BEFORE THE HEARINGS PANEL

IN THE MATTER of hearings on submissions concerning the Proposed One Plan notified by the Manawatu-Wanganui Regional Council

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

ON BEHALF OF HORIZONS REGIONAL COUNCIL

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1. INTRODUCTION

My Qualifications/Experience

1. My full name is Jeremy David Neild. I am employed as a Consultancy Manager for Agriculture Services Ltd, a fully owned consultancy subsidiary company of the Agriculture Industry Training Organisation. I have held this position since April 2009. Prior to this I was employed for 14 years with PGG Wrightson Ltd and 20 years with the Ministry of Agriculture and Fisheries in various advisory and consultancy positions.

2. I hold a Bachelor of Agricultural Science Degree in Farm Management and Animal Production from Massey University, where I graduated in 1975, and a Master of Agricultural Science in Agricultural Economics and Business from Massey University, where I graduated in 1990. My thesis was based on a study using input-output economics to assess economic impacts.

3. During this period I have had significant experience in examining land use studies and applying cost benefit analysis to a wide range of situations. In addition I have applied input output economics to a number of consultancy assignments.

4. I am a member of the New Zealand Institute of Agricultural Science, the New Zealand Institute of Primary Industry Management and the New Zealand Society of Agricultural and Resource Economics. I hold a practicing certificate as a Registered Consultant with the Primary Industry Consultant's Registration Board.

5. I have read the Environment Court's practice note 'Expert Witnesses – Code of Conduct' and agree to comply with it.

2. INTRODUCTION

My Qualifications/Experience

6. My full name is Anthony (Tony) Paul Rhodes. I am employed as a Consultant by PGG Wrightson Consulting which is a fully owned subsidiary of PGG Wrightson Limited. I have been operating as an Agricultural Consultant in Dannevirke since 1974, initially with the Ministry of Agriculture and Fisheries and since 1995, with PGG Wrightson. My work is with clients locally and throughout New Zealand.

7. I hold a Bachelor of Agricultural Science from Lincoln University, graduating in 1974. Since graduating I have been and remain a member of the New Zealand Institute of Primary Industry Management. I am accredited as a user of the OVERSEER® nutrient budgeting programme.

8. I have significant experience in the application of soil-focused sustainable land management policies and practices across a wide range of Southern North Island environments. I have been involved in several studies examining and quantifying the impact of management and land use change at both district and regional levels.

9. I have read the Environment Court's practice note 'Expert Witnesses – Code of Conduct' and agree to comply with it.

Our Role in Proposed One Plan

10. Horizons Regional Council invited us to prepare a report to estimate the economic impacts of implementing Table 13.2 (Rule 13.1). This includes:
   a. Defining the changes needed to comply with Rule 13-1 which may include:
      i. Lower farm output due to either lower stocking rate and/or less fertiliser
      ii. Changes to mitigate the nitrogen leaching
      iii. Less ability to change land use to higher intensity of production
   b. The cost of making the change:
      i. One-off capital cost to change systems/structures
      ii. Higher ongoing annual costs of production
      iii. Reduced production
      iv. Compliance costs associated with Rule 13-1.
   c. Using input-output economic modelling to estimate any regional impact.

   The analysis addresses specific questions raised in the Chairperson's minute #6.

   5.16 What are the financial and economic impacts of these on-farm changes? Please identify the costs for a range of farm types including the transaction costs and the costs of preparing Farmer Applied Resource Management strategy documents and an estimation of the economic effects (including multiplier effects) on a regional scale.

   5.17 Do the financial and economic impacts of on-farm changes vary if the rate of implementation currently set out in Table 3.2 is varied?

   The work also provides answers to paragraphs 5.14 and 5.15:

5.14 What is the range of farm management practices that the Proposed One Plan envisages being used on-farm to reduce nitrogen leaching in order to achieve Table 13.2 Nitrogen Leaching/Run-off Values?

5.15 What types of farm management and practice changes will need to be made on farms to achieve the Nitrogen Leaching/Run-off Values?

Scope of Evidence

11. In preparing our analysis and report we have relied on data and case studies initiated and provided by Horizons Regional Council, their staff and other contractors. In addition, where we have sourced other data and information we have acknowledged the source.

12. In undertaking our analysis and providing our interpretation and assessment of the costs and implications we have drawn on our knowledge and experience of farming across the Horizons Region and our expertise in undertaking previous assessments of regional scale impacts.

3. EXECUTIVE SUMMARY OF EVIDENCE

13. The purpose of this study is to estimate the economic impacts of implementing Table 13.2 (Rule 13.1). The analysis addresses specific questions raised in the Chairperson's minute #6.

14. Horizons Regional Council notified the Proposed One Plan in May 2007. As part of the One Plan, intensive land-users in target catchments are required to hold consent for their farming activity and limit the level of nitrogen output from their farming operation.

15. There are a range of initiatives that will have economic consequences for farmers, both within the target Water Management Zones, and across the Region. These are:

<u>Clean Streams Accord</u>

For the dairy industry, targeted actions under the Clean Streams Accord[1] provide overlap with some of the requirements of the One Plan - specifically outcomes focused on excluding stock from streams and regular stock movements across water courses, and management of effluent.

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1 Dairying and Clean Streams Accord, May 2003. http://www.mfe.govt.nz/issues/land/rural/dairying.html

Compliance with Current Consent Conditions

Across the Region, the issue of compliance with existing consents has been highlighted in the case study process.

The predominant outstanding issue is the area over which effluent is applied.

Proposed One Plan

Rule 13-1 specifies dairy farming, cropping, market gardening and irrigated sheep and beef farming and associated activities as controlled activities within the target Water Management Zones, and details the applicable conditions, standards and terms. Rule 13-1 also provides that any new use of land for these specified activities outside these target Water Management Zones shall also be a controlled activity and subject to the same conditions.

Rule 13-1 conditions applying to these activities include the requirement to prepare and submit a Farmer Applied Resource Management strategy (FARM strategy), and to undertake the farming activity in accordance with the FARM strategy. A condition of the FARM strategy is the maximum nitrogen leaching/run-off values allowed for the whole farm, which are based on the land use capability class (LUC) limits.

Rule 13-1 is unique to farms in the target Water Management Zones. The other Rules apply equally to farms across the Region.

Rule 13-3 addresses the discharge of contaminants to land and air associated with the preparation, storage, use and transport of stock feed and the use of a pad for the feeding of livestock as a permitted activity subject to conditions.

Rule 13-5 addresses the discharge of contaminants to land and air associated with an offal hole or farm dump as a permitted activity subject to conditions.

Rule 13-6 addresses the discharge of farm animal effluent to land and air as a controlled activity subject to conditions.

16. Information on the impacts is derived from 26 case studies carried out by a number of contractors over a period of a year. Our approach has been to extrapolate from these case studies to the general situation and to develop an economic model of the costs to

the Region as a whole, without losing sight of the key drivers that will impact on cost for individual farmers.

17. Our approach has been to categorise and quantify the area of dairy land and number of businesses across each of the target Water Management Zones:

i. where both rainfall is greater than 1,200mm per annum and where the proportion of LUC Class I,II and III land is less than 50% of the regional average (Group 1) – 48 farms

ii. where rainfall is greater than 1,200mm per annum (Group 2) – 86 farms

iii. where the proportion of LUC Class I,II and III land is less than 50% of the regional average (Group 3) – 142 farms, and

iv. where none of these constraints are considered to apply (Group 4) – 152 farms

18. Throughout this report we have made a number of assumptions to enable analysis of the impact and cost of implementing the One Plan and other initiatives. These include:

i. This assessment of the costs of implementing the Proposed One Plan and other initiatives is largely confined to an appraisal of the implications for dairy farming.

ii. We have assessed that the critical criteria for serious impact is rainfall (>1,200 mm/annum) and limitation in LUC (<50% of the regional average of LUC class I, II & III).

iii. We have assumed that the average dairy farm has 0.41 ha of other land for every hectare of effective milking platform. This value is used to calculate the number of farm businesses in the target Water Management Zones.

iv. The area of land supporting the milking platform potentially has an effect on mitigating the level of N-loss from the milking platform. This will have an impact on the costs of compliance with the One Plan, and is potentially very significant and would have the effect of reducing the cost of compliance for a considerable number of farms. This effect has not been assessed within this analysis.

v. The case studies are critical to the analysis but were chosen to test particular situations, rather than being a random sample of the issues and costs facing individual farms.

vi. We have assumed that all the costs associated with the Clean Streams Accord obligations and Rules 13-1 and 13-3 start in 2012

19. The case study farms highlight the gap between current levels of N-loss and the 20-Year One Plan targets – in twelve of the twenty two case studies, current N-loss is above their Year-1 target, (Figure 1), and fifteen are above the Year-20 target.

20. The proportion of farms with current N-loss levels above target is important in assessing the regional impact of the proposal.

21. The challenge at farm level is the extent of reduction in N-loss that is needed to be achieved to meet target, the practicality of achieving this reduction, and the economic impact of the required changes.

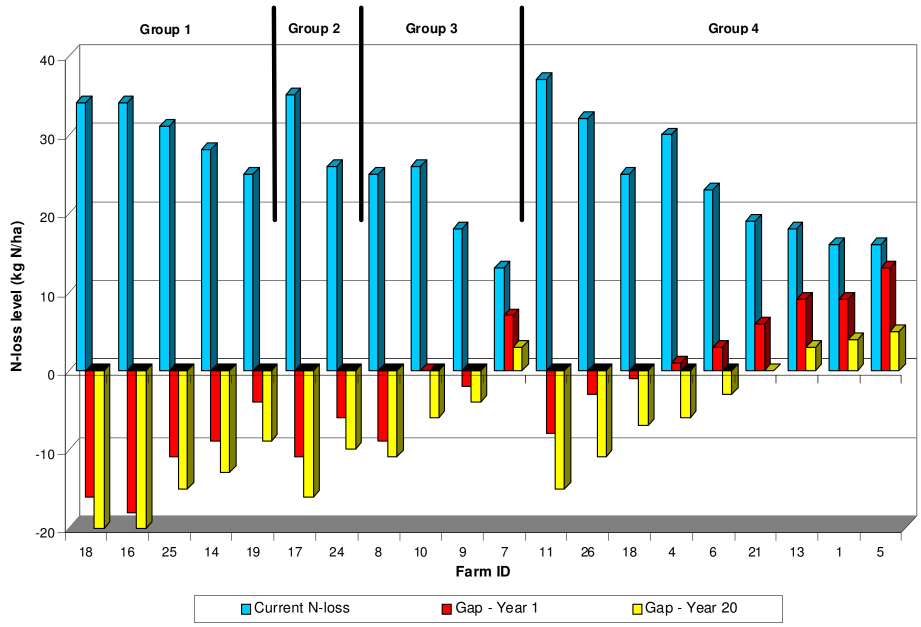

Figure 1. Farm N-loss: Current level and level of reduction required to achieve Year-1 and Year-20 targets (gap) (kg/ha).

22. 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.

23. The methodology to analyse costs that vary in their timing is to use discounted cashflow, where future costs are converted to a present cost using discounting techniques.

24. The present value of future costs for the 428 farms within the target Water Management Zones are shown below.

25. The Net Present Cost, at 6.5% discount rate, across all farms averages $191,840. For a Group 1 farm the cost is $516,470 to meet the Clean Streams Accord, to comply with

current consents and to comply with the Proposed One Plan, but only $86,900 for Group 4 farms.

Table 1. Present value of future costs for 428 farm businesses within target Water Management Zones.

Discount Rate	**6.5%**
Clean Streams Accord (CSA)	**$6,660,496**
Compliance With CCC	**$2,396,800**
Rule 13-3	**$3,997,254**
Rule 13-5	**$75,770**
Rule 13-6	**$10,735,784**
Rule13-1	**$58,241,256**
Cost of Proposed One Plan (POP)	**$73,050,064**
Cost of POP, CSA & CCC	**$82,107,360**
Cost of POP/farm	**$170,678**
Cost of POP, CSA & CCC/farm	**$191,840**

26. Sensitivity to discount rates, differences in costs for farms within the four groups, costs for the implementation stages of Rule 13-1, and the impact of delaying implementation is estimated.

4. EVIDENCE

27. Our evidence is presented in our report dated August 2009 entitled: *Economic Impacts of Proposed One Plan Limits on Nitrogen Leaching/Run-Off and Other Rule Changes*

Jeremy David Neild
August 2009

Anthony Paul Rhodes
August 2009

ECONOMIC IMPACTS OF PROPOSED ONE PLAN LIMITS ON NITROGEN LEACHING/RUN-OFF AND OTHER RULE CHANGES

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August 2009

Contents

Executive Summary

The purpose of this study is to estimate the economic impacts of implementing Table 13.2 (Rule 13.1). The analysis addresses specific questions raised in the Chairperson's minute #6.

Horizons Regional Council notified the Proposed One Plan in May 2007. As part of the One Plan, intensive land-users in target catchments are required to hold consent for their farming activity and limit the level of nitrogen and phosphorus output from their farming operation.

There are a range of initiatives that will have economic consequences for farmers, both within the target Water Management Zones, and across the Region. These are:

- Clean Streams Accord

  For the dairy industry, targeted actions under the Clean Streams Accord[2] provide overlap with some of the requirements of the One Plan - specifically outcomes focused on excluding stock from streams and regular stock movements across water courses, and management of effluent

- Compliance with Current Consent Conditions

  Across the Region, the issue of compliance with existing consents has been highlighted in the case study process.

  The predominant outstanding issue is the area over which effluent is applied.

- Proposed One Plan

  Rule 13-1 specifies dairy farming, cropping, market gardening and irrigated sheep and beef farming and associated activities as controlled activities within the target Water Management Zones, and details the applicable conditions, standards and terms. Rule 13-1 also provides that any new use of land for these specified activities outside these target Water Management Zones shall also be a controlled activity and subject to the same conditions.

  Rule 13-1 conditions applying to these activities include the requirement to prepare and submit a Farmer Applied Resource Management Strategy (FARM Strategy), and to undertake the farming activity in accordance with the FARM Strategy. A condition of the FARM Strategy is the maximum nitrogen leaching/run-off values allowed for the whole farm, which are based on the land use capability class (LUC) limits.

  Rule 13-1 is unique to farms in the target Water Management Zones. The other Rules apply equally to farms across the Region.

  Rule 13-3 addresses the discharge of contaminants to land and air associated with the preparation, storage, use and transport of stock feed and the use of a pad for the feeding of livestock as a permitted activity subject to conditions.

  Rule 13-5 addresses the discharge of contaminants to land and air associated with an offal hole or farm dump as a permitted activity subject to conditions.

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2 Dairying and Clean Streams Accord, May 2003. http://www.mfe.govt.nz/issues/land/rural/dairying.html

Rule 13-6 addresses the discharge of farm animal effluent to land and air as a controlled activity subject to conditions.

Information on the impacts is derived from 26 case studies carried out by a number of contractors over a period of a year. Our approach has been to extrapolate from these case studies to the general situation and to develop an economic model of the costs to the Region as a whole, without losing sight of the key drivers that will impact on cost for individual farmers.

