Right Tree Right Place

prepared for

Tararua District Council

September 2021

October 2021

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1.0 Acknowledgements

Rangitāne o Tamaki Nui-ā-Rua

Ngāti Kahungunu ki Tāmaki nui-a-Rua

Hawkes Bay Regional Council (and its various contributors in its Right Tree Right Place project)

James Powrie, ReAxe Forest Intelligence

Simon Taylor, Fresh Perspective Insight

David Palmer, Peter Hall, Richard Yao, Tim Ryan, Scion Land Vision Forest 360

Dr Heather Colins

2.0 Background to the Project

The project builds on the research and framework of a PGF approved project (Alternative Land Use Tararua). This first tranche was focused on horticulture.

The Tararua District Council (TDC) believes that what is still lacking for landowners is the information to consider alternative tree species that includes potential returns, regulatory consents, ability to establish and the impacts on the local ecosystem and community. Council is also trying to guide the location of future forestry that delivers the right tree in the right place that reflects community impacts, iwi aspirations and community infrastructure.

This project aims at addressing some of this information gap.

3.0 Executive Summary

The Situation in the Tararua District

- In 2019 $110,320,000 worth of pastoral land was sold, of this 31% was for carbon forestry and25% for forestry, only 37% was for strictly pastoral use. But on a per hectare (ha) basis, of the12,137ha traded, a total of 10,171ha had gone into forestry. This is approximately 85% of the land area.

- At an average stocking rate of 8.5 stock units per hectare, this would mean 50,000 stock units worth of sheep and 20,000 stock units worth of cattle would have gone from the district in one year. It has been assessed that the loss in community spend due to this decrease in stock units is between $1,700,000 and $2,100,000 per year.

- These numbers were recorded when the value of carbon (expressed in CO_2 equivalents) averaged under
- $25/tonne. At the time of the initial Right Tree Right Place work carried out forthe TDC the value of a CO_2E was $35/t with some forward contracts at $42/t. As of report finalisation the price is close to $50/t, a doubling of the NZ carbon price in two years.

- Although it is speculative by nature it would be reasonable to expect this trend to continue and possibly even accelerate.

- Any discussion around land use change in the district should involve an understanding of the implications of both the price of carbon and the impact of the National Policy for Fresh Water Management.

The Tararua District Has a Vulnerable Landscape

- The majority of the land in the Tararua District is largely suitable for pastoral use. However, there is an area that is potentially also very suitable for forestry. Of the total potential area that is suitable for forestry 54% is vulnerable to high earthflow erosion.

- Pastoral waterways generally have higher water yields, peak flows, nutrient levels, suspended sediment levels, faecal coliform numbers, and water temperatures, as well as a lower faunal diversity relative to forested waterways. Even at forestry harvest and the following three to five year risk period the indicators still amount to a lower impact on waterways overall relative to pastoral catchments.

Iwi Perspectives

Insights were sought from Rangitāne o Tamaki Nui-ā-Rua (ROTnaR) and Ngāti Kahungunu ki Tāmaki nui-a-Rua (NKTR) to assist in the selection of tree species for investigation in this project. See full reports in section 4.0.

Rangitāne o Tamaki Nui-ā-Rua (ROTnaR)

"This project will have impact on ROTnaR for a number of reasons:

- Effects on tikanga, taonga Māuri and Kaitiakitanga
- Whakapapa
- Significance of land to whakapapa
- Connections to Tupuna, places/sites of significance
- Religious or educational whakapapa
- Talking about actual whakapapa in terms of the korero that connects Rangitāne with the land, Pukakau (korero purakau) all of those things.
- Ensuring an environmentally safe and sustainable future for our next generations.

Tree species from the list of 11 in which we feel would be best fit for farmers and our Rohe:

a. Totara: It is a rākau Rangatira of Te Tapere Nui o Whatonga. It's a preferred wood for carvings, used in the framing and roofs of whare plus other building material uses, and it has medicinal uses. Its red fruit were a favourite for māori. However, is the government going to allow milling of this tree species?
b. Manuka and/or Kanuka: Many uses both culturally and medicinally also for building materials. It is great at providing a type of nursery for other plant species.
c. Mixed species Native Afforestation (Replacement of native forest): Is this a mix of local native forest species types? It has the potential to connect with many of our values above.
d. Kauri: Although not particularly native to our rohe, we have in the past been gifted a Kauri tree which sit out Kaitoki and has established well here with other trees sprouting up nearby it. However, is the government going to allow milling of this tree species?
e. Redwood: carbon credits for this tree species is at the top, it is a beautiful timber that grows tall. It seems to have established well at Pukaha.

With these species in mind, our main position is to re-estabish as best possible what once was here and native to our rohe and 'Te Tapere nui o Whatonga'."

Ngāti Kahungunu ki Tāmaki nui-a-Rua (NKTnR)

Ngāti Kahungunu ki Tāmaki nui-a-Rua provided "context from a traditional perspective of how Ngāti Kahungunu ki Tāmaki nui-a-Rua view the definition "right tree right place tikanga Kahungunu taking into consideration:

- Traditional tikanga of the ngahere (bush).
- Impacts of Colonisation, deforestation, frming, planting of Pinus radiata on the Natural Environment, and the Social destruction of traditional Māori way of life.
- The impacts deforestation has contributed to the loss of many native species significant to te ao Māori Cultural base and economic sustainability, through loss of habitat, erosion, pollution of many waterways.
- The on-going effects upon the mauri of all-natural things associated with tikanga/kawa of Māori.
- The lack of understanding by others of Māori connection to the Natural Environment as a whole, not an ecosystem approach to the way this living entity we call Papatuanuku raua ko Ranginui exist as a whole and the significance of kaitiakitanga bestowed upon Maori to be the guardians/stewards to their tuakana rakau, tuakana manu, tipuna awa and how and where human beings fit into this space.
- Climate change/Global Warming from a Māori view.
- Right Tree Right Place Tararua

- Right Tree Right Place Ngāti Kahungunu ki Tāmaki nui-a-Rua.

For generations the ngahere was our pharmacy, our supermarket, our timber yard, our source of continued survival.

Replenish our Earth Mother with the clothes that she originally was robed in."

Community Concerns in the District

That wholesale farm afforestation is not the answer, particularly when done for carbon credits and where there is no intention to ever harvest (often due to extraction costs or distance to port). This is likely to lead to the creation of a green desert, not requiring any infrastructural support, devoid of any local community and not contributing financially to society beyond its diminishing carbon revenues.

The community felt that it needs a shared focus to respond to the global challenge of climate change and meet the reduction in greenhouse gas targets.

The discussions with the community recognised that an opportunity exists to expose urban residents to New Zealand farming and its efforts to mitigate environmental issues, creating an opportunity to reconnect people to land.

Farmer Role

- To overcome the pressure for wholesale land use change farmers must, in the first instance, demonstrably take individual responsibility for the environmental outcomes on their own property. Understanding their own farm resource inventory will be key in developing sustainable low environmental impact solutions.

- The use of Land Use Capability classifications (LUCs) could be a principal driver in farm system optimisation. Understanding a farm's Land Resource Inventory (LRI) and the ensuing LUCs to a paddock-scale level, or even higher resolution, enables better systems optimisation.

- A consistent finding in the case studies carried out for this report was that there were land parcels on farms that were giving negative financial returns under current pastoral operations, but this level of detail was sometimes unobserved by the farmers.

- In general, the farmers tended to underestimate the production of the better classes of land and overestimate the poorer classes. A rule of thumb is that removing the poorer aspects of a farm from grazing (i.e., those land parcels carrying 5.0 stock units/ha or under) and a resultant increase by 0.5 stock units/ha on the better land classes, through fencing subdivision and increased water reticulation, left the farm at a similar level of net financial surplus. In a number of cases this released 20-30% of the total farm area to be utilised for production forestry (with carbon) or for retirement to other land uses.

- We also need farmers to believe in and endorse the benefits of these solutions in fully integrated and actively managed farm environment management plants (FEMPs) and not to see these as a compliance cost to be dusted off every few years for a renewal.

- Farmers should consider themselves as **land managers**, not limited to being pastoral farmers or that of a forester.

A Place for Pastoral Farming and Afforestation

- The integration of forestry systems into the pastoral landscape provided a potential win-win situation where farm profitability stayed similar or slightly reduced after the land use change, but this was more than offset by carbon revenue streams and long- term forestry returns from the land removed from pastoral systems.

- The case study farms ranged from **18% to 23% in their reduction in CO_2E emissions and, via Overseer modelling, had up to a 20% reduction in nitrogen losses to water**. Long-term sediment losses to water would also be expected to be markedly reduced. The retirement of lands, along with wetland preservation and riparian plantings, would help maintain ecological corridors that are necessary for ecosystem health. Carbon equivalent revenues have in these instances provided a generational windfall, allowing for the re-development of the poorer land that otherwise might have stayed in a financially uneconomical and environmentally precarious agricultural production.

- The decision to plant trees on a farm is a strategic decision that is influenced by a range of factors, each unique (or seen to be unique) by an individual farmer.

- Any discussion/support/schemes to support tree planting need to start with an understanding of and taking into consideration the factors that are at an individual farmer level. From there, the relative merits or benefits of different approaches or species can be discussed and investigated in a way that holds true to the end goal.

- The needs or considerations of a farmer start with a clear distinction between commercial planting and non-commercial planting.

- There is a farmer need for information and supporting evidence around different species.

- To best support farmers into a 'right tree right place' programme there needs to be a clear path of support (including the role of TDC) and farmer ownership of their property management. This needs to be easily navigated by farmers and provide genuine 'right tree right place' guidance and advice throughout in keeping with the objectives of the individual farmer.

The Right Tree

- For those farmers with commercial intent, pine is the default species due to its known performance and maturity of end market – with any additional commercial species needing a high degree of certainty and clarity to compete.

- NIWA climate change models suggest that despite an increase in risks it is likely that the future climate will be a more favourable growing environment for many tree species including pines.

- Where the commercial pressures aren't the primary driver there is a desire and willingness to use a variety of species linked to site suitability, variety/diversity, native plantings, and various cost considerations.

- Having a system that recognises the value of ecological benefits would assist in the promotion of native plantings. If there was a pricing mechanism that did this, then the relative financial imperatives of pines might be dampened.

- Spatial sensitivity analysis indicates a number of areas where there is a considerable risk for forestry based on pine timber returns only. However, the potential returns from selling carbon credits more than offsets this risk.

- Carbon farming offers a paradox with continuing whole farm conversions into forestry on productive pastoral land, yet carbon can offer a cashflow inroad for selective afforestation on the right land types and forms.

- At the current price (~$50/t C_2O E) much of the pastoral country in the Tararua District is vulnerable to wholesale land use change to carbon farming through afforestation.

- Discussions around carbon farming need to take a long-term view, beyond the first tree rotation (and carbon cycle) and so any discussion should include the long term lost opportunities of permanent exotic species forests to the district, especially given the speculative nature of the carbon price under the current New Zealand auction pricing system. This is even more relevant in the more remote parts of the district where, under some price scenarios, timber harvest is not a viable option.

- For a fully managed forest rotation of 27 years each hectare of pine forest requires 68.5 labour days per ha. Or put another way, when averaged over 27 years, 1FTE/760ha. Although this is less than what would be required in a pastoral enterprise (3.2 FTE/760ha) it still will require a substantial training programme to upskill the local labour force.

- The full report has identified areas with in the Tararua District where the establishment of alternatives to pine tree species, including hardwoods, is feasible.

- Despite this spatial work the discussion on the right tree and the right site selection remains at an individual farm level.

Alternative Options

- There are opportunities for high value smaller scale operations especially in the hardwood.

- The best path to developing sustainable regional hardwood industries is by achieving strategic annual planting targets in wood supply catchments with centrally located future processing sites.

- NZ Dryland Forests Initiative (NZDFI) has identified 12 potential wood supply catchments with suitable environments for growing durable eucalypts. These include Woodville and Masterton as potential centres for processing infrastructure.

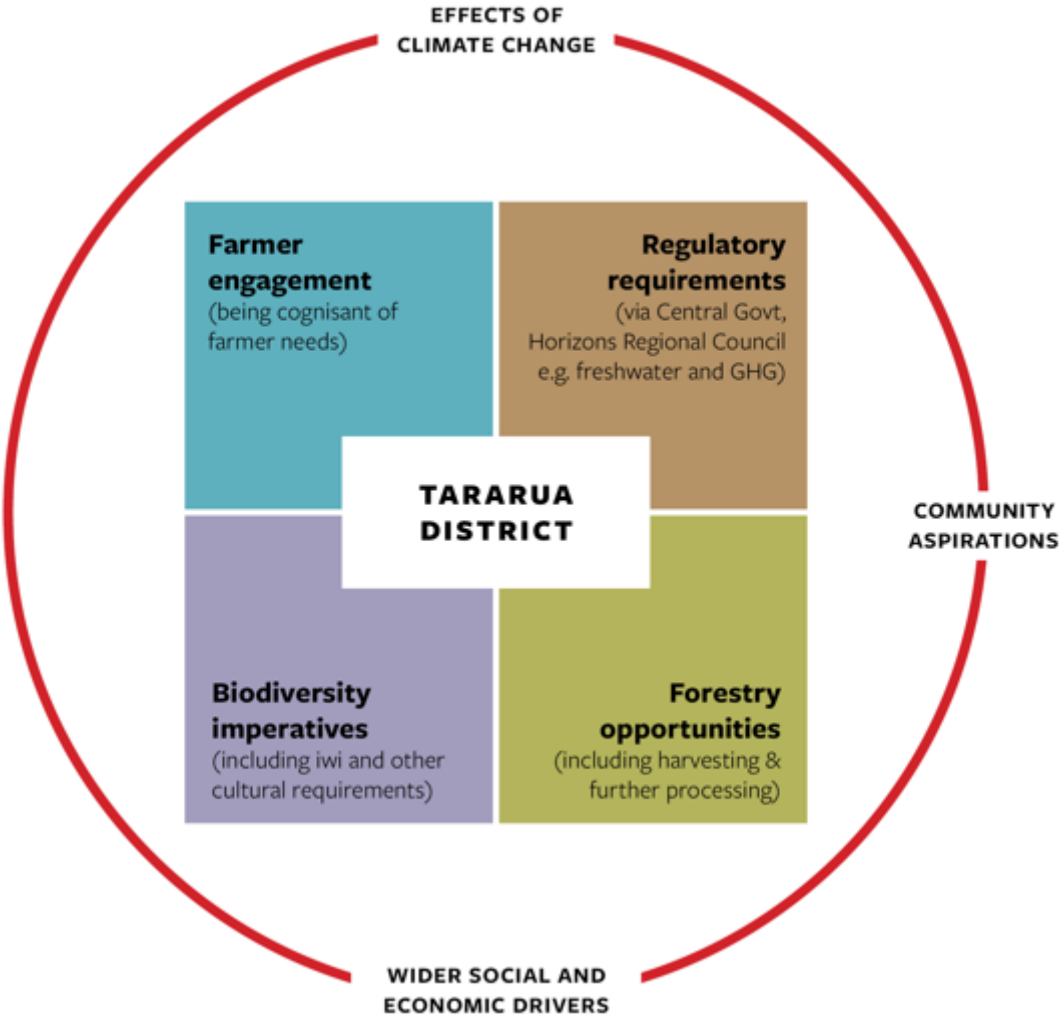
- The planting target for each wood supply catchment is 5,000 hectares over 30 years. This level of planting would sustainably provide sufficient volumes of timber to justify investment in a processing operation.

- Overall economic contribution of one regional hardwood industry ~ $82.5 million per annum with a return on capital employed ~25%.
- Silvopasture systems provide an economic way for farmers to gain benefit from the high carbon prices and yet still retain the basis of a pastoral farming enterprise, but such systems are site specific.

Deliverables

- Reducing erosion on highly erodible land to benefit soil and water quality.
- Improving financial returns through highest and best land use options.
- Providing ecosystem service benefits.
- Balancing individual, community and regional needs and expectations.

Tararua District Council Influences and Actions



Land use is a complex matrix of interacting functions which the Tararua District Council, through the aspirations of the community, will find itself acting as the central agency. It could be possible to leave the functions of linking and driving outcomes to central or regional government functions, but this in all likelihood would result in a centralised solution and not tailored to the particular requirements of the Tararua community.

The pressure for land use change will accelerate with the increasing carbon price, resulting in more land sales to forestry. TDC needs to be involved to guide the outcome in line with communities' aspirations. In order to do this it must be active in the above four pillars, each with its own but linked strategy.

If sought and driven, there is a positive linkage between the pillars that could achieve a win-win solution, but in order to achieve this TDC must be clear and articulate what its end goal is.

Recommendations

The project is potentially transformational and integrates existing forestry projects and knowledge. It provides tools and information that will help decision makers, including iwi, landowners, the wider community, and regional and national government understand the implications of different afforestation options to develop a strategy that sees the right tree planted in the right place for the desired outcomes:

- Reducing erosion on highly erodible land to benefit soil and water quality.
- Improving financial returns through highest and best land use options.
- Providing ecosystem service benefits.
- Balancing individual, community and regional needs and expectations.
- Favoured alternative species should be selected. This will allow focused effort on research, market development, wood processing options and collaboration to develop scale and infrastructure.
- Integrated land use with afforestation is recommended to maintain existing regional community structures.
- Individual whole farm assessment needs to be done at a high resolution to facilitate the process of comparing and selecting appropriate areas to consider for forestry.
- Wider education on forestry and the benefits of better land use selection and its potential is needed for landowners and other rural professionals.
- Specific interventions and investment strategies will ensure targeted afforestation is optimised and is able to deliver on a range of landowner preferences.

A combination of actions for the Tararua District Council is recommended and in particular:

- Developing internal forestry expertise and resources.
- Targeted incentives that promote RTRP programmes.
- Information support at farm/farmer level as to the options available on their land.
- GIS spatial work from this report should be available online and at farm scale resolution.
- Support and leverage existing industry and infrastructure.
- A team approach is required to assist farmers as the solutions are multi-disciplinary.
- Promoting that permanent carbon regimes should be managed with a harvest approach for a timber/fibre crop. This strategy has forest health benefits but accounts for alternative income streams if there is a very different future environment (i.e., collapse of the ETS and or high timber/fibre prices).
- Establishing linkages with other councils, both regional and district, as the Tararua District land use challenges are not unique, with a view to develop strategies, expertise, and funding resources.

Failure to increase afforestation using the right tree, right place principles could lead to:

- Failure to plant highly vulnerable soils and continued or accelerating erosion with climate change and severe storm events (and possible increased infrastructure damage from storms).
- Declines in land productivity and value.
- Widescale afforestation on non-eroding (productive fertile) landscapes including whole farm conversations, resulting in a long-term loss of employment and community viability.
- Poor rates of forest survival, productivity and ecoservices provision.
- Not achieving highest and best land use.
- Legacy issues:
    - Community dissatisfaction and lack of engagement and uptake of appropriate afforestation options.
    - Failure to meet environmental legislation.
    - Increased risk of widespread fires.

4.0 Rangitāne o Tamaki Nui-ā-Rua and Ngāti Kahungunu ki Tāmaki nui-a-Rua Insights

TARARUA DISTRICT COUNCIL

Re: 1BT 000239 Project Right Tree Right Place Milestone 2 Report

IN THE MATTER OF Cultural input to Tararua District Councils work to investigate, prioritise and promote an initial set of 10 tree species/forest systems for a range of on-farm benefits including land optimisation, increased resilience, biodiversity and water quality impacts.

REPORT BY HINEIRIRANGI HARIATA CARBERRY

Tuesday 9 December 2020

Tena Koe,

INTRODUCTION

1. We welcome the opportunity to comment on the Tararua District Council Project Right Tree Right Place. We acknowledge any submissions made by individual whanau or hapū of Rangitāne.
2. We are focused on the connection of this project with Matauranga Māori, longevity of the selection of tree species and forest systems for consideration.
3. The Tamaki nui a Rua Rohe was once part of 'Te Tapere nui o Whatonga' (70-mile bush), filled with an amazing array of native tree species and vegetation. All interconnecting with one another, papa and rangi, and each species playing a part be it big or small in the environment in which it stood. We have gone through multiple cycles where the forest has disappeared naturally and replaced by native shrub and grassland with extremely high rates of erosion[1] in our landscapes. Although we are currently in an interglacial, our human-induced clearance of Te Tapere nui o Whatonga has turned back the clock into a glacial type of environment. Where we now have grassland on our steep slopes and along waterways, of which we are not surprised to see these rates of erosion happening and water quality challenges. As kaitiaki we are asking the questions: Is this land sustainable for pastoral production? How are we evaluating the resources?
4. In order to seek clarity and to progress feedback, we have met with:
    a. Whanau and Hapū with knowledge of either forestry, tree species and environmental backgrounds.
    b. Rangitāne Tamaki nui a Rua cultural advisors

[1] As mentioned in the report (1. Executive Summary)

EFFECTS ON RANGITĀNE O TAMAKI NUI A RUA

5. This project will have impact on ROTnaR for a number of reasons:
    a. Effects on tikanga, taonga Māuri and Kaitiakitanga.
    b. Our values and resources within ngahere (these being for what was, what is and what will be):
        i. Whakapapa
        ii. Significance of land to whakapapa
        iii. Connections to Tupuna, places/sites of significance
        iv. Religious or educational whakapapa
        v. Talking about actual whakapapa in terms of the korero that connects Rangitāne with the land, Purakau (korero purakau) all of those things
        vi. Ensuring an environmentally safe and sustainable future for our next generations.

SUMMARY OF KEY POINTS AND RECOMMENDATIONS

6. It would be good to get an understanding of the connection of the species placements in regards to the Land Resource Inventory (LRI) and the Land Use Capabilities (LUC) for their uses. So as to potentially see how the planning will go in advance and what types of species will be used for them.
7. Tree species from the list of 11 in which we feel would be best fit for farmers and our Rohe:
    a. Totara: It is a rākau rangatira of Te Tapere Nui o Whatonga. It's a preferred wood for carvings, used in the framing and roofs of whare plus other building material uses, and it has medicinal uses. Its red fruit were a favourite for māori. However, is the government going to allow milling of this tree species?
    b. Manuka and/or Kanuka: Many uses both culturally and medicinally also for building materials. It is great at providing a type of nursery for other plant species.
    c. Mixed species Native Afforestation (Replacement of native forest): Is this a mix of local native forest species types? It has the potential to connect with many of our values above.
    d. Kauri: Although not particularly native to our rohe, we have in the past been gifted a Kauri tree which sits out Kaitoki and has established well here with other trees sprouting up nearby it. However, is the government going to allow milling of this tree species?
    e. Redwood: carbon credits for this tree species is at the top, it is a beautiful timber that grows tall. It seems to have established well at Pukaha.
8. With these species in mind, our main position is to re-establish as best possible what once was here and native to our rohe and 'Te Tapere nui o Whatonga'. We also value mixing of tree species for afforestation, as they work together for the mutual benefit of one another. It's a collective effort in regards to a range of on-farm benefits, increasing resilience, biodiversity and water quality impacts.
9. We would like to see TDC look for methods that reduce the carbon emissions from the waste products produced by the felling of timber. We are concerned about the carbon output when the trees are felled and the waste is pilled and left to decompose at the sites. This emits huge amounts of carbon into the atmosphere and there are machines and processes that exist to limit this. Has this been looked into by TDC?
10. As a result of consultation and the preparation of this report, the following contemporary issues have been identified as those that ROTnaR have with the Right Tree Right Place project:

a. Impacts on the environment and cultural heritage landscapes from any earthworks involved in construction of any road upgrades, "internal" project/s roads and other infrastructure.
b. Impact on wetlands, springs and waterways of construction activities including sediment and stormwater runoff and the effect this might have on waterways and in turn customary fisheries
c. Impact of the project/s on the existing native flora and fauna
d. Impact of the project/s in social terms e.g how will ROTnaR and the local community benefit?

11. Impact on landscape from construction activities

a. The concerns here are on the steeper topography, in the formation of servicing roads in particular, there would be a detrimental impact on hill sides and gully areas. ROTnaR would be concerned if this were the case and seeks assurances that any such works are properly considered and implemented so that the impact on the landscape is minimised. It is expected that these matters will be set out in a construction management plan or similar.
b. It is also ROTnaR's expectation that an accidental discovery protocol will be developed with ROTnaR and apply to all such construction activities. It is understood that TDC have a standard protocol, ROTnaR proposes that it be inclusive of our concerns in its conditions.

12. Impact on waterways

a. As part of ROTnaR's values there is a kaitiaki obligation in respect of the guardianship of all waterways within its rohe. The impact of construction activities on wetlands, springs and waterways is therefore a concern because of the potential to affect water quality through contaminants entering waterways. ROTnaR therefore seeks assurances that any such works are properly considered and implemented so that the impact on these is minimised. It is expected that these matters will be set out in a construction management plan or similar.
b. ROTnaR would like to see the installation of a comprehensive storm water capture and treatment system that would operate during construction and as an important part of the future operation of the entire wind farm installation.
c. Protection of waterways in this respect also avoids the potential to affect customary fisheries such as eels and koura in the upper reaches of the swamps, streams and rivers that flow out to the coast or find their way into other local waterways. Other species in the lower reaches of these same waterways might also be affected by construction activities in the headwaters.
d. ROTnaR's expectations is that these matters will be encapsulated in a project construction management plan.

13. Native flora and fauna

a. ROTnaR also has a kaitiaki responsibility for the ecology of the project area. The assumption is that an ecological study will be undertaken and any particularly important ecological features identified and measures proposed to avoid or mitigate for these features as part of the project's proposal. In the meantime, areas of extant native forest within or near the project/s areas should be surveyed. The data and resources collected should be utilised towards identifying the appropriate species to be used within the project/s.
b. Where relatively major construction activities are planned such as road benching or cuttings, sediment capture and stormwater treatment ponds surrounds should be planted with natives as a landscape restoration measure and to provide habitat for future birdlife.

14. *Social*
    a. The positive social impact on the local communities of having learning opportunities in planting, environmental learnings and cultural learnings.

CONCLUSION

15. In conclusion we see that the right tree right place program in connection with matauranga māori can assist in the efforts to address and reduce soil loss on vulnerable sites, improve water quality and progress to a zero-carbon emissions stance for New Zealand. Through planting erodible lands in permanent forests. This will help mitigate water quality issues from land uses, and strive towards sustainable communities and economies in our rohe.

Right Tree Right Place Tararua

Right Tree Right Place Tikanga Kahungunu

Nga mihi Ki nga mauri me nga ora o Te Ao

Nga mihi Ki nga Tipuna, nga kaitiaki

Nga mihi nui Ki nga Atua,

Ki nga Matua Atua a Ranginui raua ko Papatuanuku

Tenei te mihi nui rawa atu Te Kaihanga, te kaihanga i nga mea katoa.

Ngāti Kahungunu
ki Tāmaki nui-a-Rua

Ngati Kahungunu Ki Tamaki nui a Rua were approached by the Tararua District Council to contribute to the project referred to as *''Right Tree right place''* early 2020 by the Economic Developments Manager Mark Maxwell in conjunction with the project lead Angela Rule.

Initial engagement was slowed due to the significant impact that Covid 19 had on New Zealand and the rest of the world, inclusive of this was the impact the virus and nationwide lockdowns had on Iwi throughout the country.

