Comments on the Regional Forest Agreements extension proposal

Preface

According to the NSW DPI website the commitment to extend the NSW RFAs maintains ". . . *existing RFA boundaries, core objectives and commitment to the National Forest Policy Statement will remain unchanged, the improvements and changes to the RFAs through the extension will be informed by public consultation and the outcomes of the RFA review*."

On the boundary issue, the decision to source some 40,000 m³ of high quality sawlogs from the Southern Region, to replace 24,000 m³ in the Eden Region, would appear to have changed the boundaries. Also, given any evidence for the claimed commitment to the National Forest Policy Statement is difficult to find, it is telling that a lack of commitment will remain unchanged.

Geology and Soils

The NSW government has recently declared three State Forests and part of another in the Eden RFA area as 'Flora Reserves', to protect the last few koalas from logging. Consequently a draft working plan was produced and comments from the public have recently been accepted.

The draft working plan correctly identifies the dominant geology of the reserves as sedimentary rocks from the Ordovician period. These parent materials are also among those with the highest nutrient content in the Eden region (Kelly & Turner 1978).

However, the availability of these nutrients is limited because of the soils low to very low Cation Exchange Capacity (CEC) (Tulau 1996).

Prior to 1996, when most of the logging took place in the flora reserves, the then Environment Pollution Licence for native forest logging required an estimate of potential soil loss, using the Universal Soil Loss Equation (USLE).

The USLE employs the following equation: A=RxKxLSxCxP

Where: A is rate of soil loss in tonnes/hectare/year
R is a factor for rainfall erosivity
K is a factor for soil erodibility
LS is a factor for slope length and gradient
C is a factor for ground cover management
P is a factor for management

In the case of Compartments 2180 and 2181 in Mumbulla State Forest (SFNSW 1994), an estimated 60% or 71 hectares of the area approved for integrated logging had slopes ranging from 15- 25 degrees. Maximum distances for cross bank drainage on tracks was 30 metres for areas with slopes 15-20 degrees and 20 metres for slopes of 20 to 25 degrees.

However, the Harvesting Plan employed an average slope length of 10 metres and a weighted slope of 15 degrees. Hence estimated soil loss was 132.8 tonnes per hectare. The following equation is based on a 22 degree (40%) average slope and a 30 metre distance for cross bank drainage.

A= 3257 x 0.02 x 4.98 x 0.45 x1
A = 202.8 tonnes per hectare

The point being that small changes to the equation factors particularly R, that does not account for storms or south coast lows, along with K, generally underestimated in sedimentary geologies, or LS, can have a significant influence on the product.

With regard to the C factor, it is generally accepted that all soils subject to logging and the post logging or 'regeneration burn' are disturbed. Removing the C factor increases State Forests soil loss estimate to 236.1 tonnes per hectare and the product of the latter equation to 324.4 tonnes per hectare.

Under the current Environment Protection Licence erosion still occurs but there is no requirement to estimate soil loss. Rather, Forestry Corporation are required to determine if soils are dispersible.

"*. . . The interaction in water of the clay sized particles in aggregates can largely determine the structural stability of the soil. When an unstable soil becomes wet, the fine particles react as individuals and are readily eroded from the profile. Because of their fine nature, once they are entrained they tend to remain in suspension and this can causes serious turbidity problems in waterways for considerable periods following storm events*." (NSW EPA, 1999)

While the EPA appears to confuse erosion with dispersion, soil landscape mapping (Tulau, 1996) found all profiles of the Murrah soil landscape are dispersible and evidence from catchments in the reserves demonstrates that turbidity problems in waterways, are not constrained to storm events.

" *. . . It has been shown (Turner et al. 1978) that clear relationships exist between soil nutrient status and the species composition of coastal eucalypt forests; that is, soil nutrient status delineates forest communities. Further, Lambert and Turner (1983) found species with high tissue nutrient concentrations in these eucalypt forests to be located on soils of relatively high nutrient status. It would therefore appear probable that, during logging, relatively higher quantities of nutrients could be removed from the more fertile sites*." (Turner and Lambert, 1986)

While FCNSW are required to identify dispersible soils in pre-logging surveys, in most cases they are not identified due to the methods employed (Brown, B., 2012). On the other hand, the NPWS are not required to identify any soil limitations and neither forest management agency is required to have an understanding of soil formation processes.

