Document 9

Daniel Ohs

From: Sharon Alderson
Sent: Monday, 21 June 2021 3:19 pm
To: Meredith McKay
Subject: Fwd: RE: Pre-1990 reports: a potential way forward

Follow Up Flag: Follow up
Flag Status: Flagged

This chain is to go with Carbon programmers rather than F&B report,
But sending FYI

Sent from Workspace ONE Boxer

---------- Forwarded message ----------
From: Fiona Carswell <CarswellF@landcareresearch.co.nz>
Date: 16/06/2021 11:44 am
Subject: RE: Pre-1990 reports: a potential way forward
To: Ken Hughey <khughey@doc.govt.nz>,"Gavin Smith (Policy)" <grsmith@doc.govt.nz>,Jenny Christie <JCHRISTIE@doc.govt.nz>
Cc: Keith Briden <kbriden@doc.govt.nz>,Peter Bellingham <pbellingham@doc.govt.nz>,David Talbot <dtalbot@doc.govt.nz>,Alex Smith <alsmith@doc.govt.nz>,Sharon Alderson <salderson@doc.govt.nz>

Kia ora koutou
Apologies for my delayed response. (Stuck in meetings…)
The most recent published work on NZ indigenous forest sinks is now published by Scion (attached). They are very clear to state that tall NZ forests are at equilibrium – neither gaining nor losing overall. There's a lot of fuss in the paper over their methods vs ours but the basic facts are that their average C stock comes in at 227 t/ha whereas ours came in at 228.75 t/ha (and we also stated the tall forests were at equilibrium). DOC is running a process to identify the difference made by methodological decisions/data cleaning/data corrections etc when examining tier 1 data so we can be really transparent about comparing like with like. Elaine and Meredith have more detail on this than I have.
Given that natural forests are comprised of various aged cohorts, regrown after a variety of disturbances (scale/geochemical impact), we'd expect some areas to be losing carbon and others to be gaining. This is why it's super important that we protect the natural forests as a whole because turning a massive land use/carbon stock from C equilibrium to a net loss could be catastrophic. What matters is understanding the drivers of gain vs loss and this is where some demographic work has been proposed – what are the relative strengths of growth vs mortality vs recruitment across the tier 1 network?
The pine argument always seems to forget about the removal of the stock on a regular basis (at harvest) and that there are emissions associated with planting/spraying/felling/clearing/processing. The calculations have been done in the past that it's less than 3 harvest cycles until these forests are a net source also (it was actually a Piers McLaren calculation). Steve Wakelin should know what the current figure is. I think there is a case to be made for pine as an intermediate crop (to a long term indigenous cover) but very little is known as to how best to manage this transition and what the long term effects will be (e.g., expect pine to keep coming up whenever there are decent sized gaps). In recent years both Scion and MWLR have researched this and suggested how the process could be managed (SLMACC is the best source of these reports – I can probably find them if you want them) but we all acknowledge that because of the time scales involved there are very few "live" experiments where people have grown their pine post-harvest age and then actively managed a transition.
I'm not aware of current research on carbon (by MWLR) using the Tier 1 data, beyond the methodological investigation commissioned by DOC which I think is not carbon-specific? Given Peter is copied in here I am sure he

can provide a perspective on whether I'm right in my assumption and who we're talking to about investigating the demographic drivers? (The latter is something I've spoken with Sarah Richardson about.)
Please let me know what we can do to help inform the MPI perspective – I would have thought Nigel Searles would be closest to this having recently moved from the MfE LUCAS team to MPI.
Ngā mihi,
Fiona

Fiona Carswell (she/her)
Chief Scientist
Manaaki Whenua – Landcare Research
T s.9(2)(a) | M s.9(2)(a)
www.landcareresearch.co.nz

Manaaki Whenua
Landcare Research

From: Ken Hughey <khughey@doc.govt.nz>
Sent: Tuesday, 15 June 2021 1:14 pm
To: Gavin Smith (Policy) <grsmith@doc.govt.nz>; Jenny Christie <JCHRISTIE@doc.govt.nz>
Cc: Keith Briden <kbriden@doc.govt.nz>; Peter Bellingham <pbellingham@doc.govt.nz>; David Talbot <dtalbot@doc.govt.nz>; Alex Smith <alsmith@doc.govt.nz>; Fiona Carswell <CarswellF@landcareresearch.co.nz>; Sharon Alderson <salderson@doc.govt.nz>
Subject: RE: Pre-1990 reports: a potential way forward
Thanks Gavin – have to say, and appreciate your points, but this really do s point to the need to undertake a meta data analysis of the LUCAS data, but also to be clear in what we know and don't know, and what we are currently exploring. Fiona is in a great position to advise on some, if not all of this.
Ken

From: Gavin Smith (Policy) <grsmith@doc.govt.nz>
Sent: Tuesday, 15 June 2021 12:27 pm
To: Ken Hughey <khughey@doc.govt.nz>; Jenny Christie <JCHRISTIE@doc.govt.nz>
Cc: Keith Briden <kbriden@doc.govt.nz>; Peter Bellingham <pbellingham@doc.govt.nz>; David Talbot <dtalbot@doc.govt.nz>; Alex Smith <alsmith@doc.govt.nz>; Fiona Carswell <carswellf@landcareresearch.co.nz>; Sharon Alderson <salderson@doc.govt.nz>
Subject: RE: Pre-1990 reports: a potential way forward
Morena koutou
As in my initial email, I have already pushed back on use of this statement in MPI policy work around the ERP. However they are keen to understand what it means. Variations on the meme keep popping up, so it is evolving like the telephone game eg (the Δ variant) - forests are just temporary carbon and will eventually become emitters. This tends to diminish the value of native forest for long term carbon - the corollary being that only radiata has value in the context of CC response – so the response to the CCC may be more BAU than transformation.
Back in the relatively real world, there is no suggestion in Paul that tall indigenous forest overall is not, for our purposes, in equilibrium. However it goes on to state that within that estate, the measured loss in kamahi-podocarp forest is greater tha the error
ie -9.0 ±7.2 (Table 9, p4, p26, also Table 4).
I can relay the message that we don't think that is a real thing but I will get pushback. Because the statement originates in the Paul / Scion report for NFI / LUCAS and is reiterated in some of the new draft papers I sent round, my inc ination would be towards a formal comment on what it does/doesn't mean, which can also be released into the wild. Ideally this piece would include the original authors. If there is a real question to answer there should be some steer on what work is needed to answer it.
The report was done for MfE (NFI, LUCAS) so do we need to talk to them first / as well?
For MPI – TUR Craig Elvidge (TUR) & Steve Wakelin (Scion) are the go tos for the draft reports.
Cheers
Gavin

From: Ken Hughey <khughey@doc.govt.nz>
Sent: Monday, 14 June 2021 7:15 pm
To: Jenny Christie <JCHRISTIE@doc.govt.nz>; Gavin Smith (Policy) <grsmith@doc.govt.nz>

Cc: Keith Briden <kbriden@doc.govt.nz>; Peter Bellingham <pbellingham@doc.govt.nz>; David Talbot <dtalbot@doc.govt.nz>; Alex Smith <alsmith@doc.govt.nz>; Fiona Carswell <carswellf@landcareresearch.co.nz>; Sharon Alderson <salderson@doc.govt.nz>
Subject: RE: Pre-1990 reports: a potential way forward

Thanks heaps Jenny. My understanding as well. But there are some very big mental models out there at the moment.

So, who will go back to MPI on this? I am happy to advise John Roche, their CSA. Other thoughts?

Now to my other point. I have raised this meta analysis question with multiple people, including on this list and NO ONE has indicated any work is planned. Although, having said this my memory is so clogged at the moment maybe I didn't get the message?!

So I would hugely appreciate knowing with certainty what is planned and when because we need some key information to inform policy initiatives being discussed now! I'm very happy of course to chat re this.

Ken

Sent from Workspace ONE Boxer

On 11/06/2021 4:58 pm, Jenny Christie <JCHRISTIE@doc.govt.nz> wrote:

Kia ora Gavin & Ken

My understanding is that tall / mature native forests are in carbon equilibrium, this point is supported by the attached report Paul et al 2019. In this report the variation in carbon storage between yea rs is smaller than the error associated with the measure. There is no actual evidence from this report that mature native forests have lost carbon stock between the two measurement periods. Carswell et al. 2014 highlighted the same problem of large errors associated with carbon storage measurements in mature forests, as well as making the same conclusion of increasing carbon storage in regenerating / restored native forest. Therefore I think we should definitely push back against MPI's interpretation of mature native forests losing carbon stock, because it is a misinterpretation of the evidence.