Ngati Kahungunu Ki Tamaki nui a Rua was severely impacted on taking on a significant role providing kaitiakitanga to their whanau throughout the Tararua District, or as traditionally known as Tamaki-nui-a Rua:

Scope around Ngati Kahungunu reporting will focus on the impacts lockdown at a Global level had in regards to our Natural Environment, and will provide some context from a traditional perspective of how Ngati Kahungunu view the definition *'' Right tree right place tikanga Kahungunu ''* taking into considerations of:

1] Traditional tikanga of the ngahere –

2] Impacts of Colonisation, deforestation, farming, planting of Pinus radiata on the Natural Environment, and the Social destruction of traditional Maori way of life.

3] Impacts deforestation has contributed to the loss of many native species, significant to te Maori Cultural base and economic sustainability, through loss of habitat, erosion, pollution of many waterways.

4] The on-going attacks upon the mauri of all-natural things associated with tikanga/kawa of Maori.

5] The lack of understanding by others of Maori connection to the Natural Environment as a whole, not an ecosystem approach to the way this living entity we call Papatuanuku raua ko Ranginui exist as a whole and the significance of kaitiakitanga bestowed upon Maori to be the guardians/stewards to their tuakana rakau, tuakana manu, tipuna awa and how and where human beings fit into this space.

6] Climate change/ Global Warming from a Maori view.

7] Right Tree Right Place Tararua

8] Right Tree Right Place Ngati Kahungunu Ki Tamaki nui a Rua.

The focus of this report lies within the traditional rohe {tribal area} of Ngati Kahungunu, whose ancestors arrived from Heretaunga and Tamatea in the 16th century and settled in what is now the Tararua District.

Through conquest and intermarriage with Maori from other Iwi, the hapu of Ngati Kahungunu gradually extended their dominance over the Eastern Side of the lower North Island.

The Ngati Kahungunu rohe extends from Paritu, north of the Mahia Peninsula to Turakirae {Cape

Palliser}. Today the Crown acknowledges the mana of both Ngati Kahungunu and Rangitane iwi with-in the Tararua District, which is also referred to by its traditional name of Tamaki nui a Rua.

Kahungunu Ki Tamaki nui a Rua is an Iwi organisation who represents the collective interests of our Iwi members through our engagement with the Crown and its agencies, local government, and business and corporate entities.

This report will be brief trying to capture the eight bullet points highlighted from a Ngati Kahungunu view in regards to a lived experience of a life of being raised in the Ngahere, with the many people that no longer walk in this world but have found solace in the world of the spirits and the many Atua that created this place we refer to as home.

Mother Earth / Papatuanuku / Tamaki nui a Rua / Tararua, watching and guiding our journey in trying to halt the many things that contribute to this looming manmade disaster called climate change, which historically will impact on our Social wellbeing our very existence as tangata whenua/human beings, something we cannot predict , but can pre-plan for far greater than any natural disaster that has occurred in the past, any man made event such as the two World Wars, Global Pandemics, which all have come and gone , this phenomena called Climate Change/ Global Warming will roll out slowly and will be with us for hundreds of years, but through this project called Right Tree Right Place Tararua / Right Tree Right Place Ngati Kahungunu - getting this right will be but a drop in an ocean to slow the impacts of this event, this may seem insignificant , but many drops in an ocean will eventually fill an ocean , as every tree planted will grow an indigenous rainforest once more beginning to recloak our earth mother Papatuanuku back to the mother she was once again able to provide for us.

Ngati Kahungunu will identify and give a brief description to the trees identified as contributors to our traditional way of life and how they provided sustenance and protection to us since the separation of Ranginui and Papatuanuku.

'' Traditional Tikanga of the Ngahere''

During the research and scope around this project, what was highlighted was the lack of knowledge around the ngahere and its natural systems that sustain the many lives that rely on her for survival.

Also, the lack of understanding around the Connection that Ngati Kahungunu Ki Tamaki nui a Rua have with the ngahere, during the research period, also noted was the loss of matauranga in regard to the ngahere and its roles it provides for ira tangata, among many Maori themselves, with some by passing the tikanga and looking at the economic benefits that can be derived from the ngahere from a colonial view.

Highlighted through this project was a heightened awareness of rejuvenation of a past concept of tikanga, the matauranga practise of keeping the knowledge a live among the rangatahi and to hold wananga to pass this knowledge on before it is lost, as only a few people that have this in depth knowledge survive, and the mana of Ngati Kahungunu to go to other Iwi to learn that traditional

knowledge so that a much more robust process of tikanga can be nurtured among our rangatahi.

The research conducted by Ngati Kahungunu highlighted the significant amount of their traditional knowledge base has been lost and the realisation , that when it comes to forums like this our ability to contribute from a tikanga perspective is minimal with a approach influenced from an overview from a Colonial way of engagement, and a reference to a Westernised view from an Educational Sector that has failed to grow and enhance Maori learning with in the realms of their own matauranga Maori spectrum, through place based learning, wananga and lived experiences, this is a systemic failure with in the Westernised approach to implementing guidelines around what we do.

Loss of the Natural Environment and all that reside in her have taken away Maori abilities to learn their traditional base and how they are able to contribute to their roles as Kaitiaki.

Feelings from a tikanga base I must ask the question, are we here to contribute to this research or are we here to meet the obligations imposed on organisations that seek funding from Central Government to meet their obligations under Te Tiriti.

The resulting implementations of any recommendations will show, if Maori concepts have been taken on board and implemented in conjunction with any other recommendations or this is another one of those exercises that involve Iwi just to tick a box which is an accepted practice widely used by many now.

'' Impacts of Colonisation, deforestation, farming, planting of exotic trees, [Pinus radiata] and the Social destruction of the traditional Maori way of life.''

Colonisation has been responsible for the Social Devastation of the Maori Cultural base by significant systemic failures when it comes to all aspects of Maori life.

Alienation from traditional tribal lands, alienation from lands led to the Economic collapse of the traditional Maori Cultural Base. Deforestation, the advent of farming, the replacement of Pinus radiata,

firstly capitalising on highly unproductive land such as the Volcanic Plateau were the Kaingaroa Forest sprawls out for many miles.

Noted korero from some of the workshops highlighted the ignorance of some of the participants with a mindset based around the economic benefits that selective trees bring in as a crop that generates money.

Ngati Kahungunu acknowledge the employment this industry brings, but during the workshops, Iwi got to promote and debate the significance of the aroha and the whakapapa connections they have with the ngahere, but the reality is Maori values are challenged because of the economic base selective exotic trees provide.

During the workshops one of the presenters highlighted the planting of kowhai he had done on his farm in an area close to his residence, he highlighted the influx of tuis but highlighted the lack of economic returns this planting would generate.

The latest economic development around plantations of pine forests is a way to minimise the impacts of Climate Change/ Global Warming, with Government encouraging this by offering to pay carbon credits to maintain this, sadly many of these blocks are planted around the many small native blocks left, lack of thought has gone into the potential risks these large plantations cause around the increased risk of fire, and the risk that these fires have on the remaining blocks of the ngahere.

Ngati Kahungunu treat the impending global catastrophe coming, the impacts of climate change, this impending disaster will be more severe than any natural disaster that has occurred in the past, and greater than any man-made event from the past, with this becoming the greatest catastrophe mankind has bestowed upon himself and many of these plantation owners see this impending disaster as a continuing opportunity to make money.

Ngati Kahungunu Ki Tamaki nui a Rua during the time it participated in this project as, the only real way to combat climate change is an approach around matauranga Maori and working alongside people like James Cowie and Heater Collins to name a couple of people met during this project as, they both were prepared to listen to the view of Ngati Kahungunu and have an understanding of our overview of the Natural System.

'' Impacts deforestation has contributed to the loss of many native species, significant to the Maori Cultural Base and Economic sustainability, through loss of habitat, erosion, pollution of many waterways and loss of virtually all wetlands.''

Un-controlled impacts on Papatuanuku and her tamariki have been un-relenting over the last 200 years, with deforestation which has impacted significantly on Maori Social, cultural and economic base.

The on-going devastation of progress has increased the disconnection Maori have had with their traditional economic base, that base being the whenua, and the sustenance of mauri through the tears Ranginui sheds for his lost love Papatuanuku.

Maori lived with in the Natural System through their connection as a child in the womb is connected to her mother through the pito, we as Maori were connected to Papatuanuku in the same manner, as each blow of the axe severed the sinews that bound us through the ngahere, through the manu that connect with the ngahere as a place to rejuvenate, a place to nurture those relationships between tree and bird from the creation.

Alienation with the advent of afforestation in the form of an invasive pest in the form of pine trees is alienating nga manu from their natural system, when Maori walk through a forest of pine trees, there are no manu Rangatira present, because kai is not present, the floor of these forest, provide no sustainable habitat for the whanau of insects that's make the forest floor their home.

Pollution, the on-going use of fossil fuels has added to the demise of the Natural System as Maori lived as part of their Cultural responsibilities as kaitiaki, prolific barstardising the Natural system and the flow on effects to others that rely on that natural system to sustain the role they play in keeping that system living.

Wetland diminishment through draining, to generate more productive land to feed an already un-sustainable practise of farming due to intensification and the impacts these practises have on the Natural System, the erosion of wetlands has led to the natural filtration systems with in the Maori Natural System becoming dysfunctional leading to a failure in comparison to the failings of the kidneys of the human body, the filtration system that works in the same way as the wetlands functioned in the Natural System that Maori referred to as Te Ika a Maui.

The opportunity throughout this project to engage with Iwi and to understand the way the Natural System as Maori are part of this was not given the significance of how Ngati Kahungunu are part of this system and live as part of this system.

Throughout the research not enough emphasis was placed on the Maori view of the Ngahere and how we connect with her, but with a focus on the economic benefits that alien rakau bring to a system already struggling to survive.

'' The on-going attacks upon the Mauri of all-Natural entities associated with tikanga and kawa of Ngati Kahungunu Ki Tamaki nui a Rua ''

Tamaki nui a Rua is the homeland of Ngati Kahungunu Ki Tamaki nui a Rua. Tamaki Nui a Rua continues to be the source of inspiration for their culture, language and identity, the two being inseparable.

Ngati Kahungunu Ki Tamaki nui a Rua permanency, kaitiakitanga and mana motuhake relies on that connection with Tamaki nui a Rua.

Natures lore is stronger than any man's law, Ngati Kahungunu Ki Tamaki nui a Rua tikanga mirrors Tamaki nui a Rua lore and accepts responsibility of people needs and lifestyle on her ability to balance the needs of all that rely on her living natural system.

'' The lack of understanding by others of the Maori connection to the Natural Environment as a whole, no one ecosystem approach to the way this living entity we call Papatuanuku raua ko Ranginui exists as a whole, and the significance of kaitiakitanga bestowed upon Maori to be the guardians / stewards to their Tuakana Rakau, Tua Kana Manu, Tipuna Awa and how and where human beings fit into this space.''

'' Ko Wai ahau?''

'' Ko te wai ahau, ko ahau te wai.''

'' Ko te whenua ahau, ko ahau te whenua.''

'' Ko te taiao ahau, ko ahau te taiao.''

'' Ko Tamaki nui a Rua ahau, ko ahau Tamaki nui a Rua.''

This whakatauki gives the clarity around our whakapapa connections to our Natural Environment and shows the Wairau connection our Natural Environment has with us as a whole system not a system, broken up into ecosystems, this is a learning that needs to be accepted in a world dominated by a Western Science perception of our environment, when focusing on one system and understanding of how that system whakapapa to the next system and identifying the Wairau connection that each has to the other, this is a view Maori have had since the creation, the separation of our Earth Mother Papatuanuku from our Sky Father Ranginui and the life that has grown from that time.

Within the Maori view of the Natural System, one can draw a comparison to the terminology of Ecosystems and specific Realms of the Atua that were derived from the separation of Heaven and Earth.

Tangaroa - Atua of all living things in nga te Wai.

Tane - Atua of all living things in nga te Ngahere.

Tawhirimatea - Atua of the Winds.

Rua-u-moko - Atua of Earthquakes.

Rongo-ma-Tane - Atua of Kumara.

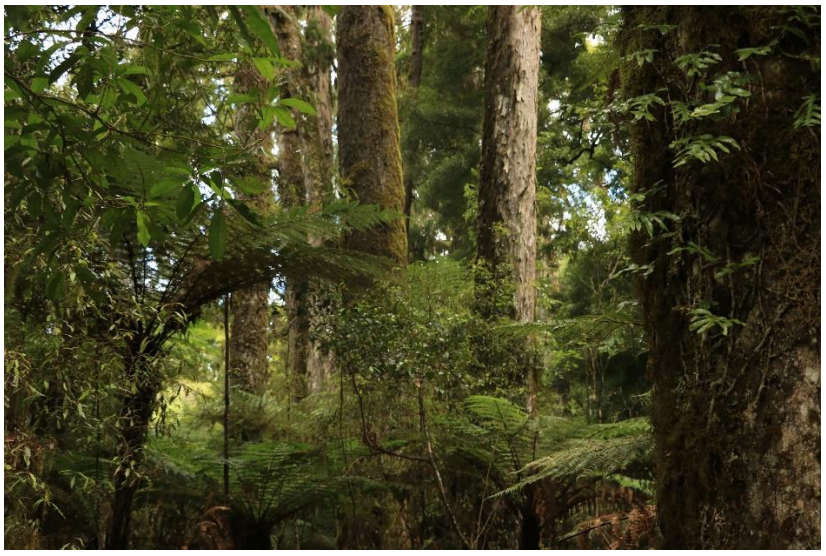
Tumatauenga - Atua of war and ira tangata.

Rua-umoko - Atua of earthquakes.

These equate to the Maori equivalent of Westernised ecosystems, but Maori through Whakapapa connected with all these Atua Realms through Wairua connections that bind whanau together.

To really understand the Natural Environment, one has to firstly be born Maori, secondly lived with in the Natural System as viewed by Maori, this knowledge is within us from the time of conception in our Mothers womb, to the day we are returned to our Earth Mother Papatuanuku.

Returning to our Earth Mother reconnects us with the lives of our Tipuna Rakau , whose mauri comes from our Earth Mother through their immense intertwining root systems under the ground that bring them together as one, this root structure holds them firm, this root structure binds our Earth Mother together , these Tipuna Rakau reach out to their Father Ranginui with their branches spread absorbing the man made gases from released Energies buried deep in the Poho of our Earth Mother, '' Fossil Fuels '' Carbon, Methane, through the process of reaching out to the Sky Father, these Tipuna Rakau absorb that Carbon and exhale Oxygen that in the Natural Systems enables us as Ira Tangata to continue to live.



These Tipuna Rakau provide a food source for their siblings Nga Manu Rangatira, they provide protection from Tawhirimatea and security from their enemies, for mortal man they provide food, building materials, medicines, our continued existence depends on the health of our Natural System, the strength of Te Taiao to maintain this balance.

So, summing up the Whakatauki speaks of the Natural System being one.

'' Am I water.?''

'' I am water, water is me.''

'' I am the land; the land is me.?''

'' I am the Natural Environment; the Natural Environment is me.?''

''I am Tamaki nui a Rua , Tamaki nui a Rua is me.?''

'' Climate change / Global warming from a Maori view.''

Climate change / Global warming is going to be the greatest challenge ever bestowed upon man and the Environment that sustains one's ability to continue to live.

Climate change has been rolling out for a number of years now and is gaining momentum, with global rises in temperature, the polar ice caps melting, glaciers withdrawing at an exorbitant rate, the result of this phenomenon, the on-going use of fossil fuels to drive economic growth.

The Rakau is becoming a very significant tipuna, to ease climate change with an increase in purchasing un-productive land and planting it in pine trees, to gain revenue from Carbon farming. Central Governments schemes around Carbon credits has led to the establishment of New Zealand Carbon Farms which are investing large quantities of money in the Tararua purchasing large tracts of land to plant pine, much of this land is currently farmland, this is the second wave of potential land to pine

investment, the first being the Forest owners group who purchased land for timber production, the latest investment is just an exercise of planting pine and leaving them grow with no real management of the tree, this increase in planting pine increases the risk of fire dangers in the Tararua greatly.

The Maori view is significantly different to the scenario's considered, to avert the looming crisis. Maori have not , only recently as the Westernised perspective of New Zealand's unique flora and fauna developed a perspective based on a scientific research approach, were as Maori have lived with their tipuna, their tuakana for generations since the separation of the Earth Mother and the Sky Father, so Maori knowledge of their Natural systems are a real Taonga orally passed on over the many generations, to the current, with the advent of colonisation much of this traditional knowledge has been lost , but there are still a few pockets of this Matauranga left, and is still lived today in a few isolated communities.

Knowledge is power, knowledge generates wealth, this has been a process adapted by Europeans and many of the remaining Maori who guard this sacred knowledge would sooner die with this as they acknowledge the cultural in-equalities that have been derived since 1840, the signing of the Treaty of Waitangi and the breaches of trust from one partner to the other over successive generations.

Climate change is going to be more severe than the next great earthquake triggered by the Trans-Alpine fault shifting, it is rolling out like a cancer, Horizons Regional Council have implemented a Climate Action Committee of which Iwi have a voice and the ability to contribute to solutions in a perspective based on their lived experiences in the realms of the Atua, the Natural System.

To succeed we have an opportunity to work as a collective to start to address this pending disaster.

'' Right tree Right place Tararua ''

''Right tree right place Tararua'' sounds good but has no real significance from a Ngati Kahungunu tikanga perspective, as discussed with Heather and Ang around this concept, Ngati Kahungunu see themselves as kaitiaki not as Atua determining were their tuakana should be planted and how they should be planted, this was decided when Rangi and Papatuanuku were separated and the Atua spread out the korowai, the ngahere, that cloaked our mother, this at the time when all living things were allocated a place on the Earth Mother.

During the duration of the project Iwi were given an opportunity to contribute, but much discussion was based on economic outcomes, climate change will not be driven by economic outcomes, she will just keep rolling out at an uncalculated pace , while people continue to debate the reasonings to combat climate change, the importance of trees to becoming a solution, but this is based on a knowledge base that goes back to the signing of Te Tiriti, Maori knowledge base goes back to the times of creation and the concept of whanau ties through whakapapa to all other living things.

Sadly, no matter how much Westernised New Zealand say they understand Maori cultural ways of life, they have absolutely no concept at all in yet Maori continually struggle to have their tikanga and kawa around the Environment, whenua, wai acknowledged and listened to, in many cases the Westernised

approach is rather than accept, through science to discredit what traditional knowledge has shown Maori for generations.

During the project the concept was to identify 10 rakau, and narrow it down to 5 rakau and highlight the relevance and significance of each.

From a Ngati Kahungunu tikanga, relevance was as simple as identifying each rakau and categorising it as a rongoa, a kai source, a timber source, the outcome of this research from a Tikanga perspective was no tree on its own has any significance hence why many different trees make up a forest, as one tree sustains the other, so they are all reliant on one another to live , the equivalent can be the human family unit, take out one member of a human family that family becomes dysfunctional till some normality returns, the ngahere functions the same, cut certain trees down and sustainable food for manu becomes scarce.

This rohe of Ngati Kahungunu was seen as one of the greatest rain forests and cloaked the huge valleys between the Puketoi Ranges in the East to the Ruahine/Tararua in the West, vast tracts of Totara, Kahikatea, Rimu, Miro thrived in this place they called their turangawaewae, now only pockets of this immense Taonga remains, from a Ngati Kahungunu tikanga, these remaining tracts were saved by the Atua so we had some Tipu Rangatira, the best of the best seeding trees left to start to re cloak our Earth Mother, what we do with these last remaining seed banks is up to us, but history shows us Maori are involved from a tokenistic perspective and very rarely listened.

For generations the ngahere was our pharmacy, our supermarket, our timber yard, and our source of continued survival.

''Right tree right place Ngati Kahungunu Ki Tamaki nui a Rua''

The above can be summed up in several words.

Replenish our Earth Mother with the clothes that she originally was robed in, in this area around sustainability of our Ngahere we are the experts, not ecologists, not geologists, not arborists, we are tangata whenua we are the last of the Atua creations, our role has and always will be to care for all the make up this Natural Systems.

There are many opportunities to learn from the people who have lived with this Natural System for hundreds of generations, no university can teach something can only be learnt in the Ngahere.

5.0 Recent Land Use Change in the Tararua District

In 2019 $110,320,000 worth of pastoral land was sold, of this 31% was for carbon forestry and 25% for forestry. Only 37% was for strictly pastoral use. But on a per hectare basis, of the 12,137ha traded, a total of 10,171ha had gone into forestry. This is approximately 85% of the land area.

At an average stocking rate of 8.5 stock units per hectare, this would mean 50,000 stock units worth of sheep and 20,000 stock units worth of cattle would have gone from the Tararua District in one year.

The analysis assessed a community spend of between $25-$30 per stock unit per year. This would mean that this decrease in stock units would cost the community between $1,700,000 and $2,100,000 per year.

Further to this would be a predicted loss of 21 farm related jobs.

Four times the number of properties were sold in the 2018/19 year than in the previous year and these numbers were recorded when the value of carbon (expressed in CO_2 equivalents) averaged under $25/tonne. At the time of writing the value of a C_2O E is $37/t with some contracts now at $42/t.

Farmers are also facing a wave of central government regulations, due in part to the sector's slow response to recognising and then mitigating the impact of agriculture on the environment. This wave may force whole farm changes that could be detrimental to New Zealand's economic production.

The raft of new regulations will have the greatest impact on the hill country farmers, typical in this district, many of whom are going to be severely tested to stay financially viable. Some farmers at a certain age and stage in their farming life may take this opportunity to exit.

The market for land is strong and supported by carbon farms, so forcing the hand of these farmers may have long-term significant consequences for the Tararua District and for New Zealand Inc as a whole.

Wholesale farm afforestation is not the answer, particularly when done for carbon credits and where there is no intention to ever harvest (often due to extraction costs or distance to port). This is likely to lead to the creation of a green desert not requiring any infrastructural support, devoid of any local community, and not contributing financially to society beyond its diminishing carbon revenues.

The Horizons Regional Council's publication on the state of the Tararua Coastal Catchment identifies 25% of the catchment as highly erodible land along with numerous streams and rivers not meeting the targets set for freshwater quality. In order to continue to meet National Fresh Water Policy (NFWP) targets a continuing farm focus on freshwater quality must continue. This will put pressure on current and future land use options resulting in some farmers opting for more afforestation or even to exit in order to meet the costs of implementing the raft of new regulations.

6.0 Climate Change Impacts in the Tararua District

Horizons Regional Council have commissioned NIWA to undergo some work on the implications of climate change in the region.

The following are some extracts from this published work in 2016.

Table 4-1: Climate change projections and impacts for the Manawatū-Whanganui region. Based on (Pearce et al., 2016, Ministry for the Environment, 2017c, Ministry for the Environment, 2018a, Ministry for the Environment, 2018b)

Climate variable/ physical process	Direction of change	Magnitude of change	Spatial and seasonal variation
Average temperature	Progressive increase with greenhouse gas concentration. Temperature increase flattens off for RCP2.6 but keeps increasing for other scenarios.	By 2040, annual increases from +0.7°C [RCP2.6] to +1.1°C [RCP8.5] By 2090, annual increases from +0.7°C [RCP2.6] to +3.1°C [RCP8.5]	Greatest warming in summer/autumn and least in winter/spring.
Growing degree-days	Increase	Specific analysis of GDD has not been carried out for the Manawatū-Whanganui Region at this stage.	Largest increase in areas and seasons with greatest warming (above).
Water temperature	Increase	Unknown, further work needed to understand magnitude of change.	Amount of warming depends on river elevation, catchment size, water source (e.g. snow melt or not).
Hot days	Increase in hot days (days with maximum temperature >25°C)	Currently 19 (average across region below 500m). By 2040, from +10 [RCP4.5] to +12 [RCP8.5]. By 2090, from +18 [RCP4.5] to +47 [RCP8.5].	Larger increases in the western Manawatū-Whanganui Region (increase of 50-60 hot days per year between Taumarunui and Whanganui under RCP8.5 by 2090).
Frosts	Decrease in frosts/cold nights (nights with minimum temperature <0°C)	Currently 18 (average across region below 500m). By 2040, from -7 [RCP4.5] to -11 [RCP8.5]. By 2090, from -11 [RCP4.5] to -16 [RCP8.5].	Larger decreases at higher elevations of the Central Plateau (reduction of >50 frosts per year for Tongariro National Park under RCP8.5 by 2090).
Rainfall	Mixed direction of change for most seasons, RCPs and time periods but consistent increases for winter.	Whanganui: By 2040, from -1% (autumn) to +5% (winter) [RCP8.5]. By 2090, from -5% (autumn) to +10% (winter) [RCP8.5]. Palmerston North: By 2040, from 0% (summer) to +6% (winter) [RCP8.5]. By 2090, from -3% (autumn) to +13% (winter) [RCP8.5].	Larger increases for the western half of the region in winter. Decreases in rainfall for the eastern part of the region (east of the Ruahine Ranges).

Climate variable/ physical process	Direction of change	Magnitude of change	Spatial and seasonal variation
Extreme rainfall intensity[2]	Increasing. Larger increases for shorter duration, rare events compared to longer duration, common events.	Shorter duration rare events undergo the largest increases in intensity (up to ~14% increase per degree of warming for a 1 hour, 1-in-100-year event). Longer duration more common events undergo the smallest increases in intensity (~5% increase per degree of warming for a 120 hour, 1-in-2-year event).	Large regional variability in changes to intensity across NZ. However, there is not enough confidence to provide regional projections so national augmentation factors are provided.
Potential evapo-transpiration deficit (a drought indicator)	Increasing everywhere, larger increases with time and RCP scenario. Generally, the region becomes more drought prone, particularly the eastern half.	Changes for 2090 under RCP8.5: Northern (Taumarunui to Feilding): up to +80 mm/yr Central (Waiouru to Fielding): around +160 mm/yr Western (Whanganui to Levin): +80-100 mm/yr Eastern (east of the ranges): +120-140 mm/yr	Largest increases east of Taihape under RCP8.5 by 2090. The area between Taumarunui and Ohakune undergoes the smallest increases (i.e. drought potential there does not change much).
Hill country erosion	Increase with larger extreme rainfall events, more rainfall in winter.		Increased land sliding: western Manawatū-Whanganui Region Increased gully erosion: Whanganui area Increased earthflow erosion: eastern Manawatū-Whanganui Region Increased sheet erosion: Volcanic Plateau, Ohakune cropping areas
Sediment loads	Increased extreme rainfall expected to increase fluvial sediment loads		
Solar radiation	Small increases in summer, decreases in winter.		

Climate variable/ physical process	Direction of change	Magnitude of change	Spatial and seasonal variation
Sea-level rise[3]	Increasing	0.5 m of SLR projected for NZ between 2060 (RCP8.5 83rd percentile scenario) and 2110 (RCP2.6 scenario). 1.0 m of SLR projected between 2100 and after 2200 for the same scenarios.	Subsidence is occurring in the south and west of the North Island (incl. Manawatū-Whanganui Region coastline) so relative SLR may be higher than projected national amount.
Coastal hazards[3]	Increasing	More frequent and severe coastal inundation events with increasing sea levels and more intense storms.	Most assets at risk from a 1-in-100-year storm tide event + sea level rise in Horowhenua and Whanganui Districts.
Manawatū river flows[4]	Decreases to mean annual low flow.	Mean annual discharge: minimal change (less than 5%) Mean annual flood: increases for all RCPs and time periods. +21% [RCP8.5, 2040], +18% [RCP8.5, 2090]. Mean annual low flow: decreases for most RCPs and time periods, e.g. -19% [RCP8.5, 2090].	Larger increases to mean annual flood by 2040 than 2090 (natural variability signal).

