ECONOMIC IMPACTS OF PROPOSED ONE PLAN LIMITS ON NITROGEN LEACHING/RUN-OFF VALUES

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1.0 EXECUTIVE SUMMARY

Brief

This report follows on from an earlier report in August 2009. The brief from Horizons was to re-estimate the net present costs for farmers in Horizons' target water management zones resulting from changes to Table 13-2 Land Use Capability (LUC) Nitrogen Leaching/Run-off Values and/or timeframes for compliance.

Conclusions

- Delaying the implementation of the Dairying and Clean Streams Accord (D&CSA) type obligations from 2012 to 2013 has a minimal impact of approximately $0.5 million or an average of $1,022 per farm. This is a 6.5% reduction in costs related to implementing the provisions of the Dairying and Clean Streams Accord.

- Reducing the N loss targets to those proposed by Fonterra has a significant impact on the cost for farmers because it would defer the costs until much later. The reduction in net present cost would be $20 m (35%) for implementing Rule 13.1, an average of $47,360 per farm.

- Deferring the implementation for three years would reduce the net present cost by a further $6.5 m (11%) or $15,000 per farm.

- Including the total costs of the Dairying and Clean Streams Accord, compliance with current consent conditions, compliance with the Proposed One Plan (POP) and a change to Fonterra's proposed N loss targets, the reduction in net present cost would be $20.7 m (25%) , from $82.1 m to $61.4 m. Deferring the cost would also provide the option of developing more cost effective technologies to reduce N loss. However, the environmental benefits from earlier reduction in N loss to the environment would be forgone. Delaying implementation by a further three years would further reduce the net present cost to farmers by $6.5 m (8%).

- The new N loss reduction estimated by Dr Mackay from Overseer, modeled on potential production, increased the net present value because it requires earlier action. This increase is in the order of $5.5 m (9%).

- The impact on the different groups of farmers is perhaps most noticeable on Groups 1 and 2, who bore a significant cost under this model.

Table 1:

	Net Present Cost/Farm				
N Loss Model Horizons	Group 1	Group 2	Group 3	Group 4	All
Horizons POP	$516,470	$321,633	$115,828	$86,900	$191,840
Fonterra	$375,236	$183,380	$105,981	$82,687	$143,487
Reduction	$141,234	$138,253	$9,847	$4,213	$48,383

Expansion of Dairying

If dairy farming continues to expand over the next 20 years at the same rate as during the last decade, the situation for Tararua District would be:

Table 2:

	10 Years Ago	Now	20 Years in the Future
Area in dairying (ha)	34,500	36,300	40,100
Cows	89,000	99,000	138,000
Total milk solids (MS) (kg)	24 m	32 m	54 m
Average farm size (ha)	85	115	215
Average herd size (cows)	220	315	740
Kg MS	59,000	102,000	292,000
Kg MS/ha	697	883	1,365
Cows/ha	2.59	2.73	3.45

2.0 INTRODUCTION & BACKGROUND

- This report follows on from the August 2009 report prepared for Horizons Regional Council and presented to the Hearings Panel in the matter of hearings on submissions concerning the Proposed One Plan notified by the Manawatu-Wanganui Regional Council.

- The brief from Horizons:

1. To re-estimate the economic costs associated with changes to Table 13.2 – Land Use Capability (LUC) Nitrogen Leaching/Run-off Values as indicated in the following tables.

Table 3: Land Use Capability (LUC) Nitrogen Leaching/Run-off Values

	LUC I	LUC II	LUC III	LUC IV	LUC V	LUC VI	LUC VII	LUC VIII
Original								
Year 1	32	29	22	16	13	10	6	2
Year 5	27	25	21	16	13	10	6	2
Year 10	26	22	19	14	13	10	6	2
Year 20	25	21	18	13	12	10	6	2
Fonterra N-Loss Targets[1]								
Year 1	32	29	25	19	18	16	6	2
Year 5	30	28	24	18	17	15	6	2
Year 10	28	26	22	17	16	14	6	2
Year 20	25	21	18	13	12	10	6	2
Overseer Modeled Based on Potential Production[2]								
Year 1	30	27.4	23.5	17.5	16.3	14.5	8.3	0
Year 5	27	25	21	16	13	10	6	0
Year 10	26	22	19	14	13	10	6	0
Year 20	25	21	18	13	12	10	6	0

The other changes requested included:

- Dairying and Clean Streams Accord to begin in 2013
- Rule 13-1 to begin in 2012 or 2015
- Other rules to remain as prepared in the original estimate.

2. To review the estimates of growth in dairying over the next 20 years.

3. To re-examine the evidence presented on voluntary versus regulatory approaches on managing nitrogen leaching/run-off in light of our experience as practicing extension/education agents.

[1] Evidence of Gerard Willis, page 43, on behalf of Fonterra,
[2] S42A evidence of Dr Mackay, summarized in the S42A evidence of Ms Marr; Table 3, page 27.

3.0 RESULTS

1. ONE PLAN COMPLIANCE

A series of scenarios is presented using different N-loss targets, by time and LUC, as proposed by Fonterra[3] and as modeled by Overseer based on potential production[4] as supplied by Horizons Regional Council.

