Respondent No: 500
Login: Anonymous
Email: n/a

Responded At: Jul 11, 2018 16:32:30 pm
Last Seen: Jul 11, 2018 16:32:30 pm
IP Address: n/a

Q1.	**First name**	Bellingen Shire Council
Q2.	**Last name**	Bellingen Shire Council
Q3.	**Phone**	[redacted]
Q4.	**Mobile**	[redacted]
Q5.	**Email**	not answered
Q6.	**Postcode**	[redacted]
Q7.	**Country**	Australia
Q8.	**Stakeholder type**	Local government

Q9. **Stakeholder type - Other**

not answered

Q10. **Stakeholder type - Staff**

not answered

Q11.	**Organisation name**	Bellingen Shire Council
Q12.	**What is your preferred method of contact?**	Email
Q13.	**Would you like to receive further information and updates on IFOA and forestry matters?**	Yes
Q14.	**Can the EPA make your submission public?**	Yes
Q15.	**Have you previously engaged with the EPA on forestry issues?**	Yes

Q16. **What parts of the draft Coastal IFOA are most important to you? Why?**

not answered

Q17. **What parts of the draft Coastal IFOA do you think have a positive outcome on the management of environmental values or the production of sustainable timber? Why?**

not answered

Q18. **What parts of the draft Coastal IFOA do you think have a negative outcome on the management of environmental values or the production of sustainable timber? Why?**

not answered

Q19. **What are your views on the effectiveness of the combination of permanent environmental protections at the regional, landscape and operational scales (multi-scale protection)?**

not answered

Q20. **In your opinion, would the draft Coastal IFOA be effective in managing environmental values and a sustainable timber industry? Why?**

not answered

Q21. **General comments**

not answered

Q22. **Attach your supporting documents (Document 1)**

[redacted]

Q23. **Attach your supporting documents (Document 2)**

[redacted]

Q24. **Attach your supporting documents (Document 3)**

[redacted]

BELLINGEN SHIRE COUNCIL

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Coastal Integrated Forestry Operations Approvals (IFOA) remake

1 Consultation process:

The New South Wales Government (NSW) is updating the rules for native timber harvesting in NSW's coastal timber production state forests.

It is understood that

1. this process includes consolidating the four Integrated Forestry Operations Approvals (IFOAs) for the Eden, Southern, Upper and Lower North East coastal regions of NSW, into a single, modern Coastal IFOA.

2. the objectives of the IFOA remake are to:
   - reduce costs associated with implementation and compliance
   - improve clarity and enforceability of the conditions for protecting the environment, threatened species and fisheries in state forests
   - incorporate innovations in best regulatory practice and advances in technology
   - deliver a contemporary regulatory framework that is fit for purpose

3. the objectives of the IFOA remake will be met with no erosion of environmental values and no net change to wood supply.

4. the draft Coastal IFOA sets out new rules for how native forestry operations can be carried out in coastal production forests in NSW. Among a range of new conditions, it sets new limits for:

   - the area of forest that can be harvested in any one place or time
   - the intensity of harvesting at a site, and across the landscape more broadly
   - the protection of threatened and protected plants, animals, habitat and vegetation communities
   - the protection of important forest features like tree hollows, rainforests, old growth forests, rocky outcrops, and wetlands and rivers
   - the protection of soils and water
   - monitoring and adaptive management to ensure ecologically sustainable forest management.

2 Background – Protection of Koalas and forestry Operations is an ongoing issue of concern for Bellingen Shire Council and its community

Bellingen Shire Council has actively considered the protection of koalas as well as issues relating to Forestry Operations and the formation of the Great Koala National Park on a number of occasions as set out below:

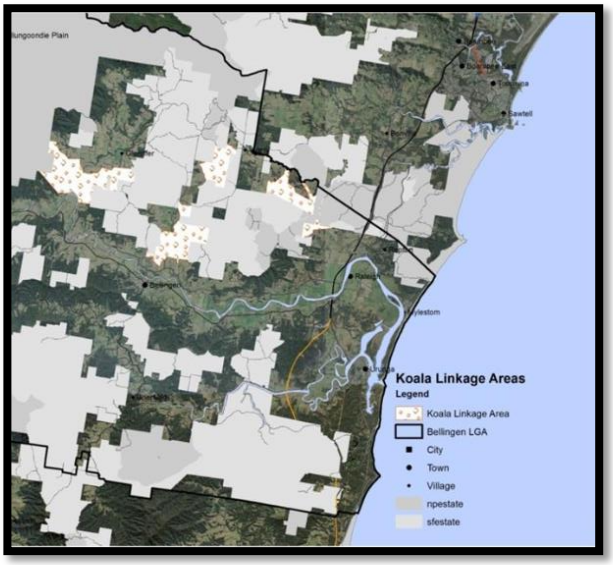
2.1 *'Bellingen Shire Council Coastal Area Koala Management Strategy – January 2017'' - The adoption of effective corridors for Koala movement across multiple land tenures*

The ''Bellingen Shire Council Coastal Area Koala Management Strategy – January 2017'' (the Strategy)'' represented the culmination of many years of detailed vegetation mapping, on-site koala surveys and community consultation. The strategy includes a statutory component to be observed when development takes place in areas of core koala habitat (The Bellingen Shire Council Coastal Area Core Koala Habitat Comprehensive Koala Plan of Management (the CKPOM)) but also includes a range of management actions aimed towards ensuring the long term health and survival of Koalas in the region.

The Strategy maps potential Koala linkage areas, at a landscape level, throughout the study area. The Strategy shows how these linkage areas would allow for Koala movement across private land and between existing areas of National Park and State Forest. Having linkages between areas of suitable habitat across the full range of land tenures that occur within the study area is important because;

- Koalas cannot distinguish between different land tenures
- It allows for Koalas to move between areas of habitat in response to change factors (e.g. climate change, deforestation)
- It allows for a suitable level of genetic diversity to exist within Koala populations.
- It provides a strategic basis for potential revegetation works on private land.

The key linkage areas that were identified by the Strategy, and which would provide for long term potential connectivity between the seaboard and plateau areas are depicted in the extract below.



Management Action 26 of the Strategy specifically identified the importance of such an approach and this is reprinted below.

''To ensure that the responsibility for Koala habitat management occurs across all landscapes, Council and the Koala Advisory Group are to advocate for an integrated approach across all land tenures and land managers.''

The renegotiation of the Regional Forestry Agreement provides an excellent opportunity for all tiers of government, and private landowners, to work together in providing meaningful habitat linkages across all different types of land tenures for Koalas. Accordingly, this report recommends that Council resolve as follows with respect to the provision of Koala movement corridors across multiple land tenures within Bellingen Shire:

It is required that the Government set aside meaningful movement corridors for Koalas in State Forest estate that integrate with, and build upon, the work undertaken by Bellingen Shire Council in identifying linkage areas on private areas of land within Bellingen Shire.

2.2 Proposed great Koala National Park

On 23 August 2017 Council resolved to support in principal the establishment of a Great Koala National Park (GKNP) as well as seeking additional information regarding the impact from a broader sustainability perspective. Council's submission to Forestry Corporation contextualised the establishment of the GKNP against the imminent expiry of the Regional Forestry Agreements. Council's correspondence is provided at Attachment one.

2.3 Regional Forestry Agreements

On 28 February 2018 Council considered a report in relation to Regional Forestry Agreements and communicated its position to the Minister for Lands and forestry by way of correspondence dated 8 March 2018, shown at Attachment two.

3 Submission

3.1 Supporting commentary

Bellingen Shire Council at its June 27 2018 Ordinary Meeting considered a Notice of Motion against the following background information:

"This motion is based on concerning changes and proposed changes to the management of public and private forests and reserves in our Shire and region.

Given that around 40% of Bellingen Shire is potentially impacted by new clearing and/ or more intensive logging, with fewer controls, fewer jobs, greater industrialisation, the cumulative impacts on our water supply, water quality, infrastructure, biodiversity (particularly koalas, turtles, old growth forests, riparian zones and rainforest remnants), tourism and related economies, fire risks and local jobs could be significant. We have sought clarification of these potential impacts (and clarification of the potential benefits, particularly in relation to local jobs) from the NSW Government on several occasions over a number of months and to date have not received Shire-specific information to allay concerns.

The scale of this threat reinforces that the concept of a Great Koala National Park in this region is an urgent and important protection to our Shire environmentally, socially and economically.

The changes of concern specifically are:

- *the rolling over of the Regional Forest Agreements*

The concerns around the Regional Forest Agreement renewal are outlined in the 2016 National Parks Association of NSW report, Regional Forest Agreements in NSW: Have they achieved their aims? (https://npansw.org/wp-content/uploads/2017/12/Regional-Forest-Agreements-Report-_web.pdf)

- *the NSW Government's new Koala Strategy*

The full report can be found at http://www.environment.nsw.gov.au/research-and-publications/publications-search/nsw-koala-strategy and a response from the NSW National Parks Association, as a peak body around conservation and reserve issues, can be viewed at https://npansw.org/2018/05/07/government-recognises-importance-of-protecting-koala-habitat-but-strategy-short-on-detail-and-overshadowed-by-deforestation/

- *changes to land clearing laws in NSW in 2016 that exposed 99% of koala habitat on private land to clearing*

http://www.abc.net.au/news/rural/2016-12-28/landmark-changes-to-nsw-land-clearing-laws/8123918
https://www.landmanagement.nsw.gov.au/
https://www.edonsw.org.au/2016_nsw_biodiversity_reforms_land_clearing_and_the_rationale_for_reform

- *new logging rules that include plans to convert over 140, 000 ha of north coast NSW native forest to plantation (with over 100, 000 ha between Taree and Grafton), reduction of environmental protections such as reducing required stream buffers from 10m to 5m, and re-mapping that reclassifies previously identified old growth and rainforest areas as logable areas again. Councillors will receive a briefing workshop on these changes and potential impacts for local government on May 20, 2018".*

3.2 Council resolution

Council's resolution in this matter is as follows:

MOVED (Cr Fenton/Cr Wright-Turner)

1. That Council note prior in-principle support for a Great Koala National Park in our region (23/8/17) and call on the Federal and NSW governments to:

> *A. Recognise that the Regional Forest Agreements have failed to deliver environmental protection or industry security in Bellingen Shire;*
>
> *B. Recognise that the benefits of non-timber forest values of biodiversity, ecosystem services and clean and consistent water flows are vital for the future of regional economies and ecosystems;*
>
> *C. Establish, with appropriate ecotourism infrastructure investment planned in conjunction with Council, the Great Koala National Park as an immediate priority and;*
>
> *D. Commit to a just transition so all current employees and contractors are offered suitable alternate employment opportunities out of native forest logging on public land and the transfer of public forests to protected areas when the RFAs expire."*

2. That Council also contribute the above advocacy points plus the concerns noted in the motion background material around water supply, water quality, and infrastructure. Biodiversity (particularly koalas, turtles, old growth forests, riparian zones and rainforest remnants), tourism and related economies, fire risk and local jobs, via submission on the draft Integrated Forestry Operations Approvals Remake document for our region.

3.3 Additional information

3.3.1 Integrated vulnerability assessment

One of the areas for which feedback is being sought is how emerging issues (such as climate change) should be addressed in the new agreement.

The Integrated Regional Vulnerability Assessment, undertaken by the NSW Office of Environment & Heritage (OEH) for the North Coast, has identified a range of climate change vulnerabilities in the region, and potential actions in response.

For example, Appendix C of the agreement discusses the expected physical responses to climate change and projects that it is very likely that there will be a ''substantial increase in runoff depths, and the magnitude of high flows'', in summer.

When documenting regionally specific impacts, it is also stated that ''higher rainfall is likely to increase sheet and rill erosion, leading to increased sedimentation of coastal floodplains.''

Forestry operations have the potential to significantly disturb large areas of earth and expose it to potential erosion. Given the rainfall scenarios contemplated by this document, it is considered prudent that the Government should take deliberate steps to mitigate against the higher likelihood of erosion events that will result from the climate change scenarios contemplated by the NSW OEH.

There are two areas capable of practical policy intervention, and which could be embedded in revised operating procedures for forestry operations. These include;

- increasing the setbacks between riparian features such as creeks, streams, and gullies that must be observed when undertaking forestry operations, to reduce the likelihood of sediment entering watercourses, and
- revising the permissible slope classes upon which forestry operations can take place in view of the increased potential for uncontrolled runoff and erosion on steep lands.

Having regard to the abovementioned matters, the NSW Governments vulnerability assessment recommends that Council resolve as follows with respect to the potential impacts of climate change on future forestry operations:

That the NSW Governments north coast climate change projections of increased rainfall depths and increased erosion, are reflected in the new RFA through the development of revised operating procedures for forestry in the north coast region. The revised operating procedures should increase the required setbacks between forestry operations and riparian features, and further limit forestry operations on land with high slopes, in order to minimise the likelihood of sediment entering watercourses as a result of forestry operations.

3.3.2 Logging on steep slopes

Council has been provided with two documents which detail concerns regarding logging on steep slopes. Both provide detailed commentary around the potential impacts and implications of proposed practices which are of significant concern. Both documents are attached for review and consideration as part of this submission.

