 4.69 to increase the efficiency of water use. It is also my view that such high rates are unlikely to be as effective in reducing the total volume of water take consented as would be lower rates.

5.12 Before I could support using this method of reducing total water permits, even at much lower rates of surrender, I would want to see some clear evidence that the alternatives had been explored and that partial surrender of transfers was more efficient. At first glance surrender, particularly at such high percentages, seems an inefficient way of reducing total allocated water, although I recognise that all systems come with drawbacks or funding problems. Offering to buy up unused water rights could be a potentially efficient solution, although that obviously comes with a cost which council may have difficulty in recovering from other users who would benefit.

15. This is the loss if there is no change in the price which those receiving it are willing to pay. The surrender will reduce the amount of water available and this may force up the price.

6. TERMS OF CONSENTS

6.1 Policy 4.76 states that consents for water take and use in the red zone will generally be limited to 5 years as the water take or the land use and associated nutrient discharge "may impede the ability of the community to find an integrated solution to manage water quality and the over-allocation of water."

6.2 The likely rates of return on investment in dairy farming of about 13 % (see Table A.5 – Appendix 2) mean that such a short consent period means dairy conversion is unlikely to occur, and the potential benefits of this will be lost.

6.3 The problem of short consent duration is exacerbated when one realises that the farm budgets that underlie Table A.5 assume that water is supplied to the farm gate for $535 / Ha / year. This cost is calculated on the basis of expected capital costs and a project lifetime of about 30 years. Shorter consent times would lead to much higher costs of water to the farm gate, and would make all forms of irrigation uneconomic, even those which under current budgets have very high rates of return to marginal investment. .

7. THE SECTION 32 ANALYSIS FROM AN ECONOMICS PERSPECTIVE.

7.1 In my evidence I have commented in a number of places about the S32 analysis undertaken by the Council, and have noted that in a number of cases the analysis has focussed more on the "Effectiveness" of proposed rules than on the "Efficiency" of the likely outcome of the rules.

7.2 Section 3.2 of Appendix 1 to the section 32 Report discusses the legal framework of the analysis. It notes that under s 32 authorities must evaluate *"whether the plan objectives are the most "appropriate" way of achieving the purpose of the RMA and whether the policies and rules in the plan, having regard to their efficiency and effectiveness, are the most appropriate way of achieving the plan objectives"*. It notes that what is most "appropriate" requires a value judgement as to what is, on balance, the most suitable means for achieving the objectives of the pCLWMP, and then sets out a process described by the Environment Court, and subsequently endorsed by the Court of Appeal.

7.3 The greater focus on “effectiveness” than “efficiency” in the sections of the Analysis to which I have drawn attention suggests that the authors of the S32 analysis have concluded that “effectiveness” is more important. I am not a lawyer and cannot comment on the legal correctness of this approach, if indeed that is the approach the authors have taken. However, I can say from an economist’s perspective the achievement of efficient resource use should be an inherent part of the assessment of effectiveness, particularly since the Plan policies refer to an objective of efficient use of water.

8. CONCLUSION

8.1 Farming generally, and irrigated farming in particular, together with the activities that depend on it are a very significant part of the Canterbury economy. The estimated 550,000 Ha of currently irrigated land leads directly and indirectly to $3.3 billion / year of GDP in Canterbury and employment of 25,000 people. That is equivalent to about 11 % of regional employment and 15 % of regional GDP.

8.2 Dairy farming in Canterbury has grown rapidly in the last decade. All told there are 13,400 jobs in Canterbury which depend directly or indirectly on dairy farming and dairy processing.

8.3 There is a significant variation in the economic impacts of different land uses. Irrigated farming has far greater employment impacts than dryland farming, and dairy farming has larger economic impacts than some other broad-acre land uses. Dryland sheep farming generates around 18 regional jobs per 1,000 Ha farmed, whereas irrigated dairy farming generates 105 jobs per 1,000 Ha.

8.4 Dairy factories use amounts of water which, on the face of it, seem large. But even a large factory such as the dairy factory at Darfield will, at full production of 6.6 million litres of milk per day, use only as much water as is used to irrigate a 140 Ha farm. If water to the factory is limited by water restrictions then the factory could have to either reduce production or close for the period of restriction. The economic cost of such a restriction would be about $5 million per day. This indicates to me that policies and rules which restrict water to a milk processing plant will have an extremely high economic cost and should be avoided if at all possible.