Also, regarding analysis of the LUCAS plot data mentioned by Ken, my understanding is that there are various research programmes via MfE, DOC and MWLCR either undertaking or planning analysis of this data. Elaine Wright and Fiona Carswell should both have good oversight of this than myself. Also, Peter Bellingham, Elaine W and myself have been discussing using the LUCAS data to answer climate change impact questions and framing up research accordingly, with an eye to collaborating / influencing external research. Ken your input into this space in terms of securing funding to progress this research would be most valuable.

Happy to discuss

Jenny

From: Ken Hughey <khughey@doc.govt.nz>
Sent: Wednesday, 9 June 2021 9:54 AM
To: Gavin Smith (Policy) <grsmith@doc.govt.nz>; Jenny Christie <JCHRISTIE@doc.govt.nz>; Keith Briden <kbriden@doc.govt.nz>; Peter Bellingham <pbellingham@doc.govt.nz>; Sharon Alderson <salderson@doc.govt.nz>
Cc: Alex Smith <alsmith@doc.govt.nz>; Fiona Carswell <carswellf@landcareresearch.co.nz>; David Talbot <dtalbot@doc.govt.nz>
Subject: RE: Pre-1990 reports: a potential way forward

Dear all

I have been buried in other work sorry (although I note Gavin you did only send yesterday so I can likely be forgiven?) but I wanted to quickly update on a thinking and learning opportunity I have started exploring, which I believe Gavin may be extremely helpful (but of course I could be wrong!?).

Manaaki Whenau holds the LUCAS data which goes back for decades. I understand it has only been used for LUCAS reporting. But it can potentially be used for a whole lot of meta data analysis linked potentially also to key events (e.g., climate variation patterns, DOC pest control interventions). I have raised this possibility with Sharon and have spoken to Fiona Carswell. I just think we need to do this sort of work because actually it could be extremely informative for a range of policy and management related thinking (and note I have copied this into Fiona). And, we need to get on with it as these sorts of questions are real in the policy space. By the way if funding is an issue then let me know and I will try my best to address.

My challenge at the moment is that all my fingers are trying to plug too many holes and thus I don't seem to be getting a lot of progress on things that just seem so logical it isn't funny (and this may be one of them, or it may not be (no has said that the latter to be yet?).

Ken

From: Gavin Smith (Policy) <grsmith@doc.govt.nz>
Sent: Tuesday, 8 June 2021 12:00 pm
To: Ken Hughey <khughey@doc.govt.nz>; Jenny Christie <JCHRISTIE@doc.govt.nz>; Keith Briden <kbriden@doc.govt.nz>; Peter Bellingham <pbellingham@doc.govt.nz>
Cc: Alex Smith <alsmith@doc.govt.nz>
Subject: FW: Pre-1990 reports

Hi all

In some recent meetings and papers MPI has talked about mature native forests losing stock. This goes a bit beyond the loss in (mostly conservation land) West Coast kamahi-podocarp forest identified by Paul et al 2019 in LUCAS monitoring. We've suggested that this is a surprising and strong statement that shouldn't be included in briefings unless or until there is a strong consensus around it.

Anyway I asked for background and have received the attached draft papers. We would all be very interested in your perspectives, mainly on Rpt 5 (discussion). Rpt 1 table of forest types follows Paul I think). The others are optional - 4 is all about exotics, 2 is about the FRL.

The burning (sorry) question for me was why would there be a loss of stock (2002/7 – 2007/14). Is there something DOC could be doing differently in its management of these forests or might we see something different in the next monitoring round?

Thanks for any thoughts you can share. Happy reading!

Alex did I get everyone?

From: Stephanie Versteeg <Stephanie.Versteeg@mpi.govt.nz>
Sent: Sunday, 30 May 2021 8:22 pm
To: Gavin Smith (Policy) <grsmith@doc.govt.nz>
Cc: Craig Elvidge <Craig.Elvidge@mpi.govt.nz>
Subject: FW: Pre-1990 reports

Here are the reports you were interested in. I suggest following up with Craig if any further questions, but please loop me in. Now that Georgia has left I have the perfect excuse to get more up to speed on this (with all my spare time).

From: Craig Elvidge <Craig.Elvidge@mpi.govt.nz>
Sent: Wednesday, 26 May 2021 4:46 PM
To: Stephanie Versteeg <Stephanie.Versteeg@mpi.govt.nz>; Bhavika Jeram <Bhavika.Jeram@mpi.govt.nz>
Subject: Pre-1990 reports

Links to files that were attached to this message:

Paul et al 2021 ForestEcosystems LUCAS.pdf Microsoft Edge PDF Document, 2.18 MB
https://doccm.doc.govt.nz/cs/idcplg?IdcService=GET_FILE&dDocName=DOC-7277720&RevisionSelectionMethod=LatestReleased&allowInterrupt=1
Open WebCenter Content Server

Document 10

Daniel Ohs

From: Meg Rutledge
Sent: Friday, 18 June 2021 11:11 am
To: Huia Forbes; Huia Lloyd; Sarah Campin-Fordham (@Parliament)
Cc: Kevin OConnor; Government Services; Simon Tapp
Subject: RE: 21-B-0456 - Advice - FW: Forest and Bird claims re pest eradication and forests

Kia ora

This email responds to the Minister's query about requested a summary of the conclusions of F&B's report and a DOC expert view on the validity of them: https://www.stuff.co.nz/environment/climate-news/125475191/culling-deer-possums-and-other-pests-could-undo-15-per-cent-of-our-annual-climate-impact--forest-and-bird

These are the Departments key points:

- Evidence from scientific research shows that carbon storage measurement in our mature native forests is stable between the two measurement periods. Within this some forests will be gaining carbon, while others may be losing carbon.
- It is hard to measure the actual effect of browsing herbivores in our mature native forests because the large measurement errors associated with measuring carbon are larger than the amount of carbon lost through ungulate browse.
- Further investigation is needed into the causes of the apparent loss of carbon storage in West Coast kamahi podocarp forest. Kamahi is a successional forest type and naturally transitions to a lower carbon forest / shrubland type.
- We know ungulate control increases carbon storage in regenerating forest and for forest restoration and we are working in some forests to promote regeneration. For example, we are working with iwi to restore the Raukumara forest on the East Coast of the North Island.
- Carbon storage and the impact of browsing herbivores on native forests is being monitored through the Tier 1 / LUCAS plot network. This is a government collective action between DOC and MFE.
- We agree there are questions around the role of ungulates in reducing carbon storage in mature native forest, and support the control of ungulates will be necessary for some sites or forest types.
- We are concerned that increasing droughts and storms as a result of climate change will damage our native forests, and that ungulate browse means they will be less likely to recover
- We're doing work to clarify the role of ungulate browse in native forest systems and we're talking to Manaaki Whenua and NIWA about potential research to measure actual carbon uptake of the forests.
- We'll be in a better position to respond to engage in more detailed feed back in a few weeks.

Ngā mihi,

Meg Rutledge, PhD
Kaiwhakahaere Kaiorau Koiora, Whakatū | Biodiversity Threats Director
Te Papa Atawhai | Department of Conservation
M: s.9(2)(a)

From: Julie Jacobson
Sent: Friday, 18 June 2021 8:47 AM
To: Bronwyn Saunders <bsaunders@doc.govt.nz>; Leigh-Anne Wiig <lwiig@doc.govt.nz>; Robyn Orchard <rorchard@doc.govt.nz>
Cc: Huia Forbes <Huia.Forbes@parliament.govt.nz>; Sarah Campin-Fordham <Sarah.Campin-Fordham@parliament.govt.nz>; Ben McLachlan <Ben.McLachlan@parliament.govt.nz>
Subject: Forest and Bird claims re pest eradication and forests

Hi all
Minister Verrall has requested a summary of the conclusions of F&B's report and a DOC expert view on the validity of them before her meeting with Kevin H at 11.30am please.

https://www.stuff.co.nz/environment/climate-news/125475191/culling-deer-possums-and-other-pests-could-undo-15-per-cent-of-our-annual-climate-impact--forest-and-bird

Thanks

Julie Jacobson | **Press Secretary**
Office of Hon Kiri Allan
Minister of Conservation | Minister for Emergency Management | Associate Minister for the Environment | Associate Minister for Arts, Culture and Heritage
4.5L Executive Wing, Parliament Buildings | Private Bag 18888 | Wellington 6160 | New Zealand
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Email julie.jacobson@parliament.govt.nz

[SEEMAIL]

Document 11

Climate Change Oversight Group

Subject	**DOC's role in Maximising carbon storage: increasing natural sequestration to achieve New Zealand's future carbon goals (CERF 1, Budget 2022)**
Paper for	Advice
Purpose	To advise on the scope and opportunities for DOC in this joint agency programme and update on work to date in Fiordland
Meeting date	18 January 2023
From	Amber Bill
Author	Michelle Crowell

Executive Summary

1. Maximising Carbon Storage aims to fill critical research and monitoring gaps in the evidence base for the policies underpinning New Zealand's carbon goals. Te Uru Rākau – New Zealand Forest Service manages the largest programme and research plan with support from DOC. There are dependencies between the DOC and Te Uru Rākau research.
2. Carbon accounting is a complex area of active policy development led by Ministry for the Environment and Ministry of Primary Industries. Carbon on Crown land is accounted for in the New Zealand Greenhouse Gas Inventory and is part of the government's National Determined Contribution under the Paris Agreement.
3. Maximising Carbon Storage is designed to build the evidence base toward recognising pest management in future carbon accounting. This is a long-term aim requiring research outcomes to be translated into policy and legislative change.

