Integrating dairy and hill country farming with forestry for profitable and sustainable land use

Case Study 4: MW & FK Linton

Report prepared by
Perrin Ag Consultants Ltd

14 May 2021

Prepared by Perrin Ag Consultants Ltd

Registered Farm Management Consultants
1330 Eruera Street, PO Box 596
Rotorua 3010
New Zealand

Phone: +64 7 349 1212
Email: consult@perrinag.net.nz
www.perrinag.net.nz

Document Quality Assurance

Prepared by:	**Leighton Parker** BApplSc (Hons), NZIPIM, ASNM Partner and Agribusiness Consultant **Les Dowling** MSc (For), MNZIF Foresty Analyst	
Reviewed by:	**Trudy Laan** B.Ag.Sc (Hons),SNM MNZIPIM (Reg), Director	
Approved for release by:	**Lee Matheson** BApplSc (Hons), NZIPIM (Reg.), ASNM Managing Director	
Status:	FINAL	

Bibliographic reference for citation:

Parker, L.; Dowling, L. Case Study 4: MW & FK Linton. Integrating dairy and hill country farming with forestry for profitable and sustainable land use. Report prepared by Perrin Ag Consultants Ltd for Te Uru Rākau. May 2021. 63 pages.

perrin ag

Executive Summary

- This case study explores how the integration of trees into a dairy farm business can support landowner objectives, including: raising productivity on the quality land, managing nutrient loss and supporting a high standard of animal welfare. Three tree planting scenarios are investigated to understand the physical, financial and environmental impact to the business.
- MW & FK Linton is a family-owned business situated in Te Ranga, 17 km south of Te Puke. The business operates 423 hectares of mixed contour including 172 ha utilised as a dairy platform, 59 ha for grazing young stock replacements, 3.6 ha of kiwifruit, 38.8 ha of plantation woodlots (*Pinus radiata* and *lusitanica*) with the balance in native bush. The dairy business operates a self-contained spring calving system peak milking 440 crossbred cows. The 3.6 ha of Kiwifruit is in its early years of production with a further 7 ha suitable and planned for conversion.
- Opportunities exist to convert pastoral land to alternative uses (kiwifruit and forestry) that provide improved financial and/or environmental performance. Competing requirements for capital impact the rate and direction of change. Providing detailed analysis of integrated forestry options will help inform the most suitable course of action regarding forestry land use change.
- Three scenarios evaluate the impact of planting *Pinus radiata* timber woodlots on 36.6 ha of hill sides and gullies. *Pinus radiata was* chosen as the timber species for it strong proven economic performance aligning with the land owners priorities. The scenarios differed in their management of forest edges against pasture. Scenario 1 ignored the extra costs of managing edges, Scenario 2 incorporate higher spraying, pruning and thinning costs within 10m of the forest edge, and Scenario 3 builds on Scenario 2's spray/prune/thin regime and incorporates natives to reduce the amount of area that was planted on narrow sections (1.3 ha).
- Options to manage forest edging to minimise damage to fences, improve aesthetics, or enhance biodiversity had a minor impact on profitability. Scenario 1 provided the highest Net Present Value (NPV) of $191,238 and Internal Rate of Return (IRR) of 10.4 percent. The cost to repair damaged fence lines was not accounted for as it was considered subjective and difficult to quantify. Scenarios 2 and 3 were slightly lower providing an NPV of $179,575 and $176,359 and an IRR of 9.9 and 10.0 percent, respectively. The small difference across the options provides the landowner with flexibility to select the scenario that best meets their preference while achieving similar financial outcomes.
- Planting 36.6 ha into trees reduced the milking platform and dry stock support areas by 15 and 17 percent, respectively. Average feed eaten per hectare on the remaining area increased 0.6 t DM/ha or 6 percent and milk solids per hectare improved 85 kg MS/ha or 10.1 percent. The improvement in per hectare productivity for the livestock enterprise after removing the most marginal land did not result in a higher IRR as the business lost economies of scale. 'Sticky costs' present challenges for small operations such as MW & FK Linton as the business still requires a certain operating structure regardless of minor changes in livestock numbers.
- The integrated forestry scenarios total property N loss reduced by 5.8 percent, P loss by 19.6 percent, and bGHG emissions by 9.7 percent. Contaminant loss on a per hectare basis was

higher across the remaining pastoral area because the land operates a higher stocking rate and is more productive. These results align with the Linton's objective to reduce their environmental footprint through retiring marginal land and focusing more of the business resources to lift productivity on the better quality land.

- Modelling showed the existing farming operation is more profitable than any of the integrated forestry scenarios considered with an NPV of $3,559,617 after 56 years (2 rotations), $102,070 to $116,949 higher, even after the sale of safe tradable carbon. There was little difference in the net equity generated after the first rotation (0.0-0.4 percent) but the timing of returns in the investment cycle lowered the NPV and IRR. Cashflow implications are important for the business as it considers multiple land use options (kiwifruit and forestry) to enhance financial and environmental performance. The forest areas evaluated are proportionately large and it would be beneficial for the Linton's to plant smaller parcels of the worst areas first that will provide the largest improvements. This will also reduce impact to cash flow due to the area converted and revenue from carbon and logs being more evenly spread.

- Assuming the case study farm operated with the average amount of debt for dairy farms in the Bay of Plenty region of $24.51/kg MS, neither the base scenario nor any of the forestry scenarios were able to cash flow minimum debt repayment requirements per annum. This highlights the limitations an overleveraged balance sheet has for all land use enterprises, and dairy farms with industry average levels of term debt (or more) may struggle to take advantage of the opportunity from existing business cash flow. Tree planting grants such as those provided by the One Billion Trees Fund and the Bay of Plenty Regional Council alleviate these cash flow constraints providing farmers with the option to integrate trees on farm.

- Good harvesting outcomes for landowners are driven by the wood harvesting agreement, selection of experienced and professional forestry consultants or contractors, and ensuring contractors have the right equipment suitable for the land being harvested. The entire process of engaging a forestry consultant, company or contractor, completing a pre-harvest assessment and harvest plan and upgrading roading infrastructure can take several months or even years. It is therefore important that this process is started early to ensure the landowner can harvest their woodlot when they want and at a time when market conditions are favorable.

- Tree planting is expensive and is often a once in a generation decision with the quality of decisions made having a dramatic impact on the outcomes achieved. With the long term nature of tree planting, planning is crucial. Key considerations include cash flow, cost of capital over time, and how these align with the owner's objectives both in the long-term and at various stages of the investment life cycle. The planning and analysis provided in this case study demonstrates the integration of the **right tree** in the **right place** to achieve the owner's objectives of: optimising land use while meeting environmental obligations, improving animal welfare through the provisional of shade and shelter and retirement of marginal land, enhancing biodiversity, providing income diversification, and improving the long-term value of the business.

CONTENTS

Introduction

The Integrated Farm Forestry Systems project is a multi-agency funded research and extension project, led by Te Uru Rākau and co-funded by DairyNZ, the Waikato, Bay of Plenty and Horizons Regional Councils, Living Water (DOC-Fonterra partnership), Farmlands Co-operative and the Forest Growers' Levy Trust.

The project is being delivered by Perrin Ag and PF Olsen in collaboration with farmer (dairy and sheep & beef cattle) and industry groups. The project aims to address key issues associated with the adoption of forestry within a farm business and provide land owners, iwi and rural professionals with the information they need to help land owners make well-informed forestry enterprise decisions and increase their confidence in implementing forestry as a land-use option.

An important phase of the project is completing 10 diverse farm case studies (including iwi-owned) to illustrate the impact of integrating various forestry options into pastoral farming systems. This phase builds on farmer interviews completed in 2019 to gain an in-depth insight into farm forestry practices, views and knowledge; and enablers and barriers to integrating forestry into pastoral farming businesses (Dooley et al., 2020).

For this component, a range of complementary, integrated farming and forestry enterprises have been evaluated with 6 Waikato / Bay of Plenty cases and 4 Rangitikei individual cases. Case studies cover a variety of primary land uses (e.g. dairy, sheep and beef cattle, deer). Forestry options include *Pinus radiata*, Douglas fir, mānuka and apiculture, PFSI (permanent forest sink initiative) forests for carbon and biodiversity, short rotation exotic species (including high stocking rate special purpose radiata pine for wood fibre supply), poplar space planting, and totara for timber. Case studies were selected on their potential to demonstrate enhanced business and environmental performance and to ensure questions and knowledge gaps identified in Phase 1 (farmer survey) of the project are explored. Once completed, the case studies will be publicly available on-line and the findings disseminated amongst farmers and rural professionals through workshop and field days.

This case study, MW & FK Linton, comprises a family-owned dairy farm in the Bay of Plenty region. It is one of six Waikato-Bay of Plenty case studies analysed. The topics covered in this case study that align with the identified concerns and knowledge gaps include:

- Evaluating land classes and details the process for selecting the right tree for the right place.
- Discusses the process for establishing a wood harvesting agreement and selection of experienced and professional forestry consultants or contractors.
- Provide robust financial and environmental analysis demonstrating potential returns, impact on environmental externalities, and the overall financial performance of the farm system. This is compared against the existing land use and clearly demonstrates the value proposition to the land owner.
- Evaluating options for managing forest edges to meet landowner's preferences regarding returns, aesthetics and biodiversity.

Method

Case studies were identified through the researchers' professional networks and local project steering groups and the final case studies confirmed after evaluating the specific opportunities and challenges for each property against the key questions and knowledge gaps identified in Phase 1, as well as ensuring appropriate regional and sector diversity.

PROCESS

A property inspection was conducted at the farm on 29 November 2019, in which the farmer's interest and preferences for integrating forestry into their existing business was explored, the suitability of potential sites assessed and information garnered about the farm and current forestry activities. A standardised data capture method adapted from the DairyNZ Whole Farm Assessment (DairyNZ, 2016) process was used to ensure consistency between case studies.

Financial and physical data from the current and preceding three years were analysed in order to develop a status quo model ("base scenario") of the business using Farmax (www.farmax.co.nz.) and OVERSEER FM (OVERSEER, 2019). This confirmed the feasibility of the farm system and generated an estimate of nitrogen (N) and phosphorus (P) losses to water and biological greenhouse gas emissions (bGHGs) from current land use activities. Data input standards were consistent with the protocols for both OVERSEER and the Bay of Plenty Regional Council.

As part of this process the farm property was mapped and analysed in ArcGIS software. This was done in order to identify the geo-physical differences of areas of the property identified for afforestation. This is needed to both ascertain the impact on aggregated pasture production of changing land use and identify forest growth potential.

To evaluate the impact of slope and aspect on pasture production and feed quality, assumptions were formed using principles drawn from journal articles, discussions with the case study farmers, and observations made by the project researchers during the farm visit (Appendix 1). Pasture production was estimated from the whole farm Farmax modelling and empirical relationships known to exist between aspect, slope and fertility and inherent pasture production potential based on Radcliffe (1982), Gillingham (1973) and Morton & Roberts (1999). The method for calibrating average forest productivity for the site is described in Palmer et al. (2010), with tree growth adjusted between the flatter contour high productivity areas and the steeper low productivity areas identified via GIS using an adjustment of 10 percent growth based on Beets et al. (2019).

Once the status quo model was confirmed for the farm, afforestation scenarios were developed in association with Murray Linton to ensure alignment with their joint objectives and of interest to them. Each scenario was analysed to determine costs, revenues and carbon sequestration. Forecaster software v2.2.1.1553 (West et al., 2013) used to determine the growth rate of *Pinus radiata* woodlots. Scenarios for both *Pinus radiata* and small areas of native (scenario 3) were analysed for both their first and second rotations (two full 28-year cycles of planting, growing, harvesting), to provide a consistent 56-year timeframe. Where applicable, the impact of accessing regional or national grant schemes was included.

The farm system was then re-modelled in Farmax and OVERSEER for each scenario to account for the reduction in the area of grazing land and quantify financial and physical outputs. These outputs were then combined with the respective forestry outputs for each scenario and to derive the aggregated changes in financial performance and environmental outcomes relative to the base scenario. This was done by utilising investment analysis tools (see page 24), primarily discounted cash flow analysis, to allow the regular (annual) cash flow from farming to be treated consistently with the irregular cash flows from forestry. OVERSEER was used to assess the overall impacts on the property's environmental footprint.

Full assumptions are presented in Appendix 3.

Section 1: Farm and business description

INTRODUCTION

MW & FK Linton is a family-owned business situated in Te Ranga, 17 km south of Te Puke. Murray and Fiona Linton originally purchased the farm from Murray parents in 1987 in partnerships with Murray's brother and sister in-law. In 1999, Murray and Fiona bought the remaining shareholding. The business operates 423 hectares including 172 ha utilised as a dairy platform, 59 ha for grazing young stock replacements, 3.6 ha of kiwifruit, approximately 38.8 ha of plantation woodlots (*Pinus radiata* and *lusitanica*) with the balance in native bush and non-productive area.

Figure 1. Aerial image of MW & FK Linton's property captured by a drone.

In 2016, 3.6 ha was converted to gold kiwifruit with a further 7 ha of suitable land planned to be planted. Elevation, climate and the high capital requirements are the main constraints for further expansion. The kiwifruit development enables higher value land use and diversifies revenue. Murray and Fiona also own and operate a Coffee and Tea supply business (Fusion) in Mount Maunganui.

The Linton's are interested in how the inclusion of trees can support their goals, including developing a more environmentally and financially robust business. Well thought out integration of forestry offers the opportunity to convert marginal land that is difficult to graze to highly productive plantation woodlots. As well as building environmental resilience and further diversify revenue streams, and enhance the property's biodiversity and aesthetics. The property's location to wood processors and the Port of Tauranga reduces the cost of log transport to market and adds to the appeal of forestry.

The integration of trees on farm may provide a valuable tool to mitigate environmental externalities. Key opportunities relate to retiring low quality land into a low nitrogen land use, providing shade and shelter to support improved livestock performance and animal husbandry, enhance biodiversity, and providing income from log sales and carbon sequestration over time. If the business can achieve the same amount of total production from less animals in addition to revenue from trees, the total environmental footprint reduces and the efficiency per unit of product increases, providing a more sustainable and resilient business.

BUSINESS STRATEGY

VISION AND GOALS

- To operate a dairy business that is profitable over the long-term, environmentally sustainable and socially responsible; and for the performance of these three pillars to be high relative to peers.
- By 2025 to be still living on farm but less “hands on”. This may include operating a lower order sharemilker as the Linton’s value retaining the cows.
- Plant a further 7 ha of kiwi fruit on suitable land to generate higher returns and enterprise scale (and therefore benefit from diversification). This will also provide a business structure that will allow their son Lachie to return home and operate the kiwifruit enterprise.

VALUES AND PRINCIPLES

- To meet targets for financial and environmental performance, while maintaining the farm’s social license.
- Maintain a high standard of animal welfare.
- Use good science and tested information to support sound decision making.
- Maintain long-term prosperous relationships with people/staff.
- Modify land use by farming the better-quality land more intensively, managing the environment externalities, and retiring low-quality steep contoured land that contributes a high nutrient load relative to its production, into trees.

Figure 2: MW & FK Linton aerial map with property boundary (bold yellow line).

FARM DESCRIPTION

The 423-ha property includes 231 ha of effective pastoral area with the balance being in trees and non-productive land (lanes, buildings). The farm's soils are predominantly allophanic (Otanewainuku steep land soils) with a small proportion of pumice (Paengaroa sandy loam) present on the steep hill sides. These soils are relatively free draining providing management flexibility during wetter weather conditions. The steeper sidlings, however, are prone to hoof damage and soil moving down slope when conditions are wet. Considering the heavy stock class utilised, these areas represent risk for sediment and phosphate loss.

Topography is characterised as mostly flat to rolling terraces with some steep gullies that meander through the property. Areas where permanent water is present have been fenced to ensure stock are excluded and mostly contain native bush.

The farm is in a high rainfall area receiving approximately 2,093 mm/year and has a mean annual temperature of 13.2^{o} C. The higher altitude contributes to a shorter growing season and challenging wet conditions for pasture grazing during winter/early spring. These periods, if not managed well, can contribute to higher rates of contaminant loss if soils are damaged. Livestock performance can also be hindered by the grazing of unimproved pastures (browntop) on the steeper land, particularly during adverse weather.

PASTURE GROWTH ACROSS FARM'S LAND CLASSES

Total annual pasture production and the seasonal distribution of growth for the evaluated land classes is presented in Figure 3. Average pasture production over the 232 effective hectares is estimated at 10.8 t DM/ha (excluding N) and considered to be representative of the property.

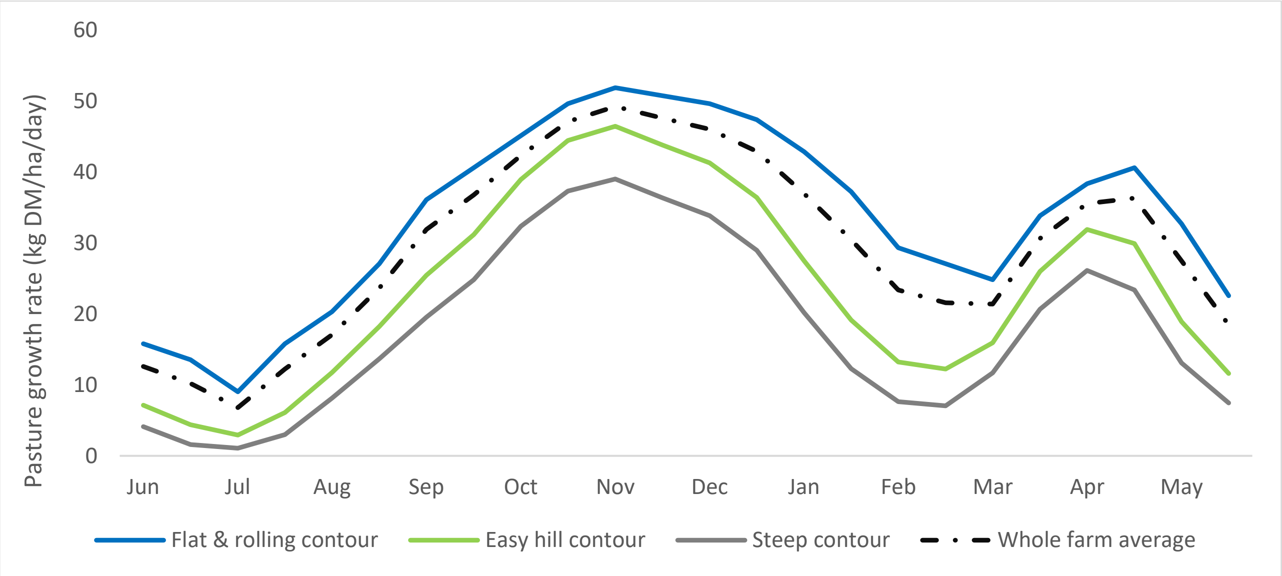

Figure 3. Estimated pasture production curves for the assessed land classes on the MW & FK Linton property.

Pasture growth curves were created for three distinct land classes based on topography: high-producing flat-rolling contour (12.2 t DM/ha/yr), easy hill (8.6 t DM/ha/yr), and steep (6.6 t DM/ha/yr). Factors influencing pasture growth rates across the land classes included slope, aspect, soil depth, soil fertility, soil temperature and pasture species (refer to p46 for further detail). The flat-rolling, easy hill, and steep country accounts for 154.9 ha (67%), 49.5 ha (21%), and 26.6 ha (12%) respectively.