8.5 A factory at Darfield (in the red zone) rather than outside of the red zone saves many millions of dollars in transport costs, and if the alternative was Clandeboye then the saving is approximately $17 million per year. There is also reduced congestion, noise, accidents and greenhouse gas emissions. Permanent closure of the Darfield factory would impose an economic cost of $67 million per year. A policy or rule that limited the use or disposal of water to such an extent that the factory was no longer viable would have very high economic costs, and this needs to be weighed up against potential alternative policies which would achieve the same outcome.

8.6 Rule 107 requires the surrender of up to 50 % of a water right on transfer. This seems very likely to prevent reallocation of water which could lead to a much more efficient use of water. For a transfer of water to make financial sense to farmers, its value in the new use would have to be between 30 % and 100 % greater than in its current use, and in many circumstances this will not be the case and hence the transfer will not happen, which seems from an economist's perspective to be inconsistent with sections 5 and 7(b) of the RMA. The s32 analysis provided little evidence that this rule is the most efficient way of reducing water use. I am not convinced that the proposed high surrender percentages will be as effective in reducing water use as would lower percentages. In my view this rule should be removed or at least modified.

8.7 Policy 4.76 stipulates that consents in the red zone will generally be limited to 5 years. Given the high capital costs and the rates of return on investment, particularly once costs of supplying water to the farm gate are taken into account, I believe that this policy will mean most new consents will not be financially viable. Given the very significant benefits and social impacts of increased irrigation, I question whether this policy is justified, particularly given the evidence of Ms Hayward (for Group 2 hearings) that in some cases within the red zone the rules may do little to achieve the objectives of higher water quality.

8.8 The section 32 analysis seems to me to focus heavily on the <u>effectiveness</u> of policies and rules in achieving outcomes, and gives insufficient weight to the <u>efficiency</u> of these policies and rules. While I cannot comment on the legal justification for this approach, I can say that from an economist's perspective

the achievement of efficient resource use should be an inherent part of the assessment of effectiveness, particularly since the Plan policies refer to an objective of efficiency use of water.

APPENDIX 1. FARM BUDGETS FOR THIS ANALYSIS

The following budgets have been used in this analysis. They are indicative only. Differences in soils, contour, rainfall and farming systems mean that individual budgets will vary widely from this.

ARABLE		$ / Ha	Total / farm
REVENUE			
25%	Wheat	656	
25%	Barley	480	
50%	Livestock	537	
		-	
GROSS FARM REVENUE		1,673	334,664
FARM WORKING EXPENSES			
Livestock Purchases		45	
Wages		54	
Animal Health		18	
Breeding		-	
Shed Expenses		-	
Electricity		7	
Feed		15	
Fertiliser		250	
Freight		18	
Seeds		50	
Shearing		26	
Weed and Pest		150	
Fuel		54	
Vehicle		40	
Repairs & Maint		50	
Rates		15	
Communication		7	
Insurance		12	
Acct, Legal,Cons		9	
Administration		5	
Other		3	
Irrigation	Off Farm		
	On Farm		
CASH FARM EXPENDITURE		828	165,600
CASH FARM SURPLUS		845	169,064

SHEEP FINISHING			$ / Ha	Total / farm
REVENUE				
Ewe Breeding	85%		913	
Cattle	15%		148	
GROSS FARM REVENUE			1,061	212,276
FARM WORKING EXPENSES				
11.64	SU/Ha	per SU		
Livestock Purchases		9.43	110	
Wages		4.00	47	
Animal Health		3.73	43	
Breeding		-	-	
Shed Expenses			-	
Electricity		0.80	9	
Feed		2.52	29	
Fertiliser		11.36	132	
Freight		1.08	13	
Seeds		1.70	20	
Shearing		5.70	66	
Weed and Pest		2.85	33	
Fuel		3.55	41	
Vehicle		2.80	33	
Repairs & Maint		2.00	23	
Rates			11	
Communication			5	
Insurance			9	
Acct, Legal,Cons			10	
Administration			4	
Other			2	
Irrigation	Off Farm			
	On Farm			
CASH FARM EXPENDITURE			641	128,101
CASH FARM SURPLUS			421	84,175

DAIRY SUPPORT		$ / Ha	Total / farm
REVENUE			
Price	0.23	1,840.00	
TOTAL REVENUE		1,840	368,000
FARM WORKING EXPENSES			
Livestock Purchases			
Wages		50	
Animal Health		45	
Breeding			
Shed Expenses			
Electricity		9	
Feed		200	
Fertiliser		132	
Freight		13	
Seeds		31	
Shearing			
Weed and Pest		33	
Fuel		41	
Vehicle		33	
Repairs & Maint		23	
Rates		11	
Communication		5	
Insurance		9	
Acct, Legal,Cons		10	
Administration		4	
Other		2	
Irrigation	Off Farm	-	
	On Farm	-	
CASH FARM EXPENDITUI		652	130,327
CASH FARM SURPLUS		1,188	237,673

