A Comparison of Changes to Nitrogen Loss Allowances on Dairying in the Upper Manawatu River Catchment

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KapAg Growing for Good

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The farm analyses were undertaken by Stefan Bryant of BakerAg, Scott Ridsdale of RD Consulting and myself. Never-the-less I take full responsibility for any remaining errors and any opinions that appear in this report.

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My thanks to all these people.

Summary[1]

The dairy farms in the Upper Manawatu River catchment can be grouped into five clusters (Parminter 2017):

- Farm #1. These are farms predominantly on allophanic soils and they typically have an initial nitrogen loss of about 40kgN/ha/yr
- Farm #2. These are farms on primarily recent soils and they typically have an initial nitrogen loss of about 46kgN/ha/yr
- Farm #3. These are farms on gley soils and they typically have an initial nitrogen loss of about 26kgN/ha/yr
- Farm #4. These are farms on brown soils that are more intensively farmed than the others. They typically have an initial nitrogen loss of about 47kgN/ha
- Farm #5. These are farms on brown and pallic soils and they typically have an initial nitrogen loss of about 39kgN/ha/yr.

All these farms have slightly differing nitrogen cap trajectories to follow if they are to apply to Horizons Regional Council for a controlled landuse consent under the original Table 14.2 One Plan (2014) conditions. The on-farm implications of following that trajectory are compared in this report with a trajectory to meet the conditions in a revised Table 14.2(R).

There are just over about 20% of farms in the Upper Manawatu River catchment that are similar to Farm#1. As well as their initial nitrogen loss of 40kgN/ha/yr they typically have an initial operational profit of just under $2,000/ha/yr. For Farm #1 to comply with the original Table 14.2 in the One Plan (2014) the results are expected to be:

- The farm continuing to make operational profits of $1,000/ha or more
- At typical debt levels in the industry this farm would have to make greater than $1,300/ha and so it could not meet the table and remain financially viable (see Parminter 2017 for more on industry debt levels)
- Whilst the calculations in Overseer® indicate that this farm system could be modified to operate within the nitrogen loss required in the table, Overseer calculations also indicate that it can only do so by operating in a nitrogen deficit, and this would not be sustainable beyond the short term[2]

For Farm #1 to comply with the proposed Table 14.2(R) the results are expected to be:

- The farm making an operational profit of over $1,500/ha or more
- The farm has sufficient operational income to cover typical debt levels and remain financially viable
- The farm being able to sustainably achieve the nitrogen reductions required to operate with in its nitrogen cap

[1] A glossary follows.

[2] This is considered likely to be the situation when over one third of the pasture produced is being harvested and removed from the farm.

There are less than about 10% of farms in the Upper Manawatu River catchment similar to Farm #2. As well as their initial nitrogen loss of 46kgN/ha/yr they typically have an initial operational profit of just over $2,000/ha/yr. For Farm #2 to farm within the nitrogen cap of the original One Plan (2014) Table 14.2 the result is expected to be:

- Having an operational profitability of over $1,200/ha
- At typical industry debt levels this would enable the farm to meet its debt requirements (about $1,100/ha)
- The farm can stay within the nitrogen caps but it has insufficient soil reserves to do so sustainably beyond the short term

For Farm #2 operating within the proposed Table 14.2(R):

- It would be able to make operational profits of $2,000/ha or more
- This would enable most farmers like this farm to service their current debt
- From year twenty, in order to stay within the nitrogen cap, some pasture would need to be harvested and sold off-farm

There are about 15% of farms in the Upper Manawatu River catchment similar to Farm #3. As well as their initial nitrogen loss of 26kgN/ha/yr they typically have an initial operational profit of just over $1,200/ha/yr. For Farm #3 to farm within the nitrogen cap of the original One Plan (2014) Table 14.2 it would:

- Have an operational profitability of generally over $1,000/ha (Year 5 an exception)
- At typical industry debt levels this would enable the farm to meet its debt requirements of about $900/ha
- The farm can stay within the nitrogen caps, but beyond Year 10 its soil nitrogen reserves become very low

For Farm #3 to operate within the proposed Table 14.2(R):

- It would make operational profits of more than $1,200/ha
- This would enable most farmers to service their current debt
- It could meet the nitrogen caps sustainably over the long term

There are over about 10% of farms in the Upper Manawatu River catchment similar to Farm #4. As well as their initial nitrogen loss of 47kgN/ha/yr they typically have an initial operational profit of just over $3,000/ha/yr. The consequences of the farming system in Farm #4 being modified to achieve the nitrogen caps in the original Table 14.2 are:

- Operating profit each year is expected to be above $1,500/ha
- At typical debt levels in the industry (about $1,300/ha) the farm can remain financially viable
- The farm can achieve the nitrogen cap in the original Table 14.2 and do so sustainably

If Farm #4 complies with the nitrogen cap in Table 14.2(R) there are expected to be the following consequences:

- Operating profits are expected to be greater than $1,500/ha
- Typical debt levels can be serviced
- The farm can sustainably achieve the nitrogen cap

The largest group of farmers within the catchment are represented by Farm #5 (45%). As well as their initial nitrogen loss of 39kgN/ha/yr they typically have an initial operational profit of just over $1,500/ha/yr. For Farm #5 complying with the original Table 14.2 in the One Plan (2014) would result in:

- The farm only just clearing its operational expenses with an annual profit of less than $500/ha. Income from an alternative land use (or other source of income) is necessary for this farm to remain profitable
- Typical debt payment levels in the industry would be more than $1,000/ha for this farm. Farm #5 would not be able to meet the nitrogen caps in the original table and remain financially viable
- Whilst the calculations in Overseer® indicate that this farm system could be modified to operate within the nitrogen loss required in the table, it is only possible by running les than 1cow/ha and harvesting about half the pasture for off-farm sale

For Farm #5 to comply with the proposed Table 14.2(R) the result would be:

- The farm making an operational profit of over $1,000/ha or more
- The farm having just enough operational income to cover typical debt levels in the industry and remain financially viable
- The farm would be able to sustainably achieve the nitrogen reductions that are required to operate within its nitrogen cap

In conclusion, the group of Cluster Farms representing about 65% of dairy farms in the Upper Manawatu River catchment are not financially viable after management practices have been introduced to enable them to operate within the original nitrogen cap of Table 14.2 in the One Plan (2014). A greater number of farms would only be able to operate within the nitrogen cap by depleting their soil nitrogen reserves. That situation would not be sustainable over time.

If the revised Table 14.2(R) is introduced all Cluster Farms are able to remain financially viable although Farm #5 could not service high levels of debt. Farm #2 is expected to continue running down its nitrogen reserves in order to operate within Table 14.2(R).

This study highlights the importance of continued improvements in production per cow within the industry. There are benefits from also improving nitrogen efficiency on-farm so that low-loss systems become more sustainable. The study reinforces the opportunities for off-farm winter grazing of cows and providing them with sheltered feed pads or barns. The latter topic has been developed already in Parminter (2017).

1. Glossary

Clustering: …… farm systems are very diverse and at a catchment scale it is hard to capture both the consistency and diversity of their operation. This study has drawn upon previous research that has established that there are five clusters of farm types within the Upper Manawatu River catchment. The farms within each cluster are more similar to each other than the farms in any other cluster and taken together the clusters can be used (as here) to ensure that the all the farms in the catchment have contributed towards the analytical results.

Nitrogen loss: ……. these are the losses of nitrogen from farm systems calculated in Overseer. They are principally as losses of ammonia into the atmosphere and nitrate into waterways.

Nutrient sustainability: … nutrients are removed from farms by selling products, exporting waste material and losses to air and to water. These losses are replaced by "importing" feed stuffs, fertiliser (artificial and organic), nutrient transfer (e.g. rain), nutrient fixation (e.g. clover rhizobium) and nutrient reserves in plant material and organic and inorganic soil reserves. The nutrient status of a farm may become unsustainable if the plant and/or soil reserves are in deficit.

Off-farm sales of pasture: … as stocking rates are reduced it becomes more difficult for farmers to maintain first the quality of their pastures, then the quantity of pasture production, and finally pasture composition. In this study, surplus and potentially uncontrolled pasture was harvested and sold off-farm. Selling pasture provides a way of efficiently "exporting" nitrogen from the farm but is unlikely to be a very profitable landuse, particularly if it is widely practiced. There may also be other landuse options such as growing arable crops on part of the farm.

Operational profit: …….. this is the gross income of the farming business from which the cash costs of generating that income have been deducted. It has not included the owner's salary or drawings, tax, depreciation or costs of borrowing.

Overseer®: …… is a computer software model that estimates nutrient use and movement within a farm system. In the One Plan (2014) the use of Overseer is the prescribed way of producing required nutrient management plans. Although Overseer is best suited to modelling stable farming systems in equilibrium, in this study it has been used to describe farm systems in transition. In particular any delayed or lagging effects from earlier farm systems have not been accounted for.

Table 14.2: …….. can be found in the One Plan (2014) where it is associated with Policy 14-5, and Rules 14-1 and 14-2 requiring consents for existing intensive farming landuse activities, as well as Rule 14-3 for new intensive farming landuse activities. Table 14.2 establishes the cumulative nitrogen leaching maximum values for intensive farming in the Manawatu Wanganui Region. The values have been established according to principles of "natural capital" and are based on Land Use Capability Classes and intervals of 5-10 years. The change in values between years is described in this report as a "nitrogen cap trajectory".

Table 14.2 (R): ……. this table is a revision of the original Table 14.2 to account for changes in Overseer over time, but still to address the same catchment objectives and policies.

2. Purpose

The purpose of this report is to assess and compare two tables of nitrogen leaching maxima for dairy farms in the Upper Manawatu River catchment, using representative farming clusters from previous research.

Table 1 is drawn from Chapter 14 of the One Plan (2014). Table 2 is a possible revision of the original table to reflect changes in versions of Overseer®. It has been drawn from Hanly, Hedley and Horne, 2018 "Sensitivity of values in Table 14.2 of the 'One Plan' to a change in the version of OVERSEER: Part B: Recalculation of the nitrogen (N) transmission coefficient using N loss to water estimates from the current version of OVERSEER® (v6.2.3)".

Table 1. Original cumulative nitrogen leaching maximums by land use capability class (LUC), taken from Table 14.2 of the Manawatu Wanganui One Plan (kgN/ha/yr)

	LUC I	LUC II	LUC III	LUC IV	LUC V	LUC VI	LUC VII	LUC VIII
Year 1	30	27	24	18	16	15	8	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

Table 2. Revised cumulative nitrogen leaching maximums by land use capability class (LUC), taken from Table 14.2 of the Manawatu Wanganui One Plan (kgN/ha/yr)

	LUC I	LUC II	LUC III	LUC IV	LUC V	LUC VI	LUC VII	LUC VIII
Year 1	50	44	36	26	23	22	11	3
Year 5	45	41	32	23	19	15	8	3
Year 10	43	36	29	20	19	15	8	3
Year 20	42	34	27	19	17	15	8	3

3. Background

There are two previous reports in this series and that are referred to in this report. The first report, "An Impact Assessment of One Plan policies and rules on farming systems in the Tararua District and the Manawatu Wanganui Region, August 2017" describes the impact that applying the original rules in the One Plan on nitrogen allocation could have on dairy farming systems in the Tararua District. Four farming systems were described:

- A self-contained dairy farm system model that started with leaching 32 kgN/ha and was then modified to be leaching only 18 kgN/ha, a reduction of 44%. These changes reduced the expected farm profit from $1,627/ha to $629/ha, a drop of over 60%. The return on assets dropped from 5.3% to 2.0%. About 10% of farms in the Upper Manawatu Catchment are tending towards this type of farming system.
- A model of a low-intensity dairy farm system that started with leaching 42 kgN/ha and was modified to be leaching only 17 kgN/ha, a drop of 60%. These changes reduced the expected farm profit from $1,848/ha to $1,064/ha, a drop of over 40%. The return on assets dropped from 6.4% to 3.7%. About 30% of farms in the Upper Manawatu Catchment are tending towards this type of farming system.
- A moderate-intensity dairy farm system that started with leaching 54 kgN/ha and was modified to be leaching only 17 kgN/ha, a drop of almost 70%. These changes reduced the expected farm profit from $2,283 /ha to $1,745/ha, a drop of almost 25%. The return on assets dropped from 7.0% to 5.0%. About 25% of farms in the Upper Manawatu Catchment are tending towards this type of farming system.
- A high-intensity dairy farm system that started with leaching 64 kgN/ha and was modified to be leaching only 17 kgN/ha, a drop of over 70%. These changes reduced the expected farm profit from $2,456/ha to $1,850/ha, a drop of 25%. The return on assets dropped from 6.8% to 4.8%. About 25% of farms in the Upper Manawatu Catchment are tending towards this type of farming system.