Sustainable management of soils has been a low priority and secondary to work 'on tree growth and productivity' (Tulau, 1996). A recent example is a study titled 'North Coast Residues' (NSW DPI, 2017). The following quote is from chapter 5 titled "Extraction of biomass for bioenergy from NSW North Coast regrowth native forests: impacts on nutrient availability".

" . . . Calcium is relatively inert physiologically and may be accumulated in plants well in excess of requirement 1[5]. Whereas the distribution of Ca is largely extracellular, K is the most abundant cation within plant cells and has many physiological roles. Its loss may be more significant than Ca. However, nutrients such as potassium and magnesium are considered to be always in surplus in forests, irrespective of management regimes, due to input from rainfall, thus their loss due to harvest activities represent less of a concern." (NSW DPI, 2017)

While Calcium '*may be accumulated in plants well in excess of requirement'*, this outcome suggests alkaline soils (ie, derived from limestone). There is no evidence to demonstrate an excess of

Calcium (Ca) in soils on the NSW coast generally and the Murrah Flora Reserves in particular.

Rather the evidence confirms soils are Ca deficient and this deficiency is the major factor influencing soil dispersion.

The suggestion that the distribution of Ca is 'largely extracellular' in trees neglects the fact that this nutrient is a major constituent and building block of cell walls. It is most likely that a deficiency of Calcium will have negative impacts on soils and on tree growth, as identified in the listing of 'Lowland Grassy Woodland in the South East Corner bio-region'.

"*. . . Contemporary tree-dominated stands of the community are largely relics or regrowth of originally taller forests and woodlands, which are likely to have had scattered shrubs and a largely continuous grassy ground cover. At some sites, mature trees may exceed 40m, although regrowth stands may be shorter than 10m.*" (NSW Scientific Committee, 2011)

Previous research on the issue of nutrient loss due to past, along with current and proposed public forest management support the fact that critical soil nutrients are being depleted.

". . . removals of Ca and B due to harvesting and burning represent a substantial proportion of exchangeable Ca and extractable B in the soil, and there is a potential risk that serious depletion of these nutrients may limit future long-term productivity of these forest ecosystems. High intensity burning of logging residues in these mixed species eucalypt forests should be avoided wherever possible." (Hopmans, Stewart & Flinn, 1993)

Similarly, the apparent changes to species mix in the reserves, appear to confirm a reduction in soil fertility.

" . . . Very good sites include E. nitens, E. elata, E. viminalis and E. smithii. On poorer sites, species such as E. sieberi, E. globoidea, E. consideniana, Angophora floribunda with Casuarina littoralis dominate and the very poorest sites include E. sieberi with C. littoralis and A.floribunda." (Turner and Lambert 1986)

To date there has been no credible attempt to ascertain the degree to which soils, in production forests, National Parks or reserves have been depleted. According to the 'North Coast Residues' report -
"*. . . A comprehensive nutrient budget analysis would consider long-term dynamics of losses (including any losses due to post-harvest regeneration burns) and inputs (e.g. via rainfall), which was outside the scope of this study. Regeneration burns oxidise much of the harvest slash and litter, and some nutrients (particularly N) are lost from the system by volatilisation and the convection of particulate matter. Where the regeneration burn is most intense, organic matter within a centimetre or more of the soil surface is also oxidised1. Losses of up to 200 kg /ha of N due to burning are typical for forest soils1[6]. However, in contrast to native forests in Southern Australia, for the North Coast the area of forest in post-harvest burns is low, and where burnings are carried out they are of low-intensity."* (NSW DPI, 2017)

This and the former DPI quote have several references that are not included in the report. However, one is thought to be the research paper 'Nutrient inputs from rainfall in NSW'. According to the paper -
". . . The primary objective of the program was to quantify temporal and spatial variation associated with chemical composition and nutrient inputs in rainfall as possible sources of nutrients for forests. In particular, the aim of this program was to quantify the long-term significance of nutrient inputs from rainfall in terms of forest nutrition and wood

production sustainability.” (Turner, Lambert & Knott, 1986)

The following table provides data from this research for one of the rainfall stations in the South East Corner Bioregion, at Mogo. There are some concerns with the information. For example, wetfall and dryfall were mixed, raising concerns that pH measurements may be biased (Bridgman et. al. 1988).