As noted in the original report, a range of factors contribute to the current level of a farm's nitrogen loss and the level of reduction in nitrogen loss that will be needed for the farm to comply with target nitrogen loss limits.

Accordingly, the required level of reduction in nitrogen loss, the likely mitigation strategies, and the costs associated with these are separately detailed for each of four farm groups. Separate data is provided for the different N-loss targets as proposed by Fonterra (Appendix 1) and Horizons (Appendix 2).

The Fonterra N-loss targets are all higher than the originally proposed targets in Year 1, Year 5 and Year 10, with the exception of LUC VII and VIII which are as proposed in the Plan.

Compared to the proposed LUC values in Table 13.2, the year 1 targets based on potential production are lower for LUC I and II, higher for LUC III, IV and V, and the same for LUC VII and VIII. The year 5, 10 and 20 targets remain the same under this scenario.

[3] Evidence of Gerard Willis, page 43, on behalf of Fonterra.
[4] S42A evidence of Dr Mackay summarized in the S42A evidence of Ms Marr; Table 3, page 27.

Table 4: Present Value of Future Costs for Dairy Farm Businesses in Horizons Regional Council's Target Water Management Zones

	August Report	Fonterra N Loss Targets	Overseer Potential	
Dairying & Clean Streams Accord (2012)	$6,660,496			
Dairying & Clean Streams Accord (2013)		$6,223,000	$6,223,000	
Compliance with Current Consent Conditions (CCC)	$2,396,800	$2,396,800	$2,396,800	
Rule 13-3	$3,997,254	$3,997,254	$3,997,254	
Rule 13-5	$75,770	$75,770	$75,770	
Rule 13-6	$10,735,784	$10,735,784	$10,735,784	
Rule 13-1 (2012)	$58,241,256	$37,971,042	$63,604,298	
Rule 13-1 (2015)		$31,434,293	$52,654,760	
Cost of POP (13.1 in 2012)	$73,050,064	$52,779,850	$78,413,106	
Cost of POP (13.1 in 2015)		$46,243,101	$67,463,568	
Cost of POP, D&CSA & CCC (2012)	$82,107,360	$61,399,650	$87,032,906	
Cost of POP, D&CSA & CCC (2015)		$54,862,901	$76,083,368	
Cost of POP/farm (2012)	$170,678	$123,317	$183,208	
Cost of POP/farm (2015)		$108,045	$157,625	
Cost of POP, D&CSA & CCC/farm (2012)	$191,840	$143,457	$203,348	
Cost of POP, D&CSA & CCC/farm (2015)		$128,184	$177,765	
Net Present Cost Per Farm Group				
Group	1	2	3	4
Number of farms	48	86	142	152
Horizons N Loss Table 13.2				
Dairying & Clean Streams Accord (2012)	$746,972	$1,338,324	$2,209,791	$2,365,410
Compliance with CCC	$268,800	$481,600	$795,200	$851,200
Rule 13-3	$448,290	$803,187	$1,326,192	$1,419,586
Rule 13-5	$8,498	$15,225	$25,139	$26,909

	August Report	Fonterra N Loss Targets	Overseer Potential	
Rule 13-6	$1,562,696	$2,694,780	$4,298,690	$2,179,617
Rule13-1 (2012)	$21,755,287	$22,327,281	$7,792,620	$6,366,069
Cost of POP (13.1 in 2012)	$23,774,771	$25,840,472	$13,442,640	$9,992,181
Cost of POP, D&CSA &CCC (2012)	$24,790,542	$27,660,396	$16,447,631	$13,208,790
Cost of POP/farm (2012)	$495,308	$300,471	$94,666	$65,738
Cost of POP, D&CSA &CCC/farm (2012)	$516,470	$321,633	$115,828	$86,900
Fonterra N Loss Table[5]				
D&CSA (2015)	$697,907	$1,250,416	$2,064,640	$2,210,037
Compliance with CCC	$268,800	$481,600	$795,200	$851,200
Rule 13-3	$448,290	$803,187	$1,326,192	$1,419,586
Rule 13-5	$8,498	$15,225	$25,139	$26,909
Rule 13-6	$1,562,696	$2,694,780	$4,298,690	$2,179,617
Rule 13-1(2012)	$15,025,119	$10,525,489	$6,539,390	$5,881,044
Rule 13-1(2015)	$12,438,531	$8,713,517	$5,413,628	$4,868,617
Cost of POP (13.1 in 2012)	$17,044,603	$14,038,680	$12,189,410	$9,507,156
Cost of POP (13.1 in 2015)	$14,458,015	$12,226,708	$11,063,648	$8,494,728
Cost of POP, D&CSA &CCC (2012)	$18,011,309	$15,770,696	$15,049,251	$12,568,393
Cost of POP, D&CSA &CCC (2015)	$15,424,721	$13,958,724	$13,923,489	$11,555,966
Cost of POP/farm (2012)	$355,096	$163,240	$85,841	$62,547
Cost of POP/farm (2015)	$301,209	$142,171	$77,913	$55,886
Cost of POP, D&CSA & CCC/farm (2012)	$375,236	$183,380	$105,981	$82,687
Cost of POP, D&CSA & CCC/farm (2015)	$321,348	$162,311	$98,053	$76,026
Overseer Modelled on Potential Production[6]				
D&CSA (2015)	$697,907	$1,250,416	$2,064,640	$2,210,037
Compliance with CCC	$268,800	$481,600	$795,200	$851,200
Rule 13-3	$448,290	$803,187	$1,326,192	$1,419,586