An additional report produced in 2017 on dairying in the Tararua District was prepared by Barry Riddler of Kikorangi Farm Systems Analysis on "The feasibility of nutrient leaching reductions (N leaching) within the constraints of minimum impact on the profitability and production of three dairy farms in the Horizons Region". Its purpose was, "to determine if it was possible for a dairy farm in a sensitive catchment to have acceptable N leaching and make a profit using a whole-farm modelling approach." This report addressed the three pasture-based farming systems in Parminter 2017 and came to similar conclusions. These were that requiring all remaining dairy farms in the Tararua District to achieve the 20 year targets in Table 14.2 would result in many of them being no-longer economically viable. The report by Ridler also showed that even if typical dairy farms in the Tararua District operated above the nitrate leaching limits in Table 14.2, they were still able to achieve considerable reductions in nitrate losses and these were expected to be at little cost to each of the three farm systems. Ridler's report expressed a need for further research to be undertaken so that future impact analyses could use farm models that were more representative of farms in the Tararua District.

The second report by Parminter, "Selecting Representative Dairy Farms for the Upper Manawatu River Catchment, March 2018" described the results of applying a process identifying the attributes

of farms suitable for representing those in the Upper Manawatu River catchment in the Tararua District.

In Table 3 all the dairy farms in the Catchment on the basis of their individual attributes, have been associated with one of five different clusters. The first three clusters contain farms on the minority soil orders in the catchment: allophanic (27 farms), recent (10 farms) and gley (18 farms). Cluster 4 contains the farms in lower rainfall areas that are more intensively farmed than is general (16 farms). Cluster 5 has farms on both brown and pallic soils and are of a farm size and system intensity often found in the catchment (55 farms).

Although the median values in Table 3 are middle values for the farms within each cluster, when they are all taken together they also represent the distribution of attribute values for the farms in the whole population of dairy farms in the Upper Manawatu River catchment. This is highlighted in Tables 4 and 5 for two example attributes.

Examining Table 4 shows that the cluster medians for milk solids production per hectare are spread across all quartiles except for the first quartile (where 25% of the farmers are).

Examining Table 5 shows that the cluster medians for nitrogen losses are spread across all quartiles except for the last quartile (where 25% of farmers are).

Table 3. The five farming clusters and the attribute medians used to describe all the dairy farms in the Upper Manawatu Catchment

Cluster	Soil Order	Rainfall (mm)	Milking Platform Area (ha)	Milking Cows (Peak)	Production per cow (kgMS/cow/yr)	Production per hectare (kgMS/ha/yr)	Dairy System Type (I-V)	Pasture Consumption (kgDM/ha/yr)	Nitrogen Loss to Water (kgN/ha/yr)	Phosphorus loss to water (kgP/ha/yr)
1	Allophanic	1,376	116	370	327	896	III	10,513	40	0.9
2	Recent	1,211	112	336	369	968	III	10,903	46	1.0
3	Gley	1,241	99	256	340	917	II	10,843	26	1.3
4	Brown	1,255	131	385	387	1,136	IV	10,195	47	1.0
5	Brown & Pallic	1,354	108	270	336	830	II	9,520	39	0.9
Median of cluster medians	NA	1,190	95	220	305	829	III	10,513	43	1.5
Medians of all farms in the catchment	Brown	1,298	111	309	340	902	II	10,092	39	1.0

Taken from page 26 of Parminter, March 2018

Table 4. The percentage of farms from each cluster within each quartile for milk solids production per hectare. The coloured cells highlight the median results for each cluster.

	Annual production of milk solids (kgMS/ha/yr)				
Clusters	459-761 kgMS/ha/yr	761-902 kgMS/ha/yr	902-1050 kgMS/ha/yr	1050-1449 kgMS/ha/yr	Total (%)
1	18	33	19	30	100
2	-	20	40	40	100
3	28	17	33	22	100
4	-	13	6	81	100
5	39	28	26	7	100

Table 5. The percentage of farms within each cluster and their annual nitrogen losses (%). The coloured cells highlight the representative farm results.

	Annual Nitrogen Losses to Water (kgN/ha/yr)				
Clusters	15-29 kgN/ha/yr	30-44 kgN/ha/yr	45-59 kgN/ha/yr	60-74 kgN/ha/yr	Total (%)
1	4	59	30	7	100
2	10	40	30	20	100
3	67	28	6	0	100
4	0	44	25	31	100
5	27	49	18	5	100

4. Approach

The median figures from the five clusters of farms in the Upper Manawatu River catchment (shown in Table 3) were used to establish five model farms in Overseer® 6.3.0. Using the information in Table 1 (this report) the models were then matched to the nitrogen loss trajectory that they would be required to meet in order for them to obtain a controlled consent according to the One Plan (2014). Following that and starting from the same initial farm setup the farms were again matched to a nitrogen loss trajectory, this time from Table 2 (this report). The results of the two differing trajectories have been summarised and compared.

Three farm consultants from three different consultancy companies worked collaboratively to bring together the information in this report. The decision protocols were initially established at a joint meeting. The analyses for the five farms were then carried out with each consultant working separately and independently. Then finally all the results from the analyses were brought together and calibrated.

5. Initial Farm Results

The initial farm attributes for each of the cluster farms is shown in Table 6 along with the medians that were used to create them. There were over twice as many inputs as are shown here. The medians did not come from one farm and the Cluster Farm results haven't always matched them A decision making protocol was used to ensure that coherent farming systems were developed for each of the cluster farms and entered into Overseer®. In consecutive order the steps were:

- Locate the farm according to median rainfall, soil types and topography (LUC).
- Match the area of the milking platform and the peak number of milking cows with the cluster medians. Use cow stocking rate median to adjust this up or down, always staying between the median and the average attribute results for the cluster.
- Match the production per cow, the imported supplements and the fodder crop yields to the median results. Adjust these up or down, always staying between the median and the average for the cluster.
- Add nitrogen fertiliser and calculate nitrogen loss to water. Adjust the farming system to match the nitrogen loss median.

After the initial farming systems had been established, a profit and loss account was drawn up for each farm (see Appendix A for an example). These were based on farm accounts for farms with these systems and known to each of the consultants doing the work. Each line item in each account was adjusted in a standard way for each farm based on their area, stocking rate, and milk production. Any changes introduced to each farm resulted in financial changes that followed a consistent protocol for all the farms.

Table 6. Cluster medians and farm results for selected attributes compared

Cluster and Farm Number	Number of farms	Effective area of milking platform (MP ha)	Runoff area (RO ha)	Peak number of milking cows	Milk production from MP (kgMS/ha/yr)	Production from cows (kgMS/cow/yr)	Proportion of imported feed (%)	Nitrogen fertiliser (kgN/ha/yr)	Nitrogen losses to water (kgN/ha/yr)
#1 medians	27	116	-	370	896	327	0.12	70	40
#1 farm		116	0	340	942	321	0.15	69	40
#2 medians	10	112	-	336	968	369	0.22	64	46
#2 farm		112	40	336	1107	369	0.14	70	45
#3 medians	18	99	-	256	917	340	0.13	66	26
#3 farm		99	40	256	880	340	0.13	70	28
#4 medians	16	131	-	385	1136	387	0.28	99	47
#4 farm		131	35	385	1137	385	0.19	105	46
#5 medians	55	108	-	270	830	336	0.16	55	39
#5 farm		108	0	270	840	336	0.13	58	39
All farms	126	111	-	309	902	340	0.16	62	39
Cluster farms' weighted averages		112	-	303	926	342	0.14	69	39

6. Mitigation Steps

The mitigations introduced to each farm model followed those outlined in the early report (Parminter 2017). The operational changes were introduced first. These were changes in management that can be introduced within production seasons. All farms were required to make the following operational changes:

- Remove all nitrogen fertiliser applications from the effluent application area.
- Remove winter applications of nitrogen (April to July inclusive).
- Reduce annual nitrogen applications to 70kgN/ha per year or less. This was figure was set based on the population median shown in Table 6.
- Aggressively cull non-pregnant and poor performing cows by moving their cull-date one month earlier from April into March (17% of herd).
- Replace high-protein imported feeds with low-protein. In particular replacing grass supplements with maize silage.
- Remove all nitrogen applications except for one application in Spring, if required. Reduce herd numbers to balance.

After that system changes were introduced. The scale of these changes varied with each farm and version of Table 14.2.

- The effluent treatment field was increased to reduce effluent applications to the equivalent of 100 kgN/ha/yr. This required a capital investment.
- Irrigation applications (on Cluster Farm #4) were optimised to reduce drainage.
- Graze off-farm (and out of catchment) rising 2yr heifers and weaned calves. Graze off-farm dry cows although if it was possible, retain at least 0.5 cows/ha for winter grazing on the milking platform. Increase pasture conserved to maintain pasture production and reduce imported feed.
- Shorten lactation length first to 10th May and reduce herd numbers. Increase pasture conserved to maintain pasture production and reduce imported feed.
- Shorten lactation length to 30th April and reduce herd numbers. Increase pasture conserved to maintain pasture production and reduce imported feed.

As milking cow numbers were reduced whilst feed supply was maintained it was expected that milk production per cow would increase. The detail on those calculations is shown in Appendix B.

There was no investment made into feed-off pads and cow housing. It was assumed that Cluster Farm #2 and Cluster Farm #4 with Type IV systems would have had facilities to provide these however that was not included in the Overseer analyses. For more information about the effects of Type IV systems refer to the earlier report (Parminter 2017).

7. Results for Cluster Farm #1

The assumptions made to establish Cluster Farm #1 are shown in Table 7. All the results shown in the Table were drawn from the specific Overseer file before any potential changes had been made. The Table describes the structure of the farm, the parameters of the dairy herd, and how the dairy herd was being fed. On the basis of these inputs the next parts of Table 7 describe the nutrient losses to the environment and the financial results for a farm owner.

The next tables in this report describe the results for Farm #1 of making management changes to meet the nitrogen caps in Table 14.2 of the One Plan (2014) and in the revised Table 14.2(R). To meet both tables, cow numbers were reduced and to achieve the original table the lactation length was shortened by 10 days. The original table of nitrogen losses required removing the forage crop over summer and there was a small increase in the amount of imported feed required. The original table required that all the non-lactating cows were grazed off-farm (and out of the catchment) over winter.

Table 8 and Table 9 are summaries of the farming system results. The changes in these Tables are sufficient for the farmers involved to apply to Horizons Regional Council for a controlled consent (as long as they were also meeting all the other requirements in the One Plan (2014)).

Table 10 and Table 11 are the farming system results projected for year 20 applying the One Plan (2014) Table 14.2 and Table 14.2(R) respectively.

For Farm #1 complying with the original Table 14.2 in the One Plan (2014) would result in:

- The farm continuing to make operational profits of $1,000/ha or more
- At typical debt levels in the industry this farm would have to make greater than $1,300/ha and so it could not meet the table and remain financially viable (see Parminter 2017 for more on industry debt levels)
- Whilst the calculations in Overseer® indicate that this farm system could be modified to operate within the nitrogen loss required in the table, Overseer calculations also indicate that it can only do so by operating in a nitrogen deficit, and this would not be sustainable beyond the short term[3]

For Farm #1 to comply with the proposed Table 14.2(R) the results are expected to be:

- The farm making an operational profit of over $1,500/ha or more
- The farm has sufficient operational income to cover typical debt levels and remain financially viable
- The farm being able to sustainably achieve the nitrogen reductions required to operate with in its nitrogen cap

[3] This is considered likely to be the situation when over one third of the pasture produced is being harvested and removed from the farm.

