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Environment and Conservation (NSW)

Macdonald River,

Yengo National Park

Wild River Assessment 2006

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Executive summary

The NSW *National Parks and Wildlife Act 1974* (NPW Act) allows for the formal recognition and protection of wild rivers. Whereas most rivers in NSW have been greatly changed by modern society, wild rivers remain in a substantially unmodified condition and are of high conservation value.

A river, or part of a river, may be declared a wild river by the Director General (DG) of the Department of Environment and Conservation (DEC) following a detailed assessment of its conservation value, in accordance with DEC's 'Framework for wild river assessment'. Wild rivers may only be declared on lands reserved under the NPW Act. Wild rivers are managed to maintain and, where possible, restore natural processes associated with river health and to permit the identification, conservation and appropriate management of Aboriginal objects and places. A wild river may also be used as a focal point for protection and rehabilitation works within the catchment.

The Macdonald River is a tributary of the Hawkesbury River and lies north of the Hawkesbury and Colo Rivers and south of the Hunter Valley. A large portion of the Macdonald catchment is within Yengo National Park. Putty State Forest is located in the most northern section of the catchment and freehold land falls between the state forest and national park, on the western side of Putty Road.

Aboriginal people have a long history of settlement in the assessment area which continues to be important to them. The Macdonald River area, including the Wollombi and Putty areas, formed part of the territory of the Darkinjung people, and the northern portion of Yengo National Park formed a part of the territory of the Wonnarua people. The Darkinjung territory contains some of the richest and most outstanding rock engraving sites in eastern NSW. Mount Yengo is a sacred site for Aboriginal people and is the site of an Aboriginal Dreamtime story. For this reason it is believed that many of the Aboriginal sites in the region are related to Mount Yengo.

The Macdonald River has been assessed for its biological, geomorphic and hydrological condition. It has been found to support a rich aquatic macroinvertebrate fauna; however, a loss of diversity was detected which is probably due to a lack of habitat diversity in the substratum caused by sedimentation.

There have been significant changes to the flow of the Macdonald River recorded since the 1940s and these correlate with natural changes in rainfall and flooding. There is nothing in this catchment's history to indicate that the hydrology of the river or catchment has been substantially influenced by human disturbances since European settlement.

A geomorphic assessment of the river indicates it is in poor condition due to extensive sedimentation. It is likely that human activities in general, and land clearing together with high intensity fires in particular, may be the cause of sand slugs (large sediment deposits) in the Macdonald River. For this reason the Macdonald River can not be considered 'substantially unmodified' since pre-European times and as such does not meet the criteria for wild rivers as required under the NPW Act. The recommendation of this assessment is not to declare the Macdonald River as a wild river.

1. Introduction

1.1 Wild rivers under the National Parks and Wildlife Act

The wild river provisions of the NPW Act present an opportunity to identify some of the most pristine rivers in NSW and ensure these rivers, including their cultural features, are well managed.

Wild rivers may only be declared within land reserved under the NPW Act. To be considered wild, a river must be in a largely natural condition. Consideration is also given to the condition of those parts of the catchment affecting the river.

The NPW Act states:

> Wild rivers are those exhibiting substantially natural flow and containing remaining examples in a condition substantially undisturbed since European occupation of:
>
> (a) the biological, hydrological and geomorphological processes associated with river flow, and
>
> (b) the biological, hydrological and geomorphological processes in those parts of the catchment with which the river is intrinsically linked, (section 61 (4) NPW Act).

The purpose of declaring a wild river is to identify, protect and conserve:

> any water course or water course network, or any connected network of water bodies, or any part of those, of natural origin, exhibiting substantially natural flow (whether perennial, intermittent or episodic), (section 61 (4) NPW Act).

Rivers are assessed in accordance with DEC's 'Framework for wild river assessment'. If the water course meets the NPW Act's requirements, a wild river is declared by the DG of the Department of Environment and Conservation (DEC) placing a gazettal notice in the *Government Gazette*. Where the declaration may affect functions carried out under the *Water Management Act 2000,* or in the case of State Conservation Areas, the *Mining Act 1992,* the concurrence of the responsible Ministers may be required prior to declaration, (section 61 (3) NPW Act).

Wild rivers are managed by DEC to maintain and restore (if necessary) their wild river values and to identify, conserve and protect associated Aboriginal objects and places (section 61 (5) (a) and (b) NPW Act). Wild river declarations can trigger investigations of Aboriginal objects and places, and the development of conservation plans.

A wild river can only be declared if it is consistent with any plan of management in operation for the reserve/s where the water course is located (section 61A NPW Act). The Macdonald River catchment falls within Yengo National Park. A draft plan of management has been prepared for this park which identifies the Macdonald River as a potential wild river.

1.2 Why declare wild rivers?

Wild river declaration can raise the profile of the most pristine rivers in the state and provide a focus for environmental monitoring and scientific study.

