IS IT POSSIBLE TO ENHANCE ENVIRONMENTAL PROTECTION ON A FARM WITHOUT SACRIFICING ALL YOUR FARM PROFITS?

Dwayne Cowin

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EXECUTIVE SUMMARY

Environmental protection to some degree is something that every sheep and beef farmer in the country is going to have to either deal with currently, or sometime in the near future. The degree of environmental protection will depend on the region's location and also the issues relevant to every individual farm, but it would be naive for anyone do think that doing nothing is an option.

The purpose of this project is to try and quantify some of the costs associated with environmental protection to an individual farmer and their farm. It is also about investigating whether farm policy changes or changes in management practices could generate increased income to cover the costs of environmental protection. Any changes to the farming system had to be sustainable though, and not have an increased environmental footprint.

The project focused on a case study 420 effective hectare sheep, beef, and dairy support farm in the King Country. The main costs associated with enhancing environmental protection included riparian fencing and planting, stock exclusion from native bush and wetlands, poplar pole plantings, and reticulated water system upgrades. The total cost for the farm is calculated to be $124,920, or $297/eff ha.

Scenario analysis was then conducted and different stock class policies were analysed, giving a lift in annual farm profit from current farm profits, ranging from $41,442 to $138,587. All of these scenarios required additional capital funds for capital stock purchases, ranging from $80,530 to $378,921.

All of the scenarios analysed were also modelled through computer nutrient budgeting software programme Overseer, and all scenarios either held or decreased nutrient outputs lost to water.

After comparing and contrasting all the scenarios, it was decided to implement a scenario that did not generate the highest lift in profit, but one which was relatively risk averse, and had the best fit with the vision and long term goals of the farm and farm shareholders.

In this case, it was possible to demonstrate that it was possible to enhance the level of environmental protection on a sheep and beef farm without sacrificing farm profits, however it did require stock class and policy change in order to fund this. Farms where stock class and policy change is not an option would have to look at increasing the performance of their current stock classes in order to achieve the same outcome.

FOREWORD

Having recently become an equity manager in a 450-hectare sheep, beef, and dairy support property in the King Country, the farm shareholders have a long term vision for the property that we want to one day sell the property in a better physical, financial, and environmental state than when we bought it.

In our case though, we wanted to quantify some of the costs associated with environmental protection, and also develop a farm system where extra farm income can meet these costs so the financial profit return from the farm is not negatively impacted. It was also important to us that a greater profit farm system did not increase our negative environmental outputs.

Hopefully not too much to ask, but as someone once said to me, 'where there is a will, there is a way!'.

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1. INTRODUCTION

New Zealand agriculture, and in particular the sheep and beef sector, has been coming under increasing pressure from a number of different angles in recent times.

With increasing rural land prices, and in some areas pressure of rural land use change into lifestyle or urban housing, increasing the size of the farming operation for many operators is limited. With volatile commodity prices, making profit increases from the same production output on farm has been difficult to budget on and achieve on a regular basis. These factors have seen a drive from many farming business operators to increase production 'within the farmgate'. This has resulted in both an increase in desirable products produced shown in Table 1, but also the associated increase in by-products produced as a result of increasing production.

Table 1: Export volume of beef, mutton, and wool in 2012 and 2015

	2012	**2015**
Beef (000 tonnes)	346	400
Mutton (000 tonnes)	254	296
Wool (000 tonnes)	113	126

(MPI, 2016)

At the same time as we have seen this drive for increasing production, the sector has been progressively coming under pressure to increase the sustainability of these production increases to meet environmental protection expectations both on-farm and further afield. These environmental protection expectations are set through a number of channels, be it either regulatory at a Central Government level (e.g. National Policy Statement for Freshwater Management) or at a Regional Council level (e.g. Waikato Regional Councils development of 'Healthy Rivers' documentation); or in a more intangible manner, such as contribution to our clean, green image and selling 'New Zealand's Story'.

Some of these protection measures include nutrient output limits on farm (e.g. Variation 5 around Lake Taupo), which on the surface would mean limits to further on farm production increases. Combined with fluctuating and unpredictable farmgate returns to operators making profit increases difficult through product price increases, farm business operators feel the squeeze from these pressures and wonder 'what can I do to keep my farm business operating?'

These pressures, which initially seem somewhat conflicting and lead to the long held belief by many that "you can't be green if you're in the red", formed the basis of my thinking as to whether there could be a way to increase environmental protection on farm, yet not have to sacrifice farm profits to achieve this.

2. AIMS AND OBJECTIVES

The aim of this project is to investigate:

"Whether it is possible to enhance environmental protection on a sheep and beef farm without having to sacrifice farm profits?"

Some of the objectives set out at the start of this project included:

- Investigating the cost associated with increasing environmental protection on a sheep and beef farm to a level above current council regulatory requirements,
- Look at how these costs could be funded from the farming business,
- Setting a bottom line that 'these environmental protection measures are to have a neutral financial impact on farm profit',
- Look at potential farm system changes that could be made to pay for the development,
- Setting another bottom line that 'any changes to the farm system are to have a neutral impact on farm nutrient output'.
- And also that these farm system changes could not have a wider detrimental impact on the environment.

Ultimately, it was about developing a more physically, environmentally, and financially efficient farming system in order to pay for increasing environmental protection on a sheep and beef farm.

3. BACKGROUND (LITERATURE REVIEW)

What is environmental protection?

For what is it worth, Wikipedia, (2016) defines environmental protection as:

"a practice of protecting the natural environment on individual, organisation controlled or governmental levels, for the benefit of both the environment and humans".

While this gives a broad introduction into what environmental protection means, of more importance is what is what environmental protection means to New Zealand and New Zealanders.

New Zealand's principal legislation document for environmental protection and management is the Resource Management Act (RMA), passed in 1991. The core purpose of the RMA is to promote the sustainable management of natural and physical resources such as land, air, and water. In the RMA it defines sustainable management as:

"managing the use, development and protection of natural and physical resources in a way, or at a rate which enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while-

(a) Sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) Safeguarding the life-supporting capacity of air, water, soil, and ecosystem; and

(c) Avoiding, remedying or mitigating any adverse effects of activities on the environment."

(NZ Legislation, 2016)

The RMA has a framework set out so that resources can be managed sustainably at a National, Regional, and District level. At a national level, the Environmental Protection Agency (EPA), Ministry for the Environment, and Department of Conservation are key players in the RMA, while Regional and District/City councils develop regional and district plans for their area. These plans must however be consistent with the National Environmental Standards and Regulations. (MFE, 2016).

While the RMA sets the foundation for our sustainable resource management in New Zealand, other industry led initiatives have been developed and implemented in the past. For example, in 2003 the Dairying and Clean Streams Accord agreement was signed between Fonterra, Ministry for the Environment, the then Ministry of Agriculture and Forestry, and regional councils. The Accord's aim was to contribute toward clean, healthy freshwater resources including streams, rivers, lakes, groundwater, and wetlands in dairying areas. It was an important voluntary environmental initiative alongside other projects and strategies that support and improve the dairy industry's social, economic and environmental performance (MPI, 2013).

As we continue to drill down further, van Reenen (2012) undertook a project looking at 'Increasing uptake of environmental practices on sheep and beef farms'. In this project farmers were interviewed and asked to define some of the environmental practices undertaken and responses were anything from fencing waterways, riparian planting, having reticulated water in every paddock, walking instead of using motorbikes, recycling plastic silage wrap, operating with a nitrogen cap, never grazing below 1500kgDM/ha.

As we can see, individual people have different views on what environmental protection looks like to them, and this can also be related to individual farms. Therefore, although it is easy to define environmental protection in a broad sense, the 'how to' in terms of what we can do becomes a little harder to define in a 'textbook' like definition. It is often a combination of factors that best fit with both the farm and farmer.

How do we measure environmental protection?

Given that environmental protection is not all that easy to define down to a detailed level, measuring environmental protection can also present some challenges.

Through various research points, the main overarching issue surrounding environmental protection was around water quality and the effects that farming has on water quality. Beef and Lamb NZ, (2014) highlights the four main containments of New Zealand waterways as Nitrogen, Phosphorous, sediment, and faecal matter.

Raised Nitrogen levels in waterways can promote the growth of algae and aquatic weeds, which can destroy aquatic life such as insects and fish. High Phosphorous levels in water can result in waterways becoming nutrient enriched, with nuisance plant and algae growth increasing. Sediment in waterways reduces water clarity and visibility, and also settles on the beds, smothering the substrate. This can kill aquatic life and destroy spawning areas, and also makes swimming and other water recreational activities unpleasant and unsafe. Faecal matter such as *E. coli* and other bacteria entering the waterways can make water unsafe for drinking or for recreational use.

While there is plenty of information available on the effects of these containments on water quality, the measurement of individual farmers and their farming practices contribution to water quality can be somewhat more difficult to measure. While physically sampling and measuring each individual farmers' water quality on farm to test and record the four main containment outputs would give us an accurate measurement of their contribution to water quality and the effects their farming practices have, it is simply just not practical or financially feasible. Instead, the best way we currently have available to measure containment output is through nutrient budgeting software such as OVERSEER. A description of Overseer, its functions, and how it works can be found in Appendix 3; however, Overseer basically takes into account nutrient inputs into the farming system, through fertiliser applications, any supplements purchased in, any irrigation applied, clover Nitrogen fixation, and rainfall. It also takes into account the nutrients removed from the farming system, through products sold

(meat and fibre), any supplements sold or effluent exported, and nutrients removed to atmosphere and/or water.

Overseer does have limitations though around the fact it does not take into account how some different management practices can influence the level of Nitrogen and Phosphorous removed from the farm, particularly into waterways, and it also does not measure sediment and faecal matter contamination and its effect on water quality.

While most of the research information provided focuses on water quality, there are plenty of other aspects that contribute to environmental protection. The RMA talks about the management of not only water, but land and air and for example Waikato Regional Council has many environmental indicators which measure on a range of areas from soil, land, water, air, coastal, and geothermal.

Issues around air quality on farm can range from preventable causes like burning of inorganic rubbish to much harder to manage aspects like methane production from farmed animals being expelled into the atmosphere. Land and soil issues can range from issues arising around cultivation, fertiliser use, stock density and grazing management practices just to name a few.

Also there are a range of issues on farm right down to things like dealing with silage wrap and other farm rubbish, chemical use and disposal on farm, and offal disposal.

Again, setting out to measure individual farmers output on every aspect of environmental protection is just not practical or financially feasible. It is therefore more practical to have guidelines on management practices that affect the environment, rather than specific output measurements.

Environmental protection information currently available

There is currently a wide range of information around environmental protection available presented in a number of different formats. Information can be presented in a rather raw, largely scientific based research type format in something like the 'Proceedings of the New Zealand Grassland Association', where something quite detailed would have been researched for example 'the effects of hillslope forage crop grazing in winter on soil erosion'. The associated article would have the methodology, results, and conclusions in the paper.

More farmer friendly format information sources include publications such as 'management practices to improve water quality' produced by both regulatory authorities such as regional councils, or industry association groups such as Beef and Lamb NZ or DairyNZ, or a combination with input from both parties. In these publications, they can mention an issue, on farm practices to mitigate of eliminate the issue, and a ranking of potential cost/benefit back to the farm. For example, the issue mentioned could be crop management to reduce soil losses, the management practice would be start grazing at the top of the crop paddock as opposed to the bottom (this way the crop can act as a filter holding some of the soil runoff). This example has a low cost and medium benefit ranking. Although the scientific results data

is not mentioned in this publication, the message is presented in a much easier to understand format.

As well as the written information sources, there are also interactive tools and computer programmes that can be used to tailor to an individual farm. Beef and Lamb NZ have developed Land and Environment Plan Guidelines, which allows individual farms to develop their own assessment of environmental issues most relevant to the property, then develop a response plan and implementation strategy based around addressing these issues. Although run by DairyNZ, the online Riparian Planner is a great interactive tool that can be used by anyone to plan waterway fencing and riparian planting. Other computer programmes such as Overseer can also be used to predict nutrient losses based on stock classes run on farm, products removed from farm, and inputs entered in (such as soil type, rainfall, and fertiliser use).

4. METHODOLOGY

The best way to complete the investigative question "Whether it is possible to enhance environmental protection on a sheep and beef farm without having to sacrifice farm profits?" would be through the establishment and analysis of a case study farm.

Firstly, we need to think about a benchmark, or a 'where are we now?' type situation. This will enable us to give us a baseline in terms of physical performance, financial performance, and the level of environmental protection currently in place on a particular farm.

Secondly, we want to establish 'where do we want to be?' in terms of environmental protection. The easiest and most farmer friendly way to set out where we want to be would be to develop a Land and Environment Plan (LEP), which is a free publication available through Beef and Lamb NZ. A land and environment plan is designed to assess issues relevant to an individual farm and farming system, what responses can be put in place to mitigate these issues, and allows for a timeframe and costing to be put against the responses to each issue.

Once the costings have been established, the third part is deciding on what we can do to pay for the environmental protection, or a 'how do we get there?'. Different scenario analysis can be run on any potential either stock policy or management practice changes that could be implemented in an effort to increase financial performance to a level above the cost of the environmental protection. Also for each scenario, environmental output analysis can be done to ensure that each scenario does not result in an increased level of nutrient output as measured through Overseer.

Once the financial and environmental analysis is done, I think it is also important to take into consideration the vision and long term goals of the farm when deciding on a scenario to implement. Also some thought around the risk associated with each scenario would be appropriate before making recommendation on a scenario to implement.

5. ANALYSIS AND RESULTS

Where are we now?

To set the scene, the case study farm we choose to investigate is Tetipu Farms Ltd, located in the Aria district, North King Country. Tetipu Farms was purchased in October 2015 and is owned by three main shareholders. Dwayne and Zara Cowin own 20% of the shareholding and are equity managers on the property. Julie Thomson owns 40%, and also works part time on the farm. Blair and Anna Nelson own the remaining 40%, with the Nelsons farming on their own 1100ha sheep and beef farm also located in Aria.

Tetipu farms places a high level of importance on their farm vision and long term goals. Tetipu farms wants to have 'a profitable and sustainable business enterprise which has the ability to encompass, stimulate, and ultimately grow all of the business shareholders'. Some of the long term goals centre around being able to provide financial and lifestyle returns and balances to shareholders, and that any changes to the business would not negatively impact on these goals. It is therefore important that any changes to the farm business need to still meet the vision and long term goals which are important to the shareholders.

Physically

Tetipu Farms is 420 effective hectares and consists of 178 hectares flat to rolling country and 233 hectares of steeper hill country. The hills and the flat/rolling country are quite defined form the basis of the two management units run over the farm.

Tetipu Farms has 4 livestock enterprises run on the property, with a summary of numbers and a basic outline of the stock policy associated with each enterprise shown below:

Breeding Ewes:

Table 5.1: Sheep numbers for Tetipu Farms

FARMAX YOUR ADVANTAGE

Mob Numbers for Base Farm : Sheep

Jul 16 - Jun 17

Mob	Aged from	Open	Wean	Die	Buy	Sell	Transfer		Close
							In	Out	
Ewes		1,033		96		205	301		1,033
2th Ewes	Ewe Hoggets	301						301	
Ewe Hoggets					301				301
Mixed Lambs			1,735			1,735			
Rams		13		4	4				13
Total		**1,347**	**1,735**	**100**	**305**	**1,940**	**301**	**301**	**1,347**

All mixed age ewes and two tooths are mated to a terminal sire at the end of March, giving a 25th of August lambing date. Ewes are shorn with lambs at foot in early November. Lambs are weaned early December, with lambs sold prime off mum at weaning, then the balance through the summer and early autumn months. Average lamb kill weight for the 2015/16 season was 17.5kg CWT, with average kill date being the 17th of January 2016. Remaining lambs are shorn in January, then ewes are shorn again in May post ram removal.

Beef Cow Herd:

Table 5.2: Beef Cow numbers for Tetipu Farms

Mob Numbers for Base Farm : Beef Herd
Jul 16 - Jun 17

Mob	Aged from	Open	Wean	Die	Buy	Sell	Transfer		Close
							In	Out	
Cows		74		2		18	20		74
2-Year Heifers	1-Year Heifers	20						20	
1-Year Heifers	Heifer Calves	41				21			20
Heifer Calves			41						41
Steer Calves			41						41
1-Year Steers	Steer Calves	41				41			
Total		**176**	**82**	**2**	**0**	**80**	**20**	**20**	**176**

The mixed age cows and yearling heifers are mated at the beginning of December with both Maternal and Terminal sire bulls to give a calving date commencing on the 15th of September. The cows' progeny are weaned at the end of March and taken through one winter. The yearling steers and terminal heifers are sold in January store. Replacement maternal heifers then enter the herd after their first calving.