The steep contoured land is estimated to produce 61% of the farm's average pasture growth and has proportionately larger growth peaks and troughs relative to the other land classes. The sward largely includes unimproved pastures (e.g. browntop) which contributes lower feed quality (MJME/kg DM) compared to the improved pastures (ryegrass and white clover) on the easier contoured land. Steep land is challenging to manage, particularly during the spring flush when stock need to be pushed to utilize the growth otherwise feed quality deteriorates significantly leading into summer. These areas were identified by the Linton's for potential tree planting.

CURRENT FARM SYSTEM

The farm winters 450 high genetic merit crossbred cows (approximately 450 kg live weight) to provide 440 cows at peak milk. A seasonal spring calving system is operated with the cows mated on 12 October for a 20 July planned start of calving. Total milk production for the 2019/20 season was 147,766 kg MS (859 kg MS/ha and 336 kg MS/cow). Days in milk (DIM) typically range between 230 to 240 days with the cows dried off in April the last few seasons due to dry summer conditions. A "system 3" production system is operated with approximately 12 percent of feed sourced externally. Around 130 t DM of grass silage is harvested annually and a further 240 t of palm kernel (PKE) is imported. Supplement is fed during winter to early-spring and summer to fill feed deficits. Eight hectares of swede is also grown on the dairy platform to provide winter feed and is grazed in June/July. All mixed age cows and young stock are wintered and grazed on farm. The farm utilises a 23% replacement rate with all heifer replacements raised on the support land (59 ha). The R2 heifers are mated to AI to provide higher genetic merit replacements. Mating commences a week ahead of the MA cows recognising they are under more pressure in their first lactation and more difficult to get back in calf on time.

Pasture eaten is approximately 10 t DM/ha and has varied 1 t DM/ha across the last three seasons. Pasture management is challenging due to the low stocking rate (2.56 c/ha), farm contour, and higher altitude. Dry conditions through summer and early autumn, which have been particularly severe over the last three seasons, have a large impact on feed supply, quality, and ultimately animal performance. These challenges are amplified on the steeper contoured land which contain unimproved pasture and less topsoil and require more energy from the cows to harvest.

Animal performance metrics are heavily impacted by spring (cold and wet) and summer (dry) conditions and the grazing of the challenging steep country. Per cow milk production is only 74% of liveweight (331 kg MS/450 kg liveweight) and does not express the genetic potential of the high index herd. Young stock growth rates have also tracked below target resulting in smaller in-calf heifers entering the herd (400 kg liveweight by 1 May). The lower liveweights coming into the herd result in a "finer framed" cow that is not fully grown out. This is likely impacting productivity, heifer competitiveness during the first lactation and the number of heifers not getting back in calf.

All these factors (climate, mixed variable topography and pasture species) constrain management and physical productivity and lead to the question: "If the steep contoured land was retired and planted in trees what would be the overall impact on the businesses"? The smaller nature of the farm (440 cows) means even small reductions in milk production could influence higher cost centres such as labour and further reduce already limited economies of scale. This case study seeks to address this question.

CURRENT TREE PLANTING

Currently there is 42.3 ha of forestry comprising approximately 36.8 ha of Pinus radiata, 3.5 ha of mānuka and kānuka and 2 ha of *Lusitanica*. Twenty hectares of *Pinus radiata* was harvested 2 years ago which comprised four blocks ranging from 0.8 to 14.6 ha. Some of this area was replanted in native (around 5 ha) with the balance in *Pinus radiata*. The remaining 21.8 ha of *Pinus radiata* is 4-5 years old in four blocks ranging 1.6 to 13.8 ha. Murray plans to prune and thin these stands to grow higher quality timber and maintain tidy woodlots. The mānuka and kanuka is planted in small pockets of less productive land which will likely regenerate to native forest. The *Lusitanica* are 25 years old and are also planted in small blocks and have been pruned but not thinned. Current plantings are not registered in the ETS. Murray's current perception of carbon credits and the ETS is it would provide a small amount of revenue, but he would not expect to "get rich from it".

The Linton's experience in harvesting gathered over the years have produced some key learnings including: selecting the right forestry consultants and contractors, establishing a detailed harvest plan that sets out expectations and how the process will be completed, ensuring harvest contractors have the right equipment to minimise soil damage, and requiring a good health and safety plan and processes are in place. For further information on setting up a wood harvesting agreement, refer to p16. A NOTE ON WOOD HARVESTING AGREEMENTS

The Linton's criteria for further tree plantings on marginal land (steep sidlings) are to provide an equivalent return to livestock and be affordable from a cashflow perspective. The later point is important because the kiwifruit development has a high working capital requirement in the medium term. Milk price volatility has a large impact on the farm's year to year free cash and developing too much land into orchards and forestry present liquidity challenges. Secondary criteria are to improve environmental performance and maintain the businesses' "social licence to farm" through sustainable land use.

A NOTE ON WOOD HARVESTING AGREEMENTS

Good harvesting outcomes for landowners are driven by the wood harvesting agreement and selection of experienced and professional forestry consultants or contractors. Small forest landowners should engage professionals with good track records. The NZ Institute of Forestry has a register of professional forestry consultants required to meet their standards and may be a good starting point (NZFFA, 2015).

To ensure landowners can make an informed decision when entering a wood harvesting agreement, landowners should seek advice and understand their harvest area and the requirements needed of harvesting contractors. The first step is undertaking a pre-harvest assessment which evaluates the forest area, financial feasibility, state of the market, forest access and availability of contractors (Visser, 2016). At this stage, a decision should be made on which forestry consultant, company or contractor to engage with.

Following this a harvest plan, required by law, should be developed forming a key part of the agreement that sets out expectations of when and how the harvest is completed. It should include a map defining the physical characteristics of the harvest area and operation, the location of roading and landing sites, and specify the harvesting system. It is important the harvest system and equipment used, which will guide the forestry company selection, matches the forest stand, terrain and landowner objectives. The system needs to be physically feasible, safe, have a low environmental impact and be cost effective (Visser, 2016).

Landowners have a responsibility for health and safety and should ensure persons undertaking work on behalf of the owner have sound systems in place. The harvest plan should provide guidance on health and safety requirements, physical hazards and any environmental or resource consent requirements. Any additional landowner requirements should also be added which may include restoring fences, removing wood waste or requesting a summer harvest on dry ground to minimise soil disturbance (Visser, 2016).

The agreement should also state the manner and standard of performance expected, method and timing of payment, consequences of breach or delay and how disputes are to be resolved. Many small forest owners select a managed sale when selling their farm woodlots. This is where the owner appoints a professional harvesting or marketing company to oversee all aspects of the project. This is usually a transparent process where the owner receives a detailed report of all revenue and costs incurred during the project. However, as an open book project, the owner takes all the market risk of selling the logs. The option is a stumpage sale, where the forest owner receives an exact figure per tonne of logs sold. The disadvantage is the stumpage buyer will usually discount the buy price to offset any grade, volume or market risk (Woodbank, n.d.).

After harvest, owners should complete a post-harvest inspection with the harvesting contractor and/or consultant to satisfy themselves that the work has been completed to the standard prescribed. This should include checking all saleable timber has been transported to market and no logs of value have been left in the cut-over or landing site. Landowners should also check that slash has been managed to the standard defined in the harvest plan and contract. Often woodlot owners request slash to be returned to the cut-over to recycle nutrients but should be done in a way as to not impede replanting. A common occurrence in poorly managed operations is slash left over the side of a landing on steep terrain. This is referred to as a 'birdsnest' and creates a risk of debris flow in heavy rain events into receiving waterways. Other areas worth inspecting are skid trails which provide tracking for soil and debris to rapidly and easily flow into waterways. At the end of harvest these trails should be closed off by water bars at regular intervals to avoid sedimentation (Visser, 2016).

The entire process of engaging a forestry consultant, company or contractor, completing a pre-harvest assessment and harvest plan and upgrading roading infrastructure can take several months or even years. It is therefore important that this process is started early to ensure the landowner can harvest their woodlot when they want and at a time when market conditions are favorable.

ENVIRONMENTAL FOOTPRINT

Total N loss for the property is 13,311 kg N/yr or 31 kg N/ha/yr as modelled in Overseer v6.3.4. Per hectare N loss is much lower because 192 ha of the 423 ha is in forestry or native bush which leaches only 2-3 kg N/ha/yr. Excluding this area, the pastoral N loss is 12,735 kg N/yr or 54 kg N/ha/yr. The farm's biological greenhouse gas (GHG) emissions are 76% methane and 24% nitrous oxide and average 8.1 tonnes of carbon dioxide equivalents per hectare per year (CO2e/ha/yr) across the pastoral area (231 ha). Methane is directly related to dry matter intake (DMI x 21.6 g/kg DM eaten) whereas nitrous oxide (N_2O) emissions are driven by nitrogen fertiliser use, total annual nitrogen excreted and soil type (high losses on heavier soils).

While agriculture is not yet explicitly in the Emissions Trading Scheme (ETS), the sector has a target under the Zero Carbon Act to reduce emission 10% by 2030 relative to the 2017/18 levels and between 24-47% by 2050. These targets pose a large challenge for the sector and farmers will need to plan and implement well thought changes to their businesses to meet them.

More information on expected GHG requirements is provided in Appendix 5.

BASE SYSTEM

The representative status quo farm system for MW & FK Linton, or base scenario for the analysis, is presented in this section. This system reflects the performance achieved from the property over recent years.

STATUS QUO PHYSICAL PERFORMANCE

The business' status quo physical performance and parameters is presented in Table 1.

Table 1: Summary of key metrics for the status quo farm system.

Farm details		Base farm system	
Nearest town and catchment	Te Puke	**Herd size (peak lactation)**	440
Season's rainfall (OVERSEER)	2093 mm	**Breed and liveweight**	Crossbred 450 kg
Soil type(s)	Mku_1a.1 (57%) Mku_11a.1 (8%) Oraka_1a.1 (35%)	**Farm system (% feed brought in)**	3 (14%)
Terrain (flat/rolling/steep)	Flat to rolling (65%) Moderate to steep hill (35%)	**Comparative stocking rate (kg LW/ha/t DM/ha)**	87
Total farm size (ha)	423	**Stocking rate (cows/ eff ha)**	2.56
Effective dairy area (ha)	172	**N fertiliser (kg N/ha/yr)**	110
Dry stock support area (ha)	59	**Per cow production (kg MS)**	330
Labour (FTE)	2.7	**Per hectare production (kg MS)**	843
Effluent irrigation area (ha)	30	**Planned start of calving**	20-Jul
Stand-off pad/herd home infrastructure	Feed pad	**Breeding Worth (BW)**	180/63
Shed type	36 HB	**Production Worth (PW)**	152/53
Native and riparian trees (ha)	153.2	**Young stock**	On Farm
Timber woodlots (ha)	38.8	**Wintering MA cows**	On farm

STATUS QUO FINANCIAL PERFORMANCE

The business' status quo financial performance is presented in Table 2.

Table 2: Status quo financial performance of dairy enterprise.

Financial KPIs	Status quo
Gross farm income ($/ha)	5,817
Farm working expenses ($/kg MS)	4.61
Operating expenses ($/ha)	4,878
Operating profit ($/ha)	940
Operating profit margin ($/kg MS)	1.11
Cash operating surplus ($/ha)	1,930
Operating return on dairy assets percent	2.8%
Total ROA percent*	2.1%

**Inclusive of total business pastoral assets (excludes kiwifruit development).*

Additional historical financial data on the farm business are presented in Appendixes 6 & 7.

STATUS QUO ENVIRONMENTAL PERFORMANCE

The business' assumed status quo environmental indicators are presented in Table 3.

Table 3: Status quo environmental performance indicators for MW & FK Linton.

Environmental indicators	Status quo
Total N leached (kg N/yr)	12,539
N leached per hectare (kg N/ha)	54
N surplus (kg N/ha/yr)	162
N conversion efficiency	23%
Kg MS/kg N leached	11.4
Operating profit/kg N leached	$11.56
P loss (kg P/ha/yr)	3.5
bGHG/ha (t CO_2e/ha)	7.8
bGHG efficiency (kg CO_2e/kg MS)	12.44

** KPI's are modelled through OVERSEER FM v. 6.3.5.*

** Note per hectare indicators have tree losses removed and calculated against 231 ha rather than the 423 ha of the total property.*

Section 2: Forestry options

In this section options are evaluated for integrating trees to improve farm performance and meet the Linton's goals and values. The current physical, environmental and financial performance and identified constraints discussed earlier provided guidance for designing planting scenarios.

The tree planting objectives identified from discussions with the Linton's that were considered in the scenario design include:

- Raising productivity on the quality land, managing nutrient loss, and putting steep country back into trees.
- Supporting a high standard of animal welfare.
- Use good science and tested information to support sound decision making.

RIGHT TREE, RIGHT PLACE: SUITABLE SPECIES SELECTION FOR THE FARM

Understanding a planting site and its effect on tree performance and future harvesting operations is essential for selecting the right tree to achieve the desired outcomes. In this section the tree options for the different land classes on the Linton's farm are explained. As noted earlier, the property is characterized by three distinct land types: the flat to rolling productive land, easy hill country, and steeper gully systems. The easy hill and steep land classes are only discussed in this section as the quality land was not considered for forestry.

EASY HILL LAND

The easy hill areas cover 50 ha and have a mean slope of 18.2°. The dominant soil type is Oropi loam (Oropi1_a.1: belonging to the Pumice soil order) with smaller areas of Ngakura loam (Ngak_2a.1: belonging to the Allophonic soil order). These soils are classified as deep (>1 m) with no significant rooting barrier, are well drained with low vulnerability of water logging, and have high soil water holding capacity. The area has high rainfall (2,093 mm) providing good growing conditions. The soils are moderately fertile having a long history of maintenance fertilizer application.

The climatic conditions and deep soil types on this area of the farm provide good growing conditions for timber species. The easy slopes support ground based extraction. Site access is good with well-formed central races to most areas.

GULLY SYSTEMS/STEEP SIDELINGS

The farm area categorised as steep covers 26.6 ha with an average slope of 28.5°. These areas are less productive compared to the easier slope classes due to shading, less topsoil and lower soil fertility. The dominant soil type is Otanewainuku loam (Otanw_1a.a: belonging to the Allophanic soil order) with smaller areas of Oropi loam. Otanewainuku has a loam subsoil with rock contact at less than 100 cm of the mineral soil depth which can impede root depth. The subsoil also has low capacity to store water and oxygen.

The gullies represent an opportunity to retire low productivity areas of farmland for timber and/or carbon, biodiversity benefits and environmental protection. The gullies contain several zones that need considering when thinking about the right tree species. These include the steep slopes, lower slopes and flats, and gully bottoms. Access and potential harvest costs are not considered limiting factors due to the gullies being near farm laneways and roading. Harvesting woodlots during summer would limit soil damage.

On the lower slopes, drainage tends not to be impeded and topsoil is deeper and more fertile than the steeper slopes thus providing more suitable growing conditions for a wide range of tree species. Gully slopes are also shadier and more prone to frosts than the upper zones which impacts tree species selection. Species such as Tasmanian Blackwood (*Acacia melanoxylon*) tolerate these conditions. The flat zones at the bottom of the gullies are often wet, prone to frost, and may be exposed to periodic flooding and/or sedimentation. Trees such as Coast Redwoods (*Sequoia sempervirens*) or some species of eucalyptus can thrive under these conditions (Satchell, 2018). Planting the bottoms of gullies with trees can also act as a mitigation for sedimentation and nutrient loss, particularly phosphorus, from harvesting of the upper slopes. Permanent species such as natives are a good choice for these areas and help maintain or improve water quality.

FORESTRY ANALYSIS

The Linton's showed interest in *Pinus radiata*, largely because of its strong financial returns and greater ability to sequester carbon relative to other species. Their goals for increased efficiency and proven returns makes radiata pine an obvious component of tree planting scenarios, complemented by native to support improved environmental and biodiversity outcomes. Radiata pine provides a resilient species capable of good growth across a wide range of sites. It has well established log markets with price series to reference for economic comparisons, and familiarity for all forestry service providers. Radiata pine is widely grown locally with strong infrastructure and supply chains in place to support planting, silviculture, harvest and the sale of timber. If logs were harvested during summer the potential planting sites would require minimal roading development and soil damage can be minimised. The distance to port or processor typically has the largest impact on the profitability of small woodlots due to high associated transport costs. The farm has several local processors of Radiata pine within 50 km, and the Port of Tauranga and Kawerau Pulp Mill are 44 km and 81 km, respectively, from the farm.

Three scenarios with the same planting area were tested. Matching planting areas (36.6 ha) meant the net impact on the livestock business was the same.

Afforestation was classified as either timber woodlot or native. Woodlots were assessed for economic potential (including carbon) while native plantings were included as costs for establishment (less any grants available for planting), plus any carbon revenue they would accrue over time for areas that were eligible for registration in the ETS. For this case study it was assumed that grants similar to both Te Uru Rākau and Bay of Plenty Regional Council landowner grants were able to be secured to subsidise planting and fencing costs. The cost of seedlings assumed a small number of species and not pre-spaced to keep planting costs at the lower end of the range for natives. Costs for follow up weed and pest control for up to two years after planting were included without subsidies.

The main land use and farm system changes are presented in Table 4, with further details specific to each scenario provided below. A map of the three scenarios and their respective planting designs are presented in **Error! Reference source not found.**.

Table 4: Summary of scenario design compared to the base system (status quo).

Farm parameters	Base system (status quo)	Forestry scenarios 1, 2, 3
Effective pastoral area (ha)	231	194.4
- Milking platform (ha)	172	145.4
- Support land (ha)	59	49
Timber woodlots (ha)	38.8	75.4, 75.4, 74.1
Native (ha)	153.2	153.2, 153.2, 154.5
Peak cows milked	440	395
Stocking rate (c/ha)	2.56	2.71
Production	145,000	135,000
per hectare (kg MS/ha)	843	928
per cow (kg MS/cow)	330	342

Figure 4. Forestry scenario design map.

FORESTRY SCENARIOS

The forestry scenarios evaluate a range of options for managing forest edges against pasture. Within 10 m of a forest edge it is difficult to use helicopter spraying without risk to pasture resulting in more expensive use of ground-based spraying by knapsack. Higher pruning and thinning costs can also be incurred due to larger branches and having to push trees into the forest to avoid fences. Due to the nature of the Linton's identified planting areas, the proportion of forest edges relative to the total forest area is much higher than larger more contiguous forestry blocks.

Details for each scenario design are provided below:

- Scenario 1 – Ignored the extra costs of edges. The planted area contains 36.6 ha of *Pinus radiata*.
- Scenario 2 – Includes the same planting area as scenario 1 and incorporate higher spraying, pruning and thinning costs within 10 m of the forest edge.
- Scenario 3 – Includes some narrow-planted sections in native to reduce the amount of higher cost edge *Pinus radiata* and incorporates scenario 2's spraying, pruning and thinning costs within 10 m of fence lines. The planted area includes 35.3 ha of *Pinus radiata* plus 1.3 ha of native.