All rivers within the existing reserve system fulfil a role in protecting freshwater and riparian dependent flora and fauna. Wild rivers, because of their excellent condition, potentially play a wider role in providing a range of environmental services for other parts of their catchment, including a source for recolonisation, water quality improvement, water supply assurance and flood mitigation. They also have a role in protecting cultural and historic heritage.

Wild rivers can provide a focus for land managers who wish to identify and manage streams of high conservation value as part of their activities. Those individuals managing lands outside of the reserve system may wish to complement the wild rivers program with conservation programs in other parts of the catchment.

2. Assessment

2.1 Assessment methodology

Biological, geomorphic and hydrological aspects of the Macdonald River were assessed to determine whether it was substantially undisturbed and met the definition of a wild river. The assessment was undertaken in accordance with DEC's Framework for wild river assessment (DEC 2005). A range of existing information on the condition of the Macdonald River and its catchment was reviewed and local knowledge was sought.

The following assessment techniques were used to measure the biological and geomorphic conditions and these were compared to a reference condition:

- Biological health was assessed using 'AUSRIVAS' (Davies 2000) analysis. This method samples and analyses freshwater invertebrates and uses the presence or absence of groups of invertebrates as a surrogate for biological health.
- Geomorphic condition was assessed using River Styles (Brierley and Fryirs 2005). This method measures a range of physical features of rivers to determine whether there are unnatural rates of change in the river system.

These methods have been used extensively in NSW.

AUSRIVAS uses those rivers in the most pristine condition as benchmarks against which other rivers are compared. These benchmarks, or reference sites, are considered to be rivers which are the least affected by post-European human activities.

Under the River Styles system, each section of a river is classified according to factors such as rainfall, geology and topography of the landscape (e.g. whether the river occurs in a rocky gorge or on a floodplain). Certain features of the river, such as extent of bank vegetation or presence of deep pools, are compared with predicted or reference features for that particular river type. River condition is determined according to how well the river's features meet the reference condition. River condition assessed using this method is indicative of whether the river's geomorphology is changing at an unnatural rate due to human disturbance.

Changes in river hydrology may be determined with some accuracy where flow-monitoring stations have been located for some years. Flow monitoring commenced in St Albans, south of the study area, in 1954 and rainfall data from varying locations in the Macdonald catchment is also available.

Hydrological changes may also be deduced using information on water and land use in the catchment; for example, extent of clearing in the catchment, impediments to river flow such as dams or weirs and estimates of water usage from water extraction licences.

Current and historical land use practices were investigated within the catchment of the Macdonald River where these had the potential to directly impact on river condition. Current land use information was also used to highlight any management practices that might impact on the river or catchment in the future. Disturbances that may impact on the biology, hydrology and/or geomorphology of the river include logging, clearing, roads, mining, drainage works, water extraction, frequent or severe fire, intensive recreational activities, grazing, the presence of certain weeds and feral animals. Sources of information used in this study included maps of vegetation structure, aerial photographs, physical evidence and documents relating to the history, use and management of the area. Local knowledge was also obtained. Data sources used and experts consulted for the technical assessment are listed in Appendix 1.

3. Results

3.1 Description of the catchment

The Macdonald River lies to the north of the Hawkesbury and Colo Rivers and south of the Hunter Valley. A large portion of the Macdonald catchment is within Yengo National Park. Putty State Forest is located in the most northern section of the catchment with freehold land occurring between the state forest and the reserve on the western side of Putty Road. The entire catchment covers an area of 1909 square kilometres.

The Macdonald River is a tributary of the Hawkesbury River (Figure 1). The upper reaches are characterised by narrow v-shaped channels before broadening to a very wide channel with over-steepened banks; a legacy of a series of extreme floods between 1949 and 1955 (Henry 1977). Collapsing banks in 1955 revealed established trees buried five metres below the surface of the present bank (Henry 1977) suggesting a prior history of massive sand slugs. The depositions of large volumes of sand have transformed the lower Macdonald River from a relatively narrow, deep river to a much broader system. No major channel changes have occurred after 1955, although it has remained unstable with frequent variations in bed elevation and is characterised by periods of slight channel constriction and widening (Erskine 1986). Because of the rugged topography and unproductive sandy soils, much of the Macdonald catchment is uncleared and supports limited grazing, with logging occurring in state forest in the upper reaches.

The majority of streams within the national park flow south-east into the Hawkesbury River near Wisemans Ferry via the Macdonald River and Webbs Creek (NPWS 2004). The north-eastern section of the catchment is located in a rain shadow and, as a result, receives lower rainfall than the higher tableland areas to the west and the coastal ranges to the east. Relatively steep drainage gradients, localised areas with milder temperatures and small areas of good quality soils, scattered through the infertile sandstone, have resulted in an area of high biodiversity.

