Submission No 304

INQUIRY INTO MANAGEMENT OF PUBLIC LAND IN NEW SOUTH WALES

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NORTH EAST FOREST ALLIANCE SUBMISSION TO: INQUIRY INTO THE MANAGEMENT OF PUBLIC LAND IN NEW SOUTH WALES

IN RELATION TO: Native Hardwood State Forests in Northern NSW

Prepared by Dailan Pugh, North East Forest Alliance, August 2012

The North East Forest Alliance was formed in 1989 with the principal aims of protecting oldgrowth, rainforest, wilderness and threatened species in north-east NSW. NEFA campaigned strongly to achieve these goals in the early 1990s and won a place representing conservation groups in the Forest Reform process that commenced with the election of the Carr Government in 1995. NEFA worked hard with other stakeholders to ensure the required data was collected and faithfully applied. In 1998 the Carr Government did a deal with the timber industry and unions which failed to deliver the promised Comprehensive Adequate and Representative reserve system and committed remaining state forests to unsustainable logging for 20 years. NEFA publicly disowned the outcomes and campaigned to have the promised protections implemented and improved. In recent years NEFA has focussed on trying to get Forests NSW to comply with their licence requirements.

SUMMARY AND RECOMMENDATIONS

RESERVE SELECTION PROCESS

The foundation for the Forest Reform process was the adoption of the National Forest Policy Statement in 1992 and the commitment to establishing a comprehensive, adequate and representative (CAR) reservation system to protect old-growth forest and wilderness values by the end of 1995 for public lands, with the inclusion of necessary forest from private land by 1998. After an aborted attempt to use the NSW Environmental Impact Statement process to establish a reserve system in north east NSW, the Forest Reform process started in NSW in 1995 with the election of the Carr Government. The process continued until 2003, though some reserve additions are still outstanding.

It is important for the Inquiry to recognise that while it was the Carr Government that implemented the Forest Reform process, it was the Greiner Government that established the process with the signing of the *National Forest Policy Statement* in 1992 and the Howard Government that set the required reservation targets with the adoption of *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia* in 1997.

The 1996 Interim Assessment Process was a trial of using explicit reserve criteria and targets, along with detailed vegetation and structural mapping, models of species distributions and timber resource mapping, in a negotiated process involving stakeholders using a Geographic Information System to identify forests likely to be required for the reserve system.

The outcome was inclusion of 172,012ha in reserves, placing approximately 600,000 hectares of State Forest in a moratorium from logging in Interim Deferred Forest Areas (IDFA) until the Comprehensive Regional Assessment was complete, placing mapped oldgrowth under a moratorium, adoption of Conservation Protocols to regulate logging, and granting five-year

tradeable wood supply agreements to quota sawmillers at 50% of 1995/6 quota allocations, renewable for a further 5 years provided value-adding criteria were satisfied (known as "5 by 5" year agreements).

The Inquiry needs to acknowledge that the Comprehensive Regional Assessments were the first time in NSW that a systematic and scientifically rigorous assessments of conservation and socio-economic values had ever been undertaken with the aim of satisfying explicit national reserve targets to establish a Comprehensive Adequate and Representative reserve systems. Until near the end it was an open and balanced process allowing principal interest groups real and meaningful involvement. At the end the process was subverted by the Government giving the timber industry timber volume commitments that undermined their willingness to negotiate and precluded the creation of a CAR reserve system.

The Forestry Reform process delivered a significant increase in the reserve system in north east NSW based on a rigorous scientific assessment and delivered a comprehensive regime for off-reserve management. Tragically the reserve outcome fell far short of what was required to fulfil the minimum requirements of the national reserve criteria. Government agencies identified 1,027,655 hectares of public forests in north-east NSW as requiring reservation in order to reasonably satisfy the national reserve criteria, though the outcome was the reservation of 410,547 ha in 1998, with a further 122,334 hectares of unloggable forests and Crown land being added by 2002. A further 370,000 hectares of unloggable forests, wilderness, oldgrowth and rainforest was included in Forest Management Zones excluded from logging.

Regrettably the industry was given 20 year Wood Supply Agreements until 2018 for volumes of large quota sawlogs from public lands at intentionally unsustainable levels. Industry groups supported the outcome while conservation groups opposed it.

Soon after the RFA it became apparent that yields were substantially below those predicted. By 2002 it was apparent that at least an immediate 18% reduction in commitments was required because of Forests NSWs over-estimates. Estimates of long-term sustainable yields had plummeted.

The 2003 Icon decision protected 45,000 hectares in 15 "icon" areas as reserves and placed 20,000 hectares of oldgrowth forest on state forest into protected zones. This filled some significant gaps in the reserve system and resulted in the protection of most large patches of oldgrowth on public lands, though still left many reserve targets unmet. Forests NSW's resource assessment showed this reduction in areas available for logging could be compensated for by reducing the protection provided to exclusion areas by removing "buffers on buffers".

The Government then reduced annual timber commitments down to the levels identified in the limited 2002 review. Regrettably the Government entrenched unsustainable logging by extending Wood Supply Agreements for a further 5 years until 2023, thereby increasing total committed volumes of large sawlogs and adding commitments for small and low quality sawlogs.

In 2004 Forests NSW operations were exempted from the Environment Protection Licence for most operations so they could log tens of thousands of hectares of the banks of unmapped streams that had not been counted as contributing to timber commitments. While this represented a major resource bonus to the industry, it has also resulted in significantly increased environmental impacts and stream pollution.

In 2006-7 another $2.8 million of public monies were spent to buy back timber that had been given for free to the industry a couple of years earlier.

The Inquiry needs to recognise that the reserve system in north-east NSW still does not satisfy the national reserve targets, even when informal reserves and values protected by prescription are counted the reserve system remains grossly deficient. Only 64% of the total area of ecosystems needed to satisfy the ecosystem targets has been reserved and 33% of ecosystems have not met even half their targeted areas. It is most worrying that 52% of fauna species fail to meet the targets set for any of their populations and that only 31% of populations have achieved targets aimed at encompassing viable populations of our most vulnerable species into the reserve system.

The inquiry should recognise the need to significantly expand the reserve system in north east NSW to provide the needed protection for biodiversity and to bring it up to national standards.

The NSW and Commonwealth Governments initially committed to undertake a World Heritage assessment as part of the CRA process. The March 1999 Forest Agreements committed NSW to undertake studies of rainforest and to nominate additional qualifying areas of reserves for World Heritage Listing as extensions by 1 April 2001. They also agreed to identify qualifying eucalypt and Aboriginal dreaming sites by 2002. In 2007 the name of the world heritage property was changed to Gondwana Rainforests of Australia and in 2009 the rainforest assessment was finally undertaken. In 2010 the NSW, Queensland and the Commonwealth submitted a Tentative List of 459,739 ha of NSW national parks to the World Heritage Centre which were proposed for future nomination as additions to the Gondwana Rainforests of Australia World Heritage area on the basis of rainforest values.

The State and Commonwealth Governments have agreed to limit any renomination to existing reserves. An expansion of the Gondwana Rainforests of Australia World Heritage property will increase recognition of these reserves' values, attract tourists, and require the Commonwealth to assist in management costs.

The Inquiry needs to recognise that the rainforests and eucalypt forests of north east NSW are of world significance and recommend that the overdue process of renominating an expanded Gondwana Rainforests of Australia, incorporating a eucalypt theme, for inclusion on the World Heritage List be progressed without further delay.

SOCIO-ECONOMIC IMPACTS OF FOREST REFORMS

Non-use values are of high importance to the community and need to be accounted for in any socio-economic cost-benefit assessment. The community in north-east NSW has clearly identified that they place a very high value on native forests for wildlife, beauty, water and recreation, compared to a relatively low value for logging, mining and shooting. **The Inquiry needs to recognise that the regional community have clearly shown they have a significantly greater preference for environmental benefits over economic costs. The protection of public forests in the Forest Reform process was clearly in the public interest.**

Many natural forest values cannot be readily replaced or substituted. Some forest values, such as oldgrowth forest, rainforest, wilderness and endangered species, are considered to be irreplaceable by the community and are in effect priceless. **The Inquiry needs to be aware that the protection of irreplaceable values such as oldgrowth forest, rainforest, wilderness and endangered**

species in the Forest Reform process was clearly in accord with the preferences of regional, state and national communities.

The Inquiry should recognise there has been an increase of over 250% in visitation to national parks and reserves in north east NSW since the Forest Reform process started, resulting in national parks and reserves now generating a business turnover of some $416-476 million and some 2,642-3,026 direct and indirect jobs in the regional economy. The demonstrated economic value (consumer surplus) is some $348-399 million. The creation of reserves in the Forest Reform process has been of significant economic benefit to the residents of north-east NSW.

The Inquiry needs to recognise that logging has significant impacts on water yields from native forests, such that:

a. **Reduction of mature and oldgrowth forest to younger growth stages will cause a significant reduction in water yields;**
b. **Water yields will increase with increasing forest maturity; and,**
c. **Logging should be excluded from significant water catchments.**

The Inquiry should consider that regeneration in the reserves created in the Forest Reform process will have already resulted in significantly increased water yields to surrounding streams and dams. Water yields will go on increasing for many decades. The increase in water yields from maturing forests in the reserves represents a significant economic benefit to regional communities that should be quantified by the inquiry.

The Inquiry needs to recognise that logging has significant impacts on carbon storage in native forests, such that:

a. **Reduction of mature and oldgrowth forest to younger growth stages will cause a significant reduction in carbon storage in forest;**
b. **Carbon storage will increase with increasing forest maturity;**
c. **Large trees are particularly important for carbon storage; and,**
d. **Forests should be managed so that they are carbon sinks.**

The inquiry should consider that the creation of reserves in north-east NSW during the Forest Reform process has avoided significant releases of CO_2 and that since their protection large volumes of carbon have been sequestered and stored in tree trunks and soils of the regenerating forests. The regenerating forests will continue to store carbon in ever increasing volumes as they mature over decades and centuries. It needs to be recognised that the reserve system in north-east NSW makes a significant contribution to Australia's national carbon accounts. The increase in carbon storage represents a significant economic benefit to all people in NSW that should be quantified by the inquiry.

Some 260,000 hectares of oldgrowth eucalypt forest was protected as a result of the Forest Reform process in north-east NSW, stopping logging of the accessible stands will have avoided significant CO_2 emissions and maintained carbon storage at maximum levels.

The economy of north-east NSW generally boomed through the Forest Reform process, with the exception of the New England Tablelands which was severely affected by the drought. The growth in the labour force and employment has outstripped population growth and unemployment has dropped. In return for increased reserves, generous government assistance packages for sawmillers and timber workers helped overdue restructuring of the timber industry.

The Inquiry needs to acknowledge that logging of public native forests in NSW does not pay a resource rent to the community and is receiving a massive public subsidy, thereby creating a significant market distortion to the detriment of private landholders and plantation growers, and the financial viability of ecologically sustainable forestry. It is requested that the Inquiry recognise the market distortions and lack of transparency caused by NSW's amalgamation of plantations and native forests for resource allocation and reporting and recommend separate reporting of native forests. It also needs to be recognised that costs are rapidly escalating and timber volumes declining. The Inquiry should consider identifying means of removing public subsidies to the timber industry and returning a resource rent to the community from the commercial use of public resources.

The Inquiry needs to recognise that NSW's Wood Supply Agreements distort the hardwood sawlog market and are for excessively long periods. The Inquiry should consider recommending that every opportunity should be taken to reduce the volumes committed and the length of the agreements.

IMPLEMENTING SUSTAINABLE USE

Public forests in north-east NSW have never been managed on a sustainable yield basis. In 1998 the Government adopted a "*Sustainable Wood Supply Strategy*" that involved intentionally overcutting for a further 20 years until 2018 before reducing logging volumes down to a sustainable level. Following a desktop yield review in 2003 the Government reduced annual commitments but increased the total volumes committed by extending unsustainable logging for another five years until 2023.

NEFA recommends that the Inquiry consider two fundamental changes in timber resource allocation from State Forests to improve its sustainability;

- **The urgent reduction in allocations of sawlogs down to the estimated long-term sustainable yield and the refocus of silviculture from liquidating the large sawlog resource to sustaining it in multi-aged forests.**
- **A reduction in yields commensurate with the additions necessary to establish a truly Comprehensive Adequate and Representative reserve system.**

Stronger deterrents are required to stop Forests NSW from routinely causing environmental degradation by logging in areas required to be protected. **NEFA recommends that Forests NSW be required to provide compensatory habitat for areas illegally logged and be required to actively rehabilitate degraded areas.**

NEFA recommends the Inquiry improve the sustainability of logging operations by recommending the retention and protection of all large old trees (>140 years old) for their biodiversity and heritage values.

The inquiry needs to recognise that the maintenance of large old hollow-bearing trees in perpetuity is the single most important requirement for ecologically sustainable forestry. Despite retention requirements being specified for the retention of hollow-bearing trees, and recruitments to grow into the hollow-bearing trees to replace them when they die, the achievement of requirements are often grossly inadequate and there appears to be a war of attrition being waged against hollow-bearing trees. **For ecological sustainability the exemption applied to the coastal forests from having to maintain the next largest trees where there are less than 10**

hollow-bearing trees per 2 hectares needs to be removed. The aim should be to retain or restore hollow-bearing trees throughout public forests.

Despite the aims of silvicultural prescriptions being the maintenance of multi-aged forests, Forests NSW are rorting the intent by practicing virtual clearfelling of large tracts of forests to convert them into single-aged regrowth monocultures. This is contrary to the intent of the legal requirements and the basic precepts of ecologically sustainable forestry.

NEFA asks that the Inquiry consider improving the sustainability of logging by recommending the adoption of a prime silvicultural objective for state forests: to maintain or restore structurally diverse forests with trees through a natural range of size classes and species, including those trees needed to meet standards set for wildlife habitat, food and recruitment trees.

At Yabbra State Forest, Forests NSW were found guilty for illegally logging 3ha of rainforest, 2 wetlands, numerous stream banks, and potentially hundreds of feed trees of the Yellow-bellied Glider, and were fined a total of $2,200 with no requirements to do any rehabilitation works.

The Inquiry should recognise that the penalties applied to breaches of the Threatened Species Licence are not commensurate with the environmental harm caused and are grossly inadequate to act as a deterrent. To be effective penalties need to be increased to reflect the gravity of the offence. There is a need to require active rehabilitation of illegally logged areas and protection of compensatory habitat.

There are many rare and threatened features that can not be dealt with remotely and are not covered in the pre-logging fauna surveys. These require on-ground investigations to identify them ahead of logging. Experts with the required specific expertise are needed to identify an array of features requiring protection, including Koala High Use Areas, Yellow-bellied Glider den and feed trees, and threatened plants. Forests NSW have proven themselves incapable of performing these tasks.

The Inquiry should consider recommending that people with specific expertise in the relevant threatened plants and threatened fauna, mark up the required environmental features ahead of logging operations independently of Forests NSW. In order to sustain populations of threatened fauna and flora it is essential that alternative precautionary protection measures are applied in areas considered impenetrable for compartment mark-up.

NEFA suggests the Inquiry recommends the adoption of performance measures for flora and fauna prescriptions and auditing of their effectiveness in achieving those measures. Along with a transparent independent expert process overseen by the Environmental Protection Agency to review prescriptions to improve their performance.

Forests NSW have proven time and time again that they are reluctant to implement requirements for ecologically sustainable forest management. The EPA have proven themselves to be reluctant and ineffective regulators. **The Inquiry should consider that, for Forests NSW to implement them, and EPA to enforce them, Threatened Species Licence conditions need to be made clearer, unambiguous, capable of auditing, and clearly enforceable. Penalties for non-compliance need to be sufficient to act as a meaningful deterrent.**

It is suggested that the Inquiry consider the issue of public forest management arrangements and recommend further separation of policy and regulation from Forestry operations. Any such system would be enhanced by allowing members of the public third party appeal rights.

The Inquiry should consider the need for Environmental Protection Licences to be subject to independent expert review to identify appropriate constraints to reduce erosion and stream pollution in light of contemporary logging practices, recent science and climate change.

The Inquiry needs to recognise that over 90% of logging operations were exempted from requiring Environment Pollution Licences in 2004. Forests NSW have proven themselves incapable of self-regulation to limit soil erosion. To improve environmental outcomes and the sustainability of forestry operations it is suggested that the Inquiry recommend the Environmental Pollution Licence be again applied to all forestry operations and that the EPA undertake a rigorous enforcement program to establish a culture of compliance. Protection must be restored to all streams.

Audits have revealed that, if at all, Forests NSW are undertaking deficient Aquatic Habitat Assessments that routinely omit endangered fish, fail to collect adequate water data, and use inappropriate sites. Forests NSW's continuing refusal to consider the endangered Oxleayan Pygmy Perch on the grounds that Fisheries NSW have still not provided the required distribution maps is untenable for both organisations.

The Inquiry should recognise the contempt with which threatened fish are treated by Forests NSW and their failure to recognise their presence and adopt required mitigation measures. Forests NSW need to be directed to have suitably qualified people prepare Aquatic Habitat Assessments and to apply the intent of the Fisheries Licence. The Fisheries Licence needs to be amended to make its intent, to minimise eroded soil entering streams and affecting populations of threatened fish, clear and legally enforceable.

Bell Miner Associated Dieback is a major threat to the sustainability of many forest ecosystems over large areas of north-east NSW, and appears to be rapidly worsening. Tens of thousands of hectares of forest in north-east NSW are affected and hundreds of thousands of hectares are vulnerable. It is a serious threat that has been procrastinated over for far too long.

Bell Miner Associated Dieback is associated with logging opening up the canopy and understorey disturbance promoting lantana, which in turn favour Bell Miners who aggressively exclude other birds and thereby facilitate outbreaks of sap-sucking insects which kill the trees. BMAD is degrading, and increasingly destroying, both forest ecosystems and forest productivity.

For over 60 years the growing problem of Bell Miner Associated Dieback has been procrastinated over despite the clear evidence that it is being facilitated by the opening of the canopy by logging and the consequent spread of lantana facilitated by machinery disturbance and burning. BMAD affected forests are being targeted for increased logging intensity without rehabilitation works.

The Inquiry is requested to support a sustainable approach to the key threatening process Bell Miner Associated Dieback by recommending an urgent moratorium on logging in and adjacent to BMAD areas until such time as rehabilitation strategies for restoration of ecosystem health are implemented.

Forests NSW are targeting Bell Miner Associated Dieback Areas for removal of all healthy remaining trees and then abandoning them to their fate as destroyed ecosystems. **A sustainable response to Bell Miner Associated Dieback involves:**

a. **Identifying and mapping all affected and susceptible areas in harvest plans;**
b. **Placing all affected and susceptible areas under a logging moratorium until such time as appropriate management responses that restore ecosystem health and functioning are identified;**
c. **Undertaking rehabilitation works (i.e. lantana control) in affected stands; and,**
d. **Monitoring effects of any treatment and refining methods before repeating it.**

The Inquiry needs to recognise that grazing has significant impacts on streams, vegetation, threatened plants and the habitat of many native animals, and ensure that no expansion of grazing on public lands is allowed so that a portion of the total forest estate remains free of these impacts.

Contents

1. Process of conversion and the assessment of potential operational, economic, social and environmental impacts

The process of establishment of conservation reserves in NSW began in 1866 with the allocation of the first area of public land primarily for conservation. Since then the area of public land allocated to conservation has progressively increased. This has been complemented by some relatively minor purchases of private property over time.

Reserves to protect spectacular natural features and lookouts began to be created in NSW in 1866 with the Fish River (Jenolan) Caves. The 'National Park' (now Royal NP, south of Sydney) was gazetted on 26 April 1879 as the second national park in the world. However, rather than being established to protect its natural values it was a Crown reserve, established for ornamental gardens, racecourses, recreational pursuits and an artillery range. In 1894 Ku-ring-gai Chase National Park was the first reserve to be established primarily for nature conservation.

The Cape Byron Headland Reserve was established in 1903 for *"public recreation and the preservation of native flora"*. Mount Warning National Park was one of NSW's early parks, being protected in 1920. Agitation for more national parks in north-east NSW gained momentum through the 20th century.

The United States' system of 'wilderness areas' (changed to 'primitive areas' in 1929) administered by the US Forest Service was an inspiration to a growing number of bushwalkers around Sydney. Frawley (1988) considers:

> *The wilderness preservation movement had its roots in the Romanticism of the late eighteenth and early nineteenth centuries with its enthusiasm for wild forested and mountainous country, and later the philosophy of Transcendentalism, as espoused by Emerson and Thoreau, which, in the relationship between humans, nature and God argued for the spiritual value of wild and natural country*

Because the concept of national parks had become debased by their emphasis on roads, recreational infrastructure and commercial use, in the 1930s Sydney bushwalkers promoted the creation of 'Primitive Reserves' and the zoning of primitive areas within national parks (Prineas and Gold 1983). The Tallowa Primitive Reserve was created in 1934, and many more were proposed for reservation, including the Upper Hastings in north-east NSW.

The National Parks and Wildlife Service was established by the National Parks and Wildlife Act 1967 by the amalgamation of officers formerly attached to the Fauna Protection Panel and the Parks and Reserve Branch of the Department of Lands. The prime objectives of the legislation were: the reservation of national and state parks and historic sites already in existence or to be provided in the future; and their preservation, care, control and management, and to these ends, the bringing together in one service the related functions of national parks and fauna and flora protection.

The Act identified twenty five areas, as National Parks, State Parks and Historic Sites, though most areas were already reserved.

When speaking to the bill the responsible Minister the Hon. Tom Lewis MLA, Minister for Lands and Mines, stated (1 December 1966):

> *...one of the primary objects of this legislation is to put aside sufficient land within this vast State to be preserved for all time for the enjoyment of the natural solitude and beauty within various areas of the State. In addition, and certainly with equal importance, is the need to halt civilisation's extinction of the various animal and bird life within our shores.*

In the 1960's and 70's there were major additions to the national park estate in north-east NSW.

The report 'Wilderness in Australia' (Helman *et. al.* 1976) identified 20 wilderness areas in eastern NSW and gave focus to the wilderness campaign started in the 1930s. Helman *et. al.* (1976) state:

> *"The greatest single benefit of retaining large natural areas is not the immediate value placed on these areas by contemporary society but their worth to future generations. These areas are certainly valuable at present for recreation and scientific study, but their value, as they become fewer, will increase"*

While the protection of specific rainforest stands extends back to the early 1900s, the Rainforest Campaign effectively started in the early 1970's with efforts to protect then virgin rainforests on the Wiangaree and Lever's Plateaus in the ranges along the NSW-Queensland Border. Concerns over other rainforest areas arose during the next decade. Sydney conservation groups joined efforts to protect the Border Ranges in the mid 1970's. They succeeded in making it into a significant political issue, but only managed to achieve a narrow park along the border. When concerned locals took direct action to protect rainforest at Terania Creek in August 1979 the media coverage dramatically brought the issue of rainforest logging to the nation's attention. Thereafter the campaign broadened into a thematic rainforest campaign, though remained focussed on specific areas.

Following Terania Creek the Forestry Commission argued for a phasing out of rainforest logging subject to existing commitments. The problem was that most rainforest under their control was already committed. In 1979 the Forestry Commission identified that there were 8 sawmills processing 52,820 cubic metres of rainforest timber each year and employing 487 people. The timeframes for completing rainforest logging, and ending the employment dependent on it, ranged from 1982 to 1996.

On 26 October 1982 the Government of Premier Wran made its historic 'Rainforest Decision'. The end result was 118,000ha being transferred to National Parks and 1,800 hectares to flora reserves. Rainforest logging continued on State Forests, with a variety of areas that had been previously protected opened up for logging, though the intent was to phase out rainforest logging within 10 years.

Community campaigns to protect oldgrowth forests extend back to the first attempts to establish reserves in NSW, however, back then the emphasis was on specific areas of unlogged natural forests. It has always been the aesthetic appeal of natural forests and landscapes that has primarily motivated people to protect them. It has been the emotional appeal of oldgrowth forests that stirred people into direct action and ignited the conservation blockades of recent history. In the late 1980's localised campaigns in north-east NSW began to become focussed on the concept of oldgrowth eucalypt forest.

The North East Forest Alliance was formed in June 1989 in response to numerous proposals to log the last accessible areas of oldgrowth forests on public land in north-east NSW. NEFA's primary objectives were to protect all oldgrowth forests, rainforest, wilderness and threatened species. The

formation of NEFA represents the commencement of the concerted Oldgrowth Campaign in north-east NSW.

Soon after its formation, the North East Forest Alliance held its first blockade at North Washpool in 1989 to stop logging of oldgrowth rainforest and eucalypt forest in the (North) Washpool Wilderness. This was followed by a blockade to stop logging of oldgrowth forest at Chaelundi in 1990 in the Guy Fawkes River wilderness. Thereafter NEFA has had many blockades to protect areas of oldgrowth forest and wilderness.

As a result of two successful court cases by NEFA (Mt. Royal and Chaelundi), with threats of many more to follow, over Forests NSWs failure to prepare Environmental Impact Statements (EISs) prior to logging oldgrowth forests, the State Government was soon left with no alternative but to commit to undertaking EISs. On the 24th June 1990 Premier Greiner launched 'Meeting the Environmental Challenge: A Forestry Strategy', which was an undertaking to prepare Environmental Impact Statements (EISs) for some 180 000 ha of oldgrowth forest. Announcing *"180,000 hectares of timber in 14 oldgrowth forests would be subject to environmental studies"* and *"...it is important to examine these forests and their values in considerable detail, evaluate the options for land use, and determine those areas where logging can be undertaken using sensitive management practices in order to lessen and ameliorate the environmental impact."*

When the details were released, oldgrowth areas in Jenner, Mt. Royal, Oakwood, London Bridge and Riamukka State Forests had been deleted, reducing the area to be protected by some 10,400 ha. The Forestry Commission reneged on Greiner's announcement by only protecting 169,600 ha. Many other stands of oldgrowth had been totally excluded from consideration.

The NSW Government used a contrived crisis over the Endangered Fauna (Interim Protection) Act 1991 to get its Timber Industry (Interim Protection) Act through parliament in March 1991. Rather than addressing issues with endangered fauna, it basically exempted the Forestry Commission from having to comply with the EP&A Act for logging oldgrowth and other forests outside specified oldgrowth and wilderness moratorium areas while they prepared EIS's for 21 management areas according to a set timetable. The NSW Government intended to use the EIS process to complete the reserve system. It was left up to the Forestry Commission to decide where to locate the reserves, with the only apparent objectives being to protect about 10% of each of five broad groupings of forest types over all public lands while minimising timber losses. The proposed reserves were mostly unloggable forests on steep slopes and poor soils, or forests that had been logged or were proposed for logging. Most of the reserves were proposed as informal reserves that could be altered at the Forestry Commission's discretion, with logging allowed in many.

The first EIS for Mount Royal was refused by the Minister for Planning, and the next two were heavily conditioned. With a legal action by NEFA on the draft Dorrigo EIS, and the Minister for Planning about to refuse it, the Forestry Commission hastily withdrew it. This was the last straw for the EIS process which, despite numerous time extensions, was in a shambles. The NSW Government's $15 million EIS strategy had failed and they were left with no alternative but to announce a temporary freeze on EISs while they tried to find a way out of the mess created by the Forestry Commission.

The NSW Government's refusal to heed calls for the protection of oldgrowth forests and denial of the need to improve the reserve system generated community angst and forest conflicts. At the

same time the NSW Government was embarking on its EIS folly, the Commonwealth was identifying means of satisfying its obligations for the national estate, world heritage, export woodchipping, and biodiversity. This led to the formulation of a National Forest Policy Statement in 1992, which committed both Commonwealth and State Governments, to establish a Comprehensive, Adequate and Representative (CAR) reserve system based on applying agreed national reserve criteria in a systematic manner to fill gaps in the existing reserve system.

It was not until the election of the Carr Goverment in 1995 that this agreed national forestry reform process began to be implemented in NSW. Since 1995 the area of formal reserves in north-east NSW has almost doubled to now include almost 19.7% of the region. However, this hides the fact that more than one quarter of all reserves in the region are sandstone reserves in the Sydney Basin, at the far south of the region. The entire area south of the Hunter River is a separate biogeographical zone which represents an entirely separate bioregion from north-east NSW. When only that part of north-east NSW that lies north of the Hunter River is considered, the area currently reserved is 16.4% of the region.

Prior to the forestry reform process, which the NSW Labor Party commenced soon after they took Government in 1995, there was 1.03 million hectares of National Park estate in north-east NSW, of which approximately 500,000 hectares were sandstone reserves in the Sydney Basin. The remaining 530,000 ha was spread throughout the region north of the Hunter River and it was significantly biased towards steep and infertile areas (Pressey et al. 1996). It was generally comprised of dry gorges along the Great Escarpment or large areas of coastal heath or rainforest, while productive tall eucalypt forests were poorly represented.

Table 1 shows the additions to the National Park estate each year since 1995 as a result of the forestry reform process. The forestry reform process has directly resulted in the formal reservation of some 737,720 hectares of forest in north-east NSW between 1995 and June 2006.

Table 1 Area of new formal reserves (National Parks, Nature Reserves and State Conservation Areas) each year since 1995 as a result of the Forest Reform Process

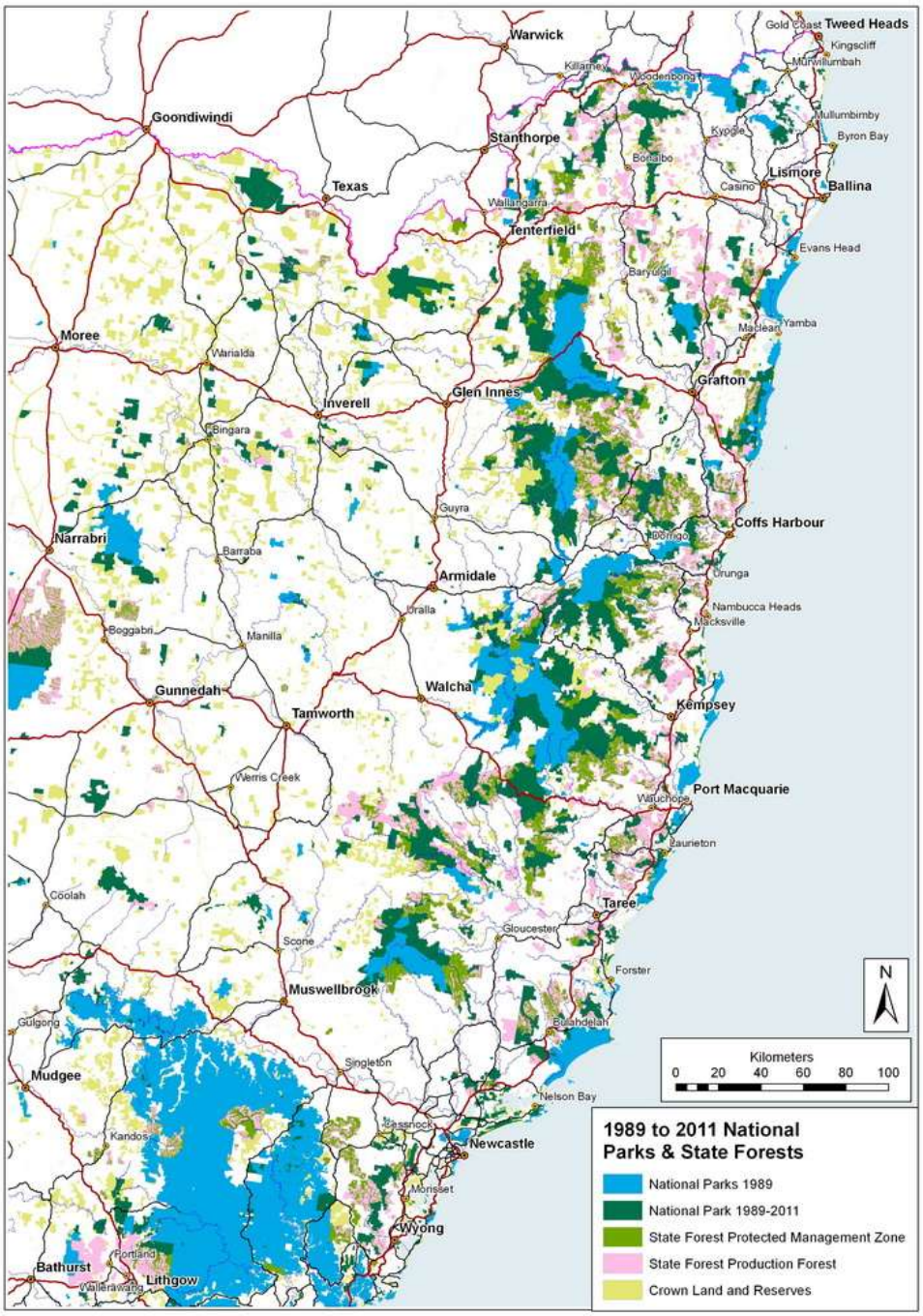
Year	Process	Area (hectares)*
1995	24 New Parks Election Promise	14,107
1996	Interim Assessment Process	172,012
1998	Comprehensive Regional Assessment	386,627
1999	Vacant Crown Land	40,667
2002	Forest Management Zones, Wilderness	81,667
2003	Forest Icon Areas	42,522
2006	Delayed transfers	118
TOTAL		**737,720**

* Areal figures produced by direct GIS reporting against NPWS estate layer.

Including freehold and Crown leasehold areas purchased by NPWS and gazetted as National Parks estate and lands dedicated as a result of other processes, the total area of new National Parks estate in north-east NSW since 1995 has increased by some one million hectares to 2.03 million

hectares. Most of these areas are north of the Hunter River where the size of the reserve system has more than doubled since 1995. (Figure 1).

In addition to these increases in the National Parks estate, there have also been increases in the informal reserve system in north-east NSW over the same period with the placement of some 310,000 hectares of State Forest in the region in Special Management Zones which are protected from logging under the *Forestry Act 1916*.



There are two remaining assessment processes that are still theoretically underway in the region. A further 40,000 hectares of Special Management Zones, many of them identified wilderness areas, have been earmarked for future transfer to National Parks estate pending voluntary acquisition of

leasehold interests. The vacant Crown land assessment process is also on-going, with a further 30,000 hectares still being considered for transfer to the National Parks estate.

Despite the major increases in the reserve system in north-east NSW as a result of the Forest Reform process, most forest types, animals and plants remain well below the national reserve targets. North east NSW still does not have a reserve system that satisfies the criteria of comprehensive, adequate or representative, nor the national reserve criteria. The Government's attempts to improve the outcomes by counting informal reserves and "values protected by prescription" towards reserve targets, still leaves north east NSW with the worst forest reserve system in Australia. This is a shameful outcome for a forest area identified as one of the world's 35 biodiversity hotspots and, in part, one of Australia's 15 biodiversity hotspots.

In the CRA process extensive studies of regional community structures and economics were undertaken. Given the Government's unwillingness to interfere with market forces by directing where the timber had to be processed, the availability of specific volumes of quota quality sawlogs became the most significant surrogate for economic impacts.

In a deal with the timber industry the NSW Government placed a 20 year timber supply limit of 270,000 m^3 per annum of large quota sawlogs on reserve outcomes, complementing this with multi-million dollar industry assistance packages. The intent was to continue logging unsustainably for 20 years until 2018 before reducing logging down to a sustainable level. In 2003 this was extended to 2023.

1.1. Establishing a Systematic Reserve Selection Process

In response to the conflict over logging and woodchipping the Commonwealth established the Resource Assessment Commission (RAC) and directed it to hold a Forest and Timber Inquiry in 1989.

The RAC Inquiry (RAC 1992) considered that *"two challenges important to the nation are to establish an acceptable conservation reserve system and to define the allocation of forested land to particular uses outside conservation reserves."* The Inquiry identified several tasks to be performed to establish a system of conservation reserves:

- *identify the data requirements and modelling techniques necessary to review the adequacy of the present conservation reserves system;*
- *develop principles and inventory techniques for identifying the forest resource and in particular, old-growth forests;*
- *determine whether present conservation reserve systems represent all forest ecosystems and species and are of sufficient size;*
- *develop criteria for determining the best possible location, size and configuration of reserves.*

The RAC Inquiry (RAC 1992) concluded that:

> *A reserve system that conserves viable representative samples of the biological diversity of natural forest ecosystems in Australia is an essential component of any strategy to maintain the permanent forest estate. Further, biological conservation outside reserves is an essential component of such a strategy.*

The RAC Inquiry (RAC 1992) considered that their proposed national forest strategy should incorporate the following national policy goals:

- *to ensure that the reserve system is fully representative of forest ecosystems and viable populations of species in both national and regional contexts;*
- *to improve the structure and connectivity of the reserve system;*
- *to maintain ecosystems, populations of species and ecological processes in all tenures, including production tenures;*
- *to minimise the risk of extinction of all species;*
- *to conserve rare and endangered species across all tenures, including wood production tenures;*
- *to minimise the impacts of human use on natural ecosystems and species.*

The RAC Inquiry (RAC 1992) recommended that a national framework be established for *"cooperative, integrated, prospective regional assessments of National Estate, World Heritage, endangered species, biodiversity, oldgrowth, vegetation remnants, pests, diseases, water catchments and fire management, taking into account social and economic considerations."*

The RAC Inquiry suggested the development of a national forest strategy as a suitable vehicle for development and implementation of a national policy concerned with the maintenance of a permanent forest estate in Australia.

The RAC Inquiry (RAC 1992) singled out oldgrowth forests and wilderness for special consideration. The Inquiry emphasised that it is not feasible to log oldgrowth forests and still retain, or ever regain, their full complement of old growth attributes and values, concluding:

> *"Logging of old-growth forest potentially violates the precautionary principle of sustainable development in that an irreplaceable resource is being destroyed ... the values associated with the pristine attributes can not be replaced."*

The RAC Inquiry gave two "*justifiable*" options for the management of identified oldgrowth forest:

> *The first option is to require a rapid cessation of all logging operations within [oldgrowth] forests; or*
>
> *The second option is for forest management agencies to prepare comprehensive management plans that identify and rank old-growth forests in terms of their full range of values. Under this option it may be decided that after adequate protection of examples of old-growth forests some old growth may be available for logging.*

The RAC Inquiry also recognised the increasing rarity and value of wilderness in recommending:

> *"The Inquiry considers that the appropriate state and territory agencies should undertake comprehensive reviews ... of public land to determine all areas of wilderness quality, and that protection should be afforded these areas under state and territory legislation."*

The principle outcome of the RAC Inquiry was the development of the National Forest Policy Statement (CoA 1992) which was signed by the Prime Minister and the Premiers of all the mainland states, including NSW Premier Nick Greiner, in December 1992.

The NFPS (CoA 1992) outlines a shared *"vision of ecologically sustainable management of Australia's forests"* which is to be ensured by the pursuit of eleven broad national goals for: conservation; wood production and industry development; integrated and coordinated decision making and management; private native forests; plantations; water supply and catchment management; tourism and other economic and social opportunities; employment workforce education and training; public awareness, education and involvement; research and development; and, international responsibilities.

The NFPS (CoA 1992) established that *"It is important that Australia has a comprehensive, adequate and representative network of dedicated and secure nature conservation reserves for forests and reserves for protecting wilderness."*, with the governments agreeing *"that the system of reserves should be reviewed and its development completed as a matter of priority."*

The NFPS (CoA 1992) states that for conservation:

> *The goals are to maintain an extensive and permanent native forest estate in Australia and to manage that estate in an ecologically sustainable manner so as to conserve the full suite of values that forests can provide for current and future generations. These values include biological diversity, and heritage, Aboriginal and other cultural values.*

In signing the NFPS the states, including the NSW Greiner Government, committed themselves to establishing a comprehensive, adequate and representative (CAR) reservation system to protect old-growth forest and wilderness values by the end of 1995 for public lands, with the inclusion of necessary forest from private land by 1998. The NFPS (CoA 1992, pp 11-12) singled out oldgrowth forest and wilderness for special consideration *"because of their very high aesthetic, cultural and nature conservation values and their freedom from disturbance",* stating:

> *"The Governments' agreed approach to conserving and managing old-growth forests and forested wilderness has five basic elements:*

- *First, agreed criteria for old-growth forests and wilderness will be determined through the working group process already described.*
- *Second, using those criteria, the relevant State agencies will, as a matter of high priority, undertake assessments of forests for conservation values, including old-growth values, and of forested land for wilderness values.*
- *Third, until the assessments are completed, forest management agencies will avoid activities that may significantly affect those areas of old-growth forest or wilderness that are likely to have high conservation value.*
- *Fourth, forested wilderness areas will be protected by means of reserves developed in the broader context of protecting the wilderness values of all lands. For old-growth forest, the nature conservation reserve systems will be the primary means of protection, supported by complementary management outside reserves. The Governments agree that, conditional on satisfactory agreement on criteria by the Commonwealth and the States, comprehensive, adequate and representative reservation system to protect old-growth forest and wilderness values will be in place by the end of 1995. … All necessary forest from private land will be included, preferably by agreement with landowners, in the reservation network as soon as possible thereafter. The Governments have agreed that their objective is to complete, to the extent feasible, the inclusion of any private forested land in the reservation network by 1998.*
- *Fifth, the relevant management agencies will develop management plans to appropriately protect old-growth and wilderness values.*

The principal biodiversity conservation outcome of the NFPS was the establishment of the principles of 'comprehensive', 'adequate' and 'representative' as the basis for developing reserve criteria from which to review and establish reserve systems to protect the conservation values of forests. These three key words are defined in the NFPS as:

> ***comprehensiveness*** *- includes the full range of forest communities recognised by an agreed national scientific classification at appropriate hierarchical levels;*
> ***adequacy*** *- the maintenance of ecological viability and integrity of populations, species and communities;*
> ***representativeness*** *- those sampled areas of the forest that are selected for inclusion in reserves should reasonably reflect the biotic diversity of the communities.*

The signing of the NFPS was followed by a long period of inactivity. It was not until a major public outcry over export woodchipping, and the Government's failure to protect high conservation value forests, in late 1994 that the Commonwealth was forced into action again and finally began to implement the NFPS. It was not until 1996 that Scoping Agreements committing the Commonwealth and the states to proceed to the negotiation of Regional Forest Agreements began to be signed.

In 1995 the NSW Government signed the National Strategy for the Conservation of Australia's Biological Diversity, which again committed the Government to the establishment of a comprehensive, adequate and representative network of terrestrial and marine protected areas by 2005.

In accordance with the National Forest Policy Statement a working group of Commonwealth and State bureaucrats, called the Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee (known as JANIS), was established in 1993 to identify national reserve criteria. In a clear display of its contempt for the NFPS, the NSW State Government appointed a Forestry Commission employee, with no expertise in reserve design, as NSW's sole representative on the sub-committee.

In desperation after the 1994 woodchipping debacle the Commonwealth developed their own *"National Forest Conservation Reserves, Commonwealth Proposed Criteria"* (CoA 1995). The Commonwealth criteria were developed by a Scientific Advisory Group based upon the JANIS deliberations to that time, and also involved reference to the Commonwealth's Forest Policy Advisory Forum (including representatives from conservation groups, the unions and the timber industry) and public submissions. The Commonwealth's criteria were a compromise between conflicting interests and were evidently based upon maintaining the apparition of being world leading while minimising the impact of establishing a reserve system on a national scale.

The Commonwealth criteria (CoA 1995) for the first time established quantitative targets for forest ecosystems, oldgrowth and wilderness. Perhaps the most significant, and certainly the most controversial, of these for NSW was the requirement to reserve 15% of the pre-1750 distribution of each forest ecosystem. Up until that time the NSW NPWS had been operating on the benchmark of 5% of the remaining extent of forest ecosystems as a basis for assessing the adequacy of the NSW reserve system. The Commonwealth's (CoA 1995) setting of reservation baselines of 60% for the remaining extent of oldgrowth and 90% of only the highest quality wilderness were regarded by the conservation movement as far too short of the RAC (1992) recommendations.

With the election of the Federal Howard Government the criteria were further compromised and weakened, finally resulting in *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia* (JANIS 1997). Finally four years after the working group was established, and two years after the reserve system was due to be completed for public lands, the JANIS reserve criteria were agreed to by the Commonwealth and State Governments (though not the conservation movement).

JANIS (1997) establishes the objectives of biodiversity conservation for forests are:

- *to maintain ecological processes and the dynamics of forest ecosystems in their landscape context;*
- *to maintain viable examples of forest ecosystems throughout their natural ranges;*
- *to maintain viable populations of native forest species throughout their natural ranges; and*
- *to maintain the genetic diversity of native forest species.*

For forest ecosystems and species JANIS (1997) establishes that:

(1) As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the CAR reserve system with flexibility considerations applied according to regional circumstances, and recognising that as far as possible and practicable, the proportion of Dedicated Reserves should be maximised (see Section 4).

(2) Where forest ecosystems are recognised as vulnerable, then at least 60% of their remaining extent should be reserved. A vulnerable forest ecosystem is one which is:

i) approaching a reduction in areal extent of 70% within a bioregional context and which remains subject to threatening processes; or

ii) not depleted but subject to continuing and significant threatening processes which may reduce its extent.

(3) All remaining occurrences of rare and endangered forest ecosystems should be reserved or protected by other means as far as is practicable.

(4) Reserved areas should be replicated across the geographic range of the forest ecosystem to decrease the likelihood that chance events such as wildfire or disease will cause the forest ecosystem to decline.

(5) The reserve system should seek to maximise the area of high quality habitat for all known elements of biodiversity wherever practicable, but with particular reference to:

* *the special needs of rare, vulnerable or endangered species;*
* *special groups of organisms, for example species with complex habitat requirements, or migratory or mobile species;*
* *areas of high species diversity, natural refugia for flora and fauna, and centres of endemism; and*
* *those species whose distributions and habitat requirements are not well correlated with any particular forest ecosystem.*

(6) Reserves should be large enough to sustain the viability, quality and integrity of populations.

(7) To ensure representativeness, the reserve system should, as far as possible, sample the full range of biological variation within each forest ecosystem, by sampling the range of environmental variation typical of its geographic range and sampling its range of successional stages.

(8) In fragmented landscapes, remnants that contribute to sampling the full range of biodiversity are vital parts of a forest reserve system. The areas should be identified and protected as part of the development of integrated regional conservation strategies.

Section 4 of JANIS (1997) notes the aim of applying the reserve criteria is to include sufficient forests to meet the criteria in Dedicated Reserves equivalent to Categories I, II, III or IV as defined by the IUCN Commission for National Parks and Protected Areas.

Where this is demonstrated to be not possible or practicable it is allowable to meet the targets in other areas set aside in Informal Reserves specifically for conservation purposes. Where this too is impractical then protection may be prescribed in Codes of Practice or Management Plans. These lesser categories are required to conform with the following principles:

- there is an opportunity for public comment on proposed changes;
- they have a sound scientific basis;
- they are able to be accurately identified on maps; and
- they are adequate to maintain the values they seek to protect.

All states finally agreed to, and signed, both the NFPS and the JANIS reserve criteria after they had been weakened sufficiently to minimise impacts and meet the lowest common denominator. Despite this, the States and Commonwealth maximised the use of prescriptions to achieve reserve targets rather than inclusion in Dedicated Reserves and limited application of reserve targets on the basis of limited and selective economic assessments.

The foundation for the Forest Reform process was the adoption of the National Forest Policy Statement in 1992 and the commitment to establishing a comprehensive, adequate and representative (CAR) reservation system to protect old-growth forest and wilderness values by the end of 1995 for public lands, with the inclusion of necessary forest from private land by 1998. After an aborted attempt to use the NSW Environmental Impact Statement process to establish a reserve system in north east NSW, the Forest Reform process started in NSW in 1995 with the election of the Carr Government. The process continued until 2003, though some reserve additions are still outstanding.

It is important for the Inquiry to recognise that while it was the Carr Government that implemented the Forest Reform process, it was the Greiner Government that established the process with the signing of the *National Forest Policy Statement* in 1992 and the Howard Government that set the required reservation targets with the adoption of *Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia* in 1997.

1.2. NSW Processes

While the Australian conservation movement was justifiably sceptical about the CRA and RFA processes, NSW conservation groups took the decision from the start to become involved. For north east NSW this was in part because we were aware that our forest reserve system was one of the worst in Australia. It was evident that a major expansion in reserves was required, even with the minimalist national reserve criteria.

Conservation groups engaged with the Commonwealth and made repeated attempts to engage with the NSW Government in the implementation of the National Forest Policy Statement. It wasn't until the election of the Carr Labor Government in 1995 that the NFPS began to be implemented in NSW. The incoming Government was committed to a three stage approach:

1. urgently rescheduling State Forests' logging programs to avoid logging and roading in all high conservation value old growth forests and identified wilderness areas pending the completion of an interim assessment process;

2. initiating an interim assessment process, to be completed within nine months, to examine all available information bases to determine areas to be placed under logging moratoria at the completion of the interim assessment process; and

3. undertaking comprehensive environmental regional assessments of both public and private lands to establish a comprehensive, adequate and representative reserve system.

Following the election of the ALP Government the Resource and Conservation Assessment Council (RACAC) was established with a membership comprised of 6 Chief Executive Officers from appropriate State Government agencies, 4 non-government organisations (NGOs), a Commonwealth observer and a chairperson. The NGOs comprised a timber industry representative (Forest Products Association - FPA), a union representative (Construction Forestry Mining and Energy Union - CFMEU), a conservation representative (Nature Conservation Council - NCC) and a scientist.

Following further representations by conservationists an additional conservation representative was eventually added to RACAC to provide a balance in stakeholder representation between conservation and industry (including union). For NGOs there was then a balance between the two industry representatives (bosses and workers) and the two conservation representatives, with the scientist in the middle.

1.2.1. IAP PROCESS

The first task of RACAC was to undertake an Interim Assessment Process (IAP). The objective of the IAP (RACAC 1996) was to:

identify, on a regional basis, those forest areas that may need to be set aside from logging for inclusion in a Comprehensive, Adequate and Representative (CAR) reserve system.

This was to be achieved by:

1. identifying likely high conservation value old growth forest; and,

> *2. taking into account the proposed Commonwealth reserve selection criteria in relation to biodiversity (including threatened species), wilderness and reserve design.*

The objective was implemented by establishing a Steering Committee with one representative from each of the RACAC secretariat, the Commonwealth, the National Parks and Wildlife Service, State Forests, CFMEU, and FPA, and two NCC (one NEFA and one SEFA) representatives. The Steering Committee's role was to co-ordinate the assessments being undertaken by a Conservation Working Group and a Socio-economic Working Group (with membership reflecting the Steering Committee), resolve disputes within the working groups and develop the assessment process.

The working groups identified the data requirements (achievable within the time and budget limits), developed and oversaw projects carried out by agencies and consultants, and developed methods to apply the data. Where possible all data was captured as digital layers in a Geographic Information System (GIS) at a scale of 1:25,000.

Some computer GIS software and most relevant data layers were provided to all stakeholders, along with other data generated in the process. The conservation movement considered this relatively open access to data as a very significant breakthrough.

The Commonwealth's *"National Forest Conservation Reserves, Commonwealth Proposed Criteria"* (CoA 1995) were used as the basis for determining reservation targets.

The negotiation process involved a group, paralleling membership of the Steering Committee, using an interactive computer system (C-plan) to negotiate over the 11 identified regions. The RACAC secretariat acted as the arbiter of disputes. Two sets of negotiations occurred concurrently (north and south of Sydney), with two days allocated to each region (though there were often delays). The selection units utilised were State Forests' compartments with average areas of around 200 hectares.

The aim was to generate up to four options for each region: full application of the reserve criteria (Conservation Criteria Outcome), maintenance of 70% of 1995 quota sawlog supplies to industry, 50% of the 1995 quota sawlog supply and 30% of the 1995 quota sawlog supply. These were derived by firstly identifying the conservation outcome and then a "wind back" until the appropriate resource level was met.

C-plan was used to regularly check progress against conservation targets and at periodic intervals reports on remaining timber volumes and the sustainable yield of sawlogs were obtained.

Following negotiations conservation groups reviewed the data and identified additional areas required to meet targets and areas considered to be of high conservation value. Conservation groups campaigned for identified wilderness areas and some long-standing national park proposals to be immediately reserved, for the Conservation Criteria Outcomes and their additional high conservation value areas to be placed under moratorium, and no resource security. Meanwhile the timber industry and union campaigned for minimal new parks, no moratoria and resource security.

Following the obligatory period of consultation and furious lobbying, in September 1996, the NSW Government reviewed the various options developed by the IAP and made a decision to:

- Permanently protect 172,012 hectares consisting of 46,411 hectares in eight new national parks and one nature reserve and approximately 125,601 hectares of dedicated wilderness

- Place approximately 600,000 hectares of the remaining CCO in a moratorium from logging in Interim Deferred Forest Areas (IDFA) until the Comprehensive Regional Assessment was complete.
- Place mapped oldgrowth forest outside the CCO in a moratorium, subject to ground truthing.
- Grant five-year tradeable wood supply agreements to quota sawmillers at 50% of 1995/6 quota allocations (71% of 1996 levels), renewable for a further 5 years provided value-adding criteria were satisfied (known as "5 by 5" year agreements).
- Reduce sawlog quotas by a further 5-10% (depending upon the region) as from July 1997.

The wood supply agreements committed the NSW Government to supply 270,000 cubic metres of quota sawlogs from north-east NSW for five years, with a guarantee of an additional five years subject to minimal value adding criteria. The contracts were binding on the NSW Government and meant that any future action by Governments to reduce timber supply would almost certainly require compensation to be paid to the industry.

