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Environmental Impacts of the Sustainable Forest Management on NSW Crown Lands with regard to biodiversity, soils, water and carbon balance (Green House Gas emissions).

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If growing and harvesting native forests
*is **not** a sustainable land use, I can't imagine what would be.*
Dr. Hal Cogger, Deputy Director, Australian Museum at Newcastle University, 1993: Forest Conservation Conference.

How much Green House Gas is released by a wildfire as opposed to the carbon sequestered by a growing forest next door?

Or:

How do we make the priceless valuable?

EXECUTIVE SUMMARY

This review of the Regional Forest Agreement proposes a system of forest management for all Crown lands termed Sustainable Forest Management. A systematic review of the available literature was conducted as new research carried out to prepare this submission. Green house gas emissions, fire, biodiversity, soil and water impacts were assessed to compare and contrast the impacts of the proposed Sustainable Forest Management system, the most intensive harvest/maximum utilization option and the maximum reservation/passive management option. It is concluded that the Sustainable Forest Management system provides a better outcome than maximum utilization or increased reservation/passive management...

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1. INTRODUCTION

The Sustainable Forest Management on Crown Lands in NSW is a process that actively manages forests in NSW to provide conservation in perpetuity of natural values in forests by active management, including timber harvest and active fire management.

1.1 Background

The proponents {LES and associates} of the Sustainable Forest Management process have identified unresolved issues concerning the carbon/GHG balance and environmental impacts of the proposal to produce useful products from dead wood and wood (in this case, logging slash, thinnings and down timber from coupes in NSW Crown Lands) These issues were derived from first principles. A survey of stakeholders and investors confirmed that there were serious concerns that the SFM will result in increased Green House Gas emissions and have negative impacts on biodiversity, water, soil and other environmental values. These two issues - environmental impacts and carbon/GHG balance- of the forest-to-mill portion of the proposal have been assessed in detail over the past 40 years and reported in the scientific literature and as reports to State and Federal government agencies and processes (in particular, Regional Forest Agreements funded by the Australian Government 1994-2006).

Information concerning these two issues has been summarised in a report as part of the Sustainable Forest Management.

This report will present analyses of the results available (February 2018) from these assessments. These results will be used to calculate the balance of carbon sequestered (taken from the atmosphere) by the forest operations of the SFM against the carbon emitted by these operations [Green House Gas (GHG)]. The report will use a review of these assessments to describe the effects of implementing the East Gipplsand Project with regard to biodiversity, water, soil and other environmental values.

1.2 Scope and Objective

Scope: A systematic review of the scientific information available will be conducted sufficient to describe the effect on GHG emissions (carbon balance) and the effect on environmental values resulting from carrying out the Sustainable Forest Management. The systematic review will consider peer-viewed scientific publications, departmental publications ("grey literature" including RFA reports), available data-bases and non-refereed publications (publications of nature societies, scientific correspondence, historical records). The systematic review will be fully referenced and provide links to meta-data for information sources (e.g. link to Atlas of Living Australia data-base).

The time frame addressed is the period from the 2017 to 2067. This time frame (50 years) is based on forest successional processes that occur from stand establishment through to canopy closure (0-10 years), pole stage (10-30 years) and forest growth to saw-log / canopy maturity stage (30-50 years). Predicted effects of climate change will considered where there is adequate information available to do so.

Objective: The systematic review will deliver an assessment and report on the issues raised by *regulators, stakeholders and investors* concerning the clear *view* that there the SFM will *intensify carbon* emissions and *negative environmental impacts.* This report will deliver clearly argued conclusions with regard to the effect on GHG emissions and environmental impacts of the Sustainable Forest Management.

This report does not consider the economics, logistics, manufacturing processes, environmental impacts and carbon balance of the *manufacturing process of the SFM.* (Refer to Dr. Lian Zhang and Sustainable Forest Management documentation).