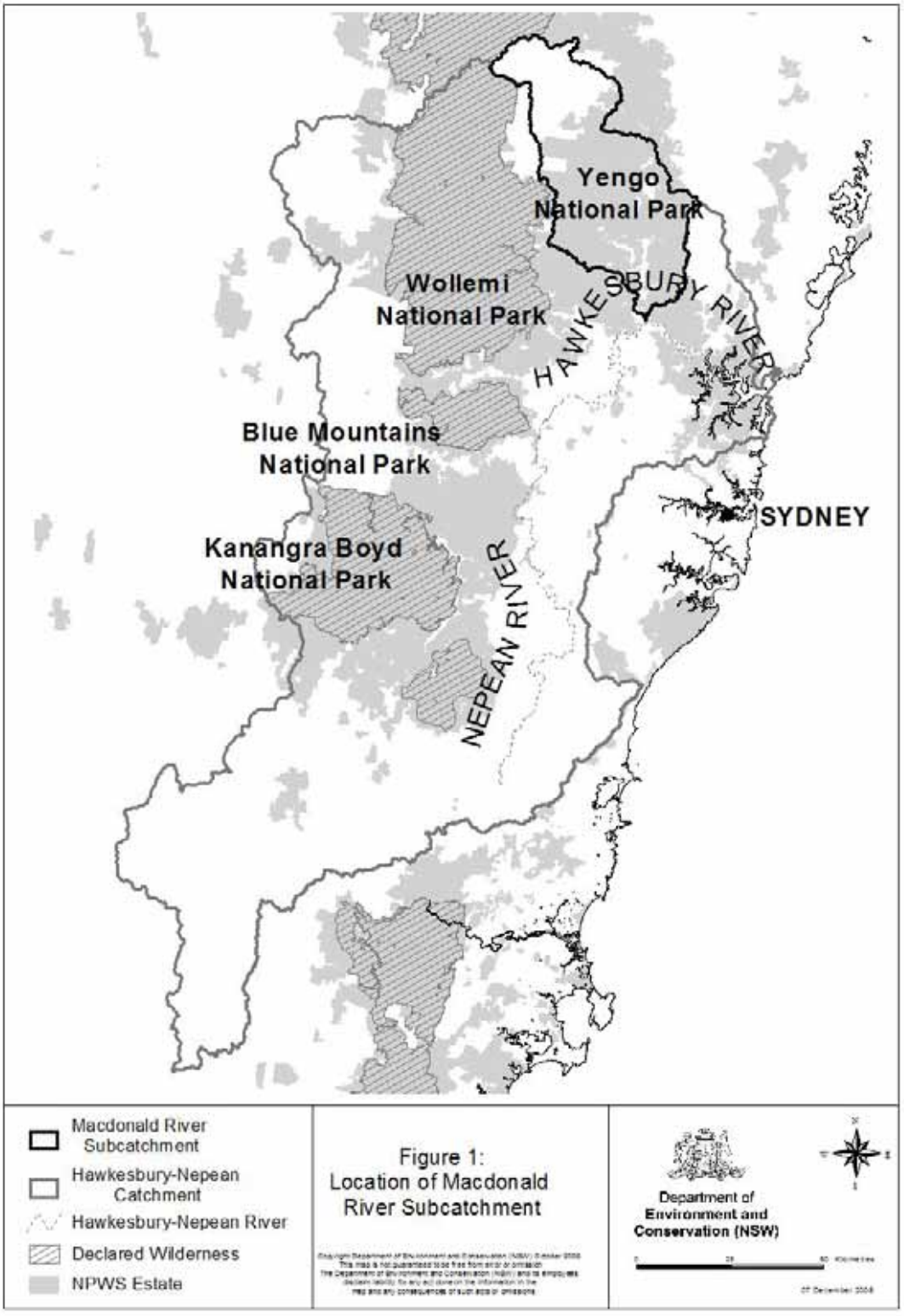
3.2 Description of the study area

3.2.1 Physical features

Yengo National Park forms part of the Hornsby Plateau, a highly dissected sandstone plateau within the Sydney basin, which extends from the eastern edge of the Blue Mountains and the southern rim of the Hunter Valley (Bell et al 1993, NPWS 1994). Two sedimentary series from the Triassic geological period make up the majority of rock type within the catchment. The lowest rocks in Yengo belong to the Narrabeen Group, which is a mixture of sandstone, mudstone and shale. Above this are the rocks of the Hawkesbury sandstone. There is a gentle tilting of the layers upward towards the north so that the rocks of a particular sequence are often located in different topographical positions across the Park (Sanders et al 1988).

Another geologic feature occurring in the catchment area is small outcrops of Tertiary volcanics, including basaltic extrusions and diatremes (Bell et al 1993). These are very restricted in distribution and include Mogo Hole and Frog Hollow in the south east. Formations of the tertiary basalt occur as the spectacular mountains of Yengo and Wareng and as plugs at the bottom of crater-like valleys. Areas of Quaternary and recent sandy alluvium material are also restricted in distribution, with major deposits occurring at the bases of some valleys.