FARM SYSTEM CHANGES

The total retired area across the three scenarios is 36.6 ha. The farm system changes modelled include:

- The effective pastoral areas for the dairy platform and support block reduce from 172 and 59 ha to 145.4 and 49 ha, respectively.
- Peak cows milked reduce from 440 to 395 with the stocking rate increasing slightly from 2.56 to 2.72 c/ha. A slight increase in stocking rate was modelled as the average quality and quantity of feed harvest per hectare increased with a large portion of poor contoured land retired. Also, total imported supplement remained in line with the base system results in more supplement being fed per cow.
- Total milk production reduced from 145,000 to 135,000 kg MS/yr.
- Young stock replacements remained at 23% including 94 R1 dairy heifer calves and resulting in 91 R2 in-calf dairy heifers entering the herd at 22 months of age.
- Proceeds from the sale of livestock and shared are used to reduce debt.
- Per cow production increased slightly (+4% or 12 kg MS/cow/yr) relating to improved feed quality and land contour.
- Pasture growth rates remained consistent with the base model for each land class tested. Overall growth rates, feed distribution, and feed quality adjusted at a farm level with lower quality land being retired.
- Fertiliser inputs remained consistent on a per hectare and land contour basis and was adjusted relative to the land being retired.

A NOTE ON INVESTMENT ANALYSIS

The relative financial performance of the both the individual forestry and aggregate land use enterprises in each scenario is measured by both net present value ("NPV") and internal rate of return ("IRR"). The forestry enterprises are also described using an annuity.

The net present value of an investment is the sum of the present value for each year's net cash flow less the initial cost of the investment. Investments with a positive NPV mean that the investment generates a return greater than the assumed discount rate (see below); those with a negative NPV generate a lower return than the assumed discount rate and would be rejected.

The IRR is the actual rate of return on an investment with proper accounting for the time value of money – essentially the discount rate at which the NPV of an investment would be zero.

An annuity is an annual cash flow that would deliver the same net present value over the lifetime of the investment at the assumed discount rate (in today's dollars) as the investment itself. This is useful in helping quantify the relative annual average profitability of forestry with land uses that generate revenue every year. However, the phasing of cash flows is not directly apparent from this measure so it needs to be considered in conjunction with time series cash flow analysis.

A uniform discount rate of 6 percent has been used in analysing across both the forestry and farming aspects of the business model, including returns from ecosystems services such as nitrogen and carbon. A consistent discount rate is necessary when presenting NPV indicator between scenarios but may not be appropriate where landowners have a preference for one revenue source over another. The use of a consistent discount rate here was a necessary practical assumption.

We note that while 6 percent is a common agricultural discount rate, 8 percent is a more common forestry discount rate. There are also other conventions which differ between standard practices for agricultural and forestry economic evaluation, such as the treatment of land opportunity costs and the length of time considered. These factors interact with the choice of discount rate. Additionally, it is useful to treat uncertain revenue streams such as the sale of carbon credits with a higher discount rate. While differing discount rates are useful to account for differences in risk profiles and other aspects of the revenue streams included, that additional level of analysis is considered out of scope for this report.

In this analysis, the investment in the land is deliberately excluded and only reflects the investment made by the case study in livestock, tree stock, plant and machinery and any additional rights to discharge nutrients to water. This assumption is made on the basis that the investment in the land is not discretionary between scenarios, but the choice of land use is.

Section 3: Results of forestry scenario analysis

This section describes the performance of the forest investment under each scenario and separate from the dairy business. Table 5 summarises the investment outcomes from two full forest rotations (plan, grow, harvest, replant, grow, harvest), both excluding and including carbon revenues, and does not include carbon revenues from the new native plantings established under scenario three as the areas were deemed too small to qualify under the ETS. The full cash flow analyses are presented in Appendices 8.

Reductions of environmental externalities (N and P loss to water, reduced GHG emissions and carbon sequestration) are discussed later in Section 5 (whole farm business analysis). Details of the individual scenarios are discussed below.

Table 5. Summary of individual investment performance of the forestry investments, under each scenario.

Planted Area	Scenario 1 36.6		Scenario 2 36.6		Scenario 3 36.6	
Area in P. radiata	36.6	ha	36.6	ha	35.3	ha
Area in native	-	ha	-	ha	1.3	ha
Area in ETS qualifying native and riparian	36.6	ha	36.6	ha	35.3	ha
Returns over two rotations (56 years)	**Total**	**/ woodlot ha**	**Total**	**/ woodlot ha**	**Total**	**/ woodlot ha**
NET PRE-TAX LOGS (undiscounted)	**1,910,537**	**52,200**	**1,893,304**	**51,730**	**1,839,721**	**52,102**
Present Value for whole term (WACC = 6%)	**95,911**	**2,623**	**84,403**	**2,305**	**84,862**	**2,403**
Internal Rate of Return (IRR)	**7.9%**		**7.6%**		**7.7%**	
	Total	**/ planted ha**	**Total**	**/ planted ha**	**Total**	**/ planted ha**
NET PRE-TAX LOGS & CARBON (undiscounted)	**2,120,908**	**57,948**	**2,103,325**	**57,468**	**2,041,643**	**57,821**
Present Value of free cashflow (WACC = 6%)	**191,238**	**5,230**	**179,575**	**4,906**	**176,359**	**4,995**
Internal Rate of Return (IRR)	**10.4%**		**9.9%**		**10.0%**	

SCENARIO 1

The net undiscounted proceeds of Scenario 1 for timber only (pre-tax) was $1,910,537 ($52,200/woodlot ha) over 56 years (two rotations) which included total revenue of $2,631,876 ($71,978/ha) less expenses of $721,339 ($19,728/ha) (Appendix 8). Over this timeframe, this is equivalent to an annuity (annual payment) of $5,984 or $164/ha in present value. By way of comparison, at the same discount rate, the existing dairy farm enterprise generates a return equivalent to an annuity of $961/ha.

Applying a discount rate of 6 percent to the investment provided a positive present value of $95,911 ($2,623/woodlot ha). The IRR for this investment was a modest 7.94 percent over the 56-year investment period.

If the safe tradeable carbon is sold between year 8 (the point at which sufficient carbon worth selling has been sequestered) and year 17 (point at which half the carbon captured by a *Pinus radiata* forest has been sequestered), the present value of free cash flow over the whole term increases to $191,238

($5,230/total planted ha) and provides a healthier IRR of 10.4 percent. The equivalent annuity is $326/ha. Scenario 1 provides the highest return of the three scenarios. Carbon and log revenue per hectare of planted forest is slightly lower than Scenario 3 but incurring lower expenses provides an overall higher net return.

SCENARIO 2

The net undiscounted proceeds of Scenario 2 for timber only (pre-tax) was $1,893,304 ($51,730/ha) which included total revenue of $2,638,885 ($72,081/ha) less expenses of $745,581 ($20,366/ha). This is equivalent to an annuity (annual payment) of $5,266 or $144/ha.

Higher revenue was achieved from more extensive silviculture on the forest perimeter slightly improving log quality and yield. The relative impact on revenue, compared to Scenario 1, is small due to the assumed prices for lower grades reflecting the historically high demand from China. The higher revenues received were also insufficient to offset additional silviculture costs but the net difference compared to Scenario 1 is not significant (-$17,233 or -0.9%). The forestry analysis does not account for increased fencing repairs caused by fallen limbs/trees or the value of improved aesthetics which may have a higher weighting for the Linton's. Applying a discount rate of 6 percent to the whole term provided a positive PV of $84,403 ($2,305/ha) and an IRR of 7.6 percent, the lowest of the three scenarios.

If the safe tradeable carbon is sold, the net pre-tax return (logs + carbon) increases by $210,371 ($5,746/ha). The present value of free cash flow over the whole term increases to $179,731 ($4,909/ planted ha) and provides a healthier internal rate of return of 9.9 percent and an equivalent annuity of $306/ha.

SCENARIO 3

The net non-discounted proceeds from Scenario 3 for timber only (pre-tax) was $1,839,721 ($52,102/ha) which included total revenue of $2,544,941 ($72,074/ha) less expenses of $705,219 ($19,972/ha). This is equivalent to an annuity (annual payment) of $5,294 or $150/ha at a 6 percent discount rate. The total net return is the lowest of the three scenarios due to the reduced forest area (-1.3 ha) but the net present value ($84,862) and (IRR of 7.72%) was the second highest. Scenario 3 provided similar revenue per hectare planted as Scenario 2 but the costs incurred were lower as narrow planted sites were retired into native species. Planting of the natives was assumed to be cost neutral as grants similar to the One Billion Tree and Regional Council grants were assumed to be sufficient to fully offset them. If these grants were not taken or available at a lesser extent, costs would increase eroding returns and potentially providing the lowest of the three scenarios as income is not derived from the natives.

Applying a discount rate of 6 percent to the whole term provided a positive PV of $176,359 ($4,995/planted ha). The investment's IRR was 10.0 percent being 0.4% lower than Scenario 1. Scenario 3 provides an option to minimise fence maintenance across the lifecycles of the forest, improve aesthetics, and provide biodiversity corridors by linking to native bush nearby.

RISK ANALYSIS

The following section analyses the sensitivity of each forest scenario internal rate of return (IRR; pre-tax) to changes in log and carbon price ($/NZU). Results are presented in Table 6, Table 7 and Table 8.

Log price has been sensitised +/- 20 percent in 10 percent increments whereas carbon price is valued at 0, 20, 35, and 50 dollars per NZU. The carbon values provided align with the fixed-price option under the ETS – a clause allowing emitters to pay money instead of surrendering carbon credits – for $35, along with a $20 price floor and a $50 price cap. The $0/NZU reflects the discrete IRR (from point of planting) of the second rotation when there is no safe tradeable carbon to sell.

The three scenarios have a similar sensitivity to both carbon and log price as the forest edges contribute small differences in planted area, carbon sequestered, log yield and grade. The impact of log price on the IRR is moderate changing 0.28 to 0.63 percent for each +/- 10 percent price movement for the price series sensitised (refer to Table 6, Table 7 and Table 8). The impact of log price lessens as carbon price contributes to a higher proportion of forest revenue and the converse relationship occurs as carbon price decreases. Therefore, log price risk increases from the second rotation as there is no safe tradeable carbon to sell. Log price risk can be reduced by managing harvest dates to avoid market slumps as the trees can sit on stump for around five years. Taking advantage of market peaks is difficult because of contractor availability, and how quickly the price can change.

Table 6. Impact of log price and carbon price ($/NZU) on internal rate of return (IRR percent) pre-tax on Scenario 1.

		Log price				
		-20%	**-10%**	**0%**	**10%**	**20%**
Carbon price ($/NZU)	**0**	6.6	7.2	7.7	8.3	8.7
	20	8.8	9.3	9.8	10.3	10.7
	35	10.7	11.2	11.6	12.0	12.3
	50	12.8	13.2	13.5	13.8	14.1

Table 7. Impact of log price and carbon price ($/NZU) on internal rate of return (IRR percent) pre-tax on Scenario 2.

		Log price				
		-20%	**-10%**	**0%**	**10%**	**20%**
Carbon price ($/NZU)	**0**	6.3	6.9	7.5	8.0	8.4
	20	8.3	8.9	9.4	9.8	10.3
	35	10.2	10.6	11.1	11.4	11.8
	50	12.1	12.5	12.8	13.1	13.4

Table 8. Impact of log price and carbon price ($/NZU) on internal rate of return (IRR percent) pre-tax Scenario 3.

		Log price				
		-20%	**-10%**	**0%**	**10%**	**20%**
Carbon price ($/NZU)	**0**	6.3	6.9	7.5	8.0	8.5
	20	8.4	9.0	9.5	10.0	10.4
	35	10.2	10.7	11.1	11.5	11.8
	50	12.2	12.6	12.9	13.2	13.5

Carbon price has a much larger bearing on the IRR changing 0.08-0.11 percent per dollar value of NZU. Carbon price is highly sensitive to government policy and has increased from $22.50 to $38.50 /NZU (71 percent) for the period March 2020 to March 2021. This price movement amounts to the IRR changing 1.4 to 1.8% for the tested scenarios. If the carbon price continues to increase to $50/NZU, the IRR increases by 2.1 to 2.8 percent. This highlights the potential impact carbon value has on the first rotation's net return and what the business's carbon strategy might be. If the business is required to purchase carbon credits in the future to offset the dairy enterprise, a short-term sale of carbon could be a missed opportunity. Conversely, if agriculture remains outside of the ETS, carbon provides good cash flow with minimal risk to the business. The above factors highlight the need to carefully evaluate what options best meet the business's current and long-term objective regarding cash flow, building balance sheet liquidity, providing emission offset, and building wealth.

At a $0/NZU carbon value, indicative of the second rotation return (from the point of planting), the IRR percent is 6.3-8.7 percent with a +/- 20 percent variability in log price. The returns are considerably lower, highlighting the impact carbon value has on financial performance of the forest enterprises analysed. Lower investment yields highlight the need to reduce debt in the first rotation otherwise, depending on the forested area, the long-term financial viability may be compromised.

Section 4: Impact on the dairy farm system

IMPACTS OF LAND RETIREMENT

The impacts of the proposed land use change to forestry on the residuals farming enterprise are summarised in Table 9 and Table 10 below.

MILK PRODUCTION

Total milk production for the forestry scenarios decreased by 10,000 kg MS or 6.9% compared to the base system. As the effective milking platform reduced by 15%, the change in production was less significant reflecting lower productivity land being retired. This is supported by the average feed eaten across the pastoral area increasing by 0.6 t DM/ha or 6%. Consequently, per hectare milk production increased by 10.1%. Lost milk production from the area now in trees is partially offset by increased per cow performance (+ 12 kg MS/cow or 4%) as the animals are not required to expend as much energy harvesting challenging areas, overall feed quality is higher, and imported feed is spread across fewer cows. Higher per cow productivity also ensures a higher proportion of feed eaten is partitioned to milk production relative to maintenance, having a positive impact on environmental performance indicators (discussed further on p38). Impacts to other performance indicators such as young stock growth rates and reproductive performance were outside of the scope of this analysis. However, anecdotal evidence would suggest an improvement in animal feeding would have a positive impact on these areas.

Table 9: Summary of physical parameters of the scenarios compared to the base system.

Farm Parameters	**Base system**	**Forestry scenarios**
Effective pastoral area (ha)	231	194.4
Milking platform	172	145.4
Support land	59	49
Timber Woodlots (ha)	38.8	74.1-75.4
Native (ha)	153.2	153.2-154.5
Peak cows milked	440	395
Stocking rate (c/ effective grazing ha)	2.58	2.72
Production	145,000	135,000
per hectare (kg MS/ha)	843	928
per cow (kg MS/cow)	330	342
Production as a percentage of liveweight	73%	76%
Feed eaten		
Dry Matter Intake (DMI)/ha	10.8	11.6
Pasture eaten (t DM/ha)	9.9	10.5
Imported feed eaten (t DM/ha)	0.9	1.1
Imported supplement per cow (kg DM/cow)	491	547

** The forestry scenarios are grouped together as they represent the same retired areas.*

*** Feed eaten indicators are reported against the effective pastoral area.*

PROFITABILITY

Total gross income reduced by $70,053 due to lower milk proceeds ($62,400), less dividend ($2,000) and lower livestock proceeds ($5,653) from operating less animals (-10.2 percent). Per hectare gross farm income was slightly higher ($583/ha or 10 percent) than the base model due to higher milk production per hectare and a slightly higher stocking rate.

Total farm working expenses (FWE) reduced by $44,520 which was insufficient to offset the reduction of gross farm income. The resultant cash operating surplus decreased by $25,533 or 7.7 percent (refer to Table 10). Larger reductions in expenditure related to animal expenses (animal health, breeding, shed expenses) and cost associated with the retired land (fertiliser). However, "sticky costs" such as labour, vehicle, and feed expenses saw little change while areas such as administration, insurance, rates and depreciation did not change. Consequently, FWE on a per hectare basis increased. Even though poor-quality land was retired, the dairy operation shows the effects of scale on cost dilution and the cash operating margin per kilogram of milk solids. This has consequences for the business's exposure to milk price risk and increases the likelihood of generating a cash operating deficit in a lower milk price year.

With less free operating cash flow available it is important to understand whether the business still generates enough cash to meet debt repayment, CAPEX requirements, and ultimately the cash the Linton's want to draw from the business. To remain viable the business would need to operate with lower debt to asset levels relative to the base to support land being planted in trees.

Table 10: Summary of financial performance indicators for the dairy enterprise.

Farm parameters	Base system	Forestry scenarios
Gross farm income ($/ha)	$5,817	$6,400
Farm working expenses ($/ha)	$3,888	$4,293
Total dairy cash operating surplus	$331,883	$306,350
Change from base system		-$25,533
Cash operating surplus / effective ha	$1,930	$2,107

** Dairy enterprise financial KPI's are calculated with a status quo $6.24/kg MS milk price and a $0.20/share dividend.*
*** Per hectare prices are calculated from the effective dairy platform areas.*

Section 5: Whole farm business analysis

IMPACT OF INTEGRATED FORESTRY LAND USE

Whole business cash flows, with and without, carbon for the three forestry scenarios compared to the base system were completed and analysed using discounted cash flow analysis. The results are summarised in Table 11 below.

Table 11: Summary of financial results from integrated land use.

Integrated business financial analysis	Base system*	Scenario 1	Scenario 2	Scenario 3
Area in farming (ha)	231.0	194.4	194.4	194.4
Area in forestry (ha)	38.8	75.4	75.4	74.1
Excluding carbon				
Aggregate NPV of investment (over 56 years)	$ 3,559,647	$ 3,362,250	$ 3,350,742	$ 3,351,200
Aggregate internal rate of return	20.84%	19.58%	19.46%	19.52%
Farm enterprise	20.84%	20.48%	20.48%	20.48%
Forestry enterprise (woodlot and native)	-	7.94%	7.64%	7.72%
Projected equity at Year 28	$ 8,727,438	$ 8,486,940	$ 8,468,085	$ 8,460,938
Δ from base system		-$ 240,498	-$ 259,353	-$ 266,500
Including carbon				
Aggregate NPV of investment (over 56 years)	$ 3,559,647	$ 3,457,577	$ 3,445,913	$ 3,442,698
Aggregate internal rate of return	20.84%	19.85%	19.73%	19.78%
Farm enterprise	20.84%	20.48%	20.48%	20.48%
Forestry enterprise (woodlot and native)	-	10.40%	9.94%	10.02%
Projected equity at Year 28	$ 8,727,438	$ 8,764,927	$ 8,745,615	$ 8,727,766
Δ from base system		$ 37,489	$ 18,177	$ 328

** Existing forestry assumed to have no net timber value and is ineligible for the ETS.*

Key observations from this analysis include:

- For this case study, the existing farming operation is more profitable than any of the forestry scenarios considered (with the highest NPV).
- The improvement in per hectare productivity for the livestock enterprise after removing the most marginal land did not result in an improved IRR as the business lost economies of scale. 'Sticky costs' present challenges for small operations such as MW & FK Linton as the business still requires a certain operating structure regardless of minor changes in livestock numbers.
- Options to manage forest edging to minimise damage to fences, improve aesthetics, or enhance biodiversity had a minor impact on profitability. This provides the landowner with flexibility to select the most appropriate option that best meets their preference while achieving similar financial outcomes.
- The ability to sell "safe" carbon has a significant impact on the relative profitability of forestry as a land use. Including the sale of carbon provided Scenario 1 with the highest wealth creation (+$37,489 or 0.4 percent), followed by Scenario 2 (+$18,177 or 0.2 percent), while Scenario 3 provided similar results to the base system. Although the net equity gain after 28 years is slightly above or similar to the pastoral enterprise, poor liquidity of the forestry scenarios

meant the NPV was $102,000 to $117,000 less with carbon and $197,000 to $209,000 less without carbon highlighting weaker liquidity and net returns in the second rotation without the provision of grants and the sale of safe carbon. For smaller business's, debt levels would need to be less in the second rotation to allow for this reduction and ensure the business maintains adequate liquidity and returns to achieve the landowner's objectives.