3.3.3 Rating of State Forests

Forestry Corporation of NSW do not pay Local Government rates for State Forests despite the fact that they are a commercial enterprise operating in the open market and cause significant damage to the road and bridge networks maintained by councils. The obvious inequity with private forestry being required to pay rates should also be expressed. This failure to pay rates is a hidden subsidy in the operation of the Forestry Corporation and is a matter which should be addressed in the Regional Forest Agreements.

They are intergovernmental agreements and it is proper that this inequitable example of cost shifting be remedied.

It is also understood that Forest Corporation pay a dividend to the State Government demonstrating that there is capacity to pay rates. Specifically, In 2016 Forestry Corporation paid $38million to shareholders in dividends and taxes during the financial year and declared dividends of $22million.

The Council has already made representations to the Department of Primary Industries on the extension of the North East Regional Forest Agreement registering its objection to a new 20 year agreement being entered into without any provision for the payment of local government rates on State Forests despite the fact they are a commercial enterprise; cause significant damage to council road and bridge networks and provide unfair competition to private forestry which does pay rates.

4 Conclusion

Council therefore has serious concerns around the new IFOA and the following key issues:

- The impact on the Waterways within the Bellingen Shire from a more intensive industrial logging regime on the steep erodible slopes located in areas of high rainfall.
- The lack of communication, consultation and clarity/transparency from the State Government and Forest Corp to Local Government. Particularly around past and current operations and changes to RFAs and forestry practices.
- The lack of any science around the cumulative impact of logging operations on biodiversity, waterways and forest health.
- The consistent breaches of Forestry regulations by contractors and Forestry Corp staff as reported by other stakeholders and community.
- The impacts of Climate Change and consideration of the vulnerability assessment process being undertaken by the NSW government.
- Payment of rates by Forestry Corporation on the basis that they are a enterprise competing in a commercial marketplace

Yours sincerely

Cr Dominic King
MAYOR

BELLINGEN SHIRE COUNCIL

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WEBSITE: www.bellingen.nsw.gov.au

Our Ref: Great Koala National Park
LJ:mf

15 September 2017

The Manager
Forestry Corporation NSW
Head Office
121-131 Oratava Avenue
WEST PENNANT HILLS NSW 2125
info@fcnsw.com.au

Dear Sir/Madam

Proposed Great Koala National Park

The Bellingen Shire Council at its general meeting held on 23 August 2017 resolved to support in principal the establishment of a proposed Great Koala National Park. In addition, it resolved to seek information which would help it understand the local socio and economic impact of such a proposal. This is in terms of both employment loss as well as potential employment gain. Council also understands that whilst aggregate employment outcomes are one matter, there is the further consideration of the effort required to transition a worker between alternate employment sectors.

The Council would appreciate any advice which could be provided on the economic impact to the Bellingen Shire Local Government Area and more broadly to the economy of the Mid North Coast of the proposed conversion of existing State Forests in the Nambucca, Bellingen and Coffs Harbour local government areas to form the proposed Great Koala National Park.

Background

There is a proposal from the NSW National Parks Association to convert existing State Forests in the Nambucca, Bellingen and Coffs Harbour local government areas into a new Great Koala National Park. This would add 175,000 hectares of state forests to the existing 140,000 hectares of protected areas.

According to the National Parks Association:

"Large and well-managed protected areas remain the single most effective tool to protect biodiversity around the world, and Australia is no different. The Great Koala National Park, which is designed as the key component of a larger strategic koala reserve network for the north coast, is the best chance for koalas to have a secure future in NSW. The new National Park will encompass 315,000 ha of public land in the Coffs Harbour region. This biodiversity hotspot includes two nationally recognised koala meta-populations, estimated to contain almost 20% (about 4,500) of NSW's remaining wild koalas. The Great Koala National Park is comprised of 175,000 ha of state forests added to 140,000 ha of existing protected areas. Because it's all public land, it's a cost-effective reserve option. (A map showing this proposal is attached).

Importantly, this koala population is one of the more stable in NSW. This is most likely due to Bongil Bongil National Park acting as a source area of animals which has – so far – offset losses of koalas from land clearing and logging. Because the population has not yet dramatically declined like many others in NSW, the Great Koala National Park has an outstanding chance of making a real difference to koalas. But we must act now while there's still a chance!

Scientists tell us that as the climate changes koala feed trees and populations will move east as inland NSW becomes too hot. So protecting habitat on the eastern seaboard is a vital strategy to help koalas cope with climate change. The Great Koala National Park would both protect coastal forests on the east coast and *restore a link between coastal forests and the escarpment to allow koalas to move in response to extreme weather events and climate change."*

Bellingen Shire Council understands that the proposal for the Great Koala National Park coincides with the imminent expiry of the Regional Forest Agreements (RFAs).

The NSW National Parks Association (NPA) believes that the RFAs have failed in all of their aims to a greater or lesser extent, particularly those pertaining to ecologically sustainable forest management, but including failing to deliver economic stability for the logging industry.

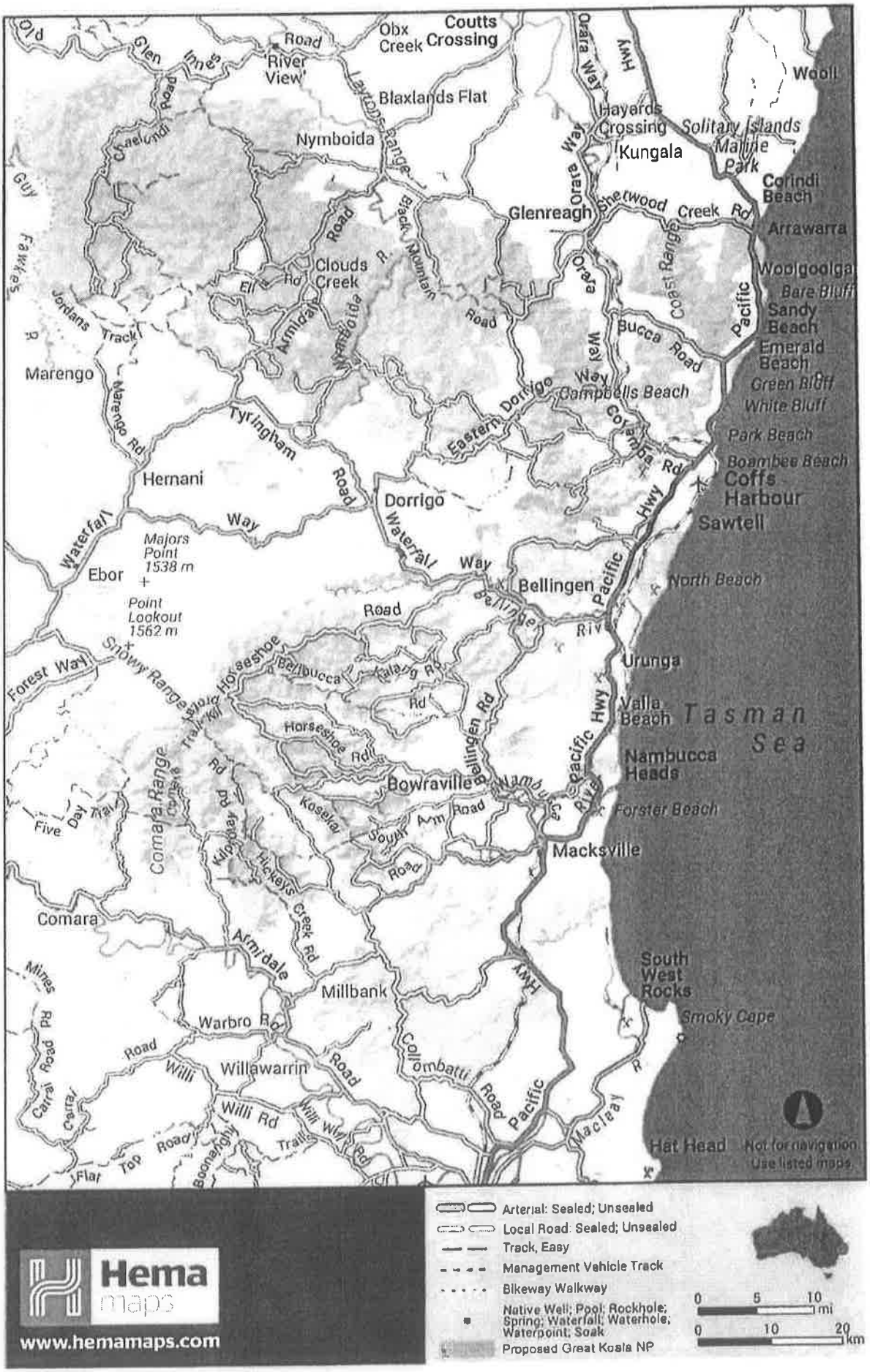
The NPA proposes that the expiry of the RFAs in NSW be the point at which the State exits native forest logging on public land, transitions to 100% plantation timber and alternative fibres for wood and fibre needs and protects public forests for the benefit of the entire community. They wish to see all public forests in the RFA regions protected and access to forests promoted for Indigenous uses, recreation and nature based tourism to benefit regional communities.

Once again, the Council would appreciate any advice you can provide on the economic impact to the Bellingen Shire Local Government Area and more broadly to the economy of the Mid North Coast of the proposed conversion of existing State Forests in the Nambucca, Bellingen and Coffs Harbour local government areas to form the proposed Great Koala National Park.

It is noted that the Bellingen Shire Local Government Area has a number of sawmills and associated support industries and Council would be particularly interested in your advice as to the likely direct and indirect impacts on these industries.

Yours faithfully

Liz Jeremy
GENERAL MANAGER
Enc


Old
Glen Innes
River View
Obx Creek
Coutts Crossing
Blaxlands Flat
Nymboida
Lavenders Range
Guy Fawkes R.
Clouds Creek
Armidale
Wrattonbida
Black Mountain
Road
Jordans Track
Marengo
Marengo Rd
Tyringham
Hernani
Waterfall Way
Majors Point 1538 m
Point Lookout 1562 m
Ebor
Dorrigo
Waterfall Way
Eastern Dorrigo Way
Orara Way
Glenreagh
Sherwood Creek Rd
Kungala
Hayards Crossing
Solitary Islands Marine Park
Woolgoolga
Corindi Beach
Arrawarra
Bare Bluff
Sandy Beach
Emerald Beach
Green Bluff
White Bluff
Park Beach
Boambee Beach
Coffs Harbour
Sawtell
Bucca Road
Coast Range
Pacific
Coramba Rd
Campbells Beach
Bellingen
Pacific Hwy
North Beach
Urunga
Valla Beach
Tasman Sea
Nambucca Heads
Bowraville
Bellingen Rd
Nambucca River
Forster Beach
Macksville
Forest Way
Snowy Range
Horseshoe Rd
Kalang Rd
Comara Range
Five Day Trail
Koselar
Upper Arm Road
Hickeys Creek Rd
Comara
Armidale
Millbank
South West Rocks
Smoky Cape
Mines Rd
Carrai Road
Warbro Rd
Willawarrin
Willi Rd
Collombatti Road
Pacific
Hat Head
Not for navigation
Use listed maps
Hema maps
www.hemamaps.com
Arterial: Sealed; Unsealed
Local Road: Sealed; Unsealed
Track, Easy
Management Vehicle Track
Bikeway Walkway
Native Well; Pool; Rockhole; Spring; Waterfall; Waterhole; Waterpoint; Soak
Proposed Great Koala NP
0 5 10 mi
0 10 20 km

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Our Ref: Forest NSW & Koala
Plan of Management
MF:js

8 March 2018

The Hon Paul Toole, MP
Minister for Lands and Forestry
NSW Government
GPO Box 5341
SYDNEY NSW 2001

Dear Minister

Regional Forestry Agreements – Council Submission

The NSW and Commonwealth Governments recently invited stakeholders to a briefing regarding future Regional Forest Agreements (RFAs). A report was submitted to Council at its meeting of 28 February 2018 providing details relative to the process along with key issues of concern, recommending the contents of a submission to government in the matter.

Council wishes to make submission as follows:

That Council register its objection to a new 20 year agreement being entered into without any provision for the payment of local government rates on State Forests despite the fact they are a commercial enterprise; cause significant damage to council road and bridge networks; and provide unfair competition to private forestry which does pay rates.

That Council strongly advocate to the NSW government that the Regional Forest Agreement renegotiation process is used as an opportunity to set aside meaningful, movement corridors for Koalas in State Forest estate that integrate with, and build upon, the work undertaken by Bellingen Shire Council in identifying linkage areas on private areas of land within Bellingen Shire.

That Council strongly advocate to the NSW government that the NSW Governments north coast climate change projections of increased rainfall depths and increased erosion, are reflected in the new North East Regional Forest Agreement through the development of revised operating procedures for forestry in the north coast region. Specifically, the revised operating procedures should increase the required setbacks between forestry operations and riparian features, and further limit forestry operations on land with high slopes and erosive soils, in order to minimise the likelihood of sediment entering watercourses as a result of forestry operations.

