Bay of Plenty Regional Council

Methodology for creation of NDA reference files and stocking rate table

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August 2015

PERRIN
AG CONSULTANTS

REPORT PREPARED BY

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DISCLAIMER

The information presented in this report is based on conservative current prices and returns to the best of the author's knowledge. No guarantees are given for the final result, which may be affected by factors outside the author's control.

1. Statement of qualifications and experience

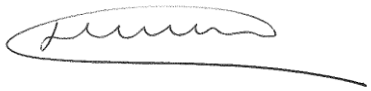
1.1 My name is Lee Matheson. I am a Director and Shareholder of Perrin Ag Consultants Limited, an advisory and consultancy business providing a range of services to the pastoral agricultural sector, and have been an employee of the company since August 2006, becoming a director in April 2008.

1.2 I hold the degree of Bachelor of Applied Science (Rural Valuation and Management) with First Class Honours (Plant Science) and an Advanced Certificate in Sustainable Nutrient Management in New Zealand Agriculture from Massey University. I am a Registered Member of the New Zealand Institute of Primary Industry Management. I also hold a Diploma in Financial Services from the Australian Financial Markets Association and have completed the OneFarm Governance Advisory Training Programme.

1.3 My area of expertise is financial analysis and modelling, profitable nutrient management and farm business management. In addition to the provision of project-based agribusiness advisory, I also hold direct executive management authority for a number of dry stock and dairy farming operations (4,747ha) in the greater Rotorua region.

1.4 I have am actively engaged in the provision of professional advisory services to both regional government and land owners as it relates to sustainable nutrient management in both the Rotorua lakes and Upper Waikato catchments. This includes the primary authorship of Farmer Solutions Project (2012), NDA Impact Analysis Phase 1 (2014), Upper Waikato Drystock Nutrient Study (2013) and the Upper Waikato Dairy Support Project (2014).

1.5 Our firm is also one of the approved Land Use Advisory service providers for the Bay of Plenty Regional Council.



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Managing director, Perrin Ag Consultants Ltd

3. Background and terms of reference

3.1 A draft OVERSEER version management method has been developed as part of the new rules structure for the Lake Rotorua catchment. This draft method relies on:

(i) Calculating property NDAs using the dual range allocation method[1]

(ii) Establishing one dairy reference file and one drystock reference file that approximately represent the average per ha discharge of the range in N losses associated with each sector as determined by the dual range allocation method. These averages are currently 64.53 kg N/ha for the dairy sector and 25.59 kg N/ha for the drystock sector (OVERSEER Version 6.2.0).

(iii) Expressing each property's NDA as a percentage of the relevant reference files

(iv) Re-running the reference files when new versions of OVERSEER are released and calculating the percentage shift from the previous reference file N loss

(v) Apply the reference file percentage shifts to each block on a property and then summing those blocks to give the whole property NDA.

3.2 The intent is that these reference files will be published as a report that is referenced in the proposed rules i.e. the reference file inputs will remain constant. Therefore it is important that the reference files, while hypothetical, represent a credible good practice farm system. They should also aim to be simple files that don't rely on the less well understood and complex functionality within OVERSEER.

3.3 In addition to the average sector discharge reference files, a stocking rate table for all the stock types used in Fact Sheet 10 that equate to the BOPRC definition of low intensity farming was created.

3.4 The limitations on stock numbers set by the stocking rate table is intended to permit a farm system that:

a. Achieve the lowest practical stocking rate that will allow effective management of low intensity lifestyle block pastures;

b. Can favour a beef policy (≈ 70% cattle as a proportion of all livestock);

c. Achieve a leaching rate similar to 17.9 kg N/ha/year (based on OVERSEER version 6.2.0), given 17.9 kg N/ha/year was established as the bottom of the drystock sector NDA allocation range.

[1] The full detail of the allocation can be found in http://www.rotorualakes.co.nz/vdb/document/1255. It is sufficient to know for the purposes of this methodology that NDAs (to be met by 2032) will be determined based on 2001-04 land use and N loss rates. NDAs will be allocated over a range or band of N loss rates per hectare.

[2] The reference files are a prediction of the average properties 2032 NDA. When developing these files consideration needs to be given to entering practices, inputs and outputs that are likely to be possible in 2032 given current knowledge and historical trends.

4. Methodology

4.1 Reference files

4.1.1 Reference files for two hypothetical properties: a 100 ha drystock farm; and a 100 ha dairy farm, were created in Overseer 6.2.0.

4.1.2 The block set-up in each of the files consisted of blocks totalling 100ha of effective area, comprising the soil, rainfall and slope combinations that proportionally represents the benchmarking data within the catchment.

4.1.3 These discrete management blocks were each allocated to one of 12 broader geophysical zones for the purposes of allocating pasture growth potential and subsequently relative productivity. These geophysical zones comprised the four main soil orders found in the catchment, two slope classes and, if the range in rainfall across a soil order was broad enough, a delineation for either high or low rainfall. The boundary that defined the high and low rainfall bands varied for the pumice (1,900mm) and podzol soils (2,000mm), as did the nominal delineation of the slope classes for dairy (13°) and drystock (16°) sectors.

<table>
<tr><th>Soil type</th><th colspan="2">Slope class</th><th colspan="2">Rainfall band</th></tr>
<tr><td>Allophanic (Al)</td><td rowspan="4">Gentle (1)</td><td rowspan="4">Steep (2)</td><td colspan="2" rowspan="2">n/a</td></tr>
<tr><td>Recent (Re)</td></tr>
<tr><td>Podzol (Po)</td><td rowspan="2">Low (L)</td><td rowspan="2">High (H)</td></tr>
<tr><td>Pumice (Pu)</td></tr>
</table>

4.1.4 Baseline status quo models of representative dairy and dry stock farming operations for all of the catchment's geophysical zones had previously been developed in Farmax, based on actual farming enterprises within these same zones, for the farm level component of the recently completed Rotorua N-reduction economic impacts project[2]. As a result, validated potential pasture growth curves existed for all of the relevant geophysical zones that had dairy activity. In combination with the validated potential drystock pasture growth curves for five geophysical zones, pasture growth potential for the balance of the geophysical zones had been calculated, through interpolations based on the observed relativity between actual pasture growth due to soil type, rainfall, slope class and soil fertility (assuming dairy land typically had a higher average level of fertility[3] versus drystock land).

4.1.5 An average potential pasture growth curve was then able to be estimated for both the dairy and drystock sectors, weighted by the relative proportionality of each geophysical zone among each sector in the catchment.

4.1.6 Pasture growth potential was then used to determine the level of relative productivity between blocks required to be utilised in the Overseer model.

[2] Parsons *et al*. 2015

[3] As represented by soil Olsen P

4.1.7 Feasible Farmax models were then created for both the sector reference files, utilising their respective weighted average pasture growth curves to set the pasture productivity limit. The modelled systems were designed to:

(i) reflect a requirement to minimise the less-well understood and complex functionality within OVERSEER; and

(ii) represent systems that were deemed likely to be economically[4] viable for an average efficient farmer in 2032.

4.1.8 Both factors require a degree of professional judgement and the author readily accepts that different systems could be designed by others that could equally achieve the targeted mid-points of the allocation range, depending on the specific interpretation of these two "constraints".

4.1.9 Cost and revenue assumptions used for forecasting the financial performance of the dairy system in Farmax were primarily based off the 2012/13 Central Plateau Owner-Operator benchmark from DairyBase data. A milk price of $5.50/kg MS was used for determining dairy farm milk revenue, while an appropriate medium term price expectation for manufacturing beef ($4.20/kg) was applied to the normal seasonal schedule distributions in Farmax. The milk price used is lower than both the nominal average Fonterra milk price ($6.07/kg MS)[5] for the period 2006/07 through 2014/15 and the real (CPI adjusted) NZ milk price since 1975, at just under $6/kg MS[6]. However, we believe this price represents more fairly the current global medium term outlook for milk. These are summarised in Appendix 1 below.

