REPORT ON THE IMPACTS OF PERMANENT CARBON FARMING IN TE TAIRĀWHITI REGION

- JULY 2021

Foreword

The Tairāwhiti Economic Action Plan (TEAP) Operations Group is pleased to present this report on the impacts of permanent carbon farming in Tairāwhiti. It was funded by Trust Tairāwhiti following a request from a concerned community delegation and has been endorsed by the TEAP Operations Group, with the support of the regional governance body, Rau Tipu Rau Ora.

The report considers the potential social, economic, and environmental impacts of permanent carbon farming in Tairāwhiti. It highlights challenges for our region, including the potential for significant job losses. It provides a regionally specific addition to the research into the impacts of permanent carbon farming under New Zealand's Emissions Trading Scheme (ETS).

While the report does not reflect a regional position, it highlights the need for the ETS to be amended. There are concerns that the ETS will lead to unintended and negative outcomes for the region in its current form.

The TEAP Operations Group is confident the report will be a catalyst for continued, broad-ranging regional discussion on the challenges and opportunities for Tairāwhiti.

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Te Runanganui O Ngati Porou

Trust Tairāwhiti
Regional Wellbeing
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30 July 2021

Dear members of TEAP Operations Group

Report on the impacts of Permanent Carbon Farming in Te Tairawhiti

Please find attached our final report on the impacts of permanent carbon farming in Te Tairawhiti region. The first draft of the report was issued to Trust Tairawhiti on 15 April 2021 after which it was provided by Trust Tairawhiti to stakeholder groups within the Tairawhiti community for feedback over a three month period. The stakeholder group consisted of groups or individuals from within Tairawhiti representing forestry, farming, native forest, Iwi, local government and central government.

Two face to face sessions were held with the stakeholder group, one to discuss the draft report and the other to discuss the way forward including potential solutions and additional workstreams. There were ten written responses received as feedback on the draft report and some verbal. All responses unanimously agreed that there needed to be regulation of the permanent carbon farming industry.

When commenting on the detail of the report the responses sometimes contradicted each other between groups and sometimes within industries. However, themes were consistent that groups want continuing stakeholder engagement as solutions are developed and central government engaged with. As such the recommendation section of our report includes examples only and not firm recommendations for regulatory change which will continue to be developed through the stakeholder group and in conjunction with experts in policy. There are more areas where research is needed as identified in the report.

We thank the executive of Trust Tairawhiti for engaging us on such an important and complex matter for the people of Tairawhiti. The draft of the report has definitely created engagement on the topic within the community. We trust that the final report will provide important thought leadership on the journey to increasing understanding of the impacts of permanent carbon farming on regional communities and raising the associated issues with central and local government.

Yours sincerely

Charles Rau

Charles Rau
Director
BDO Gisborne Limited

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BACKGROUND

Permanent Carbon Farming is not production forestry but forests that are used to produce carbon credits and will never be harvested. That is, they are forests where there is no intention to harvest. There is also a sub-group that deserves comment that is better described as semi-permanent carbon farming where the rotation length of exotic production forests is purposely extended well past its optimum commercial age for maximising internal rates of return for timber production in order to maximise carbon credit returns net of harvest costs. An example of this would be extending Pinus radiata rotation lengths past forty years in the Tairawhiti region but still harvesting, or selective harvesting in order to keep the forest out of the permanent carbon category.

The incidence of planting of permanent exotic forests (forests that will never be harvested) in Tairawhiti has been growing in recent years. Two reports, one commissioned by Beef and Lamb[1] and completed by BakerAg in 2019 and the other by Te Uru Rakau[2] and completed by the accounting firm PWC in 2020 both agreed that the employment provided by permanent exotic forests over a fifty-year period is on average less than one job per 1,000 hectares per year which almost all relates to the first year when the trees are planted.

Trust Tairawhiti in conjunction with the Tairawhiti Economic Action Plan (TEAP) have become concerned about the long-term impacts of this trend on the people and whenua of Tairawhiti, in particular future generations.

This is a topic on which the production forestry and livestock farming sectors are both affected because the permanent carbon farming industry competes for land use with both production forestry and livestock farming. Agriculture and production forestry are the two main industries in Tairawhiti although horticulture is significant.

The scope of this report was approved in a meeting with TEAP members Eastland Wood Council, Eastland Group, Trust Tairawhiti and others in November 2020. The Federated Farmers local representative has approved the scope of the report also. BDO Gisborne Ltd was commissioned by Trust Tairawhiti to do this report on 10 March 2021.

What makes this report unique is that:

- It focuses only on permanent carbon farming
- It is not commissioned by any particular industry
- It takes a regional/community focus
- It considers environmental and wellbeing outcomes as well as economic
- It looks at these issues from the perspective of generations 100 years from now.

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[1] Ed Harrison, Hannah Bruce (2019). *Socio-Economic impacts of large-scale afforestation on rural communities in the Wairoa District*. BakerAg.

[2] Richard Forgan, Darryl Pollard (2020). *Economic Impact of Forestry in New Zealand*. PWC

SCOPE

The report will focus on the current and expected future impacts of permanent carbon farming of exotic forest in the Tairawhiti region.

The report will, where possible use locally relevant data and expertise to determine the expected effects on the Tairawhiti region of current and announced central government policy and legislative settings. The report focuses on three pillars:

Wellbeing

Wellbeing focuses on the people of the region and in particular employment opportunities and household incomes which directly impacts on the social, physical, and mental wellbeing of the people of Tairawhiti.

Environment

Environment focuses on the environmental and biodiversity outcomes from permanent carbon farming.

Economy

Economy focuses on the Gross Domestic Product for the region as well as returns for land or forest owners.

Where negative consequences are identified for the Tairawhiti region the report will where possible suggest responses and solutions at a local and national level.

EXECUTIVE SUMMARY

Background

- 83% of Tairawhiti's grassland area is in Land Use Class 6-8 which could go into permanent carbon farming at or above current carbon prices;
- Approximately 54% of Tairawhiti existing exotic forest area was first planted after 1989 making it susceptible to going into permanent carbon farming depending on carbon price and other factors such as access and distance to port;
- 37% of Tairawhiti's existing exotic forests are currently registered in the Post-1989 ETS stock change approach, meaning they can be left as permanent carbon forests without any additional actions;
- Whether or not any land goes into permanent forests depends on the motivations of the landowner which are not only economic and can change over time;
- There is currently no regulation of the management of any forests that are not intended to be harvested;
- The Government has announced its intention to regulate by way of requiring resource consents for new forests established on Land Use Classes 1-5. Due to Tairawhiti's typography the proposed regulation will do nothing to ensure sustainable management of new permanent exotic forests on 83% of Tairawhiti grassland and 54% of existing Tairawhiti exotic forests;
- Current carbon prices are over $45 per tonne which is 25 times the carbon price at the start of 2013;
- The Climate Change Commission suggests carbon prices of at least $140 per tonne by 2030 and $250 by 2050 will be needed to meet the Governments international obligations;

Economy

- Due to carbon price increases the average east coast forest's highest financial return is now from permanent exotic carbon farming which is significantly in excess of returns on production forestry and livestock farming until the forest matures. The carbon farming returns will continue to increase with increases in carbon price;
- Permanent carbon forests are typically Pinus radiata due to cost, ease of establishment and financial returns are far in excess of native forests;
- Although the cash flow returns from exotic permanent carbon farming are positive for the current generation of forest owners, once the forest matures the forests will have negative returns for future generations;
- The negative cash flow post forest maturity means future generations will not be able to meet annual overheads such as rates and insurance;
- The land would be worthless on sale as the ETS liability attached to the land would far exceed the land value meaning rates and other creditors of the landowner may not get paid;
- The landowner of permanent exotic carbon forests is usually a company meaning individuals could not be pursued for outstanding debts especially if they were not directors at the time of distributions;
- Permanent carbon farmers often say they will transition the exotic forest to native but based on current growth data there is a significant financial cost within the ETS of anyone transitioning exotic forests to native forests so this is unlikely to happen;
- There is a burgeoning industry of financial incentives for native forests but at present they do not offset the financial incentives in the ETS for exotic forests and are unlikely to in the future due to the focus on finance rates;
- The Government and taxpayer would have to incur a significant liability at the international level if it were to allow forestry participants to transition exotic forests to native without a cost;

- Exotic forestry participants would have received the revenue and taxpayers the liability if the forestry participants were allowed to transition their forests to native without a cost so this is unlikely to happen;

Wellbeing

- If all Te Tairawhiti land use class 6-8 land was placed into permanent carbon forests the total jobs at risk is over 10,000 or almost half the jobs within Tairawhiti ANZSIC data;
- The number of jobs at risk would be less but still significant if the forests were semi-permanent involving selective harvesting;
- Not all of the jobs would disappear as it would take generations for the conversion of the Tairawhiti region to permanent forest and significant amounts of land would not be converted even at high carbon prices as it depends on landowner intent;
- If all susceptible land use class 6-8 land in Tairawhiti was placed into permanent carbon forests, once the forests are mature and the carbon runs out the GDP lost to the region would be $146 million from livestock farming and $173 million from forestry based on 2019 values;
- After the first year of planting, permanent carbon farming in its current plant and leave format is unlikely to produce any significant local enduring employment;
- For Tairawhiti the average wage for planting the permanent carbon forests is $29,900 less than the average production forestry wage and $13,800 less than the average livestock farming wage with no enduring employment;
- Any significant reduction in jobs and wages is likely to lead to significant migration out of the district;

Environmental

- Replacing farmland and production forests with permanent exotic forests would increase water quality as a whole but decrease surface water availability;
- Permanent native forests increase water quality more than permanent exotic forests and permanent exotic forests more than farmland in the Tairawhiti region;
- Water yield from pine forests average 100 mm less per year than indigenous forest and 160-260 mm less per year than pastoral farming depending on the silviculture regime. This will have an effect on water available for activities downstream such as orchards and cropping;
- Macroinvertebrate community composition in streams in Tairawhiti is better in native forest than pine forest and better in pine than farmland;
- There are water quality issues associated with farmland and harvesting of production forests including sediment loss, habitat loss and slash in waterways which will not be present for permanent forests;
- Bacterial and sediment contamination is less in permanent forests than farmland but can be improved by fencing of waterways where practical;
- Radiata plantation forest within Tairawhiti has significantly limited ability to sustain the range of endemic and native animal species historically found within Tairawhiti compared to native forest;
- Radiata pine forests are an alien environment for the vast majority of endemic species within New Zealand. Very few primary remnant native animal species remain and those that do remain highly impacted by pest species such as deer, goat, ship rat, possum, feral cat, and mustelids and continue to decline;
- Historically pest control in plantation forests only seems to be a consideration when juvenile Pinus radiata are under threat from introduced deer or goats (therefore threatening revenue) and largely absent post this stage meaning it is insufficient to achieve an ecological benefit. Exotic carbon forests are no different;
- The benefit to native or endemic species from developing large areas of densely populated mono-culture exotic permanent forests will be negligible;

- Many permanent exotic carbon farming proposals are being sold, as eventually transitioning to native forest without significant investment in the fundamental management practices being put in place to ensure adequate native regeneration and succession will occur;
- There is a range in the quality of management of permanent exotic forests and so environmental regulation is for the bottom end performers.

Recommendation

This report has highlighted sufficient concerns that central government should look into further research and the regulation (not banning) of permanent and semi-permanent exotic forests. Such regulation should not impact current production forestry and pastoral farming which is already regulated.

There is clearly a unanimous desire from the stakeholder group to have permanent exotic carbon farming regulated but to also have additional tools to regulation. Ideas on how to regulate it should be consulted with experts in the fields concerned, including but not limited to forestry, farming and Iwi. Ideas outside of regulation on how to address the permanent carbon farming issues identified in this report should be consulted with stakeholders and can form additional workstreams.

By way of example, a regulatory solution that would not impact production forestry or farming while capturing existing permanent exotic forests (forests not intended to be harvested) would be to require permanent exotic forest owners of greater than 50 hectares to get consent to keep exotic forests past normal production forestry age. For example, 35 years for Pinus radiata and 50 years for eucalyptus. Without such regulation huge plantings or retirement of areas in a permanent monoculture will continue as the lowest cost option to produce a carbon credit.

An example of an incentive based solution that could work well in conjunction with the resource consent (but not by itself) would be to provide bio-diversity credits for native plantings within 30 metres of waterways in either production forests or farmland. There is an existing voluntary market for this but it would be bolstered if, for every defined number of exotic carbon credits purchased in the ETS by an emitter they had to purchase one biodiversity credit (ratio to be determined by Govt native planting goals). The market would require the cost of the biodiversity credit to at least meet the establishment cost of the natives which is the current deterrent to native plantings. There would initially be a shortage of biodiversity credits which could be filled with emitters entering into forward contracts with landowners for biodiversity credits for future native plantings. This would also go a long way to solve biodiversity and water quality issues nationwide while not impacting significantly on production forestry or farming or resulting in whole-region plantings due to being limited to 30 metres from waterways. The 30 metres from waterways would be essential to prevent whole block plantings concentrated in only a few regions and to ensure that all regions benefit. He Waka Eke Noa could be used for these credits.

When considering the tests the consent applicant should meet to prove sustainable management of the exotic forest, the expert group should focus on the wellbeing, environmental and financial implications for generations of New Zealanders after the carbon runs out. The time is right for such wide ranging consents with the review and replacement of the Resource Management Act. It is likely regulation outside of the RMA would be needed. In forming the tests we should be stepping into the shoes of our Mokopuna.

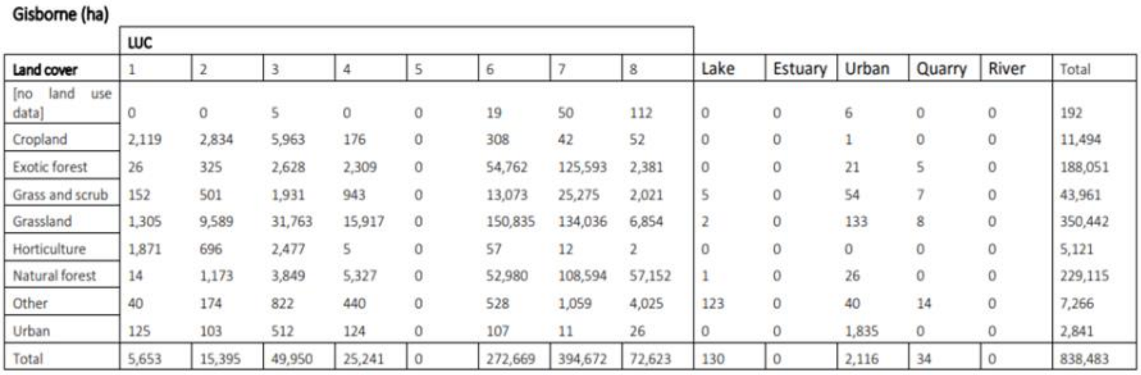
Where to from here:

- This report is sent to central Government and dialogue entered into
- Regulatory workstream – with experts in policy/planning to address how permanent carbon forests can be captured by compliance and incentive based regulation
- Catchment management – understand eligible land in each catchment and the implications, community/cultural values
- Region integration – Working with other regions to inform government on impacts/solutions.

WHAT LAND IS SUSCEPTIBLE

We have attached as appendix 1 a map of land cover by land use classification in Tairawhiti and provide a table below.

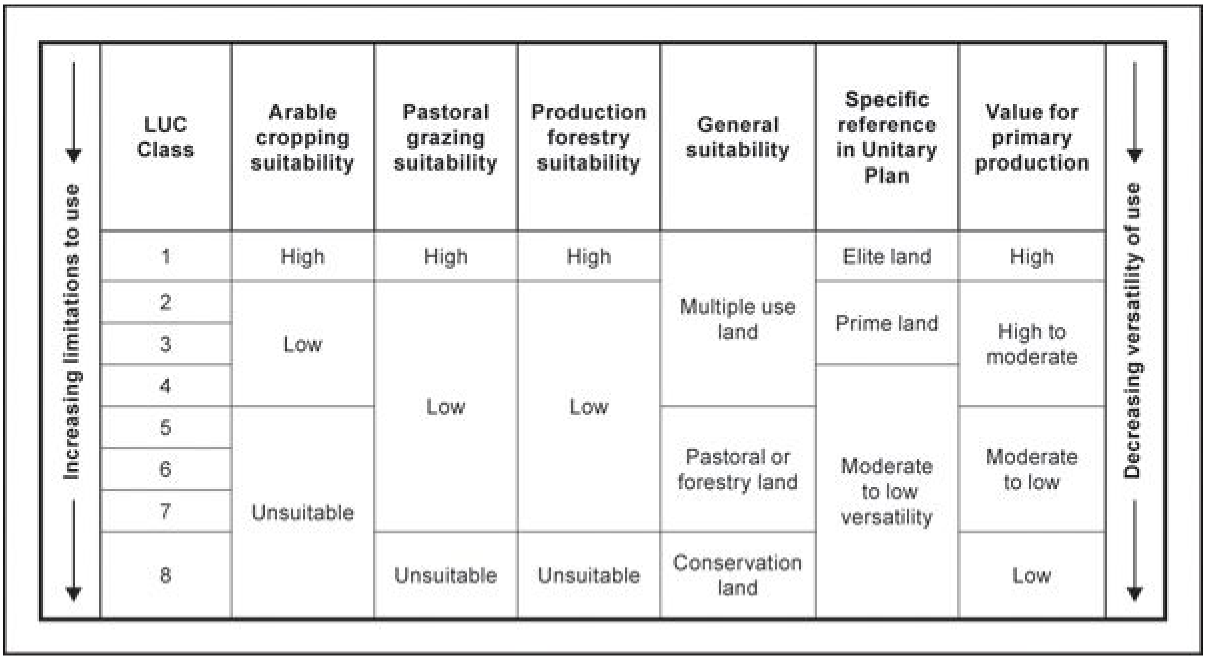
Table 1: Land Use in the Gisborne Region by Land Class



Gisborne (ha)

Land cover	LUC 1	2	3	4	5	6	7	8	Lake	Estuary	Urban	Quarry	River	Total
[no land use data]	0	0	5	0	0	19	50	112	0	0	6	0	0	192
Cropland	2,119	2,834	5,963	176	0	308	42	52	0	0	1	0	0	11,494
Exotic forest	26	325	2,628	2,309	0	54,762	125,593	2,381	0	0	21	5	0	188,051
Grass and scrub	152	501	1,931	943	0	13,073	25,275	2,021	5	0	54	7	0	43,961
Grassland	1,305	9,589	31,763	15,917	0	150,835	134,036	6,854	2	0	133	8	0	350,442
Horticulture	1,871	696	2,477	5	0	57	12	2	0	0	0	0	0	5,121
Natural forest	14	1,173	3,849	5,327	0	52,980	108,594	57,152	1	0	26	0	0	229,115
Other	40	174	822	440	0	528	1,059	4,025	123	0	40	14	0	7,266
Urban	125	103	512	124	0	107	11	26	0	0	1,835	0	0	2,841
Total	5,653	15,395	49,950	25,241	0	272,669	394,672	72,623	130	0	2,116	34	0	838,483

[3]



LUC Class	Arable cropping suitability	Pastoral grazing suitability	Production forestry suitability	General suitability	Specific reference in Unitary Plan	Value for primary production
1	High	High	High	Multiple use land	Elite land	High
2	Low	Low	Low		Prime land	High to moderate
3						
4					Moderate to low versatility	
5	Unsuitable			Pastoral or forestry land		Moderate to low
6						
7						
8		Unsuitable	Unsuitable	Conservation land		Low

[4]

Land currently in pasture

All land currently in pasture is technically susceptible to conversion to permanent forestry which is 350,442 hectares of grassland and a further 43,961 hectares of grass /scrub could also be susceptible. However, practically large-scale conversion is only likely to happen on land use classes 6 – 8. This is because return on investment is higher in LUC 6-8 due to lower land purchase costs. It is for the same reason that 97% of Tairawhiti exotic forestry is currently on LUC 6-8.