That Council strongly advocate to the NSW Government the necessity for the establishment of an additional consultative process specifically with Local Government, given the issues outlined in this report and concerns generally around economic benefit such as jobs within the shire, and processing arrangements for timber as well as environmental protection.

I would welcome the opportunity to discuss these important matters further at your convenience.

Yours faithfully

Dominic King
MAYOR

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Forestry Corporation

CF2017/015

Ms Liz Jeremy
General Manager
Bellingen Shire Council
PO Box 117
Bellingen NSW 2454

Dear Ms Jeremy

Forestry Corporation of NSW (Forestry Corporation) has recently been approached by the neighbouring Nambucca Shire Council, who had received a proposal to convert some areas of State forest into a national park and resolved to seek information from Forestry Corporation on the impact of this proposal.

I note that Bellingen Shire Council discussed the same proposal in its 23 August 2017 meeting and made a similar resolution, so have taken the opportunity to enclose a copy of my advice to Nambucca Shire Council for your information and consideration.

We would be happy to extend to you the same offer that has been made in that letter to address council and respond to any additional questions you or your councillors may have in person, if that would be of assistance.

If you would like further information, or to arrange a meeting, please contact Senior Planning Manager Dean Kearney on 6656 8800.

Yours sincerely

25 SEP 2017

Nick Roberts
Chief Executive Officer

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Forestry Corporation

CF2017/0012

COPY

Mr Michael Coulter
General Manager
Nambucca Shire Council
PO Box 177
MACKSVILLE NSW 2447

Dear Mr Coulter

Thank you for your letter of 26 August 2017 seeking information on the impact of a proposal by the National Parks Association (NPA) to convert 185,179 hectares of productive State forest between Kempsey and Woolgoolga to National Park.

I have addressed the range of issues raised in your letter in turn below.

Koalas and forestry
Koala populations have lived alongside timber production in State forests for more than 100 years and there is no scientific evidence that points to a decline in koalas in NSW State forests. A substantial body of research shows the main threats to koalas are drought, disease, fire and permanent land clearing for urban development, where koalas become vulnerable to increased car activity and dog attacks and their habitat is replaced by houses. This is recognised in the Chief Scientist's recent report into the decline of koala populations in key areas in NSW.

State forests, National Parks and areas of privately owned forests all contribute to a large continuous network of koala habitat across the landscape. Recent research published last year showed that there were more than 1.5 million hectares of moderate and high quality koala habitat across northern NSW and only around 14 per cent of this is in the timber production areas of State Forests.

Furthermore, surveys in State forests using new vocal recognition devices last year detected very strong koala occupancy right across the northern NSW forests. In this study, Koalas were detected in areas that had been harvested for timber both recently and historically at an equal rate to areas where no timber harvesting had occurred, indicating measures to protect koalas in these timber production areas are working well.

Existing koala protections within State forests
Forestry Corporation's native forest operations only take place in regrowth forests that have been harvested for timber previously and regrown. Timber harvesting in these State forests is tightly regulated to ensure thorough searches are completed for evidence of

koala habitat, continuous areas of habitat and feed trees are retained throughout productive forests and harvested areas are quickly regenerated to provide ongoing habitat and a future supply of timber. Around one per cent of the State forest estate is harvested in any given year and harvested areas are quickly regenerated to ensure there remains a mix of young and mature forest across the landscape, supporting a diversity of wildlife.

Tourism and Indigenous uses in State forests

State forests are managed for a wide range of uses including tourism, biodiversity and Aboriginal cultural heritage. Tourism in State forests is already actively promoted and Forestry Corporation is regularly recognised in local and state tourism awards. Forestry Corporation has strong partnerships with local Aboriginal communities and has for many years facilitated community management of significant places and access to cultural materials. More recently, Forestry Corporation has been working with local Aboriginal communities to develop cultural tourism opportunities and carry out traditional cultural burning. Tourism opportunities in State forests are distinct from those offered in National Parks and include camping with pets, horse riding, trail bike riding, four wheel driving, hunting, organised events such as car rallies, including the World Rally Championships, and club activities such as archery.

Impact on timber production and other activities

The area subject to the NPA's proposal contains about half of NSW's blackbutt resource and around a third of the State-owned hardwood timber plantations in NSW. Blackbutt timber is highly sought after by timber processors and consumers and, along with other hardwood species from native forests and plantations, is critical to the operations of processors on the north coast, from Herons Creek to Grafton.

Timber from the forests and plantations in the proposal area is used to create specialised products not readily produced elsewhere, including high quality flooring and decking timbers suitable for external use in bushfire prone areas and power poles, with lower-grade timber also used in pallets for transporting goods and as commercial firewood. All of these timber products are renewable and can be used in place of carbon-intensive alternatives such as concrete, steel or plastics.

Significant areas of State forests are also available to local farmers and businesses under permit for commercial activities such as grazing and bee keeping and Forestry Corporation offers low-cost permits for domestic firewood collection, providing affordable home heating to local communities. These opportunities are generally not permitted in National Parks.

Impact on local sawmills

I note that you have expressed a particular interest in the potential impact this proposal would have on sawmills on the Nambucca Shire. While Forestry Corporation supplies timber to local mills and I have noted above that it is critical to their operations, they are privately owned and managed businesses and Forestry Corporation cannot provide any specific information on their behalf. I would encourage you to contact Timber NSW, which

COPY

represents many hardwood sawmills on the north coast, or the sawmills directly to seek this information from them.

Further Information
If you would like any further information, please don't hesitate to contact Senior Planning Manager Dean Kearney on 6656 8800. We would also be happy to address council and respond to any additional questions you or your councillors may have in person, if that would be of assistance.

Yours sincerely

25 SEP 2017

Nick Roberts
Chief Executive Officer

The Folly of Logging on Steep Erodible Slopes, 2 Case Studies.
Dailan Pugh, NEFA

There have been two significant past events within the area now proposed for logging on highly erodible steep slopes by the Forestry Corporation. As an outcome of these events logging was excluded from the steepest and most highly erodible and unstable slopes throughout NSW. It is outrageous that the NSW Government is now intending to allow the Forestry Corporation to resume logging in such extreme risk areas.

In 1989 Justice Hemmings found that logging on slopes over 25° in part of Mistake SF was likely to have significant environmental impacts and restrained the Forestry Commission from logging on such slopes until they prepared an Environment Impact Statement. In 1992 Justice Hemming's concerns were proved to be well founded when a relatively small operation in part of Oaks SF resulted in over 88,000 tonnes of soil being eroded into the headwaters of the Bellinger River. It was this later case that established the need for licensing of Forestry Commission's logging operations. Parts of these sites are now protected in national parks, though they emphasise the real and extreme risks of allowing logging on the steep slopes in this region.

In Bailey vs Forestry Commission of NSW Justice Hemmings (1989) found that logging on slopes over 25° in Mistake State Forest was likely to have a significant environmental impact and must be stopped until an Environmental Impact Statement was prepared, stating:

> *... I am satisfied that the proposed logging operations of the Forestry Commission and the contractors must be likely to pose a substantial threat to landscape stability in the subject area in the longer term. This is a consequence of the potential in this area for rains of high intensity, duration and prevalence on land which has long slopes in the elevated parts of the catchment, and which are potentially readily reactivated, erosion prone drainage systems.*
>
> *... in the up river forest where the surface soil was removed and the sub-soil exposed it must be likely to be highly erodable, particularly as a result of logging and tracks on slopes over twenty-five degrees. The Standard Erosion Mitigation Conditions imposed on the operations by the Forestry Commission are likely to be unsuitable guidelines for erosion control in the steeper catchments in the Mistake State Forest. ...even if the Standard Erosion Mitigation Conditions were conscientiously applied, it was very doubtful whether they would hold such exposed soils and prevent the formation of gullies and continuing generalised erosion.*
>
> *... I consider that the most serious matter is the likelihood of soil erodability in steep country ...*

In April 1992 the North East Forest Alliance blockaded a logging operation at Mount Killekrankie (Oakes SF) in the New England Wilderness to halt horrendous logging and roadworks that were causing massive erosion and pollution of the Bellinger River. CaLM (1992) investigated the complaints for the Forestry Corporation and found numerous violations of the Standard Erosion Mitigation Conditions, including 26 incursions into streamside protection areas, pushing of soils into watercourses, unmapped drainage lines "did not obtain special protection", logging occurred on mapped "steep slideslopes", 86 required cross banks were not constructed, 179 cross banks were inadequate or failed, snig track grades were exceeded on 82 readings, snig tracks were constructed on side slopes in excess of 30° on 220 occasions, and a log dump was constructed in a drainage line (to name just a few). CaLM (1992) noted:

> *In total this represents an estimated 88,140 tons of soil lost from the batters and tracks of these compartments. If it was necessary to carry that tonnage out of the forest in trucks it would take 8,814 loads or at one truck per hour over a 40 hour week it would take over 7 months to remove that volume of fill.*

As has been found on innumerable occasions, CaLM also found that part of the problem is that

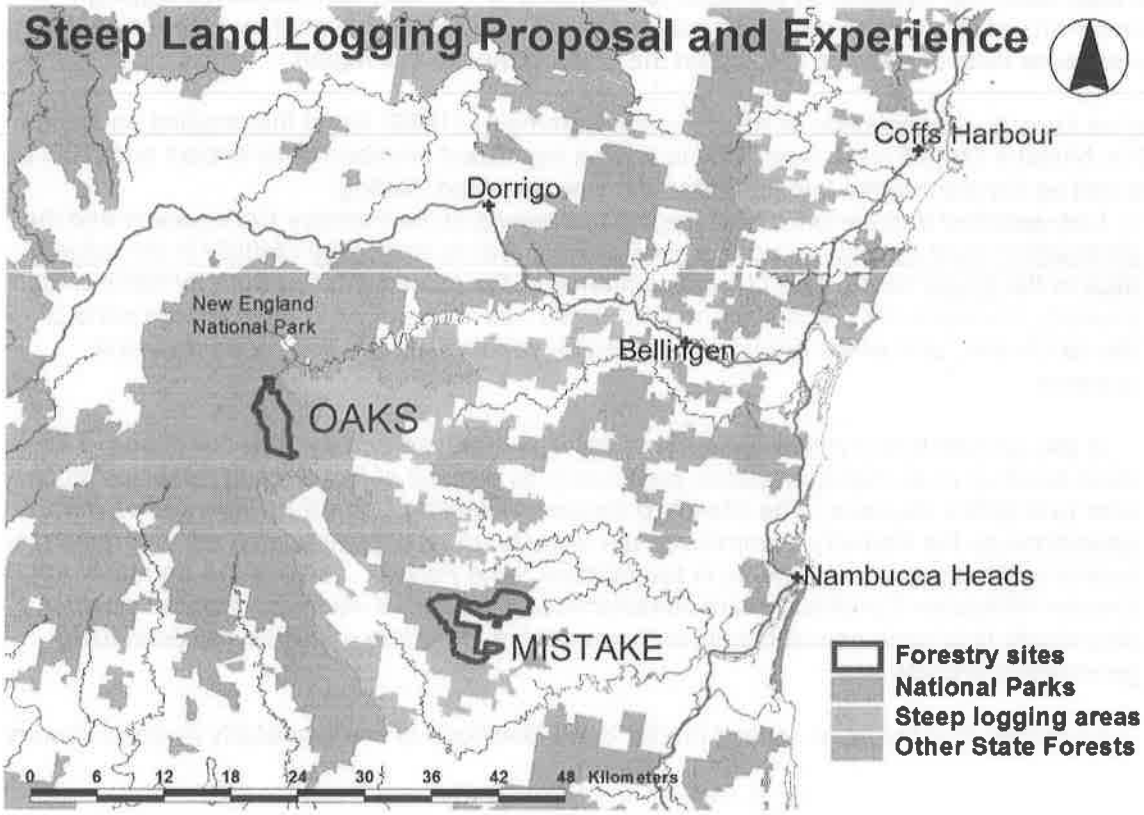
neither the contractors nor the Forestry Commission implemented the legal requirements, noting:

It was apparent that the operator had no understanding of the standards with which he was obliged to comply.

The supervisor, likewise

- *had no understanding; or*
- *did not check or see the operation; or*
- *if he did understand, was not prepared to enforce the conditions.*

The Forestry Commission was charged by the EPA with an offence of polluting waters contrary to s 16 of the *Clean Waters Act* 1970, and while the offence was proven no conviction was entered against the Forestry Commission. This case did prove the need for legally enforceable prescriptions for forestry and did result in the application of Pollution Control Licences to Forestry Commission's operations throughout NSW.



Department of Conservation and Land Management (CaLM) (1992) Soil Conservation Issues Compartments 168-170 Oakes State Forest. Prepared for the Forestry Commission of NSW.

Tim's website Rave

It's land slide country!

The areas proposed for the steep land cable logging trial are on geology known as the Nambucca Shale Beds. The rock is composed of fine marine sediment that has been uplifted, compressed, faulted and folded. As the rock weathers, the joints are lubricated by clay, mica minerals and water. This makes the rock uniquely prone to landslides, particularly on steep slopes where stabilizing vegetation is removed.