The annual cash surpluses/deficits (before principal repayments) and the net impact on the farm's equity position over time from these cash surpluses (+/- the value of trading assets bought or sold) are presented in Figure 5 and Figure 6 for the base position and each of the scenarios.

At the milk, log and carbon prices assumed, none of the forestry scenarios can meet the assumed levels of term debt repayment for at least 10 years, as post-tax cash surpluses do not exceed $100,000 until at least that point in time. Without the sale of safe carbon, it would take a further two years. The negative cash position is largely impacted by the high level of average debt modelled and the requirement to make [minimal] principal repayments of $40,000/yr. Even the base system is only able to fully amortise debt by year 34 which is outside lenders' 20-year requirements and highlights the business need to operate below average debt levels. The forestry scenarios are projected to fully amortise debt 3 years after the base system at year 37. The forest areas modelled are large relative to the size of the pastoral business. Staggering plantings as the business strengthens its balance sheet or grows cash returns would be sensible to ensure the business maintains sufficient liquidity to meet its requirements for debt servicing, capex, and drawings.

If the business can forgo the need to sell tradeable carbon as it is sequestered, this would increase liquidity on the balance sheet and provide an option to smooth cash flow through tactical carbon sales in years when the milk price is low. However, as the businesses is modelled with a high level of debt, the proceeds from carbon sales would be required immediately to support principal repayments and control overdraft requirements.

Of course, the income from so called "safe carbon" can only be realised for the first rotation, reducing the relative returns from the second rotation which relies solely from timber. Cash flow and equity movements presented in Figure 6 demonstrate the impact of the exclusion of carbon income. As expected, the cash movements worsen, now achieving a cash flow greater than $100,000 per annum by year 12 instead of year 10. If the business was required to repay the debt within 20 years, the integration of larger forestry areas would be further restricted by cash flow, even with the inclusion of Te Uru Rākau grants and the sale of safe tradeable carbon. This highlights the weak cash positions that many dairy businesses are facing due to their high debt levels. This may constrain land use decisions and the potential integration of forestry.

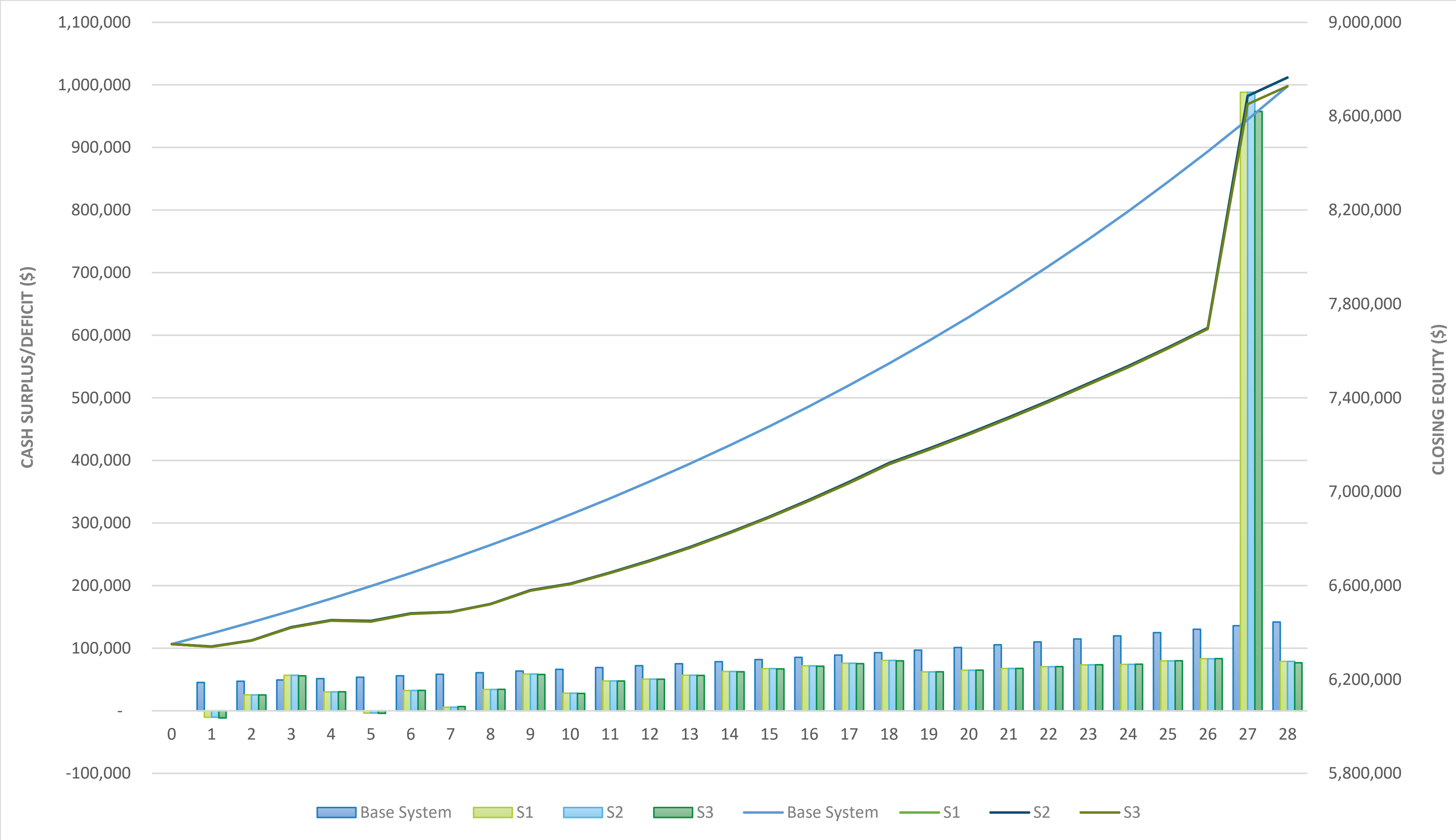

Figure 5: Comparison of total business cash surplus/deficits before principal repayment (LH axis, bars) and closing equity positions (RH axis, line) for Scenario 1 (S1), Scenario 2 (S2), and Scenario 3 (S3) compared to the base system including the sale of carbon.

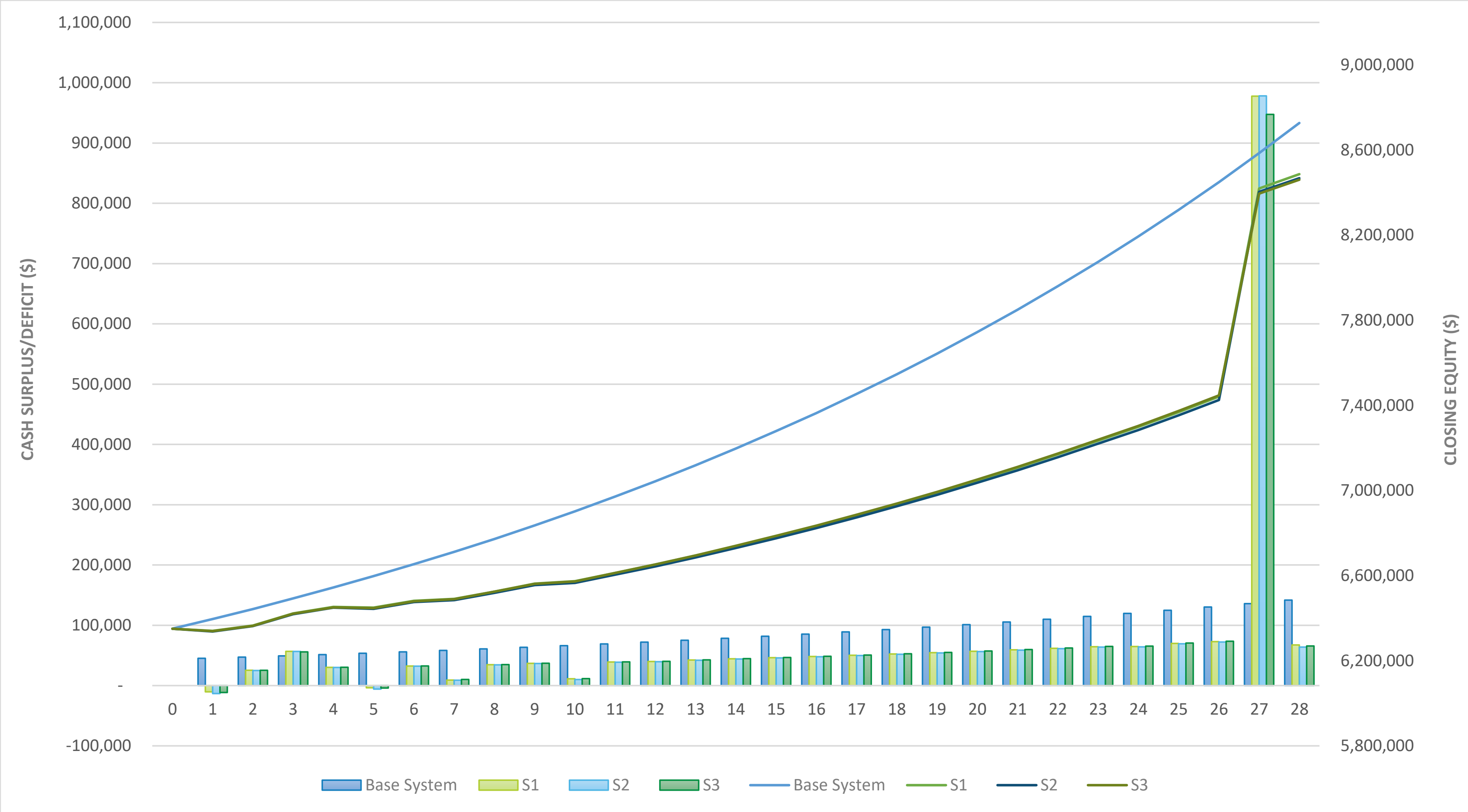

Figure 6: Comparison of total business cash surplus/deficits before principal repayment (LH axis, bars) and closing equity positions (RH axis, line) for Scenario 1 (S1), Scenario 2 (S2), and Scenario 3 (S3) compared to the base system excluding the sale of carbon.

RISK ANALYSIS

The following section analyses the sensitivity of the status quo system and three scenarios' internal rate of return (IRR) to carbon ($/NZU) and total milksolid production. These are presented in Table 12 to Table 15.

Total production has been sensitised +/- 10 percent in 5 percent increments whereas carbon price is valued at 0, 20, 35, and 50 dollars per NZU, consistent with the earlier risk analysis completed. As the business is achieving lower per cow milk output, the +5 percent and +10 percent demonstrates possible returns from an optimised system. Alternatively, lower productivity highlights the impact potential N and GHG limits may have on the dairy operating system and profitability. Carbon price ($/NZU) is modelled at $25/NZU but current pricing is around $35/NZU with medium term projections suggesting further increasing.

Total milksolid production has the largest bearing on IRR varying 2.9 percent for the status quo (refer to Table 12) and between 2.7-2.8 percent for the forestry scenarios (refer to Table 13 to Table 15 Table 15). Milk production is the largest variable affecting the IRR highlighting the importance of protecting and optimising profitable milk production. Lower milk production from current levels would further reduce the business ability to dilute expenses resulting in higher costs per kilogram of milk solid produced and put further strain on the business cash returns. On the other hand, higher productivity alleviates liquidity challenges and would support the business rate of land use change (into either kiwi fruit or forestry). The challenge is minimising impacts to production by enhancing performance on the better-quality land during this change.

Table 12. Impact of carbon price ($/NZU) and total milksolid production on internal rate of return (IRR percent) pre-tax status quo.

		Production (kg MS)				
		-10%	-5%	-	+5%	+10%
	20.8%	130,500	137,750	145,000	152,250	159,500
Carbon Price ($/NZU)	0	15.0%	17.9%	20.8%	23.7%	26.6%
	20	15.0%	17.9%	20.8%	23.7%	26.6%
	35	15.0%	17.9%	20.8%	23.7%	26.6%
	50	15.0%	17.9%	20.8%	23.7%	26.6%

Table 13. Impact of carbon price ($/NZU) and total milksolid production on internal rate of return (IRR percent) pre-tax Scenario 1.

		Production (kg MS)				
		-10%	-5%	-	+5%	10%
	19.8%	121,500	128,250	135,000	141,750	148,500
Carbon Price ($/NZU)	0	13.9%	16.6%	19.3%	22.1%	25.0%
	20	14.3%	17.0%	19.7%	22.5%	25.4%
	25	14.4%	17.1%	19.8%	22.6%	25.4%
	35	14.6%	17.3%	20.0%	22.8%	25.6%
	50	15.0%	17.6%	20.3%	23.1%	25.9%

Table 14. Impact of carbon price ($/NZU) and total milksolid production on internal rate of return (IRR percent) pre-tax Scenario 2.

		Production (kg MS)				
		-10%	-5%	-	+5%	10%
	19.7%	121,500	128,250	135,000	141,750	148,500
Carbon Price ($/NZU)	0	13.7%	16.4%	19.2%	22.0%	24.9%
	20	14.2%	16.9%	19.6%	22.4%	25.2%
	25	14.3%	17.0%	19.7%	22.5%	25.3%
	35	14.5%	17.2%	19.9%	22.7%	25.5%
	50	14.8%	17.5%	20.2%	23.0%	25.8%

Table 15. Impact of carbon price ($/NZU) and total milksolid production on internal rate of return (IRR percent) pre-tax Scenario 3.

		Production (kg MS)				
		-10%	-5%	-	+5%	10%
	19.8%	121,500	128,250	135,000	141,750	148,500
Carbon Price ($/NZU)	0	13.8%	16.5%	19.3%	22.1%	24.9%
	20	14.2%	16.9%	19.7%	22.5%	25.3%
	25	14.3%	17.0%	19.8%	22.6%	25.4%
	35	14.6%	17.2%	20.0%	22.7%	25.5%
	50	14.9%	17.5%	20.3%	23.0%	25.8%

The impact of carbon price ($/NZU) is minor changing 0.02 percent per $/NZU. Increasing the carbon price to $35/NZU or even $50/NZU, the current cap, still provides a lower IRR compared to the status quo system. This is due to carbon contributing a small amount of revenue relative to annual milk proceeds. As such, carbon could be maintained as a liquid asset on the balance sheet and sold as the business required without having a significant impact on the long term financial performance of the business.

N AND P LOSS TO WATER

The forestry scenarios demonstrate a 760 kg or 5.8 percent reduction in total N loss achieved by less livestock (-10.4 percent), lower total production (-6.9 percent), and reduced N fertiliser use (-9.3 percent). N surplus and N leaching loss on a per pastoral hectare basis actually increased (11 percent) as the remaining land is farmed more intensively reflected by the stocking rate, pasture eaten and milk production per hectare increasing. Milk produced per unit of N leached remain static even though per cow performance improved due to higher fertiliser N use per hectare. Although the farm is not required to lower N loss, the forestry scenarios demonstrate a system that can generate similar wealth and lower overall N leaching losses to the receiving environment.

OVERSEER is unable to provide an accurate estimation of reduced P loss to water, although the magnitude and direction of changes in P loss can be considered indicative of what would actually be expected. Reported P loss decreases by 0.5 kg, primarily from reduced P fertiliser use (from the reduction in grazeable area) and exclude any reductions associated with improving land stability and providing contaminant buffers. The farm's gully sidelings and base contribute to P loss from sediment loss via overland flow. The retirement of a large number of the property's gullies would help reduce high fluxes of P loss during heavy rainfall events by providing stable land cover, the removal of livestock (tracking causing bare soil), reduced nutrient application and the provision of permanent buffer strips at the base of gullies to slow water and filter sediment. The ecosystem improvements provided by these changes are not costed in the analysis but would provide meaningful benefits to Kaituna River and the Maketu estuary by reducing contaminant load.

Table 16: Summary of water contaminant losses compared to the base system.

Nitrogen and phosphorus*	Base system	Forestry Scenarios
Total Farm N Loss (kg N)	13,115	12,355
N loss attributed to pastoral area (kg N)	12,539	11,669
N Loss/ha (kg N/ha)*	54	60
N surplus (kg N/ha)*	162	178
Kg MS/kg N leached*	11.56	11.57
Total Farm P Loss (kgP)	1,483	1,192
P Loss/ha (kgP/ha)	3.5	3

** Calculated against the effective pastoral area.*

*** Environmental indicators are reported from OVERSEER FM v6.3.5.*

BIOLOGICAL GHG PROFILE

Biological greenhouse gas emissions at a whole property level, modelled in OVERSEER, reduced by 0.4 t CO_2 eq./ha/yr (refer to Table 17), mostly from lower methane emissions (less feed intake), but also less nitrous oxide emissions (less N fertiliser use). The GHG emissions efficiency, measured by kg CO_2 equivalent per kilogram of milksolid produced remained unchanged. Improvements made in lowering Methane emissions from improved animal performance were offset by higher N fertiliser use relative to total milk production. Total annual biological emissions reduced to 1,664 t CO_2 eq/yr, down 161 t CO_2 eq/yr (9.7 percent) compared to the base system reducing exposure to a potential future liability from biological emissions not able to be offset by sequestered carbon. Assuming these emissions were similarly price to carbon NZUs, this would save the business $4,029 per annum at a $25/t CO_2e price point.

Table 17: Summary of emissions and net carbon footprint for the scenarios compared to the base system.

Greenhouse gases*	Base system	Forestry Scenarios
Total biological GHG (t CO2 eq./ha/yr)	4.3	3.9
Methane (t CO2 eq./ha/yr)	3.3	3.0
Nitrous oxide (t CO2 eq./ha/yr)	1.0	0.9
GHG emissions efficiency (kg CO2 eq./kg MS)	12.6	12.6

** Environmental indicators are reported from OVERSEER FM v6.3.5 and reported against the total farm area.*

*** Averaged across forests lifecycle.*

Figure 7 and Figure 8 provide the net accumulated emissions and safe carbon claim for the three forestry scenarios (two rotations or 56 years) compared to the base system. The graphs demonstrate the impact the carbon claim would have on total emissions if these were not sold and used as a direct emission offset for residual emissions, if allowed. As the native areas in scenario 3 do not qualify due to their size, the safe tradable emissions, excluding emissions surrendered for the 1BT grant, occur between years 8-17. Scenario 1 provides the most safe carbon claims (NZU) at 9,106, followed by scenario 2 at 9,092, with scenario 3 having 8,768. Scenario 3 demonstrated a lower profile as the 1.3 hectares was planted in unqualified native.

