CHAPTER 12

The Nandewar Bioregion

1. Location

The Nandewar Bioregion lies in northern NSW and across the Qld border. The bioregion is bounded by the North Coast, New England Tablelands and Brigalow Belt South bioregions in the south, east and west respectively. It spans an area of 2,700,313 ha, with 2,069,604 ha or 76.6% of it falling in NSW and occupying 2.59% of the state.

The bioregion encompasses Inverell and Tamworth and the smaller towns of Quirindi, Bingara, Barraba, Manilla and Bendemeer.

Part of the MacIntyre, Gwydir and Namoi catchments are located in the bioregion, and the Peel, Macdonald, McIntyre, Namoi, Severn and Gwydir Rivers traverse the bioregion.

2. Climate

The Nandewar Bioregion is considered mostly to be fairly warm and dry, although average annual temperatures and rainfall vary markedly across the bioregion in relation to elevation (NSW NPWS 2000). The central areas, such as the Nandewar Range and the northern slopes of the Liverpool Range, are generally cooler as they tend to have a higher elevation, whereas the warmer areas correspond to the lowlands around the main river catchment areas.

Average annual rainfall also varies distinctly across the bioregion. It is characterised by frequent rains of high intensity and high run-offs caused by the steep slopes and shallow soils that feature prominently in the bioregion (Morgan and Terrey 1992). Rainfall generally decreases from east to west, but the differing topography across the bioregion alters this trend somewhat, with areas at higher altitudes, such as Mt Kaputar, receiving significantly more rain annually than lower lying areas in the west (NSW NPWS 2000). The Nandewar Bioregion is subject to summer rainfall (Benson 1999), with the rainfall pattern described as being slightly summer dominant (Morgan and Terrey 1992).

3. Topography

The Nandewar Bioregion is formed on Palaeozoic sedimentary rocks on the western edge of the New England Tablelands and includes the Tertiary basalts of Inverell and Kaputar. The hilly landscapes are warmer but drier than the tablelands and carry vegetation communities more typical of the western slopes, with some tableland species.

Mean Annual Temperature	Minimum Average Monthly Temperature	Maximum Average Monthly Temperature	Mean Annual Rainfall	Minimum Average Monthly Rainfall	Maximum Average Monthly Rainfall
10 – 18°C	-3.5 – 3.6°C	22.9 – 34.7°C	566 – 1270mm	31 – 83mm	76 – 137mm

4. Geology and geomorphology

The New England Fold Belt is the youngest structural feature in NSW and is separated from the Lachlan Fold Belt by the Sydney-Bowen Basin that is filled with Mesozoic sediments. The oldest rocks in the sequence are Devonian sedimentary and volcanic rocks, formed in an island arc environment. The youngest are Triassic sandstones and shales deposited by rivers on the edge of the Gunnedah Basin, about 250 million years ago, at a time when New England was being lifted by intrusions of granite.

Major volcanic eruptions occurred in two phases: in the lava field flood basalts of the Inverell area (34-32 and 22-19 millions of years ago), and in a central volcano similar to that in the Nandewar Ranges (21-17 million years ago). The maximum preserved thickness of the flows is 800m in the variety of lavas present. Only the core of the Nandewar volcano remains as exposed plugs and dykes. Flows from the New England centres buried river gravels and lake sediments that are now being exposed and contain deposits of tin, sapphires and diamonds.

A narrow strip of ultrabasic rocks, including serpentinites that are derived from a deep ocean floor, marks the suture where a former island arc complex was linked to the Australian mainland. These rocks pass through Woodsreef and Tamworth where they are associated with limestones in which karst landscapes are formed. The composition of these rocks is so unusual that they always have distinct soils and vegetation.

Geomorphically, the western slopes can be seen as a dissected ramp that links the uplifted highlands with the western plains. Western rivers pass across the ramp without depositing large volumes of sediment and the Darling Riverine Plains alluvial fans begin at the base of the ramp.

5. Geodiversity

The broad geologic features of these environments can be seen in other parts of the western slopes and Great Dividing Range but particular features of note include the following:

- the volcanic landforms of Mt Kaputar and the cold-tolerant vegetation found on it;
- the karst landscape features at Ashford Caves and near Tamworth;
- rare geology of the serpentinites with unusual mineralisation, soils and vegetation, including heritage elements of a former asbestos mine at Woods Reef;
- sub-basaltic drainage patterns in the Inverell basalts, the occurrence of leaf fossils, gemstones and tin and the associated mining heritage; and
- the granite tor topography and deep gorge of the Severn River near Ashford.

6. Soils

The bioregion is characterised by clay or loam soils, but siliceous soils derived from acid volcanic rocks are also found.

On the sedimentary rocks, shallow stony soils occur on ridges passing to texture contrast soils on almost all slopes. These change in colour from red brown subsoils on upper slopes to yellow subsoils on lower slopes. They support diverse vegetation communities that are also affected by altitude.

The granites develop gritty shallow profiles between outcrops and tors on the crests, grading to harsh texture contrast soils with yellow clay subsoils that are prone to gully development on the lower slopes.

Basalt areas on Kaputar have frequent rock outcrops interspersed with shallow, stony, brown loams. Black earths are found on lower slopes and in valleys.

In the Inverell area the basalts develop black earth profiles that thicken downslope and, where the underlying sands and gravels are exposed, the coarse sandy soils may develop podsol pans and support different vegetation. Alluvial loams and clays with moderate to high fertility are found in the valleys.

Dark, alkaline, pedal clays develop on limestone, and the serpentinites have shallow stony profiles with concentrations of elements that are toxic to many plants.

7. Biodiversity

7.1 Plant communities

The vegetation of the Nandewar Bioregion is influenced primarily by geology and the influence of altitude on temperature and rainfall. The bioregion is characterised by box woodlands that occur on clay or loam soils, typically at low to mid elevation in agriculturally productive areas. The principal dominants of these box woodlands are white box (*Eucalyptus albens*), yellow box (*Eucalyptus melliodora*), Blakely's red gum (*Eucalyptus blakelyi*) and grey box (*Eucalyptus mollucana*). Bimbil box (*Eucalyptus populnea subsp. bimbil*), fuzzy box (*Eucalyptus conica*) and western grey box (*Eucalyptus microcarpa*) also occur, particularly in the western half of the bioregion.