Our approach has been to categorise and quantify the area of dairy land and number of businesses across each of the target Water Management Zones:

- where both rainfall is greater than 1,200mm per annum and where the proportion of LUC Class I,II and III land is less than 50% of the regional average (Group 1) – 48 farms
- where rainfall is greater than 1,200mm per annum (Group 2) – 86 farms
- where the proportion of LUC Class I,II and III land is less than 50% of the regional average (Group 3) – 142 farms, and
- where none of these constraints are considered to apply (Group 4) – 152 farms

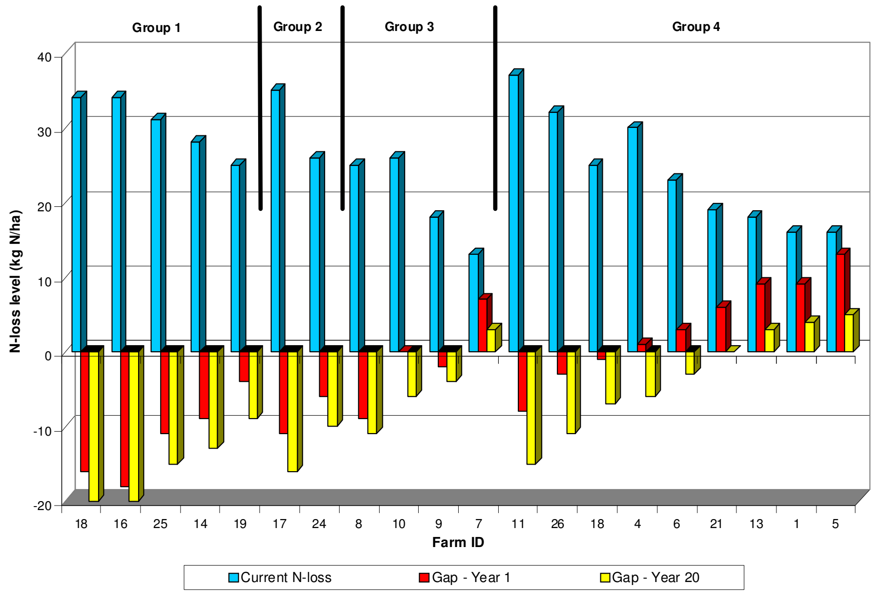
Throughout this report we have made a number of assumptions to enable analysis of the impact and cost of implementing the One Plan and other initiatives. These include:

- this assessment of the costs of implementing the Proposed One Plan and other initiatives is largely confined to an appraisal of the implications for dairy farming.
- we have assessed that the critical criteria for serious impact is rainfall (>1,200 mm/annum) and limitation in LUC (<50% of the regional average of LUC class I, II & III).
- we have assumed that the average dairy farm has 0.41 ha of other land for every hectare of effective milking platform. This value is used to calculate the number of farm businesses in the target Water Management Zones.
- the area of land supporting the milking platform potentially has an effect on mitigating the level of N-loss from the milking platform. This will have an impact on the costs of compliance with the One Plan, and is potentially very significant and would have the effect of reducing the cost of compliance for a considerable number of farms. This effect has not been assessed within this analysis.
- the case studies are critical to the analysis but were chosen to test particular situations, rather than being a random sample of the issues and costs facing individual farms.
- we have assumed that all the costs associated with the Clean Streams Accord obligations and Rules 13-1 and 13-3 start in 2012.

The case study farms highlight the gap between current levels of N-loss and the 20-Year One Plan targets – in twelve of the twenty two case studies, current N-loss is above their Year-1 target, Figure 2, and fifteen are above the Year-20 target.

The proportion of farms with current N-loss levels above target is important in assessing the regional impact of the proposal.

The challenge at farm level is the extent of reduction in N-loss that is needed to be achieved to meet target, the practicality of achieving this reduction, and the economic impact of the required changes.



Figu . -
20 targets (gap) (kg/ha).

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.

The methodology to analyse costs that vary in their timing is to use discounted cashflow, where future costs are converted to a present cost using discounting techniques.

The present value of future costs for the 428 farms within the target Water Management Zones are shown below.

The Net Present Cost, at 6.5% discount rate, across all farms averages $191,840. For a Group 1 farm the cost is $516,470 to meet the Clean Streams Accord, to comply with current consents and to comply with the Proposed One Plan, but only $86,900 for Group 4 farms.

Table 2: Present value of future costs for 428 farm businesses within target Water Management Zones.

Discount Rate	**6.5%**
Clean Streams Accord (CSA)	**$6,660,496**
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Cost of Proposed One Plan (POP)	**$73,050,064**
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Cost of POP/farm	**$170,678**
Cost of POP, CSA & CCC/farm	**$191,840**

Sensitivity to discount rates, differences in costs for farms within the four groups, costs for the implementation stages of Rule 13-1, and the impact of delaying implementation is estimated.

Introduction

Horizons Regional Council notified the Proposed One Plan in May 2007. As part of the One Plan, intensive land-users in target catchments are required to hold consent for their farming activity and limit the level of nitrogen and phosphorus output from their farming operation.

At the same time, Council released a template entitled a Farmer-Applied Resource Management Strategy (FARM Strategy) which would be required to be completed for all land uses and activities specified in rule 13-1 of the One Plan. Completing this template is intended to allow an assessment of existing land-use practices and also provide best management practice that should be implemented where the existing operation does not achieve the required standards. Compliance with the requirements of the FARM Strategy is required to ensure that the farming operation does not have significant adverse effects on the environment.

To assist in the process of considering the Proposed One Plan, Council commissioned case studies[3] of farming enterprises with the purpose of determining:

- current levels of nutrient output across a range of pastoral land-use activities, farm businesses and environments
- farm-specific N-loss mitigation options
- the extent and nature of compliance with FARM Strategy requirements
- economic cost, impact and practicality of achieving compliance

In addition, these case studies examined the impact of regional- and farm-scale LUC definition; illustrated the impact on N-loss limits on farming in high rainfall zones; and highlighted the challenge of intensive farming on more constrained LUC class land.

Information from these case studies has been used in undertaking this analysis.

Terms of reference

The purpose of this study is to estimate the economic impacts of implementing Table 13.2 (Rule 13.1)

The analysis aims to address specific questions raised in Chairperson's minute #6.

5.18 What are the financial and economic impacts of these on-farm changes? Please identify the costs for a range of farm types including the transaction costs and the costs of preparing FARM strategy documents and an estimation of the economic effects (including multiplier effects) on a regional scale.

5.19 Do the financial and economic impacts of on-farm changes vary if the rate of implementation currently set out in Table 13.2 is varied?

The work should also produce answers to paragraphs 5.14 and 5.15:

[3] FARMS test farms project. Manderson, A.; Mackay, A. AgResearch, 2008.
FARM Strategy. LandVision, February 2009
FARM Strategy. AgResearch, March 2009
FARMS Report, Sheppard Agriculture, April 2009
FARM Strategy, DairyNZ, July 2009
FARMS Report – Further Analysis, Sheppard Agriculture, July 2009

5.16 *What is the range of farm management practices that the Proposed One Plan envisages being used on-farm to reduce nitrogen leaching in order to achieve Table 13.2 Nitrogen Leaching/Run-ff Values?*

5.17 *What types of farm management and practice changes will need to be made on farms to achieve the Nitrogen Leaching/Run-off Values?*

We would also make brief comment on *5.7 – the economic benefits of a trading scheme and 5.12* – to assist Council to provide complete answers for the Water Hearing Panel.

In undertaking this analysis we will be:

d. Defining the changes needed to comply with rule 13-1 which may include:
   - iv. Lower farm output due to either lower stocking rate and/or less fertiliser
   - v. Changes to mitigate the nitrogen leaching
   - vi. Less ability to change land use to higher intensity of production

e. The cost of making the change:
   - v. One-off capital cost to change systems/structures
   - vi. Higher ongoing annual costs of production
   - vii. Reduced production
   - viii. Compliance costs associated with rule 13-1.

f. Using input-output economic modelling to estimate any regional impact.

One Plan Policies and Rules

The One Plan, Chapter 13, details the policies and rules for discharges to land and water.

Table 13.1 in the One Plan sets out target Water Management Zones where specified intensive farming land-use activities will be controlled and subject to a range of conditions, and the dates after which the provisions of the One Plan that relate to these Water Management Zones come into force (Table 3).

Table 3: One Plan Table 13.1: Water Management Zones for intensive land use activities.

Catchment	Water Management Zone	Date the rules of the Plan come into force
Mangapapa	Mana_9b	1 April 2009
Mowhanau	West_3	1 April 2009
Mangatainoka	Mana_8a Mana_8b Mana_8c Mana_8d Mana_8e	1 April 2010
Upper Manawatu above Hopelands	Mana_1a Mana_1b Mana_1c Mana_2a Mana_2b Mana_3 Mana_4 Mana_5a Mana_5b Mana_5c Mana_5d Mana_5e	1 April 2011
Lake Horowhenua	Hoki_1a Hoki_1b	1 April 2012
Waikawa	West_9	1 April 2012
Manawatu above Gorge	Mana_6 Mana_9a Mana_9c	1 April 2013
Other south west catchments (Waitarere and Papaitonga)	West_7 West_8	1 April 2013
Other coastal lakes	West_4 West_5 West_6	1 April 2013
Coastal Rangitikei	Rang_4	1 April 2014
Mangawhero/Makotuku	Whau_3b Whau_3c Whau_3d	1 April 2015

Rule 13-1 specifies dairy farming, cropping, market gardening and irrigated sheep and beef farming and associated activities as controlled activities within the target Water Management Zones, and details the applicable conditions, standards and terms. Rule 13-1 also provides that any new use of land for these specified activities outside these target Water Management Zones shall also be a controlled activity and subject to the same conditions.

Rule 13-1 conditions applying to these activities include the requirement to prepare and submit a FARM Strategy, and to undertake the farming activity in accordance with the FARM Strategy. A condition of the FARM Strategy is the maximum nitrogen leaching/run-off values allowed for the whole farm, which are based on the land use capability class (LUC) limits, set out in Table 13.2 (Table 4).

Table 13.2 in the One Plan sets the maximum nitrogen leaching/run-off rate allowed for land within the specified land use classes after the dates specified in Table 13.1.

Table 4: One Plan Table 13.2 - 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
Year 1 (when rule comes into force) (kg of N/ha/year)	32	29	22	16	13	10	6	2
Year 5 (kg of N/ha/year)	27	25	21	16	13	10	6	2
Year 10 (kg of N/ha/year)	26	22	19	14	13	10	6	2
Year 20 (kg of N/ha/year)	25	21	18	13	12	10	6	2

Rule 13-2 addresses the discharge of fertiliser to land and air as a permitted activity subject to conditions.

Rule 13-3 addresses the discharge of contaminants to land and air associated with the preparation, storage, use and transport of stock feed and the use of a pad for the feeding of livestock as a permitted activity subject to conditions.

Rule 13-4 addresses the discharge of biosolids and soil conditioners to land and air as a permitted activity subject to conditions.

Rule 13-5 addresses the discharge of contaminants to land and air associated with an offal hole or farm dump as a permitted activity subject to conditions.

Rule 13-6 addresses the discharge of farm animal effluent to land and air as a controlled activity subject to conditions.

Scope of this analysis

This assessment of the costs of implementing the Proposed One Plan and other initiatives is largely confined to an appraisal of the implications for dairy farming. The reasons for this are:

- Dairy farming is the predominant land use activity covered by Rule 13-1, both in terms of area of land use and number of business units impacted.
- Data about business activity and detail about the issues and implications for market gardening are very limited.
- Data from the albeit very limited number of case studies on cropping and irrigated sheep and beef farming indicate few implications.

The dairy industry

The land on which dairy farming is undertaken

Across the Region, dairy farming is estimated to involve 149,000 ha and accounts for 6.69% of the total land use[4].

Dairy farming is predominantly undertaken on the more highly versatile classes of land. Across the Region LUC classes I, II and III account for 68% (101,600 ha) of the area in dairy. Land classes with greater constraints (LUC IV – 10%, LUC VI – 18% and LUC VII – 4%) are also used both as the milking platform and in a support role for dry stock and other grazing (Table 5).

Table 5: LUC Class: Total area occupied by dairy farming across the Region[5].

	LUC Class									
	I	II	III	IV	V	VI	VII	VIII	UNKNOWN	Total
Hectares	8,139	53,070	40,331	14,419	244	26,408	5,769	715	133	149,228
Proportion of Total Dairy Land	5%	36%	27%	10%	0%	18%	4%	0%	0%	

The target Water Management Zones account for 48% of all dairy farming land in the Region (71,618 ha). On average across these zones, dairy farms have less of the most versatile LUC class I and II land (34% c.f. 41%) and more LUC class III, IV and V land (Table 5).

Table 6: LUC Class: Area occupied by dairy farming across target Water Management Zones[5].

	LUC Class									
	I	II	III	IV	V	VI	VII	VIII	UNKNOWN	Total
Hectares	1,835	22,453	22,050	8,044	117	13,797	3,089	154	78	71,618
Proportion of Target WMZ Dairy Land	3%	31%	31%	11%	0%	19%	4%	0%	0%	

4 Land Use and Land Use Capability in the Manawatu-Wanganui Region. Clark, M.; Roygard, J.. Report No: 208/INT/616. Horizons Regional Council, May 2008.
5 Horizons unpublished data.

Based on the Proposed One Plan permitted N-loss limits, total loss limits for dairy farms in these zones on average will be slightly lower because of the greater proportion of LUC class III, IV, V, VI and VII land farmed.

However, within the target Water Management Zones there are significant differences in the proportion of LUC class I, II and III land.

In this analysis we have set a criterion that farms in catchments that have less than 50% of the regional average proportion of LUC class I, II or III land will experience greater difficulty in compliance due to lower permitted N-loss limits.

Using this criterion we have identified target catchments where the proportion of LUC class II land is 18% or less (50% of the regional average proportion of 36%) or where the proportion of LUC class III land is 13% or less (50% of the regional average proportion of 27%).

Based on this criterion it is estimated that 71,618 ha of dairy land has constrained N-loss limits due to LUC (Table 7).

Table 7: Area of dairy land within target WMZs which have significantly less[6] LUC Class I, II & II Land.

Target Water Management Zone	Area of dairy farm land with limited LUC Class I, II & III land	% of total land in Water Management Zone
WMZ	Hectares	
Hoki_1a-1b	1,295	100%
Mana-1a-9c	16,308	37%
Rang_4a-4d	1,967	15%
West_3-9	12,494	100%
Whau_3b-d	593	100%
Total Area (ha)	**32,657**	**71,618**

Number of businesses

Across the Region, it is estimated that there were 866 dairy herds in the 2007/08[7]. This is a slight reduction on the 882 herds in 2006/07[7] and reflects the 30-year national trend of herd number decline and increasing herd size.