Figure 1. Location of Macdonald river subcatchments.



3.2.2 Natural values

Flora

The Macdonald catchment contains a diverse mosaic of vegetation communities that exist in response to complex interactions of environmental factors including climate, topography, drainage, geology and fire history. Communities found on the more sheltered southern and south-eastern slopes generally show the highest plant diversity. Most of the ridge-tops and northwest-facing slopes consist of a less diverse low woodland with sclerophyllous shrubs underneath. There is considerable local variation, such as the occurrence of an open forest of ironbarks with an open grassy understorey, usually found in dry habitats with high clay content in the soil (Bell et al 1993).

The wetter area closer to the coast in the south-east of the catchment supports small stands of tall eucalypt forest and warm temperate rainforest in sheltered gullies. The warm temperate rainforest in sheltered valleys and the dry rainforest on the basalt tops (such as Mount Yengo and Mount Wareng) reflect the climatic changes that occurred in eastern Australia during the late Tertiary and Quaternary periods. Mount Yengo and Mount Wareng's basalt caps support Red Cedar (*Toona cilliata*) and Stinging Trees (*Dendrocnide excelsa*) within dry rainforest. The drier north-eastern part of the area supports plant communities with species typical of the western slopes of NSW, such as ironbarks and cypress pines. The Hawkesbury sandstone plateau tops include heathland and dry Hawkesbury woodland.

Vegetation associations of regional conservation significance in the area include rough-barked apple woodland, woodland on perched sands, swamp woodland on perched sands, grey box open forest, stinging tree dry rainforest and the melaleuca swamp forest (Bell et al 1993). Sydney coastal river-flat forest, an endangered ecological community, also occurs in this area. Thirty-two species of plants classified as rare or threatened have been identified in this area (NPWS 2001, Briggs and Leigh 1996).