With decreasing soil fertility and increasing topographic relief the box woodlands are replaced by ironbark/cypress pine communities which characterise much of the agriculturally less productive parts of Nandewar. These communities are common at mid elevations, particularly on sedimentary hills and ranges, and form woodlands and open forests typically consist of silver-leaved ironbark (*Eucalyptus melanophloia*), white cypress pine (*Callitris glaucophylla*) and tumbledown red gum (*Eucalyptus dealbata*). Canopy combinations vary in relation to environmental factors, with narrow-leaved ironbark (*Eucalyptus crebra*) common on sediments and Caleys ironbark (*Eucalyptus caleyi*) and black cypress pine (*Callitris endlicheri*) favouring granitic areas. White box and stringybarks can be additional components of the ironbark/cypress pine communities, and in localised areas form associations with mugga ironbark (*Eucalyptus sideroxylon*), an important habitat resource for fauna.

At mid to high elevations in mountainous terrain, forests of silver-top stringybark (*Eucalyptus laevopinea*), manna gum (*Eucalyptus viminalis*) and mountain gum (*Eucalyptus dalrympleana subsp. heptantha*) occur. Montane woodlands and sub-alpine forests of snow gum (*Eucalyptus pauciflora*), mountain gum, manna gum and rough-barked mountain gum (*Eucalyptus volcanica*) occur at high elevation on Mt Kaputar.

Riparian forests of river oak (*Casuarina cunninghamiana*), sometimes with river red gum (*Eucalyptus camaldulensis*), occur along the major watercourses, with Blakely's red gum and rough-barked apple (*Angophora floribunda*) forming the common association along minor drainage lines. Forest and woodlands of northern smooth-barked apple (*Angophora leiocarpa*) and dirty gum (*Eucalyptus chloroclada*) are associated with sandstone parent material on the north-western edge of the bioregion.

Basalt-derived soils around Inverell support vegetation dominated by white box and silver-leaved ironbark grading to yellow box, rough-barked apple, Blakely's red gum and white cypress pine on lower slopes. Manna gum can occur in the valleys with river oak along the streams.

Vegetation communities on limestone and serpentinite sites are usually floristically distinct from adjacent areas. Large grass trees (*Xanthorrhoea* sp.) can be a prominent feature of such sites. Serpentinite areas are botanically important as they support endemic flora and currently undescribed species, including a red stringybark, which together with spinifex hummock-grass dominates several sites.

The Nandewar Bioregion also supports small patches of dry rainforest vegetation including the endangered ecological communities – semi-evergreen vine thicket and ooline. Other endangered ecological communities in the bioregion include the much depleted white box/yellow box/Blakely's red gum and brigalow woodlands, Howell shrublands, McKie's stringybark open forest and minor occurrences of native grasslands on cracking clays in the bioregions southwest.

At least two-thirds of the original cover of woody vegetation in the bioregion has been cleared and less than 2% is protected in conservation reserves. Vegetation clearance remains a significant threat to biodiversity across the bioregion. Coolatai Grass (*Hyparrhenia hirta*), an invasive species, is threatening to displace the indigenous ground flora of large tracts of grassy box woodlands, derived native grasslands and granite woodlands.

7.2 Significant flora

More than 60 rare or threatened species have been recorded from the Nandewar Bioregion. This includes 18 species listed under the NSW TSC Act 1995, 9 of which are considered as endangered and 9 vulnerable. The remainder are rated as rare or threatened at a national scale (Briggs and Leigh 1995). Two of these, *Euphrasia arguata* and *Euphrasia ruptura*, are now thought to be extinct.

The major threats to these species continue to be vegetation clearance and habitat fragmentation and disturbance. Species such as *Digitaria porrecta*, and *Cadellia penstalylis*, are seriously threatened by weed invasion and pasture improvement of native grasslands.

The Nandewar Bioregion supports many other plant species of conservation significance such as the serpentinite endemics and presently undescribed taxa, for example members of the *Macrozamia* and *Homoranthus* genera.

Photo: NPWS

7.3 Significant fauna

Four hundred and sixty seven vertebrate species are known to occur in the bioregion. Of these, 134 species, or almost one-third, are considered to be of conservation significance and 51 of these are listed as extinct, endangered or vulnerable in the TSC Act. Protection of the remnant vegetation of the Nandewar Bioregion is critical to the survival of these species.

Several frogs are considered to be of extremely high conservation significance in the bioregion, having declined in distribution. These include *Litoria booroolongensis* and *Adelotus brevis*, both of which are now extremely rare in the bioregion.

One turtle species, *Elseya bellii*, is listed as a threatened species and found on the upper reaches of the Gwydir, Namoi and Macdonald rivers. It is considered to be of high conservation significance in the Nandewar Bioregion. Very little is known about turtle distribution in the bioregion in general, including that of *Chelodina expansa*, which has secretive habits and is usually found in muddy water (Cann and Ward 1998).

Twelve lizard species are considered to be of conservation significance, including *Anomalopus mackay* and *Underwoodisaurus sphyrurus*. Two-thirds of the records for the latter occur in the Nandewar Bioregion.

Half of the 26 snake species of the bioregion are considered to be of conservation significance. This may be partly due to the lack of data for the bioregion. Among these, *Holocephalus bitoquatus* is known from historical records in the bioregion but there have been no records of recent sightings.

There is a high diversity of woodland birds in the Nandewar Bioregion, including significant populations of a number of threatened species, such as the turquoise parrot (*Neophema pulchella*), brown treecreeper (*Climacteris picumnus*), speckled warbler (*Chthonicola sagittatus*), diamond firetail (*Emblema guttata*), grey-crowned babbler (*Pomatostomus temporalis*) and hooded robin (*Melanodryus cucullata*). Of the 252 diurnal bird species of the bioregion, 45 are of conservation significance and 18 of these are listed in the TSC Act.