4.1.10 For the drystock farm, Beef+Lamb NZ data for Class 4 farms from the 2014/15 Beef + Lamb Economic Service Sheep & Beef Farm Survey was used to inform the operating expense parameters used in Farmax (the "Farmax expense plan"), which was then applied to the model to calculate operating costs and, in conjunction with revenue, farm profitability. Our own medium term revenue expectations were applied to the normal seasonal schedule distributions in Farmax for sheep meat ($5.50/kg), beef ($4.20/kg base price) and wool ($3.40/kg). These are summarised, along with the operating expense parameters and how they were applied, in Appendix 2 to Appendix 6 below.

4.1.11 The feasible files were then replicated in Overseer in order to generate nitrogen losses. A number of iterations of stock classes, stock performance levels, N fertiliser usage and the area of silage harvest and fed back out were undertaken in order to create viable farm systems that come close to the desired sector range mid-points. With the pasture growth potential essentially forming a fixed constraint to the models, it was not necessarily possible to achieve the exact range mid-point.

[4] Defined as having a positive EBIT/EFS.
[5] Source: interest.co.nz and Fonterra Cooperative Group Ltd
[6] LIC, BERL 2015

4.2 Stocking rate table

4.2.1 The stocking rate table was developed utilising slightly different methodology.

4.2.2 There is wide variability in stock class combinations and levels animal performance likely to be found on farm properties, with subsequent variation in impact on N leaching as assessed in Overseer. In order to provide a process by which "low intensity" farm systems could more easily and cost effectively ascertain compliance with the proposed permitted activity status, a simple stocking rate table that indicated the relative stocking levels of various livestock classes that a landowner could farm and remain compliant was proposed by the BOPRC.

4.2.3 Analysing Overseer outputs for a series of standardised animal types would allow the maximum number of head of that livestock type that could be carried on a representative Rotorua property and leach less than the target 17.9kg N/ha/year to be calculated. This output could then be presented in tabular form. This table was also to express livestock types in terms of revised stock units ("RSU"). A revised stock unit is equivalent to the consumption of 6,000MJ of metabolizable energy ("ME"), broadly equivalent to 545kg DM at an average quality of 11MJ ME/kg DM.

4.2.4 To achieve this, a series of feasible Farmax files were created using the lowest "observed" level of pasture growth potential for drystock land in the catchment (see 4.1.4), just under 7t DM/ha/year, as the underlying limit on farm production (and therefore N leaching).

4.2.5 Viable production systems were then created for this level of pasture production, encompassing a selection of typical stock class mixes for the Rotorua catchment. These included a traditional sheep & beef cattle breeding system, a singular bull beef policy, a deer breeding and finishing system and a sheep and mixed-sex cattle trading system based on purchasing 3-month-old weaned dairy cross calves. A slightly lower level of pasture utilisation was also targeted within the systems, to reflect a lower level of management intensity that is assumed to accompany properties with a lower level of N loss and there was no use of imported feed supplements or fertiliser N. Some guidance as to the file parameters was sought from and provided by the BOPRC during the development process.

4.2.6 These feasible files were then replicated in Overseer, using the balanced geophysical parameter drystock block set-up for the drystock reference file, in order to generate an annual nitrogen loss figure and assess it against the nominal "target" of ≤17.9kg N/ha/year. Some modelling iteration between Farmax and Overseer was then undertaken to adjust animal performance parameters (sale dates, growth rates), whilst maintaining overall system feasibility, to deliver system pasture N losses as close to 17.9kg N/ha as was possible. In the end the four systems modelled resulted in assessments of annual N losses in Overseer 6.2.0 between 15kg N/ha and 17.5kg N/ha.

4.2.7 These Overseer files then formed the basis of the typical animal performance parameters used to define the livestock types in Fact Sheet 10. Where animal types had not been captured by the Farmax modelling, (equids, camelids and goats), Overseer defaults were used

4.2.8 Multiple iterations of static monthly numbers of the livestock types in these four Overseer files were then individually run through the monthly stock calculator in Overseer to determine their annual N losses.

4.2.9 These N loss outputs were then analysed in order to determine the stocking rate for each discrete livestock class that would leach 17.9kg N/ha on a seasonal basis[7]. As a result of this analysis, it was apparent that there are individual N loss "signatures" for both male and female cattle, sheep, goats, deer, equids (horses, ponies) and camelids (llamas, alpacas).

4.2.10 These nominal stocking rates were then used to populate the stocking rate table.

5. Limitations of the methodology

5.1 Reference files

5.1.1 The basis for the use of a reference file within the allocation framework is an attempt to anchor the relativity over time of permitted N losses allocated to properties, both within and between sectors, without the necessity of having to continually reassess allocations.

5.1.2 The reference files have deliberately avoided the inclusion of many of the system components that have historically delivered the greatest variances in N loss estimates as the Overseer model has evolved i.e. forage cropping, irrigation. Nor were all stock classes represented in the reference files. Should future versions capture changes in how the scientific community understand N losses associated with these system components, the reference file won't reflect these. As a consequence, land owners whose original relativity in the initial allocation process was based on systems with these "missing" components or stock classes could be affected relative to those that did not.

5.1.3 The obvious solution to this would be to create a reference file that incorporated or utilised all possible farm system components and stock types. However, in the author's opinion this would undoubtedly create a nonsensical and unfeasible system. We consider ensuring that the reference files reflected a possible feasible reality a better compromise than the former approach.

5.1.4 It is also important to remember that that reference files represent "average" Rotorua farm in a geophysical sense. Replicating the reference file farm systems on individual properties is unlikely to deliver the same assessed N losses and care needs to be taken not to represent the models in this way.

5.2 Stocking Rate Table

5.2.1 The stocking rate table concept attempts to take an extremely complex N loss calculation methodology and simplify it to a single table that is designed to be used by a wide range of land owners. We fully recognise that most farm systems typically have differing numbers of a given livestock class over a calendar year. Animal feed intake and N leaching also have seasonal variation within the Overseer model.

[7] All year for "adult" livestock, from weaning until mid-winter for livestock <1 year old

5.2.2 Accordingly the assumption of static seasonal stocking rates in the Overseer modelling used to produce the output used in the table will invariably result in a different result than were variable monthly stocking rates used. However, in our view the need for transparency and simplicity as regards the development of the table warranted this approach.

5.2.3 The use of averages (albeit ones based on reasonable assumptions) will result in a compromise with accuracy. It is undoubted that were land owners to model their farm system in Overseer almost all will end up with a slightly different N loss result to that implied in the table; some would find that while their current stocking rates are nominally in-excess of the limits established in the table, modelling in Overseer would result in N losses the same or less than the implied 17.9kg N/ha/year limit for permitted activity status.

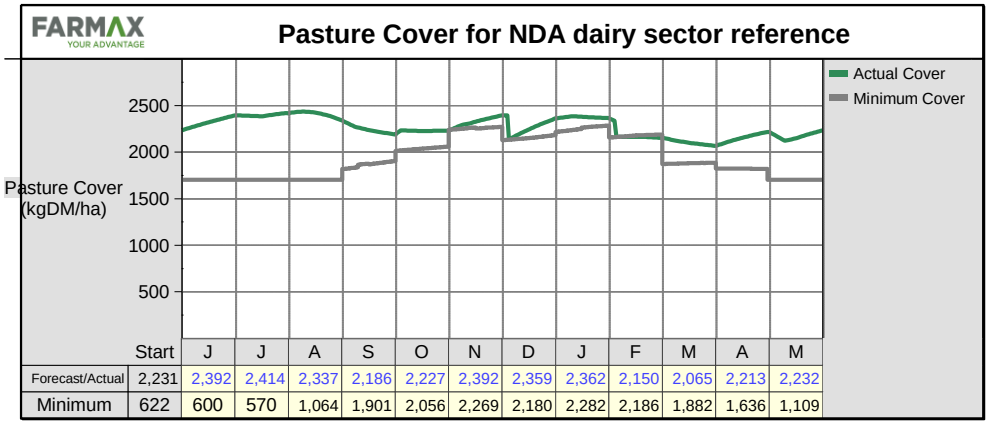
5.2.4 It is not the intention of the author or the BOPRC for the table to in essence, be a proxy for Overseer (a so called Overseer "*Lite*"), which would be in breach of the license agreement under which the author uses Overseer. Nor is there an assumption the table will have the same level of accuracy as Overseer. Rather the table exists provides information on the limits on stock numbers that the BOPRC deem appropriate for a property to comply with permitted activity status.