Table 7. Farm #1 initial year farming system results

INFRASTRUCTURE					
Farm Area	122 ha	**Milking platform**	116 ha	**Runoff area**	0 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		18 ha
Rainfall	1351mm/yr	**Irrigation system**	N/A		
Soils	70ha	Dannevirke s.l.	Capital fert 31-51-09		
	46ha	Matamau s.l.	28-46-19		
HERD					
340 cows	68 replacements (grazed off for 18 months from 3 months of age)		**Cow wintering**	Half the herd grazed off-farm for 3 months	
Calving date	16th August		**Drying off date**	10th May	
109,269 kgMS	942 kgMS/ha MP		321 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			12,540 kgDM/ha/yr		
Imported feed			104 T DM – 50:50 PKE and silage	12 %	
Winter forage crop			N/A		
Summer forage crop			6 ha	Turnips	9 T/ha yield
NUTRIENTS					
Clover nitrogen	148 kg/ha		**Fertiliser nitrogen** – Aug, Nov, Apr.	68 kg/ha	
Other nitrogen	21 kg/ha		**Available nitrogen**	237 kg/ha	
Surplus nitrogen	177 kg/ha		**Nitrogen conversion efficiency**	26 %	
Lost nitrogen to water	41 kg/ha		**Phosphorus losses**	0.7 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$710,249		**Gross Farm Income**	$758,229	
Farm working expenses	$522,321		**Operational profit**	$235,908	
Farm working expenses	$4.78/kgMS		**Profit per eff. hectare**	$1,934	
Capital adjustment	0		**Capital adjusted profit**	$235,908	

Table 8. Summary for Farm #1 of changes between years in One Plan Table 14.5

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	116				
Total Cows	340	230	180	150	150
Stocking Rate (cows/ha)	2.9	2.0	1.6	1.3	1.3
Stocking Rate (SU/ha)	24.3	14.6	14.4	12.7	12.0
Farm Labour (FTE)	2.5	2.0	1.5	1.5	1.5
Nitrogen Leaching	41	22	19	17	16
Pasture Consumption	12540	8056	6386	5417	5313
Production (kgMS/cow)	321	316	329	349	370
Production (kgMS/ha)	942	626	511	451	478
Total Milksolids (kgMS/yr)	109,269	72,616	59,220	52,350	55,500
Milk as a proportion of farm income (%)	94	87	81	79	79
Gross Farm Income	$758,229	$541,804	$474,070	$431,395	$459,220
Farm Working Expenses	$523,876	$431,746	$376,351	$342,975	$353,342
Operational profit	$234,352	$110,058	$97,719	$88,420	$105,878
Capital Adjustments	-	$20,676	$29,095	$33,796	$31,971
*Surplus / Deficit	$234,352	$130,734	$126,814	$122,216	$137,848
Profit per unit area ($/ha)	$1,934	$902	$765	$724	$868

**No drawings, depreciation, tax or principal payments included*

Table 9. Summary for Farm #1 of changes between years in Table 14.5(R)

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	116				
Total Cows	340	325	270	250	235
Stocking Rate (cows/ha)	2.9	2.8	2.3	2.2	2.0
Stocking Rate (SU/ha)	24.3	22.7	19.7	18.3	18.1
Farm Labour (FTE)	2.5	2.5	2.0	2.0	2.0
Nitrogen Leaching	41	32	28	25	24
Pasture Consumption	12540	11926	10392	9605	9488
Production (kgMS/cow)	321	325	340	360	400
Production (kgMS/ha)	942	911	791	776	810
Total Milksolids (kgMS/yr)	109,269	105,625	91,800	90,000	94,000
Milk as a proportion of farm income (%)	94	94	92	90	91
Gross Farm Income	$758,229	$732,863	$650,010	$648,220	$671,920
Farm Working Expenses	$523,876	$500,325	$454,341	$455,754	$447,684
Operational profit	$234,352	$232,537	$195,669	$192,466	$224,236
Capital Adjustments	-	$2,413	$11,401	$13,701	$13,821
*Surplus / Deficit	$234,352	$234,950	$206,167	$206,167	$238,057
Profit per unit area ($/ha)	$1,921	$1,906	$1,604	$1,578	$1,838

**No drawings, depreciation, tax or principal payments included*

Table 10. Farm #1 year 20 farming system results for One Plan table 14.2

INFRASTRUCTURE					
Farm Area	122 ha	**Milking platform**	116 ha	**Runoff area**	0 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		27 ha
Rainfall	1351mm/yr	**Irrigation system**	N/A		
Soils	70ha	Dannevirke s.l.	Capital fert 31.51.9		
	46ha	Matamau s.l.	28.46.19		
HERD					
160 cows	30 replacements (grazed off for 18 months from 3 months of age)		**Cow wintering**	All the herd grazed off-farm for 3 months	
Calving date	16th August		**Drying off date**	30th April	
64,000 kgMS	478 kgMS/ha MP		370 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			6,128 kgDM/ha/yr		
Imported feed			N/A	11 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	152 kg/ha		**Fertiliser nitrogen** – Nov	18 kg/ha	
Other nitrogen	2 kg/ha		**Available nitrogen**	172 kg/ha	
Surplus nitrogen	44 kg/ha		**Nitrogen conversion efficiency**	74 %	
Lost nitrogen to water	16 kg/ha		**Phosphorus losses**	0.5 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$360,750		**Gross Farm Income**	$459,220	
Farm working expenses	$353,342		**Operational profit**	$105,878	
Farm working expenses	$5.52/kgMS		**Profit per total hectare**	$868/ha	
Capital adjustment	$31,971		**Capital adjusted profit**	$137,848	

Figure 11. Farm #1 year 20 farming system results for table 14.2(R)

INFRASTRUCTURE					
Farm Area	122 ha	**Milking platform**	116 ha	**Runoff area**	0 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		18 ha
Rainfall	1351mm/yr	**Irrigation system**	N/A		
Soils	70ha	Dannevirke s.l.	Capital fert 31-51-09		
	46ha	Matamau s.l.	28-46-19		
HERD					
340 cows	68 replacements (grazed off for 17 months from 3 months of age)		**Cow wintering**	Half the herd grazed off-farm for 3 months	
Calving date	1st August		**Drying off date**	10th May	
109,269 kgMS	718 kgMS/ha MP		319 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			7,710 kgDM/ha/yr		
Imported feed			104 T DM – 50:50 PKE and silage	15 %	
Winter forage crop			N/A		
Summer forage crop			6 ha	Turnips	9 T/ha yield
NUTRIENTS					
Clover nitrogen	148 kg/ha		**Fertiliser nitrogen** – Aug, Nov, Apr.	68 kg/ha	
Other nitrogen	21 kg/ha		**Available nitrogen**	237 kg/ha	
Surplus nitrogen	177 kg/ha		**Nitrogen conversion efficiency**	26 %	
Lost nitrogen to water	41 kg/ha		**Phosphorus losses**	0.7 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$611,000		**Gross Farm Income**	$671,920	
Farm working expenses	$447,684		**Operational profit**	$224,236	
Farm working expenses	$4.10/kgMS		**Profit per total hectare**	$1,838	
Capital adjustment	$13,821		**Capital adjusted profit**	$238,057	

8. Results for Cluster Farm #2

The assumptions made to establish Cluster Farm #2 are shown in Table 12. All the results shown in the Table were drawn from the specific Overseer file before any potential changes had been made. The Table describes the structure of the farm, the parameters of the dairy herd, and how the dairy herd was being fed. On the basis of these inputs the next parts of Table 12 describe the nutrient losses to the environment and the financial results for a farm owner.

The next tables in this report describe the results for Farm #2 of making management changes to meet the nitrogen caps in Table 14.2 of the One Plan (2014) and in the revised Table 14.2(R). This farmer replaced imported feed with silage made on the "home farm" and removed the summer forage crop. Cow numbers were reduced and more cows were grazed off-farm. Lactation length was reduced by five days.

Table 13 and Table 14 are summaries of the farming system results. The changes in these Tables are sufficient for the farmers involved to apply to Horizons Regional Council for a controlled consent (as long as they were also meeting all the other requirements in the One Plan (2014)).

Table 15 and Table 16 are the farming system results projected for year 20 applying the One Plan (2014) Table 14.2 and Table 14.2(R) respectively.

For Farm #2 to farm within the nitrogen cap of the original One Plan (2014) Table 14.2 would result in:

- Having an operational profitability of over $1,200/ha
- At typical industry debt levels this would enable the farm to meet its debt requirements (about $1,100/ha)
- The farm can stay within the nitrogen caps but it has insufficient soil reserves to do so sustainably beyond the short term

For Farm #2 operating within the proposed Table 14.2(R):

- It would be able to make operational profits of $2,000/ha or more
- This would enable most farmers like this farm to service their current debt
- From year twenty, in order to stay within the nitrogen cap, some pasture would need to be harvested and sold off-farm

Figure 12. Farm #2 initial year farming system results

INFRASTRUCTURE					
Farm Area	158 ha	**Milking platform**	112 ha	**Runoff area**	35 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		19 ha
Rainfall	1227 mm/yr	**Irrigation system**	N/A		
Soils	67 ha	Manawatu s.l.	Capital fert 30-51-21		
	45ha	Kopua s.l.	29-53-10		
	40	Kumera	29-0-15		
HERD					
336 cows	67 replacements (grazed on runoff from 3 months of age)		**Cow wintering**	40% of the herd grazed off-farm for 2 months	
Calving date	16th August		**Drying off date**	20th May	
123,984 kgMS	1107 kgMS/ha MP		369 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			11,866 kgDM/ha/yr		
Imported feed			88 T DM – 50:50 PKE and silage	11 %	
Winter forage crop			N/A		
Summer forage crop			7 ha	Turnips	9 T/ha yield
NUTRIENTS					
Clover nitrogen	144 kg/ha		**Fertiliser nitrogen** – Aug, Nov, Apr.	70 kg/ha	
Other nitrogen	16 kg/ha		**Available nitrogen**	230 kg/ha	
Surplus nitrogen	164 kg/ha		**Nitrogen conversion efficiency**	28 %	
Lost nitrogen to water	40 kg/ha		**Phosphorus losses**	1.6 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$805,896		**Gross Farm Income**	$853,136	
Farm working expenses	$477,764		**Operational profit**	$375,372	
Farm working expenses	$3.85/kgMS		**Profit per eff. hectare**	$2,376	
Capital adjustment	0		**Capital adjusted profit**	$375,372	

Table 13. Summary for Farm #2 of changes between years in One Plan Table 14.5

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	112				
Total Cows	336	230	210	170	150
Stocking Rate (cows/ha)	3.0	2.1	1.9	1.5	1.3
Stocking Rate (SU/ha)	22.7	15.9	14.4	11.8	10.9
Farm Labour (FTE)	2.5	2.0	2.0	1.5	1.5
Nitrogen Leaching	42	24	22	19	18
Pasture Consumption	11,866	8,872	8,017	6,597	6,067
Production (kgMS/cow)	369	390	380	390	425
Production (kgMS/ha)	1107	801	713	592	569
Total Milksolids (kgMS/yr)	123,984	89,700	79,800	66,300	63,750
Milk as a proportion of farm income (%)	94	94	82	79	79
Gross Farm Income	$853,136	$680,750	$634,040	$543,450	$523,795
Farm Working Expenses	$476,014	$399,335	$389,911	$320,232	$312,253
Operational profit	$377,122	$281,415	$244,129	$223,218	$211,542
Capital Adjustments	-	$16,726	$21,456	$31,913	$34,438
*Surplus / Deficit	$375,372	$298,141	$244,129	$223,218	$211,542
Profit per unit area ($/ha)	$2,387	$1,839	$1,596	$1,459	$1,383

**No drawings, depreciation, tax or principal payments included*

Table 14. Summary for Farm #2 of changes between years in Table 14.5(R)