For the purpose of this analysis, we have assumed that these 866 dairy herds represent individual businesses. Clearly there are numerous instances of businesses owning and operating several herds, and there are a few examples of more than one herd being milked through the same farm dairy. Practically, we have assumed that each herd represents business unit which creates obligations under the One Plan, and meeting these obligations involves costs and benefits for the business.

6 Farms in this category have less than half the proportion of LUC Class I, II & III land compared to the Regional average
7 New Zealand Dairy Statistics 2007-08, LIC 2008.

Characteristics of dairy farm business

Based on the Livestock Improvement Corporation (LIC) data, the effective area occupied by these 866 dairy herds is 105,456 ha (Table 8). This area is the total effective farm area and specifically excludes any runoff associated with the farm.

This 105,456 ha accounts for only 70% of the total area in dairy farming across the whole Region. The explanation for this difference is:

- the LIC data only accounts for the effective farm area – the area that is available for grazing
- run-off land and other support blocks of land that are not grazing cows in-milk are excluded from the LIC data.

By deduction, on average, across the Region, every hectare of effective milking platform is complemented by an additional 0.41 ha of land which may be:

- excluded from grazing
- used to provide grazing for replacement stock or other livestock
- used for winter grazing of dry cows
- growing supplementary feed.

While this factor of an additional 0.41 ha of land associated with dairying for every hectare of milking platform may appear large, it is supported by other data.

The Ministry of Agriculture and Forestry (MAF) looked at LIC data for dairy farming in the lower North Island (Horizons Region excluding Ruapehu District, Hawkes Bay and Wellington Regional Councils) and concluded that the effective area of the average dairy farm was 129 ha effective milking platform and 33 ha effective run-off land, ie. the effective run-off area was 0.26 of the effective area. The area of ineffective or ungrazable land was not assessed in this analysis.

So in summary, the total area of land associated with the effective milking platform comprises the effective milking platform plus the non-grazable land associated with the milking platform. In many situations, this will be complemented with a runoff or support area, which may or may not be in the same target Water Management Zone as the milking platform (Figure 3).

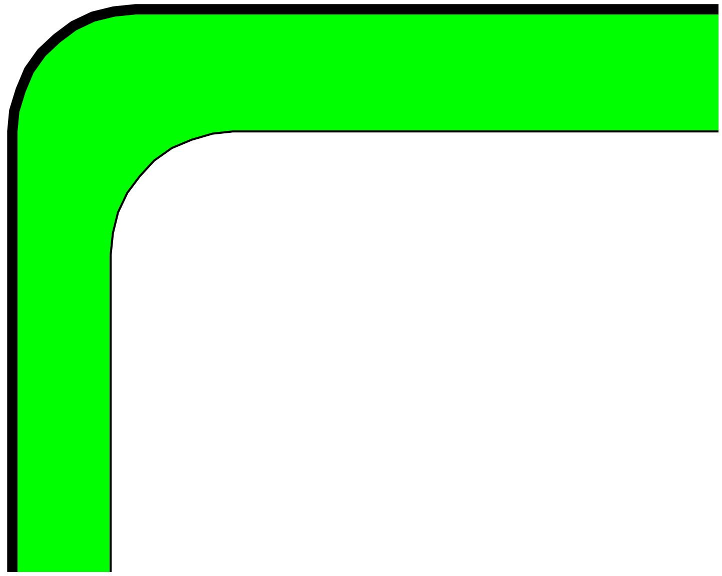

Figure 3: Components of the total land area associated with dairy farming.

While each dairy farm will be unique in the area of land supporting the milking platform, the effect that this has on mitigating the level of N-loss from the milking platform and the impact on the costs of compliance with the One Plan is potentially very significant and would have the effect of reducing the cost of compliance for a considerable number of farms.

There is significant variation in herd size, stocking rate, production per hectare and performance per cow across districts, reflecting the impact of climatic and environmental constraints on farming systems (Table 8 and Table 9).

Table 8: Features of dairy farm performance – 2007/08.

	Season 2007/08						
	Total		Average				
TLA District	Herds	Eff ha	Herd size	Eff ha	Cows/ha	kg MS/ha	kg MS/cow
Ruapehu	21	3,410	393	162	2.46	627	255
Wanganui	21	2,819	351	134	2.67	783	293
Rangitikei	85	10,540	365	124	2.90	983	339
Manawatu	267	32,220	334	121	2.79	879	312
PN City	39	5,301	357	136	2.66	824	299
Horowhenua	121	15,830	354	131	2.73	888	325
Tararua	312	35,336	306	113	2.72	812	297
Total	**866**	**105,456**					

Source: New Zealand Dairy Statistics 2007-08, LIC 2008

Table 9: Features of dairy farm performance – 2006/07.

	Season 2006/07							
	Total		Average					
TLA District	Herds	Eff ha	Herd size	Eff ha	Cows/ha	kg MS/ha	kg MS/cow
Ruapehu	20	3,034	392	152	2.59	760	293
Wanganui	20	2,788	366	139	2.69	875	325
Rangitikei	86	10,403	361	121	2.93	990	340
Manawatu	274	32,341	318	118	2.74	902	326
PN City	38	5,452	391	143	2.72	879	323
Horowhenua	127	15,828	335	125	2.70	867	318
Tararua	317	34,880	302	110	2.75	847	308
Total	**882**	**104,726**					

Source: New Zealand Dairy Statistics 2006-2007, LIC, 2007

Businesses in target Water Management Zones

Applying the multiplier of 0.41 ha of supporting land for each hectare of effective farm area, and relating this to the effective farm size across each of the TLA districts, the number of dairy farm businesses in the target Water Management Zones has been derived (Table 10). Milk solids production has been calculated multiplying average milk solids production in either 2007/07 or 2007/08, whichever is the greater, by the average effective area of farms in the respective districts.

Table 10: Derived number of dairy businesses and production in target Water Management Zones.

Water Management Zone	Land Area (ha)	Representative TLA Area	Av farm area per business (ha)	Av farm production (kg MS)	No of Businesses	Estimated No of Businesses with limited proportion of LUC Class I, II & III land[8]
Hoki_1a-1b	1,295	Horowhenua	185	116,000	7	7
Mana-1a-9c	44,020	Tararua	159	96,000	276	103
Rang_4a-4d	13,214	Rangitikei	175	123,000	76	11
West_3-9	12,495	Wanganui	189	117,000	66	66
Whau_3b-d	594	Wanganui	189	117,000	3	3
	71,618				**428**	**190**

High-rainfall zones

Rainfall has a significant effect on the quantity of soil drainage flow and consequently N-loss as predicted by Overseer®[1].

Within the target Water Management Zones there is large variation in rainfall, with annual levels in excess of 1,200mm experienced over dairy farms along the eastern border of the Ruahine Range (parts Mana_1a,_1b,_2b, _3, _4, _5b, _5c, _5d, _5e, _9b, _9c); Tararua Range (parts Mana_8a, _8b, _8c, _9a).

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8 Derived from average farm area in Table 6

Dairy farms in high rainfall zones are likely to experience high N-loss mitigation costs due to:

- relatively high soil drainage water flows and consequential nitrogen leaching potential per hectare
- generally being located on classes of land that have greater constraints to use such as contour, stoniness, drainage, shallowness of topsoil or erosion potential. Consequently, these farms tend to have a greater proportion of LUC Class IV, VI and VII land which, under the Proposed One Plan, have lower permitted thresholds for nitrogen leaching (Table 4).

In the absence of specific data, estimates have been made for the number of farms in the high rainfall zone for each of the target Water Management Sub-zones in which dairy farming occurs in Tararua District. Local knowledge of the rainfall trends and likely spread across the catchment has been used to subjectively rate catchments for the proportion of farms in the catchment exceeding the 1,200mm threshold.

This data has been further categorised to quantify the area of dairy land and number of businesses across each of the target WMZs (Table 11 and Table 12):

- where both rainfall is greater than 1,200mm per annum and where the proportion of LUC Class I,II and III land is less than 50% of the regional average (Group 1)
- where rainfall is greater than 1,200mm per annum (Group 2)
- where the proportion of LUC Class I,II and III land is less than 50% of the regional average (Group 3), and
- where none of these constraints are considered to apply (Group 4)

Table 11: Schematic representation of dairy land in target Water Management Zones and assessed constraints.

Rainfall	**Dairy Land where the proportion of LUC class I, II or III land compared to regional average proportion is:**	
	<50%	**>=50%**
>1,200 mm	**Group 1**	**Group 2**
<=1,200 mm	**Group 3**	**Group 4**

Table 12: Categorisation of dairy farm land in target Water Management Zones by assessed constraints.

	Dairy Land with >1,200mm rainfall and where LUC Class I, II & III is <50% of regional average		Dairy Land with >1,200mm rainfall only		Dairy Land where LUC Class I, II & III is <50% of regional average only		Dairy Land where LUC Class and rainfall constraints are excluded	
	Group 1		Group 2		Group 3		Group 4	
Water management Zone	Hectares	No of Businesses	Hectares	No of Businesses	Hectares	No of Businesses	Hectares	No of Businesses
Hoki_1a,1b					1,295	7		
Mana_1a-9c	7,577	48	13,716	86	8,731	55	13,996	87
Rang_4a-4d					1,967	11	11,247	65
West_3-9					12,495	66		
Whau_3b-d					594	3		
	7,577	**48**	**13,716**	**86**	**25,082**	**142**	**25,243**	**152**

Options and opportunities for achieving compliance: Financial impacts of achieving compliance with the requirements of the One Plan and other initiatives

The case studies used in this analysis present a range of strategies for achieving compliance with both immediate and long-term requirements of the One Plan.

Broadly, the financial impact of these can be categorised as:

- Additional costs of doing business for the initial FARMS planning and ongoing evidence of compliance – costs incurred in completing the initial FARMS Workbook to the level required for receiving consent; and the annual cost of providing evidence of management and practices.
- Additional capital investment required to achieve initial compliance with FARMS requirements; and additional capital investment to achieve compliance with reducing N-loss limits – bridging and stream crossings, silage storage and handling areas, fencing to exclude stock from streams and rivers, expansion of stock water reticulation, expansion or upgrading of effluent storage, application systems or treatment areas.
- Increased annual operating cost, primarily as a consequence of introducing N-loss mitigating technology and practices – changed grazing off systems, use of urease[9] and nitrification inhibitors, additional supplements fed.
- Reduction in farm production, revenue and cash farm surplus as a result of farm system changes necessary to achieve compliance.
- Effect on perceived market value of land, and investors wealth, as a consequence of constraint on the production level that can be achieved.

The capital investment costs and the ongoing extra annual costs and reduced farm output and revenue, where required, to meet the requirements of the Proposed One Plan can be converted to a present value. The present value of these future costs and forgone revenue is the amount of money that would need to be invested at a specified interest rate to meet the costs as they occurred. Future costs are converted to present values by discounting, using discounting factors which are a function of interest rate and time.

In a perfect market the net present cost of these future costs will be equivalent to the loss of market value of the farm. The market value of an asset such as a farm will be a function of the future earning potential of that asset. Any event or change that alters the earning potential of that asset will impact on the market value, ie. the loss in earning potential is the same as the market loss and they are not additive. Obviously the market is seldom perfect in the short run and change in market value of an asset can be less or more than net present value (NVP) of the changes in future earnings, reflecting investor optimism/pessimism, imperfect knowledge, and appetite for risk or some other value associated with the asset such as speculative and consumptive values.

Consequently, in this analysis the costs in achieving compliance have been discounted to produce a NPV, and any perceived impact on the market value of land is considered already accounted for.

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[9] Enzymatic breakdown of urea.

Constraint to future productive growth by intensive dairy farms in the target Water Management Zones

Many landowners will likely be concerned that the constraints imposed on their productive activities by the Proposed One Plan will prevent them from growing the performance of the business and ensuring the ongoing viability of their business.

Improving productivity is important for New Zealand and our export industries in particular. Productivity means improving the value of output/unit of input – particularly per unit of land, capital and labour. The value of output will reflect both the volume and/or the value of milk through modifying the components or increasing the value through processing/marketing activities.

Looking at the Dairy Statistics relating to Horizons' region over the last 14 years, there has been significant change (Table 13).

Table 13: Changes in dairy production and productivity – 1993/94 to 2007/08.

TLA	No of Herds	No of Cows	Area	Production/ Farm	Total Production	Production/ Cow	Production/ Ha	Cows/Ha
2007/08								
Ruapehu	21	8245	3410	97818	2054178	249	602	2.42
Wanganui	21	7363	2819	104398	2192358	298	778	2.61
Rangitikei	85	31000	10540	122588	10419980	336	989	2.94
Manawatu	267	89099	32220	106846	28527882	320	885	2.77
Palm North	39	13936	5301	117308	4575012	328	863	2.63
Horowhenua	121	42869	15830	117006	14157726	330	894	2.71
Tararua	312	95348	35336	92224	28773888	302	814	2.70
Total	866	287860	105456		90701024	315	860	2.73
1997/98								
Ruapehu	15	3750	1680	68004	1020060	272	607	2.23
Wanganui	29	8177	3364	73838	2141302	262	637	2.43
Rangitikei	98	25967	9800	76794	7525812	290	768	2.65
Manawatu	321	75650	28248	66449	21330129	282	755	2.68
Palm North	43	12602	4429	84508	3633844	288	820	2.85
Horowhenua	175	41771	16450	65975	11545625	276	702	2.54
Tararua	398	79096	32636	58482	23275836	294	713	2.42
Total	1079	247013	96607		70472608	285	729	2.56
1993/94								
Ruapehu	7	1162	576	43069	301483	259	523	2.02
Wanganui	26	5871	2613	56136	1459536	249	559	2.25
Rangitikei	78	15732	7004	57434	4479852	285	640	2.25
Manawatu	311	61040	24631	53225	16552975	271	672	2.48
Palm North	39	10144	4005	70252	2739828	270	684	2.53
Horowhenua	166	33227	14027	52593	8730438	263	622	2.37
Tararua	462	79324	32478	47267	21837354	275	672	2.44
Total	1089	206500	85334		56101466	272	657	2.42

Over the decade from 1997-1998 to 2007-2008, there has been a decline in the number of herds of nearly 20%, but an increase in number of cows milked of 16.5%, an increase in effective milking area of 9.1% and increased milk solids production of 28%.

The components of the increase in milk solids production are detailed in Table 14.

Table 14: Factors contributing to increase in dairy farm production.

Factors	Increase in Milk Solids	Per Annum Gain
Total increase in production (over decade)	20 m kg	2.5% compound
Increase due to extra land production	6.5 m kg	0.9%
Increase due to intensification (productivity effect)	13.5 m kg	1.65%

Farmers have been intensifying their production per hectare by 1.65% per year for at least 10 years. However, this is not all a gain due to improved productivity. Much of it reflects either purchasing in of feed grown elsewhere (in the region or elsewhere in New Zealand, and overseas) or grazing out of livestock to enable more home grown feed to be used for milk production often through a higher stocking rate of milking cows per hectare.