6. The reference files

6.1 Dairy

6.1.1 The dairy reference file was based around a 100ha milking platform with annual pasture growth rate potential of 13t DM/ha. Net growth was subsequently assessed in Farmax at 12t DM/ha including the effect of N fertiliser.

6.1.2 Total milk production of 88,519kg MS was produced from a herd of 225 crossbred dairy cows, of which 110 were wintered off the milking platform for all of June and July. No imported feed was used, but surplus pasture of 112t DM was harvested and fed out during the autumn and winter periods. A total of 83kg N/ha of fertiliser nitrogen was used. No forage cropping was undertaken. All heifer replacements were grazed off from weaning, returning as in-calf heifers at 22 months of age.



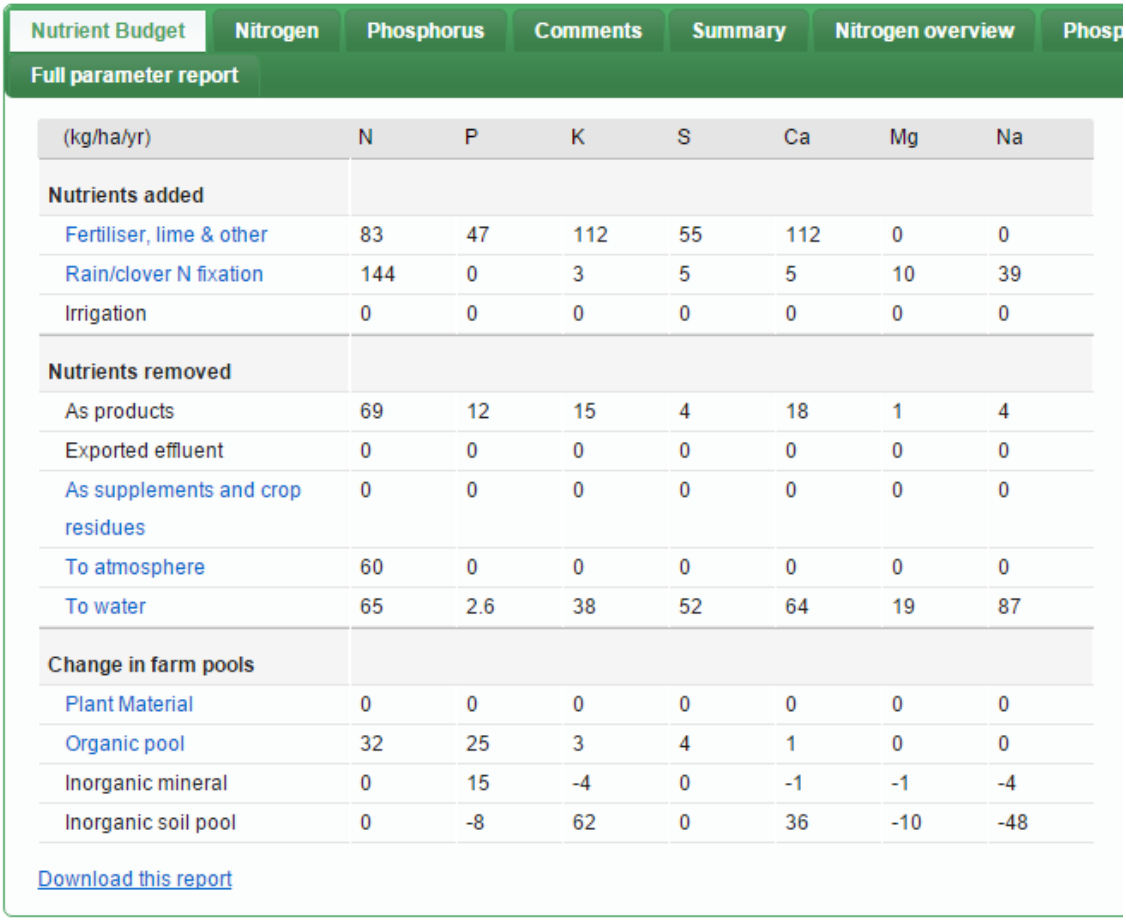
	Start	J	J	A	S	O	N	D	J	F	M	A	M
Forecast/Actual	2,231	2,392	2,414	2,337	2,186	2,227	2,392	2,359	2,362	2,150	2,065	2,213	2,232
Minimum	622	600	570	1,064	1,901	2,056	2,269	2,180	2,282	2,186	1,882	1,636	1,109

Figure 1: Forecast average pasture cover for the dairy sector mid-point reference file Farmax model

6.1.3 From an Overseer perspective, in total 35% of the property is deemed to receive liquid dairy effluent, while all silage harvested is cut from the flat (<7° slope) areas of the farm, but fed out evenly across the property.

6.1.4 Annual nitrogen leaching was estimated in Overseer 6.2.0 at 6,469kg N, versus the "target" of 6,453kg N - a variance of +0.25%.

6.1.5 Annual profitability was calculated in Farmax (at a $5.50/kg MS milk price) at $1,286/ha.



Nutrient Budget | Nitrogen | Phosphorus | Comments | Summary | Nitrogen overview | Phosp

Full parameter report

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	83	47	112	55	112	0	0
Rain/clover N fixation	144	0	3	5	5	10	39
Irrigation	0	0	0	0	0	0	0
Nutrients removed							
As products	69	12	15	4	18	1	4
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	60	0	0	0	0	0	0
To water	65	2.6	38	52	64	19	87
Change in farm pools							
Plant Material	0	0	0	0	0	0	0
Organic pool	32	25	3	4	1	0	0
Inorganic mineral	0	15	-4	0	-1	-1	-4
Inorganic soil pool	0	-8	62	0	36	-10	-48

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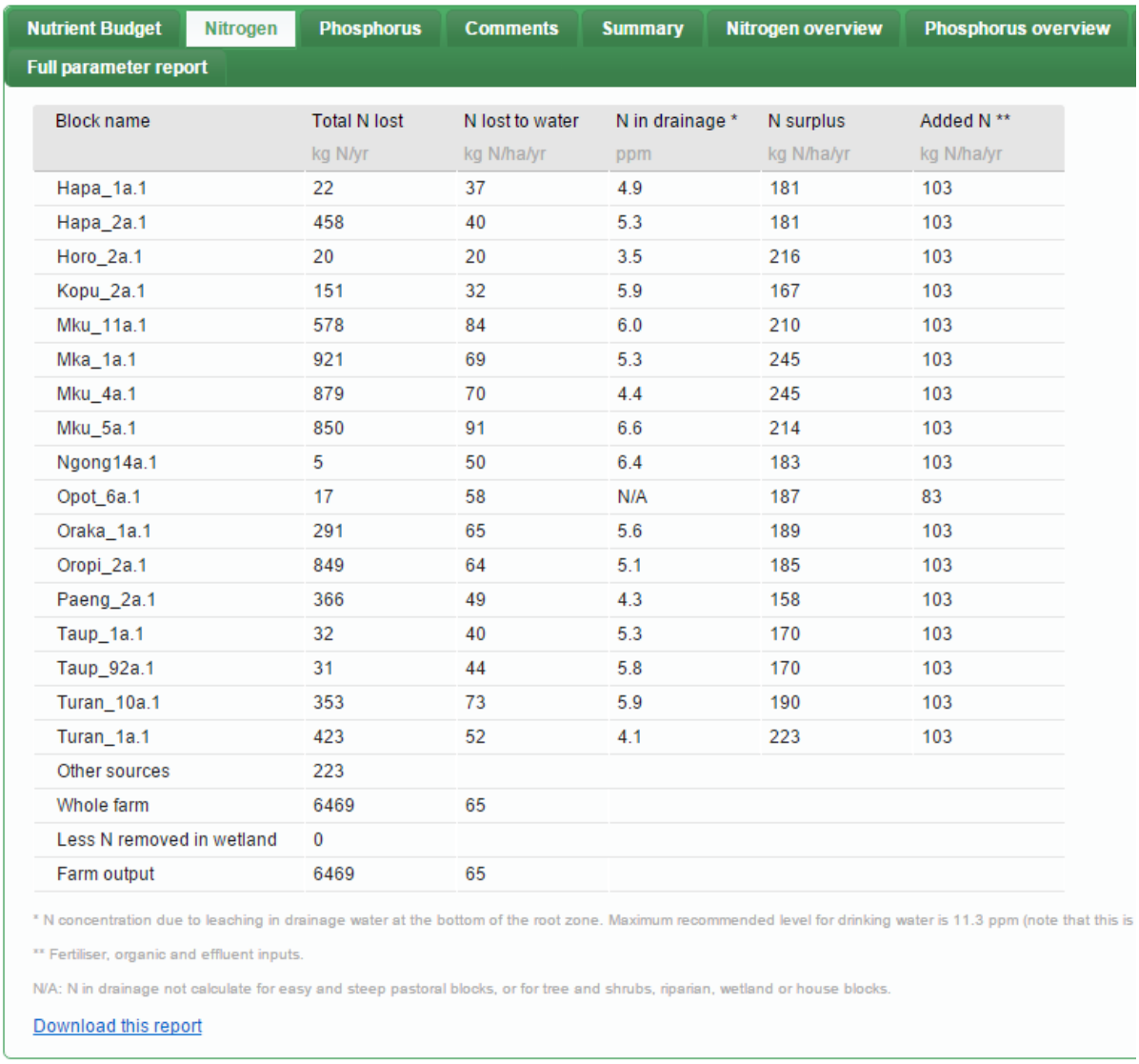
Figure 2: Dairy sector reference file Nutrient Budget