Sector	Impact	Comment – over time, anticipate:
• Forestry (exotic and native)	• As with all primary industries, the risk of biosecurity hazards increases (Kean et al., 2015) • Warmer temperatures and higher snowline have implications for weed & pest management (Rutledge et al., 2017) • Pine forestry may benefit due to increased *Pinus radiata* growth in cooler regions (Ministry for the Environment, 2017a) • However, higher risk of pine species disease (Reisinger et al. 2014) • Increased risk of fire – post fire regeneration of forests requires water, reducing water yields (Reisinger et al. 2014, Ministry for the Environment, 2017a, Pearce et al., 2010) • Long production cycles expose forestry industry to climate change impacts over longer periods (Ministry for the Environment, 2017a) • Increased risk of pest and disease because of rising temperatures, and habitat loss via erosion and unstable land are key risks to the industry (Ministry for the Environment, 2017a) • Increase in native and exotic forests in the coastal regions (Reisinger et al. 2014)	•Improved opportunities for pine forestry, but an increased risk of fire (increased temperatures, drought) •Improved opportunities for forestry in coastal areas (improved climate) •Increased risk of coastal inundation

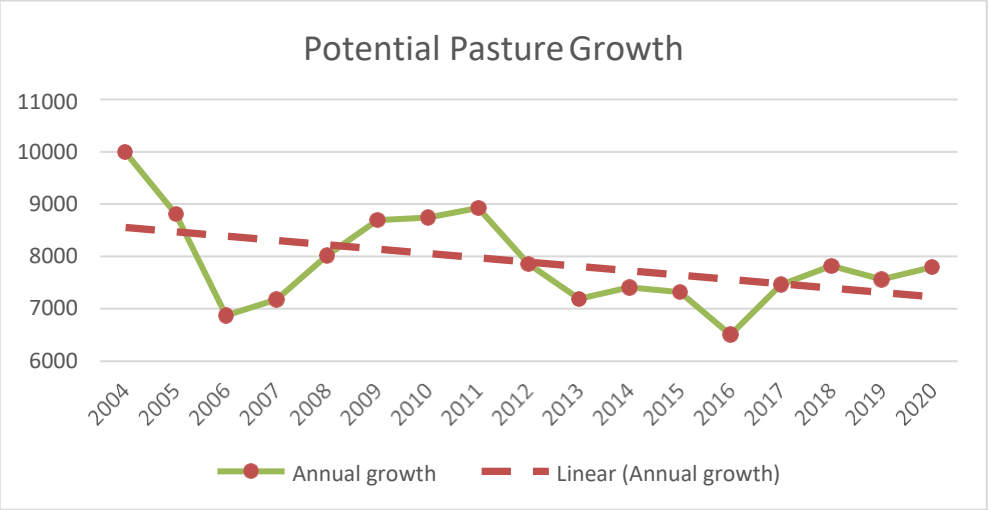
The report covered the likely impacts on agriculture, noting that there were some positives to agriculture. For example, the increase in temperatures over time is expected to favour wheat yields and benefits in the production of other crops such as onions, potatoes, other vegetables crops and also with horticulture.

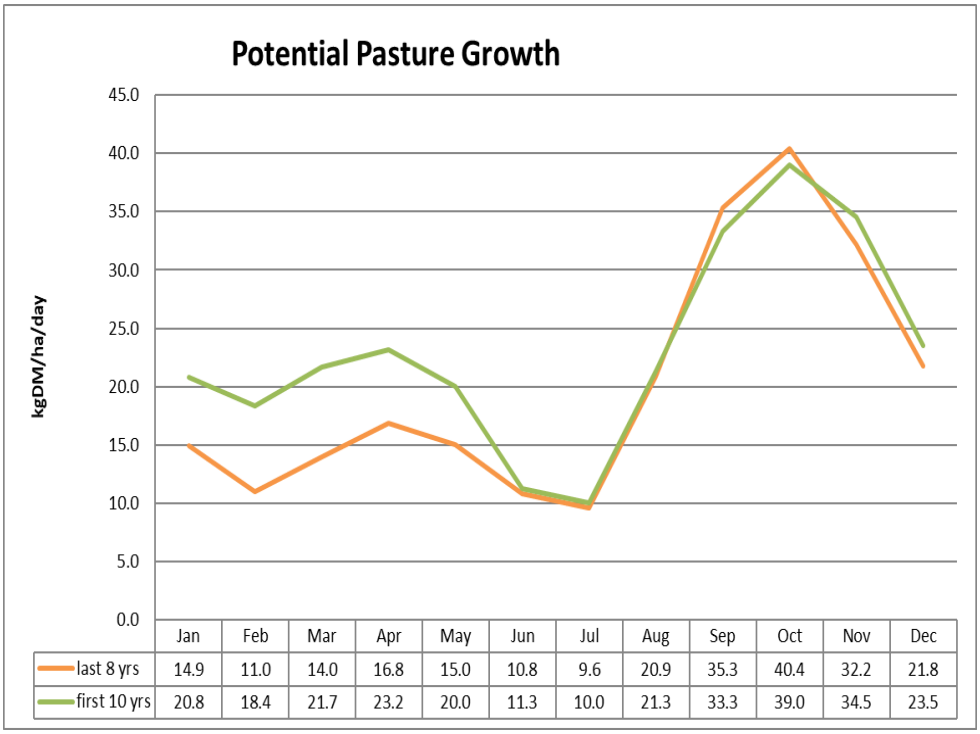
Impacts on forestry are likely to be mixed but conditions for pine forestry may improve due to carbon dioxide fertilisation and warmer temperatures. Nevertheless, there will be a higher risk during the establishment phase as well as an increased risk of fires and severe gales as well as weeds due to an increase in the number of hot days. The more localised effects will be through the reduced rainfall and the increase in wind runs. These effects have not been modelled in the spatial analysis.

Despite the increased risks the report writers believed that the increase in temperatures over time is expected to favour the growth of native and exotic forests in the district.

The impact in the Tararua District on pasture production may be more marked. The following graphs, complied from AgFirst pasture data records, show the decline in pasture production and growth patterns in the Hawke's Bay districts over the last twenty years due to the varying climate. The eastern areas in the Tararua District would be likely show a similar decline and change in pattern. With climate change this change in pasture growth rates is likely to continue.

Climate change modelling tends to add more risk and challenges to pastoral systems and will require a relook at current pastoral systems.





	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
last 8 yrs	14.9	11.0	14.0	16.8	15.0	10.8	9.6	20.9	35.3	40.4	32.2	21.8
first 10 yrs	20.8	18.4	21.7	23.2	20.0	11.3	10.0	21.3	33.3	39.0	34.5	23.5

7.0 Community Feed Back on the Right Tree Right Place Project

7.1 The Impacts of Afforestation on Rural Communities in the Tararua District

Below is the Executive Summary of Healther Colins' report. The full report can be found in the appendices.

This social research study explores the impact of afforestation[2] on local communities in the Tararua District. In particular, this research report explores: what 'right tree, right place' means for individuals, whanau/families, business and communities; any perceived opportunities, challenges or concerns that afforestation can bring; and the relationship between afforestation and tourism.

A single-case study research strategy was used to explore the community's responses to afforestation. The research used a number of established case-study methods, including document collection, community engagement (face to face interviews and workshops), and field observations. These methods were chosen to enable a wide range of individuals and groups to share their ideas and to enable a deeper and richer exploration of this case. The field work was completed between June-November 2020.

This research presents a rural community's responses to the recent large scale afforestation of land traditionally used for hill country sheep and beef farming. The community's responses as presented in this report, are a combination of participants' emotions (e.g. how people feel); perceptions (e.g. what people believe) and behaviour (e.g. how people may and are acting and reacting).

'Right tree, right place', the slogan of the One Billion Trees Programme (1BT), was a key focus of this social research. A wide range of perspectives were shared, reinforcing the participants' desire to plant a range of tree species in a range of locations for a range of environmental, economic, social and cultural reasons. Radiata pine, blanket planted on productive farmland for carbon farming, without the intention to manage or harvest, was not commonly described as 'right tree, right place'. Blanket planted radiata pine is also contrary to the government's stated desire in the 1BT programme to encourage the planting of native species to encourage biodiversity. The main report includes more detail around what participants believe to be 'right tree, right place'.

Herein lies a conundrum: 'right tree right place' is a seemingly simple slogan, yet one that highlights a deeper complex value and ethical debate. What is right and what is wrong is a personal values-based judgment, and who has the right to determine priorities and to decide what is right and wrong? Additionally, the 'right tree right place' concept does not appear to encompass all cultural worldviews. As a result, a binary argument has developed around this complex issue - right versus wrong, pines versus natives, pastoral farming versus forestry, carbon farming versus rotational forestry - with a strong polarisation of views contributing to this ongoing and emotive binary argument.

While the discussion appears to be about which tree to plant where, it is in fact a discussion about land use change and what is considered to be effective land use. How individuals and communities manage land use change, and how to encourage and enable diverse vibrant economically-driven rural communities, underpins this ongoing discussion and debate. The participants in this research are aware of and accept that land use change will occur in some form, but the pace of change, a perceived loss of control over the change and the

[2] Afforestation is defined as the establishment of a forest by natural succession or by the planting of trees on land where they did not grow formerly

unintended impacts of change are of concern to the community. Individuals and groups feel they are not part of these large-scale decisions, their voices are not being heard, and they are not included in the changes that impact on their way of life and the lives of their families/whanau and their mokopuna. A loss of agency was described: change is happening *to* them rather than *with* them. Traditional sheep and beef farmland being blanket planted in pine for carbon farming, is a symbol of a change that the community feel they have neither input into nor control over. Carbon farming is perceived to reduce opportunities for current and future generations, and in many ways, signals a loss of community. As one participant described: 'a community can't be built around carbon farming.'

Afforestation does bring opportunities (positive impacts) to the local community. Some examples include: increased short-term business for food and accommodation providers (during planting); pastoral farmers being able to realise their asset and exit with dignity; soil stabilisation and other environmental benefits; and rotational forestry contributing to increased socio-economic growth from increased employment, potential wood processing businesses, and the flow-on benefits to the local community.

Afforestation bring concerns and challenges (negative impacts), with a primary focus on the threat of carbon farming in particular on pastoral businesses and the rural community way of life. A number of issues were raised, including: a loss of jobs; the flow-on impact of less pastoral farm businesses on rural professionals and the businesses that support the farming sector; increasing risk of fire (amplified by concerns about reduced emergency access to carbon farming blocks); increasing risk of pests and Tb; decreased human health from increasing pollen; concerns about road quality and increasing volumes of forestry logging traffic; potential impacts on rural school rolls and provision of services; and potential impacts on community infrastructure (power and water supplies). Increasing stress, strong negative emotions and decreasing mental health and wellbeing from this rapid land use are of real concern.

Other concerns could not be as easily articulated. The participants' narratives spoke of undefinable losses, or personal losses that are deeply felt, yet unable to be precisely defined or described, and not easily put into words. A loss of community and familiarity was described, contributed to by a change in community dynamics, community structure and community culture. A loss of connection with place and people was described, as intergenerational properties convert from pastoral farming to forestry. A loss of opportunity and a loss of control were also described.

While the primary industries are a key land use in the Tararua District, domestic tourism is emerging as a significant growth area for the district's and Pongaroa's businesses and communities. Visitors come to Tararua for the natural beauty, rural environments and friendly people, and commonly travel 'the back roads'. While some believe pine afforestation will negatively impact on the views and reduce the visitor stay and experiences, others believe increased native afforestation would increase biodiversity and could attract visitors. Context is a key factor here, and the relationship between afforestation and tourism is not well understood. More work is needed to determine whether afforestation could positively or negatively impact on current and future tourism opportunities and businesses; and the tourism activities that attract people to the District and generate flow-on income.

In the context of increasing afforestation in the Tararua District, three key roles for Tararua District Council were identified (among others):

- An ongoing and active role in discussions around the development of central government policy and regulation regarding afforestation;
- Raising awareness about the ongoing social impacts of afforestation and in particular, increased fire risk; and
- Enabling and supporting communities to build their capacity and capability to manage change and transition.

It is recommended that:

- Mayor Tracey Collis and Council staff continue to communicate with, and provide central government with the extent and rate of land use conversion and the social impact of land use change on rural communities;
- At a district level, Council to consider the potential holistic impacts of land-use change as part of the District Plan review, and in particular, the impacts of pine plantation on social amenities and net community and business viability;
- Council and Fire and Emergency New Zealand (FENZ) work together to investigate the potential fire risk and emergency services access to rural sites;
- Council to continue to consider the social impacts of land use change on the community, including sharing research findings and being involved in ongoing social research;
- Council continue to work with and support the communities to build their capacity and capability to manage change and transition; and
- Council to continue to enable, support and build District-wide tourism opportunities.

(These recommendations are described in more detail in the report, including specific actions for Council.)

7.2 Community Views

A meeting was held at on the 27th of July 2021 at the Tararua District Council offices where the following general community views were expressed:

- Weather events will increase in severity.
- The community needs to build resilience to accommodate these events.
- Withdrawal of current land use where climatic events and climate change drive deterioration of the natural resource and biodiversity.
- This may mean that marginal land may become untenable, and the community needs to "get ahead of these risks and changes".
- Does the community stand and protect vulnerable landscapes or strategically withdraw from current land use?
- Decisions now have a 'legacy grade' impact. We need to be cognisant of the next generation.
- Mā mua ka kite a muri, Ma muri ka ora a mua. Those who lead give sight to those who follow, those who follow give life to those who lead. Is the knowledge we share with our rangatahi and tamariki, and therefore the decisions we make on their behalf, giving them the vision for their future that they want and need? From their perspective we are looking after them and what will belong to them, so let that inspire us to do the right thing for them? “A 1000-year-old tree has seen it all before”.
- The community needs to create a knowledge hub/network with low-cost support avenues, locally supported but nationally connected.
- Scion mapping resource which translates to a local web-based tool. This allows for information to be available to landowners such as map layers, cases studies, farm budgets and environmental and climate change mitigations templates.
- The aim would be to provide general information and leg-ups to farmers and then aid farm specific actions. It must be decipherable, not just a raw data.
- There was some concern around whose advice to trust.
- The Red Meat Profit Partnership (RMPP) model run by Beef+Lamb NZ was cited as a useful methodology to inform farmers.

A Youth’s perspective

- Earth does not care. It is humans’ responsibility to respond to climate change.
- The speaker thought that his life expectancy might be less than recent generations and he doubts that humanity will get a further 200 years of existence.
- Humanity needs to make it better now for his children.
- He felt that we need to be living sustainably now and to do this we must return to humanity and communities driving outcomes, not corporations.
- The community should drive the quality of life and not be focused material things.

Future generations

There was a belief that there would be continuation of the urban-rural drift apart and that the urban children see farming as polluting the environment. An opportunity exists expose urban children to New Zealand farming and that in doing so the opportunity is created to reconnect people to the land.

Further Community Perspectives

- Community needs a shared focus to respond to a global challenge.
- But fix local, then look outside to see where we can help others.
- The community must be wary of the hollow promise of pines as seen in Ruatoria in 1970s.
- Future proofing by species choices, diversity, breeding.
- Less pines, not no pines, healthy diversity to provide resilience.
- Tourism opportunities will increase.
- Eco sourcing seen as important, seed collection, nursery, care for placement of natives.
- Watch out for future weeds that will happen with climate change.
- The community needs a champion.
- Do not treat Iwi as one, there are different hapu/iwi.

8.0 Afforestation Species Options

Tararua District Council commissioned this work to investigate, prioritise and promote an initial set of ten tree species/forest systems for a range of on-farm benefits including land optimisation, increased resilience, biodiversity and water quality impacts, and that this was to be narrowed down to at least five tree species for a more detailed investigation as to their suitability.

The range of approaches and aspirations and experience levels regarding trees and forests shows that a range of species options should be considered to address likely considerations around tree planting. Initial 'human factors' work undertaken in this process showed that to be successful, the targeting and execution of afforestation options on farms must align with landowner needs and expectations.

8.1 Summary

Tararua District Council faces soil erosion and water quality challenges in relation to hill country farming activities. Forest cover has been identified as a mechanism to address soil loss on vulnerable sites and to improve water quality. Improved landscape function associated with appropriately sited trees is also expected to promote increased farm and community resilience and biodiversity.

Through a better understanding the aspirations of farmers, and in concert with their trusted advisors, forest cover can be restored according to a range of approaches and systems.

The study initially looked at ten tree species. This was further narrowed down to a more indepth study of six species. That is for, Pinus radiata (radiata pine), Sequoia sempervirens (coast redwood), Cupressus lusitanica, Eucalyptus (generic scenario), Leptospermum scoparium (mānuka), and Podocarpus totara (tōtara).

Reinstatement of native species may be chosen where long term reforestation and a heavy emphasis on biodiversity and restoration of original species is desired, while carbon may provide some limited cashflow a system like this is largely appropriate where the ecosystem services are valued highly by the farmer and family. Many in the community describe the very high aesthetic value of native species and the consequential attractiveness of having indigenous birds such as Korimako (Bellbird), Tui, or the Kereru (Native Wood Pigeon) in the gardens due to the presence of ecological corridors assisting in their migratory habits.

Where continued grazing is a driver, Silvopasture systems can incorporate livestock within spaced treecover and enhance grazing prospects while adding the benefits of trees to the farm system. Where economic benefit from log sales or on farm use of timber is desired a number of native and exotic afforestation options also exist.

Arriving at a rational and artful blend of these options may lead to a mosaic of more balanced and sustainable forestry policies that benefit the whole region.

Vital to the success of this vision is an understanding of and empathy around the landowners' wants and needs. Due to the complexities around the various options that are available, when writing a right tree, right place plan the landowner will need a trusting relationship with their advisor(s).

The initial report of ten tree species offers a range of forest tree species and systems with the intention to support TDC and their community to build understanding together for successful on farm tree planting in the future.

8.2 Land Use and Landowner Context

The project commissioned a human factors report (The Impacts of Afforestation on Rural Communities: A case study in the in the Tararua District of New Zealand) which highlighted that are a number of factors that influence the focus and direction of tree planting on-farm:

- Succession planning and structures/approaches.
- Financial risk management and potential benefit.
- Integration of tree-planting with other land-use activities.
- Workload and cashflow impacts in comparison to other strategic options.
- Emotional factors including their relationship with the property and wider eco-system.

Significant individualized investigation is needed to understand the landowner's context. This understanding needs to include current situation, future objectives, and parameters for decision making (e.g. risk appetite, financial limitations, operational considerations).

Hence this report presents a table of afforestation options with relevant attributes teased out for landowners to consider alongside TDC if required. They can then work to match these to their own aspirations with the help of relevant experts as required.

This report offers attributes, benefits and challenges associated with eleven forest species/systems in a succinct manner. These are offered in the spirit of being a rational set of options rather than an exhaustive one. Deployment of any of these options will be empowered following later site allocation work as part of this project for TDC.

Individual species/systems reports are supplied as reference material, with the generosity of HBRC who had these commissioned as part of their Right Tree Right Place Project which had its initial phase concluded in May 2020.

8.3 Afforestation - Environmental Benefits

Natural rates of erosion in this country are high by world standards> New Zealand makes up ~0.1% of the global land mass yet discharges 1-2% of average annual sediment yields to the ocean. Erosion in New Zealand has been exacerbated by anthropogenic activities, such as deforestation, which reduced forest cover from approximately 50% of land area in 1840 to 18% by 1920.

This deforestation was recognised as early as the 1930s for being responsible for the increased flooding and soil erosion throughout the country. Post-deforestation soil loss on Taranaki hill country has been assessed and it was estimated in 1993 that there was an average soil depletion rate of 1.8 ± mm in yr-1 off pastoral land. These findings were corroborated later in the 1990s and the early 2000s.

The increase of sedimentation, and a general decline in freshwater quality, has had a devastating impact on New Zealand's freshwater biodiversity. New Zealand's record of threatened aquatic species is unfortunately one of the world's worst – 68% of all native fish species are listed as threatened.

Although only one species (the grayling) has become extinct, fish numbers and diversity have been in national decline for at least the last century and this decline has accelerated.

This acceleration can be seen from the increase in the number of species listed as threatened over a 13-year period:

- In 1992 the Department of Conservation (DOC) listed 10 species as being in threat of extinction.
- In 2002 this number had risen to 16 species, and
- In 2005 24 species were listed as threatened, a 140% increase.

In 2007 a new threat classification scheme was established and under this system 68% of all extant native taxa and 76% of all non-diadromous taxa (fish that do not make migrations between the sea and freshwater) are considered threatened or at risk.

To summarise the findings on New Zealand agriculture, pastoral waterways generally have higher water yields, peak flows, nutrient levels, suspended sediment levels, faecal coliform numbers and water temperatures, as well as a lower faunal diversity relative to forested waterways. Even at forestry harvest and the following three to five-year risk period, the indicators still amount to a lower impact on waterways overall relative to pastoral catchments.

Landscape function depends on soil function. Biology is the key to carbon storage, water storage, nutrient cycling (and reduced leaching and erosion). The colonies of millions of species of bacteria, viruses, nematodes, fungi, worms, many of which are unnamed, and their functions are interdependent, but the bonding of soil particles by these soil ecological systems can result in less sediment movement into water with the phosphorous and nutrients.

Soil organic matter is fundamentally carbon stored in the soil (from deeper root material and sugars exchanged with soil biology, in exchange for other nutrients). This high carbon often leads to more resilience to drought and faster recovery from these events, as well as better nutrient cycling and less loss of soil particles (due to better bonding) which ultimately leads to cleaner water. Trees are seen as a way of increasing the soil carbon reserves.

Ultraviolet (UV) light and raindrops are incredibly destructive to soil ecosystems, consequently 100% soil cover by vegetation all year is a worthy goal for farmers. Trees could be part of this target.

The last 180 years of agricultural drive has degraded our waterways and diminished New Zealand's biodiversity,

with some evidence indicating that this is occurring at an increasing rate. The challenge to the pastoral sector is to lift its environmental game, but still remain financially and socially viable. Trees play a part in this bigger system and so it will be important as this project unfolds, that trees are seen as components among these interacting drivers.

8.4 Regulatory and Market Drivers for the Pastoral Sector

There are a number of Fresh Water Policy regulation impacts that will influence decision making across the district, but some of the biggest impacts on afforestation may be due to Green House Gas (GHG) legislation. The Climate Change Response (Zero Carbon) Amendment Act 2019 aims at reducing methane to 10% below 2017 levels by 2030 and with net carbon and nitrous oxide emissions at zero by 2050. On top of this methane emissions are to be reduced to 24-27% below 2017 levels by 2050.

Agricultural GHG will be priced from 2025 (initially at 5% of emissions) and all farmers will need to report on farm GHG emissions by the end of 2022.

It is uncertain at this stage whether the costs of GHG will be at an individual farmer level or at processor level. At a farmer level it drives behavioural change, but it is administratively complex.

Studies show that it is more profitable to seek carbon sequestration opportunities rather than reduce production to meet these targets.

Carbon sequestration rates for forests less than 100ha are set according to location and forest type (exotic, hardwood, native). For forests 100ha and over the forester must record tree growth and then adjust carbon sequestration accordingly.

Pine forest plantings to offset carbon emissions are not a permanent solution, as it is only the first cycle (17 years) where carbon can be claimed. So, if 10ha of forest was planted to offset carbon emissions, this would have been used up by year 17, and so a further 10ha would be required to be able to continue to offset. Hence by year 51, a farm would need a further 30ha, bringing the total to 40 ha, to keep emitting at the same level.

Native trees keep sequestering for 200-300 years, but only 30% per year of the carbon compared to pines for the first seventeen.

In theory farmers cannot off set GHG by planting forests, but in practice they would work around this by selling the carbon credits to pay for the GHG levies.

Key to this is that farmers do not need to offset the GHG on their own farm and they will probably purchase or lease land for forestry with a land value lower than their own.

This is likely to have a significant impact on districts like Tararua where the hill country has a lower value than other areas under pastoral farming, but with good pine and carbon sequestration rates. This will have the effect of accelerating the demand for pastoral hill country to convert into forests in the district. The table below shows the area of land required to be planted in pines to offset average GHG production for a 17-year cycle.

Area of forestry in hectares required to offset GHG Using Averaging Scheme					
% Offset	5%	10%	25%	50%	100%
151 ha dairy farm- (ha)	3.3	6.6	16.5	33.0	66.0
640 ha sheep and Beef farm – (ha)	4.6	9.2	23.0	46.1	92.2

Note: this table is based on average Pinus radiata and gives a 17-year offset.

An activity to mitigate wholesale land conversion into forestry might be facilitating farmers to connect with other businesses wanting to offset emissions. This would allow farmers to retire small portions of low pastoral production land, rather than the current wholesale land conversions.

8.5 Determining Site Suitability for Different Types of Tree Cover

Landscape function can be driven not only by vegetation cover whether, pasture, crops or trees, and their synergies but also by soil biota.
Trees protect landscapes especially in intensive storm events, by providing a canopy that intercepts rainfall, reducing water in the soil profile, and with roots that provide structural integrity by binding the soil matrix together.

Generally, erosion factors include, (1) rainfall intensity and runoff, (2) antecedent moisture, (3) slope and slope length, (4) soil type and geology, (5) vegetation cover, and (6) previous intensive storm events (availability of material to erode).

While the benefits of afforestation are well documented, vulnerable landscapes remain at risk of extreme storm events and will be riskier for commercial plantations where soil may fail under rootplates. These locations are likely to have parent materials predisposed to slope failure, landscapes that are too steep, and with aspects aligned with frequent incoming intense storm events. These locations often exhibit soils that are termed skeletal in nature - shallow soils lacking horizons, and often on rocky substrates.

The project aimed at using land units based on LUC, slope and aspect to support the accurate assignment of land to forestry. This will accumulate in the development of the Sustainable Land Afforestation Protocol (SLAP) with the purpose of SLAP to help make informed decisions around the right tree in the right place in the landscape.

The overarching premise for developing the SLAP from the LUC units was to identify locations suited to afforestation with commercial plantings, compared to sites with limitations, that require approaches like retirement, reversion, or potentially carbon sinks, or other ecosystem services like filtration of water, and erosion reduction. SLAP provides a useful resource in the decision-making process.