Station	Mean weighted average pH	Median conductivity	Mean Annual Calcium input (kg ha^{-1} yr^{-1})	Mean Annual Magnesium input (kg ha^{-1} yr^{-1})	Mean Annual Potassium input (kg ha^{-1} yr^{-1})	Mean Annual Sodium input (kg ha^{-1} yr^{-1})	Mean Annual Chloride input (kg ha^{-1} yr^{-1}	Mean Annual Sulphate -sulpher input (kg ha^{-1} yr^{-1}	Mean Annual Phosphate-phosphorus input (kg ha^{-1} yr^{-1}	Mean Annual Nitrate-nitrogen input (kg ha^{-1} yr^{-1}	Difference vs Total Cations
Mogo	4.6	51.5	4.2	4.27	9.38	33	34.9	0.89	0.028	0.18	-28.6

With regard to Calcium (Ca), there were four other stations in the Bioregion where Ca inputs ranged from 1.8 kg ha^{-1} yr^{-1} near Eden to the highest, 4.2 kg ha^{-1} yr^{-1} at Mogo.

The following table provides an approximation of Ca in above ground biomass where an idealised tree and a small area (30 sq/meters) of surrounding litter weigh 1 tonne.

	Bark	Branch	Leaves	Wood	Litter
Weight (kg.)	150	400	50	350	50
% Ca	0.9 [1]	0.5 [1]	0.45 [1]	0.04 [1]	0.6 [1]
Ca (kg.)	1.35	2	0.22	0.14	0.31

([1] NSW DPI, 2017)

As indicated the average volume of Ca (4.02 kg) represents a little over 0.4% of the total above ground volume of biomass, presumably excluding large woody debris on the forest floor.

In the case of Compartments 2180 and 2181 in Mumbulla State Forest (SFNSW, 1994), an estimated 89 hectares were logged with an estimated volume of 9,500 tonnes of wood being removed, including sawlogs and pulplogs. The following table employs the previous proportions, based on an average timber removal of 106.74 tonnes per hectare from the compartments.

	Bark	Branch	Leaves	Wood	Litter
Weight (tonnes)	45.5	121.35	15.5	106.74	16.4 [2]
Ca (tonnes)	0.409	0.607	0.068	0.043	.098

([2] Price. Penman. Bradstock. Boer. & Clarke. 2015)

Approximately 3.8 tonnes of Ca, or 42.7 kg per hectare was removed from the compartments in wood. Given an input of 4.2 kg of Ca per annum from rain it would take 10.2 years to replace. At the lower input figure of 1.8 kg per hectare per year, 23.7 years would be required to replace the Ca.

However, the combined loss from bark, branches, leaves, wood and litter equals 1.225 tonnes of Ca per hectare. The amount would take 292 years to replace from rainfall given an input of 4.2 kg of a hectare per annum. At a rainfall input rate of 1.8 kg per annum the Ca replacement time is 680 years.

In dense stands of 40 year old black forest oak, accumulated fine fuel can exceed 50 tonnes per hectare. Based on a notional 0.6% of this litter being Ca, a potential loss from fire of 300 kg per hectare is possible. The amount of Ca would take 71 years to replace from rainfall given an input of

4.2 kg of a hectare per annum. At a rainfall input rate of 1.8 kg per annum the Ca replacement time is 167 years.

A comprehensive nutrient budget analysis would also consider inputs including Sodium, that counters the positive influence Ca has on soils.

The NSW Department of Primary Industries points to soil pH and Cation Exchange Capacity as useful indicators of soil fertility. (DPI: https://www.dpi.nsw.gov.au/agriculture/soils/structure/cec)

" *Soil pH is important for CEC because as pH increases (becomes less acid), the number of negative charges on the colloids increase, thereby increasing CEC*."

The DPI also suggests " . . .*Clay has a great capacity to attract and hold cations because of its chemical structure. However, CEC varies according to the type of clay. It is highest in montmorillonite clay, found in chocolate soils and black puggy alluvials. It is lowest in heavily weathered kaolinite clay, found in krasnozem soils, and slightly higher in the less weathered illite clay. Low CEC values can be improved by adding organic matter*"

The evidence indicates that native marsupial species, many of which have become extinct or greatly reduced in numbers and range, played the largest role adding organic matter to the soil and the dispersal of hypogeal fungi spores. There is also some limited evidence suggesting soil pH may have reduced since Soil Landscape Mapping was undertaken (Tulau, 1996). This reduction may also be attributed to a lack organic matter being dug into the soils.

