The Vertebrate Fauna of Dharawal State Conservation Area, Dharawal Nature Reserve and Adjacent Lands

Project funded by the Illawarra Area, Parks and Wildlife Group

Information and Assessment Section
Metropolitan Branch
Climate Change & Environment Protection Group
Department of Environment & Climate Change (NSW)
December 2007

Department of **Environment & Climate Change** NSW

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FINAL REPORT Version 1

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Eastern Three-lined Skink: N. Williams

Back cover
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OVERVIEW

In 2007 a comprehensive study of the vertebrate fauna of the Greater Southern Sydney Region was finalised by the Department of Environment and Climate Change (DECC), leading to a detailed understanding of the conservation priorities for fauna and their habitats across the region. The fauna surveys described herein were instigated and funded by the Illawarra Area of the DECC Parks and Wildlife Group to implement a number of recommendations of that regional study for further survey. In addition, the work described herein applied systematic fauna survey techniques that for the first time sought to comprehensively sample the full range of environments present in Dharawal State Conservation Area and Nature Reserve and adjacent lands.

This document details the terrestrial vertebrate fauna of Dharawal State Conservation Area and Nature Reserve, which encompass approximately 6700 hectares of land on the Woronora Plateau 45 kilometres south of Sydney. The systematic and targeted surveys have provided a comprehensive species inventory, identified fauna conservation and management priorities, and assessed the relative conservation value of lands being considered for addition to the reserve system. A total of 140 systematic and targeted survey sites have sampled the birds, frogs, reptiles, bats, arboreal and terrestrial mammals. Dharawal SCA and NR are species rich relative to their size, largely because of the sharp gradient of environments that occur from the Illawarra Escarpment across to the edge of the Cumberland Plain, including part of the largest expanse of Upland Swamp in the southern Sydney Basin. Some key findings of the surveys are summarised below.

- 222 native fauna species are known to inhabit Dharawal SCA and NR including 23 frogs, 39 reptiles, 128 birds and 32 mammals. An extra two native species have been recorded in the surveyed adjacent lands.
- The Upland Swamps have exceptional importance for the conservation of threatened, regionally significant and locally significant species. They provide habitat for at least ten species listed as threatened on the NSW Threatened Species Conservation Act (1995) and a further six regionally significant species. The Upland Swamps are the highest priority for the management of threatening processes and for land acquisition in the area.
- The surveys failed to detect five threatened species that have previously been recorded in Dharawal SCA and NR, including Ground Parrot, Eastern Bristlebird, Long-nosed Potoroo, Stuttering Frog and Green and Golden Bell Frog. These are of the highest conservation priority, but will be considered to be locally extinct until further surveys prove otherwise.
- The surveys greatly increased the understanding of vertebrate fauna in the study area and detected fourteen species that had not previously been recorded. A total of seventeen species listed on the NSW Threatened Species Conservation Act (1995) are now known to occur, as well as five species considered to have moderate to high regional conservation significance. Of these, Dharawal SCA and NR are considered critical to the regional conservation of Littlejohn's Tree Frog, Beautiful Firetail, Southern Emu-wren, Tawny-crowned Honeyeater, Rosenberg's Goanna, Giant Burrowing Frog, Red-crowned Toadlet and Eastern Pygmy-possum. Another exciting discovery was the Eastern Three-lined Skink on Maddens Plains, which constitutes a range extension for the species.
- The habitats present across Dharawal SCA and NR are characterised by different groups of fauna species. The Upland Swamps support the most distinct assemblage of fauna, including for example Littlejohn's Tree Frog and Eastern Pygmy-possum. The Exposed Sandstone Woodlands that cover the majority of the reserves support fauna typical of coastal sandstone plateaux across the Sydney Basin. The woodlands and forests that occur in the far north-west of the reserves are influenced by the richer soils of the Cumberland Plain and play an important role as part of a regional habitat corridor, while providing habitat for species such as Koala and Greater Broad-nosed Bat.
- Eleven introduced species (seven mammals and four birds) have been confirmed to occur. Several threatening processes act within the study area, the most significant being predation by the Fox in Upland Swamps, environmental degradation caused by Feral Deer, and infection of frogs with Chytrid fungus. Alteration to habitat following subsidence due to longwall mining is a highly significant potential threat.
- Areas of Upland Swamp are the highest priority for addition to Dharawal SCA and NR, including the Crown lands north of the Nature Reserve, the Sydney Catchment Authority lands to the south of the Nature Reserve, and the Crown Reserve north of Bulli-Appin road, listed in order of priority. Future proposals for extension should also consider inclusion of Western Gully Forest to the north and west of Dharawal SCA.

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1 INTRODUCTION

1.1 PROJECT RATIONALE

In 2007, DECC in conjunction with the Sydney Catchment Authority completed a comprehensive study of the vertebrate fauna of the Greater Southern Sydney Region, encompassing the Special Areas of the Woronora Plateau. The study resulted in a clear understanding of the relative conservation priorities for fauna and fauna habitats across the Greater Southern Sydney Region, and produced a series of reports on the vertebrate fauna, vertebrate pests and species of conservation concern, and management priorities and recommendations. *Volume 4 – The Fauna of the Woronora, O'Hares Creek and Metropolitan Special Areas* (DECC 2007a) of this series detailed the current state of knowledge on vertebrate fauna in these Special Areas, set local conservation priorities and provided recommendations for species and habitat management. One of the recommendations was to undertake targeted surveys for particular threatened species and of high priority fauna habitats in the O'Hares Creek Catchment. The O'Hares Creek Catchment is largely comprised of Dharawal State Conservation Area and Dharawal Nature Reserve, which are managed by the DECC Parks and Wildlife Group, Illawarra Area. The Illawarra Area instigated and funded the current survey project to implement a number of recommendations made by DECC (2007a). This report links with and builds upon the documents produced for the Greater Southern Sydney region project.

Vegetation within Dharawal State Conservation Area and Nature Reserve has been the subject of extensive study, and has been mapped by Keith (1994). The former National Parks and Wildlife Service, in conjunction with the Macarthur Branch of the National Parks Association, has undertaken a small amount of fauna survey work and environmental education over several years, but the area has never been the subject of a dedicated systematic fauna survey that sought to sample the full range of environments. The systematic vertebrate fauna survey described in this report was undertaken within the reserves over the spring, summer and autumn of 2006-07 in order to address this shortfall. The systematic and targeted surveys will result in a more detailed understanding of the fauna occurring within Dharawal State Conservation Area, Nature Reserve and adjacent lands, and the role that these areas play in the regional conservation of vertebrate fauna.

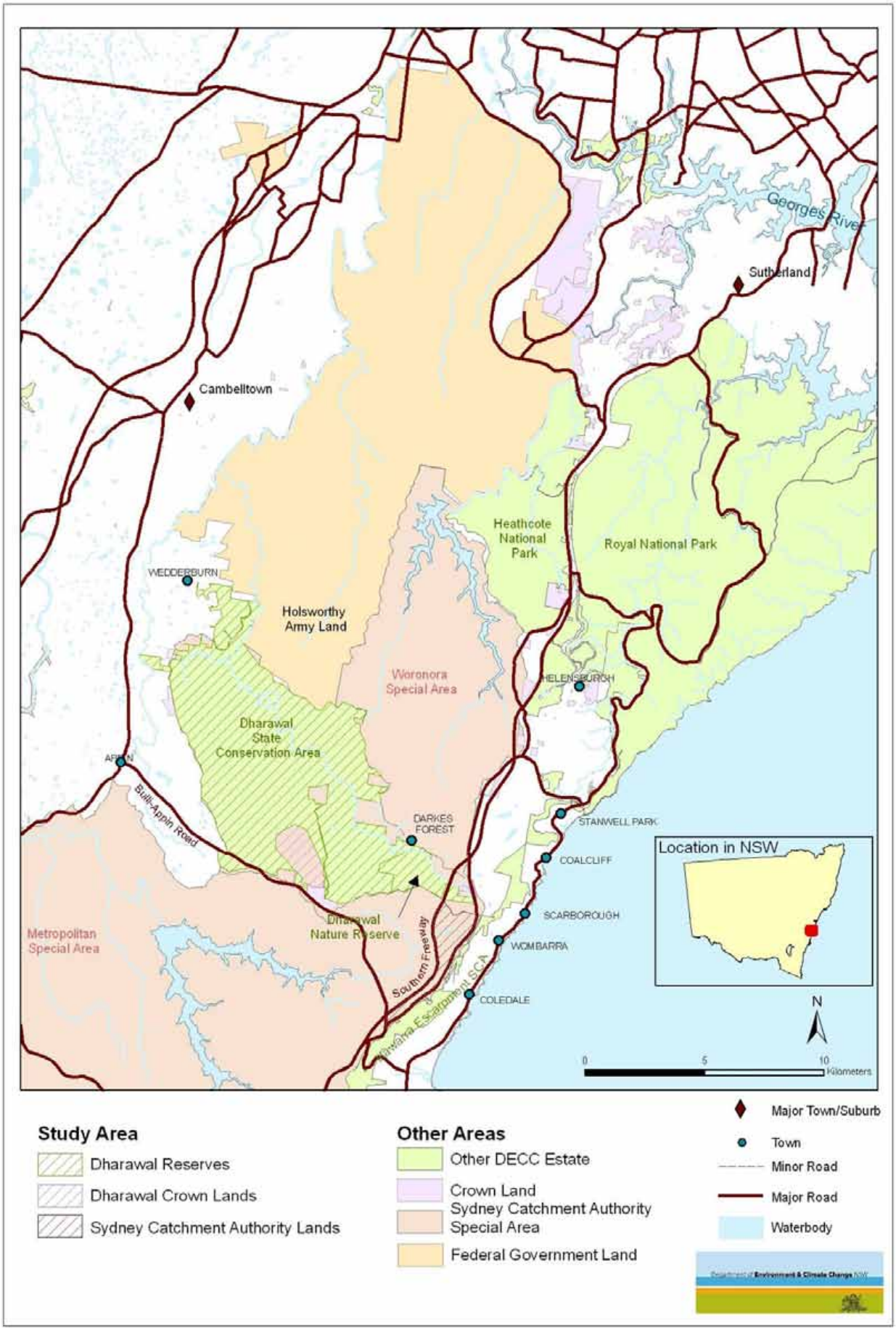
1.2 PROJECT AIMS

The primary objectives of the surveys were to:

- Undertake a review of previous systematic fauna survey effort across the study area and identify gaps for particular fauna groups, habitats or areas.
- Undertake systematic survey to fill in the gaps identified above, including a focus on proposed reserve additions.
- Undertake targeted survey for threatened and regionally significant species.

The specific objectives of this report are to:

- Document the methodology of the survey techniques applied.
- Document, review and collate information on the terrestrial vertebrate fauna of the study area, bringing together results of the current survey project with those of previous studies to provide a complete species inventory.
- Identify broad-scale patterns in fauna habitat use across the study area and identify habitats of particular conservation significance in a regional context.
- Make an assessment of the contribution that Dharawal State Conservation Area, Nature Reserve and adjacent lands make towards the protection of vertebrate fauna in the region.
- Identify priorities for conservation and management of fauna in the study area, including key locations of threatened and regionally significant fauna species, pest fauna species and threatening processes.



Map 1: Location of the Study Area

1.3 STUDY AREA

Dharawal State Conservation Area (DSCA) and Dharawal Nature Reserve (DNR) (collectively Dharawal SCA and NR) are located roughly 45 kilometres south west of Sydney General Post Office. Dharawal SCA and NR incorporate approximately 6740 hectares of land that extends from immediately west of the Illawarra Escarpment at Maddens Plains through to Wedderburn, which is immediately south of Campbelltown (Map 1). The reserves are bounded by Holsworthy Military Range and Woronora Special Area to the north, Darkes Forest Road to the north-east, Princes Highway to the east, Bulli-Appin Road to the south and Lysaghts Road to the west. Together the reserves encompass the majority of the catchment of O'Hares and Stokes Creeks, which comprise the head-waters of the Georges River. The reserves are located on the Woronora Plateau, which forms part of the southern rim of the Sydney Basin (DEC 2006a).

The current survey incorporated areas of land that are under consideration for addition to Dharawal SCA and NR. These include: the Crown Reserve extending from the junction between Bulli-Appin road and the 10B fire trail, northwest along the upper reaches of Stokes Creek (Map 3; herein referred to as 'Stokes Creek Crown Reserve'); Crown lands that occur between the Southern Freeway and the Princes Highway between the Nature Reserve and the golf course (herein referred to as 'Maddens Plains Crown land'); and Sydney Catchment Authority lands between the Southern Freeway and the Princes Highway south of the Nature Reserve (Map 3, herein referred to as 'Maddens Plains SCA land').

The study area is located within a much larger protected area system that extends from Royal National Park in the north, Budderoo and Morton National Parks in the south and Nattai and Blue Mountains National Parks in the west (DEC 2006a). It mostly lies within the Sydney Catchment Authority Special Areas system. Other land uses adjacent to the east and west of the study area include coal processing, light aircraft activities, rural residential, and rural (primarily commercial orchards).

As part of the 2006-07 project a small amount of survey was undertaken on the lands owned by the Tharawal Local Aboriginal Land Council, between the western boundary of Dharawal State Conservation Area and the Georges River (Map 3). However, access could not be obtained to comprehensively assess the conservation value of this area in a regional context, and hence comments provided in this report are of a general nature. The Tharawal lands are privately owned and are not included in the term 'study area' in this report, but are herein referred to as the Tharawal lands.

1.3.1 Geomorphology, soils, elevation and climate

The environment of Dharawal SCA and NR is summarised in the *Dharawal Nature Reserve and Dharawal State Conservation Area Plan of Managemen*t (DEC 2006a), and for the wider area in *The Native Vegetation of the Woronora, O'Hares and Metropolitan Catchments* (NPWS 2003a). A brief synopsis is provided here, to give context for understanding fauna distribution patterns.

A sharp gradient of environmental variables occurs from the east to the west of the study area. The Woronora Plateau, on which the study area lies, drops in elevation along a north-west axis, from the Illawarra Escarpment down towards the Cumberland Plain. At its eastern extremity in Dharawal Nature Reserve, the plateau stands at just below 400 metres above sea level (asl), before gradually dropping to approximately 250 metres asl in the north-west around Wedderburn. The O'Hares Creek gully system deeply incises this plateau, and reaches a minimum elevation of 130 metres asl where it flows out of the northern boundary of DSCA.

Mean annual rainfall drops sharply with distance from the coast. The Nature Reserve receives an average of 1500 millimetres of rain per annum, while the majority of DSCA receives between 1000 and 1300 millimetres. In the far north-western corner of DSCA annual precipitation drops to an average of around 900 millimetres.

The Woronora Plateau is dominated by Triassic Hawkesbury Sandstone, which is associated with shallow, sandy and infertile soils. Occasional small outcrops of ironstone and shale occur, the latter resulting in higher fertility clay loams. Deposits of swamp alluvium have accumulated in low-relief headwater valleys along the eastern edge the plateau (DEC 2006a). West of Lysaghts Road, residual shale soils mix with quartz sandstone of the Mittagong series, forming a slightly richer substrate (NPWS 2000a).

1.3.2 Vegetation

Vegetation of the study area was mapped by Keith (1994) and is described in a regional context in NPWS (2003a). A brief overview is given here to provide context for understanding the range of fauna habitats available within the reserves. The vegetation communities defined in NPWS (2003a) have been grouped into 'habitat groups' for this study, with groups formed on the basis of similarity in vegetation structure, soil type, climatic variables and to some extent floristics. The habitat groups and how they relate to vegetation communities are described below. These habitat groups are used in this report as a surrogate for environments utilised by a suite of fauna with similar habitat requirements. They represent the different environmental gradients that occur across the study area and, being a mappable unit, are able to be easily applied for targeted management of the reserves.

Upland Swamps

The vegetation communities included in this habitat group are Upland Swamps: Sedgeland Heath Complex: Upland Swamps: Fringing Eucalypt Woodland, Upland Swamps: Banksia Thicket, and Upland Swamps: Tea-tree Thicket. These hanging swamps occur in poorly drained soils in the east of the study area, and are subject to varying degrees of inundation depending on topographic position (NPWS 2003a). The largest expanse of this habitat group in the study area occurs on Maddens Plains, much of which is contained in DNR and the Maddens Plains SCA lands (Map 2). They are generally treeless plains, with a dense shrub layer of Banksia (e.g. Heath-leaved Banksia (*Banksia ericifolia*), Fern-leaved Banksia (*B. oblonga*)), Dagger Hakea (*Hakea teretifolia*) or Tea-trees (e.g. *Leptospermum juniperinum*) and/or a dense ground layer of sedges, rushes and ferns (such as *Gahnia sieberiana, Leptocarpus tenax*, *Schoenus brevifolius*, *S. paludosa* and *Gleichenia* spp.). Trees, including Blue Mountains Mallee Ash (*Eucalyptus stricta*) and Scribbly Gums (*E. racemosa/haemostoma/sclerophylla*), occasionally emerge from the shrub thickets, particularly at the ecotone with sandstone woodlands and in smaller patches of swamp. Small patches of Upland Swamp are scattered through the eastern third of DSCA and the Stokes Creek Crown Reserve, at the low relief headwaters of minor drainage channels.

Heath and Fringing Heath Woodland

This habitat group includes the Sandstone Heath-Woodland, Woronora Tall Mallee Heath, Dwarf Apple Heath and Rock Pavement Heath vegetation communities defined by NPWS (2003a). This group occurs in small isolated patches on sandstone ridge tops, primarily on sandstone outcrops and rock plates along the central spine of DSCA. The tree canopy is very sparse or absent, and where present is comprised of Red Bloodwood (*Corymbia gummifera*), Scribbly Gum (*E. sclerophylla*) or Silvertop Ash (*E. sieberi*), or sometimes low mallee species (*E. luehmanniana* and *E. multicaulis*). The dense, sometimes impenetrable, shrub layer is variously dominated by Banksias (e.g. Heath-leaved Banksia, Old Man Banksia (*B. serrata*)), Conesticks (*Petrophile pulchella*), various Hakeas and Tea-trees, Tick Bush (*Kunzea ambigua*), *Darwinia fascicularis*, and Wattles (*Acacia* spp.). A distinctive variant of heath occurs west of North Cliff Mine, characterised by the presence of Dwarf Apple (*Angophora hispida*).

Exposed Sandstone Woodlands

Vegetation communities included in this habitat group are Exposed Sandstone Scribbly Gum Woodland and Silvertop Ash Ironstone Woodland (NPWS 2003a). Exposed Sandstone Scribbly Gum Woodland occupies by far the greatest proportion of the study area, occurring on ridge tops and exposed slopes throughout DSCA. Silvertop Ash Ironstone Woodland is much more restricted in extent, primarily restricted to the Nature Reserve and private lands adjacent to Darkes Forest. This habitat group features a low open woodland of Scribbly Gums, Red Bloodwood, Narrow-leaved Stringybark (*E. oblonga*) and/or Silvertop Ash, above a diverse heathy shrub layer of Banksias (e.g. Heath-leaved Banksia, Old Man Banksia, Hairpin Banksia (*B. spinulosa spinulosa*), Tea-trees and Broad-leaved Hakea (*Hakea dactyloides*). The ground cover is usually sparse and rocky. Silvertop Ash Ironstone Woodland is taller and includes Gymea Lily (*Doryanthes excelsa*) in the understorey.

Upper Georges River Sandstone Woodland

This habitat group is comprised of a single vegetation community, and was separated from the other Exposed Sandstone Woodlands because it occurs on slightly enriched shale-influenced soils in areas with lower rainfall and at lower elevation. It occurs west of Lysaghts Road, including a small patch in the far western pocket of DSCA and through the ridges and upper slopes of the Tharawal lands. The canopy is dominated by Red Bloodwood, Grey Gum (*E. punctata*), Scribbly Gum and Stringybarks from the *E. oblonga/globoidea/eugenioides* species complex. Unlike the other Exposed Sandstone Woodlands, Banksias are not prominent in the shrub layer, with Wattles (e.g. *Acacia ulicifolia, A.*

terminalis), Slender Tea-tree (*Leptospermum trinervium*) and Narrow-leaved Geebung (*Persoonia linearis*) more common. The ground layer is grassier, including Wiry Panic (*Entolasia stricta*) and Kangaroo Grass (*Themeda australis*).

Eastern Gully Forests

The vegetation communities included in this group are Sandstone Gully Apple-Peppermint Forest and Sandstone Riparian Scrub. This habitat group is extensive along sheltered slopes and gully lines of Stokes and O'Hares Creeks and their major tributaries (Map 2). Sydney Peppermint (*E. piperita*) and Smooth-barked Apple (*Angophora costata*) make up a tall open forest above a tall shrub layer of Old Man Banksia and Christmas Bush (*Ceratopetalum gummiferum*). A lower shrub layer is made up of Banksias, Hakeas and Wattles. The ground cover is made up of Gymea Lily, Bracken (*Pteridium esculentum*) and Matt-rush (*Lomandra* spp.), growing around rocky outcroppings. Immediately adjacent to the most sheltered watercourses, these species give way to a riparian community with Water Gum (*Tristaniopsis laurina*) and Black She-oak (*Allocasuarina littoralis*) in the overstorey and a dense cover of ferns such as Umbrella Fern (*Sticherus flabellatus*) growing adjacent to rock pools.

Western Gully Forest

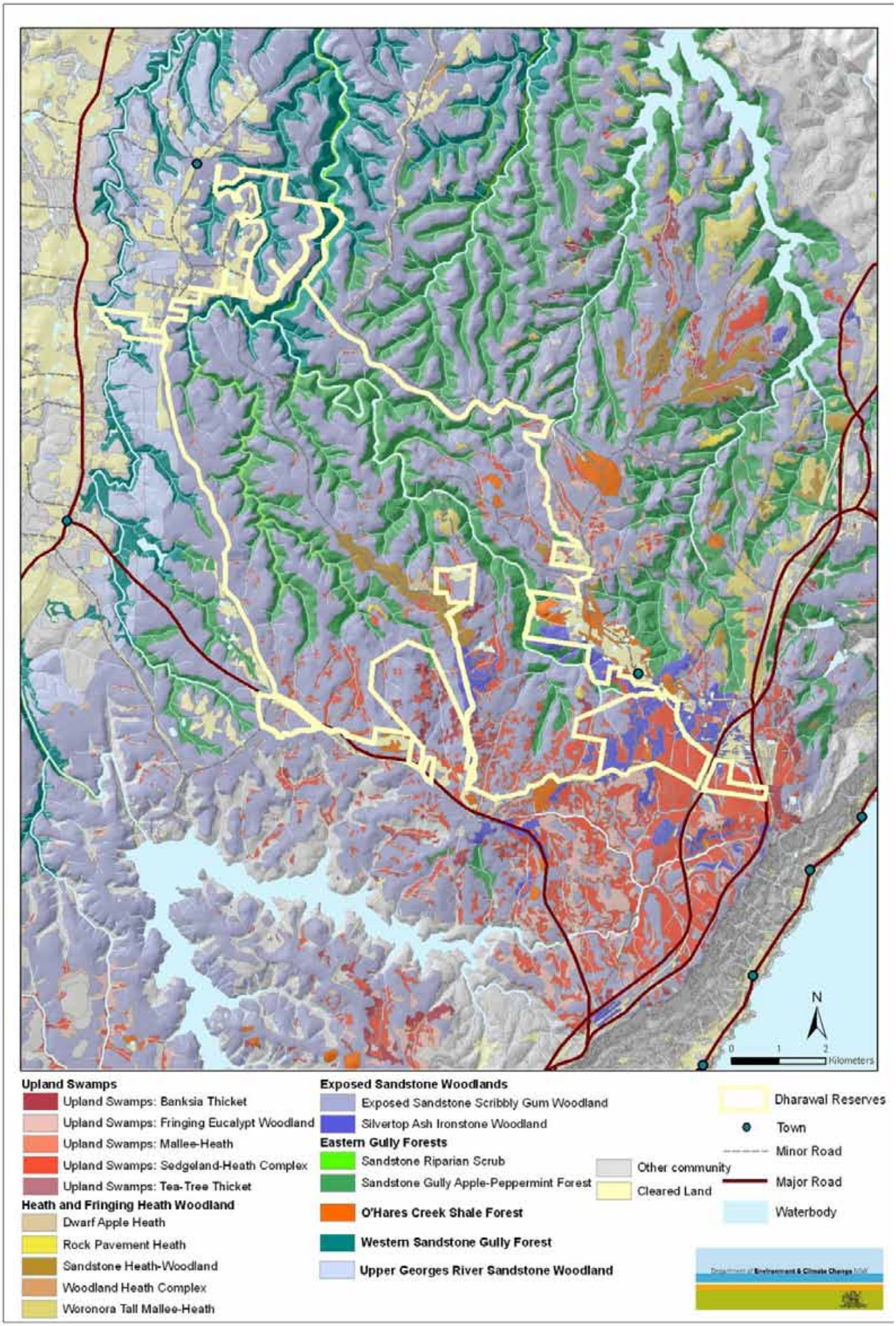
This vegetation community has been separated from the Eastern Gully Forests habitat group because it occurs at lower elevation in areas that that receive lower average annual rainfall. It is restricted to lower slopes and gully lines in the far north-western corner of Dharawal SCA (Map 2). It also occurs along the Georges River. The habitat group features a tall open forest of Smooth-barked Apple, Grey Gum and Blackbutt (*E. pilularis*) with occasional Blue-leaved Stringybark (*E. agglomerata*) and Red Bloodwood. A small sparse tree layer of Black She-oak and Christmas Bush occurs above *Acacia terminalis*, Slender Tea-tree and Narrow-leaved Geebung.