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	112				
Total Cows	336	336	326	310	260
Stocking Rate (cows/ha)	3.0	3.0	2.9	2.8	2.3
Stocking Rate (SU/ha)	22.7	23.7	23.2	21.2	19.3
Farm Labour (FTE)	2.5	2.5	2.5	2.5	2.0
Nitrogen Leaching	42	37	34	30	28
Pasture Consumption	11,866	12,078	11,343	10,999	10,168
Production (kgMS/cow)	369	357	366	362	425
Production (kgMS/ha)	1107	1071	1066	1002	987
Total Milksolids (kgMS/yr)	123,984	119,949	119,349	112,240	110,500
Milk as a proportion of farm income (%)	94	94	94	94	93
Gross Farm Income	$853,136	$826,909	$822,109	$773,560	$771,950
Farm Working Expenses	$476,014	$499,045	$488,559	$430,573	$396,144
Operational profit	$377,122	$327,864	$333,550	$342,987	$375,806
Capital Adjustments	-	-$1,677	-$617	-$600	$7,846
*Surplus / Deficit	$377,122	$326,187	$332,933	$342,387	$383,652
Profit per unit area ($/ha)	$2,387	$2,075	$2,111	$2,171	$2,379

**No drawings, depreciation, tax or principal payments included*

Table 15. Farm #2 year 20 farming system results for One Plan table 14.2

INFRASTRUCTURE					
Farm Area	158 ha	**Milking platform**	112 ha	**Runoff area**	35 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		30 ha
Rainfall	1227 mm/yr	**Irrigation system**	N/A		
Soils	67 ha	Manawatu s.l.	Capital fert 36-106-24		
	45ha	Kopua s.l.	35-120-14		
	40	Kumera	36-56-19		
HERD					
150 cows	30 replacements (grazed on runoff from 3 months of age)		**Cow wintering**	94 cows grazed off-farm for 3 months	
Calving date	16th August		**Drying off date**	15th May	
63,750 kgMS	569 kgMS/ha MP		425 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			6,067 kgDM/ha/yr		
Imported feed			N/A	8 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	154 kg/ha		**Fertiliser nitrogen** – Nov	0 kg/ha	
Other nitrogen	2 kg/ha		**Available nitrogen**	156 kg/ha	
Surplus nitrogen	23 kg/ha		**Nitrogen conversion efficiency**	86 %	
Lost nitrogen to water	18 kg/ha		**Phosphorus losses**	1.3 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$414,375		**Gross Farm Income**	$523,795	
Farm working expenses	$312,253		**Operational profit**	$211,542	
Farm working expenses	$4.90/kgMS		**Profit per eff. hectare**	$1,339/ha	
Capital adjustment	$34,438		**Capital adjusted profit**	$245,980	

Table 16. Farm #2 year 20 farming system results for table 14.2(R)

INFRASTRUCTURE					
Farm Area	158 ha	**Milking platform**	112 ha	**Runoff area**	35 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		30 ha
Rainfall	1227 mm/yr	**Irrigation system**	N/A		
Soils	67 ha	Manawatu s.l.	Capital fert 33-56-22		
	45ha	Kopua s.l.	32-73-12		
	40	Kumera	34-4-18		
HERD					
260 cows	52 replacements (grazed on runoff from 3 months of age)		**Cow wintering**	153 cows grazed off-farm for 2 months	
Calving date	16th August		**Drying off date**	15th May	
110,500 kgMS	987 kgMS/ha MP		425 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			10,168 kgDM/ha/yr		
Imported feed			N/A	5 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	162 kg/ha		**Fertiliser nitrogen** – Nov.		19 kg/ha
Other nitrogen	2 kg/ha		**Available nitrogen**		183 kg/ha
Surplus nitrogen	105 kg/ha		**Nitrogen conversion efficiency**		42 %
Lost nitrogen to water	28 kg/ha		**Phosphorus losses**		1.5 kg/ha
OPERATIONAL PROFIT					
Milk income (includes dividends)	$718,250		**Gross Farm Income**		$771,950
Farm working expenses	$396,144		**Operational profit**		$375,806
Farm working expenses	$3.59/kgMS		**Profit per eff. hectare**		$2,379
Capital adjustment	$7,846		**Capital adjusted profit**		$383,652

9. Results for Cluster Farm #3

The assumptions made to establish Cluster Farm #3 are shown in Table 17. All the results shown in the Table were drawn from the specific Overseer file before any potential changes had been made. The Table describes the structure of the farm, the parameters of the dairy herd, and how the dairy herd was being fed. On the basis of these inputs the next parts of Table 17 describe the nutrient losses to the environment and the financial results for a farm owner.

The next tables in this report describe the results for Farm #3 of making management changes to meet the nitrogen caps in Table 14.2 of the One Plan (2014) and in the revised Table 14.2(R). Farm #3 had the lowest initial level of nitrogen leaching of all the farms. To meet the original table Farm #3 had to remove its crop and reduce cow numbers by over 30%. To meet the revised table Farm #3 needed to maintain existing nitrogen losses. In the expectation that milk production would still increase Farm #3 reduced cow numbers by 8% and increased the proportion of imported feed used. The lactation had to be shortened by 10 days.

Table 18 and Table 19 are summaries of the farming system results. The changes in these Tables are sufficient for the farmers involved to apply to Horizons Regional Council for a controlled consent (as long as they were also meeting all the other requirements in the One Plan (2014)).

Table 20 and Table 21 are the farming system results projected for year 20 applying the One Plan (2014) Table 14.2 and Table 14.2(R) respectively.

For Farm #3 to farm within the nitrogen cap of the original One Plan (2014) Table 14.2 it would:

- Have an operational profitability of generally over $1,000/ha (Year 5 an exception)
- At typical industry debt levels this would enable the farm to meet its debt requirements of about $900/ha
- The farm can stay within the nitrogen caps, but beyond Year 10 its soil nitrogen reserves become very low

For Farm #3 to operate within the proposed Table 14.2(R):

- It would make operational profits of more than $1,200/ha
- This would enable most farmers to service their current debt
- It could meet the nitrogen caps sustainably over the long term

Table 17. Farm #3 initial year farming system results

INFRASTRUCTURE					
Farm Area	144 ha	**Milking platform**	99 ha	**Runoff area**	40 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		14 ha
Rainfall	1257 mm/yr	**Irrigation system**	N/A		
Soils	59 ha	Kairanga s.l.	Capital fert 24-1-15		
	40 ha	Dannevirke s.l.	30-25-6		
	40 ha	Kumeroa s.l.	32-0-16		
HERD					
256 cows	51 replacements (grazed on runoff from 3 months of age)		**Cow wintering**	69cows grazed off-farm for 2 months	
Calving date	16th August		**Drying off date**	20th May	
87,145 kgMS	880 kgMS/ha MP		340 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			9,158 kgDM/ha/yr		
Imported feed			110 T DM – 50:50 PKE and silage	9 %	
Winter forage crop			N/A		
Summer forage crop			3.5 ha	Turnips	9 T/ha yield
NUTRIENTS					
Clover nitrogen	105 kg/ha		**Fertiliser nitrogen** – Aug, Nov, Apr.	70 kg/ha	
Other nitrogen	19 kg/ha		**Available nitrogen**	194 kg/ha	
Surplus nitrogen	142 kg/ha		**Nitrogen conversion efficiency**	26 %	
Lost nitrogen to water	28 kg/ha		**Phosphorus losses**	1.5 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$566,443		**Gross Farm Income**	$602,603	
Farm working expenses	$416,454		**Operational profit**	$186,149	
Farm working expenses	$4.78/kgMS		**Profit per eff. hectare**	$1,293	
Capital adjustment	$0		**Capital adjusted profit**	$186,149	

Table 18. Summary for Farm #3 of changes between years in One Plan Table 14.5

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	99				
Total Cows	256	256	256	240	175
Stocking Rate (cows/ha)	2.6	2.6	2.6	2.4	1.8
Stocking Rate (SU/ha)	18.5	17.5	17.4	15.9	13.6
Farm Labour (FTE)	2.0	2.0	2.0	2.0	1.5
Nitrogen Leaching	28	24	22	19	17
Pasture Consumption	9158	8815	8582	8310	6969
Production (kgMS/cow)	340	331	323	323	425
Production (kgMS/ha)	880	855	834	782	752
Total Milksolids (kgMS/yr)	87,145	84,630	82,579	77,418	74,400
Milk as a proportion of farm income (%)	94%	94%	94%	94%	89%
Gross Farm Income	$ 602,603	$ 586,255	$ 572,924	$ 537,037	$ 546,180
Farm Working Expenses	$ 416,454	$ 424,637	$ 427,288	$ 400,239	$ 336,504
Operational profit	$ 186,149	$ 161,618	$ 145,636	$ 136,798	$ 209,676
Capital Adjustments	-	$ 1,083	$ 468	$ 2,488	$ 9,114
*Surplus / Deficit	$ 186,149	$ 160,535	$ 145,168	$ 139,286	$ 218,790
Profit per unit area ($/ha)	$ 1,293	$ 1,122	$ 1,011	$ 950	$ 1,456

**No drawings, depreciation, tax or principal payments included*

Table 19. Summary for Farm #3 of changes between years in Table 14.5(R)

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	99				
Total Cows	256	253	243	235	235
Stocking Rate (cows/ha)	2.6	2.6	2.5	2.4	2.4
Stocking Rate (SU/ha)	18.5	18.5	18.4	18.4	18.8
Farm Labour (FTE)	2.0	2.0	2.0	2.0	2.0
Nitrogen Leaching	28	28	28	28	28
Pasture Consumption	9,158	9,162	9,134	9,099	9,098
Production (kgMS/cow)	340	349	374	396	425
Production (kgMS/ha)	880	891	919	939	1,008
Total Milksolids (kgMS/yr)	87,145	88,250	91,000	93,000	99,800
Milk as a proportion of farm income (%)	94	94	95	95	95
Gross Farm Income	$ 602,603	$609,705	626,060$	$637,580	$681,780
Farm Working Expenses	$ 416,454	$415,896	$414,398	$410,092	$431,636
Operational profit	$ 186,149	$193,809	$211,662	$227,488	$250,144
Capital Adjustments	-	$782	$1,116	-$1,312	-$4,372
*Surplus / Deficit	$ 186,149	$193,027	$210,546	$226,177	$245,773
Profit per unit area ($/ha)	$ 1,293	$1,346	$1,470	$1,580	$1,737

**No drawings, depreciation, tax or principal payments included*

Table 20. Farm #3 year 20 farming system results for One Plan table 14.2

INFRASTRUCTURE					
Farm Area	144 ha	**Milking platform**	99 ha	**Runoff area**	40 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		21 ha
Rainfall	1257 mm/yr	**Irrigation system**	N/A		
Soils	59 ha	Kairanga s.l.	Capital fert 32-56-20		
	40 ha	Dannevirke s.l.	38-75-11		
	40 ha	Kumeroa s.l.	32-10-16		
HERD					
175 cows	35 replacements (grazed on runoff from 3 months of age)		**Cow wintering**	Half the herd grazed off-farm for 3 months	
Calving date	16th August		**Drying off date**	20th May	
74,400 kgMS	752 kgMS/ha MP		425 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			7,033 kgDM/ha/yr		
Imported feed			N/A	7 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	142 kg/ha		**Fertiliser nitrogen** – Nov	0 kg/ha	
Other nitrogen	2 kg/ha		**Available nitrogen**	144 kg/ha	
Surplus nitrogen	57 kg/ha		**Nitrogen conversion efficiency**	60 %	
Lost nitrogen to water	18 kg/ha		**Phosphorus losses**	1.4 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$483,600		**Gross Farm Income**	$546,180	
Farm working expenses	$336,504		**Operational profit**	$209,676	
Farm working expenses	$4.52/kgMS		**Profit per eff. hectare**	$1,456/ha	
Capital adjustment	$9,114		**Capital adjusted profit**	$218,790	

Figure 21. Farm #3 year 20 farming system results for table 14.2(R)

INFRASTRUCTURE					
Farm Area	144 ha	**Milking platform**	99 ha	**Runoff area**	40 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		16 ha
Rainfall	1257 mm/yr	**Irrigation system**	N/A		
Soils	59 ha	Kairanga s.l.	Capital fert 24-0-14		
	40 ha	Dannevirke s.l.	30-16-5		
	40 ha	Kumeroa s.l.	33-0-16		
HERD					
235 cows	45 replacements (grazed on runoff from 3 months of age)		**Cow wintering**	52 cows grazed off-farm for 2 months	
Calving date	16th August		**Drying off date**	10th May	
99,800 kgMS	1008 kgMS/ha MP		425 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			9,098 kgDM/ha/yr		
Imported feed			145 T DM – 40:60 PKE and silage	15 %	
Winter forage crop			N/A		
Summer forage crop			3.5 ha	Turnips	9 T/ha yield
NUTRIENTS					
Clover nitrogen	106 kg/ha		**Fertiliser nitrogen** – Aug, Nov, Apr.	70 kg/ha	
Other nitrogen	24 kg/ha		**Available nitrogen**	200 kg/ha	
Surplus nitrogen	144 kg/ha		**Nitrogen conversion efficiency**	28 %	
Lost nitrogen to water	28 kg/ha		**Phosphorus losses**	1.5 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$648,700		**Gross Farm Income**	$681,780	
Farm working expenses	$431,636		**Operational profit**	$250,144	
Farm working expenses	$4.33/kgMS		**Profit per eff. hectare**	$1,737	
Capital adjustment	$4,372		**Capital adjusted profit**	$245,773	

10. Results for Cluster Farm #4

The assumptions made to establish Cluster Farm #4 are shown in Table 22. All the results shown in the Table were drawn from the specific Overseer file before any potential changes had been made. The Table describes the structure of the farm, the parameters of the dairy herd, and how the dairy herd was being fed. On the basis of these inputs the next parts of Table 22 describe the nutrient losses to the environment and the financial results for a farm owner.