It is difficult to avoid the conclusion that soil degradation and loss is factor in both a reduction in koala habitat and the poor regeneration and growth of preferred feed species in the SECB.

FLORA

" *. . . The Governments recognise the unique nature of Australia's biota and that the natural interrelationship between native flora and fauna is essential for the health of the forest ecosystem. Accordingly, they will manage for the conservation of all species of Australia's indigenous forest fauna and flora throughout those species' ranges, and they will maintain the native forest cover where a reduction in this cover would compromise regional conservation objectives, consistent with ecologically sustainable management."* NATIONAL FOREST POLICY STATEMENT - A NEW FOCUS FOR AUSTRALIA'S FORESTS (1994)

As indicated in the NFPS, back in 1994, all governments agreed that fauna is required for healthy forest ecosystems.

" . . . Bell miner associated dieback (BMAD) occurs across public and private land and in both state forests and national parks. Bell miner birds (Manoria melanophrys) aggressively exclude other birds which would otherwise feed on leaf-eating Cardiaspina psyllid insects. This allows Cardiaspina psyllid numbers to increase and repeatedly defoliate and ultimately kill trees. This results in a loss of threatened species habitat and commercial timber resources. There is no scientific consensus on BMAD's root causes or the most appropriate ways to treat it. The lack of low intensity fire in the landscape appears to help create the conditions that allows BMAD to spread. In 2001, the NSW Government established the BMAD Working Group to promote research into the causes of dieback, support the implementation of control measures and assist in coordinating control programs. The BMAD Working Group's members include NSW Government agencies, community groups, landholders, FCNSW and others." (NSW EPA, 2017)

As indicated in the above quote regarding this particular listed Key Threatening Process (KTP) in NSW, there is no scientific consensus on the cause. This lack of consensus appears to stem from the

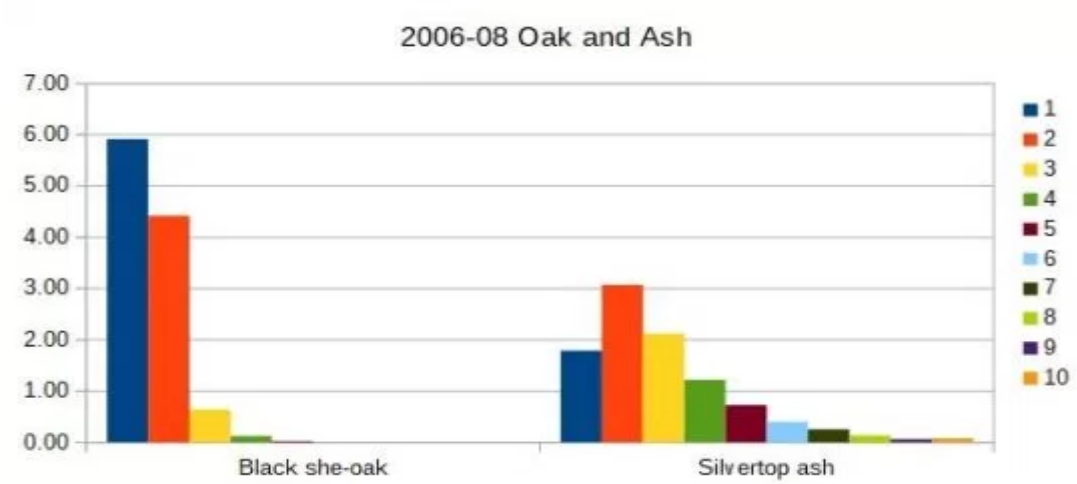
fact that the NSW government believes its limited understanding about the interactions between soils, water, flora and fauna reflect ecologically sustainable management.

Hence, since 2001, the BMAD Working Group have worked on the assumption that a lack of fauna plays no part in BMAD. More recently the Forestry Corporation has proposed a lack of regular burning as the cause of BMAD. As one of its regulators, the NSW EPA, appear to support this theory. While BMAD is a listed as a KTP, yet to be nominated and listed is extensive canopy dieback, associated with dry weather and drought in the South East Coastal Bio-region (Jaggers 2004, NSW SC 2007).