Bull Beef Finishing:

Table 5.3: Finishing Bull numbers for Tetipu Farms

Mob Numbers for Base Farm : Bulls
Jul 16 - Jun 17

Mob	Aged from	Open	Wean	Die	Buy	Sell	Transfer		Close
							In	Out	
Bull Calves					35				35
1-Year Bulls	Bull Calves	35				35			
Autumn Bull Calves					41				41
Autumn Born 1 Year Bulls	Autumn Bull C...	41				41			
Total		**76**	**0**	**0**	**76**	**76**	**0**	**0**	**76**

Although a relatively small component of the current whole farm system, 100kg Friesian bull calves are purchased in July (autumn born calves) and in October (spring born calves). These are then taken through a winter, with the autumn born bulls sold in December and the spring born bull calves sold in January/February, all prime to the works.

Dairy Heifer Grazing:

Table 5.4: Dairy Heifer numbers for Tetipu Farms

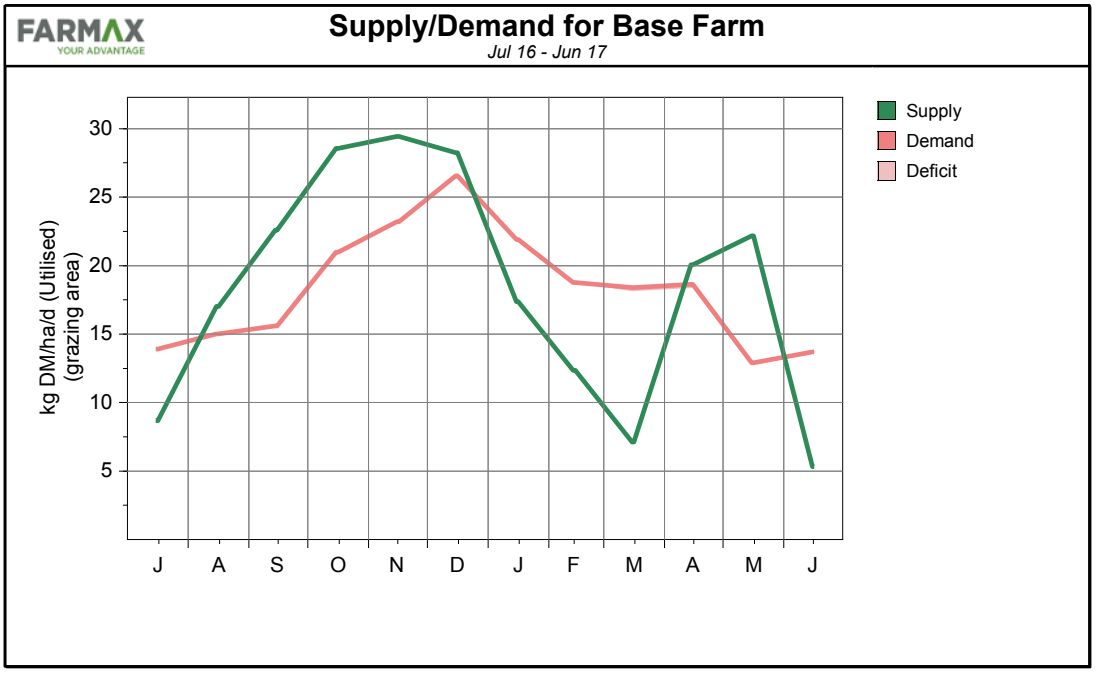
Mob Numbers for Base Farm : Dairy Grazers
Jul 16 - Jun 17

Mob	Aged from	Open	Wean	Die	Buy	Sell	Transfer		Close
							In	Out	
Heifer Calves							261		261
1-Year Heifers	Heifer Calves	261						261	
Total		**261**	**0**	**0**	**0**	**0**	**261**	**261**	**261**

Dairy heifers arrive on farm in December, taken through one winter and transferred off the following May as vetted in calf rising two-year-old heifers. This enterprise makes up a large component of the current farm system, particularly on the flats area of the farm.

With the current stock classes and numbers, the annual feed supply and demand over the whole farm can be shown in graph 5.1 below:

Graph 5.1: Annual feed supply and demand for Tetipu Farms



As is shown in graph 5.1 above, and is typical of most farm systems with a large dairy heifer grazing component, feed supply far exceeds demand in the spring, then feed demand is far greater than supply in the summer and autumn months till the dairy heifers are sent home in early May. Ideally we would want a farm system which has feed supply and demand much more closely aligned.

Currently as part of the farm system, 235 15 bale equivalents of balage are made from 25 hectares on farm in November and December in order to control surplus spring feed. This is fed out from as early as March the following year in order to fill the autumn feed deficit.

4.2 hectares of swedes are planted in early December and break-fed to mixed age breeding cows from mid-July to mid-September. This winter crop allows the farm to bring the cows off the hills once it gets wet in the winter, minimises any soil damage and erosion on the hills, and confines soil damage to a small area on the flats. 3.1 hectares of Greenfeed oats are planted at the end of March and fed to autumn-born bulls through August. Both the breeding cows and bulls are supplemented silage whilst on these crops, and the dairy heifers are fed silage and pasture through the winter months.

Nitrogen is applied to the whole farm in early May at 35kgN/ha and again in early August at 25kgN/ha.

Based on the current physical and financial performance of the farm, we were able to break down the performance at an enterprise level and is shown in the table 5.5 below:

Table 5.5: Individual Enterprise performance for Tetipu Farms

Enterprise	Cents/kgDM consumed	Top 15%
Sheep breeding	12.5	15-18
Beef breeding	9.8	10-11
Bulls	23.2	22-24
Dairy Grazers	17.8	17-18

(Ogle, 2016)

Table 5.5 above shows good performance in the bulls and dairy grazers enterprises, average performance in the beef breeding herd, and a lower level of performance in the sheep breeding enterprise. One of the main contributing factors to the lower level of performance in the sheep enterprise is the reliance on buying in replacement two tooths to enter the system versus the farm breeding replacements on farm.

Environmentally

We needed to set a baseline environmental output footprint. As mentioned previously, Overseer is currently the best commercially available computer software programme to measure nutrient losses. It does have limitations as it does not measure sediment or faecal bacteria losses, however from McDowell, et al. (2008) we can assume to a certain degree that higher levels of phosphorous runoff can relate to higher levels of sediment runoff. Table 5.6 below shows the Tetipu Farms whole farm nutrient budget for status quo stock policy and management practices:

Table 5.6: Current whole farm nutrient budget for Tetipu Farms

Nutrient Budget OVERSEER

	N	P	K	S	Ca	Mg	Na
				(kg/ha/yr)			
Nutrients added in							
Fertiliser, lime & other	63	42	0	28	49	0	0
Rain/clover N fixation	56	0	2	3	2	5	15
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	15	3	1	2	6	0	0
Exported effluent	0	0	0	0	0	0	0
As Supplements	0	0	0	0	0	0	0
To atmosphere	37	0	0	0	0	0	0
To water	26	1.5	16	28	33	11	35
Change in internal pools							
Plant material	-4	0	-3	0	0	0	0
Organic pool	42	4	0	2	0	0	0
Inorganic mineral	0	9	-26	0	-5	-7	-8
Inorganic soil pool	3	26	14	0	18	1	-12

As is shown in table 5.6 above, Nitrogen losses to both atmosphere and water are the greatest major nutrient losses on Tetipu farms, with Phosphorus losses relatively low at 1.5 kg/ha/yr.

Table 5.7 below shows Nitrogen losses in more detail, and in particular the separation of the cropping area from the pasture area of the farm and the impacts cropping has on the whole farm system.

Table 5.7: Current Nitrogen losses by block for Tetipu Farms

Block Nitrogen

OVERSEER

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Te tipu farm	6469	22	3.7	102	64
crops	1206	241	32	49	35
Other farm sources	129				
Whole farm	7804	26			
Less N removed in wetland	0				
Farm output	7804	26			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommeded level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

As is shown in table 5.7 above, Nitrogen losses to water from the crop area are very high at 241kg/ha/yr. This is however absorbed by the rest of the farm in the whole farm nutrient budget, and as the cropping area is such a small component of the whole farm system, the overall whole farm Nitrogen loss to water is not so high.

Table 5.8 below shows the Phosphorus losses over the crop area and the pasture areas of the farm.

Table 5.8: Current Phosphorus losses by block for Tetipu Farms

Block Phosphorus

OVERSEER

Block name	Total P (kg P/yr)	P lost (kg P/ha/yr)	P loss categories		
			Soil	Fertiliser	Effluent
Te tipu farm	409	1.4	Medium	High	N/A
crops	3	0.7	N/A	N/A	N/A
Other Sources	25				
Whole farm	438	1.5			

As stated in table 5.8, Phosphorus losses over the farm are relatively low and the cropping has minimal impact on these losses. This would be due to the fact that the cropping is

undertaken on flat or gently rolling land and as a result sediment loss from the cropping area is minimal.

While there is some degree of riparian fencing that has been done over the last 7 years by the previous owners, totalling to an estimated 20% of permanent waterways fenced on one side, this is one area where the new shareholders of the business feel there can be significant improvements made to enhance environmental protection.

Protection of the hill country is also important to the new shareholders. No poplar pole plantings in any of the hill paddocks have been done to date, so this area would need to be starting from scratch. Approximately 1/3 of the hill country would be unsuitable for poplar pole planting so other methods to prevent erosion and minimise phosphorous loss will have to be looked into here.

Rubbish management is also an area where the shareholders place importance on. They want to move away from a system of 'digging a hole to bury everything' to a system of more efficient rubbish management.

Financially

As part of our goals we set at the start, we don't want the farm to be in a worse financial position as a result of any environmental improvements made, so benchmarking our financial position and performance is also important. Through the computer modelling software programme Farmax (which a description of its functions, and how it works can be found in Appendix 4) we were able to enter the following financial information from our base year accounts and this is shown in table 5.9 below:

Table 5.9: Current Financial Performance for Tetipu Farms (2015/16 season)

Revenue	Sheep	Sales - Purchases	120,062
		Wool	26,262
		Total	**146,323**
	Beef	Sales - Purchases	137,401
		Contract Grazing	173,080
		Total	**310,481**
	Crop & Feed	Capital Value Change	38
		Total	38
	Total Revenue		**456,842**
Expenses	Wages	Wages	65,000
	Stock	Animal Health	12,500
		Shearing	15,000
	Feed/Crop/Grazing	Conservation	8,986
		Forage Crops	10,020
	Fertiliser	Fertiliser (Excl. N & Lime)	43,500
		Nitrogen	30,061
	Other Farm Working	Weed & Pest Control	6,500
		Vehicle Expenses	10,000
		Fuel	7,000
		Repairs & Maintenance	48,000
		Freight & Cartage	2,600
		Electricity	4,380
		Other Expenses	6,250
	Standing Charges	Administration Expenses	5,500
		Insurance	4,250
		ACC Levies	1,600
		Rates	16,750
	Total Farm Working Expense		**297,897**
	Depreciation		15,000
	Total Farm Expenses		**312,897**
Economic Farm Surplus (EFS)			**143,945**
Other Expenses		Interest	78,000
Farm Profit before Tax			**65,945**
Farm Profit per ha before Tax			**157**

Where do we want to be?

The easiest and most farmer friendly way to set out where we want to be was to develop a Land and Environment Plan (LEP), which is a free publication available through Beef and Lamb NZ. A land and environment plan is designed to assess issues relevant to an individual farm and farming system, what responses can be put in place to mitigate these issues, and allows for a timeframe and costing to be put against the responses to each issue. A full Land and

Environment plan for Tetipu Farms is attached in Appendix 1, and address the issues relevant to the farm and also the objectives set at the beginning of the project. A farm map showing proposed areas of environmental protection and plan is shown in Figure 1.1 on the next page.

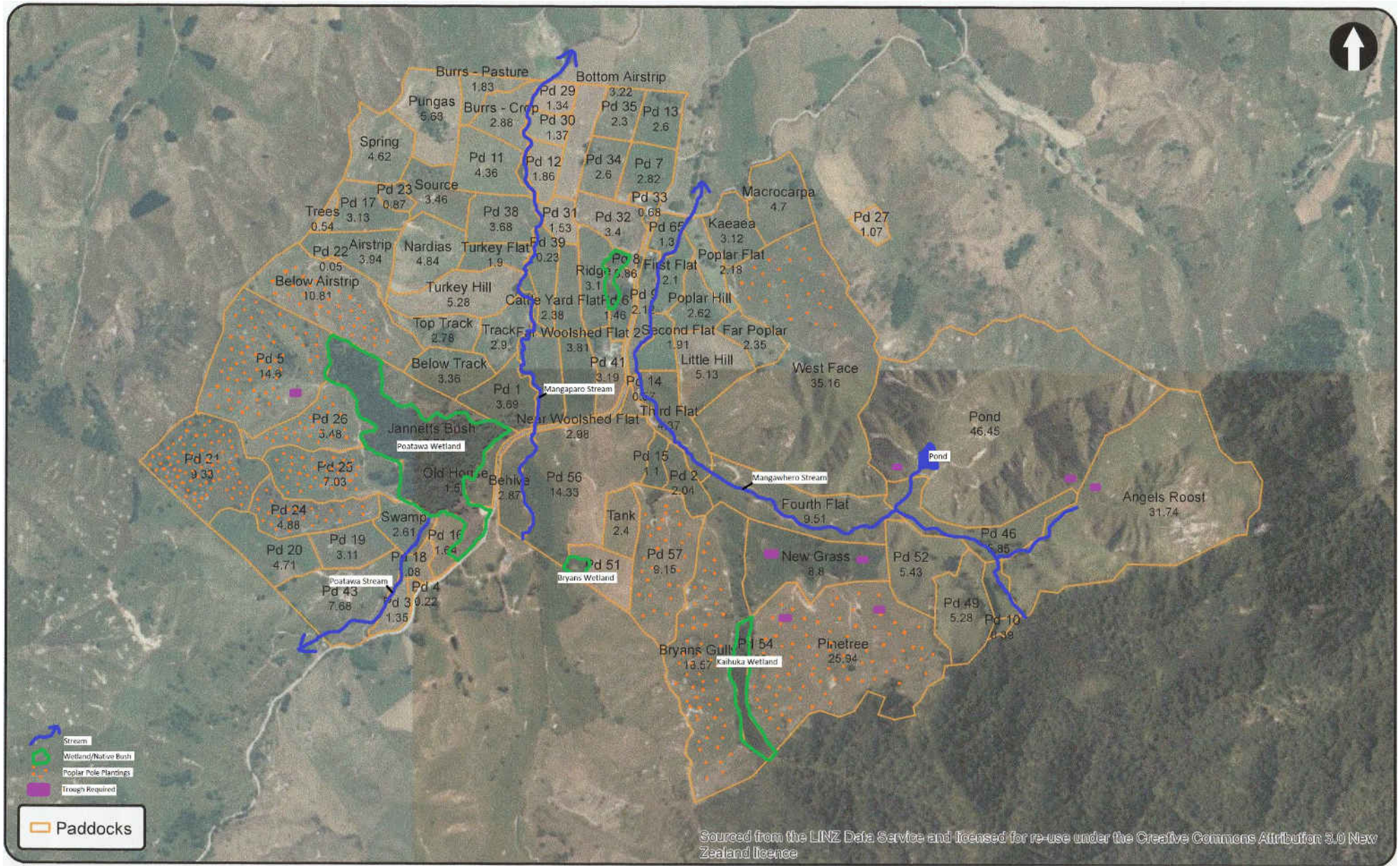
Some of the main findings from the LEP included the need for riparian fencing and planting of permanent waterways, upgrade and completion of the current reticulated water system, fencing for stock exclusion from areas of native bush, and poplar pole planting of some of the hill country. These costs would be classed in the LEP as one off costs. Some of the smaller ongoing costs centred around rubbish management, and future ongoing maintenance costs with weed control in retired conservation areas.

Table 5.10 below shows the one off costs associated with environmental protection on Tetipu Farms:

Table 5.10: Estimated one off environmental protection costs for Tetipu Farms

Environmental Protection - One off costs		
Riparian Management		
Site Preparation	$ 360	
Fencing	$ 49,900	
Planting	$ 19,250	
Subtotal		$ 69,510
Stock Exclusion		
Site Preparation	$ 4,800	
Fencing	$ 39,610	
Subtotal		$ 44,410
Poplar Pole Planting		
Pole and Planting cost	$ 6,000	
Subtotal		$ 6,000
Water System Upgrade		
Trough and Water pipe cost	$ 4,000	
Labour cost	$ 1,000	
Subtotal		$ 5,000
Total one off Cost		**$ 124,920**
One off cost per hectare		$ 297.43
One off cost per year		$ 24,984
(assuming 5 year implementation)		

Figure 1.1: Proposed areas of environmental protection on Tetipu Farms



While this is a significant number for a one off cost, Appendix 2 shows in more detail the costings spread over a timeframe of 5 years. While some may think that this is still a short enough timeframe for implementation of this plan, for the purposes of this project I have left it at a 5-year timeframe to implement these changes.