[5] Evidence of Gerard Willis, page 43, on behalf of Fonterra.
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	August Report	Fonterra N Loss Targets	Overseer Potential	
Rule 13-5	$8,498	$15,225	$25,139	$26,909
Rule 13-6	$1,562,696	$2,694,780	$4,298,690	$2,179,617
Rule13-1 (2012)	$27,400,992	$22,327,281	$7,594,194	$6,281,831
Rule13-1 (2015)	$22,683,886	$18,483,619	$6,286,847	$5,200,408
Cost of POP (Rule 13-1 in 2012)	$29,420,476	$25,840,472	$13,244,215	$9,907,943
Cost of POP (Rule 13-1 in 2015)	$24,703,370	$21,996,810	$11,936,867	$8,826,520
Cost of POP, D&CSA & CCC (2012)	$30,387,182	$27,572,488	$16,104,055	$12,969,180
Cost of POP, C D&CSA & CCC (2015)	$25,670,076	$23,728,826	$14,796,707	$11,887,757
Cost of POP/farm (2012)	$612,927	$300,471	$93,269	$65,184
Cost of POP/farm (2015)	$514,654	$255,777	$84,062	$58,069
Cost of POP, D&CSA & CCC/farm (2012)	$633,066	$320,610	$113,409	$85,324
Cost of POP, D&CSA & CCC/farm (2015)	$534,793	$275,917	$104,202	$78,209

4.0 DISCUSSION

- Delaying the implementation of the Dairying and Clean Streams Accord (D&CSA) type obligations from 2012 to 2013 has a minimal impact of approximately $0.5 million or an average of $1,022 per farm. This is a 6.5% reduction in costs related to implementing the provisions of the Dairying and Clean Streams Accord.

- Reducing the N loss targets to those proposed by Fonterra has a significant impact on the cost for farmers because it would defer the costs until much later. The reduction in net present cost would be $20 m (35%) for implementing Rule 13.1, an average of $47,360 per farm.

- Deferring the implementation for three years would reduce the net present cost by a further $6.5 m (11%) or $15,000 per farm.

- Including the total costs of the Dairying and Clean Streams Accord, compliance with current consent conditions, compliance with the Proposed One Plan (POP) and a change to Fonterra's proposed N loss targets, the reduction in net present cost would be $20.7 m (25%) , from $82.1 m to $61.4 m. Deferring the cost would also provide the option of developing more cost effective technologies to reduce N loss. However, the environmental benefits from earlier reduction in N loss to the environment would be forgone. Delaying implementation by a further three years would further reduce the net present cost to farmers by $6.5 m (8%).

- The new N loss reduction estimated by Dr Mackay from Overseer, modeled on potential production, increased the net present value because it requires earlier action. This increase is in the order of $5.5 m (9%).

- The impact on the different groups of farmers is perhaps most noticeable on Groups 1 and 2, who bore a significant cost under this model.

Table 5:

	Net Present Cost/Farm				
N Loss Model Horizons	Group 1	Group 2	Group 3	Group 4	All
Horizons POP	$516,470	$321,633	$115,828	$86,900	$191,840
Fonterra	$375,236	$183,380	$105,981	$82,687	$143,487
Reduction	$141,234	$138,253	$9,847	$4,213	$48,383

5.0 FURTHER ASPECTS OF DAIRY FARMING INTENSIFICATION IN HORIZONS' REGION

(a) Intensification Over the Last Decade from 1998-99 to 2008-09

Table 6: Dairy Farming Statistics for Horizons' Region for the Last Decade by Territorial Authority (TA)

TA	No. of Herds	No. of Cows	Area	Production/Farm	Total Production (Kg MS)	Production/ Cow	Production/ Ha	Cows/Ha
2008-09								
Ruapehu	25	11,115	4,355	121,890	3,047,250	274	700	2.55
Wanganui	21	7,735	2,997	116,701	2,450,721	317	818	2.58
Rangitikei	88	34,469	12,400	143,502	12,628,176	366	1,018	2.78
Manawatu	263	90,854	32,604	113,998	29,981,474	330	920	2.79
Palm North	38	13,928	5,417	123,380	4,688,440	337	866	2.57
Horowhenua	120	44,709	16,156	124,329	14,919,480	334	923	2.77
Tararua	315	99,273	36,359	101,955	32,115,825	324	883	2.73
Total	870	302,083	110,288	114,749	99,831,366	330	905	2.74
1998-99								
Ruapehu	15	3,812	1,680	65,076	976,140	256	581	2.27
Wanganui	29	7,570	3,422	66,080	1,916,320	253	560	2.21
Rangitikei	97	26,220	10,476	74,258	7,203,026	275	688	2.50
Manawatu	325	76,021	29,900	60,964	19,813,300	261	663	2.54
Palm North	44	11,962	4,796	70,388	3,097,072	259	646	2.49
Horowhenua	173	41,370	16,781	61,313	10,607,149	256	632	2.47
Tararua	406	89,471	34,510	59,212	24,040,072	269	697	2.59
Total	1,089	256,426	101,565	62,124	67,653,079	264	666	2.52