However, the current Environment Protection License, issued by the EPA was released prior to the release of Soil Landscape mapping (eg.Tulau, 1996). This licence allows Forestry Corporation to ignore the credible information on soils and the whole NSW government follows along.

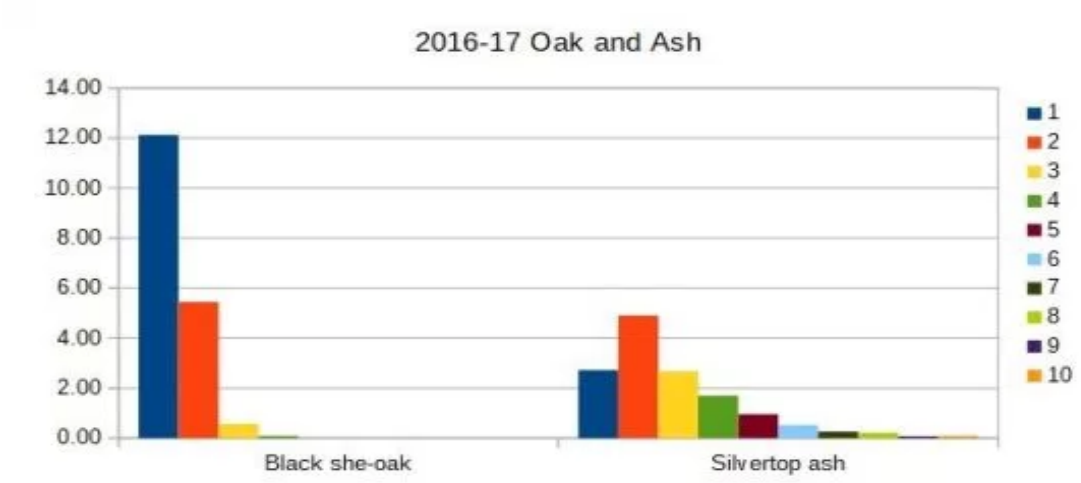
A good example is the $6m 'Foundations for River Recovery and Return of Koalas to the Bega Valley' project, started in 2011and undertaken by Southern Rivers CMA, now Local Land Services. No reports have been produced but the project was apparently based on the notion that soil fertility has not reduced. So the idea was to plant primary koala feed trees, in the Bega Valley, but rumour has it the whole project was a failure.

Given the reduction in koala numbers, reducing soil fertility in forests is likely to be a general trend and associated changes to species compostion. The following chart, featuring Silvertop Ash and Black forest oak ranked by diameter classes, is based on data from trees (n = 17,670), recorded during the 2006-2008 koala surveys. At the time Silvertop ash accounted for 9.9% of all trees above 150mm DBH. Black forest oak accounted for 11.1% of the trees



The next chart also features Silvertop Ash and Black forest oak ranked by diameter classes and is based on data from trees (n = 9,360), recorded during the 2016-2017 koala surveys.

Silvertop ash now account for 14.1 % of all trees above 150mm DBH. Black forest oak accounts for 18.2% of trees above 150mm DBH.



With regard to the volumes of timber being removed during logging, the following data is from "Table 75: Timber volumes produced (m³ p.a.) from South Coast sub-region by financial year from July 2004 to June 2014" (EPA 2017).

South Coast sub-region	HQL	HQS	Large sawlog	Small sawlog	Girder	Piles	Poles	Veneer	Salvage	Pulp	Residue	Totals
Average period 2	42447	6002	41820	5723	176	102	408	325	32397	86566	5360	172878
Average period 3	37396	6692	36951	6282	111	86	619	187	24060	68092	17827	154214
Totals	79843	12694	78771	12005	287	188	1027	512	56457	154658	23187	327092
Average	39921.5	6347	39385.5	6002.5	143.5	94	513.5	256	28228.5	77329	11593.5	163546
Percentage	24.41	3.88	24.08	3.67	0.09	0.06	0.31	0.16	17.26	47.28	7.09	121.20

Unfortunately, the average of the totals for periods two and three do not add up. The Following table attempts to correct the average volumes. As indicated the average for the two periods moves from 163,546 m³ to 209,814.5 m³.