Tairawhiti LUC 6-8 represents 291,725 hectares in grassland and a further 40,369 classed as grass/scrub which could be susceptible. **LUC 6-8 in grassland in Tairawhiti equates to 83% of our**

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[3] Gisborne District Council: *Tairawhiti Spatial Plan*

[4] Source: https://www.arcgis.com/apps/MapJournal/

grassland which is quite unique compared to the rest of New Zealand. This also highlights why Tairawhiti is vulnerable to carbon farming.

Land currently in exotic forestry

Land in exotic forestry in Tairawhiti per table one is 188,051 hectares (Table 1). However, not all of this is susceptible to permanent carbon farming. There is no carbon farming of pre-1990 forest land[5] and there is less value in older post-1989 forests.

We have received the following breakdown of Pre-1990 and Post-1989 forest area from Te Uru Rakau:

- The area planted in exotic forest at 31 December 1989 (pre-1990) is approximately **89,807ha** according to the LUCAS NZ Land Use Map https://data.mfe.govt.nz/layer/52375-lucas-nz-land-use-map-1990-2008-2012-2016-v008/
- The area of post 89 forest as of 2016 is **105,010ha** again data is taken from LUCAS NZ Land Use Map

Based on the above information from Te Uru Rakau, **approximately 54% of Tairawhiti's exotic forestry is post-1989. There is currently 57,673[6] hectares of Tairawhiti exotic forests registered in the post-1989 Emissions Trading Scheme ("ETS") meaning a further 47,000 hectares approximately could be registered.** It is likely one of the reasons these hectares are not registered is because their age means that all the carbon has to be paid back on harvest so the owners have decided not to register. That outcome would not change regardless of the number of rotations provided the trees were still harvested. However, these forest owners could decide to register the second rotation if they decided to leave the forests as permanent. These forests would have to be of little commercial value to do this as the carbon grown before 1 January 2008 is not claimable.

What forests are at risk from switching to permanent carbon farming is dependent on a number of factors including:

- The age class of the forest
- Carbon price
- Distance to port
- Access
- Quality of the forest management
- Motivations of the owner, including whether or not the trees are needed in their supply chain

During the consultation phase of the draft of this report we were asked to comment on the likelihood of post-1989 forests being left as permanent. That is difficult to do with any degree of certainty because owners of the land and their motivations will change over time. The same problem would apply if we were to comment on the likelihood of conversion of farmland to permanent forest.

As the carbon price increases older post-1989 age classes will be susceptible to being left as permanent forests.

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[5] As defined in the Climate Change Response Act 2002
[6] https://www.mpi.govt.nz/dmsdocument/43999-Emissions-Trading-Scheme-for-Forestry

REGULATION

Current regulation focuses on water quality, land disturbance and vegetation clearance activities[7] or plantation forestry. Plantation forestry for the purposes of the Resource Management (National Environment Standards for Plantation Forestry) Regulations 2017 only includes forestry that **"has or will be harvested"[8].**

Plantation forestry that will not be harvested is an un-regulated activity[9]. We expect that this is because historically there was an economic cost to not harvesting and so market forces acted as a restraint and so regulation was not needed. Now due to the ETS and rising carbon prices market forces are acting as an incentive to not harvest, we still do not have any regulation in this area.

A cabinet paper prepared for the Ministry for the Environment for the Hon David Parker was produced in 25 November 2019 and made available under the Official Information Act[10]. The cabinet paper titled "Investigating the need to limit plantation forestry on productive land" only addresses Afforestation as defined in the Resource Management (National Environment Standards for Plantation Forestry) Regulations 2017, **so excludes permanent carbon farming in its focus.**

Prior to the last election in October 2020, environment spokesman Hon David Parker announced plans for more controls on plantation forests by revising the Environment Standards for Plantation Forestry (Resource Management (National Environment Standards for Plantation Forestry) Regulations 2017) to allow Councils to once again determine what classes of land could be used for plantation forestry and carbon forests within the first six months of the new term of Government[11]. Any forest over 50 hectares on land use classes 1-5 could require resource consent[12]. Land use classes 6-8 would not require resource consent.

Interestingly, even once the policy is enacted, and if the definition of afforestation in the regulation would be widened to cover permanent exotic forests as well as production forestry, **the announced policy would do nothing to limit permanent forests on 83% of grassland in Tairawhiti; neither will it do anything to limit 54% Tairawhiti's existing forests which are post-1989 being left as permanent forests. This means Tairawhiti in particular because of its typography will be significantly exposed to permanent carbon farming, especially if the carbon price continues to rise as expected.**

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[7] Gisborne District Council: *Tairawhiti Resource Management Plan 2020*

[8] Definition of Afforestation: Resource Management (National Environment Standards for Plantation Forestry) Regulations 2017

[9] Confirmed by Gisborne District Council staff

[10] Sourced from: https://www.mfe.govt.nz/sites/default/files/media/Legislation/Cabinet%20paper/cab-paper-investigating-need-limit-plantation-forestry-productive-land.pdf

[11] Source: https://www.stuff.co.nz/business/farming/122754809/environment-minister-we-thought-it-was-right-at-the-time

[12] https://www.stuff.co.nz/national/politics/122036457/labours-forestry-policy-a-step-in-the-right-direction-farmers-say

ECONOMY

The rise of permanent carbon farming – Why are investors looking to permanent forests now?

The rise of permanent carbon farming as an activity competing directly with production forestry and livestock farming on Tairawhiti hill country is a direct result of the ETS and the NZU carbon price rise over the last decade but particularly since 2018:

[13]

Current NZU prices may be low compared to near term future prices. The Climate Change Commission in its advice to government has recommended the Government "*Immediately start to factor target-consistent long-term abatement cost values into policy and investment analysis in central government. These values should be informed by the Commission's analysis which suggests values of* ***at least $140 per tonne by 2030 and $250 by 2050 in real prices***[14]*.*"

Further on in the report[15] the Climate Change Commission recommend the Government:

i. ***"Increase the cost containment reserve trigger price to $70 as soon as practical and then every year by at least 10% plus inflation.***

ii. *To maintain continuity with recent prices, immediately increase the auction reserve trigger price to $30 as soon as practical, followed by annual increases of 5% plus inflation per year."*

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[13] Source:www.carbonforestservices.co.nz

[14] Page 129, Climate Change Commission. *He Pou a Rangi, Climate Change Commission: 2021 Draft Advice for Consultation.*

[15] Page 133

History has shown us that as carbon prices rise more and more land will be converted to carbon farming.

Revenue for the sale of carbon credits comes from emitters in those sectors that have to provide carbon credits to the Government for their emissions which are currently forestry, waste, synthetic gases, industrial processes, liquid fossil fuels and stationary energy[16]. Therefore, the revenue source for carbon forests comes from these sectors, in particular the fossil fuel sector.

Financial returns to investors

Since 2018 traditional forestry investment analysis from forestry advisers has often been showing a higher internal rate of return or net present value for permanent Pinus radiata forests exceeding that of production forests or livestock farming.

With the permission of Margules Groome[17] we have attached an example of their forestry investment analysis of a typical Tairawhiti forest as appendix 2 and outline the results below:

Regime		**NPV (NZD/ha)**
Averaging	$	2,881.54
Stock Change - Full NZU Sale	$	3,827.78
Safe Carbon - Safe NZU sale only	$	(157.60)
Plant and Leave	$	4,875.54

The “Plant and Leave” regime is permanent carbon farming. “Averaging” is the method that will become compulsory for new post-1989 forest registrations in the ETS other than permanent forests from 2023. “Stock change” is selling all carbon under the current post-1989 accounting method for forests, requiring purchasing credits back at harvest with uncertain price differential. “Safe carbon” is only selling the safe carbon in the current post-1989 accounting method for forests, preventing the need to buy back credits at harvest.

We say traditional forestry investment analysis because such analysis typically focuses on financial returns from forestry only within the first fifty years (largely because MPI growth statistics are only available for the first fifty years) and tends to exclude things like decreases in land value due to the carbon credit liability attaching to the land and qualitative issues like the environment. That is, they are cash flow forecasts for a limited period without taking into account land values and environmental values.

The ETS is designed to financially incentivise forest owners for locking up carbon. Forest owners that are purchasing land to put into permanent carbon forests or deciding to do so with existing land are simply responding to the incentives built into the ETS.

The permanent forests are typically Pinus radiata because of cost, ease of establishment and the fact that Pinus radiata financially outperforms any other forest type for carbon returns per the carbon sequestration graphs below:

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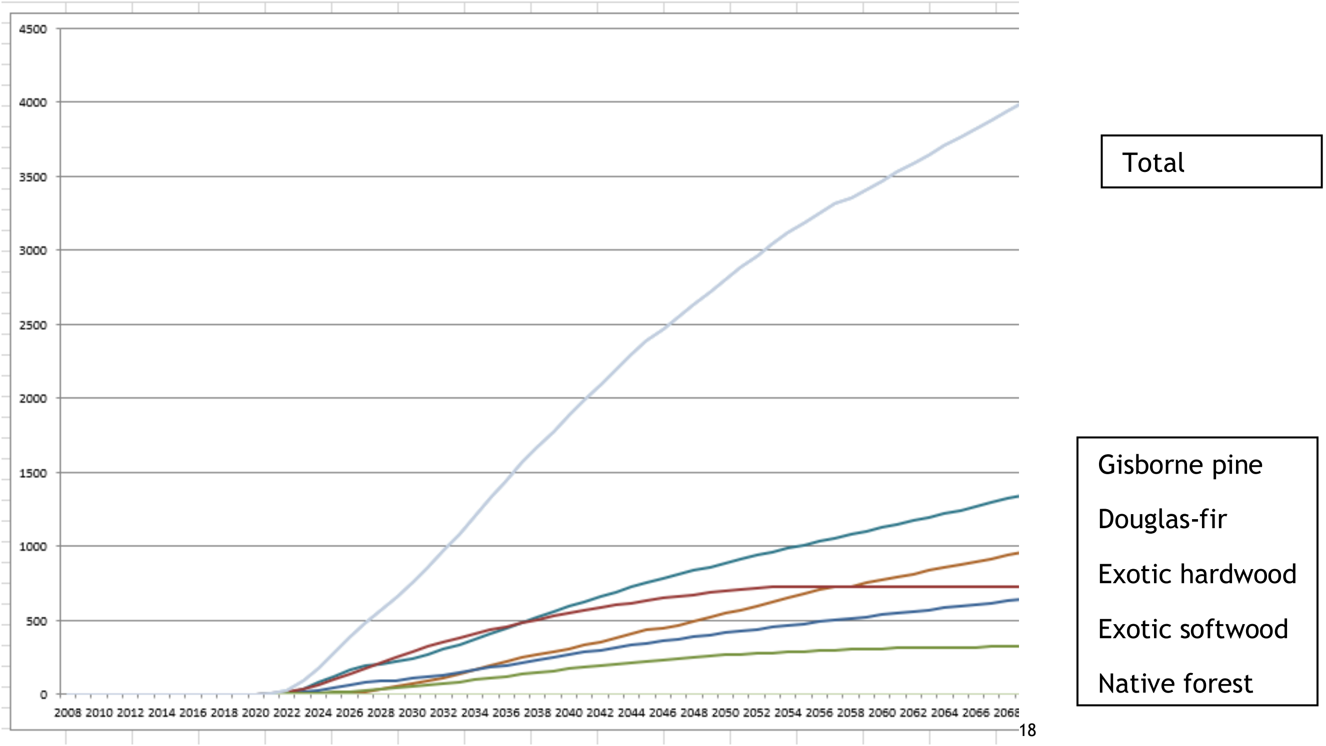
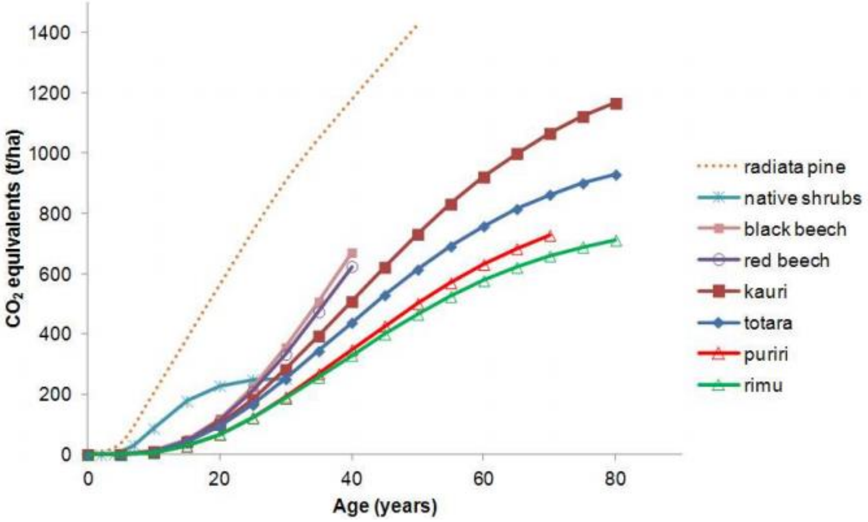
[16] Source: https://www.mfe.govt.nz/climate-change/new-zealand-emissions-trading-scheme/about-nz-ets

[17] Source: https://www.margulesgroome.com/publications/an-investigation-into-the-viability-of-harvesting-blocks-based-on-carbon-price-in-new-zealand/



[18]



[19]

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[18] Source: MPI look up tables, BDO Carbon Calculator

[19] Tane Tree Trust (2021). *Carbon Sequestration by Planted Native Trees and Shrubs*. Tanestrees.org.nz

Recent amendments to the ETS and on-going consultation

The Climate Change Response (Emissions Trading Reform) Amendment Act was passed into law in 2020 with the following key changes as it relates to forestry:

- introducing average accounting for some post-1989 forests;
- creating a new permanent forestry activity in the NZ ETS;
- exempting post-1989 forests from the requirement to surrender New Zealand Units to cover emissions from temporary adverse events (such as fire or wind throw);
- allowing some types of post-1989 forestry participants to offset their deforestation liability by planting a forest elsewhere;
- improving the pre-1990 forest land offsetting.

The new permanent forest category in the ETS is expected to further incentivise permanent forest plantings. Due to the sequestration rates for exotic forests, exotic forests, particularly pine continue to be more financially rewarding under the ETS than native.

Until 2023, new forests can continue to be registered under the Stock Change method which essentially produces the same amount of carbon as the permanent forest category calculations without the restrictions so there is currently a rush by many permanent forest investors to register before the change.

From 1 January 2023, all new post-1989 forests either have to be in the averaging approach or the permanent forest category. If we go back to the NPV analysis prepared by Margules Groome above, this will only widen the NPV gap between production forestry and plant and leave (permanent carbon farming) as the stock change option will not be available for new forests.

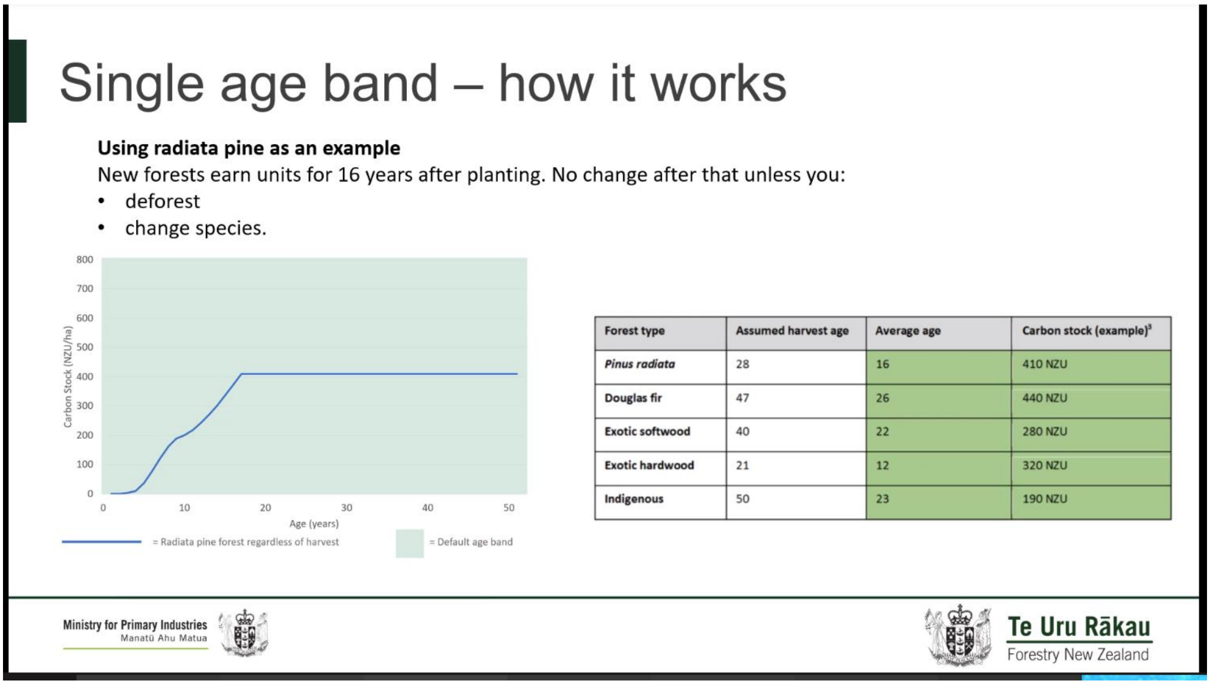
The change allowing some types of post-1989 forestry participants to offset their deforestation liability by planting a forest elsewhere is likely to mean the replacement forest will be on the lowest cost land which could likely be in Tairawhiti.