Shale Forest

This habitat group is comprised of a single vegetation community, O'Hares Creek Shale Forest, which is listed an Endangered Ecological Community on the NSW Threatened Species Conservation Act (1995) (TSC Act). Only a handful of small patches occur on shale soils in the eastern third of the study area (Map 2). The key structural features are a forest of tall straight Sydney Peppermint, White Stringybark (*E. globoidea*) and Smooth-barked Apple above a dense ground cover of ferns (*Calochlaena dubia*, *Pteridium esculentum*), lilies (Gymea Lily, *Dianella caerulea*) and Spiny-headed Matt-rush (*Lomandra lanceolatus*). The shrub layer is either sparse or absent, and is dominated by Wattles.

1.3.3 Fire

The *Fire Management Strategy for Dharawal Nature Reserve and State Conservation Area* (DEC 2006b) provides a detailed description of fire history and fire behaviour in the reserves. The most recent fire event affecting the current study is the extensive and intensive wildfire that burnt the entire study area in December 2001. The fire started near the town of Appin and spread quickly across the ridge tops and through the gullies of the reserves to the town of Helensburgh in the east. The level of intensity varied, but was fierce through the majority of the reserves. Evidence of this fire was clear at the time of this fauna survey, in the form of canopy gaps, epicormic growth, fire scars, and shrub growth form, amongst other things. This wildfire inevitably had an impact on the vertebrate fauna of the study area, and consequently on the findings of the current survey. A separate research project is currently investigating the impact of this wildfire on diurnal birds, arboreal mammals and diurnal reptiles across the Woronora Plateau (DECC in prep.). Initial investigation of the data suggests that arboreal mammals, shrub-frequenting birds and litter-dwelling skinks are the most susceptible fauna groups (DEC 2004). Research is also being undertaken on the impacts of fire on the vegetation in Upland Swamps in the region (Keith *et al.* 2006). The findings of these studies will have implications for the management of fauna across the region, and should be read in conjunction with this report.



Map 2: The vegetation of Dharawal SCA and NR and adjacent lands

1.4 PROJECT TEAM

Elizabeth Magarey, Martin Schulz and Helen Jessup were primarily responsible for the design and management of this project. Elizabeth Magarey undertook the field survey planning and logistics, report writing and map production. Field surveys were undertaken by Narawan Williams, Martin Schulz, Clive Heywood Barker, Dion Hobcroft, Garry Daly, Elizabeth Magarey, Joshua Madden, Helen Jessup, Lucinda Ransom, Ahamad Sherieff and Debbie Andrew. Pitfall traps were installed by Illawarra Area staff. Kylie Madden provided valuable input into the survey components and design, and together with Peter Ewin and Daniel Connolly generated the habitat models presented in Appendix B. Valuable comments on earlier drafts of this report were provided by Daniel Connolly, Helen Jessup, Garry Daly, Narawan Williams and Martin Schulz. Kerry Oakes designed the report cover and formatted the report.

2 SURVEY METHODS

2.1 PRE-EXISTING FAUNA DATA

2.1.1 Major sources of opportunistic records

The Atlas of NSW Wildlife (DECC 2007b) was the primary resource used to access pre-existing data on the fauna of the study area. Dharawal SCA and NR have been visited by numerous fauna enthusiasts and researchers over the decades, resulting in a large number of sightings records. Opportunistic records within the Atlas of NSW Wildlife derive from observations made by: park rangers and field officers; bushwalkers and naturalists; scientific researchers working in the area; environmental consultants; neighbours and other visitors to the park. These records have various levels of reliability depending on the type of observation, as well as the certainty and identification experience of the observer. In addition, several dedicated survey projects have been undertaken for particular fauna groups. These include:

- Bird surveys by the Royal Australian Ornithologists Union (undertaken between 1977 and 1981; Blakers *et al.* 1984) and by Birds Australia (undertaken in 1999 and 2000; Barrett *et al*. 2003). Records from these surveys exist at three point localities in the centre and south of DSCA.
- Reptile and Frog Survey of O'Hares Creek Catchment by Harlow and Taylor (1995). Sites scattered throughout DSCA.
- Wedderburn Fauna Planning Study by the Australian Koala Foundation (1996). This survey was centred around the town of Wedderburn, but a small number of sites were located in the far west of DSCA, west of Lysaghts Road and around the headwaters of Pheasants Creek.

2.1.2 Systematic fauna survey data

Prior to 2006 a number of projects had included the implementation of systematic fauna survey techniques in the study area (Table 1, see Section 2.4 for technique description). As can be seen from the table, the systematic surveys were weighted towards diurnal birds, and had not adequately systematically sampled microbats, ground mammals, owls or amphibians.

Table 1: Systematic fauna survey effort prior to July 2006

Project	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Location of sites	Timing of survey
National Parks Association Community Biodiversity Survey	6	3		1	3	4	1	1	Scattered through eastern two-thirds of DSCA	1997
Georges River Biodiversity Survey (NPWS 2000b)	10	4		1	3				Mostly east of Wedderburn but also a few sites near fire trail 10B	1999-2000
Fauna of the Illawarra Escarpment, Coastal Plain and Plateau (NPWS 2002)			3			2	1		South-eastern corner of DSCA	2001
Woronora Post-fire Survey	11	4	7						Scattered through eastern two-thirds of DSCA	2002-2007
Total	27	11	10	2	6	6	2	1		

2.2 GAP ANALYSIS

Prior to the commencement of field survey, an analysis was performed to identify gaps in the fauna survey effort previously undertaken within the study area. This analysis looked at the data in three ways, being: the level of systematic survey effort undertaken within each habitat type; the spatial coverage of survey effort across the study area; and the level of survey effort for particular fauna groups, including threatened and regionally significant species. The analysis led to two aspects of field survey, being systematic and targeted techniques.

2.3 TARGET SPECIES LIST

A list of target species was derived prior to the commencement of field surveys, in order to ensure adequate survey effort was directed towards these key fauna species. This list was compiled using a combination of the following: expert opinion (M. Schulz) on regionally and locally significant species that have the potential to occur in the study area but are not adequately surveyed using conventional systematic survey techniques; state and/or federally listed threatened species that have the potential to occur in the study area; and recommendations of DECC (2007a). These target species were sampled using both systematic and targeted survey techniques in potential habitat areas, as described in Sections 2.4 and 2.5 below.

Table 2: Target species list derived prior to the commencement of the 2006-07 field surveys

Common Name	Scientific Name	Reason for inclusion as target species	Optimal survey method
Green and Golden Bell Frog	*Litoria aurea*	Threatened and thought to be locally extinct. Recommendation of DECC 2007a.	Nocturnal streamside search after spring/summer rain, tadpole searches.
Littlejohn's Tree Frog	*Litoria littlejohni*	Threatened. Recommendation of DECC 2007a.	Nocturnal streamside search after spring rain, tadpole searches.
Stuttering Frog	*Mixophyes balbus*	Threatened and thought to be locally extinct. Recommendation of DECC 2007a.	Nocturnal streamside search and tadpole survey in remote sections of O'Hares Creek.
Casuarina Skink	*Cyclodomorphus michaeli*	Locally significant	Pitfall trapping in heathlands.
Broad-headed Snake	*Hoplocephalus bungaroides*	Threatened	Diurnal herpetofauna search in sandstone outcrop areas in early spring and late autumn.
Barking Owl	*Ninox connivens*	Threatened	Nocturnal call playback.
Grass Owl	*Tyto capensis*	Threatened	Nocturnal call playback in open heathland.
Masked Owl	*Tyto novaehollandiae*	Threatened	Nocturnal call playback.
Powerful Owl	*Ninox strenua*	Threatened	Nocturnal call playback.
Sooty Owl	*Tyto tenebricosa*	Threatened	Nocturnal call playback.
Chestnut-rumped Heathwren	*Calamanthus pyrrhopygius*	Locally significant	Diurnal call playback, passive listening and active searching in heathland and heathy woodland.
Eastern Bristlebird	*Dasyornis brachypterus*	Threatened and possibly locally extinct. Recommendation of DECC 2007a.	Diurnal call playback and passive listening in wet heath, sedgelands and heathy woodlands.
Glossy Black-cockatoo	*Calyptorhynchus lathami*	Threatened	Diurnal bird survey and opportunistic identification of feeding signs.
Ground Parrot	*Pezoporus wallicus*	Threatened and possibly locally extinct. Recommendation	Passive listening at dusk in open heathland areas.

Common Name	Scientific Name	Reason for inclusion as target species	Optimal survey method
		of DECC 2007a.	
King Quail	*Coturnix chinensis*	Locally significant	Diurnal call playback, passive listening and active searching in open heathland areas.
Lewin's Rail	*Rallus pectoralis*	Locally significant. Seen in Maddens Plains SCA Land in 1980s (D. Hobcroft pers. comm.). Recommendation of DECC 2007a.	Diurnal call playback, passive listening and searching for indirect signs in wet heathland areas and gullies.
Pheasant Coucal	*Centropus phasianinus*	Locally significant	Passive listening in forest/heathland ecotone.
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis gularis*	Threatened	Diurnal bird survey and opportunistic searching in autumn.
Striated Fieldwren	*Calamanthus fuliginosus*	Threatened	Diurnal call playback and passive listening in heathland.
Swift Parrot	*Lathamus discolor*	Threatened	Diurnal bird survey and active searching around flowering Swamp Mahogany, Mugga Ironbark, White Box and Spotted Gum.
Australasian Bittern	*Botaurus poiciloptilus*	Threatened. Recommendation of DECC 2007a.	Diurnal call playback and passive listening in wet heath, sedgelands and wetlands.
Grey-headed Flying-fox	*Pteropus poliocephalus*	Threatened	Site spotlighting and nocturnal call playback, particularly around flowering Eucalypts.
Large-footed Myotis	*Myotis adversus*	Threatened	Harp trapping, bat ultrasonic call recording and searching overhangs along and adjacent to major watercourses.
Greater Broad-nosed Bat	*Scoteanax ruepellii*	Threatened	Harp trapping, bat ultrasonic call recording
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Threatened	Harp trapping.
Large-eared Pied Bat	*Chalinolobus dwyeri*	Threatened	Harp trapping.
Common Dunnart	*Sminthopsis murina*	Locally significant	Pitfall trapping, hair tubes and predator scat collection in heathland and various types of forest.
Eastern Chestnut Mouse	*Pseudomys gracilicaudatus*	Threatened	Elliott A trapping, hair tubes and predator scat collection in heathland and heathy forest.
Long-nosed Bandicoot	*Perameles nasuta*	Regionally significant	Elliott B trapping, cage trapping, hair tubes and predator scat analysis in heathland and various forest types.
Long-nosed Potoroo	*Potorous tridactylus*	Threatened and possibly locally extinct. Recommendation of DECC 2007a.	Cage trapping, Handiglaze 'tunnel' hair tubes, predator scat analysis in tall heathland and dense vegetation in various forest types.
New Holland Mouse	*Pseudomys novaehollandiae*	Locally significant	Elliott A trapping, pitfall trapping, hair tubes and predator scat analysis in heathland and heathy forest.
Southern Brown Bandicoot	*Isoodon obesulus*	Threatened	Elliott B trapping, cage trapping, hair tubes and predator scat analysis in heathland and various forest types.
Spotted-tailed Quoll	*Dasyurus maculatus*	Threatened. Recommendation of DECC 2007a.	Cage trapping, hair tubes and predator scat analysis in various forest types.

Common Name	Scientific Name	Reason for inclusion as target species	Optimal survey method
Eastern Pygmy-possum	*Cercartetus nanus*	Threatened	Pitfall trapping, Elliott A trapping and predator scat analysis on heathland and various heathy forest types.
Squirrel Glider	*Petaurus norfolcensis*	Threatened	Nocturnal site spotlighting survey and call playback in shale sandstone transition forest.
Yellow-bellied Glider	*Petaurus australis*	Threatened. Recommendation of DECC 2007a.	Nocturnal site spotlighting survey and call playback in shale sandstone transition forest.

2.4 SYSTEMATIC SURVEY TECHNIQUES

2.4.1 Site selection

The aim of the site selection process was to ensure that all of the habitat types contained within the study area were systematically sampled in proportion to the land area they each occupy. Additionally, it aimed to fill spatial gaps in systematic survey effort, such as occurred in more remote sections of O'Hares Creek, and to target proposed reserve additions.

The primary stratum used as a surrogate for habitat type was vegetation community, using the digital vegetation map produced by Keith (1994) and NPWS (2003a). The sampling strategy aimed to sample the mapped vegetation communities proportionately according to the mapped area of each community within the reserves and to include enough repeat sampling within each vegetation community to provide reasonable reliability that potential variations within widespread stratum were captured. Such replication of sites serves to strengthen the reliability of patterns derived from collected data. The pre-trip site selection process aimed to fulfil this goal as much as possible, taking into account previous systematic survey effort. The primary gaps in systematic survey that required filling were:

- Microbat surveys in all vegetation communities.
- Ground mammal surveys in all vegetation communities.
- Owl surveys in Upland Swamp, Eastern Gully Forests and Western Gully Forest.
- Reptile surveys in less burnt Exposed Sandstone Woodlands, Eastern Gully Forests and Upland Swamps.
- Diurnal bird surveys in Eastern Gully Forests and less burnt areas of Exposed Sandstone Woodland.
- Site spotlighting surveys in Eastern Gully Forests.
- Nocturnal streamside searches in all appropriate habitat groups.

Some vegetation communities were present in too small an area to be sufficiently replicated, including Upper Georges River Sandstone Woodland, O'Hares Creek Shale Forest and the various Heath communities. Furthermore, for some communities, such as Silvertop Ash Ironstone Woodland, it was not possible to replicate sampling in areas that had not been severely burnt during the 2001 fires.

Sites were initially selected using a Geographic Information System (ArcView 3.3) with information gained from the vegetation map, topographic maps, access trails, and knowledge held by Illawarra Area staff. Wherever possible sites were placed a minimum of one kilometre apart from each other, however due to the size and shape of the study area this was not always achievable. Owl call playback sites were spaced two kilometres apart to avoid double counting of individuals. Sites were positioned primarily on or close to access trails to maximise the number of sites that could be accessed during the limited survey period. The exception to this was sites selected along O'Hares Creek, which aimed to fill the spatial gap in fauna information along this incised creek line. The placement of harp traps to capture microbats was limited by the availability of suitable fly-ways, such as vegetation constrictions along roads and creek lines.

In the field, the proposed site locations were ground-truthed to ensure that they were representative of the mapped vegetation community, had suffered a minimum amount of disturbance and comprised a

single vegetation community. If these criteria were not met, an alternative location was selected for the site. Systematic survey sites were 100 metres by 200 metres (two hectares) in area.

2.4.2 Survey methods

The systematic fauna survey methods used were based on those developed by the NPWS Biodiversity Survey Coordination Unit (NPWS 1997) and sample the following vertebrate fauna groups: diurnal and nocturnal birds, diurnal and nocturnal reptiles, bats, arboreal and ground-dwelling mammals and amphibians. Consistency in the use of the systematic techniques allows a comparison between fauna species detected across different vegetation communities and environments within the study area. Furthermore, it will allow future comparisons with consistent surveys of environments elsewhere.

The field survey team were supplied with field proformas to facilitate comprehensive, consistent recording of field data and to increase accuracy and efficiency of data entry into the DECC Biodiversity Sub-system (BSS) of the Atlas of NSW Wildlife computer database. The names of observers and recorders were noted on every data sheet to aid data verification and entry. Data entry was undertaken by Yvonne Davila and Joshua Madden.

Site attributes

A site attribute form, aiming to characterise fauna habitat, was filled out at every systematic site where survey techniques were conducted. A 20 by 20 metre quadrat typical of the overall 100 by 200 metre site was used for the assessment. The site attribute locates and describes the site in a format that is comparable to other sites. Data relating to physio-geographic, disturbance, structural and floristic, microhabitat and stream categories were recorded. Standard codes provided by the Australian Soil and Land Survey Handbook (McDonald *et al*. 1990), particularly for vegetation (i.e. Walker and Hopkins 1990) were used wherever possible.

Diurnal bird survey

Diurnal bird censuses comprised a twenty-minute observation and listening search within a two hectare (100 by 200 metre) area, conducted by an experienced bird surveyor. Censuses were conducted only during periods of relatively high bird activity (usually in the early morning) and reasonable detectability (e.g. low wind and cicada activity). Almost all surveys were undertaken in spring and summer. All bird species and the abundance of individuals seen or heard were recorded. Individuals were scored as on-site if they were detected within the two hectare plot. Individuals recorded outside the plot, in adjacent vegetation types or flying overhead were recorded as off-site.

Diurnal herpetofauna search

A standard half hectare (50 by 100 metre) area was searched for one person-hour at each site. Censuses were restricted to spring and summer during the period between mid-morning to late afternoon, when temperature and insolation are sufficient to ensure maximum reptile activity. Surveying was not conducted on overcast or rainy days or in extreme heat.

This census technique entailed active searching of potential reptile and frog microhabitats within the half hectare area. Active or basking reptiles were identified by sight or captured and identified by the use of keys. Sheltering or cryptic species were detected by searching around, under and within fallen logs, litter, decorticating and fallen bark, rock outcrops and other likely shelter sites. Incidental observations of other fauna were also recorded.

Nocturnal site spotlighting survey

This census comprised searching for arboreal mammals along a 200 metre transect within a site for half a person hour. Fifty watt spotlights were used to scan the vegetation for animals and enable detection of reflected eye shine. Surveyors also listened intently for fauna calls during the survey period. All fauna observed or heard within the census period were recorded, noting whether they were on or off site.

Plate 1: Harp trap on Maddens Creek © H. Jessup/DECC

Harp trapping

While ultrasonic recorders were used principally to detect high-flying bat species, collapsible bat traps, known as harp traps (Tidemann and Woodside 1978), captured low-flying species (Plate 1). Two nights of trapping were conducted at each bat trap site, in spring and summer. Sites were selected for their perceived potential to interrupt bats along their flight paths, and were usually positioned on tracks or creek lines or in gaps between trees where adjacent vegetation may 'funnel' flying bats.

Traps were checked each morning. Captured bats were identified by external morphology, forearm measurement and body weight, and keyed out where necessary using Parnaby (1992a) and Churchill (1998). Animals were released on the following night at the point of capture.

Bat ultrasonic ('Anabat') call recording

Ultrasonic recorders (Corben 1989) are particularly useful for detection of high-flying species, which often comprise more than one third of an area's bat species (Parnaby 1992b), yet are under sampled by harp trapping (Richards 1992). Additionally, ultrasonic detectors also record low-flying species. The method requires the recording and identification of high frequency, echo-location "calls" made by bats, which, except for one or two species, are ultrasonic, that is, inaudible to humans. All recordings were made during spring and summer, when bat activity is highest.

Georges River Biodiversity Survey and CRA

The recording equipment for the surveys consisted of an Anabat II® detector and a tape recorder. Census duration was 30 minutes. Censuses were conducted between dusk and up to two hours after dusk, a peak activity period for microchiropteran bats. A 40 kilohertz calibration tone was recorded for a few seconds at the start and end of each recording session and sometimes at intervals during the recording period.

Current survey

The recording equipment for the surveys consisted of an Anabat II® detector and digital flash card recorder, housed within a Tupperware box for weather protection. The box was set up in locations where bats were expected to fly, such as over water bodies, at cave entrances and along tracks. The Anabat was set to commence detection at dusk and turn off at dawn. During the night, a delay switch operated to turn on the recording device when bat activity was detected and then de-activate the device while no bat activity was occurring. The equipment was left in each location for one night only, and then moved elsewhere. A 40 kilohertz calibration tone was recorded for a few seconds at the start and end of each recording session.

Anabat recordings were transferred onto computer and analysed by Narawan Williams, a recognised expert in this field. Troublesome calls were further verified by Michael Pennay. Identification was designated as definite, probable or possible, following the methodology of Parnaby (1992b) and Pennay *et al.* (2004). Reference calls were collected for a number of species in order to document local call patterns and to assist with the identification and verification of non-reference calls.

Nocturnal streamside search

Streamside searches for frogs were undertaken for half a person hour in one of two ways: in stream or gully habitats a 200 metre stretch was searched; at standing water bodies a half hectare (50 by 100 metre) area was surveyed. The searches were only conducted on warm, dark, humid and wet nights or nights within two days of rain. All frogs, and other animals, identified visually or by call within the time period were recorded, together with the weather conditions at the time of the survey.

Nocturnal call playback

Nocturnal birds and mammals are often detected only when they vocalise for territory or social contact, behaviour which can be elicited by broadcasting specific calls. A standard survey census involved broadcasting the calls of each of the four large forest owls - Powerful Owl (*Ninox strenua*), Masked Owl (*Tyto novaehollandiae*), Sooty Owl (*T. tenebricosa*) and Barking Owl (*N. connivens*) - from the centre of a site. Prior to call broadcasts, on arrival at the site, the surrounding area was searched by spotlight for five minutes to detect any fauna in the immediate vicinity and then a ten minute period of listening was undertaken.

A pre-recorded compact disc of each species' call series was played, amplified through a megaphone. Calls of each species were played for five minutes, followed by a five minute listening period. The surrounding area was again searched by spotlight after a final ten minute listening period. After the census, the response or presence of any fauna, date and time that response occurred, and weather

details such as amount of cloud cover was recorded. Very windy and rainy periods were avoided where possible. Censuses conducted in poor weather were noted. Censuses were undertaken in autumn and winter.

Elliott A trapping

This technique involved setting ten Elliott A traps at approximately twenty metre intervals along a 200 metre transect through a site. Traps were baited with a mixture of peanut butter, oats and honey. Traps were left in place for four nights, checked and emptied every morning soon after dawn. Any animals captured within the traps were identified, sexed if possible, and released.

Cage and Elliott B trapping

This technique involved setting five large cage traps (Plate 2) and five Elliott B traps alternately at 20 metre intervals along a 200 metre transect through a site. The technique is designed to target medium-sized ground mammals, particularly Bandicoots (*Isoodon* spp. and *Parameles* spp.) and Spotted-tailed Quolls (*Dasyurus maculatus*). Traps were baited with a mixture of rolled oats, peanut butter, honey and sardines. Elliott B traps were left in place for four nights, while cage traps were left in place for seven consecutive nights. Traps were checked and emptied every morning soon after dawn. Any animals captured within the traps were identified, sexed if possible, and released.

Plate 2: Cage trap beside Stokes Creek © H. Jessup/DECC

'Faunatech' Hair tube sampling

Ten large 'Faunatech' hair-sampling tubes were placed at approximately twenty metre intervals along a 200 metre transect. All tubes were baited with a mixture of peanut butter, honey, rolled oats and sardines. Each tube was fitted with an adhesive wafer to collect hairs of small and medium sized mammals that were attracted to the bait. Tubes were left on site for a minimum of ten nights. Hair samples were identified using the techniques described by Brunner and Coman (1974) by an expert in the field, Barbara Triggs. Identifications were classified into three levels of reliability: definite, probable and possible. At two locations, five 'Faunatech' tubes were replaced with Handiglaze 'tunnel' tubes, following the design described for targeted Potoroo survey below. The aim of this replacement was to qualitatively compare the relative effectiveness of the two designs for sampling common ground-dwelling mammals.

2.5 TARGETED SURVEY TECHNIQUES

A number of the threatened and regionally significant target fauna species are not adequately sampled using standard systematic survey techniques alone. Targeted survey methods were therefore used for these species. In addition, it was determined that the standard active reptile search technique was inadequate for sampling the reptile and terrestrial mammal fauna in Upland Swamps and Heath, and that this gap should be addressed by the implementation of pitfall trapping. The targeted survey techniques employed are described below.

Additional Nocturnal Call Playback

Target Species: Grass Owl, Squirrel Glider

The call of the Grass Owl was broadcast shortly after dusk in areas of potential habitat, namely the open heathlands and Upland Swamps in the far east of the study area. Three such surveys were undertaken in conjunction with systematic nocturnal call playback in May 2007.

Calls of the Squirrel Glider and the Yellow-bellied Glider were broadcast shortly after dusk in the shale sandstone transition forest in the far west of the study area. This one-off survey was undertaken in conjunction with systematic nocturnal call playback in May 2007.

Additional Nocturnal Streamside Search and Tadpole Search

Target Species: Littlejohn's Tree Frog, Green and Golden Bell Frog

Littlejohn's Tree Frog is highly vocal in late winter and early spring (Daly and Craven, in prep.). Following heavy rains in September 2006, a series of nocturnal streamside searches and tadpole searches were undertaken in areas that contained potential habitat for Littlejohn's Tree Frog or Green and Golden Bell Frog. These nocturnal streamside searches are included in Table 4. Seven

individuals of Littlejohn's Tree Frog were swabbed during these surveys and samples sent to CSIRO to test for Chytrid fungus (Gaia Research 2007).