South Coast sub-region	HQL	HQS	Large sawlog	Small sawlog	Girder	Piles	Poles	Veneer	Salvage	Pulp	Residue	Totals
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Average period 3	37396	6692	36951	6282	111	86	619	187	24060	68092	17827	198303
Totals	79843	12694	78771	12005	287	188	1027	512	56457	154658	23187	419629
Average	39921.5	6347	39385.5	6002.5	143.5	94	513.5	256	28228.5	77329	11593.5	209814.5
Percentage	19.03	3.03	18.77	2.86	0.07	0.04	0.24	0.12	13.45	36.86	5.53	100.00

WATER

The photo below shows a polluted pond at the end of a small forested catchment in the Eden region. There is a similarly polluted pond at the end of the adjacent larger named catchment. Forests around and upstream from these ponds have been subject to BMAD since the early 1990's.

Immediately adjacent to these ponds is a river with relatively clear flowing water.

" . . . A large stand of dead Eucalypt trees (many are Bangalays - Eucalyptus botryoides) exists on the southern side of Sandy Creek channel. Some tree deaths, those in low-lying areas, are attributed to prolonged inundation when the estuary entrance has been closed but majority of dead trees exist above the water high stand and the most probable cause of death for those trees can be attributed to Bell Miner Associated Dieback (BMAD). Recommend community education and or signage that explains the background history of artificial entrance opening of Middle Lagoon and the influence that practice has had on vegetation distribution and that some of the tree dieback is a natural process in response to the lagoon resuming its natural opening and closing regime. Further explanation of the issue of BMAD in the coastal forests of Mimosa Rocks National Park (Refer Action 7 in Section 5.1.4 (NPWS 2011) would also be valuable." (BVSC. 2016)

More recently and as indicated in the above quote, from the Rapid Catchment Assessment undertaken in Middle Lagoon catchment, trees around the edges of coastal lakes have been dying.

Similarly, the remaining melalucas trees in photo below adjacent to the southern side of Cuttagee lake, some kilometres to the north, have recently died. The first dieback event among these trees was in 2014. While prolonged inundation is generally accepted as a reason for such mortality, the deaths did not occur during inundation events. The timing of these dieback events has, in both cases, been 14 years after the first and second extensive canopy dieback events in the SECB.

It is quite possible that groundwater was polluted during these events, possibly with aluminium leading to subsequent negative impacts at the bottom of the catchment.

Consistent with data from oveseas research undertaken in catchments on the NSW north coast has confirmed that the majority of annual water flow, 58 – 79% is groundwater beneath channel sediments (Webb A. 2008).

According to the NSW Groundwater Quality Protection Policy -

" *. . . Principle One All groundwater systems should be managed so that the most sensitive identified beneficial use (or environmental value) is maintained. Once the beneficial use of a groundwater system has been identified, the obligation to protect it lies both with the industry or people involved in the activity which has the potential to contaminate the groundwater, and with the government authorities that regulate the activities. Potential dischargers need to either establish that their activity does not contaminate the groundwater system, or show that their proposal will not affect the beneficial use selected.*" (DLWC 1998)

<u>Fauna</u>

" . . . The Governments recognise the unique nature of Australia's biota and that the natural interrelationship between native flora and fauna is essential for the health of the forest ecosystem. Accordingly, they will manage for the conservation of all species of Australia's indigenous forest fauna and flora throughout those species' ranges, and they will maintain the native forest cover where a reduction in this cover would compromise regional conservation objectives, consistent with ecologically sustainable management." NATIONAL FOREST POLICY STATEMENT - A NEW FOCUS FOR AUSTRALIA'S FORESTS (1994)

" . . . An example of an ongoing cooperative activity related to endangered species is the relocation of long-nosed potoroos (Potorous tridactylus) from state forests near Eden to Booderee National Park near Jervis Bay where they have been extinct for many years. In late 2014, a partnership of FCNSW, Parks Australia and other collaborators trapped the potoroos to be relocated. Following monitoring of the relocated population and indications of successful re-establishment, the partnership is planning to relocate southern brown bandicoots (Isoodon obesulus) to Booderee National Park from state forests south of Eden." (NSW EPA, 2017)

While FCNSW may support the translocation of threatened and endangered species out of State Forests and into '*more suitable habitats to support their survival*'. FCNSW does not support the translocation of the same or other species into areas of State Forests where they have also been extinct for many years.

This fact is yet another example of a lack of commitment to the National Forest Policy Statement and its core objectives.