As an outcome of the process, the NSW Government agencies also developed and formalised systematic Conservation Protocols to regulate logging on State Forest land outside the IDFA (NPWS 1996), although there was one to two years further delay before these protocols were fully implemented (NPWS 1998a). The Protocols included:

- general prescriptions aimed at protection of broad landscape features (*i.e.* oldgrowth forest, rainforest, rare non-commercial forest types, riparian buffers, wetlands, heath, rock outcrops, caves, and minimum numbers of habitat trees);
- species-specific prescriptions aimed at providing some level of protection of potential habitat and habitat features (ie nest sites, roost sites) specific to a species;
- site specific prescriptions to be applied should one of a number of the most poorly known species be found; and
- pre-logging and pre-roading survey requirements aimed at locating threatened species in compartments prior to harvesting.

The Protocols were based on a relatively sound framework for ecologically sustainable management but often failed drastically in the specifics of protection measures applied. The Conservation Protocols were essentially developed through negotiations between the regulator (NPWS) and the regulated agency (SFNSW) without any independent scientific review process. While many of the prescriptions had largely been developed in the NPWS licensing system since the introduction of the *Endangered Fauna (Interim Protection) Act 1991*, they had never been subject to any monitoring or evaluation to assess their effectiveness (and still haven't).

The 1996 Interim Assessment Process was a trial of using explicit reserve criteria and targets, along with detailed vegetation and structural mapping, models of species distributions and timber resource mapping, in a negotiated process involving stakeholders using a Geographic Information System to identify forests likely to be required for the reserve system.

The outcome was inclusion of 172,012ha in reserves, placing approximately 600,000 hectares of State Forest in a moratorium from logging in Interim Deferred Forest Areas (IDFA) until the Comprehensive Regional Assessment was complete, placing mapped oldgrowth under a moratorium, adoption of Conservation Protocols to regulate logging, and granting five-year tradeable wood supply agreements to quota sawmillers at 50% of 1995/6 quota

allocations, renewable for a further 5 years provided value-adding criteria were satisfied (known as "5 by 5" year agreements).

1.2.2. CRA PROCESS

The final CRA process technically commenced late in late 1996, with the first meeting of the Joint Steering Committee on 30 October 1996.

The NSW Regional Forest Agreement Scoping Agreement broadly outlines the matters which both Governments aimed to agree upon through the process of undertaking Comprehensive Regional Assessments (CRAs) and negotiating Regional Forest Agreements (RFAs):

- conservation of forest areas needed to form a comprehensive, adequate and representative (CAR) reserve system;
- definition of areas available for ecologically sustainable commercial use of forests;
- accreditation of codes of forest practice, including the process for continual improvement of these codes, and other management arrangements for forests within RFA boundaries;
- identification of forest resource use and sustainable development options and examination of any potential economic and social implications, including for communities, of these options;
- identification of the region's industry and other potential;
- measures to protect biodiversity, threatened species and cultural heritage;
- identification of performance indicators and development of monitoring arrangements to enable detailed assessment and reporting on the indicators and of performance of the agreement every 5 years.

The NSW CRA process was established on the basis of achieving balanced representation of four state officials, four commonwealth officials, two (timber) industry people and two conservationists. This basic structure was replicated on the Steering Committee and in each of the four technical working groups. This level of participation gave interest groups a real and meaningful say in what was done and how it was done.

Following the IAP two mining industry representatives (one government and one Minerals Advisory Council) and one Aboriginal Land Council (ALC) representative were added to RACAC. A new Joint Steering Committee was formed to oversee the CRAs and four technical committees were formed to undertake the assessments: Environment and Heritage (E&HTC), Social and Economic (S&ETC), Ecological Sustainable Forest Management (ESFM) and Forest Resource and Management System (FRAMES).

The Steering Committee and technical committees were established on the basis that their membership would comprise 4 state representatives, 4 Commonwealth representatives, and 4 non-government representatives (1 FPA, 1 CFMEU and 2 conservation). At one stage the Commonwealth insisted that the Steering Committee should be expanded to include one additional timber industry representative (National Association of Forest Industries) and one Forest Protection Society representative. The conservation movement made it clear that this was unacceptable and that it jeopardised our continued participation. Initially NAFI was added, thereby creating an imbalance in representation. Though later a representative of the New South Wales Farmer's Association (NSWFA) was also added. NSW also appointed a representative of the Aboriginal Land Council (ALC). The Steering Committee became the principle decision making body, with RACAC now reduced to a state approval body with limited power.

The stacking of the non-government representation on the Steering Committee resulted in the two conservation representatives being pitted against a block invariably comprised of FPA, NAFI, CFMEU and NSWFA - hardly a balanced process, particularly with the conservationists' perception of a distinct bias on behalf of the Commonwealth towards industry. Aside from an ALC representative being added to the E&HTC, the membership of the technical committees basically remained as intended. A NAFI representative participated in E&H TWG meetings but didn't have voting rights.

Late in 1997 the CRA Steering Committee meetings began to become increasingly frustrated by the State's Resource and Conservation Division (RACD) and Commonwealth's Prime Minister and Cabinet (PM&C) insisting on postponing meetings while they discussed issues in secret for hours. Non-government groups were excluded from the Steering Committee in November 1997.

The continual pressure from conservation groups to establish the Regional Assessment Committees promised in the ALP Forest Policy finally resulted in Regional Forest Forums (RFFs) being established in each region, though with a greatly reduced role from that envisioned by the ALP Forest Policy.

The CRA provided a far more sophisticated and comprehensive assessment of conservation values in north-east NSW than previous assessments. Major additional biological surveys were conducted and new analytical approaches were utilised to produce much improved data on natural and cultural heritage values, national estate values, forest ecosystems, oldgrowth forests, wilderness, centres of endemism, significant fauna species, fauna assemblages and significant plant species (NSW and Commonwealth Governments 1999). Fine scale mapping of forest growth stages across all tenures resulted in a detailed oldgrowth forest layer defined in accordance with JANIS (1997) as "*ecologically mature forest where the effects of disturbances are now negligible"* (NPWS 1999b, d).

As for the IAP, independent scientists were again crucial to the scientific integrity of the process as participants on expert panels that determined core definitional and methodological issues, priority species lists, and the application of reserve criteria to produce conservation targets. Conservation targets were often reduced by the Steering Committee.

In a process similar to that utilised in the IAP, though with less flexibility employed for forest ecosystems and oldgrowth, the specific reservation thresholds set down by the JANIS criteria (1997) were applied to each of the mapped environmental attributes to produce targets for each conservation entity (NPWS 1999b).

There were little spatial data collected on socio-economic values and instead this information was largely presented in written reports. Timber volumes were represented spatially by a coarse timber volume priority index from 1 (highest volume) to 5 (lowest volume) and the overall timber impacts of reserve options were assessed through a yield simulator and scheduler known as the Forest Resource and Management Evaluation System (FRAMES) developed by SFNSW (SFNSW 1998a, b, c, d, e, f).

The negotiation and options development component of the CRA process for north-east NSW was conducted in September/October 1998. Immediately before negotiations were due to commence, the Commonwealth agencies withdrew from the process. The north-east region had previously been split into two separate regions, the Upper North East and Lower North East, but these were combined and conducted simultaneously.

In early September 1998 the Government agencies (State Forests, National Parks and Wildlife Service and Department of Urban Affairs and Planning) applied the environmental data and the national reserve criteria to identify 'information points' that were presented to the full stakeholder process. The information points were designed to illustrate the range of potential reserve and timber outcomes from the process.

The information point "Maximised JANIS" was intended "*to provide an indication of the likely maximum practicable achievement of targets in dedicated reserves within the region*". However, even this benchmark was not allowed to be implemented unhindered and, regardless of significant shortfalls in target achievement, agencies were directed not to exceed an arbitrary 70% of the State Forest estate in either region. Even with this limitation 1,027,655 hectares of public forests in north-east NSW were identified as requiring reservation in order to reasonably satisfy the national reserve criteria.

Once the information points had been identified, there were effectively two sets of negotiations conducted. One negotiation was principally between non-government stakeholders and the other was conducted between Government agencies, behind closed doors, to develop an agreed State Government reserve position.

The union and industry representatives then refused to take part in negotiations until they had obtained private commitments from the Government. After a delay of a month the purported "stakehoder negotiations" began in early October 1998. The Government had set them up to fail by stacking them with industry groups and undermining the industry's willingness to negotiate with promises of 20 years resource security at current levels and other commitments. Conservationists repeated requests to make negotiations have balanced representation and not be constrained by timber volumes were ignored. Having done their deal with the Government, the industry did not care if negotiations failed.

Conservation groups applied the science and utilised the reserve selection software to identify 1.2 million hectares as being needed to best achieve the national reserve criteria. Though for negotiations they tried to implement the process used in the IAP which involved applying decision rules using the reserve selection software to start by selecting small numbers of compartment with relatively high conservation values and low timber volumes.

After rejecting all of the areas put forward by conservationists, at one stage the industry groups proposed the reservation of 1,160 areas, including oldgrowth forests that they considered to be of the highest conservation value. When conservationists agreed to accept these as a starting point, the industry changed their collective mind and removed 900 of them. After two weeks of obstruction, delay and farce the negotiations came to a stalemate. It became apparent that the industry had already prepared their option and never had any intent of negotiating an outcome with conservationists. They were just going through the motions.

The timber industry groups ignored the science and refused to consider the protection of any forests outside some 335,000 hectares of predominately unloggable and low productivity areas they were prepared to accept for reservation. Approximately half of the areas proposed consisted of Crown leasehold over State Forest which was unavailable for immediate gazettal, or widely scattered, small parcels of Vacant Crown Land which generally could not be gazetted as reserves because of various encumbrances and whose conservation value is significantly compromised by their fragmented nature.

While the farcical stakeholders negotiations were being undertaken, State Forests and National Parks and Wildlife Service under the guidance of RACD (Department of Urban Affairs and Planning) negotiated a State Position.

The State Government agencies were instructed to develop a reserve system that would allow the supply of 270,000 cubic metres of sawlogs per annum for 20 years only, with reductions in supply volume allowable thereafter. This volume was the full annual volume already committed in 5 by 5 year wood supply contracts in 1996. There was very little 'timber' left above and beyond this volume for building reserves, which meant that the overall size of the reserve outcome was severely constrained from the outset.

The starting point for the agencies was the stage in development of the Maximised JANIS information point that provided sufficient timber resources. In the agency negotiations the National Parks and Wildlife Service struggled to hang onto some of the higher conservation value areas while State Forests pushed for smaller reserves and unloggable areas. Every time the agencies reached agreement, State Forests would renege and, with their Minister, try to undermine it. In the end, the chairman of the Resource and Conservation Assessment Council, Mr. Gerry Gleeson, intervened to develop a final State position. Unperturbed State Forests continued to undermine it. There was also a negotiation with the mineral resources agency over areas of high mineral value. Most high value mineral areas were removed from the final position, and some were proposed for inclusion in informal reserves that would prevent logging but allow continued access for mineral extraction and exploration.

The outcome of the State agency negotiation in early November 1998 was the finalisation of a 'State Agency position' on reserves that identified approximately 554,000 hectares of land for reservation. This included 390,447 hectares for immediate reservation as National Parks, Nature Reserves or Flora Reserves, 20,161 hectares for reservation in a new form of Crown reserve, a further 76,106 hectares of State Forests for later reservation following resolution of mineral and leasehold interests, and 67,000 hectares of vacant Crown land for later reservation following resolution of other interests and impediments. This outcome met the specified political constraint of maintaining current timber commitments for the next 20 years.

The conservation movement did not accept the State Position, but instead proposed to the NSW Government that it could be markedly improved by the reservation of an extra 65,000 hectares of the highest conservation value areas and the protection of all oldgrowth forest (Pugh 1998). According to State Forests own timber data, this could be achieved within the timber constraints set down by Government by implementing a reduction in the size of quota log specifications to come into effect in 10 years time.

The NSW Government finally decided to broadly implement the negotiated 'State Agency position', although it was reduced by 76,106 to exclude the State Forest areas that were previously earmarked for later reservation, and a further 15 compartments chosen specifically by the timber industry were also removed from the position. The 67,000 hectares of vacant Crown land remained earmarked for potential later reservation, though with somewhat less emphasis than in the original position.

On the 12 November 1998, Premier Carr announced the creation of 386,627 hectares of new NPWS reserves, 3,820 hectares of new SFNSW Flora Reserves and 20,100 hectares of new Crown reserves in north-east NSW (Anon. 1999c and Anon. 1999d). The decision was implemented by the *Forestry and National Parks Estate Act 1998.*

At the same time, the Government announced it would sign wood supply agreements with the timber industry committing to supply 270,000 cubic metres of quota sawlogs for 20 years (Anon. 1999c and Anon. 1999d). The value-adding review set down in the previous contracts that required value-adding measures to be implemented prior to further timber commitments being made, was dropped entirely. The new 20-year contracts had a clause that required a review of the available timber resource and sustained yield to be undertaken by December 2006 (Anon. 2000). This review represented the only mechanism for the Government to reduce timber volumes to industry at any time in the 20-year period without paying compensation.

The decision also promised to protect a subset of oldgrowth forests designated as 'high conservation value', all mapped rainforest, wilderness and steep and non-commercial areas in a management zoning system on State Forest tenure (Anon 1999c and Anon 1999d). After on-going agitation by conservationists over the following year, this promise was finally implemented with the inclusion of 370,000 hectares in protected Forest Management Zones in late 1999. Forest Management Zones can be amended or revoked by the Minister for Forests at any time. The most common 'protected' zones do not allow logging, but do allow on-going roading, mining, burning and grazing (Anon 1999c) and are not actively managed for conservation.

The Forestry and National Parks Estate Act 1998 that implemented the decision included major windbacks to the legislative controls on forestry. Existing legislation was amended so that State Forests of NSW forestry operations were exempted from the *Environmental Planning and Assessment Act 1979*, thereby removing the requirement for Environmental Impact Statements and Species Impact Statements (FNPE 1998). It introduced ministerial discretion into the implementation of the *Threatened Species Conservation Act 1995* and the *Protection of the Environment Operations Act 1997*, prevented the application of stop work orders to forestry operations, removed third party appeal rights on forestry activities and exempted forestry from most other pertinent environmental legislation including the *Wilderness Act 1987* (FNPE 1998). These changes represented a fundamental erosion of the most important legislative controls on forestry in NSW. They were implemented without any community consultation, were opposed by the conservation movement, and directly contradicted the ALPs own 1995 election policy.

The outcome also included a revised set of threatened species licence conditions for off-reserve management of State Forests, based on the previous Conservation Protocols. The revised conditions were once again negotiated between State Government agencies without accounting for independent scientific reviews or any assessment of their effectiveness. The licence conditions were included in the Integrated Forestry Operations Approval (IFOA) which is a statutory document under the *Forestry and National Parks Estate Act 1998* that includes all regulations pertaining to forestry operations (Anon 1999a, b).

The CRA decision also included the provision of $18 million for State Forests to purchase private land to log, and a further $5 million as a transport subsidy to the timber industry (Anon 1999c and Anon 1999d). It also included $500,000 for on-going monitoring and review of timber supply data (Anon 1999c, d). There was no money allocated to purchase freehold land for biodiversity or oldgrowth, or to upgrade or refine conservation data.

The outcomes were documented in the NSW Forest Agreements for north-east NSW that were completed in March 1999 (Anon 1999c,d). The NSW Agreements were later used as the basis for Regional Forest Agreements that were signed by NSW and Commonwealth Governments in March 2000 (Anon. 2000).

The Forest Products Association (*The Sydney Morning Herald*, 20 November 1998) stated that the Agreement *"has delivered a balanced outcome for all sides, the greens, the timber industry and rural communities...it is not true to claim there are major shortfalls in the protection of old growth, wilderness and threatened species – 68 percent of all public forests are now reserved in national parks."*

The Forest Products Association and the Construction Forestry Mining and Energy Union lobbied hard for the *Forestry and National Parks Estate Act 1998*, though conservationists did not 'agree' with the outcomes of the process and actively opposed the Act.

The Inquiry needs to acknowledge that the Comprehensive Regional Assessments were the first time in NSW that a systematic and scientifically rigorous assessments of conservation and socio-economic values had ever been undertaken with the aim of satisfying explicit national reserve targets to establish a Comprehensive Adequate and Representative reserve systems. Until near the end it was an open and balanced process allowing principal interest groups real and meaningful involvement. At the end the process was subverted by the Government giving the timber industry timber volume commitments that undermined their willingness to negotiate and precluded the creation of a CAR reserve system.

The Forestry Reform process delivered a significant increase in the reserve system in north east NSW based on a rigorous scientific assessment and delivered a comprehensive regime for off-reserve management. Tragically the reserve outcome fell far short of what was required to fulfil the minimum requirements of the national reserve criteria. Government agencies identified 1,027,655 hectares of public forests in north-east NSW as requiring reservation in order to reasonably satisfy the national reserve criteria, though the outcome was the reservation of 410,547 ha in 1998, with a further122,334 hectares of unloggable forests and Crown land being added by 2002. A further 370,000 hectares of unloggable forests, wilderness, oldgrowth and rainforest was included in Forest Management Zones excluded from logging.

Regrettably the industry was given 20 year Wood Supply Agreements until 2018 for volumes of large quota sawlogs from public lands at intentionally unsustainable levels. Industry groups supported the outcome while conservation groups opposed it.

1.2.3. ICON DECISION

There were several on-going reserve processes which continued after the signing of Forest Agreements in north-east NSW. These included the transfer to National Parks estate of large blocks of 'unloggable' Forest Management Zones, the new Crown reserves created in the 1998 decision, and the review of the 70,000 hectares of vacant Crown land. Over the next few years the Government reviewed these areas to decide which areas to be reserved and in what form. The

outcome was the reservation of a further 81,667 hectares of State Forest tenure and 40,667 hectares of vacant Crown land from 1999 to 2002.

Some 310,000 hectares of State Forest areas in the region already protected in Forest Management Zones were also given increased protection as Special Management Zones in 2002 under the *Forestry Act 1916* as a result of the on-going reserves processes (enacted in the *National Parks Estate Reservations Act 2002*). With 2003 additions, the Special Management Zones now include all mapped oldgrowth forest, wilderness and most rainforest on State Forests in the region, but also include large areas of steep, low conservation value, and essentially unloggable lands. These Zones now require an Act of Parliament to be amended or revoked and thus have improved legislative security to previous management zonings. They are not available for logging, but are generally available for grazing and mining and are, as yet, not actively managed for conservation.

The FMZs were required to be given the increased protection provided by Special Management Zones so that they could be counted as informal reserves. They were relied upon in the NSW and Commonwealth Regional Forest Agreement (2000) to better attain reserve targets for forest ecosystems, oldgrowth and wilderness.

By 2002 comparisons of actual yields to Forests NSW's predicted yields were showing significant shortfalls. In 2002 a desktop review (Vanclay 2002) concluded "*that the harvest able to be sustained during the next 20 years is 220,000 m3/year at most*" with long term yields predicted to frop to 175,000 m^3/year for the subsequent 20 years, before dropping to a sustainable yield of 110,000 m^3/year.

In January 2003 Forests NSW forgave some $1million of debt owed by Ford Timbers in return for 15,000 m^3/year of quota, though claimed they intended to re-sell it.

Due to an ongoing campaign by conservationists, in the lead-up to the NSW State elections in March 2003, the ALP announced that it would protect a further 65,000 hectares of public forests (MR 'Premier Carr Announces Protection for Forest Icons', 2 March 2003). This included 45,000 hectares contained in 15 "icon" areas that were transferred to formal reserves and 20,000 hectares of oldgrowth forest that was transferred to Special Management Zones protected from logging (*National Parks Estate Reservation Act 2003*). The icons included many of the highest conservation value forests in the region, including a sequence of large coastal forest reserves and some important oldgrowth stands. The protection of the 20,000 hectares of oldgrowth meant that all large areas of mapped oldgrowth on State Forest tenure in north-east NSW were finally protected.

Despite the reduction in the area of state forest the "net harvest area", which is the basis of yield estimates, was actually increased by some 700ha according to Forests NSW's FRAMES modelling, primarily because of the decision to remove "buffers on buffers". This was achieved by amending the IFOA to allow the accidental felling of trees into most exclusion areas and the entry of machinery into some exclusion areas to fell trees. This significantly increased the proportion of the gross area that could be harvested, theoretically compensating for the new reserves.

Timber availability at that time had also been increased by new plantations and additions to State Forests' estate from private property purchases, while commitments had been reduced by the buy-back of quota from Ford Timbers. So if resource estimates were accurate there should have been no resource problems caused by the new reserves.

For the timber industry the NSW Government issued new Wood Supply Agreements to north coast sawmillers for quota, small and low quality sawlogs and extended them for 5 years (until 2023) past the expiry of the NSW Forest Agreements. Most significantly the NSW Government foolishly removed the clause that allowed for a non-compensable reduction in commitment following a review of available timber resources.

For quota sawlogs this set a volume of 215,422m^3 per annum for 20 years, five years past the end of the LNE and UNE Forest Agreements, and resulted in firm commitments for a total supply of 4,365,852m^3, and tentative commitments for a further 95,687m^3. At the time the new WSA were made there were remaining commitments of 254,000m^3 of large quota sawlogs for 15 years, which is a total of 3,810,000m^3. These new WSAs thus resulted in an increase in committed volumes of large quota sawlogs of 555,852 to 651,539m^3 - not a bad windfall for millers, particularly as Ford Timbers' quota had been bought back for some $1million and yield reviews were showing that commitments needed to be substantially reduced.

The Government was even more generous, giving millers commitments of up to 1,777,180m^3 of high quality small sawlogs and 4,097,940m^3 of low quality sawlogs, increasing the total volume of sawlogs committed in WSAs by up to 271%. While such commitments of tradeable timber rights are worth a fortune to the millers, they were given freely. The large quota sawlog component alone had a market value of over $60 million, though there was no tendering process.

The Auditor General (2009) commented:

> *In this new agreement, the Government waived its rights to reduce commitments without compensating industry for any loss. This removed Forests NSW's ability to better manage supply risks by adjusting commitments. In addition, timber volumes were more or less maintained despite the loss of forest estate to national park and reserves.*

As if Forests NSW and the timber industry had not already been given enough, the area available for logging was again significantly increased in 2004 by amendments to the Environment Protection Licence that effectively allowed logging within the buffers of most unmapped streams. This was simply achieved by excluding non-scheduled forestry activities from the requirements of the Environment Protection Licence on 17 May 2004. As a result of this change, over 90% of logging operations no longer required Environmental Protection Licences. By removing the requirements for 10m buffers on unmapped streams and the requirement to limit damage to drainage depressions this significantly increased the areas and volumes available for logging. It has also resulted in significantly increased environmental harm and stream pollution.

Forest Management Zone 8 areas are primarily comprised of modelled unmapped streams, with some modelled high erosion areas, that are intended to be further assessed at the Harvesting Plan stage. These represent over 100,000 hectares that were not counted as contributing to timber supply on the basis that they would be refined by field assessments and allocated to exclusion zones (ie FMZ 3A). In practice, since unmapped streams are no-longer required to be protected (except where threatened fish are present downstream), they are not further assessed and now simply counted as being part of the general logging area. This represents a major increase in the area available for logging, at significant environmental cost.

And in another attempt to reduce timber commitments, in 2006 and 2007 $2,777,000 was spent buying back 12,194m^3 of Wood Supply Agreement commitments (substantially more than was paid to Ford Timbers a few years earlier).

Soon after the RFA it became apparent that yields were substantially below those predicted. By 2002 it was apparent that at least an immediate 18% reduction in commitments was required because of Forests NSWs over-estimates, estimates of long-term sustainable yields had plummeted.

The 2003 Icon decision protected 45,000 hectares in 15 "icon" areas as reserves and placed 20,000 hectares of oldgrowth forest on state forest into protected zones. This filled some significant gaps in the reserve system and resulted in the protection of most large patches of oldgrowth on public lands, though still left many reserve targets unmet. Forests NSW's resource assessment showed this reduction in areas available for logging could be compensated for by reducing the protection provided to exclusion areas by removing "buffers on buffers".

The Government then reduced annual timber commitments down to the levels identified in the limited 2002 review. Regrettably the Government entrenched unsustainable logging by extending Wood Supply Agreements for a further 5 years until 2023, thereby increasing total committed volumes of large sawlogs and adding commitments for small and low quality sawlogs.

In 2004 Forests NSW operations were exempted from the Environment Protection Licence for most operations so they could log tens of thousands of hectares of the banks of unmapped streams that had not been counted as contributing to timber commitments. While this represented a major resource bonus to the industry, it has also resulted in significantly increased environmental impacts and stream pollution.

In 2006-7 another $2.8 million of public monies were spent to buy back timber that had been given for free to the industry a couple of years earlier.

1.3. Environmental Assessment

Reserve targets were established strictly in accordance with the JANIS national reserve criteria. Expert panels in various disciplines oversaw and reviewed the data analyses and established targets for all entities. The expert panels placed each entity on a scale from 1 to 5 (from highest to lowest priority) according to its relative vulnerability to threatening processes (such as logging and associated forestry activities) and its need for incorporation into the reserve system.

Data on environmental entities including 240 forest ecosystems, populations of 152 fauna species, 444 plant species, oldgrowth forest and wilderness was applied in the north-east NSW CRA process. Due to the years of systematic collection of environmental data in the north-east forests, these data (though not without their problems) were the most comprehensive and reliable available for any regional forest assessment in Australia.

There was significant information collected on National Estate values (both cultural and environmental), though most of it was incomplete. The refusal of the Commonwealth to allow targets to be set for National Estate areas, the partial provision of data only for the UNE before the Commonwealth withdrew from the process and the lack of interest in National Estate values from State agencies in negotiations, meant that this data was to all intents and purposes ignored. World Heritage assessments did not occur until a decade later and are still incomplete.

For forest ecosystems the base target was set at 15% of their pre-1750 distribution. Rare and endangered forest ecosystems were given a 100% target and vulnerable forest ecosystems a target of 60% of their remaining extent.

Rainforest across all tenures was mapped by Aerial Photographic Interpretation (API) of 1:25,000 photographs. All rainforest patches down to 2 ha in size visible on 1:25,000 scale photographs were mapped. This means that up until the stage where a closed rainforest canopy becomes completely obscured by the emergent eucalypts (approximately 35% crown cover) it is classed as rainforest. Rainforest was set a 100% target.

The JANIS (1997) criteria adopt base targets for oldgrowth of 100% of rare and endangered oldgrowth and 60% of remaining extent for the rest. JANIS (1997) provides for these base targets to be increased to the "*levels of protection necessary to achieve*" protection of high quality habitat for species, appropriate reserve design, protection of the largest and least fragmented areas of oldgrowth, specific community needs for recreation and tourism, protection of rare and depleted oldgrowth and protection of aesthetic and cultural values.

An additional category of "High Quality Habitat Old Growth" (HQHOG) was created by intersecting modelled high quality habitat for 21 oldgrowth dependent species (selected by fauna experts) with mapped oldgrowth. HQHOG was assigned a target of 100%.

For wilderness areas identified in accordance with the Commonwealth's criteria the minimal JANIS (1997) requirement for protection of 90% of the "highest quality" wilderness areas was all that was adopted.

To satisfy the JANIS requirement to incorporate viable populations of priority fauna into the reserve system, reserve targets were identified by application of a formula which used life history parameters known to influence a species probability of extinction to give an estimate of the relative amount of area different species may need to persist. This was described as the minimum viable

area needed to maintain a species in perpetuity and the output was termed a habitat protection target. Expert panels then identified subregions for populations separated by dispersal barriers. Targets were applied using modelled mapped habitat reviewed by expert panels.

For flora, targets were primarily based on reserving numbers of localities, as determined by an expert flora panel, rather than percentages of localities. This is still a long way from the goal of protecting viable populations.

An endemic species was defined as a species for which more than 75% of its range or more than 75% of its total population falls within north-east NSW (Upper and Lower North East regions combined). 15 Centres of Endemism for assemblages of flora, 6 for assemblages of fauna, and 12 for invertebrates were identified and assigned targets of 100%.

The outcome of the process was that most reserve targets were not satisfied. The NSW Government limited its Summary of Achieved Targets (Anon. 1999c, Attachment 2) to forest ecosystem and oldgrowth targets:

> *In the Upper North East Region there are 162 forest ecosystems and 144 old growth ecosystems. If the additions to the formal reserve system are adopted, as outlined in this Cabinet Minute, a total of 59 forest ecosystems and 26 old growth ecosystems will achieve conservation targets. This will leave 103 forest ecosystems below target, of which 74 are ranked highly vulnerable, and 118 old growth forest ecosystems below target, of which 76 are ranked highly vulnerable (see attachment G).*
>
> *In the Lower North East Region, there are 198 forest ecosystems and 169 old growth ecosystems. If the additions to the formal reserve system are adopted, a total of 83 forest ecosystems and 59 old growth ecosystems will achieve conservation targets. This will leave 115 forest ecosystems below target, of which 87 are ranked highly vulnerable, and 110 old growth ecosystems below target, of which 56 are ranked highly vulnerable (see attachment H).*

Since the 1998 decision there have been a number of areas added to reserves as part of the resolution of outstanding areas and as a consequence of the Icon Decision. This process has resulted in most larger areas of mapped oldgrowth forest and wilderness on public land being protected and significant improvements in forest ecosystem, fauna and flora target achievement. Despite this there are still significant shortfalls in many reservation targets.

Off-reserve protection in Forest Management Zones (FMZ 1,2,3A) and Special Management Zones, as well as protection by prescription, make significant contributions towards attainment of the JANIS reserve targets. While we have updated the attainment of targets within reserves we have not been able to do so for off-reserve protection at this time. For illustrative purposes we have indicated the magnitude of the likely contribution such categories make to attainment of forest ecosystem targets based on the RFA's (Anon 2000) claims. Though it needs to be stressed that this is only indicative as many of the areas contributing in 2000 have since been added to the reserve system. It has also been found that logging incursions into areas meant to be informal reserves are common, that FMZ3B is not managed for its special values, and prescriptions are often not applied.

An assessment of overall achievement of reserve targets for the upper and lower north-east shows that there is still a shortfall of over 670,000 ha (36%) in the attainment of the JANIS reserve targets for ecosystems within the formal reserve system. 282,000 ha of these unmet targets could be satisfied from public lands if the Government wanted to, though the balance would need to be

sourced from private lands. If allowance is made for informal reserves on state forests and logging prescriptions then the shortfall in ecosystem protection is still over 410,000 ha, of which some 115,000 ha could be protected on public lands.

		Upper North East	**Lower North East**
Number of Ecosystems		162	198
Total target area		759,801ha	1,079,667ha
Total target area attainable from public land.		567,622ha	883,018ha
Reserves as at 2004	Number of Ecosystems under target	95	107
	Remaining Shortfall in targets	322,675ha	348,472ha
	Remaining shortfall available from public lands	130,097ha	151,823ha
Reserves as at 2004, plus informal reserves and prescriptions+	Number of Ecosystems under target	80	92
	Remaining Shortfall in targets	199,551ha	214,044ha
	Remaining shortfall available from public lands	59,778ha	54,876ha

+ Note that the areas counted as being protected in informal reserves or by prescription are those given in the 2000 RFA, and as many of these areas were subsequently incorporated into reserves they have been in effect double counted – these figures thus overstate the ecosystem reservation status.

The reserve additions since 2000 have significantly improved the reservation status of forest ecosystems, though across both UNE and LNE 202 ecosystems (56%) remain below target, with 119 (33%) not even achieving 50% of their targets. Even with allowance for off-reserve protection it is likely that some 172 ecosystems (48%) remain below target.

		UNE Ecosystem Target Achievement (no)				
		<25%	**25-49%**	**50-74%**	**75-99%**	**>100%**
2000	**Dedicated Reserves**	52	23	17	18	52
	Dedicated and Informal Reserves and Prescriptions	34	24	11	20	73
2004	**Dedicated Reserves**	38	22	16	19	67

		LNE Ecosystem Target Achievement (no)				
		<25%	**25-49%**	**50-74%**	**75-99%**	**>100%**
2000	**Dedicated Reserves**	48	29	20	23	78
	Dedicated and Informal Reserves and Prescriptions	36	21	21	27	93
2004	**Dedicated Reserves**	36	23	23	25	91

Flint, Pugh and Beaver (2004) analysed the adequacy of the reserve system for fauna in 2004. They found that there is still grossly inadequate reservation for most species;

> *A binary target assessment of all 710 fauna populations under consideration (excluding targets for bat roosts) reveals that only 217 (31% of all populations) have met conservation targets. Seventy-two of the 139 species (or 52% of species) with targets set have failed to meet target for any of their populations. Only 17 species have met target for all their populations, while the remaining 50 species have met target for at least one but not all populations.*
>
> *A proportional target analysis indicates that only 45% of fauna populations have sufficient habitat reserved to achieve 50% or more target fulfilment, and 20% of fauna populations are yet to achieve even 10% of the habitat required to meet targets. The mean target achievement for all populations across all tenures is 49%, and the target area index is 33%. The mean target achievement for public lands is 76% and the target area index is 70%.*
> *...*
> *Of the 38 fauna species ranked by the expert panel as having the highest vulnerability to threatening processes (vulnerability 1), 30 do not attain targets for any populations, and none attain targets for all populations. Only 8 species attain targets for one or more populations. Therefore, species with the highest vulnerability to threatening processes remain very poorly reserved.*

Examples of the achievement of reservation targets for particular species (Flint, Pugh and Beaver 2004) in north-east NSW (UNE and LNE) were:

- **Hastings River Mouse**, a nationally Endangered species; target was 33,969 breeding females distributed across 8 populations (of up to 4,251 females each). The outcome was the reservation of a total of 2,863 breeding females, with 8% of the mean target achieved (1-29%).
- **Spotted-tailed Quoll**, a nationally Vulnerable species; target was 4536 breeding females distributed across 4 populations (of up to 1,800 females each). The outcome was the reservation of a total of 1,201 breeding females, with 25% of the mean target achieved (10-55%)
- **Barking Owl**, a State Vulnerable species; target was 1,610 breeding females distributed across 2 populations (of up to 805 females each). The outcome was the reservation of a total of 466 breeding females, with 61% of the mean target achieved (44-79%)
- **Powerful Owl**, a State Vulnerable species; target was 756 breeding females distributed across 2 populations (of 378 females each). The outcome was the reservation of a total of 234 breeding females, with 14% of the mean target achieved (11-18%)
- **Yellow-bellied Glider**, a State Vulnerable species; target was 9,240 breeding females distributed across 8 populations (of 1,155 females each). The outcome was the reservation of a total of 1,636 breeding females, with 18% of the mean target achieved (6-33%)

These outcomes highlight the failure of the RFA process in north east NSW to satisfy national reserve criteria and deliver on the promise of an adequate reserve system sufficient to maintain the ecological viability and integrity of fauna populations. The extremely poor reservation status of many threatened fauna species in north-east NSW emphasises the need for substantial additions to the reserve system to improve fauna conservation, as well as the strict application of strengthened logging protocols that take into account the poor reservation outcomes. Evidence from NEFA's audits is that off-reserve management prescriptions for fauna are frequently not being applied, are inadequately implemented or are negated by other forestry practices.

The Inquiry needs to recognise that the reserve system in north-east NSW does not satisfy the national reserve targets, even when informal reserves and values

protected by prescription are counted the reserve system remains grossly deficient. Only 64% of the total area of ecosystems needed to satisfy the ecosystem targets has been reserved and 33% of ecosystems have not met even half their targeted areas. It is most worrying that 52% of fauna species fail to meet the targets set for any of their populations and that only 31% of populations have achieved targets aimed at encompassing viable populations of our most vulnerable species into the reserve system.

The inquiry should recognise the need to significantly expand the reserve system in north east NSW to provide the needed protection for biodiversity and to bring it up to national standards.

1.4. World Heritage Values

With the NSW opposition parties threatening to open up the new rainforest parks for logging, the Wran Government moved to cement its 1982 Rainforest Decision by having the new parks given World Heritage Listing. In March 1985 the NSW Government nominated 203,088ha of reserves in north east NSW for inclusion on the World Heritage List as the 'Subtropical and Temperate Rainforests of Eastern Australia', with the nomination accepted in 1986.

In 1992 the Commonwealth and state governments put forward a further nomination for World Heritage Listing that added additional rainforest areas in the state of Queensland to the existing NSW 'Subtropical and Temperate Rainforests of Eastern Australia' sites as the Central Eastern Rainforest Reserves of Australia (CERRA). The NSW Government at that time refused to consider any additions.

In June 1993 the IUCN's World Heritage Bureau responded, noting that *"There has been a tendency in Australia to take an incremental or phased approach to delimiting boundaries of World Heritage properties"* and suggesting that five areas in NSW and one area in Queensland *'from a value-added viewpoint and to strengthen manageability'* be considered for addition. In response, for NSW the State and Commonwealth governments decided to add to the existing nomination the existing Oxley Wild Rivers National Park (93,220ha) and 16 generally small and disjunct flora reserves on state forests (totalling 7,837ha) where they also occurred in the missing areas identified by IUCN. In December 1994 IUCN's World Heritage Bureau agreed for the proposed areas to be incorporated into CERRA.

In 1996 the Commonwealth of Australia and the State of New South Wales signed a Scoping Agreement for New South Wales Regional Forest Agreements which committed:

> *(f) World Heritage values*
> *This assessment will allow the Commonwealth to meet its obligations arising both from it being a State Party to the World Heritage Convention and from its own statutory requirements as set out in the World Heritage Properties Conservation Act 1983. The output from this assessment will be an assessment of World Heritage values of the forested areas of New South Wales.*

The NSW CRA process made no attempt to specifically identify World Heritage values. As an alternative in 1998 the Commonwealth established a 'World Heritage Expert Panel' to identify places of possible outstanding universal values in forested areas as part of its Regional Forest Agreement process. As well as rainforest, the panel identified that *Eucalyptus* dominated vegetation in Australia is of World Heritage value as an outstanding example on a continental scale of forest and woodland vegetation dominated by a single genus, noting

- There are two major peaks of eucalypt species richness in the eucalypt forests of the Australian continent – one in the Blue Mountains and the other in north east NSW extending into south-east Queensland.
- All major ecological types of eucalypt forest, except monsoon forest, are well represented in these two areas.
- Two of the eucalypt subgenera, Monocalyptus and Symphyomyrtus, and the genus *Angophora* are most diverse within these two areas.
- The emphasis should be on inclusion of large natural areas of eucalypt forests.
- CERRA was designed for rainforest representation and does not cover the variety of eucalypt species and forest types in the region.
- To adequately encompass the eucalypt theme, CERRA needs to be expanded to include adjoining areas of National Parks, State Forests and private property.

- Supporting values include representation of passive marginal swells and Aboriginal ceremonial sites.

The UNE Forest Agreement (2.7) signed by the NSW Ministers on 5 March 1999 states:

> *The rainforest values contained in existing reserves, which have been recognised internationally by being listed as World Heritage Areas, must be protected. These areas are collectively known as Central Eastern Rainforest Reserves, Australia (CERRA).*
>
> *As a result of the UNE agreement, substantial new rainforest areas have been added to existing reserves. The Ministers agree to undertake studies in the new dedicated reserve* areas, and if they meet World Heritage criteria, to nominate additional areas for World Heritage Listing as extensions to CERRA, by 1 April 2001.*
>
> *The Ministers also recognise that the forests of the UNE Region may potentially contain other outstanding universal World Heritage values apart from rainforests. These other potential values may include Eucalypt dominated vegetation and religious beliefs embodied in the landscape (Aboriginal dreaming sites and bora grounds). The Ministers* agree to further studies being undertaken in the forests of the dedicated reserve* areas of the UNE Region by 1 April 2002, to investigate and document other potential World Heritage values. If areas are demonstrated to be of outstanding universal significance on the basis of these values, the Ministers* agree to put them to the Government for consideration of their protection and nomination for World Heritage Listing.*

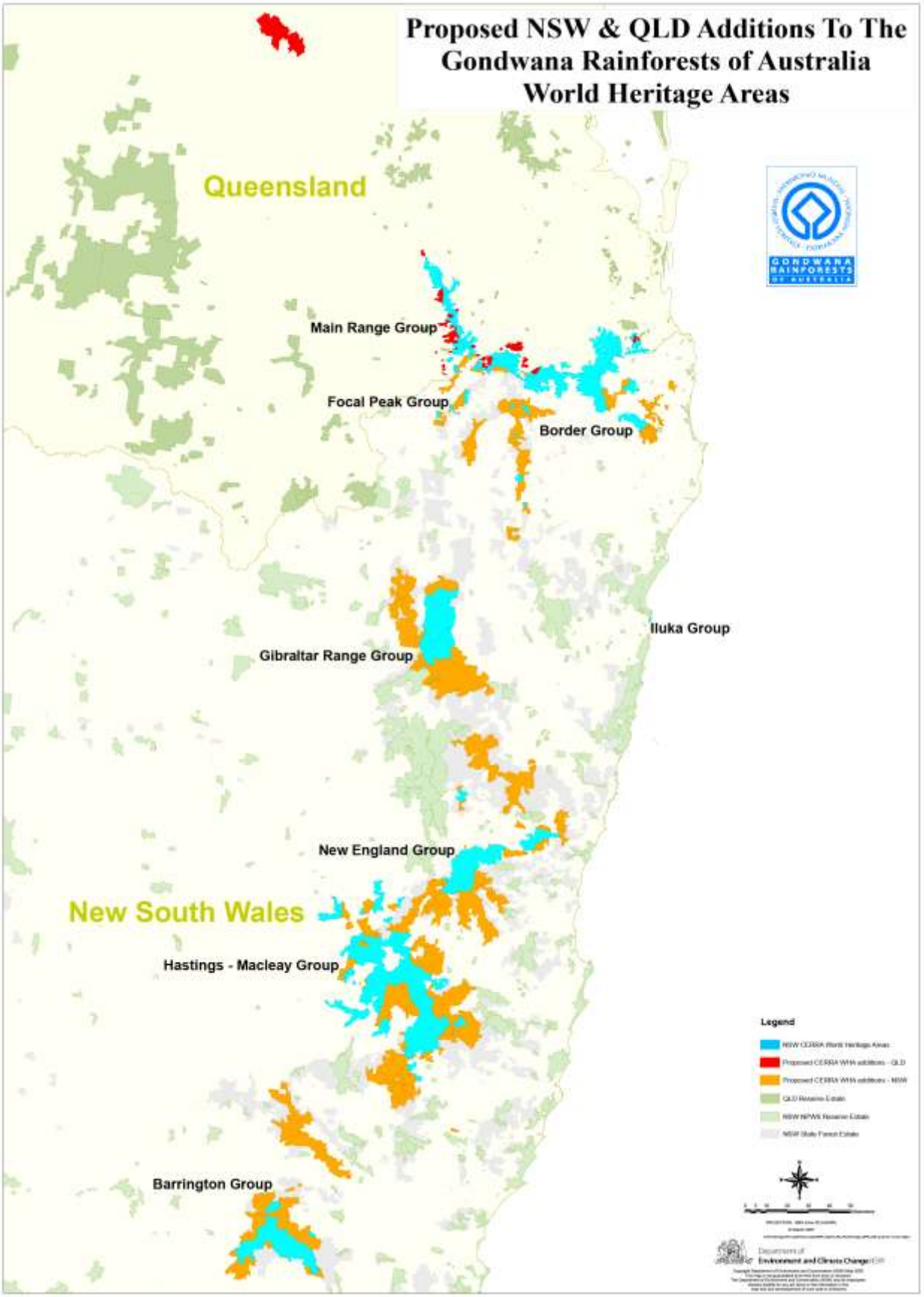
In March 2000 the NSW and Commonwealth governments signed Regional Forest Agreements for north-east NSW which committed them to (clause 27):

> *Parties agree to actively investigate, and jointly participate in the further World Heritage assessment of the relevant Australia-wide themes specified in Section 3.4.2 (Table 17) of the World Heritage Expert Panel report, including any potential contribution from the Upper North East and Lower North East regions.*

Rather than completing the renomination by 2001, DECCW (2010) note that they didn't start until 2003–04 and limited consideration to *"its current rainforest theme*". In 2007 the name of the world heritage property was changed to Gondwana Rainforests of Australia.

Belatedly an assessment was undertaken by scientists from both the Office of Environment and Heritage and the Gondwana Rainforests Technical and Scientific Committee (TSAC), with review by the Gondwana Rainforests Community Advisory Committee, that assessed existing reserves for addition to the World Heritage property "*against objective criteria to establish those sites which would both best add to the outstanding universal values of the property and those which would facilitate further protection of these values"* (DECCW 2009). DECCW (2009) note:

> *The values that may justify inscription are those Gondwana Rainforests values that met the UNESCO criteria for World Heritage listing in 1986 and 1994 as detailed below. These values are represented largely by its biota, in particular, biota that are relictual (dating from earlier stages of Earth's evolutionary history), are endemic to small areas (indicating ongoing evolutionary processes) and are rare or threatened. The areas proposed for addition included those with a high proportion of rainforest, those containing key biota linked to World Heritage values and those which contained rainforest types and values currently not well represented in Gondwana Rainforests.*



Proposed additions to the Gondwana Rainforests World Heritage Area

In 2010 NSW, Queensland and the Commonwealth submitted a Tentative List of national parks to the World Heritage Centre which were proposed for future nomination as additions to the Gondwana Rainforests of Australia World Heritage area. Most of the NSW qualifying area of 459,739 ha is comprised of areas added as part of the Forest Reform process.

Areas of NSW Reserves Submitted to IUCN as Tentative Additions to the Gondwana Rainforests of Australia.

QUALIFYING CATEGORY	**Area**
Areas previously recommended by the IUCN to be a part of Gondwana Rainforests	250,491 ha
Areas that formed a contiguous addition to an existing part of Gondwana Rainforests	105,247 ha
Areas that had a high total score against the criteria	104,001 ha
TOTAL area of identified NSW additions	**459,739 ha**

Unfortunately the Tentative List submitted to IUCN failed to consider additional areas that could qualify for listing as World Heritage based on the eucalypt theme or the supporting values of passive marginal swells and Aboriginal ceremonial sites.

The National Parks Association (Cerese 2012) undertook a preliminary assessment of the World Heritage values of the eucalypt forests in north east NSW , finding:

> *The significant eucalypt attributes detailed in the report suggest that the northeast NSW region is likely to make a significant contribution to the recognition of the outstanding universal value of the eucalypts in Australia. The ecological diversity apparent in the large numbers of eucalypt dominated communities in the study area; the high level of species diversity and endemicity; the wide range in structural forms of eucalypt vegetation present in the region; and the domination of the terrestrial environment across a broad latitudinal range from the coast and across the higher altitudes of the escarpment ranges to the western slopes of the Great Dividing Range, all add considerably to the representation of the World Heritage Eucalypt theme. The unique biogeographic placement of the region within a zone of subtropical/temperate overlap, and the altitudinal range and geologic/edaphic variation across the Study Area, means that this region supports a diversity of eucalypt vegetation mosaics that is possibly unique continent wide. The exceptional wet sclerophyll forests of the region form an integral component of this unique ecological diversity. In addition, the biological diversity attributes detailed in the report, and the dependence of the flora and fauna of the region on the essential habitat requirements provided by the eucalypt biota, suggests that these forests contain the most important and significant natural habitats for in-situ conservation of biological diversity in the region.*

Cerese (2012) evaluated the diversity and significance of eucalypt flora and biodiversity in north east NSW (north from Hunter River) finding:

1) **Eucalypt species:**
    i) Overall species richness - 143
    ii) Number of endemic species - 43
    iii) Number of threatened species - 21
    iv) Number of ROTAP-listed species - 43
2) **Forest ecosystems and communities:**
    i) Total number of eucalypt ecosystems - 159
    ii) Number of endangered ecological communities (with a eucalypt component) - 11
3) **Vertebrate fauna species:**
    i) Total number of species - 695
    ii) Number of threatened species - 148

4) Vascular flora species:

i) Total number of species - 3412
ii) Number of threatened species - 231
iii) Number of ROTAP species - 390

Cerese (2012) recommends undertaking an assessment to identify the 'best of the best' of eucalypt vegetation across all tenures in north east NSW, stating:

> *Given the significant areas of eucalypt forest located within existing Gondwana Rainforests World Heritage Area (and the proposed additions to this area) as well as the recent fossil evidence confirming the Gondwanan origins of the eucalypts, this report concludes that the most effective and appropriate way to recognise and protect the eucalypt values of the forests of northeast NSW is to include them within a new and revised 'Gondwana/Gondwana Forests World Heritage Area'. It is therefore recommended that all those areas of outstanding eucalypt forest in the subtropical biogeographic region that are identified by a further assessment process are then incorporated into a renomination or additional nomination for this property.*

The forests of north-east NSW have also been identified as being of outstanding value for threatened biodiversity in numerous other assessments, for example they have been identified as part of one of the world's 35 biodiversity hotspots because of their exceptional species endemism (at least 1,500 endemic plant species, i.e., 0.5% of all known species) and habitat loss (70% or more of an area's primary vegetation cleared) (Williams *et.al.* 2011).

The upper north east encompasses part one of one of Australia's 15 recognised biodiversity hotspots, the 'Border Ranges North and South (Queensland and New South Wales)'. Biodiversity hotspots are areas that support natural ecosystems that are largely intact and where native species and communities associated with these ecosystems are well represented. Areas with many endemic species where the levels of stress or future threat were considered to be high were identified by the Australian Government's Threatened Species Scientific Committee as hotspots. In relation to the Border Ranges North and South the Environment Australia website notes;

> *This sub-tropical and temperate hotspot is one of Australia's most diverse areas - and it is* the *most biologically diverse area in New South Wales and southern Queensland. It has a variety of significant habitats: subtropical rainforest, wet sclerophyll forest, mountain headlands, rocky outcrops and transition zones between forests.*
>
> *These habitats support a huge variety of bird and macropod species. Many are rare or threatened: the Richmond Bird-wing Butterfly, Fleay's Frog, Hastings River Mouse, Long-nosed Potoroo, Spotted-tailed Quoll, Eastern Bristle Bird, Rufous Scrub-bird and the critically endangered Coxen's Fig parrot. Notable birds such as Albert's Lyrebird and the Paradise Riflebird make their home here, and in the south-east Queensland rainforests live a rich variety of primitive plant species, many of them similar to fossils from Gondwana.*
>
> *This region's high population growth, with associated urban and tourist developments along the coast, is a major cause of habitat loss and fragmentation. Although most remaining natural areas are protected, they are under considerable threat from weeds, fire and recreational use.*

The NSW and Commonwealth Governments initially committed to undertake a World Heritage assessment as part of the CRA process. The March 1999 Forest Agreements committed NSW to undertake studies of rainforest and to nominate additional qualifying areas of reserves for World Heritage Listing as extensions by 1 April 2001. They also agreed to identify qualifying eucalypt and Aboriginal

dreaming sites by 2002. In 2007 the name of the world heritage property was changed to Gondwana Rainforests of Australia and in 2009 the rainforest assessment was finally undertaken. In 2010 the NSW, Queensland and the Commonwealth submitted a Tentative List of 459,739 ha of NSW national parks to the World Heritage Centre which were proposed for future nomination as additions to the Gondwana Rainforests of Australia World Heritage area on the basis of rainforest values.

The State and Commonwealth Governments have agreed to limit any renomination to existing reserves. An expansion of the Gondwana Rainforests of Australia World Heritage property will increase recognition of these forest's values, attract tourists, and require the Commonwealth to assist in management costs.

The Inquiry needs to recognise that the rainforests and eucalypt forests of north east NSW are of world significance and recommend that the overdue process of renominating an expanded Gondwana Rainforests of Australia, incorporating a eucalypt theme, for inclusion on the World Heritage List be progressed without further delay.

2. Operational, economic, social and environmental impacts after conversion, and in particular, impacts upon neighbours of public land and upon Local Government

The economy of north-east NSW generally boomed through the Forest Reform process, with the exception of the New England Tablelands which was severely affected by the drought. The growth in the labour force and employment has outstripped population growth and unemployment has plummeted. Generous government assistance packages for sawmillers and timber workers helped overdue restructuring of the timber industry.

Visitation to national parks has increased by 250%, generating hundreds of millions of dollars worth of business turnover of and thousands of jobs in the regional economy. As the logged forests incorporated into reserves recover they are storing more carbon and yielding more water to streams, providing real environmental and economic benefits to regional communities.

The protection of rainforest, oldgrowth forest, wilderness and threatened species that occurred through the Forest Reform process was clearly in society's best interests, as of most of the region's residents, and many park neighbours, have consistently weighted these forest values above logging.

An assessment of socio-economic values to identify the costs and benefits to society as a whole arising from forest use is required to inform decision making processes. Assessments of economic impacts are usually simplistic and biased towards the identification of worse-case scenarios for affected extractive industries. There is a need to consider the costs and benefits of forest use. A holistic socio-economic assessment requires consideration of all values, including forest protection values and community values.