	IRRIGATED SHEEP FINISHING				
			$ / Ha	Total	
	REVENUE				
90%	Lamb Finishing	$ 955	$ 6	$ 5,643	
0%	Ewe Breeding	$ -	$ 92	$ -	
10%	Beef Finishing	$ 73	$ 4	$ 300	
	GROSS FARM REVENUE			$ 5,943	$ 1,188,627
	FARM WORKING EXPENSES				
	$ 27 SU/Ha		per SU		
	Livestock Purchases		$ 2,539	$ 2,539	
	Wages		$ 7	$ 183	
	Animal Health		$ 4	$ 101	
	Breeding		$ -	$ -	
	Shed Expenses			$ -	
	Electricity		$ 2	$ 45	
	Feed		$ 1	$ 27	
	Fertiliser		$ 11	$ 307	
	Freight		$ 2	$ 59	
	Seeds		$ 3	$ 94	
	Shearing		$ 2	$ 41	
	Weed and Pest		$ 3	$ 89	
	Fuel		$ 4	$ 96	
	Vehicle		$ 2	$ 64	
	Repairs & Maint		$ 2	$ 54	
	Rates		$ 20	$ 20	
	Communication		$ 8	$ 8	
	Insurance		$ 25	$ 25	
	Acct, Legal,Cons		$ 13	$ 13	
	Administration		$ 7	$ 7	
	Other		$ 4	$ 4	
	Irrigation	Off Farm	Excluded	$ -	
		On Farm		$ 75	
	CASH FARM EXPENDITURE			$ 3,851	$ 770,212
	CASH FARM SURPLUS			$ 2,092	$ 418,415

	IRRIGATED DAIRY SUPPORT			
	REVENUE			
Price	$ 0		$ 3,795	
TOTAL REVENUE			$ 3,795	$ 759,000
	FARM WORKING EXPENSES			
Livestock Purchases		$ -		
Wages		$ 50		
Animal Health		$ 45		
Breeding		$ -		
Shed Expenses		$ -		
Electricity		$ 42		
Feed		$ 400		
Fertiliser		$ 290		
Freight		$ 13		
Seeds		$ 90		
Shearing		$ -		
Weed and Pest		$ 84		
Fuel		$ 45		
Vehicle		$ 38		
Repairs & Maint		$ 100		
Rates		$ 20		
Communication		$ 8		
Insurance		$ 25		
Acct, Legal,Cons		$ 13		
Administration		$ 7		
Other		$ 4		
Irrigation	Excluded	$ -		
	On Farm	$ 75		
CASH FARM EXPENDITURE			$ 1,349	$ 269,800
CASH FARM SURPLUS			$ 2,446	$ 489,200

APPENDIX 2 - THE ECONOMIC SIGNIFICANCE OF IRRIGATION AND DAIRYING

A2.1 Current Significant of Irrigation in Canterbury

1. There is considerable uncertainty as to the total area of irrigated land in Canterbury at present, and the types of farming that take place on that land. Saunders *et al*[16] quote estimates ranging from 364,000 in 2009[17] to 500,000 in 2008[18], and also estimate increases in per Ha farm production and value added. Lilburne[19] gives a figure of 586,000 in 2012. Using a mix of land uses[20] and associated farm budgets, I estimated that 550,000 Ha of irrigation has increased direct farm output by $3.0 billion / year, value added (GDP) by $1.5 billion per year, and employment by 8,000 FTE jobs.

2. Farming purchases inputs and those employed on the farm spend their incomes, both of which generate multiplier effects. There are further multiplier effects associated with the processing of the additional meat and milk which is produced. Taking all these factors into account, I estimate that irrigation of 550,000 Ha increases regional output by $10 billion per year and regional GDP by $3.3 billion per year. It also generates 25,000 jobs in the Region.

3. These are very significant impacts. They represent approximately 10 % of all employment in Canterbury and 15 % of all GDP[21].

4. Of course if irrigation had not been established, then the resource currently used on farm and in supporting industries would have been available for use elsewhere, but the point to be made here is that irrigation is enormously significant to the Canterbury economy.

A2.2 Current significance of Dairying in Canterbury.