The next tables in this report describe the results for Farm #4 of making management changes to meet the nitrogen caps in Table 14.2 of the One Plan (2014) and in the revised Table 14.2(R).

In the initial year this farm grazed its young stock and non-lactating cows on the runoff. In order to meet the original Table 14.2 in the One Plan (2014) they would need to be grazed off farm during winter and out of the catchment. With the revised table this would only be required after the fifth year. Many farms in the catchment similar to this farm are likely to have covered feed pads available. In those circumstances grazing off the farm would not be required as part of meeting the conditions in Table 14.2(R). In both situations this farm is expected to remove the winter crop. Table 23 and Table 25 are summaries of the farming system results. The changes in these Tables are sufficient for the farmers involved to apply to Horizons Regional Council for a controlled consent (as long as they were also meeting all the other requirements in the One Plan (2014)).

Table 25 and Table 26 are the farming system results projected for year 20 applying the One Plan (2014) Table 14.2 and Table 14.2(R) respectively.

The consequences of the farming system in Farm #4 being modified to achieve the nitrogen caps in the original Table 14.2 are:

- Operating profit each year is expected to be above $1,500/ha
- At typical debt levels in the industry (about $1,300/ha) the farm can remain financially viable
- The farm can achieve the nitrogen cap in the original Table 14.2 and do so sustainably

If Farm #4 complies with the nitrogen cap in Table 14.2(R) there are expected to be the following consequences:

- Operating profits are expected to be greater than $1,500/ha
- Typical debt levels can be serviced
- The farm can sustainably achieve the nitrogen cap

Table 22. Farm #4 initial year farming system results

INFRASTRUCTURE					
Farm Area	172 ha	**Milking platform**	131 ha	**Runoff area**	35 ha
Feedpad	-	**Effluent system and area**	Sump, to pond and travelling irrigator		18 ha
Rainfall	1190mm/yr	**Irrigation system**	Pivot irrigation-Dec to Feb		65.5ha
Soils	52ha	Kairanga s.l.	Capital fert 24-0-8		
	114ha	Kopua s.l.	23-16-0		
HERD					
385 cows	77 replacements (grazed on runoff from 3 months of age)		**Cow wintering**	100 cows grazed on runoff for 2 months	
Calving date	10th August		**Drying off date**	20th May	
149,000 kgMS	1137 kgMS/ha MP		387 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			11,794 kgDM/ha/yr		
Imported feed			474 T DM – 33:33:33 PKE, maize and pasture silage	19 %	
Winter forage crop on ronoff			8.8 ha	Kale	10 T/ha yield
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	117 kg/ha		**Fertiliser nitrogen** – Aug, Nov, Apr.	105 kg/ha	
Other nitrogen	55 kg/ha		**Available nitrogen**	277 kg/ha	
Surplus nitrogen	206 kg/ha		**Nitrogen conversion efficiency**	26 %	
Lost nitrogen to water	46 kg/ha		**Phosphorus losses**	0.9 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$968,500		**Gross Farm Income**	$1,022,800	
Farm working expenses	$608,739		**Operational profit**	$414,061	
Farm working expenses	$4.09/kgMS		**Profit per eff. hectare**	$3,161	
Capital adjustment	0		**Capital adjusted profit**	$414,061	

Table 23. Summary for Farm #4 of changes between years in One Plan Table 14.5

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	131				
Total Cows	385	380	350	320	300
Stocking Rate (cows/ha)	2.9	2.9	2.7	2.4	2.3
Stocking Rate (SU/ha)	25.3	20.9	19.8	18.5	17.4
Farm Labour (FTE)	2.5	2.5	2.5	2.5	2.5
Nitrogen Leaching	46	24	21	19	18
Pasture Consumption	11794	9349	8772	8030	7445
Production (kgMS/cow)	387	381	404	425	425
Production (kgMS/ha)	1137	1105	1079	1038	973
Total Milksolids (kgMS/yr)	149,000	144,715	141,300	136,000	127,500
Milk as a proportion of farm income (%)	95	95	95	95	95
Gross Farm Income	$1,022,800	$994,168	$ 967,990	$ 929,520	$871,190
Farm Working Expenses	$608,739	$620,084	$631,711	$621,593	$610,907
Operational profit	$414,061	$ 374,084	$ 336,279	$ 307,927	$ 260,283
Capital Adjustments	-	$ 1,574	$ 5,198	$ 9,428	$ 13,738
*Surplus / Deficit	$414,061	$ 375,657	$ 341,477	$ 317,356	$ 274,021
Profit per unit area ($/ha)	$2,407	$2,175	$1,955	$1,790	$1,513

**No drawings, depreciation, tax or principal payments included*

Table 24. Summary for Farm #4 of changes between years in Table 14.5(R)

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	131				
Total Cows	385	380	380	370	355
Stocking Rate (cows/ha)	2.9	2.9	2.9	2.8	2.7
Stocking Rate (SU/ha)	25.3	22.6	21.7	20.7	20.0
Farm Labour (FTE)	2.5	2.5	2.5	2.5	2.5
Nitrogen Leaching	46	30	27	24	22
Pasture Consumption	11794	10209	9764	9207	8565
Production (kgMS/cow)	387	390	390	390	399
Production (kgMS/ha)	1137	1131	1131	9207	1081
Total Milksolids (kgMS/yr)	149,000	148,222	148,222	148,115	141,553
Milk as a proportion of farm income (%)	95	95	95	95	95
Gross Farm Income	$1,022,800	$1,013,928	$1,016,963	$1,015,368	$970,375
Farm Working Expenses	$608,739	$632,607	$654,773	$647,681	$674,383
Operational profit	$414,061	$381,320	$362,190	$367,686	$295,992
Capital Adjustments	-	$662	$482	$1,394	$4,682
*Surplus / Deficit	$414,061	$381,942	$362,672	$369,080	$300,674
Profit per unit area ($/ha)	$2,407	$2,221	$2,109	$2,146	$1,748

**No drawings, depreciation, tax or principal payments included*

Table 25. Farm #4 year 20 farming system results for One Plan table 14.2

INFRASTRUCTURE					
Farm Area	172 ha	**Milking platform**	131 ha	**Runoff area**	35 ha
Feedpad	-	**Effluent system and area**	Sump, to pond and travelling irrigator		31 ha
Rainfall	1190 mm/yr	**Irrigation system**	Pivot irrigation-Dec to Feb		65.5ha
Soils	52ha	Kairanga s.l.	Capital fert 32-42-14		
	114ha	Kopua s.l.	31-62-5		
HERD					
300 cows	60 replacements (grazed off for 12 months from 9 months of age)		**Cow wintering**	Half the herd grazed off-farm for 3 months	
Calving date	16th August		**Drying off date**	30th April	
127,500 kgMS	973 kgMS/ha MP		425 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			7,445 kgDM/ha/yr		
Imported feed			20 T DM	9.5 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	127 kg/ha		**Fertiliser nitrogen** – Nov		28 kg/ha
Other nitrogen	5 kg/ha		**Available nitrogen**		160 kg/ha
Surplus nitrogen	110 kg/ha		**Nitrogen conversion efficiency**		32 %
Lost nitrogen to water	18 kg/ha		**Phosphorus losses**		0.8 kg/ha
OPERATIONAL PROFIT					
Milk income (includes dividends)	$828,750		**Gross Farm Income**		$871,190
Farm working expenses	$610,907		**Operational profit**		$260,283
Farm working expenses	$4.79/kgMS		**Profit per eff. hectare**		$1513/ha
Capital adjustment	$13,738		**Capital adjusted profit**		$274,021

Table 26. Farm #4 year 20 farming system results for table 14.2(R)

INFRASTRUCTURE					
Farm Area	172 ha	**Milking platform**	131 ha	**Runoff area**	35 ha
Feedpad	-	**Effluent system and area**	Sump, to pond and travelling irrigator		18 ha
Rainfall	11m 90m/yr	**Irrigation system**	Pivot irrigation-Dec to Feb		65.5ha
Soils	52ha	Kairanga s.l.	Capital fert 32-42-14		
	114ha	Kopua s.l.	31-62-5		
HERD					
355 cows	71 replacements (grazed off for 12 months from 9 months of age)		**Cow wintering**	Half the herd grazed off-farm for 3 months	
Calving date	16th August		**Drying off date**	30th April	
141553 kgMS	1081 kgMS/ha MP		399 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			8,565 kgDM/ha/yr		
Imported feed			327 T DM – 50:50 PKE and maize silage	19 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	119 kg/ha		**Fertiliser nitrogen** – Oct.	28 kg/ha	
Other nitrogen	36 kg/ha		**Available nitrogen**	183 kg/ha	
Surplus nitrogen	126 kg/ha		**Nitrogen conversion efficiency**	31 %	
Lost nitrogen to water	22 kg/ha		**Phosphorus losses**	0.8 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$920,095		**Gross Farm Income**	$970,375	
Farm working expenses	$674,383		**Operational profit**	$295,992	
Farm working expenses	$5.06/kgMS		**Profit per eff. hectare**	$1,480	
Capital adjustment	$4,682		**Capital adjusted profit**	$300,674	

11. Results for Cluster Farm #5

The assumptions made to establish Cluster Farm #5 are shown in Table 27. All the results shown in the Table were drawn from the specific Overseer file before any potential changes had been made. The Table describes the structure of the farm, the parameters of the dairy herd, and how the dairy herd was being fed. On the basis of these inputs the next parts of Table 27 describe the nutrient losses to the environment and the financial results for a farm owner.

The next tables in this report describe the results for Farm #5 of making management changes to meet the nitrogen caps in Table 14.2 of the One Plan (2014) and in the revised Table 14.2(R).

Cow numbers would be reduced and the cows would need to continue to be grazed off farm. The lactation length would need to be reduced by 10 days to the end of April. Both farm scenarios include removing the summer crop of turnips, for the original table, there would be no imported feed used. For meeting Table 14.2(R) in Year 20, it would be replaced by imported feed.

Table 28 and Table 29 are summaries of the farming system results. The changes in these Tables are sufficient for the farmers involved to apply to Horizons Regional Council for a controlled consent (as long as they were also meeting all the other requirements in the One Plan (2014)).

Table 30 and Table 31 are the farming system results projected for year 20 applying the One Plan (2014) Table 14.2 and Table 14.2(R) respectively.