Comments

- Milk production in the Region has increased by 47.6% over the decade 1998-99 to 2008-09 from 67.6 m kg MS to 99.8 m kg MS, which is less than the 58.3% increase in milk production for New Zealand over the same period. However, this still represents a compound growth rate of 4% per annum every year for the decade. This seems high compared to the 2.5% per annum (compounding) that I reported in my earlier evidence, which was from 1997-98 to 2007-08. However, 1998-99 and 2007-08 were significant drought years while 1997-98 and 2008-09 were more normal years. Adjusting for the 1998-99 drought year, the annual compound growth rate of milk production in the Region was 3.15% for the decade 1998-99 to 2008-09.

- This growth in milk supply reflects a combination of extra area brought into dairying from other land uses, a higher stocking rate and higher per cow production.

I have estimated the sources of this growth in production as follows:

Total Increase in Production from 1998-99 to 2008-09 32,178,287 kg MS

(i) Increase in production due to extra land – 8,725 ha @ 666 kg/ha = 5,810,850 kg MS (18%)
(ii) Increase in production per ha – 110,288 ha @ (905-666) kg/ha = 26,358,832 kg MS (82%)

Of this increase in production per ha:

- Increase due to stocking rate – 110,288 ha @ (2.74-2.52) cows/ha x 264 kg/cow = 6,405,527 kg MS (25%)
- Increase in per cow production – 302,083 cows @ (330-264) kg/cow = 19,937,478 kg MS (76%)

i.e. of the total increase in production, 18% was due to extra land in dairying, 20% due to stocking rate and 62% due to higher per cow production.

Given that the gains in pasture production per ha are 5% or more over the last 20 years of plant breeding, most of the increase in milk solids per ha reflects extra inputs (nitrogen, irrigation, cropping, purchased-in feed) and gains in animal genetics (estimated at 2.8 kg MS/cow/year).

- The number of herds in the Region has declined by 20% over the last decade.

- The area in dairying in the Region has increased by 8.6% over the last decade (compared to 16.2% for New Zealand). This 8.6% increase in the Region in a decade represents a compound increase of 0.85% per annum. However, most of the growth is in Manawatu (2,700 hectares), Ruapehu (2,675 ha), Rangitikei (1,924) and Tararua districts (1,849). Wanganui and Horowhenua districts and Palmerston North City have shown little or declining growth.

- The number of cows in the Region has increased by 17.8% over the last decade (compared to 29.3% for New Zealand). This growth in the Region is a compound increase of 1.65% per annum.

There has been a significant increase in cows in Manawatu (14,833 cows or 19.5%), Tararua (9,802 cows, 10.9%), Rangitikei (8,249 cows, 32%) and Ruapehu (7,303 cows 192%) districts.

Given that the main areas targeted by Rule 13-1 are in Tararua District and on the West Coast sand country of Horowhenua, Manawatu and Rangitikei districts, it is perhaps more important to look at dairying in Tararua District to avoid the effect of the growth in dairying in Ruapehu and inland Rangitikei and Manawatu districts.

- Milk production in Tararua District increased from 24,040,072 kg MS to 32,115,825 kg MS from 1998-99 to 2008-09. If we exclude the impact of the drought in 1998-99, this increase of 8,075,753 kg MS (33.6%) is adjusted to 5,498,203 (20.7%) to take account of the drought in 1998-99. This is a compound increase of 1.9% per annum.

This increase in Tararua District reflects:

- Increase in production due to extra land – 1849 hectares @ 770 kg/ha = 1,423,730 kg MS (26%)
- Increase in production due to extra cows – 36,359 ha x 0.14 cows/ha x 297 kg/cow 1,511,807 kg MS (27%)
- Increase in production/cow – 99,273 cows @ (324-297) kg/cow = 2,680,371 kg MS (49%)

(b) Where will we be in 20 Years if Horizons Region gets this sort of Growth for 20 Years?

Table 7:

Horizons	Compound Growth Rate %	Year 0	Year 5	Year 10	Year 15	Year 20	Total % Change Over 20 Years
Area	0.85%	110,288	115,055	120,029	125,218	130,631	18%
Cows		302,083	328,960	357,266	388,084	422,785	40%
Cows/ha		2.74	2.86	2.97	3.09	3.23	18%
Milk Production (kg MS)		99.8 m	117 m	137 m	160 m	188 m	88%
Kg/cow	1.5%	330	355	383	413	444	35%
Kg/ha	2.34%	905	1,015	1,140	1,280	1,437	59%

i.e. over 20 years, a compounding of modest growth can lead to significant total increases in area in dairying, cow numbers, cows per ha, and production.