1.3 The Study Site: NSW Crown Lands Timber Harvest Operations

This report considers the forested areas of NSW Crown Lands of all tenures. Areas available for harvest operations are largely State Forests managed by State forest authority although there are some areas of private land that are used for timber production. Management is largely driven by commercial considerations to maximize the volume harvested and minimize costs. Environmental values are protected in areas harvested by a rule set that was agreed in the NSW Regional Forest Agreement process in conjunction with permanent reserves that are largely un-managed forests administered by various NSW agencies responsible for these tenures (National and State Parks, Nature Reserves amongst others). The major fire management tool is broad scale Hazard Reduction Burning, particularly after harvest when logging slash is raked into windrows and then burnt 1-2 years after logging. Reserve tenures are also subject to HRB fuel management. Protection of residential and infrastructure assets are a primary objective and wildfire prevention plans are prioritized accordingly.

The most intensive silvicultural harvest system practiced by State forest authority is clear falling with retained seed trees in the net harvest area. Areas protected for environmental values (stream side corridors, steep areas, amongst others) are marked out in the field. Flora and fauna values are largely managed by the provisions of the Threatened Species License of the Integrated Forestry Act.

2. METHODS

2.1 Reviews

The relevant literature was reviewed with regard to environmental impacts and GHG balance for this proposal. The scientific experimentation in particular was focused upon rather than policy analyses, theoretical papers and research based on speculative modeling e.g. models that cannot be or were not verified by post hoc ground truthing and based on reliable data. Although the reviews were wide-spread, they focused Australian research and ensured that comparable operational factors and environmental conditions were used to derive conclusions about environmental impacts and GHG balances for the SFM. For instance, harvesting biomass for fuel by utilizing firewood from the Murray Basin is not directly comparable to using biomass to make useful products as in the SFM, nor is salvage logging after fire comparable to harvesting logging slash that would be otherwise be burnt.

Relevant data bases from government and non-governmental organizations were accessed to provide an objective basis for conclusions about flora, fauna, water, soils and cultural impacts.

2.2 Analyses

The results from the review and data base searches are summarised in the discussion points below. Relevant equations are presented in tabular form (Table 1.) This is to present the carbon balance calculations for the possible forest management regimes that are possible in the context of the NSW Crown Lands area.

3. RESULTS

Timber Produced

Most of NSW's forest products have come from the extensive mixed-species forest of the east coast (Flinn et. al., 2007). The authors indicate that there have been major shifts in the production of specific products during the 1945-2000 periods: pulpwood production has increased consistently from; firewood production has fallen; and annual sawlog production has been fairly stable. It is interesting to note the compensating changes in firewood and pulpwood production.

3.1 Soil

To determine impacts on environmental factors, including soil, an optimum state or basic reference point needs to be established. In Australia, this is generally taken to be the environment as it existed in 1788, before the arrival of Europeans. The settlement of the continent from that point forward changed environmental conditions due to different methods of primary production and the establishment of large permanent human settlements, amongst other factors. However, the Australian continent had been managed by indigenous people for the past 40-60 000 years.

Fire was the main management tool, which was used to shape the Australian landscape into an environment that was highly productive in human terms. Although large-scale wildfires occurred at 1788, their impacts were mitigated by frequent, low intensity burns in strategic areas conducted by indigenous people.

Burns were conducted to maintain grassy habitat for macropods, protect or promote favoured food plants, to protect key areas where people lived, and to maintain open conditions to facilitate human movement across the landscape. Indigenous use of down timber comprised a continual removal of woody material from the pre-1788 forest floor.

A wide spectrum of experimental research on soil and effects of logging has been done in the project area and in adjacent parts of Victoria*. Soil protection is addressed by prescriptions such as riparian buffers, restrictions for machinery in steep areas, roading standards and other similar ameliorative measures. The greatest threat to soil values comes from wildfire, hazard reduction burns and flood events.