7.6 Initial Species Options Attributions Array

Tararua District Council Afforestation Initial Species Options Attributes Array V1																	
Prepared by James Powrie - RedAxe Forestry Intelligence June 2020																	
	Species or forest systems category	Native/ Exotic	Financial return	Typical rotation length in years (indic-ative)	Establish-ment cost	Principal advantages for farming context and local development.	Principal disadvantages for farming context and local development.	Market development	Biodiversity	Genetic development	Long term Erosion control	Carbon fixation rate	Integration with grazing systems	Stock feed potential (foliage)	Stock feed potential (undergraz-ing)	Expert contact	Supporting document title
1	Cypresses (Lusitanica, Macrocarpa, Ovensii)	Exotic	Significant sales price possible if marketed well, dependent on local milling demand or export option at the time.	40	Med	Attractive timber for legacy use for family projects. Well recognised. Some existing markets.	Slower growth rate.	Recognised, small volume niche demand domestically, strong export demand at times.	Monoculture disadvantage, but bird roost, fungal and soil species diversity may improve.	Informal breeding and selection means these species not at their potential yet.	Longer rotation nominally favours erosion control from these species given less frequent harvest.	Med	Poor, some early grazing with extreme caution, bark stripping likely and toxic foliage can be problematic.	Nil, can be problemati c due to toxicity/ab ortion risk.	Poor.	Specialty Wood Products, NZ Farm Forestry Association, Dean Satchell (paper author)	Species assessment – Cypresses
2	Dryland eucalyptus (Globoidea, bosistoana, quadrangulata showing local promise in trials within Tararua District).	Exotic	Potentially excellent given nationwide adoption of NZ Dryland Forest Initiative technology an dwidepsread market development through time.	25	Med	Emerging development of breeding, research and development and markets. Field testing and trials advancing nationwide with local proponents. Offer naturally durable timbers with no chemical treatment needed. Excellent for sustainable winegrowing, engineering applications.	Very site specific, expert matching required.	In early phase but well funded and supported by industry, councils, Marlborough Researcgh Centre, School of Forestry and MPI.	Monoculture disadvantage, but bird roost, fungal and soil species diversity may improve.	Underway, advancing well with support of University, funders, Proseed (Ngai Tahu).	Relatively short rotation length.	High	Poor grass growth generally likely under eucalypts. High rainfall improves this picture.	Nil.	Poor.	NZ Dryland Forests Initiative. Paul Millen, paper author. Specialty Wood Products, NZ Farm Forestry Association. Existing local growers and trials.	Species assessment - Eucalyptus, Specialty wood products strategy
3	Kauri	Native	Potential for high log sales price, but long rotation impacts return in today's dollars. (Net present value)	80	High	Legacy grade future use of timber. Enjoyment and satisfaction.	Siting will be critical as outside natural range.	Tane's Tree Trust are pursuing this.	Potential benefit of preserving national seedsource away from dieback areas.	Poor.	Slow to develop but infrequent harvest disturbance is a nominal advantage.	Low	Poor.	Nil.	Poor.	Tane's Tree Trust	Species assessment – Kauri and Totara afforestation option in Hawke's Bay: preliminary economic analysis, Spp_Kauriandtotara_HorganKimberleyBergin.docx
4	Totara	Native	Potential for high log sales price, but long rotation impacts return in today's dollars. (Net present value)	80	High	Legacy grade future use of timber. Potential ceremonial use for local Marae. Enjoyment and satisfaction.	Require frequent silviculture in early years, but slow growing an dtherefore nil financial return in todays terms.	Some niche potential as availability for traditional uses especially will deteriorate. Tane's Tree Trust are pursuing this.	Monoculture disadvantage, but bird roost, fungal and soil species diversity may improve.	Poor.	Slow to develop but infrequent harvest disturbance is a nominal advantage.	Low	Poor.	Nil.	Poor.	Tane's Tree Trust	Species assessment – Kauri and Totara afforestation option in Hawke's Bay: preliminary economic analysis, Spp_Kauriandtotara_HorganKimberleyBergin.docx
5	Manuka for honey	Native	Potential for high export price. Success dependent on kind seasons, excellent beekeeper performance and neighbourly beekeeping. Relatively slow carnbon sequestration.	25 to assumed succession of other native species, highly dependent on existence of seed.	Low	Provides erosion protection and some soil retention gain at fairly low cost with additonal benefit of honey sales, and carbon revenue or offset.	Slower carbon sequestration.	Ongoing with medical product potential.	Has benefit of offering nurse crop to other natives and habitat, especially if blended with other flowering and native species.	Ongoing toward suitable timing of flowering, regional matching and enhanced honey qualtiy an dvalue.	Excellent if succession of other native occurs.	Low	Moderate, essential to supervise closely.	Nil.	Moderate, essential to supervise closely.	NZ Manuka Farming	Species assessment – Manuka
6	Poplar Silvopastoral Systems	Exotic	Portable sawmilling can lead to valuable on farm resource and local sales. Occasional log sales possible for export or pulp.	25	Med	Offers maximum integration of shade, shelter, carbon, eroision control stock feed from foliage and some timber potential. Enhanced economics if on site sawmilling added judiciously where access allows.	Poplars have a use by date and cleanup cost if inaccessible for harvest.	Excellent on farm use and trading examples via NZ Farm Forestry Association.	Monoculture disadvantage, but bird roost, fungal and soil species diversity may improve.	Ongoing through Poplar and Willow Trust	Excellent until senescence and then require cleanup and replacement.	Low-High, spacing dependent	Excellent if poles protected or fenced off.	Excellent drought relief forage.	Poor.	Rural Directions. Ian Millner - paper author.	Species assessment – Silvopastoral Systems

7	Radiata Pine	Exotic	Shorter rotation length and solid market options and faster carbon sequestration lead to fairly strong financial returns.	25	Low	Dependable makets and crew familiarity. Shorter rotations offer cashflow to farm business or succession opportunity. Faster canopy closure hastens erosion control benefits relative to other options.	Farmer resistance may be rooted in tradition , or folklore. Eg. A magpie chased me because it was nesting in a pine., or, schools close because of forestry. Harvest cycle means more frequent soil impact possible on vulnerable sites.	Advanced for domestic and export and on farm use.	With higher rainfall understory biodiversity can be high. Some bird species favour it, eg NZ falcon and Kiwi feed and nest in pine forest.	Advanced.	Dependent on harvest location and conditions. Shorter rotation leads to nominally more frequent harvest and impact relative to slower growing species.	High	Moderate, essential to supervise closely.	Nil.	Moderate.	PF Olsen author of paper. NZ FFA	Species assessment – Radiata pine
8	Coast Redwoods	Exotic	Nationally this species has grown in popularity with one company, likely to result in processing options being developed, but unless these are local export dependence may limit returns	40	Med	Long rotation and impressive stature/enjoyment of the visual impact.	Require deeper moister soils. Reach massive size which may become problematic.	Well recognised internationally. Some likelihood of futre dedicated sawmills in NZ.	Monoculture disadvantage, but bird roost, fungal and soil species diversity may improve.	Imrpoving due to one company investing in NZ.	Longer rotation nominally favours erosion control from these species given less frequent harvest. Coppicing (shooting from stump) keeps proection in place after harvest by keeping roots alive.	High	Poor.	Nil.	Poor but storm shelter may have value to the farming system.	NZ Redwoods. Simon Rapley.	Species assessment – Redwoods
9	Douglas-fir	Exotic	Well recognised species internationally, little or no mainstream processing in NZ. Some portable milling potential and export. Moderate returns impacted by longer rotation.	40	Med	Elegant species with useful wood proerties and on farm or legacy use potential for beams furiture etc.		Traditonally accepted in Asian market, treatment regulations impeding to building use in NZ.	Monoculture disadvantage, but bird roost, fungal and soil species diversity may improve.	Moderate.	Longer rotation nominally favours erosion control from these species given less frequent harvest.	Med	Poor.	Nil.	Poor but storm shelter may have value to the farming system.	PF Olsen author of paper. NZ FFA	Species assessment – Douglas fir
10	Mixed species Native Afforestation (Replacement of native forest)	Native	Long term forest cover the goal so no market opportunities other than low volume carbon and potentially miscellaneous honey production.	1000	Extreme	Beautifcation and biodiversity may be excellent. May attract funding and QE2 support.	Expensive and site specific. Excellence requires diligent effort around weed an dpest control especially. May require deer fencing.	Not applicable.	Optimal biodiversity outcomes if well established and managed in applicable local species and ecosourced.	Ecosourcing a primary success factor and to be faithful to local genetics.	Excellent if understory species succeed. This is dependent on selection and survival.	Low	Not applicable.	Nil, but some seasonal traditonal medicinal effects possible if stock can reach over fences.	Nil.	Palnt Hawkes Bay. Marie Taylor, Paul Millen. Wildlands Consultants.	Species assessment – Native restoration, Species assessment – Establishment of Indigenous Forests in Hawkes Bay
11	Mixed native and exotic carbon crop with long term biodiversity gain.	Native/Exotic	Long term forest cover the goal so no market opportunities other than low volume carbon and potentially miscellaneous honey production.	25/1000 Short term exotic carbon or timber crop with long term native understory to remain in pertpetuity. An experimental option developed by Ekos Ltd.	Med	Potential to create longterm biodiversity while using exotic native species to attract carbon revenue in ealry years through additon of exotic hardwoods or	Untested and site specific, will require siting expertise.	Species dependent.	Optimal biodivrsity outcomes if well established and managed in applicable local species and ecosourced.	Species dependent as above.	Excellent if succession of other native occurs.	High	Not applicable.	Nil, but some seasonal traditonal medicinal effects possible if stock can reach over fences.	Nil.	Ekos Limited. Dr. Sean Weaver.	Species assessment – Ekos native/exotic forest carbon regime, Mixed NativeExotic_Ekos_WeaverHawkes BayForestCarbon.pdf
12	Tawa	Native	Potential for high log sales price, but long rotation impacts return in today's dollars.		High	Legacy grade future use of timber. Enjoyment and satisfaction	Require frequent silviculture in early years, but slow growing and therefore nil financial return in today's terms.	Tane's Trees Trust are pursuing this.	Monoculture disadvantage, but bird roost, fungal and soil species diversity may improve.	Poor	Slow to develop but infrequent harvest disturbance is a nominal advantage	Low	Poor	Nil	Poor	Tane's Tree Trust	Principles of native tree establishment would apply. Early ordering essential for an unusual species for forest development.

9.0 Tree Species Analysis

Site suitability in the Tararua District for six tree species was narrowed down from the initial ten species first analysed, that is for Pinus radiata (radiata pine), Sequoia sempervirens (coast redwood), Cupressus lusitanica (a Cypress species), Eucalyptus (generic scenario), Leptospermum scoparium (mānuka), and Podocarpus tōtara (tōtara).

Species		Market Risk	Site Suitability	Erosion Control	Financial Risk	Farmer appeal*	Further Analysed in this report
1	Cypress	7	6	7	6	7	☑
2	Dryland Eucalyptus	7	7	6	7	7	☑
3	Kauri	n/a	4	n/a	n/a	5	
4	Tōtara	n/a	7	9	n/a	6	☑
5	Manuka for Honey	9	6	9	7	8	☑
6	Silvopastoral	7	4-8	8	6	8	
7	Radiata	9	7	7	9	5	☑
8	Coastal Redwood		7	8	7	7	☑
9	Douglas Fir	8	4	7	8	5	
10	Mixed Species Indig		7	9	n/a	6	

* assessed in discussions

No further analysis was done for Douglas Fir (climate limiting), Kauri (climate limiting, but potentially similar to Tōtara and therefore covered in some environs), Silvopastoral (has significant benefits in space planting on hill country but it is so site specific that was not assessable in the resolution data set). The mixed species option did have farmer appeal, but the range here was too wide for the spatial analysis objectives. This of course may understate the ecosystem, cultural and emerging potential human health benefits which were not fully accounted for in this study. It is noted though that there was some farmer concern in the risks of establishing mixed indigenous species due to the changing and drying climate adding variability and hence risk in the establishment success rates.

A generic scenario for the Eucalyptus species was developed because for many Eucalyptus species, the specifics of tree species characteristics were unknown, but it was considered preferable to cover the wide range of environmental conditions in which Eucalyptus species are found.

Site suitability characteristics for tree species include ranges of average annual temperatures, total rainfall, elevations above sea level, site fertility including soil water availability, rooting depth, and soil fertility, tolerance to wind exposure damage, and tolerance to saltwater spray. Information was collected for each of the tree species to help inform us of their preferred environmental and climatic conditions for establishment and growth.

When looking at reports associated with tree species preferred site suitability characteristics, the information is generally anecdotal. However, there were empirical models available that can provide insights into site selection.

The data were compiled into a spatial database and summary statistics calculated to provide values for elevation, rainfall and mean annual temperature. Empirical data to determine tree species site suitability characteristics for Eucalyptus, tōtara and mānuka for honey regime was not available. Consequently, grey literature and expert knowledge was used to fill in the species site suitability characteristics gaps.

9.1 Objectives of Spatial study work

To assist the Tararua District Council explore and understand opportunities for afforestation strategies that not only reduce soil erosion but are also economically and environmentally sustainable the study has to:

- Identify areas highly prone to erosion that could be prioritised for afforestation and provide high level information about afforestation options using the TreeScape model.
- Identify options for different tree species and regimes that are matched to specific sites and understand their merits and drawbacks using the Tree Species Site Suitability model.
- Calculate timber returns and their costs for Pinus radiata, but also the potential for carbon sequestration using the Forest Investment Framework (FIF).
- Outline existing and future wood supply issues and wood processing options using the WoodScape model.

9.2 Results of Spatial Modelling

Response curves and "fuzzy logic" techniques were used to develop tree species site suitability maps for Radiata pine, coast redwood, Cupressus lusitanica, a Eucalyptus generic scenario, tōtara, and mānuka.

Fuzzy logic techniques spatially define landscapes suitable for afforestation, while addressing some of the issues related to coarse LUC spatial information.

This approach not only gives a useful prediction of where a species can be planted, survive, and grow from low to high productivities, but also provides an estimation of suitability between species. The approach has also been designed to enable the modelling to be updated, not only as thinking changes around what constitutes tree species characteristics that comprise site suitability but also allows for the redevelopment of tree species site suitability maps as new information becomes available. It is a dynamic modelling framework that can evolve as the knowledge and science progresses.

9.2.1 Pinus Radiata

The site suitability for Radiata pine is shown in (Figure 3 in the full report and shown below) suggest that Radiata pine is suitable across much of the Tararua District with site suitability only decreasing with elevation and low temperatures. Rasters representing the site characteristics of elevation, total annual rainfall, mean annual temperature, and ProfileElevation shows the higher altitude areas as not suitable, whereas total annual rainfall values are suitable at most locations, and mean annual temperatures warmer along coastal regions, and reducing at elevated areas of the Tararua District.

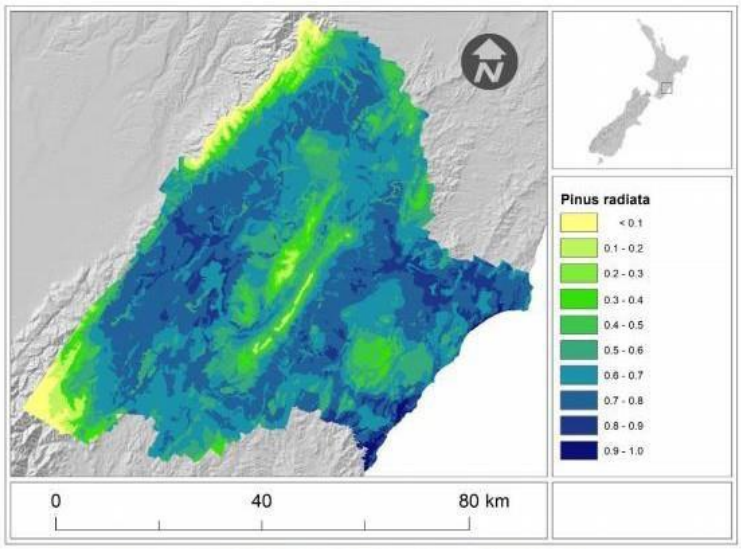


Figure 3: Tree species site suitability degree of membership for radiata pine.

9.2.2 Coast Redwood

Coast redwood (Figure 5 in the full report and shown below) has a similar spatial pattern to radiata pine but with elevation, and temperatures having a stronger effect at cooler elevated locations. Wind also excludes locations with higher exposure. Coast redwood has the additional rasters representing salt intolerance with the distance from the coast, while a wind exposure raster identifies landscapes that are exposed to wind that can cause wind damage to plantations.

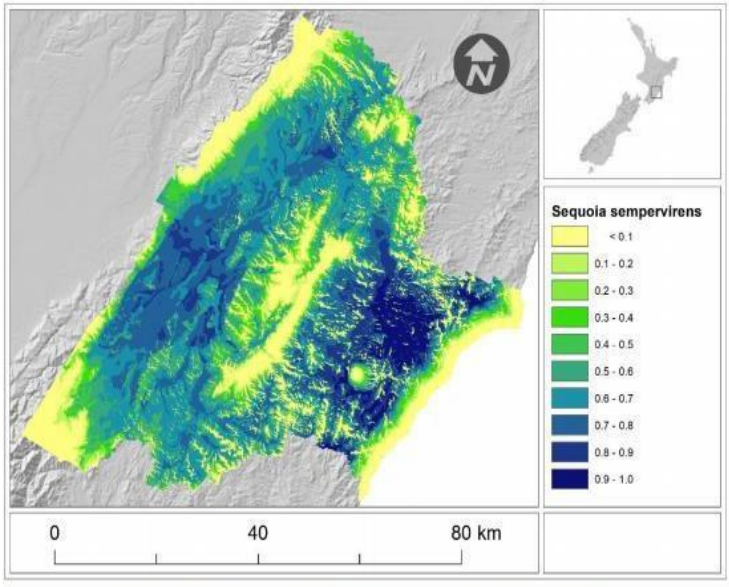


Figure 5: Tree species site suitability degree of membership for coast redwood.

9.2.3 Cupressus

Cupressus lusitanica site suitability maps (Figure 7 in the full report and shown below) show that, for themost part, this species is only suitable at lower elevations below the ranges across the Tararua District. When investigating Cupressus lusitanica patterns for elevation, temperatures, and rainfall, the later stands out as having a stronger influence on site suitability. Rainfall limits suitability to the inland regions for the Tararua District (Figure 8).

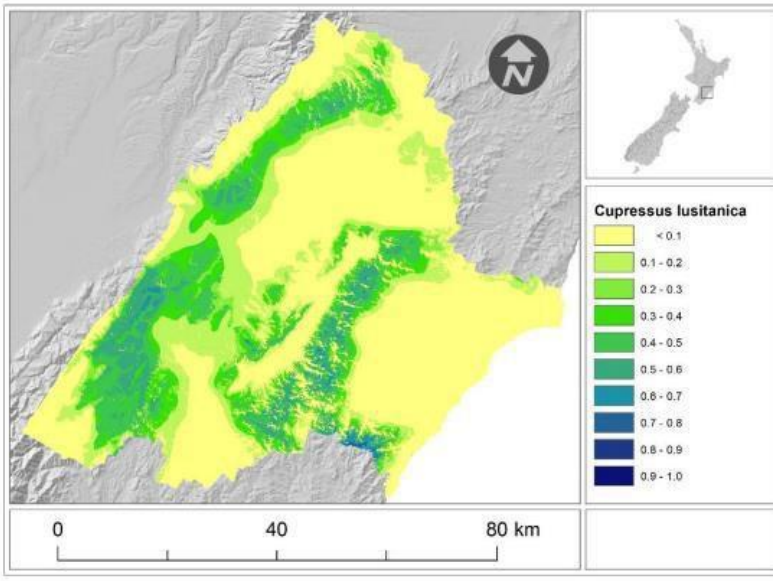


Figure 7: Tree species site suitability degree of membership for *Cupressus lusitanica*.

9.2.4 Eucalyptus

Eucalyptus generic scenario site suitability maps (Figure 9 and shown below) show that this species is most suited to the coastal and lower ranges regions of the Tararua District.Temperature, frost days and wind exposure are influencing site suitability (Figure 10). Additionally, rasters representing PAW, wind exposure, and the number of days ground frost restrict a substantial part of the Tararua District Eucalyptus generic scenario site suitability

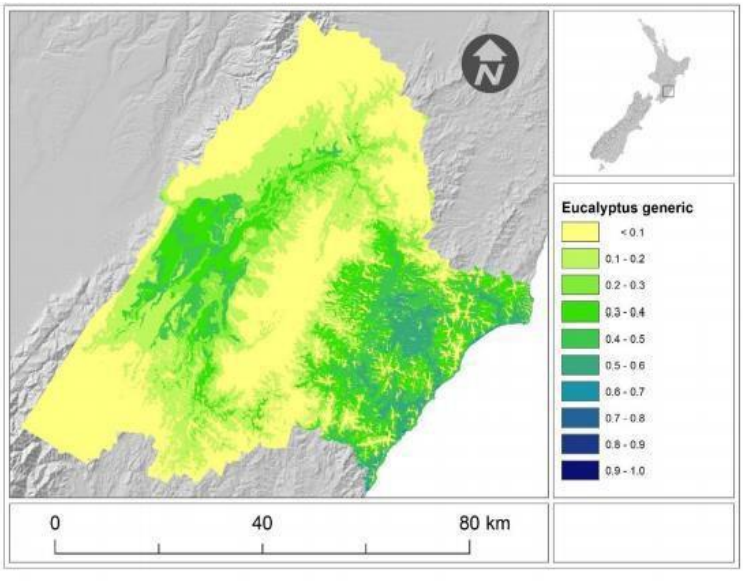


Figure 9: Tree species site suitability degree of membership for *Eucalyptus* generic scenario.

9.2.5 Tōtara

A substantial part of the Tararua District is suitable for the establishment of tōtara as shown below.

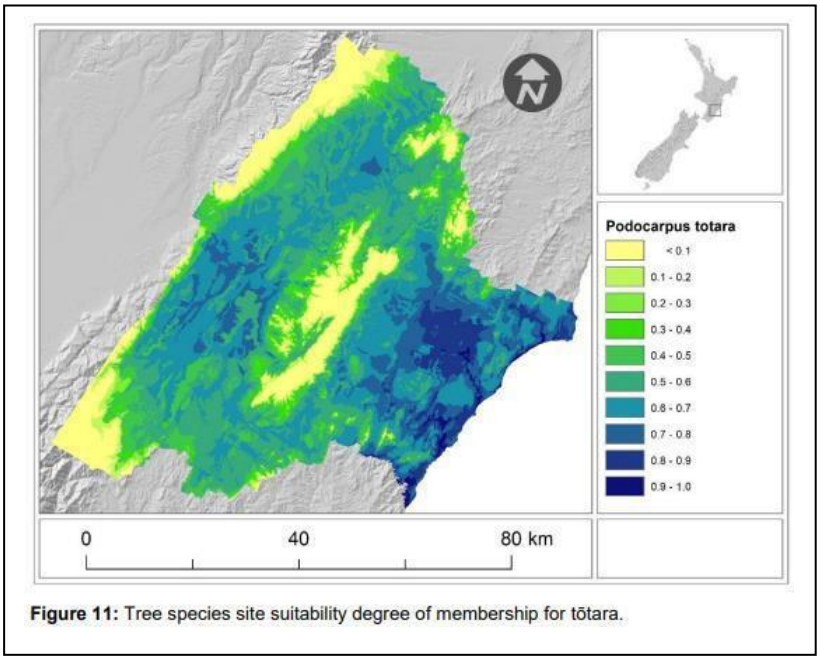
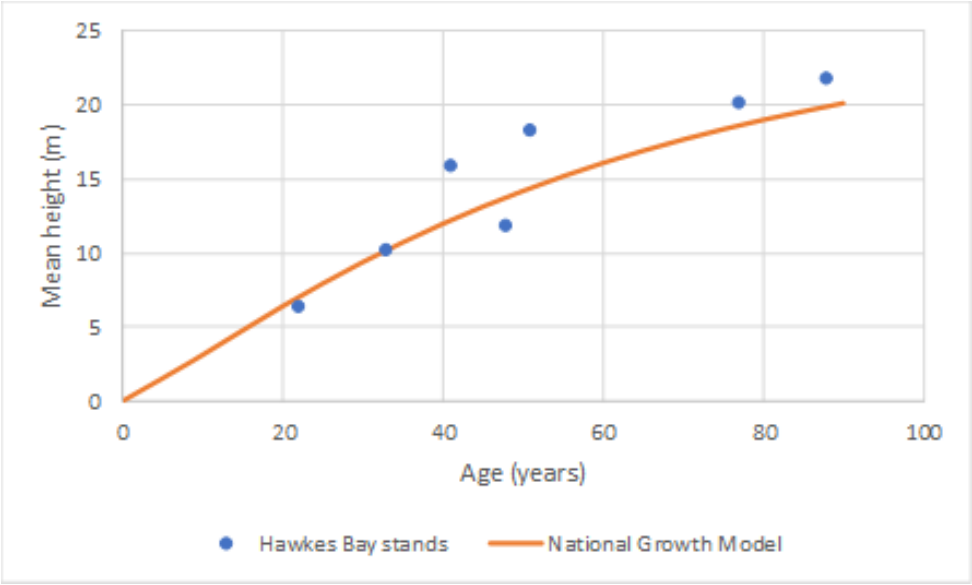


Figure 11: Tree species site suitability degree of membership for tōtara.

Tōtara growth



Although tōtara are suited to many parts of the district when compared to many exotic species they have relatively slow accumulation of timber.

Predictions of stem volume and CO_2 sequestration using national growth models.

Species	Age (years)	Stem Volume(m^3/ha)	CO_2 (t/ha)
Kauri	20	52	164
	40	352	644
	60	844	1,285
	80	1,394	1,827
Tōtara	20	36	136
	40	255	478
	60	637	925
	80	1.091	1,286
Shrubs	20	-	160
	40	-	295
	60	-	303
	80	-	267

Indicative prices for tōtara timber

Log grades	Tōtara log value ($/m3)
Pruned minimum SED 40 cm	480
Pruned minimum SED 30cm	240
Small branch minimum SED 30cm	185
Small branch minimum SED 20cm	155
Large branch/sleeper/box minimum SED 20cm	130
Firewood logs	70

Indicative log value for tōtara.

Harvest Age	Tōtara log value ($/m3)
40 Years	135
60 Years	156
80 Years	210

With tōtara and kauri one is dealing with species with minimum modelled rotation lengths of, typically, at least forty to sixty years. Real-world for these species, as opposed to that of the model rotations, may well be 80 or more years. In addition, commercial investors, particularly when they factor in the risks associated with growing these species are likely to be using discount rates in excess of 4 percent, and quite possibly greater than 10 percent. However, this means that for most 'commercial' investors any projected dollar of stumpage return (based on the above figures) is likely to have a current (year zero) value of less than 4 cents in their economic analysis.

Discount rate (%)	Harvest age (years)	Harvest cost including roading ($/ha)	Merchantable volume at 70% TSV (m^3/ha)	Average 'at mill' log price ($/m3)	NPV of regime
2	40	7,140	178.5	135	-$6,477
	60	17,863	445.9	156	$1,839
	80	30,548	763.7	210	$12,395
4	40	7,140	178.5	135	-$8,168
	60	17,863	445.9	156	-$6,209
	80	30,548	763.7	210	-$5,274
6	40	7,140	178.5	135	-$8,773
	60	17.863	445.9	156	-$8,436
	80	30,548	763.7	210	-$8,639

9.2.6 Manuka

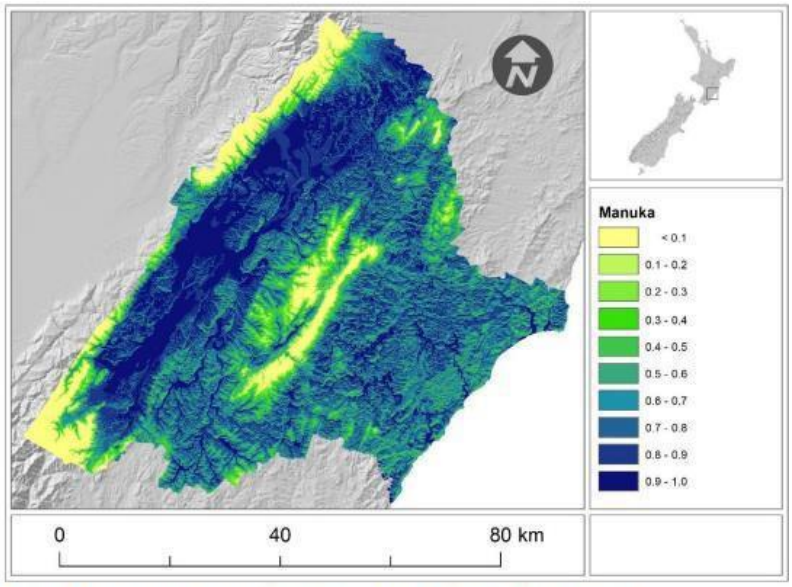


Figure 13: Tree species site suitability degree of membership for mānuka.