Land use inflexibility

The report from the "Forestry Reference Group" to Government in November 2018 when commenting on the proposed changes states in the summary "*future market opportunities for New Zealand under climate change are unknown and possibly short-lived. We believe land use flexibility will be increasingly important, and forestry is not a flexible land use. Trees grow slowly; and forests under the ETS cannot be cleared for other land uses without repaying all of the issued carbon credits. Offsetting may lessen the impact of the ETS on land use flexibility*."

Financial cost in transitioning pine forests to native using averaging accounting in the ETS

Many investors in permanent pine forests say they will transition them to native forests eventually. For production forests from 2023 onwards, the averaging accounting method is still being consulted on by MPI but none of the current methods being proposed would allow a transition from an exotic pine forest to a native production forest without paying back carbon credits. The most likely option to allow this is the single age band options but as per the below slide from MPI would result in a 220 carbon credits per hectare financial loss in transitioning exotic pine forest to native forest.



Single age band – how it works

Using radiata pine as an example

New forests earn units for 16 years after planting. No change after that unless you:

- deforest
- change species.

Forest type	Assumed harvest age	Average age	Carbon stock (example)[3]
Pinus radiata	28	16	410 NZU
Douglas fir	47	26	440 NZU
Exotic softwood	40	22	280 NZU
Exotic hardwood	21	12	320 NZU
Indigenous	50	23	190 NZU

Ministry for Primary Industries
Manatū Ahu Matua

Te Uru Rākau
Forestry New Zealand

There is the ability to transition from the average accounting method to the permanent forest category. For those forests under the current stock change method, they do not have to make any transition and so the decision to leave a forest as permanent will not be evident until the forest is too old to harvest. In all cases, which systems the landowners adopts is private and not public information.

Costs to transition to native goes up for permanent forests and stock change approach

For forest owners in the permanent forest category or the stock change method, they would have to pay back the difference between the carbon stored in the exotic forest and that stored in the native in order to transition to native. Under the look up tables, at year 50 for an east coast pine forest versus native, the forest owner would have to pay back 1,024 credits per hectare. At a current carbon price of $39 this amounts to $40,000 per hectare. Most forestry advisers consider the standard look up table for pine on the east coast are conservative by up to 20% so the actual cost to transition is likely to be higher and goes up as the carbon price rises. There is insufficient data for both pine and native forest growth past 50-100 years.

Unlikely to find significant change without a cost to Government

If the ETS was amended to allow forest owners to transition from exotic to native without a cost to the forest owner then the New Zealand government will have to pick up the cost at the international level.

The NZ Government has indicated in its first Nationally Determined Contribution under the Paris Agreement that it will use the same accounting method for the 2030 target as for the 2020 target. New Zealand has however reserved the right to adjust its accounting method for the 2030 target on the proviso that any adjustment does not reduce the ambition of the target.

The accounting method for the 2030 target is likely to be confirmed in New Zealand's first communication under the Paris Agreement (2024). While New Zealand could have adopted a completely different accounting method for its first National Determined Contribution under the Paris Agreement (the 2030 target), any method is subject to the integrity principles set out in the Paris Agreement (article 4.13). The Paris Agreement also requires countries to take into account the existing rules and guidance under the United National Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol.[20]

What do the financial implications look like for generations 100 years from now?

We asked Margules Groome to model what the financial return would be on a permanent Gisborne pine forest 100 years from now assuming the forest had matured by then, so the carbon revenue had run out. Essentially, what would our grandchildren be living off from that piece of land. The results are detailed in appendix 4 and outlined below:

NPV - 2121		
Averaging	$	8,134.58
Stock Change	$	23,048.48
Safe Carbon	$	8,134.58
Plant and Leave	-$	826.80

The "Plant and Leave" scenario above is permanent carbon farming. The return is negative after forest maturity. Essentially there would not be any revenue from the forest unless there was selective harvesting (that is, only if it was not permanent). This would raise the issue of how the landowner would pay rates and other holding costs causing the cash flow to be negative after forest maturity.

An issue would arise where companies had paid dividends with past carbon profits with no ability to meet their future obligations post forest maturity including rates and fire insurance. The land could not be sold to recover rates as the land would be worthless because the carbon liability attached to the land would far exceed the land value. For example, at age 50 a Gisborne pine forest will have 1,348 carbon credits attached to the land as a liability[21]. At a carbon price of $40 that is a liability of $53,920 per ha attached to the land making the land likely unsalable due to the liability exceeding the land value (current market prices for land use classes 6-8 is around $10,000 per hectare for pastoral land and $3,000 - $4,000 per hectare for cut-over forestry). This liability increases further as the trees mature and the carbon price goes up.

If the forests were selectively harvested to derive a revenue stream post forest maturity (post-carbon) a liability could arise under the measurement approach in the ETS if the selected harvest sites included the randomly selected measurement sites by MPI.

There is potential in the future for high value wood such as native to be extracted by aerial means (helicopters/drones) without significant disturbance to the understory provided the technical and ETS costs discussed above can be resolved. Although harvested by low impact selective ground-based methods this potential is illustrated in the article *Northland Totara: Sustainably managing a native forest resource in New Zealand*[22].

There is also a burgeoning industry of financial incentives for biodiversity instruments[23] and financing mechanisms for native plantings[24]. However, most will require systems and legislative change[25]. These mechanisms will work well to incentivise those with environmental intentions for planting native. The risk is the return on the financial instruments may not be sufficient to offset

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[20] Ministry for the Environment: Technical appendix 8 to the International Commission on Climate Change

[21] MPI look-up tables for Post-1989 forestry in the ETS

[22] Michael Smith, Timber & Forestry E-News, issue 634. *Northland Totara: sustainably managing a native forest resource in New Zealand.*

[23] https://www.mohio.co/biodiversity-finance-instruments

[24] https://pureadvantage.org/healing-our-markets-with-better-facts/

[25] Dr David Hall and Sam Lindsay: *Scaling climate finance, forest finance instruments. February 2020: Climate Innovation Lab*

the ETS incentives for planting permanent pine forests for investors after the highest rate of return and therefore, alone, may not curb current permanent forest planting trends which favour exotics.

In short, it is difficult to see a financial return at all for future generations based on current ETS law and current commercial uses for mature exotic forests without a significant ETS cost of transitioning the forest to production forests.

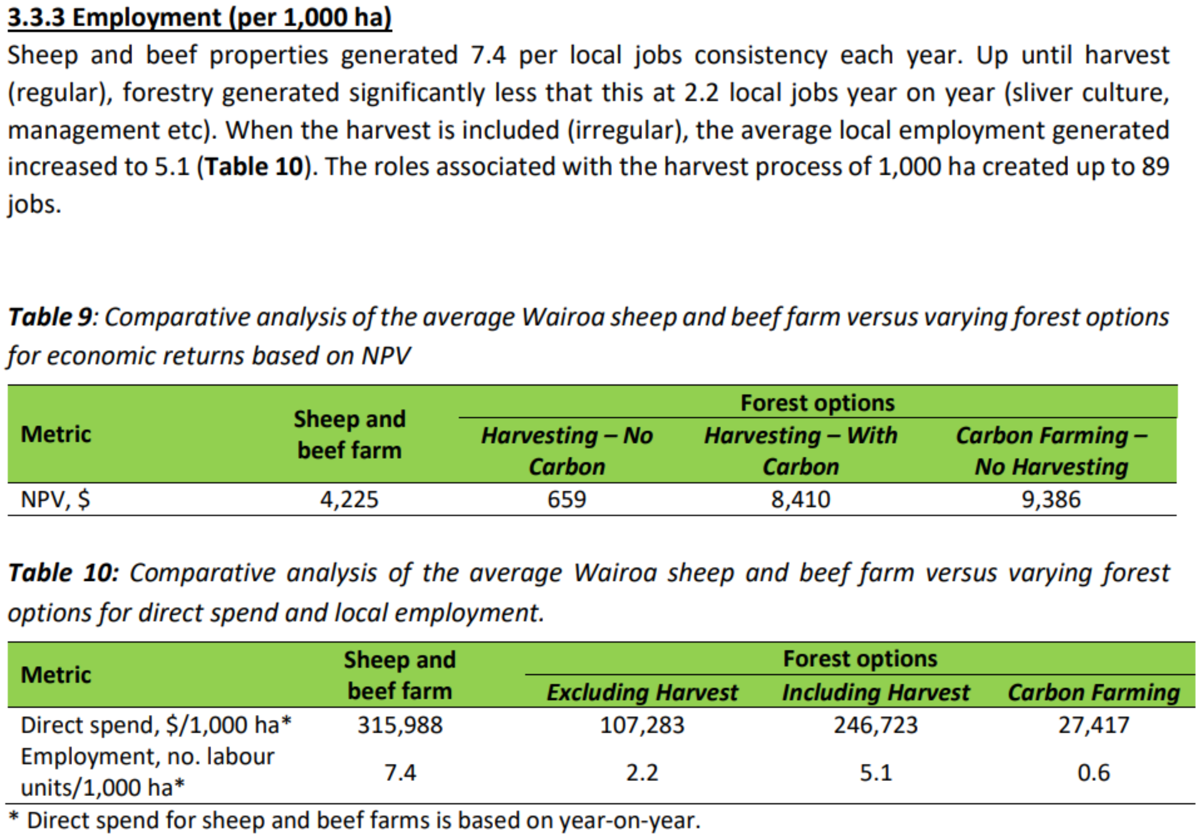
WELLBEING

Employment and regional economy

Jobs per 1,000 hectares has been chosen as one of the two indicators of wellbeing for the people of Tairawhiti. There are two notable reports that have considered employment per 1,000 hectares for permanent carbon farming versus livestock farming and production forestry:

1. **Report on the Socio-economic impacts of large-scale afforestation on rural communities in the Wairoa District**[i26]

This report published in August 2019 was commissioned by Beef and Lamb NZ, produced by BakerAg and focuses on afforestation impacts on the Wairoa region. The report uses case study analysis. The main results were summarised on page 17 of the report:



3.3.3 Employment (per 1,000 ha)

Sheep and beef properties generated 7.4 per local jobs consistency each year. Up until harvest (regular), forestry generated significantly less that this at 2.2 local jobs year on year (sliver culture, management etc). When the harvest is included (irregular), the average local employment generated increased to 5.1 (**Table 10**). The roles associated with the harvest process of 1,000 ha created up to 89 jobs.

Table 9*: Comparative analysis of the average Wairoa sheep and beef farm versus varying forest options for economic returns based on NPV*

Metric	Sheep and beef farm	Forest options		
		Harvesting – No Carbon	*Harvesting – With Carbon*	*Carbon Farming – No Harvesting*
NPV, $	4,225	659	8,410	9,386

Table 10: *Comparative analysis of the average Wairoa sheep and beef farm versus varying forest options for direct spend and local employment.*

Metric	Sheep and beef farm	Forest options		
		Excluding Harvest	*Including Harvest*	*Carbon Farming*
Direct spend, $/1,000 ha*	315,988	107,283	246,723	27,417
Employment, no. labour units/1,000 ha*	7.4	2.2	5.1	0.6

* Direct spend for sheep and beef farms is based on year-on-year.

2. **Report on the Economic Impact of Forestry in New Zealand**[27]

This report published May 2020 was commissioned by Te Uru Rakau (Ministry for Forestry) and produced by PWC. The report uses national input-output multipliers. The report is for all of New Zealand and the main results are summarised on page five of the report as follows:

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[26] Ed Harrison, Hannah Bruce (2019). *Socio-Economic impacts of large-scale afforestation on rural communities in the Wairoa District*. BakerAg.

[27] Richard Forgan, Darryl Pollard (2020). *Economic Impact of Forestry in New Zealand*. PWC

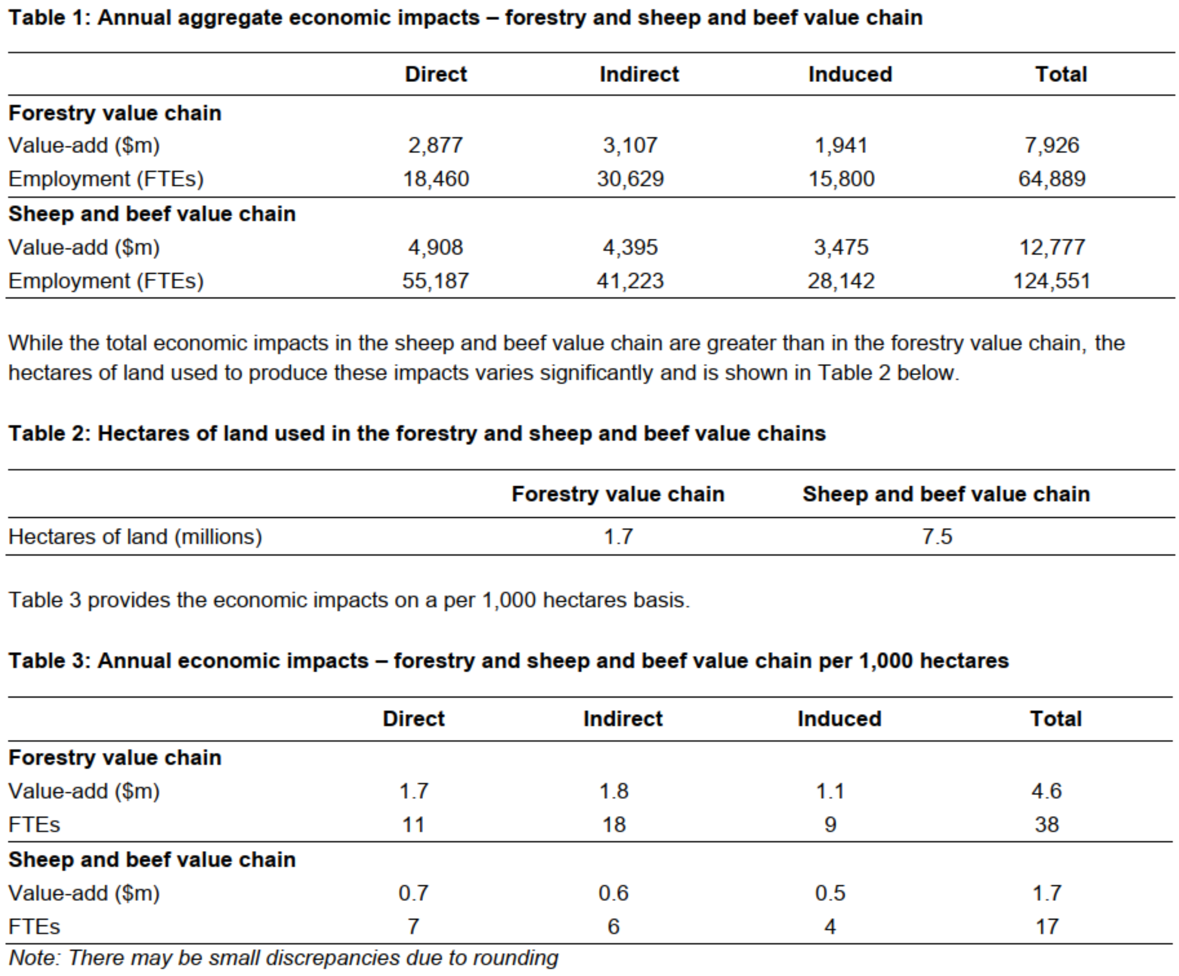

Table 1: Annual aggregate economic impacts – forestry and sheep and beef value chain

	Direct	Indirect	Induced	Total
Forestry value chain				
Value-add ($m)	2,877	3,107	1,941	7,926
Employment (FTEs)	18,460	30,629	15,800	64,889
Sheep and beef value chain				
Value-add ($m)	4,908	4,395	3,475	12,777
Employment (FTEs)	55,187	41,223	28,142	124,551

While the total economic impacts in the sheep and beef value chain are greater than in the forestry value chain, the hectares of land used to produce these impacts varies significantly and is shown in Table 2 below.

Table 2: Hectares of land used in the forestry and sheep and beef value chains

	Forestry value chain	Sheep and beef value chain
Hectares of land (millions)	1.7	7.5

Table 3 provides the economic impacts on a per 1,000 hectares basis.

