UPPER BROGO RIVER
WADBILLIGA NATIONAL PARK

Wild River Assessment

Parks and Wildlife Division
Department of Environment and Conservation

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Department of **Environment and Conservation** NSW

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Department of Environment and Conservation
59–61 Goulburn Street
PO Box A290
Sydney South 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (information and publications requests)
Fax: (02) 9995 5999
E-mail: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

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SUMMARY

NSW has recently introduced legislation that enables wild rivers to be formally recognised and protected. Wild rivers are those rivers of which the biology, geomorphology and hydrology are in a substantially unmodified condition. Wild rivers are declared within areas currently reserved and managed for nature conservation purposes to ensure that the high conservation values of these rivers are maintained. Wild rivers can also be used as focal points for a range of protection and rehabilitation works outside reserves.

The Brogo sub-catchment falls within Bega catchment in south-east NSW. The highly fertile Bega Valley has undergone substantial land clearing, and the rugged and mountainous upper reaches of the catchment provide important examples of the catchment's original geomorphic features and freshwater biota. The Brogo sub-catchment is immediately upstream of the Brogo Dam and provides water for the Bega district's town and irrigators.

The section of Brogo River under investigation falls within Wadbilliga National Park, and the entire sub-catchment is wilderness. The steep terrain in most of the sub-catchment has historically prohibited development. Grazing and logging activity has been fairly well localised to the flatter areas, and only one historic mine has been recorded. Weed (basket willow) infestations along the river have been vigorously and successfully controlled by DEC in recent years.

The Brogo River has been assessed in terms of its biological, geomorphic and hydrological condition. The Brogo has been found to support a highly diverse range of macroinvertebrate fauna, and an 'AUSRIVAS' (Davies 2000) biological assessment indicated that the river's condition has not suffered as a result of the minor disturbances that have taken place in the catchment. A geomorphic assessment of the river indicated that it is in good geomorphic condition. The Brogo is a gorge river that is relatively resilient to geomorphic disturbances. Historical flow data, which are used to detect flow changes over time, are not available for this river. However, there is nothing in the catchment's history to indicate that the hydrology of the river or catchment would be substantially disturbed. Overall, DEC considers the Brogo suitable for declaration as a wild river.

1 INTRODUCTION

Wild Rivers under the National Parks and Wildlife Act

The *National Parks and Wildlife Act 1974* (NPW Act) provides for the declaration of wild rivers.

In order to be considered wild, a river must be in a relatively natural condition. Both the river and the parts of the catchment that affect the river are taken into account:

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. (s. 61 (4), NPW Act)

Wild Rivers may be declared only on reserves managed by the Department of Environment and Conservation (DEC).

A wild river may be an estuary, a freshwater creek, or a chain of ponds. The Act states that a wild river may be:

> *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) (s. 61 (4), NPW Act).*

Declaration of a wild river is made by notice in the *Government Gazette*.

The Director General of DEC has the power to declare a wild river without an Act of Parliament, but in some cases the concurrence of certain Ministers must first be obtained: if the declaration may affect the functions of the Minister responsible for the *Water Management Act 2000* or, in the case of State Conservation Areas, the Minister responsible for the *Mining Act 1992,* the concurrence of the Minister(s) may need to be obtained (s. 61 (3), NPW Act).

DEC also needs to consider how the river will be managed. A river may not be declared wild unless the declaration is consistent with any Plan of Management that applies to the river's reserve, (s. 61A, NPW Act).

Wild rivers are to be managed in a manner that is consistent with the maintenance and restoration (if necessary) of their wild river values. Aboriginal objects and places associated with the wild river are to be identified, conserved and protected (s. 61 (5) (a) and (b)). Wild river declaration can therefore be used to trigger investigations of Aboriginal objects and places and the development of conservation plans.

The objectives of the NPW Act, such as the conservation of significant natural and cultural features and the fostering of a public appreciation and enjoyment of nature, also apply to wild rivers.

Community consultation

It is a requirement of the NPW Act that any plan of management for a reserve be made available for public comment before being adopted.