Handiglaze 'tunnel' hairtubes

Target species: Long-nosed Potoroo

A local community member has reported sightings of Long-nosed Potoroo at Maddens Creek Crossing. A high degree of survey effort was therefore targeted towards this location in an attempt to confirm the species presence. Surveys included systematic cage trapping, Elliott B trapping, and Faunatech funnel hairtubes, as described above. In addition, 30 Handiglaze tunnel hair tubes were placed at the crossing and left in place for 23 nights between 8th and 31st May 2007. Research undertaken in Victoria has found this design of hair tubes to be effective for the detection of Potoroos. The hairtubes followed the design used by Murray (2005). The tunnels were made from clear, polycarbonate sheets ('Handiglaze Premium') each measuring 250 x 300 millimetres. The bait holder, a stainless steel double-spoon type tea infuser, was lodged into a 22 millimetres circular hole cut 100 millimetres along the long edge and 125 millimetres along the short edge of the Handiglaze sheet. A single length of galvanised wire (5 millimetres diameter, 600 millimetres long) was bent into a 'U' shaped peg that was passed through the handle of the bait holder to hold the tunnel in shape, hold the components together and fix the tunnel to the ground (Plate 3). The hair sampling surfaces were two lengths of adhesive tape (double sided cloth tape 48 mm wide, 'Qualtape') placed along the length of the short edges of the polycarbonate sheet. The tape was placed over four 60 millimetres lengths of reinforced garden hose. The hose pieces provide more sampling surface area and provided a slightly protruding surface against which animals are likely to brush their heads and/or flanks. The tunnels were baited with a mixture of peanut butter, rolled oats, honey or golden syrup, and pistachio essence.

Plate 3: Handiglaze 'tunnel' hairtube © E. Magarey/DECC

Diurnal Call Playback, Passive Listening and Active Searching in Upland Swamps and Heathlands

Target Species: Chestnut-rumped Heathwren, Eastern Bristlebird, Ground Parrot, King Quail, Lewin's Rail, Pheasant Coucal, Striated Fieldwren, Australasian Bittern

Highly experienced bird surveyors undertook targeted surveys for threatened and regionally significant birds in the Upland Swamps, heathlands and heathy woodlands in the east of the study area, primarily in early February 2007. These surveys utilised a range of techniques including active searching, passive listening at dawn and dusk, and call playback as appropriate where potential habitat for particular species occurred. A total of approximately twenty-five person-hours were spent undertaking these targeted surveys.

Pitfall Trapping

Target Species: Reptiles and terrestrial mammals in Upland Swamps and Heath.

This technique involved placing five 20 litre buckets into the ground at approximately five metre intervals (Plate 4). The buckets were buried flush with the ground, and connected by shade-cloth fencing designed to divert animals into the traps. The fencing was dug approximately five centimetres into the ground to prevent animals burrowing underneath it, and stood approximately 25 centimetres above the ground. The fencing was held in place by lengths of galvanised wire placed at approximately one metre intervals. A mixture of soil, leaf

Plate 4: Pitfall trap line on Maddens Plains © N. Williams/DECC

litter and bark was placed at the bottom of each pitfall traps to provide substrate and shelter for captured animals. If ants were present in the vicinity of a trap, residual powder pesticide was placed around the rim to prevent predation on trapped animals. Pitfall traps were left open for between three and four nights per survey. Traps were checked shortly before dusk and after dawn each day, upon which captured animals were identified, sexed if possible, and released. In between surveys the traps were left in place and secured tightly with a lid. The timing of pitfall trapping surveys is outlined in Table 3 below.

2.6 OPPORTUNISTIC TECHNIQUES

During the implementation of the systematic and targeted survey work, opportunistic techniques were also employed wherever possible. These included the following.

Predator and herbivore scat and pellet collection

The large numbers of hairs, and occasionally skeletal remains, in predator scats and pellets results in a high level of confidence in identifications of prey species and is hence an efficient sampling technique for prey animals. In addition, the recording of predator or non-predator scats constitutes records for the species that deposits the scat, providing locality records for species such as the Spotted-tailed Quoll, Fox (*Vulpes vulpes*), Dingo (*Canis lupus dingo*), Dog (*Canis lupus familiaris*) and Pig (*Sus scrofa*). Due to the unknown time delay between prey ingestion and defecation, the location in which the prey animals lived cannot be accurately known, so this technique is useful only for detecting the species presence within a general area. Lunney *et al.* (2002) showed that on average Dogs and Foxes defecate within a two kilometre radius of the site of prey ingestion.

Predator scats were collected, placed in paper envelopes, labelled and sent to specialist Barbara Triggs for analysis. Hair samples were identified using the techniques described by Brunner and Coman (1974). Identifications were classified into three levels of reliability: definite, probable and possible.

The location of herbivore scats was also noted on an opportunistic basis to indicate the presence of an animal. If there was any doubt in herbivore scat identification in the field, samples were brought back for identification by an expert.

Searches of caves and overhangs

All caves and overhangs encountered during the survey were thoroughly searched with a head torch for animals such as cave-roosting bats, geckos and nesting birds.

Incidental records

Incidental records are point localities of fauna encountered opportunistically during the survey. This is an opportunity to augment the number of records of species that are not well sampled by standard systematic survey techniques, such as large ground mammals, raptors, non-vocalising birds and secretive or cryptic species. The date, time, observer, map grid location (usually obtained from a GPS) and microhabitat of the animal were recorded on a data sheet.

2.7 SURVEY TIMING

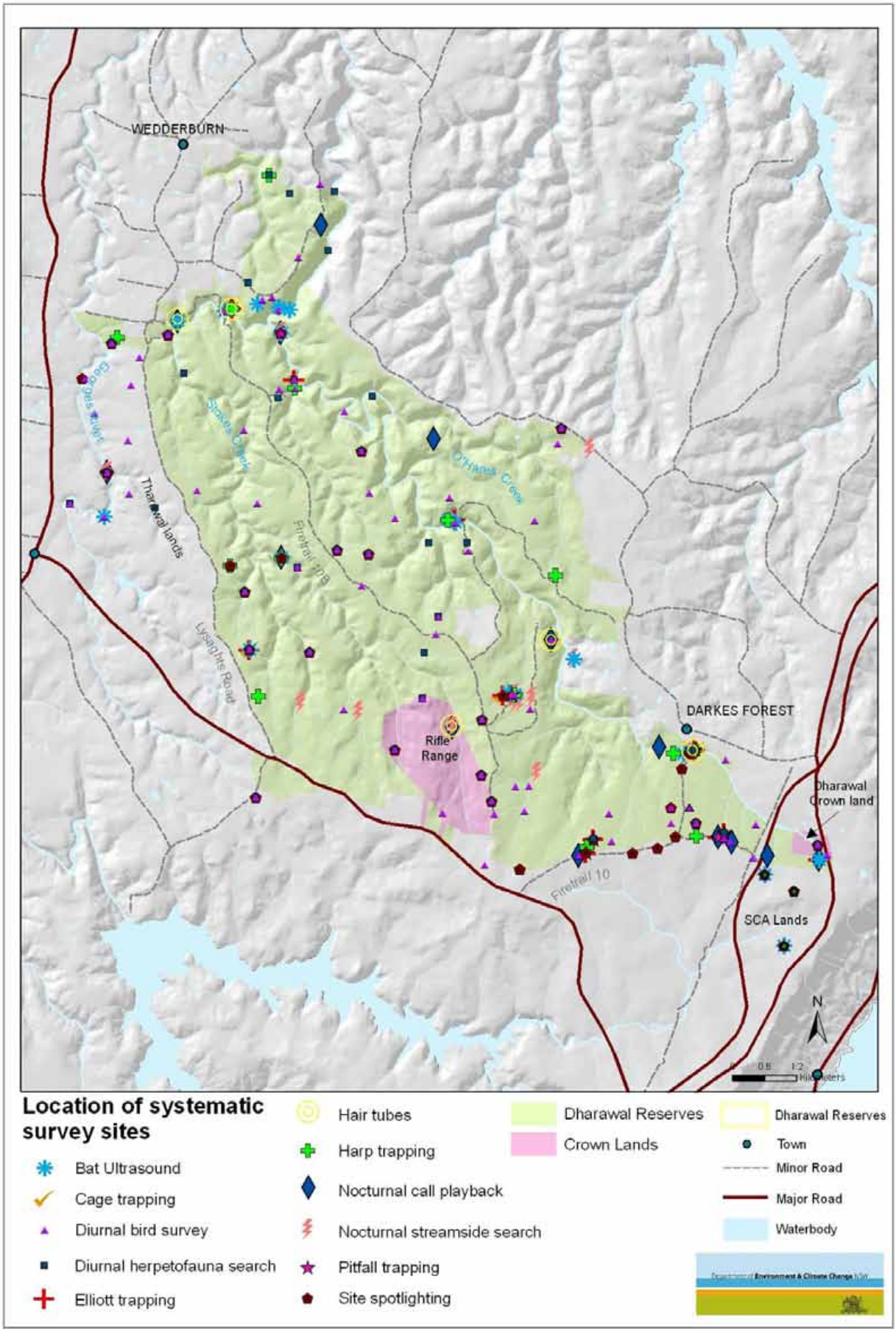
Field surveys for the current project were undertaken between the 13th of September 2006 and 31st of May 2007. Table 3 summarises the timing of survey techniques over this period and prevailing weather conditions. Weather conditions during the November-December and January-February survey weeks precluded the completion of the planned number of diurnal herpetofauna searches, and somewhat hampered the detection of microbats.

Table 3: Timing of DECC systematic and targeted fauna surveys within Dharawal SCA and NR and adjacent lands

Timing	Systematic techniques employed	Targeted techniques employed	Dominant weather conditions
13 to 16 September 2006	Nocturnal streamside search, diurnal herpetofauna search	Streamside searches and tadpole searches were targeted towards potential Littlejohn's Tree Frog habitat.	Heavy rainfall over preceding week. Cool and clear at time of survey.
27 November to 1 December 2006	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, harp trapping, bat ultrasonic call recording, Elliott A trapping	Pitfall trapping	Conditions varied from very hot and windy in the first half of the week to cool and overcast in the second half.
29 January to 2 February 2007	Diurnal bird survey, diurnal herpetofauna search, nocturnal site spotlighting, harp trapping, bat ultrasonic call recording, Elliott A trapping, Elliott B trapping, cage trapping	Pitfall trapping, targeted diurnal surveys for heathland and Upland Swamp priority bird species	Overcast and warm in the first half of the week followed by a storm with heavy rainfall in the east and then cool sometimes overcast conditions for the remainder of the week.
8 to 10 May 2007	Layout of hairtubes, nocturnal call playback	Layout of 'Handiglaze' tunnel hair tubes for Long-nosed Potoroo; call playback for Grass Owl; opportunistic bird surveys for winter migrants	Some light rainfall in the east, but otherwise partly overcast with quite mild temperatures.
31 May 2007	Pick up of hairtubes, nocturnal call playback	Single call playback of Yellow-bellied Glider and Squirrel Glider in western pocket of DSCA	Cool and clear.

2.8 SURVEY SITE LOCATIONS

A total of 141 systematic sites have been established and surveyed in the study area. Table 4 shows the number of systematic survey sites sampled in each vegetation community after completion of the 2006-07 field surveys, including sites from the 2006-07 project and the projects listed in Section 2.1.1 above. Map 3 shows the location of systematic survey sites and point locality-based targeted survey sites. Appendix A provides the specific AMG, vegetation type and survey techniques completed at each of these sites. Table 4 and Appendix A does not include the systematic surveys that have been undertaken on the Tharawal lands, which were observation-based techniques in Western Sandstone Gully Forest and Upper Georges River Sandstone Woodland.



Map 3: **Location of systematic survey sites and pitfall trap sites in Dharawal SCA and NR and adjacent lands**

Habitat Group	Vegetation Community	Area (hectares)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Elliott B and cage trapping	Faunatech Hair tube detection	Handiglaze Hair tube detection	Pitfall trapping
Upland Swamps	Upland Swamps: Sedgeland-Heath Complex	602	14	4	3	2	3	5	4	4		0.5	0.5	8
	Upland Swamps: Fringing Eucalypt Woodland	46			3									
	Upland Swamps: Banksia Thicket	45	1	1	1									
	Upland Swamps: Tea-Tree Thicket	45	4	1			1		1	1				
Heath and Fringing Heath Woodland	Sandstone Heath-Woodland	128	2											
	Woronora Tall Mallee-Heath	29	1											
	Dwarf Apple Heath	12	1	1										
	Rock Pavement Heath	11												
Exposed Sandstone Woodlands	Exposed Sandstone Scribbly Gum Woodland	3482	14	13	13	3	2	1	1	2	2			
	Silvertop Ash Ironstone Woodland	242	5	3	8	2	1	2		1	1	1	3	2
Upper Georges River Sandstone Woodland	Upper Georges River Sandstone Woodland	39	3		1	1								
Eastern Gully Forests	Sandstone Gully Apple Peppermint Forest	1455	7	6	4	1	2	1	2			0.5	0.5	
	Sandstone Riparian Scrub	181	3	3	1	2	3	1	2	2				
Western Gully Forest	Western Sandstone Gully Forest	343	6	5	2	2	4		3	2	1	2		
Shale Forest	O'Hares Creek Shale Forest	23	3	1	3		1	1	1	1				2
Clearings	Cleared	60	1			1	3	2						
Total		6743	65	38	39	14	20	13	14	13	4	4	4	12

Table 4: Vegetation communities within the study area and corresponding allocation of fauna survey effort as at June 2007.

3 FAUNA SPECIES INVENTORY AND OVERVIEW OF SURVEY RESULTS

3.1 REVIEW OF PRE-EXISTING FAUNA RECORDS

All records of vertebrate fauna for the study area on the Atlas of NSW Wildlife were reviewed as part of this project. Several records were identified as having a high degree of spatial inaccuracy, or as potential mis-identifications or database errors. Other species were accurately recorded at the time of survey, but are now considered to be locally extinct. In order to make the species inventory provided in this report as accurate as possible, all species that have only been recorded during the first Royal Australian Ornithologists Union survey (between 1978 and 1981) have been excluded. This includes several rainforest species, sea-birds and intertidal species, as habitat does not occur in Dharawal SCA and NR. It also includes at least two species, the Ground Parrot and Eastern Bristlebird, which are known to have occurred in the Upland Swamps but are now thought to be locally extinct.

Table 5 provides a list of all species that have been removed from the fauna inventory given in Appendices C and D and from the species totals provided in this report. They are presented here for reference, as it is possible that some of the species will be confirmed to occur in the study area in the future.

Table 5: Species recorded on the Atlas of NSW Wildlife for which there is some doubt about their current occurrence in the study area and that have been removed from the species inventory provided in this report. Potential habitat occurs for some of these species and it is possible that some of them will be confirmed in the study area in the future.

Common Name	Scientific Name	Reason for omission from species inventory
King Quail	*Coturnix chinensis*	Single museum specimen of only 10 km spatial accuracy and no known date.
Little Black Cormorant	*Phalacrocorax sulcirostris*	Recorded only during RAOU survey at very low spatial accuracy.
Pied Cormorant	*Phalacrocorax varius*	Recorded only during RAOU survey at very low spatial accuracy.
Australian Pelican	*Pelecanus conspicillatus*	Recorded only during RAOU survey at very low spatial accuracy.
Cattle Egret	*Ardea ibis*	Recorded only during RAOU survey at very low spatial accuracy.
White-necked Heron	*Ardea pacifica*	Recorded only during RAOU survey at very low spatial accuracy.
Latham's Snipe	*Gallinago hardwickii*	Recorded only during RAOU survey at very low spatial accuracy.
Rock Dove	*Columba livia*	Recorded only during RAOU survey at very low spatial accuracy.
Wonga Pigeon	*Leucosarcia melanoleuca*	Recorded only during RAOU survey at very low spatial accuracy.
Little Corella	*Cacatua sanguinea*	Recorded only during RAOU survey at very low spatial accuracy.
Budgerigar	*Melopsittacus undulatus*	Recorded only during RAOU survey at very low spatial accuracy.
Ground Parrot	*Pezoporus wallicus*	Not recorded in the last twenty years and presumed locally extinct.
Brush Cuckoo	*Cacomantis variolosus*	Recorded only during RAOU survey at very low spatial accuracy.
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	Recorded only during RAOU survey at very low spatial accuracy.

Common Name	Scientific Name	Reason for omission from species inventory
Eastern Bristlebird	*Dasyornis brachypterus*	Not recorded since the 1960s and presumed locally extinct.
Yellow-throated Scrubwren	*Sericornis citreogularis*	Recorded only during RAOU survey at very low spatial accuracy.
Large-billed Scrubwren	*Sericornis magnirostris*	Recorded only during RAOU survey at very low spatial accuracy.
Regent Honeyeater	*Xanthomyza phrygia*	Single record for 'Upper Georges River' from 1934. The study area does not support habitat for this species, and at most it would be an extremely rare visitor, en route to more favourable habitat
Logrunner	*Orthonyx temminckii*	Recorded only during RAOU survey at very low spatial accuracy.
Restless Flycatcher	*Myiagra inquieta*	Recorded only during RAOU survey at very low spatial accuracy.
White-bellied Cuckoo-shrike	*Coracina papuensis*	Recorded only during RAOU survey at very low spatial accuracy.
Cicadabird	*Coracina tenuirostris*	Recorded only during RAOU survey at very low spatial accuracy.
Green Catbird	*Ailuroedus crassirostris*	Recorded only during RAOU survey at very low spatial accuracy.
House Sparrow	*Passer domesticus*	Recorded only during RAOU survey at very low spatial accuracy.
European Goldfinch	*Carduelis carduelis*	Recorded only during RAOU survey at very low spatial accuracy.
Red-whiskered Bulbul	*Pycnonotus jocosus*	Recorded only during RAOU survey at very low spatial accuracy.
Golden-headed Cisticola	*Cisticola exilis*	Recorded only during RAOU survey at very low spatial accuracy.
Stuttering Frog	*Mixophyes balbus*	Single Australian Museum specimen registered in the Darkes Forest area, precise locality and date unknown. May possibly have occurred on Maddens Creek, but presumed locally extinct.
Dainty Tree-frog	*Litoria gracilenta*	Database error or released individual. This species occurs in coastal northern NSW and Qld.
Green and Golden Bell Frog	*Litoria aurea*	Last known from Darkes Forest area in the 1980s, but presumed locally extinct.
Pied Butcherbird	*Cracticus nigrogularis*	Recorded on in 1982, but considered to be a database or identification error. Outside the known range of this species.
Figbird	*Sphecotheres vieilloti*	Single opportunistic record from 2001 just outside boundary of DSCA at Darkes Forest. Suitable habitat not present within the study area for this species.
Eastern False Pipistrelle	*Falsistrellus tasmaniensis*	Recorded on three occasions from bat ultrasonic call analysis, but definite identification could not be obtained. The call of this species is easily confused with Eastern Broad-nosed Bat and Greater Broad-nosed Bat. May occur, though this would only be determined by targeted mist-netting surveys.
Southern Forest Bat	*Vespadelus regulus*	Two records from bat ultrasonic call analysis, but likely to be errors. Call frequency overlaps with that of Eastern Bentwing-bat (Pennay *et al.* 2004) and can be difficult to identify.

3.2 FAUNA SPECIES INVENTORY

A total of 224 native vertebrate fauna species are currently confirmed to occur within the study area. This total is comprised of 23 frogs, 40 reptiles, 123 native diurnal birds, six nocturnal birds and 32 native mammals. In addition, seven introduced mammals and four introduced birds have been confirmed.

Table 6 presents the total numbers of native, threatened and introduced fauna species recorded in each of the different land tenures examined for this study. A complete species list for all terrestrial vertebrate fauna groups recorded in Dharawal SCA and NR is provided in Appendix C, and in the proposed additions in Appendix D.

Table 6: Number of vertebrate fauna species known to occur in the study area

	DSCA & DNR	Maddens Plains Crown Lands	Stokes Creek Crown Reserve	Maddens Plains SCA Land
Total no. native fauna species known to occur	222	36	62	76
No. species listed as threatened on TSC Act	18	0	2	2
No. species listed as threatened on EPBC Act	5	0	0	0
No. introduced mammals	7	3	2	1
No. introduced birds	4	0	0	0

A total of 200 fauna species were recorded during the 2006-07 surveys. The surveys resulted in the discovery of fourteen species that had not previously been recorded on the Atlas of NSW Wildlife for the study area. Three of these newly recorded species were only detected by Pitfall trapping, reinforcing the value of this method for detection of cryptic and trap-shy species. On the completion of the field surveys, approximately 1900 records had been added to the fauna survey database.

3.2.1 Amphibians

The thirteen nocturnal streamside searches that have been undertaken within the study area detected fifteen species of frog. The additional eight species known to occur have been recorded during diurnal herpetofauna searches, site spotlighting, or incidentally. This taxonomic group is very rich in species due to the high diversity of habitats available within DSCA and DNR, which range from Upland Swamps to sheltered creek lines in the deeply incised sandstone plateau. As elsewhere in the region, by far the most commonly encountered species is the Common Eastern Froglet, which was detected during 60 percent of nocturnal streamside searches and occurs across the reserves almost everywhere that water pools. Also widespread are the Blue Mountains Tree Frog, Green Stream Frog and Eastern Banjo Frog. Of particular importance is the occurrence of Littlejohn's Tree Frog, which has been recorded in six locations in Upland Swamps in the east of DSCA (Map 6). The study area is considered critical to the survival of this species in the southern Sydney Basin (DECC 2007a).

Plate 5: Lesueur's Tree Frog © N. Williams/DECC

Two groups of frogs that occur in Dharawal SCA and NR have recently undergone taxonomic revision. The systematic surveys undertaken in the region in recent years have greatly increased our understanding of the distribution of these newly described species (DECC 2007c). Both the Lesueur's Tree Frog (Plate 5) and the recently described Stony Creek Frog occur across the reserves, including each in both O'Hares and Stokes Creeks. The Green Stream Frog is widespread on the Woronora Plateau, including within the study area. The newly described *Litoria nudidigita*, however, is mostly restricted to creek lines along the escarpment and the coastal plain below (NPWS 2002). The recording of a *Litoria nudidigita* in Stokes Creek in November 2006 is worthy of further investigation

and if confirmed to be established in this creek system may lead to a new understanding of the species distribution.

3.2.2 Reptiles

A total of 40 species of reptile are known to occur in the study area. This includes one turtle, four geckos, one legless lizard, fourteen skinks, four dragons, two goannas and fourteen snakes. The 37 systematic diurnal herpetofauna searches detected nineteen of these species, while the pitfall trapping detected ten species, including three not detected by the systematic searches. The remaining reptile species were detected during other survey techniques, or on an incidental basis. The reptile recorded most frequently during systematic herpetofauna searches is the Copper-tailed Ctenotus (48 percent of sites), followed by the Lesueur's Velvet Gecko (33 percent of sites). These rock-loving species are common due to the abundance of rocky outcrops exposed on ridgelines and slopes across the study area. The Dark-fleck Garden Sunskink is also common (detected at 30 percent of sites), as it occurs wherever there is adequate ground cover. The Eastern Water-skink was detected during 25 percent of searches, with all but one of these sites located along a major creek line. This pattern of reptile occurrence is typical of coastal sandstone hinterland environments of the Sydney Basin.

Plate 6: Eastern Three-lined Skink in Upland Swamp © N. Williams/DECC

The reptile fauna is species rich in comparison to the size of the study area. Of particular note is the high number of snakes, with fourteen species recorded. Again this richness is due to the diversity of habitats present, and includes species typical of the Upland Swamps such as the Marsh Snake and Mainland Tiger Snake, species that require more sheltered environments such as Diamond Python and Green Tree Snake, rock-loving species such as Broad-headed Snake, as well as a number of generalist species such as Eastern Brown Snake.

The discovery of the Eastern Three-lined Skink (Plate 6) in Dharawal Nature Reserve in November 2006 is very exciting and constitutes a range extension for the species. The Eastern Three-lined Skink is a high-altitude species, common along the Great Dividing Range of southern NSW and Victoria (Cogger 1996). The closest to Sydney that the species has previously been recorded is in Barren Grounds Nature Reserve (K. Griffiths pers. comm.), which is over 50 kilometres to the south of Dharawal. Barren Grounds lies at over 500 metres above sea level, while the locality of the species in Dharawal Nature Reserve is only 380 metres asl. The species was observed at a single location only, in a drainage channel within Upland Swamp dominated by Button Grass, but is likely to occur at further locations in similar environments. The protection of the Eastern Three-lined Skink in Dharawal Nature Reserve has local conservation significance. Also of local significance was the finding of Casuarina Skink on Iluka Creek during the DECC post-fire fauna surveys in September 2006. This species is highly cryptic and rarely encountered, though it has previously been recorded on Maddens Plains north of the Maddens Plains Crown land and also west of the Southern Freeway. These findings reinforce the extremely important role the Upland Swamps on Maddens Plains play in the conservation of vertebrate fauna diversity in the local area.

Plate 7: New Holland Honeyeater © DECC

3.2.3 Native diurnal birds

The review of records conducted for this report indicates that at least 119 species of native diurnal bird occur in the study area. Some of these species are sedentary, while others are migratory, seasonal visitors or nomads. The systematic diurnal bird census technique resulted in the detection of 82 species. The species most commonly recorded by this technique were Eastern Spinebill (77 percent

of sites), Rufous Whistler (63 percent of sites), White-throated Treecreeper (59 percent of sites), Grey Fantail (53 percent of sites), Grey Shrike-thrush (53 percent sites), New Holland Honeyeater (52 percent of sites, Plate 7), Brown Thornbill (45 percent of sites), Spotted Pardalote (45 percent of sites), Australian Raven (42 percent of sites), Little Wattlebird (41 percent of sites) and Yellow-faced Honeyeater (40 percent of sites). This result is typical of Sydney Basin sandstone environments, and closely aligns with the pattern found across the Greater Southern Sydney Region (DECC 2007c) and in northern Wollemi National Park (DEC 2005 and 2006c). These species flourish in dry sclerophyll forests and woodlands like the Exposed Sandstone Woodlands habitat group that covers much of the study area.