Table 3: Annual economic impacts – forestry and sheep and beef value chain per 1,000 hectares

	Direct	Indirect	Induced	Total
Forestry value chain				
Value-add ($m)	1.7	1.8	1.1	4.6
FTEs	11	18	9	38
Sheep and beef value chain				
Value-add ($m)	0.7	0.6	0.5	1.7
FTEs	7	6	4	17

Note: There may be small discrepancies due to rounding

Permanent carbon farming results are published on page 21:

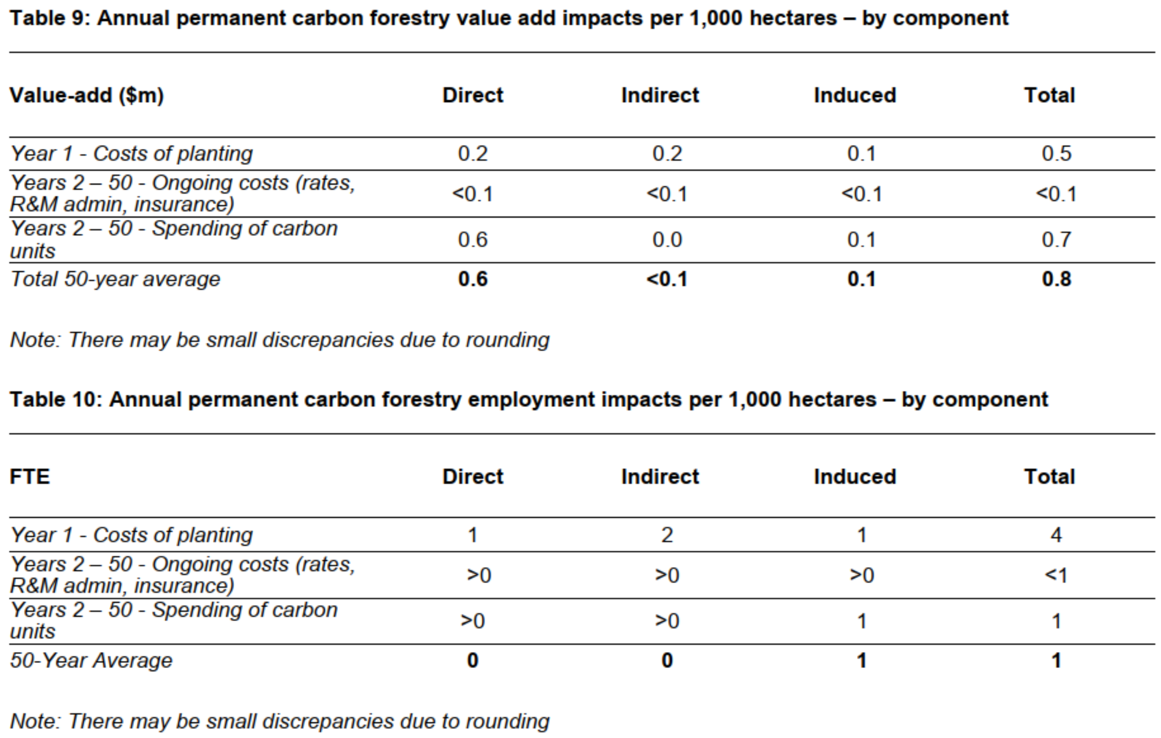

Table 9: Annual permanent carbon forestry value add impacts per 1,000 hectares – by component

Value-add ($m)	Direct	Indirect	Induced	Total
Year 1 - Costs of planting	0.2	0.2	0.1	0.5
Years 2 – 50 - Ongoing costs (rates, R&M admin, insurance)	<0.1	<0.1	<0.1	<0.1
Years 2 – 50 - Spending of carbon units	0.6	0.0	0.1	0.7
Total 50-year average	**0.6**	**<0.1**	**0.1**	**0.8**

Note: There may be small discrepancies due to rounding

Table 10: Annual permanent carbon forestry employment impacts per 1,000 hectares – by component

FTE	Direct	Indirect	Induced	Total
Year 1 - Costs of planting	1	2	1	4
Years 2 – 50 - Ongoing costs (rates, R&M admin, insurance)	>0	>0	>0	<1
Years 2 – 50 - Spending of carbon units	>0	>0	1	1
50-Year Average	**0**	**0**	**1**	**1**

Note: There may be small discrepancies due to rounding

How applicable are the reports to the Tairawhiti region?

The focus of the BakerAg report and PWC reports are different to this report in that they do not focus on permanent carbon farming or environmental and social outcomes for Tairawhiti although some of the conclusions are relevant. Instead of using case study analysis or theoretical input-output multipliers we have sought to analyse actual gross domestic product and job data from Tairawhiti split by industry and sub-category to determine actual direct jobs per 1,000 hectares on an annualised basis and then compare this to the above reports.

The actual job data is supplied by Statistics New Zealand by industrial classification divisions and sub-divisions (Australia, New Zealand Standard Industry Classification Codes, “ANZSIC”). We have had economists Infometrics[28] sort the data by sub-category and Tairawhiti region and provide it to us which is summarised as total values as follows:

Primary industry				**Tairawhiti**	
2019 years statistics by ANZSIC				**GDP**	**Direct Employment**
Livestock farming				146,910,000.00	2,410
Forestry				173,000,000.00	832

We also obtained the following Tairawhiti data from the Ministry of Primary Industries of hectares of exotic forestry harvested in 2019 and 2020 (2020 reduced due to COVID-19):

Survey Year	Total Clear-Felled Area (Ha)
2019	3131

Survey Year	Total Clear-Felled Area (Ha)
2020	2964

Year planted	**Total Net Stocked Area ha**	
Pre-1990	15,400	10%
1990-1999	68,961	44%
2000-2007	26,379	17%
2008+	44,620	29%
Total	**155,360**	

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[28] www.infometrics.co.nz

The total exotic forest area of 155,360 hectares is less than in table 1 due to table 1 being the total forest estate including, non-production, production, unstocked and temporarily unstocked areas not the net stock area and a few years difference.

We have the total areas in Tairawhiti in exotic forest in the above table and pastoral farming in table 1. If we simply take the total hectares and direct employment data from Infometrics in appendix 3 we get direct jobs per 1,000 hectares as follows:

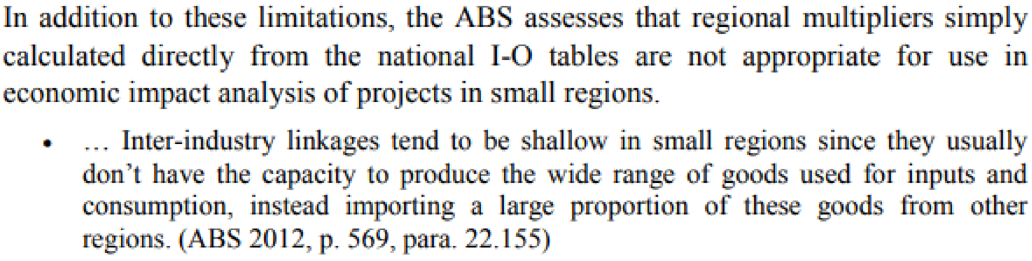
Tairawhiti			
	Total hectares		
		GDP/1,000 ha	**Jobs/1,000 ha**
Livestock farming	350,442	$419,213	6.88
Exotic Forestry	155,360	$1,113,543	5.36

The jobs per 1,000/ha for the livestock farming results are very similar to both the Baker Ag and PWC reports, subject to rounding to the nearest FTE. The GDP per 1,000/ha for livestock farming was considerably less than the $727,000 gross revenue per 1,000/ha in the Baker Ag report and the $654,000 GDP per 1,000/ha in the PWC report.

The jobs per 1,000/ha for forestry is considerably less than the 11 direct jobs per 1,000 hectares in the PWC report but very similar to the 5.1 jobs per 1,000 hectares in the BakerAg report. This may be in part because Tairawhiti has not yet reached a steady state level of harvest for current forests. If we assume a 28.3-year average production cycle and 1 year stand-down, one 29th of 155,360 is 5,357 hectares. Some areas will never be economic to harvest but this simple analysis indicates our current harvest rate of 3,100 hectares has an increase of approximately 30% to go.

A 30% increase in harvested area would result in the same amount of direct jobs as livestock farming. As such for the purposes of this report we have assumed forestry and farming both contribute direct employment of seven FTE's per 1,000ha. For the purposes of this report the comparison of livestock farming and production forestry compared to permanent carbon farming is what is important to determine the potential jobs lost on land use classes 6-8 to permanent carbon farming. The difference between the Baker Ag report results and PWC report results can be explained in part by the PWC report's use of national level economic multipliers and the BakerAg scenario analysis; and the PWC report focuses on **national** level impacts whereas the BakerAg report focusing on **regional** level impacts.

The Australian Bureau of Statistics recommends caution in the use of national economic multipliers when assessing the impacts of projects on small regions as the economic linkages within a small region can be shallow or non-existent compared to the national level:



> In addition to these limitations, the ABS assesses that regional multipliers simply calculated directly from the national I-O tables are not appropriate for use in economic impact analysis of projects in small regions.
>
> - … Inter-industry linkages tend to be shallow in small regions since they usually don't have the capacity to produce the wide range of goods used for inputs and consumption, instead importing a large proportion of these goods from other regions. (ABS 2012, p. 569, para. 22.155)

29

A simple example of this is where the PWC report uses an FTE multiplier of 8.22 for Pulp, Paper and converted paper products manufacturing. Tairawhiti does not have such manufacturing so the multiplier is irrelevant to this region. The PWC report also states "input-Output analysis – there are

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[29] Paul Gretton. (2013). *On input-output tables: uses and abuses*. Productivity Commission, Australian Government.

well known limitations to this approach, including that it tends to produce higher estimates of economic impacts than other approaches".

It is also important to note that when it came to permanent carbon farming the PWC report referenced back to the analysis in the BakerAg report as its source and used an assumption regarding multipliers. **Both reports agreed on the low economic value and low employment contributed by permanent carbon farming**.

Our above analysis indicates that Tairawhiti has a similar direct forestry and farming job profile to the Wairoa region as over 90% of Tairawhiti logs are exported[30]. However, we note that our above analysis is of direct jobs only and does not capture the significant contribution that potential further downstream processing of logs in Tairawhiti can make. **If anything, the difference between the PWC and Baker Ag reports as they relate to forestry indicates the largely untapped economic potential of further in-region processing of more than 90% of Tairawhiti logs that are exported whole.**

Potential Jobs lost to permanent carbon farming

Given permanent carbon farming only produces 0.6 FTE equivalent direct jobs per 1,000 hectares from the year after planting onwards and forestry and livestock farming 7 FTE the difference is 6.4FTE/1,000ha. Land use class 6-8 in Tairawhiti in grassland is 350,442 and up to 105,000 in exotic post-1989 forestry the potential direct jobs lost to permanent carbon farming for both livestock and forestry is 2,914 direct jobs.

2020 ANZIC data showed a further 293 jobs involved in wood product manufacturing and 267 jobs in meat and meat product manufacturing plus 535 in road transport (assume 80% in primary production) which brings the total to over 4,000 or 18% of total regional jobs.

The question remains as to how many other jobs in the region rely on the revenue from these industries passing through the local economy and so would not exist without them. The weighted average of the Statistics NZ multipliers for forestry and sheep and beef would indicate a conservative multiplier of at least 2.5, bringing the total jobs at risk to over 10,000 or almost half the jobs within 2020 Tairawhiti ANZSIC data. Of course, this assumes all class 6-8 land goes into permanent carbon forest.

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[30] 30 Trust Tairawhiti, preliminary to Scion report (2020) on *Comparing green-house gas emissions of onshore and offshore log processing; Gisborne, New Zealand versus China.*

Average wage

Permanent carbon farming

For permanent carbon farming, almost all of the work is in the initial planting. In 2019 silviculture workers earned on average $35,000 per annum[31]. What's more, **there is no further work after the first year except measuring growth and filing emissions returns** which are minor and could well be done by workers outside of Tairawhiti. Satellite imagery and software could well eventually replace both measuring forests and filing returns.

Production Forestry

ANZSIC codes show that the combined forestry and logging average earnings per worker in 2019 in Tairawhiti was $64,900 per annum[32].

Pastoral Farming

ANZSIC codes for agriculture showed average annual earning per worker in 2019 in Tairawhiti was $48,000 per annum[33].

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[31] https://www.stuff.co.nz/business/farming/110212861/400-a-day-forestry-industry-told-to-improve-pay-to-meet-one-billion-tree-planting-target

[32] Source: infometrics

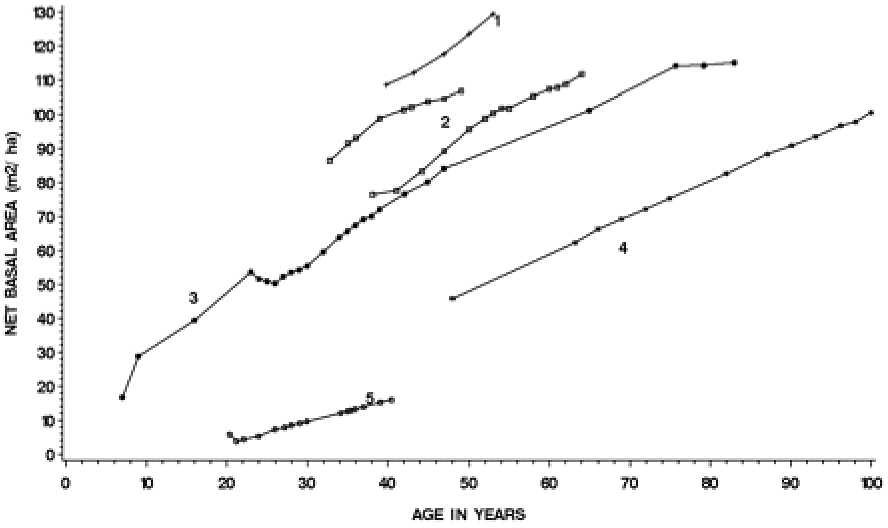
[33] Source: infometrics

ENVIRONMENT

Erosion

Many respondents to the **Eastland Wood Council 2013 report on the Economic Impact of Forestry in the Gisborne region** agreed that *"plantation species intended to halt erosion, need to be harvested and replaced before they die and fall naturally. This requires forest management – silviculture and harvesting, roading and forest engineering.* ***If forest management is not applied the exposure to land erosion risk increases****. This view was affirmed by the Waipaoa River Catchment Study (SCION, 2012)*[34]*".*

Half of a trees dry weight is in carbon and 35% of its wet weight is water[35]. One tonne of carbon is one carbon credit[36]. The MPI Pre-1990 look up tables indicate 1,348 tonnes of carbon is stored per hectare in a fifty-year-old Gisborne pine plantation. This equates to 2,696 tonnes of extra dry weight on the land per hectare at age 50 but its green/wet weight is 3,639 tonnes. It is unknown how long Gisborne pines will grow for but there are 100-year-old pines in New Zealand that are still growing per the table below:



[37]

None of the above older plots are in Tairawhiti. If Gisborne pine increase its 50-year-old weight by 80% at year 100 that is over 6,500 tonnes per hectare of wood on the land. **The uncertainty is whether these forests will remain standing on Tairawhiti erodible hill sides as these permanent forests get well past the normal age for harvesting**. The only thing we could find to go on is the opinions of experienced foresters in the Eastland Wood Council report as referenced back to the SCION report **which indicates a need for more scientific research in this area.** Feedback on the draft of this report from the forestry sector has indicated erosion is more likely to occur from the wrenching effect of mature tree toppling than the weight which is insignificant compared to the weight of the wet soil mantle.

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[34] Institute for Business Research, University of Waikato (2013). *Economic Impact Assessment of the Forest Industry in the Gisborne-Tairawhiti Region.*

[35] https://forestlearning.edu.au/images/resources/*How carbon is stored in trees and wood products*

[36] MPI: Forestry in the Emissions Trading Scheme/Deforesting forest land.

[37] R.C. Woollons, B.R. Manley: *Examining growth dynamics of Pinus Radiata plantations at old ages in New Zealand.* Forestry: An international journal of Forest Research, Volume 85, issue1, January 2012, pages 79-86.

Water Quality

Water Quality Effects from changing Land Use

Lilian Harley, Allegrow Limited

Water quality is a significant issue in New Zealand currently as we all work towards the protection and improvement of water quality in our rivers and streams so that they can be enjoyed by today's population and future generations. Land use can have a significant effect on water quality and this section considers water quality data and findings from scientific studies in relation to land use, and in particular exotic forestry.

A paper was published in 2015 by Baillie and Neary[38] which reviews the key physical, chemical, and biological water quality attributes of surface waters in New Zealand's planted forests. This paper provides a good overview of studies carried out on water quality up until the paper was published. The authors note that water quality in mid-rotation to mature forests, which is a large proportion of the forestry cycle, was highly variable but characterised by cool water temperatures, low concentrations of sediment and nutrients, with aquatic invertebrate community's indicative of high water quality. Land-use comparisons generally showed improving water quality from pasture to planted forest to indigenous forest. Typically, streams from undisturbed native forests and mature undisturbed plantation forests contain lower bacteria counts, fewer suspended solids and lower concentrations of nutrients.

A report prepared by NIWA in 2010[39] considers water quality data in rivers and streams across the country from 1998 to 2007. The report includes data to suggest that sites in the Pastoral and Urban Land-cover categories tended to have the highest nitrogen concentrations and lowest clarity. For forested areas (indigenous and exotic), clarity was high and median TN concentrations were low; however median TN concentrations were higher, and clarity was lower in areas of Exotic Forest than Indigenous Forest.

Forests have a strong influence on catchment hydrology and water quality. Interception and evapotranspiration processes in forests reduce the amount of precipitation reaching the forest floor (Baille and Neary 2015). This results in less run off to streams and less infiltration to groundwater. Water yield averaged approximately 160–260 mm/year, less from pine than pasture, depending on the silvicultural regime. Water yield from the pine forest averaged around 100 mm/year less than from indigenous forest (Beets and Oliver 2005)[40] The reduction in surface water yields flows can be reduced to levels that adversely affect in-stream aquatic ecosystems and existing direct users of the water.

Macroinvertebrates are organisms that are large (macro) enough to be seen with the naked eye and lack a backbone (invertebrate). Macroinvertebrates can be used as an indicator of water quality as they are relatively sedentary, they are sensitive to water quality and they are easy to sample and identify.

A State of the Environment Report (SOE)[41] was prepared by the Gisborne District Council in 2018 based on macroinvertebrate sampling carried out at 81 sites on rivers in the Gisborne region from 2015-2018. Five land use types are considered in the report including indigenous forest, exotic forest,

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[38] Baillie, B.R., Neary, D.G. Water quality in New Zealand's planted forests: a review. N.Z. j. of For. Sci. 45, 7 (2015). https://doi.org/10.1186/s40490-015-0040-0

[39] Ballentine D, Booker D, Unwin M, Snelder T (2010) Analysis of national river water quality data for the period 1998-2007, prepared for the Ministry of the Environment by the National Institute of Water and Atmospheric Research Ltd (NIWA)

[40] Beets, P.N., Oliver G.R. (2006) Water Use by Managed Stands of Pinus Radiata, Indigenous Podocarp/hardwood forest and improved pasture in the central North Island of New Zealand, New Zealand Journal of Forestry Science 37(2): 306-323 (2007) https://scion-web.squiz.cloud/__data/assets/pdf_file/0007/59056/11_BEETS_Water_use.pdf

[41] Roil H, Death R (2018) SOE Report 2015-2018 Aquatic Ecosystems in Gisborne MACROINVERTEBRATE COMMUNITIES August 2018

pasture, urban and cropland. The report concludes that land use and geology have an influence on the health of a stream, with sites that had higher levels of deposited sediment and conductivity having a lower MCI compared to sites with low deposited sediment levels that were found in indigenous or mature exotic forest.

The SOE report states that the invertebrate community composition was different across all metrics between exotic forest and indigenous forest land use. This was different to previous studies that have shown that mature exotic forest can support the same macroinvertebrate communities as indigenous forest. In some areas in New Zealand it has been shown that indigenous forest and exotic forest can support the same macroinvertebrate communities. This was not the case in Gisborne and there was a difference in macroinvertebrate community composition between exotic and indigenous forest. The MCI was highest in indigenous forest and pasture had the lowest MCI scores.

