Friends of the Five Forests comments on the draft report on progress with the implementation of the New South Wales Regional Forest Agreements.
September 2009

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Summary

While this submission is focused on Eden, it is clear that the draft report downplays or ignores the significant uncertainty around forest health issues in NSW, particularly for coastal forests.

It is claimed that science formed the basis of the Comprehensive Regional Assessment process but soils and their limitations were not considered. This is still the case and this significant deficiency means cumulative impacts are similarly not considered. This failure alone lays the RFA's and all levels of government in support of the agreements, open to challenge from a local to a global scale {clauses 33 and 46(a)}.

The NSW Government agencies have comprehensively failed to achieve any progress against the Montreal criteria {46(c)}. Forest management, including that of National Parks has failed to adequately manage and conserve identified CAR values {clause 65}.

The Eden RFA states- "ESFM would utilise the concept of adaptive management and continuous improvement based on best science and expert advice and targeted research on critical gaps in knowledge, monitoring or evaluation." The evidence of the decline of fauna and forests confirms that under the RFAs ESFM is the last consideration.

Post-RFA changes to the forest management system and additional reserves.

The addition of 471 hectares to the Dangelong Nature Reserve on the tablelands in the Eden region is claimed to be potential koala (*Phascolarctos cinereus*) habitat, although there is no evidence of koalas in this reserve. Rather this claim would appear to be based on a report[1] produced for the NPWS by their threatened species officer prior to his full time employment with the NPWS. The report suggests, amongst other things that –

> " . . . Given the conservation status and the limited knowledge about the distribution of Koalas in SENSW any area that provides evidence of Koalas such as provided by this survey should be considered to be important for the long-term conservation of the species." Allen et al. 1999

Three koalas were sighted during the surveys but no consideration was given to undertaking any genetic testing. During these and previous surveys in the area three koala skulls were found, although the 'experienced team' saw nothing odd with finding as many dead koala as live ones.

Despite this uncertainty and 'strike rates' so low as to suggest very limited habitat availability, the report concludes that –

> The data from this study suggests that the Numerella Koala population spreads least from the Numerella/Countegany Road southwards for approximately 15 km. Other evidence suggests that there is a low density Koala population stretching from north to south for at least 50 km. The rugged terrain, the scattered nature of the active sites in most areas searched, and the low

activity levels at almost all of the active sites assessed, all suggest that breeding associations are small and widely scattered and that some, or indeed most of the active sites located in the survey are those of dispersing young."

All the evidence suggests this theoretical population of translocated koalas either dispersed elsewhere or died locally.

Missing from the assessment of the Eden region is the areas of Crown lands that have been incorporated into the region since the RFA. In particular areas such as Eucumbene, Ingebirah and Delegate that are all outside the original Eden region but now contribute a heavily subsidized boost to timber supplies.

Biodiversity

The RFA's are based on the notion that 'biodiversity' is largely protected in National Parks, however a credible assessment of biodiversity requires a credible starting point. The following table provides areas depicted in the following map of woody and non-woody vegetation, pine plantation and water, in the IBRA areas (Version 6.1) that make up the Eden region.

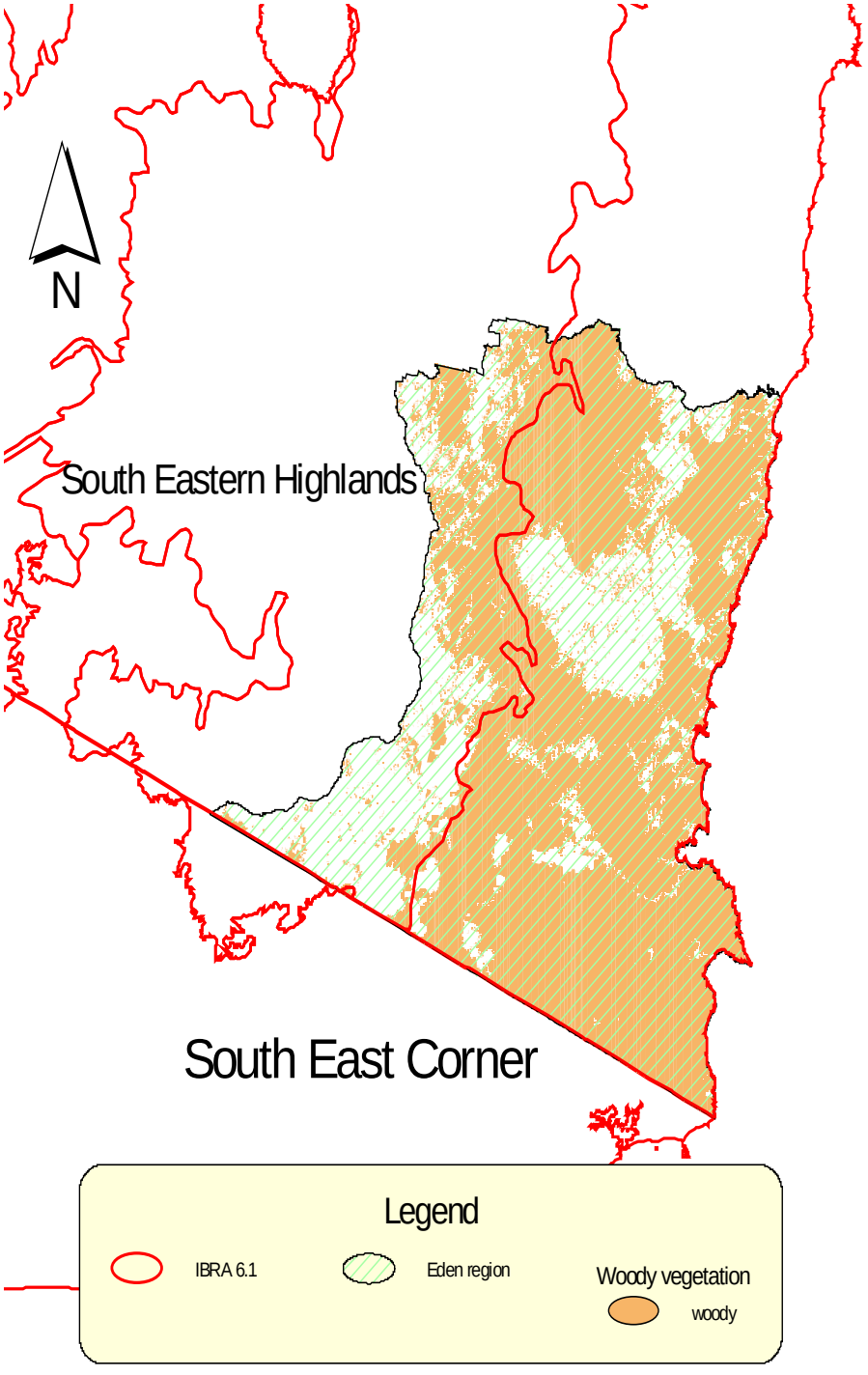
Sum of HECTARES	Bioregion	Bioregion	
LABEL	South-East Corner	South Eastern Highlands	Grand Total
non-woody	114640	102531	217171
pine	10030	27894	37924
water	396	81	477
woody	451762	99235	550997
Grand Total	576828	229741	806568