Looking at the MAF Farm Monitoring data for the lower North Island Model Farm, the feed costs (not including nitrogen fertilizer) have increased from $20,110 per farm in 1997/98 to $137,910 in 2007/08. Feed costs per cow and per kg milk solids produced have increased from $105 to $383 per cow and from 36 cents/kg milk solids to $1.22/kg milk solids, as shown in Table 15. While 2007-08 was a drought year, when more supplementary feed was used and it cost more than in the 2006/07 year, there is no doubt purchased-in feed is a much more significant item now than in 1997/98.

Table 15: Dairy farm expenditure on feed – lower North Island model farm.

	Feed Cost		
Year	**Per Farm**	**Per Cow**	**Per kg Milk Solids**
2008/09	141,500	393	$1.26
2007/08	137,910	383	$1.22
2006/07	73,360	262	$0.79
1997/98	20,110	105	$0.36
1993/94	16,560	100	$0.345

Source: MAF Farm Monitoring Reports

The Farm Monitoring data in 1997/98 shows one line for feed costs - $20,110, but in 2007/08 it is now shown as four sub-items – hay and silage $59,500, feed crops $7,200, grazing costs $46,600 and other feed $28,200. This reflects the growing significance of purchased feed in dairy farmers' costs of production and intensification on the milking area.

So both increased production and intensification of land use have occurred and are likely to continue to occur in the future in response to a range of factors.

The current Proposed One Plan Rule-13 does not stop farmers from changing land use or improving their productivity but does require them to factor in the costs of their externalities and apply technologies that mitigate loss and leaching of nutrients into the region's waterways.

In our opinion the Proposed One Plan LUC based N-loss limits provides greater transparency, certainty and equity compared to the option of "grand parenting" current use N-loss levels and allocating the required reduction in nutrient losses proportionate to the current losses. In one sense, "grand parenting" rewards heavy polluters at the expense of land use activities that result in low levels of pollution. However, the benefit of "grand parenting" is that it does recognise historical investment in polluting activity, but it fails to recognise investment in pollution mitigation technology and activities that have been implemented.

As proposed, the One Plan approach preserves equal opportunity for all land users to consider alternative uses for their land and adoption of practices and management that enable nutrient losses to be minimised consistent with their respective LUC class limit. It also recognises any mitigation investment by current land owners.

Constraints to land use change within Horizons' Region

Rule 13-1 requires that any new use of land, including conversion, in all Water Management Zones in the region for:

(a) Dairy farming
(b) Cropping
(c) Market gardening
(d) Intensive sheep and beef farming

…is controlled and will require the land user to prepare and submit a FARM Strategy.

Consequently any land owner within the Horizons Region wishing to change land use to dairying, market gardening, cropping or irrigated sheep and beef will be subject to Rule 13-1 and the nitrogen leaching/run-off values of Table 13.2.

The question has been raised as to the scale required before becoming subject to this requirement, ie:

- If a landowner buys an adjourning 10 ha to add to his existing 120 ha dairy farm, will he/she be required to prepare a FARM Strategy for his 130 ha farm, given he is outside the target Water Management Zones of Table 13.1, or

- If a landowner leases a 20 ha paddock to a commercial potato grower to grow potatoes on for several years as part of a pasture renewal programme, will this require the preparation of a FARM Strategy, or

- If a landowner with a 200 ha finishing sheep and cattle property decides to grow 50 ha of grain after destocking because of a one in 50 year drought while he rebuilds his stock numbers gradually over several years, or

- A sheep and beef farmer with 600 ha of hill country wishes to irrigate 60 ha of flats to create a finishing platform for his surplus stock.

Will these initiatives lead to having to comply with all the requirement of a controlled consent?

Horizons Regional Council has indicated that it will develop a minimum level of activity – perhaps a minimum area of intensification, e.g. 30 ha, or a minimum percentage of the base operation converted to a new use, e.g. 30%, before consent under Rule 13-1 becomes a requirement.

This would seem to be a reasonable and sound provision.

However, the question is just how much impact this rule will have in limiting land use changes to a “higher” or more valuable use.

Horizons Regional Council has asked the authors of this report to assess the impact of this restriction upon the future economic activity of the region. We have been reluctant to do this because of the many uncertainties but would make the following comments.

Dairy conversions have been a significant feature in New Zealand since the early 1990s. Herd numbers increased most years from 1991/92 (14,452) to 1996/97 (14,741) and then declined most years since, but the effective milking platform continued to increase most years. However, much of this increase was in the South Island and on the Central Plateau.

Perusing the MAF Farm Monitoring Reports from 1996/97 indicates:

1996/97	30-40 conversions for the “old” Tui Dairy Company supply
1997/98	20-25 conversions for the whole Kiwi supply area including Taranaki
1998/99	12 conversions for the Kiwi supply area
1999/00	6 conversions – lower milk prices and higher share values noted
2000/01	Very few conversions – interest is in purchasing larger farms or land in the South Island for conversion to dairy
2001/02	Few conversions
2002/03	Drop in livestock price reflects few dairy conversions and low South Island demand for dairy livestock
2003/04	With lower payouts, there is little expansion of the industry
2004/05	No comment on conversions
2005/06	There is no profit in dairy farming at $4/kg MS
2006/07	Conversions increasing in Canterbury and Southland and farmer confidence is high (payout $5.53/kg)
2007/08	100 conversions in Southland, five in Taranaki, 80 conversions in Canterbury, conversions from forestry in Central Plateau 9 in 2008/09, maybe 21 in 2009/10

In summary, there has not been significant conversion in Horizons Region since 1996-98 despite favourable conditions elsewhere.

However, will the imposition of Rule 13-1 have a significant impact upon those landowners who may wish to intensify their operation?

2009 Farm Monitoring reports suggest that sheep and beef intensive farms are provisionally valued at $25,000/ha (land and buildings) and dairy farms are currently valued at $30,000/ha (land and buildings) excluding shares. Conversion costs in 2007 were about $8,000/ha, which indicates that there is little advantage to conversion – it is more cost effective to buy an existing farm.

In terms of the impact of the proposed plan, firstly many of the costs associated with Rules 13-3, 13-5 and 13-6 would not apply as converting farms are not requiring upgrades to existing facilities but can adopt new technology.

The impact of Rule 13-1 is a net present cost of $136,000 per farm for those farms within the target Water Management Zones but varies from $453,235 for a farm in the high rainfall zone with limitations on land capability class to $42,000 on the fourth group without land capability or rainfall constraints. This cost is relatively minor in comparison to all the other costs associated with conversion, but Rule 13-1 ensures that the externalities are costed into the decision to convert.

Clean Streams Accord

For the dairy industry, targeted actions under the Clean Streams Accord[10] provide overlap with some of the requirements of the One Plan - specifically outcomes focused on excluding stock from streams and regular stock movements across water courses, and management of effluent:

- *dairy cattle excluded from 90% of streams, rivers and lakes by 2012, and*
- *90% of regular crossing points have bridges or culverts by 2012*
- *100% of farm dairy effluent discharges to comply with resource consents and regional plans immediately*

While these obligations are not legally binding on individual dairy farmers, the Accord's targeted actions reflect the industries intentions.

Assumptions: For the purpose of this analysis, the cost of strategies which are targeted in the Clean Streams Accord will be separately itemised and excluded from the direct cost of the One Plan implementation.

Farm-scale impacts of the One Plan: Case studies

To build understanding of the nature and scale of the impacts of the Proposed One Plan, Horizons commissioned the FARMS test farms project[3] which examined in detail five farms and produced six case studies.

Undertaken by AgResearch, the purpose of this was to test the proposed FARM Strategy Approach and develop a FARMS reporting template similar to that used for SLUI whole farm plans, and included evaluating the economics of preparing and implementing FARM Strategies for each case study, and comparing permissible nitrogen-loss limits calculated using two scales of LUC.

Subsequently, an additional sixteen farms were examined[2, 3, 4, 5, 6, 7] producing a further twenty case studies. Farms were selected which were considered to be challenging, in terms of:

- currently operating at a high level of production intensity
- farming in a potentially high N-loss environment, due to high rainfall
- farming on land class(es) with lower N-loss/leaching permitted levels

An added dimension was that these case studies were undertaken by a range of consultants to provide a range of perspectives in the application of the FARM Strategy. Accordingly, the case studies are likely to reflect the mitigation options, costs and impact preferences of the case study farmer and consultant.

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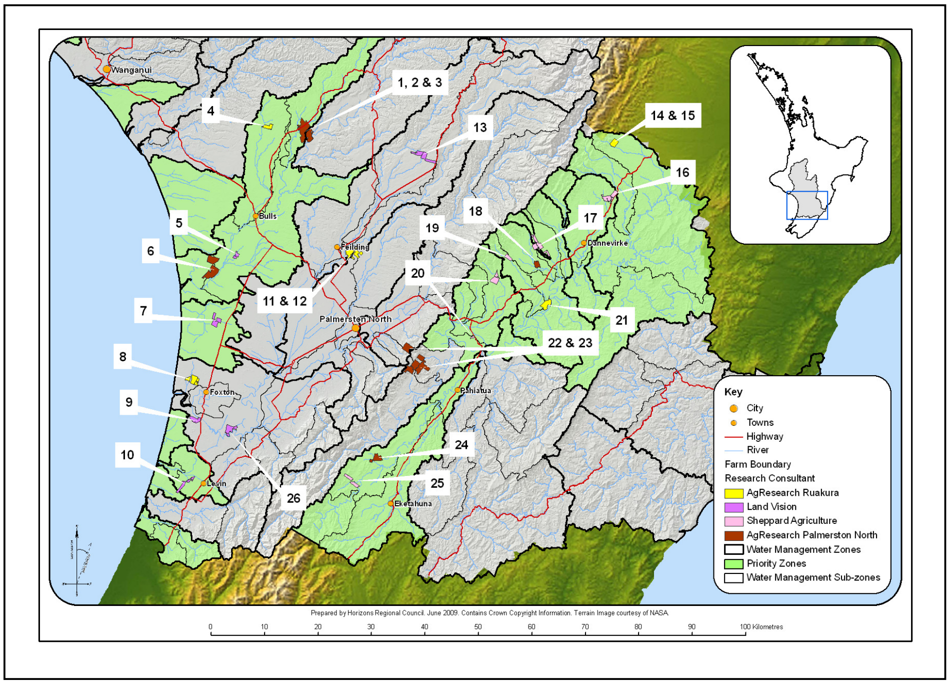
[10] Dairying and Clean Streams Accord, May 2003. http://www.mfe.govt.nz/issues/land/rural/dairying.html

The target Water Management Zones and location of the case study farms are illustrated in Map 1.



Map 1: Locations of the Horizons test FARM strategies in relation to the target catchments. Some locations are numbered more than once to indicate scenarios tested e.g. including or excluding support block; or sheep/beef and potential conversion to dairy.

Summary data for the case studies is included in Appendix 1.

It is important to acknowledge that the case studies represent a potentially biased sample of farms. Consequently, the incidence of the issues faced in complying with the One Plan and the costs of compliance provide an indication of the impact of the One Plan on farms across the Region.

One way to fully cost the impact of the One Plan would be to undertake detailed analysis on every farm across the region; however this is not currently practical.

Accordingly, we have used the data from the case studies, together with our understanding of the industry, to estimate the likely incidence and cost of compliance.

Important assumptions: A reminder

Throughout this report we have made a number of assumptions to enable analysis of the impact and cost of implementing the One Plan and other initiatives.

We have commented on these as they arise throughout the analysis, but have detailed them here to ensure the reader is fully aware of them:

• this assessment of the costs of implementing the Proposed One Plan and other initiatives is largely confined to an appraisal of the implications for dairy farming.	Page 18
• we have assessed that the critical criteria for serious impact is rainfall (>1,200 mm/annum) and limitation in LUC (<50% of the regional average of LUC class I, II & III).	Page 20 & Page 24
• we have assumed that the average dairy farm has 0.41 ha of other land for every hectare of effective milking platform. This value is used to calculate the number of farm businesses in the target Water Management Zones.	Page 22
• the area of land supporting the milking platform potentially has an effect on mitigating the level of N-loss from the milking platform. This will have an impact on the costs of compliance with the One Plan, and is potentially very significant and would have the effect of reducing the cost of compliance for a considerable number of farms. This effect has not been assessed within this analysis.	Page 22
• the case studies are critical to the analysis but were chosen to test particular situations, rather than being a random sample of the issues and costs facing individual farms.	Page 30 & Page 31
• we have assumed that all the costs associated with the Clean Streams Accord obligations and Rules 13-1 and 13-3 start in 2012	Page 51

Farm management practices: Potential mitigations

Based on the case studies undertaken to date, the key issues and the range management practices farmers need to consider to address these issues are summarised in Table 16. Mitigation practices are tagged to the respective One Plan rule, Clean Streams Accord (CSA) obligation, or current consent conditions (CCC).

Table 16: Potential farm management mitigation practices

Rule	Issue	Mitigation strategies	Possible consequential liabilities	Practicality
Minimising Direct-to-Waterway Contamination				
CSA	Animal defecation direct to waterways	Fencing waterways to exclude stock	• Additional stock water reticulation may be required • Chemical control of woody weeds adjacent to waterway	• Generally practical for dairy/cattle farming, where typically two-wire electric fencing would be adequate • More difficult for sheep due to requirement for more substantial fence construction to be stock proof • There will be difficulty around waterways that have a large flood plain and very high peak flows • There will be greater cost and difficulty in maintaining land use integrity in highly dissected landscapes
CSA		Installation of culverts and bridging at stock crossings	• May require design of structures to minimise discharge of ponded effluent into waterways • Effluent concentrating at bridges, underpass, crossings may need to be collected and returned to effluent system	• Often practical for small waterways • May involve major engineering design to meet requirements for some situations. Impractical where cost is high, area accessed is small or unimportant, or frequency of use is low • May result in greater walking distances for milking herds in highly dissected landscapes
13-3	Faecal contamination of waterways	Relocate or redesign animal intensive activities so that faecal material flow direct to watercourse is avoided	• Hard standing areas, forage crop and stand off areas are buffered by a 20m riparian margin	• Practical with planning
13-5		Re-site animal waste/ offal pits		• Could be achieved at very low cost as existing facilities come to the end of their useful life and are replaced
Minimising Direct-to-Waterway Contamination and Reducing N-loss				
CCC	Ponding, over-land flow and direct-to-drainage flow	Increase the land area to which effluent is applied to reduce total nutrient loading		• Practical. • A range of application systems with different labour requirements are available • Positive impact on improving efficiency of nutrient recovery from effluent
13-6		Revise rate of effluent application to be consistent with soil infiltration rate	• May involve require changes to yard cleaning processes to reduce the volume of water diluent	• Practical. • May be as simple as changing operation of existing equipment, but typically will involve purchase of new