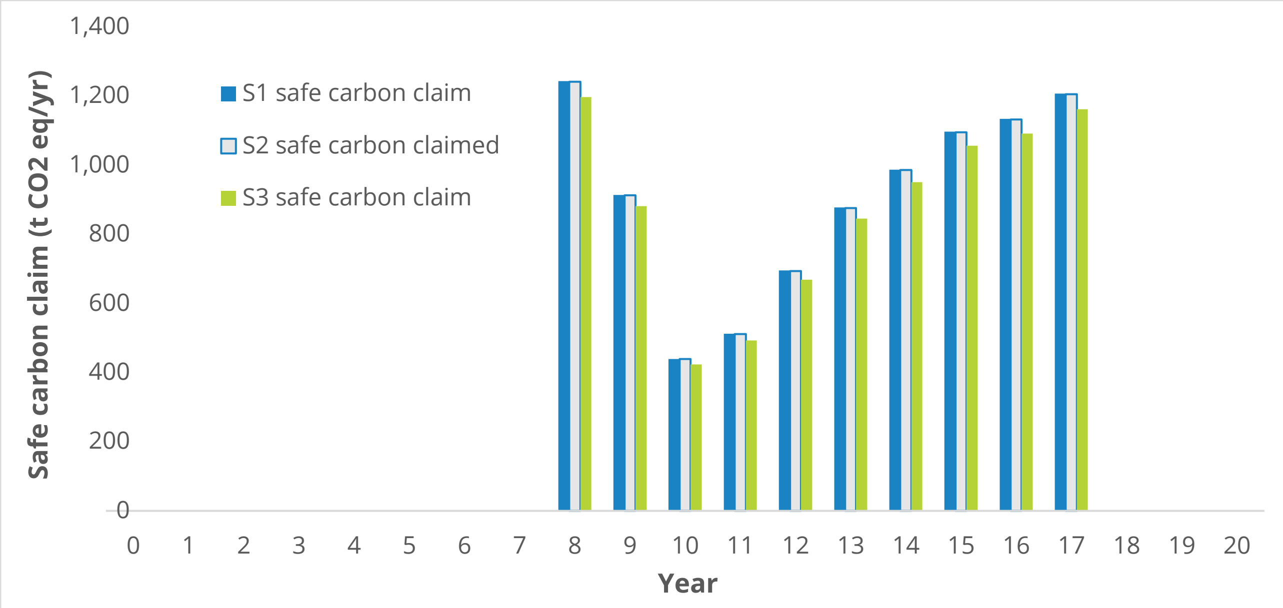

Figure 7: Comparison of the safe carbon claim for tested scenarios.

The safe carbon claims provide a short-term offset which have a reasonable impact on total emissions for the period analysed. The safe carbon claim represents approximately 5.5 years of total farm emissions. Further reductions are achieved by lowering livestock numbers which provides a modest permanent reduction (-161 t /t CO_2e/yr). For the first rotation this equates to 4,508 t CO_2 eq (28 years x 161 t /t CO_2e/yr), half the safe carbon claim of the forestry scenario, but it represents a permanent reduction. By year 17, the forestry scenarios reduce total accumulated emission, assuming a carbon offset from the safe carbon claim, by 37% which gradually levels out to a permanent reduction of 18% by year 51. This provides meaningful long-term reductions and puts the business in a strong position to meet potential requirements to manage its GHG emissions and reduce any potential liability that may occur.

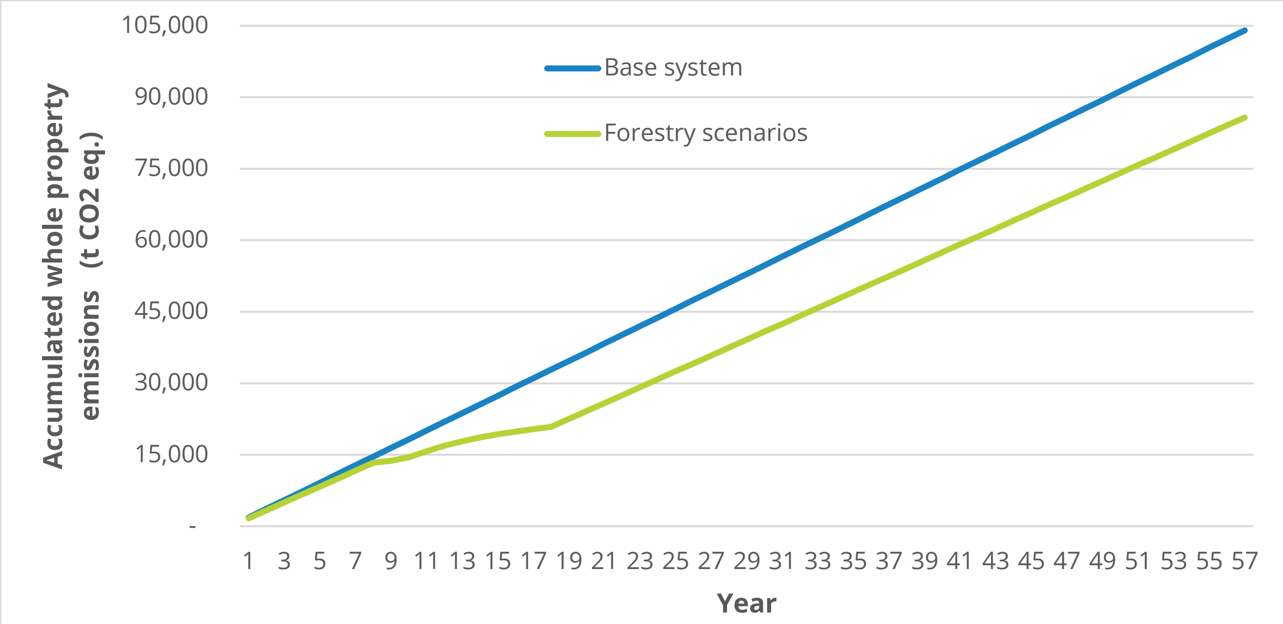

Figure 8. Accumulated whole property emissions (sequestered carbon plus residual biological emissions) compared to the base system.

Key summary points for case study farm

- The improvement in per hectare productivity for the livestock enterprise after removing the most marginal land did not result in an improved IRR as the business lost economies of scale. 'Sticky costs' present challenges for small operations such as MW & FK Linton as the business still requires a certain operating structure regardless of minor changes in livestock numbers. Progressively retiring smaller parcels of land, starting with the least productive, offers the ability to lessen the impact on liquidity and allow the farm system to gradually adjust overtime. Staggering plantings would also provide the flexibility to utilise the sale of safe tradable carbon to fund planting, pruning and thinning requirements.

- Options to manage forest edges to minimise damage to fences, improve aesthetics, or enhance biodiversity had a minor impact on profitability. This provides the landowner with flexibility to select the most appropriate option that best meets their preference while achieving similar financial outcomes.

- Modelling showed the existing farming operation is more profitable than any of the integrated forestry scenarios considered with an NPV of $3,559,617 after 56 years (2 rotations), $102,070 to $116,949 higher, even after the sale of safe tradable carbon. There was little difference in the net equity generated after the first rotation (0.0-0.4 percent) but the timing of returns in the investment cycle lowered the NPV and IRR. Cashflow implications are important for the business as it considers multiple land use options (kiwifruit and forestry) to enhance financial and environmental performance. The forest areas evaluated are proportionately large and it would be beneficial for the Linton's to plant smaller parcels of the worst areas first that will provide the largest improvements. This will also reduce impact to cash flow due to the area converted and revenue from carbon and logs being more evenly spread.

- Assuming the case study farm operated with the average amount of debt for dairy farms in the Bay of Plenty region of $24.51/kg MS, neither the base scenario nor any of the forestry scenarios were able to cash flow minimum debt repayment requirements per annum. This highlights the limitations an overleveraged balance sheet has for all land use enterprises, and dairy farms with industry average levels of term debt (or more) may struggle to take advantage of the opportunity from existing business cash flow. Tree planting grants similar to those assumed to be provided by the One Billion Trees Fund and the Bay of Plenty Regional Council alleviate these cash flow constraints providing farmers with the option to integrate trees on farm.

- It is important to understand current performance to plan how the business best positions itself to meet present and future environmental challenges. The integrated forestry scenarios total property N loss reduced by 5.8 percent, P loss by 19.6 percent, and bGHG emissions by 9.7 percent. Contaminant loss on a per hectare basis increase slightly as the better quality land is farmed more productively. These results align with the Linton's objective to increase the productivity of the better quality land while lowering their environmental footprint.

- Good harvesting outcomes for landowners are driven by the wood harvesting agreement, selection of experienced and professional forestry consultants or contractors, and ensuring contractors have the right equipment suitable for the land being harvested. The entire process of engaging a forestry consultant, company or contractor, completing a pre-harvest assessment and harvest plan and upgrading roading infrastructure can take several months or even years. It is therefore important that this process is started early to ensure the landowner can harvest their woodlot when they want and at a time when market conditions are favorable.

- Tree planting is expensive and is often a once in a generation decision with the quality of decisions made having a dramatic impact on the outcomes achieved. With the long term nature of tree planting, planning is crucial. Key considerations include cash flow, cost of capital over time, and how these align with the owner's objectives both in the long-term and at various stages of the investment life cycle. The planning and analysis provided in this case study demonstrates the integration of the right tree in the right place to achieve the owner's objectives of: optimising land use while meeting environmental obligations, improving animal welfare through the provisional of shade and shelter and retirement of marginal land, enhancing biodiversity, providing income diversification, and improving the long-term value of the business.

References

Beets, P.N., Kimberley, M.O., Garrett, L.G., Paul, T.S.H., & Matson, A.L. (2019). Soil productivity drivers in New Zealand planted forests. *Forest Ecology and Management*, 449, 117480.

Brown, I. (2006, August). Blackwood – an overview. *New Zealand Tree Grower.* https://www.nzffa.org.nz/farm-forestry-model/resource-centre/tree-grower-articles/august-2006/blackwood-an-overview/

DairyNZ. (n.d.). Trees on farms: trees for shelter. https://www.dairynz.co.nz/environment/land-management/trees-on-farms/

DairyNZ. (2016). Whole Farm Assessment Guide and Questionnaire. Available from DairyNZ

DairyNZ. (n.d). Riparian Planner. https://www.dairynz.co.nz/environment/waterways/riparian-planner/

Dooley, L., Parker, L., & Durie, R. (2020). Farmer Interviews on Practice, Perceptions and Knowledge of Trees on Farm, Report provided to Te Uru Rakau.

Environment Bay of Plenty. (2003). Uses and management of Tagasaste (Chamaecytisus palmensis). https://www.boprc.govt.nz/media/29167/LandManagement-090526-Factsheet19.pdf

Gillingham A. G. (1973). Influence of physical factors on pasture growth on hill country. *Proceedings of the New Zealand Grassland Association,* 35, 77-85.

FARMAX. (n.d.). Farmax pastoral decision support tool. http://www.farmax.co.nz

Farmers Weekly (2016). Back to grazing basics. www.farmersweely.co.nz/topic/feed/view/feed-demand-limits-gass-harvest

Jackson, R. (2006). Blackwood – the Westland experience. *New Zealand Tree Grower August 2006.*

Ministry for Primary Industries (2017, July) A guide to Carbon Look-up Tables for forestry in the Emissions Trading Scheme. https://www.mpi.govt.nz/dmsdocument/31695/send

Morton, J., & Roberts, A. (1999). Fertiliser use on New Zealand sheep and beef farms. Wellington, *New Zealand Fertiliser Manufacturers' Association*, 40.

NZFFA. (2005a). Choosing land for planting for profit. *NZFFA Information leaflet No. 1.* https://www.nzffa.org.nz/

NZFFA. (2005b). Australian blackwood (*Acacia melanoxylon*). *NZFFA Information leaflet No. 20*. https://www.nzffa.org.nz/farm-forestry-model/resource-centre/information-leaflets/farm-forestry-association-leaflet-series/no-20-australian-blackwood/

NZFFA. (2015). Choosing a consultant. *NZFFA Information Leaflet No. 16*. Retrieved from https://www.nzffa.org.nz/farm-forestry-model/resource-centre/information-leaflets/farm-forestry-association-leaflet-series/choosing-a-consultant/

OVERSEER. (2019). OverseerFM User Guide. http://www.docs.overseer.org.nz/fm/OverseerUserGuide.pdf

Palmer, D. J., Watt, M. S., Kimberley, M. O., Hock, B. K., Payn, T. W., & Lowe, D. J. (2010) Mapping and explaining the productivity of Pinus radiata in New Zealand. *NZ Journal of Forestry* 55 (1), 15-21.

Radcliffe, J. E. (1982). Effects of aspect and topography on pasture production in hill country. *New Zealand Journal of Agricultural Research* 25:4, 485-496.

Satchell, D. (2018). *Trees for steep slopes.* https://www.nzffa.org.nz/farm-forestry-model/why-farm-forestry/trees-for-erosion-controlsoil-conservation/report-trees-for-steep-slopes/

Visser, R. (2016). Timber harvesting in New Zealand: A guide for small scale forest landowners. Retrieved from https://www.nzffa.org.nz/article-archive/timber-harvesting-in-new-zealand- a-guide-for-small-scale-forest-landowners/

West, G. G., Moore, J. R., Shula, R. G., Harrington, J. J., Snook, J., Gordon, J. A., & Riordan, M. P. (2013) Forest management DSS development in New Zealand. In Tucek, J., Smercek, R., Majilingova, A. & Garcia-Gonzalo, J. (Eds) Implementation of DSS Tools into the Forestry Practice, 153-163.

Woodbank. (n.d.). *Harvesting and marketing*. Retrieved from http://www.woodbank.co.nz/harvesting-marketing/

Appendices

APPENDIX 1: IMPACT OF ASPECT, SLOPE AND FERTILITY ON PASTURE PRODUCTION

IMPACT OF ASPECT, SLOPE AND FERTILITY ON DRY MATTER PRODUCTION AND FEED QUALITY

To ascertain the impact of retiring pastoral area to forestry, an understanding of the productivity of the land being retired needs to be established. This required developing pasture growth curves for the various land classes retired which could later be used to model the accompanying dairy system changes. The land classes retired include steep silages and flat gully bottoms. Evaluating the productivity of each land class required evaluating differences in soil fertility, pasture species, slope, aspect, and management.

To evaluate the impact of slope, aspect and fertility on pasture production and feed quality, assumptions were formed using principals drawn from journal articles, discussions with the case study farmers, and observations made by the project researchers during the farm visit. The assumptions are subjective but provide a sound approximation for the analysis completed. A brief summary of the key principals captured from the journal articles are provided below, along with the observations from the case study farmer.

- The main factors influencing pasture growth in steep hill country are soil moisture, temperature, soil fertility and grazing management (Radcliffe, 1982).
- Trials conducted throughout the North Island have shown variation in pasture growth and distribution being affected by slope and aspect (Radcliffe, 1982). There are no set figures for their relative difference with climate, soil type, and seasonal factors influencing variation across regions. Single trial sites have shown no impact in a single season to as high as 30 percent difference in dry matter production impacted by slope and aspect.
- North facing slopes are warmer promoting growth rates when soil moisture is not limited whereas south facing slopes contain higher soil moisture through the summer months.
- North facing slopes may contain more low quality native and summer grasses (e.g. Paspalum), and a higher proportion of dead material inversely with the amount of legumes and other grasses (Gillingham, 1973).
- The distribution of pasture species is related to topography, especially as this is affected by animal treading, depletion or enrichment of nutrients through animals, or soil moisture conditions.
- The major factor causing variability in DM production and species composition is the fertility of the soil. On steeper slopes this is further complicated by changes in slope and aspect of the soil surface. On moderately steep hill country, variable pasture utilization and nutrient transfer cause by grazing animals create marked differences within a paddock and land that is steep enough to develop stock tracks cause further variability to pastures and soil (Gillingham, 1973).
- AgResearch's senior scientist Warren King states "as the slope increases, pasture production decreases from 100-400 kg DM/ha/yr per degree of slope" (Farmer Weekly, 2016). The magnitude of change is largely affected by soil fertility, pasture species and management factors.

- The relationship between soil fertility (as measured by Olsen P) and pasture dry matter production has been well established for the three main soil types in NZ (pumice, allophanic and sedimentary) and productivity curves as presented in Morton and Roberts (1999) provide good guidance as to the impact on relative pasture productivity for soils as Olsen P values change.

FARMER AND RESEARCHERS' OBSERVATIONS

- The low productive gullies identified for potential land use change on the Linton property accounts for approximately 26.6 ha, has an average slope of 23 degrees (steep sidelings combined with flat gully bottoms), and is represented by steep gully systems that meander through the property.
- The gullies contain mixed contour with steep sideling's (>25 degrees) leading to a flat base with wet seepage areas. Aspect varies across the gully systems with largely east and west facing slopes on the dairy platform and north and south facing slopes on the support land. The steep sideling's, which represent between 80-90 percent of the gullies systems, contain unimproved pastures (i.e. browntop) and have a high proportion of stock tracking which contributes to bare soil and sheet erosion. The base of the gullies are more productive with nutrients translocated by stock and soil movement. These area are included in the normal grazing rotation but care is needed during wet weather or when soils are saturated to mitigate soil damage.
- The steeper contoured land receives less fertilizer than the higher quality flat to rolling country. Fertiliser is applied by helicopter to these areas, largely in the form of DAP or a high analysis blend.
- Poorer feed quality, relative to the improved flats, and steeper topography makes grazing management a challenge on these areas. Growth rates vary considerably through the gully systems from aspect, slope, topsoil depth, soil fertility, and soil temperature. These factors make pasture management more challenging and contribute to lower livestock performance relating to lower energy intakes.

APPENDIX 2: SUMMARY OF HISTORICAL PHYSICAL, FINANCIAL AND ENVIRONMENTAL PERFORMANCE

PHYSICAL PERFORMANCE

Farm performance and the systems operated have undergone change as the business lower cow numbers and converted land to a kiwifruit orchard.

Table 18: Summary of MW & FK Linton physical performance indicators for the period 2017/18 to 2019/20.

Physical indicators	2017/18	2018/19	2019/20
Peak cows milked	430	440	440
Stocking rate (c/ha)	2.50	2.56	2.56
Comparative stocking rate (kg LWT/t DM)	82	86	87
Total production (kg MS)	135,949	136,812	147,766
Production per hectare (kg MS/ha)	790	795	859
Production per cow (kg MS/c)	316	311	336
Production as a percentage of live weight	70%	70%	76%
Average kg MS through lactation (kg MS/c/d)	1.4	1.3	1.4
Feed Conversion Efficiency (kg DM/kg MS)	14.7	14.3	13.2
Pasture eaten (t DM/ha)	10.1	9.4	9.7
Imported supplement eaten (t DM/ha)	1.5	2.0	1.7
Nitrogen fertiliser applied (kg N/eff. ha)	156	107	92
6-week in-calf rate	73%	75%	67%
Empty rate	12%	13%	13%

FINANCIAL PERFORMANCE

Table 19: Summary of MW & FK Linton financial performance indicators for the period 2017/18 to 2019/20 compared to the DairyBase Bay of Plenty owner operator benchmark (n = 64 farms).

	2017/2018		2018/19		2019/20	
Financial KPIs	**Farm**	**Benchmark**	**Farm**	**Benchmark**	**Farm**	**Benchmark**
Gross Farm Income ($/ha)	5,715	6,697	5,683	6,578	5,130	7,451
Farm Working Expenses ($/kg MS)	4.99	3.54	5.13	3.5	3.55	3.64
Operating Expenses ($/ha)	4,798	4,688	5,343	4,709	4,619	5,064
Operating Profit ($/ha)	917	2,009	340	1,869	512	2,386
Operating Profit Margin ($/kg MS)	1.16	1.78	0.43	1.63	0.6	2.01
Cash Operating Surplus ($/ha)	1,886		1,627		2,084	
Asset Turnover %	14.6%	11.4%	15.3%	12.0%	15.1%	13.7%
Operating Return on Dairy Assets %	3.1%	3.4%	1.7%	3.4%	2.4%	4.4%

ENVIRONMENTAL PERFORMANCE

Table 20: Summary of MW & FK Linton environmental performance indicators for the period 2018/19 to 2019/20.