Forests NSW research[2] provides the following categories for Eden forests.

". . .Five probability categories of forest decline were mapped by using Arcview to intersect layers depicting forest type with layers depicting forest structure. Regrowth stands were categorised as High Potential, High / Low Potential or Low probability of decline *(Refer toTable 2)."*

PROBABILITY OF DECLINE	STATE FOREST	NATIONAL PARK	PRIVATE	TOTAL	% OF TOTAL
High	11,521	36,217	40,709	90,684	16
High / Low	11,017	14,659	6,233	33,281	6
Low	83,767	111,853	24,338	223,387	41
High Potential	25,051	9,186	8025	42,835	8
High/Low Potential	18,944	3,315	1,805	24,353	4
High Altitude	10,124	55,946	37,186	110,193	20
Totals	160,424	231,176	118,296	524,733	100

IBRA and the Eden region



When considered from a bioregional perspective, particularly given threats like BMAD do not apply to the tablelands, the area with a 'High or High/Low - probability of decline' accounts for 46% of coastal forests as per the following table.

PROBABILITY OF DECLINE	STATE FOREST	NATIONAL PARK	PRIVATE	TOTAL	% OF TOTAL
High	11,521	36,217	40,709	90,684	22
High / Low	11,017	14,659	6,233	33,281	8
Low	83,767	111,853	24,338	223,387	54
High Potential	25,051	9,186	8025	42,835	10
High/Low Potential	18,944	3,315	1,805	24,353	6

Extent of forest/vegetation type by growth stage.

According to the information in the previous table as of 2005, there was just over 20,000 hectares of mature (unlogged) forest in State Forest of the EMA. This figure contrasts with the 64,000 odd hectares of 'mature forest' in the draft report (Table 5.5 Growth stage distribution – Eden region).

However Forests NSW has concluded that about 20% of forests in the EMA and 28% of those in the Southern Region are in decline. This figure is suggested to exclude even aged regrowth forests up to around 30 years old that are said to be generally healthy, but apparently does not include hardwood plantations, that all died.

Unfortunately the 'forest type' GIS layers Forests NSW have created for their research are not consistent with 'floristic assemblages' and are not publicly available.

Hence 'forest types' like 'Southern Blue Gum' (*E. saligna*), a species not found in the Eden region, are suggested to be like 'vegetation type' 13 named Hinterland Wet Fern Forest and dominated by Monkey Gum *(E cypellocarpa*). While the "Southern blue gum' forest type apparently has a low probability of decline, such areas are susceptible to and frequently subject to Bell-miner Associated Dieback.

According to Jaggers (2005) forest types with a 'high probability of decline' include "woollybutt" the eucalyptus indicator species for Coastal Foothills Dry Shrub Forest. This forest ecosystem was observed to have a greater probability of decline when woollybutt is present.

Perhaps consistent with these observations is data from Coastal Foothills Dry Shrub Forest in an unlogged coupe of Mumbulla State Forest as per the following stand table. The information in the table represents an adaptation of the FRAMES plot methodology to accommodate changes to the distribution of and negative impacts on live trees associated with dieback during dry weather and drought.

DBH Class		50-99	100-299	300-499	500-699	700+
Species	E agg	0	1	1	2	1
	A flo	0	1	0	0	0
	E lon	0	1	2	0	0
	E sie	0	2	7	1	0
	E tri	1	3	0	0	0
	Total	1	8	10	3	1
	Dead	0	2	5	1	0
	Deadtop	1	2	1	3	1

As indicated in the table of the 23 trees in the plot, eight trees (35%) are dead and eight of the remaining live trees have dead tops. All of the dead trees in the plot are Silver –top Ash (*E.sieberi*) a forest type that is claimed to have a low probability of decline (ibid).