All too often assessment of the economics of public forest use are based solely on the economic benefits of the timber industry and other exploitative uses, with the costs ignored. The Department of Planning (1994) in its report on the Kempsey/Wauchope EIS notes:

> *"The NSW Guidelines for Economic Appraisal (NSW Treasury 1990) proposes two techniques for economic appraisal, cost benefit analysis (CBA) and cost effectiveness analysis (CEA). Both techniques have the underlying objective of identifying alternatives which maximise community welfare and thus improve economic efficiency and require as many as possible of the benefits and costs to be quantified. The Guidelines also clearly identify that while regional impact analysis may prove a useful adjunct to CBA (consideration of costs and benefits) it is not an alternative to CBA (NSW Treasury 1990)."*

As noted by the Public Accounts Committee (1990):

> *"... native forest asset valuations really only consider replacement costs, a satisfactory inventory of native forests is lacking, there is no accounting for the non-timber values inherent in the native forest, ... and numerous subsidies enjoyed by the Commission ... are not quantified in the accounts." (p21)*

A proper cost-benefit analysis should account for the standing value of the trees, management, extraction and transport costs, and quantifiable reductions in water yields, carbon storage, and soil nutrients resultant from logging. There are the numerous "non-use" values that need to be accounted for, for example URS (2008) note:

> *Native forests and plantations provide many unpriced goods and services to the economy and values to society, none of which are reflected in the marketplace. Trees assist with water and land management by reducing run-off and controlling erosion. They sequester carbon and reduce greenhouse gas emissions. Forest ecosystems are a major protector of biodiversity and provide habitats for native species. In such circumstances, market forces alone will not provide economically efficient outcomes, as individual decisions will not reflect social benefits and costs. ...*
>
> *...*
>
> *Some of the environmental benefits of forests and plantations are public goods. The aesthetic values of forested landscapes are available for all to enjoy, for example. Similarly, the benefits to water quality accrue to all water users. On the other hand, bushfires are a public 'bad' that impose significant economic costs on the community at large and on individuals.*
>
> *It is therefore important to determine the impacts of economic settings of forest policies on such public goods.*

Mackey et. al. (2010) consider:

> *The concept of 'ecosystem services' aims to express in economic terms the benefits humans derive from the free goods and services received from natural ecosystems. These can be measured in four classes, namely, 'supporting' (e.g. nutrient cycling), 'provisioning' (e.g. of freshwater), 'regulating' (e.g. regulation of flooding regimes) and 'cultural' (e.g. iconic and totemic species) (MEAB 2005). People and other species benefit directly from the functioning of ecological systems, including the supply of clean air and fresh water and the removal of waste products. Such ecosystem services are critical for life on Earth. Some analysts have quantified these ecosystem services in financial terms (Daily and Ellison 2002) and have placed an average global price tag of $US33 trillion a year on the provision of fundamental global ecosystem services (Costanza et al 1997). This is nearly twice the value of the global gross domestic national product of $US18 trillion. Some of the phenomena we value about biodiversity can be treated as economic services or even as commodities. In these cases a real or 'shadow' market price can be obtained.*

For the UNE and LNE CRAs the approach taken to integrate both "use" and "non-use" values within a socio-economic framework was a "Benefit Transfer Threshold Values Analysis" (Bennett 1998). This is based upon identifying the "threshold values" of the "opportunity costs" resulting from the protection of an area which need to be exceeded by the "forest protection values" *"for it to be in the best interests of the community overall for the forests to be reserved from timber production"* (Bennett 1998).

Some of the direct primary benefits of forests to communities are:

- Protection of biodiversity,
- Provision of water,
- Use for recreation,
- Provision of timber, and
- Storage of carbon.

It is generally acknowledged that logging causes decreases in water yields, water quality, carbon storage, aesthetic values and the populations of some plant and animal species. Thus conflicts in use exist between logging and all of the other primary values. There have historically been minimal attempts to assess the forest's preservation values (i.e. by assessing and accounting for public opinion and identifying priceless attributes), the replacement cost of public resources removed (e.g. soils eroded, nutrients lost, water yield declines, habitat removed) or the real and potential economic worth of non-timber values (e.g. recreation, tourism, water supply, carbon storage).

Bennett's (1998) framework aids decision making by collating the available information into a logical framework to identify the likely magnitudes of the key costs and benefits to the community of protecting the areas available for reservation.

Bennett (1998) notes that *"It is relatively straight forward to estimate the opportunity costs of forest protection in monetary terms. The timber products that are forgone are brought and sold in markets. Market data can be used to estimate their value."* Bennett (1998) identified the "opportunity costs" by aggregating the foregone "producer surpluses" (normal profits of timber mills) and "consumer surpluses" to estimate the total surplus foregone.

Bennett (1998) assessed the "threshold values" of "opportunity costs" arising from larger reductions in timber supply and considered that the "opportunity costs" were outweighed by the "forest protection values". His assessment indicates that the "opportunity costs" of reducing timber supply from public lands in the UNE from 129,000m^3 per annum by a fifth down to 104,000m^3 per annum would represent a threshold value of some $259,535. This is the "opportunity cost" threshold that Bennett considered the current year's forest protection benefits must exceed for forest protection to be socially desirable. For reductions much larger than this he still concluded;

> *An analysis of the extent and composition of forest protection benefits estimated in other studies indicate that only moderate increases in visitation numbers in the proposed forest protection areas and relatively small numbers of people to support the proposals would be required for the threshold values to be exceeded.*

Bennett (1998) identified that forest protection benefits can be classified broadly into use and non-use values:

> *Use values involve beneficiaries experiencing first hand the forest ecosystem. Non-use values are enjoyed even without that direct contact. Use values are mostly associated with tourism and recreation activities such as sight seeing, camping or bush walking.*

Non-use values are expressed in a variety of forms; *"passive use values"* include such things as *"reading books or watching films that are based on the environment …benefit from scientific advances that have been made through research undertaken in a protected forest … high quality water supplies that have originated in protected forest catchments", "existence values" "are held by people who simply enjoy the knowledge that some forest areas have been set aside in reserves even though they have no wishes to visit them"* and *"bequest values"* represent the desire to protect areas for *"members of future generations"* (Bennett 1998).

While it is relatively easy to identify some use values in economic terms (i.e. visitation rates and associated expenditure) it is harder to quantify non-use values. Bennett (1998) considered that that a ratio of 1:3 for use to non-use values was applicable for north-east NSW. This emphasises the immense importance of non-use values and the need to account for them in decision making.

A community attitude survey (McGregor *et. al.* 1997), undertaken throughout the NSW CRA regions, analysed the strength of people's economic, social and environmental values of forests. The report found that in relation to forests:

- at the macro-scale more people put environmental principles (62%) before economic principles (19%) when an environment versus economic question was posed;
- at the micro-scale more people value the biological communities (71%) of forests more than they value the economic (15%) benefits of forests; and
- at the personal level most people indicated the main reason they valued forests was for aesthetic reasons (76%), followed by conservation (42%), spiritual (32%) and much further down the list economic and employment (5%).

It terms of overall community preferences revealed in community attitude surveys, it is apparent that cessation of logging within an area identified as having extremely high conservation and social value is in the best interests of the majority of the community. Associated with this is the next question of whether it would also be in the community's best economic interests?

Economic benefits from the full range of activities possible within an area accrue differentially to separate sections of the community. It is therefore desirable to compare all the social and economic benefits of an areas values in order to help clarify what is truly in the community's best socio-economic interests.

WHIAN WHIAN STATE CONSERVATION AREA
A STUDY IN RESERVE BENEFITS

Pugh (2000) undertook an assessment of the values of the then Whian Whian State Forest and found that timber was worth only a fraction of the other values identified:

VALUE	ANNUAL VALUATION ($1,000)
Timber	2.5 - 11
Water	4,500
Recreation	2,500 - 5,000
Conservation	2,250 - 15,000

Whian Whian State Forest encompassed a major part of the catchment for the Rocky Creek Dam (a regional water supply for 4 local government areas) and had a visitation of 125,000 visitors per annum. Given that both water yields and visitation would increase in the absence of logging, there could be no doubt that both these use values far outweighed the value of the forest for timber production.

Pugh (2000) found that, based upon optimistic yields, timber production from Whian Whian State Forest had a current value of $2,484 - $10,953 per annum. This was the threshold that the forest protection benefits had to exceed for cessation of logging to be in the best economic interests of the community. He found this would require an increase in the annual visitation rate of somewhere between 62 to 540 people (0.05% to 0.43%) for reservation to be of net economic benefit to the community.

State Forests (Cornish 1997) conservatively estimated that logging had to date resulted in an overall reduction in water yields to the dam of 15-23% (5,600 to 8,400 megalitres – ML per annum), though the reduction could have been double this. Pugh (2000) found that cessation of logging in the catchment would result in water yield increases of 62 to 185 ML per annum for the next 60 years. He estimated that the Net Present Value of water yield increases from ceasing logging in the remaining 30% of the catchment would be somewhere between $2.5 and $9.3 million.

Given that the forest also supported eleven species of plants and animals listed as in danger of extinction, 61 species listed as vulnerable to extinction, and a further 22 species of plants considered nationally rare, along with significant rainforest stands, and extremely high national estate values, there could be no doubt that its protection as National Park was also in the community's best interests.

It was primarily the neighbours who lobbied and negotiated for better management of this forest, and their years of effort resulted in its addition to the reserve system as the Whian Whian State Conservation Area in the 2003 Icon Decision. It's visitation has now doubled to 250,000 people per annum, its forests are maturing and increasing water yields into the Rocky Creek Dam, its forests are sequestering and storing increasing volumes of carbon every year, threats to its numerous threatened species have been reduced, and the neighbours welcome the change. There can be no doubt that the community has socially and economically benefited from its protection.

2.1. Community Values.

A valid economic assessment must identify socially optimal outcomes of the use of public forests. These are part of the commons in which we all own a share. The aim has to be to manage public forests to maximise benefits to the community. Economic benefits accruing to individual are often used to decide uses of public lands, though on their own economic benefits do not reflect what is in the best interests of the community.

Economists often use "non-use values" as a means of incorporating community values into economic valuations, these are often characterised as ecological function value, option value, existence value and bequest value. The need to incorporate these into economic assessments is well established in the literature. Community attitude surveys are a clear indicator of community preferences and the magnitude of "non-use values". Bennett's (1998) rule of thumb for forest protection benefits is that non-use values are worth three times the value of recreational use.

The presence of existence value is a powerful social reason for conservation and is a value felt by all Australians. All Australians own an equal share in the public forests and they are all entitled to an equal say in their future. Theoretically each Australian who feels a personal consumption loss if the proposal goes ahead should be compensated. Any survey of the value of the forest must survey nationally, as well as locally, if it is to capture this effect. There are a range of techniques available to evaluate public opinion (e.g. contingent valuation, switching value) which should be utilised.

A major requirement of any social assessment, and a key component of determining the social values of public lands, is the determination of public preferences. The Community Attitude surveys undertaken for the CRAs (McGregor *et. al.* 1997, a,b) show that the regional communities place far more emphasis upon "forest protection values" than "opportunity costs" and establish that "non-use" values are extremely important to the broad regional community. McGregor *et. al.* (1997) concluded *"Forests have a very strong symbolic environmental value that people want to preserve even if this is seen to cause local social and economic difficulties."*

The Community Attitude survey for the Upper North East (UNE) CRA (McGregor *et. al.* 1997a) established that the priorities respondents gave to *"various activities with relation to public forests"* were;

- protecting native plants and animals (100%),
- maintaining sites of natural beauty (99%),
- educational/scientific (97%),
- maintaining water quality (96%),
- aboriginal sites (89%),
- bushwalking/picnics (87%),
- protecting wilderness (87%),
- camping (79%), and
- eco-tourism (75%).

Exploitative uses of public lands received a lot less support (timber production 24%, woodchipping 7% and mining 13%), with the highest opposition being to mining (72%), hunting (70%) and woodchipping (65%).

In response to the question *"what is it about forests that you value?",* those values ranked highest were aesthetic (80%), conservation reasons (46%), spiritual (25%), intergenerational equity (14%)

and recreation (10%) as compared to relatively low values for economic/employment (6%) and economic goods and use (5%).

The UNE Community Attitudes survey (McGregor *et. al.* 1997a) showed that at both the macro and micro scales more respondents put environmental principles before economic principles when faced with conflict between the two, finding that:

- 56.3% of the people surveyed agreed that they *"would like to see more forested land conserved, even if it means a loss of state income from timber harvesting"* as compared to 23.2% disagreeing
- When asked if it is the case that *"Timber harvesting in native forests may have an adverse impact on the abundance of native plants and animals"*, 66.1% of people surveyed considered *"The environmental costs are too high, it might be better to compromise on forestry activities"* as compared to 15.6% considering *"This is unfortunate but we need forestry products and employment."*
- When asked if it is the case that *"Forestry jobs may be lost to create new environmental reserves. This may affect some small communities adversely, by reducing their access to basic services"*, 45% considered this *"Unfortunate for these communities but we need environmental reserves for the benefit of future generations"* as compared to 31.5% considering *"The social costs are too high, it may be better to compromise on creating environmental reserves than reduce people's access to basic services."*

A recreation survey conducted by the Forestry Commission and Truyard Pty Ltd (1992) in the Wingham area revealed that while only 15% of those surveyed considered the Forestry Commission was not doing a good job of managing forests (25% don't know), 51% believed that unlogged forests should be left unlogged even if it means loss of jobs (11% don't know), 49% believed that unlogged forests have an intrinsic spiritual value which is destroyed by logging (14% don't know), 72% believed that siltation of streams is a significant issue in forestry activities (16% don't know), and 70% considered government incentives should be provided for the establishment of private plantations as a substitute for logging old-growth forests (10% don't know).

Rogers (1992a,b) undertook a survey of 210 residents of Armidale and Dorrigo during the height of the controversy focused on the logging of three compartments of oldgrowth forest at Chaelundi, on the edge of the Guy Fawkes River Wilderness. These were the nearest large towns, with the sawmills around Dorrigo proposing to process most of the timber. There were dire warnings that the town of Dorrigo would become a ghost town if the oldgrowth logging did not proceed. The conservation case was focused on oldgrowth, wilderness and threatened species.

Rogers (1992a,b) found that:

- 76-97.5% (average 88%) of those surveyed believed that the environment must be protected even if they had to make a financial sacrifice, while 43.7-62% were willing to make environmental sacrifice to protect industry.
- From 54% (Dorrigo) to 81.3% (Armidale) considered any habitat loss of endangered species unacceptable (14-8.4% don't know).
- The average annual amount people were prepared to pay, in addition to taxes, for environmental protection was $114 each. This nominal payment was separated into four issues (soil conservation, protecting native vegetation, Sydney beach pollution and improved waste disposal) with protecting native vegetation ranking a close second to soil conservation at $33 per person, with this in turn divided into protecting endangered species ($12.44), protecting native old growth forest ($14.47) and preventing logging in the three compartments in Chaelundi ($6.13).

- Those asked (130) to rank four other forest values besides timber and ecological values, ranked water production and protection highest followed by recreation/tourism, pharmaceutical products, then honey production. 32-35% reported they were not prepared to forgo any proportion of these benefits to protect the timber industry, of those prepared to forego a proportion the average was 24-33.5% of non-forestry income.
- Of those asked (130) how much income they were prepared to forego to protect species from extinction; 5% of Armidale respondents and 44% of Dorrigo residents said none, 2.9% and 4.0% respectively said $5 million, 18.2% and 10% said $10 million, 23.2% and 10% said $100 million and 50.7% and 32% said whatever it costs.

In September 1991 Justice Stein found that roading and logging of these 3 compartments would take or kill 22 endangered species, commenting:

> *"The high species diversity of arboreal marsupials and the presence of numerous significant species listed in Schedule 12 of the NPWAct makes it a veritable forest dependent zoo, probably unparalleled in south-eastern Australia. Every species of forest dependent marsupial is present. It contains prime or critical habitat for numerous species of endangered fauna or "faunal hot spots". Special pleading for individual areas as exhibiting particular value relating to flora or fauna is not uncommon. However, the evidence before me is overwhelming that this portion of forest is significantly unique in Australia for its natural wildlife values."*

The last 2 of these three compartments weren't finally protected until the 2003 Forest Icon decision.

Duthy (1998) undertook a 'contingent valuation study' to determine the level of community support for the dedication of Whian Whian State Forest as a new national park. Consistent with regional attitudes, local respondents to his survey identified catchment protection, endangered species habitat and preservation for future generations as the most important uses of the Whian Whian area.

As an example of the weighting provided by local communities, out of a scale of 1 to 10, use of Whian Whian as a commercial timber resource achieved a mean ranking of 3.79, compared to camping and recreation achieving 6.38, endangered flora and fauna habitat achieving 8.77 and catchment protection achieving 9.03 (Duthy 1998). Catchment protection was considered extremely important by 63% of respondents, endangered flora and fauna habitat by 60% of respondents, and enjoyment of future generations by 56%, as compared to 8% considering commercial timber resource as extremely important (Duthy 1998).

In response to the request for local people to indicate their relative priorities between sometimes opposing environmental issues, Duthy (1998) found a similar preference for environmental concerns over economic concerns as McGregor *et. al.* (1997). For example when respondents were asked to rank utilisation versus conservation of natural resources; 43% indicated that they considered they had a balanced view, a further 43% indicated that conservation was the priority and only 14% indicated utilisation as the priority. When the issue related to employment versus the environment less people considered they had a balanced view, with those favouring employment increasing to 25% and 41% still placing environment protection above employment. Conversely, when the issue related to private development issues versus environmental protection those favouring development declined to 7% while those favouring environmental protection increased to 71%. (Duthy 1998).

Duthy (1998) concluded *"The dedication of Whian Whian SF as a new national park is supported by the level of valuation, the amount of voluntary labour available, and the consistency with national park management objectives of the majority of the more important uses."*

Duthy (1998) found from his sample of the local community that the mean willingness to pay for the non-consumptive use and non-use values of Whian Whian State Forest was $18.89 per respondent per annum, which was extrapolated to $2.25 million per annum across the local area.

> **Non-use values are of high importance to the community and need to be accounted for in any socio-economic cost-benefit assessment. The community in north-east NSW has clearly identified that they place a very high value on native forests for wildlife, beauty, water and recreation, compared to a relatively low value for logging, mining and shooting. The regional community have clearly shown they have a significantly greater preference for environmental benefits over economic costs. The protection of public forests in the Forest Reform process was clearly in the public interest.**

There is a need for decision makers to consider the 'irreplaceability' of conservation values along with the 'replaceability' of resource values when making decisions. As noted by Bennett (1998):

> *In general, forest protection benefits are likely to increase through time whereas the opportunity costs will most probably remain static. These differential growth rates are largely the result of the degree to which substitute goods are available for both the timber and non-timber forest products. Timber products are easily substituted. … The non-timber, or protection values, of forests are, however, much more difficult to substitute. For instance, habitat for endangered species cannot be readily "manufactured". Recreation in constructed or artificial sites may not be considered as providing the same experience as time spent in a protected forest reserve.*

Rainforest, wilderness and oldgrowth forest have been identified in various community attitude surveys undertaken within north-east NSW and in the CRA cultural heritage workshops as environmental attributes of particular social and cultural value. This is reflected in the concerted public campaigns to protect these attributes that conservation groups have waged over the past 40 years.

The heritage value of oldgrowth forest has also long been recognised. In 1989 the Chairman of the Australian Heritage Commission, Mr. Pat Galvin (1989), in a speech given to the Institute of Foresters of Australia 13th Biennial Conference stated:

> *"… I believe that there is now an irrefutable argument for forestry operations to cease in all remaining undisturbed native forests. All of us, whether from Government or the community at large and especially those charged with leading the forestry program, must agree that it is time to call a halt if we are to have the opportunity of leaving for future generations those forests which are of significant heritage value. … Better to err now on the side of the future than place ourselves again with the vandals of the past."*

The Australian Heritage Commission's findings were echoed in the Resource Assessment Commission's Forest and Timber Inquiry Final Report Volume 1 (1992) which found that it is not feasible to log old-growth forests and still retain, or ever regain, their full complement of old growth attributes and values, stating:

> *"Logging of old-growth forest ... potentially violates the precautionary principle of sustainable development in that an irreplaceable resource is being destroyed ... the values associated with the pristine attributes can not be replaced."*

As noted by the Resource Assessment Commission (1992a) *"logging of old-growth forest can only be justified in the context of sustainable development only when the loss to current and future generations is outweighed by the harm done to current generations because of the disruption of industry or lifestyles caused by a transient shortfall in timber supply."*

Again in 1992 the National Forest Policy Statement recognised the importance of oldgrowth forests to the Australian community:

> *"The Governments have agreed to a strategy designed to conserve and manage areas of old-growth forests and wilderness as part of the reserve system. The strategy acknowledges the significance of these areas to the Australian community because of their very high aesthetic, cultural and nature conservation values and their freedom from disturbance."*

For the Joint Old Growth Forests Project, Lambcon Associates (1996) undertook a literature review and a pilot attitude study using both expert and community focus group interviews and responses to slides of various forest types and growth stages. From their focus group interviews Lambcon Associates (1996) found that the three most significant theme categories for forests were:

> *Content was the theme category with the greatest content …Within the content category, there appear to be important elements, such as big trees, vegetation types/rainforest, epiphytes/moss/fungi/ferns, disturbance, water, wildlife, leaf litter/understorey and moistness/dampness.* (p 35).
>
> *Spiritual values are about the meanings of forests to people and do not depend on the finite experience of being in the forest. …* (p 36)
>
> *Symbolic values are about the meanings which forests signify to people and are also not dependent on finite experience. However, the expectation is that the experience would give rise to manifestations of that value in a person. …Important symbolic values included untouched/wilderness, awe/majesty, naturalness, age/story/history, achievement/effort and health. …The importance of untouched/wilderness is significant in that it indicates the focus of the study and also establishes a sense of the equivalence of the meaning of wilderness with old growth.* (p 37)

From analyses of responses in focus group meetings Lambcon Associates (1996) concluded:

> *The community group had a spiritual, symbolic attachment to old growth forest, with wildlife an important element. Experts appear to have a symbolic attachment to an unchanging, wilderness-like forest, with abstract and context values which are related. The mental picture each group shared was similar; big old trees, generally in an undisturbed state. For the community group it was dense and tangled. Disturbance was only moderately significant to either group and was not much differentiated, though weeds and logging were mentioned. Fire was not a significant concern. The community group were more tolerant of disturbance than experts.*

From reactions to slides of various forest types and growth stages Lambcon Associates (1996) concluded:

> *Of the various judgements used, naturalness and old growth character are the two which are most relevant to the definition of old growth forests. …In three of the four judgements (liking, interest, and old growth character) there were significant differences related to the age of the forest between young and old and between young and mature growth only. The differences between mature and old growth was not significant. …Disturbance was a quality which could be discriminated from photographs to some extent, but there was no discrimination between low and medium levels except for liking, which increased as disturbance decreased.* (pp25-6)

As part of the Comprehensive Regional Assessment process all oldgrowth forests throughout the CRA regions were mapped. In the community heritage workshops undertaken as part of the CRA process the community again singled out oldgrowth forest for special consideration, placing such weight upon it in north-east NSW that the Commonwealth identified all oldgrowth forests as being worthy for listing on the Register of the National Estate for their social values alone (Contex P/L 1998b, 1998c). In relation to oldgrowth forest, Contex P/L (1998c) note:

> *This place type was identified and assessed for social value (Criterion G1) through an analysis of data collected through a community workshop process and is considered to meet the National Estate threshold for social value. Old growth forest, as a distinctive forest type, is recognised and highly valued by communities throughout the region. Old growth forests were identified at a majority of the workshops, and strongly supported in subsequent research. Old growth forests are valued as landmarks of great majesty and age, important as a way of understanding the regional and local environment in all its diversity and complexity. Old growth forests are important as a symbolic link between the present and the ancient past. The power of these forests to move people to action in their defence appears to closely relate to this sense of their ancient presence in today's world. Use of the forests reflects a series of important historical phases that have shaped the identity of today's community; there are long and close associations between many local and regional communities and this place type. The evidence suggests that there is a longevity and continuity of symbolic importance across several generations, although the meanings have varied (for example from a landscape to be cleared for farming and cut for timber, to one to be protected). The complexity of meanings and strength of attachment are demonstrated by the longevity and extent of community action focused on the use and conservation of this place type throughout the region."*

As well as all oldgrowth forests, there were a number of oldgrowth forests and sites which were identified as being above the threshold for listing on the Register of the National Estate because of their association with forest blockades: 'Chaelundi Forest Protest Site', 'Richmond Range Blockade Site', 'Wild Cattle Creek, Compartments 579 and 546', 'Timbarra Plateau', and 'Mt. Killecrankie' (Context P/L 1998c). For example, in regards to Chaelundi the assessment of significance, in part, states *"It is widely valued as a symbol of changing community attitudes and responses towards conservation, which is actively reinforced through the continuation of the protest movement".* Chaelundi was one of those areas protected as part of the 2003 Icon Decision.

At its meeting of 21st March 2000 the State Heritage Committee identified its intention to list High Conservation Value Old Growth Forest sites within northern NSW on the State Heritage Register. In a political decision, they only agreed to the listing of "Protected_HCVOG" (thereby excluding oldgrowth on private land, oldgrowth in national parks predating the RFA and oldgrowth on State forests that wasn't so identified).

Many natural forest values cannot be readily replaced or substituted. Some forest values, such as oldgrowth forest, rainforest, wilderness and endangered species, are considered to be irreplaceable by the community and are in effect priceless. The Inquiry needs to be aware that the protection of irreplaceable values such as oldgrowth forest, rainforest, wilderness and endangered species in the Forest Reform process was clearly in accord with the preferences of regional, state and national communities.

2.2. Recreational Values of Reserves

National parks and reserves provide a range of economic values to society including those associated with recreation and conservation. Visitation to, and management of protected areas, also provides stimulation to regional economies from the associated expenditures that occur within the region. Tourism is the most rapidly expanding sector of the regional economy. The long-term economic value of national parks for recreation will often outweigh any short-term economic return from logging, mining and/or grazing. It is thus essential that the socio-economic values associated with visitation to parks be duly accounted for.

Public land is a highly valued resource, providing the only natural areas for recreation for many residents. The Centre for Coastal Management (1993) note *"as indicated by the recreationalist survey … the most significant source of recreational forest visitation comes from the residents of the local government area".*

Roy Morgan Research Ltd (2011) undertook a series of telephone surveys to identify visitation to NSW national parks and reserves, estimating 38,057,162 visitors in 2008 and 34,607,247 visitors in 2010 (with the drop considered to be due to extreme weather and overseas travel). Around 12% of people had visited a park in the last 4 weeks. Primary activities in 2010 were walking (50%), water-based activities (18%), picnicking and dining (16%) and touring and sightseeing (10%).

Buultjens et. al. (1998) considered that:

> *The natural environment is perceived to be the one of the most important tourist attractions for Australia, and in particular of the north east NSW region. Forested areas represent a significant proportion of tourism and recreational attractions in natural environments (Commonwealth Department of Tourism, 1994; Northern Rivers Regional Development Board, 1994). Furthermore, demand for nature-based experiences is increasing significantly, with a 48 percent increase in National Park visitation in NSW and a 66 percent increase in bushwalking between 1989 and 1994 (Blamey, 1995)*
>
> *The majority of visitors to National Parks and State forests seek passive experiences, enjoying the scenic beauty, tranquillity, solitude, smells and sounds of nature in undisturbed natural areas with family groups (Worboys, 1997; Chapman, 1995). The trips are predominantly two - four hours in duration (Chapman, 1995). A majority of visitors (89 percent) engage in rest and relaxation, 82 percent in landscape appreciation, 76 percent in wildlife appreciation, 73 percent in swimming, 71 percent in short walks and 66 percent in barbeques (Chapman, 1995). Off-road driving and trail bike riding account for 11 percent and 4.8 percent of activities, respectively*
>
> *...*
>
> *A 1995-96 survey of Tourism Council Australia (TCA) members revealed that 43 percent of operators utilised National Parks. The survey respondents ranked scenic attractions, a clean environment, wildlife, outdoor activities and National Parks as the most important attributes of the Australian tourism product, along with service, price and climate (Huyers and Bennett, 1997).*
>
> *These same operators rated natural resource management, wilderness protection, conservation/heritage and wildlife protection as the four main environmental issues facing the Australian tourism industry. ...*

The act of converting a State Forest to a National Park can increase its recreational use because national parks are a international concept and this recognition attracts both domestic and international tourists. As noted by Buultjens and Luckie (2004):

> *National park visitation is a prominent part of both domestic and inbound travel within Australia. In a 1998 survey of international visitors to Australia it was found that 47 per cent of visitors aged 15 and over reported that they had visited at least one national park during their trip (BTR 1998). Visitation to national parks was even higher (57 per cent) among those international visitors travelling for holiday or pleasure purposes. For domestic travellers, visiting national parks is also popular. The National Visitor Survey revealed that a visit to a national park featured in 13 per cent of domestic overnight trips in 1999 (BTR 1999). This figure is significant when considering that domestic tourism in Australia represents a much larger market compared to inbound tourism.*
>
> *In NSW during 1999, 11 per cent of domestic overnight travellers reported visiting national parks, bushwalking and rainforest walks as part of their trips (BTR 1999). Visiting national parks, bushwalking and rainforest walks in NSW were slightly more common among intrastate visitors (11 per cent) compared to interstate visitors (9 per cent).*

There have been many attempts over the years to identify the economic benefit of national parks and reserves to regional economies. This has been an evolving process that has been developed and refined in a variety of studies in north-east NSW over the years. The economic stimulus provided to regional economies by National Parks and reserves arises from two sources:

- expenditure in the region by visitors to the protected areas; and.
- expenditure in the region that is associated with the management of reserves.

The Kuring-gai Colledge of Advanced Education (1988) found that of visitors to the rainforest parks of New England and Dorrigo 37% were local visitors, 12% were 'day-trippers' from outside the region, and 51% 'overnight visitors' from outside the region. The average daily expenditure per visitor were estimated as $34, $59 and $89 respectively. Of this expenditure 39% has been estimated to flow directly into local wages (Kuring-gai Colledge of Advanced Education 1988), which has an employment flow on effect of 2.06 (employment multiplier).

For the Dorrigo National Park, Powell and Chambers (1995) found the average expenditure per person associated with visits was $175.03 and for the Gibraltar Range National Park it was $73.45, respectively with 35% and 23% spent on accomodation, 20% and 15% spent on meals, 14% and 27% spent on shopping, 20% and 25% spent on cars, 9% and 8% on fares, with the remaining 2% classed as ‘other’(Powell and Chambers 1995). For the Dorrigo National Park, 11% of this, an average of $20.10 per person, was assessed as being expended in the township of Dorrigo and the surrounding area. With 160,000 visitors per annum Powell and Chambers undertook and input/output analysis to assess that;

> *“the total impact associated with visits to the Dorrigo National Park generated $3.6m in regional output; $2.0m in regional value added activity; $1.3m in regional household income; and 59 jobs. This represented 7 per cent of output, 6.5 per cent of value added activity and household income and 7 per cent of employment in the Dorrigo region.”*

Using the same data, Bennett (1995) undertook an assessment using the Travel Cost Method (TCM) to identify the net economic benefit, or the consumer surplus, for the parks. The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the “price” of access to the site. The consumer surplus generated reflects the satisfaction a consumer receives over and above the price paid. Bennett identified *“the amount the surveyed visitors would be willing to pay for their experience at the park, in excess of what they have to pay”* as $17.33 per visit to Dorrigo National Park and $15.83 per visit to Gibraltar Range

National Park. Bennett identified the economic value of recreation use of Dorrigo as $2,772,800 per annum and Gibraltar Range as $633,200 per annum.

It is estimated that, in 1997, there were 3.8 million visitors to National Parks and other protected areas in north-east NSW and 1.4 million visitors to State Forests (Buultjens et. al. 1998). On a hectare basis, there were almost three times as many visitors to reserves as compared to State Forests.

Buultjens et. al. (1998) used the consumer surplus identified by Bennett (1995) for Gibraltar Range National Park, adjusted for inflation (taking the consumer surplus to $20.30 per visit), to identify a total consumer surplus of $77,100,131 for visits to national parks. Buultjens et. al. (1998) also used expenditures by visitors to the region for Dorrigo and Gibraltar Range National Parks (Powell and Chalmers 1995), adjusted for inflation, to identify a total expenditure of $80,290,481 to $100,420,071 per annum by visitors to national parks in the region.

Buultjens et. al. (1998) identify that studies by Powell and Chalmers (1995) and Gillespie (1997a) estimated that the total (direct and indirect) employment impact per 10,000 visitors ranged from four to seven jobs. Based on this, in 1997 National Parks and reserves in north-east NSW resulted in 1,480-2,590 local jobs (direct and indirect) generated from visitor expenditure.

Buultjens and Luckie (2004) examined the local economic impact of a suite of seven national parks in north-eastern New South Wales (Yuraygir, Nightcap, Border Ranges, Boonoo Boonoo, Bald Rock, Gibraltar Range and Washpool National Parks) finding from visitor surveys that:

> *Visitors to most parks travelled at least 300 kilometres to and from their home. The only exception was visitors to Nightcap who travelled on average 90 kilometres. Nearly 46 per cent of respondents stated their visit to the park was the sole purpose of their trip. A majority of visitors (55 per cent) were on a day trip while 45 per cent were holidaying in the park. The average length of the trip undertaken by the visitors was 6 days duration while the average time spent in the national park was 3 days.*

For the seven National Parks Buultjens and Luckie (2004) found:

> *Using visitor and NPWS expenditure it was estimated that the annual total expenditure in the north-eastern NSW economy by visitors to the seven national parks was $24.3m, consisting of NPWS expenditure of $3.3m and $21mvisitor expenditure. In addition to these direct benefits, there were also flow-on or multiplier effects estimated to be in the range from $17.1m to $22.4m. The total economic effect (direct benefits plus flow-ons) of the seven national parks was estimated to be in the range of $41.4m to $46.6m. These figures are an underestimate of the total expenditure undertaken in north-east NSW because only a limited number of towns were listed for each park as 'local' and it is very likely there would have been substantial expenditure undertaken in other towns within the region.*
>
> *...*
>
> *The annual total expenditure adjusted for type of visitation, leakages and the proportion of the trip related to the national park visit was $6.2m, consisting of NPWS expenditure of $3.3m and $2.9m visitor expenditure. The flowons ranged from $5.2m to $5.9m and total effect was estimated to be between $11.5m to $12.2m. The employment effects for NPWS expenditure was estimated to be between 40 and 97 jobs, while visitor expenditure effects, adjusted for type of visitation, leakages and the proportion of the trip related to the national park visit, were between 38 and 68 jobs. The flow-on effects accounted for between 55 and 99 jobs and total effects accounted for 151 to 263 jobs. The figures for expenditure adjusted for type of visitation, leakages and the proportion of trip, while an underestimate, are the most accurate reflections of the economic impact of NPWS and visitor expenditure.*

Gillespie Economics (2006) expanded on the work of Buultjens and Luckie (2004) to study the impacts of 167 National Parks and Reserves in the Upper North East region, Based on previous

studies and new information they found that the reported 5,891,684 visitors per year to protected areas in the north-east of NSW and park management expenditure were estimated to make the following total contribution to the regional economy.

Table – 2005 Regional Economic Impact of Protected Areas in Upper North East NSW From Gillespie Economics (2006)

	Visitor Expenditure	**Park Management Expenditure**	**TOTAL**
Total output	$225M	$29M	$254M
Total value-added	$107M	$17M	$124M
Total income	$59M	$13M	$72M
Total jobs	1,651	265	1,916

Gillespie Economics (2006) found that in 2005 the total annual regional economic impact on the economy of north-east NSW from the expenditure of 5,891,684 visits to National Parks and reserves to be:

- $225M in direct and indirect output or business turnover;
- $107M in direct and indirect value-added;
- $59M in direct and indirect income; and
- 1,651 direct and indirect jobs.

Using the Travel Cost Method Gillespie Economics (2006) found that the economic value (consumer surplus) of visits to the seven national parks assessed by Buultjens and Luckie (2004) was estimated at between $25 and $50 per person, which equates to an annual value of $188M when extrapolated to the 5,891,684 visitors per year to protected areas in the north-east of NSW.

As at 2010 the visitation to National Parks and reserves in north east NSW was estimated on the ground from a variety of sources as 9.4 million visitors (OEH pers. comm.), which represents a 250% increase since 1997 (Buultjens et. al. 1998). Roy Morgan Research Ltd (2011) assessed visitation to north-east NSW in 2010 as 10.8 million from telephone surveys, with this having declined compared to 2008, likely due to extreme weather and increased overseas travel (Roy Morgan Research Ltd 2011). The Roy Morgan estimates are likely to be more accurate, though don't include international visitors. The range of estimates are used below.

Extrapolation of the results of Gillespie Economics (2006), adjusted for inflation to 2010, gives the total annual regional economic impact on the economy of north-east NSW from the expenditure of 9.4-10.8 million visits to National Parks and reserves to be:

- $416-476 million in direct and indirect output or business turnover;
- $199-228 million in direct and indirect value-added;
- $110-126 million in direct and indirect income; and
- 2,642–3,026 direct and indirect jobs.

Using the Travel Cost Method calculations of Gillespie Economics (2006), the economic value (consumer surplus) of visits, adjusted for inflation, equates to an annual value of $348-399 million when extrapolated to the 9.4-10.8 million visits per year to protected areas in 2010 in the north-east of NSW.

The Inquiry should recognise there has been an increase of over 250% in visitation to national parks and reserves in north east NSW since the Forest Reform process started, resulting in national parks and reserves now generating a business turnover of some $416-476 million and some 2,642-3,026 direct and indirect jobs in the regional economy. The demonstrated economic value (consumer surplus) is some $348-399 million. The creation of reserves in the Forest Reform process has been of significant economic benefit to the residents of north-east NSW.

2.3. Water Values of Reserves

Forests are responsible for capturing water from the atmosphere by increasing rainfall and condensing fog. This effect is enhanced by the taller trees and rougher canopy of an oldgrowth forest. Forests are also responsible for returning significant amounts of water to the atmosphere through transpiration, thereby contributing to rainfalls elsewhere.

Of the rain that falls upon a forested catchment some is evaporated directly from leaf and ground surfaces and part may be redirected by surface flows directly into streams. Except in intense rainfall events, the majority can be expected to infiltrate the soil where it is used for transpiration by plants, with the excess contributing to groundwater seepage into streams or possibly seeping deep down to aquifers. In a natural forest situation most of the streamflow response to rainfall is provided by the groundwater system.

Mackey *et. al*. (2010) identify that native vegetation has a multitude of effects in catchments:

> *Various studies have also found that the presence of native vegetation can influence local rainfall in complex and unexpected ways and that land clearing can lead to a reduction in rainfall (Lyons et al 1993; Lyons 2002; Durieuxa et al 2003; Silberstein et al 2004; Gero and Pitman 2006; Preston and Jones 2006; Ray et al 2006). Native vegetation protection and rehabilitation are also important to other aspects of the hydrological cycle, including groundwater recharge, managing dryland salinity and maintaining riparian vegetation (Hairsine 1997).*

The identification of a relationship between forests, rainfall and water yields has long been recognised. Andreassian (2004) cites Pliny the Elder as probably the first to allude to the hydrological role of forests in his Natural History (written in the first century AD);

> *Often, after woods have been cut down, springs on which trees used to feed emerge: for example, on mount Himus, when Cassander besieged the Gauls, who cut down a forest to build themselves an entrenchment. Often, disastrous torrents are formed after the felling of mountain woods, which used to hold back clouds and feed on them"*

Andreassian (2004) cites Bernardin de Saint Pierre Studies of Nature 'Etudes de la Nature' published between 1784 and 1788, describing the impact of forests on rain and streamflow in Mauritius:

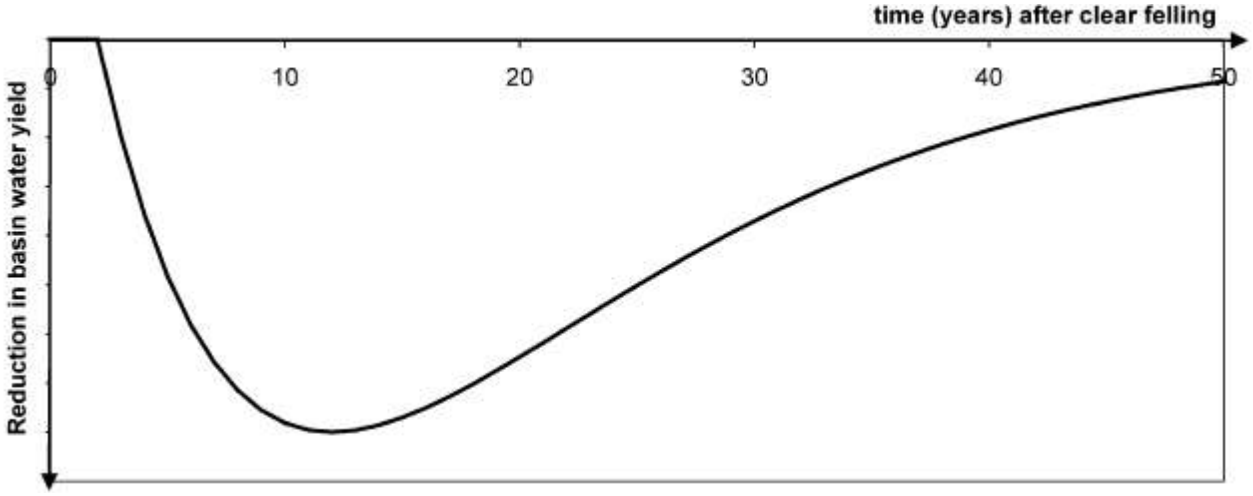
> *This attractive force of the forests on this island is such that a field in an uncovered situation close to them often suffers a lack of rain whereas it rains almost all year long in woods that are situated within gunshot. It is by destroying part of the trees crowning the heights of this island that one has caused most of the streams that watered it to dry up. I attribute to the same lack of foresight the notable diminishing of the streams and rivers in a large part of Europe."*

Dargavel *et. al* (1995) note:

> *Streamflow is the residue of rainfall after allowing for evaporation from vegetation, changes in soil storage from year to year and deep drainage to aquifers. Forest management operations can interfere with these processes by:*
>
> - *changing the type of vegetative cover on a catchment. Experimental results show that these changes can affect evapotranspiration and therefore streamflow;*

- *changing the soil properties. The ability of the soil to both absorb and store moisture infiltration can affect the proportion of rainfall delivered. Forest operations which compact the soil can reduce both infiltration and storage capacities.*

The most significant relationship between water yields and vegetation is that related to forest age. The basic relationship between water yields and eucalypt forest age was established by studies of regrowth Mountain Ash forests following wildfires in Victoria. Kuczera (1985, cited in Vertessy *et. al*. 1998) developed an idealised curve describing the relationship between mean annual streamflow and forest age for mountain ash forest. This shows that after burning and regeneration the mean annual runoff reduces rapidly by more than 50% after which runoff slowly increases along with forest age, taking some 150 years to fully recover.

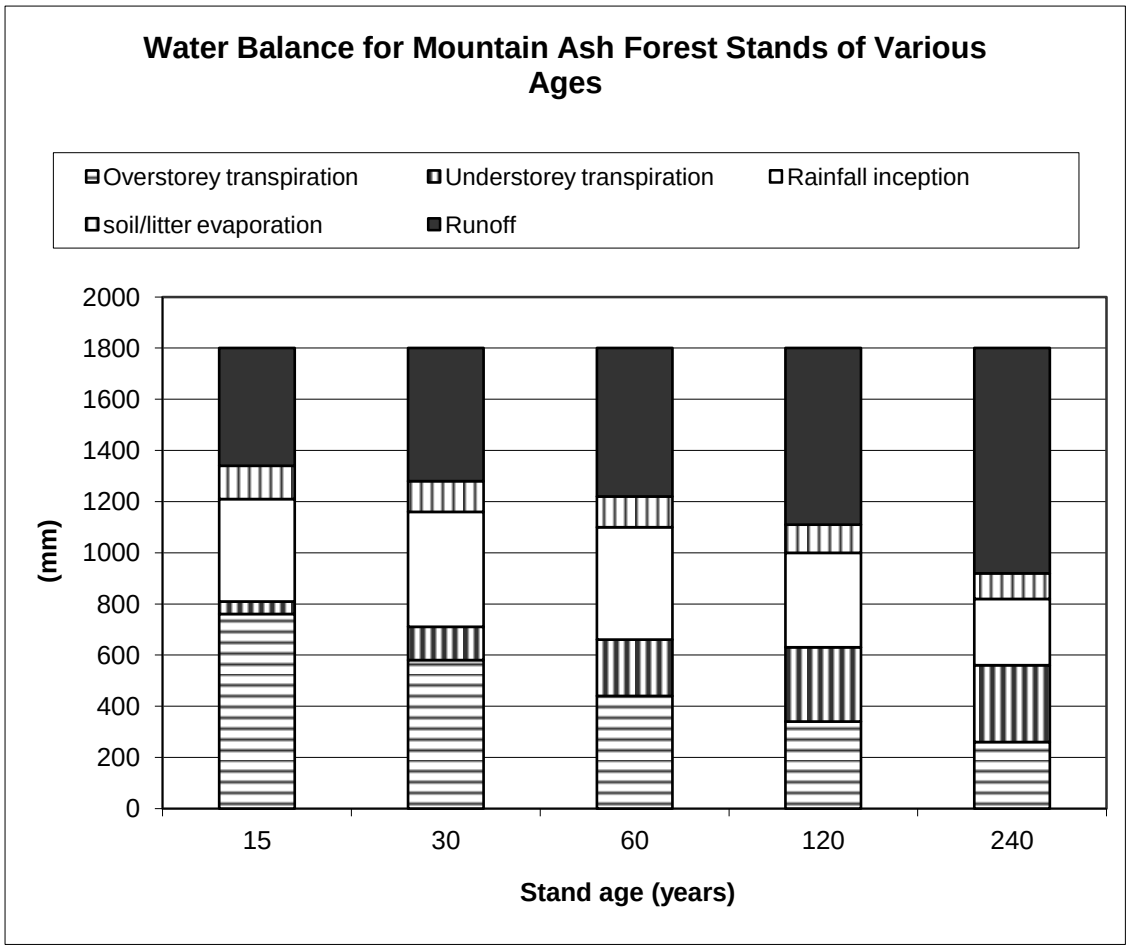


Kuczera (1985) Curve.

Vertessy *et. al.* (1998) has attempted to quantify the different components of rainfall lost by evapo-transpiration, identifying them as: interception by the forest canopy and then evaporated back into the atmosphere; evaporation from leaf litter and soil surfaces; transpiration by overstorey vegetation; and transpiration by understorey vegetation. All of these have been measured as declining with increasing forest maturity, with the exception of understorey transpiration which becomes more important as transpiration from the emergent eucalypts declines.

While not apparent at the large catchment scale used to generate the Kuczera curve, smaller catchments have been found to often generate increased flows of water following clearfelling where a significant area of the catchment is cleared. This “initial yield increase” is largely due to removal of vegetation and soil disturbance causing increased overland flows during rainfall events.

The generalised pattern following heavy and extensive logging of an oldgrowth forest is for there to be an initial increase in runoff peaking after 1 or 2 years and persisting for a few years. Water yields then begin to decline below that of the oldgrowth as the regrowth uses more water. Water yields are likely to reach a minimum after 2 or 3 decades before slowly increasing towards pre-logging levels in line with forest maturity.



Water balance for Mountain Ash forest stands of various ages, assuming annual rainfall of 1800 mm (after Vertessy et. al. 1998)

Following clearfelling of a forest there may or may not be an initial increase in water yields for a relatively limited period. Thereafter water yields usually decline relatively rapidly in relation to growth indices of the regrowth, after some decades maximum transpiration of the regrowth is reached and water yields begin to recover with increasing forest maturity.

For Mountain Ash forest in Victoria, a mean annual rainfall of 1,800 mm/yr has been found to generate a mean annual runoff from oldgrowth Mountain Ash forest of about 1,200 mm/yr (Kuzcera 1987, Vertessy et. al. 1998). After burning and regeneration the mean annual runoff reduces rapidly by more than 50% to 580 mm/yr by age 27 years, after which runoff slowly increases along with forest age, taking some 150 years to fully recover (Kuzcera 1987).

In the Barrington Tops area Cornish (1993) found that *"water yield decline exceeded 250 mm in the sixth year after logging in the catchment with the highest stocking of regeneration and the highest regrowth basal area".* This represents a major reduction given that the mean runoff pre-logging was only 362 mm (38-678 mm) and that only 61% of its catchment was logged.

Cornish and Vertessy (2001) report that the yields kept declining:

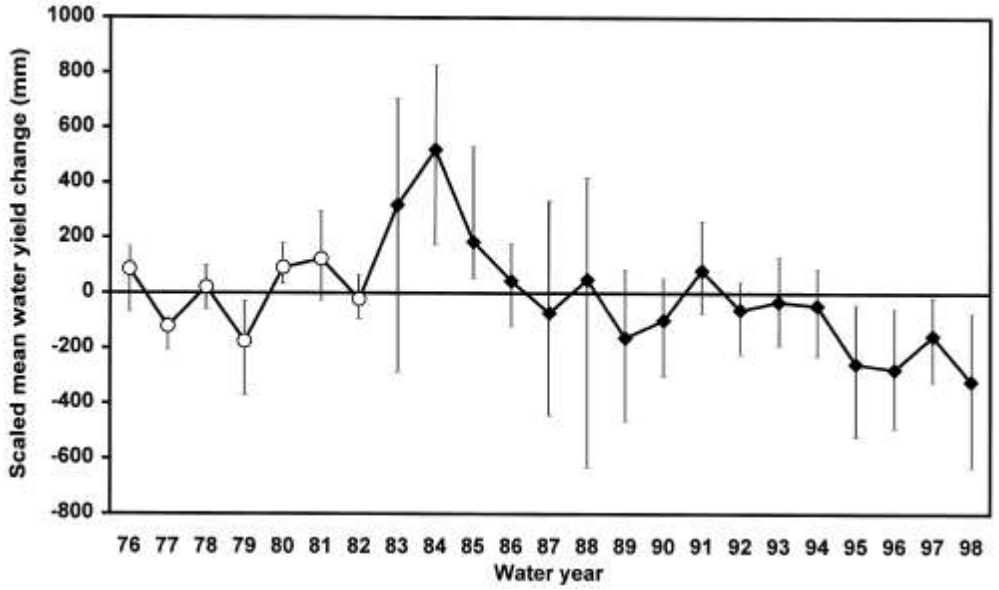
> *Water yields in a regrowth eucalypt forest were found to increase initially and then to decline below pre-treatment levels during the 16-year period which followed the logging of a moist old-growth eucalypt forest in Eastern Australia. ... Yield reductions of up to a maximum 600 mm per year in logged and regenerated areas were in accord with water yield reductions observed in Mountain Ash (Eucalyptus regnans F.J. Muell.) regeneration in Victoria. This*

> *study therefore represents the first confirmation of these Maroondah Mountain Ash results in another forest type that has also undergone eucalypt-to-eucalypt succession. Baseflow analysis indicated that baseflow and stormflow both increased after logging, with stormflow increases dominant in catchments with shallower soils. The lower runoff observed when the regenerating forest was aged 13–16 years was principally a consequence of lower baseflow.*

Cornish and Vertessy (2001) elaborate:

> *This analysis indicates that (in common with the results of many previous studies, e.g. Bosch and Hewlett, 1982) canopy removal increased water yield substantially. Mean increases here were frequently significant while the regrowth trees were less than 3 years old. As the trees increased in age water use increased, but mean water use was not significantly different from the pre-treatment forest between ages 3 and 12. Water yields then declined further between ages 13 and 16 years, resulting in mean reductions being statistically significant in all but one catchment.*

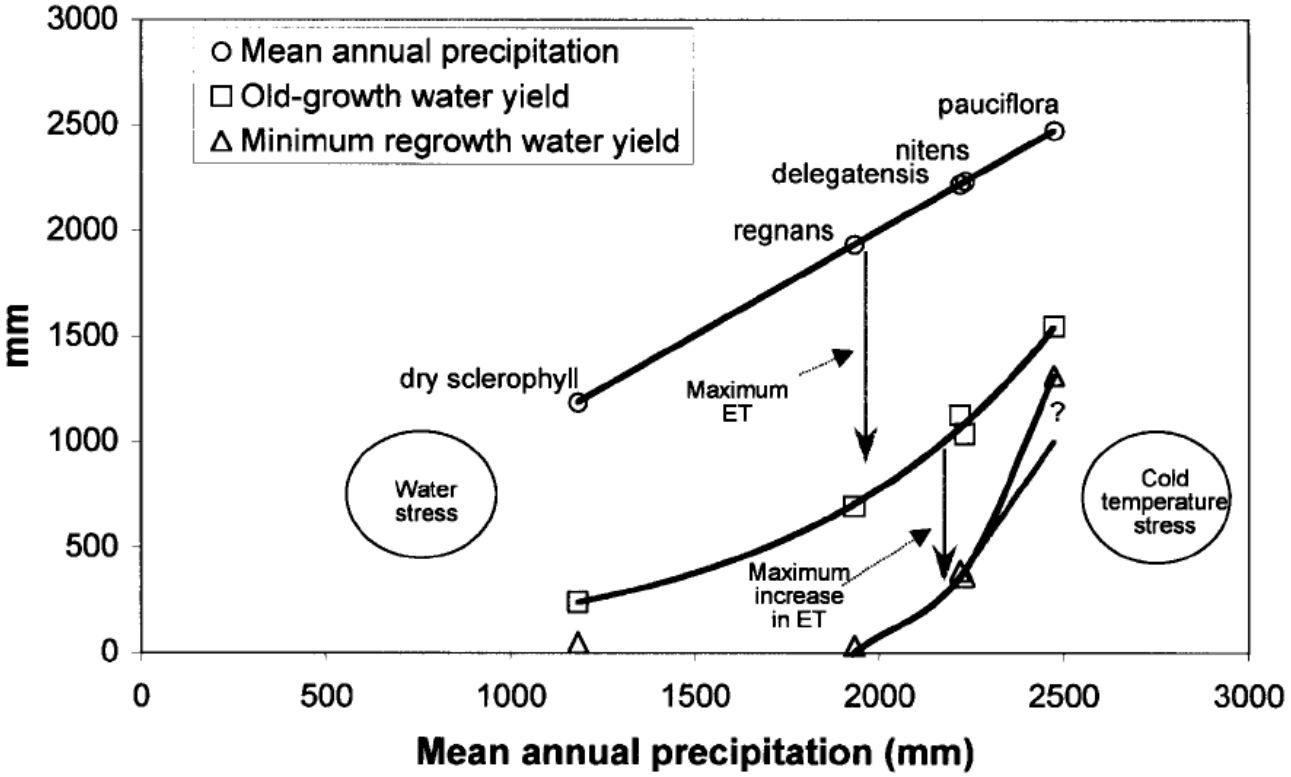
Vertessy (1999) notes that *"the maximum decrease in annual streamflow is over 60 mm per 10% of forest area treated, which is similar to the maximum reductions noted for Victorian mountain ash forests"*.