Taking the worst-case scenario, the forest operations of the SFM should not alter the status quo for soil conservation. Although harvest operations to implement the SFM will cause a new form of ground disturbance by machinery used to carry out harvest of large woody debris, this will be more than compensated for by a reduction of machine-caused disturbance during post-harvest windrowing, which is not required for the SFM implementation. Although some soil nutrients will be removed by harvest of large woody debris, this will be more than compensated for by additional soil nutrients acquired through decomposition of slash, rather than lost in the process of post-logging windrow burns.

The SFM in the best-case scenario will improve soil quality in both chemical and physical properties. Using mechanical removal to replace or reduce the extent of hazard reduction burns will provide greater protection from exposure to wind and rain events than at present. Reduction of risk from wildfire through the use of mechanical removal for fuel will provide additional protection to forest soils. The Deloitte's study in particular provides risk-analyses that support this outcome.

*Footnote *NB Australian forest soils are globally unique and results from other continents are not generally applicable.

3.2 Water

A wide spectrum of experimental research on water and the effects of logging has been done in the project area and in adjacent parts of NSW in terms of chemical properties (e.g. water *quality*) and hydrological flows (e.g. water *quantity*).

Water protection is addressed by prescriptions such as riparian buffers, restrictions for machinery in creek crossings, roading standards and other similar ameliorative measures. This research concluded that chemical properties were adequately protected by these prescriptions.

Water-shed hydrological flows (e.g. water *quantity*) are varied through the logging cycle, with high run-off but low water use by vegetation during the establishment phase resulting in increased flows. During the pole stage of forest succession, there are reduced flows from run-off but higher water usage by vegetation. During the growth-to-maturity phase of succession (30-50 years), water usage by vegetation and water production from run-off to reach equilibrium with precipitation.

The greatest threat to water quality comes from siltation after roading and flood events. The forest operations of the SFM should not alter the status quo.

3.3 Biodiversity

Biodiversity is generally considered to be the sum total of living organisms, including the communities formed by this assemblage biological entities. Relevant units of biodiversity are the species, the population and the individual organism. A species consists of a group of individual organisms which can reproduce viable offspring under natural conditions. A population is a group organism of the same species which occupy the same geographic area.

An individual is a single living organism.

Impacts can be assessed in terms of their effect on each of these units, and these impacts are addressed by different regulations and social drivers. Species are managed by state and federal conservation regulations, which are enforced by conservation agencies of the relevant agency. Populations are managed by the regulations which apply to the geographic region in which they occur, usually the local government. Individual organisms are managed by animal welfare acts and social perceptions. In general vertebrate animals are the only organisms managed by regulation; invertebrates, fungi and plants are generally not considered as individuals. Ecological communities are regulated by conservation regulations, and individual trees are sometimes regulated by local government.

Pest species are managed by regulation at all levels of government.

The timber harvest regimes proposed for the Sustainable Forest Management are clearly less intensive than any current harvest operation and will have a smaller negative impact with the exception of exclusion. The sum total effect when fire is considered will be a smaller negative impact than reserves through decreasing the size and frequency of catastrophic wildfire. The same reasoning holds true for Green House Gas Emissions.

4. DISCUSSION

The results indicate that, in the long-term, unmanaged eucalypt forests are carbon neutral, as growth captured CO^2 is balanced by emissions from fire and/or decay *(in the absence of landscape scale, repeated, uncontrolled wildfire)*.

The major exception to this principle – which results in a *positive* balance for CO_2 sequestration - is where mesic (wet sclerophyll) forest progresses through successional stages to rainforest; in the absence of fire or similar large scale disturbance, rainforest has long term carbon storage capacity. An example of this would be an area where the moist sclerophyll overstorey has been killed by Bell Miner Dieback, which effects eucalypts but not rainforest trees, is allowed to regenerate in the absence of fire. This seldom occurs because introduced and native vines and understorey species develop thick stands underneath the dead eucalypts and prevent regeneration of any overstorey species. Examples do occur in low elevation forests in NSW Crown Lands [Pers. Obs., Shields 2017].