Mapping of floristic assemblages found a greater proportion of Silver-top Ash after logging and in contrast to the Forestry Act, Forests NSW have also acknowledged a ' . . . *changed species mix in Murrah State Forest area following logging'*, because the eucalyptus species most likely to regenerate on hard setting soils is Silver –top Ash (*E.sieberi*), where tree recruitment occurs.

Rainforest

The rainforest layer is supposed to be fixed, changes to the areas of rainforest are likely to reflect changes made by Forests NSW to this GIS layer. Such changes have been observed in Bermagui SF (Cpt 2005) and more recently in Tantawanglo SF (Cpt 2433) and Nadgee SF (Cpt 133). In this latter compartment, according to the approved harvesting plan, all the former rainforest has totally disappeared.

Changes to the rainforest layer represent a breach of the IFOA that in the case of Bermagui SF formed part of a complaint questioning Forests NSW compliance with the Australian Forestry Standard (AFS) in January 2009. As of 20 August 2009 this complaint had still not been recorded in the complaints register on the AFS website.

High-conservation-value old-growth

The factors that lead to an increase or decrease in the areas of this structural class are not defined, although Forests NSW did put an additional road through an area of high-conservation-value old-growth in Mumbulla SF.

Listing forest-dwelling species

MIG indicator 1.2.a: A list of forest-dwelling species (UNE, LNE, Eden, Southern regions)

Indicator 1.3.b: List of representative species by abundance. Representative sample to include threatened species, key functional groups and indicator species (Eden region)

> " . . . Based on habitat models developed during the CRA which utilised forest types (identified by *Research Note 17: Forest Types in NSW*, Forestry Commission of NSW 1989) and forest structure, habitat areas for threatened

> species were identified within the Forests NSW forest estate. The outcomes of these models are set out in table 5.7."

If Forests NSW produced a habitat model with 792 hectares of high quality koala habitat in the Eden region, it has not been made available and it is not based on the results of credible surveys. If this habitat exists, the questions would be why the agencies have spent the last 2 years surveying in the Five Forests and why there have been no other koala sightings.

Status of threatened forest-dwelling species

MIG Indicator 1.2.b: The status (threatened, rare, vulnerable, endangered or extinct) of forest-dwelling species at risk of not maintaining viable breeding populations, as determined by legislation or scientific assessment (UNE, LNE, Eden, Southern regions)

The only known endemic koalas in the Southeast Corner Bioregion are constrained to forests on the Murrah soil landscape in the Murrah river catchment area. These few animals were nominated as an endangered population in 2001. The NSW Scientific Committee finally rejected the nomination and considerable further information in 2007 but did acknowledge 'extensive canopy dieback' as a factor that would lead to the extinction of the species.

However, it was not until recently that the NSW Minister for Primary Industries indicated that Forests NSW had provided the NSW Scientific Committee with undisclosed information suggesting koala numbers had not declined. At this time Forests NSW were also involved with developing the Far South Coast Koala Management Framework that stemmed from community protests and arrests in Murrah State Forest near Bermagui during 2005.

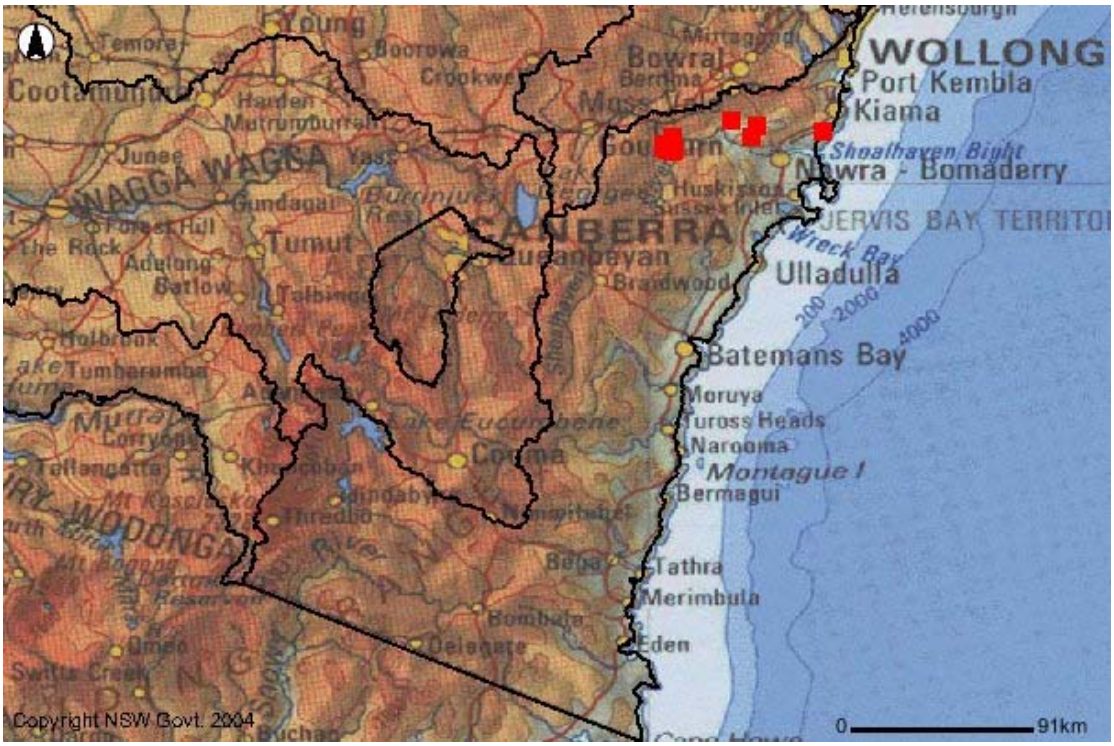
As documented in the Far South Coast Koala Management Framework consultant's report, at a workshop held on 14 June 2006 representatives from Forests NSW, including their current representative on the NSW Scientific Committee, Dr Rod Kavanagh, also fully endorsed to the following focus statement[3].