The Upper Brogo falls within Wadbilliga National Park, for which a Plan of Management is currently being prepared. The management of the Brogo River as a wild river will be

discussed in the draft Wadbilliga Plan of Management, which will be available for public comment.

2 ASSESSMENT

The NPW Act requires that rivers and relevant parts of their catchments meet certain standards of biological, geomorphological and hydrological condition in order for them to be declared wild rivers. A range of existing information is available on the condition of the Brogo River and its catchment. This study has drawn from this information and local expertise to assess whether this river is wild.

DEC has assessed the Upper Brogo River in accordance with its *Framework for Wild River Assessment* (Department of Environment and Conservation 2005b). This document outlines DEC's policy in relation to wild river assessment and declaration. The techniques adopted to assess wild rivers measure the current biological and geomorphological condition and compare it with a reference condition.

- For assessment of **biological** health, 'AUSRIVAS' (Davies 2000) analysis is used. This method samples and analyses freshwater invertebrates and uses the presence/absence of groups of invertebrates as a surrogate for biological health.
- For assessment of **geomorphological** condition, River Styles® (Brierley and Fryirs 2005) is used. This method measures a range of physical features of a river to determine whether there are unnatural rates of change in the river system.

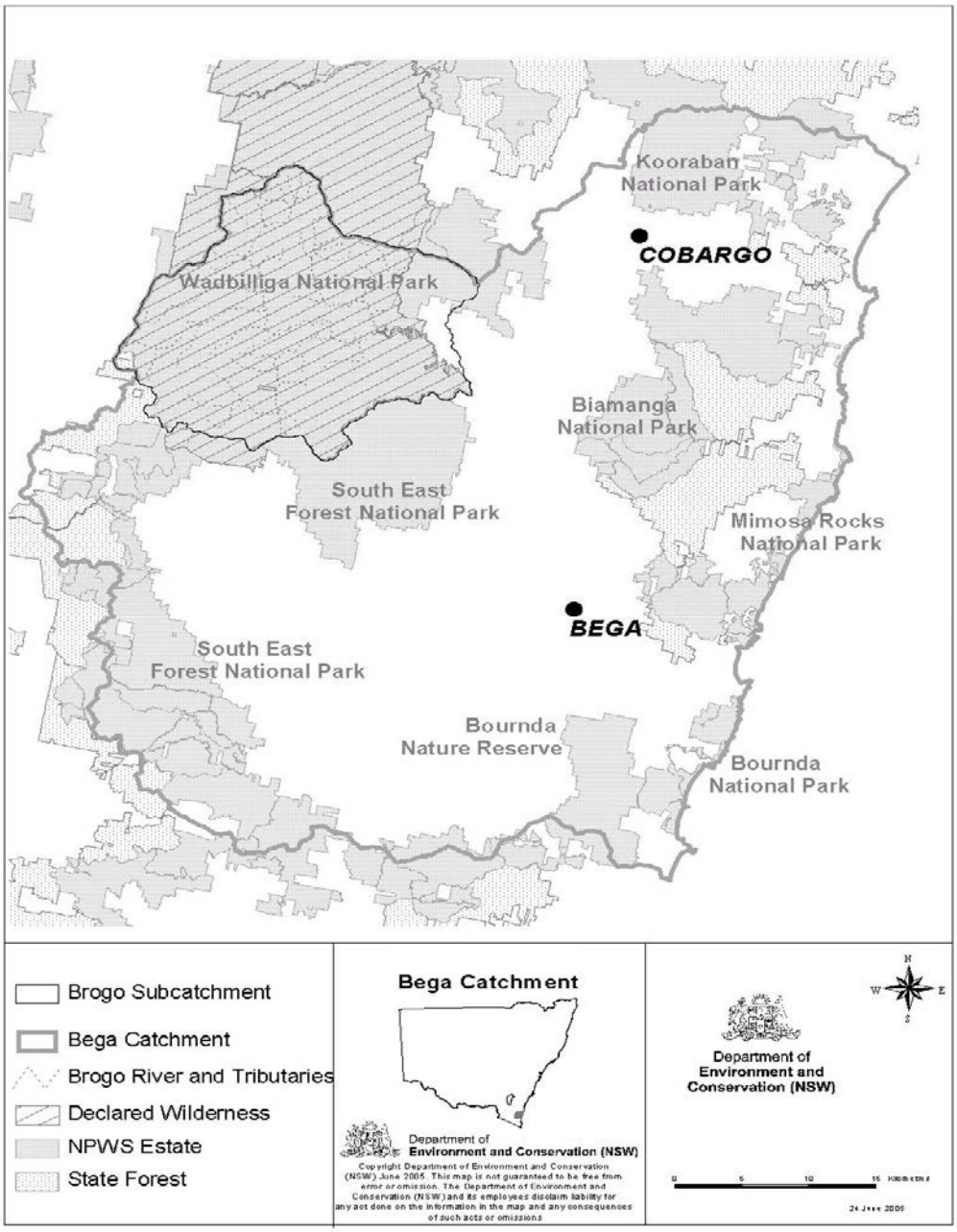
These methods have been used extensively in NSW. For AUSRIVAS the reference condition is represented by reference sites from all major river systems across NSW; these sites were selected from river reaches thought to be least affected by post-European human activities. Some minor disturbances may still be present at reference sites.