Statistics NZ[42] provides data for the national macroinvertebrate community index (MCI) from 696 sites in rivers across the country from 1998-2017. The data is presented as a comparison between the MCI scores for land covered in native forests compared to urban, pastoral, and exotic forest land. Modelled data indicated that when compared to the native land cover class, median MCI scores were 15% lower (worse) in the pastoral class, and 6% lower (worse) in the exotic forest class.

Of the sites that had trends that could be determined, MCI scores improved at 39 percent of sites and MCI scores worsened at 61 percent of sites. This pattern was observed in land cover classes for native, pastoral, and urban land where there were more sites that worsened than improved. In the exotic forest land cover class there were similar numbers of sites that improved as worsened. The land cover class with the greatest proportion of sites with worsening trends was native for MCI.

There are a large number of scientific papers that have been prepared comparing differing land uses and their effects on water quality, a few of these have been considered above. The majority of scientific studies in regard to water quality to date are for pine forests which will be harvested and replanted. There are obvious water quality issues associated with the harvesting of pine forests including sediment loss, habitat loss and the potential for slash to end up in waterways. These issues would not be present for permanent exotic forests that are not harvested.

To date permanent exotic forests are not commonplace and therefore water quality data specific to waterways in these forests are not available. The general theme in the scientific studies is that water quality in native forests is the highest, however water quality in exotic forests in not far behind. This is because exotic forests up until they are harvested, provide good shading which provides cooling for the waterways and woody debris provides a good habitat for macroinvertebrates and other stream life.

While there can be some bacterial and sediment contamination from populations of wild deer, pigs or waterfowl in exotic forestry, this is generally not to the scale as pastoral farming and therefore in general terms the water quality is better. The fencing of waterways from livestock and the planting of riparian margins to provide shade can contribute towards improved water quality in waterways where the land is used for pastoral farming. However, particularly in Tairawhiti where extensive sheep and beef farming on hill country is prevalent it is not practical to do this for all of the waterways.

LL Harley

Lilian Harley, Allegrow Limited

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[42] Statistics New Zealand website https://www.stats.govt.nz/indicators/river-water-quality-macroinvertebrate-community-index

Biodiversity

Author: Steve Sawyer,

Director,

Ecoworks NZ Ltd.

12th March 2021

Biodiversity within Pinus Radiata Forest - Te Tairawhiti.

The following summarises the field experience gained after thirty years of biodiversity management experience across New Zealand, the Chatham, Pacific and Hawaiian Islands and seventeen years of biodiversity survey, monitoring and restoration within both indigenous and exotic *P.radiata* production forest within the Tairawhiti Region.

Ecoworks NZ has been involved with a number of forest production companies within Tairawhiti since 2004 both surveying and monitoring rare and threatened species, botanical values and implementing pest and habitat management programmes for species such as the endangered long-tailed bat, brown kiwi, NZ falcon and rare plants. Ecoworks NZ has produced a number of management plans for clients aimed at enhancing the reproductive success of threatened species within largely exotic forest environments. These sites have included remnant and generally small highly modified indigenous forest areas lying within a larger landscape of *P.radiata* production forest and conservation planting areas, which generally includes species such as introduced *Salix* (willow), and *Populus* (Poplar), seral scrub forest and wetland habitats.

Radiata production forest within our region appears to have a significantly limited ability to sustain the range of endemic and native species historically found within our region. Ecosystem function as we know it within New Zealand indigenous forests is vastly different from exotic radiata forest environments which have evolved within North America. Indigenous ecosystem processes which have occurred for many millions of years within New Zealand and which many of our endemic species rely on, do not exist within radiata production or radiata carbon ‘farming’ Units.

Pine forests are literally an alien environment for the vast majority of endemic species within New Zealand. Indigenous forests have evolved over 70+ million years as have the species within them, i.e. *Powelliphanta* snails, long-tailed bat and rifleman.

Some species however appear to have adapted rapidly to radiata production forest sites and populations appear to be increasing, however the number of species is significantly reduced compared to what would be present within an indigenous New Zealand forest habitat.

The Gisborne Region has lost c.84% of its original native forest cover (Ewers *et al*. 2006) and c.98% of its wetlands (Gisborne District Council 2016). This has caused catastrophic biodiversity loss for iconic taonga species such as our national icon the brown kiwi, brown teal, matuku, crake, native bats, blue duck, *Dactylanthus*, kokako, native mistletoe, yellow and the red crowned kakariki, titi and kaka to name but a few species. You can add another 57 extinct New Zealand birds to this list (Gill & Martinson 1991)

Very few primary remnants remain within Tairawhiti (26%), and those which do remain are highly impacted and are continually modified by introduced pest species such as deer, goat, ship rat, possum, feral cat and mustelids (stoat, ferret and weasel). This has caused a catastrophic loss of biodiversity within Tairawhiti. Many forest areas are still suffering the sustained loss of endemic species within our region at the moment. Areas which Ecoworks NZ staff have surveyed and contained whio (blue duck) and brown kiwi less than a decade ago now show no signs of these species remaining after exhaustive survey using remote, spectral sonograph acoustic recording technology.

1.0 Species

Many of our endemic species rely on intact and functional indigenous forest ecosystems which contain a wide diversity of forest species, quality habitat and intact forest tiers to support breeding, feeding and insulation from winter weather, i.e. North Island tomtit and rifleman. Many species such as kaka, kakariki and North Island robin rely on low to moderate vertebrate pest species populations to enable annual reproductive success. Some of these species are included below.

1.1 Eastern NI Brown Kiwi

Kiwi can survive in a wide range of habitat types. Within the Tairawhiti region this includes seral scrub and broadleaf successional forest, mature indigenous podocarp-hardwood and beech forest. At Motu we have kiwi surviving on grazed hill-country farmland which contains small pockets of regenerating manuka – broadleaf forest. During 2019 we believe we found evidence of kiwi located within Huanui production forest (kiwi prints -right (*Photo:* D.Laffey) near Tolaga Bay. Further investigation by the forest company has not been supported and no vertebrate pest control has been implemented to protect this area effectively for kiwi.

Kiwi rely on low vertebrate pest densities, particularly stoat and ferret, otherwise breeding is not successful with 95% of chicks being predated by stoats annually (Dr J. Maclennan, Lk Waikaremoana Research 1990's). Ideally kiwi also require native forest habitat which is damp and provides a wide range of food types and worms which are captured by bill probing. Dry mono-culture pine habitats generally do not provide this quality habitat as evidenced by underweight kiwi chicks requiring supplementary feeding at some locations.

Right – A kiwi chick roost burrow within closely spaced *P.radiata* plantings in Hawkes Bay. A sub-standard dry habitat with limited capacity to provide invertebrates and fruit as required to effectively sustain kiwi and other endemic species (*Photo:*Ecoworks NZ)

1.2 North Island Kaka

Kaka have been recorded within central North Island pine forest however again this is not preferred habitat. Pine forest does not contain the target food species; honey-dew, nectar, fruit, seed material and variety of invertebrates that indigenous forests provide, nor does it not provide mature hollow trees suitable for nesting. In my experience key pest species which prey on kaka and their chicks are also not managed within pine forest in Tairawhiti. This includes stoats, feral cat and ship rat.

Kaka are becoming very rare within Tairawhiti (Ecoworks NZ, *pers.obs*). The loss of native forest habitat, stoat predation and replacement with pine has contributed to this loss.

1.3 Long-tailed Bat

The Department of Conservation and IUCN (International Union for Conservation of Nature) rank the conservation status of this species as 'Nationally Vulnerable'. It is found within radiata forest within Tairawhiti however appears to use both mature pine and streamside willow, silver poplar and young native species as temporary roosting habitat only.

Our experience after seventeen years of bat survey within Tairawhiti is that healthy bat populations are associated with nearby mature native forest remnants. Protected native forest micro-climates which contain mature podocarp or beech, cavity bearing (hollow) trees of sufficient age to provide breeding sites for long-tailed bats.

Pinus radiata forest harvested at age 30-35 years does not provide these valuable and key habitat features. The indigenous trees which do provide suitable cavity bearing, breeding sites for bats are generally indigenous tree species such as kahikatea that are centuries old and have been used by successive generations of bat.

Bats are also impacted by a range of predator species including ship rat, stoats and feral cat. Control of these species to a sufficient level does not occur within Tairawhiti *P.radiata* forests.

1.4 North Island Tomtit and Rifleman

Tomtit are found in low numbers within some Tairawhiti pine forests, i.e. Waimata and Riverside Roads area. Harvesting at year 30-35 destroys these populations. NI tomtit require reasonably dense forest tiers which provide invertebrates and insulation against winter winds. NI tomtit are more common and appear to survive better within protected indigenous hardwood-podocarp forest habitats within our region.

We have not recorded rifleman within Tairawhiti radiata forest compartments. This species is common at Motu within predator (ship rat) managed areas however does not appear to survive well in radiata forest within Tairawhiti or in radiata forest at Cape Sanctuary, Hawkes Bay where it is predator free. Native forest plantings or existing cover provides both insulation and target invertebrate food sources for this species.

1.5 Tui, Bellbird and Kereru

These three species are relatively common across New Zealand except for north of Auckland where bellbird are extremely rare or locally extirpated, i.e. Leigh-Warkworth (G.Murman, *pers.comm*).

Pinus radiata does not provide a food source or habitat of sufficient quality to support strong populations of these iconic species. All three are found in low densities within radiata forests across Tairawhiti however they are all reliant on adjacent indigenous forest remnants for seasonal target food types such as karamu, tawa, pigeonwood, kahikatea and kowhai. Mixed forest types with relatively low pest densities are an ecological requirement for these species. These species are quite common within our cities such as Gisborne because pest numbers (particularly ship rat and stoat) are low and a wide mix of tree species both exotic and native are available as a food source. Radiata mono-cultures are not sufficient to protect and sustain robust populations of these three key species.

1.6 North Island Robin

This species should be abundant within Tairawhiti and is now range restricted. We have never recorded this species within Tairawhiti radiata forests though it does occur within central North Island production pine forests. This appears to be because ship rat populations are lower within colder climate forests on the central plateau. Our experience is that radiata forest in this region does not successfully support NI robins. This has also been seen in Hawkes Bay. NI robin did not survive well within radiata forest at Cape Sanctuary however bred successfully within indigenous coastal forest immediately adjacent, possibly where invertebrate densities were higher where robins spend significant time foraging in leaf litter and within the shrub layer.

1.7 Native Mistletoe, 'Woodrose' and Orchids.

Both endemic red and green mistletoe species within Tairawhiti do not survive on *Pinus radiata* as a host tree. Indigenous beech is required for red mistletoes (*Peraxilla*) and kohuhu, mahoe and other broad-leaved native spp. are required as green mistletoe host tree species.

Dactylanthus or 'Wood-rose' is an ancient plant and is indigenous to New Zealand forests. It is found between Mahia and Te Araroa within some remnant indigenous forest areas. It does not live on *Pinus radiata* host roots. Many of our native orchid species also do not live on *P.radiata* as a host tree. Where hanging tree and spring orchids are common in forest production areas such as Te Kopua, 40 kms south of Gisborne they only occur on peripheral and riparian native tree species such as putaputaweta and kohuhu.

1.8 Striped Skink

The endangered striped skink is found within the Tairawhiti region. It is rare and was discovered in 2018 (Ecoworks NZ Ltd.) and has its own DOC species recovery taxon plan. This species requires indigenous forest habitat and particularly mature totara, podocarp-hardwood forest where it lives amongst epiphytic canopy plants growing on old age forest trees. This species is not recorded within *P.radiata* mono-culture forest areas. It is highly unlikely that radiata pine would provide the epiphytic habitat requirements that this specialist climbing skink would require to survive.

1.9 Whitehead

This endemic species appears to survive and breed relatively well within *P.radiata* forests within Tairawhiti. They are an insectivorous species residing predominantly within the forest canopy tier. We have recorded this species in *P.radiata* forests mainly within the Waingake, Te Kopua, Wharerata and Waimata Production Forests.

1.10 Karearea (NZ Falcon)

Ecoworks NZ has been monitoring this species alongside Aratu Forests Ltd since 2005. All Aratu (prev HFF) forests appear to contain falcon pairs.

Right - NZ falcon in the head of a post-harvest Waimata Catchment, Aratu Forest (Photo: Ecoworks NZ)

After many hours of remote camera monitoring, we have discovered that many nests are destroyed by feral cat and possum however breeding appears to be sufficient within *P.radiata* forests to see a gradual population increase (Ecoworks NZ Ltd. *Pers.obs*). *P.radiata* production forests provide a range of tree stand age cohorts which cater for falcon nesting, raising juveniles and habitat to provide a range of target food species such as starling, rock pigeon, yellowhammer, greenfinch, redpoll etc.

Carbon farms with a high radiata planting density per hectare will not provide features such as mixed age class tree stands and open ground for nesting. However they will likely produce an increase in predator densities which will impact negatively on this threatened and protected species. Particularly feral cat, possum and mustelids.

2.0 Indigenous Forest Plant Species and Habitat

Ecoworks NZ has been undertaking botanical surveys within radiata production forest since 2004. Our experience indicates that radiata forest contains a limited diversity of indigenous forest species.

Most production forest understorey forest tiers within Tairawhiti are dominated by shade tolerant broadleaf species such mingimingi, mahoe, rangiora, karamu, pate, kotukutuku, five-finger, makomako, manuka, putaputaweta, tree ferns and a range of less palatable ground ferns such as *Hyplolepis*, shield fern, kio-kio fern etc. Due to the 30–35-year harvest cycle, the climax canopy hardwood, podocarp and beech species do not have the ability to establish to sub-canopy or canopy levels. Within most radiata production forest areas, we record seedling and shrub tiers dominated by young *Dicksonia* and *Cyathea* ferns and broadleaf species, particularly non palatable species such as mingimingi (*Cyothodes*), manuka and makomako. This produces an extremely limited species diversity and in turn poor habitat for most of our endemic invertebrate, reptile and bird species. Prior to harvest most indigenous plants have grown to c.4-6 metres in height; a tall shrub layer and not sufficient to be defined as effective sub-canopy. This contributes very limited environmental services benefit for our wildlife with regard to seed material volume produced and species diversity, or protection from winter weather conditions which are required by many of our forest bird species.

Right – Intact native forest showing emergent podocarps growing over a sub-canopy tier of tarata, tawa, hinau and tree ferns providing a wide diversity of seed, invertebrate species and insulation from extreme weather conditions supporting several hundred native species.

Because this native sub-canopy and/or canopy of older indigenous podocarp, hardwood or beech has not had sufficient time to establish (<35 years) we then see a very limited ability to support species such as rifleman, bats, kereru, robin, tomtit, bellbird and many more. Tree species such as tawa, kohekohe, hinau, beech, kahikatea, matai, miro and many more are not present as mature trees, fruit species diversity and production is highly restricted therefore radiata forests in our experience do not support the variety of native species which would be present within a functional and intact indigenous forest habitat.

3.0 Pest Species in Tairawhiti Pine Forests

After seventeen years of monitoring biodiversity within radiata production forest it is unequivocal that quality animal and weed pest control is a low priority for most forest production companies. Vertebrate pest control to protect rare, threatened, or endangered species (RTE's) is not a priority and is not sustained at a level which sufficiently protects biodiversity values.

Most Tairawhiti forests both native and production contain c.15 vertebrate pest species (Ecoworks NZ Te Kopua Report 2018). Environmental management and pest control plans are in place for the companies we have worked with to meet FSC requirements, RTE species guidelines and regional unitary authority RPMS requirements regarding possum management, particularly around TB control. However pest control only appears to be a major consideration if and when juvenile *Pinus radiata* are under threat from introduced deer or goats or for example RPMS regional boundary or residual trap catch requirements are to be met for possum control.

Aerial or ground culling of goats and deer is generally undertaken prior too or shortly after planting pine seedlings as ungulates will bite the terminal shoot out of a young pine seedling.

As the trees grow rapidly and become less attractive to browsers very little vertebrate pest control takes place thereafter. Several companies do contract possum control operators and possum population auditing (RTC) contractors to reduce possum densities however this does not appear to be aimed at protecting indigenous forest remnants or identified ecological values at specific sites, i.e. kereru, kawaka stands, bat roost forest remnants. A number of options have been looked at with contractors paying their own way, i.e. plucking and skinning possums or culling and selling goat meat. This all depends however on current market climates and currently possum fur is at a low price therefore possum populations are building within pine areas and in turn impact on indigenous remnants within and surrounding radiata forest areas.

In our experience it seems forest company owners, shareholders and directors are hesitant to spend money on biodiversity protection even though it is an FSC requirement. FSC Indicator 10.5.2 states that 'A minimum area of reserve set-asides of 10% or equivalent by Ecological District and if not possible then Ecological Region shall be managed to be protected and/or restored to natural vegetation over time'.

In our view this rarely, if ever occurs and the majority of native forest remnants are severely modified and negatively impacted by vertebrate pest browse with seedling, shrub and sub-canopy tiers highly modified by browsing goat, deer, possum and sometimes feral cattle. Often the tree canopy is present within small remnant native stands however lower tiers are often missing altogether which then causes the erosion of sediment into streams and loss of freshwater ecosystems and downstream marine habitats.

Above Right –*Pinus radiata* at Tutamoe, Gisborne after significant slipping into and across a waterway impacting a range of species and freshwater habitats downstream.

Unless pest management is a legal requirement or there is a capital cost incurred on the company's investment, i.e. pine seedling damage, the level of pest control required to achieve ecological benefit generally does not appear to happen.

It is therefore highly likely that carbon farming practices will follow suite. Some goat and red deer control is likely to take place at early stages to protect the capital investment in seedlings. As we understand it trees are planted at a higher density per hectare therefore these sites will become difficult sites to successfully control all pests to a low level using either ground trappers, cullers or aerial control methods as is done currently. Within the current climate aerial 1080 use is an unlikely option. These forests will likely become reservoirs for feral deer and goats which will impact on surrounding ecological and freshwater ecosystem values and services and neighbouring farmland unless sustained ungulate control is carried out using standardised control and monitoring methodology as developed by DOC, Landcare Research and the NPCA.

These sites will also become sheltered and favoured sites for other invasive pest species such as possum, stoat, feral cat, weasel, ferret, hedgehog, hare and rabbit as has been recorded within other *Pinus radiata* compartments, a dry sheltered habitat is created which provides excellent cover however pest species will travel significant distances to target preferred food types which impacts on adjacent indigenous forests and productive farmland. For example a feral red deer will eat c.1.3 kg of dry matter per day, a significant impact on indigenous vegetation and adjacent farming operations as deer egress out of cover to feed at night.