Environmental Indicators	2018/19	2019/20
Total N leached (kg N/yr)	12,810	12,206
N leached per hectare (kg N/ha)	30	29
N surplus (kg N/ha/yr)	90	88
N conversion efficiency	23%	23%
kg MS/kg N leached	10.7	12.1
Operating Profit/kg N leached	-$4.22	$7.21
P Loss (kg P/ha/yr)	3.4	3.4
bGHG/eff. ha (t CO2 eq./ha)	4.27	4.25
Green House Gas emissions (kg CO2 /kg MS)	13.2	12.2

** Contaminant loss KPI's are modelled through OVERSEER FM v. 6.3.5.*

APPENDIX 3: KEY MODELLING ASSUMPTIONS

For the MW & FK Linton case study, the following key assumption have been used in the analysis:

FARMING ENTERPRISES

- A status quo milk price and the Fonterra dividend were calculated at $6.24/kg MS and $0.20/share largely reflective of the 5-year rolling average.
- Input expense data and product pricing were sourced from the farms historic accounts and the 2019/20 Farmax farm expense schedule which is updated by Farmax and DairyNZ each year, with the application of these prices reflecting the unique farm system of the case study.
- Adjustments for wages of management were included to account for the owner's time contributions, negating the requirement to include drawings and thus providing comparative data to other dairy businesses.
- Average closing liabilities ($24.51/kg MS) were sourced from the 2017/18 DairyNZ Economic Survey (DairyNZ, 2019), allowing the farm's actual debt position to remain undisclosed. For the case study, with status quo milk production of 145,000 kg MS, total debt is $3.55 million and opening equity is $6.35 million (based on assumed land values).
- Debt servicing applied at a status quo interest rate of 6 percent, the same as the discount rate of 6 percent used to calculate the Present Value (PV) of future cash flows (see below).
- The financial performance of status quo farming system has been described both in terms of operating profit (earnings before interest, tax and rent - EBITR) and cash operating surplus.
- Reported bGHGs comprise methane (CH_4) and nitrous oxide (N_2O) and are expressed as t CO2 equivalent/ha over the entire property area.
- Key Farmax modelling assumptions are detailed in Appendix 3.

FORESTRY ENTERPRISES

- The growth rate of *Pinus radiata* woodlots for timber production was assessed using a forest simulation software; Forecaster (West et al., 2013) version 2.2.1.1553.
- Rates of carbon sequestration from ETS eligible forestry are referenced against the MPI lookup tables (MPI, 2017).
- Only "safe" carbon is considered tradeable. Under changes to the ETS, forestry planted from 2019 is able to sell the average amount of carbon deemed to be sequestered in a woodlot that is perpetually planted, harvested and replanted without incurring a deforestation liability. For *P. radiata*, this is considered to be half the total quantity carbon sequestered in a rotation and in this region is deemed to be reached 16 years after establishment.
- Log prices were for the 12 quarter averages at December 2019 from AgriHQ for a mix of export and domestic log grades.

- Forest industry representative values were used for seedlings and associated royalties, fencing, track upgrades and maintenance and annual costs such as operations management, property maintenance and public liability insurance.
- The forest operations included land preparation, planting, releasing, animal control and thinning.

WHOLE BUSINESS

- We have assumed a requirement to repay loan principal of $40,000 per annum. This amount of debt repayment is still insufficient to amortize the assumed level of debt ($3.55 million for a 145,000 kg MS property) over a 20-year term but reflects the compromised capacity of many dairy farm businesses to both service and repay term debt at medium term milk price expectations (c. $6.24/kg MS).
- A provision for annual capital reinvestment in the farming enterprise, equivalent to the assumed level of annual depreciation in the operating profit calculation, has been made in the discounted cash flow analysis.
- To provide a "like with like" analysis the dairy assets (excluding land) were purchased and sold at the start and end and full conversion costs for forestry being replanted were included at the end of the second rotation (year 56) in the cash flow analysis.
- Annual cash surpluses/deficits were applied to the farm's total closing liabilities after debt repayment ($40,000/year) along with the annual CAPEX provision ($20,000/year), which flowed through to the projections of closing equity.
- Changes in the value of livestock on hand and Fonterra shares flowed through to the equity calculation (effectively offsetting the cash flow implication of these transactions).

APPENDIX 4: FARMAX MODELLING ASSUMPTIONS

PHYSICAL

Normal

- Farmax Dairy is utilised for the physical modelling. If specific assumptions have not been listed below then the standard farm inputs were used.
- The long-term modelling function was used to create a status quo system.
- Pasture type selected for the flat, rolling, and easy hill slope classes was 'North Island' with the standard inputs for sward composition and energy content maintained.

Month	Controlled %			Uncontrolled %			Energy MJME/kgDM		
	Green	Stem	Dead	Green	Stem	Dead	Green	Stem	Dead
Jan	70	10	20	55	20	25	11.3	8.0	6.0
Feb	70	5	25	50	15	35	11.1	8.0	6.0
Mar	75		25	60	10	30	11.0	8.0	6.0
Apr	80		20	70		30	11.3	8.0	6.0
May	85		15	75		25	11.7	8.0	6.0
Jun	90		10	85		15	11.8	8.0	6.0
Jul	95		5	90		10	12.0	8.0	6.0
Aug	95		5	95		5	12.1	8.0	6.0
Sep	95		5	95		5	11.7	8.0	6.0
Oct	90		10	90		10	11.4	8.0	6.0
Nov	80	10	10	75	15	10	11.3	8.0	6.0
Dec	75	15	10	65	25	10	11.3	8.0	6.0

- Pasture type selected for the steep slope class was 'Kikuyu' with the standard inputs for sward composition and energy content maintained. Kikuku input data was considered more consistent of the sward composition and quality attributes of a browntop dominant sward that is challenging to control on a steeper land class.

Month	Controlled %			Uncontrolled %			Energy MJME/kgDM		
	Green	Stem	Dead	Green	Stem	Dead	Green	Stem	Dead
Jan	60	20	20	55	20	25	10.5	9.4	8.2
Feb	60	15	25	50	15	35	10.2	9.3	8.0
Mar	70		30	60	10	30	10.2	6.0	6.5
Apr	75		25	70		30	10.8	6.1	6.7
May	85		15	75		25	11.5	6.3	6.9
Jun	90		10	85		15	11.8	5.7	6.1
Jul	95		5	90		10	12.0	5.8	6.2
Aug	95		5	95		5	12.1	5.6	6.1
Sep	95		5	95		5	12.0	1.3	8.6
Oct	90		10	90		10	11.9	11.0	8.5
Nov	75	15	10	75	15	10	11.4	10.8	8.4
Dec	65	25	10	65	25	10	10.8	9.5	8.4

- Pasture curves were calculated by inputting the physical data, setting cover targets and using the 'Calibrate Pasture' function.
- The property areas were split into 5 pastoral blocks: flat/rolling dairy (127 ha), easy hill dairy (19 ha), steep dairy (27 ha), flat/rolling dry stock (28 ha), and easy hill dry stock (31 ha).
- Pasture silage is harvested from the flat/rolling country at 2.5 t DM/ha net yield. All silage is made into pit silage and store on farm to be later fed out.

- Nitrogen fertiliser applications align with long term annual applications and monthly distributions.
- Utilisation rates for supplement were 75 percent for pasture silage, 90 percent for PKE and 80 percent for swede.

FINANCIAL

- The properties Fonterra shareholding is adjusted in line with modelled milk production. Fonterra shares are valued at $4/share with the balance sheet and annual dividend adjusted for each scenario.
- Milk income and dividend is standardised at $6.24 (7 year average) and $0.20/kg MS, respectively.
- Expenses are based on the 2018/19 actuals with adjustments made to provide a status quo system.
- Labour reduced to 2.5 FTE lowering the total wage expense reducing $14,839 or 10%.
- Animal related expenses (animal health, breeding, shed expenses, electricity, young stock grazing) were adjusted on a per herd rate relative to the base system.
- Repairs and maintenance on plant and equipment is adjusted on a per cow basis reflecting the magnitude of use.
- Feed costs used include: cereal silage $320/t
- DM landed, PKE $280/t DM. PKE and molasses freight costs are assumed at $25/t DM.
- Sticky cost associated with supplement feeding include vehicle, fuel, and R&M. These are estimate at $0.02/kg DM for each category.
- Silage making costs are assumed at $0.14/kg DM as all silage is made into pit silage.
- Actual fertiliser spend for the 2019/20 season were used for the base model. Changes in fertiliser expenditure from the base model are updated in line with the Farmax base model.

APPENDIX 5: GREENHOUSE GAS (GHG) COMMITEMENTS

New Zealand has signed up to international conventions and protocols to reduce GHGs including:

- Reduce emissions to 5 percent below 1990 levels by 2020.
- Reduce emissions to 30 percent below 2005 levels by 2030 (Paris Agreement).
- Reduce emissions to 50 percent below 1990 levels by 2050. This was notified in the New Zealand Gazette in March 2011.
- The Zero Carbon Bill introduced in 2019 requires carbon dioxide (CO_2) and nitrous oxide (N_2O) to reduce to net zero by 2050 and methane (CH_4) to reduce to 10 percent below 2017 by 2030 and 24-47 percent below 2017 by 2050.

Reducing agriculture emission will be essential for achieving these targets as the sector contributes 48 percent of New Zealand's total emissions and 85 percent of the sector's emissions are generated on farm. Other than for biogenic methane and nitrous oxide (through the Zero Carbon Act) and indirectly for fuel and electricity, GHG reduction targets have not yet been set for the sector and agriculture is not yet explicitly in the Emissions Trading Scheme (ETS). However, farmers can expect to be required to make changes to reduce on-farm GHGs and contribute to the above targets being met. The ETS is being updated, including with respect to the settings for forestry, to support the attainment of these reduction targets. Including forestry in farm business enterprises, particularly on land less suited to intensive agriculture, can provide a practical multi-purpose solution to the above challenges.

APPENDIX 6: HISTORIC FINANCIAL PERFORMANCE

	Income Statement $	**16/17** Actual	**17/18** Actual	**18/19** Actual	**19/20** Actual
	GROSS FARM REVENUE (GFR)				
INC	Net Milk Proceeds	841,521	914,785	889,880	823,199
	Corrected Milk Proceeds (milksolids x milk price)				
INC	Net Dairy Livestock Proceeds	126,563	86,031	67,555	55,898
INC	Value of Change in Dairy Livestock	(124,007)	(19,271)	(3,583)	(626)
INC	Other Dairy Revenue	17,171	1,365	23,621	3,959
INC	**DAIRY GROSS FARM REVENUE**	**861,248**	**982,910**	**977,473**	**882,430**
	Operating Espenses				
EXP	***Labour***				
EXP	Wages	142,089	173,195	154,839	21,077
EXP	Labour Adjustment - Unpaid	0			
EXP	Labour Adjustment - Management	45,133	44,253	69,480	46,592
EXP	Total Labour Expenses	187,222	217,448	224,319	67,669
EXP	***Stock Expenses***				
EXP	Animal Health	45,620	48,544	50,970	39,146
EXP	Breeding & Herd Improvement	28,861	26,066	22,738	30,738
EXP	Farm Dairy	4,098	7,442	4,738	677
EXP	Electricity (Farm Dairy, Water Supply)	16,838	17,857	22,412	22,628
EXP	Total Stock Expenses	95,417	99,909	100,858	93,189
EXP	***Feed Expenses***				
EXP	Supplement Expenses				
EXP	Net Made, Purchased, Cropped	95,517	93,733	126,396	137,304
EXP	Feed Inventory Adjustment		(29,120)	14,110	
EXP	Calf Feed	14,771	19,919	16,486	16,477
EXP	Total Supplement Expenses	110,288	84,532	156,992	153,781
EXP	Grazing & Run Off Expenses				
EXP	Young & Dry Stock Grazing				
EXP	Winter Cow Grazing				
EXP	Support Block Lease				
EXP	Owned Support Block Adjustment	48,750	52,000	48,000	50,150
EXP	Total Grazing & Support Block Expenses	48,750	52,000	48,000	50,150
EXP	Total feed expenses	159,038	136,532	204,992	203,931
EXP	***Other Working Expenses***				
EXP	Fertiliser	93,485	104,409	96,755	98,524
EXP	Nitrogen	18,315	13,332		9,981
EXP	Iriigation				
EXP	Regrassing	11,188	16,322	11,730	11,300
EXP	Weed & Pest	6,680	6,465	8,885	2,037
EXP	Vehicles	18,635	39,447	38,002	16,419
EXP	Fuel	8,177	7,879	11,501	7,947
EXP	R & M - Land & Buildings	24,139	33,348	32,959	19,334
EXP	R & M - plant and equipment	14,284	11,785	16,914	20,460
EXP	Freight and General	16,096	11,568	15,011	20,998
EXP	Total Other Working Expenses	210,999	244,555	231,757	207,000
EXP	***Overheads***				
EXP	Administration	19,867	21,469	39,430	21,853
EXP	Insurance	10,391	13,810	12,364	12,569
EXP	ACC	5,080	1,599	7,226	3,315
EXP	Rates	18,696	9,646	11,904	11,901
EXP	Depreciation	44,548	81,058	86,992	172,970
	Total Overheads	98,582	127,582	157,916	222,608
EXP	**TOTAL DAIRY OPERATING EXPENSES**	**751,258**	**826,026**	**919,842**	**794,397**
EXP	Non Dairy Operating Expenses	8,934			
EXP	**Total Operating Expenses**	**760,192**	**826,026**	**919,842**	**794,397**
		5.43			
EXP	**OPERATING PROFIT**				
EXP	**DAIRY OPERATING PROFIT**	**109,990**	**156,884**	**57,631**	**88,033**
EXP	Non-Dairy Operating Profit	(8,934)	(4,949)	(111,709)	
EXP	**TOTAL OPERATING PROFIT**	**101,056**	**151,935**	**(54,078)**	**88,033**
	per hectare	584	878	(313)	509

APPENDIX 7: FULL SCENARIO FARM ENTERPRISE FINANCIAL ANALYSIS

	Income Statement $	Status quo system	Forestry Scenarios
	GROSS FARM REVENUE (GFR)		
INC	Net Milk Proceeds	904,800	842,400
	Corrected Milk Proceeds (milksolids x milk price)		
INC	Fonterra Dividend	29,000	27,000
INC	Net Dairy Livestock Proceeds	55,272	49,619
INC	Other Dairy Revenue	11,529	11,529
INC	**DAIRY GROSS FARM REVENUE**	**1,000,601**	**930,548**
	Operating Espenses		
EXP	***Labour***		
EXP	Wages	154,839	142,000
EXP	Labour Adjustment - Unpaid		
EXP	Labour Adjustment - Management	51,365	51,365
EXP	Total Labour Expenses	206,204	193,365
EXP	***Stock Expenses***		
EXP	Animal Health	39,146	35,142
EXP	Breeding & Herd Improvement	30,738	27,594
EXP	Farm Dairy	677	608
EXP	Electricity (Farm Dairy, Water Supply)	22,628	20,314
EXP	Total Stock Expenses	93,189	83,658
EXP	***Feed Expenses***		
EXP	Supplement Expenses		
EXP	Net Made, Purchased, Cropped	110,400	110,400
EXP	Feed Inventory Adjustment	0	0
EXP	Calf Feed	16,486	14,800
EXP	Total Supplement Expenses	126,886	125,200
EXP	Grazing & Run Off Expenses		
EXP	Young & Dry Stock Grazing		
EXP	Owned Support Block Adjustment	48,000	39,864
EXP	Total Grazing & Support Block Expenses	48,000	39,864
EXP	Total feed expenses	174,886	165,064
EXP	***Other Working Expenses***		
EXP	Fertiliser	96,755	85,864
EXP	Nitrogen		
EXP	Iriigation		
EXP	Regrassing	11,730	11,730
EXP	Weed & Pest	8,885	6,664
EXP	Vehicles	38,725	36,788
EXP	Fuel	9,690	9,206
EXP	R & M - Land & Buildings	32,959	31,311
EXP	R & M - plant and equipment	16,914	16,068
EXP	Freight and General	20,998	19,948
EXP	Total Other Working Expenses	236,656	217,579
EXP	***Overheads***		
EXP	Administration	25,655	25,355
EXP	Insurance	12,364	11,746
EXP	ACC	7,226	6,756
EXP	Rates	11,904	11,904
EXP	Depreciation	70,866	70,866
	Total Overheads	128,015	126,627
EXP	**TOTAL DAIRY OPERATING EXPENSES**	**838,949**	**786,293**
EXP	Non Dairy Operating Expenses		
EXP	**Total Operating Expenses**	**838,949**	**786,293**
		5.79	5.82
EXP	**OPERATING PROFIT**		
EXP	**TOTAL OPERATING PROFIT**	**161,652**	**144,255**
	per hectare	940	992

perrin ag

Capital Statement

Dairy Assets	Price	Base System	Forestry Scenarios	Diff.
Livestock				
MA cows	$ 1,600.00	560,000	499,200	- 60,800
R2 heifers	$ 1,280.00	128,000	116,480	- 11,520
R1 Heifers	$ 750.00	78,750	70,500	- 8,250
Total Livestock		766,750	686,180	- 80,570
Machinery		150,000	150,000	-
Shares	$ 4.00	580,000	540,000	- 40,000
Total Dairy Assets		**1,496,750**	**1,376,180**	**- 120,570**
LIQUIDITY				
Net Cash Income		1,000,601	930,548	- 70,053
Farm Working Expenses		668,718	624,198	- 44,520
Cash Operating Profit		331,883	306,350	- 25,533
+ Net non Dairy Cash Income				
+ Net off-farm income				
- Interest		213,237	206,003	- 7,234
- Tax		13,378	8,255	- 5,124
- Rent				
Discretionary Cash		**105,268**	**92,092**	**- 13,175**
Net Capital Transaction		20,000	20,000	-
Net Debt		40,000	40,000	-
Net Drawings		40,000	40,000	-
Introduced Funds				
Cash Surplus/Deficit		**5,268**	**- 7,908**	**- 13,175**
TOTAL WEALTH				
Opening Dairy Assets		5,803,525	5,682,955	- 120,570
Opening Total Assets		9,904,759	9,784,189	- 120,570
Opening Total Liabilities		3,553,950	3,433,380	- 120,570
Opening Total Equit		**6,350,809**	**6,350,809**	**-**