The Nandewar Bioregion, together with the New England Tableland Bioregion, supports a significant proportion of the NSW population of the regent honeyeater (*Xanthomyza phrygia*). Declines in the numbers of ground-feeding insectivores, grassland and freshwater birds and some temperate woodland birds are evident in the bioregion.

Populations of musk lorikeets (*Glossopsitta concinna*) have increased in this and the New England Tableland Bioregion, as have little corella (*Cacatua sanguinea*) populations (Australian Terrestrial Biodiversity Assessment 2002), while 6 of the 11 nocturnal birds of the bioregion, including several owls and the bush stone-curlew (*Burhinus grallarius*), are considered to be of conservation significance.

Six of the 9 native arboreal mammals of the bioregion are of conservation significance, including the koala (*Phascolarctos cinereus*) which although widespread relies on remnant forest in the bioregion. The bioregion also supports high density populations of squirrel glider (*Petaurus norfolcensis*). The greater glider (*Petauroides volans*) is an example of the disjunct faunal populations found in Mt Kaputar National Park.

Fourteen of 27 bats in the bioregion are also of conservation significance, including some of the rarest bats in north-eastern NSW such as *Vespadelus troughtoni* and *Chalinolobus dwyeri*, which are known from several locations in the bioregion.

7.4 Significant wetlands

There were no significant wetlands recorded for this bioregion (Australian Terrestrial Biodiversity Assessment 2002).

8. Regional history

8.1 Aboriginal occupation

The Aboriginal language groups whose traditional lands lie in the Nandewar bioregion include the Anaiwan (south of Inverell, west to Tingha, to Armidale and south of Uralla), Kamilaroi (from Liverpool Plains to Gwydir; Walgett, Bingara, Quirindi), the Weraerai (Wirrayaraay) and the Kwaimbul in the north.

Aboriginal people used the landscape as both a natural and cultural resource. Evidence of "transient campsites", (noted by Mitchell as being distributed among the casuarinas and acacias) suggested a seasonal approach to hunting and gathering activities. A range of stone tools were developed with local and traded stone, including "greywackes" and quartz. Mammals such as kangaroo and possum were used for food, clothing, decoration, and stone and wooden hunting tools such as jagged spears, boomerangs and waddies were developed to catch them. Fish were trapped and taken from Gwydir using stone weirs and nets made from plant fibre.

The landscape has influenced the names of many of the local towns and stations which are named after Aboriginal words for aspects of the landscape, usually in association with water which is an important resource in dry country. Bingara – "creek" or "shallow crossing", Barraba – "camp by the riverbank", Manilla – *muneela* – "winding river", Quirindi – *guyerwarindi* – "waters fall together". The region is known for ornately carved trees, ceremonial bora grounds and art sites, indicating an intimate spiritual, as well as a physical, attachment to the sacred landscape the Aboriginal people inhabited.

The region is also the place of a marked history of conflict between Aboriginal and non-Aboriginal people. The Europeans pushed the indigenous community away from creeks and waterholes and seized the women and girls. The Aboriginal men retaliated by spearing stock and attacking the stations. In response, several organised massacres took place in the region, including the infamous Myall Creek massacre. At this place, nearly 28 Wirrayaraay, reputedly a peaceable community, were gruesomely murdered at their camp by 11 local stockmen and station hands who were later hanged for their crime. A memorial to those who once lived there now stands as a reminder to passers by.

8.2 European occupation

John Oxley explored the northern tablelands including the Nandewar Bioregion in 1818. Squatters began to occupy the area in the 1830s, looking for suitable grazing land (NSW NPWS 1991). Inverell, on the eastern border of the bioregion, originated in 1837 as a 50,000-acre station run by Alexander Campbell (HO and DUAP 1996).

Cattle grazing was the dominant land use of the bioregion in the early days of European settlement but by the end of the 1800s sheep grazing was expanded due to improved pastures and better fencing (NSW NPWS 1991).

The gold rush of the 1850s led to the rapid entrenchment of several towns in the Nandewar Bioregion. Goldfields in the centre of the bioregion saw the origin of the town of Barraba in 1852, which later became a centre of wheat and pastoralism and was also supported by the Woods Reef Asbestos mine until it closed in 1982 (HO and DUAP 1996). Similarly, Bingara began as a small village until gold was discovered nearby and the All Nations Gold Mine, active from 1880 to 1948, ensured its permanence. Diamonds representing most of Australia's yield were also mined near Bingara (HO and DUAP 1996). Inverell benefited from the surrounding mines and sapphire mining also became a basis for the town's economy for several years. The fertility of its soils allowed increased farm yields in order to feed the miners.

The Liverpool Plains supported the estates of the Australian Agricultural Company from 1832 (HO and DUAP 1996), when the squatters were driven further north. The company's headquarters became the basis of the town of Tamworth when urban development began to occur in earnest in the 1850s. By 1861 Tamworth had a population of 654 people and became a link in the traffic route from the north, especially when the railway reached the town in 1873 (HO and DUAP 1996). Tamworth became a municipality in 1876 and by this time it was a successful town with much industry and facilities such as a hospital, banks and schools. In 1888, after building its electricity generating plant (NSW NPWS 1991), Tamworth became the first town in Australia to use electric lighting (HO and DUAP 1996) and eventually it serviced much of the north of the state.

Inverell was not planned as a town until 1858, and later thrived as a result of agricultural production, particularly wheat, with the advent of more sophisticated equipment introduced in the 1860s and 1870s. The railway reached Quirindi in 1877 and by the 1890s this area too was a major wheat centre (HO and DUAP 1996).

Soft wood timber was abundant in the bioregion although it was difficult to retrieve. Many forests were dedicated as state forests around 1900 and most are still managed by State Forests of NSW (NSW NPWS 1991).