Rule	Issue	Mitigation strategies	Possible consequential liabilities	Practicality
			• May require diversion of storm water to reduce total loading	irrigator/system to enable low intensity application and improved pattern of effluent distribution. • Storm water diversion, scrape rather than water dilution systems may be required
13-3	Contamination of waterways	Re-site silage/feed storage and/or redesign to stop leachate discharge	• Construction of new storage facilities • Any discharge will need to be collected and returned to the effluent system • Leachate is indicative of poor supplement making or rainfall contamination of the supplement	• May involve considerable cost to relocate and construct sealed structure with leachate collection. • Leachate should not occur under best practice supplement management
13-6		Provide effluent storage to avoid application during periods of high soil moisture content	• May require additional/new structures to ensure storage is sealed and not leaking	• Assuring no leakage may be problematic in some soils
13-1		Grazing dry cows off-farm for up to 10 weeks through May-July period	• Benefit gained if feed saved results in less purchased or imported supplement • If feed saved on-farm results in more cows, N-loss is likely to be unchanged • Risk of exporting N-loss to other sensitive catchments	• Involves a major change in management practice and farm system • Involves adjustments to stock policy, stock numbers, supplement and nitrogen use • Risks simply transferring N-loss to the graziers property, which may be in the same or another sensitive catchment.
13-1		Use a sealed wintering pad/stand-off pad with effluent collection		• Practical alternative to grazing cows off-farm
13-1		Create wetland attenuation zones where runoff occurs	• Fencing to exclude livestock	• Practicality limited by contour and natural landforms
Reducing N-loss				
13-1		Avoid winter (May, June, July) application of N	• Reduction in amount of pasture grown	• Practical • Positive impact on improving efficiency of nitrogen use
13-1		Restrict N fertiliser application on effluent application area to a maximum of 150 kg N/ha (inclusive of both effluent plus fertiliser)	• Reduction in amount of pasture grown	• Practical
13-1		Decrease urea usage	• Reduction in amount of pasture grown	• Difficult as a stand-alone action • Needs to be considered as component of the whole farm system including grazing-off and use of other supplements
13-1		Substitute low protein content supplements for nitrogen use		• Practical

Rule	Issue	Mitigation strategies	Possible consequential liabilities	Practicality
				• Needs to be considered as component of the whole farm system including grazing-off and use of other supplements
13-1		Use urease and nitrification inhibitors	• Applying the same rate of N/ha will increase total pasture production and consequent N-loss • Amount of nitrogen applied should be reduced	• Practical, but nitrification inhibitors need to be applied twice and may require three applications per year in warm environments • Assumed avg. 6% additional N efficiency in annual DM production from nitrification inhibitor use. Net cost of $92/ha/yr • Urease inhibitor net benefit of $27/ha assumed. • There is currently limited research detailing the impact and repeatability of response to these modifiers across the Southern North Island.
13-1		Decrease stocking rate and production per hectare	• From fewer cows with higher per cow performance	• Unlikely to be readily accepted • Likely to have significant economic impact on business performance
13-1		Destocking by grazing replacement stock off the farm	• If cows replace young stock, N-loss is likely to be unchanged, or may increase	• Practical but likely to have limited impact on reducing N-loss – may increase N-loss depending on associated farm system changes

Achieving targets

The case study farms highlight the gap between current levels of N-loss and the 20-Year One Plan targets – in twelve of the twenty two case studies, current N-loss is above their Year-1 target (Figure 4), and fifteen are above the Year-20 target (Figure 5).

The proportion of farms with current N-loss levels above target is important in assessing the regional impact of the proposal.

The challenge at farm level is the extent of reduction in N-loss that is needed to be achieved to meet target, the practicality of achieving this reduction, and the economic impact of the required changes.

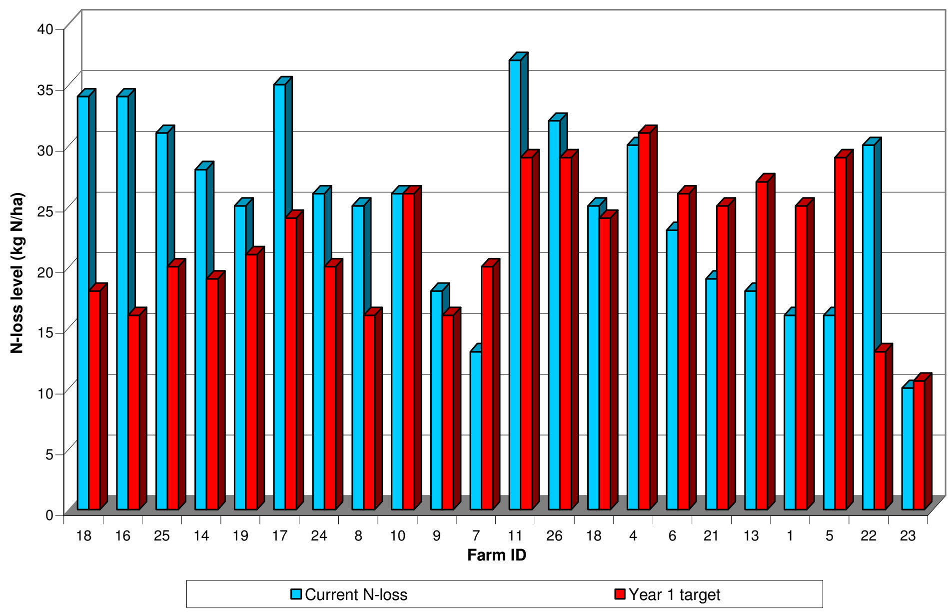


Figure 4: Farm N-loss: Current and Year-1 N-loss target (kg/ha).

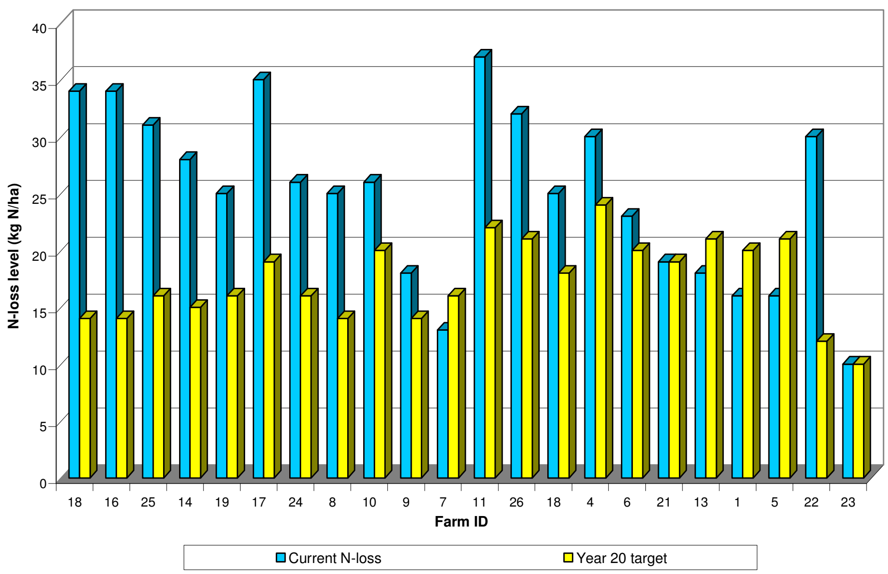


Figure 5: Farm N-loss: Current and Year-20 N-loss target (kg/ha).

The approach adopted in this report has been to examine the extent of the required reduction on N-loss across each of the four groups previous described. In this analysis, data from only 20 case studies has been considered - the sheep and beef farm and dairy conversion has been excluded.

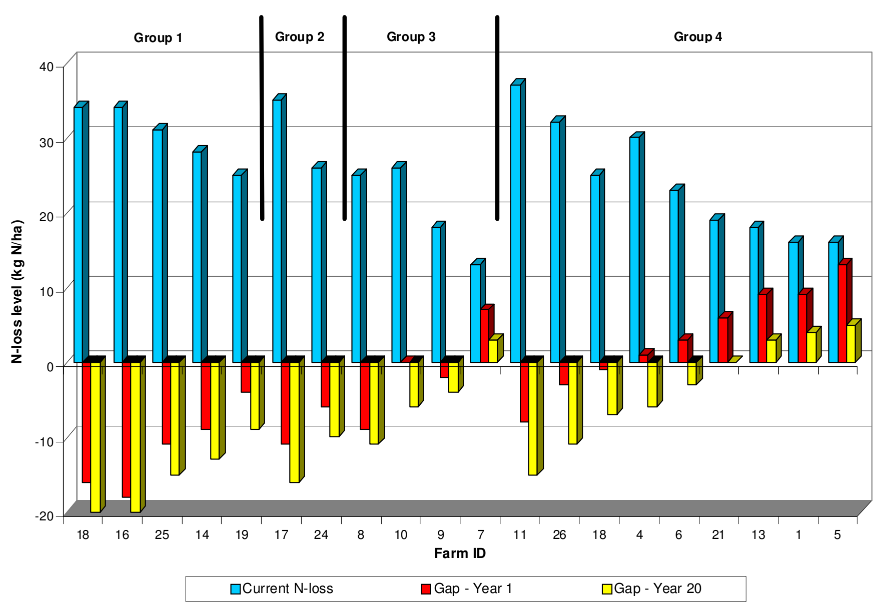


Figure 6: Farm N-loss: Current level and level of reduction required to achieve Year-1 and Year-20 targets (gap) (kg/ha).

The data in Figure 6 illustrates the point that the required level of reduction differs across groups 1 to 4: nitrogen loss is greatest on farms in groups 1 and 2; whereas in group 4, while some farms would be required to achieve significant reduction in nitrogen loss, others would not.

In practice, farms would be required to implement a hierarchy of strategies in order to achieve compliance with N-loss targets. It is expected that the first target would be to adopt low cost strategies that achieve a high cost-benefit return, progressively adopting more expensive input cost options, and constraints on production as farms strive to achieve large N-loss and Year-20 targets (Figure 7). These strategies and their preference may change over time as the relevant input and output costs change over time, and new technologies emerge and gain acceptance.

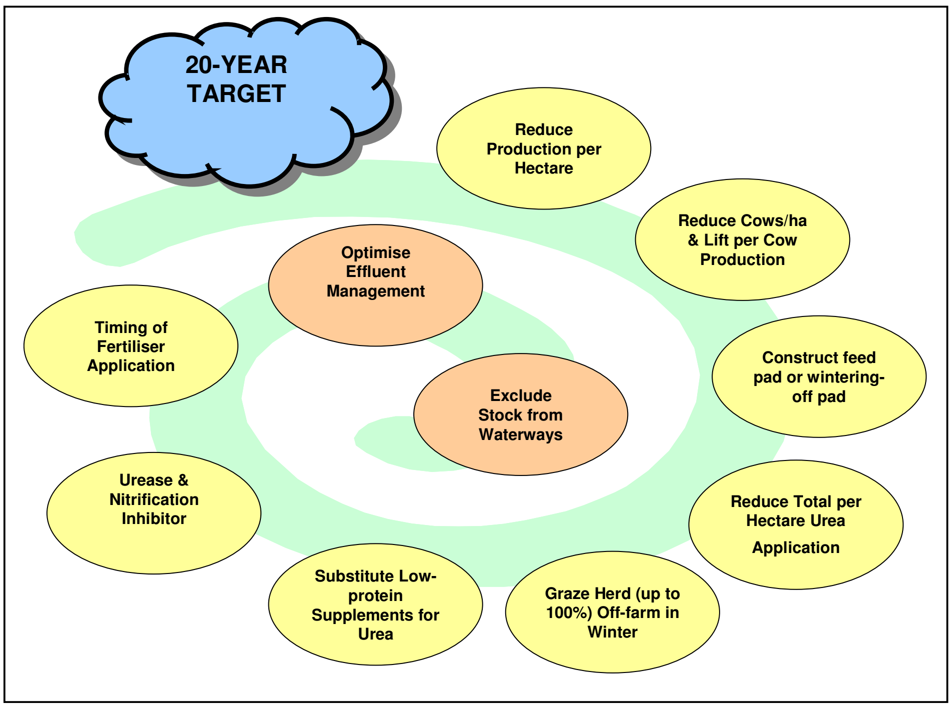


Figure 7: Progressive approach to strategy adoption to achieve N-loss targets.

Cost and effectiveness of mitigation options

The real impact of particular strategies in reducing N-loss, and the cost of implementation, can only be assessed or modelled case-by-case.

However, the case studies provide an indication of both the order of impact of mitigation strategies on N-loss reduction and cost. Clearly, the combination of strategies used and the order in which they are adopted by farmers to meet N-loss targets is speculative. However, it is reasonable to assume that mitigations that provide reliable N–loss reduction benefits at least cost will be preferentially adopted. Equally, where the choice is between options that involve either capital investment or result in increased annual cost of business, farmers will initially favour options that avoid significant capital investment. An example is removing cows from pasture grazing over the winter. Similar benefit can be expected from grazing the cows off-farm compared to constructing a wintering/feed pad, and farmers are expected to initially favour grazing cows off-farm, however over time as demand for grazing increases and grazing-off is tempered by some bad experiences, some farmers can be expected to invest capital in wintering/feed pads.

The incidence associated with a mitigation option relates to the number of case studies where the strategy was identified as being required or provided an option to mitigate N-loss.

The range of N-loss impact is as detailed in each case study. In some cases, no N-loss impact was attributed to an option and this is noted as a zero.

The cost estimate is based on the assumptions detailed in each of the case studies.

The range in values for N-loss reduction and cost of implementation calculated across the case study farms is detailed in Table 17. Average values are detailed, but these have been subject to some adjustment in final calculation of costs across each of the four groups. A range of values use in these calculations is included in Appendix 2.

Table 17: Mitigation Strategies: Impact on N-loss reduction and cost of implementation.