Nutrient Budget | Nitrogen | Phosphorus | Comments | Summary | Nitrogen overview | Phosphorus overview

Full parameter report

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
Hapa_1a.1	22	37	4.9	181	103
Hapa_2a.1	458	40	5.3	181	103
Horo_2a.1	20	20	3.5	216	103
Kopu_2a.1	151	32	5.9	167	103
Mku_11a.1	578	84	6.0	210	103
Mka_1a.1	921	69	5.3	245	103
Mku_4a.1	879	70	4.4	245	103
Mku_5a.1	850	91	6.6	214	103
Ngong14a.1	5	50	6.4	183	103
Opot_6a.1	17	58	N/A	187	83
Oraka_1a.1	291	65	5.6	189	103
Oropi_2a.1	849	64	5.1	185	103
Paeng_2a.1	366	49	4.3	158	103
Taup_1a.1	32	40	5.3	170	103
Taup_92a.1	31	44	5.8	170	103
Turan_10a.1	353	73	5.9	190	103
Turan_1a.1	423	52	4.1	223	103
Other sources	223				
Whole farm	6469	65			
Less N removed in wetland	0				
Farm output	6469	65			

* N concentration due to leaching in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this is

** Fertiliser, organic and effluent inputs.

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

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Figure 3: Dairy sector reference file Nitrogen Report

FARMAX YOUR ADVANTAGE	Forecast Profit and Loss for NDA dairy sector reference					
			$ Total	$/ha	$/cow	$/kg MS
Revenue	Stock	Net Milk Sales - this season	443,302	4,433	2,062	5.01
		Net Milk Sales - last season	44,995	450	209	0.51
		Net Milk Sales - dividend	0	0	0	0.00
		Net Livestock Sales	29,674	297	138	0.34
		Contract Grazing	0	0	0	0.00
		Change in Livestock Value	0	0	0	0.00
		Total	**517,971**	**5,180**	**2,409**	**5.85**
	Crop & Feed	Capital Value Change	-508	-5	-2	-0.01
		Total	-508	-5	-2	-0.01
	Total Revenue		**517,463**	**5,175**	**2,407**	**5.85**
Expenses	Wages	Wages	55,040	550	256	0.62
		Management Wage	22,575	226	105	0.26
	Stock	Animal Health	19,275	193	90	0.22
		Breeding	7,993	80	37	0.09
		Farm Dairy	3,861	39	18	0.04
		Electricity	9,030	90	42	0.10
	Feed/Crop	Pasture Conserved	23,005	230	107	0.26
		Bought Feed	0	0	0	0.00
		Calf Feed	1,138	11	5	0.01
	Grazing	Grazing	57,402	574	267	0.65
	Other Farm Working	Fertiliser (Excl. N)	42,578	426	198	0.48
		Nitrogen	14,964	150	70	0.17
		Weed & Pest Control	3,400	34	16	0.04
		Vehicle Expenses	16,900	169	79	0.19
		Fuel	7,300	73	34	0.08
		R&M Land/Buildings	27,400	274	127	0.31
		R&M Plant/Equipment	7,200	72	33	0.08
		Freight & Cartage	4,945	49	23	0.06
	Overheads	Administration Expenses	14,200	142	66	0.16
		Insurance	6,200	62	29	0.07
		ACC Levies	2,100	21	10	0.02
		Rates	10,700	107	50	0.12
	Total Farm Working Expenses		**357,207**	**3,572**	**1,661**	**4.04**
	Depreciation		31,700	317	147	0.36
	Total Farm Expenses		**388,907**	**3,889**	**1,809**	**4.39**
Economic Farm Surplus (EFS)			**128,556**	**1,286**	**598**	**1.45**
Farm Profit before Tax			**128,556**	**1,286**	**598**	**1.45**

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.

Figure 4: Dairy sector reference file profitability analysis

6.2 Drystock

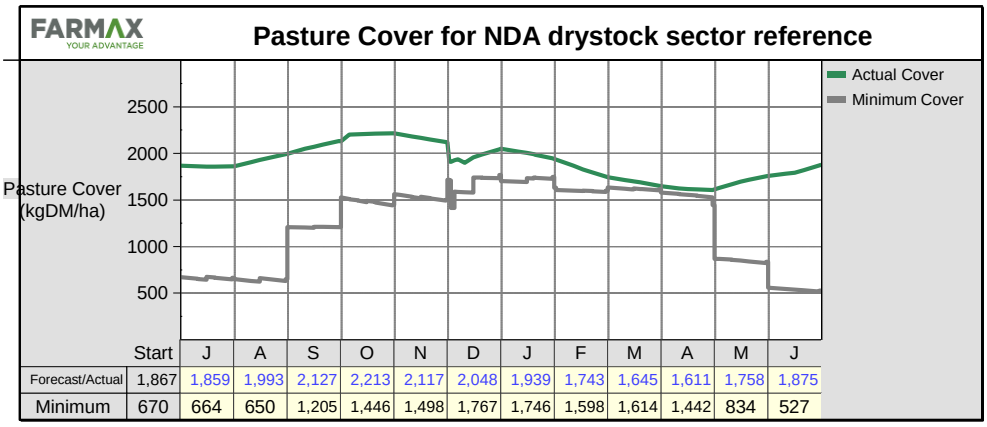
6.2.1 The drystock reference file was based around a 100ha property with annual pasture growth rate potential of 10.3t DM/ha. Net growth was subsequently assessed at 8.6t DM/ha.

6.2.2 The model farm ran a breeding ewe flock of 557 mixed-aged ewes, with 156 ewe hogget replacements. The farm lambed at 126% (lambs weaned/ewes mated). Ewe hoggets are not lambed. All the non-replacement lambs are finished, with an average carcass weight of 17.2kg.

6.2.3 The cattle policy comprised of a dairy support operation and a steer trading system. The dairy grazing operation consisted of grazing 53 crossbred dairy heifers calves from mid-December (90kg live weight) though until the heifers are 22 months of age, in-calf and

weighing 419kg. The steer policy comprised purchasing 53 white-face steers (100kg) in December, taking them through one winter and progressively selling them to local trade slaughter as they reach c. 490kg live weight. No cattle are taken through a second winter.

6.2.4 No nitrogenous fertiliser is used, while 118t DM of pasture silage is cut at the end of November/early December for feeding out from May through to the end of September.



	Start	J	A	S	O	N	D	J	F	M	A	M	J
Forecast/Actual	1,867	1,859	1,993	2,127	2,213	2,117	2,048	1,939	1,743	1,645	1,611	1,758	1,875
Minimum	670	664	650	1,205	1,446	1,498	1,767	1,746	1,598	1,614	1,442	834	527

Figure 5: Forecast average pasture cover for the drystock sector mid-point reference file Farmax model

6.2.5 From an Overseer perspective all silage harvested is cut from the flat (<7° slope) and rolling (7°-16° slope) areas of the farm, but fed out evenly across the property.