In contrast, a number of species were recorded on only a few occasions. These include Spotless Crake, Scarlet Honeyeater, Double-barred Finch and Rose Robin. Other species only occur in a narrow range of environments, such as Southern Emu-wren, Tawny-crowned Honeyeater and Australian Pipit which are largely restricted to the Upland Swamps, and Brown Gerygone and Red-browed Treecreeper which prefer moist sheltered gullies.

The Rockwarbler, Spotted Quail-thrush, Red-browed Treecreeper and Tawny-crowned Honeyeater are each thought to have declined in numbers across their national range in recent years (Barrett *et al*. 2003). In addition, several species that occur within Dharawal SCA and NR have had a decreased rate of reporting in the Sydney Basin Bioregion, including Jacky Winter, Beautiful Firetail, Southern Emu-wren, Wedge-tailed Eagle, Nankeen Kestrel, Dusky Woodswallow, Brown Falcon, Australian Pipit, Scarlet Robin, Black-shouldered Kite, Swamp Harrier, Varied Sittella and Grey Currawong. As part of the protected area system that extends from southern Sydney to the south coast, the study area plays an important role in the regional conservation of habitats for these species. In addition, the occurrence of Pheasant Coucal and Chestnut-rumped Heathwren has local conservation significance. Pheasant Coucal depends on Upland Swamps on Maddens Plains for its survival in the local area, while Chestnut-rumped Heathwren is more widely distributed through the south-eastern half of the study area in a range of Upland Swamps, Heaths and Exposed Sandstone Woodlands.

3.2.4 Nocturnal birds

Six species of nocturnal bird are known to occur in the study area. Five of these have been detected during systematic nocturnal call playback census, while the Tawny Frogmouth has been observed during systematic site spotlighting, as well as incidentally. The most commonly recorded nocturnal bird is the Southern Boobook, which has been heard calling in all of the habitat groups found within the study area, and is a regular feature of any nocturnal surveys done in sandstone environments in spring and summer. The larger owls are less abundant, with Barn Owl only recorded on one occasion and Powerful Owl restricted to the sheltered gully forests along Dahlia and O'Hares Creek. Both the Australian Owlet-nightjar (Plate 8) and White-throated Nightjar are widespread, the latter often encountered on roads at night-time.

Plate 8: Australian Owlet-nightjar © N. Williams

3.2.5 Arboreal Mammals

A total of seven species of arboreal mammal have been recorded within Dharawal SCA and NR. The area is relatively depauperate in large possums and gliders, which were detected during only 30 percent of systematic site spotlighting surveys. The only two species frequently recorded are Common Ringtail Possum and Sugar Glider, the former of which is more often seen in the east and the latter sparsely distributed through all the habitat groups. Common Brushtail Possum is rarely encountered, as it does not occur in the exposed sandstone woodlands that blanket most of the area. It has been recorded in the north-western corner of the study area, in the slightly richer riparian Western Sandstone Gully Forest, a pattern consistent with findings elsewhere in the Sydney Basin (DEC 2005, 2006c and DECC 2007c). Yellow-bellied Glider was not recorded during the 2006-07 surveys, and may not persist within Dharawal SCA and NR. Habitat for this species is limited to the far north-west of the study area, as well as potentially along the Georges River west of Lysaghts Road, however further survey would be required to determine whether the species still occurs. The Greater Glider is also very rare, known from only a single sighting in 1997. It is possible that a combination of restricted low quality habitat, low population numbers and the 2001 wildfires caused local extinction of this species, as has been postulated for Royal National Park.

The Eastern Pygmy-possum is a feature of the Upland Swamps and Exposed Sandstone Woodlands in the eastern third of the study area, flourishing where Heath-leafed Banksia occurs. In contrast, Koala only occurs in the far west, specifically within the Upper Georges River Woodland and Western Gully Forest habitat groups. Koala recorded within Dharawal SCA and NR are part of the Campbelltown population, for which more high quality habitat occurs outside of the reserve north and north-west of Wedderburn and in the Tharawal lands.

3.2.6 Native Ground Mammals

Twelve species of native ground mammal have been recorded within Dharawal SCA and NR. This includes species that are common and widespread (such as Swamp Wallaby, Bush Rat and Brown Antechinus) species that are restricted to a specific habitat group (such as Swamp Rat), and species recorded on only a handful of occasions (including Common Dunnart, Red-necked Wallaby and Long-nosed Bandicoot). The Elliott B and cage trapping surveys had very limited success, with only one Brown Antechinus captured in each kind of trap. In contrast, the Elliott A traps captured Brown Antechinus (54 percent of Elliott A trap sites), Bush Rat (23 percent of sites) and Swamp Rat (8 percent of sites). Pitfall trapping resulted in the detection of the locally significant Common Dunnart (which was not detected by any other method, Plate 9), as well as Brown Antechinus, Swamp Rat (and the semi-terrestrial Eastern Pygmy-possum). The *Faunatech* style hairtubes detected Brown Antechinus, Bush Rat and Swamp Wallaby, while the *Handiglaze* style tubes only detected the latter two species. These results highlight the need to employ a wide range of survey techniques over an extended time period in order to gain a comprehensive inventory of an area.

Common Wombat has only been directly observed on one occasion, along O'Hares Creek upstream of the river level gauge in January 2007. Evidence in the form of scats, burrows and diggings is widespread across the study area, however, with signs of fresh activity located in 2006-07 around Maddens Creek Crossing, Maddens Falls and the Blackburn Road crossing over the Georges River. This data suggests that the species is widespread within Dharawal SCA and NR, but only at low abundance.

Records of Eastern Grey Kangaroo are concentrated in the east of DSCA, primarily on the outskirts of Darkes Forest. The records of Common Wallaroo are also on the outskirts of the reserve, including near Darkes Forest and along Lysaghts Road. It is unlikely that either of these species occur deeply within the park proper. Red-necked Wallaby is also only very sparsely occurring, recorded at four widely scattered locations.

Long-nosed Bandicoot is thought to have suffered declines in abundance in developed areas along the coast of the Greater Southern Sydney Region, and hence is considered to be a regionally significant species (DECC 2007c). Though no actual sightings are recorded within Dharawal SCA and NR, evidence of the species exists at three locations near the southern end of the 10B fire trail, Exposed Sandstone Woodland and Upland Swamp. Diggings most likely made by Long-nosed Bandicoot have been recorded at three further locations, also in the east of DSCA, in Upland Swamp, Eastern Gully Forest and Shale Forest. Just under five percent of modelled high quality habitat for this species in the Greater Southern Sydney Region occurs within Dharawal SCA and NR (DECC 2007a), and hence the area is considered important to the regional conservation of the species.

Plate 9: Common Dunnart captured in Upland Swamp
© N. Williams/DECC

3.2.7 Bats

A total of thirteen species of bat are known to utilise the study area, including one fruit bat, the Grey-headed Flying-fox, and twelve species of small insectivorous bat. The harp trapping censuses undertaken in 2006-07 yielded relatively few captures of microbats, which is probably attributable to the difficulty in locating ideal trap positions, as well as a generally low level of bat activity during the time of the surveys. This technique resulted in the detection of six species of microbat, while bat ultrasonic call recording detected all twelve species known to occur. The most frequently captured microbat species were the Gould's Long-eared Bat (Plate 10) and Little Forest Bat (each recorded at 36 percent of harp trap sites), followed by Chocolate Wattled Bat (captured at 29 percent of sites). The latter two of these species are also frequently detected by ultrasonic call recording, as are Gould's

Wattled Bat (74 percent Anabat sites) and Eastern Freetail-bat (47 percent of Anabat sites). The Large Forest Bat is also relatively common, though it appears to be restricted to the eastern half of the study area above 300 metres asl in elevation. Another commonly recorded species is the White-striped Mastiff-bat, as the navigation pulses of this species are audible to the human ear. This species has been recorded during site spotlighting, nocturnal call playback, and ultrasonic call recording censuses, but has not been captured in harp traps as it tends to fly above the tree canopy, and thus evade capture. This composition of common bat species is typical of coastal sandstone hinterlands in the Sydney Basin.

Plate 10: Gould's Long-eared Bat © H. Jessup/DECC

Two of the microbat species that occur in the study area roost in caves, including Eastern Bentwing-bat which is an obligate cave-roosting species, and Large-footed Myotis which will roost in caves, overhangs, tree-hollows and man-made structures (Churchill 1998). A Large-footed Myotis roost site was located along O'Hares Creek, upstream of the River Level Gauge, in January 2007. Four bats were detected in a depression in the ceiling of an overhang, approximately five metres above the ground. Further roost sites for this species are sure to occur elsewhere along the creek, and potentially also on Stokes Creek. Eastern Bentwing-bat scats were detected in an overhang on Stokes Creek in January 2007, though no individuals were seen. Temporary roost sites such as this are likely to occur elsewhere along Stokes and O'Hares Creek, but no maternal roost sites are known from the study area.

There is doubt about the occurrence of a fourteenth species of microbat, Little Bentwing-bat (*Miniopterus australis*) which was identified to the 'probable' level of reliability from a bat ultrasonic call recording on a slope above Stokes Creek during the 2006-07 surveys. Confirmation of this species occurrence in Dharawal SCA and NR would be very interesting, as the area is at the southern limit of the species known distribution. A roost site of the Little Bentwing-bat was recently discovered in a disused tunnel near Stanwell Park (M. Schulz pers. comm.), so the species existence in Dharawal SCA and NR is plausible. Further surveys for this species are recommended. As discussed in above, there is also doubt about the occurrence of Eastern False Pipistrelle and Southern Forest Bat within the study area, while Large-eared Pied Bat is considered to have the potential to occur. Confirmation of whether these species occur or not would only be obtained by further targeted survey. Surveys for Eastern False Pipistrelle and Southern Forest Bat must aim to capture the species by harp trapping or mist netting, as the ultrasonic calls are easily confused with those of the other species.

3.2.8 Introduced Species

Seven species of introduced mammal and four species of introduced bird are known to inhabit the study area. The birds are restricted to the urban/bushland interface, and are hence unlikely to be having a significant impact on the native fauna of the study area at this stage. In contrast, introduced mammals are widespread in the study area, and pose a significant threat to native fauna. The most commonly recorded is the Fox, which though only observed five times has been detected by scats or footprints at a further 20 locations. This feral predator has been recorded across the study area in all of the habitat groups, but most frequently in Exposed Woodlands, Western Sandstone Gully Forests and Upland Swamps. Wild Dogs are also widespread, detected by their scats at fifteen locations including in the centre of DSCA.

The Fox consumes a wider range of prey in the Greater Southern Sydney Region than the Wild Dog (DECC 2007c), a trend which has also been found during recent DECC surveys in the northern half of the Sydney Basin (DEC 2006c). The Fox diet on the Woronora Plateau is dominated by small and medium-sized mammals, birds, reptiles and insects, and includes Eastern Pygmy-possum, Long-nosed Bandicoot and Swamp Rat (DECC 2007a). Wild Dogs prefer larger prey species, particularly Swamp Wallaby, but also Long-nosed Bandicoot and occasionally Rusa Deer (DECC 2007a). The 30 predator scats analysed for the 2006-07 survey project showed a similar pattern with the vertebrate animal prey of Wild Dog found to comprise Swamp Wallaby, Rabbit and Rusa Deer, while that of the Fox comprise Bush Rat, Brown Antechinus and Rabbit. It is extrapolated from these results that the

Fox has the potential to pose a greater risk to threatened and regionally significant fauna species than the Wild Dog, and is therefore a higher priority for control.

Of the introduced herbivores that occur, Rusa Deer are the most abundant, though their distribution currently appears to be restricted to higher rainfall areas, particularly on Madden Plains, around Darkes Forest and at the southern end of the 10B fire trail. However, recent sightings have been made near Douglas Park and Wilton, as well as in Holsworthy Army land (DECC 2007d), suggesting that the species has the potential to spread to the western edge of the study area in future, if left unchecked. Rabbit have been recorded at just four locations within Dharawal SCA and NR, primarily occurring close to the park boundaries. Feral Cat, Goat and Brown Hare have been recorded three times, twice and once respectively. Feral Cat are likely to be more common than records suggest, but go largely undetected due to their habit of burying faeces and their cryptic nature. The distribution of Feral Cat in the study area is not well understood, but if widespread may pose a significant threat to native vertebrate fauna. Section 5.4 of this report discusses the potential impacts that introduced mammals have on native fauna of the study area.

3.3 ADDITIONAL SPECIES THAT HAVE THE POTENTIAL TO OCCUR

An examination of records occurring within five kilometres of the study area provides some insight into additional species that are likely to occur within the study area, but gone undetected. Table 7 lists species that, in addition to those already listed in Table 2, are considered highly likely to occur.

Table 7: Species recorded within a five kilometre radius of Dharawal SCA and NR that have the potential to also occur in the study area

Common Name	Scientific Name	Reason it is considered to have the potential to occur
Burton's Snake Lizard	*Lialis burtonis*	May have evaded detection in a range of habitat types in DSCA and DNR.
Tree-base Litter Skink	*Carlia foliorum*	Occurs on the outskirts of Wedderburn and may also occur in the far western block of DSCA, west of Lysaghts Road.
Eastern Brown Tree Snake	*Boiga irregularis*	May occur in low abundance in more sheltered areas.
Red-naped Snake	*Furina diadema*	May occur west of Lysaghts Road.
Chestnut Teal	*Anas castanea*	May occur utilise dams and inundated areas, particularly the Maddens Plains Crown land.
Grey Teal	*Anas gracilis*	May occur utilise dams and inundated areas, particularly the Maddens Plains Crown land.
Pacific Baza	*Aviceda subcristata*	May utilise the study area as part of foraging habitat.
Australian Hobby	*Falco longipennis*	May utilise the study area as part of foraging habitat.
Dusky Moorhen	*Gallinula tenebrosa*	May utilise inundated areas of Upland Swamp, dams, or sections of Maddens Creek.
Purple Swamphen	*Porphyrio porphyrio*	May utilise inundated areas of Upland Swamp, dams, or sections of Maddens Creek.
Musk Lorikeet	*Glossopsitta concinna*	May visit the north-west of the study area during times of abundant flowering.
Weebill	*Smicrornis brevirostris*	May occur in north-west of study area on the edges of the

Common Name	Scientific Name	Reason it is considered to have the potential to occur
		Cumberland Plain.
White-plumed Honeyeater	*Lichenostomus penicillatus*	May occur in north-west of study area on the edges of the Cumberland Plain.
Feathertail Glider	*Acrobates pygmaeus*	Known to be widespread through other sandstone reserves, but difficult to detect.
Platypus	*Ornithorhynchus anatinus*	Anecdotal record in O'Hares Creek. Potential habitat along O'Hares and Stokes Creek at large permanent water pools.
Water-rat	*Hydromys chrysogaster*	Potential habitat along O'Hares and Stokes Creek at large permanent water pools.

4 PATTERNS IN NATIVE FAUNA HABITAT USE

The gradient of environmental variables across the study area leads to distinct changes in the vegetation communities present from east to west and hence variation in the types of fauna habitat available. The vegetation communities have been subjectively lumped into broader 'habitat groups'. Habitat groups bring together vegetation communities that are similar in vegetation structure, habitat features (such as rockiness and hydrology), and average annual rainfall. It is important to note that the habitat groupings have not been derived from statistical analysis of fauna records, and thus do not necessary represent true fauna assemblage boundaries for each taxonomic group. Nevertheless the habitat groupings provide a useful broad-scale basis for understanding fauna distribution patterns across the study area. The species lists and discussion in this section is based upon: qualitative assessment of all fauna records including those collected during the 2006-07 surveys; quantitative statistical analysis of systematic survey data undertaken for the *Fauna Assessment of the Illawarra Escarpment, Coastal Plain and Plateau* study (NPWS 2002); and findings of the *Terrestrial Vertebrate Fauna of the Greater Southern Sydney Region* study (DECC 2007c) and *Biodiversity for the Georges River Catchment Volume 2: Fauna Assessment* (NPWS 2000b).

4.1 UPLAND SWAMPS

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The complex of Upland Swamp vegetation communities is a distinctive feature of the eastern third of the study area. These hanging swamps occur on poorly drained soils that are subject to varying degrees of inundation depending on topographic position (NPWS 2003a). They are generally treeless, with a dense shrub layer of Banksia and Tea-trees and/or a dense ground layer of Button Grass, sedges and/or rushes.

Upland Swamps support a diverse and unique array of fauna, many of which are of conservation concern. Upland Swamps are very restricted in extent and the Maddens Plains area contains one of the most extensive expanses of Upland Swamps in the Sydney Basin. Upland Swamps are of high regional significance and are identified as ***Priority Fauna Habitat*** in DECC (2007c).

Commonly Observed Herpetofauna

The Upland Swamps support a high diversity of frogs, including ground frogs such as the Common Eastern Froglet, Eastern Banjo Frog and Haswell's Froglet, and tree frogs such as Peron's Tree Frog, Blue Mountains Tree Frog, Freycinet's Frog and Littlejohn's Tree Frog. The most frequently encountered reptiles are Eastern Water-skink, Dark-flecked Garden Sunskink and Pale-flecked Garden Sunskink. The Eastern Three-lined Skink is extremely hard to detect because of the high vegetation density in its preferred habitat, but is a characteristic feature of the herpetofauna, as is the Marsh Snake and She-oak Skink.

Commonly Observed Birds

The bird fauna occurring here is the most distinct of all the habitat groups in the study area. Honeyeaters are common, particularly Tawny-crowned Honeyeater, New Holland Honeyeater, Little Wattlebird, Eastern Spinebill and White-cheeked Honeyeater. The Southern Emu-wren is characteristic of these environments, and is rarely found in the other habitat groups, as is also the case for Pheasant Coucal. Also frequently observed are Rufous Whistler, Grey Fantail, Fan-tailed Cuckoo, Grey Shrike-thrush, Tree Martin, Variegated Fairy-wren and Beautiful Firetail. Birds of prey are commonly seen soaring above the plains, including Swamp Harrier, Black-shouldered Kite and Nankeen Kestrel.

Commonly Observed Mammals

The only two commonly occurring arboreal mammals are the Eastern Pygmy-possum and Common Ringtail Possum. Both the Swamp Wallaby and the Swamp Rat are common, though the latter is generally only recorded by trapping. Numerous bat species have been recorded flying over the swamps, including White-striped Freetail-bat, Gould's Wattled Bat and Chocolate Wattled Bat.

Threatened Species Known to Occur

Common Name	Scientific Name	Percentage of Records in this Habitat Group
Giant Burrowing Frog	*Heleioporus australiacus*	18
Red-crowned Toadlet	*Pseudophryne australis*	19
Littlejohn's Tree Frog	*Litoria littlejohni*	100
Rosenberg's Goanna	*Varanus rosenbergi*	17
Gang-gang Cockatoo	*Callocephalon fimbriatum*	11
Eastern Pygmy-possum	*Cercartetus nanus*	75
East-coast Freetail-bat	*Mormopterus norfolkensis*	50
Large-footed Myotis	*Myotis macropus*	6
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	9
Greater Broad-nosed Bat	*Scoteanax rueppellii*	17

4.2 HEATH AND FRINGING HEATH WOODLAND

The heaths, mallees and heath-woodlands all have naturally restricted distributions and occur as small isolated patches on sandstone ridge tops, primarily along the central spine of the study area. This habitat group is characterised by a low very sparse to absent canopy above a dense shrub layer, usually with massive sandstone outcrops and rock plates.

As this habitat group is so limited in extent, it is difficult to obtain a clear understanding of its fauna characteristics. This assessment must therefore not be treated as a definitive guide, but rather a summary of the results of surveys in this habitat group to date. Patches of coastal sandstone heath and mallee are found in eastern sandstone plateaux of the Sydney Basin and are well reserved.

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Commonly Observed Herpetofauna

The very limited number of reptile searches undertaken in this habitat group have most frequently detected dragons, including Mountain Heath Dragon, Jacky Lashtail and Eastern Bearded Dragon. The frog fauna is relatively depauperate, though Common Eastern Froglet, Red-crowned Toadlet and Keferstein's Tree Frog have been observed in low numbers.

Commonly Observed Birds

The most commonly recorded birds are honeyeaters, particularly New Holland Honeyeater, Little Wattlebird, Eastern Spinebill and occasionally Tawny-crowned Honeyeater. Also common are White-throated Treecreeper, Superb Fairy-wren, Chestnut-rumped Heathwren, Beautiful Firetail and Spotted Quail-thrush.

Commonly Observed Mammals

No mammal surveys have been undertaken in this habitat group, with all mammal sightings being made on an incidental basis. Species known to occur include Swamp Wallaby, Common Ringtail Possum and Common Wombat, though neither have been seen in high numbers.

Threatened Species Known to Occur

Common Name	Scientific Name	Percentage of Records in this Habitat Group
Giant Burrowing Frog	*Heleioporus australiacus*	9
Red-crowned Toadlet	*Pseudophryne australis*	6

4.3 EXPOSED SANDSTONE WOODLANDS

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Woodlands on Hawkesbury Sandstone ridge tops and exposed slopes take up by far the largest proportion of the study area. These drop out to the east, where they are largely replaced by the Upland Swamps, and to the west where Upper Georges River Sandstone Woodland dominates.

The primary features of this habitat group are relatively low woodland on skeletal sandy soil, often with rocky outcrops and exfoliating rock. The shrub layer is diverse and of varying density, while the ground cover is sparse. These woodlands were severely affected by the 2001 fire, particularly towards the eastern half of the study area where the fire was most intense. This habitat group is widespread in the coastal hinterland of the Sydney Basin, and is well represented in reserves.

Commonly Observed Herpetofauna

The Exposed Sandstone Woodlands support a high richness and diversity of reptiles. The most commonly encountered species are the Copper-tailed Skink and Lesueur's Velvet Gecko, each easily located under sandstone exfoliations and in rock crevices. The Dark-flecked Garden Sunskink and Red-throated Cool-skink are also frequently seen, either around rock outcrops or within leaf litter. Most creek lines within this habitat types support the Common Eastern Froglet, and Keferstein's Tree Frog is often heard calling from tree hollows. Jacky Lashtail and Mountain Heath Dragon are also commonly seen in these environments.

Commonly Observed Birds

Honeyeaters are frequently recorded, particularly Eastern Spinebill, White-eared Honeyeater, Little Wattlebird, New Holland Honeyeater and Yellow-faced Honeyeater. Also common are the Brown Thornbill, Rufous Whistler, Spotted Pardalote, Striated Thornbill, White-throated Treecreeper, Crimson Rosella, Yellow-tailed Black-cockatoo, Eastern Yellow Robin, Grey Currawong and Grey Shrike-thrush. White-throated Nightjar and Australian Owlet-nightjar are often heard calling after dusk.

Commonly Observed Mammals

The Swamp Wallaby is the most commonly recorded terrestrial mammal in this habitat type, as it is highly visible and easy to identify. More cryptic, though abundant, is the Brown Antechinus, and to a lesser extent the Echidna. Arboreal mammals are generally sparse, though both the Sugar Glider and Common Ringtail Possum do occur. The majority of bat trapping in the study area has been done in this habitat type, and has resulted in the capture of the Large Forest Bat, Little Forest Bat, Gould's Wattled Bat and Gould's Long-eared Bat most frequently.

Threatened Species Known to Occur

Common Name	Scientific Name	Percentage of Records in this Habitat Group
Giant Burrowing Frog	*Heleioporus australiacus*	73
Red-crowned Toadlet	*Pseudophryne australis*	38
Rosenberg's Goanna	*Varanus rosenbergi*	61
Broad-headed Snake	*Hoplocephalus bungaroides*	80
Gang-gang Cockatoo	*Callocephalon fimbriatum*	67
Turquoise Parrot	*Neophema pulchella*	100
Spotted-tailed Quoll	*Dasyurus maculatus*	50
Koala	*Phascolarctos cinereus*	1
Grey-headed Flying-fox	*Pteropus poliocephalus*	75
Eastern Pygmy-possum	*Cercartetus nanus*	25
Large-footed Myotis	*Myotis macropus*	25
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	36

4.4 UPPER GEORGES RIVER SANDSTONE WOODLAND

Upper Georges River Sandstone Woodland occurs on broad ridges and upper slopes in the far west of the study area, largely west of Lysaghts Road. Rainfall is generally less than 1000 millimetres per annum and soils are slightly richer. Structurally this habitat group differs from the Exposed Sandstone Woodlands group by being taller and having a grassier ground cover.

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As this habitat group is so limited in extent within the study area, it is difficult to obtain a clear understanding of its fauna characteristics. This assessment must therefore not be treated as a definitive guide, but rather a summary of the results of surveys in this habitat group in the study area to date, together with surveys in this vegetation community elsewhere in the Georges River catchment. This vegetation community is more extensive north-east of Appin, but nevertheless occupies a moderately small portion of the Sydney Basin and is not well reserved.