Overview of the Maximising Carbon Storage joint agency programme

4. *Maximising carbon sequestration: increasing natural sequestration to achieve NZ's future carbon goals* ('Maximising carbon sequestration') is a joint agency research programme led by Te Uru Rākau– New Zealand Forest Service (Te Uru Rākau) and designed to maximise sequestration benefits from forestry, long-lived wood products, and native ecosystems, and to quantify carbon stock changes in mineral soils. The Budget 22 initiative stated the aim is to 'directly contribute to reductions in the first three emission budgets by more than 9.3 million tonnes over 2022 – 2035'.

5. 'Maximising carbon sequestration' received funding through the Climate Emergency Response Fund in Budget 22. Funding has been allocated to each agency accordingly to deliver on its research outcomes and investments:

   - Maximising Forest Carbon – Te Uru Rākau – New Zealand Forest Service
   - Maximising Carbon in Mineral Soils – Ministry for the Environment
   - [redacted]

6. [redacted]

Maximising Carbon in Native Systems – Department of Conservation ($3.36M over 4 years)

7. This project will improve the accuracy and quantify the potential carbon benefits from native ecosystems by using modern remote sensing tools and drawing on existing data to understand the causes of forest and canopy damage.
8. Recruitment is underway for a project manager. In the interim, a contractor is engaged to draft the detailed business case by February 2023 and procurement plans for science contracts, Subject matter experts have been secured as project leads, who are working with the contractor to scope and develop the four workstreams:
   - Improve accuracy of spatial location for better biodiversity and carbon mapping
   - Analysis of drought impacts on forest trees, using Tier 1 monitoring data
   - Build on a meta-analysis of carbon storage trends using Land Use and Carbon Analysis System (LUCAS) data over a 20-year period
   - Spatial analysis of PCL suitable for appropriate indigenous restoration to maximise biodiversity and carbon gains.
9. The Maximising Forest Carbon programme has some dependencies on the workstreams in Maximising Carbon in Native Systems.

Maximising Forest Carbon – Te Uru Rākau – New Zealand Forest Service ($26.626M over 4 years)

10. The Budget 22 initiative set out that $6.6M of total allocation will be aligned to the 2021 Te Mana o Te Taiao gap analysis. DOC actively supports Maximising Forest Carbon at steering committee (Amber Bill) and the working group (currently Meredith McKay and Jenny Christie).
11. A Maximising Forest Carbon Research Plan has been developed around three focus areas, within which research aims have been defined and scoped:
    - Improve our understanding of exotic and native forests, and carbon measurement methods for implementation (including via the Emissions Trading Scheme)
    - Improve management for new and existing native and exotic forests and link management actions to changes in forest carbon stocks
    - Future-proofing the outcomes under climate change
12. A summary of the research plan is on the Ministry for Primary Industries (MPI) website.

13. The research plan is underpinned by overall approach that common pool of 'trial sites with active forest management' will be defined and intensively monitored to address research aims across the plan, for example to achieve:
    - Defined native forest types based on key anchor species
    - Improved accuracy of carbon measurement via LiDAR and other remote sensing
    - [redacted]
14. [redacted] has [redacted]
15. [redacted] Forest Carbon research plan is dependent on DOC continuing core work, such as maintaining national monitoring networks and improving the accuracy of plot locations.

Building the evidence base and pathway toward recognising pest management in future carbon accounting

16. There is broad interest from many stakeholders (including DOC) to investigate potential changes to forest carbon attributable to pest management. The most relevant research aim in the Maximising Forest Carbon research plan is 'Detecting forest management benefits' and is designed to leverage off the common pool of sites identified for the broader research plan. The current operating budget assumes that pest management (or other forest management) would already be planned and funded at sites within this pool. No budget has been allocated for pest control or eradication at trial sites.

Science

17. The current state of science around carbon storage and browser impacts was summarised in a context briefing to support the DOC Investment Brief for Maximising Native Carbon in August 2022 (**Appendix 1**). In mature native forest, it is difficult to quantify and attribute any additional carbon to removal of browsing pests.
18. The research to date suggests we should be cautious about detecting change in a short timeframe, unless sites are carefully selected for forest type and condition where carbon gain might be faster and therefore detectable. This will be a key driver for selecting sites for the common pool of sites identified for the broader research plan.

Policy framework for carbon accounting on public conservation land

19. Carbon accounting is a complex area of active policy development led by Ministry for the Environment (MfE) and MPI.
20. Carbon on Crown land is accounted for in the New Zealand Greenhouse Gas Inventory and supports the government is achieving the 2030 Nationally Determined Contribution (NDC) under the Paris Agreement (for example native restoration and afforestation). Management interventions such as pest control are not accounted for in the Greenhouse Gas Inventory at present due to the research and modelling gaps that Maximising carbon joint agency programme has been designed to fill.

21. The Emissions Trading Scheme (ETS) cannot be applied to Crown loan and the only mechanisms for investment from the ETS on public conservation land is temporary; under the Climate Response Act, third party investment in public conservation land to gain credits for the duration of their concession only. Legislative change could be initiated to make this mechanism more enduring.
22. s.9(2)(f)(iv) [redacted]
23. The voluntary carbon market has started to develop however how this will work is currently unclear (for example whether credits need to be backed by the ETS). There could be significant future opportunity here to incentivise carbon offsetting investment on public conservation land.

Fiordland

24. We started with the Fiordland opportunity for the browser-carbon research due to the sheer scale and an indicative support from mana whenua. There was also strong interest from Zero Invasive Predators to investigate carbon gain as a potential funding source toward Predator Free 2050.
25. In 2022, a team identified sites and design considerations to investigate potential changes to forest carbon attributable to pest management in a Fiordland context.
26. Secretary Island was identified where forest carbon attributable to deer management could be modelled by comparing carbon estimates from historical NZ Forest Service plots with New carbon re-measurement to be commissioned for 2022/23.
27. Potential mainland sites were identified, however further scoping was deferred to the national site selection given the risk that the forest types in Fiordland won't deliver results in the timeframe needed and other site constraints.

Next steps

28. We are scoping procurement of science and geospatial support to select an optimal set of sites on public conservation land for the Maximising Forest Carbon research plan (sections 13-14).

Appendices

- Appendix 1: Context briefing for the DOC Investment Brief for Maximising Native Carbon, August 2022 DOC-7123864

Document 12

Departmental Memo

Department of Conservation
Te Papa Atawhai

In Confidence

Date: 19 July 2021

To: Senior Leadership Team

From: Meg Rutledge – Director Threats

Subject: **Forest and Bird carbon sinks report analysis**

Executive summary – Whakarāpopoto ā kaiwhakahaere

1. This memo is in response to a request from Lou Sanson to provide the DOC Senior Leadership Team with an analysis of the recent Forest and Bird report on the protection of natural carbon sinks.
2. Forest and Bird released a report on 18 June 2021 focused on carbon stored in natural carbon sinks and the impacts introduced browsing pests cause to these sinks.
3. This memo analyses the key conclusions drawn from the report, provides a DOC and MfE expert view on their validity, and likely implications to work underway or planned.
4. DOC agrees New Zealand's natural forests need to be managed so that they do not lose carbon. Turning the entire natural forest carbon stock from carbon equilibrium to a net loss could be catastrophic. Enhancing carbon sequestration in natural forests is secondary to managing them to prevent carbon loss.
5. Further research and monitoring is required to better understand the relationship between carbon storage and control of introduced browsing pests in the various natural ecosystems across New Zealand.

Purpose – Te aronga

6. The purpose of this memo is to analyse the conclusions of the Forest and Bird report 'Protecting Our Natural Ecosystems' Carbon Sinks' and provide a DOC expert view on their validity.
7. This memo provides an overview of potential strategic implications of the Forest and Bird report for DOC's Senior Leadership Team.
8. Note, the Acting Minister of Conservation was provided with advice regarding the Forest and Bird Report [21-B-0456] on 18 June 2021.
9. Note, a separate memo will be provided to the Senior Leadership Team regarding the final Climate Change Commission Advice, including analysis of advice on maintaining, protecting, and restoring existing carbon stocks.