Some of the smaller costs associated with rubbish disposal are negligible, for example recycling silage wrap $100 per year, free disposal of plastic containers through Agrecovery programme, small income from scrap steel, wire etc. sold each year. I personally would just be happy to absorb these into increased farm costs, and for the purposes of this project have left this out of the analysis.

There will also no doubt be some ongoing costs associated with weed control in the retired riparian areas and further down the track repairs and maintenance fencing costs. Again for purposes of the project I have left these out of the analysis.

Also in the LEP there were some management practices that needed to be reviewed, for example the timing of our superphosphate fertiliser application needed to be reviewed in conjunction with our fertiliser rep. I have left out the change in management practices like this from the analysis for the purposes of this project. The cost is still going to be similar (we still will put the fertiliser on, just maybe at a different time of the year) so the overall financial impact will be small. This is not to say these types of things should be excluded from our thinking, it is just going to have a relatively small cost impact on the business.

How can we get there?

Now that we know where we are with our baseline, where our ultimate level of environmental protection on farm, we wanted to see if we could make any physical changes to our farm system that would allow us to increase profit to cover the costs of the environmental protection, yet not increase our environmental footprint in terms of nutrient losses through Overseer.

Any changes had to also fit in line with Tetipu Farms shareholders vision and long term goals for the farm. We weren't interested to converting to dairying or sheep milking, creating our own niche brand to attempt to receive a premium price per kg over our current prices, we wanted reasonably sound farm system changes that would also be able to fit in with our current physical landscape and limitations. With this in mind we looked at 5 different scenario options that we could analyse. These were:

1. Remove breeding cows from the system, buy in yearling cattle to control spring feed; and replace dairy heifers with finishing bulls.
2. Replace dairy heifers with a winter lamb finishing system.
3. Replace dairy heifers with finishing bulls.
4. Replace dairy heifers with finishing bulls; move from a terminal sire ewe flock to a self-replacing ewe flock.
5. Leaving some dairy heifers in the system, more finishing bulls, and self-replacing ewe flock.

Each of these scenarios are analysed in more detail below.

Scenario 1 – No Breeding Cows

In this scenario, cutting the beef cow herd would ultimately mean that we would not have to plant and feed out any winter crop, as is the case in the current system (the winter crop is currently used to bring the cows off the hills when it gets wet in the winter and reduce soil compaction to a small area of the farm). This would be a huge positive in terms of our soil protection and nutrient output, as was shown earlier in the Overseer baseline, that the cropping area has a large level of Nitrogen losses to water. We would however have to buy in cattle to control spring feed, and in this scenario we looked at purchasing yearling cattle store in August and selling again in the late summer and autumn months.

Tables 5.11 below show the number of yearling cattle required to purchase in order to replace the beef cow herd and control feed in the spring and budgeted sales in the autumn:

Tables 5.11: Required purchases and sales of yearling cattle under Scenario 1

FARMAX — ases for No herd,grazers increase bulls : Steers : 1-Year Steers

Jul 16 - Jun 17

Date	Source	Number	Live Wt. kg	$ per kg	$ per hd	$ Total
01 Aug 16	Store	231	350	2.95	1,032.99	238,621
[01 Aug 16]	Total Store	231	350	2.95	1,032.99	238,621

FARMAX — es for No herd,grazers increase bulls : Steers : 1-Year Steers

Jul 16 - Jun 17

Date	Destination	Number	Carc. Wt. kg	$ per kg	$ per hd	$ Total
28 Feb 17	Works	116	309	3.99	1,232.66	142,988
31 Mar 17	Works	115	288	3.92	1,127.41	129,653
[15 Mar 17]	Total Works	231	298	3.96	1,180.26	272,641

SALES: Lists individual sale events.

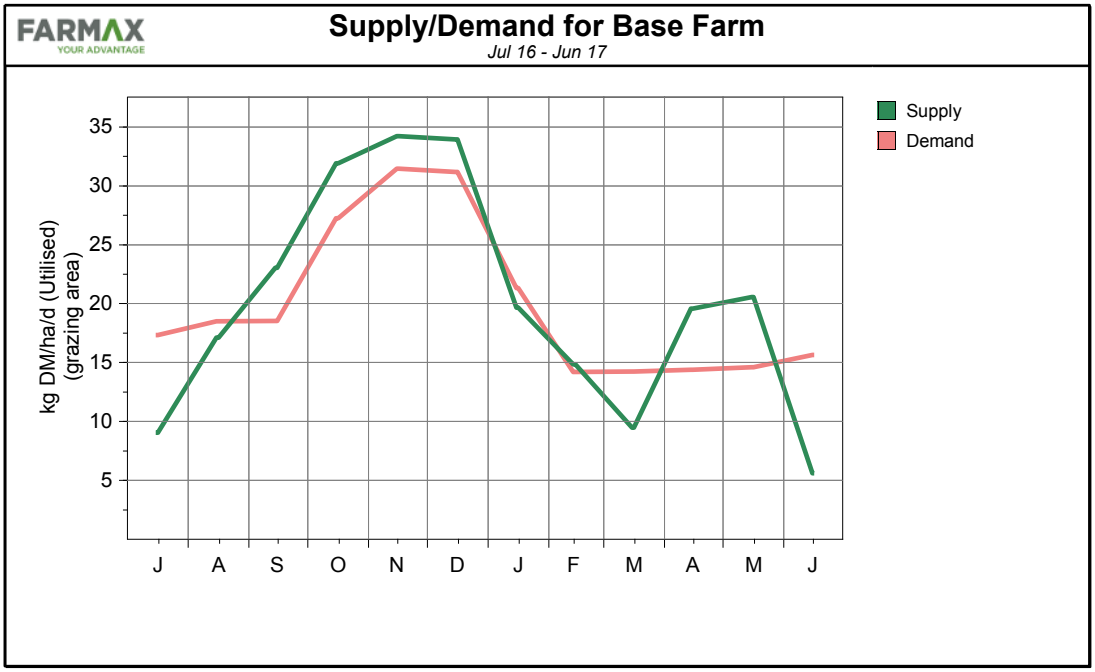
BY MONTH: Includes all sales, using model data where there are no actuals.

TO DATE: Includes only historical sales for which actual data has been supplied.

There is no change to the breeding ewe flock, however in this scenario we also looked at replacing the dairy heifers with finishing bulls to introduce more flexibility and profitability into the system (the 261 dairy heifers were replaced with 271 bulls, with all assumptions as per scenario 3).

Graph 5.2 below shows the annual feed supply and animal demand under this scenario:

Graph 5.2: Annual feed supply and demand under Scenario 1



Graph 5.2 shows a much closer alignment between feed supply and demand compared with the current farm system. The finishing bulls have a higher feed demand in the spring compared to the dairy heifer, and are also able to put on more liveweight as a result. Also the bulls are sold in the early summer months and do not have to be taken through the late summer and early autumn like the dairy heifers currently do, resulting in a closer match of

feed supply and demand during this time. Yearling cattle are also purchased in the early spring in place of removing the beef cow herd, and are used to control spring surplus feed during this time.

From an environmental point of view, a full Overseer report for this scenario can be found in Appendix 3.1, removing the crop and changing enterprises results in Nitrogen loss to water over the whole farm dropping to 23kgN/ha/year, down from 26kg N/ha/year under the current farm system. P loss to water drops from 1.5kgP/ha/year to 1.4kgP/ha/year by removing the crop.

Table 5.12 below shows the change in financial performance as a result of removing the beef cow herd and replacing the dairy heifers with finishing bulls:

Table 5.12: Change in financial performance under Scenario 1

FARMAX YOUR ADVANTAGE

Compare Forecast Profit and Loss

Jul 16 - Jun 17

			Base	No herd,grazers increase bulls	Difference
Revenue	Sheep	Sales - Purchases	120,062	120,062	0
		Wool	26,262	26,262	0
		Total	**146,323**	**146,323**	**0**
	Beef	Sales - Purchases	137,401	412,657	275,257
		Contract Grazing	173,080	0	-173,080
		Total	**310,481**	**412,657**	**102,177**
	Crop & Feed	Capital Value Change	38	38	0
		Total	38	38	0
	Total Revenue		**456,842**	**559,019**	**102,177**
Expenses	Wages	Wages	65,000	65,000	0
	Stock	Animal Health	12,500	12,457	-43
		Shearing	15,000	14,989	-11
	Feed/Crop/Grazing	Conservation	8,986	8,986	0
		Forage Crops	10,020	3,720	-6,300
	Fertiliser	Fertiliser (Excl. N & Lime)	43,500	43,500	0
		Nitrogen	30,061	30,061	0
	Other Farm Working	Weed & Pest Control	6,500	6,500	0
		Vehicle Expenses	10,000	10,000	0
		Fuel	7,000	7,000	0
		Repairs & Maintenance	48,000	48,000	0
		Freight & Cartage	2,600	2,600	0
		Electricity	4,380	4,380	0
		Other Expenses	6,250	6,250	0
	Standing Charges	Administration Expenses	5,500	5,500	0
		Insurance	4,250	4,250	0
		ACC Levies	1,600	1,600	0
		Rates	16,750	16,750	0
	Total Farm Working Expense		**297,897**	**291,542**	**-6,355**
	Depreciation		15,000	15,000	0
	Total Farm Expenses		**312,897**	**306,542**	**-6,355**
Economic Farm Surplus (EFS)			**143,945**	**252,477**	**108,531**
Other Expenses	Interest		78,000	78,000	0
Farm Profit before Tax			**65,945**	**174,477**	**108,531**
Farm Profit per ha before Tax			**157**	**415**	**258**

EFS is a measure of farm business profitability independent of ownership or funding, used to compare performance between farms.

EFS should include an adjustment for unpaid family labour and management. This can be added to the expense database as management wage.

As is shown in table 5.12 above, under this scenario there would be a pre-tax farm profit increase of $108,531. The move to replace the dairy heifers with finishing bulls generates a

large lift in beef income, however this is somewhat dented by the selling of the beef herd and buying in cattle to control spring surplus. As mentioned previously, the beef cow herd generates a gross margin of 9.8 cents per kg of drymatter (DM) consumed. Having to use yearling cattle to control feed generates only 4.7 cents/kgDM consumed. This is mainly due to the fact that the cattle have to be purchased at a high store price (in the early spring) and sold at a low works price (in the late summer and autumn).

Scenario 2 – Winter Trade Lambs

Scenario 2 would involve replacing the dairy heifers with winter trade lambs. The beef herd, breeding ewe, and finishing bull enterprises would remain unchanged. This scenario would have a low wintering stock weight on the soils, which are prone to holding large amounts of water over the winter. While this will be excellent in terms of protecting any soil damage over the winter, the main foreseeable issue though could be how spring feed is controlled once winter lambs are sold, again yearling cattle could have to be purchased in order to do this.

Tables 5.13 below show the purchases and sales of the winter lamb finishing enterprise in place of dairy heifer grazing:

Tables 5.13: Required purchases and sales of trade lambs under Scenario 2

FARMAX YOUR ADVANTAGE **Purchases for Base Farm : Winter Lambs : Ram Lambs**

Jul 16 - Jun 17

Date	Source	Number	Live Wt. kg	$ per kg	$ per hd	$ Total
01 Mar 17	Store	914	28.0	2.28	63.87	58,377
01 Apr 17	Store	914	30.0	2.30	69.07	63,128
[16 Mar 17]	**Total Store**	**1828**	**29.0**	**2.29**	**66.47**	**121,505**

FARMAX YOUR ADVANTAGE **Sales for Base Farm : Winter Lambs : Ram Hoggets**

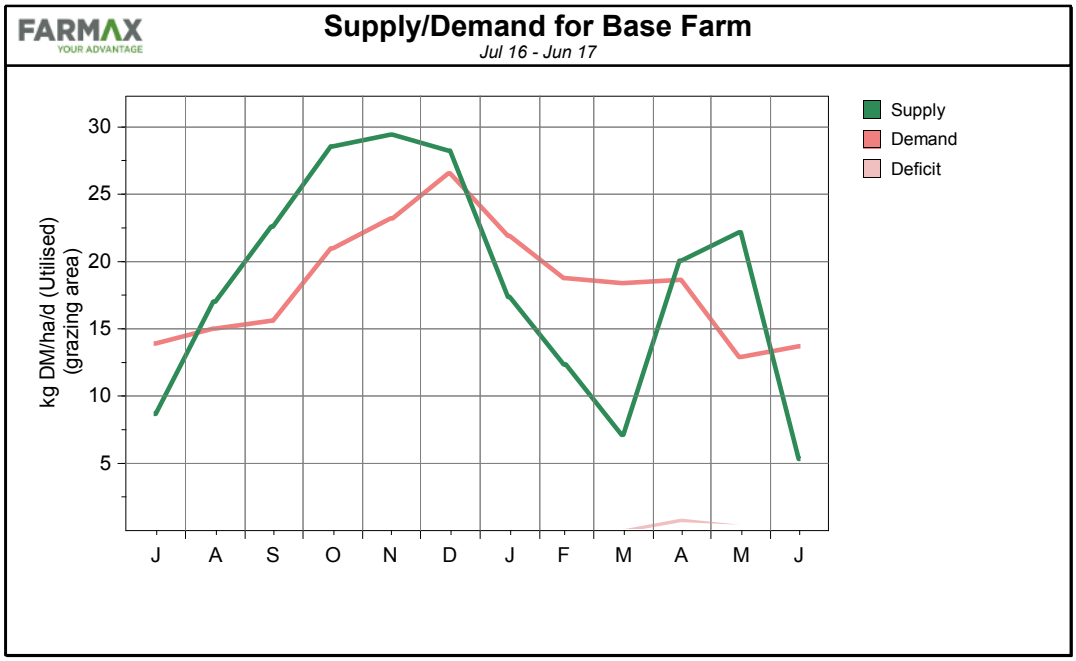
Jul 16 - Jun 17

Date	Destination	Number	Carc. Wt. kg	$ per kg	$ per hd	$ Total
16 Jul 16	Works	549	22.5	5.14	115.50	63,411
16 Aug 16	Works	921	22.7	5.42	122.66	112,967
16 Sep 16	Works	358	22.8	5.64	128.43	45,979
[12 Aug 16]	**Total Works**	**1828**	**22.6**	**5.38**	**121.64**	**222,357**

SALES: Lists individual sale events.
BY MONTH: Includes all sales, using model data where there are no actuals.
TO DATE: Includes only historical sales for which actual data has been supplied.

Graph 5.3 below shows the annual feed supply and animal demand running a winter trade lamb scenario:

Graph 5.3: Annual feed supply and demand under Scenario 2



Graph 5.3 above shows an extremely poor alignment with pasture supply and animal demand. The main issue with this scenario is that while the lambs are brought in at a low store price and sold at a high schedule price, this does not at all fit the seasonal pasture growth profile of the farm. Lambs are brought in through the autumn months and sold again in the spring months to the works. This would result in a massive spring surplus of feed on farm, and given in the last scenario we saw the relatively poor returns of buying in cattle to control this feed, it is hard to see how this scenario would be financially sound.

Analysing this scenario through Overseer (full report attached in Appendix 3.2) sees Nitrogen loss to water over the whole farm drop to 20kgN/ha/year, down from 26kg N/ha/year under the current farm system. P loss to water drops from 1.5kgP/ha/year to 1.4kgP/ha/year by removing the crop.

Table 5.14 below shows the change in financial performance as a result of removing the dairy heifers and replacing them with a winter trade lamb enterprise. Note that in this financial analysis does not include any spring cattle purchases to control feed:

Table 5.14: Change in financial performance under Scenario 2

Compare Forecast Profit and Loss
Jul 16 - Jun 17

			Base	Winter lambs no grazers	Difference
Revenue	Sheep	Sales - Purchases	120,062	220,914	100,852
		Wool	26,262	26,259	-2
		Total	**146,323**	**247,174**	**100,850**
	Beef	Sales - Purchases	137,401	251,738	114,337
		Contract Grazing	173,080	0	-173,080
		Total	**310,481**	**251,738**	**-58,743**
	Crop & Feed	Capital Value Change	38	38	0
		Total	38	38	0
	Total Revenue		**456,842**	**498,949**	**42,107**
Expenses	Wages	Wages	65,000	65,000	0
	Stock	Animal Health	12,500	13,177	677
		Shearing	15,000	14,989	-11
	Feed/Crop/Grazing	Conservation	8,986	8,986	0
		Forage Crops	10,020	10,020	0
	Fertiliser	Fertiliser (Excl. N & Lime)	43,500	43,500	0
		Nitrogen	30,061	30,061	0
	Other Farm Working	Weed & Pest Control	6,500	6,500	0
		Vehicle Expenses	10,000	10,000	0
		Fuel	7,000	7,000	0
		Repairs & Maintenance	48,000	48,000	0
		Freight & Cartage	2,600	2,600	0
		Electricity	4,380	4,380	0
		Other Expenses	6,250	6,250	0
	Standing Charges	Administration Expenses	5,500	5,500	0
		Insurance	4,250	4,250	0
		ACC Levies	1,600	1,600	0
		Rates	16,750	16,750	0
	Total Farm Working Expense		**297,897**	**298,562**	**665**
	Depreciation		15,000	15,000	0
	Total Farm Expenses		**312,897**	**313,562**	**665**
Economic Farm Surplus (EFS)			**143,945**	**185,387**	**41,442**
Other Expenses		Interest	78,000	78,000	0
Farm Profit before Tax			**65,945**	**107,387**	**41,442**
Farm Profit per ha before Tax			**157**	**256**	**99**

EFS is a measure of farm business profitability independent of ownership or funding, used to compare performance between farms.
EFS should include an adjustment for unpaid family labour and management. This can be added to the expense database as management wage.