Plantation function	Post plantings costs ($ per hectare)		
	Manuka (Honey)	Manuka (Erosion)	Manuka (Erosion)
Cost element (spha)	1100	1600	2000
Releasing	360	400	600
Blanking (10%)*	88	265	302
Pest control**	23	23	50
Total	1571	2288	2952

Data source; HBRC RTRP- PF Olsen

Growth models

Currently there are no growth or productivity models that exist for manuka.

Rotation Length

Plantation manuka can be expected to be productive for between 15 and 30 years with no interference beyond pest control and some trimming. After this time manuka will usually be outcompeted by canopy species. Manuka cannot be cultivated indefinitely and, although continuous trimming will extend the plant's productive life, it will not change the lifespan.

Long-term Impact

Both kanuka and manuka are known as nursery species to the larger native timber trees of New Zealand. If left undisturbed and given proper conditions, it is possible for these forest dominants to grow through and exclude the pioneering scrub species. This nursery effect is somewhat attributed to the mycorrhizal partnerships formed by both manuka and kanuka as they are the only woody species that form these relationships with both ectomycorrhizal and endomycorrhizal fungi, which is fairly rare in the plant world. Ectomycorrhizal presence allows increased germination and growth by the larger timber species.

Manuka and kanuka are both known to increase water quality as the anti-bacterial properties (measured in the honey and oils) are qualities also present in the root systems. Microbial loads are reduced significantly faster under both species. The lowered bacteria levels also affect the cycling of nitrogen, with manuka and kanuka significantly reducing the leaching of nitrogen versus pasture or pine.

9.2.7 Honey production

Honey yields
Manuka honey yields generally range between 15 and 25kg per year per hive on average, depending on location and various other factors. There is often high variability between years. Industry best practice is to allocate one hive per hectare of manuka plantation, although some manuka cultivars can support two hives.

Honey Prices
The price of manuka honey is strongly dependent on the UMF™ (Unique Manuka Factor) content. Methylglyoxal (MGO) is created from a component of manuka nectar and is also used in conjunction with UMF™ to distinguish the value of manuka honey. Sourcing honey with a high UMF™/MGO factor is the goal of honey producers.

Prices can range from $16/kg to $60+/kg for high UMF™/MGO honey. There is also an increasing drive to create plantation owner collectives, to market packed and branded honey to retailers rather than bulk supply, and obtain some price certainty.

9.3 Conclusions and recommendations

The purpose for developing tree species site suitability maps was to provide broad level knowledge of where in the landscape a species can be established and grow. The degree of membership (DOM) values associated with each species provide an estimate of where a tree species finds site characteristics as unsuitable (zero) through to optimal (one) across the landscape. Tree species site suitability maps have been designed as a dynamic modelling framework that can be updated and improved as new information or knowledge becomes available.

Overall, the modelling suggests Radiata pine as the most versatile, closely followed by tōtara, albeit at lower elevations, redwood, and mānuka for honey. The tree species site suitability maps cover highly productive agriculture areas where trees are unlikely to be established because of the high cost of land, through to areas where the landscape is eroded, with skeletal soils that would suit the establishment of trees and the retirement of the land for reducing erosion and ecosystem services benefits.

The DOM values associated with each species provide an idea of where a tree species finds site characteristics as unsuitable (zero) through to optimal (one) across the landscape, and it is hoped that this will encourage discussion and conversation as to the right species in the right landscape. The thinking here is to provide landowners with information that can assist in the decision-making process around the establishment of trees. This work is not a replacement for expert advice and the recommended next stage would be to engage a forest specialist that can walk across the landscape and undertake an assessment of the establishment and management of trees for a landowner.

The purpose of developing afforestation groupings was to help make informed decisions around the right tree, in the right place in the landscape. The fuzzy membership approach was used to improve the spatial resolution at which soil erosion risk was mapped, and thereby the protection from forests established across these landscapes. Currently, the NZLRI units are recognised at a ~1:50,000 map scale (i.e. 1cm on a map represents 50,000cm on the earth's surface (500m), which is considered to represent the regional level (coarse). With visual inspection of the afforestation grouping fuzzy membership maps, the improvement seems realistic.

However, without some type of validation it is not possible to clarify the question of certainty, other than at the level of expert knowledge. The overarching premise for developing the afforestation groupings from the LUC units was to identify locations within the Tararua District suitable for afforestation with commercial plantings, compared to sites with limitations that may require alternate approaches. These afforestation groupings will provide a useful resource in the decision-making process for the Tararua District.

10 Spatial economic assessment of potential afforestation areas

10.1 Findings Summary.

Plantation forests provide multiple benefits to society such as timber, carbon sequestration, erosion control, flood mitigation, improved water quality, biodiversity and recreational resources.

The non-timber values of forests can be highlighted as green credentials and as a point of difference in the competitive global marketplace. In this work the writers have used the spatial economic tool Forest Investment Framework (FIF) which combines Geographic Information System (GIS) technology and economic valuation techniques to timber and carbon values for potential forests across the Tararua District.

FIF was used to calculate the plantation forestry costs that include the establishment of Radiata pine plantation forests for a structural regime, the construction of roads and landings, harvesting, and transport to markets using representative fine resolution spatial surfaces (25-m cell size resolution). The returns from forestry were estimated using predictive surfaces for volume (Pinus radiata productivity, 300 Index; Palmer et al. 2010a, b), and carbon sequestration (CO2 equivalents, t/ha-1). Maps from this project are spatial surfaces demonstrating the potential value of forestry to the economy, and which can be used to support policy and investment decisions.

10.2 Objectives of this work

The objectives of this work are to develop and apply spatial models to:

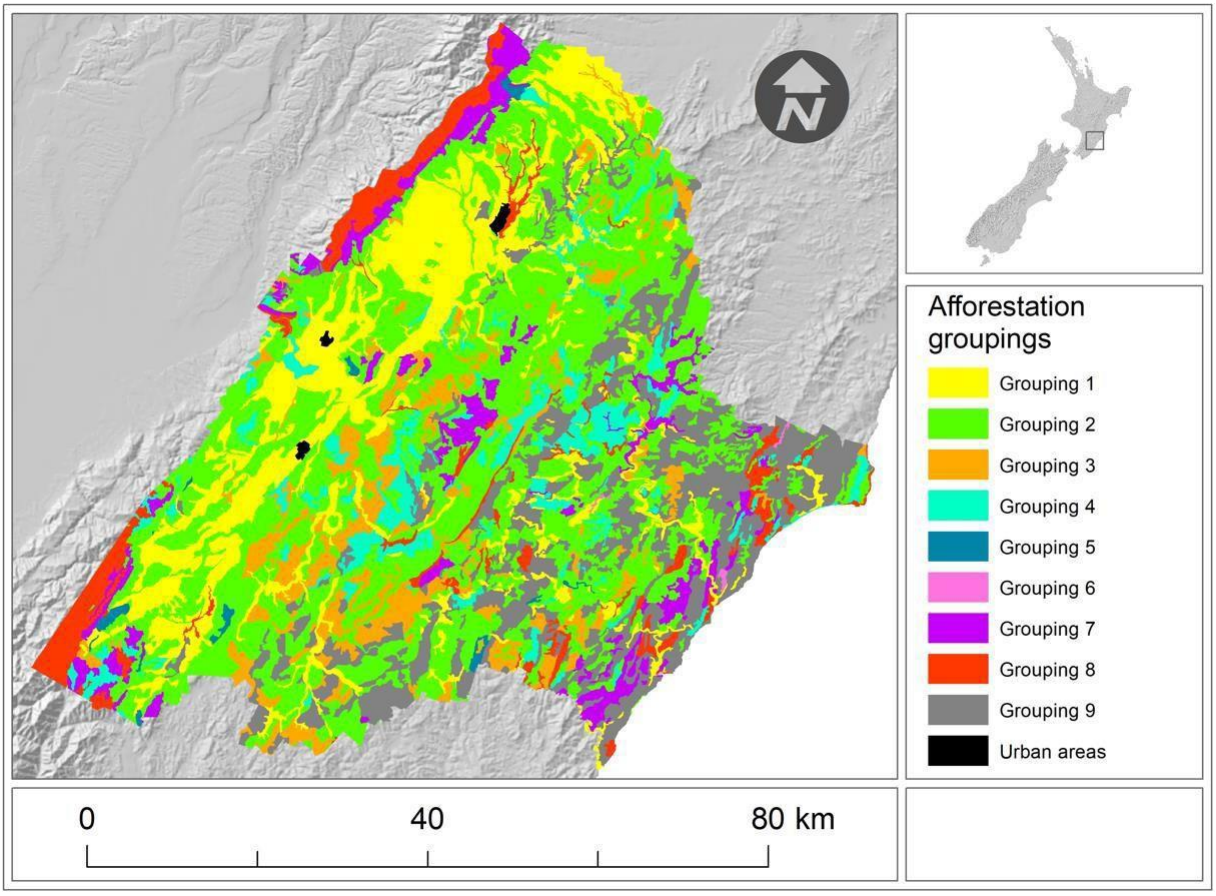
1. Estimate the cost of establishing plantation forests across the Tararua District for timber production and carbon sequestration.
2. Estimate the cost of constructing internal forestry roads, and the cost of constructing internal landings within a forest.
3. Estimate the cost of harvesting based on slope and soil types.
4. Estimate the cost of transporting forest products to their destinations (ports and processing plants) using cost-path analysis.
5. Generate spatially explicit surfaces of forest productivity (300 Index) and carbon sequestration (CO2 equivalent).
6. Evaluate the applicability of developing these models for general trend economic analysis across the Tararua District

10.3 Results of The Assessment of Potential Afforestation Areas

The majority of the land in the Tararua District is largely suitable for pastoral use. However, there is an area that is potentially also very suitable for forestry. The potential areas available for afforestation were divided into groupings from 3 up to 9, and with sediment yields 500 – 750, 750 – 1000, > 1000 t km-2 yr-1 after the intersection with available LUCAS land classes can be seen in the table below.

The afforestation grouping 9 found predominantly on LRI Earthflow units has the largest area of land available for the Tararua District with the sediment yield > 1000 t km-2 yr-1 (35,418 ha). The second largest area of land available for commercial afforestation are groupings 3 and 4 (13,726 and 9,176 ha, respectively). Afforestation groupings 7 and 8 also have potential, but grouping 8 is for permanent forest cover, and unsuitable for commercial timber forests.

Afforestation Groupings	Sediment (t/km^2/yr)			Total Area (ha)	Potential use
	500-750	750-1000	>1000		
Group 3	10,420	2,501	13,726	26,648	Commercial timber forests
Group 4	507	496	9,176	10,179	Commercial timber forests
Group 5	600	384	611	1595	Commercial timber forests
Group 6	18		65	83	Commercial timber forests
Group 7	1,149	1,366	4,574	7,089	Commercial timber forests
Group 8 - reversion	514	418	4,785	5,717	Permanent forests
Group 9 Earthflow	12,695	1465	35,418	49,578	Commercial timber forests
	25,903	6603	68,355	100,889	



The Figure below (Figure 3 in the Spatial economic assessment of potential afforestation areas across the Tararua District report) indicates the commercially suitable areas for production forestry under two discount rates (3% and 6%) across a varying log price (Pinus) range. Within each graphic, darker green colours highlight higher NPV returns shown across the central Tararua District, whereas lighter colours show the areas of lower NPVs.

The series of analyses modelled highlight the sensitivity of economic harvest to slight timber fluctuations, meaning prospective financial returns of newly planted forest are being underwritten by carbon sequestration returns.

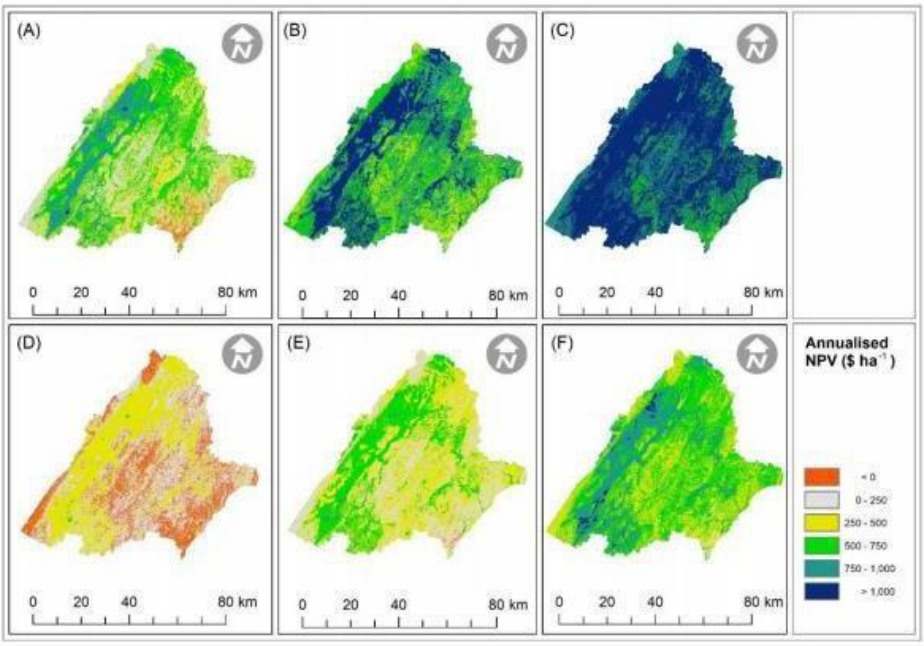


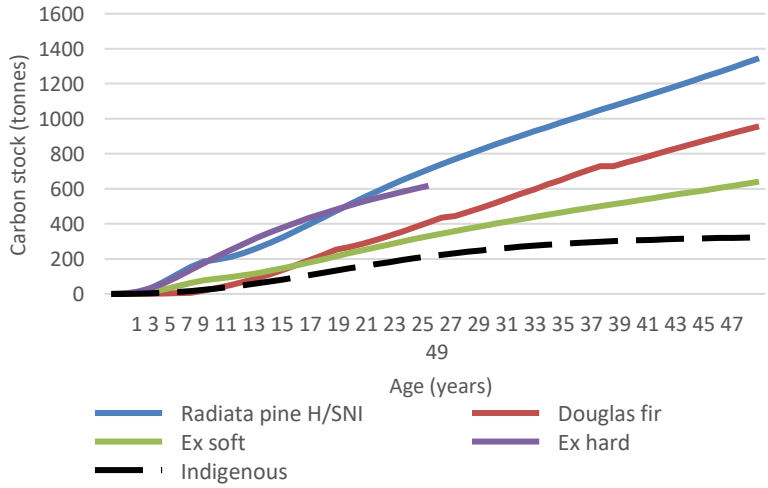
Figure 6: Annualised NPV calculated using a 3% discount rate (upper graphics) with log prices at minus 18% of the average (A), the average (B) and plus 18% of the average (C), and at a 6% discount rate (lower graphics) with log prices at minus 18% of the average (D), the average (E) and plus 18% of the average (F) for the Tararua District using the FIF model.

As would be expected, at a 3% discount rate NPV values are substantially higher in comparison to using a 6% discount rate. A pattern of increasing NPV values from lower to higher log grade prices are also seen. At these higher discount rates, and more in line with rates used in the past, significant areas would be uneconomic for forest harvest.

Carbon sequestration

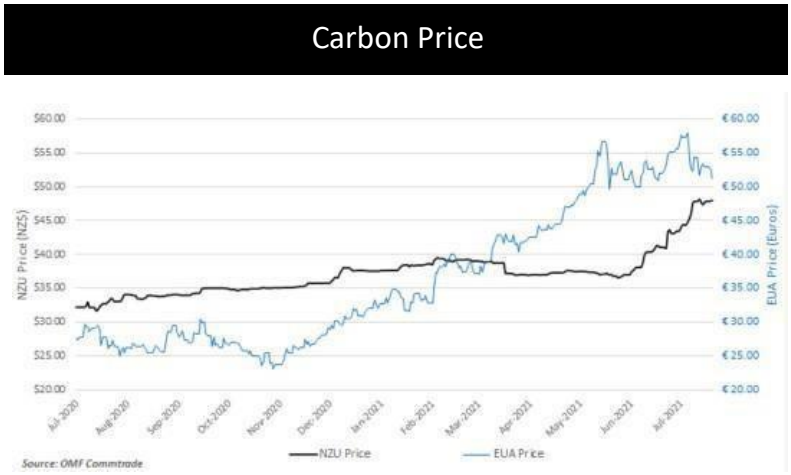
Not all forests are eligible to earn carbon credits under the New Zealand Emissions Trading Scheme (NZ ETS). Generally, only land that was not forested on 31st December 1989 can be registered in the NZ ETS once forests are planted. For eligible forests profitability can be increased with the sale of carbon credits. The additional revenue from the sale of carbon credits can assist with the upfront costs and delayed returns from forestry. The spatial modelling tools used have an economic component that quantifies the volume of carbon dioxide sequestered by planted forests which enables the estimation of their monetary value.

MPI generic look-up tables for different species groups for the SNI region.



The price for an NZU has been increasing steadily since 2014. The price of NZ$35 per tonne of CO_2E was used in this analysis as the price in mid-August 2020 was NZ$33.88 per NZU with a rising trend.

Carbon prices (NZ and EU)



Source: PF Olsen

In the graphics below, Figures 8 (A), (B) and (C) show carbon returns calculated with a 3% discount rate using carbon prices at minus 18% of $35/t, at $35/t and plus 18% of $35/t ($41/t), respectively. Figures8 (D), (E), and (F) show carbon returns calculated with a 6% discount rate and carbon prices at the above-mentioned rates. At a 3% discount rate carbon returns are substantially higher when compared with a 6% discount rate. A spatial pattern of increasing carbon returns from lower to higher carbon returns are also seen. Across each graphic, darker green colours highlight higher carbon returns for the Tararua District, whereas pale green colours highlight areas with lower carbon returns.

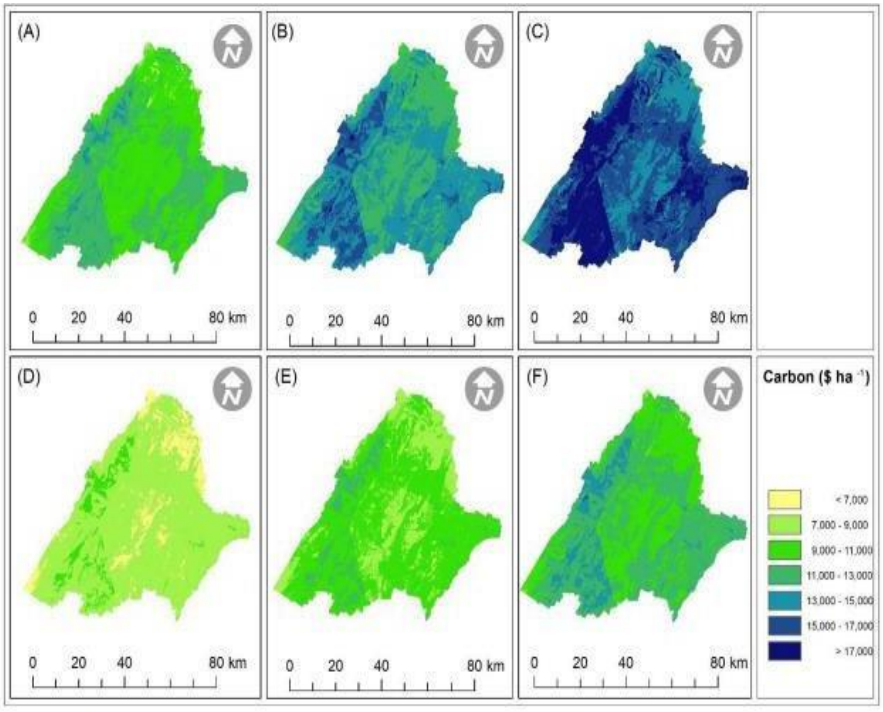


Figure 8: Carbon sequestration was calculated using a 3% discount rate (upper graphics) with carbon prices at minus 18% of the average (A), the average (B) and plus 18% of the average (C), and at a 6% discount rate (lower graphics) with carbon prices at minus 18% of the average (D), the average (E) and plus 18% of the average (F) for the Tararua District using the FIF model.

Carbon impact on forestry profitability

Case study: pines

	S&B farming	Forest for timber	Forest for timber & carbon @ $25/t	Forest for timber & carbon @ $50/t
EBIT/annuity ($/ha)	$245	$292	$744	$1,196
IRR on investment	4.5%	7.9%	14.7%	24.3%

Native forestry: 50 years

	Carbon @$25	Carbon @$50
NPV	-$11,743	-$8,805
IRR	-1.4%	0.8%

The table above demonstrates the relative profitability of farming as opposed to forestry and carbon sequestration. Clearly carbon plus forestry has the highest short term financial gains

It is also noted that plantation forests also provide other non-market ecosystem service values such as avoided erosion, avoided nutrient losses, provision of habitats for native species (e.g. brown kiwi, bush falcon), and recreational walking, mountain biking and hunting. These public values can be quantified using spatial economic approaches and they can be expected to be more valuable than timber returns. Estimating these other ecosystem service values would better represent the broader set of values provided by forests leading to a more informed policy decision making.

11 Tararua District Wood Supply and Processing Opportunities

11.1 Report Summary

This report is aimed at describing the existing wood supply and the potential for expanded wood processing based on this available resource. It also covered the potential for expanded afforestation and the impact of this on wood processing options in the future. The quantity of forest residues is also described, along with its potential for use as an energy resource and other added value processing.

The analysis was based on publicly available data on the existing plantation forest resources by area, age class and species. Growth modelling was used to assess the potential for future forests to add to the Tararua District wood supply in the future.

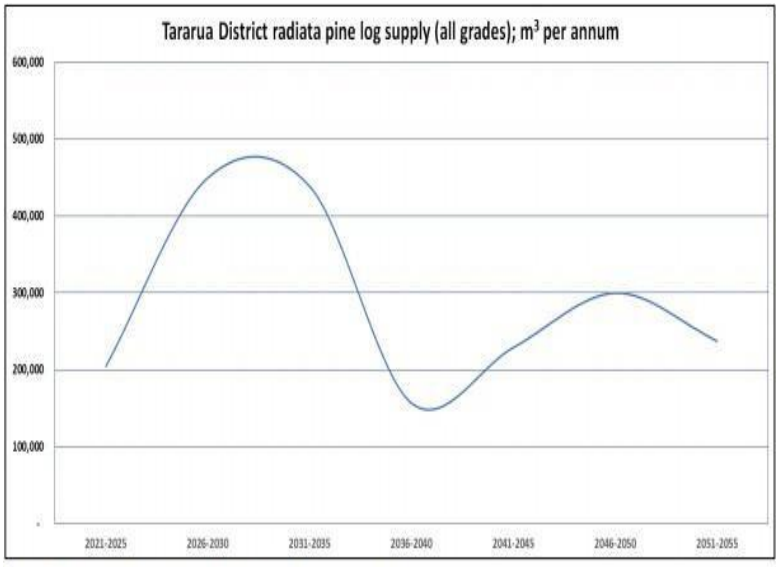
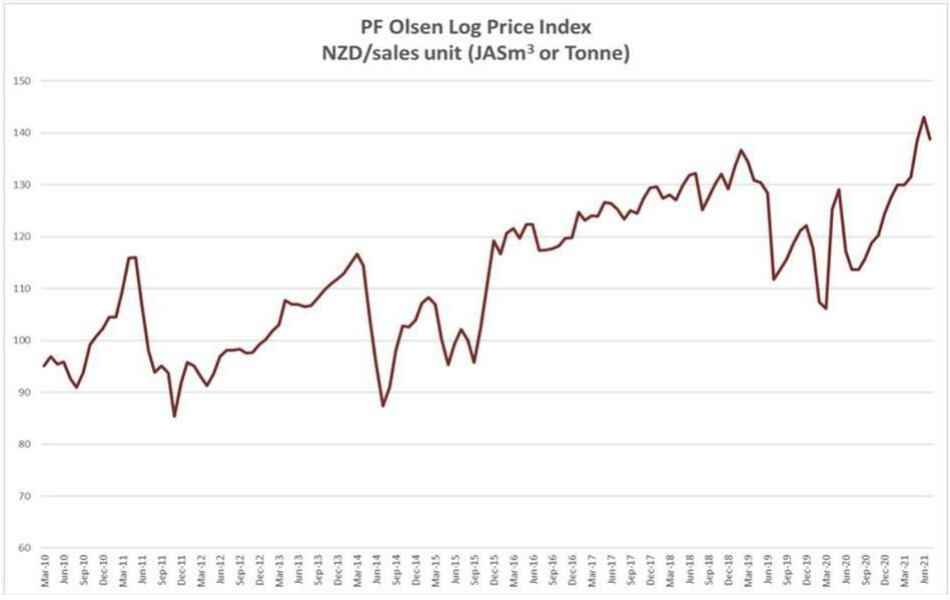
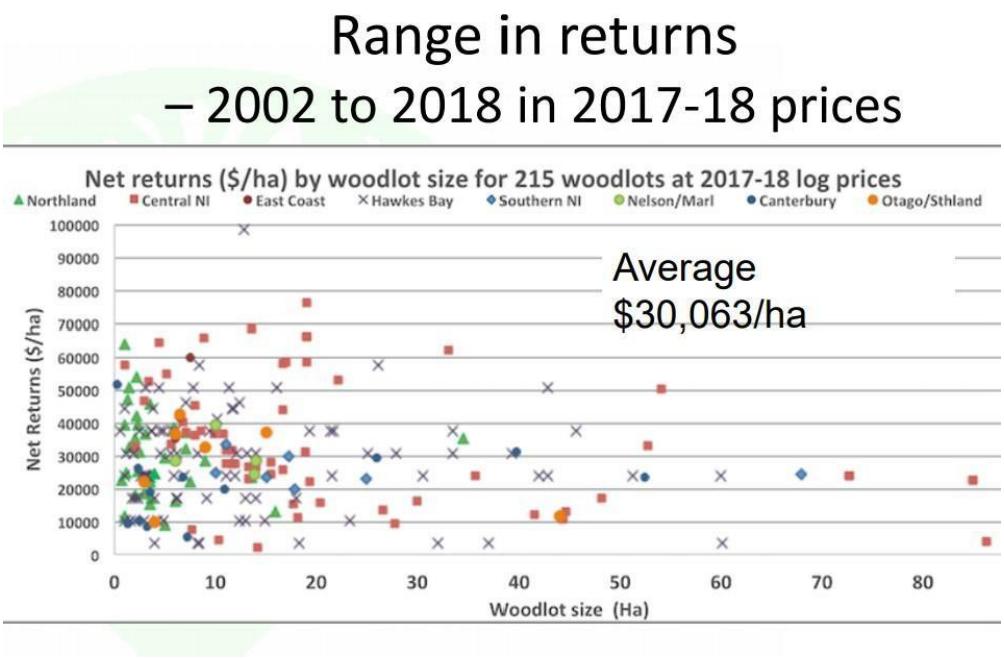


Figure 1: Radiata log supply in Tararua District to 2055





The following table is based on these assumptions:

Economic returns

- $50/t carbon
- Last quarter log prices

	IRR without carbon	IRR with Carbon	Annual Carbon income (av/ ha over 17 years)
Radiata Pine	9%	31%	$1,060
Redwood	7%	11%	$543
Poplar poles		31%	$746
Native Regeneration		1.5%	$318
Manuka (JV 30% honey)	5.4%	12.8%	$405
Pine/ plant and leave		31+%	$1,060

Some of the information for the above two graphics above was kindly provided by John-Paul Praat, GroundTruth Ltd

11.2 Key results found

- There is a minimal amount of non-radiata species in the Tararua District, making it difficult to foresee a wood processing industry based on anything other than Radiata pine for at least 25years. The small non-traditional log supply could be processed by either an existing mill just outside of the Tararua District at Waipukurau, or by portable sawmills brought in to meet the occasional demand.