For river **hydrology**, there is no widely available means of estimating a river's natural flow and the degree of flow alteration since European occupation. Stations that measure river flow have been established along some rivers, and from the data obtained from them it is possible to estimate a river's flow regime. These data can be compared with those of models of pre-European flow conditions to determine the degree of alteration. Accurate data on river flow are available only where river-flow monitoring stations have been installed and data on river flow and rainfall in the catchment have been collected over long periods. To determine whether any land-use changes have had an impact on river flow, flow data from before and after major disturbances need to be collected. Such information is rarely available. In cases where data are insufficient the hydrological condition can only be surmised, on the basis of coarse indicators of river flow alteration such as water extraction or the presence or absence of dams and weirs.

The current and historical land-use practices within the relevant parts of the catchment may directly affect the river condition. Current land-use information is used to highlight any management practices that might affect the river or catchment in the future. Disturbances that may have an impact on the biology, hydrology and/or geomorphology of the river include logging, clearing, road works, mining, drainage works, water extraction, frequent or severe fires, intensive recreational activities, grazing, and the presence of certain weeds and feral animals. Sources of information include spatial data sets, maps of vegetation structure, aerial photographs, physical evidence and any documents relating to the history, use and management of the area. In this study, local knowledge has also been used.

Experts consulted for the technical assessment are listed in Appendix A.

Figure 1. The Bega catchment



3 RESULTS

Description of the Bega catchment

The Bega catchment is located on the far south-east coast of NSW and covers approximately 284 000 hectares (Figure 1). The land forms steep hills with narrow river flats in the western section and wide river flats in the east. Extensive clearing has occurred on the coastal flats, and native vegetation is confined mainly to DEC reserves and State Forests, which are concentrated on the steeper country in the north-west and north-east corners of the catchment and around the catchment's perimeter. Approximately 37% of the Bega catchment has been cleared (NSW National Parks and Wildlife Service 2001). The catchment is a major dairying region with significant urban and industrial development pressure and high tourist and recreational demand.

Before European settlement, many of the watercourses in the upper reaches of the Bega catchment were probably discontinuous, with extensive swamps and chains of ponds. Within a few decades of settlement, gully erosion had released massive quantities of material and created steep-sided continuous channels up to 10 metres deep and 100 metres wide. Eroded material was flushed downstream, and the river channels became wider and shallower as large quantities of sand were deposited in the channel and on the floodplain (Brierley *et al.* 1999).

Geomorphic changes to river structure have modified the availability of instream habitats for aquatic animals throughout the Bega catchment. The impacts have been less pronounced in headwater streams such as those in the Upper Brogo, but they have been dramatic along virtually all river courses beyond the base of the escarpment. Changes in river structure have been directly related to altered riparian vegetation cover, and vice versa. As a consequence of changes to river structure, the calibre of the bed substrate and the supply volume and rate have been modified along most streams (Brierley *et al.* 1999).