These increases in output are consistent with Mr Matthew Newman's (Fonterra) prediction for 2030 (Scenario Two for 2030-31). The intensification per cow and per ha is within 2% but there is approximately 8 -10% difference in land area and cow numbers.

Table 8:

	Newman/Fonterra Estimate	This Estimate	Difference %
Area (ha)	121,200	130,631	+7.8%
Cows	383,700	422,785	+10.2%
Milk Production (kg MS)	171.6 m	188 m	+ 9.5%
MS/cow	447	4444	-0.7%
MS/ha	1,415	1,437	+1.5%
Cows/ha	3.16	3.23	+2.2%

Table 9:

Tararua District	Compound Growth Rate	Year 0	Year 5	Year 10	Year 15	Year 20	Total % Change Over 20 Years
Area (ha)	0.5%	36,359	37,277	38,218	39,183	40,172	10%
Cows		99,273	107,884	117,109	127,553	138,822	40%
Cows/ha		2.73	2.89	3.06	3.25	3.45	26%
Milk Production (kg MS)		32.1 m	36.6 m	41.9 m	47.9 m	54.8m	70%
Kg MS/cow	1.0%	323	340	358	376	395	22%
Kg MS/ha	2.2%	883	984	1,097	1,224	1,365	55%

In a district like Tararua, where most of the farms are in a targeted water management zone, based on the numbers from the last decade milk production could be expected to expand by a further 46%. If there is a correlation between milk production and N loss, then there is significant potential for N loss and run-off issues to grow. To put this into a farm situation, for Tararua district:

Table 10:

	10 Years Ago	Today	In 20 Years
No. of farms	406	315	187
Average farm size (ha)	85	115	215
No. of cows/farm	220	315	740
Milk Production (Kg MS)	59,212 m	101,955 m	292,000 m
MS/cow	269	324	395
MS/ha	697	883	1,365
Stocking Rate (cows/ha)	2.59	2.73	3.45

6.0 COMMENTS ON THE VOLUNTARY VERSUS REGULATORY APPROACHES

1. Voluntary vs Regulatory

Fonterra strongly advocates for a voluntary regime as being cheaper and more effective in getting change in behaviour and uses its Dairying and Clean Streams Accord as an example.

Sean Newland, in paragraphs 31 and 32 of his evidence in chief states "The use of a non-regulatory approach is best exemplified through the Accord. It contains a number of action based targets" (the targets are summarised in his paragraph 32 and achievement of those targets is summarised in Table 11 below).

Table 11: Summary of D&CSA target achievement from the evidence of Sean Newland, paragraph 33.

	2003-04	2007-08	2008-09
Dairy cattle excluded from streams	54%	78%	80%
Regular crossings, bridges and streams	92%	98%	98%
Full compliance with effluent consents	67% in 2004-05	64%	60%
A system to manage nutrient inputs and outputs	17%	98%	99%

On the surface, the response looks quite good, but further analysis changes the perception.

Where the required change is a single one-off piece of technology (e.g. a fence, bridge or culvert) the response is very good.

Where the respondents' required response involves ongoing effort, monitoring and maintaining (complying with consents), the response is less impressive (e.g. complying with current consents has declined from 67% to 60% in five years). The recent release of 2008-09 Accord snapshot shows the number of farms where effluent discharge complied with the farms' consents dropped to its lowest level yet.

Where someone else makes the change (i.e. fertiliser reps complete a nutrient budget), compliance advances rapidly although there is no evidence that a nutrient budget has changed environmental behaviour. The 2008-09 Accord snapshot indicates that using the nutrient budget to actively manage nutrient inputs and outputs is the next step.

Compliance with effluent rules remains problematic (evidence of Sean Newland, paragraph 35).

In June 2008 Fonterra created a rule and financial penalty to help improve compliance with regional council rules, to be fully implemented in 2010-11 (Sean Newland, paragraph 41).

APPENDICES

Appendix 1: Mitigation Strategies Based on Fonterra N-loss Targets[7]

Table 1: Group 1 Farms - Dairy land with > 1,200 mm rainfall and where LUC Class I, II & III is < 50 % of regional average

- Number of farms in priority water management zones = 48
- Total farmed area = 7,577 hectares
- All farms require mitigation strategies to achieve Year 1 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		30	21	20	18	15
	Cumulative Reduction in N-loss		-9	-10	-12	-15
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
D&CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-1	Create wetland attenuation zones	-0.9	24 farms @ $15,000 per farm = $360,000			
13-1	Construct wintering pad/standoff pad	-4		0	8 farms @ $200,000 per farm = $1,600,000	8 farms @ $200,000 per farm = $1,600,000
13-3	Re-locate silage /feed storage	0	3 farms @ $150,000= $450,000			
13-5	Re-locate animal waste/offal pits	0	48 farms @ $200 =			

[7] Evidence of Gerard Willis, page 43, on behalf of Fonterra.