6.2.6 Annual nitrogen leaching is estimated in Overseer 6.2.0 at 2,624kg N, versus the "target" of 2,559kg N - a variance of +3.2%.

6.2.7 Annual profitability was calculated in Farmax at $234/ha.

Nutrient Budget | Nitrogen | Phosphorus | Comments | Summary | Nitrogen overview | Phosph

Full parameter report

(kg/ha/yr)	N	P	K	S	Ca	Mg	Na
Nutrients added							
Fertiliser, lime & other	0	26	0	44	63	0	0
Rain/clover N fixation	120	0	3	5	4	8	34
Irrigation	0	0	0	0	0	0	0
Nutrients removed							
As products	31	6	2	4	12	0	1
Exported effluent	0	0	0	0	0	0	0
As supplements and crop residues	0	0	0	0	0	0	0
To atmosphere	34	0	0	0	0	0	0
To water	26	1.7	18	44	29	15	72
Change in farm pools							
Plant Material	0	0	0	0	0	0	0
Organic pool	28	14	2	1	1	0	0
Inorganic mineral	0	8	-12	0	-2	-3	-5
Inorganic soil pool	0	-4	-7	0	27	-5	-34

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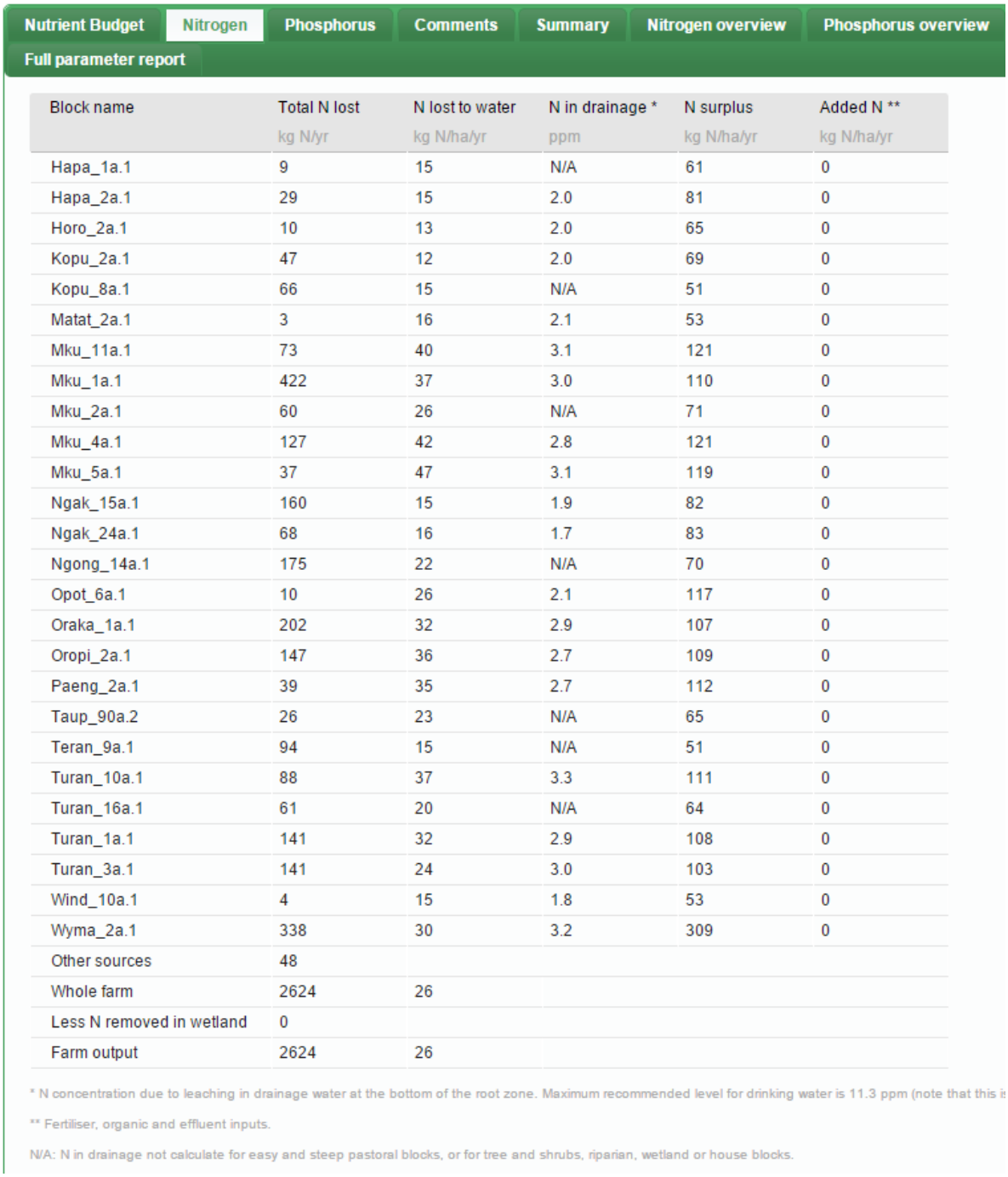
Figure 6: Drystock sector reference file Nutrient Budget



Nutrient Budget | Nitrogen | Phosphorus | Comments | Summary | Nitrogen overview | Phosphorus overview

Full parameter report

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
Hapa_1a.1	9	15	N/A	61	0
Hapa_2a.1	29	15	2.0	81	0
Horo_2a.1	10	13	2.0	65	0
Kopu_2a.1	47	12	2.0	69	0
Kopu_8a.1	66	15	N/A	51	0
Matat_2a.1	3	16	2.1	53	0
Mku_11a.1	73	40	3.1	121	0
Mku_1a.1	422	37	3.0	110	0
Mku_2a.1	60	26	N/A	71	0
Mku_4a.1	127	42	2.8	121	0
Mku_5a.1	37	47	3.1	119	0
Ngak_15a.1	160	15	1.9	82	0
Ngak_24a.1	68	16	1.7	83	0
Ngong_14a.1	175	22	N/A	70	0
Opot_6a.1	10	26	2.1	117	0
Oraka_1a.1	202	32	2.9	107	0
Oropi_2a.1	147	36	2.7	109	0
Paeng_2a.1	39	35	2.7	112	0
Taup_90a.2	26	23	N/A	65	0
Teran_9a.1	94	15	N/A	51	0
Turan_10a.1	88	37	3.3	111	0
Turan_16a.1	61	20	N/A	64	0
Turan_1a.1	141	32	2.9	108	0
Turan_3a.1	141	24	3.0	103	0
Wind_10a.1	4	15	1.8	53	0
Wyma_2a.1	338	30	3.2	309	0
Other sources	48				
Whole farm	2624	26			
Less N removed in wetland	0				
Farm output	2624	26			

* N concentration due to leaching in drainage water at the bottom of the root zone. Maximum recommended level for drinking water is 11.3 ppm (note that this i

** Fertiliser, organic and effluent inputs.

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

Figure 7: Drystock sector reference file Nitrogen Report

FARMAX YOUR ADVANTAGE	Forecast Profit and Loss for NDA drystock sector reference				
			$ Total	**$/ha**	**$/SU**
Revenue	Sheep	Sales - Purchases	52,001	520	34.5
		Wool	13,379	134	8.9
		Total	**65,379**	**654**	**43.3**
	Beef	Sales - Purchases	35,779	358	23.7
		Contract Grazing	32,012	320	21.2
		Total	**67,791**	**678**	**44.9**
	Crop & Feed	Capital Value Change	-91	-1	-0.1
		Total	-91	-1	-0.1
	Total Revenue		**133,079**	**1,331**	**88.2**
Expenses	Wages	Wages	28,667	287	19.0
	Stock	Animal Health	3,342	33	2.2
		Shearing	6,538	65	4.3
	Feed/Crop/Grazing	Conservation	17,650	176	11.7
	Fertiliser	Fertiliser (Excl. N & Lime)	20,323	203	13.5
		Lime	1,509	15	1.0
	Other Farm Working	Weed & Pest Control	1,765	18	1.2
		Vehicle Expenses	2,930	29	1.9
		Fuel	2,500	25	1.7
		Repairs & Maintenance	6,421	64	4.3
		Freight & Cartage	2,520	25	1.7
		Electricity	1,298	13	0.9
		Other Expenses	905	9	0.6
	Standing Charges	Administration Expenses	2,919	29	1.9
		Insurance	1,397	14	0.9
		ACC Levies	694	7	0.5
		Rates	3,018	30	2.0
	Total Farm Working Expense		**104,394**	**1,044**	**69.2**
	Depreciation		5,281	53	3.5
	Total Farm Expenses		**109,675**	**1,097**	**72.7**
Economic Farm Surplus (EFS)			**23,404**	**234**	**15.5**
Farm Profit before Tax			**23,404**	**234**	**15.5**

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.