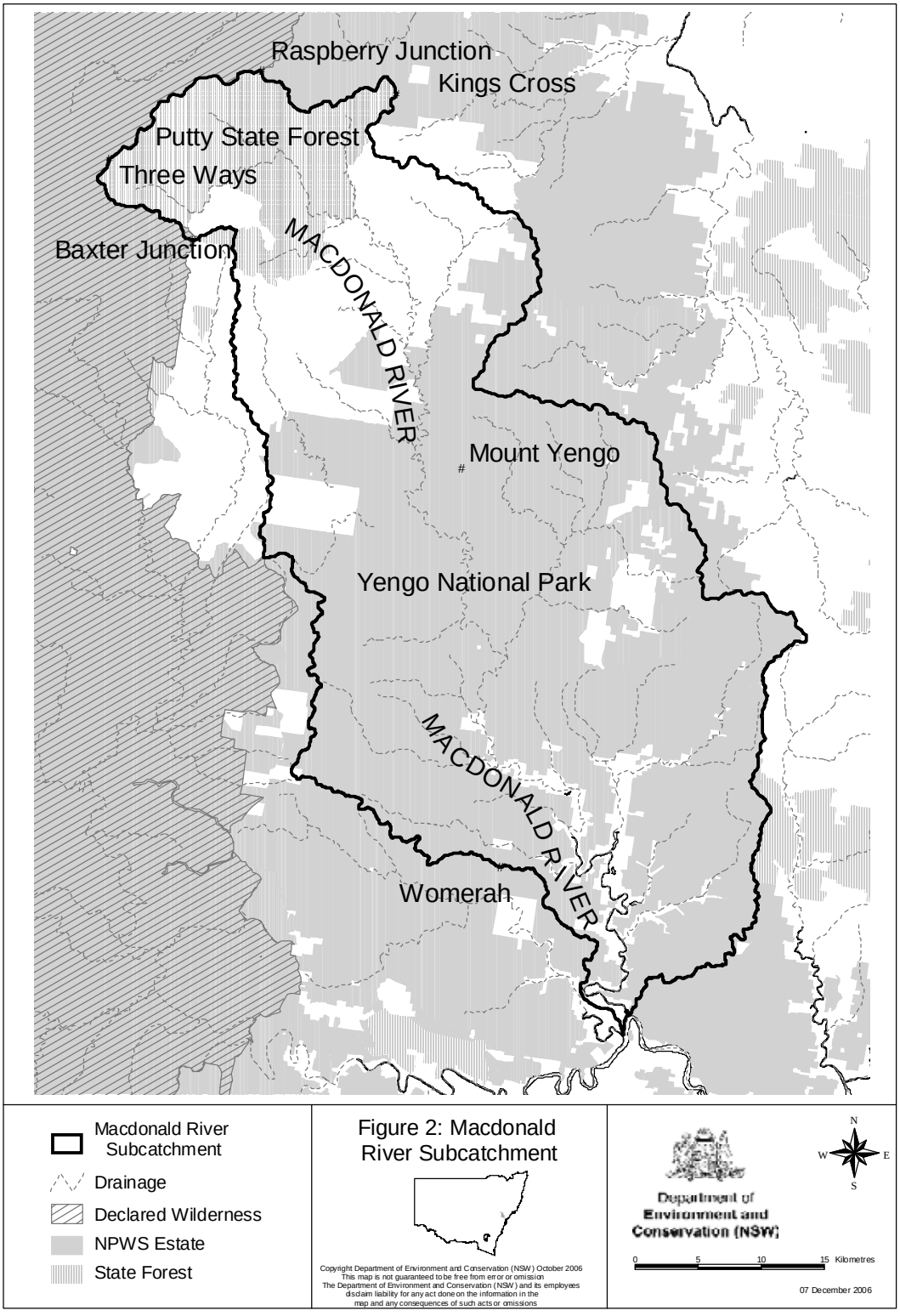
Fauna

There are 276 six fauna species currently listed as occurring within Yengo National Park. To date, 53 species of mammals, 154 bird species, 20 species of amphibians and 49 species of reptiles have been recorded in DEC's Wildlife Atlas.

Twenty eight species of threatened fauna have been recorded, comprising two endangered species and 22 vulnerable species listed under the *Threatened Species Conservation Act 1995*. The catchment encompasses important habitat for the endangered Regent Honeyeater (*Xanthomyza phrygia*). The area also provides specialised habitat for the threatened Brush-tailed Rock Wallaby, which now occurs only in very small disjunct populations.

Other regionally significant species are the Legless Lizard (*Anomalopus swainsonii*), New Holland Mouse (*Pseudomys novaehollandiae*), Yellow-tailed Black Cockatoo (*Calyptorhynchus fenereus*) and the Gang Gang Cockatoo (*Callocephalon fimbriatum*).

Figure 2. Macdonald river subcatchments.



3.2.3 Aboriginal cultural heritage

Aboriginal people have a long history of settlement in the assessment area. The Macdonald River area, including the Wollombi and Putty areas, formed part of the territory of the Darkinjung people, whereas the northern portion of Yengo National Park formed a part of the territory of the Wonnarua people (Sim 1966). Approximately 40 local groups comprised the Darkinjung people. Such groups included the Wollombi tribe, the Macdonald River group and the Kamilroi tribe (Sim 1966, Slater unpublished).

There are currently 638 Aboriginal sites of great variety recorded in the DEC Aboriginal Heritage Information System (AHIMS), in the vicinity of the catchment. The Darkinjung territory contains some of the richest and most outstanding rock engraving sites in eastern NSW. Mount Yengo is a sacred site for Aboriginal people and is the site of an Aboriginal Dreamtime story. For this reason it is believed that many of the Aboriginal sites in the region are related to Mount Yengo.

3.2.4 Recreational values

Four-wheel drive vehicle touring and bushwalking are the main recreational activities in the area, followed by mountain-bike riding, horse riding and trail-bike riding (NPWS 2001). Visitation is not high compared with coastal parks; however, mountain biking around Wiseman's Ferry and St Albans, and horse riding in the southern section of the catchment are becoming more popular. Day trips, particularly by recreational vehicles, are the most common use of the northern section of Yengo National Park, with Howes Trail and Old Settlers Road being the most popular.

Vehicle-based camping occurs at Big Yengo, Mogo and Finchley camping areas. Overnight camping occurs along the Old Great North Road for walkers. For day visitors, picnic facilities are provided at Finchley, Mogo camping area, Bucketty Wall and Little Mogo Creek.

3.2.5 Land use history

Grazing

The fertile valley of the Macdonald River was settled and cleared early in the nineteenth century, when a mixture of grazing and farming occurred. From this area, European settlers ventured out and cleared most of the remaining valleys that showed agricultural potential, such as along Mogo, Melon and Womerah Creeks (Hutton Neve 1978). However, it is estimated that only 5% of the Macdonald catchment has ever been cleared (Prineas 1997). The Boree Valley was grazed as early as 1803. The Wallambine Common (now known as the St Albans Common) at the confluence of the Mogo and Macdonald Rivers and the Boree Swamp on Thompson Creek have supported dairy and beef cattle grazing for 150 years (Hutton Neve 1978). The common provided rich grazing land, with the shallow water and swamp offering communal use for grazing, the cutting of wood for fuel and furniture, and turf to burn. The farms on the banks of the Macdonald River as far up as the Wallambine Common numbered 50 to 60 by 1834. These farms would most commonly have cultivated maize and raised beef cattle (Hutton Neve 1978).