5. Dairy farm production in Canterbury has grown at 12 % per annum during the period 1998-99 – 2011-12[22], and Statistics NZ estimates that there are now 4,540 people employed directly in dairy farming, although this figure is likely to be low[23]. I estimate a regional employment multiplier of 2.2 for dairy farming which implies that

---

16. Total Value of Irrigation Land in Canterbury; Caroline Saunders and John Saunders. AERU, Lincoln University. September 2012.
17. Government National Infrastructure Plan 2011. Quoted in Saunders p 5
18. Canterbury Water Management Strategy. Quoted in Saunders p5
19. Lilburne, L. Landcare Research, pers comm December 2012 quoted in ECan S 32 analysis Appendix 1 p 10
20. 57 % dairying, 20 % sheep and beef, 20 % cropping and 3 % high value cropping. Saunders p 19
21. Regional employment is approximately 257,000, and regional GDP is very approximately $22 billion/yr.
22. Livestock Improvement Corporation Annual Summaries. 1998-99 36M kg milkfat; 2011-12 167M kg milkfat and 298M kg milk solids.
23. The Business Demographics figures are survey- based, and hence have an error margin attached which can be significant, particularly for farming. In the 2006 census, national dairy farming employment was 33,500 people (30,015 FTEs) and the Business Demographics figures was 20,850 implying very significant understatement by the BD figure. For Canterbury, the corresponding figures were 2,950 from the BD and 3,102 from the census, implying under-reporting of 5 per cent. In 2001 the BD did not report results for agriculture. Our model estimates based on employment per million kg of milkfat suggest employment in Canterbury dairy farming could be 25 % greater than the BD figures suggest.

in total there are 9,990 people who work in dairy farming, or whose jobs are in some way dependent on dairy farming, and this excludes the impacts of dairy processing.

6. There are a further 1,310 employed in dairy processing. I estimate a regional employment multiplier for milk processing (excluding dairy farm impacts[24]) of 2.6 which implies that in total there are 3,410 people in Canterbury whose jobs depend on milk processing.

7. Hence all told there are 13,400 jobs in Canterbury which depend on dairy farming and milk processing. This is equivalent to 5.2 % of all employment in Canterbury.

Table A.1 Dairy-Dependent Economic Activity in Canterbury

	Dairy Farming	Total Dairy Farming (Mult=2.2)	Dairy Factories	Total Dairy Factories (mult=2.6)	Total Dairy-dependent	Total All Sectors
2001 (census - FTE)	2,122		651			
2006 (census - FTE)	2,790		696			
2006 (census – no.)	3,102		717			
Business Demography						
2006	2,950	6,490	1,090	2,830	9,320	
2010	3,820	8,400	1,080	2,810	11,210	
2012	4,540	9,990	1,310	3,410	13,400	256,560
Total Dairy –related as % of Canterbury					5.2 %	

A2.3 Recent Growth in Dairy Farming Output and Productivity

8. Growth in milkfat production in Canterbury has averaged 12.6 % per annum over the last 13 years, while the area in dairying has grown by 8.4 % per annum. The implication is that production per Ha has grown by 4.0 % per annum over this period. Note that this is not a pure efficiency gain since it is likely that farm operating inputs per Ha have grown significantly as well. Nonetheless, it demonstrates the ability of dairy farming to expand in absolute terms, and also to use land with increasing efficiency. Both these factors indicate that dairying may be an increasingly efficient use of land, and that to inhibit the conversion of land to dairying may have significant economic costs. However, this indication of increased efficiency has to be considered in the context of any non-market costs associated with dairying, including effects on water quality.

Table A.2 Trends in Dairy Farm Production in Canterbury: 1998-2012

Year	Ha in Dairying	Number of cows (000)	Kg of Milkfat (000)	Annual % Growth	
				Ha	Milkfat
1998-99	78,101	226	36	7%	-

24. Normal economic multipliers include all impacts associated with the supply of inputs. For the purposes of this modeling we treated milk inputs to dairy processing as an import, hence ensuring that the multiplier for dairy processing excluded feed-back effects. Source: Regional input – output table (estimated multiplier was 2.62) and Project Analysis for West Coast Dairy Products proposed plant at Rolleston (estimated multiplier 2.65).

1999-00	83,933	245	44	7%	22%
2000-01	89,732	255	48	19%	9%
2001-02	107,187	309	60	9%	25%
2002-03	117,192	339	68	6%	13%
2003-04	124,536	377	76	4%	12%
2004-05	130,062	402	79	6%	4%
2005-06	137,310	432	86	6%	9%
2006-07	145,611	467	96	9%	12%
2007-08	158,272	518	105	19%	9%
2008-09	187,676	609	119	4%	13%
2009-10	194,862	351	132	9%	11%
2010-11	211,596	696	140	4%	6%
2011-12	219,275	753	164		17%
Average				8.4 %	12.6 %

9. The area in dairying has increased by 11,000 Ha / year over the past ten years on average, with the increase having been 14,000 Ha / year over the last five years.