Background and context – Te horopaki

Forest and Bird report context and conclusions

10. On 18 June 2021, Forest and Bird released a report on New Zealand's natural ecosystem carbon sinks.
11. The report estimates carbon stored in the various natural ecosystems across New Zealand, assesses the impact of introduced mammalian herbivores on these ecosystems, and estimates the emissions mitigation potential of wide-spread pest control.
12. The report highlights the decline in carbon stored in kāmahi-podocarp forest and attributes this to introduced mammalian herbivores. The report also assesses the potential emissions mitigation that could be achieved through widespread herbivore control.
13. The report concludes that control of mammalian herbivores is likely to be one of the most significant and cost-effective options for protecting and enhancing the country's massive stores of natural carbon and contributing to emission targets.
14. The report proceeds a Forest and Bird submission on the Climate Change Commissions draft advice report. The submission used context from the subsequent report to call for greater emphasis on the management of browsing pests in the final Commission advice.
15. The final Commission advice report incorporates some of the recommendations of the Forest and Bird submission regarding increased protection of natural carbon stores.

Use of LUCAS/Tier 1 inventory data

16. The Forest and Bird report relies heavily on the most recent analysis (Paul et al. 2019, i.e. the "Scion report") of the LUCAS (Land Use and Carbon Analysis System)/Tier 1 natural forest plot measurement programme (referred to as the Natural Forest Inventory in the Forest and Bird Report).
17. The Scion report concluded that New Zealand's natural forest estate is in equilibrium, but also showed there are four forest types showing statistically significant changes in carbon stock. Three of which were gaining carbon, and that Kāmahi-podocarp (a widespread forest type) was losing carbon.
18. The Scion report clearly states that tall NZ forests are at equilibrium – neither gaining nor losing overall. This conclusion is supported by the previous analysis by Manaaki Whenua (Carswell et al. 2014), which also reported similar measures of average carbon stock (228.75 t/ha compared to the 227 t/ha for the Scion report). However, a difference in the methods between these two reports makes direct comparisons difficult.
19. The LUCAS programme commenced in 2002 to monitor and report on carbon stock and change in NZ forests and shrublands. DOC took over collection of the LUCAS inventory data for MFE exclusively from 2011 under an MOU.
20. In 2012, DOC built on MFE's plot network and implemented Tier 1. The programme is designed to integrate both vegetation, mammal, and bird measures allowing DOC to monitor and report status and trend of a selection of native species and pests on all Public Conservation Lands.
21. There is considerable overlap in the sites visited, methods and data required by each programme. DOC and MfE work as a central government collective to complete both programmes.
22. LUCAS data was originally collected on a five year remeasure cycle. However, in 2014 the LUCAS programme transitioned to a 10-year remeasurement cycle as this is generally accepted as a good interval for carbon stock and stock change monitoring of indigenous forests and is comparable to measurement intervals in slow growing boreal or temperate hardwood forests (Beets et al. 2009).

23. The Tier 1 data have remained on five-year measurement cycle so that impacts of management of herbivores on vulnerable ecosystem components can be documented.

24. The LUCAS/Tier 1 network provides information on carbon stocks and tree dynamism at a landscape scale (8 km grid). This information helps New Zealand to meet its mandatory international and domestic climate change reporting requirements for the land use, land use change and forestry (LULUCF) sector. These data are also used by a variety of New Zealand agencies to answer a range of questions. Recent requests include state and trends of National Parks, North Island Forest Parks (including Raukumara), and as such this data is important for our relationship with mana whenua.

25. The information has also been used to support national and international plans and strategies such as the DOC Deer Strategy -Te Ara ki Mua, New Zealand State of the Environment reporting, Te Mana o te Taiao (ANZBS) and the Convention on Biological Diversity report.

Gaps in the Forest and Bird Report

26. The drivers of carbon storage loss in kāmahi-podocarp forest are unclear and may not be caused by browsing herbivores.

27. Population maintenance of kāmahi at a range of scales was reported on in 2014 by DOC, MfE, and StatsNZ using the 2014 LUCAS/Tier 1 data. In the South Island the rate of kāmahi recruitment exceeded its mortality rates, which is potentially at odds with a view that herbivores are detrimental to southern populations of kāmahi.

28. In other research (Ramsey et al. 2019) showed that southern rātā canopy condition is enhanced when possum management is applied.

29. It is risky to highlight only one forest type out of suite of natural forest types, as it is important that natural forests are managed as a whole. We would expect some forests to be naturally losing carbon and others to be gaining, because natural forests are comprised of various aged cohorts, regrown after a variety of disturbances (scale/geochemical impact).

30. The report likely over-estimates the potential emissions mitigation that could be achieved by introduced herbivore control. There is little scientific evidence for the potential emissions mitigation identified in the report, and their calculations include a few errors.

31. Manaaki Whenua (Carswell et al. 2014) found it was not possible using current methods to quantify the effect of introduced herbivore control on carbon sequestration in mature native forest because the errors associated with measuring carbon are larger than the impact of browsing on carbon by introduced herbivores.

32. The report does not address the potential for additional carbon storage in regenerating and restored forest. Manaaki Whenua (Carswell et al. 2014) suggested that controlling introduced herbivores could have significant benefits in terms of increasing carbon sequestration in regenerating and restored native forest.

33. The report did not address of the risk of increasing droughts and storm events due to climate change to our native forests, and that ungulate browse means they will be less resilient and likely to recover.

Work underway or required

34. The apparent loss of carbon stored in kāmahi-podocarp forest is a concern and further investigation into the drivers is needed.

35. The LUCAS/Tier 1 network provides information on carbon stocks and tree dynamism at a landscape scale (8 km grid). This data informs questions about the drivers of gain versus

loss across all forest types. Demographic work has been proposed looking at what are the relative strengths of growth vs. mortality vs. recruitment across the LUCAS/Tier 1 network. This provides an opportunity to investigate the effect of browsing ungulates and climate change (e.g. drought, cyclone damage) on all forest types.

36. The coarse (8-km) resolution of the LUCAS/Tier 1 network may mask local-scale tree dynamics and carbons stocks that are known to change along gradients of disturbance (forests are often affected by wind and landslides) and elevation.

37. DOC has local networks of plots that can provide catchment-scale resolution of carbon fluxes and tree dynamics and these plots can provide much longer temporal resolution (up to 50 years) – much longer than the LUCAS/Tier 1 network. Candidates for remeasurement are those with up to five measurements already, including Kokatahi, Whitcombe (both established 1972), and Rakiura (established 1980) plots Remeasurement and analysis of all three sites would reveal spatial and long-term carbon dynamics in the presence of mammalian herbivores, providing additional power to interpreting carbon fluxes in these forests.

38. Since we know that fluxes of carbon depend not only on the dynamism of live trees but also on the sometimes-slow decay of dead trees in kāmahi–podocarp forests (Mason et al. 2013), pools of coarse woody debris also require measurement (measured in the Kokatahi in 1997 but not elsewhere).

39. To enable better transparency for comparing like with like regarding future analyses of the LUCAS/Tier 1 data, the Planning and Support unit is running a process to identify the difference made by methodological decisions/data cleaning/data corrections etc.

40. A DOC strategy to manage deer and other ungulates s being developed. One of it's objectives will be to ensure resilience is retained in our forest ecosystems The strategy will be partly underpinned by the LUCAS/Tier 1 programmes and ongoing collection of data.

Risk assessment – Aronga tūraru

41. There has been a loss of precision regarding reporting on the effects of introduced herbivores on natural forest post 2014, because reporting is now only on half of the data.

42. In 2014 when MfE moved the natural forest remeasurement component to a 10-year cycle, but DOC maintained its investment on a 5-year cycle so that responses to management of herbivores on vulnerable ecosystem components could be documented.

43. However, in 2020/21, DOC decided to reduce the Tier 1 budget by $500k net. As a result, the programme stopped the vegetation monitoring of all Tier 1 Forest plots and some non-Forest plots on PCL including NI forest parks. This effectively reduces this component to a 10-year cycle as well.

44. Reductions in remeasurement went against internal and external expert advice [redacted]

45. In absence of Tier 2 data, DOC is completely reliant on LUCAS/Tier 1 data for making conclusions about the effects of introduced herbivores on native ecosystems. Also, halving to the remeasurements to a 10-year cycle has compromised our ability to relate changes in occupancy and abundance of herbivores to forest recruitment and mortality and provide the underpinning data for the DOC's deer strategy.

Next steps – Ngā tāwhaitanga

46. DOC currently is in preliminary discussions with Manaaki Whenua about the potential delivery of the climate change aspect of the analysis of the LUCAS/Tier 1 data. As well as the potential remeasurement of the Kokatahi, Whitcombe and Rakiura plots. Both research projects would have a focus on Kāmahi.