Commonly Observed Herpetofauna

Due to unsuitable weather conditions during the period of the 2006-07 survey in this area, no systematic reptile searches were undertaken in this habitat type. Species recorded incidentally include Red-throated Cool-skink, Copper-tailed Ctenotus, Jacky Lashtail and Eastern Stone Gecko. Other species that are sure to be found with systematic searching are Dark-flecked Garden Sun-skink and Lesueur's Velvet Gecko.

Commonly Observed Birds

The most frequently recorded bird species are Eastern Spinebill, Red-browed Finch, Yellow-faced Honeyeater, White-eared Honeyeater, Grey Fantail and Australian Raven. Also notable are Buff-rumped Thornbill, Grey Shrike-thrush, Rufous Whistler, White-throated Treecreeper, Brown-headed Honeyeater, Spotted Pardalote and Double-barred Finch.

Commonly Observed Mammals

Amongst the species known to occur are Koala, Sugar Glider, Swamp Wallaby and Brown Antechinus. Only one species of bat, the White-striped Mastiff-bat has been recorded to date, but is likely that many more species at least forage in this habitat, such as Little Forest Bat and Gould's Long-eared Bat.

Threatened Species Known to Occur

Common Name	Scientific Name	Percentage of Records in this Habitat Group
Koala	*Phascolarctos cinereus*	45

4.5 EASTERN GULLY FORESTS

Sandstone Gully Apple Peppermint Forest occurs on sheltered slopes and gullies on Hawkesbury Sandstone in the south-eastern three quarters of the study area. Riparian Scrub comprises a very narrow band of lower vegetation along the edges of Stokes and O'Hares Creeks. These two communities have been combined for the purpose of this habitat description because they often intergrade, with the gully forest overhanging the riparian scrub.

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The dominant features of this habitat group are a moderately tall open forest above a tall shrub/small tree layer with a mix of mesic and sclerophyllous species. The lowest vegetation layer is dominated by rushes, Tea-trees and Banksia on the slopes, and by ferns along stream channels. Slopes support rocky outcroppings, while stream channels contain a series of rock pools, sandy deposits and rock pavements.

This habitat group is widespread in the Sydney Basin coastal plateaux and well protected within the current reserve system.

Commonly Observed Herpetofauna

The creek lines support a range of frog species, the most commonly recorded being Common Eastern Froglet, Lesueur's Frog, Blue Mountains Tree Frog and Green Stream Frog. Rock outcrops on the slopes feature Lesueur's Velvet Gecko and Broad-tailed Gecko, as well as Copper-tailed Ctenotus. The Dark-flecked Garden Sunskink is commonly seen in leaf litter or basking on logs, while the Eastern Water-skink and Eastern Water Dragon bask along the water's edge.

Commonly Observed Birds

Frequently recorded species include White-throated Treecreeper, Spotted Pardalote, Rock Warbler, Eastern Spinebill, Yellow-faced Honeyeater, Eastern Yellow Robin, Grey Shrike-thrush, Brown Thornbill, Rufous Whistler, Golden Whistler, Grey Fantail, Rufous Fantail. Brown Gerygone and Red-browed Treecreeper occur in the most sheltered gullies where mesic vegetation with rainforest elements occurs. Australian King-parrot and Lewin's Honeyeater are also a feature of the more sheltered creek lines.

Commonly Observed Mammals

The Bush Rat is commonly recorded in these environments, as is the Brown Antechinus to a lesser extent. Swamp Wallaby are frequently seen. Arboreal mammals are relatively sparse, though the Sugar Glider can be heard calling at times. The most commonly recorded bat species include the Eastern Freetail-bat, Gould's Wattled Bat and Chocolate Wattled Bat.

Threatened Species Known to Occur

Common Name	Scientific Name	Percentage of Records in this Habitat Group
Red-crowned Toadlet	*Pseudophryne australis*	31
Rosenberg's Goanna	*Varanus rosenbergi*	17
Glossy Black-cockatoo	*Calyptorhynchus lathami*	66
Powerful Owl	*Ninox strenua*	80
East-coast Freetail-bat	*Mormopterus norfolkensis*	50
Little Bentwing-bat	*Miniopterus australis*	100
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	18
Large-footed Myotis	*Myotis macropus*	6
Greater Broad-nosed Bat	*Scoteanax rueppellii*	17

4.6 WESTERN GULLY FOREST

Western Sandstone Gully Forest occurs in the far west of the study area, in the north-west of the State Conservation Area and in the adjacent Tharawal Local Aboriginal Land Council Lands. It occurs where rainfall drops below about 1050 millimetres per annum (NPWS 2002 veg report). The dominant features of this habitat group are a moderately tall open forest on slightly enriched sandy soil. A sparse layer of smaller trees is usually present, above a sparse shrub layer. The ground layer is comprised primarily of ferns and grasses.

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Western Sandstone Gully Forest is not very well protected in the reserve system, as it largely occurs along the interface of the Campbelltown urban area.

Commonly Observed Herpetofauna

The herpetofauna located here shares much with the Eastern Gully Forest habitat group. Common Eastern Froglet and Green Stream Frog are the most commonly recorded frog species, while Lesueur's Velvet Gecko, Broad-tailed Gecko, Copper-tailed Ctenotus, Dark-flecked Garden Sunskink, Eastern Water-skink and Eastern Water Dragon are often seen reptiles.

Commonly Observed Birds

As with the Eastern Gully Forest group, White-throated Treecreeper, Spotted Pardalote, Brown Thornbill, Rockwarbler, Eastern Spinebill, Yellow-faced Honeyeater, Rufous Whistler and Grey Fantail are all common. In addition Yellow-tufted Honeyeater, Mistletoebird, Peaceful Dove, Sulphur-crested Cockatoo and White-throated Gerygone are a feature of the Western Gully Forest group, while Rose Robin occurs in the autumn and winter period.

Commonly Observed Mammals

The most notable arboreal mammal is the Koala, which is often observed on the outskirts of Wedderburn and in the Georges River Valley. The Sugar Glider is less-often reported, but can frequently be heard calling. As across the study area, the Swamp Wallaby is commonly seen here, while the Bush Rat and Brown Antechinus can be detected by trapping. Of the bat species known to occur, Large-footed Myotis, Gould's Wattled Bat, Eastern Freetail-bat and Chocolate Wattled-bat have been recorded most frequently.

Threatened Species Known to Occur

Common Name	Scientific Name	Percentage of Records in this Habitat Group
Broad-headed Snake	*Hoplocephalus bungaroides*	20
Gang-gang Cockatoo	*Callocephalon fimbriatum*	11
Glossy Black-cockatoo	*Calyptorhynchus lathami*	33
Grey-headed Flying-fox	*Pteropus poliocephalus*	25
Large-footed Myotis	*Myotis macropus*	50
Eastern Bentwing-bat	*Miniopterus schreibersii oceanensis*	18
Greater Broad-nosed Bat	*Scoteanax rueppellii*	33
Koala	*Phascolarctos cinereus*	49
Yellow-bellied Glider (feed marks only)	*Petaurus australis*	100

4.7 SHALE FOREST

O'Hares Creek Shale Forest is very restricted in extent in the study area, occurring in small patches in the eastern third. It occurs on remnant shale soils that lie as isolated caps above the sandstone plateau (NPWS 2003a). The most notable features of the habitat are a tall forest with moderately sparse shrub cover and a dense ground cover of ferns, lilies, grasses and rushes. The soil is a rich reddish-brown clay that differs markedly from the surrounding sands.

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As this habitat group is so limited in extent, it is difficult to obtain a clear understanding of its fauna characteristics. This assessment must therefore not be treated as a definitive guide, but rather a summary of the results of surveys in this habitat group to date.

O'Hares Creek Shale Forest is listed as an Endangered Ecological Community. It is restricted to the O'Hares and Woronora Catchments and is poorly reserved.

Commonly Observed Herpetofauna

The most frequently recorded frogs include the species most common across the study area, namely Common Eastern Froglet, Lesueur's Frog and Green Stream Frog. Few reptiles have been recorded, but the Dark-flecked Garden Sunskink appears to be the most common.

Commonly Observed Birds

The most frequently recorded bird species in this habitat in the study area are White-throated Treecreeper, Rufous Whistler, Crimson Rosella, Brown Thornbill, White-browed Scrubwren, Eastern Spinebill, Golden Whistler, Grey Fantail, Spotted Pardalote and Australian Raven. Based on results elsewhere in the Illawarra, the Striated Thornbill, Yellow-faced Honeyeater, Variegated Fairy-wren and Pied Currawong are also a feature of such habitats.

Commonly Observed Mammals

Both Sugar Glider and Common Ringtail Possum have been recorded in the Shale Forest, as has Brown Antechinus, Bush Rat and Swamp Wallaby. Bat species recorded include Gould's Wattled Bat, Gould's Long-eared Bat, Large Forest Bat and Little Forest Bat, though given the size of the patches it cannot be ascertained whether these species roost in the shale forest or just fly through it.

Threatened Species Known to Occur

Common Name	Scientific Name	Percentage of Records in this Habitat Group
Gang-gang Cockatoo	*Callocephalon fimbriatum*	11

5 PRIORITIES FOR FAUNA CONSERVATION AND MANAGEMENT IN THE STUDY AREA

5.1 CONSERVATION PRIORITY OF FAUNA SPECIES

The Vertebrate Fauna of the Greater Southern Sydney Region study reviewed all terrestrial fauna known to occur in the region, identified fauna species of conservation concern, and predicted their relative abundance across the landscape (DECC 2007c, 2007d). That study then set a region-specific list of fauna conservation priorities, based on: the level of decline in the region; the level of threat to remaining populations; the total amount of habitat in the region; the importance of the region to the overall survival of the species; and the amount of habitat that has already been lost. As Dharawal SCA and NR and adjacent lands are contained within the Greater Southern Sydney Region, these fauna conservation priorities apply to the study area.

Table 8 lists all the species of regional conservation concern that have been recorded at some time in the study area, with a ranking of their regional conservation priority according to DECC 2007c. The table identifies key threats for each species in the region and the study area. The species listed in grey have not been recorded in Dharawal SCA and NR or adjacent lands for many years and are thought to be locally extinct.

The meaning of the regional conservation rankings given in the table are as follows:

Highest Regional Conservation Priority

Species that are either perilously close to extinction or are possibly already extinct. Without action, these species will almost certainly disappear from the region in the short term (DECC 2007c). If re-discovered in the study area these species must be managed at a site by site level.

High Regional Conservation Priority

Species that are rare or very rare and have suffered substantial declines within the region. These species have significant continuing threats, chiefly habitat loss or alteration, and require action for their persistence in the region; however most may be conserved by managing key habitats or key threats rather than by management at a site by site level.

Moderately High Regional Conservation Priority

Species that are either uncommon or locally common, but have suffered significant habitat loss or threats across their range or in some areas. Species are included in this category if they are secure in part of their range, but extinct or very threatened in another part of their range, or if they are rare and highly restricted in range.

Moderate Regional Conservation Priority

Species that are uncommon to common in the region with large areas of protected habitat and few apparent threats, but only occur in a restricted range of environments. These species' restricted range makes them vulnerable to future declines. These species require few targeted management actions within the region but are of higher conservation significance at a broader scale.

Lower Regional Conservation Priority

Species that are threatened in NSW but are relatively common in the region with a large amount of habitat in protected areas and few threats acting in them, or are believed to have only peripheral habitat in the region. These species require few or no targeted management actions for their long-term survival in the region.

In addition to the species listed in Table 8, the following are considered to be locally significant: Eastern Three-lined Skink, Casuarina Skink, Common Dunnart, Chestnut-rumped Heathwren and Pheasant Coucal.

Table 8: Regional conservation priority of fauna species that are known to occur, or to have once occurred in the study area

Regional Conservation Priority (DECC 2007c)	Species	NSW Legal Status	Federal Legal Status	Key Threats in the Greater Southern Sydney Region (DECC 2007c)
Highest Priority Currently presumed to be locally extinct. Rediscovery would immediately trigger targeted management at a site level.	Ground Parrot	V		Feral predators, frequent fire
	Eastern Bristlebird	E	E	Feral predators, frequent fire
	Long-nosed Potoroo	V	V	Feral predators, frequent fire
	Stuttering Frog	E	V	Disease
	Green and Golden Bell Frog	E	V	Disease
High Priority Require management of key habitats and key threats.	Broad-headed Snake	E	V	Collection, bushrock removal
	Littlejohn's Tree Frog	V	V	Disease
	Koala	V		Habitat loss
	Spotted-tailed Quoll	V	E	Habitat loss, feral predators and competitors, 1080 baiting
	Large-footed Myotis	V		Habitat loss, decline in water quality
	East-coast Freetail-bat	V		Habitat loss
	Green Tree Frog	P		Possibly disease
Moderately High Priority Require management of key habitats and key threats.	Beautiful Firetail	P		Habitat loss, frequent fire
	Grey-headed Flying-fox	V		Habitat loss
	Greater Broad-nosed Bat	V		Habitat loss
	Turquoise Parrot	V		Habitat loss
Moderate Priority Require few targeted management actions	Southern Emu-wren	P		Frequent fire, restricted habitat
	Tawny-crowned Honeyeater	P		Restricted habitat
	Rosenberg's Goanna	V		Restricted habitat
	Giant Burrowing Frog	V	V	Restricted habitat
	Red-crowned Toadlet	V		Restricted habitat
	Eastern Pygmy-possum	V		Restricted habitat, frequent fire
	Rockwarbler	P		Restricted habitat
Lower Priority Do not currently require management actions	Long-nosed Bandicoot	P		Regionally secure
	Mainland Tiger Snake	P		Regionally secure
	Bibron's Toadlet	P		Regionally secure
	Eastern Bentwing-bat	V		Regionally secure
	Gang-gang Cockatoo	V		Regionally secure
	Powerful Owl	V		Regionally secure
	Red-browed Treecreeper	P		Regionally secure
	Spotted Quail-thrush	P		Regionally secure
	Varied Sittella	P		Regionally secure
	Glossy Black-cockatoo	V		Regionally secure
	Greater Glider	P		Regionally secure
	Yellow-bellied Glider	V		Regionally secure

5.2 KEY LOCATIONS OF CONSERVATION PRIORITY SPECIES

Table 9 identifies key locations for each moderate, moderately high and high priority fauna species that is known to still occur in the study area, and provides an assessment of the importance of the study area to the regional survival of the species. The latter assessment is made on the basis of modelling of high quality habitat undertaken across the Greater Southern Sydney Region (DECC 2007a). Species for which more than seven percent of the total amount of high quality habitat in the region is located in Dharawal SCA and NR are rated as 'critical', more than one percent as 'important', between 0.02 and one percent as limited, and less than 0.02 percent as 'very limited'. Table 10 identified key locations of other threatened fauna species that are known to occur in the study area.

The Vertebrate Fauna of the Greater Southern Sydney Region study generated habitat models for conservation priority and pest species across greater southern Sydney, including the current study area. Many of these maps are of a fine enough scale and quality to be informative at a local level, and thus provide a tool for assessing the relative quality of habitat for different species across the study area. Maps of relative habitat quality have been produced for many moderate, moderately high and high priority fauna species within the study area, and are presented in Appendix B together with the location of records on the Atlas of NSW Wildlife. For details on how these models were generated, the types of the models, the variables used and the pitfalls of various models refer to DECC 2007c and 2007d. It is important to note here that the quality of the model outputs were limited by the quality of the predictive variables and vegetation mapping used to generate the maps, a limitation which is more evident for some species than others. For example, the amount of high quality Broad-headed Snake habitat available in Dharawal SCA and NR may be underestimated, because rock outcrops have not been mapped at a fine scale. The Holsworthy Army Land has not been mapped at a fine scale, leading to the appearance of artificial habitat boundaries at the edge of the more finely mapped Dharawal reserves, as is clear for the Grey-headed Flying-fox model.

Table 9: Key locations and habitats of moderate, moderately high and high priority species currently known to persist in the study area and the relative importance of the study area to their regional conservation

Species	Key Locations in the Study Area	Significance of Habitat in the Study Area to Regional Survival of the Species	Habitat model presented in this report?
Broad-headed Snake	Rock outcroppings along ridgelines in Exposed Sandstone Woodlands; hollow-bearing trees and rock overhangs in Eastern Gully Forests and Western Gully Forest.	Important	Yes
Littlejohn's Tree Frog	Upland Swamps and creek lines in the east and south of DSCA and in DNR.	Critical	No
Koala	The Campbelltown population extends to the Western Gully Forest and Upper Georges River Sandstone Woodland west of Lysaghts Road. The Tharawal lands contain high quality habitat, which form part of a corridor between the Campbelltown and Avon/Nepean colonies (DECC 2007a). Dispersing males occasionally move through the Darkes Forest area.	Limited	Yes
Spotted-tailed Quoll	Sightings in the last decade have centred around Lysaghts Road and Wedderburn, but the largest expanse of potential habitat occurs along O'Hares Creek.	Important	Yes
Large-footed Myotis	Creek lines with permanent water including Stokes, O'Hares and Maddens Creeks.	Important	No
East-coast Freetail-bat	Recorded only twice, each time foraging over open water (including along Stokes Creek and abandoned quarry on 10U). No identifiable key habitats.	Very Limited	Yes
Green Tree Frog	Only recent records are at Maddens Creek crossing. Potential habitat also occurs on the eastern edge of the Cumberland Plain (far north-western corner of study	Very Limited	Yes

Species	Key Locations in the Study Area	Significance of Habitat in the Study Area to Regional Survival of the Species	Habitat model presented in this report?
	area).		
Beautiful Firetail	Upland Swamps and Heaths through the eastern half of the study area.	Critical	Yes
Grey-headed Flying-fox	Likely to occur sporadically across the area in response to flowering and fruiting events. Sightings are made most frequently in the vicinity of Darkes Forest and Wedderburn (H. Jessup pers. comm.).	Important	Yes
Greater Broad-nosed Bat	Areas with higher fertility soils including the far west, around Darkes Forest and potentially patches of O'Hares Creek Shale Forest.	Very Limited	Yes
Turquoise Parrot	Upland Swamps and fringing sandstone woodland in the eastern half of the study area.	Limited	Yes
Southern Emu-wren	Upland Swamps and to a lesser extent Heaths through the eastern half of the study area.	Critical	Yes
Tawny-crowned Honeyeater	Upland Swamps and to a lesser extent Heaths and heathy Exposed Sandstone Woodlands through the eastern third of the study area.	Critical	Yes
Rosenberg's Goanna	Exposed Sandstone Woodlands and Heaths throughout the study area.	Critical	Yes
Giant Burrowing Frog	Areas with deep sandy soil, particularly between North Cliff Colliery and the Stokes Creek Crown Reserve, and to a lesser extent along Maddens Creek. Breeding occurs in rock pools along minor drainage lines and swamps.	Critical	Yes
Red-crowned Toadlet	Widespread through sandstone upper slopes across the centre of DSCA, occurring in minor drainage lines and depressions.	Critical	Yes
Eastern Pygmy-possum	Heath and woodland areas where Heath-leaved Banksia (*Banksia ericifolia*) is abundant, mostly in the east of DSCA and the Stokes Creek Crown Reserve.	Critical	Yes
Rockwarbler	Rocky lower slopes and mid slopes in Eastern Gully Forests and Western Gully Forest.	Important	Yes

Table 10: Key locations of other threatened species

Species	Key Locations in the Study Area	Significance of Habitat in the Study Area to Regional Survival of the Species	Habitat model presented in this report?
Eastern Bentwing-bat	No known roost sites. Forages widely across the study area, most often recorded above water and along major creek lines.	Important	No
Gang-gang Cockatoo	Widespread through sandstone woodlands and forests, but occurs only at moderately low abundance.	Important	No
Powerful Owl	Dahlia Creek and O'Hares Creek between Iluka and Dahlia Creek junctions.	Limited	No
Glossy Black-cockatoo	Sheltered gully forests, particularly towards the west and north-west where She-oak (*Allocasuarina littoralis*) is more common.	Very Limited	No

5.3 RELATIVE PRIORITY OF FAUNA HABITATS

Fauna habitats vary widely in their spatial extent, with some being widespread, some naturally restricted and others heavily depleted due to clearing. They also vary greatly in their level of modification and number of threatened fauna. The result of this is that some environments provide habitat for a disproportionately large number of threatened species. Given limited resources, protection and enhancement of these environments will generate the maximum benefit to threatened species conservation and to vertebrate diversity in the study area. The Fauna of the Greater Southern Sydney Region study (DECC 2007c) identified Upland Swamps as a ***Priority Fauna Habitat*** that has exceptional importance for the conservation of threatened and regionally significant species. Upland Swamps are highly restricted in extent; Maddens Plain supports the most extensive swamp system in the Greater Southern Sydney Region and is listed on the Directory of Important Wetlands in Australia (Environment Australia 2001). In addition to the known threatened and regionally significant species, the detection of the Eastern Three-lined Skink is an example of the fauna values held within these environments that are only recently being discovered. The Upland Swamps habitat group is the highest priority for the management of threatening processes and for land acquisition in the study area.

The Western Gully Forest and Upper Georges River Sandstone Woodland habitat groups are each fairly poorly reserved in the southern Sydney region. The Western Gully Forest in particular provides habitat for many threatened species. Together these habitat groups play a very important role as part of a corridor of intact vegetation along the eastern edge of the Cumberland Plain, providing a linkage for wildlife around the urban fringes of southern Sydney. For these reasons, the Western Gully Forest and Upper Georges River Sandstone Woodland in the far north-western corner of Dharawal SCA are a high conservation priority, and should be targeted for the abatement of threatening processes. The Tharawal lands that extend from the western boundary of the study area to the Georges River also hold high conservation significance, and are particularly important for the Koala, as they form part of a habitat link between the Campbelltown and Avon/Nepean colonies. Several threatening processes act upon the Tharawal lands, including a reduced number of hollow bearing trees, proliferation of tracks and trails and associated erosion, and impacts of adjacent land use. DECC should aim to work cooperatively with the Tharawal Local Aboriginal Land Council to address these threats, and thus preserve the habitat linkage between the Illawarra Escarpment and the Georges River.

The Exposed Sandstone Woodlands and Eastern Gully Forests that dominate the central portion of the study area are extensive across the coastal sandstone plateau of the Sydney Basin and are well represented in the reserve system. The most important role that these habitat groups play is as part of the chain of protected areas that extend from Royal to Morton National Parks, providing an unbroken expanse of native vegetation that will enable fauna species to respond to environmental factors such as climate change. In addition, these habitat groups support a number of threatened species and are integral to the ongoing local conservation of fauna diversity. Species that depend almost entirely on one or both of these habitat groups are Broad-headed Snake, Gang-gang Cockatoo, Rosenberg's Goanna and Spotted-tailed Quoll, while numerous bat species rely upon these environments as part of their foraging habitat, including Grey-headed Flying-fox, Large-footed Myotis and Eastern Bentwing-bat.

5.4 THREATENING PROCESSES

Several Key Threatening Processes (KTPs), as identified under state and federal legislation, act within the study area. Table 11 summarises the KTPs that are thought to occur within the study area, including threats that are thought to currently be having a significant impact on native fauna (shaded red), threats that are restricted in extent or which are not well understood in the study area (shaded pink) and threats that may arise in the future (shaded orange). Also listed are the moderate to high conservation priority and threatened fauna species that still occur in the study area and that are likely to be impacted upon by these processes. At present, probably the most significant threat is competition and/or predation by the Fox, as this species is widespread and frequently recorded. The consequences of high frequency fire have already impacted on the study area, and potentially contributed to the local extinction of Ground Parrot, Eastern Bristlebird and Long-nosed Potoroo. Similarly, infection of frogs by Chytrid fungus is postulated to have caused the severe decline or local extinction of Green and Golden Bell Frog, Stuttering Frog and potentially Green Tree Frog, while it may currently be a significant threat to Littlejohn's Tree Frog. Five Littlejohn's Tree Frog tadpoles tested positive for Chytrid fungus in September 2006 from a tributary of O'Hares Creek near fire trail 10R, however no sick or moribund frogs were observed. Specific recommendations for management

of threatening processes in the study area are provided in DECC 2007a. Table 11 and Table 12 will aid in the prioritisation of areas and habitats for threat abatement, and again highlight the need for a focus on the Upland Swamps habitat group.

Threat Abatement Plans have been written for a number of the species, and are hence relevant to the study area. These include the Threat Abatement Plans for: predation by the Fox (NPWS 2001a, DEH 1999a); Predation by the Feral Cat (DEH 1999b); infection of frogs with chytridiomycosis (DEH 2004); competition and land degradation by Feral Rabbit (DEH 1999c); and predation by Plague Minnow (NPWS 2003b).

In addition to the KTPs, several other processes act within Dharawal SCA and NR and adjacent lands that have the potential to significantly impact on native fauna. These are summarised in Table 11.