Much of the rugged country between cleared valleys was subject to cattle grazing, and associated frequent burning to induce green feed, plus intense agriculture on small plots. This annual burning practice affected the natural ecological processes in the area. Pastures were affected by the encouragement of bracken fern and blady grass. The diversity of forest understorey declined and the soil landscape became unstable (Strom 1981). The village of St Albans developed and the Macdonald Valley communities became well-established by the 1830s and 1840s. The maximum population in the valley reached

1200 people around 1841, and had reduced to 149 by 1971 (Strom 1981). Permissive occupancies were granted on Crown land that allowed for rough cattle grazing. Much of the eastern side of the catchment contained native grasses which were grazed on until declaration of the park in 1988.

Clearing of the best land was undertaken by early settlers. These settlers applied for land title in the cleared valleys that constitute the freehold blocks today. Very little clearing took place on the additional Crown land areas where permissive occupancies were granted. Often, these were sufficiently open to allow rough cattle grazing. Two types of cattle grazing have been practised in the area. In the more fertile valleys, the land was cleared and improved pastures were introduced. The grazing on improved pasture was predominantly on freehold lands, whereas grazing on native pasture was often practised on grazing licences. Some feral cattle survive today within Yengo National Park as a result of these past grazing practices.

The most actively managed property within the assessment area was the Big Yango Station. The property ran cattle and horses and harvested timber for some 150 years. Clearing took place at Big Yango for cattle grazing from the early 1900s with over 50 dams built throughout the property. This property covered 5300 hectares of freehold land and a further 47,800 hectares of permissive occupancies over Mount Yengo and other areas. The property was purchased by DEC in 2000 and is now part of the national park (NPWS 2001).

Howes Valley district was cleared and has been heavily grazed on improved pasture by cattle since 1825. This valley is located on alluvial floodplains, which are very erodible and may account for the large amount of sand carried by the Macdonald River. The more accessible holdings such as Darkey and Devils Hole have broad open valleys and were more intensively cleared. More remote holdings encompassed steep ridges and were not cleared due to their isolation and ruggedness (NPWS 2001). Fire was an integral part of pasture management in this area, with land being burnt approximately every two years to promote growth of Kangaroo Grass, and to control scrub (NPWS 2001).

In recent years freehold areas of the Macdonald River have been bought by people moving out of Sydney seeking quieter lifestyles, hobby farms, and ‘weekenders’, and agricultural activity has reduced. Some grazing continues on freehold inholdings within the national park and some permissive occupancies for cattle grazing also persist in the catchment.

Logging

Some early logging activities occurred in the 1940s. The timber industry gathered momentum in the catchment in the 1950s with four mills operating simultaneously, all supplied from the Yengo area. These included a mill down by the Colo, another at Colo Heights that subsequently burnt down, the Culoul Sawmill currently at Colo Heights, and another on the southern side of the Colo River. Timber felling activities, predominantly for fencing and building materials took place in valleys where blue gum, ironbark and turpentine were found (NPWS 2001).

In the early 1980s, a mill was established at Putty to produce railway sleepers. The associated logging was more intensive than previous activities, using large volumes of Swamp Gum. The logging operation focussed on the swampy country in the Mellong Swamps and substantial logging took place in the 1980s until Yengo National Park was gazetted in 1988. As a result, parts of the catchment have been logged within the last 20 years. Only one sawmill, ‘Culoul Sawmill’, at Colo Heights is still in operation (NPWS 2001).

Mining

Mining in the catchment has been restricted to small-scale, local operations. There were small quarries at Mogo Creek Road, Womerah, Yango and Boree Tracks from which roadbase or blue metal was acquired. Minor sand mining activities continue to operate around the Mellong Swamps area (NPWS 2001).

Tracks and trails

An extensive system of fire trails was constructed by the army which increased access for timber-getting and other landuses. Other currently used fire trails include Mount Simpson Track, Bala Range Trail and Boree Track. There is no extensive network of walking tracks through the assessment area. Walkers often use management tracks or fire trails.

Introduced flora

The principal weeds in the area are blackberry (*Rubus fruticosus*), pampas grass (*Cortaderia selloanna*), noogoora burr (*Xanthium occidentale*), dandelion (*Taraxacum officinale*), weeping willow (*Salix babylonica*), fireweed (*Senecio madagascariensis*), pink/red lantana (*Lantana camara*), fleabane (*Conyza* sp.), and prickly pear (*Opuntia* sp.) in the Big Yango Station area (NPWS 2001). Tree of heaven and black willow are major weeds within the Macdonald River catchment.

Infestations within the national park are limited to sites subject to previous modification from development of agricultural use. Runoff from the developed urban and rural zones and increased nutrients from such areas encourage weed infestations. The Macdonald River and its tributaries are of concern for the spread of weeds because the upper reaches of these watercourses originate from freehold land outside of the park. Straying stock and dumping of green waste along the Putty and Wollombi Roads are other ways that weeds are dispersed, causing infestations.