As table 5.14 above shows, this farm system would only generate and extra $41,442 increase in farm profit compared to the current system. Also there needs to be the consideration of an additional capital stock to purchase in these lambs in place on non-owned dairy heifers. In this analysis, replacing the 260 dairy heifers with 1828 finishing lambs would require an additional $121,500 in the first year to purchase the stock. The relatively poor financial performance of this enterprise, the additional capital required to undertake this enterprise, and probably most importantly, the large imbalance of feed supply and demand, leads to the conclusion that this would not be a viable scenario to implement on farm.

Scenario 3 – Bulls versus Dairy Heifers

This scenario would analyse the difference in physical and financial performance between running finishing bulls versus dairy heifers. Finishing bulls would be able to allow more

flexibility in the system, as purchases could be delayed, stock could be sold earlier in adverse weather events, and during favourable weather events bulls can be carried through to heavier weights. Also as previously mentioned, the ability of bulls to eat more in the spring and have faster liveweight gains allows a better utilisation of cheaply grown spring feed.

Through Farmax modelling, we were able to determine that we could run an extra 271 bulls in place of the current 261 dairy heifers, as well as the 76 in our current farm system. While this may initially seem surprising that we could in fact run more bulls than dairy heifers, they actually have a better ability to fit the pasture supply curve of the farm throughout the year. Also without having to take dairy heifers into the autumn, pasture covers were able to be built going into winter and allowed us to purchase more autumn born bull calves than would be possible in a system with dairy heifer component.

In this scenario we assumed purchasing 187 autumn bull calves at $550 (an increase of 146 bulls on current scenario) and 160 bull calves at $480 (an increase of 125), requiring a total capital purchase of $179,650 (an additional $140,300 over the current scenario).

Tables 5.15 below show the sales of finishing bulls in this scenario in place of dairy heifer grazing:

Tables 5.15: Budgeted sales of finishing bulls under Scenario 3

FARMAX YOUR ADVANTAGE **Sales for Base Farm : Bulls : Autumn Born 1 Year Bulls**

Jul 16 - Jun 17

Date	Destination	Number	Carc. Wt. kg	$ per kg	$ per hd	$ Total
30 Dec 16	Works	187	310	5.15	1,593.25	297,938
[30 Dec 16] Total Works		**187**	**310**	**5.15**	**1,593.25**	**297,938**

SALES: Lists individual sale events.
BY MONTH: Includes all sales, using model data where there are no actuals.
TO DATE: Includes only historical sales for which actual data has been supplied.

FARMAX YOUR ADVANTAGE **Sales for Base Farm : Bulls : 1-Year Bulls**

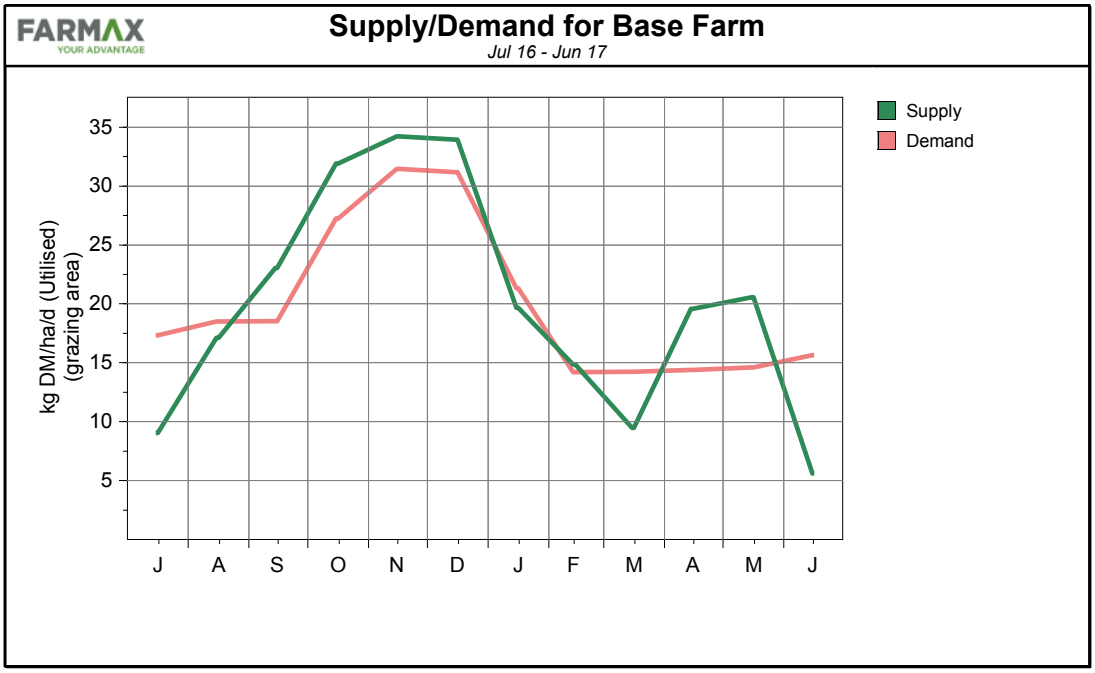
Jul 16 - Jun 17

Date	Destination	Number	Carc. Wt. kg	$ per kg	$ per hd	$ Total
31 Jan 17	Works	160	285	4.91	1,396.98	223,517
[31 Jan 17] Total Works		**160**	**285**	**4.91**	**1,396.98**	**223,517**

SALES: Lists individual sale events.
BY MONTH: Includes all sales, using model data where there are no actuals.
TO DATE: Includes only historical sales for which actual data has been supplied.

Graph 5.4 below shows the annual feed supply and animal demand running a finishing bull enterprise in place of dairy heifers:

Graph 5.4: Annual feed supply and demand under Scenario 3



Graph 5.4 above shows a well aligned feed supply and animal demand curve, similar to scenario one with purchasing in yearling cattle, however in this scenario, having more bulls on allows for greater spring demand and negating the need to buy in expensive cattle to control spring surplus. Demand though the summer months is also a lot more flexible than in the current system, as already mentioned that bulls can be sold earlier or later depending on the feed supply situation.

A full Overseer report is attached in Appendix 3.3, however changing from dairy heifers to bulls in this scenario resulted in no change to the level of either Nitrogen or Phosphorus lost to water compared to the current farm system.

The table below shows the change in financial performance from running a larger finishing bull enterprise and no dairy heifers:

Table 5.16: Change in financial performance under Scenario 3

Compare Forecast Profit and Loss

Jul 16 - Jun 17

			Base	No Grazers More Bulls	Difference
Revenue	Sheep	Sales - Purchases	120,062	120,062	0
		Wool	26,262	26,259	-2
		Total	**146,323**	**146,321**	**-2**
	Beef	Sales - Purchases	137,401	441,476	304,075
		Contract Grazing	173,080	0	-173,080
		Total	**310,481**	**441,476**	**130,995**
	Crop & Feed	Capital Value Change	38	38	0
		Total	38	38	0
	Total Revenue		**456,842**	**587,835**	**130,993**
Expenses	Wages	Wages	65,000	65,000	0
	Stock	Animal Health	12,500	12,929	429
		Shearing	15,000	14,989	-11
	Feed/Crop/Grazing	Conservation	8,986	8,986	0
		Forage Crops	10,020	10,020	0
	Fertiliser	Fertiliser (Excl. N & Lime)	43,500	43,500	0
		Nitrogen	30,061	30,061	0
	Other Farm Working	Weed & Pest Control	6,500	6,500	0
		Vehicle Expenses	10,000	10,000	0
		Fuel	7,000	7,000	0
		Repairs & Maintenance	48,000	48,000	0
		Freight & Cartage	2,600	2,600	0
		Electricity	4,380	4,380	0
		Other Expenses	6,250	6,250	0
	Standing Charges	Administration Expenses	5,500	5,500	0
		Insurance	4,250	4,250	0
		ACC Levies	1,600	1,600	0
		Rates	16,750	16,750	0
	Total Farm Working Expense		**297,897**	**298,314**	**418**
	Depreciation		15,000	15,000	0
	Total Farm Expenses		**312,897**	**313,314**	**418**
Economic Farm Surplus (EFS)			**143,945**	**274,521**	**130,575**
Other Expenses	Interest		78,000	78,000	0
Farm Profit before Tax			**65,945**	**196,521**	**130,575**
Farm Profit per ha before Tax			**157**	**468**	**311**

EFS is a measure of farm business profitability independent of ownership or funding, used to compare performance between farms.

EFS should include an adjustment for unpaid family labour and management. This can be added to the expense database as management wage.

Table 5.16 above shows a healthy lift in farm profit of $130,575, or $311/ha as a result of implementing this enterprise change into the farm system. The lost grazing income of $173,080 is more than made up for by an increase in beef income of $304,075. Most of the farm working expenses remain unchanged therefore the increased income under this scenario largely flows through to increased profit. Again as in scenario 2, the consideration of additional capital stock purchases in the first year of scenario need to be taken into account, as previously mentioned in this scenario $144,350. At 5% interest this would have an annual interest cost of $7,217.50. Also some people could argue there will be an increased repairs and maintenance cost running bulls versus dairy heifers, as bulls can do more damage to fences when they become unsettled and start fighting.

Scenario 4 – Bulls and Ewe Replacements

Scenario 4 not only compares the finishing bulls versus dairy heifers, but if the farm were to breed its own ewe replacements rather than buying them in as is the current policy. The flexibility of the bulls, compared to dairy heifers, could allow for better feeding of capital and replacement stock, and also reduce the current expenditure incurred with having to buy in replacement two tooths which enter the breeding ewe mob.

Table 5.17 below shows the sheep enterprise numbers when going to a self-replacing ewe flock:

Table 5.17: Sheep numbers for a self-replacing ewe flock under scenario 4

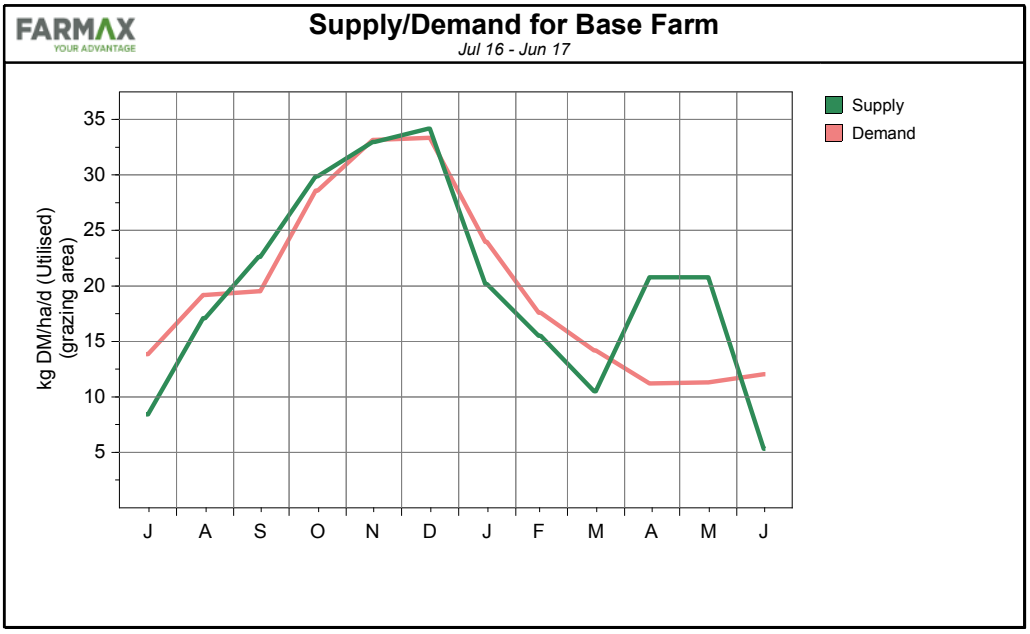
FARMAX Mob Numbers for No Grazers sel replacing flock : Sheep
Jul 16 - Jun 17

Mob	Aged from	Open	Wean	Die	Buy	Sell	Transfer		Close
							In	Out	
Ewes		1,033		96		205	300		1,032
2th Ewes	Ewe Hoggets	300						300	
Ewe Hoggets	Ewe Lambs	300							300
Ewe Lambs			999					699	300
Mixed Lambs			998			1,697	699		
Rams		13		4	4				13
Total		**1,646**	**1,997**	**100**	**4**	**1,902**	**999**	**999**	**1,645**

This scenario also assumes we take 300 ewe lamb replacements through and mate all ewe lambs. The beef cow enterprise remains unchanged. The change in enterprises from dairy heifers to bulls is relatively similar to scenario 3, however some small adjustments were made dropping bull numbers slightly and bringing kill dates forward in order to feed replacement ewe lambs over the summer and autumn months.

Graph 5.5 below shows the annual feed supply and animal demand under this scenario:

Graph 5.5: Annual feed supply and demand under Scenario 4



Graph 5.5 above shows the closet fit of supply and demand of all the scenarios. Of some concern could however be that demand is slightly higher than supply though the summer and autumn months, however this could be adjusted by finishing bull sale date adjustments.

Through Overseer analysis of this scenario (full report attached in Appendix 3.4), this scenario resulted in Nitrogen loss to water over the whole farm dropping to 23kgN/ha/year, down from 26kg N/ha/year under the current farm system. P loss to water remained unchanged.

Table 5.18 below shows the corresponding change in financial performance under this scenario:

Table 5.18: Change in financial performance under Scenario 4

Compare Forecast Profit and Loss

Jul 16 - Jun 17

			Base	No Grazers sel replacing flock	Difference
Revenue	Sheep	Sales - Purchases	120,062	150,585	30,523
		Wool	26,262	29,006	2,744
		Capital Value Change	0	-113	-113
		Total	**146,323**	**179,478**	**33,154**
	Beef	Sales - Purchases	137,401	415,913	278,513
		Contract Grazing	173,080	0	-173,080
		Total	**310,481**	**415,913**	**105,433**
	Crop & Feed	Capital Value Change	38	38	0
		Total	38	38	0
	Total Revenue		**456,842**	**595,429**	**138,587**
Expenses	Wages	Wages	65,000	65,000	0
	Stock	Animal Health	12,500	12,500	0
		Shearing	15,000	15,000	0
	Feed/Crop/Grazing	Conservation	8,986	8,986	0
		Forage Crops	10,020	10,020	0
	Fertiliser	Fertiliser (Excl. N & Lime)	43,500	43,500	0
		Nitrogen	30,061	30,061	0
	Other Farm Working	Weed & Pest Control	6,500	6,500	0
		Vehicle Expenses	10,000	10,000	0
		Fuel	7,000	7,000	0
		Repairs & Maintenance	48,000	48,000	0
		Freight & Cartage	2,600	2,600	0
		Electricity	4,380	4,380	0
		Other Expenses	6,250	6,250	0
	Standing Charges	Administration Expenses	5,500	5,500	0
		Insurance	4,250	4,250	0
		ACC Levies	1,600	1,600	0
		Rates	16,750	16,750	0
	Total Farm Working Expense		**297,897**	**297,897**	**0**
	Depreciation		15,000	15,000	0
	Total Farm Expenses		**312,897**	**312,897**	**0**
Economic Farm Surplus (EFS)			**143,945**	**282,532**	**138,587**
Other Expenses	Interest		78,000	78,000	0
Farm Profit before Tax			**65,945**	**204,532**	**138,587**
Farm Profit per ha before Tax			**157**	**487**	**330**

EFS is a measure of farm business profitability independent of ownership or funding, used to compare performance between farms.
EFS should include an adjustment for unpaid family labour and management. This can be added to the expense database as management wage.

Table 5.18 above shows the greatest lift in farm profit out of all 5 scenarios analysed, with an increase of $138,587 or $330/ha, over the current farm system. Although the beef income is

reduced slightly because of running a few less bulls than in scenario 3, sheep income is boosted by not having to purchase replacement stock in, and extra lamb sales from hoggets which would have lambed down in this scenario. The additional capital cost in this scenario is also slightly lower at $121,140 (because of the few less bulls purchased than in scenario 3), and also the funds used to currently purchase two tooths can be reallocated to purchasing bulls.

Scenario 5 – Dairy Heifers, Bulls, and Ewe Replacements

In this scenario we left approximately half the dairy heifers in the system, added additional bulls in to replace the drop in heifer numbers, and left the self-replacing ewe flock described in scenario 4 unchanged.