47. DOC has also initiated discussions between Manaaki Whenua and NIWA about improving the measurement of carbon exchange associated with native forests. This is at a preliminary stage, and the next steps are for Manaaki Whenua and NIWA to scope what a research project would look like.

48. DOC is working with the University of Canterbury testing the use of LIDAR to remotely measure carbon storage accurately in native forest. Preliminary discussion about how to ground truth the LIDAR information are taking place.

49. DOC is working in partnership with iwi to restore the Raukumara forest on the East Coast of the North Island.

50. DOC Partnerships Group is investigating the opportunity to enable biodiversity improvement through native restoration for carbon benefits. This is at the early stages of investigation.

51. As part of the Emission Reduction Plan, which will be set by the Government by the end of 2021, it is currently proposed a longer-term cross-government work plan will be agreed with a particular focus on building the evidence base for interventions to maintain and enhance sequestration and/or avoid carbon loss in existing forests.

52. MfE is working with Scion to analyse LUCAS data collected in the third measurement cycle (2014-2020). This will provide further insight into how carbon stocks are changing through time at the national scale, as well as for individual forest types (such as Kāmahi-podocarp forest). The analysis will be due in June 2022.

Contact for queries: Meg Rutledge, Director Threats, s.9(2)(a)

ENDS

TMOTT Logo

Te Mana o te Taiao Project Template

This template should be completed for each project to inform future resourcing requirements for the implementation of TMOTT. A project is a grouping of actions undertaken by an organisation or agency to achieve one of the TMOTT 2025 goals.

PROJECT DETAILS

Item	Detail
1. Pou	Tiaki
2. Objective	13. Biodiversity provides nature-based solutions to climate change and is resilient to its effects
3. 2025 Goal	**13.1.1** The potential for carbon storage from the restoration of indigenous ecosystems, including wetlands, forests, and coastal and marine ecosystems (blue carbon), to contribute to our net emissions targets is understood
4. 2030 Goal	**13.1.2** Carbon storage from the restoration of indigenous ecosystems, including wetlands, forests, and coastal and marine ecosystems (blue carbon), contributes to our net emissions targets
5. 2050 Goal	**13.1.3** Carbon storage from the restoration of indigenous ecosystems, including wetlands, forests, and coastal and marine ecosystems (blue carbon), is a key contributor to achieving netzero emissions for Aotearoa New Zealand
6. Goal Category	3
7. Lead Organisation / Agency	DOC
8. Key contact person	Jenny Christie (science), Helen Kettles (marine), Alan McDonald (restoration), Alex Smith (policy)
9. Goal definition assumptions	*Include any assumptions you are making about what the goal means* • The protection of existing carbon storage in Pre 1990 native forests, shrublands, grasslands, blue carbon and peatlands are included in this goal. • Introduced browser control research is included in TMOTT goal 11.1.1 • Nature based solutions (NbS) for increasing carbon storage in particular ecosystems is included here, not in TMOTT goal 13.2.1 • Research for the protection of Pre 1990 native forests from climate change is included here, not in TMOTT goal 13.3.1 • Gaps for mapping the current extent of coastal and marine habitats, including kelp and coastal wetlands is being addressed under Goal 10.4.1.
10. Current state/ trend and current activity	*Describe the current state in relation to the goal and/or relevant trends over time. Describe the actions/activities/effort currently underway and already planned that are assisting towards achievement of the 2025 goal (and how).*

Indigenous ecosystems are responsible for a large proportion of the carbon stored in New Zealand. Four indigenous ecosystems store much of the carbon, these are defined as:

- Pre 1990 old growth and Post 1989 regenerating / restored indigenous forest
- Other terrestrial ecosystems, such as shrublands and tall tussock grasslands
- Wetlands, such as peat bogs with significant carbon storage in soil
- Blue carbon in the coastal / marine environment including coastal wetlands, seagrass and kelp.

Carbon storage from native trees is the main indigenous contributor to the New Zealand Governments emissions reduction national accounting system. Mainly through the restoration / regeneration of post 1989 forest. The Climate Change Commission (CCC) has called for sequestration from native trees to form a much larger part of New Zealand's climate response. Their recent report sees native forest regeneration/planting ramping up to 25,000 ha per year by 2030. In total, close to 300,000 ha of new native forests would be established from 2021 to 2035.

However, protection of the carbon stored in pre 1990 indigenous forests is also crucial. Since 2002 this has been measured via the LUCAS (Land Use and Carbon Analysis System)/Tier 1 natural forest plot measurement programme. Recent analysis of this data concluded that New Zealand's natural forest estate is in equilibrium, but also showed there are four forest types showing statistically significant changes in carbon stock. Three of which were gaining carbon, and one Kāmahi-podocarp (a widespread forest type) was losing carbon. Some research into the drivers of loss of carbon storage in indigenous forests has been done, with a primary focus on introduced ungulate browsers. However, other drivers of tree recruitment and mortality, such as extreme weather events, climate change, pathogens and insect irruption are a gap. Emerging technologies, such as remote sensing which could enhance our ability to measure patterns of carbon flux, should provide a better understanding of how these drivers interact to affect carbon storage.

Carbon storage in non-forested terrestrial ecosystems is also important and these are not currently included in NZ government policy for NDC. The CCC report recommended "preventing further loss of carbon from organic soils, particularly due to the degradation of drained peatlands and the destruction of wetlands." Methods to measure carbon storage from these ecosystems was also highlighted as a future need in the report. New Zealand has a soil carbon monitoring network. The organic soils measured as part of this monitoring include some coastal wetland and peatland sites. There is existing literature on the importance of wetlands for carbon sequestration globally and in New Zealand. They store a disproportionally large amount of soil carbon. Loss of wetlands in NZ is still large and ongoing, and this will need to be addressed to meet the 2030 goal.

	The significant contribution of NZ's coastal and marine environment to store carbon is often overlooked. The marine environment currently takes up a third of anthropogenic carbon emissions on the planet. The Nature Conservancy are undertaking a coastal "blue carbon" credit feasibility study, to be finished in 2021, which includes looking at some locations for restoration opportunities. Research into wider blue carbon is still in its infancy. Seaweeds are by far the most studied habitat/taxa regarding carbon sequestration capacity. In addition, climate change will probably affect the carbon sequestration capacity of these ecosystems (e.g. loss of constrained coastal wetlands due to sea-level rise, loss of deep water seaweed, major retraction in kelp forest southwards.
11. Problem or opportunity	*Please describe whether the actions already underway are sufficient to meet the 2025 goal. If not, how much of the goal will they likely achieve and will additional actions be needed. Describe the challenges and opportunities related to achieving the 2025 goal.* Protecting the existing carbon storage in indigenous ecosystems is crucial, as loss of this resource would be catastrophic. Alongside this, enhancing carbon storage by restoring and promoting indigenous regeneration is important for meeting New Zealand's net emissions targets. Also, without protection stored carbon may be degraded and counteract the good achieved via restoration. These are the associated problems / opportunities: ***1.*** **Contribute to the existing terrestrial carbon monitoring programme** The relative quantities of sequestered carbon across all indigenous ecosystems are not fully understood. LUCAS (Land Use and Carbon Analysis System)/Tier 1 is the natural forest plot measurement programme (referred to as the National Monitoring and Reporting System in TMOTT goal 4.1), implemented to measure carbon storage in natural (i.e. indigenous) old growth forests. LUCAS commenced in 2002, and DOC took over the remeasurement under MOU to MfE in 2011. However, Tier 1 monitoring of biodiversity outcomes and browsing herbivore occupancy and assessment of non-forested ecosystems carbon storage only occurs on Public Conservation Land (PCL). This means we are unable to demonstrate the wider carbon storage benefits of indigenous ecosystem protection or restoration, particularly for wetlands and coastal ecosystems which mostly occur off PCL. There is an immediate need to estimate the carbon storage potential of non-forested and regenerating ecosystems to be able to prioritise which ecosystems to manage for carbon storage. There is also a need to increase the precision of the carbon measurement so that we can better relate the impact of pressures (e.g. browsers, drought, storms) and management on carbon storage. We need to be able to model the carbon storage implications of different management interventions. ***2.*** **Research to understand the drivers of changes in carbon storage** Research into the drivers and population dynamics within indigenous ecosystems that influence carbon storage or loss, including the effect of