The Nambucca Shale Beds weather to fragile soils with a particularly dispersible subsoil. Any disturbance to the surface on even gentle slopes promotes gulleying and tunnel erosion where water flow penetrates the surface and washes out the dispersible clays. These then move downstream to produce turbidity and sedimentation in the streams and rivers that supply domestic and agricultural water, and then on into the marine reserves and fish habitats.

Undisturbed forests mediate runoff water flows. When vegetation is removed from slopes, drought water levels become lower and flood peaks higher.

Mount Killiekrankie

In April 1992 NEFA blockaded a logging operation at Mount Killekrankie (Oakes SF) in the New England Wilderness to halt horrendous logging and roadworks that were causing massive erosion and pollution of the Bellinger River. Dept of Consservation and Land Management (CaLM) (1992) investigated our complaints and found numerous violations of the Standard Erosion Mitigation Conditions

(SEMCs), including 26 incursions into
streamside protection areas, pushing of soils into watercourses, unmapped drainage lines "did not obtain special protection", logging occurred on mapped "steep slideslopes", 86 required cross banks were not constructed, 179 cross banks were inadequate or failed, snig track grades were exceeded on 82 readings, snig tracks were constructed on side slopes in excess of 30o on 220 occasions, and a log dump was constructed in a drainage line (to name just a few). CaLM (1992) estimated soil losses were 3,300 tons from snig tracks, at least 17,140 tons from snig track batters, and 67,700 tons from road batters, noting:

In total this represents an estimated 88,140 tons of soil lost from the batters and tracks of these compartments. If it was necessary to carry that tonnage out of the forest in trucks it would take 8,814 loads or at one truck per hour over a 40 hour week it would take over 7 months to remove that volume of fill.

Nefa Submission to: Remake of the Coastal Integrated Forestry Operations Approvals, Discussion Paper prepared by Dailan Pugh for North East Forest Alliance April 2014 p. 43

Land and Soil Hazards on the Nambucca Beds, Northeast NSW

Michael Eddie

March 2018

Senior Soil Scientist (retired), formerly of the Science Division, NSW Office of Environment and Heritage.

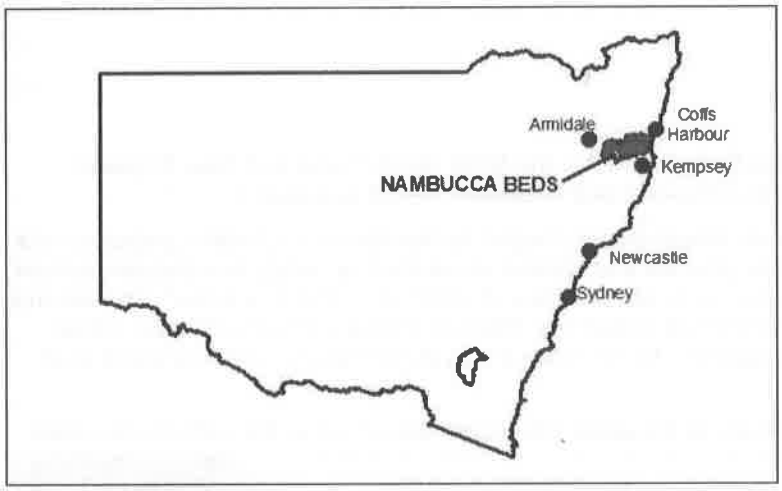
Author, Eddie M.W. (2000). *Soil Landscapes of the Macksville & Nambucca 1:100 000 Sheets*, DLWC, Sydney.

Member, Australian Soil Science Society.

INTRODUCTION

This report was commissioned by Mr Ashley Love of the Bellingen Environment Centre, on behalf of the North Coast Environment Council (NCEC), due to concerns about proposed logging activities on steep land by the NSW Forestry Corporation in river catchments on the Nambucca Beds on the NSW mid north coast. The concerns primarily relate to the impacts of proposed forestry operations in the steep headwaters on soil erosion and its effects on pollution and sedimentation in downstream waterways.

Figure 1. Location.



Two reports were recently commissioned regarding logging risks in the upper Nambucca and Kalang catchments—

1. A report was commissioned through the Environmental Defender's Office on behalf of Ms Joy van Son, landowner, in relation to her concerns about the adequacy of the methods proposed to be used by the Forestry Corporation of NSW (FC) to assess the impacts on soils and downstream waterways of proposed forestry operations in Mistake State Forest in the upper Nambucca catchment (Eddie, 2017a).
2. A report was requested by Mr Ashley Love (Bellingen Environment Centre), who represented residents concerned about proposed logging activities on steep land by the Forestry Corporation (Forestry Corporation of NSW, 2017) in the Oakes, Roses Creek and Scotchman State Forests in the headwaters of the Kalang River catchment (Eddie, 2017b).

Logging and associated erosion and mass movement on steep land in Oakes SF was investigated by Atkinson *et al* (1992).

Residents downstream of these State Forests are concerned that the soil assessment methods used to prepare the draft Harvest Plans are inadequate and that Forests NSW might not sufficiently adhere to them. These are termed "Methods for assessing the soil erosion and water pollution hazard associated with scheduled and non-scheduled forestry activities" (Soil and Water Methodology). The

current version of the Soil and Water Methodology can be found at Schedule 3 of the Lower North East Region Environmental Protection Licence (EPL), which is Attachment A to the IFOA.

The most severe impacts occur on the underlying Nambucca Beds geology, which have been identified as having especially severe erosion and mass movement hazards. The Nambucca Beds cover all of the Kalang River catchment, most of the Bellingen and Nambucca catchments and much of the middle Macleay in the Macleay Gorges (Map 2).

State Forests on the Nambucca Beds are the Buckra Bendinni, Gladstone, Irishman, Lower Creek, Mistake, Nulla-Five Day, Oakes, Pee Dee, Roses Creek, Scotchman, Styx River, and Thumb Creek State Forests. Forestry operations in these State Forests are currently regulated by the Integrated Forestry Operations Approval for the Lower North East Region (IFOA).

This report will—

- Focus on the steep mountainous terrain on the Nambucca Beds;
- Address the critical nature of soils and regolith on the Nambucca Beds and the special case to be made for the Nambucca Beds with regard to erodibility of their soils and regolith;
- Address the thresholds of settings of the Inherent Hazard Levels, and the restrictions on logging for each level, in preventing erosion and water pollution;
- Address catchment management issues.

Relevant maps are presented in Appendix 1.

PHYSICAL ASPECTS

Physiography

The area covered by the Nambucca Beds falls within the **NSW North Coast** and **New England Tablelands** Biogeographic Regions (Thackway and Cresswell, 1995). See Map 1.

The IBRA **New England Tablelands** Biogeographic Region is described as "Elevated plateau of hills and plains on Palaeozoic sediments, granites and basalts; dominated by stringy bark/peppermint/box species, including *Eucalyptus caliginosa*, *E. nova-anglica*, *E. melliodora* and *E. blakleyi*". The relevant Subregions of the New England Tablelands include the Armidale Plateau, Walcha Plateau, Carrai Plateau and Round Mountain Subregions. The Armidale and Walcha Plateaus can be treated as a single unit (Tablelands).

Figure 2. Steep ridge and ravine terrain of the upper Nambucca catchment in the Coffs Escarpment.

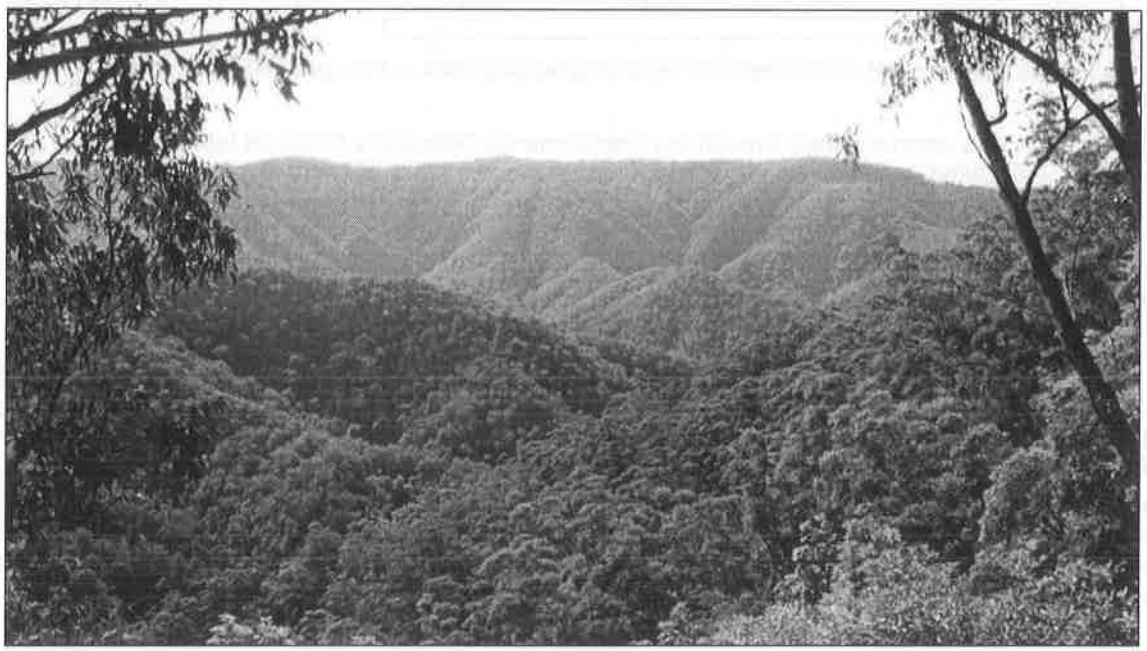


Figure 3. Precipitous terrain at Wollomombi Falls at the head of the Macleay Gorges below the Armidale Plateau.

The **Armidale – Walcha Plateaus** occur on mostly undulating with some steeper areas associated with scattered small hills and some strongly dissected terrain adjoining the Macleay Gorges. Some flat to very gently undulating plains also occur (King, 2004). Elevation is from approximately 800m rising to 1500m.

The IBRA **NSW North Coast** Biogeographic Region is described as "Humid; hills, coastal plains and sand dunes; *Eucalyptus - Lophostemon confertus* tall open forests, *Eucalyptus* open forests and woodlands, rainforest, *Melaleuca quinquenervia* wetlands, and heaths". This is a complex Region; the relevant Subregions of the NSW North Coast include the Coffs Escarpment, Macleay Gorges, Macleay - Upper Manning and Nambucca – Macleay Subregions.

The **Coffs Escarpment** subregion occurs below the Ebor – Dorrigo Plateau west to the Armidale Plateau. Drainage is south to the mid-Macleay River and east to the Bellinger – Nambucca catchment. The terrain is predominately rolling to very steep dissected mountain slopes, dominated by ridge and ravine terrain of narrow ridges and deeply incised valleys with interlocking spurs (Eddie 2000). Slope gradients range from 25% to 60 - 70%, local relief is 150m rising to 1,000m, and elevation range from 1,500m at Point Lookout down to 100m near the coast. Ridge crests are narrow (50 - 150m), and sideslopes are long to very long (800m to up to 3,000m). The long side-slopes often comprise the colluvial footslopes to steeper upper slopes and ridges. Rock outcrop is uncommon, but there may be areas of talus slopes. More detailed information on physiography is provided in McGarity (1988).

The **Macleay Gorges** are narrow escarpments of the Macleay River and its tributaries and are actively retreating into the New England Tablelands. Terrain is comprised of deeply incised valleys with talus slopes, bedrock confined streams, cliffs and steep to precipitous sideslopes and footslopes. The gorges begin as small gullies on the Tablelands, then widen downstream to 11 km wide below the Carrai Plateau. Rivers which enter the gorge do so by way of waterfalls and other steep entry points (King, 2004). Much of the Macleay Gorges are reserved in the Oxley Wild Rivers National Park and the Macleay Gorge Wilderness area, and World heritage listed as part of the Central Eastern Rainforest Reserves (Australia).

Because of their mountainous terrain, this report will focus on the **Coffs Escarpment** and **Macleay Gorges** subregions. The complexity of this terrain exerts a major influence on climate and therefore on vegetation communities.

Geology

The Nambucca Block or Nambucca Slate Belt is a major structural unit in the eastern part of the New England Fold Belt (Brownlow et al., 1988), faulted against the Coffs Harbour Block to the north and the Hastings Block to the south. It comprises moderately to intensely folded and Late Carboniferous to Early Permian metasediments, and generally interpreted as products of accretionary prism accumulation east of a northerly-trending volcanic arc and fore-arc marine basin. Intense orogenic deformation occurred during the Late Permian, characterised by regional dynamic and thermal metamorphism, most intensely in the core of the belt. The distribution of lithologies is complex, owing to large-scale displacement. The Nambucca Beds (Pn) are a major component (Gilligan *et al.*, 1992; Leitch, 1978; Lennox & Roberts, 1988).