Figure 8: Drystock sector reference file profitability analysis

7. The stocking rate table

7.1 The draft stocking rate table is presented below, along with the definitions of the animals that were used to establish both the RSUs and the static stocking rates equivalent to 17.9kg N/ha/year in Overseer 6.2.0.

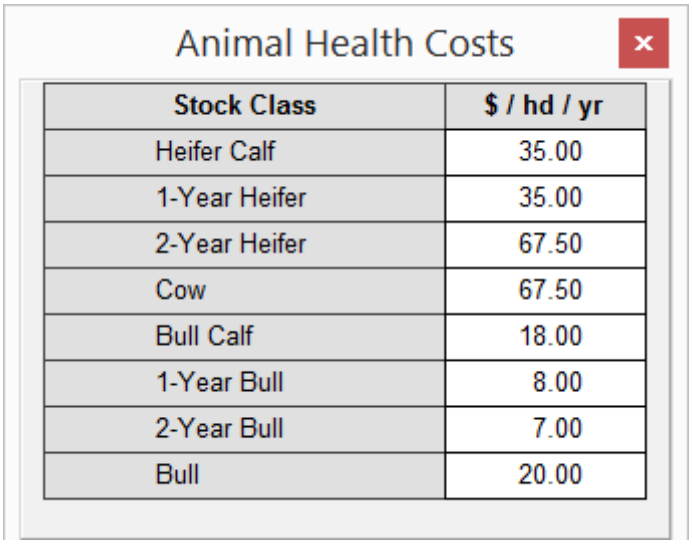
Table 1: Stocking rate table

Stock class	1 animal = (RSU)	SR = PA status (animals/ha)	Area required to support one head of livestock and comply with PA status (ha)	Animal performance definition (for inclusion in methodology)
Dairy bull	6.1	1.5	0.66	620kg Friesian breeding bull
Dairy cow	10.4	0.9	1.15	450kg F8J8 dairy cow producing 400kg MS
Dairy heifer 1-2 years age	5.1	1.6	0.65	F8J8 199-419kg Jul to Apr
Dairy heifer calf (weaned)	1.6	3.5	0.29	F8J8 110-199kg Dec to Jun
Beef bull	6.0	1.5	0.68	620kg Beef cross MA breeding bull
Beef cow	7.5	1.3	0.79	480kg MA Beef cross breeding cow calving at 96%
Bull 1-2 years age	6.8	1.5	0.65	Friesian bull 209kg to 535kg slaughter weight
Steer 1-2 years age	5.8	1.8	0.56	WF steer 203kg to 478kg slaughter weight
Heifer 1-2 years age	5.7	1.7	0.58	WF heifer 208kg to 420kg slaughter weight
Steer calf < 1 year (weaned)	2.7	3.8	0.26	WF steer 100kg to 203kg Dec to Jun
Bull calf < 1 year (weaned)		3.5	0.29	Fresian 100kg to 209kg bull Dec to Jun
Heifer calf < 1 year (weaned)	1.6	3.0	0.33	WF heifer 90kg to 208kg Dec to Jun
Ram	1.0	15.5	0.06	73kg Romney ram, 4.5kg wool
Adult ewe	1.01	15.0	0.07	63kg Romney MA ewe lambing at 126%, 4.5kg wool
Sheep 1-2 years of age	0.9	14.2	0.07	Romney hogget 46kg to 66kg, 4kg wool
Sheep <1 years of age (weaned)	0.5	25.9	0.04	Romney 26kg to 46kg from Dec to June, 2kg wool
Bucks & does < 1 year (weaned)	0.5	24.9	0.04	Overseer default
Angora does	1.1	11.3	0.09	Overseer default
Feral does	0.9	13.8	0.07	Overseer default
Feral bucks & wethers	0.5	24.9	0.04	Overseer default
Stag	2.4	4.9	0.21	Red stag 200kg, 4kg velvet
Breeding hind	2.5	5.0	0.20	Red hind 110kg, 86% fawning
Hind 1-2 years age	1.2	9.9	0.10	Red hind 53kg-75kg
Hind fawn (weaned)	1.0	15.0	0.07	Red hind 37kg - 53 kg over 4 months, annualised to 12 months
Stag 1-2 years age	2.3	4.2	0.24	Red stag 55kg -159kg over 12 months, 2kg velvet
Stag fawn (weaned)	1.1	15.2	0.07	Red stag 42kg -55kg over 4 months, annualised to 12 months
Alpaca	0.8	15.4	0.06	Overseer default
Llama	1.6	7.7	0.13	Overseer default
Pony	6	2.1	0.48	Overseer default
Pony brood mare w/ foal	8	1.6	0.64	Overseer default
Small hack	8	1.6	0.64	Overseer default
Small hack broodmare w/ foal	10	1.2	0.80	Overseer default
Large hack	12	1.0	0.96	Overseer default
Thoroughbred	12	1.0	0.96	Overseer default
Large hack broodmare w/ foal	14	0.9	1.12	Overseer default

Appendix 1: Dairy operating expense assumptions

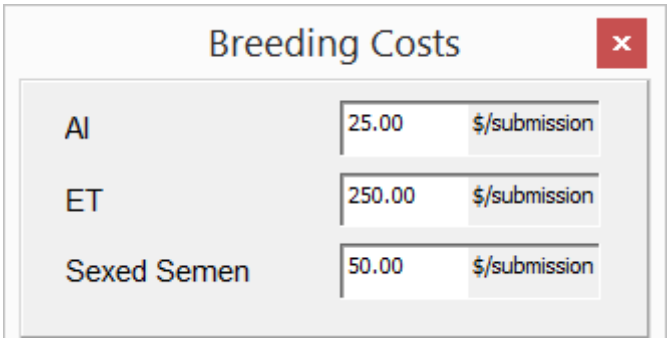
Expense item	Applied	Rotorua
Wages	/cow	$ 256.00
Management Wage	/cow	$ 105.00
Electricity	/cow	$ 42.00
Fertiliser (Excl. N)	/kg MS	$ 0.51
Weed & Pest	/ha	$ 34.00
Vehicles	/ha	$ 169.00
Fuel	/ha	$ 73.00
R&M Land & Buildings	/ha	$ 274.00
R&M Plant & Equipment	/ha	$ 72.00
Freight	/cow	$ 23.00
Administration	/ha	$ 142.00
Insurance	/ha	$ 62.00
ACC	/ha	$ 21.00
Rates	/ha	$ 107.00
Depreciation	/ha	$ 317.00

Source 1: DairyBase 2012/13 Central Plateau Owner Operator Survey

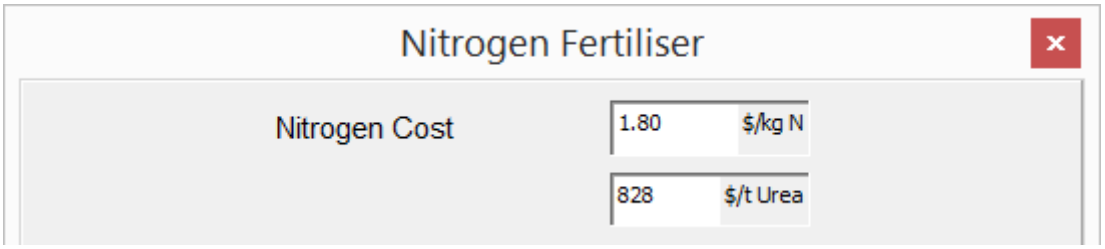


Stock Class	$ / hd / yr
Heifer Calf	35.00
1-Year Heifer	35.00
2-Year Heifer	67.50
Cow	67.50
Bull Calf	18.00
1-Year Bull	8.00
2-Year Bull	7.00
Bull	20.00