Minimising Direct-to-Waterway Contamination

Rule	Issue	Mitigation strategies	Impact on N-loss	Capital Cost	Annual Cost
CSA	Animal defecation direct to waterways	Fencing waterways to exclude stock	• Incidence 8/20 • Range = 0 to -2 kg N/ha • Average = -1 kg N/ha	• Incidence 8/20 • Range = $2,200 to $17,400/farm • One large cost at $59,200 • Average = $6,700/farm • Weighted average = $5,300	• Incidence 3/20 • Range $1,060 to $6,400 • Average $3,400 • Weighted average = $500
CSA		Installation of culverts and bridging at stock crossings	• Incidence 8/20 • Range = 0 to -0.6 kg N/ha	• Range = $3,400 to $73,000/farm	

Minimising Direct-to-Waterway Contamination

			• Average = 0	• One large cost at $300,000 • Average = $25,000/farm • Weighted average = $8,800	
13-3	Faecal contamination of waterways	Relocate or redesign animal intensive activities so that faecal material flow direct to watercourse is avoided	• Incidence 3/20 • Range = 0 • Average = 0	• Incidence 3/20 • Range = $1,000 to $2,000 • Average = $1,500 • Weighted average = $200	
13-5		Re-site animal waste/ offal pits	• Incidence 3/20 • Range = 0 • Average = 0	• Incidence 3/20 • Range = $1,000 to $1,500 • Average = $1,200 • Weighted average = $200	

Minimising Direct-to-Waterway Contamination and Reducing N-loss

Rule	Issue	Mitigation strategies	Impact on N-loss	Capital Cost	Annual Cost
Current consents	Ponding, over-land flow and direct-to-drainage flow	Increase the land area to which effluent is applied to reduce total nutrient loading	• Incidence 8/20 • Range = 0 to -7 • Average = -1	• Incidence 8/20 • Range = $1,000 to $32,000 • Average = $14,000 • Weighted average = $14,000	• Credit based on reduced fertiliser application
13-6		Revise rate of effluent application to be consistent with soil infiltration rate. Precursor is appropriate sized area	• Incidence 3/20 • Range = 0 to -3 on selected blocks • Average = -1	• Incidence 3 /20 • Range = $0 to $31,500 • Average = $2,000 • Most likely = $6,000	
13-3	Contamination of waterways	Re-site silage/feed storage and/or redesign to stop leachate discharge	• Incidence 1/20 • Range = 1/20	• Incidence 1 /20 • Cost = $180,000 • Most likely = $150,000	
13-6		Provide effluent storage to avoid application during periods of high soil moisture content	• Incidence 4/20 • Range = 0 to – 2.6 • Average = -1	• Incidence 4 /20 • Range = $1,500 to $49,300 • Average = $16,700 • Most likely = $26,000	
13-1		Grazing dry cows off-farm for up to 10 weeks through May-July period	• Incidence 7/20 • Range = -1 to -9 • Average = -3.8		• Incidence 7/20 • Range = cr$7,000 to $18,400 • Average = $12,000
13-1		Use a sealed wintering pad/stand-off pad with effluent collection	• Likely benefit = -4	• Most likely = $200,000	
13-1		Create wetland attenuation zones where runoff occurs	• Incidence 1/20 • Range = -0.9	• Incidence 1 /20 • Most likely = $15,000	

Reducing N-loss

Rule	Issue	Mitigation strategies	Impact on N-loss	Capital Cost	Annual Cost
13-1		Avoid winter (May, June, July)	• Incidence 5/20		• Incidence 5 /20

Minimising Direct-to-Waterway Contamination

	application of N	• Range = -1 to -4 • Average = -1.8	• Range = $0 to $20,000 • Average = $7,200 • Weighted average = $1,100
13-1	Restrict N fertiliser application on effluent application area to a maximum of 150 kg N/ha (inclusive of both effluent plus fertiliser)	• Incidence 3/20 • Range = 0 to -4 • Average = -2	• Incidence 3 /20 • Range = $350 to $3,000 • Most likely = $700
13-1	Decrease urea usage by 100 kg/ha and substitute low protein content supplements for nitrogen use	• Incidence 8/20 • Range = -1 to -4 • Average = -2.2	• Incidence 8 /20 • Range = $0 to $22,800 • Average = $7,800 • Most likely cost = 10c/kg DM • Weighted average = $13,000
13-1	Use urease and nitrification inhibitors	• Incidence 12/20 • Range = -1 to -6 • Average = -4.6	• Applied to milking platform only (130 ha avg.) • Urease inhibitor = -$3,600 /farm • Nitrification inhibitor = $12,000 /farm net at 6% benefit
13-1	Decrease stocking rate and production per hectare	• Incidence 3/20 • Range = -1 to -3 • Average = -2	• Incidence 3 /20 • Range = $60,000 to $100,000 • Average = $78,000

Cost of achieving compliance

FARM strategy preparation and ongoing costs of evidencing compliance

Cost estimates provided in the FARM Strategy test farms project[1] ranged from a low of $1,500 where regional LUC mapping is used and farmer's time is costed; $2,300 to $5,000 where mapping verification may be required and external specialists are employed; to greater than $10,000 in complex situations and where farm-scale LUC mapping is required.

The One Plan is not specific on how compliance with the FARM Strategy will be required to be evidenced. When OVERSEER is used to model N-loss, the indicated outputs assume that best practice management is applied and operated for effluent management, fertiliser application, supplementary feed management and livestock grazing.

It is expected that that farmers will be required to retain detailed records for each year that demonstrate:

- compliant management practice around effluent application area, effluent application nutrient loadings and timing
- compliance with fertiliser type, application rate, time of application and specific area fertilised
- compliance around supplement type, quantity, area fed out on or area grazed by stock fed supplement, and quantity and location of supplement harvested
- compliance around number and timing of classes of stock that graze on and off respective land areas and classes

Recording and retrieving such evidence of management and practice is expected to involve additional ongoing cost for each business. Our estimate for a likely cost of this additional record keeping is 4 hours of management time per month. Fair value for this time is estimated to be $60/hour.

Assumptions:

- 5% of FARM Strategies will be prepared at an initial cost of $1,500.
- 35% of FARM Strategies will be prepared at an initial cost of $2,300
- 40% of FARM Strategies will be prepared at an initial cost of $5,000
- 20% of FARM Strategies will be prepared at an initial cost of $10,600

- Accordingly, the weighted average cost of preparing FARM Strategies is estimated to be $5,000 per farm

- A processing fee of $500, paid to the Regional Council, will be incurred for each FARM Strategy submitted

- The annual cost of additional data recording and analysis to evidence compliance is estimated at $2,880 per farm

Clean Streams Accord compliance

The need to take action to minimise direct-to-waterway contamination from both livestock grazing and stock crossings, and also to reduce nitrogen loss associated with effluent system management is an issue for sixteen of the eighteen dairy farm case studies.

From the case studies, achieving compliance appears likely to involve a combination of actions, 90% of which, based on the Accord targets, should be completed by the end of 2012 (Table 18).

Assumptions:

- actions and costs associated with achieving the Clean Streams Accord targets are separate from the One Plan implementation cost

Table 18: Clean Streams Accord (CSA): Attributable actions and costs.

Rule	Actions and Cost	Capital Cost	Annual Cost
CSA	a small number of farms (estimated 5%) will incur disproportionately large expenditure to achieve compliance around stock crossings. This could involve 20 farms with a cost of $100,000 per farm for crossings and bridging	$2,000,000	
CSA	40% of farms (170 farms) require additional fencing of waterways at an average cost of $5,300 per farm	$901,000	
	15% of farms (65 farms) will lose significant grazable land which will result in a decrease in production of $3,400 per farm.		$221,000
CSA	40% of farms (170 farms) require additional culverts and stock crossings at an average cost of $8,800 per farm	$1,496,000	

Compliance with current consent conditions

Across the region, the issue of compliance with existing consents has been highlighted in the case study process.

The predominant outstanding issue is the area over which effluent is applied.

Based on the case study results, we have assumed that 40% of farms in the target water management need to expand the area over which effluent is applied to be compliant with current consents (Table 19).

Table 19: Compliance with Current Consent Conditions (CCC)

Rule	Actions and Cost	Capital Cost	Annual Cost
CCC	40% of farms (170 farms) need to expand the area over which effluent is applied at an average cost of $14,000 per farm	$2,380,000	

One Plan compliance

As previously noted, in Table 11 and Figure 5, there is a range of factors that contribute to the current level of a farms nitrogen loss and the level of reduction in nitrogen loss that will be needed 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.

Table 20: Group 1 Farms - Dairy Land with >1,200mm rainfall and where LUC Class I, II & III is <50% of regional average

- Number of farms in target 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	17	16	15
	Cumulative Reduction in N-loss		**-11**	**-13**	**-14**	**-15**
Rule	**Mitigation**	**Estimated N-loss reduction (kg/ha)**	**Implementation Cost Year 1**	**Year 5**	**Year 10**	**Year 20**
	Capital Expenditure					
CSA	Fencing 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		8 farms @ $200,000 per farm = $1,600,000	8 farms @ $200,000 per farm = $1,600,000	
13-3	Re-site silage /feed storage	0	3 farms @ $150,000= $450,000			
13-5	Re-site animal waste/offal pits	0	48 farms @ $200 = $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			

		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	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	Grazing 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 & 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	Decreasing 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 21: Group 2 Farms - Dairy Land with >1,200mm rainfall only

- Number of farms in target 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					
CSA	Fencing 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-site silage /feed storage	0	4 farms @ $150,000= $600,000			
13-5	Re-site animal waste/offal pits	0	86 farms @ $200 = $17,200			
13-6	Reduce rate of effluent application	-1	43 farms @ $6,000 = $258,000			
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	Grazing 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 & 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 22: Group 3 Farms - Dairy Land where LUC Class I, II & III is <50% of regional average only

- Number of farms in target 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	19	18	17	16
	Cumulative Reduction in N-loss		**-2**	**-3**	**-4**	**-5**
Rule	**Mitigation**	**Estimated N-loss reduction (kg/ha)**	**Implementation Cost Year 1**	**Year 5**	**Year 10**	**Year 20**
	Capital Expenditure					
CSA	Fencing 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-site 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			
	Annual Cost of Operation					
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2		106 farms @ $700 per farm = $74,200	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 & 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 23: Group 4 Farms - Dairy land where LUC Class and rainfall constraints are excluded

- Number of farms in target 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	27	24	22	21
	Cumulative Reduction in N-loss		**+3**	**0**	**-2**	**-3**
Rule	**Mitigation**	**Estimated N-loss reduction (kg/ha)**	**Implementation Cost Year 1**	**Year 5**	**Year 10**	**Year 20**
	Capital Expenditure					
CSA	Fencing waterways	-1				
CCC	Increase effluent area	-1				
13-3	Re-site silage /feed storage	0	8 farms @ $150,000= $1,200,000			
13-5	Re-site 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					
13-1	Restrict N fertiliser application on effluent area to 150 kg/ha max	-2		45 farms @ $700 per farm = $31,500	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

Economic analysis

Introduction

Discounted cashflows

The methodology to analyse costs that vary in their timing is to use discounted cashflow, where future costs are converted to a present cost using discounting techniques. Normally, any project would involve future costs and benefits being discounted back to a Net Present Value.

In this study, we do not have a market value of the expected environmental benefits. Consequently we only have the present value of future costs.

Discount rates

The Net Present Cost is significantly dependent on the discount rate chosen – a high discount rate has the impact of lowering the significance of future costs and benefits, while a low discount rate increases the significance of future costs and benefits.

The New Zealand Treasury[11] has recently reviewed its real discount rate to be used in Government investment projects and has chosen a real rate of 8.0% per annum. This is a relatively high rate and reflects both the Crown's cost of borrowing and the cost of taxation – the expected opportunity cost associated with taxing the private sector and reducing the returns from private investment activity.

Another option is to use the average returns to dairy farming as their cost of capital, given most of the costs are imposed on dairying.

The return on dairy farm assets has averaged 9.38%[12] over the last 10 years. Given an inflation rate of 2.8%, the real rate would be 6.4%.

Consequently, a discount rate of between 6.4% and 8.0% would be appropriate to use.

Cashflows

Cashflows have been developed for six components that will impact on farms, particularly dairy farms within the target Water Management Zones as identified in Rule 13.1 of the Proposed One Plan. These are detailed in Table 24.

The cashflows have been developed for 30 years.

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[11] http://www.treasury.govt.nz/releases/publications/guidance/costbenefitanalysis
[12] Table 76 Dairy NZ Limited, 2008. Dairy NZ Economic Survey, 2006-07

Table 24: Cashflow (including both capital and ongoing annual costs).

Year	Clean Streams Accord		Compliance with CCC		Rule 13-3		Rule 13-5		Rule 13-6		Rule 13-1	Combined POP		Total Cashflow		Total Cashflow/Farm	
	Within WMZ	Rest of Region	Within WMZ	Rest of Region	Within WMZ	Rest of Region	Within WMZ	Rest of Region	Within WMZ	Rest of Region		Within WMZ	Rest of Region	Within WMZ	Rest of Region	Within WMZ	Rest of Region
																428	438
2010			$2,396,800	$2,452,800			$17,120	$17,520	$2,425,728	$1,465,548		$2,442,848	$1,483,068	$4,839,648	$3,935,868	$11,308	$8,986
2011							$17,120	$17,520	$2,425,728	$1,465,548		$2,442,848	$1,483,068	$2,442,848	$1,483,068	$5,708	$3,386
2012	$4,772,200	$4,883,700			$3,306,300	$3,383,550	$17,120	$17,520	$2,425,728	$1,465,548	$3,134,000	$8,883,148	$4,866,618	$13,655,348	$9,750,318	$31,905	$22,261
2013	$218,280	$223,380			$96,300	$98,550	$17,120	$17,520	$2,425,728	$1,465,548	$3,304,540	$5,843,688	$1,581,618	$6,061,968	$1,804,998	$14,163	$4,121
2014	$218,280	$223,380			$96,300	$98,550	$17,120	$17,520	$2,425,728	$1,465,548	$3,304,540	$5,843,688	$1,581,618	$6,061,968	$1,804,998	$14,163	$4,121
2015	$218,280	$223,380			$96,300	$98,550					$3,304,540	$3,400,840	$98,550	$3,619,120	$321,930	$8,456	$735
2016	$218,280	$223,380			$96,300	$98,550					$3,304,540	$3,400,840	$98,550	$3,619,120	$321,930	$8,456	$735
2017	$218,280	$223,380			$96,300	$98,550					$4,904,540	$5,000,840	$98,550	$5,219,120	$321,930	$12,194	$735
2018	$218,280	$223,380			$96,300	$98,550					$4,268,440	$4,364,740	$98,550	$4,583,020	$321,930	$10,708	$735
2019	$218,280	$223,380			$96,300	$98,550					$4,268,440	$4,364,740	$98,550	$4,583,020	$321,930	$10,708	$735
2020	$218,280	$223,380			$96,300	$98,550					$4,268,440	$4,364,740	$98,550	$4,583,020	$321,930	$10,708	$735
2021	$218,280	$223,380			$96,300	$98,550					$4,268,440	$4,364,740	$98,550	$4,583,020	$321,930	$10,708	$735
2022	$218,280	$223,380			$96,300	$98,550					$6,318,440	$6,414,740	$98,550	$6,633,020	$321,930	$15,498	$735
2023	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2024	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2025	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2026	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2027	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2028	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2029	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2030	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2031	$218,280	$223,380			$96,300	$98,550					$5,219,640	$5,315,940	$98,550	$5,534,220	$321,930	$12,930	$735
2032	$218,280	$223,380			$96,300	$98,550					$10,019,640	$10,115,940	$98,550	$10,334,220	$321,930	$24,145	$735
2033	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735
2034	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735
2035	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735
2036	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735
2037	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735
2038	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735
2039	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735
2040	$218,280	$223,380			$96,300	$98,550					$7,311,240	$7,407,540	$98,550	$7,625,820	$321,930	$17,817	$735

(a) Clean Streams Accord

Adoption of the Clean Streams Accord will have an impact on not only the 428 dairy farms within the target Water Management Zones but also on 438 farms outside of these zones. It is assumed that the impact of complying with the Clean Streams Accord will be similar for both groups of farms.

It is also assumed that the capital costs occur in 2012 when the industry expects to achieve the outcomes of the Accord.

There will be a small ongoing cost associated with the Clean Streams Accord because about 15% of farms will lose significant grazable land associated with fencing of waterways.