Tables 5.19 below show the stock numbers in this scenario:

Tables 5.19: Finishing bulls and dairy heifer numbers under scenario 5

FARMAX YOUR ADVANTAGE **Mob Numbers for No Grazers sel replacing flock : Bulls**

Jul 16 - Jun 17

Mob	Aged from	Open	Wean	Die	Buy	Sell	Transfer		Close
							In	Out	
Bull Calves					108				108
1-Year Bulls	Bull Calves	108				108			
Autumn Bull Calves					126				126
Autumn Born 1 Year Bulls	Autumn Bull C...	126				126			
Total		**234**	**0**	**0**	**234**	**234**	**0**	**0**	**234**

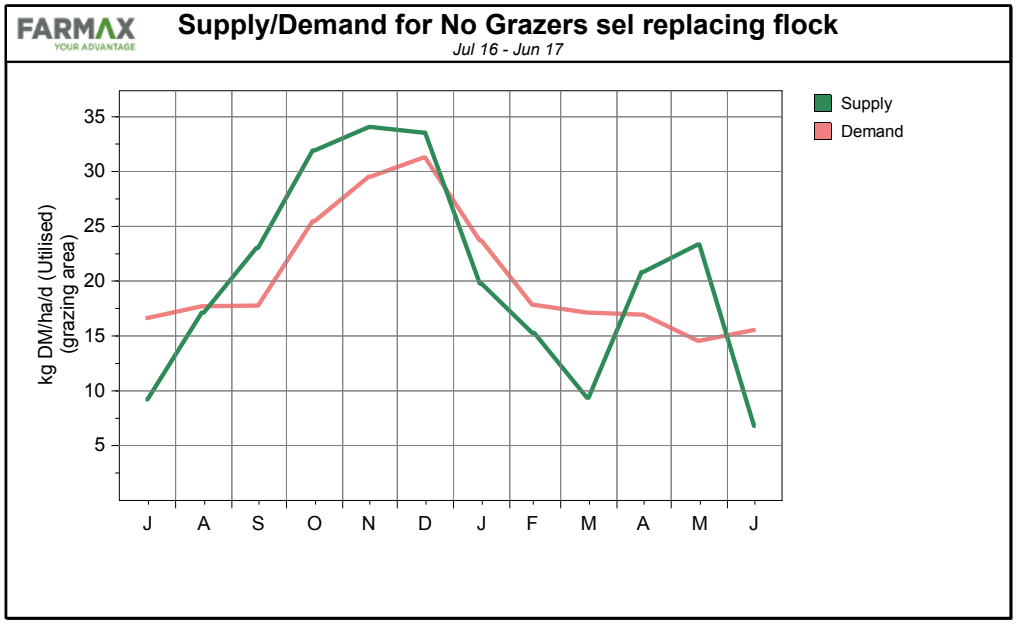
FARMAX YOUR ADVANTAGE **Mob Numbers for No Grazers sel replacing flock : Dairy Grazers**

Jul 16 - Jun 17

Mob	Aged from	Open	Wean	Die	Buy	Sell	Transfer		Close
							In	Out	
Heifer Calves							120		120
1-Year Heifers	Heifer Calves	120						120	
Total		**120**	**0**	**0**	**0**	**0**	**120**	**120**	**120**

Graph 5.6 below shows the annual feed supply and animal demand match in this scenario:

Graph 5.6: Annual feed supply and demand under Scenario 5



Graph 5.6 above shows not quite as good a supply and demand fit as in scenario 3 and 4. This is mainly attributed to the dairy heifers remaining in the system and the previously mentioned feed demand requirements. Some of this surplus spring feed would most likely have to be transferred into the autumn through making silage during late spring.

Overseer analysis for this scenario, with a full report in Appendix 3.5, shows a Nitrogen loss to water over the whole farm drop to 24kgN/ha/year, down from 26kg N/ha/year under the current farm system. P loss to water drops remaining unchanged.

Table 5.20 below shows the corresponding change in financial performance under this scenario:

Table 5.20: Change in financial performance under Scenario 5

Compare Forecast Profit and Loss
Jul 16 - Jun 17

			Base	No Grazers sel replacing flock	Difference
Revenue	Sheep	Sales - Purchases	120,062	150,585	30,523
		Wool	26,262	29,006	2,744
		Capital Value Change	0	-113	-113
		Total	**146,323**	**179,478**	**33,154**
	Beef	Sales - Purchases	137,401	304,307	166,906
		Contract Grazing	173,080	78,811	-94,269
		Total	**310,481**	**383,119**	**72,638**
	Crop & Feed	Capital Value Change	38	38	0
		Total	38	38	0
	Total Revenue		**456,842**	**562,634**	**105,792**
Expenses	Wages	Wages	65,000	65,000	0
	Stock	Animal Health	12,500	12,500	0
		Shearing	15,000	15,000	0
	Feed/Crop/Grazing	Conservation	8,986	8,986	0
		Forage Crops	10,020	10,020	0
	Fertiliser	Fertiliser (Excl. N & Lime)	43,500	43,500	0
		Nitrogen	30,061	30,061	0
	Other Farm Working	Weed & Pest Control	6,500	6,500	0
		Vehicle Expenses	10,000	10,000	0
		Fuel	7,000	7,000	0
		Repairs & Maintenance	48,000	48,000	0
		Freight & Cartage	2,600	2,600	0
		Electricity	4,380	4,380	0
		Other Expenses	6,250	6,250	0
	Standing Charges	Administration Expenses	5,500	5,500	0
		Insurance	4,250	4,250	0
		ACC Levies	1,600	1,600	0
		Rates	16,750	16,750	0
	Total Farm Working Expense		**297,897**	**297,897**	**0**
	Depreciation		15,000	15,000	0
	Total Farm Expenses		**312,897**	**312,897**	**0**
Economic Farm Surplus (EFS)			**143,945**	**249,738**	**105,792**
Other Expenses		Interest	78,000	78,000	0
Farm Profit before Tax			**65,945**	**171,738**	**105,792**
Farm Profit per ha before Tax			**157**	**409**	**252**

EFS is a measure of farm business profitability independent of ownership or funding, used to compare performance between farms.
EFS should include an adjustment for unpaid family labour and management. This can be added to the expense database as management wage.

Under this scenario, there is still a $105,792 or $252/ha increase in farm profit over the current farming system. Sheep income is increased by not having to purchase in two tooths as in scenario 4, beef income increases through the extra bulls run, and some dairy heifer grazing income remains in place. However, under this scenario the additional capital cost is a lot lower at $80,530, as less bulls need to be purchased in by keeping some dairy heifers in the system. (We assumed purchasing 108 autumn bull calves at $550 (an increase of 67 bulls on current scenario) and 126 bull calves at $480 (an increase of 91), requiring a total capital purchase of $119,880 (an additional $80,530 over the current scenario)).

6. FINDINGS AND DISCUSSION

Scenario Summary

Table 6.1 below shows the current farm system numbers down the left hand side, and any number changes under the 5 scenarios we analysed:

Table 6.1: Summary comparison of current policy and scenario changes

Current Numbers	Change in Numbers	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Sheep					
1033	Ewes					
300	2th Ewes					
0	Ewe Hoggets				300	300
867	Ewe Lambs				131	131
868	Ram Lambs		1828		131	131
	Breeding Cattle					
74	MA Cows	-74				
20	2 yr old Heifers	-20				
41	1 yr old Heifers	-41				
	Heifer Calves					
	Steer Calves					
41	1 yr old Steers	231				
	Finishing Bulls					
41	1 yr old Autumn Born Bulls	146		146	126	85
35	1 yr old Bulls	125		125	108	73
	Dairy Heifers	-261	-261	-261	-261	-141
	Change in Nutrient Status					
	kg lost to water / ha / year					
26	Nitrogen	-3	-6	0	-3	-2
1.5	Phosphorous	-0.1	-0.1	0	0	0
	Change in Farm Profit					
$ 65,945	ncrease over current system	$ 108,531	$ 41,442	$ 130,575	$ 138,587	$ 105,792
	Additional Capital Required					
	For capital stock purchases	$ 378,921	$ 121,505	$ 140,300	$ 121,140	$ 80,530

As is shown in table 6.1 above, scenario three changing from dairy heifers to bulls had no change in nutrient output when analysed through Overseer, however all other scenarios had a decreasing level of nutrient output. The biggest drop in nutrient output was achieved under a system of winter lamb trading, and surprisingly dropping the breeding cows and winter crop out as analysed in scenario 1 had the same benefit as running bulls and a self-replacing ewe flock.

Table 6.1 also showed that all the scenarios analysed generated an increased level of profit over the current farming system, ranging from an increase of $41,442/year for scenario two winter lamb finishing, to $138,587/year in scenario four running all bulls and having a self-replacing ewe flock. All of these scenarios are able to cover the $24,984 required annually

over 5 years to implement the environmental protection enhancement changes set out in the developed Land and Environment Plan.

However, in order to achieve these increased profits, all of the scenarios analysed showed a requirement for additional capital funds in order for extra farm owned stock to be purchased.

Deciding on a Scenario to Implement

Analysing the five scenarios involved a lot of numbers and computer based analysis in order to be able to come up with something that was consistent to compare across all scenarios.

However, when deciding on a scenario to implement, I felt that there was more to think about than just the farm profit increase or other numbers at the bottom of the page. For me it had to 'feel right', fit within our shareholders' visions and long term goals previously, be practical to implement, be an enjoyable farm system to operate, and most importantly be a 'strong, sound' scenario. By this I mean something that insulates the business from a lot of risk, and is able to deliver the returns budgeted on in the scenario analysis on a regular basis.

While it would have been nice to do away with the breeding cows and completely eliminate any winter cropping from the farm system, as was analysed in scenario one, but the poor returns of purchasing in cattle to control spring feed and then selling out again at the bottom of the market in autumn made it a relatively unappealing scenario choice. The dairy heifers had to be substituted for finishing bulls in order to make this scenario more profitable than the current farm system.

Winter lamb trading would have been a better stock enterprise to run on the winter wet soils, however the low financial return gains and massive feed imbalance made this the poorest of all the potential scenarios physically and financially. It did however give us the greatest reduction in nutrient output through Overseer.

While I did not conduct any sensitivity analysis on these scenarios, I was always nervous every time we analysed giving up the dairy heifers in place of bulls. There is no question that with today's market prices, finishing bulls make more money than grazing dairy heifers, but they do also present a market risk (in terms of purchase and sale price changes) and also a capital investment to purchase initially.

On the other hand, currently a risk I see to Tetipu Farms is the reliance on purchasing in two tooths each year for the breeding ewe flock. Not only again does this present market risk, in terms of purchase price of these sheep, but also a performance risk to the flock. If top quality sheep weren't able to be sourced, and a poorer type of sheep had to be purchased, there could be serious negative implications around future breeding performance of the ewe flock. Having a self-replacing ewe flock also allows for much greater consistency of sheep entering the breeding flock, and much greater control can be placed on breeding objectives which would be relative to the specific farm and farm system.

So after comparing and contrasting all the scenarios, both physically through change in stock classes and numbers, environmentally through Overseer, and financially, it was Scenario 5 I would choose to implement. While it does not give the greatest financial return improvement,

I believe it is the best choice for not only the farm, but the operators of the farm. It somewhat maximises the strengths of the farm, by allowing a closer fit of the seasonal pasture supply and animal demand over the year. I feel more importantly though that it minimises weaknesses within the current farm system. Having a self-replacing ewe flock presents many advantages both financially and for future flock performance. Having more bulls which are able to be sold earlier allows the replacement ewe hoggets to be fed through the summer and autumn months. Having some dairy heifers retained in the system allows guaranteed income and cashflow for the business throughout the year. Having a diverse range of stock classes also spreads risk to the business, although some people could say it adds complexity.

7. CONCLUSIONS

- Environmental protection to some degree is something that every sheep and beef farmer in the country is going to have to either deal with currently, or sometime in the near future.
- Environmental protection is an extremely complex biological issue, and requires change from individual farmers.
- Don't fight it, be as proactive as you can in thinking about these changes, although we need to appreciate that some people are quicker to adapt to change than others.
- Use it as an opportunity for a whole farm review, what are the biggest strengths, weaknesses, opportunities, and/or threats to the farm.
- Setting out where you are now, and where you want to be is key.
- Put some thought around how you can get there, but there could be a multitude of ways in doing this.
- In the case of Tetipu Farms, enhanced environmental protection could be funded through changing to a more profitable stock class on part of the farm.
- A big change and lesson learnt in the process was changing to a stock class mix that had a better fit to the annual pasture supply of the farm. This created a more biologically efficient farming system.
- Changing to a system with more sheep reduces Nitrogen loses to water when measured through Overseer, but swapping female cattle for male cattle had little impact.
- The cropping area had very high Nitrogen loses to water; however, this was only a small component of the farming system so its effects were somewhat diluted when whole farm Nitrogen loses were calculated.
- Overseer does not have the ability to measure the effects of an implementation of a riparian management plan and other management practice changes which influence phosphorous, sediment, and faecal bacteria runoff into waterways.
- The limitations of Overseer and what it could not measure should not be ignored, some of these aspects can have the biggest impact on the farm and farming operation.

- Further afield, farms that have limited ability to change stock class in their system (through contour or other restrictions) may have to look at management practice changes and performance to fund their environmental protection.
- There will be some outlier farmers resistant to change, and regulatory standards will have to be put in place for these farmers; however, the vast majority of farmers should be able to operate above this line.

8. RECOMMENDATIONS

For Tetipu Farms:

- In the case of Tetipu Farms, I would recommend an uptake of scenario 5. This is where the dairy heifer numbers are reduced by approximately half, bull numbers are increased, and the farm system moves towards a self-replacing ewe flock. Although this scenario does not generate the highest profit increase, it requires the lowest additional capital and I believe well insulates the business against some of its current risks.

For other sheep and beef farmers:

- For other farmers who undertake a similar exercise to this, I would recommend setting out a 'where you are now?' and a 'where do you want to be?' approach. There is no silver bullet, right/wrong way in the 'how do you get there?', but it more a case of adapting and implementing changes to your farming system that can deliver the end goal in a manner best suited to the farm and farmer.

For the sheep and beef industry:

- In order to gain traction from case studies like this one, I feel a more collaborative approach between farmers, industry organisations, and regulatory bodies is needed to be able to tell the success stories in our industry, rather than the media honing in on the outliers of our industry. We should be able to promote and celebrate initiatives like Balance Farm Environment Awards and their winners, rather than have newspaper front page photos of cattle drinking out of a river.

For the New Zealand agricultural industry:

- A collaborative approach is also important for telling the 'where do we want to be?' message. Having a much clearer and consistent message about where we want to be as an industry is critical to move forward, and is more powerful than a whole lot of individual fragmented messages.

To move forward:

- With this in mind, I would recommend more 'like for like' engagement to promote our message within our industry, where we have farmers tell other farmers their success stories and motivations behind their change. These engagements need to have buy in from industry organisations and regulatory bodies, but the greatest success in terms of message portrayal will come from farmers and the ability to sell the success to other farmers.

9. NEXT STEPS

- For Tetipu Farms to implement the chosen strategy, I would recommend that it is not a 'flick the switch and change things overnight' type implementation, but an integrated gradual process.
- With this in mind, I would recommend the next steps as follows:

2016/2017:

- Start riparian management plan as per appendix 2.
- Purchase in autumn bull calves and spring bull calves as per scenario 5 analysis.
- Take on 120 dairy heifers instead of the normal intake of 260.
- Purchase maternal rams in place of the normal terminal sire rams.
- Select top 500 to 550 ewes to mate to maternal sire ram in autumn 2017.

2017/2018:

- Continue riparian management plan as per appendix 2.
- Maternal lambs born in spring 2017, select top 350 ewe lambs at weaning to preferentially feed.
- Sell increased bull crop as feed dictates through summer 2017/2018, with preference given to feeding ewe lambs to achieve target mating weights in autumn 2018.
- Have final selection pre ewe hogget mating April 2018, with the aim to mate 300 above 42kg LWT.

2018/2019:

- Continue riparian management plan as per appendix 2.
- No requirement to buy in two tooths from the 2018/19 season onwards as ewe flock becomes self-sufficient.
- Extra lambs born from ewe hoggets born spring 2018.
- Should have new scenario fully implemented by the end of 2018.

2019/2020 & 2020/2021:

- Continue and finish riparian management plan as per appendix 2.