	management interventions, is limited. Some research has been done around the effect of browsers on carbon storage, but the lack of precision around the carbon measure means that attributing loss of carbon to browsers is difficult. Furthermore, impacts of climate change on existing and restored / regenerating indigenous ecosystems are not fully understood. Research to identify how and where indigenous ecosystems carbon storage is most at risk from climate change and the interaction of climate change with other pressures (e.g. browsers, pathogens, insects, drainage) is needed. Funding from MPI for native forested ecosystems may be available (budget bid dependent), but there is no funding available for non-forested terrestrial ecosystems. ***3.*** **Restoration / regeneration of indigenous ecosystems for carbon storage** Restoration of indigenous ecosystems with high value carbon storage, such as coastal wetlands, is needed to reach New Zealand's carbon storage goals. These goals can't be reached by afforestation alone. But restoration ecology is an underweighted function within DOC, compared to protection, with little dedicated funding, support, coordination, or policy. Developing a landscape approach for restoration (i.e. spatial planning), to minimise maladaptation and allow for climate change adaptation planning (e.g. restored wetlands dampen the damaging effects of floods). ***4.*** **Increase knowledge about blue carbon (marine and coastal)** Knowledge of how to manage blue carbon is an emerging global field. Blue carbon includes carbon stored in marine and coastal ecosystems, and managing it involves protection or restoration of ecosystems identified as having high blue carbon storage capability. However, restoring coastal and marine ecosystems is in its infancy in New Zealand. Some existing restoration work has been undertaken in coastal wetlands, shellfish beds and kelp forests. Restoring seagrass (a threatened species) habitats is also possible but would require reducing sedimentation and potentially transplanting. More knowledge of which coastal and marine ecosystems store the most blue carbon, and the pressures affecting blue carbon storage is needed to progress management of blue carbon. This knowledge is needed to provide guidance to prioritise research, support marine protection and spatial planning decisions, and the development of a sustainable blue economy (e.g. blue carbon accounting, seaweed farming).
12. Proposed additional actions	*List the additional actions that are/could be undertaken (based on the opportunities identified above) to meet the 2025 goal.* ***1.*** **Contribute to the existing terrestrial carbon monitoring programme** **1.1 Improve understanding of carbon storage contributions for each ecosystems type.** **1.1a Initiate new expert elicitation of the relative carbon storage contributions for each ecosystem type to prioritise management**.

To be undertaken by the existing land sector group (led by MPI).

1.1b Invest in new analyses of the existing carbon monitoring data for terrestrial biodiversity. Including:

- Understand carbon flux/exchange of different indigenous ecosystems.
- Improve the precision of carbon storage measurements so they can be related to the impacts of other pressures

1.1c Invest in modelling to provide look-up tables of comparative carbon storage rates. For example, table classification could include management intervention type, ecosystem type, native forest type and possibly region.

1.2 Augment the existing carbon terrestrial monitoring system

1.2a Initiate new ground-based monitoring of terrestrial ecosystems. This includes:

- Coastal ecosystems (e.g. wetlands and mangroves)
- Restored / regenerating ecosystems after damage events (e.g fire, drought, storm, pathogens etc)

1.2b Remeasure long time-series permanent plot data.

- Kamahi-podocarp-forest data 40 years at catchment scale (Whitcombe, Rakiura & Kokatahi)
- Warm temperate forest (i.e. Waikato north, Puketi & Waipoua)

1.2c Invest in additional remote monitoring tools to monitor climate change impacts on indigenous ecosystems. Build on the investment in 4.1 to ensure baseline status and trend remeasurement at an annual frequency. Ensure these are monitored:

- Canopy damage in old growth forest
- Fire damage to indigenous ecosystems
- Rates of recovery from fire / drought / storm.

2. **Research to understand the drivers of changes in carbon storage**

2.1 Build on existing research and long-time-series data in indigenous forest ecosystems.

2.1a Build on a meta-analysis of carbon storage trends using LUCAS data over a 20-year period. Two types of analyses:

- Available ungulate management intervention data
- dynamic climate / natural event data

2.1b Analysis of long time-series permanent plot data to investigate the effects of pressures. Includes analyses of catchment scale kamahi forest data, and warm temperate forest (i.e. Waikato north)

2.2 Analyses of terrestrial monitoring and remote sensing monitoring data to understand risks to carbon storage from pressures.

2.2a New analyses of remote sensing monitoring data and

attributed causes of damage in indigenous forested ecosystems

- The extent and frequency of canopy damage (i.e. adult tree mortality) and attributed cause (e.g. drought, storm damage, pathogens, insects, browsers)
- The types of forests, and in what regions are most at risk from fire, including landscape factors which influence fire – (e.g. neighbouring landcover LCDB)

2.2b New analyses of the rates of forest recovery/regeneration following damage events. Investigate:

- The regeneration potential of different forest types after damage from events such as fire, drought, storms, pathogens
- The extent to which browsing herbivores suppress recovery / regeneration and what intervention is necessary

3. **Restoration / regeneration of indigenous ecosystems for carbon storage**

3.1 Resource an indigenous ecosystems restoration group. This would be a functional group within DOC.

3.1a Implement planning interventions and fund indigenous ecosystem restoration. For example, restoration is considered when grazing licences/ leases come up for renewal. Planning interventions to reinstate crucial hydrology for freshwater and coastal aquatic ecosystems reinstating hydrology.

3.1b Contribute to the development of national standards and policy to restore indigenous vegetation. This could include best practice (e.g. eco-sourcing, reinstating hydrology, biodiversity outcomes, benefits mapping) and contribution to a legacy fund to strengthen native afforestation efforts (described in Goal 12.6.1) and wider indigenous vegetation restoration (MPI led?).

3.2 Invest in new research to optimise the locations and indigenous vegetation types for restoration effort. To identify new and optimal areas where carbon storage could occur for priority indigenous ecosystem

3.2a Stocktake of existing research about carbon storage potential of restoration projects.

3.2b Spatial mapping of PCL suitable for appropriate indigenous restoration. To provide carbon storage opportunities and enhance biodiversity. Includes the assessment of future risk of climate change to long-term survival of restored / regenerating forests

3.2c Investigate updating historic experiments by the forest service to ascertain growth and survival rates of planted native trees on class 6–8 land. To identify where marginal land could be planted for sequestration.

4. **Increase knowledge about blue carbon (marine and coastal)**

4.1 Contribute to New Zealand's blue carbon economy

4.1a Invest in developing practical guidance for other land

	management agencies. Aimed primarily for regional councils, but also some other management agencies (e.g. Waka Kotahi), on: ○ Seagrass restoration ○ Reinstating tidal flow for coastal wetland restoration. **4.1b Contribute to developing practical guidance for protecting marine blue carbon.** For example, investigate options for fisheries management to protect ocean carbon sinks (e.g. trawling disturbs sediment carbon stores) **4.2 Invest in and contribute to research to improve understanding of the blue carbon sequestration potential and location of priority ecosystems** **4.2a Invest in stocktake of blue carbon research.** To identify the carbon sequestration capacity of coastal and marine ecosystems and species and the associated pressures which affect these (e.g. sedimentation, climate change) **4.2b Invest in spatial mapping of the locations of high value blue carbon storage indigenous ecosystems.** Prioritise for these marine and coastal systems for protection and enhancement. **4.2c Contribute to ongoing and new research by other agencies on blue carbon.** For a range of coastal and marine ecosystems.
13. Collaboration	*Identify those organisations who will be involved in the 'gap analysis' effort for this goal.* 9(2)(ba)(i) [redacted] Regional councils (via Carina ltd.) contributed some points to this gap analysis. DOC staff involved in this gap analysis: Rebecca Davies, Jenny Christie, Ken Hughey, Helen Kettles, Mathilde Richer de Forges, Philippe Gerbeaux, Alex Smith, Alan McDonald, Gavin Smith, Kate Miller, David Talbot, Elaine Wright, Meredith McKay, Peter Bellingham *Identify any other agencies or organisations will be involved in the delivery of the above actions – on an ongoing basis.* ***1.*** **Contribute to the existing terrestrial carbon monitoring programme** ○ MfE (LUCAS) ○ MPI – Land management group