A dam is located on the Brogo River where it emerges from Wadbilliga National Park. The other major dam in this catchment is the Cochrane Dam on the Bemboka River; this dam is used to generate hydroelectric power (Commonwealth of Australia 2000).

Description of the Brogo sub-catchment

Physical features

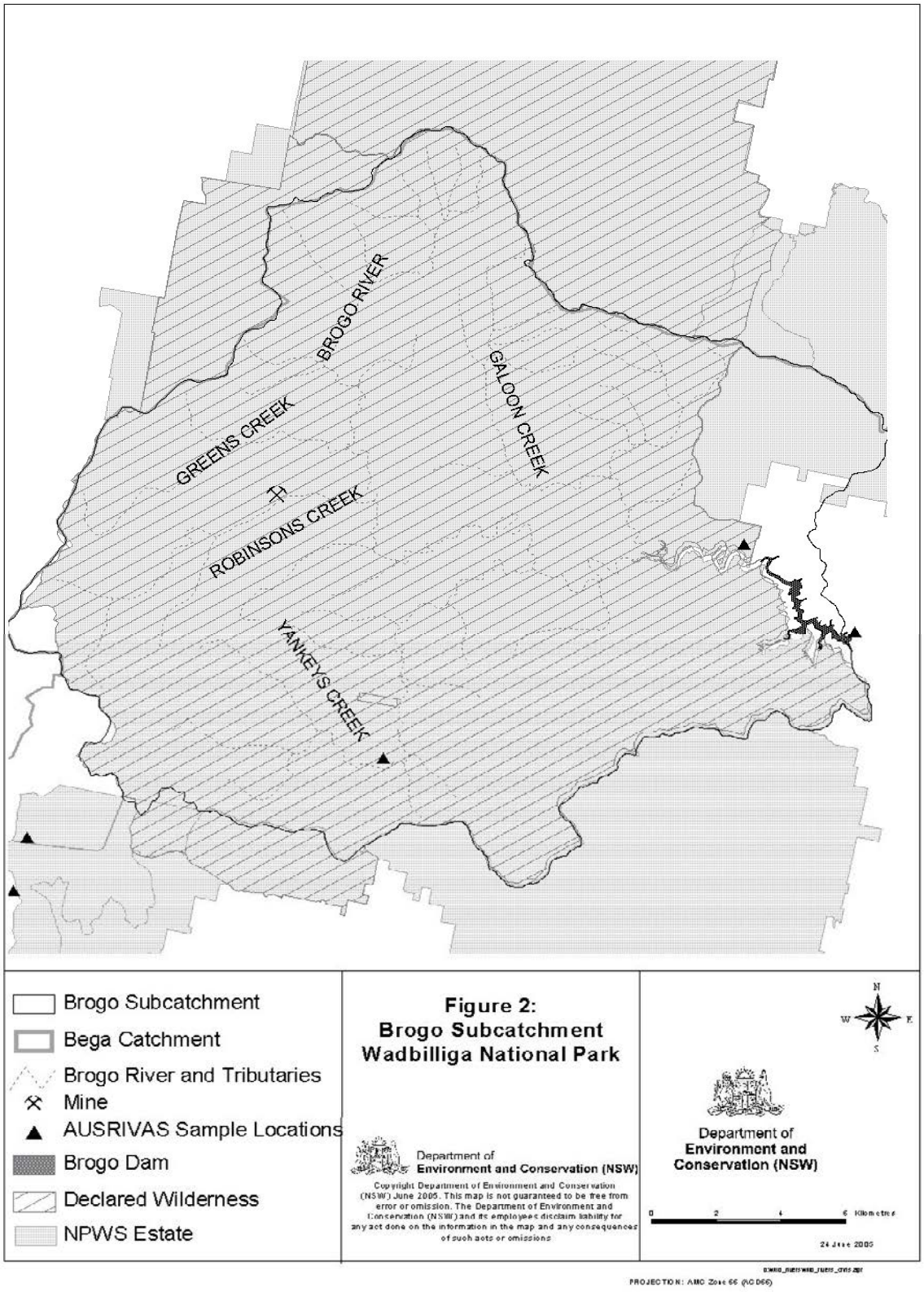
The Brogo River sub-catchment (Figure 2) is centred in Wadbilliga National Park, approximately 15 km west of Cobargo and 20 km north-west of Bega. The sub-catchment falls almost entirely within the Brogo Wilderness. The Brogo River forms the largest northern tributary of the Bega River within the Bega catchment. The sub-catchment is dominated by rugged mountainous terrain, with steep ridges and deep gullies.