Table 11: Key Threatening Processes acting within Dharawal SCA and NR and adjacent lands and the threatened fauna species affected by each

Threatened Species	Predation by the European Red Fox	Infection of frogs by amphibian Chytrid causing the disease chytridiomycosis	Herbivory and environmental degradation caused by Feral Deer	Bushrock removal and disturbance	Ecological consequences of high-frequency fires	Predation by Feral Cats	Predation by the Plague Minnow (*Gambusia holbrooki*)	Invasion of native plant communities by exotic perennial grasses	Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	Competition from Feral Honeybees	Competition and grazing by the feral European Rabbit	Competition and habitat degradation by Feral Goats	Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations	Human-caused climate change	Alteration to habitat following subsidence due to longwall mining
Key current locations of threat and areas to target for abatement/management	Occurrence is widespread. Successful abatement will require a reserve-wide approach with cooperation from neighbouring landholders. The Upland Swamp fauna assemblage is particularly susceptible.	Chytrid detected in the east of DSCA, but distribution of the disease is currently unknown. Upland Swamps are the highest priority for research and management.	Maddens Creek Crossing, Maddens Plains, vicinity of 10A and southern end of 10B trails	Ridgelines across reserve, particularly where accessible by car	Entire reserve at risk, particularly along the western boundary and Maddens Plains. Upland Swamps and areas dominated by Heath-leaved Banksia particularly susceptible.	Distribution unknown. Most susceptible areas are DSCA west of Lysaghts road, Upland Swamps and woodlands dominated by Heath-leaved Banksia	Known from a single location on Stokes Creek directly east of Blackburn Road. Potentially also in lower reaches of O'Hares Creek and in Maddens Creek..	Whisky Grass, African Love Grass and Rhodes Grass have invaded further into the reserves since the 2001 fires, particularly along old Bulli-Appin Road and trails in the north-west and south-east. Western Gully Forest, Upper Georges River Woodland, O'Hares Cree Shale Forest and Upland Swamps are particularly susceptible. Successful abatement will require cooperation with neighbouring landholders.	Maddens Creek, O'Hares Creek	Extent unknown. One hive known in Smooth-barked Apple hollow near northern end of 10D fire trail.	Edges of reserve in south-east of study area on deeper more fertile soils	Upland Swamp and fringing woodland on Maddens Plains between Freeway and Highway			
Broad-headed Snake				X								X			
Littlejohn's Tree Frog		X	X				X		X						X
Koala	X					X									
Spotted-tailed Quoll	X			X	X	X									
Large-footed Myotis									X	X					X

Threatened Species	Predation by the European Red Fox	Infection of frogs by amphibian Chytrid causing the disease chytridiomycosis	Herbivory and environmental degradation caused by Feral Deer	Bushrock removal and disturbance	Ecological consequences of high-frequency fires	Predation by Feral Cats	Predation by the Plague Minnow (*Gambusia holbrooki*)	Invasion of native plant communities by exotic perennial grasses	Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands	Competition from Feral Honeybees	Competition and grazing by the feral European Rabbit	Competition and habitat degradation by Feral Goats	Infection by Psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations	Human-caused climate change	Alteration to habitat following subsidence due to longwall mining
East-coast Freetail-bat										X					
Green Tree Frog		X					X		X						
Beautiful Firetail	X				X	X		X							X
Grey-headed Flying-fox															X
Greater Broad-nosed Bat										X					
Turquoise Parrot	X					X		X		X	X		X		
Southern Emu-wren	X					X									X
Tawny-crowned Honeyeater	X														X
Rosenberg's Goanna	X			X											X
Giant Burrowing Frog			X				X		X						X
Red-crowned Toadlet			X	X											X
Eastern Pygmy-possum	X				X	X									X
Rockwarbler															
Eastern Bentwing-bat															
Gang-gang Cockatoo										X			X	X	
Powerful Owl										X					
Glossy Black-cockatoo					X					X			X		

Table 12: Other threatening processes acting in Dharawal SCA and NR and adjacent lands

Process	Threatened species potentially affected	Key locations of threat to native fauna
Predation by Wild Dogs	Koala	Western pocket of DSCA
Invasion of Upland Swamps by Pampas Grass	Upland Swamp fauna	Disturbed areas around Maddens Plains
Reduction in water quality	Large-footed Myotis	Georges River, Maddens Creek
Collection of individual specimens	Broad-headed Snake	Rocky outcrops on ridges and exposed slopes adjacent to trails
Road mortality	Koala	Wedderburn area
Very high intensity fire/canopy fire	Koala, Eastern Pygmy-possum, Red-crowned Toadlet	Anywhere in study area where no unburnt refugia are left, but particularly the western pocket of DSCA where Koala occur.
Trail bike riding causing opening of tracks, erosion and hydrological change	Upland Swamp fauna, all frog species	South-eastern half of study area
Unauthorised horse riding through Upland Swamps keeping trails open, potentially causing erosion, hydrological change and weed invasion.	Upland Swamp fauna	Upper Stokes Creek, Maddens Plains and around Darkes Forest.
Construction of tracks, trails, fire control lines or other cleared linear corridors in Upland Swamps leading to erosion, hydrological change, spread of weeds and increased incursion of Fox and Feral Cat	Upland Swamp fauna	All areas of Upland Swamp
Development of adjacent lands impacting on water quality and ecosystem integrity	Upland Swamp fauna	Maddens Plain Crown land north of the Nature Reserve.
The disease *Chlamydia*	Koala	This disease is systemic in the Campbelltown Koala population (R. Close in DECC 2007a), but it is likely that only old or sick individuals would succumb. It may become a more significant threat in the future if the population becomes stressed or it acts in concert with other threats.
Trail maintenance that alters local hydrology or destroys road-side ditches	Red-crowned Toadlet, Giant Burrowing Frog	All trails on ridgelines and upper slopes

5.5 LAND ACQUISITION PRIORITIES FOR FAUNA

The *Fauna of the Woronora, O'Hares Creek and Metropolitan Special Areas* report (DECC 2007a) lays down a set of criteria by which to judge potential land acquisitions. Based on these criteria, the existing new area proposals can be ranked in terms of their priority for addition to Dharawal SCA and NR.

Based on the existence of the Upland Swamp ***Priority Fauna Habitat***, and the threatened, regionally and locally significant fauna species that occur therein, the new area proposals are ranked in terms of priority for addition to the reserves as follows.

- Of the existing new area proposals, the Maddens Plains Crown land, between DNR and the Golf Course, are the highest priority for addition to the reserve system. This pocket of land is almost entirely Upland Swamp ***Priority Fauna Habitat***, which provides habitat for at least ten threatened species and eight regionally or locally significant species. It also includes a stretch of the headwaters of Maddens Creek with a large pool of open water that provides habitat for numerous bird and bat species. This area is subject to a number of threatening processes, the pressure of which will increase if active management is not undertaken as adjacent land is developed.
- The block of Sydney Catchment Authority land between the Southern Freeway and the Princes Highway is second priority for addition to Dharawal SCA and NR, as it includes some of the largest patches of Upland Swamp ***Priority Fauna Habitat*** in the region. It is placed second in ranking because, being within Schedule One Special Area, the land is already offered a high degree of protection. The most significant threatening process that may act on this area in the future, if it is not protected, is alteration to habitat following subsidence due to longwall mining.
- The Stokes Creek Crown Reserve, extending north-west from the junction between Bulli-Appin road and the 10B fire trail is third in priority of the existing new area proposals. This area contains many smaller patches of Upland Swamp ***Priority Fauna Habitat***, as well as fringing heathy woodland. This area plays a significant additional role by protecting the headwaters of Stokes Creek.

Any future proposals for extension of Dharawal SCA and NR should target: Upland Swamp ***Priority Fauna Habitat***; or the Western Gully Forest and Upper Georges River Sandstone Woodland habitat groups where they lie within the corridor of intact vegetation along the eastern edge of the Cumberland Plain, providing a linkage for wildlife around the urban fringes of southern Sydney and preserving the stretch of native vegetation from the Illawarra Escarpment to the Cumberland Plain.

6 RECOMMENDATIONS FOR FURTHER SURVEY WORK

The systematic and targeted fauna survey work, and threatened species habitat modelling, that has been undertaken in Dharawal SCA and NR and adjacent lands to date have resulted in an adequate baseline understanding of terrestrial vertebrate fauna in the study area, and enabled the setting of local conservation priorities. In addition, the work has highlighted issues that require further study to broaden the understanding of fauna in the locality and region, and enable effective management in the long term. The following projects and research are recommended to address these issues. Additional recommendations for the entire Woronora Plateau are made in DECC (2007a).

- Determination of the extent of Chytrid fungus in Dharawal SCA and NR and adjacent catchments. This fungus is thought to have contributed to the local extinction or decline of several frog species yet remains poorly understood in the study area. A limited amount of testing was undertaken in September 2006 and Chytrid was detected in four Littlejohn's Tree Frog tadpoles (Daly 2007). Further testing should be undertaken in all catchments within the study area, with a focus on the eastern third of DSCA and DNR and on known locations of Littlejohn's Tree Frog. Testing should be undertaken by an experienced herpetologist, utilising the latest collection and pathology techniques. The *Hygiene protocol for the control of disease in frogs* (NPWS 2001b) must be strictly adhered to at all times.
- Confirmation of the occurrence and determination of the distribution of Plague Minnow. Surveys should be undertaken in all major waterbodies including upstream and downstream of the weirs on Maddens, O'Hares and Stokes Creeks, in Four Mile Creek, and in the vicinity of Littlejohn's Tree Frog and Giant Burrowing Frog breeding sites. This work should be planned and undertaken in conjunction with experienced fish biologists, and could be combined with surveys for native fish particularly Macquarie Perch (*Macquaria australasica*) and Climbing Galaxias (*Galaxias brevipinnis*).
- Surveys for Black-chinned Honeyeater, Regent Honeyeater and Swift Parrot. This entails diurnal bird surveys and opportunistic searches in the Western Gully Forest and Upper Georges River Sandstone Woodland habitat groups when trees are in flower in autumn and winter months. Surveys should be undertaken by an experienced bird surveyor familiar with the species calls and habitat preferences. Such surveys will need to be undertaken on an annual basis over several seasons in order to confidently determine whether these bird species use the study area as part of the foraging habitat.
- Ongoing surveys for Long-nosed Potoroo, particularly at Maddens Creek crossing. Local naturalists should be made away of the rarity and importance of this species and encouraged to immediately report any suspected sighting to the Illawarra Area Office, ideally with a photo of the animal. Re-discovery of this species in the study area would have the highest conservation priority and immediately trigger the formulation and implementation of an active management program.
- Bi-annual surveys for Upland Swamp birds. The 2006-07 surveys failed to detect Eastern Bristlebird or Ground Parrot, which are both presumed to be locally extinct. Targeted searches using call playback could be undertaken every two years to confirm the species absence. In addition, local birdwatchers should be strongly encouraged to immediately report any potential sightings to the Illawarra Area Office, with accurate location information.
- Targeted surveys for Eastern False Pipistrelle, Large-eared Pied Bat and Little Bentwing-bat. For the first two species, surveys should be centred around areas identified as potential habitat by DECC 2007a and include harp trapping and mist netting. Ultrasonic bat call detection will not be sufficient to confidently determine the presence of Eastern False Pipistrelle. These surveys will simultaneously yield information on other microbat species, which will build on the limited data gained during the 2006-07 project.
- Further surveys for Squirrel Glider. There is a chance that this species occurs in the Western Gully Forest habitat group, west of Lysaghts Road. Spotlighting by surveyors experienced in distinguishing the Sugar from the Squirrel Glider is recommended. Such surveys could also be extended to ascertain whether the Yellow-bellied Glider exists. The discovery of Squirrel

Glider within Dharawal SCA and NR or adjacent lands would have high regional conservation significance.

- Surveys for Feral Cat. Feral Cats are notoriously difficult to detect due to their cryptic nature and habit of burying their faeces. The distribution and abundance of the Feral Cat in the study area is currently unknown, but if widespread could be having a significant impact on native fauna through predation and competition. A targeted survey program should be designed in consultation with experts on the species, and focus on determining presence in the south-east and north-west of the study area. This could be undertaken in conjunction with monitoring of other predators by the installation of sand pads in the Upland Swamps and west of Lysaghts Road. In addition, park visitors should be actively encouraged to accurately report all sightings, either to the Illawarra Area Office or the Atlas of NSW Wildlife.
- Determination of whether Spotted-tailed Quoll persists in the study area. The 2006-07 surveys failed to detect Spotted-tailed Quoll despite the implementation of cage trapping, hair tubing and opportunistic techniques in high quality habitat. In order to determine whether the species persists, a larger attractant could be used to lure Quolls to survey points on Stokes and O'Hares Creeks. Large meat baits could be used as an attractant, and should be buried into the ground and secured with wire to a central stake. The meat baits should be placed within a sand pad and surrounded with digital cameras that are modified to be triggered by heat and movement. The bait should be left in place for two to three weeks, following the method being trialled in Victoria (DSE 2007). The bait could also be surrounded by a dense grid of hair tubes (a combination of *Faunatech* and *Handiglaze* 'tunnel' designs) baited with chicken or sardines. Double-sided tape could also be placed onto the central stake to capture hair from animals wrestling with the meat bait.
- The use of pitfall traps over the 2006-07 survey season detected three species not previously recorded in Dharawal SCA and NR, and a total of sixteen species. Repeated use of pitfall traps in the currently established locations will provide comprehensive baseline information on ground-dwelling mammals, reptiles and frogs at these sites, and enable monitoring of trends over the longer term. The pitfall traps could be opened on a bi-annual basis for the first few years, and then less frequently into the longer term, as appropriate. Pitfall trapping sessions must always be led by experienced personnel, but could also form a component of community involvement programmes.

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APPENDIX A: SURVEY SITES

Location of, vegetation type and techniques undertaken at systematic fauna survey sites in Dharawal SCA and NR and adjacent lands

Site number	Easting	Northing	Vegetation community (Keith ref)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Elliott B and cage trapping	Hair tube detection (Faunatech)	Hair tube detection (Handiglaze)	Pitfall trapping
APP014WB1	308150	6209150	Silvertop Ash Ironstone Woodland			1									
APP021WB2	300083	6208333	Exposed Sandstone Scribbly Gum Woodland	1	1	1									
APP022WB2	304473	6208263	Exposed Sandstone Scribbly Gum Woodland	1	1	1									
APP023WB2	302187	6212859	Exposed Sandstone Scribbly Gum Woodland	1	1	1									
APP024WMB2	308027	6208871	Silvertop Ash Ironstone Woodland			1									
APP032SB3	305700	6214915	Upland Swamps: Sedgeland-Heath Complex	1											
APP033SB3	301714	6209972	Upland Swamps: Sedgeland-Heath Complex	1											
APP034SB3	305192	6209983	Upland Swamps: Sedgeland-Heath Complex	1											
APP036SB3	305279	6213478	Upland Swamps: Sedgeland-Heath Complex	1											
APP042WB4	304287	6208753	Upland Swamps: Banksia Thicket	1	1	1									
APP069WB5	305777	6215200	Exposed Sandstone Scribbly Gum Woodland	1	1	1									
APP075SB5	302672	6213524	Upland Swamps: Tea-Tree Thicket	1											
APP076WB5	302047	6214771	Exposed Sandstone Scribbly Gum Woodland	1	1	1									
APP077WB5	301600	6212926	Exposed Sandstone Scribbly Gum Woodland	1	1	1									
APP078SB5	304916	6208541	Upland Swamps: Tea-Tree Thicket	1											
APP079H	305216	6210181	Upland Swamps: Sedgeland-Heath Complex						1						
APP080O	301997	6209925	Upland Swamps: Sedgeland-Heath Complex						1						
APP081O	300918	6210084	Sandstone Gully Apple-Peppermint Forest						1						
APP082H	305308	6208792	Upland Swamps: Sedgeland-Heath Complex						1						
APP083H	306300	6214805	Exposed Sandstone Scribbly Gum Woodland						1						
APP084W	304027	6213061	Sandstone Gully Apple-Peppermint Forest		1										
APP085W	303300	6213061	Exposed Sandstone Scribbly Gum Woodland		1										

Site number	Easting	Northing	Vegetation community (Keith ref)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Elliott B and cage trapping	Hair tube detection (Faunatech)	Hair tube detection (Handiglaze)	Pitfall trapping
APP086W	300504	6215749	Exposed Sandstone Scribbly Gum Woodland		1										
APP087O	301082	6211035	Sandstone Gully Apple-Peppermint Forest	1	1	1									
APP088O	299873	6212161	Sandstone Gully Apple-Peppermint Forest	1	1	1									
APP089O	300861	6212611	Sandstone Gully Apple-Peppermint Forest	1	1										
APP090O	298741	6216213	Sandstone Riparian Scrub		1										
APP091O	298449	6216930	Western Sandstone Gully Forest	1	1	1									
APP092O	297398	6216778	Western Sandstone Gully Forest	1	1	1									
APP093W	304294	6209777	Silvertop Ash Ironstone Woodland	1	1	1									
APP094H	305166	6208551	Upland Swamps: Tea-Tree Thicket	1											
APP095O	302674	6209218	Exposed Sandstone Scribbly Gum Woodland	1	1	1									
APP096W	303191	6210178	Exposed Sandstone Scribbly Gum Woodland	1	1										
APP097O	303662	6213490	Sandstone Riparian Scrub				1	1							
APP098W	305669	6212464	Exposed Sandstone Scribbly Gum Woodland				1								
APP099W	307872	6209163	Upland Swamps: Sedgeland-Heath Complex				1								
APP100W	300558	6212791	Sandstone Gully Apple-Peppermint Forest			1	1	1		1					
APP101O	300813	6215942	Sandstone Riparian Scrub	1			1								
APP102W	297497	6216886	Upper Georges River Sandstone Woodland				1								
APP103W	299602	6212639	Exposed Sandstone Scribbly Gum Woodland			1	1								
APP104O	299634	6217417	Western Sandstone Gully Forest				1				1	1	1		
APP105W	300131	6210217	Exposed Sandstone Scribbly Gum Woodland				1								
APP106W	308275	6209220	Silvertop Ash Ironstone Woodland		1	1	1				1	1	1	3	2
APP108S	304840	6210245	Upland Swamps: Sedgeland-Heath Complex								1				2
APP109W	308051	6209147	Upland Swamps: Sedgeland-Heath Complex					1							
APP110W	304784	6210282	Cleared					2							
APP111O	299497	6217374	Western Sandstone Gully Forest					1							
APP112O	298629	6217184	Western Sandstone Gully Forest					2		1					

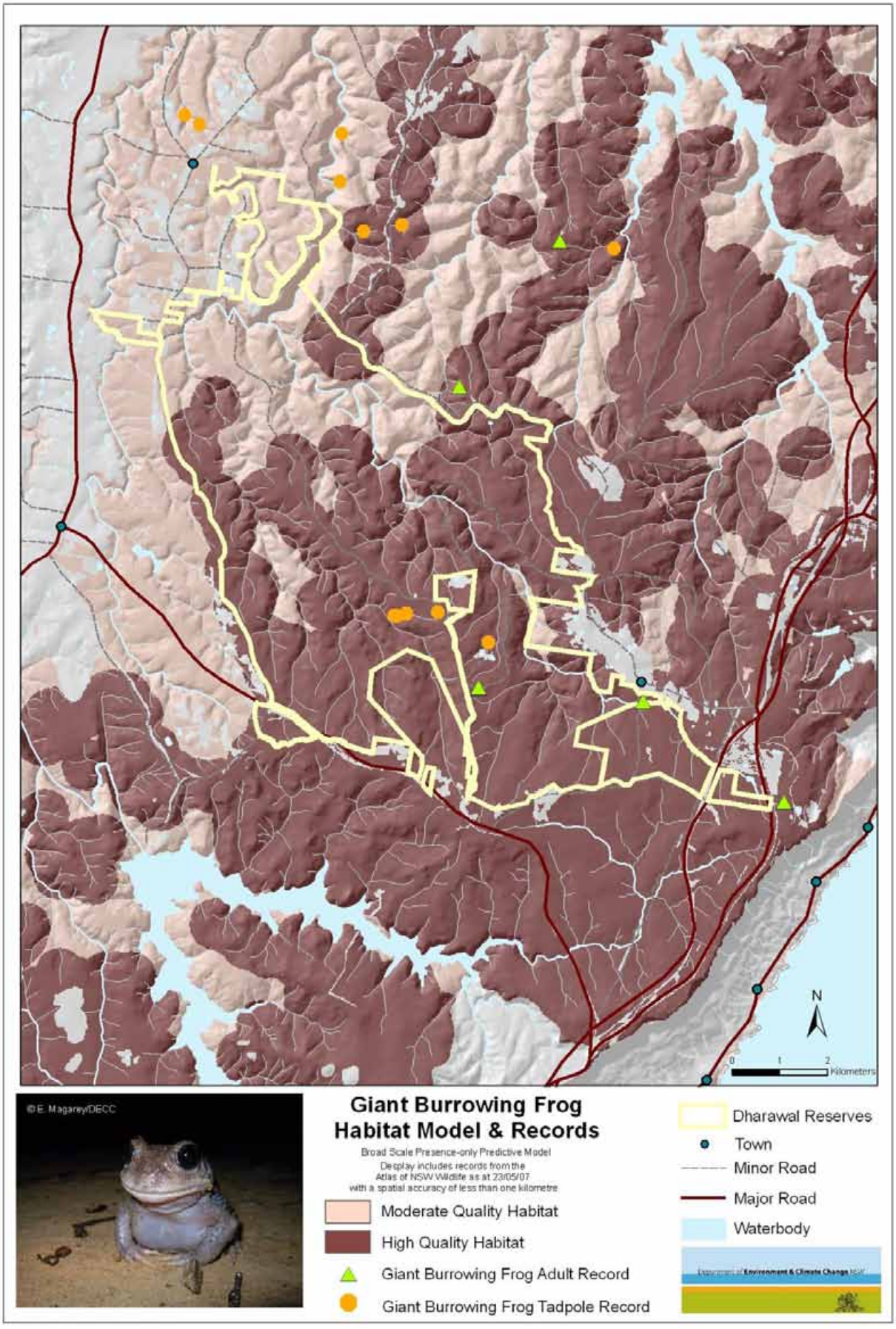
Site number	Easting	Northing	Vegetation community (Keith ref)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Elliott B and cage trapping	Hair tube detection (Faunatech)	Hair tube detection (Handiglaze)	Pitfall trapping
APP113W	305592	6211258	Sandstone Gully Apple-Peppermint Forest	1	1	1				1			0.5	0.5	
APP114H	301731	6215513	Sandstone Riparian Scrub	1											
APP115O	299849	6215168	Sandstone Gully Apple-Peppermint Forest	1											
APP120H	303479	6211684	Dwarf Apple Heath	1	1										
APP121W	298988	6214043	Exposed Sandstone Scribbly Gum Woodland	1											
APP122W	302905	6214304	Sandstone Riparian Scrub												
APP123W	299960	6211080	Exposed Sandstone Scribbly Gum Woodland	1	1	1		1			1	1			
APP124W	302254	6215786	Sandstone Gully Apple-Peppermint Forest		1										
APP125W	304692	6210230	Exposed Sandstone Scribbly Gum Woodland			1					1	1			
APP126W	301426	6218502	Riparian Scrub		1										
APP127H	301553	6219599	Riparian Scrub		1										
APP128W	300545	6216970	Sandstone Riparian Scrub	1		1		1	1	1					
APP131O	296850	6216121	Upper Georges River Sandstone Woodland			1									
APP132O	296684	6217290	Western Sandstone Gully Forest							1			1		
APP133W	301305	6218969	Western Sandstone Gully Forest							1					
APP134W	307600	6209260	Sandstone Riparian Scrub							1					
BLL001OB1	306100	6207250	O'Hares Creek Shale Forest	1											
BLL002HB1	307100	6207300	Upland Swamps: Fringing Eucalypt Woodland			1									
BLL029WB1	305000	6207000	Exposed Sandstone Scribbly Gum Woodland			1									
BLL050SB2	309336	6207216	Upland Swamps: Sedgeland-Heath Complex	1											
BLL056WMB2	307565	6207394	Silvertop Ash Ironstone Woodland			1									
BLL067OB3	308285	6207855	O'Hares Creek Shale Forest	1	1	1									
BLL085SB4	309397	6207836	Upland Swamps: Sedgeland-Heath Complex	1											
BLL086SB4	306656	6208038	Upland Swamps: Sedgeland-Heath Complex	1											
BLL109SB5	308914	6207512	Upland Swamps: Sedgeland-Heath Complex	1											
BLL110SB5	306713	6207525	Upland Swamps: Tea-Tree Thicket	1											

Site number	Easting	Northing	Vegetation community (Keith ref)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Elliott B and cage trapping	Hair tube detection (Faunatech)	Hair tube detection (Handiglaze)	Pitfall trapping
BLL115SB5	307824	6207858	Upland Swamps: Sedgeland-Heath Complex	1											
BLL131S	310549	6207447	Upland Swamps: Sedgeland-Heath Complex	1	1	1									
BLL132W	307823	6208138	Silvertop Ash Ironstone Woodland	1		1									
BLL133W	306258	6207415	Cleared				1								
BLL134H	308701	6207590	Upland Swamps: Sedgeland-Heath Complex							1	1				2
BLL135S	308805	6207679	Upland Swamps: Sedgeland-Heath Complex		1						1				2
BLL136O	306232	6207313	O'Hares Creek Shale Forest			2					1				2
BLL137S	310576	6207181	Upland Swamps: Tea-Tree Thicket					1		1	1				
BLL138S	310117	6206593	Upland Swamps: Sedgeland-Heath Complex	1	1	1									
BLL139W	309557	6206900	Exposed Sandstone Scribbly Gum Woodland	1		1		1							
BLL140O	309915	6205580	Silvertop Ash Ironstone Woodland	1		1		1							
BLL141O	308293	6207614	Silvertop Ash Ironstone Woodland				1								
BLL142H	306379	6207556	Upland Swamps: Sedgeland-Heath Complex		1	1					1				2
BLL143G	309628	6207248	Upland Swamps: Sedgeland-Heath Complex							1					
S-F-DHA-001	303800	6213450	Sandstone Gully Apple-Peppermint Forest	1				1							
S-F-DHA-002	306000	6210900	O'Hares Creek Shale Forest					1	1						
S-F-DHA-003	304900	6210250	Upland Swamps: Sedgeland-Heath Complex	1			1	2	1						
S-F-DHA-004	300800	6216100	Western Sandstone Gully Forest	1	2						1				
S-F-DHA-005	308810	6207570	Upland Swamps: Sedgeland-Heath Complex	1											
S-F-DHA-006	306790	6207330	Upland Swamps: Fringing Eucalypt Woodland												
S-F-DHA-007	308830	6209040	Silvertop Ash Ironstone Woodland	1											
S-F-DHA-008	303400	6215000	Exposed Sandstone Scribbly Gum Woodland							1					
S-F-DHA-009	305000	6210100	Cleared						1						
S-F-DHA-010	303800	6213500	Sandstone Riparian Scrub								1				
S-F-DHA-011	303800	6213500	Sandstone Riparian Scrub								1				
S-F-DHA-012	302200	6214000	Upland Swamps: Sedgeland-Heath Complex	1											