> " . . . The Far South Coast koala population has declined to very low levels and requires immediate, assertive actions to maintain and improve koala numbers in the area and avoid localised extinctions. It is very difficult to statistically determine the level of the current population and trends over the last 30 years (due to an absence of benchmark numbers). Anecdotal and scientific evidence suggests a significant decline and a lack of recovery."

Public perceptions about the credibility of information and how this can be used to mis-inform the public on the status of Australia's biodiversity, does not increase confidence.

The following map is a result of a filtered search for koalas on the BIONET website after 1-1-2005 in Southern Rivers Catchment Authority area. The records are all

outside the Southeast corner bioregion. For the same period there is one record on the tablelands (2006) close to the border of the ACT.



The lack of koala records would suggest that the only information the NSW Scientific Committee had to make their determination was Forests NSW koala habitat model and speculative wishful thinking.

Productive capacity and sustainability of forest ecosystems

Forests NSW estimates (2008) of the remaining standing volume in the Eden region are in the following table

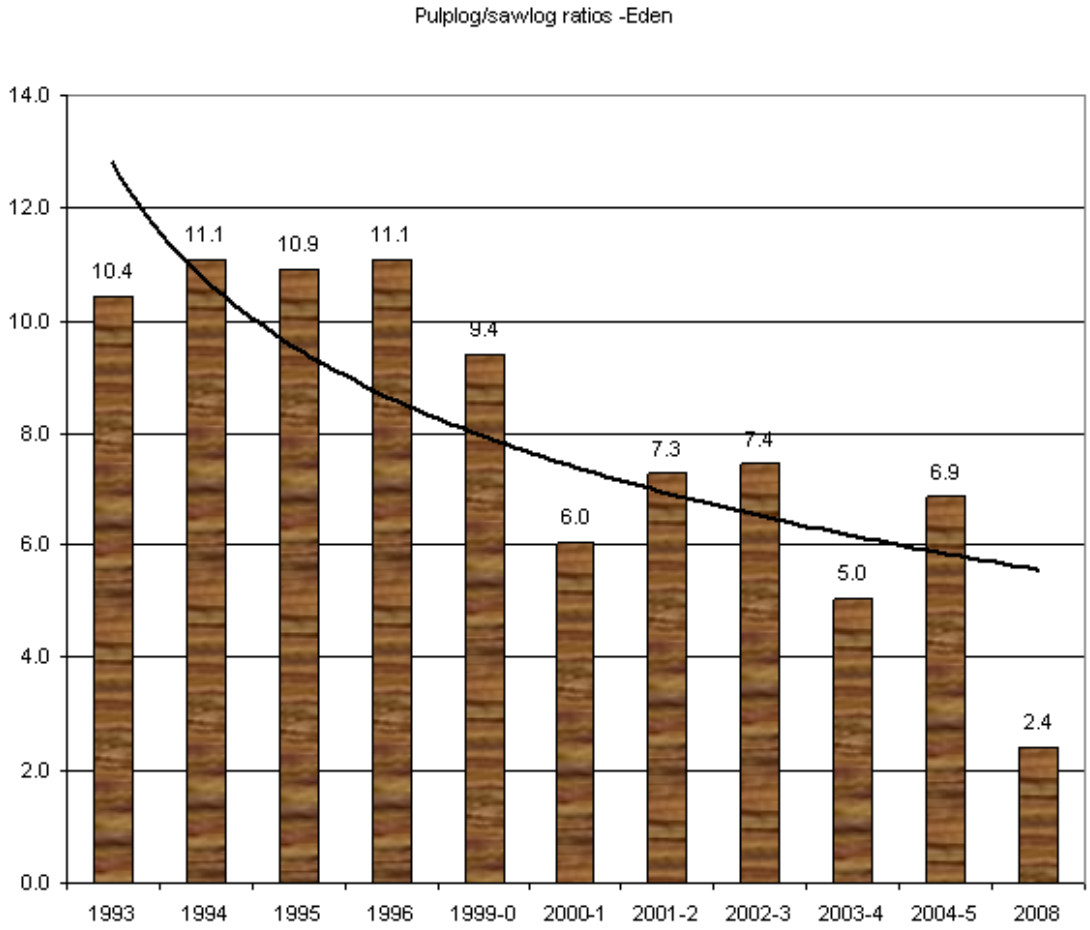
Eden	HQ Large SL	HQ small SL	Low Quality SL	Pulplogs
Standing Volume	201,196	16,744	0	527,789

Source: AUDITOR-GENERAL'S REPORT PERFORMANCE AUDIT, Sustaining Native Forest Operations, Forests NSW, 2009.

The total volume for compartments scheduled for 2009-2010 is 92,321m³ of sawlogs representing 46% of remaining standing volume and 566,275 tonnes of pulp logs representing 107% of the remaining standing volume in 2008.

The need to compare actual versus estimated yields (Milestone 51 Eden RFA Attachment 11 (1)) stemmed from data pointing to reduced yields and an apparent breakdown in the previous pulplog to sawlog ratio. The following table provides

sawlog/pulplog ratios for the years 1993 –1996[4], 1999-2005 from the draft NSW RFA report and 2008 from the Auditor Generals report.