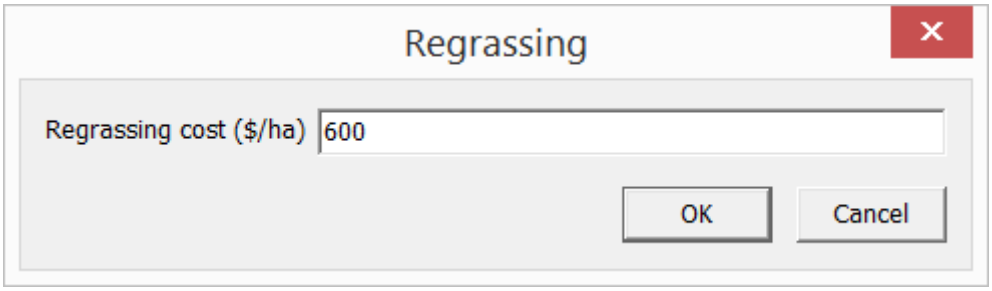
Source 2: Farmax 2015



Source: Farmax 2015



Source: Perrin Ag Consultants 2015



Source: Perrin Ag Consultants 2015

Appendix 2: Sheep revenue assumptions for a $5.50/kg base schedule

Sheep Prices Prices / kg for Rotorua

Prices / kg												
Works ($/kg Cwt)	O	N	D	J	F	M	A	M	J	J	A	S
17 kg PM Lamb	6.16	6.00	5.50	5.12	5.01	4.95	5.01	5.22	5.45	5.61	5.89	6.11
24 kg Sheep	2.96	2.76	2.53	2.35	2.25	2.33	2.50	2.46	2.72	2.80	2.94	3.11
Store ($/kg Lwt)	O	N	D	J	F	M	A	M	J	J	A	S
Ewe Lamb	2.59	2.52	2.25	2.15	2.15	2.13	2.15	2.25	2.29	2.41	2.59	2.75
Ewe Hogget	2.83	2.82	2.64	2.46	2.20	1.98	1.90	1.83	1.96	2.24	2.71	2.81
MA Ewe	2.22	2.22	2.04	1.43	1.40	1.39	1.40	1.46	1.58	1.68	2.06	2.14
Ram Lamb	2.77	2.64	2.37	2.30	2.25	2.23	2.25	2.35	2.40	2.52	2.77	2.87
Ram Hogget	4.25	4.38	4.29	2.51	2.50	2.57	2.85	3.03	3.21	3.37	3.65	3.85
MA Ram	7.45	7.25	7.59	8.34	8.51	8.61	8.91	8.36	8.17	7.80	7.77	7.57
Wether Lamb	2.71	2.58	2.37	2.25	2.20	2.18	2.20	2.30	2.34	2.47	2.71	2.81
Wether Hogget	2.34	2.22	2.04	1.94	2.05	2.03	2.00	2.19	2.34	2.52	2.59	2.44
MA Wether	1.97	2.04	1.76	1.59	1.80	1.83	1.85	1.67	1.74	1.80	1.82	1.71

Sheep Prices Charges for Rotorua

Charges				
	Transport $/head	**Commission** % of gross	**Headage** $/head	**Killing** $/head
Purchases	1.50			
Store Sales		5.50		
Works Sales				2.00

Sheep Prices Relativities for Rotorua

Relativities												
Works (/kg Cwt)	O	N	D	J	F	M	A	M	J	J	A	S
17 kg PM Lamb	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
24 kg Sheep	0.48	0.46	0.46	0.46	0.45	0.47	0.50	0.47	0.50	0.50	0.50	0.51
Store (/kg Lwt)	O	N	D	J	F	M	A	M	J	J	A	S
Ewe Lamb	0.42	0.42	0.41	0.42	0.43	0.43	0.43	0.43	0.42	0.43	0.44	0.45
Ewe Hogget	0.46	0.47	0.48	0.48	0.44	0.40	0.38	0.35	0.36	0.40	0.46	0.46
MA Ewe	0.36	0.37	0.37	0.28	0.28	0.28	0.28	0.28	0.29	0.30	0.35	0.35
Ram Lamb	0.45	0.44	0.43	0.45	0.45	0.45	0.45	0.45	0.44	0.45	0.47	0.47
Ram Hogget	0.69	0.73	0.78	0.49	0.50	0.52	0.57	0.58	0.59	0.60	0.62	0.63
MA Ram	1.21	1.21	1.38	1.63	1.70	1.74	1.78	1.60	1.50	1.39	1.32	1.24
Wether Lamb	0.44	0.43	0.43	0.44	0.44	0.44	0.44	0.44	0.43	0.44	0.46	0.46
Wether Hogget	0.38	0.37	0.37	0.38	0.41	0.41	0.40	0.42	0.43	0.45	0.44	0.40
MA Wether	0.32	0.34	0.32	0.31	0.36	0.37	0.37	0.32	0.32	0.32	0.31	0.28

Source: Farmax 2015, Perrin Ag Consultants 2015

Appendix 3: Bull beef revenue assumptions for a $4.20/kg base beef schedule

FARMAX YOUR ADVANTAGE	Bull Beef Prices Prices / kg for Rotorua											
Prices / kg												
Works ($/kg Cwt)	O	N	D	J	F	M	A	M	J	J	A	S
295 kg M Bull	4.54	4.37	4.16	4.03	3.95	3.95	3.95	4.03	4.16	4.28	4.45	4.54
Store ($/kg Lwt)	O	N	D	J	F	M	A	M	J	J	A	S
R1 Bull	4.81	4.32	3.91	3.75	3.55	2.92	2.57	2.46	2.45	2.61	2.76	2.68
R2 Bull	2.54	2.36	2.29	2.14	2.05	2.01	2.01	1.98	2.00	2.23	2.45	2.45
MA Bull	2.54	2.40	2.29	2.14	2.05	2.01	2.01	1.98	2.00	2.23	2.49	2.45

FARMAX YOUR ADVANTAGE	Bull Beef Prices Charges for Rotorua			
Charges				
	Transport $/head	**Commission** % of gross	**Headage** $/head	**Killing** $/head
Purchases	12.00			
Store Sales		5.50		
Works Sales				32.35

FARMAX YOUR ADVANTAGE	Bull Beef Prices Relativities for Rotorua											
Relativities												
Works (/kg Cwt)	O	N	D	J	F	M	A	M	J	J	A	S
295 kg M Bull	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Store (/kg Lwt)	O	N	D	J	F	M	A	M	J	J	A	S
R1 Bull	1.06	0.99	0.94	0.93	0.90	0.74	0.65	0.61	0.59	0.61	0.62	0.59
R2 Bull	0.56	0.54	0.55	0.53	0.52	0.51	0.51	0.49	0.48	0.52	0.55	0.54
MA Bull	0.56	0.55	0.55	0.53	0.52	0.51	0.51	0.49	0.48	0.52	0.56	0.54

Source: Farmax 2015, Perrin Ag Consultants 2015

Appendix 4: Prime beef revenue assumptions for a $4.20/kg base beef schedule

Prime Beef Prices Prices / kg for Rotorua

Prices / kg												
Works ($/kg Cwt)	O	N	D	J	F	M	A	M	J	J	A	S
295 kg M Steer	4.74	4.52	4.35	4.18	4.13	4.09	4.05	4.13	4.26	4.39	4.61	4.74
220 kg LT Heifer	4.69	4.43	4.22	4.13	4.05	4.01	3.96	4.09	4.09	4.26	4.66	4.74
230 kg M Cow	3.70	3.57	3.39	3.26	3.22	3.19	3.12	3.14	3.37	3.51	3.73	3.75
Store ($/kg Lwt)	O	N	D	J	F	M	A	M	J	J	A	S
R1 Heifer	2.75	2.62	2.52	2.42	2.40	2.41	2.27	2.23	2.26	2.37	2.54	2.56
R2 Heifer	2.56	2.53	2.48	2.34	2.23	2.13	2.02	1.98	2.05	2.15	2.26	2.32
MA Cow	1.90	1.95	1.83	1.67	1.78	1.68	1.86	1.82	1.88	1.89	1.84	1.85
R1 Steer	3.32	3.17	3.04	2.92	2.89	2.86	2.71	2.64	2.64	2.77	2.95	2.94
R2 Steer	2.80	2.58	2.52	2.38	2.36	2.29	2.23	2.15	2.17	2.28	2.49	2.56
MA Steer	2.70	2.49	2.39	2.30	2.27	2.25	2.18	2.15	2.17	2.28	2.49	2.56