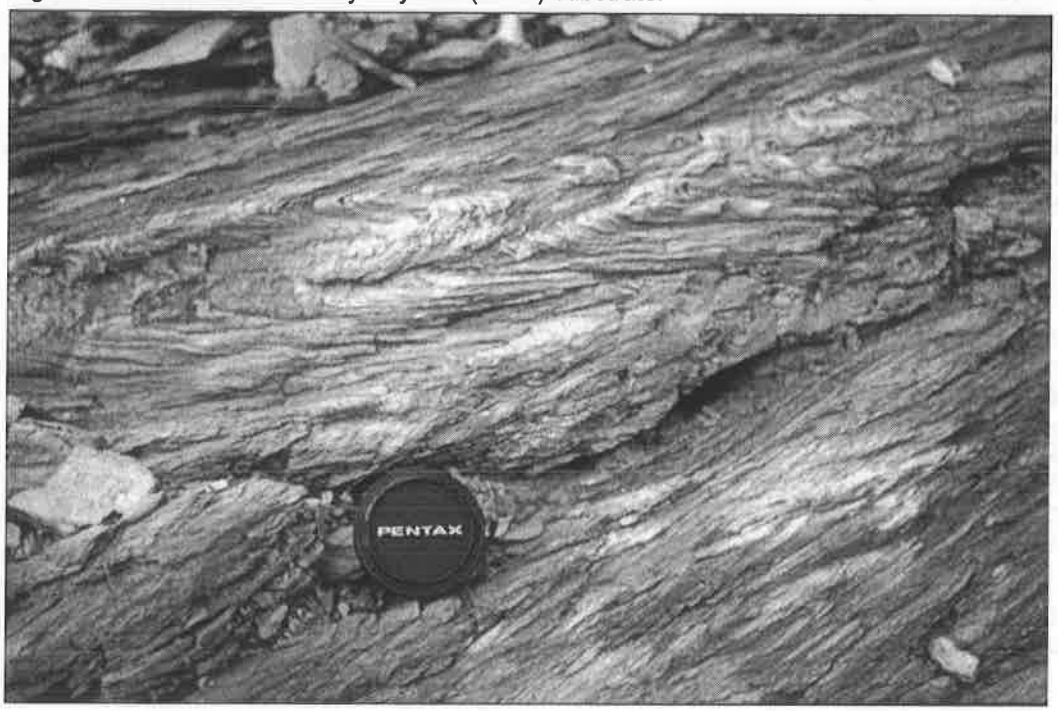
The Nambucca Beds are Permian metasediments, at least 3 - 4km thick. The lower Nambucca Beds (Parrabel Beds, Pnpx) are dominated by diamictites. The upper Nambucca Beds (Bellingen slate, Pnbf; Five Day phyllites, Pnfm; Pee Dee Beds, Pnpf) are dominated by fine-grained sediments with conspicuous soft micaceous sandstones and siltstones. Rocks are moderately to intensely cleaved, fractured and deformed, with schistose foliation especially in shear zones. Higher-grade metamorphism occurred in the "Bowra culmination" in the central region, a reflection of greater uplift of the slate belt compared with the periphery. The total area of the Nambucca Beds is 5,137 km^2.

Injected quartz veins are distinctive and very common. Slip planes (which may be indicated by the presence of springs) may form when substrate dip angles are parallel to the ground surface, and when quartz veins occur in deeply weathered substrate. There are some Tertiary basalt caps (Tb) on some high ridges. More detailed information is provided in McGarity (1988).

Other geological units within the area covered by the Nambucca Beds, which are not under consideration in this report, are Triassic granitic batholith intrusions (Round Mountain, Carrai, etc), Tertiary volcanics (Ebor basalts), and Quaternary sediments (coastal and riverine).

Regolith on the Nambucca Beds is weathered rock of weak strength, with up to 4 m depth of strongly weathered silty clays (often deep red, with mottling at depth) on colluvium and footslopes in areas of weathered substrate, to very shallow on ridges and upper slopes. Soils developed on the deep regolith are red, strongly structured, and with weak texture contrast. Soils are acidic clays and slaking when wet but generally moderately fertile. Mica flakes impart silty textures to the soil materials. Quartz gravels are common as surface lag deposits (Eddie, 2000).

Figure 4. Detail of the Five Day Phyllites (Pnfm) substrate.



Soil landscapes

The soil landscapes in the area have been mapped at regional scale (1:100,000) by Eddie (2000) and King (2004), and at reconnaissance scale (1:250,000) by the NSW Comprehensive Regional Assessments (1999). Soil landscapes are indicative at the scale of mapping and enlarging the map cannot be expected to reveal further information, and it will produce distortions whereby map boundaries will no longer correspond to boundaries on-the-ground.

The mountainous area has been mapped as the Snowy Range (sn), Macleay Gorges (mg) and Mistake (mk) soil landscapes (Table 1). Mountainous terrain is defined as land with local relief of greater than 300 metres; this comprises 46% of the area of the Nambucca Beds.

Soil landscapes with slopes greater than 20° are Snowy Range (sn) and Macleay Gorge (mg). These are 50% of the total area of the above SFs, and 46% of the total area of the Nambucca Beds. Slopes above 20° are increasingly prone to mass movement and erosion hazards.

The Styx River SF is partly on the Armidale Tablelands and has the lowest proportion of mountainous terrain (Table 2).

Table 1. Soil landscapes of the mountainous terrain.

Soil landscape	IBRA Subregion	Slope class	Terrain	Area (km^2)	Percent on Nambucca Beds
Snowy Range (sn)	Coffs Escarpment	>30°	Ridge and ravine terrain. Very steep to precipitous rectilinear slopes.	1,498	29%
Mistake (mk)	Coffs Escarpment	15-30°	Rolling to steep slopes; long side-slopes and footslopes below Snowy Range (sn).	1,035	20%
Macleay Gorge (mg)	Macleay Gorges	>30°	Ridge and ravine terrain. Very steep to precipitous rectilinear slopes in deeply incised gorges.	885	17%
			Totals	3,588	70%

Soils

Soils in the Coffs Escarpment are described by Eddie (2000) as well drained, stony, shallow to moderately deep, Red Dermosols (Brown Earths) widespread on side-slopes on weathered substrate, with deep well drained Red Ferrosols and Red Dermosols (Krasnozems) on colluvium, and shallow Paralithic Leptic Rudosols and Paralithic Tenosols (Lithosols) mainly on upper slopes.

Major soil types of the Macleay Gorge (King 2004) are Rudosols (Lithosols) and other shallow soils such as Red Kurosols (Red Podzolic Soils), Yellow Kurosols (Yellow Podzolic Soils), Yellow Chromosols (Yellow Podzolic Soils) and Yellow and Red Kandosols (Yellow and Red Earths).

These soils are spatially heterogeneous according to variations in parent material lithology and mineralogy, weathering and mass movement history; this is in accordance with the views of McGarity (1993c). Beavis (2009) provided a comparison of previous and current soil assessments.

Weathering of mica flakes imparts silty textures to soils and are slaking when wet. There is often a stone line between the A and B horizons, which indicates a colluvial history, and quartz gravels are common as surface lag deposits.

Table 2. Proportional areas of mountainous terrain within each State Forest on the Nambucca Beds.

State Forest (SF)	Area (km²)	Soil landscape	Area (km²)	Percent of SF	Slopes > 20°		Percent of SF in mountainous terrain
					Area (km²)	Percent	
Buckra Bendinni	17.6	Mistake (mk)	12.9	74%	4.7	26%	100%
		Snowy Range (sn)	4.7	26%			
Gladstone	68.2	Mistake (mk)	8.0	12%	26.7	39%	51%
		Snowy Range (sn)	26.7	39%			
Irishman	27.3	Mistake (mk)	13.1	48%	13.2	48%	96%
		Snowy Range (sn)	13.2	48%			
Lower Creek	12.7	Snowy Range (sn)	12.7	100%	12.7	100%	100%
Mistake	51.2	Mistake (mk)	24.5	48%	26.0	51%	99%
		Snowy Range (sn)	26.0	51%			
Nulla-five Day	32.4	Mistake (mk)	4.7	15%	27.4	85%	99%
		Snowy Range (sn)	27.4	85%			
Oakes	76.2	Mistake (mk)	21.2	28%	53.8	71%	98%
		Snowy Range (sn)	53.8	71%			
Pee Dee	0.6	Mistake (mk)	0.6	100%	0.0	0%	100%
Roses Creek	30.7	Mistake (mk)	12.0	39%	16.9	55%	94%
		Snowy Range (sn)	16.9	55%			
Scotchman	31.4	Mistake (mk)	3.0	10%	9.6	31%	40%
		Snowy Range (sn)	9.6	31%			
Styx River	163.8	Macleay Gorge (mg)	32.3	20%	70.8	43%	46%
		Mistake (mk)	5.1	3%			
		Snowy Range (sn)	38.5	23%			
Thumb Creek	40.8	Mistake (mk)	27.9	68%	12.8	31%	100%
		Snowy Range (sn)	12.8	31%			

Native vegetation

In the Coffs Escarpment, tall open forests (wet sclerophyll forest) of the *Eucalyptus pilularis - E. microcorys* suballiance (Hager and Benson, 1994) are common, with a *Corymbia intermedia - E. acmenoides* suballiance on exposed sites, and *Argyrodendron actinophyllum* subtropical rainforests (Floyd 1990) on sheltered slopes. The *Eucalyptus campanulata* alliance occurs above about 700m elevation, merging to subtropical rainforest of the *Sloanea woollsii - Dysoxylon fraserianum* -

Argyrodenron actinophyllum - Caldcluvia paniculosa suballiance. The *Eucalyptus grandis* suballiance occurs on sheltered lower slopes (Eddie, 2000).

In the Macleay Gorges, open woodland to open forest communities of the *Eucalyptus tereticornis - E. laevopinea - E. melliodora - Angophora floribunda* suballiance are dominant. Areas of dry rainforest are to be found on sheltered hillslopes and gullies and more commonly in incised drainage depressions and valley lines, on gradients of moisture, exposure and soil depth. Species composition is variable according to location. They are dominated by the *Backhousia sciadophora – Dendrocnide – Drypetes* and *Alectyron forsythii - Notelaea microcarpa - Olea paniculata* suballiances (Floyd 1990). Some more exposed slopes and rocky sites and on talus slopes have small stands of shrublands and vine thicket with *Pomaderris lanigera*, *Olearia elliptica*, *Cassinia quinquefaria*, *Prosanthera lasianthos*, *Bursaria spinosa* and *Acacia diphylla* (King, 2004).

Climate and Hydrology

Rainfall is summer-dominated, with a marked spring dry season and summer-autumn wet period. This pattern is fairly reliable in its relative monthly distribution whether in drought or wet years. About 60% of average annual rainfall occurs in the five-month period between December and April. Drier conditions are experienced between July and November with only about 30% of annual rainfall occurring during that five-month period. Thunder storms break the spring droughts usually in November and continue through the summer, building up convectively on hot summer days or accompanying the passage of cold fronts through the area. There are very intense orographic effects. Microclimatic effects due to relative exposure produce cooler and wetter conditions on southerly and easterly aspects, especially in the deep valleys of the ranges, and there is a strong rainshadow effect in the Macleay Gorges. Drainage lines are closely spaced (80 - 300m), low order tributary, trellised, convergent and eroding. McGarity (1988) provided further information on climate.

Rainfall

Average annual rainfall ranges from 900mm per annum in the upper Macleay Gorges and 900 – 1,300mm on the Tablelands, while the Coffs Escarpment receives 1,000mm on the lower slopes and alluvial flats and up to 2,000mm at the top below the Dorrigo Plateau (B.o.M., 1997). See Map 3.

Rainfall Erosivity

Rainfall erosivity is a critical issue to land management in the mountainous terrain. High intensity rainfall is generally associated with cyclonic depressions occurring off the NSW north coast during summer. Over a 30 minute period the intensity of rainfall can vary from 40 mm/hr for a one-year return period up to 145 mm/hr for a 100-year return period (State Forests, 1993). On average, rainfall intensities of 75 mm/hr for a 30 minute period can be expected to occur within a five-year period. Total rainfall of 200mm over a 24hr period is not uncommon. Under these conditions extensive runoff and flooding can occur, resulting in significant property damage.

Rainfall erosivity is a measure of the ability of rainfall to cause soil erosion. Average annual rainfall erosivity (USLE R-factor) has been calculated from rainfall statistics and mapped for NSW (Rosewell and Turner, 1992). There is a progressive increase in rainfall erosivity from about 1,500 in the Macleay Gorges to 7,000 in the Coffs Escarpment (Map 4). Rainfall erosivity, like rainfall, is heavily skewed towards the summer months. Rosewell and Turner (1992) demonstrated that a high percentage of erosive rainfall occurs in the four months from December to March. Rainfall erosivity in the study area is very high (R 5000), which results in very high rates of runoff.

Erosion

Moderate to severe sheet and rill erosion with minor gully erosion has been observed on steep slopes associated with road works and forestry operations (Milford, 1995; Eddie, 2000). Soils are especially erodible due to the weathered mica flakes which impart silty textures to the soil materials, and induces slaking when wet.