Blackberry has colonised disturbed sites in and around the built-up and rural inholdings. It is also a problem near creeks and on the edges of cleared flats. Water and wind-borne weeds such as noogoora burr, dandelion and weeping willow occur in some isolated localities downstream of disturbed lands that lie within the catchment.

Introduced fauna

Cats, foxes and wild dogs are thought to be distributed throughout the catchment. Wild dog and cat numbers are higher in the southern areas nearer to urban development where animals have become established in bushland areas. Cattle, rabbits, pigs and goats occur in more localised distributions. Feral deer and pigs occur in the Mellong Creek and Wallaby Swamp areas and cause soil disturbance when rooting for food and wallowing. Isolated small herds of feral goats also occur, however these are targeted quickly for control by DEC when located. Cattle escapees into the park often come from Howes Valley and the eastern side of the catchment.

Fires

A bushfire database has been established for Yengo National Park. A total of 492 unplanned fires have been recorded from 1975 to 2000. Unplanned fires within the park have burnt large areas including 43,502 hectares in the 1997/1998 fire season and 113,726 hectares in the 1993/1994 fire season. Combined, these two fire events burnt 71.3% of Yengo National Park.

Wildfire within the park is most severe during late spring and summer, when dry north-west and westerly winds influence fire behaviour. Later in the fire season thunderstorms with associated lightning strikes tend to be the main fire ignition source.

DEC fire records indicate that escaped burns from surrounding properties, rather than lightning strikes, represent the main cause of wildfires within the park.

In the 1990s fires were often caused by humans and are likely to have occurred at a much greater frequency than fires caused solely by natural causes, a situation which is a major threat to the natural values of the catchment.

Frequently burnt areas include: between Paynes Crossing and Dalton's Defence Trig; around inholdings south of Finchley and west of Yango Track, and surrounding parts of Yango Track; Mellong Range near Kimma Creek; Haughey Hut area and a large patch around Womerah Range trail; and the area west of St Albans.

3.2.6 Threatening processes

Access tracks built by the timber-cutters also provided access for others, including bush rock collectors. The boom in the landscape trade has encouraged removal of bush rock which has become a problem, particularly in the south, and poses a significant threat to the conservation of amphibians and reptiles. Bush rock removal became intense in the 1980s with up to 100 trucks a day taking rock from the catchment. Access for trucks was via the Putty Road and illegal collectors drove their trucks through vegetation on ridge tops. Bush rock collectors were operating as far north as Howes Valley from the 1970s until the late 1990s (NPWS 2001). Ridges subject to extensive removal of bush rock include: Howes Range, Wallaby Swamp, Wheelbarrow Ridge (west), Gorricks Run, East of Putty Road between Colo Heights and Putty.

In 1966, the then Soil Conservation Service conducted an investigation into the source of sand deposits accumulating along the Lower Macdonald River flats. Among the possible causes of this increase in erosion was the practice of burning scrub after logging and the proliferation of steep, poorly constructed access roads and snigging tracks (Prineas 1997).

3.3 Technical assessment

3.3.1 Biological assessment

AUSRIVAS samples were collected from the Macdonald River upstream of Yokey Creek within Yengo National Park on 31 March 2005. Two edge samples were collected using the AUSRIVAS sampling protocol (Turak et al 2004). Additional sampling was undertaken using a preliminary sampling protocol for assessing aquatic invertebrate diversity in running waters (DEC unpublished). These samples were collected from the sediment, submerged wood and riparian vegetation. The AUSRIVAS assessment rated the sites as slightly poorer than reference. A total of 30 taxa were collected and identified for the AUSRIVAS assessments and 61 taxa, including material from additional samples, were identified to the lowest taxonomic level (Appendix 2).

AUSRIVAS samples had been previously collected from two sites on the Macdonald River, for the National River Health Program, which occurred between 1994 and 1999. One of these sites (Macdonald River at Putty Road) was upstream of Yengo National Park and the other (Macdonald River above St Albans) was downstream from Yengo National Park. The upstream site was assessed and found to be similar to reference condition (undisturbed streams of the same type) and the downstream site was assessed found to be poorer than reference condition.

The AUSRIVAS results from the site on Putty Road suggest that the Macdonald River had a rich aquatic macroinvertebrate fauna upstream from the park boundary. The lower result downstream from the park boundary was likely to be caused by habitat loss resulting from extensive sand slugs. The substratum in the reach sampled in Yengo National Park had more than 60% sand. There were no stony riffles and very little stable substratum to provide habitat for macroinvertebrate fauna.

Water quality data collected together with the macroinvertebrate samples suggested that all three sites on the Macdonald River had excellent water quality on all sampling occasions.

3.3.2 Geomorphological assessment

The Macdonald River system is a confined sand bed reach caused by deposition from sandstone geology. Accordingly, the Macdonald River is a naturally sandy bed river system. However, the river currently has extensive sand slugs.