Natural values

This area has remained relatively free from human disturbance and persists in a natural state. Genetic diversity and natural ecosystem processes remain essentially unaltered across the sub-catchment. Management of the Brogo Wilderness since its declaration as reserve in 1983 has protected the largely unmodified natural values of the area.

Distinctive landscape features of the Brogo sub-catchment are the result of a number of geological processes. The area lies in the Lachlan Fold Belt, a large structural unit of south-eastern Australia laid down in the Palaeozoic Period. The impressive cliffs, spurs and ridges are part of the Great Escarpment formed when tectonic events associated with the opening

Figure 2. Brogo sub-catchment, Wadbilliga National Park



of the Tasman and Coral seas resulted in the uplift of eastern Australia. Erosion by the Brogo river and its tributaries has formed a deep V-shaped valley contrasting greatly with the gentle west-sloping sections of the Wadbilliga Plateau, where the gently flowing streams have allowed the development of swamps, fens and bogs with extensive peat development. The large granite outcrops and tors found throughout Wadbilliga National Park have been exposed by erosion following volcanic activity, and there has been large-scale granite emplacement into the Ordovician and Silurian rocks during more recent eras.

The study area incorporates a wide and varied example of vegetation associations, partly because of the altitudinal diversity of the area. Forest ecosystems dominating the drier slopes of the catchment are Wadbilliga Dry Shrub Forest (dominant species include *Eucalyptus agglomerata*,

Eucalyptus cypellocarpa, and *Eucalyptus fraxinoides*), and Wadbilliga Gorge Dry Forest (dominant species include *Angophora floribunda* and *Eucalyptus globoidea*). Riparian areas along the Brogo and its tributaries, including Robinson and Yankees creeks, are dominated by *E. cypellocarpa* forest types (Hinterland Wet Fern Forest and Hinterland Wet Shrub Forest). One of the most spectacular vegetation associations in the study area is the *Casuarina nana* heathland, which is found on the northern escarpment ridging the catchment and extending onto Wadbilliga Plateau (NSW National Parks and Wildlife Service 1998a and 1998b).

Relict pockets of cool temperate rainforest persist in the wet gully heads. These areas are dominated by sassafras (*Doryphora sassafras*) and lillipilli (*Acmena smithii*). In Wadbilliga National Park there is a small pocket of broadleaved and sub-alpine forest, which now occurs only in fire- and drought-resistant refuges associated with rugged mountainous terrain. These moist and sub- alpine forests have been largely cleared from the Monaro Tableland. The conservation of these forest communities within Wadbilliga National Park is regionally important as an example of the now-reduced forest system (NSW National Parks and Wildlife Service 1998a).

Diversity of age-structure has been noted in the canopy layer within the sub-catchment; this diversity is thought to be due to fire history rather than logging or clearing (Ross Constable, DEC, *pers. comm*. 2005). This is supported by data from the Old Growth Mapping Projects undertaken for the Eden and Southern Comprehensive Regional Assessments (NSW National Parks and Wildlife Service 1998c and 2000); the data indicate most of the catchment contains less than 30% regrowth crown cover, with over 20% of the catchment showing evidence of fire damage.

Threatened flora that is present in the study area and may occur in the riparian area includes *Grevillea acanthifolia* subsp. *paludosa* (although this species has been recorded only in the higher parts of this catchment to date). *Monotoca rotundifolia* has been recorded in the Brogo River's headwaters, and *Acacia georgensis* is known to occur just outside the study area along those parts of the river affected by the Brogo Dam. *Dichanthium setosum* also occurs within the Brogo sub-catchment (Department of Environment and Conservation 2005a).