(b) Compliance with Current Consent Conditions

Some farmers face significant costs to expand the area over which they spread effluent in order to meet the current conditions of their consent. This is not a cost of the Proposed One Plan but is included as it is a cost that will need to be met now.

It is assumed that a similar requirement will need to be met by dairy farms outside the targeted Water Management Zones.

(c) Rule 13-3 Stock Feed Including Feed Pads

There will be both one-off costs associated with re-siting silage and feed storage sites and some ongoing costs associated with changing practices to avoid waterway contamination. This requirement is expected to apply to all dairy farms in the region and is assumed to occur from 2012.

(d) Rule 13-5 Offal Holes and Farm Dumps

There will be a cost associated with re-siting offal holes and farm dumps. However, this cost can be spread over five years as offal holes and dumps come to the end of their useful life and are replaced. The cost will apply to farms both within and outside of the target Water Management Zones.

(e) Rule 13-6 Farm Animal Effluent

Some farms will need to modify their effluent system to change application rates and provide effluent storage to avoid application during periods of high soil moisture. Virtually 90% of farms will need to spend significant capital to build effluent storage but the cost will be higher for Groups 1, 2 and 3 within the target Water Management Zones where most are likely to need to use a liner (high rainfall or coastal sands). Group 4 and those farms outside the target Water Management Zones are more likely to be able to build storage without using a liner (Table 25).

Table 25: Range in effluent storage costs.

Group	Cost of Effluent storage
Group 1	$36,780
Group 2	$35,400
Group 3	$34,200
Group 4	$16,200
Average within target WMZs	$28,338
Rest of Region	$16,730

In general, the cashflow per farm within the Target Water Management Zones reaches a peak of $32,000 in 2012, when the capital requirements of Clean Streams Accord and Rule 13-3 and the operating costs of Rule 13-1 to meet Year-1 requirements occur. From then on, the annual costs are $8,500-$13,000 per annum for most years until 2032 when they increase as farms need to meet Year-20 targets.

For farmers outside the Target Water Management Zones, the cost peaks in 2012, to meet Clean Streams Accord and Rule 13-3, and decline to less than $1,000 per year after 2014.

(f) Rule 13.1 Dairy Farming, Cropping, Market Gardening and Intensive Sheep and Beef Farming and associated activities

These will apply in the first instance to all intensive farms in the target Water Management Zones and to any farm in the region that converts to an intensive use. While a phase-in across Water Management Zones from 1 April 2009 to 1 April 2015 was indicated in the proposed plan, we have chosen to assume that they all start on 2012. The reason for this is that the analysis is focusing on the range of costs between our four groups of farms rather than the year that the rule comes into force.

Net present costs

The present value of future costs for the 428 farms within the target Water Management Zones are shown in Table 26.

In paragraph (a) the impact of the selected discount rate is indicated.

For the total Proposed One Plan, costs associated with the Clean Streams Accord and compliance with existing consent conditions, a 1% increase in discount rate decreases the Net Present Cost by almost 10%. However, the impact is more significant for those items where the cost occurs in the distant future compared to those that have a higher proportion of their costs in the near future, e.g. a 1% change in discount rate from 6% to 7% decreased the cost of Rule 13-1 by 12%, but decreases the cost of the Clean Streams Accord by only 5%.

In part (b) we have considered the impact of the costs across the four groups of farms in the target Water Management Zones.

The Net Present Cost (6.5% discount rate) for a Group 1 farm is $516,470 to meet the Clean Streams Accord, to comply with current consents and to comply with the Proposed One Plan, but only $86,900 for Group 4 farms.

In part (c) we consider the cost of meeting the Year-1, -5, -10 and -20 requirements associated with Rule 13-1 for the different groups of farms.

In general, the Net Present Cost per farm for the 428 farms of meeting the Rule 13-1 Year-1 requirement is $93,234. The additional Net Present Cost of meeting Year-5 standards is an extra $19,463. Year-10 requirements involve an extra $13,139 in Net Present Cost, with a further $10,251 to meet Year-20 standards.

The impact varies significant between Group 1 and 4 farms, especially in meeting Year-1 targets. Group 1 farms will have a Net Present Cost to meet Year-1 targets of $333,535, while Group 4 farms will experience a Net Present Cost of $37,215.

Table 26 Present Value of Future Costs for 428 Farm Businesses Within Target Water Management Zones

(a) Sensitivity to Discount Rates

	Discount Rates				
	5%	**6%**	**6.5%**	**7%**	**8%**
Clean Streams Accord (CSA)	$7,278,153	$6,851,635	**$6,660,496**	$6,482,216	$6,159,490
Compliance With CCC	$2,396,800	$2,396,800	**$2,396,800**	$2,396,800	$2,396,800
Rule 13-3	$4,300,217	$4,091,593	**$3,997,254**	$3,908,729	$3,747,015
Rule 13-5	$77,827	$76,443	**$75,770**	$75,109	$73,824
Rule 13-6	$11,027,239	$10,831,132	**$10,735,784**	$10,642,181	$10,460,047
Rule13-1	$71,469,353	$62,241,874	**$58,241,256**	$54,592,704	$48,210,355
Cost of Proposed One Plan (POP)	$86,874,636	$77,241,042	**$73,050,064**	$69,218,723	$62,491,241
Cost of POP, CSA & CCC	$96,549,589	$86,489,477	**$82,107,360**	$78,097,739	$71,047,531
Cost of POP/farm	$202,978	$180,470	**$170,678**	$161,726	$146,008
Cost of POP, CSA & CCC/farm	$225,583	$202,078	**$191,840**	$182,471	$165,999

(b) Cost Per Farm Group (at 6.5% Discount Rate)

	Group			
	1	**2**	**3**	**4**
No of Farms	48	86	142	152
Clean Stream Accord	$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
Rule 13-6	$1,562,696	$2,694,780	$4,298,690	$2,179,617
Rule13-1	$21,755,287	$22,327,281	$7,792,620	$6,366,069
Cost of POP	$23,774,771	$25,840,472	$13,442,640	$9,992,181
Cost of POP,CSA &CCC	$24,790,542	$27,660,396	$16,447,631	$13,208,790
Cost of POP/farm	$495,308	$300,471	$94,666	$65,738
Cost of POP,CSA &CCC/farm	$516,470	$321,633	$115,828	$86,900

(c) Cost of Each Stage of Rule 13-1 (at Discount Rate of 6.5%)

	Group				
	1	**2**	**3**	**4**	**Total**
	48	86	142	152	428
Year 1	$16,009,666	$12,948,914	$5,284,489	$5,656,636	$39,899,705
Year 5	$2,556,560	$4,090,044	$1,445,149	$238,586	$8,330,339
Year 10	$751,492	$4,233,558	$211,357	$427,275	$5,623,682
Year 20	$2,437,569	$1,054,765	$851,625	$43,572	$4,387,531
Total	$21,755,287	$22,327,281	$7,792,620	$6,366,069	$58,241,257
Cost/Farm					
Year 1	$333,535	$150,569	$37,215	$37,215	$93,224
Year 5	$53,262	$47,559	$10,177	$1,570	$19,463
Year 10	$15,656	$49,227	$1,488	$2,811	$13,139
Year 20	$50,783	$12,265	$5,997	$287	$10,251

Impact of varying the rate of implementation

The Net Present Cost of implementing Rule 13-1 at the discount rate of 6.5% and beginning in 2012 is $58.2m. Delaying the implementation by a year reduces the Net Present Cost to $54.6m; a decrease of 6.7%. The change in costs of delaying the implementation for each year for five years is shown in Table 27.

Table 27 Net present costs for implementing Rule 13-1 (at discount rate of 6.5%)

Start of Implementation	Net Present Cost ($m)
2012	$58.2m
2013	$54.7m
2014	$51.3m
2015	$48.2m
2016	$45.3m
2017	$42.5m

Of course delaying implementation also delays the arrival of the benefits.

An alternative option is to delay the start of Rule 13-1 to reduce the pressure of complying with the Clean Streams Accord, Rule 13-3, Rule 13-5, Rule 13-6 and Rule 13-1 in the same year, but not to reduce the Year-20 target, as detailed in Table 28.

The Net Present Cost of this alternative option at 6.5% discount rate is $46.88m; a reduction of 19%.

Table 28: Alternative scenario for implementation of Rule 13-1 targets.

Implementation	One Plan Proposed Targets	Alternative Scenario Targets
2012	Clean Streams Accord	Clean Streams Accord
	Rule 13-3	Rule 13-3
	Rule 13-5	Rule 13-5
	Rule 13-6	Rule 13-6
	Rule 13-1 Year-1	
2015		Rule 13-1 Year-1
2017	Rule 13-1 Year-5	
2020		Rule 13-1 Year-5
2022	Rule 13-1 Year-10	
2025		Rule 13-1 Year-10
2032	Rule 13-1 Year-20	Rule 13-1 Year-20

Regional impacts

Introduction

Given a significant impact upon an individual industry, it is appropriate to assess how that effect will flow on to the whole economy. Input-output economics using a multiplier approach is often the preferred tool of the analyst. While input-output analysis has some significant limitations, it remains the most useful tool available.

Application of input-output to the Proposed One Plan

Input-output multipliers are generally applied to the change in output caused by the impacting agent, ie. a dairy farming output multiplier for a Horizons Region economy transaction table for June 2004 is 1.58. For every million dollars of output, the flow-on effect on the regional economy is $0.58 million of output – caused by the purchases by dairy farmers and subsequent rounds of purchases within the regional economy.

However, the impacting agent (the Proposed One Plan) is not so much changing farm output and revenue; it is more associated with changing the costs.

In fact the only reductions in production and revenue are caused by:

(a) The Clean Streams Accord where approximately 15% of farms within the Target Management Zone (64 farms) will lose $3400/farm - $218,280/annum.

(b) 20 farms in Group 1 who probably will need to destock to meet Table 13-2 (POP) requirements in Year 20.

    20 farms @ $80,000/farm = $1,600,000

Assuming these impacts relate to current farm performance (2008/09) the impact of the $3,400 or $80,000 per farm would relate to revenue of $5.53/kg MS less variable costs of production of $2.51/kg MS – a margin of $3.02/kg MS.

The gross output or revenue associated with the net margin of $218,280 due to the Clean Stream Accord is a gross revenue of $397,530 at $5.50/kg MS.

In the same way, the margin of $1.6m due to destocking in Year-20 reflects a gross income of $3.31m. However, as this does not occur for over 20years, there is considerable uncertainty due to technology changes and changes in relative costs and prices over the period.

The changes in costs of over $3 million every year are more significant. However, to apply input-output analysis to determine the impacts on the extra regional economy requires a more complex and time consuming analysis.

The impact could well be "positive" in that if the expenditure is on goods and services that have a higher regional content than the expenditure of "profit" on consumption of imported goods (overseas holidays, new cars and luxury goods), then there may be gains in regional economic activity.

To calculate this would require the development of full input data including household consumption with and without the Proposed One Plan and the insertion of these "new" industries into the transaction table to estimate flow-on effects.

Input-output impacts of the change in revenue due to the Proposed One Plan

Significant land use changes will have a range of economic impacts upon the local economy. Economic impacts can be measured in a number of ways. These include: total output (sales); value added (returns to land, labour and capital, earnings before interest tax depreciation and amortisation (EBITDA), plus wages and salaries and gross regional product); and household income and employment (full-time equivalents (FTEs)).

Jenson and West (1986)[13] defined three decisions to make in assessing any economic impact study:

1. Defining the impacting agent
2. Defining the boundaries of the economy in which impacts are to be measured
3. Choosing the most appropriate methodology and defining the impacts to be measured

Impacting Agent

The impact of the Proposed One Plan upon farming in the target water catchments at Year-20 – a change in regional income of $3.31 million.

The Boundaries

The boundaries of the economy are confined to the Horizons Regional Council's boundary. This means that forward linkages (milk processing) are very small given that 90% of the milk produced in Horizons region is processed outside the region in Taranaki and that less than 10% of milk is processed within the region (Longburn, Pahiatua).

Meat processing of cull dairy cows occurs both within region and outside (Taranaki, Wellington and Hawkes Bay) but is a smaller part of the impact).

Methodology

Note: Impacts are not benefits. If you run a business and sell $100 worth of goods, how much better off are you? It is not $100, the value of the turnover; it is not even the value added (maybe $40), because you could have done other things – opportunity cost. It is only part of the value added.

Assumptions

- We have used a June 2004 table and have deflated milk prices from the current level to the value in that year and have then used the CPI to inflate the flow-on output effect to 2009 dollars.
- We have used average multipliers for an impacting event that is marginal in its impact.
- We have used a derived table with no inserted survey data

It is important to recognise the assumptions are significant and the results are "ball-parkish".

Dairy cattle farming multipliers

Table 29: Dairy cattle farming multipliers.

	Direct	Indirect	Induced	Total	Flow-on

[13] Jensen, R.C. and West, G.R. (1986). Input-Output for Practitioners: Theory and Applications. Australian Regional developments No.1. Australian Government Publishing Service, Canberra.

Output multipliers	1.0	0.33	0.25	1.58	0.58
Employment multiplier (FTE/$m)	6.1	2.4	1.5	10.0	3.9
Value added	0.63	0.16	0.13	0.92	0.29
Net household income	0.20	0.07	0.04	0.31	0.11

The multipliers represent technical relationships that exist between the dairy farming sector and other sectors in the Manawatu Wanganui regional economy.

For every $1 in output from dairy farming, there is a flow-on increase in output of 58 cents in the Manawatu Wanganui regional economy; 33 cents of this is due to economic activity simulated by purchased inputs into the farm; and 25 cents is due to the impact of consumption stimulated by wages and salaries paid on both the farm and in the sectors supplying inputs to the farm.

In terms of value added ratios, the multipliers indicate that for every $1 of output from dairy farming, there are 63 cents of added value created, and for every 63 cents of added value on the farm, there are a further 29 cents of added value created within the regional economy.

Looking at regional household income, for every $1 of output from dairy farming, there are 20 cents of household income created on the farm and a further 11 cents in the regional economy.

For every $m of output from dairy farms, there are an additional 6.1 jobs on the farm and a further flow-on effect of 3.9 jobs in the wider economy.

However these ratios all relate to a 2004 transaction table. Looking at the 2032 impact, measured in 2009 dollars, the 3.31m of direct output needs to be deflated using 2004 milk prices; the multiplier applied and the estimated flow-on effect in 2004 dollars inflated by using either the CPI or wage index to estimate the flow-on effects in 2009 dollars.

The result of this process is shown in Table 30.

Table 30 Multiplier Effect Adjusted to 2009 Values

	Impact
Direct Effect	$3.31 million
Flow-on Output Effects	$1.72 million in output
Flow-on Value Added	$0.90 million
Flow-on Net Household Income	$342,000

Based on this approach, the flow-on impacts of the reduction in dairy farm output do not appear to be significant in terms of the total regional economy.