	○ Regional Councils ○ MWLCR ○ Crown Research Institutes ***2.*** **Research to understand the drivers of changes in carbon storage** ○ MfE (LUCAS) ○ MPI ○ MWLCR ○ Crown Research Institutes ○ NIWA ○ Universities ***3.*** **Restoration / regeneration of indigenous ecosystems for carbon storage** ○ MfE (LUCAS) ○ MPI (Te Rakau) ○ Regional Councils ○ MWLCR ○ Crown Research Institutes ***4.*** **Increase knowledge about blue carbon (marine and coastal)** ○ MfE ○ MPI ○ Regional Councils ○ MWLCR ○ Crown Research Institutes ○ NIWA ○ Universities ○ Nature conservancy
14. Crown/Maori obligations	*How do the actions and goal improve the ability of whānau, hapū, iwi, to determine and achieve their own aspirations?* Engagement with Maori by other agencies has shown support for native restoration, protection and afforestation. Maori also have significant interest in commercial exotic forestry, so policy that encourages natives over pine etc will need to engage with how to balance this appropriately to recognise rangatiratanga. Some carbon storage is a valued taonga for Maori e.g. pango, the carbon rich sequestered mud in coastal wetlands. There is much traditional knowledge associated with its location and processes for formation within landscapes. *What approaches or engagement is likely to be required to achieve the above?* Engagement around policy decisions. Supporting wānanga on pango will provide opportunities for iwi/hapū and

	whānau. Restoring coastal wetlands also has benefits for cultural materials and kaimoana provision.
15. Potential benefits	*Identify the benefits that will be realised with successful delivery of the actions that will assist towards achieving the 2025 goal, such as:* • *Enhancement of processes and systems (e.g. doing things better, doing more with the same resources)* • *Enabling whānau, hapū and iwi to practice their responsibilities as kaitiaki of natural resources* • *Working together with other stakeholders to achieve wider results* • *Contributing to managing or enhancing NZ's biodiversity* ***1.*** **Contribute to the existing terrestrial carbon monitoring programme** ***2.*** **Research to understand the drivers of changes in carbon storage** ***3.*** **Restoration / regeneration of indigenous ecosystems for carbon storage** ***4.*** **Increase knowledge about blue carbon (marine and coastal)** This would help contribute to managing enhancing NZ's biodiversity as it could open up significant public and private funding opportunities for conservation. There are risks that dual climate/biodiversity focus could dilute from a straight biodiversity focus but I think this is manageable. A focus on coastal wetlands for climate change mitigation will also bring many other co-benefits in addition to biodiversity e.g. storm surge protection (climate change adaptation), water quality improvements. Coastal and freshwater wetlands also provide buffering to attenuate flooding. An understanding of marine blue carbon in New Zealand is crucially needed to guide marine protection decision making and to support the development of an effective sustainable blue economy. Having access to baseline information regarding the carbon sequestration capacity of our marine environment will provide the pillars to develop guidance on how protection, management and new economic activities can contribute to meet NZ emissions targets.
16. Delivery timeframe	*If able to (and depends on the identification of actions), indicate the delivery timeframe of the actions. Indicate whether it has an end state or whether it will be ongoing.* 1. Investigate the contribution of indigenous ecosystems to carbon storage - The Panel is ongoing - Development of the monitoring systems will be achieved by 2026 - Carbon flux research will be achieved by 2026

	2. Understand the drivers of carbon storage increases and losses - Meta analysis will be done by 2024 - Remeasurement and analysis of permanent plots will be done by 2025 - Research into risks will be done by 2026 - Teir1 monitoring is ongoing 3. Restoration/Regeneration of indigenous ecosystems for carbon storage - Restoration group is ongoing - Framework completed by 2024 - Research to identify coast effectiveness of ecosystems for sequestration will be done by 2026 - Research to identify areas where sequestration could occur will be done by 2024 - Updating historic experiments will be done by 2026 - Climate envelope modelling will be done by 2024 - Mapping of PCL will be done by 2024 - The implementation of planning interventions will be ongoing - The creation of national standards for restoration will be done by 2025 - The policy and legacy fund for afforestation will be ongoing 4. Increase knowledge of blue carbon (Marine and coastal) - The gap analysis of international research will be done by 2026, however addressing these gaps will be ongoing - Demonstration sites and study sites to investigate impacts will be identified by 2024 - Investigation into the carbon capacity of shellfish will be done by 2026 - Investigation into shallow water habitats will be done by 2026 - Sediment study will be done by 2026 - The citizen science study will be ongoing - The guidance for councils be formulated by 2024
17. Milestones	*Indicate the milestones that will be used to track progress.* ***1.*** **Contribute to the existing terrestrial carbon monitoring programme** ***2.*** **Research to understand the drivers of changes in carbon storage** ***3.*** **Restoration / regeneration of indigenous ecosystems for carbon storage** ***4.*** **Increase knowledge about blue carbon (marine and coastal)**
18. Measures	*Please describe the measures that will be used to assess achievement towards the 2025 goal (quantity, quality, time, location, and/or cost).* ***1.*** **Contribute to the existing terrestrial carbon monitoring programme**

	2. **Research to understand the drivers of changes in carbon storage** 3. **Restoration / regeneration of indigenous ecosystems for carbon storage** 4. **Increase knowledge about blue carbon (marine and coastal)** • *Inclusion of other ecosystems in our climate accounting* • *Sequestration of other ecosystems is clearly established to enable inclusion and monitoring.*
19. Capacity and resources	*Describe the current resources and effort that is contributing towards this goal.* See section 10 *Describe the additional resources that might be required to achieve the 2025 goal – include effort on the gaps analysis and/or actions.* See Costing template
20. Costs	*Please complete the associated project costing template.* *[to be provided]*
21. Interdependencies	*Please identify whether the actions undertaken as part of this project are dependent on other known projects or initiatives (for example: National Policy Statement for Indigenous Biodiversity, the proposed conservation law reform or other TMOTT actions).* [I'm not sure what I've listed are interdependencies more overlaps, this work could progress without them) 1. **Contribute to the existing terrestrial carbon monitoring programme** ○ Funding of TMOTT goal 4.1 and 4.2 ○ Co-developed budget bids (e.g. CERF, ERP) within NRS (DOC/MPI/MfE) ○ MFE decisions around what is included in NDC and domestic accounting 2. **Research to understand the drivers of changes in carbon storage** ○ Funding of TMOTT goal 4.1 and 4.2 ○ Co-developed budget bids (e.g. CERF, ERP) within NRS (DOC/MPI/MfE) 3. **Restoration / regeneration of indigenous ecosystems for carbon storage** ○ NPSIB implementation

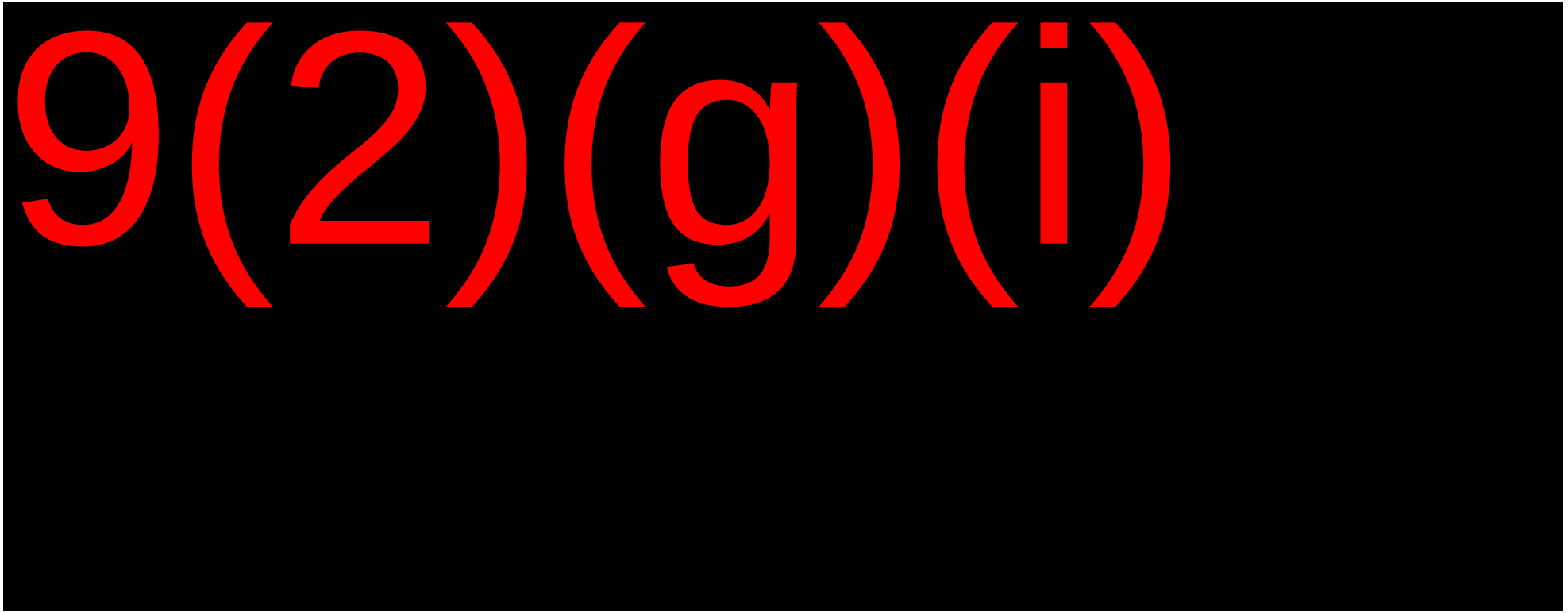
	○ Co-developed budget bids (e.g. CERF, ERP) within NRS (DOC/MPI/MfE) ○ Regional council rules? ***4.*** **Increase knowledge about blue carbon (marine and coastal)** ○ Research by CRI's and Universities .
22. Significant risks	*Please complete the risk table in the annex of this template.* ***1.*** **Contribute to the existing terrestrial carbon monitoring programme** ***2.*** **Research to understand the drivers of changes in carbon storage** ***3.*** **Restoration / regeneration of indigenous ecosystems for carbon storage** ***4.*** **Increase knowledge about blue carbon (marine and coastal)**
23. Assumptions and uncertainties	*State any key assumptions and uncertainties.* *Include and state any key reference documents here*
24. Other information	*State any other relevant contextual information* This gap analysis was not consulted outside of DOC (except for input from regional councils). MPI and MfE need input into it

ANNEX: RISK TABLE – document any risks towards the achievement of this project

List all high and extreme risks that have been identified. This information should be high level only and will be built upon in the next phase of the project. Consider the following risk groups (and see the drop-down menu for Risk Group):

- Project Delivery Risks: What are the big risks (threats and opportunities) during the life of the project?
- Ongoing Risks: What threats or opportunities are associated with the project after transition to Business as Usual?
- Flow-on Risks: What are the threats or opportunities to other parts of DOC (and externally) of this project succeeding or failing?