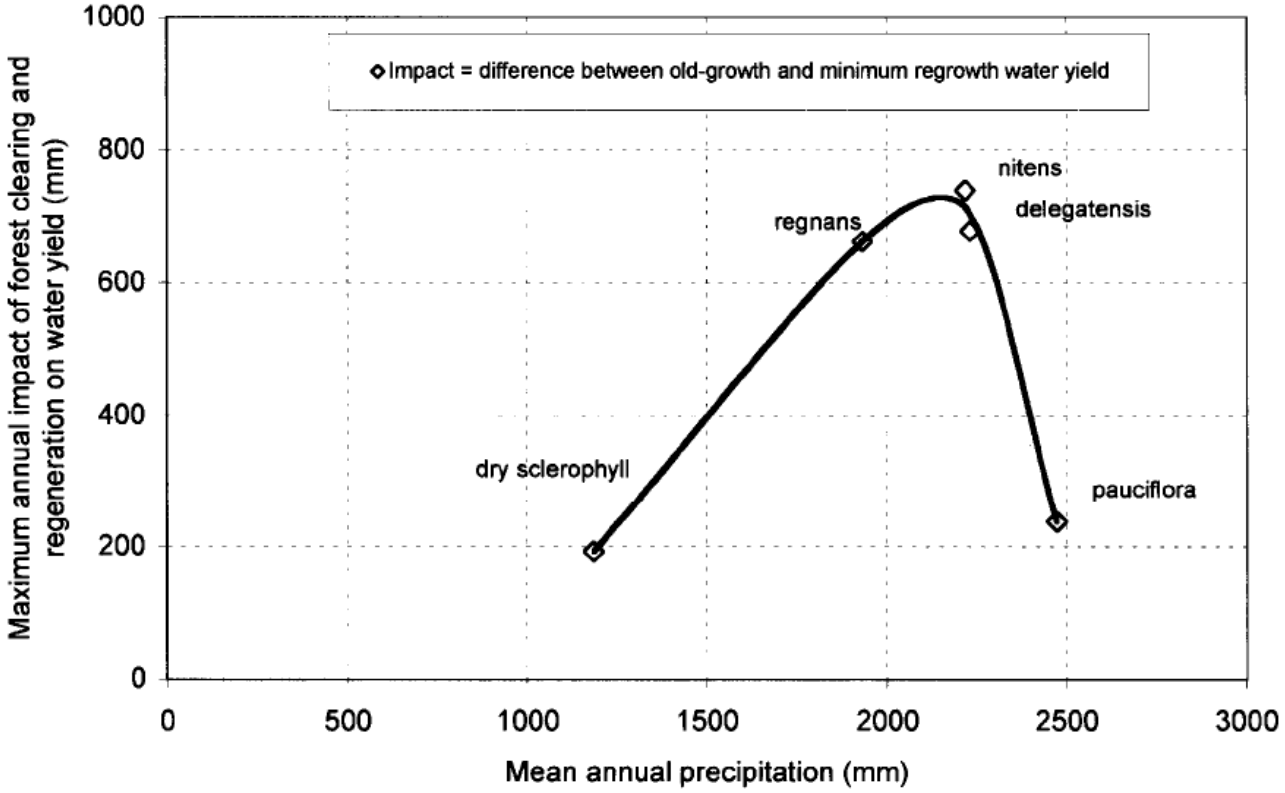
Means and ranges of estimated annual changes in water yield in the six Karuah research catchments logged (Cornish and Vertessy 2001).

To make it more confusing, this relatively simple pattern is complicated by varying vegetation types and conditions within a catchment, the depth of soils, rainfall and a multitude of environmental variables, and the compounding effects of events over time. Even then we are still dealing with averages and it is in the drought events when water stored in dams and soils is of highest value, that impacts are greatly accentuated and have the most effect.

Peel *et. al.* (2000) undertook modelling in the Maroondah and Thomson catchments to identify the variations in water yield depressions according to forest types and rainfall.



Summary of simulated impacts of forest clearing and regeneration on water yield, showing the relationship between species, precipitation, and water yields. From Peel *et. al.* (2000)



Relationship between species, precipitation and maximum impact of regeneration on water yields. From Peel *et. al.* (2000)

The effects of yield reductions are most pronounced in dry periods as the vegetation utilises proportionately more of the rainfall. Vertessy (1999) notes that South African studies demonstrated *"that absolute reductions in streamflow were greatest during the wet months, but that the reductions were* proportionally *greatest during the low flow periods"*.

Forest areas that have been recently logged or where regrowth is the dominant vegetation have a very rapid response time in relation to delivery of water into the storage system. Conversely, older less disturbed forests allow more water to permeate into the soil. Soil moisture then percolates more slowly through the catchment increasing the persistence of higher flows.

Water yield has been found not to return to pre-logging levels for some 150-200 years (Kuzcera 1987, O'Shanghnessy and Jayasuriya 1987).

SKM (2007) undertook modelling of the effects of the 2003 wildfires over the whole burnt area of Victoria and selected parts of NSW that drain into the River Murray or Victoria, and their initiation of regrowth, on water yields, identifying that in the absence of fire "*there would have been a net increase in streamflow over the next 150 years due to the natural aging of the forest*", and concluding:

> *The results indicate that the typical streamflow response following a fire consists of an initial increase followed by a long-term reduction, rejoining the streamflow response for a no-fire scenario after approximately 100 years. The initial increase in streamflow, compared to mean annual flow pre 2003, for the River Murray was predicted to be 1,116 GL and 250 GL for the Gippsland Lakes. The maximum reduction in streamflow for the Best Estimate was 692 GL for the River Murray by 2022 and 155 GL for the Gippsland Lakes by 2024, compared to mean annual flow pre 2003. However, compared to anticipated streamflow assuming no fire had occurred, streamflow under the Best Estimate fire scenario was 859 GL less for the River Murray and 195 GL less for Gippsland Lakes, both occurring by 2027.*

The Inquiry needs to recognise that logging has significant impacts on water yields from native forests, such that:

d. Reduction of mature and oldgrowth forest to younger growth stages will cause a significant reduction in water yields;
e. Water yields will increase with increasing forest maturity; and,
f. Logging should be excluded from significant water catchments.

In their review of 'Logging and Water' Dargavel et. al. (1995) concluded *"The hydrological evidence reviewed in this report indicates that current logging regimes in the native forests of eastern Australia result in a decline in water yields. … In catchments used to supply urban centres, this means that there is less water flowing into dams that provide water to cities and towns for drinking, washing, cleaning, watering gardens and industrial uses."*

All forests are important for water supply, though this importance increases in relation to the numbers of people and the value of industries a catchment supplies. For the more significant catchments water supply should be a "*primary consideration in decision-making affecting the catchment"* and not an incidental consideration as it often is now. The Sydney Water Inquiry was established following the 1998 Sydney water contamination crisis, in part it concluded (McClellan 1998):

> *"The health of the catchment is a fundamental responsibility of our community, both for this, and subsequent generations. I have concluded that immediate action must be taken to establish appropriate management and regulatory structures to ensure the catchment is not further compromised and, if possible, existing problems minimised or removed. … We must not allow vested interests to inhibit the creation of effective planning, regulatory and management structures for the catchment.*
>
> *"The problems of the catchment demand a strong and effective response. A modern treatment plant is not a substitute for proper catchment management. Protecting the catchment provides the best long-term protection for Sydney's drinking water. …*
>
> *"Under the current arrangements, the catchment is managed to allow a range of activities. Water quality considerations may be diminished in favour of agricultural, urban and rural residential, forestry, mining and other developments. …*
>
> *"In my view, this situation cannot be allowed to continue. … From now, water quality should be the primary consideration in decision-making affecting the catchment. This has significant implications for proposed future developments in the catchment. …*
>
> *"There is a need to develop directions, catchment wide strategies and water quality objectives to guide management activities and development decisions in the catchment. …*
>
> *"I also believe it is appropriate to give one agency specific responsibility for managing Government-owned land in the Inner Catchment. In my view, the National Parks and Wildlife Service is best placed to manage these areas for both water quality and broader ecological considerations, provided it is resourced adequately."*

Dargavel *et. al*. (1995) note *"There are very large costs associated with providing water storage for urban water supply, so that decrease in stream flow may mean that greater or earlier investments in dams become necessary. Similarly, increased siltation of streams due to upstream economic activities may require dredging of dams or construction of new ones before they are due. These both impose costs on urban water consumers. Sediment from logging activities can increase the cost of municipal water treatment."*

Depending on its end use water has an economic vale that is greatest in catchments supplying dams used for domestic water.

The major economic study of forests and water was carried out by Read Sturgess for Melbourne Water. Read, Sturges and Associates (1992) determined that the economic worth of water and timber from the forests of the Thomson Dam catchment, in Victoria, was maximised by either no logging at all or by strip thinning combined with a rotation length of 200 years. These two options had a 'Net Present Value' of $147 and $169 million, respectively, above continued logging under the current system.

Read, Sturges and Associates (1992) identified the current marginal willingness to pay for water at the tap as 30c, 60c and 80c per KL, which *"correspond to prices 'in the stream' of 26c, 53c and 70c".* Read, Sturges and Associates adopted a *"preferred estimate of water price of $530 per ML at the tap"*.

Pugh (2000) undertook an assessment of the costs and benefits of protecting the then Whian Whian State Forest which encompasses part of the catchment of the Rocky Creek Dam, which is a regional water supply. He identified:

> *State Forests (Cornish 1997) have conservatively estimated that logging has to date resulted in an overall reduction of 15-23% (5,600 to 8,400 megalitres - ML) in water yields to Rocky Creek Dam from the catchment. Though the actual reduction may in fact be as high as 16,800 ML .... If logging was now stopped in the whole catchment then its water yield will increase over time in line with forest maturity, with something like a third (1,900 ML to 5,600 ML) of the lost yields recoverable within the next 30 years and two thirds (3,700 ML to 11,100 ML) within 60 years.*
>
> *...*
>
> *The economic valuation of the water foregone due to continued logging of 30% of the catchment is likely to have a value of at least $124,000 to $366,000 per annum. Though if the benefits of delaying new infrastructure requirements are accounted for the Net Present Value (NPV) of ceasing logging in the remaining 30% of the catchment may be somewhere between $2.5 and $9.3 million.*

The North East Forest Alliance (2002) undertook water yield modelling to estimate how much additional water would be available if logging is excluded from the entire Central Coast catchment which is then regenerated back to an oldgrowth condition. 17,922 ha of State Forest (60%) was available for logging in the catchment, and 12,036 ha (40%) was 'unloggable'. NEFA concluded that there is a very high likelihood that the yields produced as a result of ending logging in the catchment will be in the order of 15 Gl/annum.

GROWTH STAGES AT 1997 OF EUCALYPT ADDITIONS TO NPWS ESTATE IN NORTH EAST NSW SINCE 1994 AND STATE FOREST EXCLUSION ZONES (FMZ 1,2,3A,Special Management Zones)

Growth Stage	Open woodland	Very low productivity dry sclerophyll forest and woodland	Low productivity dry sclerophyll forest	Dry sclerophyll forest	High productivity dry sclerophyll forest	Very high productivity dry sclerophyll forest / wet sclerophyll	Wet sclerophyll forest	High productivity wet sclerophyll forest	Very high productivity wet sclerophyll forest	TOTALS
Candidate Old Growth	19191	8100	21848	55972	33449	57619	13778	10897	41765	262618
Disturbed Old Growth	6082	5616	7816	18060	12871	14715	3057	973	7196	76385
Mature Forest	1573	5586	17216	22345	11235	16394	2813	3305	9042	89509
Disturbed Mature Forest	9361	21434	97503	110895	35229	60269	14344	7469	29651	386153
Young	2998	4556	11754	9221	11782	13629	2146	3980	14616	74679
Recently Disturbed	1833	1889	6061	8390	4323	6408	711	1424	3914	34952
Total	41037	47181	162197	224882	108889	169033	36847	28046	106183	924297

For this submission an assessment for both the upper and lower north-east NSW was made of mapped growth stages of eucalypt forests (as at 1997) added to the reserve system since 1994 and forests protected on State Forests as an outcome of the Forest Reform process. This specifically excludes rainforest and non-forest communities. This shows that some 661,678 hectares of

eucalypt forest protected was in a disturbed state and can be expected to have had reduced water yields that have since been increasing. This will represent a massive increase in water flows in streams throughout north-east NSW and a significant benefit to downstream water users. We were not able to assess the magnitude of this, though recommend that the inquiry undertake this task.

Water yield from forests has a real value to regional communities which increases with time since logging. The monetary value depends on the downstream uses of the water, with those waters used for urban water supply being the most valuable.

The Inquiry should consider that regeneration in the reserves created in the Forest Reform process will have already resulted in significantly increased water yields to surrounding streams and dams. Water yields will go on increasing for many decades. The increase in water yields from maturing forests in the reserves represents a significant economic benefit to regional communities that should be quantified by the inquiry.

2.4. Carbon Sequestration Benefits of Reserves

Solving the climate change problem facing Australia and the world requires that emissions of greenhouse gases be reduced and that the storage of carbon in vegetation be increased, so as to enable atmospheric concentrations of greenhouse gasses to be stabilized at a level that avoids the most dangerous climate changes.

The need for reducing emissions from deforestation and forest degradation is now recognized by the international community as an essential part of solution to addressing carbon emissions. Since the 2007 United Nations Climate Change Conference in Bali international negotiations have focused on the role of natural forests in storing carbon.

Native forests play a significant role in the storage of carbon and the sequestration of carbon dioxide from the atmosphere. Old growth forests are the most significant carbon storehouses, with most carbon stored in the oldest and biggest trees (Roxburgh *et.al.* 2006, Mackey *et. al.* 2008). Old-growth forests also remove carbon dioxide from the atmosphere and sequester it in live woody tissues and slowly decomposing organic matter in litter and soil. (Zhou *et. al.* 2006, Luyssaert *et. al.* 2008)

Mackey et. al. (2008) found;

> *Our analyses showed that the stock of carbon for intact natural forests in south-eastern Australia was about 640 t C ha-1 of total carbon (biomass plus soil, with a standard deviation of 383), with 360 t C ha-1 of biomass carbon (living plus dead biomass, with a standard deviation of 277). The average net primary productivity (NPP) of these natural forests was 12 t C ha-1 yr-1 (with a standard deviation of 1.8).*

Average Carbon Carrying Capacity of the Eucalypt Forests of South-eastern Australia. (from Mackey *et. al.* 2008)

Carbon component	**Soil**	**Living biomass**	**Total biomass**	**Total carbon**
Carbon stock ha^{-1} (t C ha^{-1})	280 (161)	289 (226)	360 (277)	640 (383)

Carbon stock per hectare is represented as a mean and standard deviation (in parentheses), which represents the variation in modelled estimates across the region

Logging significantly reduces the volume of carbon stored in forests. In regards to logging Mackey et. al. (2008) note:

> *The carbon stock of forests subject to commercial logging, and of monoculture plantations in particular, will always be significantly less on average (~40 to 60 per cent depending on the intensity of land use and forest type) than the carbon stock of natural, undisturbed forests. ...*
>
> *The majority of biomass carbon in natural forests resides in the woody biomass of large old trees. Commercial logging changes the age structure of forests so that the average age of trees is much younger. The result is a significant (more than 40 per cent) reduction in the long-term average standing stock of biomass carbon compared with an unlogged forest. ..*

It is important to recognise the outstanding contribution of big old trees to storage of carbon in forests. For example Roxburgh *et.al.* (2006) found:

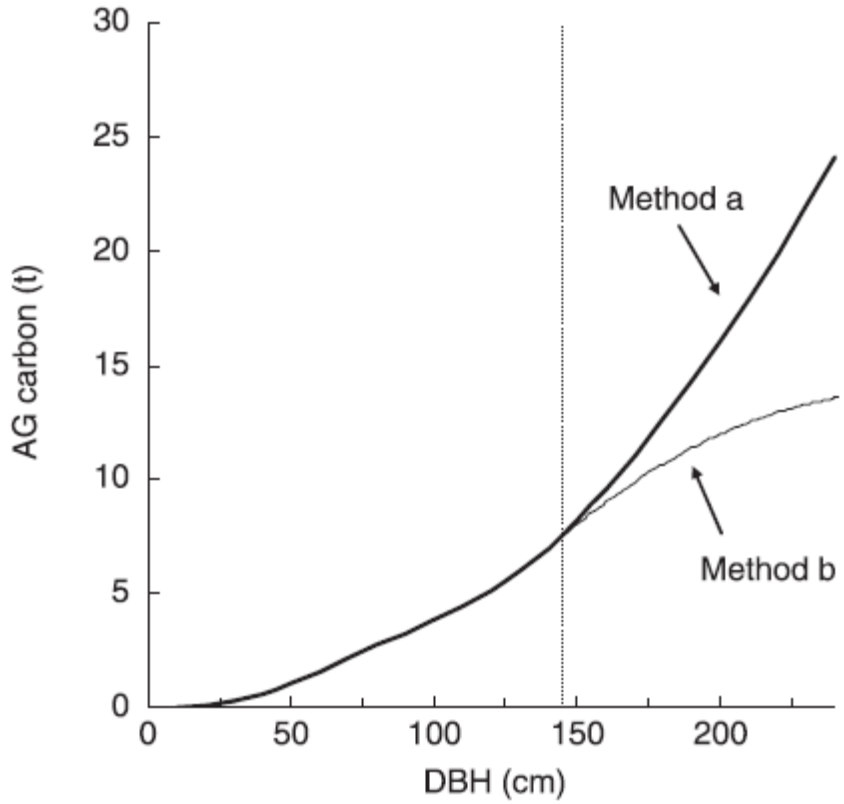
> *In mature forests, large diameter trees greater than 100 cm d.b.h. comprised 18% of all trees greater than 20 cm d.b.h. and contained 54% of the total above-ground carbon in living vegetation. ... The influence of large trees on carbon stock therefore increases with their increasing size and abundance.*

In Australian forests Roxburgh *et.al.* (2006) found that following logging:

> *Model simulations predicted the recovery of an average site to take 53 years to reach 75% carrying capacity, and 152 years to reach 90% carrying capacity.*

This is compatible with the findings of Harmon et. al. (1990) in America, who found that during simulated harvesting carbon storage is reduced by 49-62% and does not approach old growth storage capacity for at least 200 years (even when storage in wooden buildings is accounted for).

Above-ground biomass/carbon relationship to tree diameter at breast height. From Roxburgh *et.al.* (2006). Method A assumes minimal internal tree decomposition. Method B allows for internal decay.



Mackey et. al. (2008) state:

> *Conventional approaches to estimating biomass carbon stocks are based on stand-level commercial forestry inventory techniques. These data are not, however, suitable for calculating the carbon carrying capacity of natural forests.*

Roxburgh *et.al.* (2006) and Mackey *et. al.* (2008) advocate an approach to assessing the carbon stocks of native forests based on the Carbon Carrying Capacity of oldgrowth forest. Mackey et. al. (2008) consider that for reliable carbon accounts two kinds of baseline are needed;

> *1) the current stock of carbon stored in forests; and 2) the natural carbon carrying capacity of a forest (the amount of carbon that can be stored in a forest in the absence of human land-use activity). The difference between the two is called the carbon sequestration potential—*

> *the maximum amount of carbon that can be stored if a forest is allowed to grow given prevailing climatic conditions and natural disturbance regimes*

With the urgent need to sequester carbon from the atmosphere we should be managing our forests as carbon sinks. As Mackey *et. al.* (2008) conclude;

> *The remaining intact natural forests constitute a significant standing stock of carbon that should be protected from carbon-emitting land-use activities. There is substantial potential for carbon sequestration in forest areas that have been logged commercially, if allowed to regrow undisturbed by further intensive human landuse activities*

Forests recovering from logging will sequester carbon and increase the volume stored in both living biomass and soils.

For the Great Eastern Ranges corridor Mackey et. al. (2010) note:

> *One necessary action to help solve the climate change problem is to prevent emissions from deforestation and forest degradation (reduced emissions from deforestation and degradation: REDD) (IPCC 2007a). Emissions from deforestation represent about 18% of annual global emissions – a share greater than that of the global transport sector (Nakicenovic 2000; IPCC 2006). Emissions from degradation of forests and other ecosystems have yet to be fully accounted for, but they are likely to be in the order of 10–15%. This would mean that emissions from land clearing and ecosystem degradation may account for more than 20% of the root cause of the climate change problem. Various mechanisms are now being considered for directing investments for funding activities that will result in REDD. Different rules and policies may be promulgated for REDD in developing versus developed countries. In any case, we should plan for 'wall-to-wall' carbon accounting in anticipation that the green carbon in natural forests and woodlands will very soon have a market value.*
>
> *More specifically, appropriate conservation management could lead to the GER corridor making a significant contribution to Australia's national carbon accounts by (Keith et al 2009, 2010):*
>
> - *protecting the stocks of carbon in forests and avoiding depletion of these stocks through emissions associated with forest logging, soil disturbance and regeneration burning*
> - *allowing forests to reach towards their carbon-carrying capacity by cessation of the logging and other land use activities that remove, in particular, large, old trees that store most of the aboveground carbon and cause emissions of soil carbon stocks, thus restoring the forest's current carbon stocks*
> - *further increasing the stock of carbon stored in the GER corridor ecosystems by promoting permanent native revegetation and restoration.*

For this submission an assessment for both the upper and lower north-east NSW was made of mapped growth stages of eucalypt forests (as at 1997) added to the reserve system since 1994 and forests protected on State Forests as an outcome of the Forest Reform process. This specifically excludes rainforest and non-forest communities. This shows that some 661,678 hectares of eucalypt forest protected was in a disturbed state and would have had a reduced carbon storage that has since been increasing. This will represent a massive increase in carbon storage throughout north-east NSW and be a significant benefit to all NSW residents. We were not able to assess the magnitude of this, though recommend that the inquiry undertake this task.

Growth Stage	Open woodland	Very low productivity dry sclerophyll forest and woodland	Low productivity dry sclerophyll forest	Dry sclerophyll forest	High productivity dry sclerophyll forest	Very high productivity dry sclerophyll forest / wet sclerophyll	Wet sclerophyll forest	High productivity wet sclerophyll forest	Very high productivity wet sclerophyll forest	TOTALS
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GROWTH STAGES AT 1997 OF EUCALYPT ADDITIONS TO NPWS ESTATE IN NORTH EAST NSW SINCE 1994 AND STATE FOREST EXCLUSION ZONES (FMZ 1,2,3A,Special Management Zones)

The Inquiry needs to recognise that logging has significant impacts on carbon storage in native forests, such that:

- **e. Reduction of mature and oldgrowth forest to younger growth stages will cause a significant reduction in carbon storage in forest;**
- **f. Carbon storage will increase with increasing forest maturity;**
- **g. Large trees are particularly important for carbon storage; and,**
- **h. Forests should be managed so that they are carbon sinks.**

The inquiry should consider that the creation of reserves in north-east NSW during the Forest Reform process has avoided significant releases of CO_2 and that since their protection large volumes of carbon have been sequestered and stored in tree trunks and soils of the regenerating forests. The regenerating forests will continue to store carbon in ever increasing volumes as they mature over decades and centuries. It needs to be recognised that the reserve system in north-east NSW makes a significant contribution to Australia's national carbon accounts. The increase in carbon storage represents a significant economic benefit to all people in NSW that should be quantified by the inquiry.

Some 260,000 hectares of oldgrowth eucalypt forest was protected as a result of the Forest Reform process in north-east NSW, stopping logging of the accessible stands will have avoided significant CO_2 emissions and maintained carbon storage at maximum levels.

2.5. Restructuring

The north-east coast is booming and the Forest Reform process, while negatively affecting some individuals, has occurred over a boom time as employment growth has outstripped a growing population and labour force, while unemployment has declined. On the tablelands and western slopes this was the period when the droughts were intensifying and their affect will have swamped any changes due to changes in the timber industry.

A preliminary examination of census results for the Statistical Divisions covering the northern part of the region (Mid-north Coast, Richmond-Tweed, New England and North-West) for the period 1991-2006 show significant increases in population and the labour force in coastal areas, and declines on the New England Tablelands and western slopes. Employment has grown in all divisions, far outstripping labour force growth in coastal areas. Unemployment has significantly declined across all divisions.

Employment Changes in statistical divisions covering the Upper North East.

		1991	**1996**	**2001**	**2006**	%CHANGE
Mid-north Coast	Population	240753	262985	275274	284676	+18.2
	Labourforce	95222	102330	106117	114144	+19.9
	Employed	78283	85318	92071	102872	+31.4
	Unemployed	16939	17012	14046	11272	-33.5
	% Unemployed	17.8	16.6	13.2	9.9	
Richmond-Tweed	Population	179776	202635	213264	219327	+22.0
	Labourforce	73331	81555	85129	93922	+28.1
	Employed	60385	69275	74491	86335	+43.0
	Unemployed	12946	12280	10638	7587	-41.4
	% Unemployed	17.7	15.1	12.5	8.1	
New England and North West	Population	180987	175221	172862	172395	-4.7
	Labourforce	81617	77484	77615	78288	-4.1
	Employed	71914	69454	70794	72669	+1.0
	Unemployed	9703	8030	6821	5619	-42.1
	% Unemployed	11.9	10.4	8.8	7.2	

Employment Changes in Bellingen Local Government Area.

YEAR	**1996**	**2001**	**2006**	**2011**
Population	12,253	12,208	12,416	12,518
Employed	3,846	4,005	4,432	NA
Unemployed	879	681	516	NA
Unemployed % work force	18.6%	14.5%	10.4%	NA
Employed agriculture, forestry, fishing	511	439	402	NA
Median weekly individual incomes (% Australian)	204 (70%)	268 (71%)	336 (72%)	416 (72%)
Median weekly household income (% Australian)	422 (68%)	491 (62%)	622 (61%)	787 (64%)

The Bellingen Local Government Area would have been one of those most affected by the forestry reform process, particularly as many mills around Drrigo were closed due to a fire and industry restructuring and transfers of quotas to other mills. The mill closures had long been identified. An examination of the census results for the Bellingen Local Government Area from 1996 to 2011 show that the population has remained relatively stable, while employment has grown significantly and unemployment declined. There has been a decrease in employment in the sectors of agriculture, forestry and fishing. Incomes have generally kept pace with the average Australian incomes.

The Forest Reform process was accompanied by significant Government assistance programs to assist mills to restructure, to provide increased resources and to assist displaced workers.

The Forest Industry Structural Adjustment Package (FISAP) comprised a number of measures by which the Commonwealth Government assisted forest industry businesses and workers adjust to the changes in the nature and availability of native forest resources available to industry as a result of the Forest Reform process and the changes in nature and availability of the native forest resource.

The Commonwealth committed up to $60 million to NSW for a joint package. The NSW Government initially contributed $60 million, with a further $20 million added later; a total of $140 million. FISAP was extended a number of times for NSW, and wound up, with all funds spent in about 2005.

Businesses and workers, including the self-employed, were eligible for assistance if they were:

- directly affected by the outcomes of the DFAs and/or the RFAs, and were
- either directly involved in the native forest based industry sector (eg, those involved in felling and harvesting, the transport of logs from forests to mills, the transport of woodchips and sawmill residues to mills, mill workers), or
- directly dependent on the native forest industry, and demonstrated that greater than 50% of their income was from the direct supply of goods or services to the forest industry, and that they have been rendered financially unviable as a result of Commonwealth decisions.

The three key elements of FISAP were:

- Workers Assistance, which includes new training for workers both currently and formerly employed in the timber industry; relocation costs; and income support.
- Industry Assistance, for businesses needing help to upgrade and value-add.
- Business Exit Assistance, for contractors and sawmillers who may wish to leave the industry because of the structural changes it has undergone.

As an example of the financial windfall to millers:

> *As at October 2001, Boral has spent more than $10 million in capital as part of the FISAP program and a further $5.5 million is currently being invested in a key project to upgrade Boral's green mill at Koolkhan on the NSW north coast. The remaining $29.5 million of Boral's planned investment will be made at Boral's north coast timber mills including those at Murwillumbah, Koolkhan, Kyogle, Maxwells Creek and Herons Creek.*
>
> *The overall program involves total expenditure of $45 million by Boral Timber, with the NSW and Federal Governments providing $22.5 million.*
>
> *Timber companies also received government funding under various Commonwealth Regional Development programs, including the dairy industry restructuring scheme.*

The funds were fully expended in NSW. As at September 2001 629 displaced workers had been assisted.

State Forests received $679,000 from FISAP to fund purchase of private property to log to bolster timber supplies.

This injection of monies from the NSW Environmental Trust and the Commonwealth into FISAP was the centre plank of the timber industry mitigation measures. Both the CFMEU and the industry's FPA got to oversee its expenditure. Industry restructuring was being planned well before the Forest Reform process started. Many sawmills were indentified for closure as companies sought to rationalise mills. FISAP was a boon to the industry and represents a significant public investment intended to achieve establishment of the promised CAR reserve system.

The Governments announced package in 1998 included the promise of up to 160 new jobs in the timber industry, a further industry assistance package worth more than $53 million on top of the existing $120 million Forest Industry Structural Assistance Package, and 105 new jobs in National Park management. The NSW Government anticipated that there would be a net increase in employment as a result of the 1998 decision:

> *Industry development projects in the Upper and Lower North East, together with additional State Forests and National Parks and Wildlife Service positions, will provide an opportunity for the employment of between 273 and 283 people in the short to medium term, which is a net increase of between 202 and 212 jobs once potential job losses have been accounted for. This will be funded from a combination of Consolidated Revenue, Forestry Industry Structural Adjustment Program (FISAP) funds and existing funding.*

According to the Forests Products Association (2011) the outcomes have been positive for both the industry and employment:

> *Since delivery of forest agreements employment in the industry has been secure and has consequently developed, with valuable training and OH&S packages, into worthwhile career paths in country towns.*
>
> *Industry investment and development into value added products, and extended markets, has increased employment numbers in mills.*
>
> *The timber industry has responded positively under the NSW and Regional Forest Agreements, invested heavily, returned a remarkable market performance of high valued timber products, rebuilt employment levels and maintained the contribution of the rural timber industry to regional communities.*

The economy of north-east NSW generally boomed through the Forest Reform process, with the exception of the New England Tablelands which was severely affected by the drought. The growth in the labour force and employment has outstripped population growth and unemployment has dropped. In return for increased reserves, generous government assistance packages for sawmillers and timber workers helped overdue restructuring of the timber industry.

2.6. Removing Market Distortions and Providing a Public Benefit

The timber market in NSW is totally distorted by massive Government subsides, inefficient resource allocations, cross-subsidisation of public native forests by plantations, lack of competitive pricing, public subsidies distorting and depressing timber values from private forests and plantations, and excessive long-term timber allocations.

As noted by URS (2008):

> *Native forests are managed for multiple objectives – commercial and environmental. As a result public ownership is appropriate. However, achieving economic efficiency and good public administration requires clear objectives, separated institutional and governance arrangements, adequate reporting, and competitive pricing and allocation mechanisms. However in several jurisdictions there is a lack of transparency in public management of forest resources and a lack of commercial drivers within publicly owned forest managers. A key example is where the financial performance of plantations and native forest operations are not reported separately. Non-commercial public forest management also acts to encourage downstream industry dependence on government support.*

Forests NSW native forests operations are operating at a substantial financial loss. A situation that is expected to worsen dramatically into the future. NSW taxpayers are going to have to pay many millions more every year to prop up this unsustainable industry that is running down the value of the public's assets.

The subsidisation of the timber industry has been going on for decades despite repeated suggestions to remedy the situation. As noted by the Public Accounts Committee (1990):

> *"The State's timber processing industry is heavily subsidised by the public sector. Chief among the subsidies are under priced raw materials (in the case of Eucalypt logs), and failure to bear the full costs of road construction and maintenance which are attributable to the industry's operations. As a result of these subsidies, sawmilling businesses which would be marginal or non-viable in their present form are able to continue operating and to continue resisting the pressures to change their inefficient methods of operation." (p31)*

Pugh (1992) found that the then Forest Management Areas of Urbenville, Murwillumbah, Casino West and Grafton operated at a financial loss of $1,090,000 (in 1991 dollars) over the ten years 1981/82 to 1990/91. In 1987/88 the Forestry Amendment Act gave an additional subsidy to the Forestry Commission by relieving them of the interest payable on their accumulated debt of some $110 million. They were supposed to pay a dividend to Treasury in return, though failed to do so in 1987/88 or 1988/89 (PAC 1990 p27).

While Forests NSW now attempt to hide the subsidisation of logging public native forests by including their accounting with plantations, it is evident that they are still operating at a substantial loss. In response to questions on notice from the General Purpose Standing Committee No.1 Budget Estimates 2009-10, the Forestry Minister Steve Whan identified that Forests NSW's native forest operations ran at a loss of $8.1 million in 2009/10, stating:

> *Given, as reported by the Auditor General in 2009. that the current cash flow of Forests NSW Native Forests Operations Branch is negative, any NPV calculation now will result in a valuation of zero.*

The Auditor General (2009) wonders how Forests NSW will perform in the future, given that:

> *... Native forest operations operated at a loss of $14.4m for 2007-08. We are unable to conclude if this is the result of inefficient operations, or because prices do not reflect the true cost of meeting wood supply commitments or a mixture of both.*

Not only are Forests NSW losing money, the public are losing a natural resource and environmental values. There is no resource rent being paid to the community, so we are being dudded twice, as noted by URS (2008):

> *Extracting resource rent from the use of the state's forest resources – resource rent is the additional profit above "normal" business profits that can be gained by providing access to a natural resource. Because resource rent is in excess of normal business profits, there is a rational for governments to collect some of this rent on behalf of the owners of the resource – the community.*

URS (2008) note:

> *Low returns to public forestry and plantation agencies distribute income from taxpayers to the forest industry, as do subsidies to plantations and wood processing plants. The distortion in returns to forestry created by the range of poor economic policy settings reduce returns and lead to underinvestment for the longer term by both the private and public sectors.*
>
> *…*
>
> *To the extent that the market failure relating to social rates of time preference is not addressed through these policies, then future generations will be worse off. This will also be the case if there is poor transparency and reporting of native forest operations with clear achievement of environmental objectives.*

It is often claimed that Forests NSW can operate at a loss because of the public good they provide. Though URS note that *"Forests NSW received a contribution from the state government for community service obligations of approximately $9.5M pa. In 2006/07 expenditure on community service obligations was $11.1M"*. Their claims as to what constitute community services are dubious.

There is a need to make public native forestry more transparent by separating reporting on its performance from plantations.

Despite repeated claims by Forests NSW that they can turn the situation around and operate at a profit on their native forest operations, this is increasing unlikely due to the entrenched pricing distortions and subsidies built into the current system, the declining yields, and the increasing costs of accessing whatever timber is available.

Partington and Stevenson (Forests NSW 2004b) warn that *"Only 50% of the native forest volume is easily accessible - on slopes less than 20º and more than 50m from an exclusion boundary. Harvesting practices and costs will need to address the issue of difficulty of access in order to meet current native forest commitments".* This means that the costs and difficulty of obtaining available timber will increase into the future.

Partington and Stevenson (Forests NSW 2004b) also consider *"we understand that there may be an increasing need to harvest crops previously considered unmerchantable" … "areas previously considered unmerchantable are now being reclassified as merchantable as the constraints on available timber become more severe".*

The Auditor General (2009) supports the contention that obtaining whatever timber is available will become increasingly expensive:

> *Over the last five years, harvest and haulage prices for all north coast products increased 45 and 36 per cent respectively. Central Region advised that harvesting is becoming more difficult as they are moving into more remote areas with lower yield per hectare and steeper terrain.*
>
> *Regional staff believe that the last five years of wood supply agreements for the north coast (i.e. 2018-2023) will be the most difficult, with Forests NSW increasingly accessing timber further away from sawmills.*

With increasing costs involved in obtaining the timber available, Forests NSWs losses can be expected to rapidly escalate into the future.

There is a deliberate confusing of plantations with native forests in NSW. Yield estimates from hardwood plantations are included with yields from native forests to disguise the true magnitude of the grossly unsustainable logging being undertaken. Similarly the financial returns from plantations are used to disguise the major losses from native forest logging. This also results in the use of plantations to subsidise native forest logging.

URS (2008) note:

> *If a State Government chooses to be involved in commercial plantations, profit maximisation is an appropriate objective to deliver a dividend for taxpayers in contrast to the multiple objectives of native forest management. However an agency's performance in achieving its multiple objectives for native forest plantation management should be reported separately. The New South Wales, Western Australian and Tasmanian models do not perform well on these criteria as they do not produce separate financial reports for native forest and plantation operations. ...*
>
> *... In the absence of separate reporting, it is possible that softwood plantations could be used to support less profitable native forest activities. However there is no stated government policy by any Australian state supporting the provision of such subsidies.*
>
> *Lack of financial reports for native forest management can exacerbate community anxiety about achievement of environmental objectives and the extent of state support for logging in native forests. Such lack of disclosure could enable agencies to deviate from profit goals through cross subsidisation and also to pursue other unstated objectives such as regional or industry development.*
>
> *Cross-subsidisation of native forest operations by plantations is in effect a direct subsidy using taxpayer funds as the profits from plantation forestry would otherwise become direct government revenue. The risk of implicit support to native forestry operations is that it effectively builds up adjustment pressure, adding to the social and economic costs of adjustment when such operations are required to meet commercial pressures. This has implications for the certainty and risk to private businesses in the native forest supply chain, similar to the risk of a future lack of access to resources, discussed below.*

URS (2008) identify as the pre-eminent key sectoral reform:

> ***Recommendation 1 - Transparency in reporting:*** *National reporting of public forest agency performance should be improved with separation of native forest and plantation*

> *finances. Such improvements to reporting could be driven by COAG federation reform processes and be modelled on the annual Report on Government Services undertaken for COAG*

The administrative pricing system, as compared to competitive pricing, introduces distortions into prices and generally leads to lower returns to the forest owner than what would be realised in a free and competitive market. For example URS (2008) recognise that :

> *Administered pricing is the predominant pricing mechanism used in Australian states, excluding Victorian native forest sawlogs. This leads to poor price discovery in the marketplace. Based on the experience of the introduction of logs auctions in Victoria, and limited competitive sales in other states, administered prices appear to be lower than competitive prices. Low prices depress return on investment and can distort the allocation of resources from highest to lower value uses. Low or non-transparent prices could also fuel public scepticism of the ongoing requirement to pursue commercial utilisation of an asset which also provides environmental services. Competitive pricing can be used by public forest managers to realise true market value and capture resource rent on behalf of the community – the owners of the resource. However its use is limited outside Victoria.*
>
> *…*
>
> *The LVPS residual pricing methodology seeks to obtain a measure of willingness to pay, however this methodology is only used to adjust price relativities not to determine base prices and there is a high risk that the system does not result in efficient pricing outcomes that accurately reflect capacity or willingness to pay.*
>
> *The most accurate and efficient way of determining true market prices is to use the market itself. Market based approaches to log pricing and allocation promote the most efficient allocation of forest resources (allocative efficiency). This is on the basis that buyers who can put the logs to most productive use will be able to outbid those with less productive possible uses. ...*

While NSW has constrained its ability to implement a competitive pricing system due to its Wood Supply Agreement, every opportunity should be made to do so.

NSW has compounded its problems by issuing Wood Supply Agreements for excessively long periods beyond the time required to obtain a return on investments. This leads to further market distortions and favours inefficient processors. URS (2008) recognise:

> *The length of supply contracts offered by public forest agencies are generally excessive, often being much longer than pay-back period for user industries investments (e.g. saw mills). These contract lengths inhibit innovation and investment in user industries by creating barriers to entry and inflexibility in the face of changing market conditions. ...*
>
> *…*
>
> *Long term contracts create inflexibility for both forest managers and the industry. This is particularly important when supplies are being reduced as a result of continual revision of sustainable yields. The public forest managers may remain committed to their contractual obligations. In practice, such long term contracts also tend to commit the agencies to supply even in the face of changes in supply, e.g. as a result of bushfires. Such sharing of risks can lead to further deterioration in the already low profitability of native forest operations if the agency has to purchase logs from elsewhere to meet long term obligations.*
>
> *Long term supply contracts also impair the ability of the industry to effectively respond to market changes and derive the greatest value from the resource. Such changes could include changes in local and global demand for wood-based products, new technologies for*

> *processing, entrance of new processors and new investment in processing facilities and changes to transport costs.*
>
> *Long term supply contracts act as a barrier to entry into the wood products industry when the supply is being reduced overall. While new entrants to the processing sector can purchase existing processors or their long-term contracts, such buyouts generally require compensation for the vendor which has to downsize or cease operations. In contrast, under short-term agreements processors are required to compete more frequently with other existing processors and new entrants.*
>
> *Long term contracts have been justified as providing certainty of access for the processing sector. While such an argument may have some merit regarding the establishment of new timber processing facilities it is weak in a mature industry that has continuity of supply and adequate processing facilities in place. Indeed in practice there is likely to be a trade-off between 'certainty' of supply and industry competitiveness. The argument certainly does not justify contract lengths well in excess of the pay-back period for processing investment which is typically around 6 to 10 years.*

Every opportunity should be taken to reduce the terms of Wood Supply Agreements. As state by URS (2008):

> *Whilst there is likely to always be a place in the Australian industry for long term contracts, there is scope to reduce the length of long term contracts to a duration more aligned with the payback period for new investment and to increase the proportion of volume sold under short term contracts. These actions would act to increase competition and improve the environment for investment by new entrants.*

Quantifiable, but usually unaccounted, costs of logging include damage to council roads and bridges by logging trucks. These are costs principally borne by local government. The increasing centralisation of sawmills often means that local Councils may not directly benefit from trucks using its roads and bridges as timber harvesting may be undertaken by contractors from outside the area and timber processing may be undertaken a long way away.

Dobinson (1985) notes that road pavement damage increases in relation to the fourth power of axle load and that therefore a truck loaded to the permissable limit do 14,000 times the damage of an average car to road pavements. He further notes that bridge life depends on the extent of concentrated load by an axle group and the gross weight of the vehicle on the bridge.

Despite this long being recognised as a problem it has been repeatedly ignored. The State Pollution Control Commission (1975) noted that:

> *"Several submissions, in particular from local councils, commented on the damage to secondary roads by heavy woodchip vehicles. Experience in Tasmania is said to show that the damage is not trivial"*

The Department of Planning (1994) note that while they recognise *"road pavement damage from logging trucks may be considerable (as identified in a number of submissions) it has not been possible to quantify this ..."*

In 1990 the Public Accounts Commission (PAC 1990 p34) identified the 1990 rate as 4 cents per net tonne/kilometre. While this shows it is a significant impost on local government, the state

government refuses to quantify the costs of timber extraction from public forests on council infrastructure.

This emphasises the need to ensure that any resource rent obtained from use of public resources is, in part, allocated to the relevant local Governments.

The Inquiry needs to acknowledge that logging of public native forests in NSW does not pay a resource rent to the community and is receiving a massive public subsidy, thereby creating a significant market distortion to the detriment of private landholders and plantation growers, and the financial viability of ecologically sustainable forestry. It is requested that the Inquiry recognise the market distortions and lack of transparency caused by NSW's amalgamation of plantations and native forests for resource allocation and reporting and recommend separate reporting of native forests. It also needs to be recognised that costs are rapidly escalating and timber volumes declining. The Inquiry should consider identifying means of removing public subsidies to the timber industry and returning a resource rent to the community from the commercial use of public resources

The Inquiry needs to recognise that NSW's Wood Supply Agreements distort the hardwood sawlog market and are for excessively long periods. The Inquiry should consider recommending that every opportunity should be taken to reduce the volumes committed and reduce the length of the agreements.

3. Examination of models for the management of public land, including models that provide for conservation outcomes which utilise the principles of "sustainable use".

There is a need to manage forests on an ecologically sustainable basis. This is particularly true of forests that are part of the common property of all Australians – the public forest estate. This principally requires sustaining the natural values of the commons in perpetuity. So that values such as stream health and water yields, the viability of the diversity of ecosystem and species, and the aesthetic appeal and grandeur of large old forests, are maintained and enhanced for our great grandchildren.

There are many competing uses for public forests of which conservation needs to be paramount. Some uses, such as passive recreation and water yields, can be relatively benign, while other extractive uses, such as logging and mining are in direct conflict with conservation and need to be tightly controlled.

The community needs to get fair payment for use of public resources, the uses need to be appropriately constrained, and the use needs to be of net social and economic benefit to the whole community.

The primary requirement for ecologically sustainable management of the natural environment is the establishment of truly comprehensive, adequate and representative reserve systems. These are intended to be the areas needed to be protected from extractive uses in order to safeguard biodiversity, functional ecosystem processes and our natural heritage.

Outside the reserve system, extractive uses need to be constrained so as to minimise environmental impacts and retain natural processes. The forests of north-east NSW have been identified as part of one of the world's 35 biodiversity hotspots because of their exceptional species endemism (at least 1,500 endemic plant species, i.e., 0.5% of all known species) and habitat loss (70% or more of an area's primary vegetation cleared) (Williams *et.al.* 2011). Too much has already been lost, all remaining native forests, and other ecosystems, in north east NSW need to be managed to limit impacts and retain or regain natural processes.

To achieve ecologically sustainable management of native vegetation in north east NSW the primary requirements are:

1. Retention and enhancement of all remnant native vegetation.
2. Establishment of a truly comprehensive, adequate and representative reserve system in accordance with national reserve criteria targets;
3. Limiting logging to a sustainable yield obtained outside the reserve system in a manner that adequately protects soils, streams, fauna, flora, and ecosystem processes.
4. Appropriately limit where all other uses are undertaken and manage them so as to minimise impacts.

The Commonwealth Government (CoA 1990) identified five general principles of ecologically sustainable development:

- *Integrating economic and environmental goals in policies and activities*
- *Ensuring that environmental assets are appropriately valued*
- *Providing for equity within and between generations*
- *Dealing cautiously with risk and irreversibility*
- *Recognizing the global dimension*

The ESD Working Group on Forest Use (CoA 1991) concluded:

> *The principles of ecologically sustainable forest use will require the development of a policy framework and approaches which recognise three requirements:*
>
> - *maintaining ecological processes within the forests;*
> - *maintaining biodiversity; and*
> - *optimising benefits to the community from all uses within ecological constraints.*

The ESD Working Group on Forest Use (CoA 1991) also noted that:

> *"The protection of biodiversity and the maintenance of ecological systems and processes underpins economic activity. Thus, by taking an ecologically sustainable approach to development, all species, their genetic diversity and their habitats would be conserved such that the natural processes of evolution and ecosystem functioning can continue forever. This requires a recognition that there are fundamental biophysical limits to natural resource use."*

The Resource Assessment Commission Inquiry (RAC 1992) proposed that a national forest strategy should incorporate the following policy goals:

- *to ensure that the reserve system is fully representative of forest ecosystems and viable populations of species in both national and regional contexts;*
- *to improve the structure and connectivity of the reserve system;*
- *to maintain ecosystems, populations of species and ecological processes in all tenures, including production tenures;*
- *to minimise the risk of extinction of all species;*
- *to conserve rare and endangered species across all tenures, including wood production tenures;*
- *to minimise the impacts of human use on natural ecosystems and species.*

It is evident that the reserve system in north-east NSW does not satisfy the minimal national criteria for the basic requirement for inclusion of 15% of the pre-European extent of each ecosystem, nor does it incorporate the minimal populations of most threatened plants and animals identified as requiring full protection (see Section 1.3). The inadequate reserve system is supplemented by patches of forest with special values, particularly wilderness, oldgrowth and rainforest, excluded from logging across the public forest estate, mostly in Special Management Zones. Even with inclusion of these informal reserves the national criteria are far from satisfied. North east NSW's forests are one of Australia's and the world's biodiversity hotspots and yet have the worst reserve system in Australia.

There is an urgent need to expand north east NSW's reserve system to achieve the basic requirements of a comprehensive, adequate and representative reserve system.

In the whole of north east NSW only 31% of the CRA reserve targets for viable populations of fauna species have been achieved to date (see Section 1.3). The combination of extensive clearing, inadequate reservation and high biodiversity puts even greater emphasis on the need to appropriately constrain threats.

During expert workshops conducted as part of the CRA process for North East NSW information describing the disturbances that affect the priority species was collected (Environment Australia 1999). This involved experts listing all the disturbances affecting a species and then ranking them in terms of their impact on the regional population. Those disturbances that had the most detrimental affect were ranked one and so on. Many species have multiple threats.

For priority fauna species in north-east NSW the expert panels assessed threats to priority fauna species (Environment Australia 1999), finding:

- clearing is a serious threat to 88% of species, and a primary threat to 59% of species;
- logging is a serious threat to 68% of species, and a primary threat to 25% of species;
- grazing is a serious threat to 58% of species, and a primary threat to 22% of species;
- vertebrate pests are a serious threat to 64% of species, and a primary threat to 14% of species;
- fire is a serious threat to 53% of species, and a primary threat to 14% of species;
- altered hydrology is as a serious threat to 29% of species and a primary threat to 10% of species; and,
- weeds are a serious threat to 25% of species, and a primary threat to 5% of species.

Forestry operations have a large variety of impacts on our natural environment, including:

- Interference with ecosystem processes and functioning;
- Causing ecosystem dysfunction and dieback;
- Degrading and removing habitat for a large variety of mammals, birds, reptiles and frogs;
- Causing erosion and stream pollution;
- Reducing stream flows;
- Reducing carbon storage; and,
- Reducing aesthetic values.

Of those species identified as being of particular conservation concern (Environment Australia 1999), a total of 7 mammals (excluding bats), 27 bats, 31 birds, 16 frogs, 5 turtles, 15 lizards and 8 snakes were identified as being specifically vulnerable to logging, with many of these species, and a number of others, also vulnerable to the associated fire regimes, hydrological changes, stream pollution and weed invasions. For 41 of these 109 species logging is identified as a primary (number 1) threat.

Forestry operations on public lands are governed by the Integrated Forestry Operations Approval (IFOA) for Upper North East Region and the licence it contains. These are referred to as Environmental Protection Licence (EPL), Threatened Species Licence (TSL) and Fisheries Licence (FL). Together with various clauses of the IFOA these constitute the regulatory regime applied to forestry operations on the public's state forest lands in north-east NSW

3.1. Sustainable Timber Commitments

The concept of 'ecologically sustainable development' has been adopted by the world community as the solution to our rapidly deteriorating global environment. The National Forest Policy Statement adopts as the basis for ecologically sustainable development the Ecologically Sustainable Development Working Group on Forest Use's three requirements:

> *"…maintaining the ecological processes within forests (the formation of soil, energy flows, and the carbon, nutrient and water cycles); maintaining the biological diversity within forests; and optimising the benefits to the community from all uses within ecological constraints."*

The State Forests 1992-1995 Corporate Plan committed State Forests "*To manage State forests in an ecologically sustainable manner and encourage community understanding and support of forest management.*" State Forests notes that "*At this time, it considers that ecologically sustainable forest use will maintain, in perpetuity, the productive capacity and ecological diversity of the forest ecosystem.*"

It was not until the NSW Forestry Reform Process began to be implemented that the framework for ecologically sustainable development envisioned by the NFPS began to be holistically implemented, notably the establishment of an adequate reserve system and the application of prescriptions designed to minimise impacts of forest operations on soils, streams and biodiversity. Within these constraints the key requirement is to manage timber supplies on a sustainable yield basis.

The expert Review Panel to the Ministerial Committee (Attiwill, Burgman and Smith 1996) into Gaps and Clusters (patch/staged clearfelling) considered the way forward for NSW forestry was to adopt the principle of:

> *Promotion of the north-east forests as a region for production of high value-added specialty hardwood products … and biodiversity conservation, by management under low cost, low intensity (less than 35% canopy removal) selection logging techniques and discouragement of management for low-value products including scantling (housing frame), woodchips and wood fibre."*

Timber allocations have historically been on the basis of "quota sawlogs" which are generally taken to be large high quality sawlogs with minimal defect and a centre diameter of >40 cm. Some Management Areas (Kendall, Coopernook and Taree) have included small logs down to 25 cm small end diameter as quota for decades. Quota is the annual commitment of quota sawlogs to industry. In the Forest Reform process quota was taken to apply to Large High Quality sawlogs, with commitments separately being entered into for Small High Quality sawlogs and Low Quality sawlogs.

Sustainable yield is generally taken to be a specified annual volume of quota sawlogs which is expected to be able to be maintained at that level in perpetuity, generally 100 years.

Historically Forests NSW's resource assessments are at best estimates of sustained yield, i.e. the volume of "quota" sawlogs that can be maintained over some specified period, rather than in perpetuity, and without consideration of environmental constraints.

One of the prime motivations for the creation of the Forestry Commission expressed in the 1907 Royal Commission of Inquiry on Forestry was the dwindling timber resources and the need to sustain them into the future (PAC 1990). In 1980 the former Commissioner for Forests, Dr. S.W.

Gentle noted that there were many management areas not being logged on a sustained yield basis and emphasised the need to bring operations onto sustained yield (PAC 1990).

At the start of the Forestry Reform process, even without consideration of environmental constraints, it was evident that timber was grossly over-allocated. State Forests (1993) note that:

> *On some management areas with a long management history, medium-term sustained yields are expected to increase towards long-term sustainable yields in the near future, but it could be well in excess of 100 years before some management areas achieve a stand structure able to supply yields at long-term sustainable levels. Yields for the State as a whole should be approaching long-term sustainable levels when the youngest regrowth stands (regenerating about 2030) are maturing in about 2110-2130.*

For the incoming ALP Government in 1995 State Forests identified that an overall reduction of 23% was required in the 1995 allocations of quota sawlogs to reduce yields from north-east NSW to a sustainable level. Pugh (1996) reviewed State Forests' documents and actual yields to estimate that a reduction of well over 50% in 1995 allocations was likely to be required to compensate for past overcutting and achieve a sustained yield of quota sawlogs, without any conservation outcome. Sawlog quotas from state forests were reduced to 70% of the 1995 quota allocations in July 1996.