The area is habitat for many threatened fauna. Water-dependent threatened fauna recorded in the study area includes the sooty oystercatcher (*Haematopus fuliginosus*) and hooded plover (*Thinornis rubricollis*) (from the flooded section of the river downstream of the study area) and the large-footed myotis (*Myotis adversus*). The broader area of Wadbilliga and South-East Forest National Parks supports the giant burrowing frog (*Heleioporus australiacus*), giant stuttering frog (*Mixophyes balbus*), green and golden bell frog (*Litoria aurea*), powerful owl (*Ninox strenua*), masked owl (*Tyto novaehollandiae*), sooty owl (*Tyto tenebricosa*), striated field wren (*Calamanthus fuliginosus*), olive whistler (*Pachycephala olivacea*), tiger quoll (*Dasyurus maculatus*), brush-tailed phascogale (*Phascogale tapoatafa*), koala (*Phascolarctos cinereus*), yellow-bellied glider (*Petaurus australis*), squirrel glider (*Petaurus norfolcensis*), eastern pipistrelle (*Falsistrellus tasmaniensis*), golden-tipped bat

(*Kerivoula papuensis*), bent-winged bat (*Miniopterus schreibersii*), southern myotis (*Myotis macropus*) and greater broad-nosed bat (*Scoteanax rueppellii*) (Department of Environment and Conservation 2005a).

Aboriginal cultural heritage

According to tribal area maps drawn by early anthropologists, the Djiringanj people originally occupied the area known as Wadbilliga National Park. Current information indicates that the bulk of the occupation of this area occurred in the uppermost reaches, concentrated around the Wadbilliga and Tuross Rivers (NSW National Parks and Wildlife Service 1998a). Archaeological surveys have not been undertaken in the Brogo sub-catchment, and the location of Aboriginal sites and places has not been identified.

Land-use history

Grazing. The European history of the Brogo River catchment dates to the early 1800s; the first grazing lease was issued in 1828. Grazing leases were soon issued over the whole Bega area, and grazing continued across much of the accessible slopes until Wadbilliga National Park was gazetted in the late 1970s. Open-range grazing was the dominant form of land use, with the result that very little of the upper catchment has been cleared of vegetation (NSW National Parks and Wildlife Service 1998a).

Mining. Scattered gold and tin mining activity occurred in the broader catchment, and one historic mine site is located in the Brogo sub-catchment on Robinson's Creek. This mine is likely to have been active some time before 1930, and no physical evidence of the site is evident from aerial survey (Ross Constable, DEC, *pers. comm.* 2005).

Logging. Logging is thought to have been restricted to the north-western ridges of the study area, as the terrain of the remainder of the sub-catchment is inaccessible for logging purposes (Ross Constable, DEC, *pers. comm.* 2005).

Trails. A fire trail is located in the southern section of the study area (Yankees Flat); it leads to a small uncleared parcel of private property within the park. An additional trail is located to the south-east of the Brogo River (the Pigeon Box to Nelsons Creek Fire Trail); it is used to access a dam. Neither trail is maintained but may be cleared in the future if access for wildfire control is required.

Razorback Fire Trail skirts the northern boundary of the sub-catchment, and Warrigal Trail borders sections of the south-eastern boundary. Both trails are maintained between fire events and are excluded from the wilderness area.

Additional trails were placed for fire-suppression and fuel-reduction purposes after the major fires in 1939 and 1950. Many of the existing fire trails within Wadbilliga were constructed by unemployment relief projects initiated in response to public reaction to these large fire events (Ross Constable, DEC, *pers. comm.* 2005).

There are historical reports of bridal trails in the sub-catchment, but traces of these trails are no longer evident from the air and efforts to locate them have not been successful (Ross Constable, DEC, *pers. comm.* 2005.).