- Despite a fluctuating harvest return pines provide the best analysed income, and at the current carbon values provide a greater income flow per hectare than most sheep and beef enterprises. At the accelerating carbon price even dairying enterprises may become uncompetitive.

- The Radiata pine resource is also highly variable over time and this limits the processing options available as in many cases the larger the mill the more likely it is to be profitable. There is a significant drop in available wood in the period 2035 to 2045 (depicted in the graphs above).

- There is a rapidly narrowing window of opportunity to plant new Radiata pine forests grown on a short to

medium rotation (16 to 18 years) which would increase the supply of logs in the period 2035 to 2045. This new forest area could provide some logs of sawmill suitable quality.

- The area suggested as being required to stabilise the log supply at around current levels is 5,200 ha to 6,700ha, planted over a period of around 10 years. Front loading of the planting over the 10 years would allow greater flexibility in the wood supply / demand in later years.

- The Tararua District does not have a lot of major wood processors. The largest being Kiwi Lumber in Dannevirke, which is a sawmill focussed on appearance grade products. This mill takes largely pruned logs, with a capacity of around 60,000m3 of logs per annum. There are also some smaller processors, although their capacity is not known, manufacturing a range of products including treated posts and poles.

- There are a limited range of processing options available that the analysis identified as being both profitable and aligned with the size of the wood resource by log grade estimated to be available. Sawmilling is only attractive if it clusters with secondary processing such as remanufacturing of lumber into either finger jointed material / mouldings or cross laminated timber.

- For the lower grade logs the manufacture of Optimised Engineered Lumber (OEL™) is a possible option to explore, as is the cutting of big squares (large dimension sawn sections for export and reprocessing overseas).

- The use of pulp logs is limited as there are no mills taking these logs locally (Pan Pac near Napier is 163 km away). The processes that take pulp logs are typically large in scale and there is insufficient resource to support a local mill.

- The use of in-forest residues as a boiler fuel is technically possible but is limited in Tararua District by the limited demand for process heat, and the presence of a gas pipeline, that delivers natural gas to the main heat users (meat and dairy processing).

WoodScape Analysis

The WoodScape model was updated with 2020 log costs and product price data. Figure 6 from the full report and included below shows the outputs from the model that align with the wood availability calculations. The key metric used for the initial comparison of options is return on capital employed (ROCE) which has been used as a measure of profitability. For a new processing plant, a ROCE of 20% is considered a potentially attractive investment option worth further investigation. Potentially viable processing options include remanufacturing of sawn lumber, cross laminated timber (CLT), Optimised Engineered Lumber™ (OEL™). Both remanufacturing and CLT require a sawmill to be making the lumber which is their feedstock. Large scale activated carbon may also be viable, although this technology is not fully proven at a commercial scale.

Other options for processing of in-forest residue and pulp logs such as biochar are technically possible but commercially unproven in New Zealand. These opportunities have preliminary financial metrics which suggest further investigation and analysis is warranted.

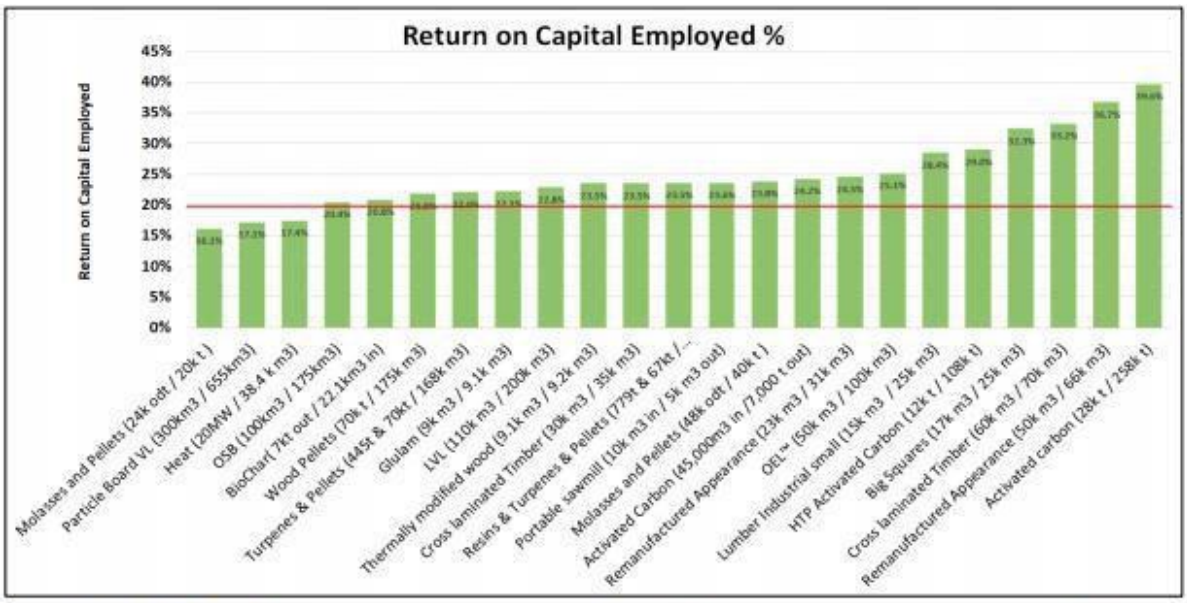


Figure 6: Results from WoodScape model analysis of wood processing options for Tararua district

12 Potential Afforestation Options for the Tararua Landscape (Scion)

12.1 Summary

Afforestation of highly erodible landscapes across the Tararua District has potential to increase financial returns from land through timber yields and carbon sequestration. New forests have the added advantage of providing a range of habitats that enhance biodiversity whilst providing other benefits like erosion and nutrient reduction. Management options can include permanent carbon exotic forests on steeper landscapes that are at high elevations or the growing of plantation podocarps such as tōtara or rimu.

Radiata pine can contribute significant value where access for harvesting and transport make this economically viable. Coastal redwood and sometimes Eucalyptus or cypresses (e.g. Cupressus lusitanica) have potential as plantation species at lower elevations if species site requirements can be met, mānuka for honey is also a good choice for warm, sunny locations.

Understandably, some landowners and other members of the community are concerned about the consequences of increasing afforestation. Ideally, tree planting should target erosion prone areas that are steeper, exposed and with poorer soils, rather than afforestation of productive land.

Landowners who have planted erodible areas of their land have reported improved returns and greater economic security. Landowners also appreciate increased biodiversity and the ecosystem services benefits from increased resilience from the impact of severe storms.

Providing information to landowners considering forestry options requires identifying high performing areas on their land and areas with potential for afforestation. In many instances the poorest performing areas could benefit from afforestation, allowing resources to be focused more intensely on the better performing classes of land.

A complementary approach, where less productive land is afforested, and higher quality land is managed more intensively, can lead to higher overall farm returns that benefit the landowner, the community and the environment.

In the current environment there is a clear gap (and opportunity) for leadership, guidance, and central support to work together with landowners. There is a need to understand landowner objectives and constraints, and for the development of a long-term plan that fits with individuals needs and expectations. This approach should be focused on what the individual landowner needs and be supported by a community that encourages responsible planting activity. Part of the direction is driven by economics, but projects also need to be shaped by the unique characteristics of their landscape and environment.

Establishment of trees can also provide the initial benefits from carbon sequestration. Carbon trading can be complex and post-1989 ETS eligibility is something that needs assessing at the farm scale. While carbon provides a huge economic incentive for planting trees (especially under current prices), participating in carbon trading (selling units) negates any official carbon neutral benefits. Land values for a cutover forest where the carbon has been traded, are likely to be significantly lower than bare land. The rationale behind this project is to focus on landscapes that could benefit from afforestation and to support landowners to make good choices around the right trees being planted in the right places.

12.2 Conclusion

This project is potentially transformational and integrates existing forestry knowledge. It provides tools and information that will help decision makers including iwi, landowners, the wider community and regional and central government understand the implications of different afforestation options to develop a strategy that sees the right tree planted in the right place for the desired outcomes:

- Reduce erosion on highly erodible land to the benefit of soil and water quality.
- Improve financial returns through the best land use options.
- Provide ecosystem service benefits, and the license to operate.
- An integrated approach that balances individual, community and regional needs and expectations.

The full document is reference in the appendices section 17.2.

13 Downstream and Value-Added Processing of Forest Products

A successful afforestation programme implies the need to market logs and other forest products profitably, preferably into a range of markets, both export and domestic.

Forest carbon and honey are two discrete disciplines of their own. They have particular merit where forest harvest is less feasible for geophysical reasons, and the need for a long-term tree crop requires alternatives to fibre production. Honey processing and beekeeping can provide for local employment.

There are many products and benefits that can accrue to an enterprise or locality from having planted forests: timber and fibre for low carbon construction, soil and water protection, farm and community resilience and biodiversity.

It is prudent to ensure that the above opportunities and the implications of these are addressed thoroughly, and that viable environmental and harvest plans (whether harvest is intended or not in a carbon regime), fire plans and wind recovery contingency plans are in place. In a catastrophic event, such as a storm causing large tree felling, harvest and recovery may become a necessity within a short timeframe.

This section focuses on solid wood products, the principles applying to existing options, and also introduces new options for the processing of logs into higher value products.

13.1 Export vs Domestic Log Sales Options

Log exports currently set the market pricing of domestic products in NZ to a large degree and these have been historically strong, especially into the Chinese market, for a number of years.

In longer term history, domestic markets have served as a buffer for those times when export pricing has been less favourable, and so some forest owners have wisely sustained sales and wood flow to their domestic options, even when export markets are compelling.

When export pricing is strong, pressure on domestic processors can result in closures. Mills heavily dependent on labour can find those times additionally tough given the relatively high cost and relatively low productivity (per labour unit) experienced by some, due to the low-tech nature of many older mills.

13.2 Drivers of Processing Capacity

Existing processing capacity in terms of sawmilling and roundwood manufacturing and treatment are represented within economic cartage range of much of the Tararua District.

To increase the likelihood of an attractive investment proposition for additional processing capacity, both overall volume of log production and annual wood flow are important. As a result, some consistency/stability of the approach to annual planting levels would be desirable.

Provision of log volume to a region or district will be subject to demand and pricing of the day and so planting programmes will increase the likelihoodof such investment but not guarantee it. Guaranteed supply, which implies the seller is captive, can be counter to best sales price, while an open market without long term contracts for supply disadvantages a processor or investor.

Processors who are vertically integrated, for example, Pan Pac Forest Products and Juken NZ Ltd., will own their own forests and industry and so sustain their profits by ensuring that internal transfer pricing recognises their overall business needs.

These companies will often also trade logs and play the export market with the arising material, or surplus logs traded while accessing their preferred log grades for their process. Often, they will purchase wood directly from forest owners and can be competitive because of their economies of scale, backload efficiencies, equipment utilisation (having logging crews busy year-round, allows lower logging cost per tonne), or proximity to source.

These are the components leading to the dance which is the log market.

For a council or government considering engaging with the promotion of appropriate afforestation, the important components are location relative to prospective markets, stable approaches to planting (i.e. longer term commitments) and promotion of timely high-quality silviculture (pruning and thinning) to ensure timely production of consistent product quality.

In the Hawkes Bay Regional Council/Te Uru Rakau funded Right Tree Right Place project three sub projects were involved which offer some translation into and synergy with, the Tararua District Council project.

These are offered by way of example because they reflect approaches relevant to the conditions and challenges in this district also.

13.3 Three Relevant Examples and Approaches to Potential Future Processing Options Within Tararua District.

To enable Tararua District Council to consider approaches to processing options, three examples are appended to this report.

These serve to enhance understanding of tools and approaches that have been developed elsewhere in New Zealand and these will be illustrative for the Tararua District Council, as it considers options for its approach to afforestation.

Portable sawmilling and small-scale sawmill development were developed as concepts and were among some 700 pages of reports in the HBRC RTRP Project, which can also be made available to Tararua District Council.

The NZ Dryland Forest Initiative processing strategy has been developed in tandem with HBRC forestry initiatives over the past 8 years and was appended to the HBRC RTRP project also.

13.3.1 Portable sawmilling

Portable sawmills allow for the economic extraction and conversion (from logs to sawn lumber) of small volumes and/or geographically isolated forest blocks.

They can also provide for low impact extraction where access is poor and/or would be prohibitive to develop, or where environmental impact of forming logging roads for trucks would be intolerable.

A portable mill can be delivered to site by tractor, light vehicle (or helicopter) with lumber removed similarly.

Portable sawmilling can offer employment, entrepreneurial opportunities, off-farm/supplementary employment for farmers, or another string to the bow of rural contractors.

It can also provide for on-farm or lifestyle use of wood products with the least transport, in instances where tree species and intended use do not require treatment.

Where species and end use determine that treatment are required, wood products can be transportedto a

treatment facility at lower cost, i.e. converted log tonnes are carted and not whole logs.

An appended report is entitled: Appendix 17.7 Portable Sawmilling of Locally Grown Alternative Timber Species.

This report concludes that portable sawmilling has the potential to be a sustainable small-scale regional industry in the Hawke's Bay region and the content supporting this conclusion has similar relevance to Tararua District.

However, while an opportunity exists, there is an urgent need for more accurate information about the alternative species resource, and a new inventory is needed.

Other New Zealand regions have a similar disparate alternative species resource, face common challenges, and also need opportunities for regional development such as portable sawmilling.

Therefore, the potential for nationwide development of the portable sawmilling industry for alternative species would likely be enhanced by further research and development. This could include inventory of existing alternative species and their quality and quantity, along with a survey of portable sawmilling businesses, and a survey of forest owners and their aspirations.

More information will enable planning and promotion of methods and protocols toward optimal management and sustainable and more profitable harvesting of the alternative species resource, which is currently underutilised, or downgraded to firewood on farm.

The farm forestry community and forestry industry may, in time, further develop work on portable sawmilling at a national and regional level.

The next step could be to draft an industry development plan for consultation with all stakeholders that identifies priorities for collaborative action, based in part on information provided in this report.

The appended report concludes a useful list of factors to aid in considering a portable sawmilling operation, which is included as both a summary of and introduction to the appended report.

The following questions have been included, based on RedAxe's experience of portable sawmilling, to guide anyone considering setting up a portable milling venture.

- What will be the costs for setting up the venture including capital cost for mill, accessories, and other equipment?
- What will be the operator and running costs for a commercial business venture, including using a suitable towing vehicle and any additional workers if required?
- How many weeks annually do you plan to use the mill?
- What is the projected hourly rate for running the mill on an annual basis?
- What is the hourly rate planned to pay the operator and a support person where required?
- Are you going to be moving the sawmill around or will it be in one fixed position?
- Will electricity be available to the site, or will the sawmill need to have a petrol or diesel motor?

If the sawmill is to be moved from site-to-site, will the terrain affect the ease of setting it up?

- What size logs will be cut, and will the logs fit into the mill?
- What size boards are you expecting to cut and what will they be for?
- What is realistic in terms of the recovery rate that you can expect from the log supply?
- Do you want to cut larger sizes to be broken down later, or sleepers out of second grade logs not

suitable to retrieve clear boards from?

- Is there a market if you cut (and sell) firewood from the slab wood or strap into bundles to sell?
- Do you want to slab any of your logs, and if so, do you need a bandsaw, a dedicated slab saw or an attachment?
- Do you want to saw as much of your logs as possible, for example, can fillets, stakes or fence battens be part of your cutting list?
- Will you need to cut to the taper of the log to gain the best wood from the outside of your logs?
- Do you or your sawmill operator have practical experience of sawmilling and if not, can that be provided by the manufacturer?
- Check on the capability of the sawmill and buy a reliable brand with good back-up service and availability of spare parts.
- Some mills require flat ground to be set up, and this is a factor to consider when purchasing your sawmill.
- How will you economically and safely harvest the trees to supply your mill?

13.3.2 Potential for Small Scale Sawmill Developments

If Tararua District Council intends to promote alternative forest species and wishes to see the benefits maximised to the community, then an intention to support or enable additional processing is a necessary parallel exercise.

When HBRC commissioned their Right Tree Right Place Project (RTRP) they were similarly considering alternative forest species and the necessity to consider processing to match. As part of their project was the report entitled Assessment of Afforestation And Future Wood Processing Opportunity With Non-Radiata Species -Wairoa District - Peter Hall, April 2020

The additional report provided the Hawke's Bay Regional Council with information on the potential for establishing a non-Radiata wood resource aligned with a potential future wood processing operation, based in Wairoa.

The start point was the existing plantation forest estate and wood processing infrastructure. And the additional milling capacity was modelled off a similar existing but Radiata focused mill in that community.

The target size of the hypothetical new wood processing operation was in the range of 50,000 to 80,000m3 of log intake per annum.

There were two parts to the operation: a sawmill and an optional, additional remanufacturing plant. The sawmill creates kiln dried lumber and the potential additional remanufacturing plant converts the lumber into high value products such as decking, cladding, flooring, stair treads, bench tops, etc. There is a market in New Zealand for this type of product, based on the volume of timber imports.

The remanufacturing plant cannot operate without a sawmill to provide it with lumber. The sawmill does not necessarily have to have the remanufacturing plant.

This paper was also later used to inform the NZ Dryland Forests Initiative strategy work around regional resource and infrastructure planning, which in turn relates to the next section of this report.

13.3.3 The New Zealand Dryland Forests Initiative (NZDFI)

The NZDFI offers a remarkably well researched alternative species opportunity for New Zealand, having developed a strategy toward a $1billion per annum, naturally durable hardwood industry in New Zealand by the year 2050.

This opportunity is supported by a national trial series and a number of stakeholders. NZDFI has been underpinned by research efforts of the NZ School of Forestry in Canterbury, with up to 20 PhD candidates engaged in related research to date.

The NZDFI is a commercially oriented research and development project. Their vision is to develop sustainable hardwood industries in a number of target regions. These industries will be based on forests of genetically improved durable eucalypts developedby NZDFI and suited to New Zealand's dryland regions.

While eucalypt suitability in Tararua District is shown as challenging in the SCION species suitability layers, it is important to recognise that this data reflects a smaller number of species, and that within Tararua District there will be niches suitable for a range of the NZDFI species with appropriate data and careful siting. The NZDFI regional strategies promote regional processing centres serving 3,000- 5,000 hectares planted over 30 years, and so this is a virtual sliver of total land area.

Breeding tomorrow's trees today

Much of north-eastern New Zealand has low rainfall (600–1000 mm per year). Rainfall is likely to become less predictable as the impacts of climate change manifest themselves. Farmers and forest owners in these regions need sustainable, economically viable land-use alternatives to compliment traditional farming enterprises and Radiata pine forestry.

The selected eucalypt species are renowned for their adaptability to drought, are very fast-growing, and produce strong, naturally durable hardwood timber. This timber remains sound in outdoor conditions for many decades without chemical treatment.

The NZDFI is breeding high-quality planting stock suitable for New Zealand's dryland regions. The first generation of plants are available in 2021.

The NZDFI is also developing forest management regimes for growers and identifying and researching high-value national and international timber markets for their strong, durable timbers.

Benefits offered by durable eucalypts as promoted by NZDFI (from Guidelines for Growers section of the NZDFI website):

- Diversify the forestry sector by providing an alternative to Radiata pine.
- Offer an alternative land-use opportunity for all landowners - farmers, forest owners, Māori - especially in drier northern and eastern regions.
- Produce naturally durable hardwood for known, high-value and expanding markets, including posts and poles for vineyards, horticulture and agriculture, and veneer for high-strength engineered wood products such as laminated veneer lumber (LVL).
- Grow and sequester carbon at rapid rates, making them attractive in terms of NZU accumulation.
- Stabilise soils, thanks to their ability to coppice (regrow from a cut stump).
- Provide pollen and nectar, often at times of year when other supplies are limited.
- Reduce the use and major disposal problems associated with CCA-treated timber.
- Offer regional communities new economic growth and development.
- Opportunity - NZDFI's vision is for centralised regional processing facilities served by growers in near-

by wood-supply catchments.

Developing Confidence In Growing Ground Durable Eucalypts

Growers considering planting durable eucalypts need to be confident that they will be rewarded for their investment.

The strength of the NZDFI project lies in the strategic scientific approach and multiple partners, backed by a network of trials on a range of land types, both on farms and in forests. NZDFI are:

- running an intensive, long-term genetic improvement programme;
- breeding improved eucalypt planting stock of a range of species;
- developing growing regimes to suit varied conditions;
- researching wood quality and products;
- working with regional partners to develop the concept of wood supply catchments centred on future processing industries;
- exploring and promoting multiple markets for durable eucalypt timber.

The NZDFI aims to make New Zealand home to a valuable ($1 billion sales per annum) sustainable hardwood industry by 2050.

NZDFI Project Manager Paul Millen inspects a 9-year-old Wairarapa E globoidea breeding trial.

14 Landowner Understanding of Research Report

Tararua District Council are undertaking a programme of work to investigate, prioritise and promote a defined set of tree species for a range of on-farm benefits including land optimisation, increased resilience, biodiversity and water quality impacts.

As the ultimate outcome of this process is uptake and use by landowners, there has been a need identified to better understand the human f actors that will support or hinder this programme including appetite, motivators and support requirements at a farm level. Without this understanding and empathy towards the landowner there is a significant risk that the positioning and execution of plans and roll-out will miss the mark due to not being aligned with landowner needs and expectations.

This report focuses specifically on landowner perceptions of tree planting and ingredients required to drive behavioural change/action.

14.1 Summary

The decision to plant trees on a farm is a strategic decision that is influenced by a range of factors, each unique (or seen to be unique) by an individual farmer.

Therefore, any discussion/support/schemes to support tree planting need to start by understanding and taking into consideration these factors. From there, the relative merits or benefits of different approaches or species can be discussed and investigated in a way that holds true to the end goal.

At a high level these needs or considerations start with a clear distinction between commercial planting and non-commercial planting and progress from there. Within each, there are a different set of needs and parameters for decision making including the required information and supporting evidence around different species.

For those with commercial intent, pine is the default species due to its known performance and maturity of end market with any additional commercial species needing a high degree of certainty and clarity to compete. In the non-commercial world there is a desire and willingness to use a variety of species linked to site suitability, variety/diversity, native plantings and various cost considerations.

To best support farmers through this journey there needs to be a clear path and ownership of support (including the role of TDC). This needs to be easily navigated by farmers and provide genuine right tree, right place guidance and advice throughout in keeping with the objectives of the Farm.

14.2 Research Objectives and Methodology

The primary objective of this research was to better understand landowner perceptions of tree planting and ingredients required to drive behavioural change/action.

More specifically, this work was based on the following objectives:

- Farm and farmer context in relation to tree planting and land optimisation. For example, what are the practical and ideological considerations that farmers make?
- What are the core criteria or factors that influence preference for different species (economic, practical, species origin etc.)?
- Perceptions of the role and remit of Tararua District Council in this initiative.

In order to best deliver to these objectives, a 2-stage process was used.

Stage 1: A review and interrogation of the existing Hawke's Bay Regional Council Right Tree Right Place outputs to extract key universal findings that can be translated to the TDC context.

Stage 2: A series of depth interviews (5 in total) with local landowners identified by TDC for participation.

14.3 Landowner Context

Any time we are seeking to engage with farmers or looking to influence their behaviour, it is important to remember and take into consideration the overarching context for these stakeholders. Farmers are running a multi-faceted business with a range of factors that can influence their ultimate success – not all of which they have direct control over. As a result, the subject of trees will vary in its focus and relative importance based on a myriad of factors (managing weather events, responding to emergency on farm needs, cashflow challenges, labour management, etc.)

For most farmers the topic of tree planting fits into a wider strategic view of how they get the best out of their property based on property specifics and their overall objectives.

Based on the work previously completed for HBRC and further validated by this process there are a number of factors that influence the focus and direction of tree planting on-farm:

- Succession planning and the most appropriate structures/approaches to this.
- Short, medium and long-term financial risk and potential benefit.
- Integration of tree-planting with other land-use activities.
- Workload and cashflow impacts in comparison to other strategic options.
- Emotional factors including their relationship with the property and wider eco-system.

Within the small sample of local farmers spoken to as part of this project, there were a range of objectives and factors considered by the individual farmer that have gone into shaping their past activity (and likely future activity).

"If we put something in trees, we want it to fit with our morals and values as farmers." "I've looked at trees at various times in the last 10 years for retiring pieces that are prone to erosion."

THEREFORE: Prior to detailed conversations regarding tree species and options there is a requirement for a significant degree of individualized investigation to understand the landowner's context. This contextual understanding needs to include current situation, future objectives and parameters for decision making (e.g. risk appetite, financial limitations, operational considerations).

14.4 Decision Making

Based on these individual contextual factors influencing farmer priorities there is a decision making structure for farmers in regard to tree-planting that can be broken into a small number of distinct areas.

Overall Farm Strategy

How does this tree planting initiative fit into the overall structure and performance of the farm?

Support for this is predominantly sought in terms of financial modelling of the impact of changing land use to trees. For those with a commercial intent the requirement at this stage is to develop a level of comfort and confidence that the numbers stack up (including carbon calculations) and are based on reasonable assumptions/levels of risk.

For those with a non-commercial focus the onus is on just confirming that they aren't putting the long-term sustainability of their operation at risk as well as potentially illustrating the limited impact on production when using marginal or unproductive land and increasing productivity on remaining land.

Requirement - Financial and Farm Systems Modelling

"It can cost a lot of money to run scenarios. And each species you add to that increases the cost."

Specific Land Management

Does the nature of the land being considered limit options or provide opportunities for certain types of planting and species?

The key requirements at this level are based on having access to a depth of knowledge and experience that can ensure the key factors are being adequately covered in relation to the feasibility of the plan. This includes the suitability of the species to the land type, assurances or clarity on the end market and harvesting viability (if commercial).

Requirement - Species and Forestry Management Expertise

"In the past we have tried poplars and we didn't have a good run with them. "

Operational Delivery

How do I best get this done (alongside everything else that needs doing)?

Once the farmer moves to implementation there is a need for guidance and advice regarding the options to put the plan in place, and support navigating the different elements that need to come together. The level of this need relates directly to the workload context for the farmer as well as their degree of comfort/interest in being involved. At one end of the spectrum is a landowner who wants the work done but to be hands off, while at the other is someone who wants to do a high degree of the work themselves. Regardless of this, there is expected to be avenues for support around consents, access to nurseries and expert advice as and when issues arise.