Since the Unsworth Government first introduced Wood Supply Agreements in 1988 these annual commitments of quota sawlogs have slowly been converted to term agreements for periods of from 10 to 20 years. Under the Greiner Government most of BORAL's annual commitments were converted into 20 year agreements, with allowances for reviews of yields if shortfalls in resources were identified.

It was the Carr Government which dispensed with the ability to change commitments in response to identified resource shortfalls when it issued 5 by 5 Wood Supply Agreements in 1996. These agreements were issued across the board as an outcome of the Interim Assessment Process to every quota sawmiller who wanted one at 50% of their 1995 allocations. They only allowed for a review after 5 years on the basis of token "value adding" criteria, no matter what the identified sustained yield at that time was.

It was on the basis of State Forests' inadequate 1996 Wood Resources Study (WRS) that forestry Minister Kim Yeadon convinced Government to give such large volumes of resources to industry in what are effectively 10 year Wood Supply Agreements. During the Interim Assessment Process major problems with State Forests' estimates of quota sawlog resources were identified by the foresters, NPWS and conservationists (Pugh and Flint 1998).

As at 1998 there was a total of 129,215 m^3 of large high quality sawlogs committed under the 5x5 Wood Supply Agreements to the timber industry in Upper North East NSW (55% of 1995 quotas) and 139,860 m^3 (49% of 1995 quotas) in Lower North East NSW from public forests (State Forests 1998f). An additional 1,877 m^3 of small high quality sawlogs were committed in the Upper North East and 8,346 m^3 in the Lower North East from public forests. These Wood Supply Agreements were issued to industry at no cost, aside from the royalties they pay when the timber is obtained.

For the CRA Forests NSW introduced a whole new resource estimation methodology called the Forest Resource and Management System (FRAMES). After the creation of the new (1998) national parks, and with the protection of the Government's HCV oldgrowth forest, rainforest, streams and allowance for threatened species protocols, FRAMES identified the 100 year sustainable yields of *High Quality Large Sawlogs* as 80,319 m^3 gross of high quality large sawlogs per annum for the

Upper North East CRA region (UNE) and 136,902 m^3 per annum in the Lower North East (LNE). Thus 217,221 m^3 per annum was identified as the sustainable yield of large quota sawlogs at that time.

As an outcome of the CRA, and based upon the FRAMES estimates, the NSW Cabinet determined in November 1998 that supplies to industry from public forests would be 109,000 m^3 of High Quality Large sawlogs (quota sawlogs) and 2,000 m^3 High Quality Small sawlogs per annum from the Upper North East, and 160,000 m^3 of high quality large sawlogs (quota sawlogs) and 8,500 m^3 High Quality Small sawlogs per annum from the Lower North East. The intent was thus to log at the unsustainable rate of 269,000 m^3 per annum until 2018, before reducing down to a sustainable yield of 183,5000 m^3 per annum thereafter. The NSW Government thereby intended to deliberately commit NSW to unsustainable logging.

The concerns of foresters and conservationists (i.e. Pugh and Flint 1999) that the resource had been over-estimated were largely in vain. The Carr Government's decision on the north-east forests included a reduction in timber volumes from the 1997/98 level of 297,781 cubic metres of quota sawlogs down to the Wood Supply Agreement levels of 269,000 cubic metres of quota sawlogs in two stages from the 1st January 2000. This proposed reduction was anticipated to cost some 80 jobs, though the industry changed their mind and instead claimed the industry would increase jobs under this scenario.

Carr's package included the promise of up to 160 new jobs in the timber industry, a further industry assistance package worth more than $53 million on top of the existing $120 million Forest Industry Structural Assistance Package, and 105 new jobs in National Park management. This meant that there was anticipated to be no negative employment outcome from Carr's decision. To the contrary, according to the Government and industry more jobs would be created. It was therefore hard for Carr to use socio-economic impacts as a justification for delivering such a poor reserve outcome.

In clear recognition of the failure to apply sustainable yield in north-east NSW, the Regional Forest Agreements (Anon 2000) now claim to be implementing a strategy:

> ***"Sustainable Wood Supply Strategy"*** *means the intent to manage yields of High Quality Large Sawlogs and Large Veneer Logs from the forest at a specific and constant level for twenty years under a given management strategy and suite of sustainable use objectives. It recognises that a transition to long term Sustainable Yield will be phased in to accommodate social and economic considerations;*

The strategy was to go on logging at unsustainable rates, and to supplement this by purchasing private properties with existing resources and for establishment of new plantations to attempt to increase future timber availability.

The Regional Forest Agreement for North East New South Wales (Upper North East and Lower North East Regions) (Anon2000) states:

> *Under the Sustainable Wood Supply Strategy, NSW agrees to supply 129,000m^3 per annum for 20 years in the Upper North East Region and 140,000 m^3 per annum in the Lower North East Region of High Quality Large Sawlogs and Large Veneer Logs. Annually, approximately 20,000 $m^3$of High Quality Large Sawlogs and Large Veneer Logs allocated in the Upper North East Region will be sourced from the Lower North East Region over the period of the Agreement.*
>
> *...*
>
> *... It is estimated that the 100 year supply levels after 2018 will average approximately*

> *70,000 m^3 per annum in the Upper North East Region and 113,500 m^3 per annum in the Lower North East Region of High Quality Large Sawlogs and Large Veneer Logs from existing native forests and Plantations on State forests and other land owned by SFNSW, assuming harvesting under existing terms and conditions.*
>
> *...*
>
> *Both Governments aim to provide additional sawlog and other wood products that will become available through purchase by SFNSW of private native forest property and through Plantations established on purchased land or as joint ventures. These measures are currently predicted to bring the average annual available High Quality Large Sawlog and Large Veneer Log yield from State forests beyond the 20 years of this Agreement to within approximately 15 per cent of the 20 year contracted levels for Upper North East Region and Lower North East Region.*

By the 30 June 2001 Ford Timbers owed Forests NSW $1 million, so Forests NSW retired the debt in return for 15,000 cubic metres of large quota sawlogs, which was to take effect from 1 January 2003. The Public Accounts Committee (2002) conducted an investigation which found:

> *The Committee understands that State Forests has never sold a resumed log allocation before and that* [Ford Timbers]*, as with all customers, was never required to pay an up front fee for the original allocation.*
>
> *... as* [Ford Timbers] *never paid for the original allocation, treating the subsequent reduction as a "repurchase" of that allocation is not consistent with commercial practice.*
>
> *...*
>
> *The Committee was concerned that this action by State Forests was in fact a forgiveness of debt. This is not State Forests' view as they expect to reassign the log allocation and obtain an up front payment from the purchaser of the allocation as well as continuing royalties*

In 2002 Jerry Vanclay (Southern Cross University) undertook a desktop review "Review of Projected Timber Yields for the NSW North Coast" of FRAMES "*based on an examination of documentation and on interviews with State Forests staff and other stakeholders involved in preparing the estimates ... no field visits were made and no new field data were obtained*". Vanclay (2002) presented results from Forestry NSW's 2002 North Coast Timber Supply Monitoring Estimate which he endorsed, stating that for both the UNE and LNE *"With these assumptions, it is evident that the harvest able to be sustained during the next 20 years is 220,000 m3/year at most ... In the longer term (21-100 years), production from native forests is expected to range between 175 and 110,000 m3/year, and will need to be supplemented from hardwood plantations.".* He recommended monitoring of a large range of key variables to improve the best current estimate.

2002 North Coast Timber Supply Monitoring Estimates of large high quality sawlogs compared to FRAMES 1998 (From Vanclay 2002)

Item & Source	RFA-FRAMES	NCTS Monitoring
Short-term yield (20 yrs)	269,000 m3/yr	220,000 m3/yr
Medium-term yield (21-40 yrs)	183,500 m3/yr	175,000 m3/yr
Average Long-term yield (41-100 yrs)	183,500 m3/yr	110,000 m3/yr

In 2003 the NSW Government created 42,522ha of new national park and reserves (the Icon decision) from Forests NSW's estate on the north coast, as well as gazetting some 19,000ha of oldgrowth forest as Special Management Zones (SMZ).

Despite the reduction in the area of state forest the "net harvest area", which is the basis of yield estimates, was actually increased by some 700ha according to Forests NSW's (2004) FRAMES

modelling, primarily because of the decision to remove "buffers on buffers". This was achieved by amending the IFOA to allow the accidental felling of trees into most exclusion areas and the entry of machinery into some exclusion areas to fell trees. This significantly increased the proportion of the gross area that could be harvested, theoretically compensating for the new reserves.

Timber availability at that time had also been increased by new plantations and additions to State Forests' estate from private property purchases, while commitments had been reduced by the buy-back of quota from Ford Timbers. So if resource estimates were accurate there should have been no resource problems caused by the new reserves.

Based on Vanclay's assessment, in 2003/4 the NSW Government issued new Wood Supply Agreements to north coast sawmillers for quota, small and low quality sawlogs and extended them for 5 years (until 2003) past the expiry of the NSW Forest Agreements. Most significantly the NSW Government removed the clause that allowed for a non-compensable reduction in commitment following a review of available timber resources.

Forests NSW's (2005) ESFM Plan provides the details of Wood Supply Agreements for north east NSW.

Table 9. 2004 Wood Supply Agreement Strategy. From Forests NSW ESFM Plan (2005)

Product	WSA Volume	WSA Type
High-quality large Products	215,422	A
	7,655	B
High-quality small Products	57,759	A
	31,100	B
Low Quality Sawlogs	14,897	A&B
	190,000	C
Total Volume	516,833	

Forests NSW (2005) explain:
The Type A agreements are for a fixed volume for a twenty-year period.

The Type B agreements provide 75% of the volume fixed for the first 10 years, with future volumes subject to resource assessment review in years 10 and 15 of the agreement. The remaining 25% is a share of production capped at 25% of the total agreement, also subject to review in years 10 and 15.

The Type C agreements are based on a share of production and if there is insufficient production in any year, the available volume will be distributed equitably amongst customers as a share of the total production in that year. The figure under WSA for Type C is a target volume rather than a fixed commitment.

For quota sawlogs this set a volume of 215,422m^3 per annum for 20 years, five years past the end of the LNE and UNE Forest Agreements, and resulted in firm commitments for a total supply of 4,365,852m^3, and tentative commitments for a further 95,687m^3. At the time the new WSA were made there were remaining commitments of 254,000m^3 of large quota sawlogs for 15 years, which is a total of 3,810,000m^3. These new WSAs thus resulted in an increase in committed volumes of large quota sawlogs of 555,852 to 651,539m^3 - not a bad windfall for millers, particularly as Ford Timbers' quota had been bought back for some $1million and yield reviews were showing that commitments needed to be substantially reduced.

The Government was even more generous, giving millers commitments of up to 1,777,180m^3 of high quality small sawlogs and 4,097,940 m^3 of low quality sawlogs, increasing the total volume of

sawlogs committed in WSAs by up to 271%. While such commitments of tradeable timber rights are worth a fortune to the millers, they were again given freely with no tender process.

The Auditor General (2009) comments:

> *In this new agreement, the Government waived its rights to reduce commitments without compensating industry for any loss. This removed Forests NSW's ability to better manage supply risks by adjusting commitments.*

As if Forests NSW and the timber industry had not already been given enough, the area available for logging was again significantly increased in 2004 by amendments to the Environment Protection Licence that effectively allowed logging within the buffers of most unmapped streams. This was simply achieved by excluding non-scheduled forestry activities from the requirements of the Environment Protection Licence on 17 May 2004. As a result of this change over 90% of logging operations no longer required Environmental Protection Licences. By removing the requirements for 10m buffers on unmapped streams this significantly increased the areas and volumes available for logging. It has also resulted in significantly increased environmental harm and stream pollution.

Forest Management Zone 8 areas are primarily comprised of modelled unmapped streams, with some modelled high erosion areas, that are intended to be further assessed at the Harvesting Plan stage. These represent over 100,000 hectares that were not counted as contributing to timber supply on the basis that they would be refined by field assessments and allocated to exclusion zones (ie FMZ 3A). In practice, since unmapped streams are no-longer required to be protected (except where threatened fish are present downstream), they are not further assessed and are now simply counted as being part of the general logging area.

Thus, despite actual yields being found to be significantly below predicted yields and the reduction in State Forests resultant from the 2003 Icon decision, the total volumes of timber committed to industry and the actual areas available for logging were significantly increased.

New Wood Supply Agreements were signed in 2003/4 for 215,422 m^3/year for 20 years until 2023. In issuing these new WSAs the NSW Government entrenched intentionally unsustainable logging for a further 5 years. In a grossly irresponsible act the NSW Government removed the clause from the WSAs that allowed yields to be adjusted in line with revised resource assessments.

The Government then bought back 12,194m^3 of the annual commitments given in the Wood Supply Agreements. In answers to questions in parliament the Minister for Forests identified that in 2006 2,000m^3 was purchased for $500,000 ($250 per m^3) and in 2007 10,194m^3 was purchased for $2,277,000 ($223.36 per m^3).

These purchases indicate that the Wood Supply Agreements are worth around $14 per m^3 per annum. This gives a value of over $61 million for the total 4,365,852m^3 of large high quality sawlogs committed in WSAs in 2003/4, with the remaining 11 years of commitments worth some $32 million.

In 2009 the NSW Auditor-General, Peter Achterstraat, prepared the report "Sustaining Native Forest Operations: Forests NSW". He reached the obvious conclusion that *"current yield from native forests in the north coast is not sustainable in the long term"* stating:

> *To meet wood supply commitments, the native forest managed by Forests NSW on the north coast is being cut faster than it is growing back. This is especially the case for the blackbutt species. This does not mean that the forest will not regrow but there will be a reduction in yield in the future.*

The Auditor General (2009) "*found that Forests NSW has adequate estimates of how much timber is available from native forests, now and into the future*". He also concluded that *"Forests NSW should have sufficient timber to meet its wood supply commitments which are fixed for periods up to 2023 using both native and plantation hardwood".*

The Auditor General (2009) recommended that Forests NSW *"by June 2010, publicly report the results of yield estimates for high quality large sawlogs, high quality small sawlogs, low quality logs and pulpwood for each region"*.

Forests NSW's (2010b) latest yield offering made on their website in response to the Auditor General's recommendation, is dated November 2010. There is no explanatory report other than the statement that *"The charts included in this report show estimated annual yields by broad product category in cubic metres (m3) over the next 100 years"*. Forests NSW's latest yield estimates are presented without any methodology, explanation or review (independent or otherwise) and thus are of unknown veracity. As yet no data on plantation resources has been provided. The only conclusion that can be reached from the data provided is that Forests NSW's new FRAMES is yet again predicting adequate resources.

The Auditor General (2009) recommended that *by June 2010* Forests NSW *"compare harvest results against its yield estimates over five year periods as a means of testing the accuracy of estimates".* In response to questions on notice from the General Purpose Standing Committee No.1 Budget Estimates 2009-10, Steve Whan claimed that the annual and five year (till June 2010) *"results will be published on Forests NSW website by December 2010".* They were not.

In 2012 Forests NSW (2012) finally presented a convoluted comparison of FRAMES-predicted volumes by log class with actual harvested volumes by log class for areas harvested during the period July 2005 to June 2010, that claimed actual yields of large high quality sawlogs were 101% of that predicted for the North East region and 103% of that predicted for Central region. They note:

> *... the study demonstrated that FRAMES predicted HQL volumes are very similar to the volumes of HQL actually harvested between July 2005 and June 2010, at both Analysis Group and Regional level, with the only exception being the highly variable Tableland forests in North East Region. There was no statistical difference between actual and predicted HQL volumes per hectare at Analysis Group level.*

NEFA remains sceptical about Forests NSW's resource assessments, though all the concerns we have detailed continue to be denied by Forests NSW and by Boral when we presented our concerns to them. If Forests NSW are correct, then there is no reason that they can't deliver their commitments to industry from current State Forests under current environmental prescriptions.

Public forests in north-east NSW have never been managed on a sustainable yield basis. In 1998 the Government adopted a "*Sustainable Wood Supply Strategy*" that involved intentionally overcutting for a further 20 years until 2018 before reducing logging volumes down to a sustainable level. Following a desktop yield review in 2003 the Government reduced annual commitments but increased the total volumes committed by extending unsustainable logging for another five years until 2023.

NEFA recommends that the Inquiry consider two fundamental changes in timber resource allocation from State Forests to improve its sustainability;

- **The urgent reduction in allocations of sawlogs down to the estimated long-term sustainable yield and the refocus of silviculture from liquidating the large sawlog resource to sustaining it in multi-aged forests.**
- **A reduction in yields commensurate with the additions necessary to establish a truly Comprehensive Adequate and Representative reserve system.**

3.2. Sustaining Forest Biodiversity and Productivity When Logging

Forests NSW undertake logging operations under a Threatened Species Licence (TSL) which attempts to regulate activities so as to protect State and national threatened species of terrestrial animals and plants. NEFA has attempted over many years to improve the protection provided by the TSL for native flora and fauna, with limited success. Aside from its inadequacies, the TSL is only subject to occasional audits and, in our experience, significant breaches are missed even when pointed out to EPA. Even when breaches are reported to the regulators they are not explicitly or comprehensively audited, the fines and penalties are grossly inadequate, and no rehabilitation or provision of compensatory habitat is required to compensate for illegally logged threatened species habitat.

Within State Forests, to maintain biodiversity logging is excluded by the TSL from a variety of important habitats – mapped rainforest, "high conservation value" oldgrowth forest, riparian habitat along mapped streams, wetlands, rock outcrops, and a variety of additional areas around records of threatened fauna and flora. Such areas are counted by the TSL as providing adequate protection for most threatened species. They are also counted as contributions towards the national reserve system to improve the poor achievement of reserve targets in the formal reserve system.

NEFA's limited audits have found a variety of incursion into required exclusion areas. It is concerning that so many have been revealed by such a small sample of operations. It is apparent that incursions into exclusion areas are common, and that required exclusion areas are often not being established. It is assumed that they occur so frequently because Forests NSW often get away with it and because when action is taken it is tokenistic. For example:

- Two wetlands at Yabbra that were required to be protected with 10m buffers were trashed (Pugh 2009). As they were likely habitat for the endangered Richmond's Frog a survey was required. Forests NSW were issued with two Penalty Infringement Notices (PINs) and fined $600 for "timber felling within a wetland and wetland exclusion zone" and "machinery entry within a wetland and wetland exclusion zone". They were issued a warning letter for not identifying habitat and surveying for Richmond's Frog. No rehabilitation was required.
- A 2.7ha stand of mapped rainforest at Yabbra was logged, primarily to remove flooded gum planted for rehabilitation when it was last logged, though mature rainforest trees were logged and hundreds of rainforest trees were bulldozed into piles in an apparent attempt to maximise damage to the rainforest (Pugh 2009, 2010a). Forests NSW were issued with a PIN and fined $300 for "harvesting timber within IFOA mapped rainforest". No rehabilitation was required.
- A wetland at Doubleduke that was required to be protected with 10m buffer had trees felled into it and tracks bulldozed through it (Pugh 2010c). Two years later, EPA are still refusing to take action on the grounds that they are prosecuting Forests NSW for a different breach in the same area. No rehabilitation was required.
- At Doubleduke a large population of the endangered fern, *Lindsaea incisa,* that was required to be protected with a 50m buffer, was logged and roaded (Pugh 2010c). Two years later, EPA are still refusing to take action on the grounds that they are prosecuting Forests NSW for a different breach in the same area. No rehabilitation was required.


PHOTOS: AT YABBRA SF TWO WETLANDS (REQUIRED TO BE PROTECTED BY 10 M BUFFERS) WERE TRASHED. FORESTS NSW WERE FINED $300 AND NOT REQUIRED TO DO ANY REHABILITATION.


PHOTOS: IN DOUBLEDUKE SF A WETLAND (REQUIRED TO BE PROTECTED BY A 10M BUFFER), AND AN ADJACENT POPULATION OF AN ENDANGERED FERN (REQUIRED TO BE PROTECTED BY A 5OM BUFFER), HAD TREES FELLEDINTO THEM AND LOGGING TRACKS CONSTRUCTED THROUGH THEM.

PHOTOS: AT YABBRA SF 2.7 HA OF RAINFOREST WAS HEAVILY LOGGED (PRIMAILY TARGETING EUCALYPTS PLANTED FOR REHABILITATION WHEN LAST LOGGED). HUNDREDS OF RAINFOREST TREES WERE BULLDOZED INTO PILES. FORESTS NSW WERE FINED $300 AND NOT REQUIRED TO DO ANY REHABILITATION.

An ecological community is a group of plants and animals that occur together in a particular area including trees, shrubs and understorey plants. An Endangered Ecological Community is an ecological community listed under the *Threatened Species Conservation Act 1995* as being at risk of extinction unless threats affecting these areas are managed and reduced.

Endangered Ecological Communities are excluded from Forests NSW's licence, making the undertaking of forestry operations within them a direct offence under sections 118A and 118D of the National Parks and Wildlife Act 1974 where it is an offence to pick or harm endangered ecological communities. Currently the maximum penalty is $220,000 and up to 2 years jail, with an additional $11,000 for each plant illegally logged (picked), bulldozed out of the ground, trampled or squashed (harmed).

At Doubleduke Forests NSW failed to take adequate measures to identify and protect the Endangered Ecological Community (EEC) *Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion* that was known to occur but was not mapped (Pugh 2010b). A NEFA audit initially identified 20 trees logged at one location within the EEC and a range of other breaches (Pugh 2010b). A subsequent inspection of a nearby area found a further 46 trees to have been logged and 1,387 other trees and shrubs bulldozed out of the ground, trampled by machinery, or had trees dropped on them within the EEC (Pugh 2010c). EPA commenced legal proceedings against Forests NSW for logging 120 trees in 7.5 ha of the EEC Subtropical Coastal Floodplain Forest, only to later drop the case.

Following complaints from conservationists Forests NSW were fined $3,000 for logging 0.5 ha of the Lowland Rainforest EEC in Grange SF, no rehabilitation was required. The EPA's inspections of NEFAs complaints about logging into the boundary of the Lowland Rainforest EEC at Wedding Bells SF found that the EECs had been damaged but that because the logging was so severe up to the boundary it was not possible to determine to what extent logging had intruded into the EEC, so they took no regulatory action despite their botanist identifying that *"ongoing deleterious impacts will continue to damage the EEC communities into the future"*, no rehabilitation was required.

PHOTOS: IN DOUBLEDUKE SF THE ENDANGERED ECOLOGICAL COMMUNITY COASTAL FLOODPLAIN FOREST WAS TRASHED

Stronger deterrents are required to stop Forests NSW from routinely causing environmental degradation by logging in areas required to be protected. It is recommended that Forests NSW be required to provide compensatory habitat for areas illegally logged and be required to actively rehabilitate degraded areas.

3.2.1. SUSTAINING HABITAT TREES

Within those areas available for logging a range of silvicultural methods and tree retention requirements are mandated to reduce logging impacts on a variety of the threatened species not adequately accommodated within exclusion areas. The evidence is that these are inadequate to achieve sustainable management and that their intent is being deliberately subverted.

A key requirement for ecologically sustainable management of native forests is the retention and restoration of a natural distribution of tree age classes in those areas available for logging.

A plethora of forest animals depend upon the trunk and branch hollows provided by big old trees for their survival. Approximately 20% of the Australian bird fauna, 75% of arboreal marsupial fauna and an undetermined proportion of the bat, reptile and invertebrate fauna are dependent on the hollows provided by old trees for roosts, nests and shelter. The loss of the hollows provided by large old trees has been identified as a primary threat to a variety of priority species in north east NSW (Environment Australia 1999); 4 mammals (non-flying), 20 bats, 3 birds, 2 frogs, 3 reptiles and 4 snakes. Numerous other species have been identified as threatened by the loss of other resources

(i.e. seeds, nectar, nest sites) provided in greater abundance by older trees and many by the increased transpiration of young trees and consequent reduction in water availability (Environment Australia 1999).

Oldgrowth trees are the primary storehouses of carbon, provide essential hollows for animals to nest and den in, provide the most abundant nectar and seed, and are of the highest aesthetic appeal. These values appreciate with age. Oldgrowth forests are those with a high proportion of relatively old trees.

It is important to recognise the outstanding contribution of big old trees to storage of carbon in forests. For example Roxburgh *et.al.* (2006) found:

> *In mature forests, large diameter trees greater than 100 cm d.b.h. comprised 18% of all trees greater than 20 cm d.b.h. and contained 54% of the total above-ground carbon in living vegetation. ... The influence of large trees on carbon stock therefore increases with their increasing size and abundance.*

The NSW Scientific Committee has identified *Loss of Hollow-bearing Trees* as a Key Threatening Process. The highest priority action for this KTP is "*Adopt appropriate policies for recruitment tree ratios with a stipulated minimum retention density in areas of forestry operations"*.

Hollow-bearing trees, and with them hollow-dependent species, have already been decimated within vast tracts of forests. The problems such fauna are facing is expected to exponentially worsen as the few remaining large old hollow-bearing trees (in both forests and pastoral lands) die-out without replacement trees being available. The full ramifications of irreversible changes already set in place will take a century or more to become fully manifest.

Generally speaking, small hollows begin to develop once a eucalypt is over 100 years old, and the large hollows required by many species after a tree is over 200 years old. Depending on the species and site conditions trees may live for 300 to over a thousand years, providing their lives are not cut short. For blackbutt forests Mackowski (1987) found (p118) that only hollows in trees greater than 100 cm. dbhob (144 years old) were utilised by wildlife and that larger species *"such as ducks, cockatoos and owls ... are probably restricted to nesting in blackbutt > 140 cm dbhob as larger hollows mainly occurred in these trees.",* (p115) *"... these hollows were not suitable for large hollow dependant wildlife unless the blackbutt was > 224 y.o."* and (p119) *"Arboreal marsupials the size of yellow-bellied glider and larger appear to require hollows > 100 cm^2 entrance size, these hollows only occur in blackbutt > 100 cm dbhob and are most abundant in blackbutt > 140 cm dbhob".* Mackowski found that the large hollow bearing trees would only persist for 80 ors so years, necessitating replacement large hollowing-bearing trees to become available.

On public lands trees over 140 years old generally predate the commencement of logging (except for Red Cedar and possibly some select individual trees) and thus are remnants of the original forest. As well as being important for sustaining populations of hollow-dependent fauna, such trees are part of our natural heritage and the relatively few that remain should be retained.

> **NEFA recommends the Inquiry improve the sustainability of logging operations by recommending the retention and protection of all large old trees (>140 years old) for their biodiversity and heritage values.**

In order to provide for hollows through time it is necessary to protect those trees with existing large hollows, as well as sufficient trees in the next age class to replace them when they die, and trees in

the next age class to replace the replacements. Successional planning is an essential requirement of ecologically sustainable forest management, particularly as most logged forests have a deficit of large hollow-bearing trees and the next age class required to replace the few that are left as they die out.

It has long been recognised that to mitigate the impact of logging operations upon some hollow-dependent fauna it is necessary to manage for provision of habitat trees in perpetuity (i.e. Saunders 1979, Recher, Rohan-Jones and Smith 1980, Mackowski 1984, 1987).

The need for retention of hollow-bearing trees in perpetuity is the intent of the requirement of the Threatened Species Licence to retain a minimum of 10 large old hollow-bearing trees (where extant) per 2 hectares and the retention of a "mature to late mature" recruitment tree for each hollow-bearing tree. In the hinterland forests the intent is to restore such habitat trees where they are no longer available, though in the coastal forests the requirement is only to retain any surviving hollow-bearing trees, it is a prescription for elimination. While the requirement is clearly for retention within each 2 hectares, the EPA also allow this to be averaged across the logging area so that all retention requirements can be met in one part of the area.

While the aim of this prescription is to retain large hollow-bearing trees in perpetuity, in the absence of an intent to manage native forests so as to retain the range of size classes it can not achieve this aim.

Retained trees are more vulnerable to windthrow and post-logging burning (Saunders 1979, Recher, Rohan-Jones and Smith 1980, Mackowski 1987, Smith and Lindenmayer 1988, Milledge, Palmer and Nelson 1991, Smith 1991a). In many areas trees marked for retention as habitat trees have been found to include dead trees and trees burnt out at the base and unlikely to remain standing for long. Logging debris are often left stacked against the bases of trees which will help ensure their rapid demise.

Trees retained as potential recruits for habitat trees will also suffer premature mortality. In natural forest there is a self thinning process that results in significant mortality (Mackowski 1987). Though there is also a high likelihood of mortality due to other factors. As noted by Mackowski (1987 p124) *"the frequent occurrence of fire in this site height blackbutt forest precludes a 100% chance of survival - a proportion will be damaged, or weakened, or burnt down by each fire. These trees are also subject to the risk of lightning and windstorm damage."*

To comply with habitat tree retention prescriptions and the requirement to maintain habitat trees in perpetuity there is a necessity to detail prescriptions for potential replacement trees to be retained sufficient to maintain the prescribed number of habitat trees over long time frames (Recher, Rohan-Jones and Smith 1980, Mackowski 1984, 1987, Recher 1991, Scotts 1991, Traill 1991).

TABLE 4.5. COASTAL BLACKBUTT RETENTION RATES REQUIRED TO MAINTAIN 10 HABITAT TREES PER TWO HECTARES IN PERPETUITY. The assumption is made that there will be 50% mortality of recruitment trees every 80 years. Adapted from Mackowski 1987.

Diameter (dbhob) cm.	Age yrs	Time-span in size class yrs	Mackowski's requirements for 3 Habitat Trees per Hectare over 100cm	Requirements to retain 10 Hollow-bearing Trees per Two Hectares
20-60	16-68	52	11.5	38.3
60-100	68-144	76	4	13.3
100-140[A]	144-224	80	2	6.6
140-180[B]	224-304	80	1	3.3

A - stage at which hollows suitable for small wildlife form.
B - stage at which hollows suitable for large wildlife form.

Mackowski (1984) considered *"The general pattern of hollow formation in many gum type eucalypts, ironbarks, bloodwoods and stringybarks is similar to that described for Blackbutt. Tallowwood and Brushbox have similar crown architecture characteristics to Blackbutt but have substantially different suites of organisms involved in the succession towards hollows, leading probably to much older age at hollow formation."*

Many forests have been denuded of habitat trees. To enhance such forests for nature conservation and maintenance of ecosystem functioning they need to be managed for the return of adequate stockings of habitat trees (Mackowski 1987). Mackowski (1987 p134) states *"where adequate hollow trees have not been retained in the past, a greater proportion of larger recruits should be selected (rather than evenly distributed between 60 & 100 cm dbhob) to facilitate the early return of hollow trees and the immigration of hollow dependant wildlife if it occurs nearby."*

It needs to be recognised that the retention of 10 hollow-bearing trees per 2 ha is inadequate to maintain biodiversity, as noted by Smith (2000);

> *Current prescriptions require the maintenance of at least 5 habitat trees per hectare. This is less than 30% of the average stocking of habitat trees in unlogged native forest. Loss of habitat trees is the single greatest cause of biodiversity reduction in logged forests. If all habitat trees in unlogged native forest were fully utilized a 70% reduction in abundance of hollow dependent fauna could be expected in logged forest under current standards. … This finding suggests that current standards for habitat tree retention are inadequate to maintain the natural diversity of hollow dependent fauna in logged forests. However, retention of higher densities of habitat trees is likely to significantly reduce timber yields.*

Under the TSL retained hollow-bearing trees must be selected from the trees with the largest dbhob and must be live trees and should have good crown development and minimal butt damage (TSL 5.6 a, c). Recruitment trees are required to be mature to late mature growth stages, to have good crown development and minimal butt damage, and also to not be “suppressed” (TSL 5.6 b, d). Suppression occurs when trees are out competed by adjoining trees and become consequently stunted and deformed, which can persist after the competing trees are removed.

Retained trees must be scattered throughout the logging area. The TSL (5.6 g) requires damage to retained trees to be minimised and that *“logging debris must not, to the greatest extent practicable, be allowed to accumulate within five metres of a retained hollow bearing tree”* or recruitment tree. Retained trees are also required to be marked for retention prior to logging.

PHOTOS :TREE RETAINED AS A HOLLOW-BEARING TREE IN A WILDLIFE CORRIDOR IN AN INFORMAL RESERVE (FMZ3B) IN GIRARD SF. ASIDE FROM BEING HALF DEAD THE TREE HAD NO HOLLOWS AND IS NOW INCAPABLE OF FORMING THEM. HEALTHY HOLLOW BEARING TREES WERE LOGGED NEARBY,


PHOTOS: DESPITE THERE BEING A PLETHORA OF LARGE HOLLOW-BEARING TREES TO CHOOSE FROM IN STYX RIVER SF, FORESTS NSW INTENTIONALLY CHOSE MANY SEVELY DAMAGED TREES UNLIKELY TO SURVIVE LONG AND OTHERS TOO SMALL TO HAVE HOLLOWS.


PHOTOS: TREES REQUIRED TO BE RETAINED AS RECRUITMENT HOLLOW-BEARING TREES ARE OFTEN TOO SMALL OR DAMAGED TO BE ABLE TO REPLACE THE OLD TREES AS THEY DIE OUT, AS IN STYX RIVER SF.

PHOTO: AT YABBRA SF THE RECRUITMENT TREES WERE OFTEN SMALL SUPRESSED TREES INCAPABLE OF FUTURE GROWTH, WHILE THE RETAINED HOLLOW-BEARING TREES WERE SEVERELY DAMAGED AND UNLIKELY TO SURVIVE LONG. THIS IS DELIBERATE TOKENISM.


PHOTOS: HOLLOW-BEARING AND RECRUITMENT TREES, LIKE THESE IN GIRARD SF, OFTEN HAVE DEBRIS LEFT STACKED AROUND THEIR BASES TO ACT A FUNERAL PYRES. DEBRIS IS REQUIRED TO BE REMOVED FROM WITHIN 5 METRES THOUGH EPA RARELY ACT ON FREQUENT COMPLAINTS.


PHOTOS: HOLLOW-BEARING TREES ARE OFTEN BURNT OUT IN POST-LOGGING BURNS, AS IN YABBRA SF, WHICH OFTEN APPEARS TO BE THE INTENT.

In our first audit of Doubleduke (Pugh 2010b) we found logging underway in Compartment 146 without hollow-bearing and recruitment trees being marked. We complained at the time. When we returned after logging had finished we found that the hollow-bearing trees that had survived had subsequently been marked. Though it appeared to us that retention requirements had not been met.

At another area in Doubleduke (Pugh 2010b) where tree retention appeared deficient, a large senescent hollow-bearing tree had been felled while nearby damaged late-mature trees without significant hollows had been marked as hollow-bearing trees for retention.

In a third area in Doubleduke (Pugh 2010c) it was found that an average of 1.9 hollow-bearing trees, and 1.3 recruitment trees, per hectare had been marked for retention. A measurement of all trees and stumps in a subset of this area found that sufficient trees had been retained to meet retention requirements, though 3 of the 7 largest trees had been logged. In this area it appeared that someone had walked along a track and the boundary of the nett harvesting area marking habitat trees in an ad-hoc manner as they went, without venturing far into the logging area.

In one area at Girard (Pugh 2010d) trees and stumps were measured to quantify tree retention standards. In that area the density of Greater Gliders exceeded 1 per hectare so the TSL owl prescription (6.9d) required the retention of 8 hollow-bearing trees per hectare and the general recruitment tree prescription required the retention of 10 mature/late mature recruitment trees per 2 hectares. It was found that while there were originally 7.8 large old (late mature/senescent) trees per hectare they only retained 4.8 per hectare, and of the next size class (mature/late mature) there were originally 19 per hectare but only 3.9 per hectare were retained. Insufficient trees were retained to satisfy TSL licence requirements. It is important to recognise that the area measured was oldgrowth forest within a special prescription zone, with tree retention generally appearing significantly lower elsewhere in the compartment.

In another area at Girard (Pugh 2010d) only three hollow-bearing trees and two recruitment trees were marked for retention in a 3.7 ha area, giving a retention rate of one hollow-bearing tree per 1.2ha and one recruitment tree per 1.4ha. In this case there were additional trees available for marking though these were not quantified. It appeared that, even with the inclusion of the unmarked trees, that retention was still deficient. It appeared that someone had walked along the track only marking easily accessible hollow-bearing and recruitment trees in the vicinity of the track. Near the end of the track a “clump” of trees had been marked in an attempt to improve counts.

In Royal Camp State Forest (Pugh 2012e) the requirement was to retain 10 hollow-bearing and 10 recruitments trees per 2 ha. In one 5 hectare area only one tree was marked for retention. In a 2.3ha sample to assess tree retention from a randomly chosen multi-aged part of the stand, only 4 out of the 11 required hollow-bearing trees were marked and retained and only 5 out of the 11 required recruitment trees were marked and retained, none of the 11 required were marked as eucalypt feed or Koala feed trees. Of the total of 16 trees removed that were over 40 cm dbhob and thus likely to have been mature, late-mature or senescent, at least 11 should have been retained as hollow-bearing or recruitment trees and should not have been logged.

Contrary to licence requirements retained hollow-bearing trees often have butt damage. Trees retained as recruitment trees are commonly too young and too suppressed to satisfy licence requirements. At both Yabbra and Doubleduke (Pugh 2009, Pugh 2010b) it was found that marked recruitment trees were often suppressed regrowth trees with poor crown development . At one site

at Girard (Pugh 2010d) 2 hollow-bearing trees and 7 recruitment trees were classed as suppressed, and one recruitment tree had 60% of its butt severely damaged. At the other site 1 hollow-bearing tree and 1 recruitment tree had significant butt damage.

In Royal Camp State Forest (Pugh 2012e) it was found that hollow-bearing trees were being marked as recruitment trees to significantly reduce tree retention, particularly of mature and late-mature trees needed as future hollow-bearing trees.

At both Yabbra and Doublebuke (Pugh 2009, Pugh 2010b) it was found that retained trees often had large amounts of debris felled and pushed around their bases. At one site at Girard (Pugh 2010d) 8 of 13 hollow-bearing trees and 7 of 10 recruitment trees had significant amounts of debris dropped or pushed around their bases. At the other site all five marked trees had significant amounts of debris left around their bases.

There is a war of attrition against hollow-bearing trees being waged. Their numbers are being depleted by continued logging, the required replacements are not being retained and funeral pyres are regularly being constructed around them in apparent attempts to burn them to the ground. We consider that the damage being caused to hollow-bearing and recruitment trees is contrary to the basic precepts of sustainable logging.

Most tree retention prescriptions are set “per 2 hectares” which both EPA and Forests NSW take to mean that this is the average density needed to be retained across a whole compartment. Tree retention can be assessed by randomly chosen representative samples, though the EPA have so far refused to do so. They prefer to claim that it can’t be assessed without auditing a whole compartment. The original intent was that Forests NSW should retain the required number of habitat trees within every two hectares, where available. Unless a more systematic approach involving recording a GPS location for every retained tree is adopted, the wording of prescriptions need to be changed from “per” to “in every” 2 hectares to make prescriptions readily implementable and auditable.

There are a variety of other tree retention requirements including

- 6 mature and late mature eucalypt feed trees for nectivorous species in every two hectares of the net logging area where they occur (increased to ten eucalypt feed trees near records of the most vulnerable nectivores);
- 10 primary Koala browse trees per 2 hectares of any size in identified “intermediate habitat”;
- 15 mature and late mature feed trees within 100 metres of a Yellow-bellied Glider sap feed tree, observation or den site record, or within 200m of a call detection record;
- Yellow-bellied and Squirrel Glider sap feed trees;
- roosts, dens and nests of various bats, owls and gliders (if found);
- all hollow-bearing trees and stags within 100m of Pale-headed Snake; and,
- ten stags (dead trees) per 2 ha where they occur and are not considered dangerous.

The evidence from our audits is that such trees are rarely identified or protected, except where they happen to also qualify as a hollow-bearing or recruitment tree. Their protection would be better served by retention of all large old trees and maintenance of trees through a range of size classes across the forest.

The inquiry needs to recognise that the maintenance of large old hollow-bearing trees in perpetuity is the single most important requirement for ecologically sustainable forestry. Despite retention requirements being specified for the retention of hollow-bearing trees, and recruitments to grow into the hollow-bearing

trees to replace them when they die, the achievement of requirements are often grossly inadequate and there appears to be a war of attrition being waged against hollow-bearing trees. For ecological sustainability the exemption applied to the coastal forests from having to maintain the next largest trees where there are less than 10 hollow-bearing trees per 2 hectares needs to be removed. The aim should be to retain or restore hollow-bearing trees throughout public forests.

The intent of current tree retention prescriptions would be better met by specifically limiting Single Tree Selection basal area, hollow-bearing tree, recruitment tree and feed tree retention requirements to "each two hectares of the nett logging area" as intended.

3.2.2. SUSTAINABLE SILVICULTURE

Forests are naturally multi-aged, in general they are composed of individuals or cohorts from a range of age classes resulting from past disturbances. These regeneration cohorts can result from past disturbances, such as wildfires, and go through a self-thinning process as they age. Forests are thus naturally multi-aged.

Mackowski (1987) and Smith (1999) provide evidence that in natural forests there is a natural mortality rate in the order of 50% of trees between each age class, with mortality rates increasing with age and increasing due to declining site quality. This means that in a natural forest, in order to retain one tree in an age class, there is a need to retain at least twice as many trees in the next youngest age class. Mackowski's (1987) assessment was that Blackbutt forests had a 50% mortality between 80 year age classes.

Smith (1999) identified the averaged structure of natural native forests according to tree size class and site productivity in eastern NSW (Table 4.1).

Table 4.1: Smith (1999) Number of stems (all species) per hectare and stand basal area (square metres per hectare) in increasing diameter classes in unlogged or "old-logged" forests.

Productivity Class	20-39 cm dbh	40-59 cm dbh	60-79cm dbh	80-99 cm dbh	>100 cm dbh	Stand Basal Area
1 low	69	24	10.8	2.5	-	18
2 low-mod	80	50	16.7	6	1.3	26
3 mod-high	87	57.4	31.6	11.5	5	43
4 high	64	44.7	14.3	7.6	11.9	47

1. Shading depicts where significant numbers of hollows with an entrance >10 cm diameter and estimated depth >25 cm were recorded.
2. Size classes are based upon diameter at breast height (dbh).

These generalised stand descriptions are indicative and do vary, particularly in the tall wet forests with rainforest understories where major disturbances are rare events. For example data for high productivity oldgrowth on the Richmond Range (Table 2) show a similar distribution of stockings by

age classes, though with more individuals in the 60-99 cm size classes and correspondingly less in the 40-59 cm size class.

Table 4.2. Stocking of diameter classes in predominately oldgrowth forest in the Duck Creek area on the Richmond Range (from State Forests' Urbenville EIS)

Productivity Class	40-59	60-79	80-99	>100
4 high	26.8	18	19.2	12

The problem is that the structure of NSWs public forests has been severely degraded by logging targeting the older age classes for removal, failure to retain trees with good growth potential through the range of tree sizes, and an obsession with clearfelling so as to create pseudo-plantations (a consequence of "pinus-envy"). This gross mismanagement has severely degraded the forests environmental services and productive potential. As noted by Smith (2000):

> *"Over–cutting without silviculture has run down both wood and non-wood values leaving forests dominated by small diameter low value wood products most suitable for woodchip and low quality sawlog. Growth rates are disappointing and there is little or no silvicultural experience to draw from the last 25 years of public forest management (J. Brandis pers. comm., R.L. Newman and Partners 1996).*
>
> *"The history of NSW public forest logging has been one of increasing harvesting intensity, decreasing harvesting intervals, declining stand volumes and declining yields. Many remaining forests are considered less than optimal for wood production…"*

In general, the coastal forests have been most severely impacted by the intention to convert them into even aged regrowth, removal of large hollow-bearing trees in Timber Stand Improvement programs, and "thinning from above" removing the most vigorous trees and leaving suppressed trees with poor form and growth potential behind. This has been exasperated in recent years by limiting the retention of hollow-bearing trees, and recruits, to however many are left (when less than 10 per 2ha) rather than the requirement in the escarpment forests to restore a stocking of 10 hollow-bearing trees per 2 hectares by retaining the largest remaining trees where there are insufficient hollow-bearing trees. The coastal forests are also now often subject to 70-80% basal area removal under a perverted application of Single Tree Selection silviculture where basal area removal is meant to limited to less than 40%.

The industry has itself been a major driver for the degradation of public forests due to their preference to maximise profits in the short-term. The NSW Public Accounts Committee (PAC 1990) recognised this, stating:

> *"In the long-term, sustainable harvesting is in the industry's best interest, but in the short-term many mills would prefer to process tomorrow's timber today, gaining tomorrow's profit today, then relocate once the resource is too degraded to be useful. Under these circumstances, it would be naive not to recognize that short-term economics is in direct conflict with regulation and the principle of sustained yield."*

For example, Forests NSW made the deliberate decision to log the Walcha and Styx Management Areas unsustainably in the 1960s on the basis "*that management of the hardwood forests on a sustained yield basis would not be economically practicable*". With repeated decisions thereafter to cut far in excess of sustainable yield estimates. In 1991, in response to the Resource Assessment Commission inquiry emphasis on sustainable yield, the quota sawmiller wrote to State Forests reminding them that in 1984 they had agreed "*the full quota in that area would be available until*

pine saw logs were made available, or when the forest was completely cut". He stressed that there was never a plan to adopt sustained yield and asked for an assurance that quotas would not be reduced. (Pugh and Flint 1999).

The Government and industry reached agreement in 1998 to extend the intentional unsustainable sawlog allocations across the whole public forest estate in north-east NSW. The consequences are massive over-logging of public forests and massive degradation of their future ability to provide large sawlogs. This intent is reflected in Forests NSW's '*Native Forest Silviculture Manual'* and its aim of liquidating the large sawlog resource to meet contractual agreements entered into as an outcome of the Regional Forest Agreements: "*… the agreements aim to optimise timber production from existing trees in native forests over a twenty year period …Commercial maturity of trees and stands will be assessed in terms of their capacity to produce realisable quota sawlog volume within the planning period."*

There is nothing sustainable about the intentional over-logging of public forests in north-east NSW. Allocations of sawlogs need to be urgently reduced down to a level that is sustainable as a priority.

The sustainable use of those public forests outside the reserve system that are identified as appropriate for timber production requires a whole new management model. The management model has to be predicated on the maintenance and restoration of an uneven-aged structure throughout native forests used for timber production.

Attiwill *et. al.* (1996) recommended:

> *"Promotion of the north-east forests as a region for production of high value-added specialty hardwood products (poles, beams, floorboards, kiln dried furniture timber, and timbers of large size and strength) and biodiversity conservation, by management under low cost, low intensity (less than 35% canopy removal) selection logging techniques and discouragement of management for low-value products including scantling (housing frame), woodchips, and wood fibre."*

Smith (2000) goes to great lengths to outline the requirements for a sustainable silvicultural system. He considers that maintenance of uneven-aged forest structure with regrowth, mature and senescent elements is the best way to optimize both wood production and non-wood production objectives simultaneously. He notes:

> *"By maintaining an uneven-aged structure it is possible to sustain wood production and biodiversity values concurrently in the one stand. Biodiversity values are optimized with a higher proportion of senescent stems while wood production is optimized with a higher proportion of mature stems. A balance between biodiversity and wood production objectives is achieved by retaining a small percentage of senescent stems and selecting a minimum stocking of mature stems of high quality to grow into large stems (>70cm) in the late mature stage. Maintenance of uneven-aged structure in combination with low intensity (partial) logging enables most forest fauna species to persist within logged forests (Dunning and Smith 1986, Kavanagh and Webb 1998).*

Florence (1996) notes:

> *"Certainly, the uneven-aged forest offers the best scope for taking into account within the one stand, a range of management objectives. …A greater emphasis on the environmental factor would characterise a more intensive approach to selection practice. Such an approach would require a good ecological appreciation of species patterns and biological process in the forest, seek to achieve near-full production on all sites, and maintain diversity in the composition and structure of the forest.*

> *"There will be those who will argue that the concept of intensive selection silviculture in this way is too divorced from the present reality, the priorities of the State, financial constraints, and the availability of experienced field foresters. Nevertheless, thinking on the future of the forests should not be constrained by immediate demands on the forest and current management philosophies. State policies, management objectives and priorities may change as the forests become an increasingly valuable environmental resource, generating a professional responsibility to keep them in near peak silvicultural condition. Moreover, the forests are rich in species providing fine timbers offering combinations of strength, durability and attractiveness. If there are, as expected, higher value markets for them in the future, both domestic and export, the case for more intensive forms of uneven-aged forest management will become stronger."*

Butcher (1994) also recognised the need for maintenance of forest structure as a measure of sustainability:

> *"ESD (1991) supports these needs in stating that* '…to ensure that there is a constant supply of the largest-sized trees required … it is necessary to develop a desired age or size class structure.' (p.38) and 'Monitoring of the forest, and particularly comparison of actual forest structure with predicted structure, is an essential part of sustainable yield management.' *(p.39).*
>
> *"Sustainable yield is therefore more critically related to sustaining a forest structure capable of supplying logs and other values than to the actual continuity of production flows. For example it is critical to continue to grow trees into the mature size classes if large diameter logs or trees with hollows are required, hence there need to be age classes continually contributing to provide the necessary perpetuation. This is most critical for those age/size classes which are hardest to replace, the large mature/senescent forest, or the climax community in a successional forest. Therefore to provide future communities with options forests at the regional level must still contain an appropriate proportion of these components."*

Smith (2000) establishes a baseline using data from unlogged or lightly logged stands (see Table 4.1), and then identifies retention rates that "*closely mimic patterns of natural disturbance",* according to percentages of regrowth, mature and hollow bearing size classes. Smith (1999) recommended minimum stocking levels for each size class at the following levels:

- *40% of the unlogged average stocking for mature (merchantable) size classes;*
- *50% of the average unlogged basal area for senescent tree size classes most likely to contain tree hollows or a minimum of five trees in the two median habitat tree size classes;*
- *70% (dry forest) to 100% (wet forest) of the unlogged stocking of small diameter stems.*

His retention rates are based upon size classes of trees and basal areas, varied according to four broad productivity classes. This methodology is aimed at managing forests primarily for the highest value large sawlogs.

Smith's retention rates are similar but lower than Curtin's idealised stocking for Blackbutt forest (Florence 1996), and as noted by Florence (2001, pers. comm.) "*is more or less consistent with the optimum stocking for a mixed species blackbutt forest as described by M.R. Jacobs in Growth Habits of the Eucalypts')".* It is worth noting that Blackbutt is generally considered an "intolerant" species and thus requires less overstorey for successful regeneration than "tolerant" species.

Table 4.3. Smith's (2000) proposed minimum retention rates (stems per hectare) are:

Productivity Class	Min Stocking 20-39 cm	Min Stocking 40-59 cm	Min Stocking 60-79cm	Min Stocking 80-99 cm	Min Stocking >100 cm	Minimum Basal Area
1	50	12.5	4	2		11
2	60	25	5	2.5	1	16
3	80	30	8	3	2.5	23
4	60	35	10	4	4	28

Smith (2000) also requires that canopy gaps do not exceed 25m diameter.

Table 4.4. Curtin's idealised stocking for Blackbutt forest (from Florence 1996).

Productivity Class	Min Stocking 20-39 cm	Min Stocking 40-59 cm	Min Stocking 60-79 cm	Min stocking 80-99 cm	Min Stocking >100 cm	Minimum Basal Area
3?	67	31	14	7	-	22

It needs to be recognised that unlike the situation where Curtin and Jacobs were developing their retention rates, there are now requirements to incorporate other values into forest management. It is apparent that from a purely timber production standpoint that Smith's retention rates are close to optimum. There is a concern that from a wildlife standpoint they are already sub-optimal, though they have the advantage of providing a retained framework for forests which is essential to support those trees needed to be retained for fauna in perpetuity.

Establishing minimum retention standards for each size class encourages the return of multi-aged stands over time. For example, in a stand dominated by 20-39 cm trees the land manager can remove a large number of these for timber, while still retaining some to grow into the next size class. Once they have grown sufficiently, they can again remove most of these while still being required to retain some to grow into the next size class, and so on. The end result is enhanced biodiversity values while still allowing for timber production.