Recent fire events. Major wildfire events occurred in 1988 and 1997, when several thousand hectares were burned to the east of Yankees Creek in the south-east of the sub-catchment. Low- to high-level fire behaviour occurred during these fires, resulting in mild to severe fire damage (DEC records). Helipads placed along a creek line to the east of Yankees Creek during the 1988 and 1997 fires have now recovered to such an extent that they cannot be identified from the air, and trails that were cleared during these fires are now regenerating (Ross Constable, DEC, *pers. comm.* 2005).

Although the Pigeon Box to Nelsons Creek Fire Trail is located within declared wilderness, because of its strategic location it is likely to be used in the future for fire-suppression purposes.

Threatening processes

Basket willows (*Salix viminalis*) occur in clumps along the Brogo. The willows have been subjected to various treatments and were last treated in 2002. Over 100 infestations have been treated, and follow-up is probably required on about 21 of these. Weed control is undertaken by small teams dropped in by helicopter. Follow-up weed control will be undertaken when sufficient funds become available. The willows are being managed in accordance with DEC's Pest Plan of Management for this area.

Recreational uses

The rugged terrain of the Wadbilliga National Park and the park's relative inaccessibility have been strong determining factors of the style and location of recreational use of the park. Although the low flow levels on the Brogo River make it unsuitable for water craft, the river is a popular location for river walks and is usually accessed from the north-west via Razorback Fire Trail, which borders the catchment (Ross Constable, DEC, *pers comm.* 2005).

Technical assessment

Biological assessment

Macroinvertebrate samples were collected from Yankees Creek and on the Brogo River downstream from Robinson's Creek approximately 300 to 400 metres upstream from the edge of the park and above the first cascade (as shown in Figure 2). These sites were sampled in October 1994, March and October 1995, and March 1996. A rich macroinvertebrate fauna comprising 57 taxa (identified mostly to family level) was collected from these sites (Appendix B).

Both AUSRIVAS scores and taxonomic richness from the site on the Brogo River were high (average observed to expected ratio O/E = 0.96, minimum O/E = 0.83, maximum O/E = 1.1, number of taxa = 47).

The AUSRIVAS scores at Yankees Creek were also high (average O/E = 1.1, minimum O/E = 0.89, maximum O/E = 1.23), and taxonomic richness (50 taxa) was slightly higher than that of the Brogo River.

These results suggest that the effects of past logging activities and other past disturbances such as mining have been too small to have a measurable impact on the aquatic fauna of the Brogo River and its tributaries. Both the high AUSRIVAS scores and high aquatic biodiversity support the view that the Upper Brogo River is suitable for listing as a wild river.

Geomorphology: River Styles®

A geomorphology assessment was undertaken from immediately upstream of the Brogo Dam lake to the river's headwaters (Fryirs and Brierley 1998). The assessment was made primarily through a desktop analysis and relied heavily on aerial photographs to assess river style and condition. The geomorphological style of this section of river is gorge, which is one of the geomorphology types most resistant to disturbance. This river section was classed as a conservation reach, which was the highest condition category given in the study. The report did not document any upstream impacts of the dam on the river's geomorphology.

As noted under *Landuse history* above, some bush grazing occurred in the Brogo sub-catchment up until the 1970s. Within 1 or 2 years, bush grazing can cause erosion that is likely to continue until ground cover vegetation re-establishes. When the topsoil is removed owing to the effects of grazing, revegetation may take some years to occur. Erosion can cause sediment slugs in the river that will continue to form as long as the sub-catchment is eroding. Often these are a couple of kilometres long and can be identified from aerial photographs, provided that the vegetation cover is sparse enough to obtain a clear view of the river, as is the case for the Brogo. No sediment slugs were noted in the River Styles® aerial photo assessment. In addition, the Brogo sub-catchment is steep, and high water flows are likely to occur in the river at least once a year. This water movement would be sufficient to flush out sediment slugs fairly quickly. It is not possible to conclude with absolute certainty that the river is free of sand slugs caused by erosion without an intensive ground survey which samples the river approximately every 500 metres; such a survey effort is not feasible in this terrain. On balance, the evidence suggests that unnatural sand slugs are not currently forming, indicating that there is no ongoing impact from previous grazing activities.