The major exception to this principle - which results in a *negative* balance for CO_2 sequestration - is poorly managed old growth that repeatedly burns. This process rapidly reduces the carbon store in the forest without the capacity to replace it. A relevant and real example that occurs in Sustainable Forest Management area, where mountain ash forest that doesn't get past regrowth stage forest stands (5-59 years) after repeat fires and there is a negative balance for CO2 sequestration. The negative balance increases with fire intensity, frequency and size.

Managed forests have positive sequestration due to active growth stages, wood utilization (wood rather than steel or concrete and sequestration in the product, for example) and avoided emissions from unplanned or controlled fires. However, the magnitude of this positive balance depends on the life cycle of wood use at present. Structures with a long planned use cycle, such as ironbark wharves and bridges, which can usually be re-used after the original structure deteriorates at least once, have a very large impact on sequestration rates indeed. The new process for wood use to produce useful products increases the carbon sequestration of the forest involved through avoided emissions from decomposition, fire, and decreased fire management operations using machinery, aircraft and chemicals.

The current status quo for the SFM study site equates with the scenario described for poorly managed old growth (the reserve system and private property) and poorly managed regrowth (intensively harvested by the State forest authority). Consequently, there is a lose-lose prospect for carbon balances from most intensive of the current management practices available.

5. CONCLUSIONS

The total real negative impact of the SFM is less than that of any current management regime. However the social perceptions and thus license to operate vary considerably from the risk. This should be addressed consistently by the RFA reviewers as part of the current process

Environmental Impacts for the SFM are less than any other possible option.

6. REFERENCES

Table 1 SFM Green House Gas Emissions

	TIME	TIME PERIOD	TIME	Total		

FOREST TREATMENT	PERIOD 0-10 Years	20-50 Years	PERIOD 50-100 years+#	Carbon Sequestered in 100 years		
NO HARVEST/NO WILDFIRE	#[-5 Tons C / HA from forest growth per year] x 10 years = 50 TC = C stored	[-10 Tons C / HA from forest growth per year] – [1 TC Decay) /HA/year x 30 = 270 TC	[-8.4 Tons C / HA from forest growth] – [2 TC Decay) /HA/year x 50 = 320 TC	-640 T C		
NO HARVEST / WILD FIRE				0 TC		
Clearfall/50 YEAR ROTATION/HRB	[(-*540TC* harvest) + (+5TC dcmp leaflitter) + (10TC hrb)] - [-5TC regrowth] X 10 = +80TC	[-10 T(C)regrowth] – [+1 T(CDecay) /HA/year x 30 = +160 T C	[-8.4 Tons C / HA from forest growth] – [2 TC Decay) /HA/year x 50 = +80 TC	+320 TC		
CLEARFALL/50 ROTATION/FREQUEN	[(-*540TC* harvest)	10 T(C)/-1 T(CDecay)	[-8.4 Tons C /	+480 TC		

T WILDFIRE	+ (5TC dcmp leaflitter) + (10TC hrb)] - [-5TC regrowth] X 10 = =+120	/HA/year x 30 = +240 T C	HA from forest growth] – [2 TC Decay) /HA/year x 50 =+120 TC			
Sustainable Forest Management/50 YEAR ROTATION *	[(-5*40TC* harvest) + (5TC dcmp leaflitter) + (10TC hrb)] - [-5TC regrowth] + [X10 = -120TC	10 T(C)/-1 T(CDecay) /HA/year x 30 = -20 T C	[-8.4 Tons C / HA from forest growth] – [2 TC Decay) /HA/year x 50 = 320 TC	-480 TC		

#TC = Tons Carbon

*silvicultural input yields increased growth and carbon sequestration/reduced GHG from decomposition, hazard reduction burns and fire suppression

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