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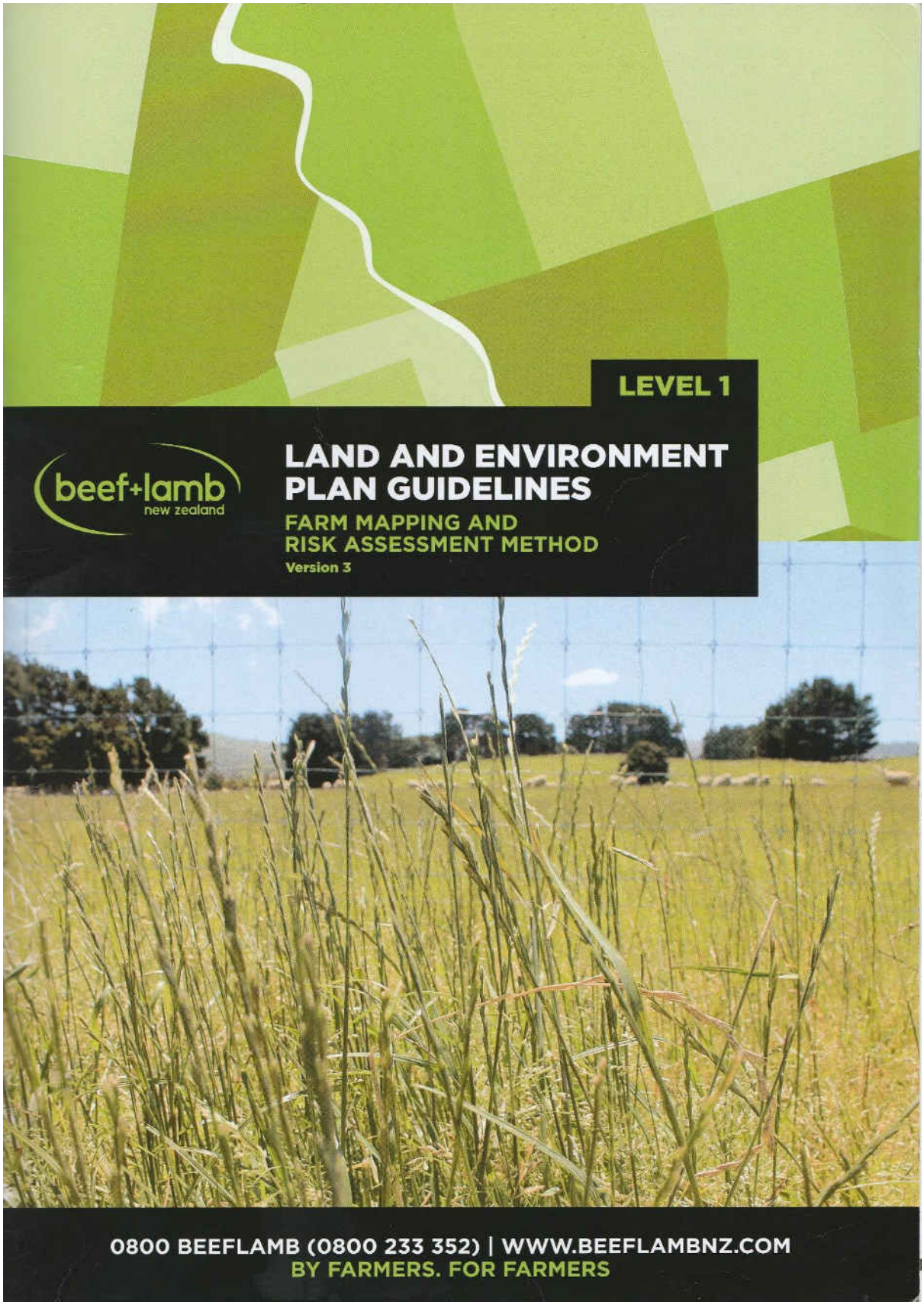
11. APPENDIX

Appendix 1 – Land and Environment Plan



Water quality (phosphorus)

'Phosphorus (P) can lead to algal blooms and eutrophication (excess nutrients) when P is limiting. These can cause problems for the health of waterways, humans and animals that drink the water or use it for recreation. P binds to soil particles, therefore P mainly enters waterways via erosion and farm runoff or direct application (from animals or fertiliser). The risk of P-loss increases when soils are bare, P concentrations are high, and runoff is significant.

1) P-loss

- **Do current Olsen-P levels exceed optimum levels on any part of the farm?** YES / NO
  - Optimum levels for sheep and beef are 20–25 (sedimentary soils), 20–30 (ash soils), and 35–45 (pumice soils).
- **Is there evidence of pugging/erosion of stream banks?** YES / NO
  - P can enter waterways with sediment lost from the stream bank into the waterway.
- **Do you practice conventional cultivation or intense strip grazing?** YES / NO
  - Both practices can expose large areas of bare soil. P-loss risk is highest on sloping and hilly land.
- **Is more than half of the farm rolling, hilly or steep?** YES / NO
  - Steeper slopes tend to generate higher rates of runoff.
- **Are dominant soils poorly drained, clayey, hydrophobic or slowly permeable?** YES / NO
  - There is a greater chance that these soil types will create higher runoff rates. Hydrophobic soils are coarse-textured soils that dry out and become water repellent (some sandy and pumice soils).
- **Do you farm in a high rainfall area, or an area subject to high rainfall intensities?** YES / NO
  - Runoff is strongly related to rainfall amount and/or intensity. High rainfall is >1500 mm/yr.

If you answered YES to one or more questions, then your farm may have an elevated level of risk.

2) Responses

Now you can write down how you will manage P-loss risk on the response plan template provided. Some suggestions include:

SUGGESTIONS:

- Exclude stock from at-risk streams with fences or other methods
- Consider installing culverts or bridges at stock crossings
- Provide alternative sources of stock water in each paddock (e.g. reticulated water in troughs)
- Consider strategic vegetated-buffer areas where runoff converges
- Consider riparian buffer strips around waterways (intensely farmed areas)
- Maintain Olsen-P at optimum levels
- Avoid direct P-fertiliser application to open water or water channels
- Avoid strip grazing and cultivation of steeper slopes
- Use slow release P-fertiliser (e.g. RPR)
- Avoid super-phosphate application when heavy rainfall is forecast (June–Sept)
- Avoid over-grazing pastures prone to drying out.

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LAND AND ENVIRONMENT PLAN

WATER QUALITY: PHOSPHORUS - How will you manage P-loss issues on your farm?

RESPONSE PLAN FOR:				YEAR:	
PRIORITY Rank each response in order of priority	**ISSUE** Detail the issue of concern	**RESPONSE** Specify your response to minimise or manage the issue	**COST** Estimate cost	**TIME-FRAME** Time-frame to be completed in	**PROGRESS** Tick when completed. Carry over if not.
1	Erosion of streambanks in Mangawheso + Mangoparo Streams.	Fence off waterways. One side cattle proof + one side sheep proof.	$46230	5 years	
2	8 paddocks still without reticulated trough water	Completion of water system upgrade to have all paddocks on trough water	$500 × 8 = $4000	2 years	
1	Lack of buffer areas adjacent to streams.	Leave 3m buffer strip when fencing off waterways. Plant with flaxes/plants	$17250	5 years.	
3	Timing of superphosphate application (currently August)	Review with fert rep and try an establish a more environmentally friendly application time	$0	1 year.	

Erosion and sediment

Common erosion types include wind, slip, slump, earthflow, gully, tunnel gully, stream bank, and silt deposition associated with flooding. Sediment can disrupt ecosystems in waterways and significantly impact on freshwater life.

1) Farm erosion risk

- **Negligible (no risk)** YES / (NO)
- Visual evidence of any erosion is hard to find
- Only a very small area of the farm is affected
- Highly unlikely to have a major erosion event even in the worst of storms
- Heavy stock are excluded from waterways with good buffer zones
- Wind erosion is not an issue.

- **Slight risk** YES / (NO)
- There is visual evidence of past erosion (scars, slumps, exposed soil)
- The area affected is reasonably noticeable, or it represents a small area of hard to manage erosion
- A major erosion event could impact on production and/or threaten infrastructure, but it would be rare and recovery would be quick
- Wind erosion happens occasionally.

- **Moderate risk** (YES) / NO
- Evidence of erosion is obvious
- A sizeable portion of the farm is potentially at risk (e.g. several large hill slopes)
- A major erosion event is a definite threat to production and/or infrastructure, and recovery time would be significant
- Heavy stock have ready access to waterways.
- Wind erosion happens regularly.

- **Severe risk** YES / (NO)
- Ongoing erosion is a characteristic of the farm
- Evidence of erosion is extensive
- A major erosion event would threaten production and infrastructure, to the point where it could threaten long-term business viability
- Wind erosion requires active management.

If you answered YES to any risk other than NEGLIGIBLE, then you should consider protecting your farm from future erosion events.

2) Responses

You can write down how you will minimise erosion risk on your farm on the response plan template provided. Some suggestions include:

SUGGESTIONS:

- Space planted poplar poles on hill slopes at appropriate densities
- Retirement from grazing of the worst affected areas, particularly those with marginal production value
- Afforestation of worst areas provided access for harvesting will be feasible
- Construct containment structures for certain erosion types (e.g. debris dams)
- Strategic tree planting to protect key infrastructure (fences, tracks, buildings, public roads)
- Design or locate tracks, fences, etc. in a way that minimises the risk of erosion damage
- Engage a regional council advisor/officer or similar specialist for advice
- Stabilisation planting such as flaxes, small trees, willows to prevent stream bank erosion. (Not grey willow or crack willow as these are unwanted organisms and are pest plants)
- Contour fencing
- Reducing weight of stock on at-risk country (e.g. replacing cattle with sheep or moving to a younger stock class of cattle)
- Identify critical source areas where sediment collects before leaving the paddock as runoff. Strategically graze towards these areas, rather than starting at them and working away (most commonly at the bottom of hills above waterways) to use remaining crop/pasture as a filter
- Exclude cattle and deer from waterways
- Consider direct drill or minimum tillage and timing of cultivation to avoid wind erosion at high risk times of the year
- Consider buffer strips around areas of land exposed to wind erosion particularly where wind-blown sediment reaches waterways.

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LAND AND ENVIRONMENT PLAN

EROSION – How will you manage erosion and sediment on your farm?

RESPONSE PLAN FOR:				YEAR:	
PRIORITY Rank each response in order of priority	**ISSUE** Detail the issue of concern	**RESPONSE** Specify your response to minimise or manage the issue	**COST** Estimate cost	**TIME-FRAME** Time-frame to be completed in	**PROGRESS** Tick when completed. Carry over if not.
1	Erosion identified in 10 hill paddocks	Space poplar pole plantings through paddocks at 5 poles/ha	120ha x $10/pole x5 = $6000.	5 years (2 pdks/yr)	
1	Cattle on hill country (esp. Breeding Cows)	Review whether beef cows still need to be in farm system	?	1 year.	
2	4 hill paddocks unsuitable for poplar pole planting.	Talk to council about sediment trap dams to prevent further water contamination	$2000?	Review ASAP	

Water quality (nitrogen)

'Nitrogen (N) becomes highly mobile within soil systems and can be easily leached beyond the root-zone into groundwater. The more free-draining the soil, and the higher the rainfall, the greater the risk. Elevated N concentrations can cause water quality problems such as algal blooms, eutrophication (excess nutrients), and nitrate toxicity (worst case). All of which can cause problems for the health of waterways, humans and animals, who drink the water or use it for recreation.

1) Nitrogen loss risk

- **Is your farm's stocking rate higher than 18 su/ha?** YES / NO
  - Higher stocking rates mean more urine patches, which are the key source of N-leaching in pastoral grazing systems. Appendix 2 shows a stock unit conversion table.
- **Do cattle make up more than 20% of total stock units?** YES / NO
  - Compared with sheep, cattle urinate in greater amounts, and they are more likely to urinate a number of times in the same general area.
- **Is your farm located in a high rainfall area (>1500 mm/yr)?** YES / NO 1400ml/year.
  - Leaching generally occurs when rainfall exceeds evapotranspiration and soil-water storage capacity is full (saturated).
- **Are N-fertilisers used?** YES / NO
  - N-fertiliser has little adverse impact unless applied excessively (>50 kg N/ha/application or >150 kg N/ha/yr) or during winter. However, more feed grown and being eaten will result in higher urine concentrations of N.
- **Are supplements used?** YES / NO
  - The use of supplements often means an increase in stocking rate. Some supplements have high N concentrations (e.g. PKE or maize silage). The N concentration in the urine is directly related to the N concentration of the feed, so a higher stocking rate and higher N feed concentration can increase N output.
- **Is soil type shallow and/or very porous (e.g. sands, gravelly soils)?** YES / NO
  - Water and dissolved N drains more quickly through shallow or very porous soils.
- **Is cropping a significant enterprise (e.g. a mixed cropping farm)?** YES / NO
  - Cropping can result in extreme N-leaching depending on cultivation methods and fertiliser policies.

If you answered YES to the first question, or YES to two or more of the other questions, then your farm may have an elevated risk.

2) Responses

Now you can write down how you will manage N-loss for your farm on the response plan template provided. Wind erosion requires active management. Some suggestions include:

SUGGESTIONS:

- Avoid winter applications of nitrogen-based fertilisers
- Avoid applications when heavy rain is forecast.
- Avoid excessive N-fertiliser rates (>50 kg N/ application or >150 kg N/ha/yr)
- Ensure other nutrients are non-limiting (maximise N-uptake opportunity)
- Undertake a comprehensive nutrient analysis using Overseer® Nutrient Budgets
- Ensure runoff from areas of high animal concentration (e.g. yards, frequently used tracks and stock camps) is discharged onto land rather than into waterways.

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LAND AND ENVIRONMENT PLAN

WATER QUALITY: NITROGEN – How will you manage N-loss on your farm?

RESPONSE PLAN FOR:				YEAR:	
PRIORITY Rank each response in order of priority	**ISSUE** Detail the issue of concern	**RESPONSE** Specify your response to minimise or manage the issue	**COST** Estimate cost	**TIME-FRAME** Time-frame to be completed in	**PROGRESS** Tick when completed. Carry over if not.
3	Increasing N use tendency.	Limit N use to no more than 150kg N/ha/year MAX, ideally 100kg.	0		
1	Breeding cows on winter crop	Review whether on/off grazing could work, or other stock class could go on crop.	?		

Water quality (faecal bacteria)

Faecal matter and its associated pathogens (e.g. bacteria) present a risk to human an animal health through waterborne infections and diseases. The extent of this risk is often assessed by measuring water concentrations of the indicator organism, *E.coli*. Sources include stock defecation into water, and faecal material being washed from pasture to streams via runoff.

1) Faecal bacteria risk

- **Do stock have open access to streams or other natural waterbodies? YES / NO**
- Direct deposition to water is a key source of faecal bacteria. Cattle, in particular, may show a defecation reflex triggered by standing in water. Deer are also attracted to water for wallows.
- **Do cattle make up more than 20% of total stock units? YES / NO**
- Sheep and goats are less attracted to waterbodies and do not tend to stand in, or wade through waterbodies and streams.

2) Responses

Now you can write down how you will manage faecal bacteria on the response plan template provided. Some suggestions include:

SUGGESTIONS:

- Exclude stock from at-risk streams with fences or other methods
- Consider installing culverts or bridges at stock crossings
- Provide alternative sources of stock water in each paddock (e.g. troughs)
- Consider strategic vegetated buffer areas where runoff converges
- Consider riparian buffer strips around waterways.

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LAND AND ENVIRONMENT PLAN

WATER QUALITY: FAECAL BACTERIA – How will you manage faecal bacteria and other water quality issues on your farm?

RESPONSE PLAN FOR:				YEAR:	
PRIORITY Rank each response in order of priority	**ISSUE** Detail the issue of concern	**RESPONSE** Specify your response to minimise or manage the issue	**COST** Estimate cost	**TIME-FRAME** Time-frame to be completed in	**PROGRESS** Tick when completed. Carry over if not.
1	Stock having access to permanent waterways.	Fence off waterways as per plan to manage Phosphorous	as per P	5years	
1	8 paddocks still without reticulated water	Completion of trough installations as per plan to manage phosphorous	as per P.	2 years	

Productive capability

Protecting the soil-plant ecosystem is an important component of Land and Environment Planning. In general, good farming practice is also good environmental practice.

1) Productive capability

- **Are current nutrient levels (P, K, S, Mg) below optimal for any part of the farm?** YES / NO
- Full pasture production potential cannot be realised if nutrient status is limiting. Appendix 1 shows target soil test ranges.
- **Do you undertake soil testing every 2-3 years using the same transect lines?** YES / NO
- Monitoring soil fertility consistently is important for optimal and sustained production. Guessing nutrient requirements increases the risk of under- or over-fertilising, both of which can represent a substantial cost.
- **Do you graze significant numbers of cattle on wet soils, or practice intensive grazing methods when soils are wet (e.g. strip grazing)?** YES / NO
- Pugging is the silent saboteur. It can result in a 50% drop in pasture yield and an 80% drop in N-fixation by clovers. Recovery can take more than a year.
- **Are invasive pasture weeds (e.g. gorse, thistles, broom, ragwort, etc) established on the farm?** YES / NO
- Pasture weeds can be toxic, physically dangerous, disease-related (scabby mouth), or just an outright nuisance. Significant infestations replace pasture and reduce stock carrying capacity and production.
- **Do you have a particular problem with pasture pests?** YES / NO
- Porina, grass grub, clover root weevil, rabbits and other pasture pests can consume or damage tonnes of potential pasture yield, often at critical times.