Refer to DOC's Risk Management Page for additional guidance.



Document 14

[Section from] Media log – Friday 20 March 2020
On call duty comms/media advisor – Jess MacKenzie s.9(2)(a)
Media phone: s.9(2)(a)

Native Forests/Carbon and Predator Free
Eloise Gibson, Stuff's climate change editor, asked for information about protecting carbon stored in our native forests and wetlands, and whether carbon is being lost or is at risk from degradation because of pest herbivores. Also wants to know how much the predator free strategy might increase carbon stored in public conservation land, by reducing predator damage to the understorey. She came back with two more specific questions – response below. We have also told her to talk to MfE if she wants more on carbon credits, or if she wants more detail on DOC's involvement in Billion Trees, she can speak to Alan McDonald. *(Leigh-Anne)*

Native Forests/Carbon and Predator Free - response

1. **The earlier (2008ish) reports discuss significant potential for DOC to claim carbon credits under Kyoto for improving carbon storage in public forests. Has this ever happened under either Kyoto or has it been progressed under any of our later international treaties (Paris), and if not why?**
   The Department of Conservation has not entered into the ETS to get carbon credits, this was a Government decision back in 2010. Note that pre-1990 indigenous forest is not part of the ETS and most of conservation forest falls into that category. Plus the ETS was intended to incentivise additional sequestration through new planting on private land. The government measures the carbon stored in our forests. This is covered in NZ's UN reporting, and if it is carried out in post 1990 forests then it counts towards our Paris targets.
   MfE is the lead for carbon sequestration calculations so you'll need to talk to the about how much carbon is calculated to be in forests on public conservation land.

2. **One of the cheapest/most significant recommendations in these reports was to sequester more carbon by allowing new forest to regenerate on public/DOC land, adjacent to existing forests, and to exclude stock from these areas. Do you know whether that has happened since the reports were produced and if so how much new forest was created? In other words - I'm wondering what actually resulted from these interesting reports!**

   DOC is committed towards halting the biodiversity decline. We work with iwi (and community groups, regional councils and others) in this space and efforts include controlling foliage browsers, restoration work, and through education and community participation.

   Current restoration funding streams include the DOC Community Fund, Trees that Count, Regional Councils and Te Uru Rākau/Forestry NZ's One Billion Trees programme. This all enables a greater volume of trees to be planted all of which are assisting in carbon sequestration. Two thirds of the funding in the Billion Trees programme will go towards funding native trees.

   In terms of grazing, some Conservation Management Strategies and National Park Management Plans discuss proactively retiring grazing land, and DOC assesses grazing licences on a case-by-case basis. When a grazing concession expires (usually at 5-10-year intervals) the Department actively considers whether it is appropriate for that land use to continue or whether the land should be retired.

DOC has also invested heavily in removing predators. We don't have specific system for measuring the carbon benefit from this work as the science is tricky to implement, and we don't have a monitoring tool which captures each parcel of regenerating land.

Carbon sequestration occurs in a wider suite than woody trees. Tussocks, soil, estuarine habitats etc all contribute towards carbon sequestration. Fire and drought can impact on sequestration, and wilding conifer control, as previously mentioned, also helps. So protecting the native forests and wetland habitats that we already have, and investing in forest health to maintain a range of ecosystem services such as erosion control and water balance will go a long way towards safeguarding existing carbon. This is DOC's focus.

Department of Conservation
Te Papa Atawhai

Document 15

Context briefing to support Investment Brief: CERF Maximising Carbon Storage

Date: 8 August

Prepared by: Michelle Crowell Threats Strategy Manager

Circulated to: DOC Finance & Investment Governance Group; Meg Rutledge, David Talbot, Sharon Alderson, Sarah Owen, Ben Reddiex

Current state – understanding carbon storage and browser impacts

Summary – In mature native forest, it is difficult to quantify and attribute any additional carbon removal to removal of pests. The CERF Maximising carbon storage programme is being designed to build on current knowledge and improve monitoring methods to be able to quantify this. Current advice is that prioritised research on mature native forest should focus on the kāmahi-podocarp forest type. Reducing browsing pressure on regenerating shrubland and restoration planting could support carbon gains as tree seedlings establish and open habitats regenerate to tall forests.

Briefing points

- **SCION report— Natural Forests in New Zealand review (**2021)– analyses the LUCAS /Tier 1 natural forest plot measurement programme from 2002 to 2014 and concludes that New Zealand's natural forest estate is in equilibrium but there are four forest types showing statistically significant changes in carbon stock.
    - According to this analysis, three forest types are gaining carbon.
    - Kāmahi-podocarp (a widespread forest type) is losing carbon.
    - The drivers of carbon storage loss in kāmahi-podocarp forest are unclear and may not be caused by browsing herbivores.
    - We would expect some forest to be naturally losing carbon and others to be gaining, because natural forests are comprised of various aged cohorts and subject to a variety of disturbances.
- **Forest & Bird—Protecting Our Natural Ecosystems' Carbon Sinks (**June 2021)– estimates the carbon stored in various natural ecosystems across New Zealand, assesses the impact of browsing pests on these ecosystems, and estimates the emissions mitigation potential of pest control.
    - The report highlights the decline in carbon stored in kāmahi-podocarp forest from the SCION report and attributes this to browsing pests. The report concludes that pest control is likely to be one of the most cost-effective options for protecting and enhancing the country's natural carbon stores and contributing to emission targets.
- **Manaaki Whenua Research Synthesis—Wild Animal Control for Emissions Management** (WACEM, 2015 and on the DOC website)– summarises the findings and lessons from five workstreams of DOC-funded research investigating the potential for wild animal control to enhance carbon storage.
    - In mature native forest, it is difficult to quantify and attribute any additional sequestration to the removal of browsing pests. This is because the uncertainties associated with measuring carbon are larger than the measured impact of browsing pests.
    - The report suggests that the fastest most cost-effective carbon gains could result from allowing successional change of existing shrublands and sites adjacent to native forest into forest, alongside recovery of existing forests.
    - The report also cautioned that management activities for carbon gains should be evaluated alongside the carbon costs of undertaking those activities

Additional information

- **Forest & Bird—Improving browsing pest control (September 2021)**– Forest & Bird provided relevant Ministers with a briefing paper recommending pest control goals for DOC, Land Information New Zealand, Ministry for Primary Industries, Ministry for the Environment, and Ministry of Defence.
    - Four DOC-specific goals in the report recommend increases in pest control aiming to increase carbon storage

Joint research programme on carbon storage and browser impact in the CERF Maximising carbon storage joint research programme

Summary – The joint research programme is being scoped and designed in line with the gaps and recommendations of the reports summarised above.

Briefing points

- **The DOC (Vote Conservation) component** is set out in the Investment briefing paper DOC-7056218
- **The MPI (Vote Forestry) component** is being scoped via a science symposium with providers on 22 August 2022
    - DOC advice has drawn on the SCION and Manaaki Whenua reports, including recommending remeasure and analysis of permanent plot data in podocarp-kāmahi forest
- **The MfE (Vote Environment) component** builds on the LUCAS/Tier 1 natural forest plot measurement programme

Additional information

DOC has no science capacity specifically dedicated to carbon storage.
Ken Hughey, Jenny Christie, Meredith McKay and Elaine Wright have offered their considerable expertise as part of their principal science advice. Jenny, Meredith, and Elaine have high workloads in their core programmes 9(2)(g)(i) [redacted] Some resources have been set aside for increasing climate adaptation support, but more is needed for sequestration and mitigation.

ENDS