Figure 5. Sheet erosion and roadside slumping.

Mass Movement

The Nambucca Beds are especially prone to mass movement. Slip planes may form with shear failure of steeply dipping decomposed phyllites and slates (Atkinson *et al.*, 1992), and with water entering deeply weathered regolith via quartz veins (Baker *et al.*, 1983). This is exacerbated where the shear plane is dipping in the direction of the slope (McGarity, 1988). Slip planes may be indicated by the presence of springs; mass movement may be identified by hummocky terrain.

Mass movement hazards increase with slope gradient, from about 20° upwards, although some slopes on the Nambucca Beds have been observed to be susceptible to mass movement on gradients as low as 7° (Eddie, 2000). This is because the deep regolith which can be hydrostatically loaded with groundwater following rain; this tension is released as mass movement when disturbed.

Debris avalanches occur on slopes greater than the natural angle of repose of unconsolidated sediment (about (25°), creating talus slopes. Ground disturbance on steep slopes risks re-activating old landslips. Large-scale slips and debris avalanches are quite common on the very steep slopes in the ranges, particularly where road cuts occur; slumping of subsoils in road batters is common, as observed by McGarity (1988).

Streambank erosion and sedimentation

The offsite consequences of erosion and mass movement are potentially severe, as sedimentation and pollution of downstream waterways. McGarity (1988) observed that eroded material, especially from gullies and mass movement events, moves into drainage lines with the finer sediments being transported away, and the coarser gravels and boulders accumulating in the bed of the channel. Slumping of subsoils in road batters is a common source of sediment movement into streams. Stream sedimentation occurs when debris is transported at high energy and then deposited in channels of lower energy, while the suspended clays and silts are transported further and therefore contribute to turbidity in waterways. It is likely that this would contribute to changes in the flow characteristics of the streams.

An estimated 46% of land within the Nambucca Beds (based on soil landscape mapping) is of slopes gradients greater than 20°. Erosion hazards increase closer to the Great Escarpment where rainfall erosivity is greater.

McGarity (1993a) stated that erosion of stream banks increases the sediment load "although the importance of this factor is unknown". The accumulation of woody debris in drainage lines also alters stream flow at times of high runoff and further destabilised stream banks.

EROSION HAZARD ASSESSMENTS

There are four methods in use for assessing soil erodibility—

1. **Soil Dispersibility**.

   a. The **Emerson Aggregate Test** (EAT) is an eight-class classification of soil aggregate coherence (slaking and dispersion) in distilled water. It can easily be tested in the field.

   Table 3. Emerson Aggregate Test classes (Hazelton and Murphy, 2013).

Class		Result
1	Slakes	Complete dispersion
2	Slakes	Some dispersion
3	Slakes	Some dispersion after remoulding
4	Slakes	No dispersion (carbonate or gypsum present)
5	Slakes	Dispersion in shaken suspension
6	Slakes	Flocculates in shaken suspension
7	No slaking	Swells in water
8	No slaking	Does not swell

   Table 4. EAT Classes 2 and 3 can be divided into subclasses —

Subclass	Dispersion
(1)	Slight milkiness immediately adjacent to the aggregate
(2)	Obvious milkiness, <50% of the aggregate affected
(3)	Obvious milkiness, >50% of the aggregate affected
(4)	Total dispersion, leaving only sand grains.

   The subclass is put in brackets. For example, a Class 3 aggregate that disperses completely on working leaving only sand grains is noted as Class 3(4). Class 2(4) is equal to Class 1.

   b. **Dispersion percentage** (DP) is a laboratory test that estimates the proportion of the clay fraction that has dispersed (Hazelton and Murphy, 2013). DP is sometimes presented as the Dispersal Index Ratio, also known as the Ritchie Method (Ritchie, 1963), which is the inverse of DP x 100. Ratings for Dispersion Percentage is shown in Table 3.

   Table 5. Ratings for Dispersion Percentage (Hazelton and Murphy, 2013).

Dispersion Percentage	Dispersal Index Ratio (Ritchie)	Dispersibility
<6	>16	Negligible
6 – 30	3 – 16	Slight
30 – 50	2.0 – 3.0	Moderate
50 – 65	1.5 – 2.0	High
>65	<1.65	Very high

c. The **Soil Dispersibility Testing Method** prescribed in Section 3 of the EPL guidelines is a very much reduced version of the EAT. After observing the behaviour of soil aggregates in water, score—

0 for no dispersion within 2 hours;

1 for slight dispersion within 2 hours;

2 for slight dispersion within 10 minutes and complete dispersion within 2 hours;

3 for strong dispersion within 10 minutes or complete dispersion within 2 hours;

4 for complete dispersion within 10 minutes.

2. Water erodibility (USLE K factor)

The Unified Soil Loss Equation (USLE) includes a soil erodibility factor known as K (Wischmeier & Smith 1978), an index of the susceptibility of a soil sample to particle detachability through sheet and rill erosion. It is derived from particle size analysis which is done in the soil laboratory. The formula used to derive K factor is USLE modified for Australian conditions and based on that used in SOILOSS (Rosewell & Edwards 1988) with profile permeability modified to follow that used by Soil and Water Conservation Society (1993).

There are limitations in the use of the K Factor, as noted by Murphy *et al* (1998): "The USLE soil erodibility factor, K, has been shown by field experience in many situations to relate poorly to the behaviour of forest soils. The K factor relates specifically to the detachment of soil through sheet and rill erosion and not to other processes of erosion, most notably gully [and slump] erosion. The K factor also does not account for susceptibility of soil material to transport and delivery to receiving waters".

3. Soil Regolith Stability Class.

The limitations of the K factor led to the development of the Soil Regolith Stability Class. This concept has two components, coherence and sediment delivery potential, to reflect the dual requirement to assess both soil erosion and water pollution hazard at the landscape level.

This approach permits a broad scale assessment which incorporates experience and knowledge of soil behaviour for the particular landscape unit from a range of similar sites. Subsequent site assessment at the harvest planning stage will verify the accuracy of the broader scale soil regolith stability classification for particular logging compartments and describe significant variability at a more localised scale (Murphy *et al*, 1998). It is assessed by field observation and requires professional judgement.

Table 6. Soil Regolith Stability Classes (Murphy *et al*, 1998).

	Low sediment delivery	**High sediment delivery**
High coherence	**R1** High ferro-mangnesium soil regolith, eg basalt, dolerite; Fine-grained argillaceous soil regolith with high gravel content, eg siltstones, metasediments; Highly organic soil regolith, eg peats.	**R3** Fine-grained argillaceous (clay) soil regolith with low/no gravel contents; Fine-grained massive soil regolith.
Low coherence	**R2** Unconsolidated sands; Medium to coarse-grained felspathic-quartzose soil regolith, eg adamellite, quartz sandstone.	**R4** Unconsolidated deposits of silt and clay; Unconsolidated fine-grained weathered soil regolith (saprolite).

4. Inherent Hazard Assessment Levels for Native Forests.

This is presented in a matrix table and uses information from a number of sources—

a. Rainfall Erosivity (6500 in the Compartments)

b. Slope Class

c. Soil Regolith Stability Class (R3 in the Compartments).

See Table 7 below.

DISCUSSION

Assessment of dispersion

K factors for soils in the Snowy Range (sn) and Mistake (mk) soil landscapes have been calculated and presented in Milford (1995) and Eddie (2000). K factors for topsoils are low (0.005 - 0.020), while K-factors for subsoils are high to very high (0.030 – 0.080). The high K factors for subsoils is probably due to their high mica content and silty textures. The subsoils typically slake when wet. McGarity (1993a, 1993c) also found a high proportion of soils have dispersible subsoils. However, Beavis (2009) noted that K values are only meant as a guide as a regional planning tool and do not preclude the need to do more intensive soil survey for detailed planning or operations.

Of twelve subsoil samples of these soil landscapes collected by Milford (1995) and Eddie (2000), Ritchie Method dispersion results range from 4.4 (slight, on metabasalt) to 1.9 (high, on phyllite).

EAT results indicate slaking with mostly high dispersibility—

- Ten samples, class 2(1): slakes, some dispersion, slight milkiness adjacent to the aggregate (high dispersibility);
- One sample, class 3(3): slakes, some dispersion after remoulding, obvious milkiness, >50% of the aggregate (high dispersibility);
- One sample (on metabasalt), class 6: slakes, flocculates in shaken suspension (low dispersibility).

These figures are indicative only and do not necessarily represent soil profiles that may be present in any study area. However, it provides sufficient evidence for moderate to high dispersion in some subsoil samples. The key feature though is the variability of the dispersibility data, undoubtedly due to variability and unpredictability in the substrate lithology and mineralogy.

The Emerson Aggregate Test (EAT) is the minimum standard for assessment of dispersion and should be backed by Dispersion Percentage / Rithie Method.

Soil Regolith Stability Class assessment

Soil Regolith Stability Class was assessed as R1, high coherence with low sediment delivery, throughout compartments 340 and 341, consistent with the mapped regolith. Murphy *et al* (1998), p.45, 48, assigned R1 for all soils developed on the Nambucca Beds. **I believe that the Soil Regolith Stability Class has been incorrectly assigned to R1 throughout the Nambucca Beds.** Several lines of evidence indicate high sediment delivery potential because of the high erodibility of the Nambucca Beds—

1. In the Snowy Range (sn) and Mistake (mk) soil landscapes (Milford, 1995; Eddie, 2000), the **subsoils typically slake when wet** due to the weathered mica content. Slaking means that the soil particles detach readily when wet, as reflected in the moderate to high ratings for the K factors in those soil landscapes. McGarity (1993a) and Eddie (2000) found a range of dispersibility in subsoils from low to high.
2. The soils typically have a **high stone content** in the form of **quartz gravels** derived from the **injected quartz veins within the substrate**. **Surface lag gravels** are also common. The stoniness and lag gravels may have some armouring effect in resisting erosion (Murphy *et al,* 1998), but the lag gravels are present because they lag behind after the fine material has been removed by erosion. Indeed, gravel may increase erosion by reducing infiltration rates and by channelling surface flow on steep slopes (McGarity, 1993a).
3. The erodibility of the Nambucca Beds is demonstrated by the fact that they are much more subject to erosion than adjacent geological units. The Eastern Escarpment within the Nambucca Block has retreated through **differential erosion to the more resistant basement rocks** of adjacent the Coffs Harbour and Dyamberin blocks, undermining the overlying Tertiary Volcanics of the Dorrigo Plateau (Ollier, 1982). See Figure 6. This observation is supported by Milford (1995). Further, the Carrai Plateau and Round Mountain granitic batholiths have persisted against erosion by escarpment retreat or by riparian erosion by the Macleay River because of their resistant nature relative to the Nambucca Beds.
4. **Soil Regolith Stability Class R3 should therefore be applied throughout the Nambucca Beds**, because of the soils with high coherence due to the high clay content and high sediment delivery due to the slaking subsoils. The rare soils developed on metabasalt which would be

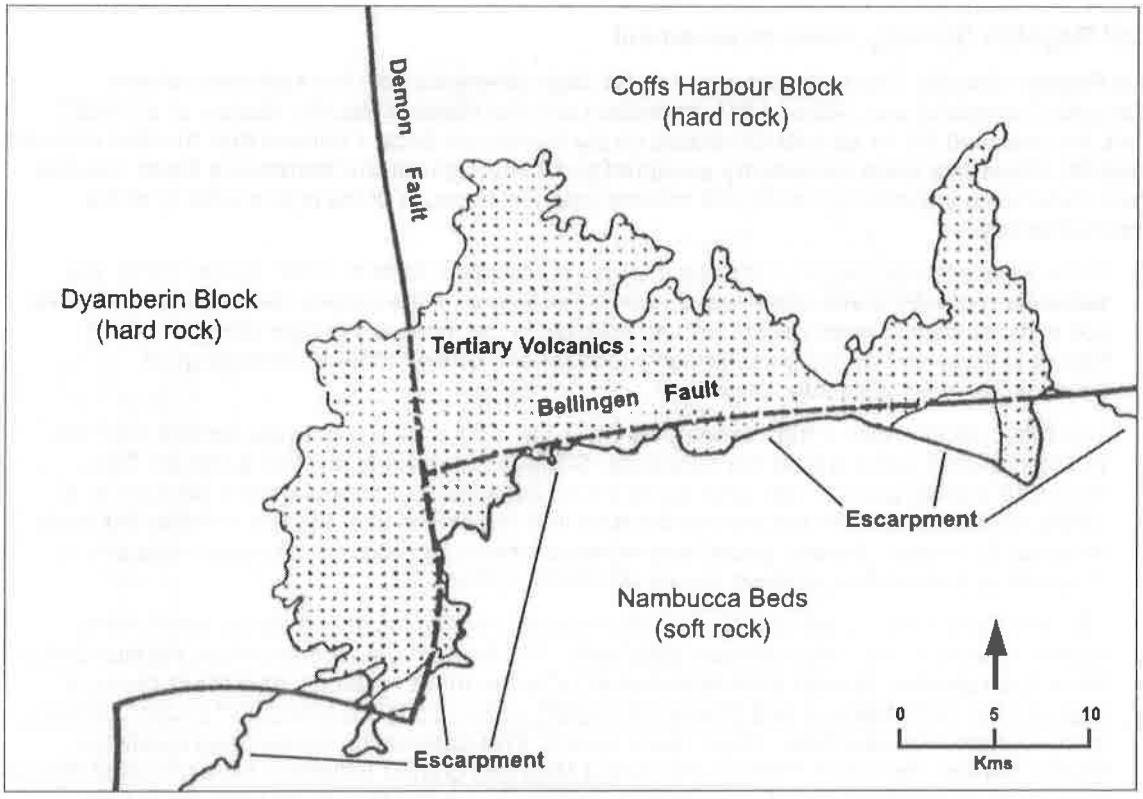
assessed as Class R1 are too rare to consider; in any case their subsoils do slake. Class R3 soil, where exposed, may display common rilling, minor gully development in drainage lines and moderate incision along road gutters (Murphy *et al*, 1998). This has been commonly observed in the field by McGarity (1993a, 1993c), Milford (1995) and Eddie (2000). Erosion on this regolith will generate material that is susceptible to transport well beyond the source and potentially into receiving waters. The R3 soils include the Red and Brown Dermosols on deeply weathered regolith with slaking subsoils (Eddie, 2000) and the Yellow Podzolic and Red Podzolic soils identified and described by McGarity (1993a, 1993c).