In his advice to the Richmond Regional Vegetation Management Committee, Florence (2001) states:

Any regulatory process for uneven-aged forest must express silvicultural objectives, for example

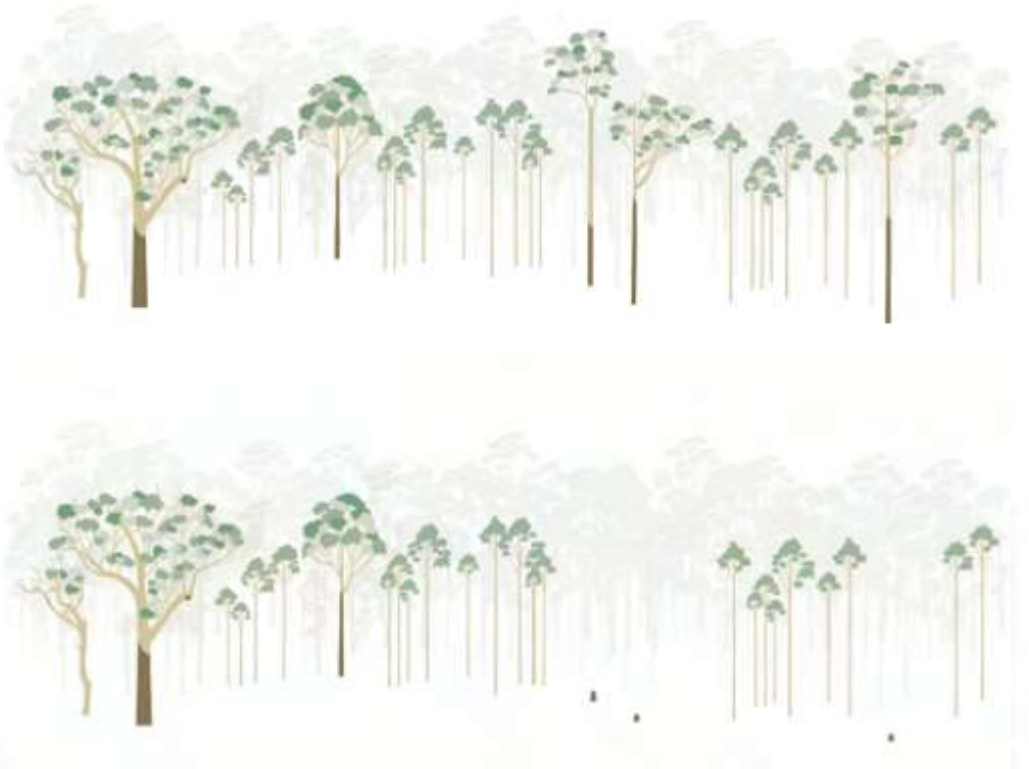
1) *to maintain a structurally diverse forest with trees through a range of size classes, including those trees needed to meet standards set for wildlife habitat, food and recruitment trees; and*
2) *to progressively improve the productive condition of the forest (consistent with ESFM principles) by*
    i) *retaining trees with good growth potential through the range of tree sizes and*
    ii) *ensuring regeneration is able to develop through the growth stages to maturity by creating canopy openings of an appropriate size.*

Currently public forestry is regulated by the Integrated Forestry Operations Approval. It authorises two silvicultural methods that can be applied in north-east NSW's forests:

- Single Tree Selection is meant to be the light impact method where no more than 40% of the basal area is harvested in any one operation.
- Australian Group Selection is the intensive method that allows for up to 22.5% of a logging area to be patch clearfelled on 4 occasions at 7 year intervals. Patches are not allowed to be bigger than 50x50m.

Single Tree Selection is the most widely used silvicultural prescription, though it is now often used to undertake the heaviest logging where 80% of the basal area is removed over large swathes of forest. Forests NSW use a loophole that allows for the 40% to be averaged across the harvest area to compensate for the heavier logging by excluding logging from a part of the area and claiming the average removal is only 40%. They then return to log the excluded area. While STS was based upon 15 years between logging events they often return a few months or years later. Despite this being a blatant rorting of the intent of Single Tree Selection the EPA refuse to do anything about it because the letter of the law does not preclude it.

New South Wales Single Tree Selection (STS)



EXTRACT FROM FORESTS NSW NATIVE SILVICULTURE MANUAL

PHOTOS: SINGLE TREE SELECTION SILVICULTURE AS PRACTICED IN YABBRA SF, IN HABITAT OF KOALA, YELLOW-BELLIED GLIDER AND ENDANGERED BLACK-STRIPED WALLABY. BASAL AREA REMOVAL WAS EXPECTED TO BE 35%, THOUGH WAS EXPECTED TO "EXCEED 40% IN SOME LOCALISED AREAS".

PHOTOS: SINGLE TREE SELECTION AS PRACTICED IN WEDDING BELLS SF

Despite the aims of silvicultural prescriptions being the maintenance of multi-aged forests, Forests NSW are rorting the intent by practicing virtual clearfelling of large tracts of forests to convert them into single-aged regrowth monocultures. This is contrary to the intent of the legal requirements and the basic precepts of ecologically sustainable forestry.

NEFA recommends that the Inquiry consider improving the sustainability of logging by recommending the adoption of a prime silvicultural objective for state forests: to maintain or restore structurally diverse forests with trees through a natural range of size classes and species, including those trees needed to meet standards set for wildlife habitat, food and recruitment trees.

3.2.3. MITIGATING EROSION OF BIODIVERSITY

The Environmental Protection Authority (nee DECCW, nee OEH) are principally responsible for ensuring Forests NSWs compliance with the Threatened Species Licence (TSL). In the initial 3 years after the RFA DECCW undertook a number of audits of forestry operations in the Upper North East CRA region, but over the 7 years 2002/2009 they undertook only 16 audits in response to 20 complaints of breaches of the TSL. It was not until 2007/2008 that 2 Penalty Infringement Notices were issued in response to a serious complaint. The EPA, in all their incarnations, appear unable to find breaches and unwilling to require compliance. They are reluctant regulators.

Since late 2009 NEFA have undertaken preliminary audits of four areas of public forests in an effort to force compliance with the IFOA. We have written audit reports and submitted them to the responsible Ministers and appropriate authorities (Pugh 2009, 2010a, 2010b, c, 2010d and 2012e). In response to complaints we have arranged expert inspections of two other forest operations (Pugh 2011b, Pugh 2012a,b,c,d).

NEFA's first systematic audit, since the RFA, was undertaken in parts of two compartments in Yabbra State Forest over a single weekend (Pugh 2009) and identified breaches of over 50 statutory licence conditions. In response the Department of Environment, Climate Change and Water and Fisheries NSW undertook a brief site inspection with Forests NSW, lasting less than half a day, and did not check all the breaches NEFA had provided GPS coordinates for.

Because of NEFA's public stance the Department of Environment, Climate Change and Water (DECCW) were forced to issue Forests NSW with four Penalty Infringement Notices and a warning letter in relation to breaches of their Threatened Species Licence, and Fisheries NSW were forced to issue 2 PINs and a warning letter for breaches of the Fisheries Licence. Breaches of the Environmental Pollution Licence were ignored because the licence was not "switched on".

NEFA had identified more serious breaches of the Threatened Species Licence in a single weekend than DECCW's full-time auditors had in 10 years. Despite the serious environmental harm caused by the breaches most went unremarked, a few warranted warning letters and the worst attracted token fines with no requirements for environmental remediation. Pursuant to our complaints for Yabbra SF (Pugh 2009, Pugh 2010a) the following action against Forests NSW eventuated:

1 DECCW issued a Penalty Infringement Notice (PIN) and a $300 fine for "harvesting timber within IFOA mapped rainforest", this was for illegally logging dozens of trees within 2.7ha of rainforest and causing massive damage by pushing over and piling up over 100 rainforest trees.
2 DECCW issued a Penalty Infringement Notice (PIN) and a $300 fine for "the failure to mark Yellow-bellied Glider sap feed trees and feed trees", we detailed 11 extant sap feed trees and estimate there were more than 50 such trees, many of which would have been logged.

In addition to retaining sap-feed trees Forests NSW were required to identify, mark and retain 15 "feed trees" within various distances of sap-feed trees and 34 mapped Yellow-bellied Glider records, which equates to hundreds of trees, none of which were marked, and many of which are likely to have been logged.

3 DECCW issued a Penalty Infringement Notice (PIN) and a $300 fine for "timber felling within a wetland and wetland exclusion zone", Fisheries NSW issued a warning letter for these same offences, this was for logging over a dozen trees within what were meant to be 10m exclusion zones around two small wetlands. They also failed to mark their boundaries, conduct searches for the frog Philoria within them, exclude post logging burning from them, and excluded cattle from them.

4 DECCW issued a Penalty Infringement Notice (PIN) and a $300 fine for "machinery entry within a wetland and wetland exclusion zone", this was for the two wetlands above, where machinery drove through the wetlands at a number of locations, causing extensive damage.

5 DECCW also issued a formal warning to Forests NSW for not identifying habitat and surveying for Richmond's Frog, and inadequate mark-up of exclusion zones and retained habitat trees.

6 Fisheries NSW issued a Penalty Infringement Notice and $500 fine, for failing to mark exclusion boundaries on unmapped drainage lines, we identified 5 unmapped drainage lines which had not been identified in the field or on harvest plans in contravention of the ESFM Plan, EPL and FL and expected there to be dozens more.

7 Fisheries NSW issued a Penalty Infringement Notice and $500 fine for logging, bulldozing and burning within 10m of these unmapped streams. We documented 22 trees to have been illegally removed from these stream banks and suspect that there were over a hundred such trees logged, as well there were a variety of snig tracks constructed within these buffers and across the streams which were not rehabilitated.

As a result of our complaints Forests NSW also repaired drainage on four stream crossings and one track because they were not up to pollution control requirements.

So, for illegally logging 3ha of rainforest, 2 wetlands, numerous stream banks, and potentially hundreds of feed trees of the Yellow-bellied Glider, Forests NSW were fined a total of $2,200. In addition to this Forests NSW were given token reprimands for a variety of other offences, excused many other breaches on the basis that they did not have an Environmental Protection Licence, and excused others on the basis that their controlled burn got out of control. This is an insult as Forests NSW and the contractors made far more money from the timber illegally logged than what they were fined. It cost us more than the fine to undertake our audit.

As well as being concerned about the paltry penalties, NEFA were concerned that DECCW and Fisheries NSW failed to explicitly identify the breaches that occurred, treated multiple breaches as single breaches, failed to apply systematic auditing methods, and (despite the evidence of systemic breaches) failed to assess additional areas in the vicinity of our complaints. Forests NSW also assessed our complaints but refused to provide us with a copy of their report.

NEFA were also concerned that at Yabbra, despite the presence of Bell Miner Associated Dieback, rampant lantana, rainforest, an endangered ecological community, the Endangered Black-striped Wallaby and a variety of other threatened species, there was no assessment of the habitat degradation associated with the breaches and no specific rehabilitation works required (aside from the erosion mitigation works) in the rehabilitation plan prepared by Forests NSW and approved by DECCW.

At Yabbra State Forest, Forests NSW were found guilty for illegally logging 3ha of rainforest, 2 wetlands, numerous stream banks, and potentially hundreds of

feed trees of the Yellow-bellied Glider and were fined a total of $2,200 with no requirements to do any rehabilitation works.

The Inquiry should recognise that the penalties applied to breaches of the Threatened Species Licence are not commensurate with the environmental harm caused and are grossly inadequate to act as a deterrent. To be effective penalties need to be increased to reflect the gravity of the offence. There is a need to require active rehabilitation of illegally logged areas and protection of compensatory habitat.

3.2.4. MARKING-UP

The Compartment mark-up is the time when many other features are marked for protection, notably a range of exclusion zones, a variety of feed trees, habitat trees, and recruitment trees. Importantly this is the time when stream and wetland exclusions are looked for and marked. As identified elsewhere Forests NSW often fail to identify and mark the boundaries of areas from which logging is required to be excluded and fail to mark the required numbers of hollow-bearing and recruitment trees for retention.

One of the basic requirements of the Threatened Species Licence is the Compartment Mark-up Surveys (TSL 5.2.). Under the TSL (5.2.1d) Harvesting Operations are prohibited in areas which have not been subject to compartment mark up surveys. At this time *"an adequately trained person must conduct a thorough search for, record and appropriately mark … threatened and protected species features".* These features include nests, roosts and dens of a variety of hollow-dependent species, Koala high use areas, latrine and den sites of the Spotted-tailed Quoll, Glossy-black Cockatoo feed trees, Yellow-bellied Glider and Squirrel Glider sap feed trees, bat tree roosts, Swift Parrot and Regent Honeyeater feed or nest trees, wombat burrows, soaks and seepages in Philoria spp. habitat, and threatened flora. This is a key step in providing the intended protection to a range of threatened species. It is only by undertaking the required on-ground assessment that the features can be found that that trigger a variety of prescriptions.

In Yabbra State Forest (Pugh 2009) NEFA found that not a single one of the required Koala browse trees had been marked and that none of the numerous Yellow-bellied Glider feed trees required to be marked had been. NEFA complained that this failure to mark feed trees was evidence that no compartment mark up survey had taken place. While OEH (then DECCW, 19 May 2010) issued Forests NSW a penalty notice in regard to the failure to mark Yellow-bellied Glider feed trees they made no mention of the failure to mark Koala browse trees. Following additional complaints DECCW (3 August 2010) stated *"...at the time of harvesting, Forests NSW officers documented numerous instances of impenetrable understorey hindering the ability to mark up exclusion zones and habitat features".* NEFA considers that many of the areas where marking up did not take place did not have an impenetrable understorey.

At Doubleduke (Pugh 2010b) NEFA again found that many areas had not been adequately marked-up. It was apparent that only the periphery of logging areas had been marked up in most areas, with no attempt to undertake tree marking within the logging area. This implies that there had been no pre-logging mark-up Koala scat searches. At one site, where logging had only recently

commenced, it was obvious that there had been no attempt to mark-up within the net logging area or search for Koala scats. In an effort to stop this unlawful logging we wrote to the ministers and issued a media release. OEH issued Forests NSW a caution for failing to adequately mark up an area prior to logging.

At Girard (Pugh 2010b) NEFA again found that no attempt had been made to mark-up in significant areas. In response to our complaints OEH (25 August 2011) replied:

> *OEH identified that thick impenetrable vegetation was present within the harvest areas. Where such vegetation occurs, Forests NSW is not required to mark up the harvest area (including in advance of the operation in preferred koala habitat) due to occupational health and safety considerations. Forests NSW has documented and justified the reasoning behind not marking up the compartment in accordance with the requirements of the TSL.*

At Girard many of the areas where NEFA found tree marking had not occurred were not impenetrable and were not identified as such by Forests NSW on maps shown to us.

At Royal Camp (Pugh 2012e) NEFA found that mark up was limited to hollow-bearing and recruitment trees, with many hollow-bearing trees marked as recruitment trees and some cut down. No marking of yellow-bellied Glider feed-trees had been done and the only Yellow-bellied Glider sap-feed tree we saw had been logged. No marking of Koala feed trees had been made and there was no evidence of anyone having undertaken thorough pre-logging mark-up surveys for Koala scats. .

The TSL (5.6 g iii) does allow for tree mark-up not to take place *"where the understorey consists of thick impenetrable lantana greater than one metre high or other impenetrable understorey"*, though this exemption is specifically limited to trees specified in that clause. In practice EPA are allowing it to be applied where there is no impenetrable understorey and to all clauses of the TSL. Though the bigger problem is that without *"an adequately trained person"* conducting thorough searches for threatened and protected species features many species are not being provided with the protection intended by the TSL.

For example the triggering of Koala protection is dependent upon mark-up searches finding sufficient Koala scats to identify Koala "high use" and "intermediate use" areas. If there is no mark up surveys then there is no protection for Koalas. Given the frequent failure to undertake mark-up surveys found in our audits it is apparent that no attempt is being made to minimise impacts on Koalas in many logging operations.

At Royal Camp State Forest NEFA (2012e) found logging of Koala High Use Areas were occurring due to a failure of Forests NSW to search for Koala scats ahead of logging. The forest had an open understorey, though there was leaf litter and bark under most trees and dense grass – it was easy to tell whether trees had been searched. In one area being logged NEFA identified 23 high use Koala feed trees (as defined by having >20 Koala scats beneath them) where Forests NSW had not identified any. Even after our initial complaint Forests NSW only identified 7 of these trees. While logging was stopped in one area, NEFA found that in the area where logging continued Forests NSW failed to search for Koala scats and continued to log Koala High Use Areas.

EDGE OF KOALA HIGH USE AREA IN ROYAL CAMP STATE FOREST, WHERE FORESTS NSW HAD NOT IDENTIFIED A SINGLE HIGH USE KOALA FEED TREE NEFA FOUND 23.

At Royal Camp State Forest NEFA (2012e) also found a distinctive Yellow-bellied Glider sap-feed tree logged that should have been identified in the compartment mark-up. Sap-feed trees are those chosen by Yellow-bellied Gliders to tap for sap by chewing, often V shaped, channels into the bark to concentrate sap for feeding. Only very specific trees are chosen.

YELLOW-BELLIED GLIDER SAP-FEED TREE FELLED AT ROYAL CAMP. THESE ARE MEANT TO BE PROTECTED AT THE MARK-UP STAGE, THOUGH RARELY ARE.

At Yabbra EPA issued Forests NSW a Penalty Infringement Notice and $300 fine for failing to mark over a dozen Yellow-bellied Glider sap feed trees and over a hundred other feed trees. At Wedding

Bells the EPA issued a warning to Forests NSW for not properly marking a Yellow-bellied Glider sap-feed tree, damaging it by dropping trees on it and leaving debris around its base. This tree had been identified by Forests NSW's fauna surveyors by a "YBG" and arrow pointing to it sprayed onto a tree alongside the track. The EPA are still refusing to take any action over two Yellow-bellied glider sap-feed trees that went unidentified at Doubleduke.

Forests NSW's Threatened Species Licence (5.2.1b) requires them to identify and appropriately protect locations around an array of threatened plant species. Except where there are pre-existing records, protection depends upon threatened species being searched for and located at the time of compartment mark-up.

In a single inspection of Doubleduke SF a botanist employed by the North Coast Environment Council (see Benwell 2010, Pugh 2010b) found *"The endangered species Lindsaea incisa (a small ground fern) was identified at a site that appeared to be within the harvestable area of cpt 145"* and in compartment 144 he found the threatened grass *Paspalidium grandispiculatum "amongst earth on an upturned stump at the edge of the recently constructed or upgraded access track, so would appear to have been directly damaged during track construction".*

NEFA subsequently found large numbers of *Lindsaea incisa* (within a wetland and its buffer that had been illegally logged) in Doubleduke SF from within which trees had been logged and machinery driven through it, despite the requirement being for a 50m exclusion zone to be established.

In Doubleduke, Benwell (2010) considered "*No pre-logging flora surveys or flora assessments that could have detected this species appear to have been carried out by FNSW".* After roading and logging resumed in compartment 144 NEFA was informed that a foreman had been trained (by showing him a picture) to identify the cryptic *Paspalidium grandispiculatum.* It is evident that most foresters do not have the required skills to identify most threatened plants.

It is evident that adequately trained people are not undertaking thorough searches for the *threatened and protected species features* required by the TSL at the mark-up stage.

Part of the problem is that often the contractors in their machines are driving around choosing what to log. They have effectively replaced the forest foreman in many operations. They have limited chance of finding many of the required fauna features, such as Koala scats, and little chance of finding cryptic threatened plants. They place reliance upon their Geographic Position Systems (GPS) and often measure exclusion areas from mapped features rather than the required natural features (i.e. top of stream banks). GPSs are also of limited accuracy in the forest.

Forests NSW appear to be moving in the direction of increasing mechanization and away from mark-up surveys. The principal problem with this is that it precludes the implementation of a raft of requirements of the TSL aimed at minimizing impacts on threatened flora and fauna.

As previously recommended, the adoption of a silvicultural objective to maintain or restore structurally diverse forests with trees through a natural range of size classes and a requirement to retain all large old trees (>140 years old) would help mitigate impacts on some species, though will not provide the protection required for other species such as Koalas and threatened plants.

It was clear from our Koala audit of Royal Camp (Pugh 2012e) that Koalas are choosy about the areas they use and the trees they select within those areas. They have distinct species preferences and prefer their trees not too young and not too old. The current requirements are to retain 10

Koala feed trees in "intermediate" habitat and to undertake Koala scat searches to identify Koala High Use Areas that must be protected from logging. The only way to activate the identification of high use Koala feed trees and Koala High Use Areas is by thorough scat searches. Without scat searches the minimum requirement to protect the Koala's highest use areas is not activated.

> **There are many rare and threatened features that can not be dealt with remotely and are not covered in the pre-logging fauna surveys. These require on-ground investigations to identify them ahead of logging. Experts with the required specific expertise are needed to identify an array of features requiring protection, including Koala High Use Areas, Yellow-bellied Glider den and feed trees, and threatened plants. Forests NSW have proven themselves incapable of performing these tasks.**
>
> **The Inquiry should consider recommending that people with specific expertise in the relevant threatened plants and threatened fauna, mark up the required environmental features ahead of logging operations independently of Forests NSW. In order to sustain populations of threatened fauna and flora it is essential that alternative precautionary protection measures are applied in areas considered impenetrable for compartment mark-up.**

3.2.5. ADAPTIVE MANAGEMENT

In relation to biodiversity Forests NSW (2005) ESFM Plan notes:

> *Forests NSW will use adaptive management principles and actions within State forests to complement the management of the CAR reserve system.*
>
> *…*
>
> *During operations, site specific conditions are continually assessed, results recorded, the appropriateness of operational conditions reviewed and plans amended where necessary.*
>
> *Operational auditing monitors compliance with plan conditions and, where non-compliance occurs, assesses environmental harm, details repair works where necessary, the cause of non-compliance, whether sanctions are necessary and how the non-compliance can be avoided in future operations.*

We have come across no evidence of this, quite to the contrary we are concerned that Forests NSW does not learn from their mistakes. We are most concerned that neither EPA nor Forests NSW have bothered to assess the effectiveness of prescriptions over the past 12 years and improve them accordingly. Rather than applying adaptive management as a routine practice we find that Forests NSW use it as an occasional excuse to log somewhere they shouldn't.

In Wedding Bells SF (Pugh 2011b) NEFA found that Forests NSW were still logging habitat of the threatened plants Rusty Plum *Amorphospermum whitei* , now called *Niemeyera whiteii*, and Milky Silkpod *Parsonsia dorrigoensis* under a 2000 prescription for these species that were effectively meant to be 2 year monitoring programs. They clearly state that logging where these species occur is expected to kill a number of individuals and that therefore monitoring will be undertaken for 2 years to ascertain the numbers killed and their regeneration ability. It states that results are

required to be reviewed after 2 years at which time a new prescription was meant to be applied. While Forests NSW were still logging under this two-year monitoring program they did not submit their first monitoring report on Rusty Plum to the EPA until 2008 and on Milky Silkpod until 2009. The EPA (2012) were not happy that the monitoring was of representative operations and for both species *"is currently reviewing the results ... with the objective to negotiate for either further monitoring or prescribed conditions during harvesting or other relevant action"*.

It is shameful that logging is still occurring 10 years after the two year monitoring plan was meant to have been completed and a final prescription adopted. This is "scientific logging" – logging under a monitoring program that is still incomplete and a prescription that has never been reviewed. This is what the agencies term "adaptive management".

It is not believed that any of the set flora or fauna prescriptions have been subject to monitoring to assess their effectiveness. Though without having a clear idea of what they are meant to achieve there is nothing to monitor their performance against.

There has been no strengthening of any of the Licence prescriptions included in the IFOA licences since they were issued 12 years ago. The major reductions in prescriptions have all been based on resource considerations, not ecological.

> **NEFA suggests the Inquiry recommends the adoption of performance measures for flora and fauna prescriptions and auditing of their effectiveness in achieving those measures. Along with a transparent independent expert process overseen by the Environmental Protection Agency to review prescriptions to improve their performance**.

3.2.6. EFFECTIVENESS OF REGULATION

NEFA's experience has been that Forests NSW refuse to acknowledge their failures and that the EPA (including in its previous incarnations) has been reluctant to take action until forced to by expert evidence presented to them. Two examples best illustrate this, the reported logging of an Endangered Ecological Community in Doubleduke State Forest and failure to protect the habitat of the vulnerable Rufous Scrub-bird in Styx River State Forest.

Endangered Ecological Communities are excluded from Forests NSW's licence, making incursions into them a direct offence under sections 118A and 118D of the National Parks and Wildlife Act 1974, where it is an offence to pick or harm endangered ecological communities. The Endangered Ecological Community (EEC) *Sub-tropical Coastal Floodplain Forest of the NSW North Coast bioregion* occurs across all coastal floodplains on the NSW North Coast and is widespread in remnant vegetation on the Richmond River floodplain. When conservationists became aware of logging in the EEC in Compartment 145 of Doubleduke State Forest they reported the breach , though it wasn't until conservation groups had the breach confirmed by two separate expert assessments that DECCW treated the breach seriously and undertook their own expert investigation. As Forests NSW continued their denials, conservationists had to undertake another expert assessment to show the extent of the intrusions.

The sequence of events is:

1. Harvesting Plan for Compartment 145 identifies the EEC *Subtropical Coastal Floodplain Forest* as occurring in the compartment and that it should be excluded from logging, though unjustifiably limits consideration to within the unloggable Forest Type 92.
2. 15 May 2010 Clarence Environment Centre write to the Environment Minister, Frank Sartor, identifying a number of breaches in Compartment 145, including the logging of the Endangered Ecological Community.
3. DECCW undertake audit in response to complaints and do not find any significant breaches. DECCW inform NEFA that they had not bothered to assess the EEC complaint.
4. 15 June 2010 North Coast Environment Council employ a botanist who identifies *"... logging was found to have extended into the Subtropical Floodplain Forest EEC in places where merchantable timber was present"*.
5. 19-20 June 2010 NEFA identify breaches of 20 statutory licence conditions in Doubleduke State Forest including the logging of twenty trees of four species and associated indiscriminate damage within the EEC.
6. 22 June 2010 Forests NSW claim in the Northern Star that the "*Department of Environment Climate Change and Water, has provided Forests NSW with the results of a recent audit of the harvest area and it does not raise any issues with threatened species".*
7. 13 September 2010, the Minister for Forests replied to a NSW Parliamentary Committee that in relation to Doubleduke "*I am advised that in that case no high conservation value old-growth habitat trees, wetlands or endangered ecological communities were disturbed in that forest".*
8. 24 October 2010 ,after 4 months, with Forests NSW having established a new auditing team and DECCW undertaking audits in Compartment 145, it appeared that they had failed to identify a single additional intrusion into the EEC. NEFA undertook a supplementary assessment that found a further 3 incursions into the EEC resulting in an additional 46 trees that had been logged within the EEC and 1,387 other trees and shrubs that had been bulldozed out of the ground, trampled by machinery, or had trees dropped on them within the EEC.
9. October 2011 EPA commence legal proceedings against Forests NSW for logging 120 trees in 7.5 ha of the EEC Subtropical Coastal Floodplain Forest. The EPA refuse repeated requests to pursue numerous other reported breaches on the grounds that they were already proceeding on one breach.
10. July 2012 EPA drop the case against Forests NSW due to inadequate soil evidence, and claim that it is too late to take any regulatory action on the other breaches, even though the 2 year limit for action had only expired for some breaches.

In 2007 Forests NSW recorded the vulnerable Rufous Scrub-bird (*Atrichornic rufescens*) at 7 sites in compartment 502 of Styx River State Forest. The Rufous Scrub-bird is a small secretive understorey bird of highland wet forests in north-east NSW. It is a living fossil with a lineage dating back 97 to 65 million years but is now listed as vulnerable to extinction, with burning and logging recognised as primary threats. It has long been considered to be in decline on the New England Tableland. The Threatened Species Licence requires that for the Rufous Scrub-bird, all microhabitat within modelled habitat and within 300m of a record, plus a 20m exclusion buffer, is to be excluded from logging.

When planning logging operations in Compartment 502 of Styx River SF Forests NSW decided to ignore their own records of the Rufous Scrub-bird on the basis that their surveyor had misidentified them and that no suitable habitat existed in the area. They made no subsequent attempt to have

the area resurveyed by a competent person with the required expertise, and in early 2012 burnt much of the area and started logging. When a complaint was made to EPA in March 2012, the EPA undertook a preliminary assessment which failed to identify any problems. Conservation groups then had to engage qualified experts to undertake two separate habitat assessments, and complain to the responsible Ministers (Pugh 2012 a, b, c, d), before EPA engaged a suitable expert in May who verified the presence of suitable habitat. EPA then allowed Forests NSW to continue to log potential habitat, with the protection of only two small areas, until the logging was complete. Because mandatory requirements of the TSL had not been met the whole operation was illegal.

The sequence of events is:

1. March 2007 Bob Turnbull undertakes diurnal bird surveys of compartment 502 for Forests NSW and records a variety of threatened species, claiming to have heard Rufous Scrub-birds call on 10 seperate occasions at 7 sites within Compartment 502 on the 18 January, 23 March, 27 March and 28 March. He played tapes of the bird's calls and listened for responses. Records subsequently entered into FNSW BIODATA data base and Wildlife Atlas as highly reliable. The Rufous Scrub-bird records are recorded in Wildlife Atlas as call detections and are not claimed to be observations.
2. 28 March 2011 Forests NSW finalise "Threatened Species Licence Pre-logging and Pre-roading Flora & Fauna Survey Report" which relies on 2007 survey results but does not acknowledge the presence of modelled Rufous Scrub-bird habitat , in Section 3.2 'Threatened Fauna and Fauna Features Detected' where it presents the findings of Turnbull's survey it omits any mention of Rufous Scrub-bird records, and in Section 4 'Prescription Implementation Summary' it makes no mention of the Rufous Scrub Bird. It identifies that there may be some *"erroneously located records"* but does not indicate that there have been any erroneous identifications. On 31 March Chris Slade certifies that all recorded species are listed in the results table and prescriptions summary table, certifying that it is a "*full and accurate account of the survey results"*.
3. July 2011 Chris Slade now claims that due to emerging *"doubts over the validity of the records"* for Rufous Scrub-bird that he and Graham Marshall undertook an "*intense habitat assessment"* in July where it *"was determined that the habitat did not constitute extremely dense cover between 2 and 50cm above the ground and moderate cover between 50 and 100 cm above the ground"*. He goes on to claim that "*Further investigation questioned the observer at length where it was revealed that the positive identification was of a bird that flew up to 2 metres off the ground and 'seemed to follow me through the forest'"*. Forests NSW claim that then "*a decision was made that the records were a misidentification and removed from FNSW BIODATA data base"*.
4. 9 November 2011 Harvest Plan approved. Plan does not make any mention of Rufous Scrub-bird or its modelled habitat.
5. Early 2012 Forests NSW conduct a pre-harvest burn which burns off most understorey within the modelled Rufous Scrub-bird habitat.
6. 9 March 2012 Joe Sparkes lodged a complaint on the EPA pollution line and contacted the manager of the EPA forestry unit by email and phone call complaining about the ongoing logging of Rufous Scrub-bird habitat in compartment 502 of Styx River State Forest. He details that Forests NSW had totally ignored the existence of 7 records of Rufous Scrub-bird within the compartment made by FNSW's own ecologist in 2007.
7. March (?) EPA undertook a brief assessment and reported that logged and burnt areas complained about had indeed been disturbed and were no longer suitable habitat,

apparently failing to identify that suitable Rufous Scrub-bird habitat remained in areas proposed for logging or to assess whether suitable habitat had already been logged or burnt. Thereafter EPA concentrate on collecting evidence as to whether the area had been burnt between the records being made in 2007 and the 2011 habitat assessment, even though Forests NSW's harvesting plan clearly identifies that it was not. The logging continued.

8. 5 April North Coast Environment Council met with forester Justin Williams at Wauchope Forestry Office to inquire into this issue and is told that Forests NSW had thought they had deleted all records of the Rufous Scrub-bird in compartment 502 from all databases, including the Wildlife Atlas.
9. 12 April North Coast Environment Council engaged two ornithologists to assess compartment 502 who identified ideal habitat for Rufous Scrub-bird still remained and considered that logged areas were likely to have been good habitat.
10. 17 April NEFA, NCEC and CEC wrote to NSW Ministers for Environment and Primary Industries asking them to take urgent action to stop Forests NSW logging habitat of the vulnerable Rufous Scrub-bird in compartment 502 while an independent investigation is undertaken. Logging continues.
11. 19 April 2012 Forests NSW undertook a supplementary habitat assessments to visually assess whether suitable microhabitat exists. All sites were located in the vicinity of the main road and no quantitative measurements of suitable microhabitat are made, instead Forests NSW rely upon whether their boots and legs are visible. They again deny suitable habitat exists.
12. 28 April 2012 NEFA engages fauna expert to assess areas of modelled habitat, who confirms the existence of suitable habitat for Rufous Scrub-bird remain and that areas of suitable habitat are likely to have been logged, roaded and burnt.
13. 30 April 2012 NEFA writes to NSW Ministers for Environment and Primary Industries providing them with the fauna expert's report and again asking them to take urgent action to stop Forests NSW logging habitat of the vulnerable Rufous Scrub-bird in compartment 502 while an independent investigation is undertaken. NEFA document why the basic requirements of the TSL have not been satisfied and why the logging is illegal This is followed up on the 1 May with a letter detailing other identified breaches found. Logging continues.
14. 4 May EPA engage expert consultant to undertake site inspection that lasted only half a day, failed to assess the whole area and failed to assess how much potential habitat was likely to have already been roaded, burnt or logged at the time of the investigation. EPA's expert identified five sites considered to still be potential Rufous Scrub-bird habitat, identifies that areas of potential habitat "*may have been fragmented by fire*" and that his limited assessment *"does not preclude other sites within the compartment that were not inspected from also containing suitable habitat"*. Three of the areas of potential habitat identified were within the area proposed for logging. EPA refuse NEFA's request to attend the site inspection on the grounds it would be independent, though two foresters attend. EPA claim to NEFA that the whole area has been assessed and that areas of likely potential habitat that have been logged or burnt have been identified.
15. 9 May Forests NSW's Justin Williams claims on ABC radio that the EPA only found one area that *"is now being protected"*, claiming *"It's about 50 metres by 30 metres in size so it's quite small. "There's a narrow group of gullies that come together and there's a little bit of rainforest that occurs in that area and it's just around there that we're protecting that habitat."* Logging continues outside this small area.

16. 15 June, NEFA was belatedly provided with a copy of EPA's May 5 inspection and immediately wrote again to the NSW Ministers for Environment and Primary Industries, again detailing how the requirements of the TSL had not been complied with and requesting that the illegal logging cease. Logging continues.
17. By the time logging was completed large areas of potential habitat within 300m of the March 2007 records appear to have been logged and burnt prior to Sparkes initial March 2012 complaint , with logging of potential habitat continuing up until May 5. One of the three areas that were assessed on May 5 was subsequently logged, along with the balance of the area that remained unassessed by EPA. Forests NSW agreed to protect 2 of the areas identified on May 5.
18. The EPA's response to complaints is still awaited.

It is astounding that in March 2011 Forests NSW certified that records of the Rufous Scrub-bird made by their own trained fauna surveyor, which were recorded in their own and NPWS's databases, did not exist. And even more astounding that they now claim that it wasn't until over three months later that they undertook investigations to determine that the records they had ignored were invalid. It is surprising that one of their rationales for retrospectively dismissing the records is that the positive identification was an observation of a bird that displayed *"extremely uncharacteristic behaviour"*, when all the records are cited as being heard rather than seen. It is telling that Forests NSW's ecologists were unable to identify suitable microhabitat before they burnt the area and started logging, particularly as three separate inspections by appropriate experts identified that suitable microhabitat still remained after large areas had been burnt and logged.

The logging operation in compartment 502 of Styx River State Forest was illegal in that mandatory requirements of the TSL had not been complied with prior to logging starting. The EPA's March inspection was obviously incompetent and it took two expert assessments by conservation groups to force them to engage their own expert two months after the first complaint was made. Even then they allowed another area assessed as potential habitat, and other uninspected areas, to be logged.

These are just two examples of the many instances in which we have found the EPA to be reluctant and ineffective regulators.

As evident from the above examples, Forests NSW are even more unwilling to audit their own operations or admit it when they are found to have stuffed up. We only checked Forests NSW's own breach reports for Girard SF (Pugh 2010d). Before NEFA informed Forests NSW that we were going to undertake an audit, they had identified 9 breaches; 6 related to trees being dropped and pushed into streams, one related to a tree being dropped into a rainforest exclusion, one related to four breaches of a frog exclusion area, and one related to bulldozing a road across two drainage lines. The records indicated that no action had yet been taken for a single breach, other than the contractors being talked to occasionally, and it is apparent that no rehabilitation works were undertaken for the road across the drainage line.

Of the 4 breaches identified after we informed Forests NSW of our audit, 3 related to hollow-bearing and recruitment trees and, significantly, one related to a major intrusion into a wildlife corridor and FMZ 2 area. It is revealing that before we specifically told Forests NSW's CEO that we expected to find breaches of hollow-bearing and recruitment tree requirements because they are common, Forests NSW had not reported any such breaches.

In our brief audit (Pugh 2010d) of the same area they had been auditing for months, and intensively for the two weeks after we informed them of our proposed audit, we independently found 3 of their reported breaches and documented numerous additional breaches of 2 conditions of Forests NSW's Integrated Forestry Operations Approval, 24 conditions of their Threatened Species Licence, 9 conditions of their Fisheries Licence and 10 conditions of their Environment Protection Licence. On a site inspection we showed some of these breaches to Forests NSW and they did not assuage our concerns.

Most resources available for auditing are used internally by Forests NSW for their own auditing program. It would be far preferable and more effective to strengthen external regulation by allocating the resources to DECCW and Fisheries NSW.

URS (2008) consider:

> *Public sector reforms across Australia over the past two decades have recognised that separating policy and regulation from operations provides greater clarity in objectives for each function of government and improved performance. ...*
>
> *Governments manage native forests for multiple objectives. They manage them to protect a range of environmental and biodiversity values as well as for commercial wood production. Separation of the environmental from the commercial objectives is fundamental to sustainable multiple-use management. So to is separation of regulatory and audit functions from the bodies being regulated and audited.*

URS (2008) state:

> *A lack of separation between environmental, governance and commercial management can result in a lack of transparency and accountability. For example, it may be in the short to medium term interests of a commercial forest manager to increase harvest volumes above long-term sustainable yields to maximise profit. To offset this incentive, checks and balances should be in place to ensure that harvest volumes are indeed sustainable and do not compromise environmental objectives (outside the domain of the forest entity).*
>
> *In Victoria, for example, DSE determines the sustainable yield while VicForests is responsible for the harvest and commercial sale of timber. The environmental aspects of commercial operations of these agencies are externally regulated though the EPA, which undertakes annual audits of compliance with relevant legislation. The situation is similar in Queensland where operational and governance/auditing activities are undertaken by separate government agencies. However in other states, there is less separation of commercial operations from the regulation and governance function. This is most notable in NSW, where Forests NSW sets sustainable harvest levels and also carries out commercial operations on public land, and is not subject to external audit against relevant legislation and regulation.*

Despite our concerns with the reluctance of EPA to be strong and effective regulators we consider that there is a need for increased separation of policy and regulation from Forests NSW's operations. The performance of the EPA will be greatly enhanced by clarifying the clauses of the TSL and other regulatory instruments to ensure that the intent is clearly reflected in licence conditions. Though most importantly third party rights to enforce prescriptions need to be restored.

Forests NSW have proven time and time again that they are reluctant to implement requirements for ecologically sustainable forest management. The EPA have proven themselves to be reluctant and ineffective regulators. The Inquiry should consider that, for Forests NSW to implement them, and EPA to enforce them, Threatened Species Licence conditions need to be made clearer, unambiguous, capable of auditing, and clearly enforceable. Penalties for non-compliance need to be substantially increased.

It is suggested that the Inquiry consider the issue of public forest management arrangements and recommend further separation of policy and regulation from Forestry operations. Any such system would be enhanced by allowing members of the public third party appeal rights.

3.3. Sustaining Soils and Streams When Logging

Raindrop impact and overland flow are the principal means of detaching and transporting sediments and nutrients in forests.

In a logging operation the removal of vegetation allows an increase in rainfall volumes and the force of raindrops reaching the ground, and thus a greater mobilisation of soil particles can occur. Movement of machinery and dragging of logs causes an increase in compacted areas of soil surface and removal of topsoil, thereby reducing the permeability of the soil and increasing runoff, as well as causing channelling and creating loose soil for easy movement. In the short term the removal of the canopy also decreases transpiration, allowing water tables to rise and the soil to become saturated sooner and begin generating overland flow, particularly nearer streams.

The increased runoff also acts to increase the erosive force as doubling the depth of overland flow increases the velocity four times, resulting in the movement of particles 4096 times larger than before and an increase of 1024 times in the total mass able to be carried.

Loss of understorey vegetation and leaf litter, which slows overland flows and traps sediment, will also facilitate transport of soil for longer distances. The impacts of logging are greatly amplified by burning which removes the understorey and ground litter and/or weakens soil structure or increases soil hydrophobic properties.

As the soil becomes more disturbed or wetter it becomes more resistant to infiltration and thus overland flow is increased and mobilised soil can pass directly into streams and thus increase stream turbidity. The potential effects of logging on streams are therefore more pronounced in wetter weather and as operations get closer to streams.

As the velocity of the water begins to slow the larger soil particles begin to be deposited, causing sedimentation of stream beds and ultimately dams.

As noted by Cornish (1980) *"the quality of water emanating from virgin forested catchments is generally of the highest order. A reduction of quality may occur as a consequence of operations associated with logging, and this is frequently due to an increase in stream sediment concentrations and associated turbidity levels."*

Logging has been found to result in a variety of impacts on stream quality:

(i) significant increases in peak sediment loads (Campbell and Doeg 1989, Lake and Marchant 1991, Bonell, Gilmour and Cassells 1991, Sadek *et. al*. 1998) leading to increased sediment deposition in streams with consequent short-term and long-term impacts on invertebrates and fish (Campbell and Doeg 1989, Lake and Marchant 1991, Davies and Nelson 1994);

(ii) increased nutrient levels which can stimulate algal production in summer (Campbell and Doeg 1989, Lake and Marchant 1991, Davies and Nelson 1994), affecting both the instream community in the vicinity of logging and downstream water users and reservoirs; and,

(iii) reductions in levels of dissolved oxygen in streams as a result of oxygen demands of decomposing logging debris in streams, which becomes most apparent in periods of low flows (Campbell and Doeg 1989).

3.3.1. MITIGATING EROSION AND STREAM POLLUTION

The community have identified the protection of streams and water quality as one of their highest concerns. Prescriptions intended to reduce soil erosion and stream pollution have long applied to forestry operations. In May 1981Commissioner Wal Gentle told a "Senior Officers Conference" that their field performance was *"too sloppy; there is no doubt in anyone's mind that the Conditions were being breached, and seriously, almost all the time"*. Stating:

> *Our barrister told us that we certainly could never put in evidence the fact that what was happening in the bush was in fact what we said was happening when we wrote these erosion conditions into our management plans. In other words, the field performance was too sloppy. So a very, very big improvement has to be made by everyone because these are the grounds we can be pulled into the Land and Environment Court for breaching the law, which we are doing.*

In the late 1980s NEFA found that the Standard Erosion Mitigation Conditions were still being routinely breached. 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 (at least 88,140 tones of soil was estimated by the EPA to have been lost into the Bellinger River from roads alone). NEFA did not proceed with a proposed court case on the basis that the Environmental Protection Authority would take action. The Forestry Commission was charged 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. Though this did result in the implementation of Pollution Control Licences for Forests NSW's operations.

The rate of soil formation in forests may be somewhere between 0.5 and 1 tonne per hectare per annum. In its submission to the Kempsey/Wauchope EIS CaLM (1993b, p.13) note that "*soil erosion is a detrimental impact under any land use circumstance, and any soil erosion in a forest situation greater than the equivalent of 1 tonne/ha/yr is unsustainable, and certainly not reversible in the short term.*"

The Standard Erosion Mitigation Guidelines for Logging (SEMGL) were drawn up by CaLM to strengthen the conditions under which logging operations could be carried out in order to control erosion. The SEMGL were only ever intended to reduce the erosion due to logging operations rather than instigate sustainable logging.

SEMGL's divided soils into erosion hazard classes:

- Low - is when less than 40 tonnes of soil is predicted to be lost per hectare in year one.
- Moderate - is when 40-400 tonnes of soil is predicted to be lost per hectare in year one.
- High - is when 400-800 tonnes of soil is predicted to be lost per hectare in one year.
- Extreme - is when over 800 tonnes of soil is predicted to be lost per hectare in year one.

SEMGL were based on 40 year logging cycles and the assumption that erosion is most likely to occur from 1-3 years. CaLM originally intended the cutoff point to be 400 tonnes of soil loss per hectare per logging operation (ie restricting logging to the low and moderate erosion hazard class) (or at least to severely restrict logging above this level) on the premise that soil loss of 10 tonnes/ha/annum is acceptable for agriculture and thus if the soil loss from one operation is averaged over a logging cycle of 40 years then the loss of 400 tonnes/ha/annum per logging operation is acceptable.

Pressure from Forests NSW prevailed to allow logging in the low, moderate and high erosion hazard classes. Allowing the loss of up to 800 tonnes of soil per hectare following logging is clearly not sustainable. Forests NSW still vigorously resisted their adoption, with the SEMGLs having to be imposed upon Forests NSW by the Minister for Planning as part of the EIS determination process.

As an outcome of the RFA in 1999 the SEMGLs were reconstituted into Environmental Protection Licences (EPLs) and applied to all logging operations on public land in north-east NSW. The EPL states:

> *The objects of this licence are to require practical measures to be taken to protect the aquatic environment from water pollution caused by forestry activities and to ensure monitoring of the effectiveness of the licence conditions in achieving the relevant environmental goals.*

Many of the basic premises underpinning EPLs are no longer relevant, most notably:

- an area may be subject to a number of logging operations over a 40 year period, rather than one;
- on going sources of erosion, such as roads and heavily degraded snig-tracks, are not accounted for;
- protection for filter strips along streams has been reduced;
- the increasing mechanisation of logging operations has resulted in far more intensive and extensive soil disturbances than accounted for; and
- the frequency of extreme rainfall events, and thus erosion events, is increasing due to climate change.

It is apparent that enhanced measures could be adopted to reduce increases in sediment mobilisation, stream turbidity and sedimentation due to logging in the catchment, though this would require significant enhancements of current practices, such as:

- Adequate buffers should be applied to all streams, stream channels and areas most likely to become saturated in wet periods;
- Logging should be discontinued when soil moisture is higher than an acceptable level;
- Heavily compacted sites (ie log dumps, snig tracks) should be deep ripped after use and revegetated to an acceptable cover within 6 months;
- Roads and tracks need to be well drained, with temporary tracks (i.e. snig tracks) having adequate cross drains constructed at the end of operations and when rain is threatening;
- Logging operations must be constantly and rigorously supervised;
- All runoff needs to be directed into areas with a good vegetation and leaf litter cover, in an area unlikely to become saturated in prolonged wet weather, and not subject to machinery disturbance or burning;
- Roads crossing streams should be avoided where possible, where a stream crossing is unavoidable the road should be properly drained well away from the stream and the road surface adequately armoured (rocks, concrete, bitumen) in the vicinity of streams to resist erosion; and,
- Roads left open for regular traffic need to be regularly maintained, with special precautions taken after grading.

The Inquiry should consider the need for Environmental Protection Licences to be subject to independent expert review to identify appropriate constraints to reduce erosion and stream pollution in light of contemporary logging practices, recent science and climate change.

The Environmental Protection Licence (EPL) attempts to regulate activities so as to protect water quality. As well as constraining sources of erosion it attempts to limit sediments entering streams by limiting machinery disturbance near streams and establishing undisturbed buffer strips to capture sediments in overland flows.

Direction of runoff onto undisturbed vegetation and the maintenance of undisturbed filter strips along streams are the principal means of reducing the impacts of logging on water quality. The theory being that the undisturbed soil allows increased infiltration of water and thus sediment deposition and the roughness of the ground litter and vegetation act as sediment traps. Though if the forest is disturbed by machinery which causes compaction or channelling, or subject to burning removing ground litter and vegetation then the effectiveness of such zones is greatly reduced. Filter strips along streams encompass the most saturated soils of a catchment, so their effectiveness as sediment traps is also greatly diminished when higher groundwater levels reduce infiltration of runoff.

Even with the implementation of 'best practice' measures logging has been found to still result in increased erosion and thus stream turbidities (Davies and Nelson 1993, Davies and Nelson 1994, Grayson *et. al.* 1993, Lacey 1998).

As noted by Croke *et. al.* (1997) *"Erosion undoubtedly occurs in forestry environments and, in particular, on disturbed areas such as snig tracks. The transportation and delivery of this material to the drainage lines depends upon a number of factors. These include the prevailing slope, topography, soil texture, and trapping efficiency of drainage structures and protection features, such as buffer strips, within the catchment."*

Davies and Nelson (1994) found that *"Logging significantly increased riffle sediment, length of open stream, periphytic algal cover, water temperature and snag volume. Logging also significantly decreased riffle macroinvertebrate abundance, particularly of stoneflies and leptophlebiid mayflies, and brown trout abundance. All effects of logging were dependent on buffer strip width and were not significantly affected by coupe slope, soil erodibility or time (over one to five years) since logging. All impacts of logging were significant only at buffer widths of <30 m."*

The Environmental Pollution Licence was amended in 2004 to have the effect of excluding "non-scheduled" forestry operations from requiring licences. Since then Forests NSW have been refusing to obtain licences for increasing numbers of their operations. Now over 90% (often over 97%) of their logging operations are no longer subject to EPLs. For example in 2006/7 there were 221 forestry operations in the UNE region, the EPL applied to 23 of these, leaving 198 operations where logging occurred without EPL coverage. This enables Forests NSW to avoid some requirements and the scrutiny of an outside agency for most operations.

Mapped drainage lines are those identified on 1:25,000 topographical maps. While the identification of streams on these maps is relatively good, many smaller streams are often missed, and some larger ones, particularly in some landscapes. These missed streams are the "unmapped drainage lines" protected by the EPL. The Fisheries Licence also protects these in the vicinity of records of threatened fish (when Fisheries bother to report their presence to Forests NSW). The Threatened Species Licence only requires protection of mapped drainage lines.

The EPL requires the exclusion of logging from within 10 metres, and the exclusion of machinery from within 5 metres, of unmapped drainage lines. An additional 10 m wide protection zone is applied in which machinery disturbance is meant to be minimised. The principal reason Forests NSW sought to be exempt from the EPL was to allow unmapped drainage lines to be logged.

This also had the effect of excluding most of their operations from external regulation of erosion mitigation conditions. While Forests NSW claim that they will still abide by the intent of the EPL our recent audits have found that they routinely breach prescriptions intended to protect water quality and fish habitat, most notably failing to adequately protect unmapped drainage lines, wetlands and drainage depressions, dropping trees into stream buffers, poorly constructing and failing to rehabilitate stream crossings, failing to establish adequate drainage on tracks and roads, and otherwise being careless.

In Royal Camp State Forest (Pugh 2012e) an illegal stream crossing was apparently constructed while forestry operations were meant to be suspended and while both EPA and Forests NSW were supposedly auditing two identified Koala High Use Areas, one 200m away and another 1km away.

AN ILLEGAL STREAM CROSSING IN ROYAL CAMP SF, APPARENTLY CONSTRUCTED WHILE EPA AND FORESTS NSW WERE AUDITING THE AREA,

In our audit of Yabbra SF (Pugh 2009) NEFA identified 5 unmapped drainage lines which had not been marked in the field and documented 22 trees that had been illegally removed from their stream banks. From NEFAs small sample it was evident that many other unmapped streams had also been subject to logging and burning, with estimates that over 100 trees were likely to have been illegally logged. Forests NSW had not switched on the EPL, though their harvest plan (which is a legal document) claimed *"all EPL conditions will apply to harvesting and roading operations"*, as well as identifying that the Fisheries Licence applied. FNSW's own audit failed to identify any problems. Fisheries NSW upheld our complaint and issued a Penalty Infringement Notice and $500 fine for failing to mark exclusion boundaries on unmapped drainage lines, and a Penalty Infringement Notice and $500 fine for logging, bulldozing and burning within 10m of these unmapped streams. A fine of less than $10 per tree illegally obtained. FNSW would have sold the trees for many times this cost to sawmillers and profited from this illegal logging.

PHOTOS: LOGGING WITHIN FILTER STRIP OF UNMAPPED DRAINAGE LINES AT YABBRA SF.

Even where Forests NSW do find breaches of unmapped drainage lines they often fail to take appropriate action or remediate damage. Forests NSW identified breaches in Girard SF in April 2010, stating "*Bulldozer driver opening old road for snig track, pushed through 2 unmapped drainage lines".* Despite appropriate stream crossings not being constructed, large amounts of fill being pushed into the drainage lines and both crossings being situated upstream (50-80m) from a Stuttering Frog exclusion zone, Forests NSW concluded that there was no environmental harm and simply explained the licence to the operator without undertaking any remedial action. When NEFA (Pugh 2010d) audited the operations in August they independently identified these breaches, observed that erosion had commenced, and that erosion was expected to rapidly worsen. While logging had finished no attempt had been made to remove the spoil from the streams or undertake rehabilitation.

PHOTOS LOGGING TRACK ILLEGALLY PUSHED THROUGH TWO UNMAPPED STREAMS IN GIRARD SF. NO ATTEMPT WAS MADE TO REHABILITATE CROSSINGS.

PHOTOS: TRACKS WERE ROUTINELY AND WANTONLY PUSHED THROUGH UNMAPPED STREAMS AT GIRARD SF WITH NO ATTEMPT AT REHABILITATION.

The EPL is the only prescription requiring protection of drainage depressions. Drainage depressions are the heads of streams above where defined beds and banks begin to form. The EPL requires that 5 meter buffer strips are retained along drainage depressions within which soil disturbance during forestry activities must be prevented to the greatest extent practicable. Since regulation of these has been removed it is open slather.

PHOTOS: TRASHED DRAINAGE DEPRESSIONS IN GIRARD SF.

At Royal Camp SF harvesting machinery had been used in a special operational zone (10m around stream buffer zones) where the soil is saturated contrary to the EPL and Fisheries Licence.

PHOTOS: MACHINERY DAMAGE TO WATERLOGGED SOILS IN A SPECIAL OPERATING ZONE IN ROYAL CAMP SF. When inspected in February there was extensive machinery damage to waterlogged soils within the operational zone that still had not been remediated 5 months later (-29.0008290 152.8824580, -29.0008290 152.8824580)

Sparkes (2010) identified 27 breaches of NSW environmental regulations by FNSW in the UNE, noting:

> *Ten of these involved failures to implement adequate erosion controls after logging, in the worse case 27 cross-banks had been so poorly constructed that they failed and caused*

significant pollution of Washpool Creek. In one case a bridge had collapsed into a 4th order stream and in another Forests NSW had failed to properly assess, and thus under-estimated, soil erodibility. DECCW directed that remediation should be undertaken for 8 of these breaches and sent warning letters in respect to 3 others. No action was taken in respect to the failure to properly assess soil erodibility.