For Farm #5 complying with the original Table 14.2 in the One Plan (2014) would result in:

- The farm only just clearing its operational expenses with an annual profit of less than $500/ha. Income from an alternative land use (or other source of income) is necessary for this farm to remain profitable
- Typical debt payment levels in the industry would be more than $1,000/ha for this farm. Farm #5 would not be able to meet the nitrogen caps in the original table and remain financially viable
- Whilst the calculations in Overseer® indicate that this farm system could be modified to operate within the nitrogen loss required in the table, it is only possible by running les than 1cow/ha and harvesting about half the pasture for off-farm sale

For Farm #5 to comply with the proposed Table 14.2(R) the result would be:

- The farm making an operational profit of over $1,000/ha or more
- The farm having just enough operational income to cover typical debt levels in the industry and remain financially viable
- The farm would be able to sustainably achieve the nitrogen reductions that are required to operate within its nitrogen cap

Figure 27. Farm #5 initial year farming system results

INFRASTRUCTURE					
Farm Area	114 ha	**Milking platform**	108 ha	**Runoff area**	0 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		18 ha
Rainfall	1351mm/yr	**Irrigation system**	N/A		
Soils	65ha	Matamau s.l.	Capital fert 26-36-18		
	43ha	Dannevirke s.l.	33-42-8		
HERD					
270 cows	54 replacements (grazed off for 18 months from 3 months of age)		**Cow wintering**	81 cows grazed off-farm for 2 months	
Calving date	16th August		**Drying off date**	10th May	
90,720 kgMS	840 kgMS/ha MP		336 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			11007 kgDM/ha/yr		
Imported feed			90 T DM – 50:50 PKE and silage	15 %	
Winter forage crop			N/A		
Summer forage crop			6.8 ha	Turnips	9 T/ha yield
NUTRIENTS					
Clover nitrogen	129 kg/ha		**Fertiliser nitrogen** – Aug, Nov, Apr.	58 kg/ha	
Other nitrogen	20 kg/ha		**Available nitrogen**	207 kg/ha	
Surplus nitrogen	153 kg/ha		**Nitrogen conversion efficiency**	26 %	
Lost nitrogen to water	39 kg/ha		**Phosphorus losses**	0.7 kg/ha	
OPERATIONAL PROFIT					
Milk income (includes dividends)	$589,680		**Gross Farm Income**	$628,140	
Farm working expenses	$453,423		**Operational profit**	$174,717	
Farm working expenses	$5.00/kgMS		**Profit per eff. hectare**	$1,618	
Capital adjustment	0		**Capital adjusted profit**	$174,717	

Table 28. Summary for Farm #5 of changes between years in One Plan Table 14.5

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	108				
Total Cows	270	185	155	120	100
Stocking Rate (cows/ha)	2.5	1.7	1.4	1.1	0.9
Stocking Rate (SU/ha)	21.5	14.9	12.6	10.4	9.4
Farm Labour (FTE)	2.5	2.5	1.5	1.5	1.5
Nitrogen Leaching	39	22	19	17	16
Pasture Consumption	11007	7150	5957	4779	4237
Production (kgMS/cow)	336	340	358	380	425
Production (kgMS/ha)	840	582	514	422	394
Total Milksolids (kgMS/yr)	90,720	62,900	55,490	45,600	42,500
Milk as a proportion of farm income (%)	90	91	87	82	81
Gross Farm Income	$628,140	$447,580	$414,820	$363,440	$340,210
Farm Working Expenses	$453,423	$398,252	$345,388	$324,969	$326,074
Operational profit	$174,717	$49,328	$69,432	$38,471	$14,136
Capital Adjustments	-	$15,642	$20,505	$26,552	$29,242
*Surplus / Deficit	$174,717	$64,971	$89,937	$65,023	$
Profit per unit area ($/ha)	$1,533	$433	$609	$337	$124

**No drawings, depreciation, tax or principal payments included*

Table 29. Summary for Farm #5 of changes between years in Table 14.5(R)

	Initial Farm	**Year 1**	**Year 5**	**Year 10**	**Year 20**
Area of Milking Platform (ha)	108				
Total Cows	270	261	230	230	230
Stocking Rate (cows/ha)	2.5	2.5	2.5	2.5	2.5
Stocking Rate (SU/ha)	21.5	20.4	18.7	18.5	18.5
Farm Labour (FTE)	2.5	2.5	2.5	2.5	2.5
Nitrogen Leaching	39	32	28	25	24
Pasture Consumption	11007	10423	9163	9036	8775
Production (kgMS/cow)	336	335	358	372	372
Production (kgMS/ha)	840	809	762	793	793
Total Milksolids (kgMS/yr)	90,720	87,420	82,340	85,620	85,620
Milk as a proportion of farm income (%)	90	94	94	95	95
Gross Farm Income	$628,140	$605,170	$567,510	$588,830	$588,830
Farm Working Expenses	$453,423	$447,694	$435,777	$443,789	$456,394
Operational profit	$174,717	$157,476	$131,733	$145,041	$132,436
Capital Adjustments	-	$1,606	$5,850	$4,866	$4,866
*Surplus / Deficit	$174,717	$159,082	$137,583	$149,907	$137,302
Profit per unit area ($/ha)	$1,533	$1,367	$1,104	$1,230	$1,119

**No drawings, depreciation, tax or principal payments included*

Figure 30. Farm #5 year 20 farming system results for One Plan table 14.2

INFRASTRUCTURE					
Farm Area	114 ha	**Milking platform**	108 ha	**Runoff area**	0 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		18 ha
Rainfall	1351mm/yr	**Irrigation system**	N/A		
Soils	65ha	Matamau s.l.	Capital fert 31.86.22		
	43ha	Dannevirke s.l.	38.94.12		
HERD					
100 cows	20 replacements (grazed off for 18 months from 3 months of age)		**Cow wintering**	20 cows grazed off-farm for 3 months	
Calving date	16th August		**Drying off date**	30th April	
42,500 kgMS	425 kgMS/ha MP		394 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			4,237 kgDM/ha/yr		
Imported feed			N/A	<1 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	104 kg/ha		**Fertiliser nitrogen** – Oct		23 kg/ha
Other nitrogen	2 kg/ha		**Available nitrogen**		129 kg/ha
Surplus nitrogen	55 kg/ha		**Nitrogen conversion efficiency**		57 %
Lost nitrogen to water	16 kg/ha		**Phosphorus losses**		0.5 kg/ha
OPERATIONAL PROFIT					
Milk income (includes dividends)	$276,250		**Gross Farm Income**		$340,210
Farm working expenses	$326,074		**Operational profit**		$14,136
Farm working expenses	$7.67/kgMS		**Profit per total hectare**		$124/ha
Capital adjustment	$29,242		**Capital adjusted profit**		-$15,106

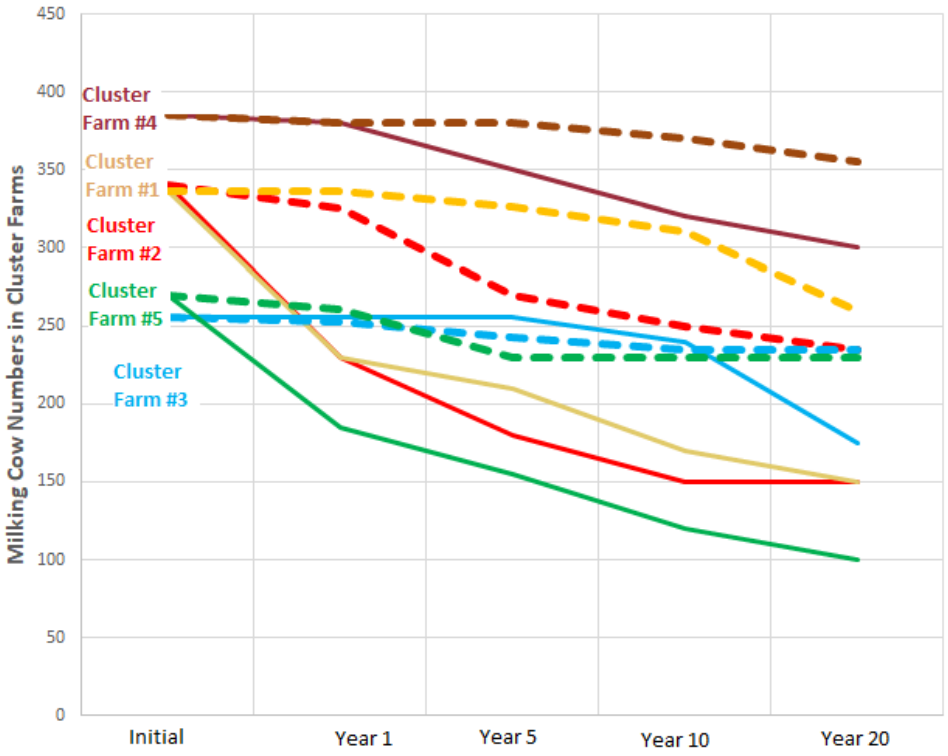
Figure 31. Farm #5 year 20 farming system results for table 14.2(R)

INFRASTRUCTURE					
Farm Area	114 ha	**Milking platform**	108 ha	**Runoff area**	0 ha
Feedpad	N/A	**Effluent system and area**	Sump, to pond and travelling irrigator		22 ha
Rainfall	1351mm/yr	**Irrigation system**	N/A		
Soils	65ha	Matamau s.l.	Capital fert 25-40-17		
	43ha	Dannevirke s.l.	37-74-11		
HERD					
230 cows	46 replacements (grazed off for 17 months from 3 months of age)		**Cow wintering**	124 cows grazed off-farm for 3 months	
Calving date	1st August		**Drying off date**	30th April	
85,620 kgMS	793 kgMS/ha MP		372 kg MS/cow		
PASTURE AND FEED					
Pasture consumed by cows			7,710 kgDM/ha/yr		
Imported feed			75 T DM –PKE	12 %	
Winter forage crop			N/A		
Summer forage crop			N/A		
NUTRIENTS					
Clover nitrogen	128 kg/ha		**Fertiliser nitrogen** – Oct.		23 kg/ha
Other nitrogen	18 kg/ha		**Available nitrogen**		169 kg/ha
Surplus nitrogen	114 kg/ha		**Nitrogen conversion efficiency**		32 %
Lost nitrogen to water	24 kg/ha		**Phosphorus losses**		0.6 kg/ha
OPERATIONAL PROFIT					
Milk income (includes dividends)	$556,530		**Gross Farm Income**		$588,830
Farm working expenses	$456,394		**Operational profit**		$132,436
Farm working expenses	$5.33/kgMS		**Profit per eff. hectare**		$1,162
Capital adjustment	$4,866		**Capital adjusted profit**		$127,570

12. Discussion

The Cluster Farms initially had between 250 and 400 cows in both scenarios (the original Table 14.2 and 14.2 (R)) however it is easier to maintain herd numbers with the proposed revised table. See Figure 1.