The benefit to native or endemic species from developing large areas of densely planted mono-cultures of *Pinus radiata* will in my view be negligible.

Above - A remote monitoring camera showing two possums eating NZ falcon eggs from a nest at Huanui Forest, Tolaga Bay and feral goats, a common site within East Coast Forests.

Common name	Species	Common name	Species
European rabbit	*Oryctolagus cuniculus*	Feral goat	*Capra hircus*
Hare	*Lepus europaeus*	Feral pig	*Sus scrofa*
Brushtail possum	*Trichosurus vulpecula*	Mouse	*Mus musculus*
Norway rat	*Rattus norvegicus*	Stoat	*Mustela erminea*
Ship rat	*Rattus rattus*	Ferret	*Mustela furo*
Red deer	*Cervus elephus*	Weasel	*Mustela nivalis*
Fallow deer	*Dama dama*	Feral cat	*Felis catus*
Hedgehog	*Erinaceus europaeus*		

The list of vertebrate pest species commonly found throughout both indigenous and *Pinus radiata* forests within Tairawhiti (Ecoworks NZ Survey Data 2019)

4.0 Summary

There is no question in my view that the diversity and density of invertebrates, moths, butterflies, native snails, worms, beetles, weta, skinks, geckos, birds and plants found within a mono-culture *Pinus radiata* forest is markedly less than what is found within an indigenous forest habitat. For example a North Island brown kiwi eats a variety of native worms, brown and manuka beetles, miro, matai and hinau fruit, freshwater koura, spiders and many other invertebrates. Only a fraction of these species are found within *Pinus radiata* mono-culture forests.

Native forest sites have the ability to support our iconic and ancient taonga species which make New Zealand incredibly unique, species such as our kereru, one of the largest pigeon species in the world and the only bird capable of transporting large tawa, puriri, karaka and other 'drupe' fruits, working as 'aerial seed dispersers across New Zealand to sustain native forests. The tui and bellbird who open a red mistletoe flower with a twist of their bill and are showered in golden pollen. Processes that have evolved over millions of years only in New Zealand.

New Zealand contains at least 179 species of native earthworm and over 1400 species of native snail and estimates are that we have 21,000 species of invertebrate which have evolved over millennia within New Zealand. These are all very important species found within the New Zealand ecological jigsaw which all contribute an important and individual role within our ecosystems. By modifying landscapes and planting monocultures of dense pines these species which have evolved within their finely tuned ecological niche can no longer exist, these species inevitably lose habitat and become extinct.

Ecoworks NZ Ltd. has been involved with threatened species management and habitat restoration for over thirty years. When we design a restoration project with a client to rebuild habitat and or restore species within New Zealand, we do not choose *Pinus radiata* as the primary forest rehabilitation species. There is a very good reason for this, it does not provide a high-quality habitat to support a diverse suite of endemic or native New Zealand species from the invertebrates through to our unique reptiles and bird species found only in New Zealand. The Department of Conservation technical advisory groups and Iwi partners would absolutely not allow us to translocate native, threatened or endemic species into a *Pinus radiata* forest habitat. I believe this tells the story.

If you require any further information regarding this note, please contact Steve Sawyer at Steve@ecoworks.co.nz or 027-209-6049.

Best,

Steve Sawyer

Director

Ecoworks NZ Ltd.

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Transitioning exotic forests to native forests

As discussed in the economic section the most significant hurdle in transitioning exotic forests to native is the financial implications of paying carbon credits back under the ETS. However, if this hurdle can be overcome the next hurdle is physical.

This is an area where the research is scant but the few papers in the area all recommend that more work is needed on how to physically intervene to manage the transition from exotic to native forests and that **the amount of physical intervention needed is significant and costly**.

Particularly on point is the research paper by Dr Adam Forbes "Transitioning Plantations to Native Forest"[43]. There are a number of points from this paper:

- *"When managed under a permanent forest regime, the opportunity presented by exotic plantations as a nurse for native forest restoration is significant for Aotearoa and is deserving of greater levels of investigation and support*
- *none of this is certain without adequate forest management. Transitioning plantations requires an ecological basis to forest management, which is in contrast to our tried-and-true exotic forestry techniques of establishing, tending and harvesting exotic tree stands. Permanent forest management, to be truly permanent, must address threats to regeneration and succession.*
- *Native species regeneration within exotic plantations is shaped by climatic constraints, meaning realistically, that recruitment of native species in plantations will require greater levels of intervention in less favourable climates. This leaves a subset of our exotic plantation estate suitable for potential use as a nurse for permanent native forest.*
- *Another key consideration in today's landscapes is the level of browser pressure (e.g., from feral ungulates such as deer and goats, and possums) on understorey regeneration and how successfully the damage by browsers can be reduced to enable diverse regeneration and succession.*
- *credible permanent forest models involving native regeneration will in most areas require significant investment in sustained browser control, whether it be through quality fencing or browser population control. In some localities other pests that threaten regeneration and succession, such as invasive vines or shade tolerant weeds, will also require comprehensive control which the forestry operation will need to address.*
- *Another reality which is central to a successful transition to native forest is the ability of native tree species to establish themselves in plantations, particularly the old-growth species which have desirable traits in terms of forming diverse, independent and long-lived native forests. Where seed sources or dispersers are scarce, these old-growth species might need to be reintroduced to plantations in some way and this action of subsidising dispersal limitation through enrichment planting is an important part of managing the transition.*
- ***We should be critical of proposals where transitions to native forest are being sold without the fundamental management being put in place to ensure adequate native regeneration and succession will occur**." (emphasis added)*

In short, transitioning an exotic forest to native species requires a significant investment in physical interventions over a long period of time. This coupled with the ETS cost in doing so means that without regulation many forests are at risk of never transitioning even where the marketing of the investments says it is their intention to do so.

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[43] Forbes, A. S. (2021). *Transitioning Plantations to Native Forest*, featured in the Pure Advantage campaign O Tātou Ngāhere Our Forest. https://pureadvantage.org/transitioning-plantations-to-native-forest/

In a later article Dr Forbes states “We have some pretty chunky issues around native forest regeneration, like feral animals [and] weed issues, which are really tough to tackle at scale, the active management required for that sort of forestry, when you start doing it at the scale of 10,000 hectares or more, requires such a lot of work that it becomes unmanageable.”

“If they don't get it right, we’re going to end up with large areas of pine that will be hell-of-a-difficult to work with, and probably harbouring a lot of pests, if it’s not managed,” he said. “The pines will only live for up to 200 years, we think, so what are future generations going to be left with... if they’re not successful in getting a native canopy away in some of these areas?”[44]

Fire Risk

Feedback on the draft report raise concerns about fire risk in permanent forests. We ran these concerns past MPI and received the following statement:

“Permanent exotic carbon forests may pose serious fire risks depending upon whether adequate fire risk mitigation is put in place for these forests. For- harvest forest companies in Tairawhiti typically have fire risk management plans in place including fire infrastructure, equipment and trained staff able to help respond in a fire event. Better information is needed on risks and whether and how carbon farmers will mitigate and manage fire risk. Fire and Emergency Management New Zealand has a duty to promote fire safety and provide fire prevention and response services working with local stakeholders to achieve these aims collaboratively. Some Council’s have also included fire risk management rules in district or regional plans where there are particular risks. The National Policy Statement for Plantation Forests currently does not address fire or non – harvest plantations. In the absence of adequate fire risk mitigation the costs of fire risk management potentially fall on the wider community including, FENZ, forest neighbours and the environment.”

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[44] **https://www.stuff.co.nz/environment/climate-news/125508000/carbon-farmers-bought-swathes-of-nz-promising-to-create-native-forests--but-researchers-doubt-it-will-work**

POTENTIAL SOLUTIONS

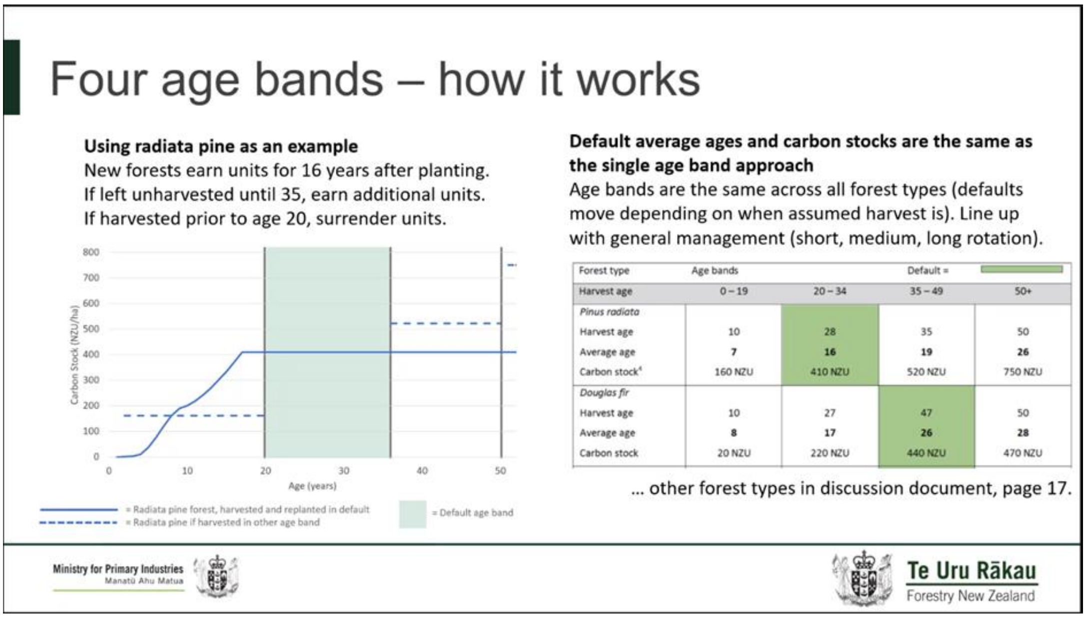
Whenever markets fail to provide sufficient protection to future generations, if the issue is big enough, central and local Government steps in with regulation. Regulation is not for market participants with good behaviour, rather to curb or prevent the worst behaviours or outcomes.

If there is a desire to have permanent exotic carbon farming regulated then ideas on how to regulate it should be consulted with experts in the fields concerned, including but not limited to those experts from the main industries and stakeholders concerned including forestry and farming and Iwi.

Requiring consent for permanent exotic carbon farming is an obvious solution as it would allow for decisions to be made at the regional level which will take into account regional variations in environmental factors. It could be made possible with relative ease by variations to the Resource Management (National Environment Standards for Plantation Forestry) Regulations 2017 to include permanent and semi-permanent carbon farming **or by the creation of separate regulation**.

The technical challenge will be at what point in time the resource consent is required and what conditions must be met to get consent.

If resource consent is required at the time of planting this will fail to capture and regulate the 90% of Tairawhiti's existing exotic forests that are already in the ground and can be left as permanent forests. Intention is not evident, and cannot be monitored so it can't be an intention test. However, if exotic forests required a resource consent to take them past a certain size and age this would capture existing exotic forests without impeding production forestry with further regulation. To an extent MPI has already done work on this in modelling age bands for the averaging method:



Four age bands – how it works

Using radiata pine as an example
New forests earn units for 16 years after planting.
If left unharvested until 35, earn additional units.
If harvested prior to age 20, surrender units.

Default average ages and carbon stocks are the same as the single age band approach
Age bands are the same across all forest types (defaults move depending on when assumed harvest is). Line up with general management (short, medium, long rotation).

Forest type	Age bands		Default =	🟩
Harvest age	0 – 19	20 – 34	35 – 49	50+
Pinus radiata				
Harvest age	10	28	35	50
Average age	**7**	**16**	**19**	**26**
Carbon stock[4]	160 NZU	410 NZU	520 NZU	750 NZU
Douglas fir				
Harvest age	10	27	47	50
Average age	**8**	**17**	**26**	**28**
Carbon stock	20 NZU	220 NZU	440 NZU	470 NZU

… other forest types in discussion document, page 17.

Ministry for Primary Industries
Manatū Ahu Matua

Te Uru Rākau
Forestry New Zealand

The above would suggest for example resource consent be required to take Pinus radiata forests past 35 years of age and Douglas-fir past 50 years old.

The difficulty will be in determining the conditions for resource consent to be met. Because permanent exotic forests are just that, a permanent land use change, we suggest the technical experts should focus on the wellbeing, environmental and financial implications for generations after the carbon runs out in determining the tests. That is, we should be stepping into the shoes of our grandchildren.

Disclaimer

This report has been prepared soley for the purposes stated herein and should not be relied on for any other purposes. We accept no liability to any party should it be used for any purpose other than that for which it has been prepared.

This report is strictly confidential and (save to the extent required by applicable law and/or regulation) must not be released to any third party without our express written consent which is at our sole discretion.

To the fullest extent permitted by law, BDO and BDO Gisborne Ltd accepts no duty of care to any third party in connection with the provision of this report and/or any related information or explanation (together, the "information"). Accordingly, regardless of the form of action, whether in contract, tort (including without limitation negligence) or otherwise, and to the extent permitted by applicable law, BDO and BDO Gisborne Ltd accepts no liability of any kind to any third party and disclaims all responsibility for the consequences of any third party acting or refraining to act in reliance on the information.

We have not independently verified the accuracy of the information provided to us and have not conducted any form of audit in respect of the organisation for which the work is completed. Accordingly we express no opinion on the reliability, accuracy, or completeness of the information provided to us and on which we have relied.

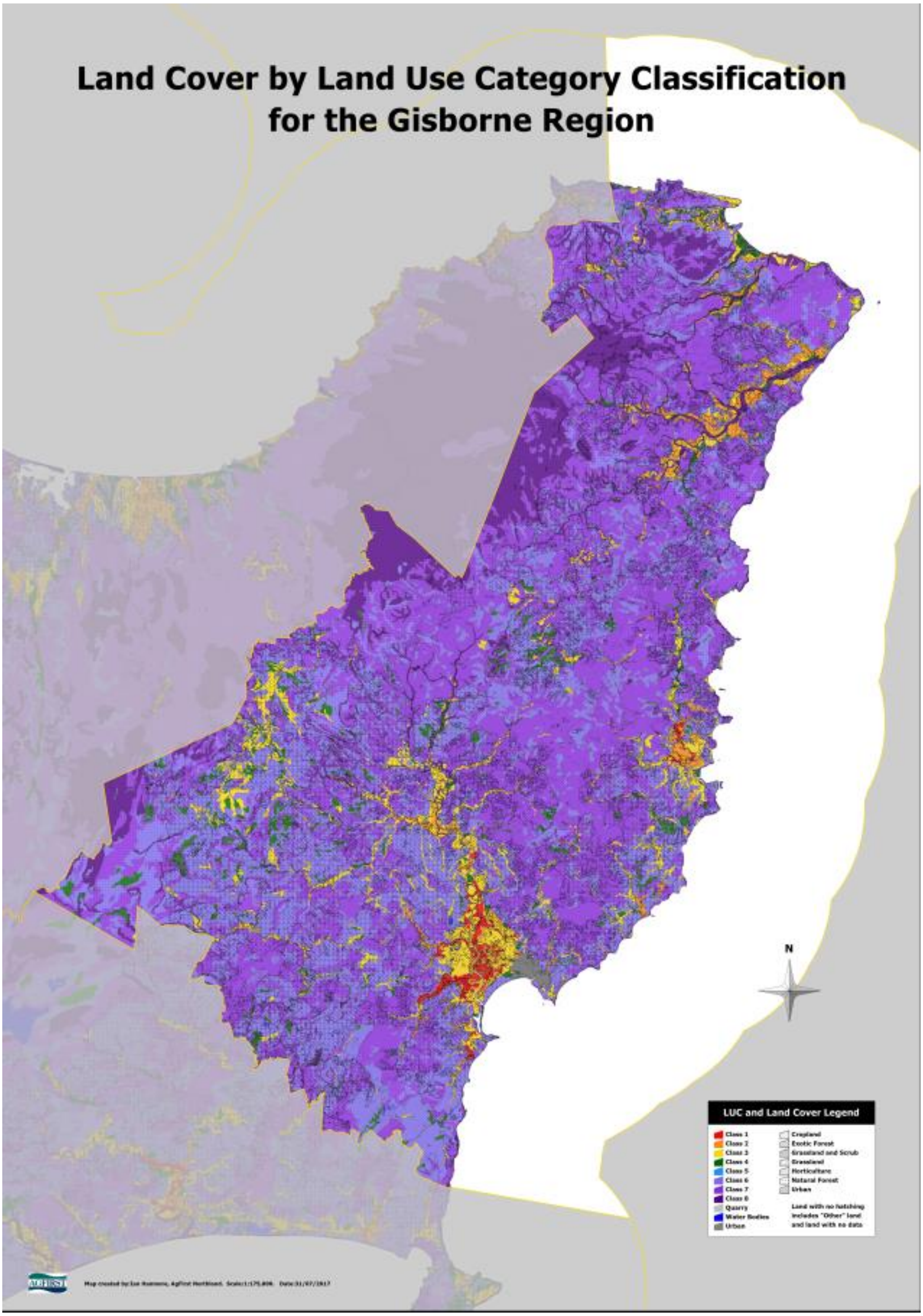
The statements and opinions expressed herein have been made in good faith, and on the basis that all information relied upon is true and accurate in all material respects, and not misleading by reason of omission or otherwise.

The statements and opinions expressed in this report are based on information available as at the date of this report.