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
			$9,600			
13-6	Reduce rate of effluent application	-1	35 farms @ $6,000 = $210,000			
13-6	Effluent storage	-1	43 farms @ $36,000 = $1,548,000			
Annual Cost of Operation						
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2	24 farms @ $700 per farm = $16,800	24 farms @ $700 per farm = $16,800	24 farms @ $700 per farm = $16,800	24 farms @ $700 per farm = $16,800
13-1	Avoid winter application of N	-1.8	10 farms @ $1,100 per farm = $11,000	10 farms @ $1,100 per farm = $11,000	10 farms @ $1,100 per farm = $11,000	10 farms @ $1,100 per farm = $11,000
13-1	Use urease and nitrification inhibitors	-4	24 farms @ $8,400 per farm = $201,600	48 farms @ $8,400 per farm = $403,200	48 farms @ $8,400 per farm = $403,200	48 farms @ $8,400 per farm = $403,200
13-1	Graze dry cows off farm	-4	32 farms @ $12,000 per farm = $384,000	32 farms @ $12,000 per farm = $384,000	32 farms @ $12,000 per farm = $384,000	32 farms @ $12,000 per farm = $384,000
13-1	Decrease urea usage and substitute low protein supplements	-2	0	0	15 farms @ $13,000 per farm = $195,000	33 farms @ $13,000 per farm = $429,000
13-1	Decrease stocking rate and production per hectare	-2				20 farms at $80,000 per farm = $1,600,000
13-3	Change practice to avoid waterway contamination from intensive animal activities		7 farms @ $1,500 per farm = $10,500	7 farms @ $1,500 per farm = $10,500	7 farms @ $1,500 per farm = $10,500	7 farms @ $1,500 per farm = $10,500

Table 2: Group 2 Farms - Dairy Land with > 1,200 mm rainfall only

- Number of farms in priority water management zones = 86
- Total farmed area = 13,716 hectares
- All farms require mitigation strategies to achieve Year-1 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		30	25	24	22	17
	Cumulative Reduction in N-loss		-5	-6	-9	-13
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
D& CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-1	Create wetland attenuation zones	-0.9	0	10 farms @ $15,000 per farm = $150,000	10 farms @ $15,000 per farm = $150,000	8 farms @ $15,000 per farm = $120,000
13-1	Construct wintering pad/standoff pad	-4				24 farms @ $200,000 per farm = $4,800,000
13-3	Re-locate silage /feed storage	0	4 farms @ $150,000= $600,000			
13-5	Re-locate animal waste/offal pits	0	86 farms @ $200 = $17,200			
13-6	Reduce rate of effluent application	-1	43 farms @ $6,000 = $258,000			

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
13-6	Effluent storage	-1	77 farms @ $36,000 = $2,772,000			
Annual Cost of Operation						
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2	43 farms @ $700 per farm = $30,100	43 farms @ $700 per farm = $30,100	43 farms @ $700 per farm = $30,100	43 farms @ $700 per farm = $30,100
13-1	Avoid winter application of N	-1.8	20 farms @ $1,100 per farm = $22,000	20 farms @ $1,100 per farm = $22,000	20 farms @ $1,100 per farm = $22,000	20 farms @ $1,100 per farm = $22,000
13-1	Use urease and nitrification inhibitors	-4	55 farms @ $8,400 per farm = $462,000			31 farms @ $8,400 per farm = $260,400
13-1	Graze dry cows off farm	-4	0	25 farms @ $12,000 per farm = $300,000	37 farms @ $12,000 per farm = $440,000	0
13-1	Decrease urea usage and substitute low protein supplements	-2			0	48 farms @ $13,000 per farm = $624,000
13-3	Change practice to avoid waterway contamination from intensive animal activities		13 farms @ $1,500 per farm = $19,500	13 farms @ $1,500 per farm = $19,500	13 farms @ $1,500 per farm = $19,500	13 farms @ $1,500 per farm = $19,500

Table 3: Group 3 Farms - Dairy Land where LUC Class I, II & III is < 50 % of regional average only

- Number of farms in priority water management zones = 142
- Total farmed area = 25,082 hectares
- 50% of farms require mitigation strategies to achieve Year 1 targets
- 75% of farms require mitigation strategies to achieve Year 5 and Year 10 targets
- 25% of farms require no mitigation strategies to achieve Year 20 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		21	22	21	20	16
	Cumulative Reduction in N-loss		+1	0	-1	-5
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
D& CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-1	Create wetland attenuation zones	-0.9			0	30 farms @ $15,000 per farm = $450,000
13-5	Re-locate animal waste/offal pits	0	142 farms @ $200 = $28,400			
13-6	Reduce rate of effluent application	-1	43 farms @ $6,000 = $258,000			
13-6	Effluent storage	-1	128 farms @ $36,000 = $4,608,000			

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
Annual Cost of Operation						
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2		0	0	106 farms @ $700 per farm = $74,200
13-1	Avoid winter application of N	-1.8		0	0	106 farms @ $1,100 per farm = $116,600
13-1	Decrease urea usage and substitute low protein supplements	-2				43 farms @ $13,000 per farm = $559,000
13-3	Change practice to avoid waterway contamination from intensive animal activities		21 farms @ $1,500 per farm = $31,500	21 farms @ $1,500 per farm = $31,500	21 farms @ $1,500 per farm = $31,500	21 farms @ $1,500 per farm = $31,500