The conclusion from this information is a trend toward a far greater volume of sawlogs, while it lasts, than previously estimated. This would seem particularly the case given the draft does not separate pulplog volumes from integrated logging and thinning operations.

Achieving 'economic' pulplog volumes from thinning operations is explained in the harvesting plan for Cpt 113. An indicative area to be thinned of 174 ha is proposed although the database provides for a 'thinnable' area of 234ha.

> Thinning will aim at a 50 - 60% reduction in the standing basal area. The current standing basal area estimate for Compartment 113 is 52 m^2/ha. Operational inventory plots established within this compartment during 2000, based on a 55% basal area removal, estimated the merchantable regrowth volume to be removed is 115m^3/ha.

According to the database for Eden the following operations were proposed.

intCPT_No	intCPE_No	dtmYrOrigin	txtOperationType	TotalSawlog	TotalPulp	YearSceduled
113	1	17/11/1980	t1	0	21456	2015
113	1	17/11/1980	t2	1073	17165	2030
113	1	17/11/1980	rh	10728	21456	2050

All inventory data has a 5year use by date, although the approved thinning plan provides the following information from 'basal area sweeps' undertaken in 2000.

		Pre thinnings			Removed			Post thinning	
CPT	Thin area	Stocking	BA	Vol/ha	Stocking	BA	Vol/ha	Stocking	BA
113	174	1820	52	210	1570	28	115	250	23

According to these figures removing 86% of the trees will result in the retention of 44% of the basal area and assumedly remove the need for a t2 operation. However and assuming these 'even –aged' stands are relatively homogenous removing this number of trees would reduce the post-thinning basal area down to $7m^2$ or around 15% of the pre-thinning BA.

Such a reduction would be inconsistent with the IFOA {PART 5 - On-going Forest Management Operations, 28. (1) (b)}, requiring a minimum retention of 25% of the pre thinning basal area.

FRAMES

> *" . . .. Inventory work need to continue, aimed at sampling the full range of stand in the resource. Measurement procedures need to be clearly documented. It is essential to resume the measurement of tree diameters"*
>
> Validation of Eden wood resources data; Forest Essentials –1997

The development of inventory methods for FRAMES was based on expert advice that facilitated data collection in a manner that would be consistent with the Forestry Act and the Montreal criteria.

The fact that Forests NSW have decided that these methods are not required and the reviewers consider achieving Milestone 49 {Eden RFA clause 46(f)} is 'underway', demonstrates that credible science is not a consideration.

There is no information in the draft on how the problems with stratification have been addressed, why there was an 'organisational shift' from Spectrum to Woodstock and how can this model accommodate 'strike rates' for threatened species when tree species and diameters are not recorded during inventory collection.

It would appear that the only area where credible inventory methods have been employed, in this case the Regularised Grid Based Spot Assessment Technique

(RGB-SAT) is in the Five Forests for koalas[5]. Unfortunately even when given a credible methodology the agencies have always changed the methods for their purposes, as they did on this occasion apparently to exclude certain landholders from participation.

Roads

There is no justification for the 2710-kilometer increase in total road length in the Eden region. The ESFM report for Eden provides the following description of roads in the EMA.

Road Class	1	2	3	4	5	6	Total	Area	Road length (m) per ha.
Roads on State Forest (metres)	84560	2200	308150	831230	244360	748860	2219360	224511	9.9
Roads outside State Forest (metres	705460	44220	292120	943030	193220	0	2178050	589739	3.7

In the absence of detailed information the area of roads in State Forests may have increased to over 15 metres per hectare. Adding to this uncertainty Forests NSW employee Mr James Jaggers stated in the Bega Local Court that Forests NSW has two G.I.S. road layers.

Socio-economic benefits

> *The koala Phascolarctus cinereus, alone, is estimated to be worth over a billion dollars annually to the Australian tourism industry* (Australian State of the Environment Committee, 2001).

Whatever the cost to the community of species extinction, deforestation and land degradation it would seem far to high price to pay, for a few unsustainable jobs in the native forest logging industry.

Feral predators

> Interactions between dingos and other mammalian predators, including foxes and cats, are complex (reviewed by Glen and Dickman 2005) . . . . When dingos are removed from a region, foxes increase in number and, if dingos and foxes are removed, the feral cat numbers increase (Johnson 2007; Linnel and Strand 2000)[6]

According to the draft (Table 5.18) the area treated for introduced predators in the State Forests of the Eden region ranged from 75,000 ha (2005-06) up to 652,779 (2004-05). The cost for these treatments (Table 5.19) ranged from $93,500 to treat 590,815 ha (2002-03) up to $206,336 to treat 568,982 ha.

Consistent with a long term baiting program that has eliminated dingos from these forests and now just aims to increase cats numbers, the aforementioned information is nonsensical.

Ecosystem health and vitality

According to the National Forest Policy Statement (4.1 Conservation) at all three levels

> 'The Governments recognize the unique nature of Australia's biota and that the natural inter-relationship between native flora and fauna is essential for the health of the forest ecosystem.'

However the regional mangers of State Forests and the NPWS have rejected as unnecessary community attempts, through an approved Natural Heritage Project, to increase biodiversity and soil fertility to address declining forest health.

Despite the fact that the Scientific Committee has acknowledged 'extensive canopy dieback' in these forests and BMAD is listed as a key threatening process there is no mention of these matters in the recent draft Management Plan for Mimosa Rocks NP.

Similarly Bega Shire Council are happy to go along with Forests NSW findings regarding a lack of soil limitations as indicated in a recently approved Harvesting Plan for the Tantawangalo catchment where dispersible soils were not identified.