Requirement - An existing eco-system to tap into to get the job done.

"You have to think about things like access and who is best to help with specific parts."

THEREFORE: Any engagement with landowners needs to consider and deliver to these various requirements. From support and advice to information and access to different parties who can help with implementation. The increased understanding and **promotion of a defined set of tree species clearly has a role within this structure, but also isn't the single requirement needing to be met.**

14.5 Species Considerations

In keeping with other decisions that farmers are making on a regular basis, species decisions and considerations are first and foremost shaped by the overall objective they have for the tree planting. In essence this is a distinction between commercial and non-commercial activity (retirement/ regeneration/erosion control/silviculture).

Commercial

When progressing commercial tree planting activity, the onus is very much on financial performance and management of risk. Farmers have a much more instinctive knowledge of the 'ins and outs' of farming and what will work or not work to support their commercial objectives. For trees, there are essentially two key considerations that underpin the species that are deemed suitable or attractive:

1. What are the commercial realities of this species (with a long-term view)?
2. What degree of risk is there in the commercial model (particularly around market pricing when it comes to harvest)?

Those wishing to minimize risk and utilize a species with a well-trodden commercial path default to pine. This is deemed to have proven markets and projectable outcomes as opposed to most other species without established or proven markets.

NOTE: For pines, there is minimal expectation that factors will come into play regarding suitability of species to site. It is assumed to work well everywhere ("It grows like a weed.")

"Farming is known. Forestry is not."Pines are simple and known." "All the infrastructure and market is set up for pine."

"Scale equals efficiencies. So whatever they back for commercial reasons needs to have scale and be very careful with the financials."

Non-Commercial

For non-commercial tree planting (retirement/regeneration/erosion control/silviculture) the dynamics become significantly different. They are essentially a combination of:

1. Suitability to site (especially with marginal or 'tricky' land).
2. Cost or financial implications.
3. Any impacts on the rest of the farm operation (e.g. use as fodder, integration with existing planting).
4. Biodiversity/variety contribution.

There are then a small number of implementation considerations that may also be made that are ultimately about reducing difficulty or 'hassle' such as availability of seedlings or maintenance needs.

"The Douglas Fir was planted by my father.He just likes to see a bit of variety. They may never be harvested."

It is important to note that while pines are a default species for commercial planting they are also automatically excluded when it comes to non-commercial. There are a number of factors playing into this including aesthetic and philosophical considerations as well as the desire to distinguish this type of activity from some of the pine planting that is taking place on what they deem to be productive or partially productive areas of farm land.

"I'm not keen on pines due to my thoughts around generational farming and their aesthetics as well."

THEREFORE: When it comes to species consideration the first influence on what is needed and what can drive decision making is the end goal (commercial or non-commercial). Based on this initial distinction, there are then a number of requirements or information needs for a farmer to take forward.

- In a commercial context any species other than pine needs to deliver a robust and reliable long-term business case, particularly in regards to harvest value.

- In a non-commercial context it is much more about defining the key parameters of the activity and then providing a small number of viable options that can support this overall objective in a simple way to enable the farmer to move pretty quickly from idea to implementation.

14.6 Perceived Role of Tararua District Council

The key factor for farmers when considering or defining the role of TDC in relation to tree planting initiatives was the distinction and clarity of role between TDC and Horizons Regional Council.

For many farmers there is an existing dynamic and positioning of Horizons as having an on-farm remit and existing relationships or dialogue. In some cases this makes Horizons a logical home for some of the support mechanisms and guidance deemed necessary to support this initiative and work closely with farmers through to implementation.

The perception of TDC from farmers is that it is well placed to provide a more local focus to any initiative in comparison to the much wider focus of Horizons. In particular this relates to the local objectives and master plan, as well as the impacts on the area in regards to infrastructure/roading, communities and rates.

"Horizons feel like the natural home for this. Need to make sure it isn't double dipping or overlap."

THEREFORE: Regardless of the final structure or model for implementing RTRP initiatives there are some core requirements from a landowner perspective.

- It is local enough to be relevant and aware of the distinct nature of the district.
- It is simple and clear who is involved at different points and what their roles are including accountability and ownership.
- There is consistency of messaging, guidelines, requirements, objectives etc.

14.7 Rules of Engagement

As part of the HBRC RTRP process there were some key 'rules of engagement' developed out of the landowner research that were reiterated and reconfirmed as part of the Tararua District farmer interviews. These are detailed below:

- It is the landowner's plan – not our plan.
  - Start with their objectives and constraints, not ours.
  - Move at the speed they are comfortable with.
  - Focus on individual/local solutions – not one size fits all.

"Each farmer will have different definitions of what is marginal land."

- Genuinely illustrate the right tree, right place ethos.
  - Don't jump straight to commercial pine as the solution.
  - Take a land optimisation view, not a tree planting view.
  - Be clearly distinct and in contrast to 'blanket planting'.

"I think it needs to be right purpose which then leads to the right tree in the right place."

- Relationship focus, not transactional focus.
  - Early engagements and initiatives should be designed to build trust.
  - Be in for the long haul.
  - Bring people and communities together to build relationships and work together.

Introduce people who can help or who have 'been there, done that'

"You have to search out a lot of info at the start. It would be good to get help with where to start."

15 Case Study Summaries

- As part of the Tararua Right Tree Right Place project three farm case studies were carried out.
- The first case study is a farmer who is very open to land use change and biodiversity management and has a range of land classes, some suitable to intensive pastoral farming and other classes that have been identified as better retired from grazing.
- The second case study is a smaller property surrounded somewhat by new forestry. This farm does not have the range of land classes as case study 1, but again the owner is open to land use change but is considering a long term lease to a pastoral farmer.
- The third case study is a farmer who has committed to forestry being part of the business mix. It has successfully harvested various blocks and these form part of an ongoing process. As this is in a stable system situation no land use change impact modelling was done for this property.
- A consistent finding was that there were land parcels on these farms that were giving negative financial returns but this level of detail was unobserved by the farmers.
- In general the farmers tended to underestimate the production of the better classes of land and overestimate the poorer classes. A rule of thumb is that removing the poorer aspects of a farm from grazing (i.e., those land parcels carrying 5.0 stock units/ha or under) and a resultant increase by 0.5 stock units/ha on the better land classes, through subdivision and increased water reticulation, left the farm at a similar level of net financial surplus.
- In all case studies there was a positive financial gain by identifying low performance blocks and incorporating a forestry regime into the farm business model.
- In all case studies there was a decrease in the environmental footprint, with 1 case study reducing nitrogen losses to water by 20%.
- All the farms had a reduced CO2 output by implementing this land use change, with one farm reducing CO2 emissions by 23%.
- For case study 2 the current pastoral returns are less than what might be achieved in the first rotation of a whole forestry and carbon regime, but pastoral returns would be superior once the safe carbon revenues were removed on the better classes of this farm.

15.1 Case Study 1

At 970 ha of rolling to steep hill country this property is typical of many found in the Tararua District. The family have been farming in this area for over 100 years and take a long-term, intergenerational view of their operation. A key component of this intergenerational thinking is ensuring the distinct areas that exist on the property are used in the most effective and sustainable manner. For the owners, sustainability is about economic and productivity performance, as well as about environmental and ecological factors. This includes diversification of land when this fits with the overall objectives of the farm.

One area of the farm that the owners have been turning their attention to lately is a 70ha block that provides much lower pasture growth than the rest of the farm and seems well suited to tree planting initiatives. However, while the appetite and energy is there to take this thinking forward, the property owners have found it difficult and frustrating trying to turn this thinking into action. This frustration is based on three key drivers:

1. A lack of clarity, direction or support around the most appropriate funding mechanism to use.
2. The majority of advice and recommendations being made with a lack of on the ground investigation is leading to inaccuracies, reworking assumptions and a slow timeline.
3. Confusing and changeable conditions around schemes and funding mechanisms, including the ETS scheme and initiatives such as Billion Trees (including getting existing areas retrospectively included in ETS)

"The most confusing part is the changeability in information around carbon and forestry rules and regulations."

A lack of progress to date is not through lack of trying. The owners have personally invested in advice and guidance through a forestry management company, but have found this process to still lack in the desired direction to move things forward. It is also a topic that is covered at discussion groups - showing that their ambitions and ideas are shared by others in the area.

"It's all been bloody confusing. We are trying to raise up our good land and manage the less productive, but it's not easy."

When thinking of Right Tree, Right Place, this property appears to be the perfect candidate. Owners who are thinking long term (and keeping productive land as productive land), a desire to engage with different entities to get support and guidance when they need it, and a track record of farming excellence and making positive changes to their farm operations.

But there is a gap. A gap that needs to be filled with closer engagement (with the owners and their property) and clear direction and expertise, particularly in the modelling and shaping of the best financial structure and outcomes of different options.

"There is so much that is unknown for us."

This property lies 35 kilometres south east of Dannevirke. Eighteen percent the property is flat, with 36%t rolling to strongly rolling and 36% described as moderately steep to steep. A further 10% is described as steep to very steep. Of the 970ha total titled land area, 791ha is pastorally farmed (81%), the remaining land is either in steep gorges or retired from grazing due to contour, slope or existing vegetation.

The property is part of Horizons Sustainable Land Use Initiative, (SLUI), which aims at identifying farms-specific land opportunities for sustainable resource management. This project established a base land resource inventory from which a further analysis has been done.

This further analysis has identified the optimal mix of land use.

15.1.1 Sustainable Land Use Initiative base line data

The SLUI project, via LandVision, identified and mapped fourteen main soil types and when these soils were integrated with other physical constraints, such as erosion susceptibility, a total of seventeen different land use capabilities (LUC) were derived.

The LUC system has two key components:

- A land resource inventory (LRI), which is an assessment of the land's physical factors.
- A classification system where the landforms are divided into eight classes – four arable (crop-growing) and four non-arable. These eight main classifications are then further broken down and defined according to physical limitations identified in the LRI.

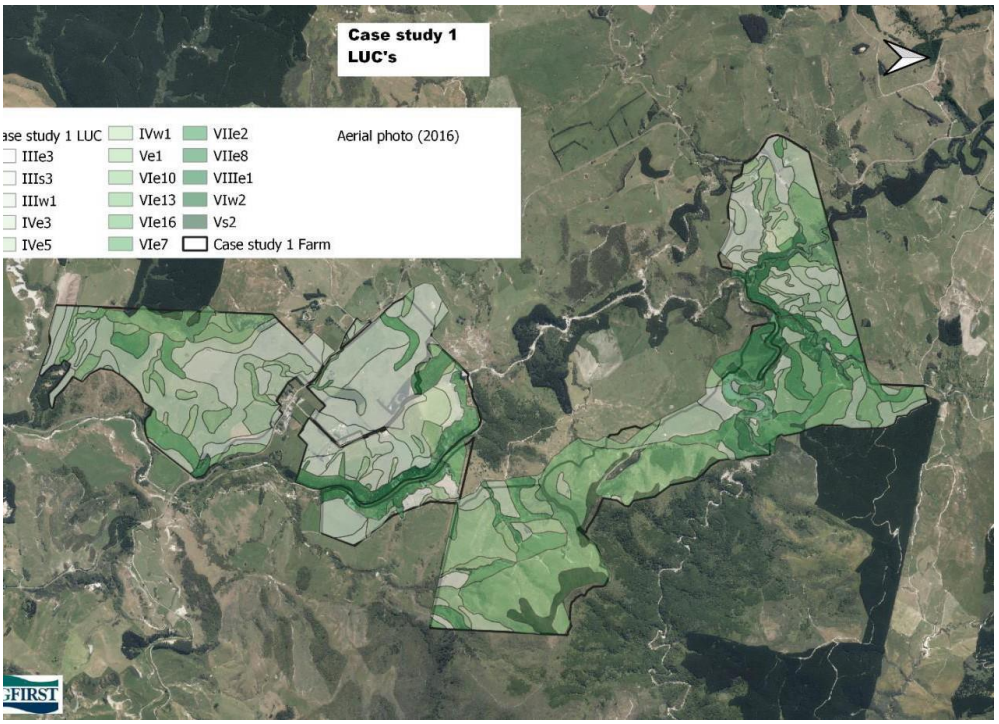
Each LUC and LUC subset has (and dependant on location) an estimated livestock carrying capacity aligned with it, which in turn can be expressed in terms of total annual pasture production. This allows for an estimate of the relative productivity between the LUCs.

The LRI and been updated over time with increasing levels of resolution, although at a national scale it is still coarse at 1:50,000. For the SLUI project the resolution was down to a paddock scale, rather than the national 1:50,000, hence the 17 LUC identified in the SLUI project.

The SLUI identified land inventory is as follows:

LUC	Area (ha)	Current land use	LUC potential pasture production (kgs DM/ha/yr)*
VIIe2	150	Retired from grazing	NIL
VIIe11	22		
VIIe8	6		
VIe13	107	Pastoral	6200
Vs2	23		6500
VIe10	61		7500
VIe7	85		7200
Ve1	102		7800
IVw1	1		8000
IVe3	164		8800
IIIw1	3		9000
IIIe3	159		9200
IIIs3	85		9500
Total	**968**		

* Pasture production is typically measured in kilograms of dry matter.



15.1.2 Base Modelling

Current farm production was modelled using Farmax and then established a baseline long term model that depicts the average production and performance. The land production was broken into nine land production blocks, representing the LUCs, each with its own pasture production volume by month.

The average of the last five years livestock prices were used in the base model development.

Total pasture offered to stock amounted to 6,155 kgs DM/ha/year across 725ha of pasture. There was a further 66ha modelled in crops of chicory, greenfield oats/ short term ryegrass and kale.

The model was based on the stock reconciliation below.

Stock Reconciliation for Case Study 1
Long term Model

Sheep	Open	Age Out	Age In	Born	Wean	Die	Buy	Sell	Tr. In	Tr. Out	Close
Ewe Lamb	581	581			1333	10		31		711	581
Ewe Hogget			581			24	343		230	1130	
Ewe	3631					186	428	1142	1400	500	3631
Ram	55					15	15				55
Mixed Lamb	590	590			3623	13		3731	5699	4988	590
Mixed Hogget			590					590	107	107	
Pre-Wean Sales								745			
Total Sheep	**4857**	**1171**	**1171**		**4956**	**248**	**786**	**6239**	**7436**	**7436**	**4857**

Beef	Open	Age Out	Age In	Born	Wean	Die	Buy	Sell	Tr. In	Tr. Out	Close
Heifer Calf	45	45			45				45	45	45
1-Year Heifer			45					37	10	18	
Cow	77					1	33	40	8		77
Bull Calf						1	51	50			
Bull	3						1	1			3
Steer Calf	179	179			44		135		44	44	179
1-Year Steer			179					179			
Total Beef	**304**	**224**	**224**		**89**	**2**	**220**	**307**	**107**	**107**	**304**

This is a sheep:cattle feed demand ratio of 80:20 and an overall stocking rate of 9.1 stock units (su)/ha on the grazed and cropped farm area.

15.1.3 Base Model Returns

The table below shows the long-term profit and loss for this case study and an Economic Farm Surplus(EFS) level. EFS is a similar key performance measure to the standard earnings before Interest and taxation (EBIT), the main difference being a cost of wages of management is included in EFS to allow for between-farm analysis. In this case study the farm has a long-term average EFS of around $127,000per year.

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Forecast Profit and Loss for Case Study 1
Long Term Model

			$ Total	$/Farm ha	$/SU
Revenue	Sheep	Sales - Purchases	573,883	726	79.7
		Wool	35,423	45	4.9
		Capital Value Change	-97	0	0.0
		Total	**609,208**	**770**	**84.6**
	Beef	Sales - Purchases	164,574	208	22.9
		Capital Value Change	-82	0	0.0
		Total	**164,492**	**208**	**22.8**
	Crop & Feed	Capital Value Change	-45	0	0.0
		Total	**-45**	**0**	**0.0**
	Total Revenue		**773,655**	**978**	**107.4**
Expenses	Wages	Wages	56,763	72	7.9
		Management Wage	80,000	101	11.1
	Stock	Animal Health	43,214	55	6.0
		Shearing	53,155	67	7.4
	Feed/Crop/Grazing	Conservation	7,000	9	1.0
		Forage Crops	59,640	75	8.3
		Regrassing	8,400	11	1.2
	Fertiliser	Fertiliser (Excl. N & Lime)	58,389	74	8.1
		Nitrogen	6,125	8	0.9
	Other Farm Working	Weed & Pest Control	9,795	12	1.4
		Vehicle Expenses	16,700	21	2.3
		Fuel	17,862	23	2.5
		Repairs & Maintenance	50,000	63	6.9
		Freight & Cartage	1,440	2	0.2
		Electricity	7,979	10	1.1
		Other Expenses	29,935	38	4.2
	Standing Charges	Administration Expenses	25,000	32	3.5
		Insurance	13,911	18	1.9
		ACC Levies	1,957	2	0.3
		Rates	13,000	16	1.8
	Total Farm Working Expense		**560,265**	**708**	**77.8**
	Depreciation		30,000	38	4.2
	Total Farm Expenses		**590,265**	**746**	**82.0**
Economic Farm Surplus (EFS)			**183,390**	**232**	**25.5**
Other Expenses		Interest	56,622	72	7.9
Farm Profit before Tax			**126,768**	**160**	**17.6**

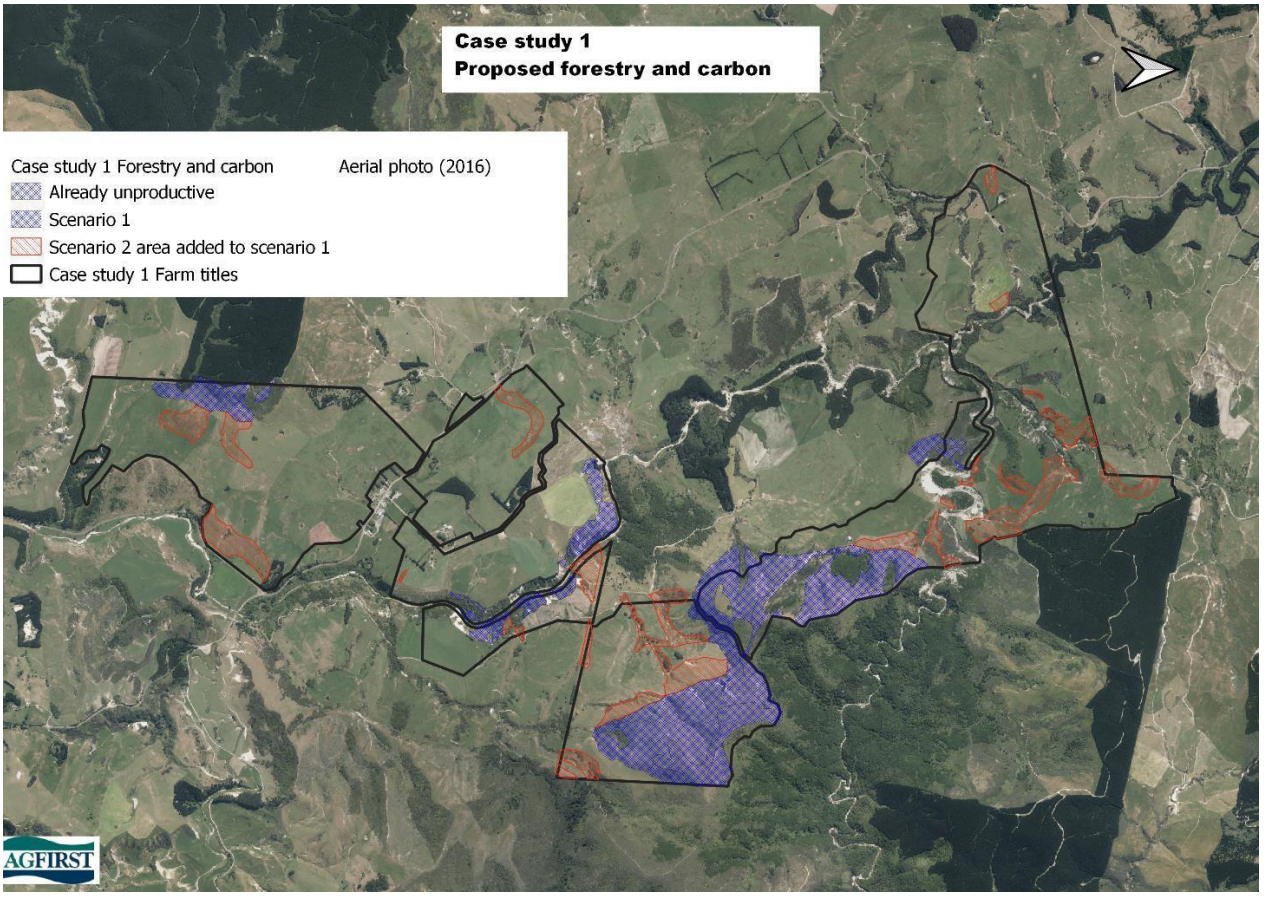
EFS is a measure of farm business profitability independent of ownership or funding, used to compare performance between farms.

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

15.1.4 Identification Of Land Production Returns And Opportunities

The breakdown of the land production into nine pasture production blocks allowed for the modelling of multiple scenarios where various combinations of land blocks were removed from the pastoral system to gauge the effect on over all farm profitability and any impact on environmental outcomes.

Two scenarios for discussion are shown in the map below.



The above map shows two scenarios. The scenario 1 has the 178 ha of land already not in production removed plus a further 130ha of LUC VIe13 and Vs2 removed. Scenario 2 has a further 85ha of LUC class VIe7 removed.

15.1.5 Results of Case Study 1 Modelling

The table below summarises these three scenarios

Case Study 1; Comparison of Scenarios.			
	Base	**Scenario I** LUC VI3e Vs2 removed from grazing	**Scenario II** LUC VI3e, **VIe7** & Vs2 removed from grazing
Grazed pasture area (ha)	791	661	576
Incremental change in grazed area	-	130	85
Total Annualised Stock units	7,134	6,510	5,953
Intake	4066209	3710438	3393379
reduction		355771	317059
Average whole of farm stocking rate (grazed)	9.0	9.8	10.3
Incremental Stock units removed		624	556
stock units removed /ha change		4.80	6.54

The modelling indicates that the 130ha is carrying 4.8 stock units (su) whilst the next tranche of low performing land carries 6.5su. Overall, the average stocking rate increases as the lower performing land is progressively removed.

The financial impact on the pastoral system is depicted in the following table.

By removing the lowest performing 130ha gross farm income (GFI) drops, as expected, by approximately $29,000, per year, but farm working expenses (FEW) also fall by $45,000, meaning that this low performing land is costing this property, on this analysis, close to $23,000 per year. Therefore, the total EFS off this farm would increase to $150,000 per year under scenario 1.

Expenses fall due a reduction of animal related expenses, i.e. wages, fertiliser, or more directly related to the land removal from the pastoral system, i.e. repairs and maintenance, but some expenses stay the same or similar. The drop in rates is picked up the potential returns from forestry and carbon.

The alignment of scenario 1 with existing fence lines would mean that less than 200 meters of new fencing is required.

Interestingly though if a further tranche of 85ha of land is removed, so that a total of 215 ha is taken from pastoral production, then the EFS falls to around the current long-term level, that is this second tranche is contributing positively to the overall performance of the farm.

Case Study 1; Comparison of Scenarios.						
	Base		Scenario I LUC VI3e Vs2 removed from grazing		Scenario II LUC VI3e, **VIe7** & Vs2 removed from grazing	
Economic Farm Surplus (EFS)	**$**	**126,993**	**$**	**149,950**	**$**	**126,619**
EFS/ha Total land area	**$**	**161**	**$**	**190**	**$**	**160**
EFS/ha grazed land	**$**	**161**	**$**	**227**	**$**	**220**
Contribution of removed grazing land to Base Scenario	-			-$22,957	$	23,330
- per ha				-$177	$	274
Annualised Carbon and Forestry/ha			$	283	$	283
Annualised Carbon and Forestry return from Scenario change			$	36,726	$	24,013
Carbon and Forestry Adjusted EFS			**$**	**186,676**	**$**	**150,633**
Adjusted EFS/ha			$	236	$	190
Total CO2 E generated from farming & forestry activities (t/year)		2,426		2,203		1,987
CO2 E generated from farming & forestry activities (kgs/ha/ year)		*3,066*		*2,785*		*2,512*
Reduction in CO2E generated due to scenario changes (t/year)				222		438
% reduction				9%		18%
Reduction in CO2E /combined ha (t/year)				1.71		2.04
Nitrogen Losses		6459		6160		5948
% reduction from base				5%		8%
Phosphate losses		121		118		116

The table above summarise the modelling results. Of important note though is by adding in the potential of new forestry returns (Pinus radiata, at an annualised per ha rate) and carbon returns from this land ($35/t) the EFS improves to $186,000/year. Putting a further 85 ha into forestry (as in Scenario 2) does not actually add to the bottom line.

In effect the difference between the two scenarios is the sweet spot where pastoral returns are greater than forestry. This is significant in the right tree right place objective.

Also significant is the reduction in CO_2 equivalents (CO2E), where there is a reduction of carbon outputs at a whole farm level of 9% in scenario 1 and 18% in scenario 2. The greater amount in scenario 2 is due to the relative decrease in methane from the reduced stock carried.

A further impact of the scenarios tested is the reduction of nitrogen lost to water, a 5% reduction in scenario 1 and a reduction in phosphate losses.

By implementing scenario 1 the case study farm is financially and environmentally more sound. Some of this land proposed to have its use reallocated has other pastoral farming benefits that are less tangible and difficult to model. An example of which is a 22ha block lying on the south west close to the boundary. The farm owner is reluctant to retire this block from grazing as it has a sheltered aspect and has uses after shearing. Nevertheless, in the long term modelling this block would return more to the farm if it was planted in trees.

15.2 Case Study 2

This case study property is a 245ha summer-dry hill country farm that the current owners have been operating for the last 8 years (and owned for the last 3).

With one of the owners working off-farm for some of the week, and a family to juggle, it is easy for initiatives or ideas to drift along, with more pressing and obvious needs taking priority. This is exactly what has happened in relation to potential tree planting activity.

One example of this is an area in the back corner of the property that was investigated and planned for tree planting only for the owners to learn that the boundary lines they had been working to were inaccurate. This potential planting of mixed natives is not off the table but has been stalled and made slightly more complex by this discovery.

"It still might happen, but probably not soon."

Another example is a lack of any real traction with potential manuka honey partners. Enquiries have been made, and conversations have been had, but it hasn't resulted in any action or clarity around what to do next.