Five of the breaches involved logging of stream exclusions imposed to protect habitat for an array of threatened species (TSL 5.7a) and water quality, with up to 2,150m^2 being logged in the worst case. DECCW issued a Penalty Infringement Notice for one of these incursions and issued warning letters for three others.

Despite most compartments not being subject to the EPL after 2004, there were 146 "non-compliance Incidents" with the EPL identified by regulators in the Upper North East from 5 audits in 2006/07 and 122 from 3 audits in 2007/08 (Pugh 2011). This is an average of over 33 breaches per audit, and not one fine was issued.

It is apparent that Forests NSW are regularly and frequently breaching requirements of the Environmental Protection Licence. Commissioner Gentle's admonishment that erosion mitigation conditions are *"being breached, and seriously, almost all the time"* is as relevant now as it ever was. For three decades they have proven themselves incapable of self regulation. What is most worrying is that over 30 years of frequent breaches has created a toxic legacy for our streams.

The Inquiry needs to recognise that over 90% of logging operations were exempted from requiring Environment Pollution Licences in 2004. Forests NSW have proven themselves incapable of self-regulation to limit soil erosion. To improve environmental outcomes and the sustainability of forestry operations it is suggested that the Inquiry recommend the Environmental Pollution Licence be again applied to all forestry operations and that the EPA undertake a rigorous enforcement program to establish a culture of compliance. Protection must be restored to all streams.

3.3.2. SUSTAINING FISH WHEN LOGGING

Forests NSW undertake logging operations under a Fisheries Licence (FL), introduced as an outcome of the RFA, which is intended to regulate activities so as to protect State and national threatened species of fish. We have found that the FL has rarely been applied or enforced. As Fisheries NSW and Forests NSW are both in the NSW Department of Primary Industry there is a strong reluctance by Fisheries to regulate or penalise their colleagues, as evidenced by just one FL audit/complaint being dealt with in the UNE over the 10 years 1999/2009, and no enforcement action being taken. Our recent audits prove that the FL is being regularly breached, the problem is that despite the lack of compliance by Forests NSW there is no effective oversight and minimal enforcement by Fisheries NSW.

The Fisheries Licence is itself a weak regulatory instrument designed to have minimal additional impact on forestry operations, thus the real lesson from Forests NSW's intentional refusal to implement the intent of the FL is that they will not implement any requirement for sustainable logging unless legally forced to.

The Fisheries Licence requires in Section 9 that "*forestry activities must not be undertaken in any compartment unless a pre-logging and pre-roading aquatic habitat assessment has been conducted".* Aquatic Habitat Assessments (AHA) are required to identify Class 1 habitat where potential habitat of threatened fish occurs within 2km upstream and 5km downstream, and Class 2 habitat where potential habitat of threatened fish occurs within 100km downstream. Class 1 and 2 habitat then triggers application of prescriptions. AHAs are to be undertaken by "*suitably experienced and trained"* surveyors.

While this appears to establish a clear requirement for AHAs to be prepared for all logging operations, it is interpreted to mean that an AHA is only required if instream works are proposed. While "in stream works" refer to any activity between the banks/edges of a watercourse, Forests NSW limit its application to the construction of stream crossings and ignore their crossing of watercourses with logging machinery. Forestry NSW's planning "Checklist to Ensure Fisheries Licence Requirements Met" only triggers the need for an AHA and the identification of Class 1 and 2 habitat where "*'in stream works' consisting of new/replacement or significant upgrade proposed"*. If such works are not proposed the checklist states *"no further assessment required*".

The other key problem is that Forests NSW consider that according to the FL, irrespective of publicly available data, they do not have to take any specified actions to protect threatened fish species unless the data is first provided to them by Fisheries NSW. On this basis, apparently the FL did not even come into effect until records of the endangered Eastern Freshwater Cod were provided to Forests NSW in 2002.

Since Forests NSW abandoned the EPL (see Section 4.2.1.) for most logging operations in 2004 the FL has taken on greater significance, particularly in Upper North East NSW where a variety of threatened fish occur within 100km downstream of operations, because it still requires the protection of unmapped drainage lines. After Forests NSW was exempted from the EPL for most operations they seem to have gone on a spree of logging unmapped drainage lines, even where they were still legally required to protect them by the FL.

In our audit of Yabbra SF (Pugh 2009) NEFA identified 5 unmapped drainage lines which had not been marked in the field and documented 22 trees that had been illegally removed from their stream banks. From NEFA's small sample it was evident that many other unmapped streams had also been subject to logging and burning, with estimates that over 100 trees were likely to have been illegally logged. Forests NSW had not switched on the EPL and ignored the requirements of the FL despite being informed that the endangered Eastern Freshwater Cod occurred downstream.

The harvest plan (which is a legal document) for Compartments 162 and 163 of Yabbra SF identified that all conditions of the IFOA, including the EPL and FL, would be applied. Though the plan made no mention of the presence of the Eastern Freshwater Cod downstream and it appears an Aquatic Habitat Assessment was not undertaken. Contrary to the harvesting plan there was no attempt made to exclude logging from the banks of unmapped streams. Because of our complaint Fisheries NSW undertook a cursory assessment of some of the areas we had identified and for the first time issued 2 Penalty Infringement Notices and $500 fines for failing to mark exclusion boundaries on unmapped drainage lines and logging, bulldozing and burning within 10m of these unmapped streams.

NEFA's audit of Doubleduke SF (Pugh 2010c) found that Forests NSW had not prepared an AHA for one compartment (despite later roading through a wetland), though had prepared what they

claimed was an AHA for another where they proposed the construction of new creek crossings. The AHA was prepared by the supervising forester instead of by a "*suitably experienced and trained"* surveyor. He recognised the presence of the endangered Eastern Freshwater Cod downstream but not the publicly available evidence of the presence and potential habitat of the endangered Oxleyan Pygmy Perch.

The Oxleyan Pygmy Perch is identified as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and the NSW *Fisheries Management Act 1994*. Threats to this species include runoff and sediment from stream crossings, logging operations and post-logging burns. The FL was specifically intended to protect this species when it was issued in 1999.

When NEFA complained that the Oxleyan Pygmy Perch had been ignored despite information presented in the 2005 Oxleyan Pygmy Perch Recovery Plan showing it occurred downstream we were told (J. Murray pers. com., November 2010) that they didn't need to consider the species because Fisheries NSW had not provided them with the required information. It is revealing that Fisheries NSW were going to give them the data years before, but apparently hadn't got around to it, as stated in the 2004/5 RFA report:

> *Preparation of distribution data for the Oxleyan pygmy perch (Nannoperca oxleyana), a species occurring in coastal areas of northern New South Wales, and Macquarie perch (Macquaria australasica) occurring in streams of the southern highlands and slopes, is complete. Both species could be affected by forestry operations and the distribution data is expected to be provided to Forests NSW shortly.*

It is also revealing that Fisheries NSW approved the Doubleduke assessment without themselves identifying the missing endangered species.

Despite discussing our concerns with both agencies and submitting a written complaint, Fisheries NSW refused to take any legal action against Forests NSW – not even a warning letter. NEFA was verbally assured by a Fisheries NSW officer that the problem had been fixed by provision of the required data to Forests NSW and would not occur again.

NEFA's audit of Wedding Bells SF (Pugh 2011b) found that Forests NSW had again failed to prepare Pre-Logging and Pre-Roading Aquatic Habitat Assessments within the catchment of known and potential habitat for the endangered Oxleyan Pygmy Perch in the catchment of the Corindi River, and failed to exclude unmapped drainage lines from logging and roading to protect downstream habitat of the Oxleyan Pygmy Perch as required by the FL. It is extremely concerning that within days of our complaints over Doubleduke SF Forests NSW had done a shoddy checklist for Wedding Bells which again ignored the presence of Oxleyan Pygmy Perch downstream.

Despite Fisheries NSW finding that instream works had indeed occurred on a number of locations in unmapped drainage lines they again refused to take any action on the grounds that they had not provided adequate records to Forests NSW.

It is revealing that since at least 2004 the Roads and Traffic Authority has been acknowledging the potential habitat of the Oxleyan Pygmy Perch in Wedding Bells State Forest in its planning processes. The RTA (2006) "Pacific Highway Upgrade – Woolgoolga to Wells Crossing Preferred Route Report" identified the presence of known habitat downstream from Wedding Bells SF and potential habitat within Wedding Bells SF from information provided by Fisheries NSW.

NEFA's audit of Royal Camp (NEFA 2012e) found that the AHA still did not consider the presence of the Oxleyan Pygmy Perch within 100km downstream, and for a crossing proposed in mapped potential habitat of the Eastern Freshwater Cod, the site of the Aquatic Habitat Assessment used to determine whether suitable habitat existed for the Cod at a proposed creek crossing was 9km away, upstream, in farming land.

NEFA's few samples of logging operations reveal that there has been a widespread and deliberate failure to implement the minimalist requirements of the Fisheries Licence to reduce impacts of forestry operations on threatened fish in New South Wales. It is important to recognise that the prescriptions are aimed at reducing pollution and sedimentation of streams and thus are of benefit to all fish species.

Fisheries NSW have still failed to provide records of Oxleyan Pygmy Perch to Forests NSW. When last checked in mid 2011 Fisheries NSW had also failed to provide records of the endangered Purple Spotted Gudgeon to Forests NSW despite its being listed in January 2008, so it has been similarly ignored. It is also apparent that the last records of the Endangered Eastern Freshwater Cod were provided in 2002 and are in need of updating. This is a significant failure on behalf of Fisheries NSW, though Forests NSW should be capable of collating this information for themselves.

Forests NSW and NSW Fisheries have colluded for over a decade to avoid preparing Aquatic Habitat Assessments and to not take any action to implement legal requirements to protect a number of Endangered fish on the pretext that the Fisheries NSW have not provided the required data to Forests NSW. Fisheries NSW have also allowed unqualified people to prepare the few AHAs that have been done and failed to critically review Forests NSW's deficient assessments.

This raises two key questions "Why have Fisheries NSW failed to provide the required data on threatened fish to Forests NSW for over 12 years?", and "Why does Forests NSW not act responsibly and take action to protect a nationally endangered species unless forced to by the letter of the law?"

The refusal by Forests NSW to employ anybody with expertise in freshwater fish to advise them or undertake Aquatic Habitat Assessments is an obvious problem that must be addressed.

Audits have revealed that, if at all, Forests NSW are undertaking deficient Aquatic Habitat Assessments that routinely omit endangered fish, fail to collect adequate water data, and use inappropriate sites. Forests NSW's continuing refusal to consider the endangered Oxleayan Pygmy Perch on the grounds that Fisheries NSW have still not provided the required distribution maps is untenable for both organisations.

To ensure that threatened fish are responsibly dealt with and treated in a more sustainable manner, Forests NSW need to be directed to have suitably qualified people prepare Aquatic Habitat Assessments and to apply the intent of the Fisheries Licence. The Fisheries Licence needs to be amended to make its intent, to minimise eroded soil entering streams and affecting populations of threatened fish, clear and legally enforceable.

3.4. Avoiding Dieback

There are many forms of dieback affecting native forests and remnant trees in partially cleared land in NSW. The most obvious example of forest ecosystem collapse in NSW is the dieback associated with logged forests, psyllid infestations and colonies of the Bell Miner. “Bell Miner Associated Dieback” (BMAD) has affected tens of thousands of hectares of forests in north-east NSW, in severe cases leading to death of trees and replacement by lantana.

Bell Miner Associated Dieback (BMAD) is recognised as a significant problem and growing threat to thousands of hectares of forests in north east NSW, it has been listed as a “Key Threatening Process” (KTP) and identified as affecting timber and water yields, as well as many plants and animals. It is associated with the invasion of forest understoreys by the weed Lantana (another KTP) following logging. Both Forests NSW and EPA appear disinterested in the problems caused by BMAD and Lantana invasion, the need to avoid logging operations in affected stands and the need for active rehabilitation of degraded areas.

The Bell Miner Associated Dieback Working Group (BMADWG 2004) summarise the problem:

> *Bell miners are a natural part of eucalypt ecosystems and normally have minor and positive impacts on forests. However, increases in Bell miner populations and their distribution, in addition to other factors such as tree stress, psyllid infestation, dense forest understories as well as weed invasion, drought, logging, road construction, pasture improvement, bio-diversity loss both floral and faunal, soil nutrient changes, and changing fire and grazing regimes have all been implicated in the spread of dieback. The outward expression of BMAD is generally characterised by:*
>
> - *trees stressed and dying;*
> - *high populations of psyllids and other sap-sucking insects contributing to tree stress;*
> - *high Bell miner numbers, with their aggressive territorial behaviour, driving away insectivorous birds that would otherwise help to control insect numbers;*
> - *alteration of the forest structure: canopy and midstories depleted with grassy and wet and dry sclerophyll understoreys replaced by dense shrubby vegetation, often associated with lantana invasion*

The Bell Miner Associated Dieback Working Group (BMADWG 2004) summarise the consequences:

> *The potential impacts of BMAD on forest productivity and biodiversity cannot be overstated.*
>
> *Potential impacts for conservation include:*
>
> - *Extreme degradation of forest ecosystems in World Heritage listed National Parks such as Border Ranges NP, Murray Scrub and Dome Mountain in Toonumbar NP, Bungdoozle and Cambridge Plateau in Richmond Range NP, Mt Nothofagus NP, Kooreelah NP, and Mt Clunie NP.*
> - *Major disruption in ecosystem function, and reduction in diversity and abundance of threatened flora and fauna species including Dunn's White Gum (Eucalyptus dunni) and Rufous Bettong (Aepyprymnus rufescens) across all land tenures,*
> - *Increased weed invasion and associated displacement of native forest species.*
>
> *Impacts on forest productivity can be severe. Dieback defoliates the crown, ultimately leading to the death of standing trees. Not only do the standing trees die, but the lack of foliage and flowering and subsequent fruiting, reduce and eventually eliminate the seed production necessary for forest regeneration. Dense understorey development (primarily*

> *Lantana weed invasion in northern NSW and Cissus in the south) continues with little overstorey and reduced alternative species competition. Reduced eucalypt flowering directly impacts on honey production and on bird species and populations that compete with Bell miners.*
>
> *Impacts of BMAD on private lands are significant, as these areas are critical to the livelihoods and well being of local communities. Forest woodlots and timber supplies, honey production, shelter belts and forest-related lifestyles are under threat from BMAD.*
>
> *Local economies may also be impacted through declining forest tourism as dieback reduces the value, significance and aesthetic appeal of the forests.*

In 2004 Forests NSW identified almost 20,000 hectares of the approximately 100,000 hectares of apparently susceptible forest types in an area of north-eastern NSW bounded by the Border Ranges, Richmond Ranges and Captains Creek as being affected by dieback attributed to BMAD (Wardell-Johnson et. al. 2006). The NSW Scientific Committee's (2008) final determination for listing 'Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners' as a Key Threatening Process notes that:

> *Of the affected area, approximately one third (6511 ha) has been assessed as 'severe', with 'many dead trees, severe thinning of crowns, low stocking rate of susceptible species and greatly increased mesophyllic ground story vegetation including weeds such as lantana' (State Forests of NSW, 2004).*

Wardell-Johnson *et. al.* (2006) state

> *Bell Miner Associated Dieback (BMAD) is a significant threat to the sustainability of the moist eucalypt forests of north-eastern NSW and south-eastern Qld, and to biodiversity conservation at a national scale.*
>
> *...*
>
> *BMAD is a nationally significant conservation problem that has the potential to reduce the chances of achieving sustainable forest management in north-eastern NSW. There is a strong likelihood for significant biodiversity loss in the medium future in the general region, including south-eastern Qld, as well as reduced available timber volumes. Blaming Bell miners for the problem will not lead to its resolution.*
>
> *...*
>
> *The severity of the BMAD problem is such that tens of thousands of hectares in north-eastern NSW is currently affected with over 2.5 million hectares considered potentially vulnerable (Ron Billyard pers comm., Nov. 2004). A substantial (although uncertain) area of south-eastern Queensland is similarly affected, although less attention has been directed there. BMAD occurs on both public and private land and the area affected is expanding rapidly. The severe impact of this form of forest canopy dieback has profound implications for the conservation of the internationally significant biodiversity of the region.*

There are numerous requirements for Forests NSW to redress dieback and restore degraded areas to a healthy and productive condition. The IFOA (2.7.1) requires that in carrying out forestry operations "SFNSW must give effect to the principles of ecologically sustainable forest management as set out in Chapter 3 of the document entitled, "ESFM Group Technical Framework".

The IFOA (4.26) also requires:

> *SFNSW must ensure that the scale and intensity at which it carries out, or authorises the carrying out of, forest products operations in any part of the Upper North East Region, does*

not hinder the sustained ecological viability of the relevant species of tree, shrub or other vegetation within the part.

Forests NSW's (2005) ESFM Plan identifies as policy:

Forests NSW will maintain or enhance the health and productivity of forests to support nature conservation, timber production and other ecologically sustainable uses in Upper North East (UNE) Region.

In relation to BMAD Forests NSW (2005) go on to state:

Chronic decline occurs when long term environmental changes, as a result of human management, impair tree health. It is increasing throughout dry and moist eucalypt forests, particularly in coastal areas. Approximately 20,000 ha of forest within UNE Region, including about 6,000 ha on State forest is showing signs of decline while a larger area of forest throughout the region is thought to be susceptible.

In UNE Region; Forests NSW is collaborating with other agencies, universities, landholders and conservation groups through the Bell Miner Associated Dieback Working Group in the coordination of efforts to better manage chronic decline. The group has identified key actions that need to be undertaken to develop effective management measures including surveying and assessing the extent of decline, supporting independent literature review, lantana removal trials, guidelines for restoration of affected areas and promotion of the issue.

…

Declining forests are susceptible to invasion by exotic weeds such as lantana because unhealthy trees are weak competitors, and the weeds are better adapted to changed soil conditions that make the trees unhealthy.

The RFA reviews recognize the significance of BMAD, The seriousness of BMAD is stated in the NSW & CoA (2009) 5 year review of the RFA:

The resultant cycle of tree stress commonly causes the eventual death of forest stands, and serious ecosystem decline. In NSW the potential impact of BMAD-induced native vegetation dieback represents a serious threat to sclerophyll forest communities, particularly wet sclerophyll forests, from Queensland to the Victorian border. The forests most susceptible to dieback are those dominated by Dunn's white gum (Eucalyptus dunnii), Sydney blue gum (E. saligna), flooded gum (E. grandis) and grey ironbark (E. siderophloia). There is also evidence that some normally non-susceptible dry sclerophyll types may be affected when dieback is extreme. Current estimates place the potential at-risk areas at a minimum of approximately two and a half million hectares across both public and private land tenures in NSW.

BMAD is emerging as a pressing forest management issue in both the UNE and LNE regions. The potential impacts include:

- *degradation of sclerophyll forest ecosystems across the UNE and LNE*
- *reduction in diversity and abundance of threatened flora and fauna species including Dunn's white gum and rufous bettong*
- *increased weed invasion and associated displacement of native forest species.*

Dieback-affected areas are located in the catchments of the major rivers of the North Coast of NSW including the Tweed, Richmond, Clarence, Macleay and Hastings. Maintenance of water quality in these river systems is critically dependent on maintenance of healthy forest

> *cover over the catchment uplands. Bell miner associated dieback has the potential to degrade these forests, and consequently impact negatively on rivers and catchment communities through increased sediment and nutrient loads, and increased frequency and intensity of flooding.*

The 2003/4 FA implementation report (NSW Government 2007) and DECCW (2010) echo these concerns and identify BMAD as *"a serious threat to sclerophyll forest communities, particularly wet sclerophyll forests".* The NSW&CoA (2009) 5 year RFA review identifies that BMAD *"is of prime concern in the northern forest regions of the state".*

Bell Miner Associated Dieback is a major threat to the sustainability of many forest ecosystems over large areas of north-east NSW, and appears to be rapidly worsening. Tens of thousands of hectares of forest in north-east NSW are affected and hundreds of thousands of hectares are vulnerable. It is a serious threat that has been procrastinated over for far too long.

3.4.1. THE CAUSES OF BELL MINER ASSOCIATED DIEBACK

NEFA considers that Bell Miner Associated Dieback is typically associated with heavily logged forests where much of the overstorey has been removed and the understorey invaded by lantana. While we recognise that there are a variety of confounding factors we consider heavy logging to be the primary factor responsible for its current extent. Our concern is that the range of secondary factors are being used to confuse the issue and frustrate required responses.

The NSW Scientific Committee's (2008) final determination for listing 'Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners' as a Key Threatening Process notes that:

> *Broad-scale canopy dieback associated with psyllids and Bell Miners usually occurs in disturbed landscapes, and involves interactions between habitat fragmentation, logging, nutrient enrichment, altered fire regimes and weed-invasion (Wardell-Johnson et al. 2006). At present, no single cause explains this form of dieback, and it appears that 'Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners' cannot be arrested by controlling a single factor. Over-abundant psyllid populations and Bell Miner colonies tend to be initiated in sites with high soil moisture and suitable tree species where tree canopy cover has been reduced by 35 – 65 % and which contain a dense understorey, often of Lantana camara (C Stone in litt.).*
>
> *…Increased light intensity associated with canopy reduction promotes the growth of the expanding foliage preferred by psyllids as well as understorey growth which is also influenced by altered fire regimes. Increased understorey growth, particularly of the invasive weed Lantana camara, suppresses eucalypt regeneration and provides enhanced shelter and safer nest sites for Bell Miners.*

Stone *et. al.* (1995) found that the affected areas range in size from 1 ha to nearly 100 hectares, with the Sydney Blue Gum league of forest types (FT no's 46, 49, 53 and 54) most affected and the grey ironbark/grey gum league (FT 60) second most affected. They note that *"The vast majority of plots (97%) had been exposed to some degree of logging and were on their second or third*

rotations", postulating *"that bell miners prefer a dense understorey and a discontinuous sclerophyll overstorey."* Stone et. al. (1995) concluded that:

> *"A possible long-term explanation of why the dieback problem may be increasing, is that the proportion of moist sclerophyll forest being exposed to selective logging is increasing throughout the State. In support of this argument is the observation that the non-logged old growth Sydney blue gum stands in Pt. Giro State Forest (Walcha District) are in good health(based on aerial observations) and bell miner colonies appear to be absent in this forest (R. Kirwood, Forester, Walcha District, pers. Comm.)."*

Wardell-Johnson *et. al*. (2006) state

> *A range of multi-tropic attributes (e.g. local climate/host tree condition and structure/natural enemies) have been identified as contributing to elevated psyllid populations. Fragmentation, changed disturbance regimes (particularly fire and logging), and pathogens are implicated. Changes in nutrients and other soil constituents, climatic regimes and hydrological factors have also been implicated.*
>
> *...*
>
> *Logging and associated disturbances can have direct and indirect effects on overstorey, midstorey and understorey structure and floristics. However, studies directly associating logging, forest structure, floristics and BMAD have not been carried out. While the proliferation of dominant understorey weeds, such as Lantana (Lantana camara), in the north-eastern region of NSW has largely been attributed to the disturbance caused by logging and associated activities, no direct link between BMAD and Lantana has been established.*
>
> *…*
>
> *Bower (1998) argued that it is probable that broad-scale habitat modification through intensive logging operations and subsequent Lantana domination has promoted conditions that favour the establishment of psyllids and Bell miner colonies.*
>
> *...*
>
> *Kavanagh and Stanton (2003) argued that their findings supported the hypothesis that the disturbance associated with logging can be a contributing factor in creating the habitat conditions required by Bell miners.*
>
> *...*
>
> *…Stone (1999) suggested that selective logging without effective overstorey regeneration encouraged dense understorey development. She suggested that this provided conditions favouring the colonisation of Bell miners. Stone (1999) argued that Bell miners then trigger forest decline because they interfere with predators that would otherwise regulate folivorous insects.*
>
> *…*
>
> *Hence, logging operations may be both implicated in the development of BMAD, and affected by changes in yield induced by BMAD. Nevertheless, the literature remains very limited concerning the impacts of logging and associated disturbance on the initiation or development of BMAD.*
>
> *...we have not been able to locate information concerning the impacts of logging on BMAD. We find it surprising that more information is not available concerning the direct and indirect impacts of logging, in the preferred Bell miner habitat of north-eastern NSW. The increase in the area of BMAD has potential not only for significant biodiversity loss, but also for significant reduction in timber yields from these eucalypt stands.*

In north east NSW BMAD is most commonly associated with the invasive weed lantana. Even where not associated with dieback, lantana is the most significant understorey weed in north east NSW. In deciding to list the Invasion, establishment and spread of Lantana (*Lantana camara* L. *sens. lat*) as a key threatening process, the NSW Scientific Committee note:

> *9. L. camara readily invades disturbed sites and communities. Various types of sclerophyll woodlands, sclerophyll forests, rainforests and dry rainforests are all susceptible to Lantana establishment ... There is a strong correlation between Lantana establishment and disturbance (Stock and Wild 2002; Stock 2004), with critical factors being disturbance-mediated increases in light and available soil nutrients (Gentle and Duggin 1998) and, in rainforest, the competitive advantage of seedlings relative to many native species (Stock 2004). ...*
>
> *...*
>
> *16. The generally suppressive effect of Lantana on a wide range of native species is attested by several studies (Gentle and Duggin 1998, Day et al. 2003) and a multitude of field observations. Swarbrick et al. (1995), citing observations by Driscoll and Quinlan (1985) that "eucalypt seedlings generally fail to establish under lantana", infer inhibition of germination through lack of light. ....*
>
> *...*
>
> *22. L. camara is "regarded as one of the worst weeds in Australia because of its invasiveness, potential for spread, and economic and environmental impacts" (CRC Weed Management 2003). It is one of the initial 20 Weeds of National Significance declared under the National Weeds Strategy, and a national Lantana Strategic Plan has been adopted (ARMCANZ ANZECC&FM 2001). ...*

In relation to lantana, the Bell Miner Associated Dieback Working Group (BMADWG 2004) state:

> *Lantana is a highly invasive weed affecting a range of land-use types within a wide range of climates and topographies of Australia. The complexity of this weed is amplified by its 29 different varieties, difficulty in integrating control measures and finding suitable biocontrol agents. The extensive infestation across more than 4 million hectares poses a threat to economically effective control. Lantana is a social problem for landholders and community. The National Lantana Strategy highlights the need for increased responsible action and incentive to landholders, local government, regions and State government to take action. The Strategy establishes the National Lantana Management Group; provides for extension and education; encourages best practice in lantana control and management; and includes a community biocontrol element encouraging adoption of biological control measures.*

Wardell-Johnson et. al. (2006) state

> *While Lantana may not be a primary causal factor initiating BMAD, the literature suggests that its presence reflects increased canopy opening, which in itself may be a primary cause for increases in psyllids. These outbreaks in turn may attract the presence of Bell miners, which have the benefit of increased food resources and suitable structure for nesting. There has been some advocacy for management strategies which reduce weed encroachment and plant community degradation to identify and maintain ecological barriers to Lantana invasion. Because large areas in the region affected by BMAD are dominated by Lantana, there has also been advocacy towards the use of fire as a means of Lantana control.*
>
> *...*
>
> *For the environments in which BMAD occurs, arguments have been presented suggesting a need both for more frequent fire, and for less frequent fire in particular ecosystems. ...*
>
> *...*

> *... Lantana in particular has become a dominant understorey plant in open areas of eucalypt forest in the region (Bower 1998: Wardell-Johnson et al., 2005). There have been many recent changes in agriculture and forest management in north-eastern NSW that have been associated with the spread and intensification of Lantana in particular, but also a wide range of other weedy species (see Kanowski et al., 2003; Wardell-Johnson et al., 2005).*
> *...*
> *Bower (1998) argued that the proliferation of Lantana in his study areas was largely associated with the disturbance associated with logging activities which improves the conditions for Lantana germination and recruitment. Bower (1998) further argued that while high intensity burns can be effective at controlling Lantana, many post-logging burns are of low to medium intensity and have often been found to be ineffective at controlling Lantana, which resprouts from basal stems. Bower (1998) argued that the inability of Lantana dominated areas to regenerate significantly impacts on the succession of a structurally complex forest ecosystem.*
> *...*
> *Gentle and Duggin (1997)...found that shading played a greater role as a limiting factor than any other and concluded that successful invasions of Lantana are likely to occur whenever canopy disturbances create patches of increased light availability. ...*
> *...*
> *... While it is no surprise that Lantana proliferates as the eucalypt canopy opens or dies or that Lantana is associated with events which disturb the soil and open the ground to sunlight, this does not mean that Lantana is a cause of BMAD.*

While there have been a number of logging trials established, the principal problem is that Forests NSW continue to log in and adjacent to BMAD areas without considering the impacts of their operations on the proliferation of the Key Threatening Processes of BMAD and Lantana invasion. In affected areas logging is focussing on the removal of most of the healthiest trees surviving, is promoting lantana due to extensive understorey removal, and this degradation then favours BMAD. And they can not be bothered monitoring the effects or undertaking post-logging rehabilitation. These impacts will be compounded by increasing severity of droughts due to climate change (which is likely to already be a factor in the spread of this problem).

Bell Miner Associated Dieback is associated with logging opening up the canopy and understorey disturbance promoting lantana, which in turn favour Bell Miners who aggressively exclude other birds and thereby facilitate outbreaks of sap-sucking insects which kill the trees. BMAD is degrading, and increasingly destroying, both forest ecosystems and forest productivity.

3.4.2. WHAT IS BEING DONE ABOUT BELL MINER ASSOCIATED DIEBACK

The North East Forest Alliance has been pursuing the issue of Bell Miner Associated Dieback for over twenty years. We tried to get it addressed in the Environmental Impact Statements prepared in the early 1990s. This was a major issue we pursued when we were on the North East Harvesting

Advisory Board in 1996/8. We unsuccessfully attempted to have this issue dealt with in the CRA process. We have been involved with the BMAD Working Group since early 2002.

While we recognise that we have made some progress over that time the condition of the forests has continued to decline, and Forests NSW are continuing to ignore and compound the problem in their logging operations.

State Forests recognised dieback associated with psyllids as a significant problem in the Gosford-Wyong area of north-east NSW in 1950 (Moore 1959). Stands of Sydney Blue Gum were reported as dying during the period 1949 to 1958, *"the increasing numbers of deaths reaching economic significance toward the end of that period"* (Moore 1959). The two areas assessed by Moore showed 55% and 59% of trees as dead or expected to die. Moore (1959) hypothesised that *"the abnormal rainfall adversely affected the physiology of* Eucalyptus *and other species generally, making them susceptible to heavy attack by psyllids*." Bird et. al. (1975) report Moore (1962) as finding that *"there were more than 150 separate occurrences of variable extent up to 1,500 ha."*

Wyong District Forester, Charlie Mackowski (pers. comm.), noted that field work in the early 1990's had delineated 5,000 hectares of "Bellbird Dieback" on State Forests in the then Wyong District.

Forests NSW (Stone et. al. 1995) have identified significant areas of dieback in the Morisset, Bulahdelah, Gloucester, Taree, Wauchope, Kempsey, Walcha and Urbenville districts. Stone et. al. (1995) notes *"More recently, District staff have reported that affected areas are increasing in size and that previously unaffected areas are developing symptoms."*

In 2003 the NSW Nature Conservation Council Annual Conference unanimously passed the resolution:

> *'that there should be no further logging in BMAD affected forests or those at high risk of developing BMAD until the causes of the problem are better understood and an acceptable, sustainable management plan is developed to restore the health of these forests'.*

The Bell Miner Associated Dieback Working Group (BMADWG 2004) has identified key actions that they consider need to be undertaken in order to develop effective management measures for BMAD. They do not address logging directly, though include "*Developing guidelines for restoration of dieback affected sites which may be implemented by landholders and government agencies*".

The NSW Scientific Committee's (2008) final determination for listing 'Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners' notes that

> *8. Due to the complex interaction between factors that have been altered as a consequence of landscape-level disturbance, there is at present no obvious means of arresting the threat presented by 'Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners'. Moreover, expert opinion varies considerably as to which factors are causes of dieback and which factors are effects. Broad-scale research and adaptive management are required to understand how to best manage this threatening process, to prevent its expansion throughout forests of eastern New South Wales.*

NEFA understand (J. Morrison pers. com.) that DECCW are presently preparing a 'Statement of Intent' to address the BMAD Key Threatening Process determination. NEFA note that this is a considerably weaker response than the preparation of a 'Threat Abatement Plan' and is only required on the NPWS estate. NEFA consider that attempts to address the BMAD issue warrants strong legislative requirements across all tenures in relation to disturbance to at risk forests and

mandatory requirements to undertake post disturbance rehabilitation where disturbance cannot be avoided.

The Bell Miner Associated Dieback Working Group (BMADWG 2004) identifies Forests NSW's claimed approach:

> *Consistent with the EFSM requirements FNSW are preparing Regional Forest Health Management Plans as part of the Native Forest Health Management Strategy. The current management intent is to integrate native forest harvesting with trials to reduce the spread of dieback into open forests by use of frequent low intensity fire and to trial rehabilitation methods for dieback affected areas.*

While some trials have been instigated, the heavy logging of BMAD affected areas continues unabated.

Wardell-Johnson et. al. (2006) conclude:

> *...It may be appropriate for management to prevent the creation of habitat that is preferred by the Bell miner, as such habitat will also facilitate the primary cause of eucalypt dieback. However, to attempt such management intervention in isolation from an understanding of both the processes and the behaviour of Bell miners under different levels of disturbance may compound the problem.*

Forests with existing colonies of bell miners and susceptible tree species are at very high risk of developing BMAD following disturbance and subsequent weed invasion. NEFA considers that considerable resources need to be directed towards rehabilitation of extensive weed infested tracts of susceptible forest types, and the minimizing of disturbance to less than thirty percent canopy removal relative to a fully stocked healthy forest stand.

When NEFA were on the North East Harvesting Advisory Board in the late 90s we attempted to get Forests NSW to map dieback areas in compartments on harvest plans. According to Jim Morrison (pers. comm. 2010) the BMAD Working Group's attempts to get Forests NSW to take appropriate action has been similarly frustrated:

> *The BMADWG has for a number of years requested that FNSW record simple data about the presence of Bell Miners and or associated dieback on its harvest plans as they are prepared. Systematic, simple BMAD identification procedures urgently need to be made a mandatory part of the harvest planning process. This could be done when ecological surveys are undertaken, and also by the harvesting forester and be required to be reported just like any other threat identified in logging compartments. In fact the continued refusal of Forest NSW to undertake this simple task requested by the BMADWG only heighten suspicion that Forest NSW don't want to reveal the full extent of the problem across its estate.*

For over 60 years the growing problem of Bell Miner Associated Dieback has been procrastinated over despite the clear evidence that it is being facilitated by the opening of the canopy by logging and the consequent spread of lantana facilitated by machinery disturbance and burning. BMAD affected forests are being targeted for increased logging intensity without rehabilitation works.

The Inquiry is requested to support a sustainable approach to the key threatening process Bell Miner Associated Dieback by recommending an urgent moratorium on logging in and adjacent to BMAD areas until such time as rehabilitation strategies for restoration of ecosystem health are implemented.

3.4.3. A CASE STUDY IN MANAGEMENT

Bell Miner Associated Dieback occurs in an area recently audited by NEFA. Despite the presence of an Endangered Ecological Community and an endangered wallaby in the same area we found that Forests NSW made no attempt to delineate the area affected by dieback, logged most of the healthiest trees remaining, and has no intention to rehabilitate the severely degraded "forest" left behind. Both Forests NSW and DECCW appear disinterested in the problems caused by BMAD and Lantana invasion, and the need for active rehabilitation of affected stands.

The audit of Yabbra (Pugh 2009) encompassed a large expanse of forests in Compartment 163 suffering from Bell Miner Associated Dieback (BMAD), with a dense lantana understorey in places. The forest ecosystems most affected are Grey Box-Red Gum-Grey Ironbark, and Wet Bloodwood-Tallowwood, which have achieved 41% and 82% respectively of their national reservation targets (including in Informal Reserves and Protection by Prescription). Also affected is the Endangered Ecological Community *White Gum Moist Forest.* In the affected areas there were numerous sick and dead trees with extensive lantana understoreys.

The degraded nature of these stands can be largely attributed to past logging opening up the overstorey and burning regimes promoting lantana. The creation of a low dense understorey and opening up of the canopy are factors which favour dominance by Bell Miners. The Bell Miners in turn facilitate lerp predation on retained trees and regrowth, causing widespread dieback.

These forests had been suffering from Bell Miner Associated Dieback for over thirty years (pers. obs.) and thus those trees still hanging on were survivors. It is likely that the presence of Yellow-bellied Gliders assisted their survival by predating on lerps. Though the ability of the few trees now remaining to persist has been jeopardised by Forests NSWs felling of the sap and feed trees required to be retained to maintain Yellow-bellied Gliders in the area.

The Harvesting Plan for compartments 162 and 163 of Yabbra SF (4.2) states:

> *Lantana & shrubby understorey is providing conditions suitable for occurrence of Bell Minor* (sic) *Associated Dieback (BMAD). A significant section of the harvest area has been adversely affected. There are many dead stems and the crowns of some of the remaining trees are thin and appear unhealthy. BMAD affected areas will have unhealthy merchantable trees removed during this operation*.

This is it. There was no mapping of dieback areas, no assessment of severity, no consideration of amelioration measures to apply in dieback areas, nothing.

The applied logging prescription "*BMAD affected areas will have unhealthy merchantable trees removed during this operation"* resulted in a logging intensity well in excess of the 35% Basal Area removal claimed in the harvesting plan and the maximum 40% allowed to be removed by the IFOA (1.5.10) silvicultural practices. What is effectively a "maximum economic utilisation" silvicultural regime is not allowed for by the UNE IFOA.

Given that most eucalypt trees in the worst affected areas were either dead or unhealthy, this prescription resulted in the removal of most of the biggest and healthiest trees from the dieback areas. Some retained trees were killed in the post logging burn and others by the added stress.

PHOTOS: BELL MINER ASSOCIATED DIEBACK IN YABBRA SF SUBJECT TO SINGLE TREE SELECTION. NO REHABILITATION IS PROPOSED AND REGENERATION IS NOW BEING SMOTHERED BY WEEDS.

From our audit (Pugh 2009), we reported that:

> *Most remaining healthy trees were removed from forests affected by Bell Miner Associated Dieback (resultant from previous logging operations), having significant degrading impacts on forest health, ecosystem functioning and viability and forest productivity. Many retained affected trees had then succumbed to the hot post-harvest burn. This logging and "management" is clearly not in accord with any of the principles of ecologically sustainable forest management as defined in the IFOA (breaches IFOA conditions 2.7.1 and 4.26).*
>
> *Bell Miner colony establishment was noted to be widespread throughout Compartments 162 and 163 and appeared to have been favoured by the logging and burning operations. It can be expected that the threatening process associated with colonies of this species (BMAD) will cause further deaths of trees, severely retard forest recovery and result in the loss of substantial areas of threatened species' habitat in the mid to long-term.*

It was obvious to those visiting the site that there had been excessive canopy removal, though neither Forests NSW nor DECCW would accede to our request to measure tree retention by establishing transects as required in their own auditing manual. Initially both Forests NSW and DECCW told NEFA that it was impossible to audit tree retention, though in accordance with an IFOA requirement in 2003 Forests NSW developed a "Forests Practices Circular" (2003/01) "Monitoring and Measuring Compliance of Operations" which includes a "Compliance check sheet – Tree retention". It basically requires the recording of trees on 250m transects.

The outcomes from this logging and burning of the dieback areas were significant reductions in canopy cover, further degradation of the understorey, and prolific weed growth, particularly of lantana. While there has been eucalypt regeneration amongst the weeds, the problem for Forests NSW is that this means that the weeds can not be burnt until the eucalypts are large enough to survive the burn. Many will not be able to out-compete the weeds. The forestry operations have greatly compounded the existing BMAD problems and left the dieback areas in a parlous state (see photos in Pugh 2009).

In DECCW's response (Simon Smith, 19/5/2010) they dismiss our concerns regarding BMAD on the spurious grounds that the logging, burning and subsequent weed proliferation that occurred in and adjacent to an existing BMAD area could not be proved to have affected it:

> *DECCW notes your concerns regarding Bell Miner Associated Dieback (BMAD) and the principles of ecologically sustainable forest management. It is noted however that the NSW Scientific Committee's determination in relation to broad-scale canopy dieback associated with psyllids and Bell Miners "involves interactions between habitat fragmentation, logging, nutrient enrichment, altered fire regimes and weed-invasion". The Scientific Committee's determination also notes that "at present, no single cause explains this form of dieback. And it appears that 'Forest eucalypt associated with over-abundant psyllids and Bell Miners' cannot be arrested by controlling a single factor". An Inter-agency BMAD working group is working to improve knowledge on the interrelation of land management activities and the prevalence of BMAD.,*
>
> ...
>
> *As noted above, the NSW Scientific Committee's determination notes that there is inadequate information available to determine if Bell Miner populations and Bell Miner associated Dieback has been favoured by these logging and burning operations.*

This is an abomination of the "Precautionary Principle" in that lack of certainty about the interaction of known causative agents of BMAD is used to justify undertaking activities known to contribute to dieback. What is most reprehensible is that DECCW did not consider that the undertaking of activities that were likely to aggravate the BMAD, a Key Threatening Process, even warranted documenting and monitoring.

It is evident that logging is a contributing factor to Bell Miner Associated Dieback, and that the reduction in canopy and the growth in weeds (enhanced by the hot fire) are contributing factors to this key threatening process and will thus exasperate existing problems. As can been seen from the photographs (Pugh 2009) the forest is a mess.

The fact that the BMAD in compartment 163 is affecting inadequately reserved forest ecosystems, the endangered ecological community *White Gum Moist Forest*, and known locations of the Endangered Black-striped Wallaby, vulnerable Yellow-bellied Glider and vulnerable Brush-tailed Phascogale, appears to be irrelevant to DECCW.

By no stretch of anyone's imagination can logging of these dieback areas be considered "ecologically sustainable". As is particularly obvious in compartment 163, logging is being undertaken in dieback areas in contravention of silvicultural requirements to apply single tree selection, retain 60% of basal area of trees above 20cm dbh, and concentrate growth on the more vigorous trees while promoting low level site disturbance for regeneration. Rather logging is based on a maximum economic utilization basis.

Despite BMAD and lantana being emphasized in our audit, and on a site inspection with Forests NSW's CEO Nick Roberts, in Forests NSW's (2010) subsequent "Rehabilitation and Monitoring Plan, Compartments 162 and 163 Yabbra State Forest No 394" there is no mention what-so-ever of the dieback issue, no delineation of problem areas, and no identification of rehabilitation measures relevant to the problem. There is no identification of problem and noxious weeds, not even a mention of Lantana. This plan has been endorsed by DECCW.

There are generic prescriptions for enrichment plantings with eucalypts and Hoop Pine should sites requiring rehabilitation be identified, though no such sites have been identified. There is also an intention to "*Introduce and maintain low intensity fire regime into the grassy forest areas on 3-5 year cycle",* though this is inappropriate in eucalypt regrowth and in areas that naturally have a rainforest understorey. Given that most of the understorey in the dieback areas is now thick weeds with a scattering of eucalypt seedling which have little chance of out-competing the lantana, the forest is in a parlous state. If they burn it again they will just kill the eucalypt seedlings. The only commitment is to some unspecified monitoring – they can watch the seedlings die.

There is no commitment for any immediate action to control rampant weeds and assist recovery of dieback areas despite the need for immediate action being obvious. It is a do nothing, wait and see, response to an urgent problem. Unless NEFA can force action we suspect we will be waiting a long time.

BMAD needs to be dealt with as a serious issue. It is contrary to the most basic principles of ESFM that Forests NSW can go on logging areas affected by BMAD, particularly as there is sufficient evidence that this is likely to aggravate the problem. For Forests NSW to be allowed to practice maximum economic usage in the worst affected stands, without specific management prescriptions, a specific rehabilitation plan, and at least a pretence of scientific monitoring, is grossly irresponsible.

The reality is that in the most heavily logged areas the survival of the stands of inadequately reserved ecosystems is doubtful and that the productive capacity of these ecosystems has been dramatically diminished to the point of being unlikely to provide any timber resources for a considerable time. BMAD is now likely to worsen and expand into the healthier stands (including Dunn's White Gum), native species have been diminished and weeds promoted. Anyone buying timber sourced from such dieback areas are aiding and abetting this environmental vandalism.

Forests NSW are targeting Bell Miner Associated Dieback Areas for removal of all healthy remaining trees and then abandoning them to their fate as destroyed ecosystems. A sustainable response to Bell Miner Associated Dieback involves:

a. **Identifying and mapping all affected and susceptible areas;**
b. **Placing all affected and susceptible areas under a logging moratorium until such time as appropriate management responses that restore ecosystem health and functioning are identified;**
c. **Undertaking rehabilitation works (i.e. lantana control) in affected stands; and,**
d. **Monitoring effects of any treatment and refining methods before repeating it.**

3.5. Constraining Grazing to Limit Impacts

It is true that people often can't see the forest for the trees. If you look hard enough beneath the trees you may still be lucky enough to see an understorey with its natural abundance of shrubs, herbs, grasses and large logs, upon which numerous species of invertebrates, mammals, birds, reptiles and frogs depend. Grazing focuses on this understorey. The impacts of grazing are concentrated in the vicinity of streams and wetlands.

Wilson *(1990)* notes *"The grazing lands are home to approximately 50 million sheep and 15 million cattle. They are also grazed by approximately 20 million kangaroos, 0.5 million feral goats and perhaps 100 million wild rabbits. This is a major increase in the intensity of defoliation compared with that 200 years ago. Herbivore numbers were then comparatively low (although more diverse), and controlled more by scarcity of water and predators than by forage supply."*

Cattle directly affect forests by permanently changing the structure and composition of forest ground cover and understorey vegetation *(Hobbs and Hopkins 1990, Wilson 1990, Bennet 1990b, RAC 1992a)*; removing nutrients from, and redistributing nutrients within, forests *(Landsberg, Morse and Khanna 1990, RAC 1992a)*; assisting the invasion of introduced plants *(Smith and Waterhouse 1988, A.N.P.W.S. 1991)*; compacting and degrading soils *(Hobbs and Hopkins 1990, Wilson 1990, A.N.P.W.S. 1991);* degrading stream banks and wetlands *(Debus and Czechura 1988, Hobbs and Hopkins 1990, CWCMA2008)*; eliminating regeneration of overstorey trees *(Saunders 1979, Bennet 1990a)*; and causing reductions in populations of a variety of mammals, birds and invertebrates by competition for food and shelter while also destroying shelter for other species *(e.g. Jarman 1986, Annon 1988, Wilson 1990, Bennet 1990b, Hobbs and Hopkins 1990, RAC 1992a)*.

The Central West Catchment Management Authority's (2008) Best Management Practices for riparian areas highlight some of the impacts of grazing in these particularly vulnerable areas:

> *The grazing and trampling activities of domestic livestock have had a particularly pervasive influence on riparian habitats. Livestock spend a considerable amount of their time at landwater interfaces as they congregate to drink, access palatable forage and gain refuge from heat. Introduced livestock and inappropriate grazing management are among the most significant causes of chronic modification to land-water interfaces in Australia*
> *...*
> ***Grazing impacts on streamside vegetation***
> *The prolonged trampling, rubbing and browsing of riparian lands by stock can physically damage plants and compact the soil. Compaction may reduce soil infiltration rates, increase runoff and decrease water availability to plants as well as reduce germination rates of seeds. The potential of the riparian zone to act as a buffer strip and improve water quality is also decreased5, while loss of groundcover allows soil temperature to rise and increases evaporation from the soil surface.*
>
> ***Grazing impacts on soil and streambeds***
> *Loss or modification in composition and biomass of soil-binding vegetation communities, together with the impact from hard-hoofed animals reduces the structural stability of stream banks6. This impact results in increased susceptibility to erosive forces and results in higher loads of sediment into waterways. ...*
> *...*
> ***Grazing impacts on water quality***
> *Uncontrolled livestock grazing affects water quality in several ways, including:*

- *an increase in water temperature due to the loss of streambank vegetation and reduced shade cover,*
- *an increase in turbidity resulting from increased levels of suspended sediments from exacerbated bank erosion and/or elevated inputs from overland flow, and*
- *an increase in nutrient and pathogen levels from soil, overland flows and faeces. Faeces and urine of stock in the riparian zone and waterway directly contributes to phosphorous and nitrogen levels in streams. Cattle have been found to defecate 50 times more per metre of stream crossing than on adjacent raceways.,,,*

...

Grazing impacts on habitat

Livestock in riparian zones can also have significant detrimental effects on instream and bank-side ecology. Elevated nutrient and sediment loads can lead to prolific algal growth, reduced light penetration in the water column and suppression of in-stream processes. Vital habitats can be smothered by deposited fine sediments and disturbed by animals walking in-stream.

Fish and aquatic invertebrate population diversity and assemblages can be indirectly affected by all the impacts to the water quality and loss of habitat as described above. Other organisms affected by uncontrolled grazing in riparian lands include terrestrial birds and freshwater crayfish.

Habitat structure is a major determinant of bird species diversity. Extensive grazing practices can significantly alter the structure and composition of riparian habitat through a combination of trampling, grazing, changes in nutrient fluxes and loss or altered recruitment. Collectively these impacts result in a decline in abundance of riparian birds. Likewise, freshwater crayfish which burrow into riverbanks, are also affected by riparian land uses that impact on soil condition and vegetation cover. In-stream habitat stability which is conferred by intact riparian vegetation is important in crayfish survivorship. In conjunction with bank instability, soil compaction and larger nutrient loads, significantly fewer crayfish burrows are found in areas of grazed riparian lands than in native forest.

Grazing impacts on flora and fauna become particularly severe in drought periods when native fauna become concentrated into wetter areas along with stock *(Hobbs and Hopkins 1990, Recher and Lim 1990)*. This effect is accentuated by the practice of maintaining excessively high stocking rates at the onset of droughts *(Hobbs and Hopkins 1990)*.

The principle management tool used by graziers in forests is fire. Most like to burn the forest frequently (often every 1-3 years) to promote fresh green pick for their cattle.

The consequences of the combination of grazing and frequent fires on our biodiversity are profound. Together they have been responsible for the elimination of numerous species from vast tracts of our native forests, some being wiped from the face of the planet. Many of our most threatened plant and animal species survive only in or near refuges from frequent fires and cattle.

State Forests have long complained that, aside from them, *"Fire has been the most destructive agency"* in the forest, and that *"Most fires result from uncontrolled or unauthorised (often illegal) burning off by pastoralists during the spring"* (ie Dorrigo Management Plan, 1985). Their commercial concern is this burning is causing "*the death of regeneration and large trees, loss of increment due to total or partial crown removal and butt and bole damage to crop trees causing increased defect"* (ie Urbenville Management Plan 1986).

It is not just the commercial potential that is being degraded. As noted in the Fauna Impact Statement prepared by Austeco (1992) for State Forests' Glen Innes EIS; *"Frequent burning*

suppresses the shrub component of the forest and greatly reduces floristic diversity in the ground cover and midstorey layers (Binns 1991). The decrease in floristic diversity and the simplification of forest structure caused by fire, in turn causes changes in the faunal species composition of the forest. In all the major faunal groups studied, Birds, Reptiles and Mammals, some species were found to be advantaged and others disadvantaged by grazing and burning. However, more species were disadvantaged than advantaged by grazing and burning, and those benefiting were predominantly common species of low conservation significance. In order to secure the future of species that are disadvantaged by frequent burning and grazing, it will be necessary to maintain some areas of hardwood forest free of grazing, and subject to infrequent fire regimes."

Frequent low intensity fires (prescribed burns) have been noted to eliminate the shrub layer and allow grasses and ferns to dominate the understorey *(Gill 1975, McIlroy 1978, Catling 1991)*; cause a loss of obligate seed-regenerating plants if they don't have enough time between fires to set seed *(Gill 1975, Floyd 1976, Ashton 1981, Noble and Slatyer 1981, Lamb 1986)*; increase the risk of fire by enhancing more inflammable species *(Floyd 1964, Gill 1975, Noble and Slatyer 1981, Hopkins 1981)*; promote weeds (Floyd 1964) and destroy eucalypt regeneration *(Floyd 1964)*.

Floyd *(1964)* notes that in northern NSW the succulent kangaroo grass has been replaced due to fire (mostly instigated by graziers) by the tough and largely unpalatable bladey grass and whisky grass, concluding that *"Perhaps the grazier is merely an unwitting slave to the fire over which he claims mastery."*

Species of small ground mammals exhibit a replacement sequence in reaching maximum abundance following fire, variously species may reach maximum abundance after one to eight years, with populations of some species found to be still increasing after six to eight years and even after 30 years *(Fox and McKay 1981, Wilson et al. 1990)*. Populations of some species may be eliminated by fire *(Wilson et al. 1990, Townley 1996)* and others may not establish populations in burnt areas for many years *(Fox and McKay 1981, Lunney, Cullis and Eby 1987, Wilson et al. 1990)*.

Fire results in the loss of shrubs, and the invertebrates, nectar, nest sites and shelter from predators they provide for birds *(Cowley 1971, Recher, Allen and Gowing 1985, Recher 1991)*, and the loss of woody material and litter, and the invertebrates and nest materials they supply *(Recher 1991)*. Recher, Allen and Gowing *(1985)* found that following a wildfire the density of birds in unlogged forest was reduced to averages of 38-54% of unburnt stands and numbers of species to 71-86%. Reptiles are affected by loss of logs and litter by burning *(Dunning and Smith 1986)*.