9. Bioregional-scale conservation

A small proportion (43,038.72 ha, or 2.07%) of the NSW part of the Nandewar Bioregion is managed under various conservation regimes. Of these, the majority is land managed under the provisions of the NPW Act 1974 as national parks or nature reserves. These occupy 40,657.46 ha or 1.97% of the bioregion. These parks and reserves include Kwiambal National Park, which is almost entirely within the bioregion, as is the majority of Mt Kaputar National Park. Three wilderness areas (Wilderness Act 1987) Grattai, Nandewar and Rusden have been declared over Mt Kaputar National Park, and together occupy 28,790.73 ha or 1.39% of the bioregion. The Torrington State Recreation Area takes up only a small portion of the Nandewar Bioregion, occupying 11.32 ha or 0.001% of the bioregion, the largest portion falling in the adjacent New England Tableland Bioregion. There are no Aboriginal areas, no historic sites, no reserves, no state recreation areas and no regional parks in the bioregion.

No voluntary conservation agreements have been entered into with landholders, but there are 3 wildlife refuges that occur on properties occupying 1,890.48 ha or 0.09% of the bioregion. Landholders on 4 properties have entered into property agreements (NVC Act 1997). The conservation zone of these agreements occupies 137.06 ha or 0.01% of the bioregion.

One flora reserve, Mehi, is managed under the provisions of the Forestry Act 1916, and occupies 48.77 ha or 0.002% of the bioregion. State forests managed primarily for forestry activities under the Forestry Act 1916 occupy 41,625.31 ha or 2.01% of the bioregion.

10. Subregions of the Nandewar Bioregion

(Morgan and Terrey 1992)

Subregion	Geology	Characteristic landforms	Typical soils	Vegetation
Peel	Fine grained Silurian to Devonian sedimentary rocks. Strongly folded and faulted with marked northwest alignment. Areas of sub-horizontal Carboniferous shales and sandstones in the north. Limited areas of basalt cap from the Nandewar and Liverpool Ranges are included. Linear outcrops of serpentinite and scattered bodies of limestone.	Low peaked hills with north-westerly alignment. Basalt caps of dissected flows, moderate slopes and flat river valleys with alluvium. Karst landscapes in limestone.	Shallow stony soils on ridges. Texture contrast soils on almost all slopes shifting in colour from red brown on upper slopes to yellow on lower slopes. Black earths on basalt. Dark, alkaline, pedal clays on limestone. Serpentinites have shallow stony profiles with concentrations of elements that are toxic to many plants. Alluvial loams and clays with moderate to high fertility in alluvium.	White box grassy woodlands, with yellow box and Blakely's red gum on lower slopes. Rough-barked apple and yellow box on flats. River oak and some river red gum along major streams. Patches of red stringybark and red ironbark on steeper slopes in the east. Silver-leaved ironbark on basalt caps, white cypress pine and kurrajong on stony areas in the west and north. Very large grass trees on serpentinite.
Kaputar	Remains of a Tertiary central volcano with a thick sequence of basaltic lavas.	Rugged steep rocky hills and peaks, exposed volcanic plugs and dykes. Benched slopes mark different lava flows.	Frequent rock outcrop interspersed with shallow stony brown loams. Black earths on lower slopes and valleys.	Snow gum and manna gum on the highest tops with silver-topped stringybark, broad-leaved stringybark and red stringybark. Black cypress pine and white cypress pine with silver-leaved ironbark, narrow-leaved ironbark on slopes. Kurrajong, yellow box, white box, rough-barked apple and Blakely's red gum on lower slopes.
Inverell Basalts	Extensive basalt flows from a Tertiary lava field eruption centre. Tertiary sub-basaltic sands and gravels exposed at the edges of the flows. Small areas of granite and Palaeozoic and Mesozoic sandstones.	Undulating low hills and the dissected edge of the New England Plateau. Long hillslopes are stepped across different lava flows and have a marked break of slope where buried sands and gravels are exposed.	Soils on sedimentary rocks similar to Peel Subregion. Brown to black pedal loams and clays on basalts thickening downslope, high nutrient levels and excellent water holding capacity. Exposed Tertiary sands have coarse sandy soils that may develop podsol pans.	White box with silver-leaved ironbark and red ironbark. Yellow box, rough-barked apple and Blakely's red gum and white cypress pine on lower slopes. Manna gum in valleys and river oak on streams.
Northern Complex	Large areas of coarse grained granite and gently folded Carboniferous quartz sandstones and shale. Isolated limestone outcrops.	Low hills and ranges, more rugged on granites with abundant rock outcrop and tors. Short, steep gorges of major rivers. Karst landscapes on limestone.	Harsh texture contrast soils with subsoils prone to gully development. Gritty shallow profiles on granite. Dark, alkaline, pedal clays on limestone.	Red ironbark with white cypress pine, grey box, forest red gum, and bull oak on granites. Lower colluvial slopes as above with pale bloodwood, and hill red gum. River red gum, river oak and rough-barked apple on creeks. Silver-leaved ironbark and white cypress pine on shale and sandstone with white box on lower slopes. Poplar box, brigalow. Bulloak on finer alluvium, forest red gum and Moreton Bay ash on coarser alluvium. Diverse understorey shrubs.