> " . . . Forest Management Zone 3bC (Catchment) exists over the majority of Compartment 2433. The Forest Management Zone 3bC (Catchment) area within Coupe 2 and 4 of Compartment 2433 forms part of the net harvest area for this harvesting operation. The effects on downstream water yield and water quality was considered and discussed with the appropriate Council and FNSW Soil and Water Specialist. It was determined due to the ratio of area proposed to be harvested versus total catchment area, the alternative coupe harvesting pattern in conjuction (*sic*) with existing stream exclusions, protection zones, and non harvest areas due to inaccessibility, that the impact on water yield and quality in the immediate or long term future is negligible. Harvesting of FMZ3bC areas within Tantawangalo Catchment does therefore not require additional modified harvesting prescriptions."

Soil and water

> *" . . . In relation to dieback, I am informed that locally it is attributed to either the current drought conditions or an over-abundance of psyllids and bell miners, all of which are evident in the area across all land tenures. Vegetation*

dieback attributed to psyllids and bell miners has recently been listed as a threatening process across NSW under the Threatened Species Conservation Act 1995.

I am also aware that vegetation dieback as a result of both soil based and environmental factors seems to be evident across the broader landscape and is not specifically a local issue. Forests NSW advises that in the Eden area it is particularly associated with private property and national park at the interface of forest and agricultural land. It also occurs in healthy forests as a response to drought, with trees recovering after rain. It is also likely that a lack of low intensity fire indices secondary changes such as increased acidity and aluminium availability that are considered to be harmful to the roots of established trees."

Letter from the MINISTER FOR PRIMARY INDUSTRIES, MINSTER FOR ENERGY, MINSTER FOR MINERAL RESOURCES, MINSTER FOR STATE DEVELOPMENT - IAN MACDONALD MLC- 5 JUN 2009

The statement in the draft that " . . . Soil and water resources are generally being managed in a sustainable manner." would suggest credible science forms the basis of the Environment Protection Licence and various research.

In 1994 the Murrah/Mumbulla Residents Group provided the NSW Government with a comprehensive analysis of native forests soils in parts of the Murrah catchment in Mumbulla State Forest. The results found all soil layers were sodic, dispersible and acid and these limitations increase with soil depth.

As a consequence in 1996 the notion of soil 'dispersion' and the requirement to undertaken certain tests to identify areas subject to this limitation was introduced into State Forests licence with the NSW Environmental Protection Agency.

In 1997 the first Soil Landscape mapping was published for the region, although the soil testing methods agreed by the EPA and Forest NSW have not located dispersible soil in any compartment since that time.

Consistent with soil research finding the loss of top soil layers, in 1999 research undertaken by the CSIRO (Attachment 1) found most of the sediment on the Murrah river floodplain had been deposited in the past 40 years.

One of the apparently few reports including soils information comes from studies undertaken in Cumberland State Forest (Stone and Simpson, 2006: *Comparison of leaf, tree and soil properties among mature Eucalyptus Saliga in a moist sclerophyll forest exhibiting canopy decline*. Cunninghamia 9: 507-520).

While noting Cumberland SF was, like other areas in NSW, not assessed for timber resource as part of the CRA process, the paper provides an indication of the gap that still exists between government research efforts and those that fulfil the criteria for reasonable scientific rigor, that the community should reasonably expect.

On a positive note the results apparently lay to rest a previous simple State Forests research theory about too much nitrogen and seemingly provide support for the notion that increasing soil acidity (pH) and Calcium deficiency may be factors in declining tree health. Changes to soil acidity, over longer timeframes, may help explain the frequent occurrence of Sweet Pittosporum (*Pittosporum undulatum*) alluded to in the study and also observed locally.

Soil samples in the Murrah catchment were undertaken with an auger at 10cm intervals through all layers of the soil profile. These methods are now standard but soil sampling for the Cumberland research was constrained to aggregated samples from the first 15 cm of soil. As a consequence other layers of the soil profile that are utilised and required by large trees were not assessed in the study.

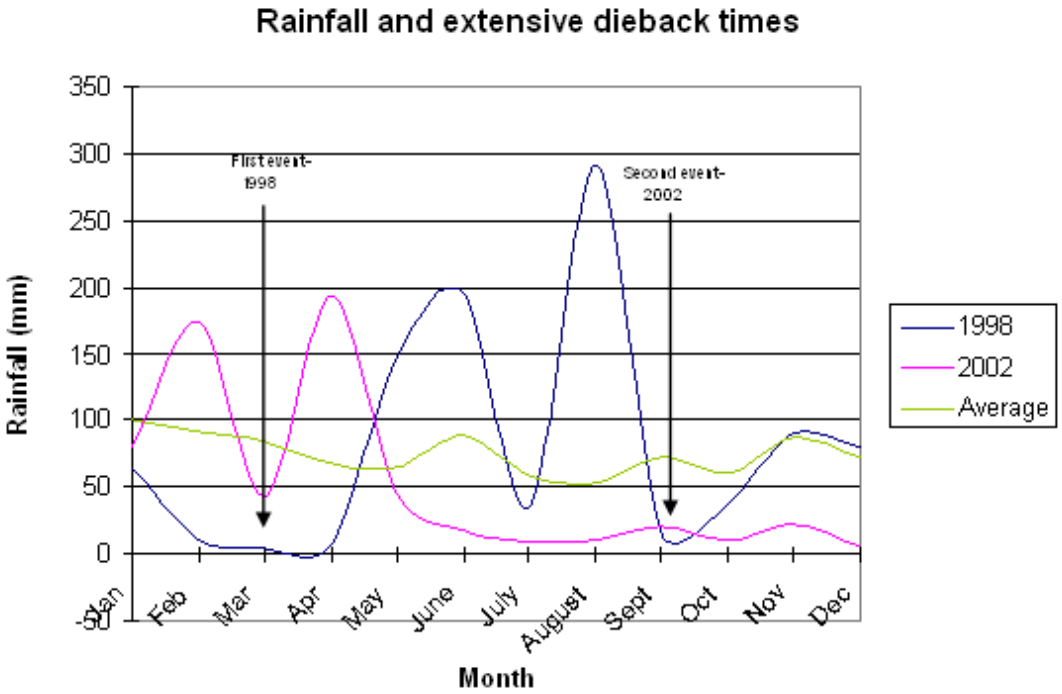
Although not referred to in the results, the selected soil properties provided in the Cumberland study (Table 4) do alert the informed reader to the fact that the soils, like the Murrah soil landscape and the evidence suggests throughout Bell-miners natural range, are sodic and therefore dispersible.