The full scope of productive capability cannot be covered in this entry level LEP. However, it is a useful starting point for considering how well these concerns are being managed. What can be done to avoid these problems (particularly seasonal weeds and pests)?

2) Responses

You may already know how best to respond to these concerns. But if there is room for improvement, then you can write down how you will manage productive capability on the response plan template provided.

SUGGESTIONS:

- **Direct response such as:**
- Managing stock off wet soils in winter
- Developing a weed control strategy
- Developing a soil testing strategy
- Using cattle to manage grass grub
- Have an immediate and aggressive response policy to any new weed.
- **Engage the help of someone with special experience or expertise such as:**
- Farm advisor/consultant
- Special experience or expertise
- Local or neighbouring farmer
- Fertiliser rep
- Regional council officer or advisor.
- **Search for ideas. Many excellent resources are available as books, fact sheets or internet resources:**
- www.beeflambnz.com
- www.fertresearch.org.nz
- www.lgnz/lg-sector/maps/index
- www.landcare.org.nz
- Your regional council.

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LAND AND ENVIRONMENT PLAN

PRODUCTIVE CAPABILITY – How will you improve your productive capability?

RESPONSE PLAN FOR:				YEAR:	
PRIORITY Rank each response in order of priority	**ISSUE** Detail the issue of concern	**RESPONSE** Specify your response to minimise or manage the issue	**COST** Estimate cost	**TIME-FRAME** Time-frame to be completed in	**PROGRESS** Tick when completed. Carry over if not.
	Grazing of soils when wet in winter	Review farm stock policy to allow more flexibility to buy/sell stock			

Biodiversity

New Zealand's biodiversity (short for biological diversity: the variety of all biological life —plants, animals, fungi, and micro-organisms) is in serious decline. Today, about 1,000 of our known animal, plant and fungi species are considered threatened, and probably many species we don't yet know about. Our most threatened habitats are in lowland areas, with only small, isolated patches remaining within or on the edge of farm or forestry land. Because many of the remaining areas of threatened habitats and their residents are found on private farm land, farmers as land owners and managers have the opportunity to make a real difference in slowing the decline in our iconic New Zealand biodiversity.

1. Biodiversity

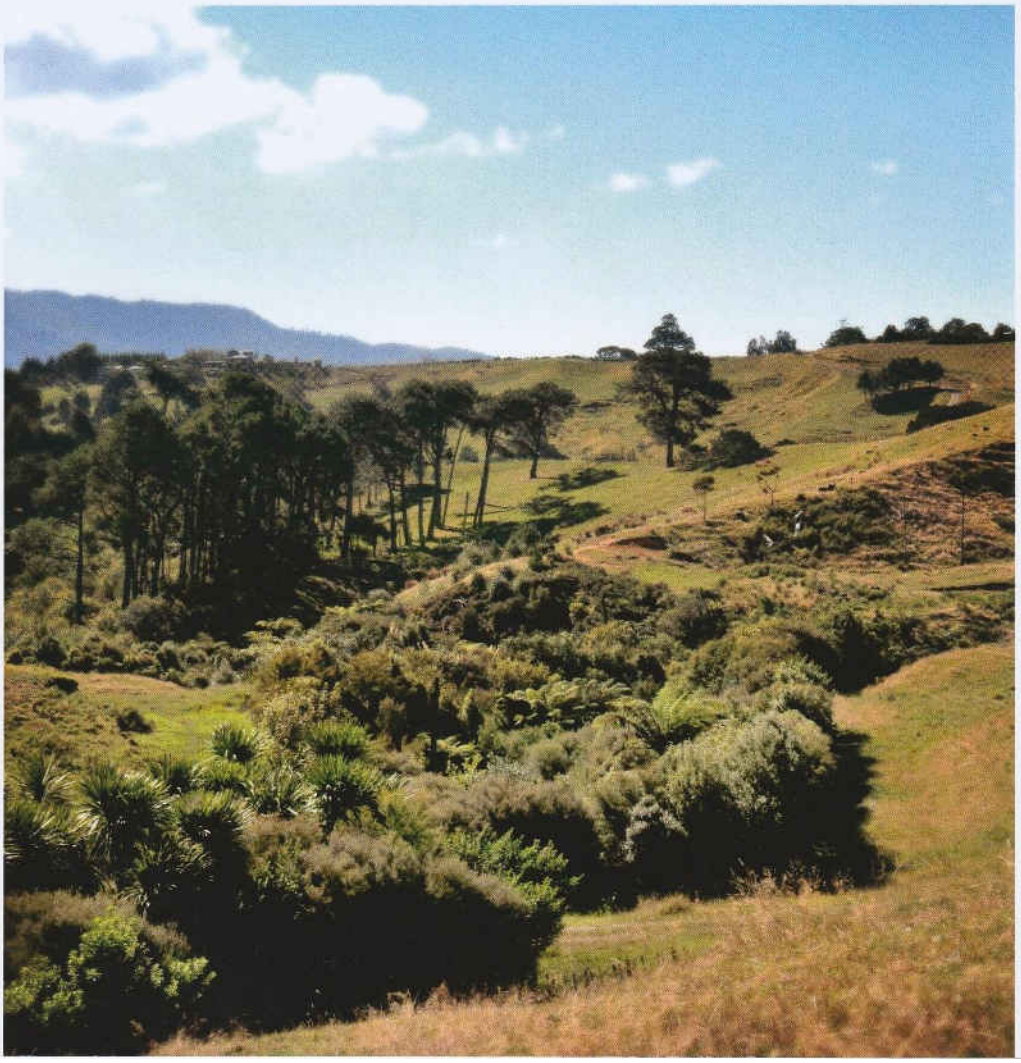
- **Do stock have access to native bush blocks on your farm?** YES / NO
  - Stock grazing in native bush prevents regeneration by eating new growth, and will eventually lead to loss of the bush altogether as older trees die and are not replaced. Stock can also degrade soils (e.g. compaction) and disperse weed species into bush remnants.
- **Do stock have access to streams and wetlands on your farm?** YES / NO
  - Stock accessing the waterway beds and margins damages the in-stream habitat for fish and insects, as well as increasing bank erosion and faecal contamination. Check with your Regional Council as there may be rules about stock access and stream and wetland protection.
- **Do you have a regular pest animal control programme in place for possums, rats, mustelids, pigs and goats?** YES / NO
  - These introduced mammals are of some of the biggest threats to our native biodiversity. Possums decimate tree foliage, goats and pigs browse the regrowth/understory and prevent regeneration, rats and mustelids eat bird eggs and chicks as well as lizards and insects.
- **Do you undertake weed control on your property (in both pastoral and natural areas?)** Yes/No
  - Weeds will readily invade natural areas (especially when areas are retired from grazing) and can quickly out-compete the regenerating plants and/or restoration plantings by choking and overgrowing them. Weeds can also invade bush remnants and wetlands an can displace native species (e.g. climbing weeds smothering native tree canopies).
- **Do you routinely drain wetlands?** YES / NO
  - Wetlands are like the kidneys of the farm and are one of New Zealand's rarest habitats with only 6% of their original extent left. They are key for removing sediment and nutrients from farm run-off, and can also help attenuate flooding by 'soaking up' excess water and releasing it slowly. Wetlands also support an array of wildlife (including 22% of our native bird species and 30% of native freshwater fish).
- **Do you have 'hung/perched' culverts (where the outlet is elevated above the downstream water surface)?** YES / NO
  - Hung culverts prevent native fish from moving upstream and significantly reduce the available area for them to live and breed. Many of our native freshwater fish are now in serious decline, especially in lowland habitats.

2. Responses

Now you can write down how you will protect and/or enhance native biodiversity on your farm using the response form provided. Some suggestions include:

- Retire and fence permanently wet areas rather than draining them
- Fence any existing bush blocks on the property and let them regenerate
- Fence streams to prevent stock access, leaving a good (e.g. 3-5m) riparian strip (buffer) either side
- Consider planting natives (e.g. cabbage trees and flax are easy to establish) in the riparian strips to shade the water and provide in-stream habitat for fish, as well as food sources for native birds

- Undertake targeted weed control (both of existing bush blocks and wetlands and in the first few years post retirement/fencing) to ensure that native regeneration and plantings get off to a good start
- Have a regular pest animal control programme in place to ensure healthy trees and flourishing bird life. If time is short, target your efforts to key times —such as baiting/trapping in winter when pests are more likely to be hungry and therefore ingest the bait, and in early spring just prior to when birds will be nesting
- Install protection around newly installed culverts (to prevent scouring beneath the culvert outfall which will lead to hung culverts), or for existing culverts retrofit rock riprap in the outfall area as a 'ramp' from the streambed to the culvert lip
- Contact your regional council—often grants are available for undertaking biodiversity enhancement works
- Biodiversity doesn't recognise property boundaries – consider joining up with adjacent landowners and tackling a project together, sharing skills and resources. Community groups and/or several landowners jointly undertaking a project are more likely to be successful in gaining funding, and completing the project
- Protect you biodiversity for the future—consider setting up a covenant on areas which should include financial support to do so. This could be done as a Nga Whenua Rahui, QEII covenant, local council covenant or others.



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LAND AND ENVIRONMENT PLAN

BIODIVERSITY – How will you manage biodiversity on your farm?

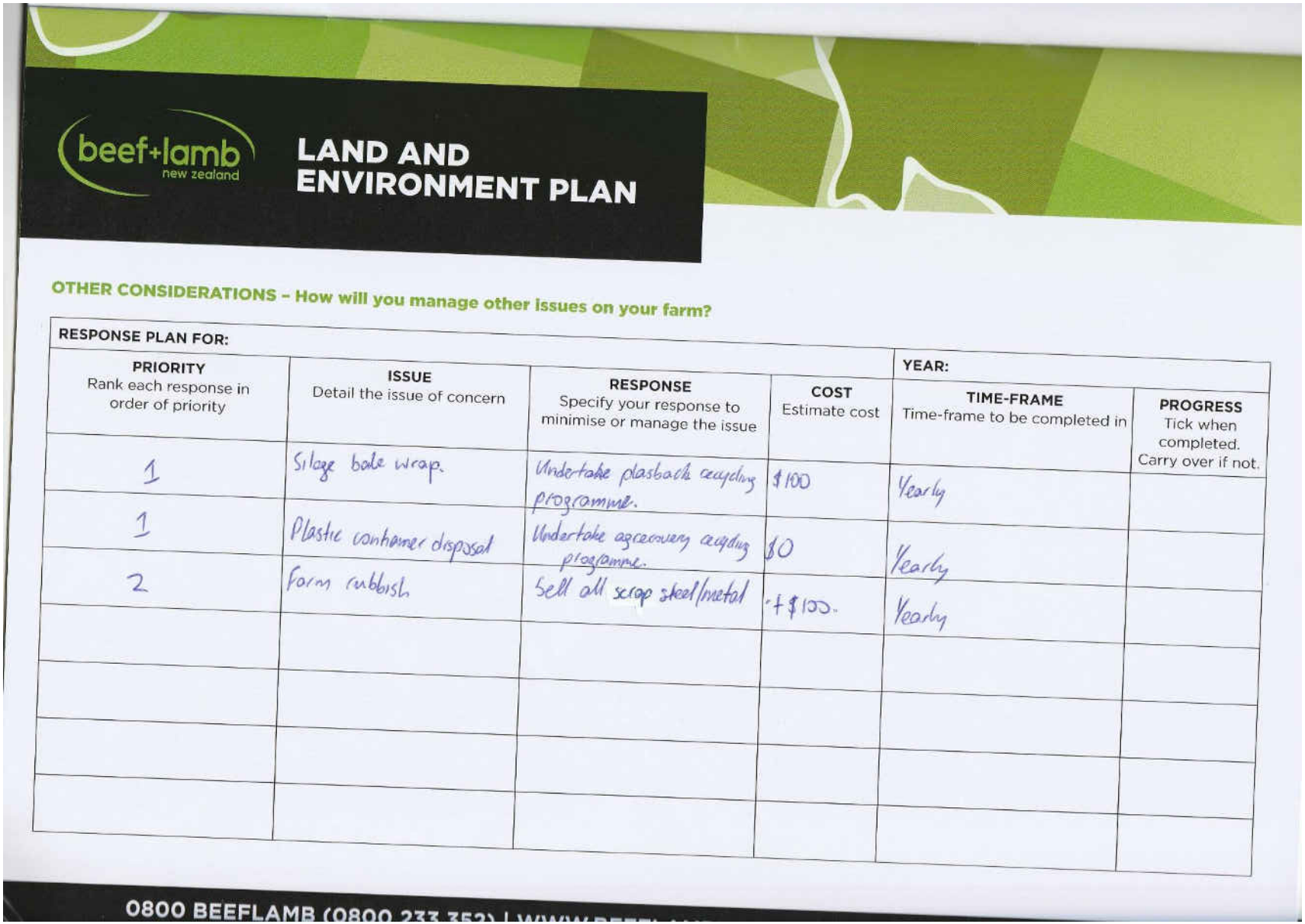
RESPONSE PLAN FOR:				YEAR:	
PRIORITY Rank each response in order of priority	**ISSUE** Detail the issue of concern	**RESPONSE** Specify your response to minimise or manage the issue	**COST** Estimate cost	**TIME-FRAME** Time-frame to be completed in	**PROGRESS** Tick when completed. Carry over if not.
1-2	Unfenced wetlands and native bush areas.	Retire and fence off the 5 identified wetlands/bush areas	$38240.	5 years	
3	Weed control in retired areas.	Maintain + Control as required	?	Ongoing once established	

Other issues

Your farm may have other important environmental issues not covered in this entry level LEP. A response plan is provided if you would like to include these. Some examples include:

SUGGESTIONS:

- Protecting indigenous forest remnants
- Soil contamination (DDT, old dips, old dosing strips)
- Wetland protection or restoration
- Flood prone areas
- Other pests (possums, wildfowl, etc.)
- Chemical storage, use and disposal
- Protecting or enhancing stream, river or lake areas
- Shade and shelter for stock
- Managing farm waste (e.g. recycling silage wrap)
- Irrigation and water use efficiency
- Greenhouse gases
- Historic and cultural sites
- Offal pits and farm dumps
- Tree planting for amenity value.



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LAND AND ENVIRONMENT PLAN

OTHER CONSIDERATIONS – How will you manage other issues on your farm?

RESPONSE PLAN FOR:				YEAR:	
PRIORITY Rank each response in order of priority	**ISSUE** Detail the issue of concern	**RESPONSE** Specify your response to minimise or manage the issue	**COST** Estimate cost	**TIME-FRAME** Time-frame to be completed in	**PROGRESS** Tick when completed. Carry over if not.
1	Silage bale wrap.	Undertake plastech recycling programme.	$100	Yearly	
1	Plastic container disposal	Undertake agrecovery recycling programme.	$0	Yearly	
2	Farm rubbish.	Sell all scrap steel/metal	+$100.	Yearly	

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Appendix 2 – Riparian Management Plan

Produced through DairyNZ riparian planner, free of charge and publicly available.