11. References

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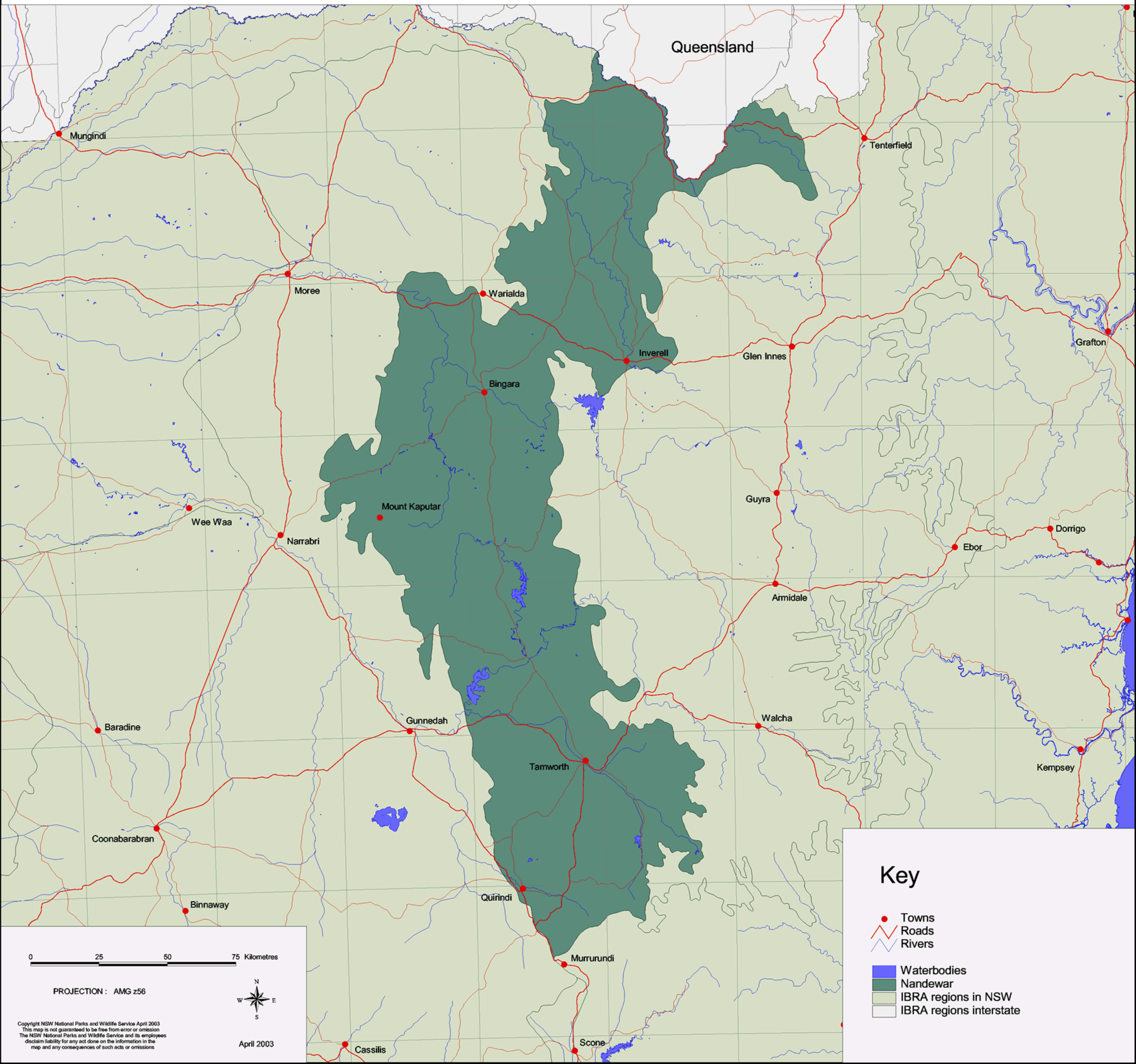
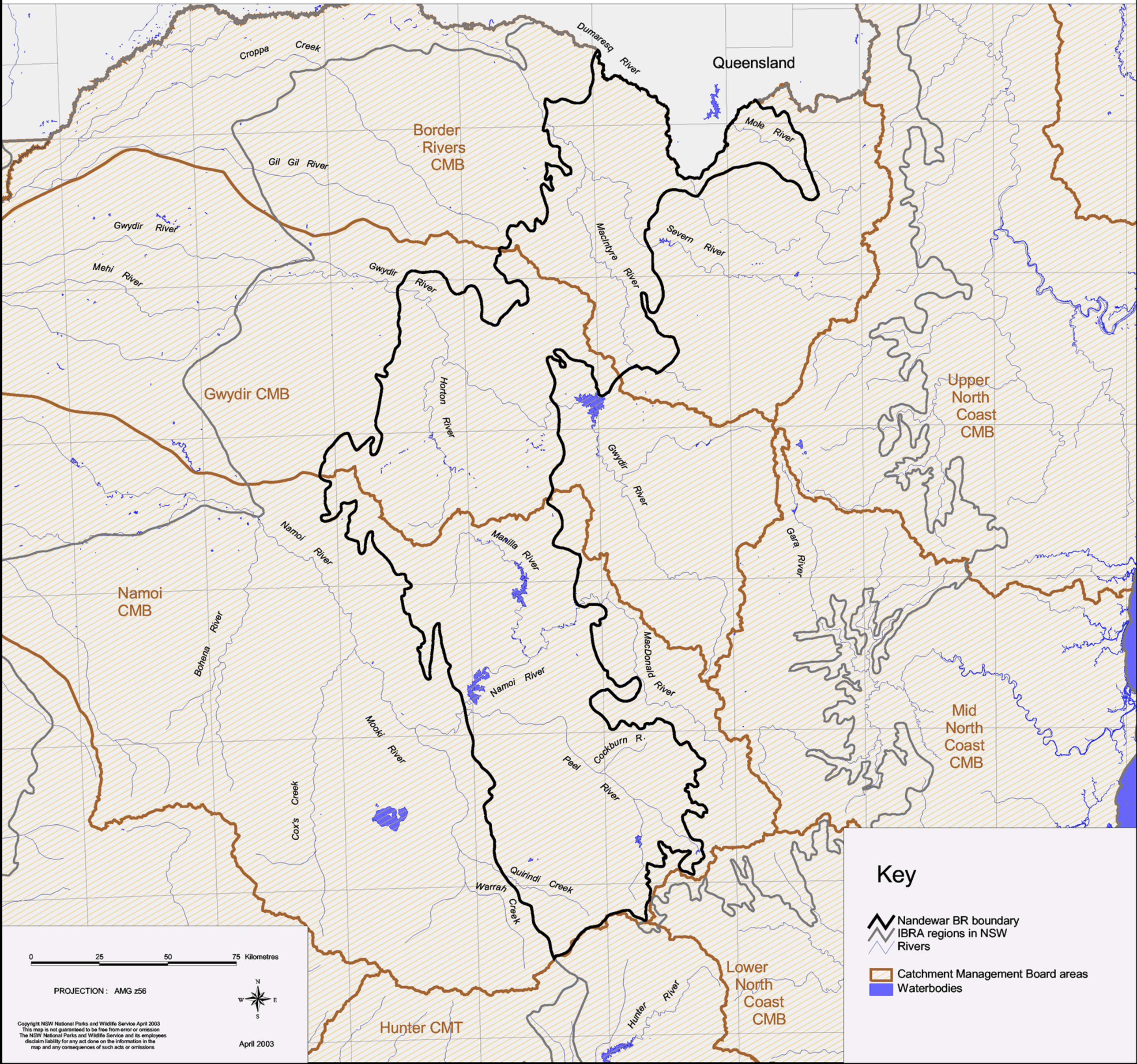
Photo: C. Perry