APPENDIX 8: FORESTRY SCENARIO FULL CASH FLOWS

SCENARIO 1 – NIL FOREST EDGE MANAGEMENT

			Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dates:	30/06/20	30/06/21	30/06/22	30/06/23	30/06/24	30/06/25	30/06/26	30/06/27	30/06/28	30/06/29	30/06/30	30/06/31	30/06/32	30/06/33	30/06/34	30/06/35	30/06/36	30/06/37	30/06/38	30/06/39	30/06/40	30/06/41	30/06/42	30/06/43	30/06/44	30/06/45	30/06/46	30/06/47	30/06/48
Year ending 30 Jun		**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**
Area																														
Stocked area (ha)				36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.2	36.2	36.2	
Clearfell area (ha)																													36.2	
Planted area (ha)			36.6																							-0.4				36.6
Forestry Costs																														
Track/Fence Upgrade																														
Land Preparation	31,994	4,570.6	9,141.0																											9,141.0
Planting	147,219		47,488.6	2,376.7																										47,488.6
Release	43,527		13,602.2	1,360.2																										13,602.2
Animal Control	27,058	2,011.1	2,011.1	2,011.1	2,011.1	1,097.0	1,097.0	1,097.0	1,097.0	365.7	365.7	365.7																		2,011.1
Pruning/Form pruning	173,831						51,556.8		35,358.5																					
Waste thin/Fertiliser	73,130											36,565.1																		
Inventory, Mapping	10,238		365.7			1,645.4																				3,290.9				
Annual Costs																														
Property Maintenance & Protection	61,020		1,097.0	1,097.0	1,097.0	2,193.9	1,097.0	2,193.9	1,097.0	2,193.9	1,097.0	2,193.9	1,097.0	2,193.9	1,097.0	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	724.0	724.0	724.0	1,097.0
Fire, Wind & Public Liability Insurance	59,597		78.7	157.4	236.0	314.7	393.4	472.1	550.8	629.5	708.1	786.8	865.5	944.2	1,022.9	1,101.5	1,180.2	1,258.9	1,337.6	1,416.3	1,494.9	1,573.6	1,652.3	1,731.0	1,809.7	1,888.4	1,947.4	2,025.3	2,103.2	78.7
Forest & Operations Management	31,225	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	543.0	543.0	543.0	548.5
Administration/Acctng/Audit	20,817	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	362.0	362.0	362.0	365.7
Rates	41,684	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3
Notional land rent																														
Total Expenditures (Logs)	**721,339**	8,227	75,430	8,648	4,990	6,896	55,790	5,408	39,749	4,834	3,816	41,557	3,608	4,784	3,765	3,478	3,557	3,636	3,714	3,793	3,872	3,950	4,029	4,108	4,186	7,556	4,308	4,386	4,463	75,064
Revenue																														
Log Revenue	2,504,785																												1,252,393	
Land sale																														
Other - 1BT	54,848		16,454		38,393																									
Tree crop sale	72,243																													
Total Revenue (Logs)	**2,631,876**	0	16,454	0	38,393	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,252,393	0
		19,728																												
NET PRE-TAX LOGS	**1,910,537**	**-8,227**	**-58,975**	**-8,648**	**33,404**	**-6,896**	**-55,790**	**-5,408**	**-39,749**	**-4,834**	**-3,816**	**-41,557**	**-3,608**	**-4,784**	**-3,765**	**-3,478**	**-3,557**	**-3,636**	**-3,714**	**-3,793**	**-3,872**	**-3,950**	**-4,029**	**-4,108**	**-4,186**	**-7,556**	**-4,308**	**-4,386**	**1,247,929**	**-75,064**
Discount rate (WACC) 6%	**6%**	1.00	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56	0.53	0.50	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31	0.29	0.28	0.26	0.25	0.23	0.22	0.21	0.20
Present Value for whole term	**95,911**	-8,227	-55,637	-7,696	28,047	-5,463	-41,689	-3,813	-26,435	-3,033	-2,259	-23,205	-1,901	-2,377	-1,765	-1,538	-1,484	-1,431	-1,379	-1,329	-1,280	-1,232	-1,185	-1,140	-1,096	-1,866	-1,004	-964	258,781	-14,685
PV/ha	**2,623**																													
Internal Rate of Return (IRR)	**7.94%**																													
Annuity	$5,983.64																													
Annuity/ha	163.64																													
Taxation analysis																														
Tax credits on capitalised costs																														
Land prep (dimin. @ 6%p.a.)																														
New tracking (dimin. @ 24%p.a.)																														
Fencing (dimin. @ 12%p.a.)																														
Tax credits on forestry/annual costs	**201,975**	2,304	21,120	2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	1,010	1,339	1,054	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,116	1,206	1,228	1,250	21,018
Tax liabilities	**721,568**																												350,670	
Total tax credit/liability	**-519,593**	2,304	21,120	2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	1,010	1,339	1,054	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,116	1,206	1,228	-349,420	21,018
NET POST-TAX LOGS	**1,390,944**	**-5,924**	**-37,855**	**-6,226**	**34,801**	**-4,965**	**-40,168**	**-3,894**	**-28,619**	**-3,481**	**-2,748**	**-29,921**	**-2,598**	**-3,444**	**-2,711**	**-2,504**	**-2,561**	**-2,618**	**-2,674**	**-2,731**	**-2,788**	**-2,844**	**-2,901**	**-2,958**	**-3,014**	**-5,440**	**-3,102**	**-3,158**	**898,509**	**-54,046**
CARBON																														
Safe Carbon Claims (NZU)	9,106									1,243	914	439	512	695	878	987	1,097	1,134	1,207											
Expenditures																														
Registration	3,566								3,566																					
Inventory	1,677								573				552					552												
ETS administration	12,036								573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	
Revenue																														
NZU Price ($/unit)			25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
NZU revenue ($)	227,650										31,075	22,850	10,975	12,800	17,375	21,950	24,675	27,425	28,350	30,175										
NZU purchase cost ($)																														
NET PRE-TAX CARBON	**210,371**	0	0	0	0	0	0	0	-4,712	-573	30,502	22,277	9,850	12,227	16,802	21,377	24,102	26,300	27,777	29,602	-573	-573	-573	-573	-573	-573	-573	-573	-573	0
Total Expenditures (Logs+Carbon)	738,618	8,227	75,430	8,648	4,990	6,896	55,790	5,408	44,460	5,408	4,389	42,130	4,733	5,357	4,338	4,051	4,130	4,761	4,287	4,366	4,445	4,523	4,602	4,681	4,760	8,129	4,881	4,959	5,037	75,064
Total Revenue (Logs+Carbon)	2,859,526		16,454		38,393						31,075	22,850	10,975	12,800	17,375	21,950	24,675	27,425	28,350	30,175									1,252,393	
NET PRE-TAX (LOGS & CARBON)	**2,120,908**	-8,227	-58,975	-8,648	33,404	-6,896	-55,790	-5,408	-44,460	-5,408	26,686	-19,280	6,242	7,443	13,037	17,899	20,545	22,664	24,063	25,809	-4,445	-4,523	-4,602	-4,681	-4,760	-8,129	-4,881	-4,959	1,247,356	-75,064
Discount rate (WACC) 6%	**6%**	1.00	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56	0.53	0.50	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31	0.29	0.28	0.26	0.25	0.23	0.22	0.21	0.20
Present Value for whole term	**191,238**	-8,227	-55,637	-7,696	28,047	-5,463	-41,689	-3,813	-29,569	-3,393	15,795	-10,766	3,288	3,699	6,112	7,917	8,573	8,922	8,936	9,042	-1,469	-1,410	-1,354	-1,299	-1,246	-2,008	-1,137	-1,090	258,662	-14,685
PV/ha	**5,230**																													
Internal Rate of Return (IRR)	**10.40%**																													
Annuity	$11,930.92																													
Annuity/ha	326.29																													
Taxation analysis																														
Tax credits on forestry/annual costs	206,813	2,304	21,120	2,421	1,397	1,931	15,621	1,514	12,449	1,514	1,229	11,796	1,325	1,500	1,215	1,134	1,156	1,333	1,200	1,223	1,245	1,267	1,289	1,311	1,333	2,276	1,367	1,388	1,410	21,018
Tax liabilities	800,667		4,607		10,750						8,701	6,398	3,073	3,584	4,865	6,146	6,909	7,679	7,938	8,449									350,670	
Total tax credit/liability	-593,854	2,304	16,513	2,421	-9,353	1,931	15,621	1,514	12,449	1,514	-7,472	5,398	-1,748	-2,084	-3,650	-5,012	-5,753	-6,346	-6,738	-7,226	1,245	1,267	1,289	1,311	1,333	2,276	1,367	1,388	-349,260	21,018
NET POST-TAX (LOGS & CARBON)	**1,527,054**	-5,924	-42,462	-6,226	24,051	-4,965	-40,168	-3,894	-32,012	-3,893	19,214	-13,882	4,494	5,359	9,386	12,887	14,792	16,318	17,325	18,582	-3,200	-3,257	-3,314	-3,370	-3,427	-5,853	-3,514	-3,570	898,096	-54,046

28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	0	1
29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56
30/06/49	30/06/50	30/06/51	30/06/52	30/06/53	30/06/54	30/06/55	30/06/56	30/06/57	30/06/58	30/06/59	30/06/60	30/06/61	30/06/62	30/06/63	30/06/64	30/06/65	30/06/66	30/06/67	30/06/68	30/06/69	30/06/70	30/06/71	30/06/72	30/06/73	30/06/74	30/06/75	30/06/76
2049	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**
36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.2	36.2	36.2		36.6
																									36.2		
																						-0.4				36.6	
																										9,141.0	
2,376.7																										47,488.6	
1,360.2																										13,602.2	
2,011.1	2,011.1	1,097.0	1,097.0	1,097.0	1,097.0	365.7	365.7	365.7																		2,011.1	
			51,556.8		35,358.5																						
								36,565.1																			
		1,645.4																				3,290.9					
1,097.0	1,097.0	2,193.9	1,097.0	2,193.9	1,097.0	2,193.9	1,097.0	2,193.9	731.3	1,828.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	724.0	724.0	724.0	1,097.0	1,097.0
157.4	236.0	314.7	393.4	472.1	550.8	629.5	708.1	786.8	865.5	944.2	1,022.9	1,101.5	1,180.2	1,258.9	1,337.6	1,416.3	1,494.9	1,573.6	1,652.3	1,731.0	1,809.7	1,888.4	1,947.4	2,025.3	2,103.2	78.7	157.4
548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	548.5	543.0	543.0	543.0	543.0	548.5	548.5
365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	365.7	362.0	362.0	362.0	362.0	365.7	365.7
731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3
8,648	4,990	6,896	55,790	5,408	39,749	4,834	3,816	41,557	3,242	4,418	3,400	3,478	3,557	3,636	3,714	3,793	3,872	3,950	4,029	4,108	4,186	7,547	4,308	4,386	4,463	75,064	2,900
																									1,252,393		
																											72,243
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,252,393	0	72,243
-8,648	**-4,990**	**-6,896**	**-55,790**	**-5,408**	**-39,749**	**-4,834**	**-3,816**	**-41,557**	**-3,242**	**-4,418**	**-3,400**	**-3,478**	**-3,557**	**-3,636**	**-3,714**	**-3,793**	**-3,872**	**-3,950**	**-4,029**	**-4,108**	**-4,186**	**-7,547**	**-4,308**	**-4,386**	**1,247,929**	**-75,064**	**69,343**
0.18	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04
-1,596	-869	-1,133	-8,645	-791	-5,482	-629	-468	-4,812	-354	-455	-331	-319	-308	-297	-286	-276	-265	-255	-246	-236	-227	-387	-208	-200	53,663	-3,045	2,654
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	1,250	21,018	812
																									350,670		20,228
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	-349,420	21,018	-19,416
-6,226	**-3,592**	**-4,965**	**-40,168**	**-3,894**	**-28,619**	**-3,481**	**-2,748**	**-29,921**	**-2,334**	**-3,181**	**-2,448**	**-2,504**	**-2,561**	**-2,618**	**-2,674**	**-2,731**	**-2,788**	**-2,844**	**-2,901**	**-2,958**	**-3,014**	**-5,434**	**-3,102**	**-3,158**	**898,509**	**-54,046**	**49,927**
25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8,648	4,990	6,896	55,790	5,408	39,749	4,834	3,816	41,557	3,242	4,418	3,400	3,478	3,557	3,636	3,714	3,793	3,872	3,950	4,029	4,108	4,186	7,547	4,308	4,386	4,463	75,064	2,900
																									1,252,393		72,243
-8,648	-4,990	-6,896	-55,790	-5,408	-39,749	-4,834	-3,816	-41,557	-3,242	-4,418	-3,400	-3,478	-3,557	-3,636	-3,714	-3,793	-3,872	-3,950	-4,029	-4,108	-4,186	-7,547	-4,308	-4,386	1,247,929	-75,064	69,343
0.18	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04
-1,596	-869	-1,133	-8,645	-791	-5,482	-629	-468	-4,812	-354	-455	-331	-319	-308	-297	-286	-276	-265	-255	-246	-236	-227	-387	-208	-200	53,663	-3,045	2,654
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	1,250	21,018	812
																									350,670		20,228
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	-349,420	21,018	-19,416
-6,226	-3,592	-4,965	-40,168	-3,894	-28,619	-3,481	-2,748	-29,921	-2,334	-3,181	-2,448	-2,504	-2,561	-2,618	-2,674	-2,731	-2,788	-2,844	-2,901	-2,958	-3,014	-5,434	-3,102	-3,158	898,509	-54,046	49,927

SCENARIO 2 – MANAGED FOREST EDGES

			Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dates:	30/06/20	30/06/21	30/06/22	30/06/23	30/06/24	30/06/25	30/06/26	30/06/27	30/06/28	30/06/29	30/06/30	30/06/31	30/06/32	30/06/33	30/06/34	30/06/35	30/06/36	30/06/37	30/06/38	30/06/39	30/06/40	30/06/41	30/06/42	30/06/43	30/06/44	30/06/45	30/06/46	30/06/47	30/06/48
Year ending 30 Jun		**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**
Area																														
Stocked area (ha)				36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.2	36.2	36.2	
Clearfell area (ha)																													36.2	
Planted area (ha)			36.6																							-0.4				36.6
Forestry Costs																														
Track/Fence Upgrade																														
Land Preparation	35,500	8,116.3	9,128.0																											9,128.0
Planting	146,997		47,417.0	2,373.2																										47,417.0
Release	56,557		17,674.2	1,767.4																										17,674.2
Animal Control	27,017	2,008.1	2,008.1	2,008.1	2,008.1	1,095.3	1,095.3	1,095.3	1,095.3	365.1	365.1	365.1																		2,008.1
Pruning/Form pruning	179,253						54,321.1		35,305.2																					
Waste thin/Fertiliser	75,862											37,931.0																		
Inventory, Mapping	10,223		365.1			1,643.0																				3,285.9				
Annual Costs																														
Property Maintenance & Protection	60,928		1,095.3	1,095.3	1,095.3	2,190.6	1,095.3	2,190.6	1,095.3	2,190.6	1,095.3	2,190.6	1,095.3	2,190.6	1,095.3	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	722.9	722.9	722.9	1,095.3
Fire, Wind & Public Liability Insurance	59,597		78.7	157.4	236.0	314.7	393.4	472.1	550.8	629.5	708.1	786.8	865.5	944.2	1,022.9	1,101.5	1,180.2	1,258.9	1,337.6	1,416.3	1,494.9	1,573.6	1,652.3	1,731.0	1,809.7	1,888.4	1,947.4	2,025.3	2,103.2	78.7
Forest & Operations Management	31,178	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	542.2	542.2	542.2	547.7
Administration/Acctng/Audit	20,785	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	361.4	361.4	361.4	365.1
Rates	41,684	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3
Notional land rent																														
Total Expenditures (Logs)	**745,581**	11,768	79,410	9,045	4,983	6,888	58,549	5,402	39,691	4,829	3,813	42,918	3,605	4,779	3,762	3,476	3,554	3,633	3,712	3,791	3,869	3,948	4,027	4,105	4,184	7,549	4,305	4,383	4,461	79,045
Revenue																														
Log Revenue	2,507,893																												1,253,946	
Land sale																														
Other - 1BT	54,765		16,430		38,336																									
Tree crop sale	76,227																													
Total Revenue (Logs)	**2,638,885**	0	16,430	0	38,336	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,253,946	0
		20,366																												
NET PRE-TAX LOGS	**1,893,304**	**-11,768**	**-62,981**	**-9,045**	**33,352**	**-6,888**	**-58,549**	**-5,402**	**-39,691**	**-4,829**	**-3,813**	**-42,918**	**-3,605**	**-4,779**	**-3,762**	**-3,476**	**-3,554**	**-3,633**	**-3,712**	**-3,791**	**-3,869**	**-3,948**	**-4,027**	**-4,105**	**-4,184**	**-7,549**	**-4,305**	**-4,383**	**1,249,485**	**-79,045**
Discount rate (WACC) 6%	**6%**	1.00	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56	0.53	0.50	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31	0.29	0.28	0.26	0.25	0.23	0.22	0.21	0.20
Present Value for whole term	**84,403**	-11,768	-59,416	-8,050	28,003	-5,456	-43,751	-3,808	-26,397	-3,030	-2,257	-23,965	-1,899	-2,375	-1,764	-1,537	-1,483	-1,430	-1,378	-1,328	-1,279	-1,231	-1,184	-1,139	-1,095	-1,864	-1,003	-963	259,103	-15,464
PV/ha	**2,305**																													
Internal Rate of Return (IRR)	**7.64%**																													
Annuity	$5,265.69																													
Annuity/ha	143.83																													
Taxation analysis																														
Tax credits on capitalised costs																														
Land prep (dimin. @ 6%p.a.)																														
New tracking (dimin. @ 24%p.a.)																														
Fencing (dimin. @ 12%p.a.)																														
Tax credits on forestry/annual costs	**201,975**	2,304	21,120	2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	1,010	1,339	1,054	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,116	1,206	1,228	1,250	21,018
Tax liabilities	**721,568**																												350,670	
Total tax credit/liability	**-519,593**	2,304	21,120	2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	1,010	1,339	1,054	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,116	1,206	1,228	-349,420	21,018
NET POST-TAX LOGS	**1,390,944**	**-5,924**	**-37,855**	**-6,226**	**34,801**	**-4,965**	**-40,168**	**-3,894**	**-28,619**	**-3,481**	**-2,748**	**-29,921**	**-2,598**	**-3,444**	**-2,711**	**-2,504**	**-2,561**	**-2,618**	**-2,674**	**-2,731**	**-2,788**	**-2,844**	**-2,901**	**-2,958**	**-3,014**	**-5,440**	**-3,102**	**-3,158**	**898,509**	**-54,046**
CARBON																														
Safe Carbon Claims (NZU)	9,092									1,241	913	439	511	694	876	986	1,095	1,132	1,205											
Expenditures																														
Registration	3,566								3,566																					
Inventory	1,677								573				552					552												
ETS administration	12,036								573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	
Revenue																														
NZU Price ($/unit)			25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
NZU revenue ($)	227,300										31,025	22,825	10,975	12,775	17,350	21,900	24,650	27,375	28,300	30,125										
NZU purchase cost ($)																														
NET PRE-TAX CARBON	**210,021**	0	0	0	0	0	0	0	-4,712	-573	30,452	22,252	9,850	12,202	16,777	21,327	24,077	26,250	27,727	29,552	-573	-573	-573	-573	-573	-573	-573	-573	-573	0
Total Expenditures (Logs+Carbon)	762,860	11,768	79,410	9,045	4,983	6,888	58,549	5,402	44,403	5,402	4,386	43,491	4,730	5,352	4,335	4,049	4,128	4,758	4,285	4,364	4,442	4,521	4,600	4,678	4,757	8,122	4,878	4,956	5,034	79,045
Total Revenue (Logs+Carbon)	2,866,185		16,430		38,336						31,025	22,825	10,975	12,775	17,350	21,900	24,650	27,375	28,300	30,125									1,253,946	
NET PRE-TAX (LOGS & CARBON)	**2,103,325**	-11,768	-62,981	-9,045	33,352	-6,888	-58,549	-5,402	-44,403	-5,402	26,639	-20,666	6,245	7,423	13,015	17,851	20,522	22,617	24,015	25,761	-4,442	-4,521	-4,600	-4,678	-4,757	-8,122	-4,878	-4,956	1,248,912	-79,045
Discount rate (WACC) 6%	**6%**	1.00	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56	0.53	0.50	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31	0.29	0.28	0.26	0.25	0.23	0.22	0.21	0.20
Present Value for whole term	**179,575**	-11,768	-59,416	-8,050	28,003	-5,456	-43,751	-3,808	-29,530	-3,389	15,768	-11,540	3,290	3,689	6,102	7,896	8,563	8,903	8,918	9,025	-1,468	-1,410	-1,353	-1,298	-1,245	-2,006	-1,137	-1,089	258,984	-15,464
PV/ha	**4,905**																													
Internal Rate of Return (IRR)	**9.94%**																													
Annuity	$11,203.23																													
Annuity/ha	306.02																													
Taxation analysis																														
Tax credits on forestry/annual costs	213,601	3,295	22,235	2,533	1,395	1,929	16,394	1,513	12,433	1,513	1,228	12,177	1,324	1,499	1,214	1,134	1,156	1,332	1,200	1,222	1,244	1,266	1,288	1,310	1,332	2,274	1,366	1,388	1,410	22,133
Tax liabilities	802,532		4,600		10,734						8,687	6,391	3,073	3,577	4,858	6,132	6,902	7,665	7,924	8,435									351,105	
Total tax credit/liability	-588,931	3,295	17,635	2,533	-9,339	1,929	16,394	1,513	12,433	1,513	-7,459	5,786	-1,749	-2,078	-3,644	-4,998	-5,746	-6,333	-6,724	-7,213	1,244	1,266	1,288	1,310	1,332	2,274	1,366	1,388	-349,695	22,133
NET POST-TAX (LOGS & CARBON)	**1,514,394**	-8,473	-45,346	-6,513	24,013	-4,959	-42,155	-3,889	-31,970	-3,890	19,180	-14,879	4,496	5,345	9,371	12,853	14,776	16,284	17,291	18,548	-3,198	-3,255	-3,312	-3,368	-3,425	-5,848	-3,512	-3,568	899,217	-56,913