Table 4: Group 4 Farms - Dairy land where LUC Class and rainfall constraints are excluded

- Number of farms in priority water management zones = 152
- Total farmed area = 25,243 hectares
- 20% of farms require mitigation strategies to achieve Year 1 targets
- 50% of farms require mitigation strategies to achieve Year 5 targets
- 60% of farms require mitigation strategies to achieve Year 10 targets
- 40% of farms require no mitigation strategies to achieve Year 20 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		24	28	27	25	21
	Cumulative Reduction in N-loss		+4	+3	+1	-3
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
D& CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-3	Re-locate silage /feed storage	0	8 farms @ $150,000= $1,200,000			
13-5	Re-locate animal waste/offal pits	0	152 farms @ $200 = $30,400			
13-6	Reduce rate of effluent application	-1	45 farms @ $6,000 = $270,000			
13-6	Effluent storage	-1	137 farms @ $16,000 = $2,192,000			
Annual Cost of Operation						

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2		0	0	91 farms @ $700 per farm = $63,700
13-1	Avoid winter application of N	-1.8			0	76 farms @ $1,100 per farm = $83,600
13-1	Use urease and nitrification inhibitors	-4				
13-3	Change practice to avoid waterway contamination from intensive animal activities		23 farms @ $1,500 per farm = $34,500	23 farms @ $1,500 per farm = $34,500	23 farms @ $1,500 per farm = $34,500	23 farms @ $1,500 per farm = $34,500

Appendix 2: Mitigation Strategies Based on Horizons N-loss Targets[8]

Table 5: Group 1 Farms - Dairy Land with > 1,200 mm rainfall and where LUC Class I, II & III is < 50 % of regional average

- Number of farms in priority water management zones = 48
- Total farmed area = 7,577 hectares
- All farms require mitigation strategies to achieve Year 1 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		30	19	16	15	15
	Cumulative Reduction in N-loss		-11	-14	-15	-15
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
D&CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-1	Create wetland attenuation zones	-0.9	24 farms @ $15,000 per farm = $360,000			
13-1	Construct wintering pad/standoff pad	-4		15 farms @ $200,000 per farm = $3,000,000	1 farms @ $200,000 per farm = $200,000	
13-3	Re-locate silage /feed storage	0	3 farms @ $150,000= $450,000			
13-5	Re-locate animal waste/offal pits	0	48 farms @ $200 =			

[8] S42A evidence of Dr Mackay, summarised in the S42A evidence of Ms Marr; page 27, Table 3.

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
			$9,600			
13-6	Reduce rate of effluent application	-1	35 farms @ $6,000 = $210,000			
13-6	Effluent storage	-1	43 farms @ $36,000 = $1,548,000			
Annual Cost of Operation						
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2	24 farms @ $700 per farm = $16,800	24 farms @ $700 per farm = $16,800	24 farms @ $700 per farm = $16,800	24 farms @ $700 per farm = $16,800
13-1	Avoid winter application of N	-1.8	10 farms @ $1,100 per farm = $11,000	10 farms @ $1,100 per farm = $11,000	10 farms @ $1,100 per farm = $11,000	10 farms @ $1,100 per farm = $11,000
13-1	Use urease and nitrification inhibitors	-4	24 farms @ $8,400 per farm = $201,600	48 farms @ $8,400 per farm = $403,200	48 farms @ $8,400 per farm = $403,200	48 farms @ $8,400 per farm = $403,200
13-1	Graze dry cows off farm	-4	32 farms @ $12,000 per farm = $384,000	32 farms @ $12,000 per farm = $384,000	32 farms @ $12,000 per farm = $384,000	32 farms @ $12,000 per farm = $384,000
13-1	Decrease urea usage and substitute low protein supplements	-2	48 farms @ $13,000 per farm = $624,000	48 farms @ $13,000 per farm = $624,000	48 farms @ $13,000 per farm = $624,000	48 farms @ $13,000 per farm = $624,000
13-1	Decrease stocking rate and production per hectare	-2			20 farms at $80,000 per farm = $1,600,000	20 farms at $80,000 per farm = $1,600,000
13-3	Change practice to avoid waterway contamination from intensive animal activities		7 farms @ $1,500 per farm = $10,500	7 farms @ $1,500 per farm = $10,500	7 farms @ $1,500 per farm = $10,500	7 farms @ $1,500 per farm = $10,500

Table 6: Group 2 Farms - Dairy Land with > 1,200 mm rainfall only

- Number of farms in priority water management zones = 86
- Total farmed area = 13,716 hectares
- All farms require mitigation strategies to achieve Year 1 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		30	22	20	18	17
	Cumulative Reduction in N-loss		-8	-10	-12	-13
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
D& CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-1	Create wetland attenuation zones	-0.9	28 farms @ $15,000 per farm = $420,000			
13-1	Construct wintering pad/standoff pad	-4				24 farms @ $200,000 per farm = $4,800,000
13-3	Re-locate silage /feed storage	0	4 farms @ $150,000= $600,000			
13-5	Re-locate animal waste/offal pits	0	86 farms @ $200 = $17,200			
13-6	Reduce rate of effluent application	-1	43 farms @ $6,000 = $258,000			