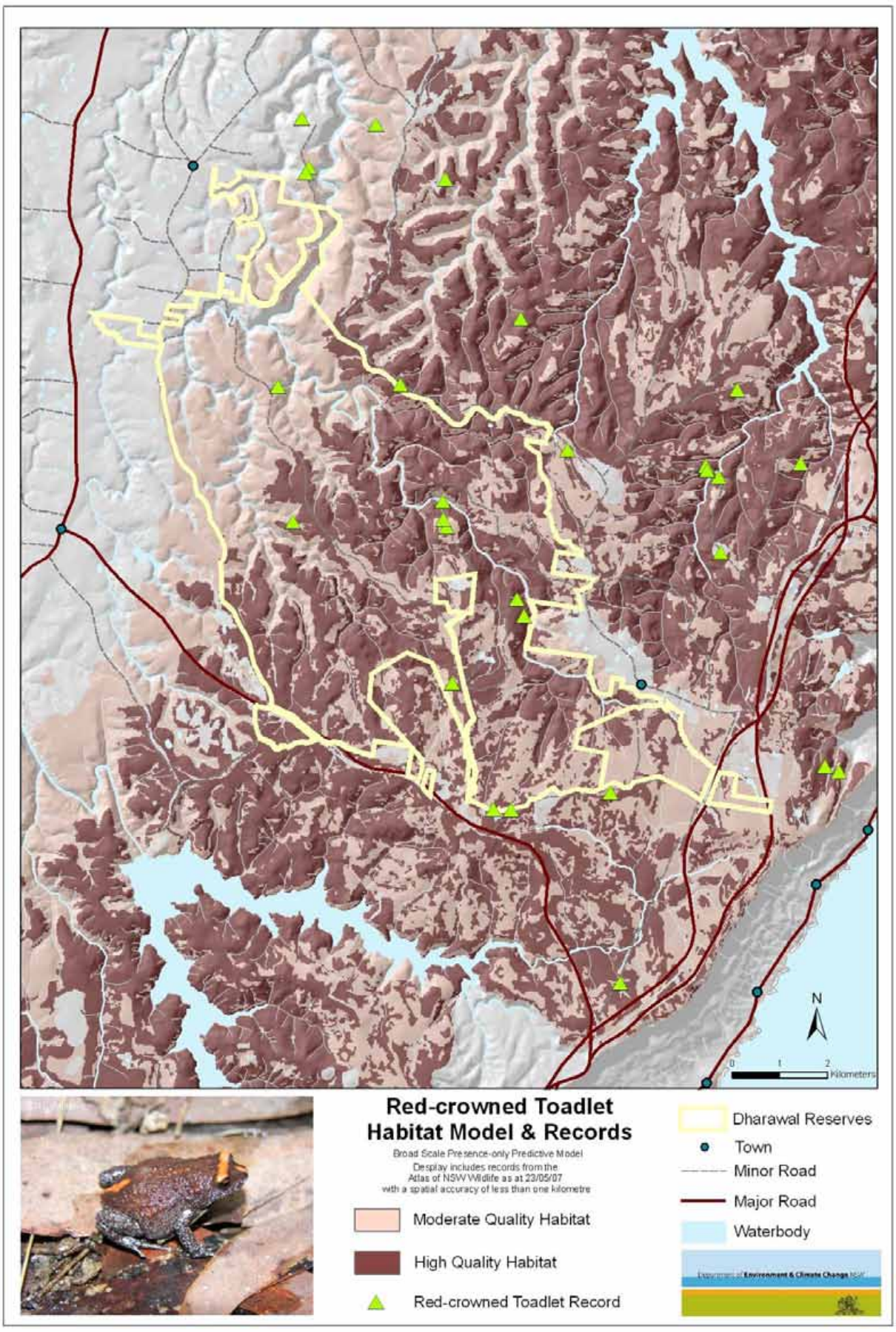
Site number	Easting	Northing	Vegetation community (Keith ref)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Elliott B and cage trapping	Hair tube detection (Faunatech)	Hair tube detection (Handiglaze)	Pitfall trapping
S-F-GRC-01-087	297720	6213980	Upper Georges River Sandstone Woodland	1											
S-F-GRC-01-088	297690	6214975	Upper Georges River Sandstone Woodland	1											
S-F-GRC-01-089	297750	6216000	Upper Georges River Sandstone Woodland	1											
S-F-GRC-03-009	300710	6219563	Sandstone Ridgetop Woodland		1										
S-F-GRC-03-024	300330	6219910	Western Sandstone Gully Forest		1		1								
S-F-GRC-03-077	300500	6217400	Western Sandstone Gully Forest												
S-F-GRC-03-094	299943	6217897	Sandstone Ridgetop Woodland		1										
S-F-GRC-03-119	300100	6217500	Cleared					1							
S-F-GRC-03-120	300500	6217450	Western Sandstone Gully Forest					1							
S-F-GRC-03-123	300700	6217400	Riparian Scrub					1							
S-F-GRC-05-016	303220	6211020	Upland Swamps: Tea-Tree Thicket		1										
S-F-GRC-05-018	303750	6209640	Upland Swamps: Sedgeland-Heath Complex						1	1			0.5	0.5	
S-F-GRC-05-019	304900	6210100	Cleared						1						
S-F-GRC-06-025	308150	6209200	Silvertop Ash Ironstone Woodland		1										
T-F-GRC-02-032	296890	6216114	Western Sandstone Gully Forest	1											
T-F-GRC-02-047	300205	6217585	Cleared	1											
T-F-GRC-02-048	300870	6218374	Sandstone Ridgetop Woodland	1											
T-F-GRC-02-049	301270	6219738	Sandstone Ridgetop Woodland	1											
T-F-GRC-02-050	300500	6217400	Western Sandstone Gully Forest	1											
T-F-GRC-02-051	304529	6208021	Silvertop Ash Ironstone Woodland	1											
T-F-GRC-02-052	304029	6212923	Woronora Tall Mallee-Heath	1											
T-F-GRC-02-053	303438	6211371	Sandstone Heath-Woodland	1											
T-F-GRC-02-054	302048	6212278	Sandstone Heath-Woodland	1											
T-F-GRC-02-055	300109	6213800	Exposed Sandstone Scribbly Gum Woodland	1											
T-F-GRC-02-056	300509	6215920	Sandstone Gully Apple-Peppermint Forest	1											
T-F-GRC-02-057	299470	6217370	Western Sandstone Gully Forest	1											

Site number	Easting	Northing	Vegetation community (Keith ref)	Diurnal bird survey	Diurnal herpetofauna search	Nocturnal site spotlighting survey	Harp trapping	Bat ultrasonic call recording	Nocturnal streamside search	Nocturnal call playback	Elliott A trapping	Elliott B and cage trapping	Hair tube detection (Faunatech)	Hair tube detection (Handiglaze)	Pitfall trapping
WOL-011	308150	6209150	Silvertop Ash Ironstone Woodland			1			2						
WOL-012	307900	6207600	Upland Swamps: Fringing Eucalypt Woodland			1									
WOL-013	307100	6207300	Upland Swamps: Fringing Eucalypt Woodland			1									
WOL-014	305000	6207000	Exposed Sandstone Scribbly Gum Woodland			1									
WOL-020	308950	6207500	Upland Swamps: Sedgeland-Heath Complex							1					
WOL-021	306100	6207250	O'Hares Creek Shale Forest	1						1					
Total				65	38	39	14	20	13	14	13	4	4	4	12

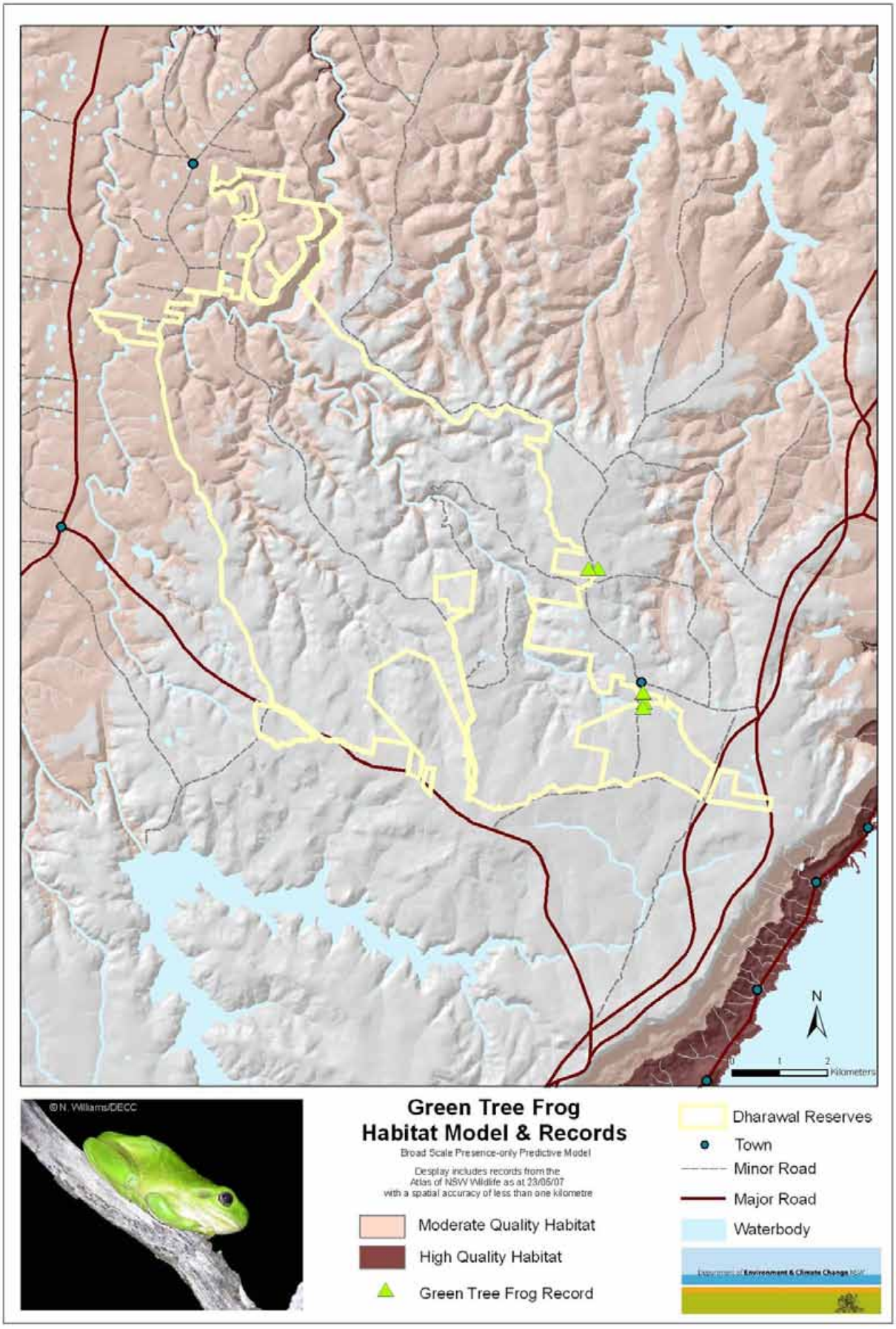
APPENDIX B: HABITAT MODELS AND SIGHTING RECORDS FOR MODERATE AND HIGH PRIORITY SPECIES AND PEST SPECIES



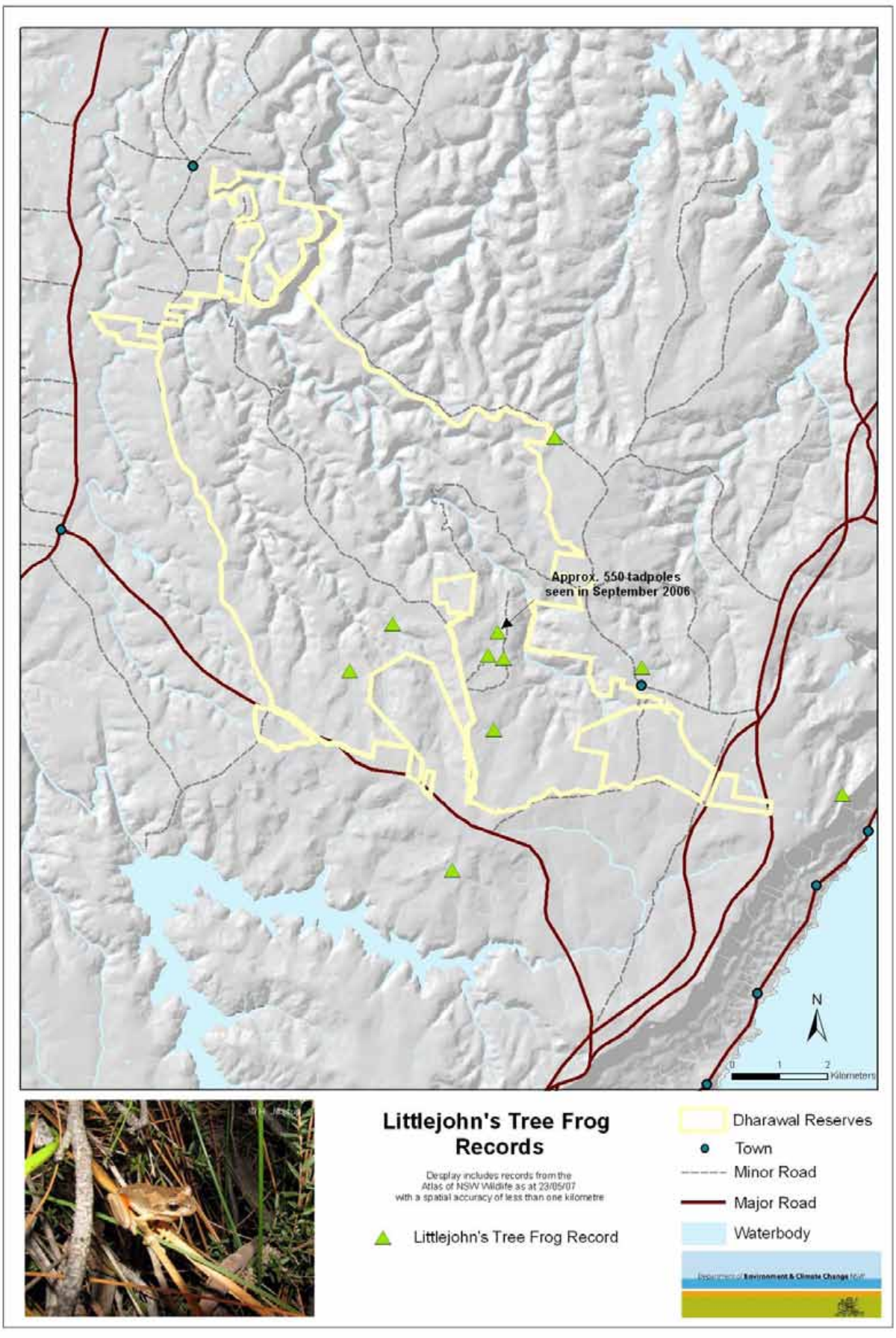
Map 4: Habitat model and records of Giant Burrowing Frog in Dharawal SCA and NR and adjacent lands



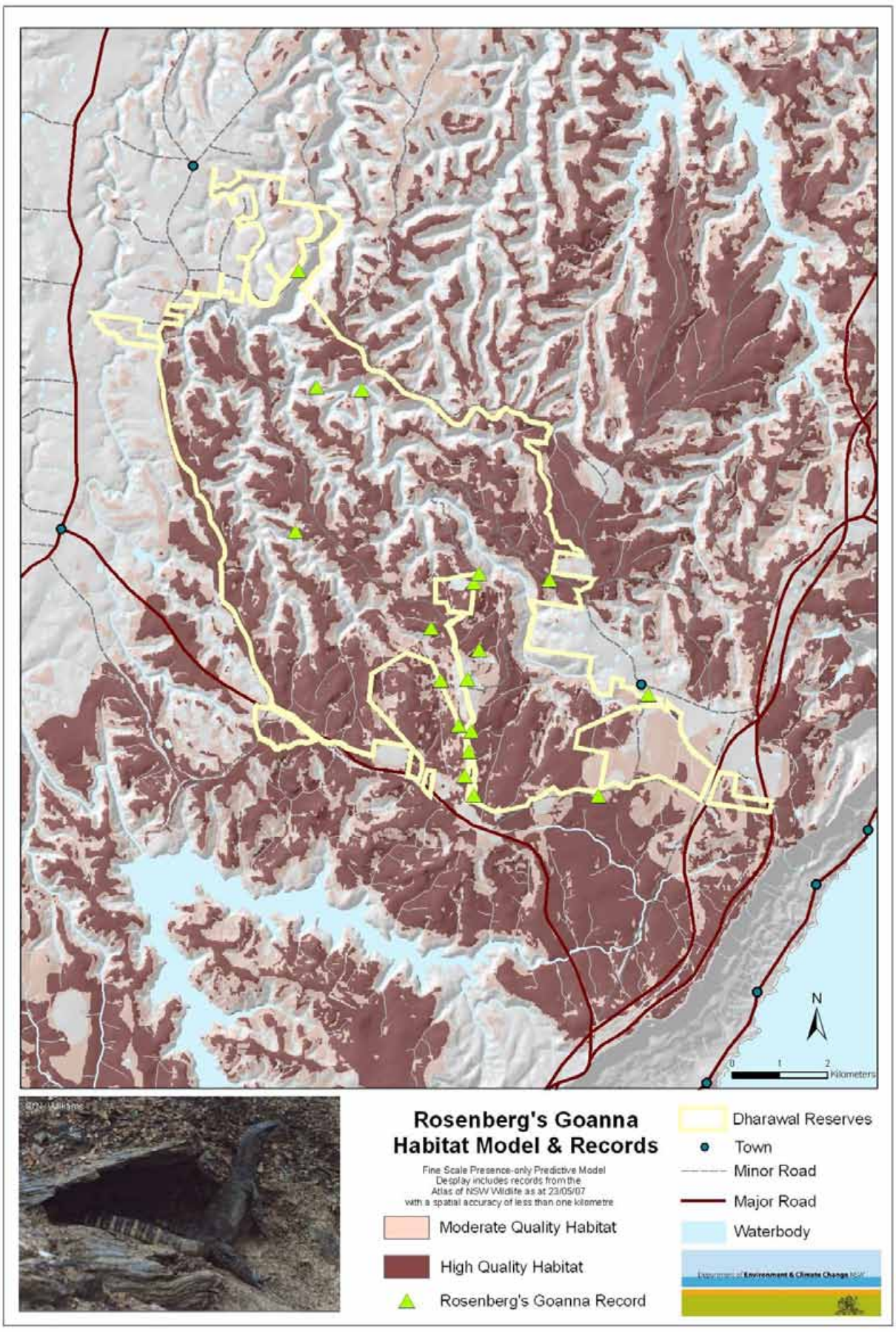
Map 5: Habitat model and records of Red-crowned Toadlet in Dharawal SCA and NR and adjacent lands



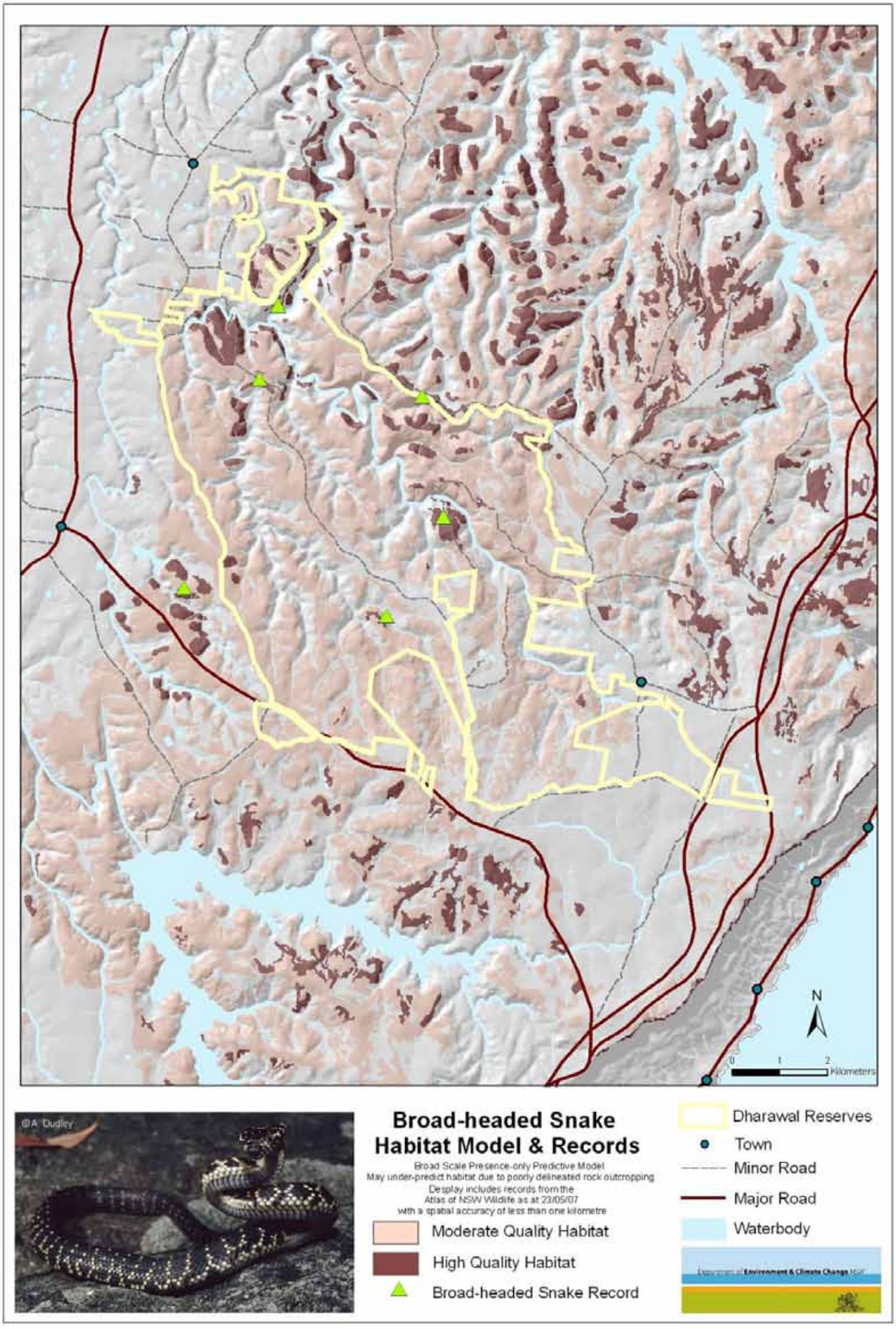
Map 6: Habitat model and records of Green Tree Frog in Dharawal SCA and NR and adjacent lands