Sand slugs are large deposits of sediment which move slowly downstream and are created episodically. Sand slugs potentially alter the natural composition of freshwater fauna (Downes et al 2006) and may take several hundred years to flush from a system. Sand slugs can be caused by natural or unnatural events.

Sedimentation is a natural process and sand bars would have occurred naturally in this system. There were also deep pools and permanent surface flow. However, due to the European land-use practices of grazing and cropping, along with more intense and frequent fire regimes, catchment sediment yield has increased and sand slugs have filled-in pools, creating a flat sandy bed with no surface flow. The sedimentation is thought to be in response to clearing and grazing from Howes Valley and the eastern side of the catchment and exacerbated by major bushfires. Flooding some 60–70 years ago would also have been a contributing factor to sediment yield increases.

Many of the minor tributaries to the Macdonald River are steeper so any excess sand has been flushed out, leaving them in good geomorphic condition.

Upstream of Howes Valley, the river's geomorphological condition is good. The rest of the river's length within the Macdonald sub-catchment is in poor condition due to the presence of sand slugs.

3.3.3 Hydrology

Only minor water extraction takes place from the Macdonald River system. All the water extraction licence holders operate at the lower end of the catchment or on the north western side of the catchment at Howes Valley. These extractions are of low volume (used for stock and domestic needs) and pose no major hydrological changes to overall river flow. This means that much less than 2% of the total water flow is likely to be extracted. This is a negligible amount compared to total water flow.

There have been significant changes to the flow of the Macdonald River recorded since the 1940s; however, these correlate with natural changes in rainfall and flooding (Erskine 1986).

There is nothing in this catchment's history to indicate that the hydrology of the river or catchment has been substantially influenced by European land-use patterns.

4. Referrals

Where a wild river declaration may affect functions carried out under the *Water Management Act 2000* or in the case of State Conservation Areas, the *Mining Act 1992,* the concurrence of the responsible ministers may be required prior to declaration. As it is not recommended that the Macdonald River be declared as a wild river, no concurrence is required.

5. Recommendation

The geomorphic assessment found that the Macdonald River is in poor condition due to extensive sedimentation. It is likely that human activities such as land clearing, together with high intensity fires, may be the causes of sand slugs in the river. For this reason the Macdonald River can not be considered 'substantially unmodified' since pre-European times and as such is not considered to meet the criteria for wild river declaration. The recommendation of this assessment is not to declare the Macdonald River as a wild river.

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7. Appendices

7.1 Appendix 1: Data sources

Technical assessment: criteria for wild rivers

	Biological condition	**Geomorphological condition**	**Hydrological condition**
Data sources	Department of the Environment and Heritage, 2003. Australian River Assessment System (AUSRIVAS) National River Health Database, Australian Government, Canberra, ANZCW0501009864	ID&A Pty Ltd Geomorphic categorisation of streams in the Hawkesbury–Nepean catchment, report for Department of Land and Water Conservation and Bega Valley Shire Far South Coast Catchment Management Committee.	DNR water extraction licence data.
Technical advice	Eren Turak, Research Scientist, Policy and Science, Department of Environment and Conservation. Joanne Ling, Research Scientist, Policy and Science, Department of Environment and Conservation.	David Outhet, Research Scientist, Department of Natural Resources.	Paul Simpson, Senior Natural Resource Officer, Water Management Division, Department of Natural Resources.

7.2 Appendix 2: Taxa found in the Macdonald River

Acarina	*Hydrobiosidae*
Araneae	*Enochrus*
Baetidae	*Cheumatopsyche*
Tasmanocoenis	*Cheumatopsyche* sp.AV1
Caenidae	*Cheumatopsyche* sp.AV6
Ceratopogoninae	*Triplectides similis*
Chironominae	*Leptoceridae*
Tanypodinae	*Atalophlebia*
Orthocladiinae	*Ulmerophlebia* sp.AV2
Chironomidae	*Leptophlebiidae*
Austroagrion watsoni	*Diplacodes haematodes*
Collembola	*Nannophlebia risi*
Hemicordulia tau	*Orthetrum caledonicum*
Micronecta	*Austroargiolestes*
Corixidae	*Enithares woodwardi*
Biodessodes	*Notonectidae*
Chostonectes	*Scatopsidae*
Lancetes	*Scirtidae*
Platynectes	*Austrosimulium bancrofti*
Rhantus	*Austrosimulium furiosum*
Aquarius antigone	*Austrosimulium*
Austrogomphus cornutus	*Simulium ornatipes*
Gordiidae	*Simulium*
Illiesoperla	*Paracnephia*
Gripopterygidae	*Simuliidae*
Gyrinidae	*Staphylinidae*
Hebridae	*Tipulidae*
Hemicordulia tau	*Tipulidae* EPA sp.30
Hydraena	*Microvelia*
Taschorema complex	*Veliidae*