References

AgResearch, 2009a. FARM Strategy - Overview Report. Report prepared for Horizons Regional Council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009b. FARM Strategy – Farm 1: Dairy conversion – Norsewood. Report prepared for Horizons Regional Council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009c. FARM Strategy – Farm 2: Irrigated beef finishing unit – Oringi. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009d. FARM Strategy – Farm 3: Intensive dairy – Feilding. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009e. Farm Strategy – Farm 4: Intensive mixed cropping – Marton. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

AgResearch, 2009f. FARM Strategy – Farm 5: Dairying under irrigation – Foxton. Report prepared for Horizons Regional council by Bob Longhurst, AgResearch Ltd.

Clark, M.; Roygard, J.. 2008. Land Use and Land Use Capability in the Manawatu-Wanganui Region. Report No: 2008/INT/616. Horizons Regional Council.

Dairy NZ Limited, 2008. Dairy NZ Economic Survey, 2006-07

DairyNZ, 2009. Jack & Rosemary Koot's Dairy Farm, Pukepuke Road, Oroua Downs. FARM Strategy. Prepared by Scott Ridsdale & Mike Bramley.

Jensen, R.C. and West, G.R. (1986). Input-Output for Practitioners: Theory and Applications. Australian Regional developments No.1. Australian Government Publishing Service, Canberra.

LandVision, 2009a. FARM Strategy Summary Report. Prepared for Horizons Regional Council by LandVision Ltd., Wanganui.

LandVision, 2009b. Moutoa M Dairy Farm, Landcorp, Foxton. FARM Strategy for Horizons Regional Council. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009c. Ivo Farms, C & B Jansen, Forest Road, Kimbolton. FARM Strategy. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009d. Martyn Farm, Taylor Road, Sanson. FARM Strategy. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009e. River Farm, Whirokino Farm Ltd., SH1, Foxton. FARM Strategy. Prepared by LandVision Ltd., Wanganui.

LandVision, 2009f. Hokio Farm, G & C Kane, Hokio Beach Road, Levin. FARM Strategy for Horizons Regional Council. Prepared by LandVision Ltd., Wanganui.

Livestock Improvement Corporation Limited, 2008. New Zealand Dairy Statistics 2007-08.

Livestock Improvement Corporation Limited, 1998. New Zealand Dairy Statistics 1997-98.
Livestock Improvement Corporation Limited, 2004. New Zealand Dairy Statistics 1993-94.

Ministry of Agriculture and Fisheries, June 1994. MAF Farm Monitoring Report, North Central, June 1994.

Ministry of Agriculture and Forestry, 1998. MAF Farm Monitoring Report, North Central Region, July 1998.

Ministry of Agriculture and Forestry, 2007. MAF Pastoral Monitoring Report, 2007.

Ministry of Agriculture and Forestry, 2008. MAF Pastoral Monitoring Report, 2008.

Ministry of Agriculture and Forestry, 2009. Lower North Island Dairy Report, 2009.

Manderson A. and Mackay A., 2008. FARM test farms project: Testing the One Plan approach to contaminant management and linking the FARM strategy to the SLUI Whole Farm Plan Design. A report by SLURI (Sustainable Land Use Research Initiative) for Horizons Regional Council

Sheppard Agriculture, 2009a. Reporting the effect and implications the One Plan and FARM Strategy has on individual dairy farm properties in the Tararua District. A case study approach. Prepared by Rachel Rogers, Sheppard Agriculture Ltd.

Sheppard Agriculture, 2009b. Reporting the effect and implications the One Plan and FARM Strategy has on individual dairy farm properties in the Tararua District. A case study approach – Further Analysis. Prepared by Rachel Rogers, Sheppard Agriculture Ltd.

Appendix 1. Case Study Farm Detail

Summary detail for each of the case studies is presented. For comprehensive data, refer to the respective FARM Strategy report.

	Farm Name	Farm type	Location	Rainfall (mm)	Total Farm Area incl. of support block (ha)	Effective Farm Area Dairy Unit(ha)	Irrigated	Cows Milked	Stocking rate TFA	Stocking rate EFA	MS/ha/yr (effective dairy unit)	N loss at survey - kg/ha/yr (whole farm)	N loss at survey - kg/ha/yr (dairy or crop unit)	N loss year 1 target - kg/ha/yr
1	Tutu Totara (Marshall)	Dairy	Marton	1141	373	305	Yes	800	2.14	2.62	1140		17	25
2	Tutu Totara (Marshall)	Crop	Marton	1141	108	108							24	30
3	Tutu Totara (Marshall)	Whole Farm	Marton	1141	778	596		800	1.03	1.34		16		25
4	Pencoed Trust Farm (Williams)	Crop	Marton	1047	115	111	No					30		31
5	Martyn	Dairy	Sanson	890	75.5	73.5	No	180	2.38	2.45	900	16		29
6	Flockhouse	Dairy/Drystock	Bulls	900	611	268	No	850	1.39	3.17	1340	18	23	24
7	Koot	Dairy	Oroua Downs	875	225	162	No	425	1.89	2.62	925	13		20
8	Johnston	Dairy	Foxton	837	257	220	Yes	730	2.84	3.32	1114	25		16
9	Whirokino Farm Ltd (Lewis)	Dairy	Waitarere	890	181	170	Yes	406	2.24	2.39	763	18		16
10	Hokio Farm (Kane)	Dairy	Levin	1040	161.5	146.5	No	370	2.29	2.53	880	26		26
11	Byreburn (Guy)	Dairy	Feilding	883	203	198	Yes	666	3.28	3.36	1780	37		29
12	Byreburn (Guy)	Dairy	Feilding	883	411	198	Yes	666	1.62	3.36	1780	28		29
13	Ivo Farms (Jensen)	Dairy	Kimbolton	970	321.5	297	No	509	1.58	1.71	889	18		27
14	Janssen	Dairy	Norsewood	1718	156	148	No	380	2.44	2.57	1284	28		19
15	Janssen	Dairy	Norsewood	1718	156	148	No	500	3.21	3.38	1284	40		19
16	Muskit Enterprises (Kelly)	Dairy	Matamau	1300	275	229	No	690	2.51	3.01	1270	34	34	16
17	Waka Dairies (Phillips)	Dairy	Kumeti	1200	265	245.5	No	800	3.02	3.26	1275	35		24
18	Barrow	Dairy	Maharahara	1200	112	94	Yes	250	2.23	2.66	1050	25		24
19	Windwood (Payne)	Dairy	Top Grass Rd	1500	90	76	No	153	1.70	2.01	442	25		21
20	Stoney Creek Partnership (Boyden)	Dairy	Woodville	1300	231	187	No	417	1.81	2.23	754	31	33	18
21	Oringi Farm (Arends)	Beef	Oringi	1168	227		Yes		3.20			19		25
22	Day	Sheep/beef	Ballance	1470	973	885	No	8369	8.60	9.46		10		11
23	Day	Dairy Conversion	Ballance	1470	973	243	No	656	0.67	2.70	891	15	30	13
24	Glenbrook (Billington)	Dairy	Hukanui	1865	188	166	No	368	1.96	2.22	830	26		20
25	Jala Enterprises (Galloway)	Dairy	Nireaha	2300	170	78	No	194	1.14	2.49	897	31	46	20
26	Moutoa M Farm (Landcorp)	Dairy	Foxton	1000	242.5	221	No	750	3.09	3.39	1200	32		29

Appendix 2 Mitigation Strategy Cost Assumptions

Effluent pond storage

- 350 cow herd
- 100 litres of effluent per day
- 90 days storage involves 3,150m^3 of effluent
- 4,000m^3 storage (e.g. 2.5m deep x 40m x 40m without allowance for batter)
- Construction cost estimate $16,000 plus lining cost of $20,000
- Total cost $36,000
- So Group 1, 2 & 3 all need liners - $36,000
- Group 4 no liner- $16,000
- Or $26,000 assuming 50% only need a liner

- The proportion of farms needing to construct effluent storage

	Group 1	Group 2	Group 3	Group 4
Construct Effluent storage	**90%**	**90%**	**90%**	**90%**

Effluent application rate reduction

- The requirement to reduce application rate to better match soil water infiltration capacity

	Group 1	Group 2	Group 3	Group 4
Need to reduce effluent application rate	**73%**	**50%**	**30%**	**30%**

- Travelling irrigator – range $4,000 to $7,000

Silage bunker

- 2 bunkers dimensions 15m x 30m x 2m wall with 10m front apron - $150,000 (650 cow herd - $230/cow)
- 13m x 68m x 2m - $150,000 (450 cow herd - $333/cow)

Feed pad

- 19.6m x 90m - $220,000 (450 cow herd - $488/cow)

Urease and nitrification inhibitor

- Best performance is in cooler soil temperatures and well drained soils
- Evidence about performance is very limited across the southern North Island (SNI) dairy districts
- At best, possibly a 6% gain in annual pasture production, but possibly nil

- 6% benefit on 12,000 kg DM annual production equates to an additional 720 kg DM.
- The cost of applying nitrification inhibitor twice per year is $200/ha.
- At this price, the additional 720 kg DM/ha is costed at 28 cent/kg DM.
- If this additional feed would otherwise be provided by additional urea application (10:1 response) at a cost of 15 cents/kg DM, the benefit from the improved efficiency of nitrogen utilisation resulting from use of nitrification inhibitor would be $108/hectare
- The net cost of nitrification inhibitor is 6 cents/kg DM or $92 for every treated hectare per year, assuming a 6% response.
- At nil pasture response, the cost is $200 per hectare
- To be cost neutral, an average response of an additional 920kg DM/ha would be required, equivalent to 11% DM/ha gain

DM Response Rate	Kg DM gain	Benefit	Net Cost/ha
0	0	$0	$200
2%	240	$36	$164
4%	480	$72	$128
6%	720	$108	$92
8%	960	$144	$56
10%	1,200	$180	$20

- Urease (Agrotain) cost is an additional $100/tonne and is assumed to provide an additional 4kg DM/kg N.
- Urea only response is 10:1 and Agrotain urea response is 13:1. Consequently 77% of Agrotain urea product is needed to equate to urea alone.
- Urea only application rate is 150 kg N/ha/yr, so across the average milking platform area of 130ha will involve 42.4 tonnes of urea at $700/tonne applied ($645/tonne plus $55/tonne application) at a cost of $29,680, or 32.6 tonnes of Agrotain urea at equivalent $800/tonne ($745 plus $55/tonne application) at a cost of $26,080.

• Overall cost	nitrification inhibitor	$92/ha x 130 ha	= $11,960
Urease (Agrotain)		=-$3,600	
Net		= $8,360	

Restricting total N application on effluent area to 150 kg/annum

- On a 350 cow herd the effluent area is approximately 14 ha (4ha/100 cows)
- Assume reduction from 200 kg/ha to 150 kg/ha
- Reduction in DM production on the 14 ha is 7,000kg DM (14 ha x 50 kg N x 10:1 response)
- Cost of substituting additional supplement to replace lost nitrogen boosted grass is 25 cents/kg DM less the cost of 15 cents/kg DM – 10 cents per kg DM
- Net cost is 7,000 kg DM at 10 cents per kg DM - $700 per farm

Avoid winter application of N

- Max 40 kg N/ha applied at 7:1 response = 280 kg DM benefit costs 22 c/kg DM.
- The additional cost of providing feed as hard supplement is 25 c/kg DM
- Net additional cost is 280 kg @ 3 cents = $8.50 per hectare
- Over 130 ha farm additional cost is $1,100 per farm

Replacing urea usage with low-protein maize silage

- Urea boosted pasture at a 10:1 response is costed at 15 cents per kg DM
- Maize silage is costed at 25 cents per kg DM
- The net cost of substitution is 10 cents per kg DM

Grazing dry cows off-farm in winter

- 350 cow herd, 130 ha dairy farm
- $18/cow/week for 8 weeks
- Transport cost of $40 inclusive of both away and return trips
- Total cost of grazing off $64,400
- Saving in feed/supplements by grazing
off 156,800 kg DM @ 25 cents /per kg DM $39,200
- Additional benefit in spring production due to reduced
pugging damage – 130 ha @ 400 kg DM @ 25 cents/kg $13,000
- Net cost of grazing off $12,200
- Net cost $94/ha or $35/cow

Appendix 3: Comments on other matters raised in Chairperson's Minutes #6

1. Comment on paragraph 5.7 of Chairperson's Minute #6

"Why was a trading regime for the nitrogen leaching/run-off values not included in the Proposed One Plan? What are the economic impacts of this?"

Trading regimes in transferable pollution permits may seem immoral but in reality it is no different from what is done in a regulatory environment where essentially the Proposed One Plan is permitting farmers to discharge nitrogen into the environment. The rationale for this is that polluters with high abatement costs will prefer to buy permits, while low abatement cost polluters will sell permits in favour of abating pollution. The overall standard is not threatened but achieved at minimum cost – the council could change the standard by buying in permits or selling more[14].

An example might be two similar catchments: Catchment A where there are two titles – one owned by a dairy farmer, one owned by a forester. The dairy farmer is subject to the Proposed One Plan limitation on nitrogen leaching given that he can only spread his nitrogen discharge over his dairy farm area.

The other similar catchment is only one title but the dairy farmer/forester has both enterprises within his title and is not effectively subject to the limitation on his dairy unit because he is able to spread his nitrogen leaching across both his dairy and forestry enterprises.

A trading regime would enable the dairy farmer in the first catchment to purchase "pollution" permits off the forester rewarding the forester for his low nitrogen discharge into the environment while allowing the dairy farmer to minimize the impact of the One Plan nitrogen leaching regime and for both "identical" catchments to leach a similar amount into the environment.

The assumption underlying such a trading regime requires that the quantum of nitrogen leaching/run-off is defined for a catchment. If the current estimates assumed that low intensive land use in the target Water Management Zones remained at their low level of nitrogen leaching and more intensive land use would reduce its impact over time, then a trading regime would not reach the target level of reduction.

[14] Meister A.D..1990. Environmental Regulation and Use of Economic Instruments for Environmental Planning and Management: An Overview. A Discussion Paper in Natural Resource Economics No 15, Massey University

2. Comment on paragraph 5.12 of Chairperson's Minute #6

"What are the key differences and similarities between a Clean Streams Accord nutrient budget, a nutrient management plan, a farm strategy and a farm-based nutrient management plan prepared by other councils?"

For several years now, fertilizer company representatives have been preparing a **nutrient budget** for their clients requesting soil tests. This has been done using the Overseer nutrient budget program. The output of the programme shows the level of nutrient inputs and outputs of the farmer's farming system. In particular, the nitrogen and phosphorus losses, phosphorus loss risk and potassium leaching.

However, the budget shows the losses and does not necessarily include a management programme to mitigate the losses and improve the environmental efficiency of the nutrients supplied to the system.

A **nutrient management plan** will use the output of the nutrient budget to make informed decisions about the various options available to the land manager to optimize their economic efficiency while minimizing their impact on the environment. It can involve changing the inputs and determining the impact on nutrient use and losses to the environment.

The **FARM (Farmer Applied Resource Management) strategy** is a process designed to assist farmers develop a management plan that will enable them to comply with Horizon One Plan Rule 13.1. The output would be essentially a checklist to ensure compliance.