Nandewar Biogeographic Region (IBRA) - Location



Nandewar Biogeographic Region (IBRA) - Rivers



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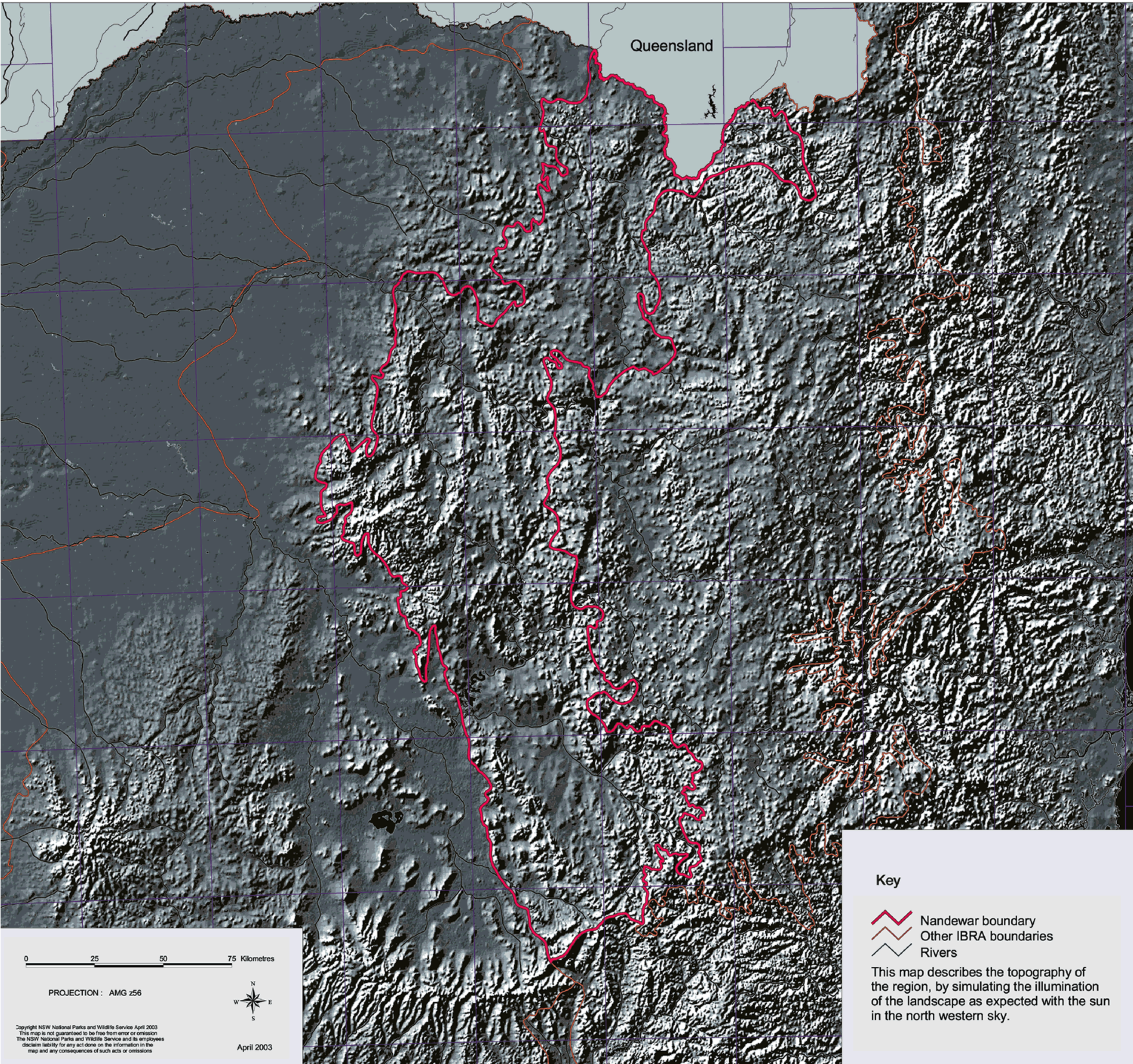