Hydrology

As the headwaters of this section of Brogo are entirely within reserve, no water extraction is taking place. There are no weirs within this river section, and there is nothing to indicate that the hydrology would be significantly altered upstream of the area flooded by the dam.

4 REFERRALS

As stated in *Wild Rivers under the National Parks and Wildlife Act* in Section 1 above, in some cases DEC requires the concurrence of certain Ministers before a river can be declared wild. Concurrence is required where the declaration may affect the functions of the Minister responsible for the *Water Management Act 2000* or, in the case of State Conservation Areas, the Minister responsible for the *Mining Act 1992* (s. 61 (3), NPW Act).

The part of the Brogo sub-catchment under investigation in this report comprises the headwaters of this river and falls entirely within national park. The declaration of this river will therefore have implications for DEC only, and the concurrence of the Ministers responsible for the *Water Management Act 2000* and the *Mining Act 1992* is not required.

5 RECOMMENDATION

The Brogo River and its tributaries, as defined in Figure 2, are considered to meet the criteria for wild rivers as listed in the *National Parks and Wildlife Act 1974.*

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APPENDIX A: DATA SOURCES—TECHNICAL ASSESSMENT CRITERIA FOR WILD RIVERS

	Biological condition	**Geomorphological condition**	**Hydrological condition**
Data source	Department of the Environment and Heritage (2003) *Australian River Assessment System (AusRivAS) National River Health Database*. Australian Government, Canberra. ANZCW0501009864	Fryirs K and Brierley G (1998) *River Styles in Bega/Brogo Catchment: Recovery Potential and Target Conditions for River Rehabilitation.* Report for Department of Land and Water Conservation and Bega Valley Shire Far South Coast Catchment Management Committee.	Department of Infrastructure, Planning and Natural Resources water extraction licence data.
Technical advice	Eren Turak, Research Scientist, Policy and Science, Department of Environment and Conservation. Graeme White, Department of Primary Industries.	Cliff Massey, Project Officer, Catchment Management Authority. David Outhet, Research Scientist, Department of Infrastructure, Planning and Natural Resources.	Paul Simpson, Senior Natural Resource Officer, Water Management Division, Department of Infrastructure, Planning and Natural Resources.

APPENDIX B: AQUATIC MACROINVERTEBRATE FAUNA

Taxon	Brogo River	Yankees Creek
Aeshnidae	X	X
Ameletopsidae		X
Athericidae	X	X
Atyidae	X	X
Baetidae	X	X
Caenidae	X	X
Calamoceratidae	X	X
Calocidae	X	X
Ceratopogonidae	X	X
Chironominae	X	X
Corbiculidae	X	
Corduliidae	X	X
Corixidae	X	X
Corydalidae	X	X
Culicidae	X	
Diamesinae		X
Dixidae	X	X
Dugesiidae		X
Dytiscidae	X	X
Ecnomidae	X	
Elmidae	X	X
Eustheniidae	X	X
Gelastocoridae		X
Gerridae	X	X
Glossosomatidae	X	
Gomphidae	X	X
Gordiidae	X	X
Gripopterygidae	X	X
Gyrinidae	X	X
Helicopsychidae	X	X
Hydracarina	X	X
Hydraenidae	X	
Hydrobiosidae	X	X

Taxon	Brogo River	Yankees Creek
Hydrophilidae	X	X
Hydropsychidae		X
Hydroptilidae		X
Isostictidae	X	
Leptoceridae	X	X
Leptophlebiidae	X	X
Lymnaeidae	X	
Megapodagrionidae		X
Notonectidae	X	X
Odontoceridae	X	X
Oligochaeta	X	X
Orthocladiinae	X	X
Philopotamidae	X	X
Philorheithridae	X	X
Polycentropodidae		X
Psephenidae	X	X
Ptilodactylidae		X
Scirtidae	X	X
Simuliidae	X	X
Synlestidae	X	X
Tanypodinae	X	X
Thaumaleidae		X
Tipulidae	X	X
Veliidae	X	X