Tetipu Farms Ltd

Supply number: (No Supply Company)

Overview

Pond

Riparian Management

Accord lake or pond - predominantly exotic trees

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$360	$360	2018	2018
Fencing 70m	$1,190	$1,190	2018	2018
Planting (5%)	$100	$100	2018	2018
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$1,650**	**$1,650**	**2018**	**2018**

Paotawa Wetland

Stock Exclusion

Accord wetland or critical source area - predominantly native dominated

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$1,800	$1,800	2017	2017
Fencing 1100m	$18,700	$18,700	2017	2018
Planting (0%)	$0	$0		
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$20,500**	**$20,500**	**2017**	**2018**

Mangawhero Stream

Riparian Management

Accord river or stream - eroding - both sides managed - predominantly grass

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$0	$0		
Fencing 4120m	$26,780	$26,780	2016	2019
Planting (25%)	$9,450	$9,450	2016	2019
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$36,230**	**$36,230**	**2016**	**2019**

Kaihuka Wetland

Stock Exclusion

Accord wetland or critical source area - predominantly native dominated

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$1,200	$1,200	2020	2020
Fencing 540m	$9,180	$9,180	2020	2020
Planting (0%)	$0	$0		
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$10,380**	**$10,380**	**2020**	**2020**

Poatawa Stream

Riparian Management

Accord river or stream - both sides managed - predominantly grass

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$0	$0		
Fencing 620m	$2,480	$2,480	2019	2019
Planting (31%)	$1,900	$1,900	2019	2019
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$4,380**	**$4,380**	**2019**	**2019**

Bryans Wetland

Stock Exclusion

Accord wetland or critical source area - predominantly native dominated

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$600	$600	2019	2019
Fencing 140m	$2,380	$2,380	2019	2019
Planting (0%)	$0	$0		
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$2,980**	**$2,980**	**2019**	**2019**

Mangawhero Stream

Riparian Management

Accord river or stream - eroding - both sides managed - predominantly grass

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$0	$0		
Fencing 200m	$1,300	$1,300	2020	2020
Planting (25%)	$750	$750	2020	2020
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$2,050**	**$2,050**	**2020**	**2020**

Kaeaea Wetland

Stock Exclusion

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$1,200	$1,200	2016	2016
Fencing 550m	$9,350	$9,350	2016	2016
Planting (0%)	$0	$0		
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$10,550**	**$10,550**	**2016**	**2016**

Mangoparo Stream

Riparian Management

Accord river or stream - eroding - both sides managed - predominantly grass

Action	Estimated total cost	Allocated cost	Start	Finish
Site preparation	$0	$0		
Fencing 3300m	$18,150	$18,150	2016	2018
Planting (25%)	$7,050	$7,050	2016	2018
Ongoing maintenance	$0	$0		
Other costs	$0	$0		
Total	**$25,200**	**$25,200**	**2016**	**2018**

Breakdown by year

2016/2017

Waterway / Action	More information	Cost
Mangawhero Stream / Fencing plan	1000m	$6,500
Mangawhero Stream / Planting	480 plants - 149 for the upper bank zone - 331 for the lower bank zone	$2,400
Kaeaea Wetland / Site Preparation		$1,200
Kaeaea Wetland / Fencing plan	550m	$9,350
Mangoparo Stream / Fencing plan	1100m	$6,050
Mangoparo Stream / Planting	470 plants - 146 for the upper bank zone - 324 for the lower bank zone	$2,350

Total plants:
- Upper Bank: 295
- Lower Bank: 655

Total Cost for the year: $27,850

2017/2018

Waterway / Action	More information	Cost
Paotawa Wetland / Site Preparation		$1,800
Paotawa Wetland / Fencing plan	550m	$9,350
Mangawhero Stream / Fencing plan	1000m	$6,500
Mangawhero Stream / Planting	470 plants - 146 for the upper bank zone - 324 for the lower bank zone	$2,350
Mangoparo Stream / Fencing plan	1100m	$6,050
Mangoparo Stream / Planting	470 plants - 146 for the upper bank zone - 324 for the lower bank zone	$2,350

Total plants:
- Upper Bank: 292
- Lower Bank: 648

Total Cost for the year: $28,400

2018/2019

Waterway / Action	More information	Cost
Pond / Site Preparation		$360
Pond / Fencing plan	70m	$1,190
Pond / Planting	20 plants - 6 for the upper bank zone - 14 for the lower bank zone	$100

Waterway / Action	More information	Cost
Paotawa Wetland / Fencing plan	550m	$9,350
Mangawhero Stream / Fencing plan	1000m	$6,500
Mangawhero Stream / Planting	470 plants - 146 for the upper bank zone - 324 for the lower bank zone	$2,350
Mangoparo Stream / Fencing plan	1100m	$6,050
Mangoparo Stream / Planting	470 plants - 146 for the upper bank zone - 324 for the lower bank zone	$2,350

Total plants:
- Upper Bank: 298
- Lower Bank: 662

Total Cost for the year: $28,250

2019/2020

Waterway / Action	More information	Cost
Mangawhero Stream / Fencing plan	1120m	$7,280
Mangawhero Stream / Planting	470 plants - 146 for the upper bank zone - 324 for the lower bank zone	$2,350
Poatawa Stream / Fencing plan	620m	$2,480
Poatawa Stream / Planting	380 plants - 0 for the upper bank zone - 380 for the lower bank zone	$1,900
Bryans Wetland / Site Preparation		$600
Bryans Wetland / Fencing plan	140m	$2,380

Total plants:
- Upper Bank: 146
- Lower Bank: 704

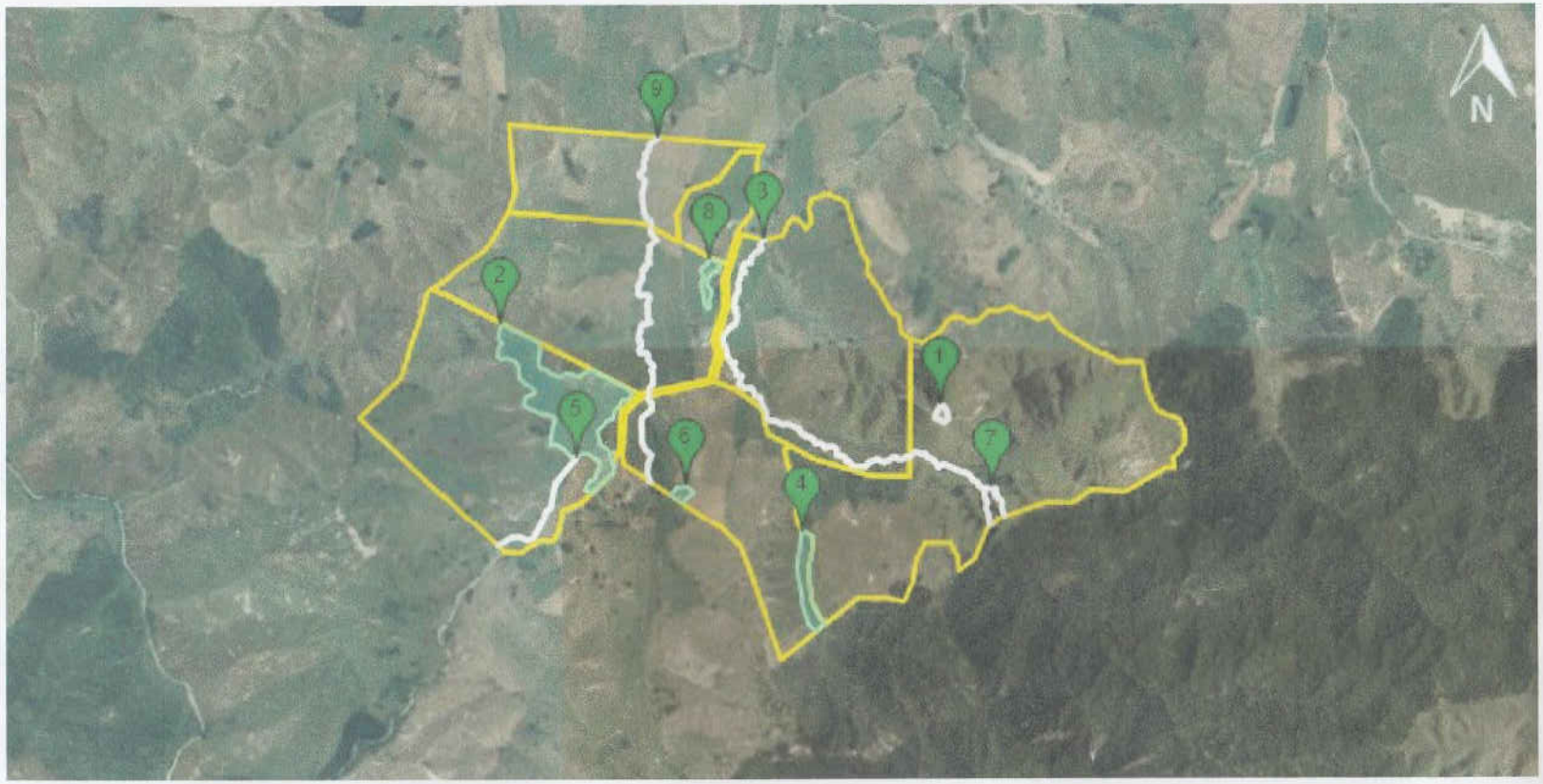
Total Cost for the year: $16,990

2020/2021

Waterway / Action	More information	Cost
Kaihuka Wetland / Site Preparation		$1,200
Kaihuka Wetland / Fencing plan	540m	$9,180
Mangawhero Stream / Fencing plan	200m	$1,300
Mangawhero Stream / Planting	150 plants - 47 for the upper bank zone - 103 for the lower bank zone	$750

Total plants:
- Upper Bank: 47
- Lower Bank: 103

Total Cost for the year: $12,430



Legend

1- Pond
2- Paotawa Wetland
3- Mangawhero Stream
4- Kaihuka Wetland
5- Poatawa Stream
6- Bryans Wetland
7- Mangawhero Stream
8- Kaeaea Wetland
9- Mangoparo Stream

Created using the DairyNZ Riparian Planner, 09/10/2016

Appendix 3: Overseer

OVERSEER is a mathematical model that captures the complexity of nutrient cycling in a farm system to help farmers and growers understand the way nutrients flow through their farm.

OVERSEER does this by modelling how nutrients coming into the farm (such as fertiliser and feed) are naturally processed by organisms (such as cows, sheep and plants) and/or transformed by physical processes (nutrient cycles) and how nutrients move within the farm.

Water coming into the farm (rain and irrigation) and plants that absorb nitrogen from the atmosphere (such as clover) also play an important role in the transfer of nutrients, and these are captured in OVERSEER.

Nutrients end up in plants (like pasture or maize) or as products leaving the farm gate (meat, milk, crops, wool and wine). For farms that produce animal products, when the pasture (or feed that is bought in to the farm) is eaten by farm animals, the nutrients they absorb are used to create product or excreted as dung and urine. The excreta is deposited on the soil or farm structures and can end up in an effluent system to be re-deposited elsewhere on the farm. OVERSEER uses information about how a farm is run to predict nutrient movement within the farm.

Depending on the local climate, management practices, how absorbent the soil is or how much water is draining through the soil; OVERSEER predicts what nutrients will be lost from the farm or be held in the soil to be re-used by plants. These losses include emissions into the air, losses through the soil (leaching) and losses across the land surface (run-off).

The vulnerability of nutrients to these losses depends on the nutrient (N, P, K, S, Ca, Mg, Na), where on the farm they are deposited and in what form (urine, dung, effluent, fertiliser). OVERSEER uses mathematical calculations to capture these complexities to produce the nutrient budget.

(Overseer, 2016)

Appendix 3.1 – Overseer Report: Scenario 1

Nutrient Budget

OVERSEER

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added in							
Fertiliser, lime & other	63	42	0	28	49	0	0
Rain/clover N fixation	56	0	2	3	2	4	14
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	10	2	1	1	4	0	0
Exported effluent	0	0	0	0	0	0	0
As Supplements	0	0	0	0	0	0	0
To atmosphere	36	0	0	0	0	0	0
To water	23	1.4	16	28	29	10	34
Change in internal pools							
Plant material	0	0	0	0	0	0	0
Organic pool	49	5	0	2	0	0	0
Inorganic mineral	0	8	-26	0	-5	-7	-8
Inorganic soil pool	0	26	11	0	23	1	-12

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Te tipu farm	6782	23	3.9	108	64
Other farm sources	130				
Whole farm	6912	23			
Less N removed in wetland	0				
Farm output	6912	23			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommeded level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Appendix 3.2 – Overseer Report: Scenario 2

Version 6.2.2, on 7/10/2016 4:02:11 p.m.

Nutrient Budget

OVERSEER

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added in							
Fertiliser, lime & other	63	42	0	28	49	0	0
Rain/clover N fixation	32	0	2	3	2	5	15
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	7	1	0	1	2	0	0
Exported effluent	0	0	0	0	0	0	0
As Supplements	0	0	0	0	0	0	0
To atmosphere	29	0	0	0	0	0	0
To water	20	1.4	15	29	28	11	35
Change in internal pools							
Plant material	-4	0	-3	0	0	0	0
Organic pool	40	4	0	2	0	0	0
Inorganic mineral	0	9	-25	0	-5	-7	-8
Inorganic soil pool	3	28	15	0	26	1	-12

This Overseer report is at all times subject to the disclaimers set out on page 2 of this report. Please read these disclaimers carefully.

Block Nitrogen

OVERSEER

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Te tipu farm	4822	16	2.7	87	64
crops	1185	237	31.4	61	35
Other farm sources	98				
Whole farm	6105	20			
Less N removed in wetland	0				
Farm output	6105	20			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommeded level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Appendix 3.3 – Overseer Report: Scenario 3

Nutrient Budget

OVERSEER®

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added in							
Fertiliser, lime & other	63	42	0	28	49	0	0
Rain/clover N fixation	50	0	2	3	2	5	15
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	6	1	0	1	2	0	0
Exported effluent	0	0	0	0	0	0	0
As Supplements	0	0	0	0	0	0	0
To atmosphere	36	0	0	0	0	0	0
To water	26	1.5	16	29	33	11	35
Change in internal pools							
Plant material	-4	0	-3	0	0	0	0
Organic pool	46	4	0	2	0	0	0
Inorganic mineral	0	9	-26	0	-5	-7	-8
Inorganic soil pool	3	28	14	0	22	1	-12

This Overseer report is at all times subject to the disclaimers set out on page 2 of this report. Please read these disclaimers carefully.

Nutrient Budget

OVERSEER

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added in							
Fertiliser, lime & other	63	42	0	28	49	0	0
Rain/clover N fixation	50	0	2	3	2	5	15
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	6	1	0	1	2	0	0
Exported effluent	0	0	0	0	0	0	0
As Supplements	0	0	0	0	0	0	0
To atmosphere	36	0	0	0	0	0	0
To water	26	1.5	16	29	33	11	35
Change in internal pools							
Plant material	-4	0	-3	0	0	0	0
Organic pool	46	4	0	2	0	0	0
Inorganic mineral	0	9	-26	0	-5	-7	-8
Inorganic soil pool	3	28	14	0	22	1	-12

This Overseer report is at all times subject to the disclaimers set out on page 2 of this report. Please read these disclaimers carefully.

Appendix 3.4 – Overseer Report: Scenario 4

Nutrient Budget

OVERSEER®

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added in							
Fertiliser, lime & other	63	42	0	28	49	0	0
Rain/clover N fixation	44	0	2	3	2	5	15
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	9	2	0	1	3	0	0
Exported effluent	0	0	0	0	0	0	0
As Supplements	0	0	0	0	0	0	0
To atmosphere	33	0	0	0	0	0	0
To water	23	1.5	15	29	31	11	35
Change in internal pools							
Plant material	-4	0	-3	0	0	0	0
Organic pool	43	4	0	2	0	0	0
Inorganic mineral	0	9	-25	0	-5	-7	-8
Inorganic soil pool	3	27	14	0	23	1	-12

Block Nitrogen

OVERSEER

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Te tipu farm	5714	19	3.3	96	64
crops	1203	241	31.9	55	35
Other farm sources	115				
Whole farm	7033	23			
Less N removed in wetland	0				
Farm output	7033	23			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommeded level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Appendix 3.5 – Overseer Report: Scenario 5

Nutrient Budget

OVERSEER

	N	P	K	S	Ca	Mg	Na
	(kg/ha/yr)						
Nutrients added in							
Fertiliser, lime & other	63	42	0	28	49	0	0
Rain/clover N fixation	49	0	2	3	2	5	15
Irrigation	0	0	0	0	0	0	0
Supplements imported	0	0	0	0	0	0	0
Nutrients removed							
As products	11	2	1	2	4	0	0
Exported effluent	0	0	0	0	0	0	0
As Supplements	0	0	0	0	0	0	0
To atmosphere	35	0	0	0	0	0	0
To water	24	1.5	16	29	32	11	35
Change in internal pools							
Plant material	-4	0	-3	0	0	0	0
Organic pool	43	4	0	2	0	0	0
Inorganic mineral	0	9	-26	0	-5	-7	-8
Inorganic soil pool	3	27	14	0	21	1	-12

Block Nitrogen

Block name	Total N lost (kg N/yr)	N lost to water (kg N/ha/yr)	N in drainage * (ppm)	N surplus (kg N/ha/yr)	Added N ** (kg N/ha/yr)
Te tipu farm	6025	20	3.5	99	64
crops	1204	241	31.9	53	35
Other farm sources	121				
Whole farm	7350	24			
Less N removed in wetland	0				
Farm output	7350	24			

* Estimated N concentration in drainage water at the bottom of the root zone. Maximum recommeded level for drinking water is 11.3 ppm (note that this is not an environmental water quality standard).

** Sum of fertiliser and external factory effluent inputs.

N/A: N in drainage not calculated for easy and steep pastoral blocks, or for tree and shrubs, riparian, wetland or house blocks.

Appendix 4: Farmax

Farmax is a software based system for planning and controlling how you can most effectively convert your pasture into profit. Farmax has three key elements which make up the programme:

Planning - At its heart is a computerised model which is used to set up a model of your farm. This unique method of planning enables you to consider a wide range of 'what if' scenarios before deciding on the right way forward.

Monitoring - To ensure you are on track and are adapting to the weather and markets a monitoring component has been developed. This provides a streamlined method of adding farm data such as liveweights and pasture cover. It immediately calculates the implications and changes in revenue.

Performance reporting - Each year you will receive trend reports and benchmarking against other similar farms. This provides a means of evaluating how well you are tracking.

(Agrione, 2016)