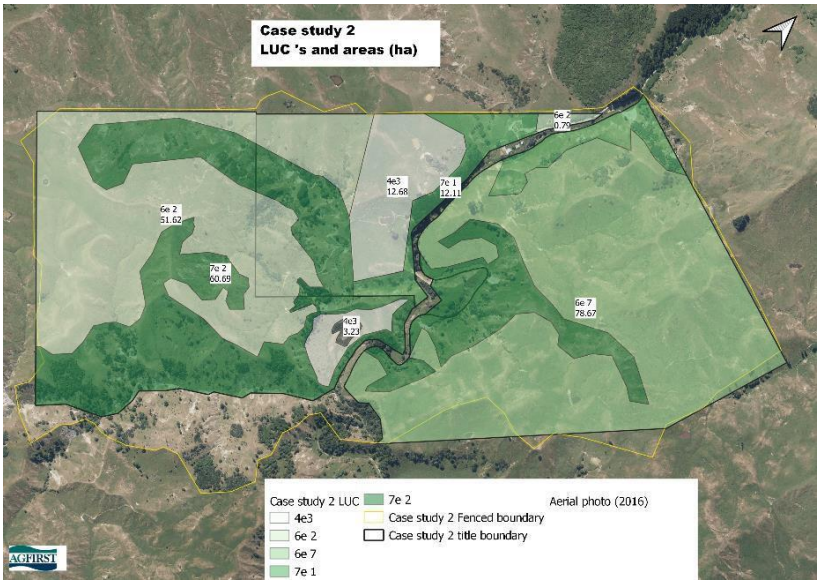
"We haven't really had people follow up or know who else we should speak to."

As seen in many cases across the region, there is an interest in using tree planting activity to support the overall farm operation, but it can easily be de-prioritised or drift along without turning into real, tangible change. This is partly because, when getting down to individual cases, there can be a lot of different factors to take into account or allow for, on top of busy workloads. It is also partially put down to a disconnect between different parties (such as Horizons and Billion Trees). This leads to different messages or priorities and also means that progress is halted when things fall between parties or transition from one initiative to another.

While not a large operation, there is opportunity here for tree planting to support the overall farming operation. But an external party helping to facilitate this and drive it is lacking.

This farm lies a further 14 kilometres south of case study 1. It is a sheep and cattle breeding system. It is not part of the SLUI project and much of the surrounding countryside is already forested. Scale is the immediate problem with this farm, and currently the owner is considering leasing the farm to a larger pastoral operation. There is pressure for this farm to become wholly forested.

15.2.1 Case Study 2 Land Inventory



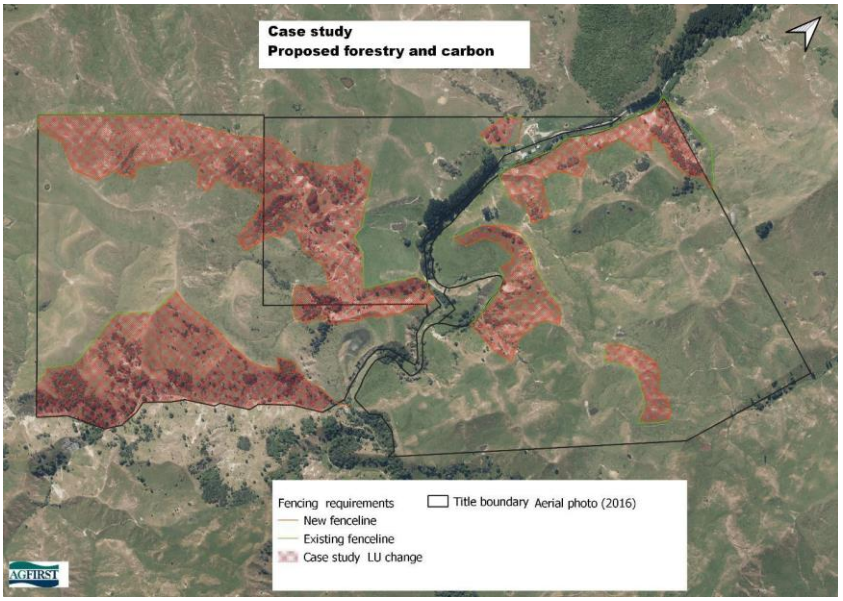
Case study 2 has only a small proportion of its land area, 15ha, that could be cropped, meaning 93% of this farm is classified as moderately steep to steep hill country.

As with many hill country farms the boundaries have a give and take relationship with the neighbouring properties.

In the map above the yellow line is the farmed boundary, whereas the black line is the title area. Any forestry considered would need to lie within the title (black line) boundary.

There is 73ha of class VII LUC land.

The map below depicts the farm if this LUC class VII was removed, but there was an effort to minimise new fencing requirements.



15.2.2 Base Model Returns

As in case study 1 a base model was developed in Farmax to represent a long-term stable pastoral situation based on the 245ha of farmed land. There is 25 ha of this outside the titled area.

Based on current average stock carried this farm has potential pasture production averaging 4,888 kgs dm/ha/year. Again, as in case study 1 the model was broken down into various pasture production and pasture profiles blocks, in this case LUC 5 blocks and 1 block for the land outside of the title area.

A long term stock reconciliation was built and is depicted in the table below.

This is approximately a 70:30 sheep:cattle ratio with a 7.1 su/ha average carrying capacity. The table below summarises the profit and loss for this farm on a long term model scenario.

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Forecast Profit and Loss for Case Study 2

Long Term Model

			$ Total	$/Farm ha	$/SU
Revenue	Sheep	Sales - Purchases	100,204	409	57.5
		Wool	11,854	48	6.8
		Capital Value Change	-112	0	-0.1
		Total	**111,947**	**457**	**64.2**
	Beef	Sales - Purchases	36,612	149	21.0
		Capital Value Change	-50	0	0.0
		Total	**36,563**	**149**	**21.0**
	Total Revenue		**148,509**	**606**	**85.2**
Expenses	Wages	Management Wage	26,157	107	15.0
	Stock	Animal Health	5,043	21	2.9
		Shearing	10,014	41	5.7
	Fertiliser	Fertiliser (Excl. N & Lime)	17,438	71	10.0
		Lime	1,397	6	0.8
	Other Farm Working	Weed & Pest Control	3,320	14	1.9
		Vehicle Expenses	5,618	23	3.2
		Fuel	5,231	21	3.0
		Repairs & Maintenance	10,000	41	5.7
		Freight & Cartage	350	1	0.2
		Electricity	1,500	6	0.9
		Other Expenses	980	4	0.6
	Standing Charges	Administration Expenses	5,836	24	3.3
		Insurance	3,087	13	1.8
		ACC Levies	1,531	6	0.9
		Rates	4,165	17	2.4
	Total Farm Working Expense		**101,667**	**415**	**58.3**
	Depreciation		9,173	37	5.3
	Total Farm Expenses		**110,840**	**452**	**63.6**
Economic Farm Surplus (EFS)			**37,669**	**154**	**21.6**
Farm Profit before Tax			**37,669**	**154**	**21.6**

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

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

15.2.3 Results of Case Study 2 Modelling

The table below depicts the scenario of what happens when the class VII country is removed from the pastoral system.

Case Study 2; Comparison of Scenarios.			
	Base	**Scenario I** LUC VII removed from grazing	**Difference**
Grazed pasture area (ha)	245	172	-$73
Change in grazed area	-	73	
Total Annualised Stock units	1,744	1,361	-$383
Average whole of farm stocking rate (grazed)	7.1	7.9	
stock units removed /ha change		5.24	

In this instance there is approximately a 380su decrease in the number of stock units that could be farmed. In doing so the average carrying capacity would increase to 7.9su/ha. The removed land was carrying 5.24su/ha.

The table on page 72 depicts the change in profit and loss by this land use change.

The analysis of this land parcel indicates that at best it was only breaking even in terms of its contribution to the farm's bottom line.

By including a potential forestry and carbon the EFS increases to $48,00, an increase of over 70%. Significantly there is a large decrease in carbon emissions, by 23%, and nitrogen losses to water by 20%.

Again, as in case study 1, by implementing a targeted land use change the overall profitability increases and the environmental footprint decreases.

At the current long term modelling this scenario is still behind that of the whole farm going into trees by $20,000 per year. This tree return calculation is only for the first harvest cycle and as such has a heavy weighting of safe carbon returns included in the modelling. If carbon is removed then the pastoral systems is more lucrative than a Pinus Radiata forestry return.

Case Study 2; Comparison of Scenarios.					
			Base	Scenario I LUC VII removed from grazing	Difference
Grazed pasture area (ha)			245	172	-$73
Change in grazed area			-	73	
Total Annualised Stock units			1,744	1,361	-$383
Average whole of farm stocking rate (grazed)			7.1	7.9	
stock units removed /ha change				5.24	
Revenue	Sheep	Sales - Purchases	$ 100,204	$ 89,965	-$10,239
		Wool	$ 11,854	$ 9,069	-$2,785
		Total	$ 112,058	$ 99,034	-$13,024
	Beef	Sales - Purchases	$ 36,612	$ 28,402	-$8,210
	Total Revenue from Farming		**$ 148,670**	**$ 127,436**	**-$21,234**
	GFI/su		$ 85	$ 94	$8
	GFI/ grazing ha		$ 607	$ 741	$134
Expenses	Wages	Wages & WoM*	$ 26,157	$ 20,419	-$5,738
	Stock	Animal Health	$ 5,043	$ 3,873	-$1,170
		Shearing	$ 10,014	$ 7,700	-$2,314
	Feed/Crop/Grazing	Conservation	$ -	$ -	$0
		Forage Crops	$ -	$ -	$0
		Regrassing	$ -	$ -	$0
	Fertiliser	Fertiliser (Excl. N & Lime)	$ 13,312	$ 8,893	-$4,419
		Lime	$ 1,397	$ 980	-$417
	Other Farm Working	Weed & Pest Control	$ 3,320	$ 2,331	-$989
		Vehicle Expenses	$ 5,618	$ 5,618	$0
		Fuel	$ 5,231	$ 4,383	-$848
		Repairs & Maintenance	$ 10,000	$ 9,500	-$500
		Freight & Cartage	$ 350	$ 350	$0
		Electricity	$ 1,500	$ 1,500	$0
		Other Expenses	$ 980	$ 688	-$292
	Standing Charges	Administration Expenses	$ 5,836	$ 5,836	$0
		Insurance	$ 3,087	$ 3,087	$0
		ACC Levies	$ 1,531	$ 1,531	$0
		Rates	$ 4,165	$ 2,924	-$1,241
	Total Farm Working Expenses		**$ 97,541**	**$ 79,613**	**-$17,928**
	FWE/su		$ 56	$ 58	$3
	FWE/ grazing ha		$ 398	$ 463	$65
					$0
	Depreciation		$ 9,173	$ 9,173	$0
	Interest on Livestock deployed		$ 14,299	$ 10,978	-$3,321
	Total Farm Expenses		**$ 121,013**	**$ 99,764**	**-$21,249**
					$0
Economic Farm Surplus (EFS)			**$ 27,657**	**$ 27,672**	**$15**
EFS/ha Total land area			**$ 113**	**$ 113**	
EFS/ha grazed land			**$ 113**	**$ 161**	
Contribution of removed grazing land to Base Scenario			-	-$ 15	
- per ha				-$0	
Potential Annualised Carbon and Forestry/ha				$283	
Annualised Carbon and Forestry return from Scenario change				$ 20,623	
Carbon and Forestry Adjusted EFS				**$ 48,295**	
Adjusted EFS/ha				$ 197	
Total CO2 E generated from farming & forestry activities (t/year)			599	462	
CO2 E generated from farming & forestry activities (kgs/ha/year)			*2,444*	*1,886*	
Reduction in CO2E generated due to scenario changes (t/year)				137	
% reduction				23%	
Reduction in CO2E /combined ha (t/year)				1.87	
Nitrogen Losses			1909	1528	
% reduction from base				20%	
Phosphate losses			66	52	

* Wages of Management

15.3 Case Study 3

Property 3 is an iconic farm in the region, including 11 kilometres of coastline and covering 3,600ha in total. This multi-generational property comprises largely argillite or yellow-brown soils.

In its current form, the 3,600ha is split into 1,700ha of Pinus Radiata, 1,100ha of grazing land and 800ha in scrub and natives with this split largely being driven by focusing farming activities on productive farmland and converting other areas to production forestry where appropriate.

The journey to get to this point began in the early 1960s, when a neighbouring property of 300ha was purchased. This property was largely scrub, but clearing, fencing, watering and fertilising took place to convert much of this to farmland which was sustainable given the subsidies in place at the time. However, these efforts were hampered by regular slips and the battle to stop the land reverting to scrub. A similar property was purchased in the mid-1960s and a similar process took place here as well.

It was an event in the early 1980s that changed the way of thinking. A mob of sheep were grazed for a month around the 8 blocks that had been created, and when they were weighed at the end of this time, they had *lost* weight.

"I remember thinking at the time. There is no way this is sustainable.'"

After a period of investigation and planning, 250ha of the most difficult and unproductive farming land was planted in pine, with additional pockets of difficult areas planted in the following years. This enabled farming efforts to focus on the best suited parts of the property and increases in productivity and efficiency were seen in these areas.

In 2008, a SLUI plan for the farm, coupled with the introduction of the ETS provided a catalyst for further pine planting to get the property to where it is today. The SLUI plan provided recommendations for further planting of forestry on the basis of supporting biodiversity, water quality and farm performance outcomes.

'I'm not too sure about the carbon farming model. We prefer to focus on production forestry – not carbon farming.'

While there might be small areas that are planted in the future, this property now has a sustainable balance of productive farm land and productive forestry land to ensure this property remains a key player in the region's landscape.

Over the course of converting areas of the property to production forestry there have been a number of key lessons that could be of value to other landowners in the region:

1. Assess the performance of different parts of the property and determine the best use of each block or area (some might be costing money to graze).

2. Think carefully about the size and accessibility of production planting, as it is easy for some areas to become unfeasible from an economic standpoint if access is costly.

3. Explore and understand the different schemes and mechanisms at play that might support what you are trying to achieve. In the 80's it was subsidies on fertiliser and livestock incentive schemes, now the policies and incentives look quite different and need to be included in farm planning.

16 Workforce implications of afforestation

A forest estate, or regional forestry initiative requires skilled labour and professional oversight at all stages of its development.

This implies recruitment and training programmes to ensure that a population of appropriate, chosen, mentored and skilled personnel will be available when required.

An additional silver lining of doing this well is that the overall capacity and capability may be raised within Tararua District, with benefit to industries outside of the initial target (if generic employment skills are improved), retention of young people in the community if they have new local employment options, and higher household incomes because productivity is increased.

Forest labour and therefore training opportunities can be viewed as a series of discrete operations, in the case of a single forest. Or potentially, as a district imperative, requiring more design and ownership at a programme scale, such as for an ongoing forestry programme across many properties.

A forest requires available skills and labour to be within striking distance of a residential area, or of rurally based crews. The approximate labour inputs of forest operations are included in the table in section 15.3 below.

Provision of labour typically requires the services of a managing entity such as a contractor, or in some instances to a training entity, or to some combination of both.

On face value the provision of labour and execution of relevant works is a package of activity within a forest investment and its management plan.

In the wider context of a council-based forestry programme there is a bigger picture around labour and workforce which may be developed to deliver not just the work as a product, but a deeper social offering.

16.1 Potential for structured internships for future workers and leaders

With ongoing programmes of forest and supplementary council work, a summer work programme can be morphed into a programme with more depth and value to the community.

For instance, in conjunction with Maungaharuru Tangitu Trust, Hawkes Bay Regional Council has operated a summer student forest internship 'Te Kapa Ngahere' – 'The Forest Team' programme since 2010. This

programme has the stated aims of building a values-based working environment to:

- develop responsible crew members with highly developed technical skills, leadership abilities, personal responsibility, compassion, service mindedness and career readiness.
- provide a pipeline of suitable young leaders for land-based industries.
- develop a continuously evolving, world class, field leadership programme using outdoor work as a platform.
- develop a responsible, safety conscious and effective weed control crew to provide high quality services to HBRC and partners.

The duplication or emulation of such a programme would be within the reach of Tararua District Council, provided they can resource the oversight, training and mentoring of the crew. And can fund their activities. In the HBRC case, a weed budget for Old Man's Beard control in the Tangoio Soil Conservation Reserve provided the base funding for development of the crew and its ethos. The reputation of the crew led to them later being engaged

by the HBRC biosecurity, engineering and parks teams, by Hastings District Council, DOC and private farmers to assist with their programmes.

16.2 Integration Of Forest Labour And Professional Requirements With Social Outcomes

The New Zealand rural landscape and communities, and the physical environment, have had their fortunes limited by having an almost bipolar approach to land use.

Farming communities tend to have a culture underpinned by a definition of stock (livestock) people. They work with livestock and fodder crops, with forestry tending to be haphazard and an opportunistic inclusion.

Forest companies tend to focus on forestry only as a land use. This includes the current frenzy of activity around forest carbon which has displaced farming, its families and its infrastructure, on some magnificent livestock properties.

An holistic approach is required to view land for its intrinsic merits and to accurately assign land use most optimally within a property. Otherwise, the risk is that continued afforestation of whole farms occurs by default.

Ideally a skillset will be built among farmers, foresters, land managers and rural professionals, which integrates the necessary disciplines so that the most sensible decisions are made in future.

16.3 Labour Required to Conduct Forest Operations

In order to understand the likely labour impact of adding more forestry to a community, the table below displays the example of a Pinus radiata forest.

Using a fairly typical pruned Pinus radiata crop as a baseline, here is a representation of potential labour requirements to grow, engineer, and harvest a 27-year forest rotation.

Alternative species may have additional weed control requirement (eucalypts, manuka or native) or higher establishment costs, and a longer wait for harvest workforce opportunities. Silviculture (thinning and pruning) may not be required for some species.

Table 1. Indicative forest labour requirements man days/hectare forest

(For a representative P. radiata forest operation)	Year	Man days/ha	$/Man day
Estimated labour cost/day with transport (labour only, not plant)			$360.00
Establishment and Silviculture			
Land preparation manual	0	0.5	$180.00
Land preparation aerial	0	0.1	$36.00
Pest control (cumulative over first 3 years)	0	0.2	$72.00
Planting	1	1.5	$540.00
Post plant spray	1	0.3	$108.00
Post plant spray	2	0.3	$108.00
Survival survey	2	0.1	$36.00
Supervision (cumulative over first 10 years)	1	0.5	$180.00
Prune 1	4	2	$720.00
Prune 2	6	2	$720.00
Prune 3	7	2	$720.00
Thin to Waste	8	2	$720.00
Supervision (cumulative over first 3 years)	10	1	$360.00
Manage (cumulative over first 10 years)	10	1	$360.00
Fire protection (cumulative over first 10 years)		1	$360.00
Subtotal establishment and silviculture labour costs			$5,220.00
Growing and Harvest Phase			
Management, harvest preparation, inventory	10-25	3	$1,080.00
Harvest planning, road design and layout in field		2	$720.00
Harvest management, log sales, and administration	25-27	8	$2,880.00
Roading and skidsite construction.	25	5	$1,800.00
Harvesting	27	22	$7,920.00
Transport	27	10	$3,600.00
Post harvest cleanup (skidsites	27	3	$1,080.00
Road Maintenance (cumulative next 5 years)	27	0.5	$180.00
Scaling/port operations	27	0.5	$180.00
Subtotal growing and harevst phase labour costs			$19,440.00
Approximate wages into community across one 27 year rotation (no processing included)		68.5	$24,660.00
Return to the top if replanted….			

16.4 Additional Employment Offered by Wood Processing

Processing clearly adds a new level of labour requirement and therefore community benefit.

The extent of this is highly dependent on the proportion of local production processed domestically and has not yet been scoped for Tararua District for this report.

The report uses the example of a sawmill of 50,000 - 80,000 tonnes of log inputs per annum and around 185 direct jobs created.

16.5 Practitioner Training and Supported Learning to Enhance Land Use Decisions

Professional level land management training for practitioners can include land use capability, Geographic Information Systems via formal programmes. Specific tailored courses and programmes may also be offered under the co-ordination of councils, advocacy groups (Dairy NZ, Beef+Lamb) and via community led programmes such as Red Meat Profit Partnership.

If a truly integrated stance to land use is generated by TDC, then catchment groups, peer networks and local special interest learning groups will likely be a subproduct (and measure of success). These groups will perform as responsible entities, seek funding and operate with least demand from Council overhead resourcing (although they will likely seek direct funding).

Seeking to encourage independently autonomous groups, established with potent shared goals, may prove to be an efficient use of Council resources, while achieving aligned aims.

16.6 Professional training and encouragement

In the event Tararua District Council wishes to embark on close alignment to the forest industry, more trees in the farming landscapes and to investment in forestry, it will encounter the need to ensure provision of professional level capacity also.

This may incorporate any internship opportunities (holiday work for those in training) as well as scholarship offerings, perhaps targeted to high performers in the intern crew?

The philosophy around this will require in depth review. But the author can share, that in the case of the HBRC/Maungaharuru Tangitu - Te Kapa Ngahere example, many past students are working in the forest industry, and within council teams, having been well prepared and vetted during their summer experiences.

16.7 Forestry/ Pastoral Labour Comparisons

A recent Beef+Lamb study in the Wairoa District calculated the local employment generated for a 1,000ha case study sheep and beef farm. The report case study had 2.6 full-time labour units and based on the amount spent on wage related expenses, at an average of 1,920 hr worked per year and an hourly rate of $25/hr, it concluded that there would be 4.2 jobs generated per 1,000ha. The Tararua District pastoral farm systems would be very similar to this.

Stock agents, etc also operated in that local community and the addition of these services generated an additional jobs per 1,000ha.

The 68.5 labour days per hectare for forestry detailed in section 15.3 above would convert to 1FTE per 760ha. In a pastoral system this 760ha would employ 3.2 FTE, not including the community jobs created.

17.0 Tararua District Council Right Tree Right Place – Contacts, Networks and Resources

In order to build the capacity and capability necessary for the Tararua community to best engage with its afforestation options, the community will need access to information and support.

A number of existing support networks and specialist entities exist to assist with this, and TDC may wish to form its own groups relevant to these topics also.

Key Contacts

The tree species promoted for consideration by Tararua District Council are at various stages of development in terms of husbandry, genetics and markets.

Aligning the community to these options will be best achieved by engaging with the various entities to access; latest research, information and when the time is right, to order trees.

Species or forest systems category	Organisation	ContactPerson	Email	Website
Cypresses (Lusitanica, Macrocarpa, Ovensii)	NZ Farm Forestry Association	Dean Satchell	dsatch@xtra.co.nz	www.nzffa.org.nz
Dryland Forests Initiative eucalyptus program	NZ Dryland Forests Initiative	Paul Millen	p.millen@xtra.co.nz	www.nzdfi.org.nz
Kauri	Tane's TreeTrust	David Bergen	office@tanestrees.org.nz	www.tanestrees.org.nz
Tōtara	Tane's TreeTrust	David Bergen	office@tanestrees.org.nz	www.tanestrees.org.nz
Manuka for honey	Manuka Farming NZ	BronwynDouglas	bronwyn@manukafarming.co.nz	www.manukafarming.co.nz
Poplar Silvopastoral Systems	NZ Poplar and Willow ResearchTrust	Ian McIvor	ian.mcivor@plantandfood.co.nz	https://www.poplarandwillow.org.nz
Radiata Pine	PF Olsen	Andrew Clarke	andrew.clarke@pfolsen.com	www.pfolsen.com
Coast Redwoods	NZ Redwood Company	Simon Rapley	simon@nzredwood.co.nz	www.nzredwood.co.nz
Douglas-fir	PF Olsen	Andrew Clarke	andrew.clarke@pfolsen.com	www.pfolsen.com
Mixed species Native Afforestation (Replacement of native forest)	Plant Hawkes Bay	Marie Taylor	planthawkesbay@xtra.co.nz	www.planthawkesbay.co.nz
Mixed native and exotic carbon crop with long term biodiversity gain.	Ekos	Sean Weaver	sean@ekos.co.nz	www.ekos.co.nz
Rongoa	Nga Whenua Rahui	Rob (Pa) McGowan	pa.r.mcgowan@gmail.com	

Key Networks

New Zealand Farm Forestry Association

Hawkes Bay Branch	Bryan & Heather Holdsworth	tetokatrust@gmail.com
Wairarapa Branch	Kolja Schaller	kolja.schaller@gw.govt.nz

New Zealand Poplar and Willow Research Trust Ambassadors

https://www.poplarandwillow.org.nz/about/who-we-are/ambassadors

The Poplar and Willow Research Trust, with the support of regional councils, has appointed a group of farmers to act as ambassadors. These farmers are experienced in the planting and management of poplars and willows and their goal is to support other farmers deciding the best trees to plant in various areas on their farms.

Ambassadors are available to talk one to one with other farmers about the environmental and financial benefits of planting these trees and their experience in planting and managing them. Invitations to visit their farms to see these trees in action is also possible. Some will also be available on request to speak at field days and meetings.

Shane Carroll - Ashhurst district
Shane can be available for occasional field days or just one on one advice or farm visits.
Telephone: 06-329
Email: westview@xtra.co.nz

Andy Renton
Andy is happy to visit people's farms or landowners can visit Tamaihu.
Telephone: 027-406
Email: andyrenton5@gmail.com

Guy Williams - Masterton
Guy is happy to talk to people one on one, speak at the occasional field day or show people around Te Parae.
Telephone: 06-372 2822
Email: guyandkim@farmside.co.nz

James Hunter - Central Hawke's Bay District
James is happy to discuss pros and cons of planting poplars and willows and to speak at events.
Telephone: 06-855 5265
Email: rangitoto@farmside.co.nz

Key Resources

Te Uru Rākau Ministry of Primary Industries – Forestry

Learn how Te Uru Rākau (Forestry New Zealand) supports forestry priorities. These include One Billion Trees and working with Māori on land development opportunities, climate change, the ETS, native planting, forestry and wood processing exports and workforce development.

https://www.mpi.govt.nz/forestry/

The NZ Farm Forestry Association

Website is an excellent resource for prospective farm foresters in New Zealand. There are many hours of exploration, reading and video available on this site.

https://www.nzffa.org.nz

New Zealand Poplar and Willow Research

Retaining fertile soil on the land is in the interests of all New Zealanders. Poplars and willows planted for erosion reduction stabilise our pastoral hill country, increase water storage, reduce sediment transfer, improve water quality, benefit stock and enhance the farm environment.

Working in close association with regional authorities and industry partners, NZPWRT develops adaptable planting materials (poplar & willow), provides technical support and promotional information to assist landowners to reduce soil erosion, lower sediment transfer off farm, and improve water quality.

https://www.poplarandwillow.org.nz

Hawkes Bay Regional Council – 2020 Right Tree Right Place Project

This project offers reports, species information and native restoration information across over 700 pages of reports, completed in 2020. This content is available on request from HBRC.

Campbell Leckie
campbell@hbrc.govt.nz

James Powrie RTRP Project Manager,
redaxenz@gmail.com

17.0 Appendices

Assessment of afforestation and future wood processing opportunity with non-radiata species – Wairoa District – Peter Hall – Scion – April 2020

Hardwood Silvopastoral Systems – Ian Millner, Rural Directions

HBRC RTRP Species Assessment - Cypresses

HBRC RTRP Species Assessment – Douglas fir

HBRC RTRP Species Assessment - Manuka

HBRC RTRP Species Assessment - Radiata Pine

HBRC RTRP Species Assessment – Redwoods

Human Factors Presentation – Simon Taylor – Workshop 28 July 2020

Learnings from HBRC RTRP & Project Species Choice Considerations for TDC - Workshop Power Point - 28July 2020

Natives as an Afforestation Option in the Hawke's Bay Region – Tane's Trust

NZDFI Assessment of Dryland Durable Eucalypts – November 2018

NZDFI Sustainable Regional Hardwood Industries

Portable Sawmilling of Locally Grown Alternative Timber Species

Potential Afforestation Options for The Tararua Landscape – Scion Power Point

Potential Afforestation Options for The Tararua Landscape – Scion Report – October 2020

Contact

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