0 25 50 75 Kilometres

PROJECTION : AMG z56

N
W E
S

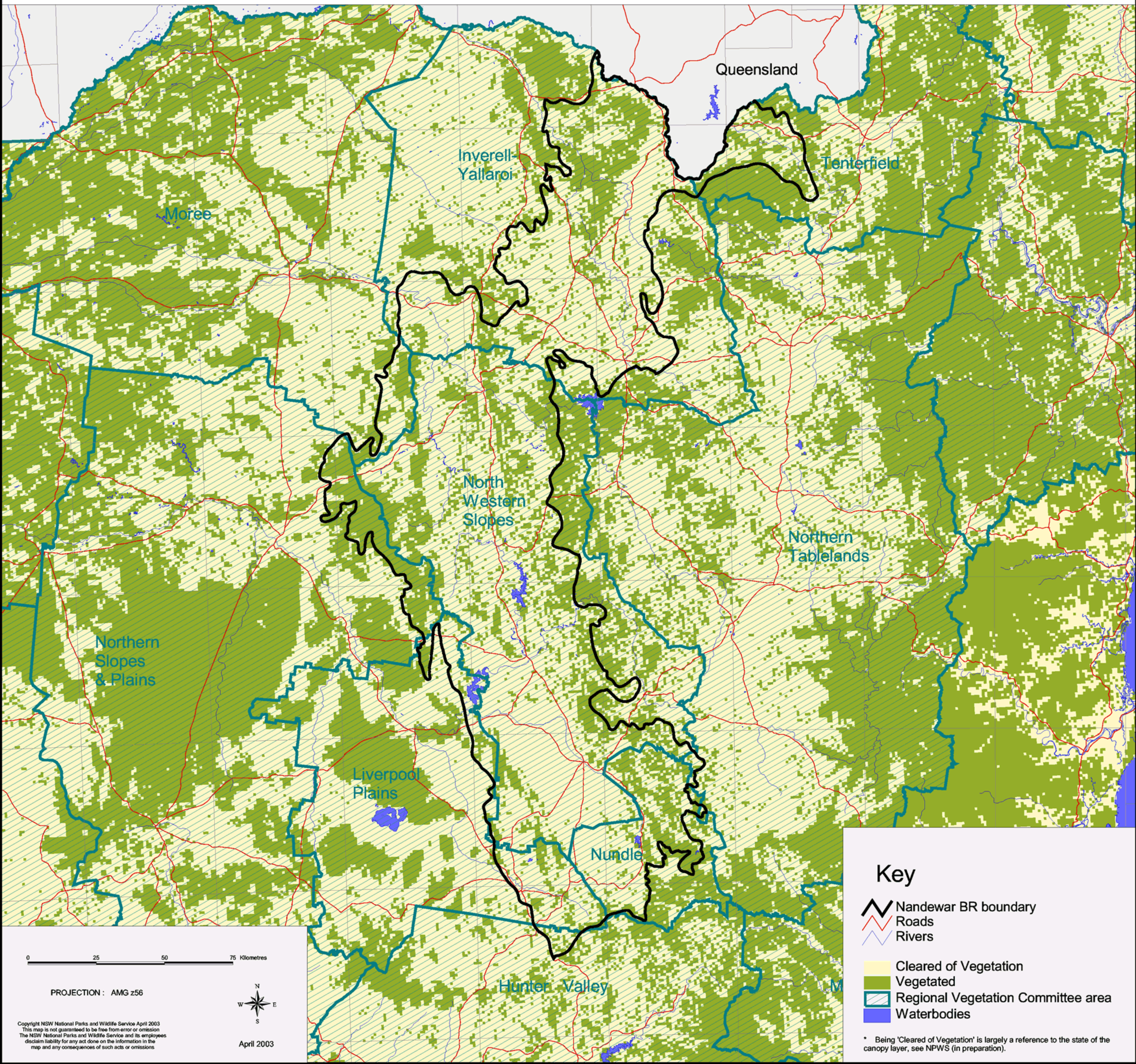
April 2003

Key

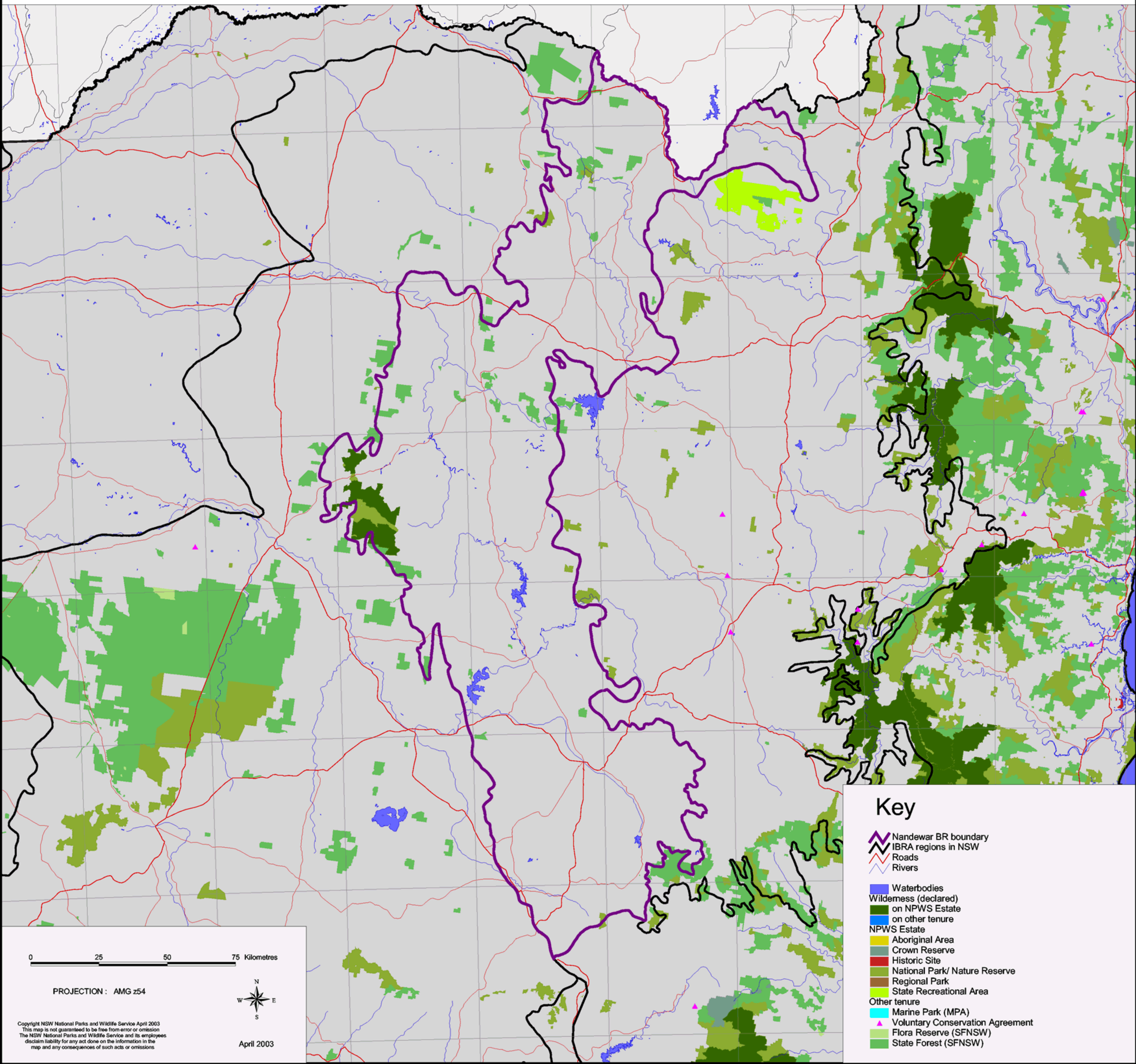
Nandewar boundary
Other IBRA boundaries
Rivers