Prime Beef Prices Charges for Rotorua

Charges				
	Transport $/head	**Commission** % of gross	**Headage** $/head	**Killing** $/head
Purchases	12.00			
Store Sales		5.50		
Works Sales				32.35

Prime Beef Prices Relativities for Rotorua

Relativities												
Works (/kg Cwt)	O	N	D	J	F	M	A	M	J	J	A	S
295 kg M Steer	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
220 kg LT Heifer	0.99	0.98	0.97	0.99	0.98	0.98	0.98	0.99	0.96	0.97	1.01	1.00
230 kg M Cow	0.78	0.79	0.78	0.78	0.78	0.78	0.77	0.76	0.79	0.80	0.81	0.79
Store (/kg Lwt)	O	N	D	J	F	M	A	M	J	J	A	S
R1 Heifer	0.58	0.58	0.58	0.58	0.58	0.59	0.56	0.54	0.53	0.54	0.55	0.54
R2 Heifer	0.54	0.56	0.57	0.56	0.54	0.52	0.50	0.48	0.48	0.49	0.49	0.49
MA Cow	0.40	0.43	0.42	0.40	0.43	0.41	0.46	0.44	0.44	0.43	0.40	0.39
R1 Steer	0.70	0.70	0.70	0.70	0.70	0.70	0.67	0.64	0.62	0.63	0.64	0.62
R2 Steer	0.59	0.57	0.58	0.57	0.57	0.56	0.55	0.52	0.51	0.52	0.54	0.54
MA Steer	0.57	0.55	0.55	0.55	0.55	0.55	0.54	0.52	0.51	0.52	0.54	0.54

Source: Farmax 2015, Perrin Ag Consultants 2015

Appendix 5: Other drystock revenue assumptions used

FARMAX YOUR ADVANTAGE	Grazing assumptions *NDA drystock sector reference*		
Age (months)	**Grazing Fee ($/hd/week)**	**Age (months)**	**Grazing Fee ($/hd/week)**
0 - 4	7.00	15	9.00
5	7.00	16	9.00
6	7.00	17	9.00
7	7.00	18	9.00
8	7.00	19	9.00
9	7.00	20	9.00
10	9.00	21	9.00
11	9.00	22	24.00
12	9.00	23	24.00
13	9.00	24 +	24.00
14	9.00		

Source: Perrin Ag Consultants 2014

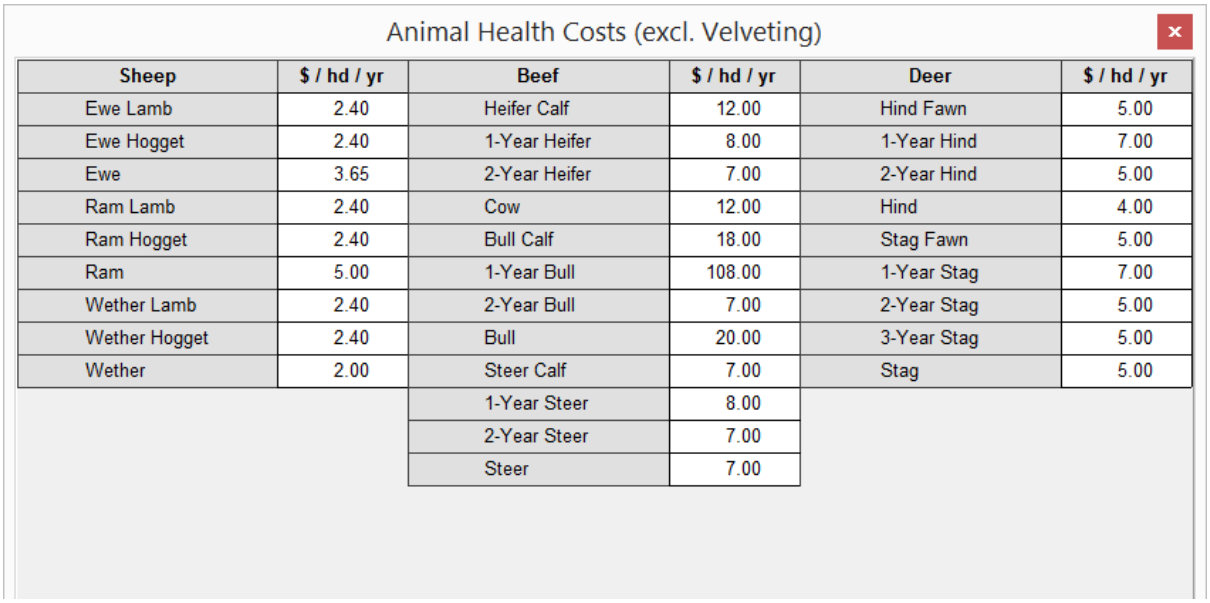
FARMAX YOUR ADVANTAGE	Wool and Velvet Prices	
Wool Prices		
Crossbred Lamb	3.50	$ / kg Greasy
Crossbred Hogget	3.60	$ / kg Greasy
Crossbred Adult	3.40	$ / kg Greasy
Superfine Lamb	9.40	$ / kg Greasy
Superfine Hogget	9.40	$ / kg Greasy
Superfine Adult	8.45	$ / kg Greasy
Ultrafine Lamb	11.16	$ / kg Greasy
Ultrafine Hogget	11.16	$ / kg Greasy
Ultrafine Adult	9.55	$ / kg Greasy
Velvet Prices		
Spiker	40.00	$ / kg
2-year	45.00	$ / kg
Adult	50.00	$ / kg

Source: Farmax 2014

Appendix 6: Drystock operating expense assumptions

Expense item	Applied	Class 4
Wages	/SU	$ 19.00
Fertiliser (Excl. N & Lime)	/SU	$ 13.47
Nitrogen		
Lime	/SU	$ 1.00
Weed & Pest Control	/SU	$ 1.17
Vehicle Expenses	/ha	$ 29.30
Fuel	/ha	$ 25.00
Repairs & Maintenance	/ha	$ 64.21
Freight & Cartage	/SU	$ 1.67
Electricity	/SU	$ 0.86
Other Expenses	/SU	$ 0.60
Administration Expenses	/ha	$ 29.19
Insurance	/ha	$ 13.97
ACC Levies	/SU	$ 0.46
Rates	/SU	$ 2.00
Depreciation	/ha	$ 52.62

Source: Beef+Lamb Economic Service Survey 2014, Perrin Ag Consultants Ltd 2015



Sheep	$ / hd / yr	Beef	$ / hd / yr	Deer	$ / hd / yr
Ewe Lamb	2.40	Heifer Calf	12.00	Hind Fawn	5.00
Ewe Hogget	2.40	1-Year Heifer	8.00	1-Year Hind	7.00
Ewe	3.65	2-Year Heifer	7.00	2-Year Hind	5.00
Ram Lamb	2.40	Cow	12.00	Hind	4.00
Ram Hogget	2.40	Bull Calf	18.00	Stag Fawn	5.00
Ram	5.00	1-Year Bull	108.00	1-Year Stag	7.00
Wether Lamb	2.40	2-Year Bull	7.00	2-Year Stag	5.00
Wether Hogget	2.40	Bull	20.00	3-Year Stag	5.00
Wether	2.00	Steer Calf	7.00	Stag	5.00
		1-Year Steer	8.00		
		2-Year Steer	7.00		
		Steer	7.00		

Source: Farmax 2015

Shearing Costs

Shearing	$ / head	Crutching	$ / head
Lambs	3.25	Lambs	1.15
Hoggets	3.55	Hoggets	1.50
Adults	3.55	Adults	1.50

Source: Farmax 2015

Nitrogen Fertiliser

Nitrogen Cost	1.81	$/kg N
	833	$/t Urea

Source: Farmax 2014, Perrin Ag Consultants 2015