Mass movement assessment

The mountainous area is susceptible to significant soil erosion and mass movement hazards. This is because of the steep dissected terrain, locally deep regolith which can be hydrostatically loaded with groundwater following rain, the presence of quartz veins which can charge slip planes, metamorphic cleavage planes dip angles parallel to the slope, and high erodibility of the regolith. These carry significant risks for forestry operations. Mass movement risk is exacerbated by tree removal, which will increase the risk by reducing soil cohesiveness and increasing infiltration of water into potential slip planes. Maintaining forest cover on potential groundwater recharge sites upslope may reduce landslip risks.

Geotechnical investigation of mass movement is recommended prior to any proposed disturbance, and to be undertaken by a suitably qualified geophysical surveyor. Mass movement hazards are site-specific and must be geo-located in some way. Mapping exercises should determine mass movement risk, including where the metamorphic cleavage planes dip angles are approximately parallel to the slope. In the absence of such information, it should be assumed that all land on slopes greater than 20° is subject to mass movement.

Figure 6. The relationships between hard (resistant to erosion) basement rock, preserved volcanic rocks, and the Great Escarpment. From Ollier (1982).



Subsoil erodibility assessment

It follows that from the soil variability and unpredictability, there is expected to be variability in dispersibility. The worst case should be assumed in a conservative approach required in Schedule 3 of the EPL; McGarity (1993a) found this in his investigation in Mistake SF. Data should not be

averaged for assessment of risks. Subsoil samples should therefore be collected on representative terrain facets for—

1. The Dispersion Percentage test, which should be undertaken and tested in a NATA registered laboratory. The dispersion percentage test is the most useful, quick way of determining the degree of dispersion susceptibility (Craze and Hamilton, 2000). The results can be presented as percentage or as Dispersal Index Ratio (Ritchie Method) as in Table 3 above.
2. The Emerson Aggregate Test. The Soil Dispersibility Testing Method as prescribed in Section 3 of the EPL guidelines is inadequate. Aggregate erodibility should be determined by using the Emerson Aggregate Test as a minimum standard.
3. Soil Regolith Stability Class. Soils mapping at the compartment scale (1:25,000 to 1:10,000) should be undertaken to determine the range and variability of regolith stability; this may not necessary when in the assessor's professional judgement the Soil Regolith Stability Class is applied uniformly (in this case at R3).

Information on the EAT and DP tests can be obtained in Charman and Murphy (2000).

The special case to be made for the Nambucca Beds

As discussed above, soils developed on the Nambucca Beds are highly erodible, because of the soils with high coherence due to the high clay content, and high sediment delivery due to the slaking subsoils due to the mica content. This is consistent with Regolith Stability Class assessment of R3 (Murphy *et al*, 1998). Eddie (2017a, 2017b) noted that it is not known whether subsoil erodibility assessments had been undertaken within the compartments under consideration in the Mistake SF and State forests in the Kalang catchment.

In soil surveys for logging plans, subsoil samples should be collected on representative terrain facets. Soils should be classified according to the Australian Soil Classification (ASC) system (Isbell, 2002), and soil profile information should be provided to the NSW Office of Environment and Heritage SALIS database. Terrain and soils should be mapped at the compartment scale (1:25,000 to 1:10,000) to account for variability.

In the absence of information on soil erodibility, it should be assumed that on the Nambucca Beds—

1. **All land on slopes greater than 20° should have a high erosion rating,**
2. **All land on slopes greater than 25° should have an extreme rating (McGarity, 1993a, 1993b),**
3. **Soil Regolith Stability Class R3 should be applied to regolith on the Nambucca Beds throughout their extent.**

The thresholds of settings of the Inherent Hazard Levels

Charman & Murphy (2000) recommend against disturbance on slopes greater than 20° due to mass movement risks. Sheet and gully erosion risks are also raised with operations on slopes greater than 20°. Disturbance on slopes above this gradient risks re-activating old landslips, and mass movement may also initiate sheet and gully erosion and stream sedimentation.

On the Nambucca Beds, in the absence of such information, to limit the potential for mass movement and erosion due to surface disturbance by forestry operations, **it should be assumed that all land on slopes greater than 20° is subject to mass movement.**

As a result of this, the Inherent Hazard Assessment Levels (Table 7) are redefined for forestry operations on the Nambucca Beds (and Soil Regolith Stability Class R3), by shifting the slope risk classes (Table 8).

The Inherent Hazard Assessment Levels are—

Level 1: Low soil erosion and water pollution risk;

Level 2: High soil erosion and water pollution risk;

Level 3: Very high soil erosion and water pollution risk;

Level 4: Extreme soil erosion and water pollution risk— scheduled or non-scheduled forestry activities prohibited for the proposed method of timber harvesting and extraction.

Table 7. Inherent Hazard Assessment Levels for Native Forests, for slopes > 10°, and Soil Regolith Stability Class R3 (modified from EPA, 1997).

Forestry Operation	Rainfall Erosivity (R-factors)	Slope Classes			
		10<20°	20<25°	25<30°	>30°
Logging with greater than or equal to 50% canopy removal within the net harvestable area	0-2000	2	2	2	4
	2000-3000	2	2	2	4
	3000-4000	2	2	2	4
	4000-5000	2	2	4	4
	5000-6000	2	2	4	4
	6000+	2	4	4	4
Logging with less than 50% canopy removal within the net harvestable area	0-2000	2	2	2	4
	2000-3000	2	2	2	4
	3000-4000	2	2	2	4
	4000-5000	2	2	3	4
	5000-6000	2	2	3	4
	6000+	2	3	4	4
Native Forest Thinning Operation	0-2000	1	1	2	4
	2000-3000	1	1	2	4
	3000-4000	1	1	2	4
	5000-6000	1	2	2	4
	6000+	2	2	2	4

Table 8. Revised Inherent Hazard Assessment Levels for Soil Regolith Stability Class R3 (modified from EPA, 1997).

Forestry Operation	Rainfall Erosivity (R-factors)	Slope Classes			
		0<10°	10<20°	20<25°	>25°
Logging with greater than or equal to 50% canopy removal within the net harvestable area	0-2000	2	2	2	4
	2000-3000	2	2	2	4
	3000-4000	2	2	2	4
	4000-5000	2	2	4	4
	5000-6000	2	2	4	4
	6000+	2	4	4	4
Logging with less than 50% canopy removal within the net harvestable area	0-2000	2	2	2	4
	2000-3000	2	2	2	4
	3000-4000	2	2	2	4
	4000-5000	2	2	3	4
	5000-6000	2	2	3	4
	6000+	2	3	4	4
Native Forest Thinning Operation	0-2000	1	1	2	4
	2000-3000	1	1	2	4
	3000-4000	1	1	2	4
	5000-6000	1	2	2	4
	6000+	2	2	2	4

Therefore, because of the extreme rainfall erosivity and extreme erosion and mass movement risks on the Nambucca beds, to limit erosion and runoff and alleviate streambank erosion and sedimentation, **native forest logging is limited to slopes below 25°**.

Logging on slopes below 25° must take heed of the potential soil erosion and water pollution risks according to the Revised Inherent Hazard Assessment Levels.

Offsite effects of logging operations on steep terrain

Monitoring and reporting should be undertaken on water quality of streams entering and exiting any compartments considered for forestry operations, before, during and after forestry operations. This will provide information on any changes in water quality as a consequence of forestry operations.

Catchment hydrological modelling should be undertaken to model the surface and channel flows into, within and out of proposed logging compartments. This will provide insights to the erosion and sedimentation risks under various weather events.

Guidelines

McGarity (1988) noted that "the Standard Erosion Mitigation Conditions [at that time] are unsuitable guidelines for erosion control in the catchments examined in the Mistake State Forest". As an outcome of the RFA in 1999 the Environment Protection Licences (EPLs) were introduced and applied to all logging operations on public land in north-east NSW (Pugh, 2104).

Discrepancies between the Environment Protection Licence guidelines and the 2009 Harvest Plan for Compartments in the Mistake SF have been noted by Eddie (2017a).

CONCLUSION

The case is made for the special case to be made for the Nambucca Beds—

- There is strong evidence that the Soil Regolith Stability Class on the Nambucca Beds is high coherence with high sediment delivery (Class R3),
- The thresholds of settings of the Inherent Hazard Level matrix table are revised,
- Logging is limited to slopes below 25°.

On the Nambucca Beds, on slopes greater than 20°, in the absence of information to the contrary, it is assumed that—

- It is subject to mass movement;
- It has a high erosion rating;
- It has an extreme erosion rating;
- Native forest logging is prohibited.

In data collection—

- The Emerson Aggregate Test (EAT) is the minimum standard for assessment of dispersion and should be backed by Dispersion Percentage / Rithie Method.
- Data should not be averaged for assessment of risks.
- The worst case should be assumed in a conservative approach required in Schedule 3 of the EPL.

To ameliorate the offsite effects of logging on steep slopes on the Nambucca Beds—

- Monitoring and reporting should be undertaken on water quality of streams entering and exiting any compartments considered for forestry operations, before, during and after forestry operations.
- Catchment hydrological modelling should be undertaken to model the surface and channel flows into, within and out of proposed logging compartments.

Mountainous land on the Nambucca Beds on gradients greater than 20° should be reserved for catchment protection.