Figure 1. Changes in cow numbers over time – a comparison between versions of Table 14.2



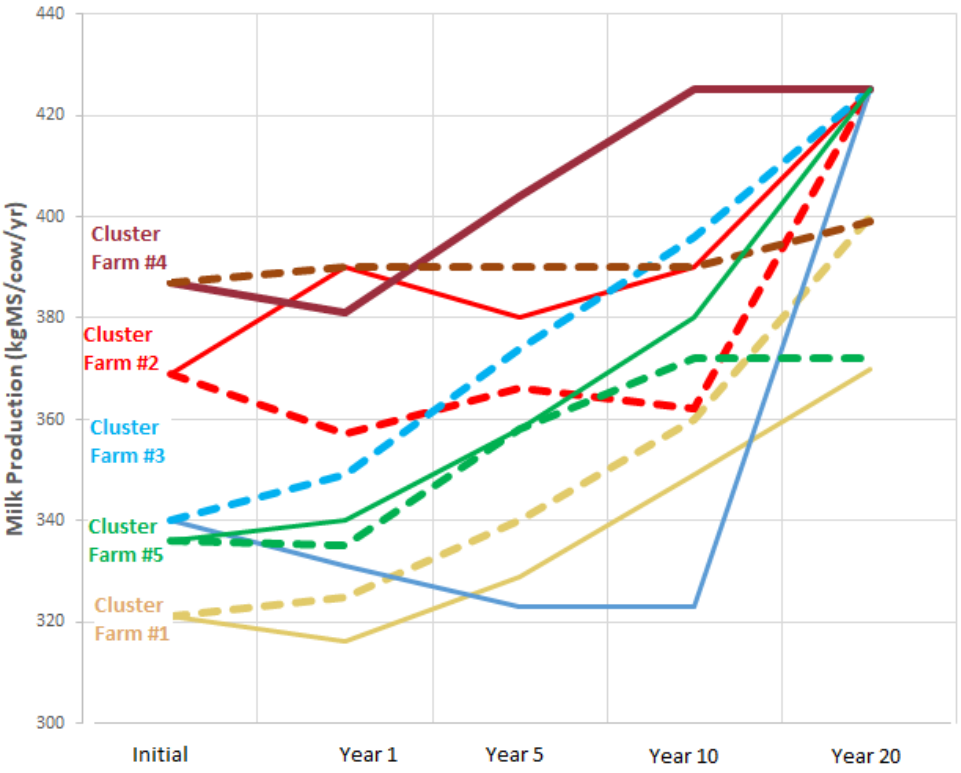
The solid lines represent the results for the original Table 14.2 and the dotted lines represent Table 14.2(R)

As cow numbers are reduced there are greater opportunities to increase production per cow (Figure 2). However as production is increased, nitrogen losses will not be reduced unless stocking rate (su/ha/yr) and annual pasture consumption are also reduced (Figure 3).

The introduction of an appropriate mix of mitigations can ensure that nitrogen losses remain capped (Figure 4). In the Figure all the cluster farms are shown to be reducing nitrogen losses to water over time. The exception is Cluster farm #3. With Table 14.2(R), Cluster farm #3 initially is already operating within its nitrogen cap. However, over time production per cow is expected to increase in-line with the other cluster farms and therefore additional mitigations will need to be introduced to keep it under the cap.

After applying the original Table 14.2 the operational profits are reduced for all the farms, except for Farm #3 that has income from sales of surplus pasture in Year 20 to supplement returns from dairying. Applying Table 14.2(R) improves the profitability of all the farms (Figure 5).

Figure 2. Changes in milk production(per cow) over time – a comparison between versions of Table 14.2



The solid lines represent the results for the original Table 14.2 and the dotted lines represent Table 14.2(R)

Figure 3. Changes in pasture consumption over time – a comparison between versions of Table 14.2

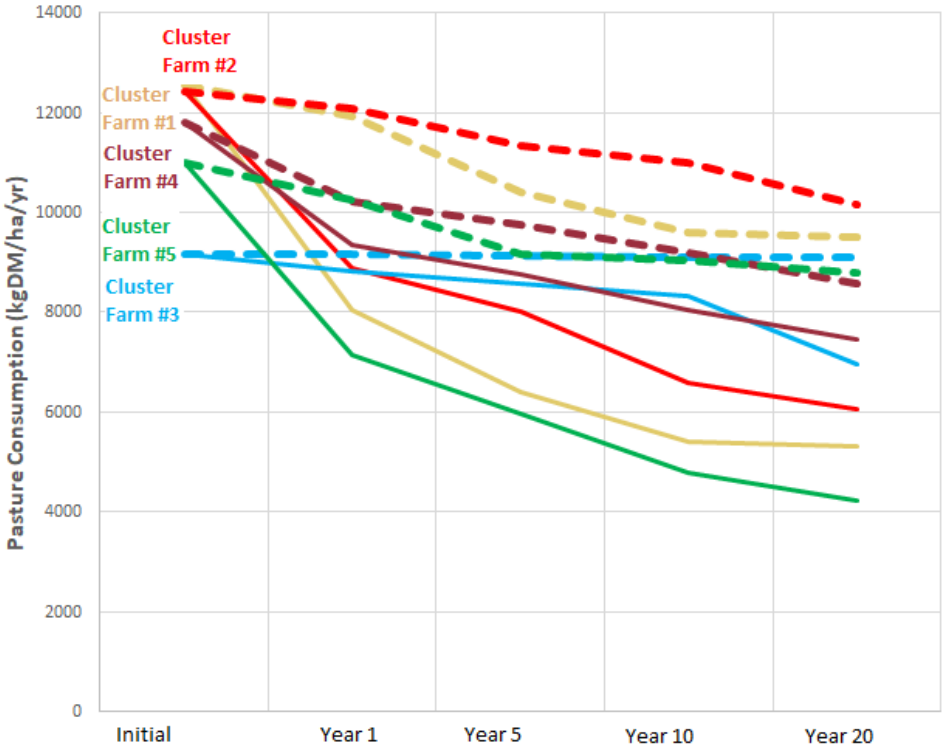
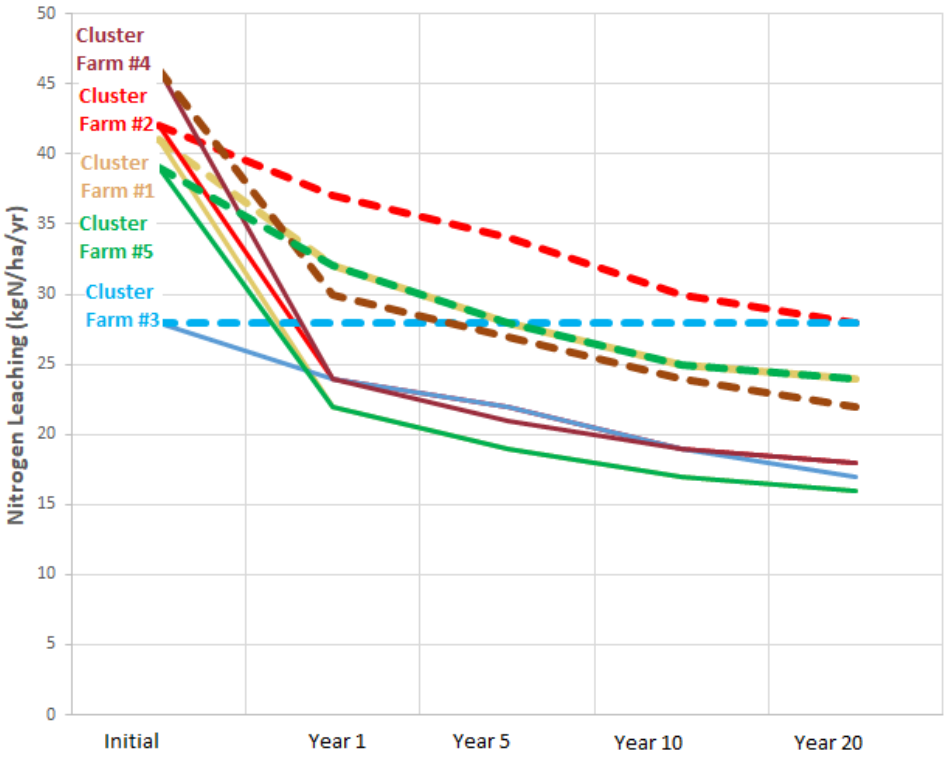
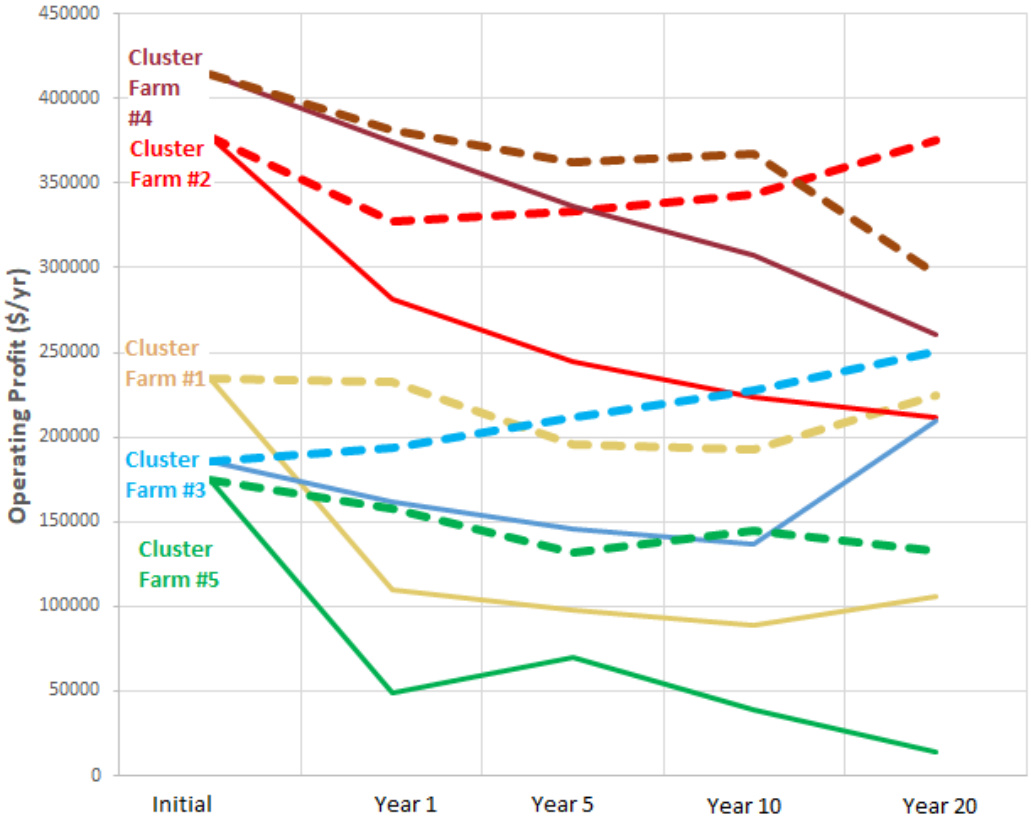


Figure 4. Changes in nitrogen leaching over time – a comparison between versions of Table 14.2



The solid lines represent the results for the original Table 14.2 and the dotted lines represent Table 14.2(R)

Figure 5. Changes in operating profit over time – a comparison between versions of Table 14.2



13. Conclusions

The Cluster Farms represent about 65% of dairy farms in the Upper Manawatu River catchment. These farms are unlikely to be financially viable after management practices have been introduced to enable them to operate within the original nitrogen cap of Table 14.2 in the One Plan (2014). A greater percentage of farms would only be able to operate within the nitrogen cap by depleting their soil nitrogen reserves. That situation would not be sustainable over time.

If the revised Table 14.2(R) is introduced, all Cluster Farms are able to remain financially viable although Farm #5 could not service high levels of debt. All farms are able to maintain sustainable nitrogen reserves under the scenarios developed for Table 14.2(R).

This study highlights the importance of continued improvement in production per cow. There are benefits from also improving nitrogen efficiency on-farm so that low-loss systems become more sustainable. The study reinforces the opportunities for off-farm winter grazing of cows and providing them with sheltered feed pads or barns. The latter topic has been developed already in Parminter (2017).

14. Limitations

The five farm models were drawn directly from the farm medians in Table 3. It was considered by the author that establishing them first as feasible systems in Farmax® (a step included in the first report), would not be needed in this study. The initial models were drawn from actual farm data, however the models were then changed considerably by introducing potential mitigations and these also were not checked in Farmax® for feasibility.

Each of the Cluster Farms was modelled by a different consultant applying similar principles and assumptions. A similar situation operates across the industry in practice. The main limitation for this study from taking this approach is that the timing and order of the introduced mitigations was not exactly comparable for each Cluster Farm. That means that the intermediate steps for the Cluster Farms between Year 1 and Year 20 in the tables may not be directly comparable. This is particularly visible in Figures 1 – 5.