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
13-6	Effluent storage	-1	77 farms @ $36,000 = $2,772,000			
Annual Cost of Operation						
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2	43 farms @ $700 per farm = $30,100	43 farms @ $700 per farm = $30,100	43 farms @ $700 per farm = $30,100	43 farms @ $700 per farm = $30,100
13-1	Avoid winter application of N	-1.8	20 farms @ $1,100 per farm = $22,000	20 farms @ $1,100 per farm = $22,000	20 farms @ $1,100 per farm = $22,000	20 farms @ $1,100 per farm = $22,000
13-1	Use urease and nitrification inhibitors	-4	86 farms @ $8,400 per farm = $722,400	86 farms @ $8,400 per farm = $722,400	86 farms @ $8,400 per farm = $722,400	86 farms @ $8,400 per farm = $722,400
13-1	Graze dry cows off farm	-4	5 farms @ $12,000 per farm = $60,000	50 farms @ $12,000 per farm = $600,000	70 farms @ $12,000 per farm = $840,000	62 farms @ $12,000 per farm = $744,000
13-1	Decrease urea usage and substitute low protein supplements	-2			48 farms @ $13,000 per farm = $624,000	48 farms @ $13,000 per farm = $624,000
13-3	Change practice to avoid waterway contamination from intensive animal activities		13 farms @ $1,500 per farm = $19,500	13 farms @ $1,500 per farm = $19,500	13 farms @ $1,500 per farm = $19,500	13 farms @ $1,500 per farm = $19,500

Table 7: Group 3 Farms - Dairy Land where LUC Class I, II & III is < 50 % of regional average only

- Number of farms in priority water management zones = 142
- Total farmed area = 25,082 hectares
- 50% of farms require mitigation strategies to achieve Year 1 targets
- 75% of farms require mitigation strategies to achieve Year 5 and Year 10 targets
- 25% of farms require no mitigation strategies to achieve Year 20 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		21	21	18	17	16
	Cumulative Reduction in N-loss		0	-3	-4	-5
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
D& CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-1	Create wetland attenuation zones	-0.9			30 farms @ $15,000 per farm = $450,000	
13-5	Re-locate animal waste/offal pits	0	142 farms @ $200 = $28,400			
13-6	Reduce rate of effluent application	-1	43 farms @ $6,000 = $258,000			
13-6	Effluent storage	-1	128 farms @ $36,000 = $4,608,000			

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
Annual Cost of Operation						
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2		0	106 farms @ $700 per farm = $74,200	106 farms @ $700 per farm = $74,200
13-1	Avoid winter application of N	-1.8		106 farms @ $1,100 per farm = $116,600	106 farms @ $1,100 per farm = $116,600	106 farms @ $1,100 per farm = $116,600
13-1	Decrease urea usage and substitute low protein supplements	-2				43 farms @ $13,000 per farm = $559,000
13-3	Change practice to avoid waterway contamination from intensive animal activities		21 farms @ $1,500 per farm = $31,500	21 farms @ $1,500 per farm = $31,500	21 farms @ $1,500 per farm = $31,500	21 farms @ $1,500 per farm = $31,500

Table 8: Group 4 Farms - Dairy land where LUC Class and rainfall constraints are excluded

- Number of farms in priority water management zones = 152
- Total farmed area = 25,243 hectares
- 20% of farms require mitigation strategies to achieve Year 1 targets
- 50% of farms require mitigation strategies to achieve Year 5 targets
- 60% of farms require mitigation strategies to achieve Year 10 targets
- 40% of farms require no mitigation strategies to achieve Year 20 targets

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
		24	26	23	21	21
	Cumulative Reduction in N-loss		+2	-1	-3	-3
Rule	Mitigation	Estimated N-loss reduction (kg/ha)	Implementation Cost			
			Year 1	Year 5	Year 10	Year 20
Capital Expenditure						
DS& CSA	Fence waterways	-1				
CCC	Increase effluent area	-1				
13-3	Re-locate silage /feed storage	0	8 farms @ $150,000= $1,200,000			
13-5	Re-locate animal waste/offal pits	0	152 farms @ $200 = $30,400			
13-6	Reduce rate of effluent application	-1	45 farms @ $6,000 = $270,000			
13-6	Effluent storage	-1	137 farms @ $16,000 =			

		Indicative Current N-loss and N-loss targets (kg N-loss/ha)				
		Current	Year 1	Year 5	Year 10	Year 20
			$2,192,000			
Annual Cost of Operation						
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2		0	91 farms @ $700 per farm = $63,700	91 farms @ $700 per farm = $63,700
13-1	Avoid winter application of N	-1.8			50 farms @ $1,100 per farm = $55,000	76 farms @ $1,100 per farm = $83,600
13-1	Use urease and nitrification inhibitors	-4				
13-3	Change practice to avoid waterway contamination from intensive animal activities		23 farms @ $1,500 per farm = $34,500	23 farms @ $1,500 per farm = $34,500	23 farms @ $1,500 per farm = $34,500	23 farms @ $1,500 per farm = $34,500