From this perspective and in addition to sampling the full soil profile, the research would have benefited from including laboratory results for the *effective* Cation Exchange Capacity (*e*CEC), incorporating exchangeable aluminium percentage, as well as the sum of the four base materials. As indicated in the letter from Minister Macdonald, increased aluminium availability may harmful to tree roots, although increases in this toxic material would confirm soils have dispersed and water holding capacity had reduced.

In common with the Cumberland research, this soil limitation (dispersion) has not been identified in the Harvesting Plan for any of the compartments logged on Murrah soil landscape since 1996. Sodium (Na) occurs naturally in most rocks and therefore the soils but an additional daily input to areas east of the escarpment, comes from the ocean. While such matters are not considered as part either day-to-day or long-term management in NSW, some work has been undertaken in New Zealand[7] to quantify seasonal sodium inputs onto the land.

The cumulative negative impacts stemming from the reduced input of soil materials that work to stabilise and build on clay aggregates, particularly Calcium, are a direct result of reduced biodiversity. The notion that a lack of fire leads to this outcome has no scientific basis and seems to rely on the argument that burning does not dry out or otherwise expose soils to degrading influences.

The following table provides rainfall records, recorded in the Murrah catchment and timeframes for dieback associated with dry weather and drought since 1998.



Rainfall this year (2009) has been consistent with that during 2002 and in the absence of sufficient rain large swathes of forest in the Southeast corner bioregion will again turn brown.

Forest contribution to global carbon cycles

The article reprinted below (Attachment 2) provides information on what happens when forests in the southeast, in this case the southwest slopes around Tumbarumba, turn brown.

Due to the cumulative negative impacts of soil dispersion such changes will soon be observed in mainland forests from Queensland to South Australia.

[1] Distribution surveys and management recommendations for koalas (*Phascolarctus cinereus) in the Numerella area;* Allen et al. (1999) Koorool Candelo NSW 2550

[2] Estimating the Extent of Declining Forest in South East NSW James Jaggers State Forests of NSW - South East Region

[3] Far South Coast Koala Management Framework (2008) **Eco Logical Australia Pty Ltd** - (02) 9542 5622 http://www.environment.nsw.gov.au/resources/threatenedspecies/sth_coast_koala.pdf

[4] Validation of Eden wood resources data (1997) Forest Essentials P/L . A report for RACAC and State Forests of NSW

[5] The utility of regularised grid-based sampling for the purposes of identifying areas being utilized by koalas (*Phascolarctos cinereus*) in the South-east Forests of NSW – a Pilot Study. (2007) Biolink Eclogical Consultants Report to NSW Dept. Environment & Climate Change.

[6] Steffan W, Burbidge AA, Hughes L, Kitching R, Lindenmayer D, Musgrave W, Smith M and Warner PA (2009) *Australia's biodiversity and climate change: a strategic assessment of the vulnerability of Australia's biodiversity to climate change.* A report to the Natural Resource Management Council commissioned by the Australian Government.

[7] *L. J. Yates and M. J. Hedley*: 2008, Understanding winter sodium deposition in Taranaki, New Zealand, *Australian Journal of Soil Research* 46(7) 600–609.

Attachment 1

CSIRO Media Release

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20 January 1999	**Ref 99/18**

EVIDENCE OF MASSIVE LANDSCAPE CHANGE UNEARTHED

Australians may have had a far more catastrophic impact on their landscape than previously suspected, according to fresh scientific evidence now coming to light.

A team from CSIRO Land & Water and the CRC for Catchment Hydrology has found signs that European settlement unleashed an episode of erosion, sediment deposition and change in river systems orders of magnitude greater than we have assumed to date.

New ways to identify and date flood deposits in river catchments in Eastern Australia are building a picture of a landscape in dramatic transition over years or decades, rather than centuries, say Dr Jon Olley and Dr Peter Wallbrink.

Metres of mud and sand deposited on river floodplains, which the scientists at first guessed to be the result of hundreds or even thousands of years of erosion, are proving to have happened in as few as 30 or 40 years.

"There's little doubt modern Australians have underestimated the extent of change we have inflicted on our landscape," says Dr Wallbrink. "In some cases the rates are staggering."

His research in the catchment of the Murrah river in southern NSW, dominated by dairying and forestry, is throwing the issue under the spotlight.

"Deposits of silt and sediment on the lower floodplain of the Murrah appeared to us to be at least a couple of hundred years old - until we began to test their composition and age."