A2. On-Farm and Total Regional Economic Impacts of Farming

10. The Canterbury regional economic model, developed by me for this Plan review, and the associated multipliers suggests that every $1 million of output from dairy farms (or 160,000kg of milk solids) is associated with direct on-farm employment of 30 people and value added[25] of $5.3 million / year, including earned household income of $1.5 million / year.

11. Farm production has multiplier effects related both to purchases of inputs and also to forward linkages through processing of milk and meat. Once these impacts are taken into account, the total Canterbury regional economic impacts arising from 1,000 Ha of dairy farming is 105 jobs and $13 million / year of value added, including $5.8 million per year of earned household income.

12. The economic impacts of various types of farming are shown in Table 3. What is particularly interesting is the high level of total employment in the Region generated by Sheep Finishing. This reflects the high employment generated in the meat processing industry per $ million of inputs from farms, compared to the employment generated in the milk processing industry.

25 Value added is the return to labour and capital. It is the equivalent of GDP.

Table A.3 Economic Impacts per 000 Ha

On-Farm Impacts				Total Regional Impacts related to Farming				Total Regional Impacts including Processing			
Output $m/yr	Jobs FTE	Value Added $m/yr	Earned Income $m/yr	Output $m/yr	Jobs FTE	Value Added $m/yr	Earned Income $m/yr	Output $m/yr	Jobs FTE	Value Added $m/yr	Earned Income $m/yr
1.7	8	0.4	0.5	3.8	18	1.4	1.0	3.8	18	1.4	1.0
1.1	3	0.5	0.2	1.9	7	0.9	0.4	5.5	19	2.1	1.1
10.6	30	5.3	1.5	18.5	72	9.0	3.6	38	105	13	5.8
4.0	8	2.0	0.5	6.8	22	3.3	1.1	8.6	28	3.9	1.5
5.9	7	2.3	0.3	7.8	16	3.1	0.8	21	57	7.7	3.3
3.8	4	2.5	0.2	5.6	13	3.3	0.7	5.6	13	3.3	0.7

Table A.4 Farm Surplus by Land Use, and Benefits of Conversion from Dryland Sheep to Irrigated Farming ($/Ha/yr)

	Net Cash Surplus ($/Ha/yr)		Net increase from Irrigation compared to dryland sheep ($/Ha/yr)	On-farm Investment Costs and Required Returns @ 8 % (rounded)		Net Benefits of Irrigation c.f. dryland Sheep ($/Ha/yr) rounded	Return on marginal Investment (% / yr)
	A	B	C=B-A	D	E=Dx8%	F=C-D	G = C / D
	Before off-farm irrig costs	After off-farm irrig costs *		Investment ($ / Ha)	Required Return on capital ($ / Ha / yr)	$ / Ha / yr	
Dryland							
Arable	497	497					
Sheep	253	253					
Dairy Support	1,020	1,020					
Irrigated							
Dairy	3,688	3,158	2,905	21,000	1,680	1,220	14 %
Arable	1,288	758	506	3,400	270	240	15 %
Sheep Finishing	1,850	1,320	1,067	3,600	286	780	37 %
Dairy Support*	2,204	1,674	1,421	3,100	246	1,170	50 %

Note: Specific situations may vary significantly from these broad averages depending on soil types, contour, rainfall, management regimes and specific crops.

Arable refers to grain crops rather than more intensive horticultural crops such as potatoes

Irrigation off-farm costs are assumed to cost $535 / Ha / year. In many cases costs will be significantly less, and in some cases will be more.

Table A.5 Change in Surplus and Benefit by Change in Irrigated Land

		From Irrigated Arable	From Irrigated Sheep	From Arable		From Sheep		From Irrigated Arable	From Irrigated Sheep
				Capital	$ / yr	Capital	$ / yr		
	A	B = A_*-A_2	C = A_*-A_3	D	E = D x8%	F	G = F x8%	H = B-E	I = C - G
To Irrigated									
Dairy	3,158	2,400	1,838	17,600	1,410	16,400	1,311	990	527
Arable	758	--	-561	--	--	550	44	--	-605
Sheep	1,320	561	--	1,240	100	--	--	462	--
Finishing	1,674	915	354	740	60	-50	-4	856	358
Dairy Support									