28	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**0**	**1**
29	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**
30/06/49	30/06/50	30/06/51	30/06/52	30/06/53	30/06/54	30/06/55	30/06/56	30/06/57	30/06/58	30/06/59	30/06/60	30/06/61	30/06/62	30/06/63	30/06/64	30/06/65	30/06/66	30/06/67	30/06/68	30/06/69	30/06/70	30/06/71	30/06/72	30/06/73	30/06/74	30/06/75	30/06/76
2049	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**
36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.6	36.2	36.2	36.2		36.6
																									36.2		
																						-0.4				36.6	
																										9,128.0	
2,373.2																										47,417.0	
1,767.4																										17,674.2	
2,008.1	2,008.1	1,095.3	1,095.3	1,095.3	1,095.3	365.1	365.1	365.1																		2,008.1	
			54,321.1		35,305.2																						
								37,931.0																			
		1,643.0																				3,285.9					
1,095.3	1,095.3	2,190.6	1,095.3	2,190.6	1,095.3	2,190.6	1,095.3	2,190.6	730.2	1,825.5	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	730.2	722.9	722.9	722.9	1,095.3	1,095.3
157.4	236.0	314.7	393.4	472.1	550.8	629.5	708.1	786.8	865.5	944.2	1,022.9	1,101.5	1,180.2	1,258.9	1,337.6	1,416.3	1,494.9	1,573.6	1,652.3	1,731.0	1,809.7	1,888.4	1,947.4	2,025.3	2,103.2	78.7	157.4
547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	547.7	542.2	542.2	542.2	542.2	547.7	547.7
365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	365.1	361.4	361.4	361.4	361.4	365.1	365.1
731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3
9,045	4,983	6,888	58,549	5,402	39,691	4,829	3,813	42,918	3,240	4,414	3,397	3,476	3,554	3,633	3,712	3,791	3,869	3,948	4,027	4,105	4,184	7,539	4,305	4,383	4,461	79,045	2,897
																									1,253,946		
																											76,227
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,253,946	0	76,227
-9,045	**-4,983**	**-6,888**	**-58,549**	**-5,402**	**-39,691**	**-4,829**	**-3,813**	**-42,918**	**-3,240**	**-4,414**	**-3,397**	**-3,476**	**-3,554**	**-3,633**	**-3,712**	**-3,791**	**-3,869**	**-3,948**	**-4,027**	**-4,105**	**-4,184**	**-7,539**	**-4,305**	**-4,383**	**1,249,485**	**-79,045**	**73,331**
0.18	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04
-1,669	-868	-1,131	-9,073	-790	-5,474	-628	-468	-4,970	-354	-455	-330	-319	-308	-297	-286	-275	-265	-255	-246	-236	-227	-386	-208	-200	53,730	-3,207	2,806
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	1,250	21,018	812
																									350,670		20,228
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	-349,420	21,018	-19,416
-6,226	**-3,592**	**-4,965**	**-40,168**	**-3,894**	**-28,619**	**-3,481**	**-2,748**	**-29,921**	**-2,334**	**-3,181**	**-2,448**	**-2,504**	**-2,561**	**-2,618**	**-2,674**	**-2,731**	**-2,788**	**-2,844**	**-2,901**	**-2,958**	**-3,014**	**-5,434**	**-3,102**	**-3,158**	**898,509**	**-54,046**	**49,927**

SCENARIO 3 – MANAGED EDGES PLUS NATIVE

			Age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
	Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	Dates:	30/06/20	30/06/21	30/06/22	30/06/23	30/06/24	30/06/25	30/06/26	30/06/27	30/06/28	30/06/29	30/06/30	30/06/31	30/06/32	30/06/33	30/06/34	30/06/35	30/06/36	30/06/37	30/06/38	30/06/39	30/06/40	30/06/41	30/06/42	30/06/43	30/06/44	30/06/45	30/06/46	30/06/47	30/06/48
Year ending 30 Jun		**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**	**2041**	**2042**	**2043**	**2044**	**2045**	**2046**	**2047**	**2048**
Area																														
Stocked area (ha)				35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.0	35.0	35.0	
Clearfell area (ha)																													35.0	
Planted area (ha)			35.3																							-0.4				35.3
Forestry Costs																														
Track/Fence Upgrade																														
Land Preparation	34,038	7,628.8	8,803.0																											8,803.0
Planting	141,763		45,728.6	2,288.7																										45,728.6
Release	53,812		16,816.2	1,681.6																										16,816.2
Animal Control	26,055	1,936.6	1,936.6	1,936.6	1,936.6	1,056.3	1,056.3	1,056.3	1,056.3	352.1	352.1	352.1																		1,936.6
Pruning/Form pruning	172,552						52,228.1		34,048.1																					
Waste thin/Fertiliser	73,002											36,501.0																		
Inventory, Mapping	9,859		352.1			1,584.5																				3,168.9				
Annual Costs																														
Property Maintenance & Protection	58,758		1,056.3	1,056.3	1,056.3	2,112.6	1,056.3	2,112.6	1,056.3	2,112.6	1,056.3	2,112.6	1,056.3	2,112.6	1,056.3	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	697.2	697.2	697.2	1,056.3
Fire, Wind & Public Liability Insurance	59,597		78.7	157.4	236.0	314.7	393.4	472.1	550.8	629.5	708.1	786.8	865.5	944.2	1,022.9	1,101.5	1,180.2	1,258.9	1,337.6	1,416.3	1,494.9	1,573.6	1,652.3	1,731.0	1,809.7	1,888.4	1,947.4	2,025.3	2,103.2	78.7
Forest & Operations Management	30,068	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	522.9	522.9	522.9	528.2
Administration/Acctng/Audit	20,045	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	348.6	348.6	348.6	352.1
Rates	41,684	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3
Notional land rent																														
Total Expenditures (Logs)	**705,219**	11,177	76,337	8,667	4,756	6,576	56,223	5,111	38,162	4,525	3,529	41,146	3,296	4,412	3,415	3,122	3,182	3,241	3,301	3,360	3,420	3,480	3,539	3,599	3,658	6,887	3,747	3,805	3,864	75,985
Revenue																														
Log Revenue	2,418,841																												1,209,421	
Land sale																														
Other - 1BT	52,815		15,845		36,971																									
Tree crop sale	73,284																													
Total Revenue (Logs)	**2,544,941**	0	15,845	0	36,971	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,209,421	0
		19,972																												
NET PRE-TAX LOGS	**1,839,721**	-11,177	-60,492	-8,667	32,215	-6,576	-56,223	-5,111	-38,162	-4,525	-3,529	-41,146	-3,296	-4,412	-3,415	-3,122	-3,182	-3,241	-3,301	-3,360	-3,420	-3,480	-3,539	-3,599	-3,658	-6,887	-3,747	-3,805	1,205,556	-75,985
Discount rate (WACC) 6%	**6%**	1.00	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56	0.53	0.50	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31	0.29	0.28	0.26	0.25	0.23	0.22	0.21	0.20
Present Value for whole term	**84,862**	-11,177	-57,068	-7,713	27,048	-5,209	-42,013	-3,603	-25,380	-2,839	-2,089	-22,975	-1,736	-2,192	-1,601	-1,381	-1,328	-1,276	-1,226	-1,177	-1,130	-1,085	-1,041	-999	-958	-1,701	-873	-836	249,994	-14,865
PV/ha	**2,403**																													
Internal Rate of Return (IRR)	**7.72%**																													
Annuity	$5,294.31																													
Annuity/ha	149.94																													
Taxation analysis																														
Tax credits on capitalised costs																														
Land prep (dimin. @ 6%p.a.)																														
New tracking (dimin. @ 24%p.a.)																														
Fencing (dimin. @ 12%p.a.)																														
Tax credits on forestry/annual costs	**201,975**	2,304	21,120	2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	1,010	1,339	1,054	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,116	1,206	1,228	1,250	21,018
Tax liabilities	**721,568**																												350,670	
Total tax credit/liability	- **519,593**	2,304	21,120	2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	1,010	1,339	1,054	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,116	1,206	1,228	-349,420	21,018
NET POST-TAX LOGS	**1,320,128**	-8,873	-39,372	-6,245	33,612	-4,645	-40,602	-3,596	-27,032	-3,172	-2,460	-29,510	-2,286	-3,072	-2,361	-2,148	-2,186	-2,223	-2,261	-2,298	-2,336	-2,373	-2,411	-2,448	-2,486	-4,771	-2,540	-2,578	856,136	-54,967
CARBON																														
Safe Carbon Claims (NZU)	**8,768**									1,197	881	423	493	669	845	951	1,056	1,091	1,162											
Expenditures																														
Registration	**3,566**								3,566																					
Inventory	**1,677**								573				552					552												
ETS administration	**12,036**								573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	573	
Revenue																														
NZU Price ($/unit)			25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
NZU revenue ($)	**219,200**										29,925	22,025	10,575	12,325	16,725	21,125	23,775	26,400	27,275	29,050										
NZU purchase cost ($)																														
NET PRE-TAX CARBON	**201,921**	0	0	0	0	0	0	0	-4,712	-573	29,352	21,452	9,450	11,752	16,152	20,552	23,202	25,275	26,702	28,477	-573	-573	-573	-573	-573	-573	-573	-573	-573	0
Total Expenditures (Logs+Carbon)	**722,498**	11,177	76,337	8,667	4,756	6,576	56,223	5,111	42,874	5,099	4,102	41,719	4,421	4,985	3,988	3,695	3,755	4,366	3,874	3,934	3,993	4,053	4,112	4,172	4,231	7,460	4,320	4,379	4,438	75,985
Total Revenue (Logs+Carbon)	**2,764,141**		15,845		36,971						29,925	22,025	10,575	12,325	16,725	21,125	23,775	26,400	27,275	29,050									1,209,421	
NET PRE-TAX (LOGS & CARBON)	**2,041,643**	-11,177	-60,492	-8,667	32,215	-6,576	-56,223	-5,111	-42,874	-5,099	25,823	-19,694	6,154	7,340	12,737	17,430	20,020	22,034	23,401	25,116	-3,993	-4,053	-4,112	-4,172	-4,231	-7,460	-4,320	-4,379	1,204,983	-75,985
Discount rate (WACC) 6%	**6%**	1.00	0.94	0.89	0.84	0.79	0.75	0.70	0.67	0.63	0.59	0.56	0.53	0.50	0.47	0.44	0.42	0.39	0.37	0.35	0.33	0.31	0.29	0.28	0.26	0.25	0.23	0.22	0.21	0.20
Present Value for whole term	**176,359**	-11,177	-57,068	-7,713	27,048	-5,209	-42,013	-3,603	-28,514	-3,199	15,285	-10,997	3,242	3,648	5,972	7,709	8,354	8,673	8,690	8,799	-1,320	-1,264	-1,210	-1,158	-1,108	-1,842	-1,006	-962	249,875	-14,865
PV/ha	**4,995**																													
Internal Rate of Return (IRR)	**10.02%**																													
Annuity	$11,003																													
Annuity/ha	312																													
Taxation analysis																														
Tax credits on forestry/annual costs	**202,299**	3,130	21,374	2,427	1,332	1,841	15,742	1,431	12,005	1,428	1,149	11,681	1,238	1,396	1,117	1,035	1,051	1,223	1,085	1,101	1,118	1,135	1,151	1,168	1,185	2,089	1,209	1,226	1,243	21,276
Tax liabilities	**773,959**		4,436		10,352						8,379	6,167	2,961	3,451	4,683	5,915	6,657	7,392	7,637	8,134									338,638	
Total tax credit/liability	**-571,660**	3,130	16,938	2,427	-9,020	1,841	15,742	1,431	12,005	1,428	-7,230	5,514	-1,723	-2,055	-3,566	-4,880	-5,606	-6,169	-6,552	-7,033	1,118	1,135	1,151	1,168	1,185	2,089	1,209	1,226	-337,395	21,276
NET POST-TAX (LOGS & CARBON)	**1,469,983**	-8,047	-43,554	-6,240	23,194	-4,735	-40,480	-3,680	-30,869	-3,671	18,593	-14,179	4,431	5,285	9,171	12,549	14,414	15,864	16,849	18,084	-2,875	-2,918	-2,961	-3,004	-3,047	-5,371	-3,110	-3,153	867,588	-54,709

28	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**0**	**1**
29	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**
30/06/49	30/06/50	30/06/51	30/06/52	30/06/53	30/06/54	30/06/55	30/06/56	30/06/57	30/06/58	30/06/59	30/06/60	30/06/61	30/06/62	30/06/63	30/06/64	30/06/65	30/06/66	30/06/67	30/06/68	30/06/69	30/06/70	30/06/71	30/06/72	30/06/73	30/06/74	30/06/75	30/06/76
2049	**2050**	**2051**	**2052**	**2053**	**2054**	**2055**	**2056**	**2057**	**2058**	**2059**	**2060**	**2061**	**2062**	**2063**	**2064**	**2065**	**2066**	**2067**	**2068**	**2069**	**2070**	**2071**	**2072**	**2073**	**2074**	**2075**	**2076**
35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.3	35.0	35.0	35.0		35.3
																									35.0		
																						-0.4				35.3	
																										8,803.0	
2,288.7																										45,728.6	
1,681.6																										16,816.2	
1,936.6	1,936.6	1,056.3	1,056.3	1,056.3	1,056.3	352.1	352.1	352.1																		1,936.6	
			52,228.1		34,048.1																						
								36,501.0																			
		1,584.5																				3,168.9					
1,056.3	1,056.3	2,112.6	1,056.3	2,112.6	1,056.3	2,112.6	1,056.3	2,112.6	704.2	1,760.5	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	704.2	697.2	697.2	697.2	1,056.3	1,056.3
157.4	236.0	314.7	393.4	472.1	550.8	629.5	708.1	786.8	865.5	944.2	1,022.9	1,101.5	1,180.2	1,258.9	1,337.6	1,416.3	1,494.9	1,573.6	1,652.3	1,731.0	1,809.7	1,888.4	1,947.4	2,025.3	2,103.2	78.7	157.4
528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	528.2	522.9	522.9	522.9	522.9	528.2	528.2
352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	352.1	348.6	348.6	348.6	348.6	352.1	352.1
731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3	731.3
8,667	4,756	6,576	56,223	5,111	38,162	4,525	3,529	41,146	2,944	4,059	3,063	3,122	3,182	3,241	3,301	3,360	3,420	3,480	3,539	3,599	3,658	6,878	3,747	3,805	3,864	75,985	2,760
																									1,209,421		
																											73,284
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,209,421	0	73,284
-8,667	-4,756	-6,576	-56,223	-5,111	-38,162	-4,525	-3,529	-41,146	-2,944	-4,059	-3,063	-3,122	-3,182	-3,241	-3,301	-3,360	-3,420	-3,480	-3,539	-3,599	-3,658	-6,878	-3,747	-3,805	1,205,556	-75,985	70,525
0.18	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04
-1,599	-828	-1,080	-8,712	-747	-5,263	-589	-433	-4,764	-322	-418	-298	-286	-275	-265	-254	-244	-234	-225	-216	-207	-199	-352	-181	-173	51,841	-3,083	2,699
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	1,250	21,018	812
																									350,670		20,228
2,421	1,397	1,931	15,621	1,514	11,130	1,354	1,069	11,636	908	1,237	952	974	996	1,018	1,040	1,062	1,084	1,106	1,128	1,150	1,172	2,113	1,206	1,228	-349,420	21,018	-19,416
-6,245	-3,359	-4,645	-40,602	-3,596	-27,032	-3,172	-2,460	-29,510	-2,036	-2,822	-2,111	-2,148	-2,186	-2,223	-2,261	-2,298	-2,336	-2,373	-2,411	-2,448	-2,486	-4,765	-2,540	-2,578	856,136	-54,967	51,108
25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8,667	4,756	6,576	56,223	5,111	38,162	4,525	3,529	41,146	2,944	4,059	3,063	3,122	3,182	3,241	3,301	3,360	3,420	3,480	3,539	3,599	3,658	6,878	3,747	3,805	3,864	75,985	2,760
																									1,209,421		73,284
-8,667	-4,756	-6,576	-56,223	-5,111	-38,162	-4,525	-3,529	-41,146	-2,944	-4,059	-3,063	-3,122	-3,182	-3,241	-3,301	-3,360	-3,420	-3,480	-3,539	-3,599	-3,658	-6,878	-3,747	-3,805	1,205,556	-75,985	70,525
0.18	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.04	0.04	0.04
-1,599	-828	-1,080	-8,712	-747	-5,263	-589	-433	-4,764	-322	-418	-298	-286	-275	-265	-254	-244	-234	-225	-216	-207	-199	-352	-181	-173	51,841	-3,083	2,699
2,427	1,332	1,841	15,742	1,431	10,685	1,267	988	11,521	824	1,137	858	874	891	908	924	941	958	974	991	1,008	1,024	1,926	1,049	1,066	1,082	21,276	773
																									338,638		20,520
2,427	1,332	1,841	15,742	1,431	10,685	1,267	988	11,521	824	1,137	858	874	891	908	924	941	958	974	991	1,008	1,024	1,926	1,049	1,066	-337,556	21,276	-19,747
-6,240	-3,424	-4,735	-40,480	-3,680	-27,477	-3,258	-2,541	-29,625	-2,119	-2,923	-2,205	-2,248	-2,291	-2,334	-2,377	-2,420	-2,462	-2,505	-2,548	-2,591	-2,634	-4,952	-2,697	-2,740	868,001	-54,709	50,778