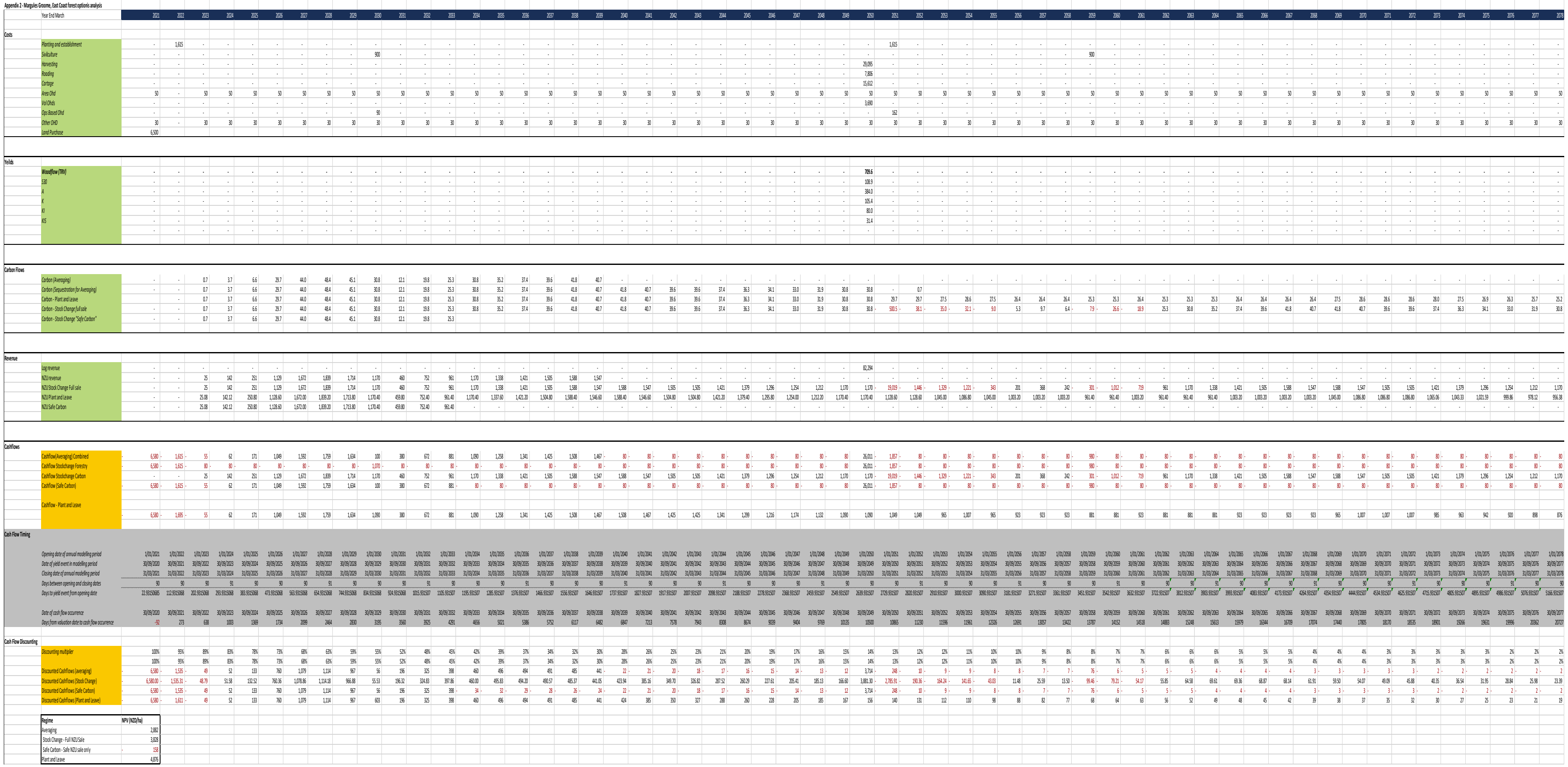
We reserve the right, but will be under no obligation, to review or amend our Report, if any additional information, which was in existence on the date of this report, was not brought to our attention, or subsequently comes to light.

This report is issued pursuant to the terms and conditions set out in the contract between Trust Tairawhiti and BDO Gisborne Limited dated 4 March 2021.

Appendix 1


Land Cover by Land Use Category Classification for the Gisborne Region
N
LUC and Land Cover Legend
Class 1
Class 2
Class 3
Class 4
Class 5
Class 6
Class 7
Class 8
Quarry
Water Bodies
Urban
Cropland
Exotic Forest
Grassland and Scrub
Grassland
Horticulture
Natural Forest
Urban
Land with no hatching includes "Other" land and land with no data
AGFIRST
Map created by: [illegible], AgFirst Northland. Scale:1:175,000 Date:31/07/2017

Appendix 2



Appendix 2 - Margules Groome, East Coast forest optionis analysis

	Year End March	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Costs																					
	Planting and establishment	-	1,615	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sivilculture	-	-	-	-	-	-	-	-	-	900	-	-	-	-	-	-	-	-	-	-
	Harvesting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Roading	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cartage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Area Ohd	50	-	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	Vol Ohds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Ops Based Ohd	-	-	-	-	-	-	-	-	-	90	-	-	-	-	-	-	-	-	-	-
	Other OHD	30	-	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
	Land Purchase	6,500																			
Yeilds																					
	Woodflow (TRV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	KI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	KIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Flows																					
	Carbon (Averaging)	-	-	0.7	3.7	6.6	29.7	44.0	48.4	45.1	30.8	12.1	19.8	25.3	30.8	35.2	37.4	39.6	41.8	40.7	-
	Carbon (Sequestration for Averaging)	-	-	0.7	3.7	6.6	29.7	44.0	48.4	45.1	30.8	12.1	19.8	25.3	30.8	35.2	37.4	39.6	41.8	40.7	41.8
	Carbon - Plant and Leave		-	0.7	3.7	6.6	29.7	44.0	48.4	45.1	30.8	12.1	19.8	25.3	30.8	35.2	37.4	39.6	41.8	40.7	41.8
	Carbon - Stock Change full sale	-	-	0.7	3.7	6.6	29.7	44.0	48.4	45.1	30.8	12.1	19.8	25.3	30.8	35.2	37.4	39.6	41.8	40.7	41.8
	Carbon - Stock Change "Safe Carbon"	-	-	0.7	3.7	6.6	29.7	44.0	48.4	45.1	30.8	12.1	19.8	25.3							
Revenue																					
	Log revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NZU revenue	-	-	25	142	251	1,129	1,672	1,839	1,714	1,170	460	752	961	1,170	1,338	1,421	1,505	1,588	1,547	-
	NZU Stock Change Full sale	-	-	25	142	251	1,129	1,672	1,839	1,714	1,170	460	752	961	1,170	1,338	1,421	1,505	1,588	1,547	1,588
	NZU Plant and Leave	-	-	25.08	142.12	250.80	1,128.60	1,672.00	1,839.20	1,713.80	1,170.40	459.80	752.40	961.40	1,170.40	1,337.60	1,421.20	1,504.80	1,588.40	1,546.60	1,588.40
	NZU Safe Carbon	-	-	25.08	142.12	250.80	1,128.60	1,672.00	1,839.20	1,713.80	1,170.40	459.80	752.40	961.40	-	-	-	-	-	-	-
Cashflows																					
	Cashflow(Averaging) Combined	-6,580	-1,615	-55	62	171	1,049	1,592	1,759	1,634	100	380	672	881	1,090	1,258	1,341	1,425	1,508	1,467	-80
	Cashflow Stockchange Forestry	-6,580	-1,615	-80	-80	-80	-80	-80	-80	-80	-1,070	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80
	Cashflow Stockchange Carbon	-	-	25	142	251	1,129	1,672	1,839	1,714	1,170	460	752	961	1,170	1,338	1,421	1,505	1,588	1,547	1,588
	Cashflow (Safe Carbon)	-6,580	-1,615	-55	62	171	1,049	1,592	1,759	1,634	100	380	672	881	-80	-80	-80	-80	-80	-80	-80
	Cashflow - Plant and Leave	-6,580	-1,695	-55	62	171	1,049	1,592	1,759	1,634	1,090	380	672	881	1,090	1,258	1,341	1,425	1,508	1,467	1,508
Cash Flow Timing																					
	Opening date of annual modelling period	1/01/2021	1/01/2022	1/01/2023	1/01/2024	1/01/2025	1/01/2026	1/01/2027	1/01/2028	1/01/2029	1/01/2030	1/01/2031	1/01/2032	1/01/2033	1/01/2034	1/01/2035	1/01/2036	1/01/2037	1/01/2038	1/01/2039	1/01/2040
	Date of yield event in modelling period	30/09/2020	30/09/2021	30/09/2022	30/09/2023	30/09/2024	30/09/2025	30/09/2026	30/09/2027	30/09/2028	30/09/2029	30/09/2030	30/09/2031	30/09/2032	30/09/2033	30/09/2034	30/09/2035	30/09/2036	30/09/2037	30/09/2038	30/09/2039
	Closing date of annual modelling period	31/03/2021	31/03/2022	31/03/2023	31/03/2024	31/03/2025	31/03/2026	31/03/2027	31/03/2028	31/03/2029	31/03/2030	31/03/2031	31/03/2032	31/03/2033	31/03/2034	31/03/2035	31/03/2036	31/03/2037	31/03/2038	31/03/2039	31/03/2040
	Days between opening and closing dates	90	90	90	91	90	90	90	91	90	90	90	91	90	90	90	91	90	90	90	91
	Days to yield event from opening date	22.93150685	112.9315068	202.9315068	293.9315068	383.9315068	473.9315068	563.9315068	654.9315068	744.9315068	834.9315068	924.9315068	1015.931507	1105.931507	1195.931507	1285.931507	1376.931507	1466.931507	1556.931507	1646.931507	1737.931507
	Date of cash flow occurrence	30/09/2020	30/09/2021	30/09/2022	30/09/2023	30/09/2024	30/09/2025	30/09/2026	30/09/2027	30/09/2028	30/09/2029	30/09/2030	30/09/2031	30/09/2032	30/09/2033	30/09/2034	30/09/2035	30/09/2036	30/09/2037	30/09/2038	30/09/2039
	Days from valuation date to cash flow occurrence	-92	273	638	1003	1369	1734	2099	2464	2830	3195	3560	3925	4291	4656	5021	5386	5752	6117	6482	6847
Cash Flow Discounting																					
	Discounting multiplier	100%	95%	89%	83%	78%	73%	68%	63%	59%	55%	52%	48%	45%	42%	39%	37%	34%	32%	30%	28%
		100%	95%	89%	83%	78%	73%	68%	63%	59%	55%	52%	48%	45%	42%	39%	37%	34%	32%	30%	28%
	Discounted Cashflows (averaging)	-6,580	-1,535	-49	52	133	760	1,079	1,114	967	56	196	325	398	460	496	494	491	485	441	-22
	Discounted Cashflows (Stock Change)	-6,580.00	-1,535.31	-48.79	51.58	132.52	760.36	1,078.86	1,114.18	966.88	55.53	196.32	324.83	397.86	460.00	495.83	494.20	490.57	485.37	441.05	423.94
	Discounted Cashflows (Safe Carbon)	-6,580	-1,535	-49	52	133	760	1,079	1,114	967	56	196	325	398	-34	-32	-29	-28	-26	-24	-22
	Discounted Cashflows (Plant and Leave)	-6,580	-1,611	-49	52	133	760	1,079	1,114	967	603	196	325	398	460	496	494	491	485	441	424

	Year End March	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Costs																					
	Planting and establishment	-	-	-	-	-	-	-	-	-	-	1,615	-	-	-	-	-	-	-	-	-
	Sivilculture	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	900	-
	Harvesting	-	-	-	-	-	-	-	-	-	29,095	-	-	-	-	-	-	-	-	-	-
	Roading	-	-	-	-	-	-	-	-	-	7,806	-	-	-	-	-	-	-	-	-	-
	Cartage	-	-	-	-	-	-	-	-	-	15,612	-	-	-	-	-	-	-	-	-	-
	Area Ohd	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	Vol Ohds	-	-	-	-	-	-	-	-	-	3,690	-	-	-	-	-	-	-	-	-	-
	Ops Based Ohd	-	-	-	-	-	-	-	-	-	-	162	-	-	-	-	-	-	-	-	-
	Other OHD	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
	Land Purchase																				
Yeilds																					
	Woodflow (TRV)	-	-	-	-	-	-	-	-	-	**709.6**	-	-	-	-	-	-	-	-	-	-
	S30	-	-	-	-	-	-	-	-	-	108.9	-	-	-	-	-	-	-	-	-	-
	A	-	-	-	-	-	-	-	-	-	384.0	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	105.4	-	-	-	-	-	-	-	-	-	-
	KI	-	-	-	-	-	-	-	-	-	80.0	-	-	-	-	-	-	-	-	-	-
	KIS	-	-	-	-	-	-	-	-	-	31.4	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Flows																					
	Carbon (Averaging)	-	-	-	-	-	-	-	-	-	-			-	-	-	-	-	-	-	-
	Carbon (Sequestration for Averaging)	40.7	39.6	39.6	37.4	36.3	34.1	33.0	31.9	30.8	30.8	-	0.7								
	Carbon - Plant and Leave	40.7	39.6	39.6	37.4	36.3	34.1	33.0	31.9	30.8	30.8	29.7	29.7	27.5	28.6	27.5	26.4	26.4	26.4	25.3	25.3
	Carbon - Stock Change full sale	40.7	39.6	39.6	37.4	36.3	34.1	33.0	31.9	30.8	30.8	-500.5	-38.1	-35.0	-32.1	-9.0	5.3	9.7	6.4	-7.9	-26.6
	Carbon - Stock Change "Safe Carbon"																				
Revenue																					
	Log revenue	-	-	-	-	-	-	-	-	-	82,294	-	-	-	-	-	-	-	-	-	-
	NZU revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NZU Stock Change Full sale	1,547	1,505	1,505	1,421	1,379	1,296	1,254	1,212	1,170	1,170	-19,019	-1,446	-1,329	-1,221	-343	201	368	242	-301	-1,012
	NZU Plant and Leave	1,546.60	1,504.80	1,504.80	1,421.20	1,379.40	1,295.80	1,254.00	1,212.20	1,170.40	1,170.40	1,128.60	1,128.60	1,045.00	1,086.80	1,045.00	1,003.20	1,003.20	1,003.20	961.40	961.40
	NZU Safe Carbon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cashflows																					
	Cashflow(Averaging) Combined	-80	-80	-80	-80	-80	-80	-80	-80	-80	26,011	-1,857	-80	-80	-80	-80	-80	-80	-80	-980	-80
	Cashflow Stockchange Forestry	-80	-80	-80	-80	-80	-80	-80	-80	-80	26,011	-1,857	-80	-80	-80	-80	-80	-80	-80	-980	-80
	Cashflow Stockchange Carbon	1,547	1,505	1,505	1,421	1,379	1,296	1,254	1,212	1,170	1,170	-19,019	-1,446	-1,329	-1,221	-343	201	368	242	-301	-1,012
	Cashflow (Safe Carbon)	-80	-80	-80	-80	-80	-80	-80	-80	-80	26,011	-1,857	-80	-80	-80	-80	-80	-80	-80	-980	-80
	Cashflow - Plant and Leave	1,467	1,425	1,425	1,341	1,299	1,216	1,174	1,132	1,090	1,090	1,049	1,049	965	1,007	965	923	923	923	881	881
Cash Flow Timing																					
	Opening date of annual modelling period	1/01/2041	1/01/2042	1/01/2043	1/01/2044	1/01/2045	1/01/2046	1/01/2047	1/01/2048	1/01/2049	1/01/2050	1/01/2051	1/01/2052	1/01/2053	1/01/2054	1/01/2055	1/01/2056	1/01/2057	1/01/2058	1/01/2059	1/01/2060
	Date of yield event in modelling period	30/09/2040	30/09/2041	30/09/2042	30/09/2043	30/09/2044	30/09/2045	30/09/2046	30/09/2047	30/09/2048	30/09/2049	30/09/2050	30/09/2051	30/09/2052	30/09/2053	30/09/2054	30/09/2055	30/09/2056	30/09/2057	30/09/2058	30/09/2059
	Closing date of annual modelling period	31/03/2041	31/03/2042	31/03/2043	31/03/2044	31/03/2045	31/03/2046	31/03/2047	31/03/2048	31/03/2049	31/03/2050	31/03/2051	31/03/2052	31/03/2053	31/03/2054	31/03/2055	31/03/2056	31/03/2057	31/03/2058	31/03/2059	31/03/2060
	Days between opening and closing dates	90	90	90	91	90	90	90	91	90	90	90	91	90	90	90	91	90	90	90	91
	Days to yield event from opening date	1827.931507	1917.931507	2007.931507	2098.931507	2188.931507	2278.931507	2368.931507	2459.931507	2549.931507	2639.931507	2729.931507	2820.931507	2910.931507	3000.931507	3090.931507	3181.931507	3271.931507	3361.931507	3451.931507	3542.931507
	Date of cash flow occurrence	30/09/2040	30/09/2041	30/09/2042	30/09/2043	30/09/2044	30/09/2045	30/09/2046	30/09/2047	30/09/2048	30/09/2049	30/09/2050	30/09/2051	30/09/2052	30/09/2053	30/09/2054	30/09/2055	30/09/2056	30/09/2057	30/09/2058	30/09/2059
	Days from valuation date to cash flow occurrence	7213	7578	7943	8308	8674	9039	9404	9769	10135	10500	10865	11230	11596	11961	12326	12691	13057	13422	13787	14152
Cash Flow Discounting																					
	Discounting multiplier	26%	25%	23%	21%	20%	19%	17%	16%	15%	14%	13%	12%	12%	11%	10%	10%	9%	8%	8%	7%
		26%	25%	23%	21%	20%	19%	17%	16%	15%	14%	13%	12%	12%	11%	10%	10%	9%	8%	8%	7%
	Discounted Cashflows (averaging)	-21	-20	-18	-17	-16	-15	-14	-13	-12	3,714	-248	-10	-9	-9	-8	-8	-7	-7	-76	-6
	Discounted Cashflows (Stock Change)	385.16	349.70	326.82	287.52	260.29	227.61	205.41	185.13	166.60	3,881.30	-2,785.91	-190.36	-164.24	-141.65	-43.03	11.48	25.59	13.50	-99.46	-79.21
	Discounted Cashflows (Safe Carbon)	-21	-20	-18	-17	-16	-15	-14	-13	-12	3,714	-248	-10	-9	-9	-8	-8	-7	-7	-76	-6
	Discounted Cashflows (Plant and Leave)	385	350	327	288	260	228	205	185	167	156	140	131	112	110	98	88	82	77	68	64