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References

Bega Valley Shire Council 2016. *Middle Lake Catchment Management Plan* Report - https://www.begavalley.nsw.gov.au/cp_themes/default/page.asp?p=DOC-GRF-81-75-46

Bridgman, H., Rothwell, R., Tio, Peng-Hin., Pang Way, C. 1988. *The Hunter Region (Australia) Acid Rain Project*. Bulletin American Meterological Society. http://journals.ametsoc.org/doi/abs/10.1175/1520-0477%281988%29069%3C0266%3ATHRARP%3E2.0.CO%3B2

Brown, B. 2012. *Logging the South East Forests*, ABC South East, http://www.abc.net.au/local/stories/2011/12/12/3389180.htm

Hopmans, P. Stewart, H..Flinn, D. 1993 *Impacts of harvesting on nutrients in a eucalypt ecosystem in southeastern Australia.* Forest Ecology and Management, Volume 59, Issues 1–2, Pages 29-51

Jaggers J. 2004, *Estimating the extent of declining forest in south-east New South Wales*, Research Division, South East Region, State Forests of NSW, Sydney.

Kelly, J. and Turner, J. 1978. *Soil nutrient -vegetation relationships in the Eden area, 1. Soil nutrient survey*'Aust. For. 41: pp 127-34.

Department of Primary Industries NSW. 2017. *North Coast Residues: A project undertaken as part of the 2023 North Coast Forestry Project*, https://www.dpi.nsw.gov.au/forestry/north-coastresidues-project

Department of Land & Water Conservation 1998 The NSW Groundwater Quality Protection Policy http://www.water.nsw.gov.au/__data/assets/pdf_file/0006/548286/nsw_state_groundwater_quality_policy.pdf

Environment Protection Authority NSW, 2017. *A report on progress with implementation of the New South Wales Regional Forest Agreements: Second and third five-yearly reviews, July 2004 to June 2014*, NSW Environment Protection Authority, Sydney.

Environment Protection Authority NSW . 1999. *Environment Protection Licence, Appendix A – Eden Region*, Schedule 3, Module 3: Soil Dispersibility Assessment.

NSW Scientific Committee. 2011. *Determination to make a minor amendment to Lowlands Grassy Woodland in the South East Corner Bioregion Part 3 of Schedule 1 of the Threatened Species Conservation Act.* http://www.environment.nsw.gov.au/determinations/lowlandgrassywoodland36a.htm

Price, O. F., Penman, T. D., Bradstock, R. A., Boer, M. M. & Clarke, H. 2015, *Biogeographical variation in the potential effectiveness of prescribed fire in south-eastern Australia*. Journal of Biogeography, 42 (11), 2234-2245.

NSW Scientific Committee (2007) - final determination *Koala, Phascolarctos cinereus, population occupying the coastal sub-catchments between Dignam's Creek and Wapengo Lagoon near Bega in south-eastern New South Wales - rejection of endangered population listing. http://www.environment.nsw.gov.au/determinations/KoalaPhascolarctosCinereusPopulationSENSWRejectionEPL.htm*

State Forests 1994. *Harvesting Plan for Compartments 2180 and 2181*, Mumbulla State Forest, Narooma District, Eden Native Forest Management Area.

Tulau M. J. 1997. *Soil Landscapes of the Bega-Goalen Point: 1:100,000 Sheet*, map and report by the NSW Department of Land and Water Conservation, Sydney.

Turner J. and Lambert M 1986. *Effects of forest harvesting nutrient removals on soil nutrient reserves*, Forestry Commission of N.S.W, P.O. Box 100, Beecroft, N.S.W., 2119, Australia.

Turner J, Lambert M and Knott J 1986. *Nutrient inputs from rainfall in NSW*, Forest Research and Development Division, State Forests of New South Wales,121-131 Oratava Avenue, West Pennant Hills, 2125 P.O. Box 100, Beecroft 2119 Australia.
https://www.dpi.nsw.gov.au/content/research/areas/resources-research/forest resources/pubs/Nutrient-Inputs-from-Rainfall-in-NSW-State-Forests.pdf

Webb AA. 2008, '*Impacts of native forest harvesting on in-channel erosion and sediment yields in unmapped headwater catchments*', in: *Sediment Dynamics in Changing Environments*, Schmidt J, Cochrane T, Phillips C, Elliott S, Davies T and Basher L (eds), International Association of Hydrological Sciences publication 325, 567–575.