While populations of some species may recover in parallel with the rate of post-fire revegetation *(Recher, Allen and Gowing 1985, Recher 1991)* it is considered that frequent burning can result in degraded habitat and the loss of habitat components upon which species rely *(Cowley 1971, McIlroy 1978, Leigh and Holgate 1979, Saunders 1979, Rohan-Jones 1981, Mackowski 1987, Debus and Czechura 1988, Moon 1990, Wilson et al. 1990, Winter 1991, Catling 1991).*

As noted by Catling (1991): "*For the long-term survival of our forest fauna, managers must begin to question the frequent use of low-intensity prescribed fires, particularly the aerial ignition of large tracts of forest as a prescribed burning technique, because it creates large tracts of simplified forest habitat detrimental for most native fauna."*

Burning has been shown to affect forest soils by releasing large quantities of nutrients in smoke to be deposited elsewhere on land or in the sea *(Harwood and Jackson 1975, Raison 1980, Stewart*

and Flinn 1985, Stewart et. al. 1989, Sims 1991), significantly changing soil chemistry, structure and functioning *(Floyd 1964, Langford and O'Shaughnessy 1977, Raison 1980, Leitch, Flinn and van de Graaff 1983, Stewart and Flinn 1985, Sims 1991)*, and exposing the soil to loss of large quantities of nutrients by wind and water transport of ashes and organic matter *(Floyd 1964, Good 1973, Raison 1980, Langford and O'Shaughnessy, 1977, Leitch, Flinn and van de Graaff 1983, Atkinson 1984).*

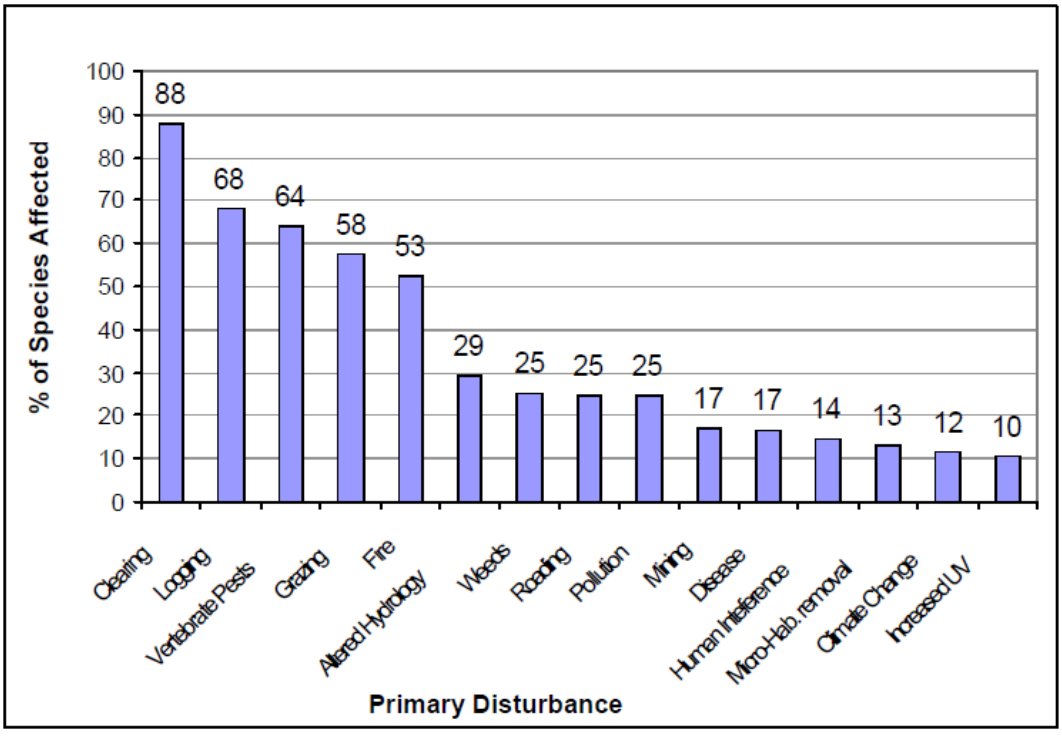
As Ashton *(1981)* points out, *"the fertility of soils is likely to be depleted in areas of high rainfall subjected to repeated burning. In terms of ecosystem potential it is a 'downward spiral'."*

The Resource Assessment Commission *(1992a)* concluded *"Given the evidence for serious impacts on the forest environment from grazing of domestic stock and the inherent difficulties of enforcing codes, forest management agencies should review whether the marginal benefits are worth the environmental risks."*

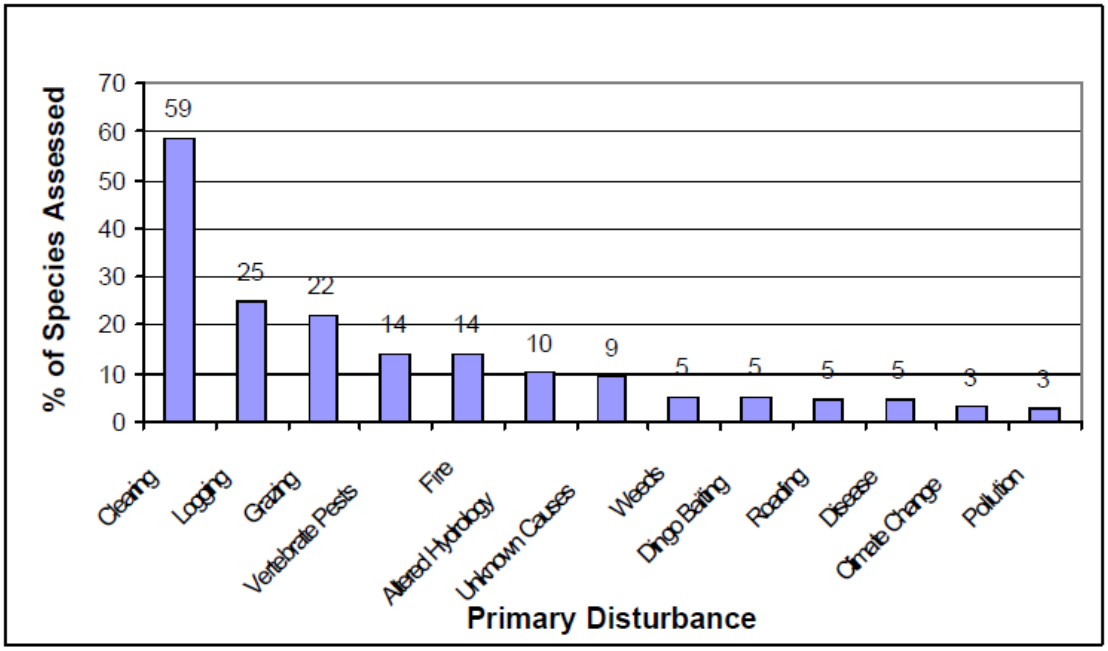
The impacts of grazing on the natural environment and the economics of grazing on public lands were considered in the Comprehensive Regional Assessment.

According to the 1998 CRA "Report on the Profile and Economic Evaluation of Grazing in State Forests" there were then 385,300ha of State forests in the UNE and 140,670ha of State forests in the LNE licenced for grazing in various forms, with licences lasting for periods from 10 weeks to perpetuity. The State Forests' based cattle industry across both regions was estimated to generate a total net profit of $826,000 to producers and result in the equivalent of nine and a half full time jobs.

The environmental impacts of grazing were considered in the expert workshops. For priority fauna species in north-east NSW the expert panels assessed threats to priority fauna species (Environment Australia 1999), finding grazing is a serious threat to 58% of species, and a primary threat to 22% of species.



The percentage of all fauna species assessed that have the listed disturbances nominated as having an adverse impact. From Environment Australia (1999).



The percentage of all fauna species assessed that have the listed disturbance ranked number one. From Environment Australia (1999).

The flora expert panel unanimously agreed the main threats to plant biodiversity in northeastern New South Wales were land clearing, inappropriate fire regime, weeds (and forest hygiene in general) and grazing (Environment Australia 1999). One of their recommendations was:

> *Exclude cattle (and feral grazing generally) from State Forest and National Parks areas or at least limit the area adversely affected by this threatening process.*

The Integrated Forestry Operations Approval (33 (1)), along with the terms of the Threatened Species Licence (TSL) and Fisheries Licence, require Forests NSW to prepare grazing management plans with specified strategies to control any adverse impacts on the environment. A model plan was due to be submitted to DUAP by 30 June 2000, with grazing management plans covering the whole of the region within 6 months of the model plan being approved. It is unknown how many of these plans have been prepared, one hadn't for Yabbra State Forest in 2010.

The TSL condition 5.15 requires that *"The areal extent of grazing authorities issued by SFNSW must not be extended".* Grazing is also required to be excluded from wetlands under TSL condition 5.9. The Fisheries Licence condition 6.1c requires that

> *The areal extent of grazing authorities issued by SFNSW must not be extended in any compartment where there is no physical barrier to prevent cattle from entering exclusion zones and buffer zones implemented under the conditions of this licence,*

The Inquiry needs to recognise that grazing has significant impacts on streams, vegetation, threatened plants and the habitat of many native animals, and ensure that no expansion of grazing on public lands is allowed so that a portion of the total forest estate remains free of these impacts.

REFERENCES

Andreassian, V. (2004) Waters and forests: from historical controversy to scientific debate. Journal of Hydrology 291 1-27.

Anon (1988), The Brush-tailed Rock-wallaby (Petrogale penicillata) in the Grampians National Park and the Black Range, Victoria, Part 2- Management and research recommendations. Australian Biological Research Group Pty. Ltd., Arthur Rhylah Institute for Environmental Research, Tech. Report Series No. 64.

Anon (1996) Scoping agreement for New South Wales Regional Forest Agreements between the Commonwealth of Australia, and the State of New South Wales. Unpublished.

Anon (1998), The Threatened Vascular Flora of North-Eastern NSW: Inventory, Assessment and Conservation. Summary outcomes of the CRA Threatened Flora Expert Workshops, June-July, 1998. Unpublished draft.

Anon. 1999a. *Integrated Forestry Operations Approval for Upper North East Region*. Department of Urban Affairs and Planning, Sydney, December 1999.

Anon. 1999b. *Integrated Forestry Operations Approval for Lower North East Region*. Department of Urban Affairs and Planning, Sydney, December 1999.

Anon. 1999c. *Forest Agreement for Upper North East Region*. Department of Urban Affairs and Planning, Sydney., March 1999.

Anon. 1999d. *Forest Agreement for Lower North East Region*. Department of Urban Affairs and Planning, Sydney., March 1999.

Anon 2000. *Regional Forest Agreement for North East New South Wales (Upper North East and Lower North East Regions) between the Commonwealth of Australia and the State of New South Wales*. Commonwealth of Australia, Canberra,

A.N.P.W.S. - Australian National Parks and Wildlife Service (1991), Plant invasions, the incidence of environmental weeds in Australia, Kowari 2. ANPWS, Canberra.

Ashton, D.H. (1981), Tall open forests. In R.H. Groves (ed.) Australian Vegetation. Cambridge Uni. Press.

Atkinson, G. (1984), Erosion damage following bushfires. Soil Con. 40, 1: 4-9.

Attiwill, P., Burgman, M., and Smith, A. (1996) 'Gaps and Clusters silviculture: How well does it balance wood production and biodiversity conservation?' A report by the Review Panel to the Ministerial Committee established to review the Principles and Application of the Gaps and Clusters Technique. Unpublished report.

Austeco Pty Ltd (1992) Proposed Forestry Operations in the Glen Innes Forest Management Area, Fauna Impact Statement. Forestry Commission of NSW.

Barrett, D.J., Hatton, T.J., Ash, J.E. and Ball, M.C. (1996) Transpiration by trees from contrasting forest types. Aust. J. of Botany 44(3):249-263.

Bennett, A.F. (1990a), Habitat Corridors: their role in wildlife management and conservation, Department of Conservation and Environment, Melbourne, Australia.

Bennet, A.F. (1990b), Land Use, Forest Fragmentation and the Mammalian Fauna at Naringal, South-western Victoria, Aust. Wildl. Res., 17: 325-47.

Bennett, J. (1995) Economic Value of Recreational Use, Gibraltar Range and Dorrigo National Parks. NSW National Parks and Wildlife Service, Environmental Economic Series, Sydney.

Bennett, J. (1998) Benefit Transfer Threshold Value analysis of non-use values of forest preservation: Upper North East Region. Unpublished report prepared for Resource and Conservation Division of the NSW Dept. of Urban Affairs and Planning.

Bell Miner Associated Dieback Working Group (BMADWG 2004) Bell miner Associated Dieback (BMAD) Strategy

Benwell, A. (2010) Inspection of Vegetation in Compartments 144 and 145 Doubleduke State Forest, 20.6.2010. Report prepared for the North Coast Environment Council.

Bird, T., Kile, G.A. and Podger,F.D. (1975) The eucalypt crown diebacks – a growing problem for forest managers. Aust. For. 37: 173-187.

Bonell, M., Gilmour, D.A. and Cassells, D.S. (1991), The links between synoptic climatology and the runoff response of rainforest catchments on the wet tropical coast of north-eastern Queensland. In The Rainforest Legacy, Australian National Rainforests Study, Vol. 2, eds. G. Werren and P. Kershaw. Aust. Heritage Comm. Aust. Govt. Publ. S., Canberra. pp 27-62.

Bren, L.J. and Leitch, C.J. (1985) Hydrologic effects of a stretch of forest road. Aust. For. Res. 15:183-94.

Bren, L.J. and Turner, A.K. (1980) Hydrologic output of small forested catchments: implications for management. Aust. For., 43(2), pp. 111-117.

Bren, L.J. (1999) Aspects of the geometry of buffer strip design in mountain country. In Forest Management for Water Quality and Quantity, Proceedings of the Second Forest Erosion Workshop, eds. Croke, J. and Lane, P. Cooperative Research Centre for Catchment Hydrology, 99/6.

Butcher, G. (1994) 'Forest productivity', in 'The development of consistent nationwide baseline environmental standards for native forests, Draft Report'. Technical Working Group on Forest Use and Management, Joint ANZECC-MCFFA National Forest Policy Statement Implementation Sub-committee. Unpublished.

Buultjens, J., Davis, D., Duthy, S. and Tiyce, M. (1998) Forest-based tourism and recreation in the upper and lower north east regions of NSW. Unpublished report prepared by Southern Cross University for the NSW CRA/RFA process.

Buultjens, J. and Luckie, K. (2004) Economic impact of selected national parks in north-eastern New South Wales. CRC for Sustainable Tourism Pty Ltd 2004.

Campbell, I.C. and Doeg, T.J. (1989), Impact of timber harvesting and production on streams: a review, Aust. J. Mar. Freshwater Res., 40: 519-39.

Campbell, K.G. and Moore, K.M. (1943) An Investigation of the Food of the Bell Bird *Manorina melanophrys* Latham. Pp. 97-8 in *What Bird Is That*, ed. N.N. Cayley. Angus and Robertson, Sydney.

Carr, Bob. 2002. Unpublished speech by the NSW Premier Bob Carr to the Total Environment Centre Green Capital conference. 29/08/02.

Carr, Bob. 2003. Media Release 'Premier Carr Announces Protection for Forest Icons', Sunday 2nd March 2003.

Catling, P.C., (1991), Ecological effects of prescribed burning practices on the mammals of southeastern Australia. In Conservation of Australia's Forest Fauna. Ed by D. Lunney. Royal Zool. Soc. NSW: Mosman. pp. 352-64.

Central West Catchment Management Authority (2008) Management and Rehabilitation of Riparian Lands. CMA Best Management Practice Manual.

Centre for Coastal Management (1993) Report on recreation, scenic and wilderness aspects of forest management, Northern Region, State Forests of New South Wales. Casino Management Area EIS and Murwillumbah Management Area EIS Supporting Document No. 9, State Forests of NSW, Coffs Harbour.

Cerese, B. (2012) The Eucalypt Forests of Northeast New South Wales. A preliminary Assessment and Documentation of their World Heritage Values. National Parks Association. NPA Publications P/L, Newtown.

Clarke, M. F. (1988) The reproductive behaviour of the Bell Miner *Manorina melanophrys*. Emu 88, 88-100.

Clarke M.F. and Fitz-Gerald, G.F. (1994) Spatial organisation of the cooperatively breeding Bell Miner Manorina melanophrys. *Emu 94, 96-105.*

CoA - Commonwealth of Australia (1990) *Ecologically Sustainable Development*. A Commonwealth Discussion Paper. AGPS, Canberra.

CoA - Commonwealth of Australia (1991) *Ecologically Sustainable Development Working Groups, Final Report - Forest Use*. AGPS, Canberra.

CoA - Commonwealth of Australia (1992) National Forest Policy Statement. Commonwealth of Australia.

CoA - Commonwealth of Australia (1992b) *National Strategy for Ecologically Sustainable Development.* AGPS, Canberra.

CoA - Commonwealth of Australia (1995) National Forest Conservation Reserves, Commonwealth Proposed Criteria. Commonwealth of Australia.

CoA & NSW - Commonwealth of Australia and the State of New South Wales (2009) *A Draft Report on Progress with Implementation of the New South Wales Regional Forest Agreements*. A report prepared by the NSW Minister for Climate Change and the Environment and the Australian Government Minister for Agriculture, Fisheries and Forestry as part of the implementation of the NSW Regional Forest Agreements. Resource and Conservation Unit, NSW Department of Environment and Climate Change NSW, Sydney

Contex P/L (1998a) Community Heritage Values Identification and Assessment Project for the Upper and Lower North East Regions, Volume 1: Workshop Overview Report. Unpublished report undertaken for the NSW CRA/RFA Steering Committee

Contex P/L (1998b) Community Heritage Values Identification and Assessment Project for the Upper and Lower North East Regions, Volume 2: Social Value Assessment. Unpublished report undertaken for the NSW CRA/RFA Steering Committee

Contex P/L (1998c) Community Heritage Values Identification and Assessment Project for the Upper and Lower North East Regions, Volume 3: Place Assessments. Unpublished report undertaken for the NSW CRA/RFA Steering Committee

Cornish, P.M. (1975) The Impact of forestry operations on water quality. Tech. Paper 24, Forestry Commission of NSW.

Cornish, P.M. (1980), Water quality studies in New South Wales state forests, 1. A north coast eucalypt forest near Lismore. Aust. For., 43 (2), pp 105-110.

Cornish, P.M. (1991), Some effects of logging on water quality and water yield in the Karuah hydrology research catchments. Paper presented at IFA meeting Dungog 10-11 August 1991.

Cornish, P.M. (1993) The effects of logging and forest regeneration on water yields in moist eucalypt forest in New South Wales, Australia. J.of Hydrology, 150:301-322.

Cornish, P.M. (1997a) Modelling water yield in the catchment of Rocky Creek Dam. Unpublished report for State Forests of NSW.

Cornish, P.M. (1997b) Response to Dailan Pugh's comments of 23 May 1997. Unpublished report for State Forests of NSW.

Cornish, P.M. (1997c) Simulation of Water Yields in Rocky Creek Dam catchment, revised State Forests logging option. Unpublished report for State Forests of NSW.

Cornish, P.M. and Vertessy, R.A., (2001) Forest age-induced changes in evapotranspiration and water yield in a eucalypt forest, Journal of Hydrology 242 43-63.

Cowley, R.D. (1971), Birds and forest management, Aust. For. 35(4), 234-250.

Croke, J. and Hairsine, P. (1995) 'A review of the code of forest practices in Victoria: water quality and quantity'. Unpublished consultancy report from Cooperative Research Centre for Catchment Hydrology to CSIRO Division of Forestry.

Croke, J., Hairsine, P. and Fogarty, P. (1999b) 'Runoff generation and re-distribution in logged eucalyptus forests, south-eastern Australia', in *Journal of Hydrology* 216:56-77.

Croke, J., Hairsine, P., Fogarty, P. Mockler, S. and Brophy, J. (1997) Surface runoff and sediment movement on logged hillslopes in the Eden Management Area of south eastern NSW. Cooperative Research Centre for Catchment Hydrology, 97/2.

Croke, J, Wallbrink, P., Fogarty, P., Hairsine, P., Mockler, S., McCormack, B. and Brophy, J. (1999) *Managing sediment sources and movement in forests: the forest industry and water quality*. Cooperative Research Centre for Catchment Hydrology, Industry Report 99/11.

Dargavel, J, Hamilton, C. and O'Shaugnessy, P (1995) Logging and Water: a study of the effects of logging regimes on water catchment hydrology and soil stability on the eastern seaboard of Australia. Australia Institute.

DASET - Department of the Arts, Sport the Environment and Territories (1992), Nomination of The Central Eastern Rainforests of Australia by the Government of Australia for inscription in the World Heritage List. Unpublished report by DASET.

Davey, S.M. (1989), Thoughts towards a forest wildlife management strategy, Aust. For. 52(2), 56-67

Davies, P.E. and Nelson, M. (1993) The effect of steep slope logging on fine sediment infiltration into the beds of ephemeral and perennial streams of the Dazzler Range, Tasmania, Australia. J. of Hydrology 150: 481-504.

Davies, P.E. and Nelson, M. (1994) Relationships between riparian buffer widths and the effects of logging on stream habitat, invertebrate community composition and fish abundance. *Aust. J. Mar. Freshwater Res.* 45, pp 1289-305.

Debus, S.J.S. and Czechura, G.V. (1988), The Red Goshawk *Erythrotriorchis radiatus*: a review. Aust. Bird Watcher 12,6:175-199.

Debus, S.J.S. (1992), A survey of diurnal raptors in north-east New South Wales, 1987-1990. Aust. Birds 25,3:67-77.

DECCW (2009), Submission justifying the inclusion on the World Heritage tentative list. DECCW NSW

Department of Environment, Climate Change and Water NSW (2010) Review of NSW Forest Agreements and Integrated Forestry Operations Approvals: Upper North East, Lower North East, Eden and Southern regions

DeVries, R. (1998), Vascular Plant Taxa of Priority Conservation Concern within North-Eastern New South Wales. CRA Response to Disturbance Project, UNE and LNE CRA regions, unpublished draft report.

DoP - Department of Planning (1994) Proposed Forestry Operation, Kempsey/Wauchope Management Areas, Environmental Impact Assessment.

Dunning, A and Smith, A.P. (1986), Integration of arboreal mammal and reptile conservation with timber production in moist hardwood forest of New South Wales, A research report to the Forest Wildlife Advisory Committee, Dept. of Ecosystem Management, Uni. of New England, Armidale.

Duthy, S. (1997) A study of the Management Options for Whian Whian State Forest, North-east New South Wales. Unpublished Integrated Project for Southern Cross University.

Duthy, S. (1998) Community support for the dedication of Whian Whian State Forest as a new national park: A contingent valuation study. Bachelor of Applied Science Honours Thesis, Southern Cross University, Lismore.

Environment Australia. 1999a. *Response to disturbance of forest species in CRA regions in NSW – Upper North East and Lower North East regions.* Unpublished report undertaken for the NSW CRA/RFA Steering Committee.

Environment Australia. 1999b. *Identification, Assessment and Protection of Natural National Estate Values in Lower North-Eastern NSW CRA Region.* Unpublished report undertaken for the NSW CRA/RFA Steering Committee project numbers NA 59/EH, NA 65/EH

Environment Australia. 1999c. *Identification, Assessment and Protection of Natural National Estate Values in Upper North-Eastern NSW CRA Region*. Unpublished report undertaken for the NSW CRA/RFA Steering Committee project numbers NA 59/EH, NA 65/EH.

Environment Australia (1999) Response to Disturbance of Forest Species in CRA Regions in NSW - Upper North East and Lower North East Regions. A project undertaken for the Joint Commonwealth NSW Regional Steering Committee as part of the NSW Comprehensive Regional Assessments, Project NA 17/EH, New South Wales and Commonwealth Governments.

Environment Australia (1999) Identification, Assessment and Protection of National Estate Values in Upper North-Eastern NSW CRA Region – Part A Natural Values. Unpublished report undertaken for the NSW CRA/RFA Steering Committee, February 1999.

Flint, C., Pugh, D. and Beaver, D. (2004) The good, the bad and the ugly: science, process and politics in forestry reform and the implications for conservation of forest fauna in north-east New South Wales. Pp 222 - 255 in the *Conservation of Australia's Forest Fauna* (second edition) 2004, edited by Daniel Lunney. Royal Zoological Society of New South Wales, Mosman, NSW, Australia.

Florence, R.G. (1996) *Ecology and Silviculture of Eucalypt Forests*. C.S.I.R.O., Australia.

Floyd, A.G. (1964), The pros and cons of control burning. Forestry Commission, Unpublished (?).

Floyd, A.G. (1976), Effect of burning on regeneration from seeds in wet sclerophyll forest. Aust. For. 39, 3: 210-220.

Forest Products Association (2011) The House of Representatives Standing Committee on Agriculture, Resources, Fisheries and Forestry Inquiry into the current and future prospects of the Australian forestry industry. Submission by the Forest Products Association.

Forestry Commission of NSW (1981) Questions relating to the Washpool E.I.S. Unpublished responses to questions from the Department of Planning.

Forests NSW (2004) A Review of Wood Resources on the North Coast of New South Wales.

Forests NSW (2005) ESFM Plan, Ecologically Sustainable Forest Management, Upper North East NSW. Forests NSW.

Forests NSW (2010) "Rehabilitation and Monitoring Plan, Compartments 162 and 163 Yabbra State Forest No 394"

Forests NSW (2010b) Forests NSW yield estimates for native forest regions.

Forests NSW (2012) Performance Audit Report, FRAMES Reconciliation

Fox, B.J. and McKay, G.M. (1981), Small mammal responses to pyric successional changes in eucalypt forest, Aust. J. Ecol. 6, 29-41.

Frawley, K. (1988) The History of Conservation and the National Park Concept in Australia: a State of Knowledge Review. Pp 395-417 in Frawley, K.J. and Semple, N. (Eds) Australia's Ever Changing Forests. Proceedings of the First National Conference on Australian Forest History, Canberra 9-11 May 1988. Department of Geography and Oceanography, Australian Defence Force Academy, Campbell, ACT.

Galvin, P. (1989) Chairman's Speech given to Institute of Foresters of Australia 13th Biennial Conference, 18 September 1989, Leura NSW.

Gill, A.M. (1975), Fire and the Australian flora: a review. Aust. For. 4-25.

Gillespie, R. (1998), Estimated Aggregate Economic Impacts of Selected Information Points. A report undertaken for the NSW CRA/RFA process. Interim report of October 1998, unpublished.

Gillespie Economics (2006) Impacts of Protected Areas on the Regional Economy of North-East NSW. A Study Prepared for NSW Department of Environment and Conservation.

Good, R.B. (1973), A preliminary assessment of erosion following wildfires in Kosciusko National Park, N.S.W. in 1973. J. Soil Con. N.S.W. 191-199.

Grayson, R.B., Haydon, S.R., Jayasuriya, M.D.A. and Finlayson, B.L. (1993) Water quality in mountain ash forests – separating the impacts of roads from those of logging operations. J. of Hydrology, 150: 459-480.

Greacen, E.L. and Sands, R. (1980), Compaction of forest soils: a review. Aust. J. Soil Res. 18: 163-89.

Harmon, M E Ferrell, W. K; and Franklin, J. F (1990) Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests. *Science;* Feb 9, 247, 4943 pp699-702.

Hart, B.T. (1992), Ecological condition of Australia's rivers. Search 23: 1, 33-7.

Harwood, C.E. and Jackson, W.D. (1975), Atmospheric losses of four plant nutrients during a forest fire. Aust. For. 38, 2:92-99.

Helman, P.M., Jones, A.D., Pigram, J.J.J. and Smith, J.M.B. (1976) Wilderness in Australia - Eastern New South Wales and south-eastern Queensland. Department of Geography, University of New England, Armidale.

Hobbs, R. J. and Hopkins, J.M. (1990), From frontier to fragments: European impact on Australia'a vegetation, Proc. Ecol. Soc. Aust. 16: 93-114.

Hopkins, M.S. (1981) Disturbance and change in rainforests and the resulting problems of functional classification. In Vegetation Classification in Australia, eds. A.N. Gillison and D.J. Anderson. ANU Press.

Hunter, J. (2004) World Heritage and Associative Natural Values of the Central Eastern Rainforest Reserves of Australia. National Parks and Wildlife Service.

Incerti, M., Clinnick, P.F. and Willatt, S.T. (1987), Changes in the physical properties of a forest soil following logging. Aust. For. Res. 17: 91-98.

Jakobsen, B.F. (1983) Persistence of compaction effects in a forest kraznozem. Aust. For. Res. 13:305-8.

Jakobsen, B.F. and Moore, G.A. (1981), Effects of two types of skidders and of a slash cover on soil compaction by logging of Mountain Ash. Aust. For. Res. 11: 247-255.

James, D. (1998) Explanatory notes on economic data and models. Unpublished notes for CRA negotiations, 16 October 1998.

JANIS - Joint ANZECC / MCFFA National Forest Policy Statement Implementation Sub-committee (1997) Nationally Agreed Criteria for the Establishment of a Comprehensive, Adequate and Representative Reserve System for Forests in Australia. Commonwealth of Australia.

Jarman, P. (1986), The red fox - an exotic, large predator. In The Ecology of Exotic Animal and Plants, some Australian case histories, Ed. R. L. Kitching. John Wiley & Sons.

Kuczera, G.A. (1987) Prediction of water yield reductions following a bushfire in ash-mixed species eucalypt forest. J. of Hydrology, 94: 215-236.

Lacey, S. (1998) Soil erosion and runoff measurement on steep forest sites in northern New South Wales. Pp 22-23 in Erosion in Forests, Proceedings of the Forest Erosion Workshop, eds. Croke, J. and Fogarty, P. Cooperative Research Centre for Catchment Hydrology, 98/2.

Lacey, S., Croke, J., Fogarty, P.and Lane, P. (1999) Runoff and soil loss from steep snig tracks under natural and simulated rainfall. Pp 51-54 in Forest Management for Water Quality and Quantity, Proceedings of the Second Forest Erosion Workshop, eds. Croke, J. and Lane, P. Cooperative Research Centre for Catchment Hydrology, 99/6.

Lake, P.S. and Marchant, R. (1990), Australian upland streams: ecological degradation and possible restoration, Proc. Ecol. Soc. Aust., 16: 79-91.

Lamb, D. (1986), Forestry. Pp. 417-443 in Australian Soils - The Human Impact, (Ed) J.S. Russell and R. F. Isbell, Uni. of Qld. Press, Qld.

Lambcon Associates (1996) Joint Old Growth Project, Cultural Investigations, The Feasibility of Including Cultural and Aesthetic Values in the Identification of Old Growth Forest. Unpublished report to NPWS.

Landsberg, J., Morse, J. and Khanna, P. (1990), Tree dieback and insect dynamics in remnants of native woodlands on farms. Proc. Ecol. Soc. Aust. 16:149-165.

Langford, K.J. and O'Shaughnessy, P.J. (1977), Some effects of forest change on water values. Aust. For. 40, 3: 192-218.

Leigh, J.H. and Holgate, M.D. (1979), The response of the understorey of forests and woodlands of the Southern Tablelands to grazing and burning, Aust. J. of Ecology, 4, 25-45

Leitch, C.J., Flinn, D.W. and van de Graaff, R.H.M. (1983), Erosion and nutrient loss resulting from Ash Wednesday (February 1983) wildfires: a case study. Aust. For., 46, 3: 173-180.

Loyn, R.H. (1985), Strategies for conserving wildlife in commercially productive eucalypt forest, Aust. For. 48(2), 95-101.

Loyn, R.H., Runnalls, R.G., Forward, G.Y. and Tyers, J. (1983) Territorial Bell Miners and other birds affecting populations of insect prey. *Science 221,* 1411-1413.

Lunney, D., Cullis, B. and Eby, P. (1978) Effects of logging and fire on small mammals in Mumbulla State Forest, near Bega, New South Wales, Aust. Wildl. Res. 14, 163-81.

Luyssaert, S., Schulze, E.D., Börner, A., Knohl, A., Hessenmöller, D., Law, B.E., Ciais, P. and J. (2008) Old-growth forests as global carbon sinks. *Nature* 455, 213-215

Mackey, B., Keith, H., Berry, S.L. and Lindenmayer, D.B. (2008) Green carbon: the role of natural forests in carbon storage. Part 1, A green carbon account of Australia's south-eastern Eucalypt forest, and policy implications. ANU E Press

Mackey, B., Watson, J and Worboys, G. L (2010) Connectivity conservation and the Great Eastern Ranges corridor. An independent report to the Interstate Agency Working Group (Alps to Atherton Connectivity Conservation Working Group) convened under the Environment Heritage and Protection Council/Natural Resource Management Ministerial Council. Department of Environment, Climate Change and Water, Sydney, NSW.

Mackay, N. and Landsberg, J. (1992). The 'health' of the Murray-Darling River System. Search 23: 1, 34-5.

Mackowski, C.M. (1984), The ontogeny of hollows in blackbutt (Eucalyptus pilularis) and its relevance to the management of forests for possums, gliders and timber. Pages 553-67 in Possums and Gliders, ed. by A.P. Smith and I.D. Hume, Australian Mammal Society, Sydney

Mackowski, C.M. (1987), Wildlife hollows and timber management, thesis for Master of Nat. Res., University of New England, Armidale, N.S.W.

McClellan, P. (1998) Assessment of the contamination events and future directions for the management of the catchment. Sydney Water Inquiry, Third Report, NSW Premier's Department.

McGregor, A., Gibson, C., Miller, F. and Sharma, K. (1997) Thinking about forests, community attitudes towards forests in New South Wales. Dept. Geography, Uni of Sydney.

McGregor, A., Gibson, C., Miller, F. and Sharma, K. (1997a) Thinking About Forests, community attitudes towards forests in the Upper North East CRA region. Unpublished report prepared Department of Geography, University of Sydney, for the NSW CRA/RFA process.

McIlroy, J.C. (1978), The effects of forestry practices on wildlife in Australia: a review, Aust. For. 41(2), 78-94.

Milledge, D.R., Palmer, C.L. and Nelson, J.L. (1991), "Barometers of Change": The distribution of large owls and gliders in Mountain Ash forests of the Victorian Central Highlands and their potential as management indicators. in Conservation of Australia's Forest Fauna, ed. D. Lunney, Royal Zoological Society of NSW.

Moon, C. (1990), Management strategy for the Iluka koala population, A report prepared for the NSW Dept. of Lands and the N.P.&W.S.

Moore, K.M. (1959) Observations on some Australian Insects, 4. *Xyleborus truncatus* Erichson 1842 (Coleoptera: Scolytidae) associated with dying *Eucalyptus saligna* Smith (Sydney Blue-gum). Proc. Linn. Soc. NSW, 84: 186-193.

Munks, S. (1996) *A guide to riparian vegetation and its management* . Dept. of Primary Industry and Fisheries: Hobart, Tas.

New South Wales Government 2007, NSW Forest Agreements Implementation Report 2003/2004: Upper North East, Lower North East, Eden and Southern Regions 2003/2004. A report prepared by the Minister for Climate Change, Environment and Water as part of the implementation of the NSW forest agreements and integrated forestry operations approvals. Resource and Conservation Unit, Department of Environment and Climate Change, Sydney.

New South Wales Government (2009a) *NSW Forest Agreements Implementation Report 2004/2005: Upper North East, Lower North East, Eden and Southern regions*. A report prepared by the Minister for Climate Change and the Environment as part of the implementation of the NSW forest agreements and integrated operations approvals. Resource and Conservation Unit, NSW Department of Environment and Climate Change NSW, Sydney.

New South Wales Government (2009b) *NSW Forest Agreements Implementation Report 2005/2006: Upper North East, Lower North East, Eden and Southern regions*. A report prepared by the Minister for Climate Change and the Environment as part of the implementation of the NSW forest agreements and integrated forestry operations approvals. Resource and Conservation Unit, NSW Department of Environment and Climate Change NSW, Sydney

New South Wales Government (2009c) *NSW Forest Agreements Implementation Report 2006–2007: Upper North East, Lower North East, Eden and Southern regions*. A report prepared by the Minister for Climate Change and the Environment as part of the implementation of the NSW forest agreements and integrated forestry operations approvals. Resource and Conservation Unit, Department of Environment, Climate Change and Water NSW, Sydney

NSW&CoA (2009) A Draft Report on Progress with Implementation of the New South Wales Reguional Forest Agreements (RFAs), North East RFA, Eden RFA, Southern RFA, A report providing information to enable public representations on the implementation of the RFAs. NSW State and Commonwealth Governments.

NSW Auditor-General (2009) Sustaining Native Forest Operations: Forests NSW. NSW Auditor-General

NPWS (1994a) Fauna of North-east NSW Forests. North East Forests Biodiversity Study Report No.3, unpublished report, NSW National Parks and Wildlife Service

NPWS (1994b) Flora of North-east NSW Forests. North East Forests Biodiversity Study Report No.4, unpublished report, NSW National Parks and Wildlife Service

North East Forest Alliance (2002) Revised Water Yield Modelling for the Central Coast Catchment. North East Forest Alliance.

PAC - Public Accounts Committee (1990), Report on the Forestry Commission. Parliament of New South Wales, PAC report no. 52.

Partington, G.H. and Stevenson, M.J. (2004) Forests NSW: Review of North Coast Standing Volumes for the 2004 Valuation, Report for the NSW Auditor General. Forests NSW

Prineas, P. and Gold, H. (1983) Wild Places. Kalianna Press, Chatswood NSW.

Noble, I.R. and Slatyer, R.O. (1981), Concepts and models of succession in vascular plant communities subject to recurrent fire. Pp 311-335 in Fire and the Australian Biota, ed. Gill, A.M., Groves, R.H. and Noble, I.R. Aust. Academy of Science.

Poinani, A. (1991) Anti-predator Behaviour in the Bell Miner Manorina melanophrys. *Emu 91,* 164-171.

Powell, R. and Chalmers, L. (1995) Regional Economic Impact, Gibraltar Range and Dorrigo National Parks. NSW National Parks and Wildlife Service, Sydney.

PAC - Public Accounts Committee (1990), *Report on the Forestry Commission*. Parliament of New South Wales, PAC report no. 52.

Peel M., Watson, F., Vertessy R., Lau A., Watson I., Sutton, M. and Rhodes, B. (2000) Predicting the water yield impacts of forest disturbance in the Maroondah and Thomson catchments using the Macaque model. Technical Report 00/14. Cooperative Research Centre for Catchment Hydrology.

Public Works Department (1984), Richmond-Brunswick regional water supply study, Discussion Paper. Report prepared for Rous County Council and Ballina Shire Council, Report No 230.

Pressey, R.L., Ferrier, S., Hager, T.C., Woods, C.A., Tully, S.L., and Weinman, K.M. 1996. How well protected are the forests of north-eastern New South Wales? – analyses of forest environments in relation to formal protection measures, land tenure, and vulnerability to clearing. *Forest Ecol. and Man.* 85; 311-333.

Pressey, R.L., Johnson, I.R., and Wilson, P.D. (1994) Shades of irreplaceability: measuring the potential contribution of sites to a reservation goal. Biodiv. Conserv., 3:242-262.

Public Accounts Committee (2002) State Forests of NSW : inquiry into the practice of trading with customers who have defaulted on renegotiated repayment terms . NSW Parliament, Public Accounts Committee Report ; no. 142, Sydney, N.S.W.

Pugh, D. (1992) How the Rainforest Decision Benefited the Far North Coast: A Reply to 'Promises and Realities'. North East Forest Alliance, June 1992.
Pugh, D. (1996) An appraisal of the reliability of State Forests' Wood Resources Study. Unpublished.

Pugh, D. 1998. *Establishing a CARR reserve system in north-east NSW*. Unpublished report for the North East Forest Alliance 35pp.

Pugh, D. (2000) Rocky Creek Dam Catchment Management, an Issue of Regional, National and International Significance. Unpublished report presented to Rous County Council and the NSW Government.

Pugh, D. (2009) Preliminary Audit of Yabbra State Forest Compartments 162 and 163. North East Forest Alliance, December 2009. http://nefa.org.au/wp-content/uploads/2011/02/Audit_Yabbra_Dec2009.pdf

Pugh, D. (2010a) Preliminary Audit of Yabbra State Forest, Compartments 162 and 163', Supplementary Report. North East Forest Alliance, 1February 2010. http://nefa.org.au/wp-content/uploads/2011/02/Audit_Yabbra_Supp1_2010.pdf

Pugh, D. (2010b) Preliminary Audit of Doubleduke State Forest Compartments 144, 145 and 146. North East Forest Alliance, June 2010.

http://nefa.org.au/audit/Doubleduke/Prelim_Audit_Doubleduke_SF_1.pdf

Pugh, D. (2010c) Preliminary Audit of Doubleduke State Forest Compartments 144, 145 and 146, Supplementary Report. North East Forest Alliance, November 2010 http://nefa.org.au/wp-content/uploads/2011/02/Audit_Doubleduke_Supp1_Nov_2010.pdf

Pugh, D. (2010d) Preliminary Audit of Girard State Forest Compartments 44, 45, 46, 54, 55 and 56. North East Forest Alliance, August 2010.
http://nefa.org.au/audit/Girard/Preliminary_Audit_of_Girard_State_Forest_1.pdf

Pugh, D. (2011) Audit of Compliance of Forestry Operations in the Upper North East NSW Forest Agreement Region. North East Forest Alliance, February 2011.

Pugh, D. (2011c) Wedding Bells State Forest Supporting Report, North East Forest Alliance, July 2011.

Pugh (2012a) Re: Immediately halt logging of Rufous Scrub Bird habitat in Styx River State Forest while an independent investigation is undertaken. Letter to Robyn Parker, Minister for the Environment, and Katrina Hodgkinson Minister for Primary Industries, 17 April 2012.

Pugh (2012b) Re: Immediately halt logging of Rufous Scrub Bird habitat in Styx River State Forest while an independent investigation is undertaken. Letter to Robyn Parker, Minister for the Environment, and Katrina Hodgkinson Minister for Primary Industries, 30 April 2012.

Pugh (2012c) Re: Immediately halt logging of Rufous Scrub Bird habitat in Styx River State Forest while an independent investigation is undertaken. Letter to Robyn Parker, Minister for the Environment, and Katrina Hodgkinson Minister for Primary Industries, 1 May 2012.

Pugh (2012d) Re: Immediately halt logging of Rufous Scrub Bird habitat in Styx River State Forest while an independent investigation is undertaken. Letter to Robyn Parker, Minister for the Environment, and Katrina Hodgkinson Minister for Primary Industries, 15 June 2012.

Pugh (2012e) NEFA Audit of Royal Camp State Forest. North East Forest Alliance.
http://nefa.org.au/audit/RoyalCamp/NEFA_Audit_Royal_Camp_SF.pdf

Pugh, D. and Flint, C. (1999) *The Magic Pudding, the Cut-an'-Come-Again Forests, A preliminary appraisal of State Forests' Forest Resource and Management System (FRAMES)*. Unpublished report for the North East Forest Alliance 174pp

Pugh, D. (2000) Rocky Creek Dam Catchment Management, an issue of regional, national and international significance. Unpublished report.

Rab, M.A. (1994) Changes in physical properties of a soil associated with logging of *Eucalyptus regnans* forest in southeastern Australia. Forest Ecology and Management, 70(1-3):215-229.

Rab, M.A. (1996) Soil Physical and hydrological properties following logging and slash burning in the *Eucalyptus regnans* forest of southeastern Australia. Forest Ecology and Management, 84(1-3):159-176.

RAC - Resource Assessment Commission (1992a), Forest and Timber Inquiry, Final Report, Volume 1. Australian Government Publishing Service.

RACAC - Resource and Conservation Assessment Council (1996) Draft Interim Forestry Assessment Report. RACAC, Sydney.

Raison, R.J. (1980) A review of the role of fire in nutrient cycling in Australian native forests, and of methodology for studying the fire-nutrient interaction. Aust. J. of Ecol. 5:15-21.

Raison, J. and Hopmans, P. (1994) Soils. In 'The development of consistent nationwide baseline environmental standards for native forests, Draft Report'. Technical Working Group on Forest Use and Management, Joint ANZECC-MCFFA National Forest Policy Statement Implementation Sub-committee. Unpublished.

Read Sturges and Associates (1992), Evaluation of the economic values of wood and water for the Thomson catchment. Report prepared for Department of Conservation and Environment and Melbourne Water.

Recher, H.F. (1991), The conservation and management of eucalypt forest birds: resource requirements for nesting and foraging. In Conservation of Australia's Forest Fauna. Ed by D. Lunney. Royal Zool. Soc. NSW: Mosman. Pp. 24-34.

Recher, H.F., Rohan-Jones, W. and Smith, P. (1980), Effects of the Eden woodchip industry on terrestrial vertebrates with recommendations for management, Forestry Commission of N.S.W. Res. Note 42.

Recher, H.F., Allen, D. and Gowing, G. (1985), The impact of wildfire on birds in an intensively logged forest, in Birds of Eucalypt Forests and Woodlands: Ecology, Conservation, Management, ed. by Keast, A., Recher, H.F., Ford, H. and Saunders, D., R.A.O.U. and Surrey Beatty & Sons.

Recher, H.F. and Lim, L. (1990), A review of current ideas of the extinction, conservation and management of Australia's terrestrial vertebrate fauna, Proc. Ecol. Soc. Aust., 16: 287-301.

Rogers, M.F. (1992) An Assessment and Allocation of Old Growth Forest Preservation in New South Wales. M.Nat.Res. Thesis, UNE Armidale.

Rohan-Jones, W. (1981), Comments on Narooma Management Plan, 11 December 1981, FC file 11261.

Roxburgh, S. H., Wood, S.W., Mackey, B.J., Woldendorp, G., and Gibbons, P. (2006) Assessing the carbon sequestration potential of managed forests: a case study from temperate Australia. *Journal of Applied Ecology* (2006) 43, 1149–1159. doi: 10.1111/j.1365-2664.2006.01221.x

Roy Morgan Research Ltd (2011) Annual Visits to PWG Managed Parks in New South Wales -Final Report. Office of Environment and Heritage, Hurstville NSW.

Rust PPK P/L (1996) Rous Regional Demand Management Strategy, Draft Stage 1 Report. Report to Rous County Council.

Sandek, T.M.,Grayson, R.B. and Gippel, C.J. (1998) The impact of roads and landslides on stream water turbidity and suspended sediment in forested catchments. Pp 50-51 in Erosion in Forests, Proceedings of the Forest Erosion Workshop, eds. Croke, J. and Fogarty, P. Cooperative Research Centre for Catchment Hydrology, 98/2.

Saunders, D.A. (1979), The Availability of Tree Hollows for Use as Nest Sites by Whiter-tailed Black Cockatoos, Aust. Wildl. Res., 6: 205-16.

Scotts, D.J. (1991), Old-growth forests: their ecological characteristics and value to forest-dependent vertebrate fauna of south-east Australia. In Conservation of Australia's Forest Fauna. Ed by D. Lunney. Royal Zool. Soc. NSW: Mosman. Pp. 147-59.

Seymour, J. (1981), Why do forest sands become less fertile. Ecos 28: 12-14.

Sigley, R. 1998. Possible RFA Outcomes, the Northern Rivers Experience. Unpublished letter from Northern Rivers Sales Manager of State Forests of New South Wales to Tim Parkes, Forest Resources

SKM (2007) Impact of the 2003 Alpine Bushfires on Streamflow - Broadscale water yield assessment. Department of Sustainability and Environment and the Murray-Darling Basin Commission

Sims, G.K. (1991), Biological Degradation of Soil. Pp. 289-327 in Advances in Soil Science, Vol. 7, (Ed.) B.A. Stewart, Springer-Verlag, New-York.

Smith, A.P. (1991a), Forest policy: fostering environmental conflict in the Australian timber industry. In Conservation of Australia's Forest Fauna ed by D. Lunney. Royal Zool. Soc. NSW: Mosman. Pp. 301-14.

Smith, A.P. and Lindenmayer, D. (1988), Tree hollow requirements of Leadbeater's Possum and other possums and gliders in timber production Ash forests of the Victorian Central Highlands. Aust. Wildl. Res., 15, 347-62.

Smith, A. (1999) *Guidelines for implementation and enforcement of sustainable forestry on private lands in NSW*. Draft report prepared for DLWC.

Smith, A. (2000) *Guidelines for Sustainable Forestry on Private Lands in NSW*. Draft report prepared for DLWC.

Smith, J.M.B. and Waterhouse, B.M. (1988), Invasion of Australian forests by alien woody plants. Pages 87-98 in Australia's Ever Changing Forests, ed. K.J. Frawley and N. Semple, Aust. Defence Force Academy, ACT.

Sparkes, M (2010) Five Years of Proven Forestry Breaches. North East Forest Alliance, September 2010

http://nefa.org.au/wp-content/uploads/2011/02/Sparkes_Forestry_Breaches_2010.pdf

Spencer, S (2009) Final Report on Progress with Implementation of NSW Regional Forest Agreements: Report of Independent Assessor November 2009.

State Forests (1993) Review of the Present Status of sustained timber yield on state forests and individual management areas. Unpublished draft position paper.

SFNSW, (1999), Environmental and Social Values Report 1998-99

State Forests (1999) Forest Management Zoning in State Forests.

State Forests 2003. Unpublished briefing note to the Forestry Board. March 2003.

Stewart, H.T.L. and Flinn, D.W. (1985) Nutrient losses from broadcast burning of eucalypt debris in north-east Victoria. Aust. For. Res. 15:321-32.

Stewart, H.T.L., Hopmans, D.W., Flinn, D.W. and Croatto, G. (1989), Harvesting effects on phosphorous availability in a mixed eucalypt ecosystem in southeastern Australia. Forest Ecology and Management, 36: 149-162.

Stone, C. (1996) The Role of psyllids (Hemiptera: Psyllidae) and bell miners (Manorina melanophrys) in canopy dieback of Sydney blue gum (Eucalyptus saligna Sm). *Australian Journal of Ecology 21.* 450-458.

Stone, C., Spolc, D and Urquhart, C.A. (1995) *Survey of Crown Dieback in Moist Hardwood Forests in the Central and Northern Regions of NSW State Forests (Psyllid/Bell Miner Research Programme).* Research Paper No. 28. Research Division, State Forests of NSW. Sydney.

Townley, S. (1996a) Report from Post-fire Trapping expedition to Billilimbra - September 11-15, 1996. Unpublished report to the Hastings River Mouse Recovery Team.

Traill, B.J. (1991), Box-Ironbark forests: tree-hollows, wildlife and management. In Conservation of Australia's Forest Fauna ed by D. Lunney. Royal Zool. Soc. NSW: Mosman. Pp. 119-24.

Truyard Pty Ltd (1992) Environmental Impact Statement, Wingham Management Area, Proposed forest management. Forestry Commission of NSW.

URS (2008) Economic Policy Settings in the Forest and Timber Industry – An inter-jurisdictional comparison. Prepared for Victorian Department of Primary Industries.

Vanclay J. (2002) Review of Projected Timber Yields for the NSW North Coast. Southern Cross University.

Wall, J. and Flint, C. (1996) Wood resources in northern New South Wales. Unpublished NPWS report.

Wardell-Johnson, G.,Stone, C., Recher, H. and Lynch, J.J. (2006) Bell Miner Associated Dieback (BMAD) Independent Scientific Literature Review; A review of eucalypt dieback associated with Bell miner habitat in north-eastern New South Wales, Australia. Occasional Paper DEC 2006/116

Wilby, R.L. and Gell, P.A. (1994) The impact of forest harvesting on water yield: modelling hydrological changes detected by pollen analysis. Hydrological Sciences J. 39:5, pp 471 – 486.

Wilson, A.D. (1990), The effect of grazing on Australian ecosystems, Proc. Ecol. Soc. Aust. 16: 235-244.

Vertessy,R., Watson, F., O'Sullivan, S., Davis, S., Campbell, R., Benyon, R. and Haydon, S. (1998) Predicting wateryield from mountain ash forest catchments. Cooperative Research Centre for Catchment Hydrology, 98/4.

Vertessy, R.A. (1999) The impacts of forestry on streamflows: a review. Pp 93-109 in Forest Management for Water Quality and Quantity, Proceedings of the Second Forest Erosion Workshop, eds. Croke, J. and Lane, P. Cooperative Research Centre for Catchment Hydrology, 99/6.

Wilson, C.and Lynch,T.(1998) The impact of logging on turbidity values in Musselboro Creek, Tasmania. Pp 64-67 in Erosion in Forests, Proceedings of the Forest Erosion Workshop, eds. Croke, J. and Fogarty, P. Cooperative Research Centre for Catchment Hydrology, 98/2.

Wilson, B.A., Robertson, D., Moloney, D.J., Newell, G.R. and Laidlaw, W.S. (1990), Factors affecting small mammal distribution and abundance in the Eastern Otway Ranges, Victoria. Proc. Ecol. Soc. Aust. 16, 379-396.

Winter, J.W. (1991), Northeastern Queensland: some conservation issues highlighted by forests mammals. In Conservation of Australia's Forest Fauna ed by D. Lunney. Royal Zool. Soc. NSW: Mosman. Pp. 113-18.

Wronski, E.B. (1984), Impact of tractor thinning operations on soils and tree roots in a Karri forest, Western Australia. Aust. For. Res. 14: 319-32.

Wronski and Associates (1993), Tantawangalo Research Catchments, Changes in Water Yields after Logging. Forestry Commission of NSW.

Zhou, G., Liu, S., Li, Z., Zhang, D., Tang, X., Zhou, C., Yan, J. and Mo, J. (2006) Old-Growth Forests Can Accumulate Carbon in Soils. *Science,* Vol. 314 no. 5804 p. 1417. *DOI:* 10.1126/science.1130168