It was the atomic bomb that did the trick. Regular atmospheric testing of nuclear weapons, which began in the late 1950s, spread a telltale layer of radioactive Caesium 137 across the globe. That layer now provides a reliable benchmark for soil scientists wanting to date recent layers of sediment.

What looked like the accumulation of centuries in the Murrah floodplain turns out to have taken place since about 1960, Dr Wallbrink says. More dramatic still, nearly a third of the deposit appears to have been dumped by a single massive flood event, back in 1971.

Subsequent tests will reveal whether it was clearing for agriculture at the top of the catchment or forestry operations in the lower catchment which was mainly responsible for the sediment - and the relative contribution of the two.

This understanding will be vital in devising the best strategies for farmers, foresters and land managers to combat future large scale erosion and deposition events and improve water quality and sustainability, says Dr Wallbrink.

"We're talking about changing the very face of Australia in comparatively few years, so dramatic is the scale of these events," he says. "The evidence is building that our landscape underwent radical change."

Dr Jon Olley is pioneering a technique called optically stimulated luminescence to date single grains of quartz sand in a sediment deposit. This technique is unfolding a new chapter in understanding of how we have reshaped the continent.

"Before European settlement, the picture is of a relatively stable landscape, well-vegetated, with lots of swampy meadows in the low lying areas to trap the sediment and nutrients and filter the waters slowly," he explains.

"The river systems at that time would have been largely clear-flowing, generally slow and dominated by organic material."

Enter European settlers and the landscape chemistry changes violently. Overclearing and heavy grazing combined with Australia's regular cycle of drought and flood to unleash a new pattern in the rivers: spates of silt sandblasting the system caused profound changes in the rivers themselves and the life they supported.

"We went, in effect, from slow rivers dominated by organic material to rivers dominated by rushes of abrasive inorganic sediment. This had huge consequences for native fish, animals, water plants and insects.

"Regrettably," says Dr Olley, "I don't think the original system is restorable. We can't put back the clock and have it the way it once was."

However both scientists consider it likely that a new landscape balance has formed, and that the rate of change is no longer as acute as it was shortly after clearing.

Nevertheless the combination of a cleared landscape with periodic episodes of natural droughts and floods has created a river regime that is now far more energetic and prone to violent flooding than previously existed.

"It's all about energy," says Dr Wallbrink. "In the original rivers the rainfall was held back by vegetation and swampy areas. Today it rushes downstream in defined channels far more quickly and in larger volumes.

"It is this new energy which underlies the dramatic rates of change we are starting to see and understand for the first time."

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Attachment 2

DRAMATIC DECLINE IN NET ECOSYSTEM CARBON EXCHANGE IN NATIVE FOREST DUE TO DROUGHT AND INSECT ATTACK

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Carbon (C) sinks created by forests depend on the balance between C uptake through photosynthesis and loss through respiration. This balance varies daily, seasonally and annually, depending on the relative effect of climatic and other environmental factors on the processes that contribute to the net C flux.

Components and dynamics of the C cycle have been measured in a native Eucalyptus delegatensis forest at Tumbarumba in southern NSW, during average rainfall

(1998-2001) and during dry years (2002-2005).

Measurements include inventory plots of forest growth dynamics, pools and fluxes of each component of the C cycle, net C flux from an eddy flux tower and micro-meteorological observations, together with calibration of a detailed process-based model.

Drought conditions during 2002-2004 had the effect of reduced soil water availability, increased vapour pressure deficit, and higher temperatures. A co-incident outbreak of psyllid insect damage reduced photosynthetic leaf area. The combined impact of these stresses resulted in markedly reduced growth (from 45 to 80%)and high mortality of trees (from 5 to 60%).

Impacts were variable across the 50,000 ha of forest, with mortality greatest in stands with highest growth rates during non-stress periods. Mortality occurred mainly in small trees, but also in mid-to-large trees (diameter 40-60 cm), indicating severely

stressed conditions. Growth rates were reduced during 2002 –3, most severely in 2003 –4, and recovering in 2004 –5.

Mortality remained high in 2004 –5 indicating the prolonged effect of the stress conditions. Mortality has a long-term effect on forest C stocks, as well as forest productivity, water availability, forest structure and biodiversity, because recruitment and growth of trees into the gaps is a slow process.

This example of the effect of drought and insect damage illustrates the high variability in forest C sinks that result from climate variability and associated disturbances. These temporal dynamics are demonstrated by the net C exchange measured by the eddy flux tower. Net forest ecosystem C exchange declined from a sink of ~3-4 tCha –1 yr-1 in 2000-2002 to a source of ~0.5 tCha -1yr-1 in 2003-2004. Reduction in biomass C increment was the major factor contributing to the change.

Long-term changes in climate conditions, such as temperature and moisture availability, could impact on forest C sinks in a similar manner. Predicting these consequences of climate change requires understanding of the factors driving respiration, photosynthesis, and the causal biology of mortality of trees.

Photosynthesis appears to be more sensitive to dry conditions than respiration, resulting in reduced C gain. Under conditions of higher temperatures, increased respiration and reduced biomass production could result in net loss of C from the soil pool.

This study has major implications for the vulnerability of forest C sinks under climate variability and change.

Important issues still to be resolved include:

- How widespread is this phenomena in Australia’s extensive native forest?
- What will be the future trend of C exchange?
- How will changes in climate impact on biomass increment and soil C turnover?
- What are the mechanisms and speed of ecosystem recovery?
- Will increased mortality and reduced growth result in higher fuel loads, greater vulnerability to wildfire, and increased emissions of GHGs?