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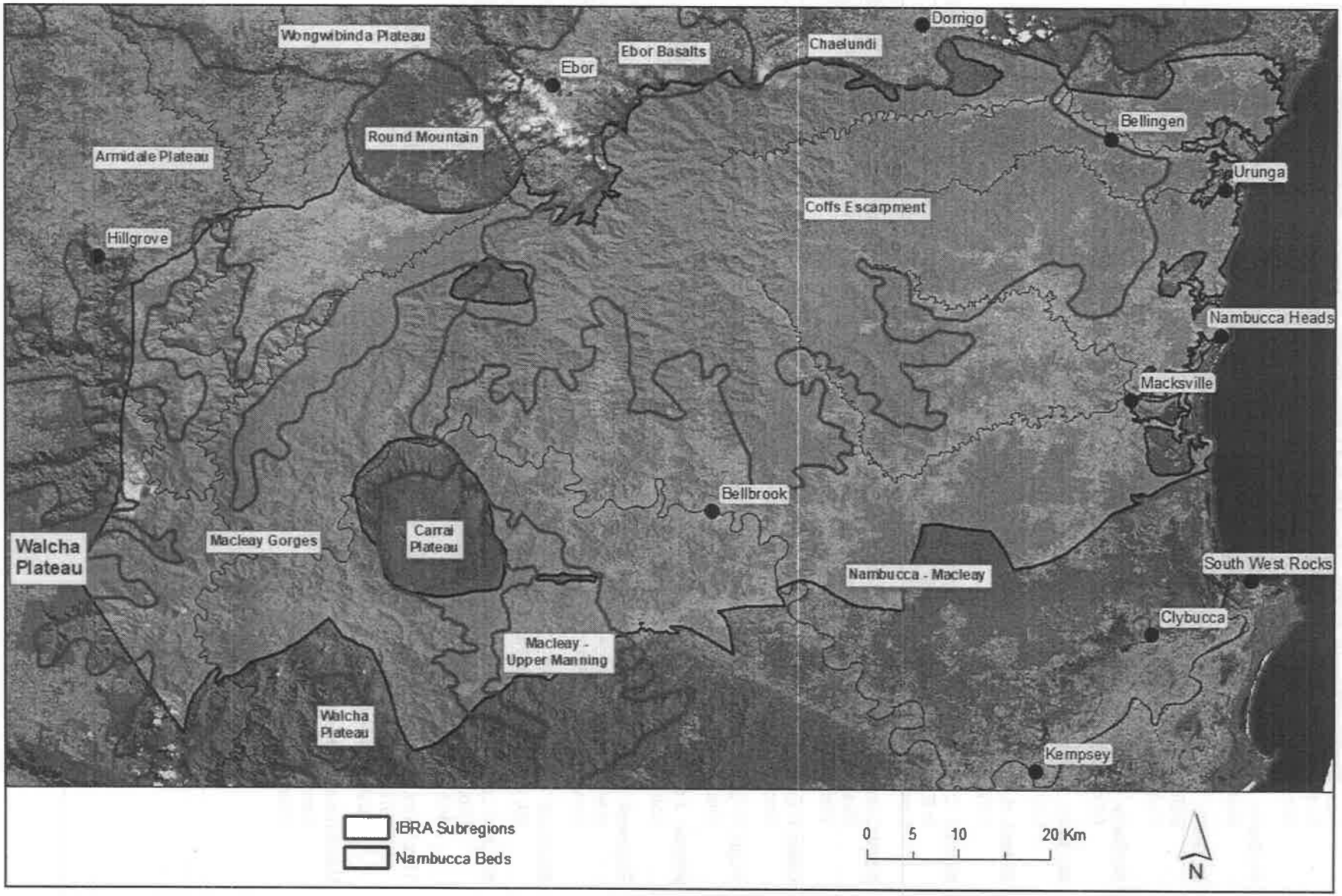
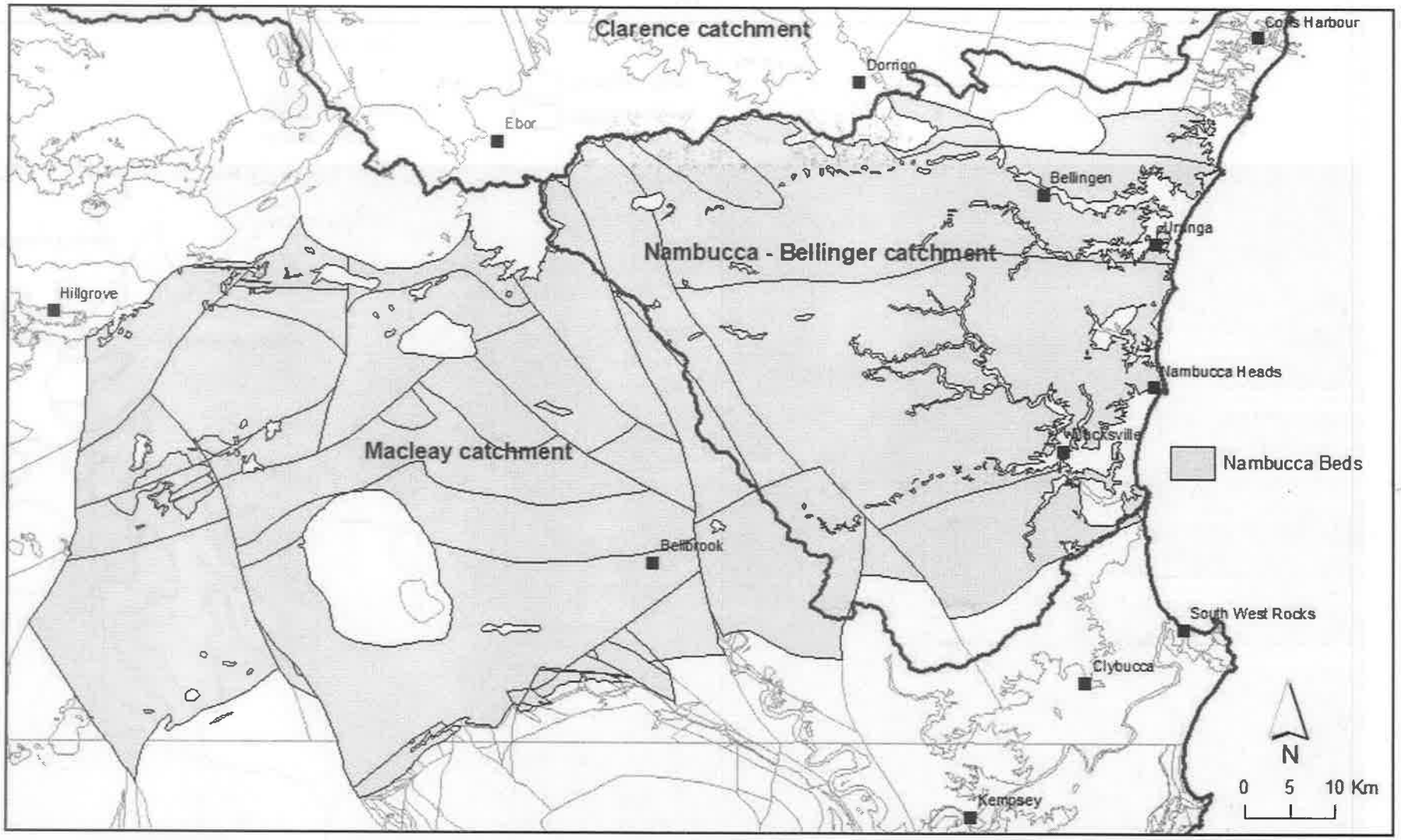
APPENDIX 1. MAPS.

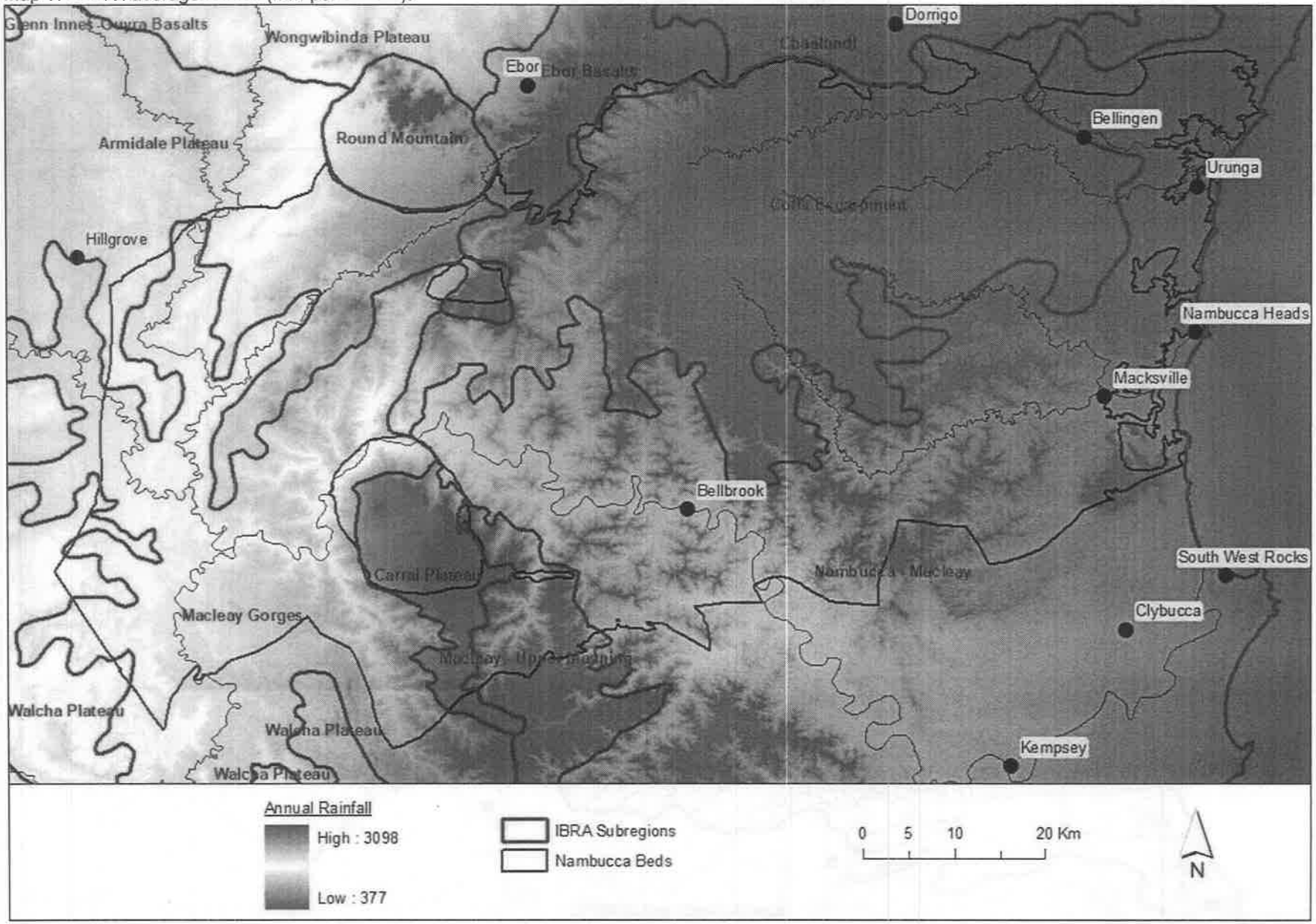
Map 1. The IBRA Subregions.



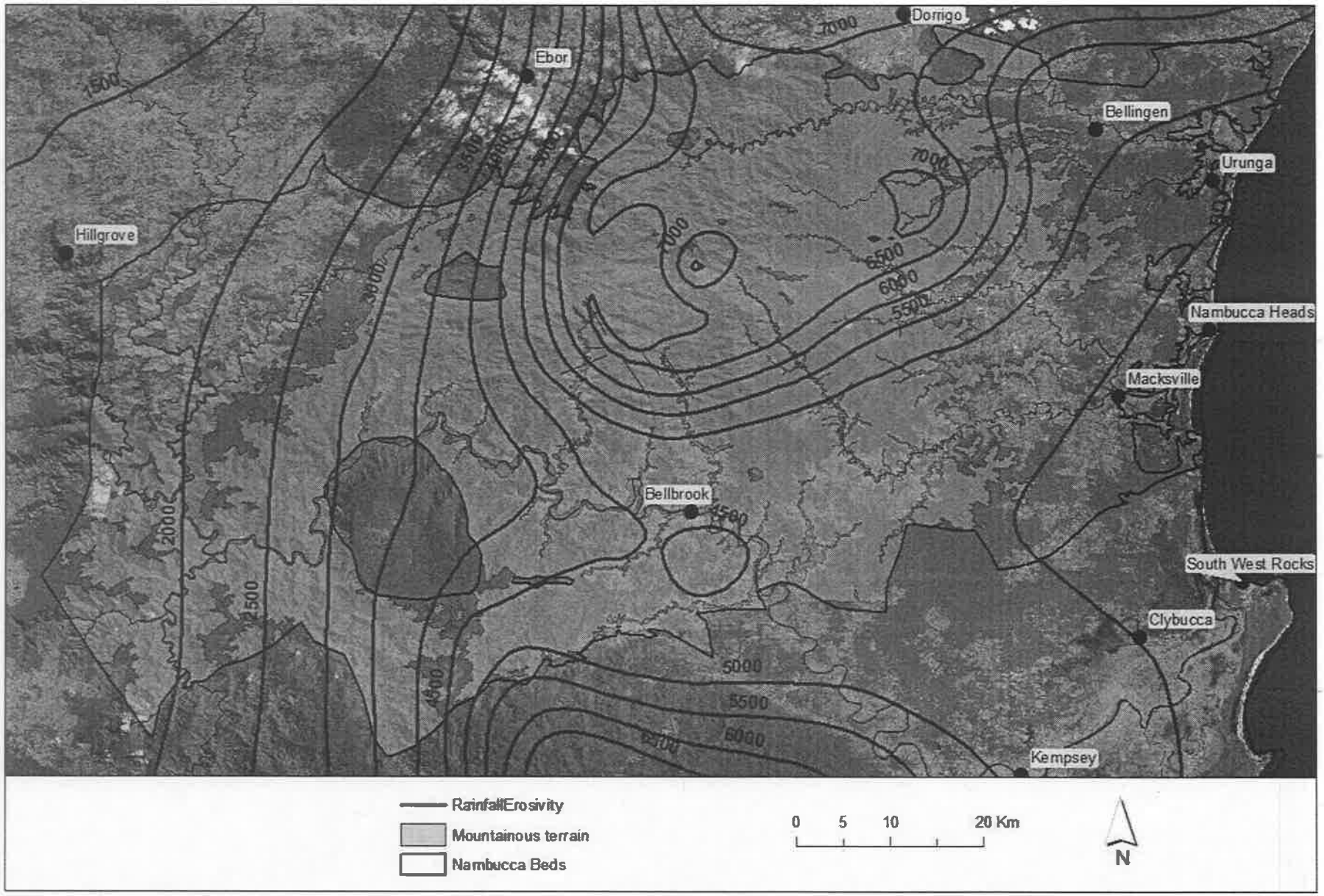
Map 2. The extent of the Nambucca Beds.



Map 3. Annual average rainfall (mm per annum).



Map 4. Rainfall Erosivity.



Map 5. State Forests on indicative mountainous terrain on the Nambucca Beds.