	Year End March	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078
Costs																			
	Planting and establishment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sivilculture	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Harvesting	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Roading	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cartage	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Area Ohd	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	Vol Ohds	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Ops Based Ohd	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other OHD	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
	Land Purchase																		
Yeilds																			
	Woodflow (TRV)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	S30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	KI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	KIS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Carbon Flows																			
	Carbon (Averaging)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Carbon (Sequestration for Averaging)																		
	Carbon - Plant and Leave	26.4	25.3	25.3	25.3	26.4	26.4	26.4	26.4	27.5	28.6	28.6	28.6	28.0	27.5	26.9	26.3	25.7	25.2
	Carbon - Stock Change full sale	-18.9	25.3	30.8	35.2	37.4	39.6	41.8	40.7	41.8	40.7	39.6	39.6	37.4	36.3	34.1	33.0	31.9	30.8
	Carbon - Stock Change "Safe Carbon"																		
Revenue																			
	Log revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NZU revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NZU Stock Change Full sale	-719	961	1,170	1,338	1,421	1,505	1,588	1,547	1,588	1,547	1,505	1,505	1,421	1,379	1,296	1,254	1,212	1,170
	NZU Plant and Leave	1,003.20	961.40	961.40	961.40	1,003.20	1,003.20	1,003.20	1,003.20	1,045.00	1,086.80	1,086.80	1,086.80	1,065.06	1,043.33	1,021.59	999.86	978.12	956.38
	NZU Safe Carbon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cashflows																			
	Cashflow(Averaging) Combined	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80
	Cashflow Stockchange Forestry	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80
	Cashflow Stockchange Carbon	-719	961	1,170	1,338	1,421	1,505	1,588	1,547	1,588	1,547	1,505	1,505	1,421	1,379	1,296	1,254	1,212	1,170
	Cashflow (Safe Carbon)	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80
	Cashflow - Plant and Leave	923	881	881	881	923	923	923	923	965	1,007	1,007	1,007	985	963	942	920	898	876
Cash Flow Timing																			
	Opening date of annual modelling period	1/01/2061	1/01/2062	1/01/2063	1/01/2064	1/01/2065	1/01/2066	1/01/2067	1/01/2068	1/01/2069	1/01/2070	1/01/2071	1/01/2072	1/01/2073	1/01/2074	1/01/2075	1/01/2076	1/01/2077	1/01/2078
	Date of yield event in modelling period	30/09/2060	30/09/2061	30/09/2062	30/09/2063	30/09/2064	30/09/2065	30/09/2066	30/09/2067	30/09/2068	30/09/2069	30/09/2070	30/09/2071	30/09/2072	30/09/2073	30/09/2074	30/09/2075	30/09/2076	30/09/2077
	Closing date of annual modelling period	31/03/2061	31/03/2062	31/03/2063	31/03/2064	31/03/2065	31/03/2066	31/03/2067	31/03/2068	31/03/2069	31/03/2070	31/03/2071	31/03/2072	31/03/2073	31/03/2074	31/03/2075	31/03/2076	31/03/2077	31/03/2078
	Days between opening and closing dates	90	90	90	91	90	90	90	91	90	90	90	91	90	90	90	91	90	90
	Days to yield event from opening date	3632.931507	3722.931507	3812.931507	3903.931507	3993.931507	4083.931507	4173.931507	4264.931507	4354.931507	4444.931507	4534.931507	4625.931507	4715.931507	4805.931507	4895.931507	4986.931507	5076.931507	5166.931507
	Date of cash flow occurrence	30/09/2060	30/09/2061	30/09/2062	30/09/2063	30/09/2064	30/09/2065	30/09/2066	30/09/2067	30/09/2068	30/09/2069	30/09/2070	30/09/2071	30/09/2072	30/09/2073	30/09/2074	30/09/2075	30/09/2076	30/09/2077
	Days from valuation date to cash flow occurrence	14518	14883	15248	15613	15979	16344	16709	17074	17440	17805	18170	18535	18901	19266	19631	19996	20362	20727
Cash Flow Discounting																			
	Discounting multiplier	7%	6%	6%	6%	5%	5%	5%	4%	4%	4%	3%	3%	3%	3%	3%	2%	2%	2%
		7%	6%	6%	6%	5%	5%	5%	4%	4%	4%	3%	3%	3%	3%	3%	2%	2%	2%
	Discounted Cashflows (averaging)	-5	-5	-5	-4	-4	-4	-4	-3	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2
	Discounted Cashflows (Stock Change)	-54.17	55.85	64.58	69.61	69.36	68.87	68.14	61.91	59.50	54.07	49.09	45.88	40.35	36.54	31.95	28.84	25.98	23.39
	Discounted Cashflows (Safe Carbon)	-5	-5	-5	-4	-4	-4	-4	-3	-3	-3	-3	-3	-2	-2	-2	-2	-2	-2
	Discounted Cashflows (Plant and Leave)	63	56	52	49	48	45	42	39	38	37	35	32	30	27	25	23	21	19

Regime	NPV (NZD/ha)
Averaging	2,882
Stock Change - Full NZU Sale	3,828
Safe Carbon - Safe NZU sale only	-158
Plant and Leave	4,876

Appendix 3 – Tairawhiti ANZSIC Data

	Gisborne Region							New Zealand					
	GDP		Employment		Businesses			GDP		Employment		Businesses	
Sub-industry	Level	% of total	Level	% of total	Level	% of total		Level	% of total	Level	% of total	Level	% of total
Sheep-Beef Cattle Farming	$82.0m	21.50%	1,135	25.30%	309	22.60%		$1,353m	8.70%	12,320	8.60%	6,747	10.00%
Other Agriculture and Fishing Support Serv	$32.5m	8.50%	708	15.80%	102	7.50%		$1,642m	10.50%	23,444	16.30%	6,432	9.60%
Logging	$115m	30.10%	390	8.70%	36	2.60%		$1,344m	8.60%	4,542	3.20%	702	1.00%
Forestry Support Services	$14.9m	3.90%	303	6.70%	30	2.20%		$223m	1.40%	3,175	2.20%	567	0.80%
Kiwifruit Growing	$10.4m	2.70%	250	5.60%	33	2.40%		$202m	1.30%	3,839	2.70%	1,836	2.70%
Shearing Services	$10.6m	2.80%	240	5.40%	12	0.90%		$242m	1.50%	3,460	2.40%	360	0.50%
Citrus Fruit Growing	$11.6m	3.00%	239	5.30%	150	11.00%		$18.0m	0.10%	343	0.20%	234	0.30%
Vegetable Growing (Outdoors)	$8.85m	2.30%	222	4.90%	21	1.50%		$229m	1.50%	4,311	3.00%	768	1.10%
Grape Growing	$7.66m	2.00%	179	4.00%	54	3.90%		$173m	1.10%	3,289	2.30%	1,404	2.10%
Beef Cattle Farming (Specialised)	$9.51m	2.50%	142	3.20%	132	9.60%		$983m	6.30%	9,013	6.30%	11,322	16.90%
Forestry	$43.1m	11.30%	139	3.10%	207	15.10%		$559m	3.60%	1,873	1.30%	3,963	5.90%
Sheep Farming (Specialised)	$5.95m	1.60%	90	2.00%	66	4.80%		$733m	4.70%	6,710	4.70%	4,797	7.10%
Other Fruit and Tree Nut Growing	$2.05m	0.50%	53	1.20%	33	2.40%		$57.8m	0.40%	1,075	0.70%	1,278	1.90%
Beekeeping	$1.94m	0.50%	52	1.20%	33	2.40%		$130m	0.80%	2,425	1.70%	1,101	1.60%
Dairy Cattle Farming	$3.94m	1.00%	43	1.00%	12	0.90%		$5,915m	37.80%	35,955	25.00%	15,189	22.60%
Other Grain Growing	$2.61m	0.70%	42	0.90%	24	1.80%		$126m	0.80%	1,149	0.80%	447	0.70%
Nursery Production (Outdoors)	$1.63m	0.40%	42	0.90%	6	0.40%		$92.9m	0.60%	1,748	1.20%	375	0.60%
Rock Lobster and Crab Potting	$3.74m	1.00%	34	0.80%	15	1.10%		$47.9m	0.30%	468	0.30%	258	0.40%
Grain-Sheep and Grain-Beef Cattle Farmin	$1.64m	0.40%	28	0.60%	9	0.70%		$109m	0.70%	995	0.70%	498	0.70%
Apple and Pear Growing	$1.00m	0.30%	27	0.60%	12	0.90%		$254m	1.60%	4,940	3.40%	513	0.80%
Line Fishing	$2.47m	0.60%	23	0.50%	6	0.40%		$66.9m	0.40%	654	0.50%	324	0.50%
Fish Trawling, Seining and Netting	$4.17m	1.10%	22	0.50%	9	0.70%		$162m	1.00%	1,574	1.10%	294	0.40%
Other Livestock Farming n.e.c.	$0.53m	0.10%	16	0.40%	12	0.90%		$38.0m	0.20%	707	0.50%	774	1.20%
Other Fishing	$1.65m	0.40%	15	0.30%	6	0.40%		$68.0m	0.40%	665	0.50%	333	0.50%
Poultry Farming (Eggs)	$0.60m	0.20%	15	0.30%	3	0.20%		$73.5m	0.50%	1,388	1.00%	147	0.20%
Vegetable Growing (Under Cover)	$0.44m	0.10%	10	0.20%	0	0.00%		$79.0m	0.50%	1,498	1.00%	285	0.40%
Deer Farming	$0.24m	0.10%	8	0.20%	9	0.70%		$55.9m	0.40%	1,040	0.70%	822	1.20%
Other Crop Growing n.e.c.	$0.22m	0.10%	7	0.10%	9	0.70%		$108m	0.70%	2,028	1.40%	1,839	2.70%
Horse Farming	$0.20m	0.10%	6	0.10%	3	0.20%		$65.4m	0.40%	1,214	0.80%	1,380	2.10%
Berry Fruit Growing	$0.20m	0.10%	6	0.10%	3	0.20%		$64.4m	0.40%	1,143	0.80%	216	0.30%
Hunting and Trapping	$0.17m	0.00%	4	0.10%	6	0.40%		$15.9m	0.10%	227	0.20%	180	0.30%
Stone Fruit Growing	$0.06m	0.00%	2	0.00%	6	0.40%		$43.4m	0.30%	801	0.60%	261	0.40%
Floriculture Production (Under Cover)	$0.07m	0.00%	2	0.00%	0	0.00%		$36.7m	0.20%	695	0.50%	303	0.50%
Cotton Ginning	$0.00m	0.00%	0	0.00%	0	0.00%		$0.00m	0.00%	0	0.00%	0	0.00%
Prawn Fishing	$0.00m	0.00%	0	0.00%	0	0.00%		$2.60m	0.00%	26	0.00%	3	0.00%
Onshore Aquaculture	$0.00m	0.00%	0	0.00%	0	0.00%		$22.0m	0.10%	216	0.20%	51	0.10%
Caged (Offshore) Aquaculture	$0.00m	0.00%	0	0.00%	0	0.00%		$14.7m	0.10%	144	0.10%	21	0.00%
Longline and Rack (Offshore) Aquaculture	$0.00m	0.00%	0	0.00%	0	0.00%		$58.4m	0.40%	571	0.40%	234	0.30%
Pig Farming	$0.00m	0.00%	0	0.00%	0	0.00%		$24.4m	0.20%	459	0.30%	129	0.20%
Poultry Farming (Meat)	$0.00m	0.00%	0	0.00%	0	0.00%		$74.9m	0.50%	1,400	1.00%	306	0.50%
Cotton Growing	$0.00m	0.00%	0	0.00%	0	0.00%		$0.00m	0.00%	0	0.00%	0	0.00%
Sugar Cane Growing	$0.00m	0.00%	0	0.00%	0	0.00%		$0.00m	0.00%	0	0.00%	0	0.00%
Rice Growing	$0.00m	0.00%	0	0.00%	0	0.00%		$0.00m	0.00%	0	0.00%	0	0.00%
Beef Cattle Feedlots (Specialised)	$0.00m	0.00%	0	0.00%	0	0.00%		$2.84m	0.00%	28	0.00%	0	0.00%
Olive Growing	$0.00m	0.00%	0	0.00%	0	0.00%		$6.92m	0.00%	131	0.10%	231	0.30%
Mushroom Growing	$0.00m	0.00%	0	0.00%	0	0.00%		$36.8m	0.20%	701	0.50%	30	0.00%
Floriculture Production (Outdoors)	$0.00m	0.00%	0	0.00%	0	0.00%		$3.26m	0.00%	62	0.00%	48	0.10%
Turf Growing	$0.00m	0.00%	0	0.00%	0	0.00%		$2.26m	0.00%	44	0.00%	6	0.00%
Nursery Production (Under Cover)	$0.00m	0.00%	0	0.00%	0	0.00%		$71.6m	0.50%	1,345	0.90%	162	0.20%
Total	$382m		4,492		1,368		$15,631m		143,835		67,170		

Primary industry		**Tairawhiti**	
2019 years statistics by ANZSIC		**GDP**	**Direct Employment**
Livestock farming		146,910,000.00	2,410
Forestry		173,000,000.00	832

Tairawhiti			
	Total hectares		
		GDP/1,000 ha	**Jobs/1,000 ha**
Livestock farming	350,442	$419,213	6.88
Exotic Forestry	155,360	$1,113,543	5.36

Appendix 4 NPV from 2121 year

		2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137
Costs																		
	Planting and establishment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Sivilculture	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Harvesting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29095.00866
	Roading	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7805.977934
	Cartage	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15611.95587
	Area Ohd	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
	Vol Ohds	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3690.09866
	Ops Based Ohd	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Other OHD	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
	Land Purchase																	
Yeilds																		
	Woodflow (TRV)	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**709.6343576**
	S30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	108.8727964
	A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	384.0186725
	K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	105.4002216
	KI	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79.96877921
	KIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31.373888
Carbon Flows																		
	Carbon (Averaging)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Carbon (Sequestration for Averaging)																	
	Carbon - Plant and Leave	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Carbon - Stock Change full sale	30.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Carbon - Stock Change "Safe Carbon"																	
Revenue																		
	Log revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82,294
	NZU revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NZU Stock Change Full sale	1,170	1,338	1,421	1,505	1,588	1,547	1,588	1,547	1,505	1,505	1,421	1,379	1,296	1,254	1,212	1,170	1,170
	NZU Plant and Leave	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	NZU Safe Carbon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cashflows																		
	Cashflow(Averaging) Combined	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	26,011
	Cashflow Stockchange Forestry	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	- 80	26,011
	Cashflow Stockchange Carbon	1170.4	1337.6	1421.2	1504.8	1588.4	1546.6	1588.4	1546.6	1504.8	1504.8	1421.2	1379.4	1295.8	1254	1212.2	1170.4	1170.4
	Cashflow (Safe Carbon)	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	26010.5319
	Cashflow - Plant and Leave																	
		-58.264	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80	-80
Cash Flow Timing																		
	Opening date of annual modelling period	1/01/2121	1/01/2122	1/01/2123	1/01/2124	1/01/2125	1/01/2126	1/01/2127	1/01/2128	1/01/2129	1/01/2130	1/01/2131	1/01/2132	1/01/2133	1/01/2134	1/01/2135	1/01/2136	1/01/2137
	Date of yield event in modelling period	30/09/2120	30/09/2121	30/09/2122	30/09/2123	30/09/2124	30/09/2125	30/09/2126	30/09/2127	30/09/2128	30/09/2129	30/09/2130	30/09/2131	30/09/2132	30/09/2133	30/09/2134	30/09/2135	30/09/2136
	Closing date of annual modelling period	31/03/2121	31/03/2122	31/03/2123	31/03/2124	31/03/2125	31/03/2126	31/03/2127	31/03/2128	31/03/2129	31/03/2130	31/03/2131	31/03/2132	31/03/2133	31/03/2134	31/03/2135	31/03/2136	31/03/2137
	Days between opening and closing dates	90	90	90	91	90	90	90	91	90	90	90	91	90	90	90	91	90
	Days to yield event from opening date	3722.931507	3812.931507	3903.931507	3993.931507	4083.931507	4173.931507	4264.931507	4354.931507	4444.931507	4534.931507	4625.931507	4715.931507	4805.931507	4895.931507	4986.931507	5076.931507	5166.931507
	Date of cash flow occurrence	30/09/2120	30/09/2121	30/09/2122	30/09/2123	30/09/2124	30/09/2125	30/09/2126	30/09/2127	30/09/2128	30/09/2129	30/09/2130	30/09/2131	30/09/2132	30/09/2133	30/09/2134	30/09/2135	30/09/2136
	Days from valuation date to cash flow occurrence	36432	36797	37162	37527	37893	38258	38623	38988	39354	39719	40084	40449	40815	41180	41545	41910	42276
Cash Flow Discounting																		
	Discounting multiplier	6.3%	5.9%	5.5%	5.2%	4.8%	4.5%	4.2%	3.9%	3.7%	3.4%	3.2%	3.0%	2.8%	2.6%	2.5%	2.3%	2.1%
		6.3%	5.9%	5.5%	5.2%	4.8%	4.5%	4.2%	3.9%	3.7%	3.4%	3.2%	3.0%	2.8%	2.6%	2.5%	2.3%	2.1%
		100.0%	95.1%	88.8%	83.0%	77.6%	72.5%	67.8%	63.3%	59.2%	55.3%	51.7%	48.3%	45.1%	42.2%	39.4%	36.8%	34.4%
		100.0%	95.1%	88.8%	83.0%	77.6%	72.5%	67.8%	63.3%	59.2%	55.3%	51.7%	48.3%	45.1%	42.2%	39.4%	36.8%	34.4%
	Discounted Cashflows (averaging)	- 5	- 5	- 4	- 4	- 4	- 4	- 3	- 3	- 3	- 3	- 3	- 2	- 2	- 2	- 2	- 2	558
	Discounted Cashflows (Stock Change)	69.10	74.48	74.23	73.69	72.91	66.25	63.68	57.85	52.53	49.09	43.19	39.10	34.19	30.85	27.81	25.02	583.00
	Discounted Cashflows (Safe Carbon)	- 5	- 5	- 4	- 4	- 4	- 4	- 3	- 3	- 3	- 3	- 3	- 2	- 2	- 2	- 2	- 2	558
	Discounted Cashflows (Plant and Leave)	- 4	- 5	- 4	- 4	- 4	- 4	- 3	- 3	- 3	- 3	- 3	- 2	- 2	- 2	- 2	- 2	- 2
	Discounted Cashflows (averaging) - 2121	- 80	- 76	- 71	- 66	- 62	- 58	- 54	- 51	- 47	- 44	- 41	- 39	- 36	- 34	- 32	- 29	8,956
	Discounted Cashflows (Stock Change)	1,090.40	1,195.54	1,191.60	1,183.07	1,170.33	1,063.45	1,022.21	928.86	843.20	788.03	693.27	627.72	548.81	495.27	446.39	401.79	9,358.54
	Discounted Cashflows (Safe Carbon)	- 80	- 76	- 71	- 66	- 62	- 58	- 54	- 51	- 47	- 44	- 41	- 39	- 36	- 34	- 32	- 29	8,956
	Discounted Cashflows (Plant and Leave)	- 58	- 76	- 71	- 66	- 62	- 58	- 54	- 51	- 47	- 44	- 41	- 39	- 36	- 34	- 32	- 29	- 28
	NPV - 2121																	
	Averaging																	
	Stock Change																	
	Safe Carbon																	
	Plant and Leave																	

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