Appendix A. Example Profit and Loss Account for Cluster Farm #5

				$	Per ha	Per cow	
Background							
	Effective Milking (ha)			108			
	Runoff (ha)			-			
	Non-productive (ha)			6			
	Effluent area (ha)			15			
	Peak cows milked			270	2.5		
	R1yr heifers		20% of herd	54	0.5		
	R2yr heifers		20% of herd	54	0.5		
	Milk production (kgMS)			90,720	840	336	
	Staffing		2.5				
	Manager	1.0		85000			
	2IC	0.0					
	Farm assisstant	1.0		48000			
	Relief milker	0.5		5000			
	Capital fertiliser (autumn)	Rate (kgP/ha/yr	Area				
	Super 20%potash	30	86ha	14,889			
	Super phosphate	12	15ha	708			
	Nitrogen fertiliser						
	winter/spring (ammo)	30	108ha	5,292			
	spring/summer (urea)	30	108ha	3,733			
	autumn (urea)	0	0ha				
Heifer Grazing	Number	54	52weeks	25,272			
Calf Grazing	Number	54	21weeks	7,938			
Cow Grazing	Number	81	9weeks	18,225			
Calf rearing	Number	54	60kg/head	3240			
	Supplementary feed						
	baleage	225	round bales	22,500			
	hay	0	round bales				
	maize silage	0	T DM				
	PKE	45	T DM	10,800			
	Conserved feed						
	baleage	200	round bales	7,000			
	hay	0	round bales				
Income							
Milk							
	Milk Income			562,464			
	Dividend Income			27,216			
Stock Sales			number				
	Culls		49	30380			
	Calves		202	8080			
	Bulls		0				
Other Farm Income:							
Total Income				$ 628,140	$ 5,816.11	$ 2,326.44	
Expenses							
Employment	Wages			138,000	1278		
Livestock	Livestock purchases		0	-			
	Bulls leased	6	$700year	4,200			
	Animal Health			24,030	223	89	
	Herd Improvement			14,040	130	52	
	Farm Dairy			6,750	63	25	
	Electricity			12,150	113	45	
	Livestock rearing & grazing			54,675	506	203	
Pastures & Feed	Fertiliser			15,597	144	58	
	Nitrogen			9,025	84	33	
	Irrigation	Area	0ha	0	200	0	
	Supplementary feed			33300	308	123	
	Conserved feed			7000	65	26	
	Cropping - summer	Area	7ha	2,720	25	10	
	Cropping - winter	Area	0ha				
	Regrassing	Area	7ha	3,400	31	13	
	Weed & Pest			3,888	36	14	
Fixed	Repairs & Maintenance -buildings			22,050	214	82	
	Repairs & Maintenance -equipment			9,273	90	34	
	Vehicles			13,395	130	50	
	Fuel			8,243	80	31	
	Frieight			5,152	50	19	
	Other farm e.g. oversowing			-	0		
Administration	Administration			20,000	185	74	
	Farm Insurance			15,000	139	56	
	Rates			25,000	231	93	
	Lease of Runoff Land						
	Industry good levy			3,084	29	11	
	ACC			3,450	32	13	
	Other administration			0			
Total Farm Working Expenses				$ 453,423	$ 4,198	$ 1,679	72%
Net Surplus (EBITD)				$ 174,717	1618	$ 647	28%
Operational Capital Adjustments							
Capital Realised							
	Number	Value					
Cows sold	0	$ 1,600.00		0.00			
Heifers sold	0	$ 800.00		0.00			
Shares sold	0	$ 6.00		0.00			
Capital expense							
Effluent field (ha)	-	$ 350.00		0.00			
				0.00			
Total Capital				$ -			0%
Personal				$ -			
				$ -			
Total Personal				$ -			
Total Other							
Surplus / Deficit				**174,717**			
Including Capital Adjustments				**174,717**			

The Profit & Loss account created in an Excel file for Cluster farm #5 is shown here in its initial state before modification.

The cells highlighted are to be input by the operator, although most of the pricing assumptions are called up from within the workbook from a shared pricing page.

Fixed costs are proportional to both farm area and changes in milk production.

For further information about the pricing assumptions refer to Parminter 2017.

Appendix B. Protocol for modifying milk production

Each of the farms had their milk production established initially from the population medians shown in Table 6. Each farm also had predetermined estimates of feed intake for the dairy cows. Both are drawn from individual farm Overseer data. These are both shown in Table B.1.

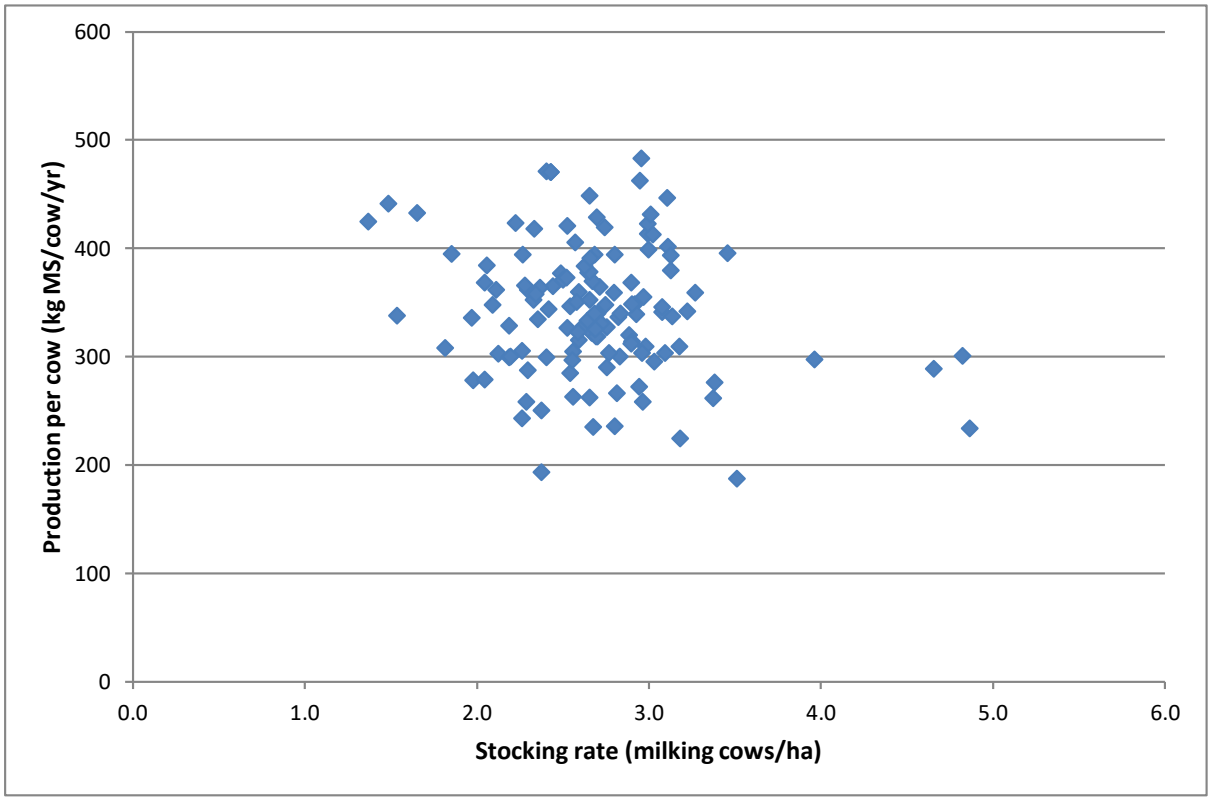
Table B.1 milk production and intake estimates

Cluster Farms	Feed Intake (kgDM/cow/yr)	Milk Production kgMS/cow/yr)
Farm #1	4793	321
Farm #2	5090	369
Farm #3	4751	340
Farm #4	5292	385
Farm #5	4704	336

Whenever farms reduced their herd numbers it was assumed that the amount of feed made available could be calculated from this table.

The amount of additional available feed was then allocated to increasing milk production. This was based on the distribution of farm milk production already known in the Upper Manawatu (Figure B.1).

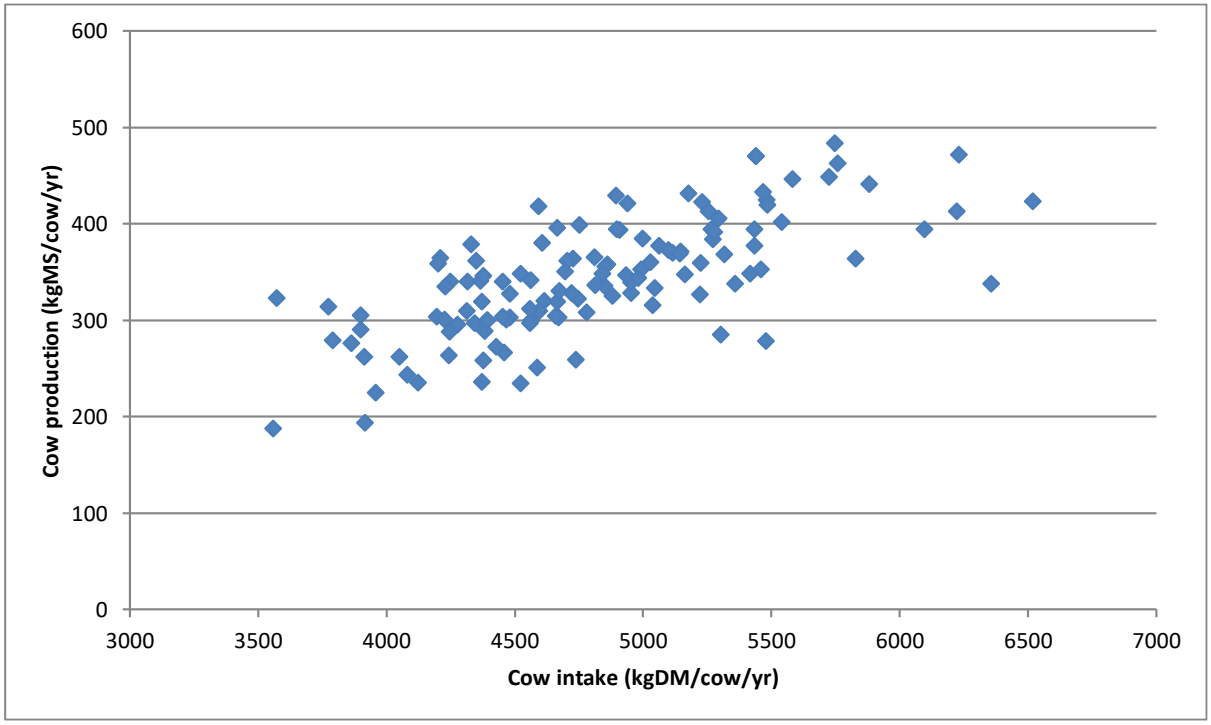
Figure B.1 The relationship between stocking rate and milk production



In Figure B.1 the herds of only 10% of farmers had achieved production results of more than 425 kgMS/cow/yr, so this figure was used as a maximum figure in the conversion of feed to production.

In Figure B.2 there is a significant relationship between cow intake and milk production (P>0.95). However on its own, cow intake only explains about half of the between-farm variance in milk production (R^2=0.49). Using these results indicated that farmers could achieve 71.7gMS/kgDM[4].

Figure B.2 Relationship between animal intake and milk production



Comparing the current median milk production in the catchment of 340 kgMS/cow with a maximum after twenty years of 425 kgMS/cow suggested that in this scenario, individual farms could achieve an increase of 1.25%/yr[5].

So in the scenarios presented in this report the feed available from reducing stocking levels was converted into production per cow (71.7g/kgDM) to achieve a gain in milk production of 1.25% per year within a maximum of 425 kgMS/cow.

Lactation length has been found to be highly correlated with milk production in high producing herds (ML Ercolin 2002)[6]. Cows grazing pastures in late Autumn to extend lactations also contribute to winter losses of nitrogen into waterways. One of the mitigations included in this study was reducing lactation lengths from 277 days to 267 days and then 257 days. Subsequent milk production took the shortened lactations into account.

[4] In Table 3.1 of the 'DairyNZ Economic Survey 2016-17' the range is from 73-80 gMS/kgDM intake

[5] In Table 3.4 of the 'DairyNZ Economic Survey 2016-17' over the last 10 years dairy farmers nationally have achieved an average increase of 2.5% or twice the rate of increase used in this report and were doing 385 kgMS/cow/yr.

[6] ML Ercolin, 2002. Lactation Curves in a Group of High Producing Dairy Farms in New Zealand. Masters Thesis, Massey University, New Zealand