This map describes the topography of the region, by simulating the illumination of the landscape as expected with the sun in the north western sky.

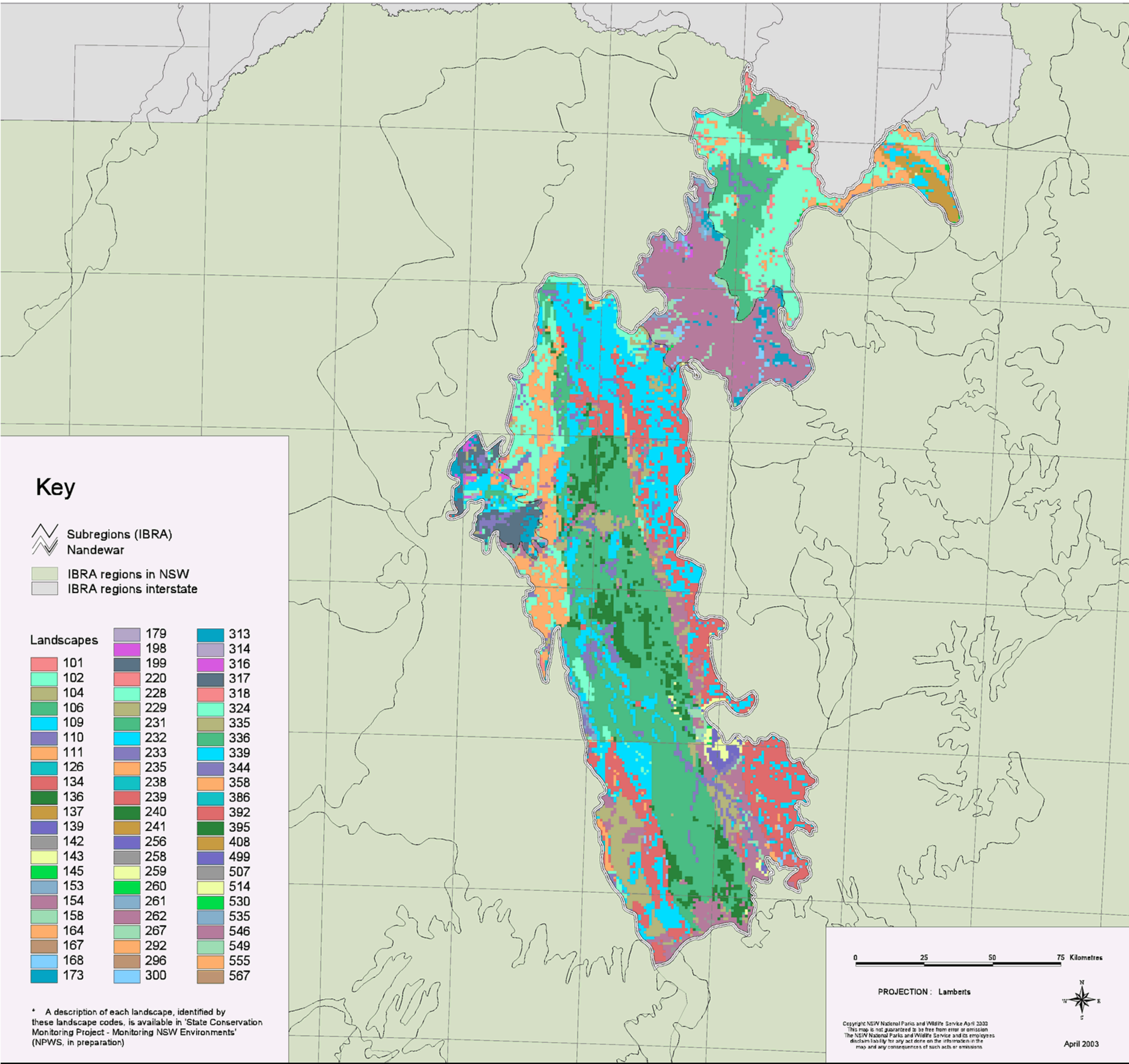
Nandewar Biogeographic Region (IBRA) - Vegetation



Nandewar Biogeographic Region (IBRA) - Tenure/Reserves



Nandewar Biogeographic Region (IBRA) - Subregions and Landscapes (NPWS, in preparation)



Key

Subregions (IBRA)
Nandewar

IBRA regions in NSW
IBRA regions interstate

Landscapes

101	179	313
102	198	314
104	199	316
106	220	317
109	228	318
110	229	324
111	231	335
126	232	336
134	233	339
136	235	344
137	238	358
139	239	386
142	240	392
143	241	395
145	256	408
153	258	499
154	259	507
158	260	514
164	261	530
167	262	535
168	267	546
173	292	549
	296	555
	300	567

* A description of each landscape, identified by these landscape codes, is available in 'State Conservation Monitoring Project - Monitoring NSW Environments' (NPWS, in preparation)

0 25 50 75 Kilometres

PROJECTION : Lamberts

N W E S

April 2003