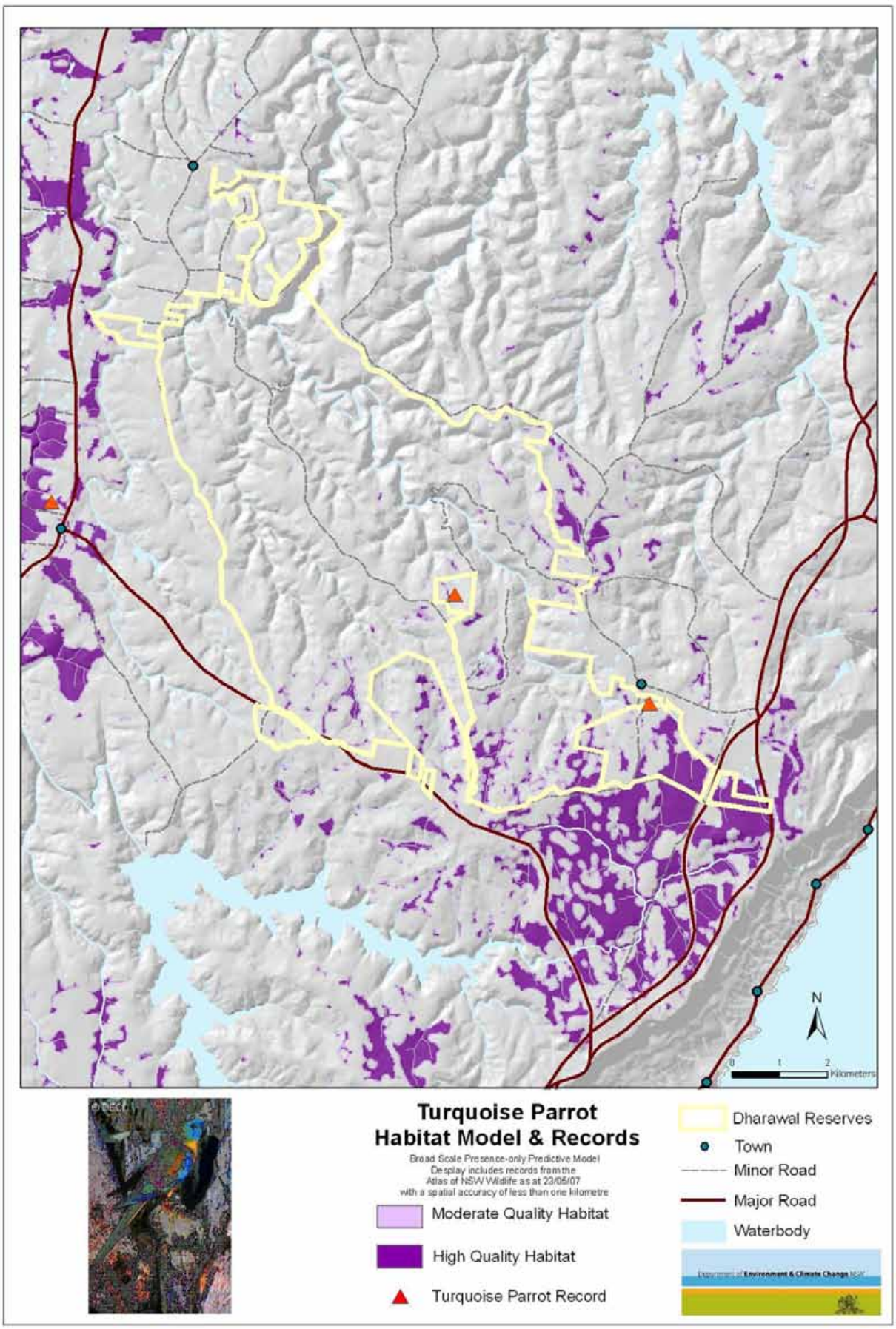
Map 7: Records of Littlejohn's Tree Frog in Dharawal SCA and NR and adjacent lands



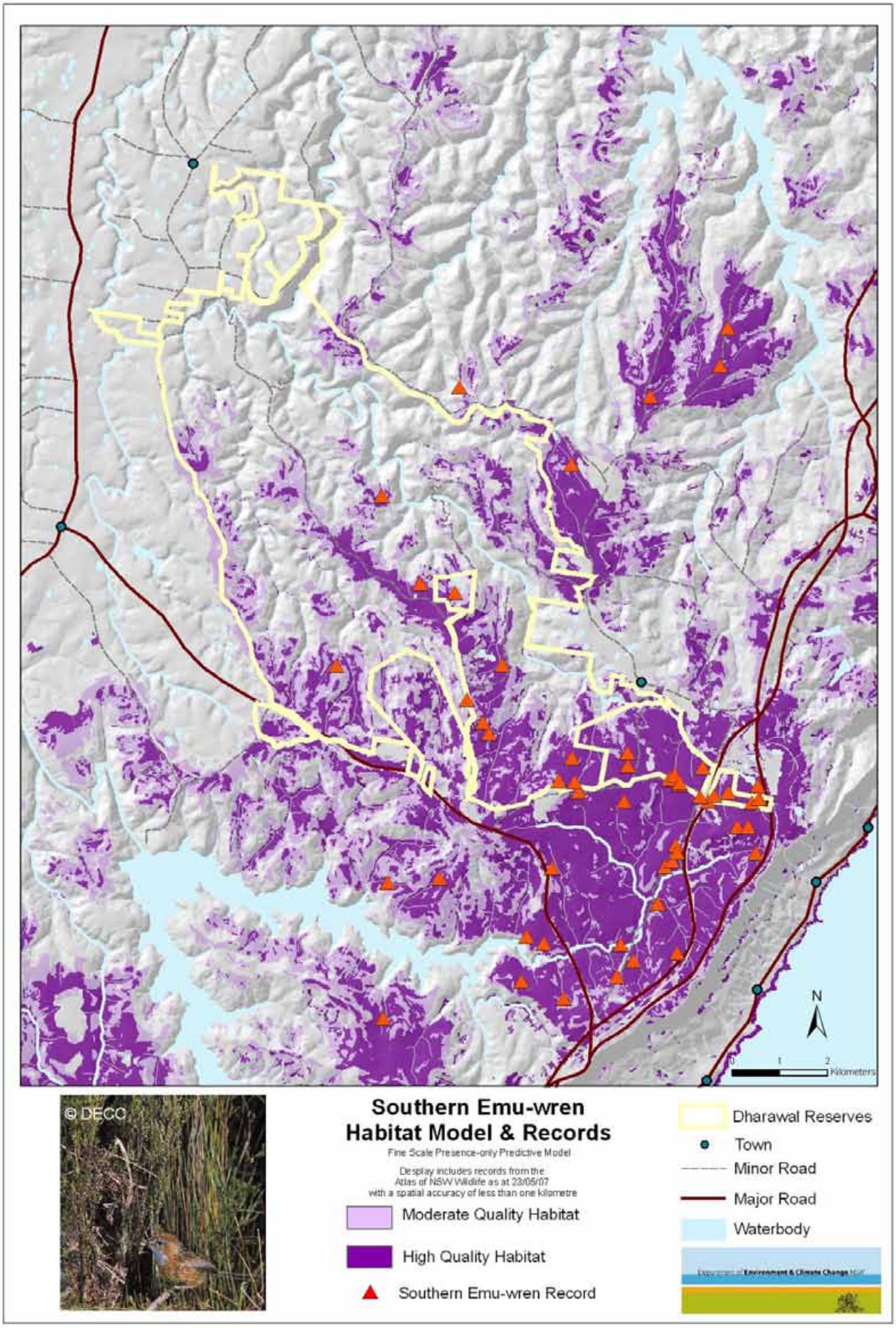
Map 8: Habitat model and records of Rosenberg's Goanna in Dharawal SCA and NR and adjacent lands



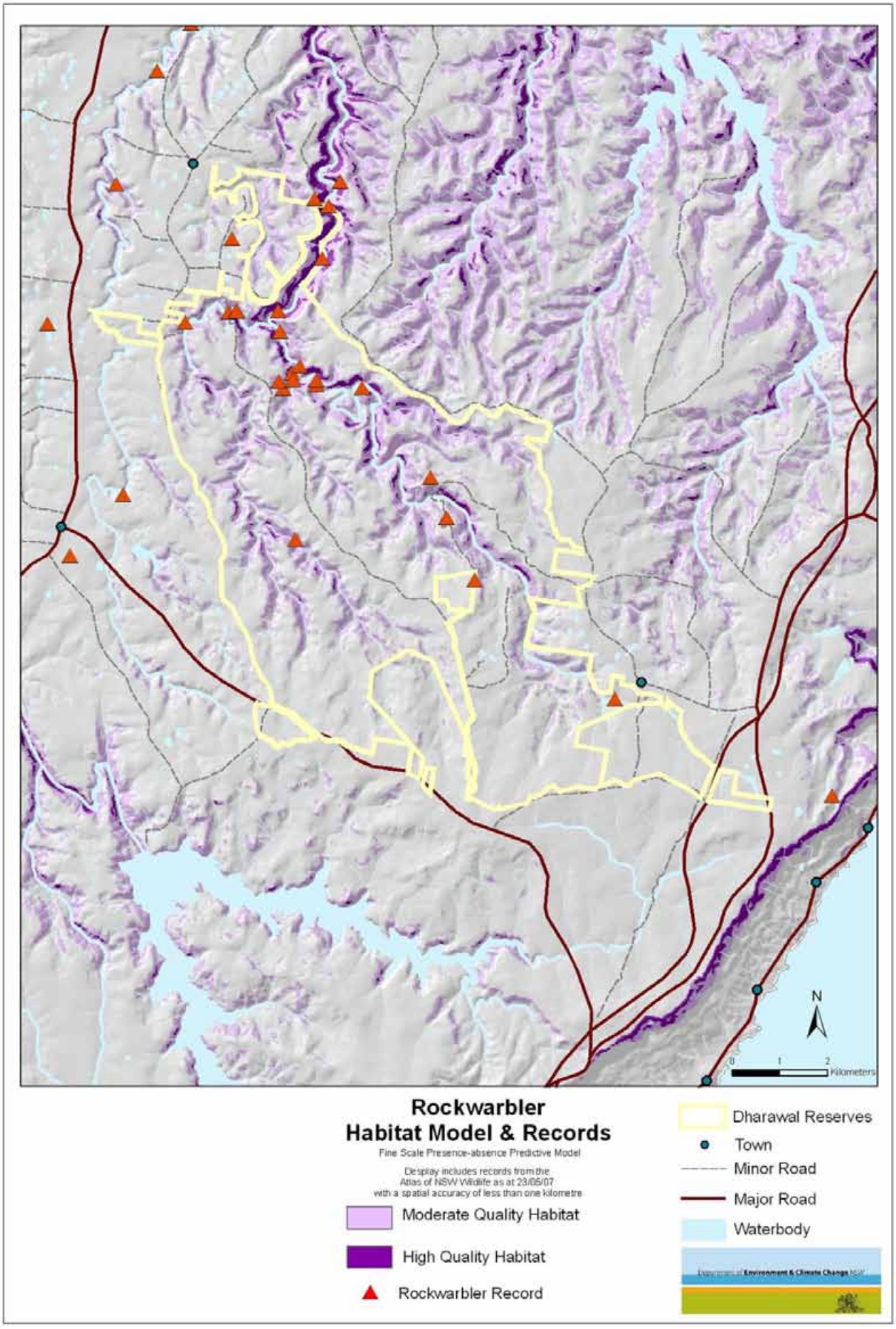
Map 9: Habitat model and records of Broad-headed Snake in Dharawal SCA and NR and adjacent lands



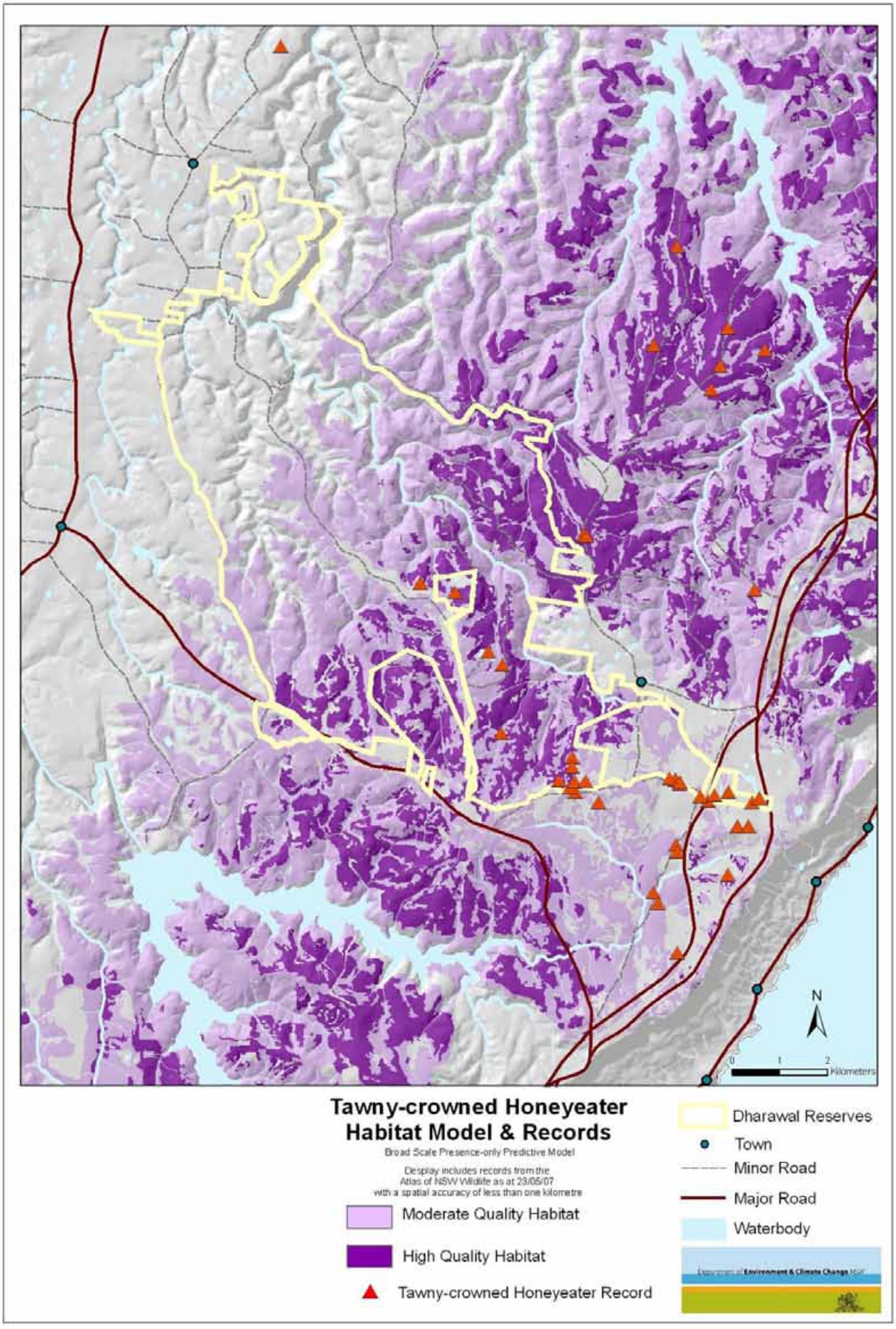
Map 10: Habitat model and records of Turquoise Parrot in Dharawal SCA and NR and adjacent lands



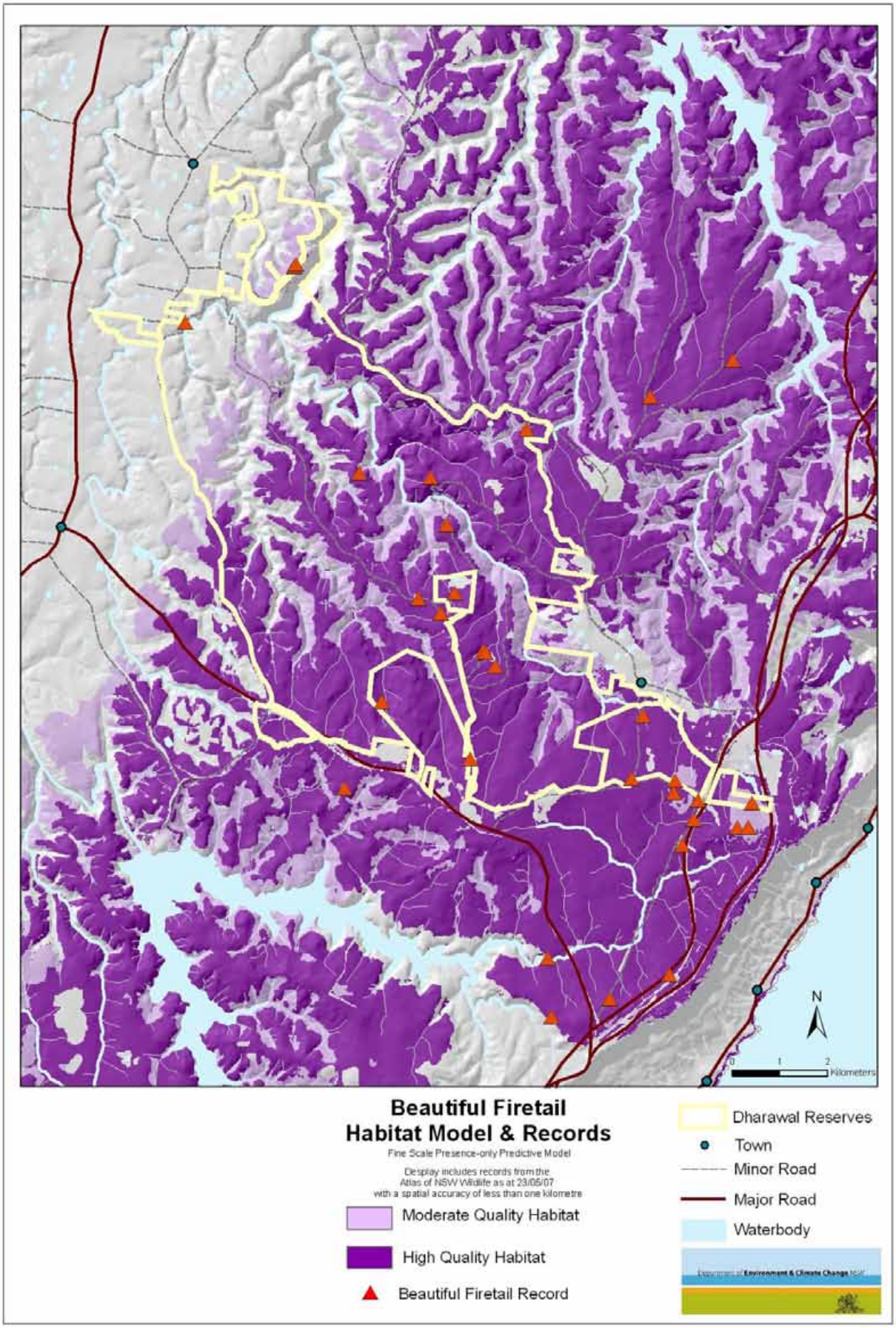
Map 11: Habitat model and records of Southern Emu-wren in Dharawal SCA and NR and adjacent lands



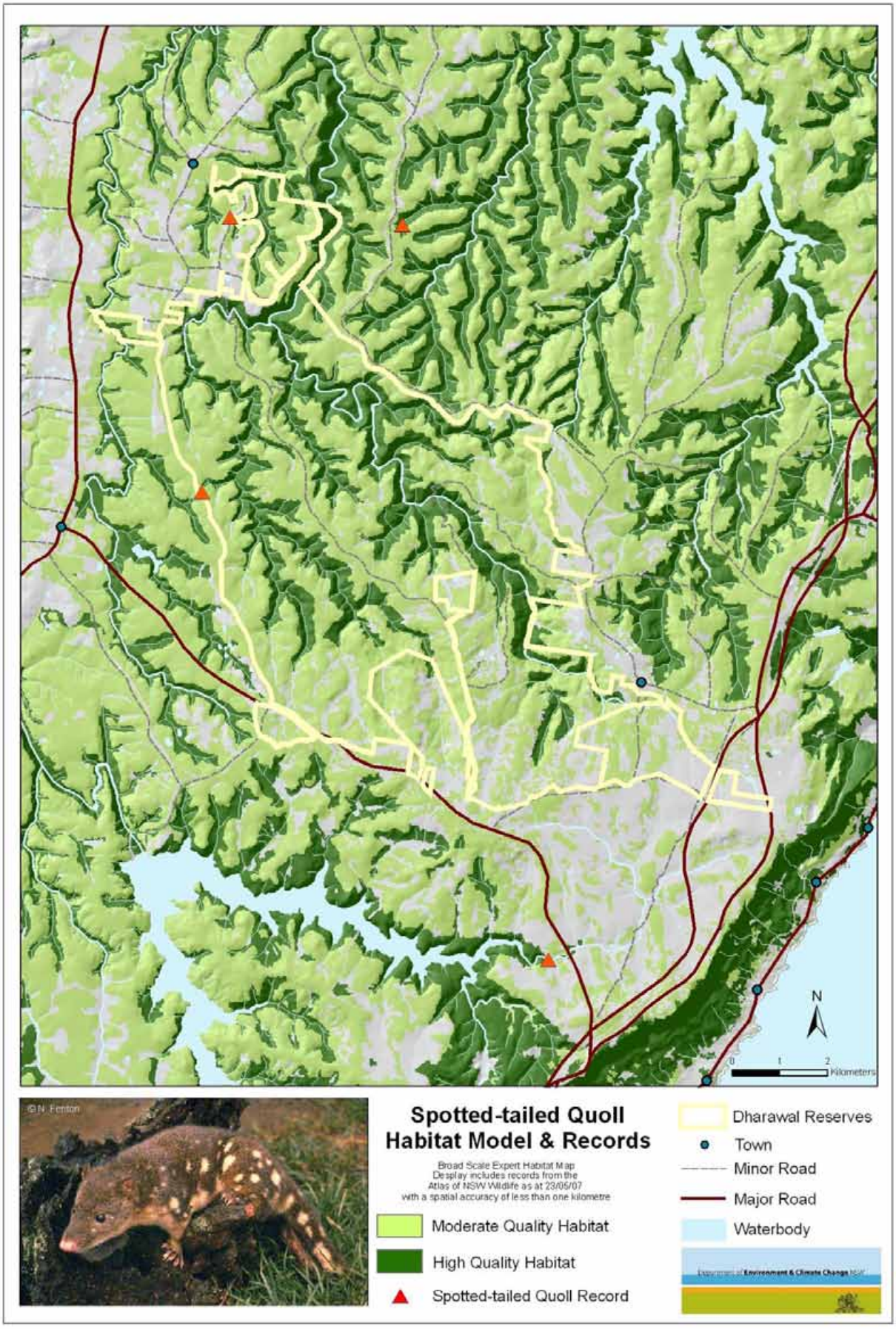
Map 12: Habitat model and records of Rockwarbler in Dharawal SCA and NR and adjacent lands



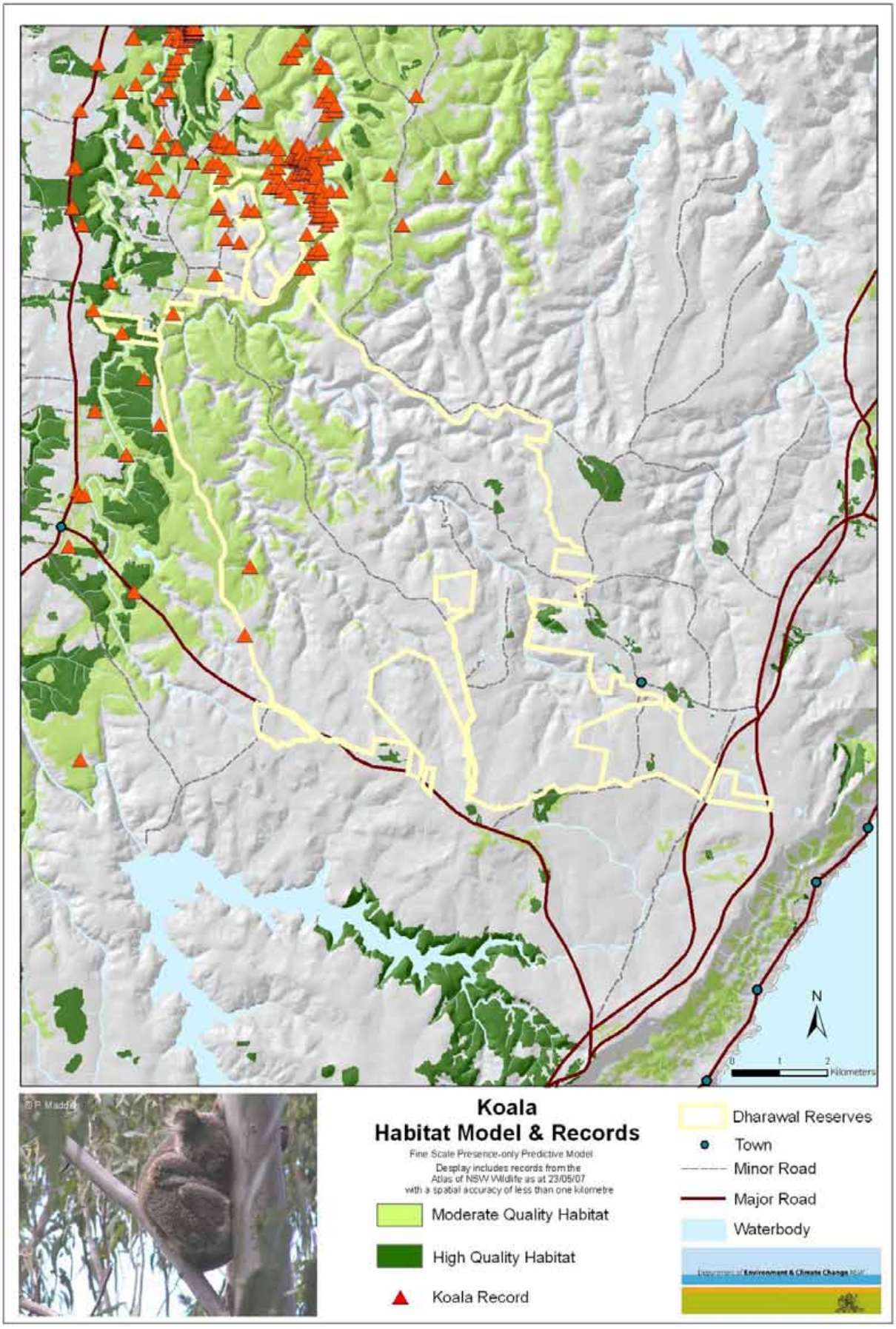
Map 13: Habitat model and records of Tawny-crowned Honeyeater in Dharawal SCA and NR and adjacent lands



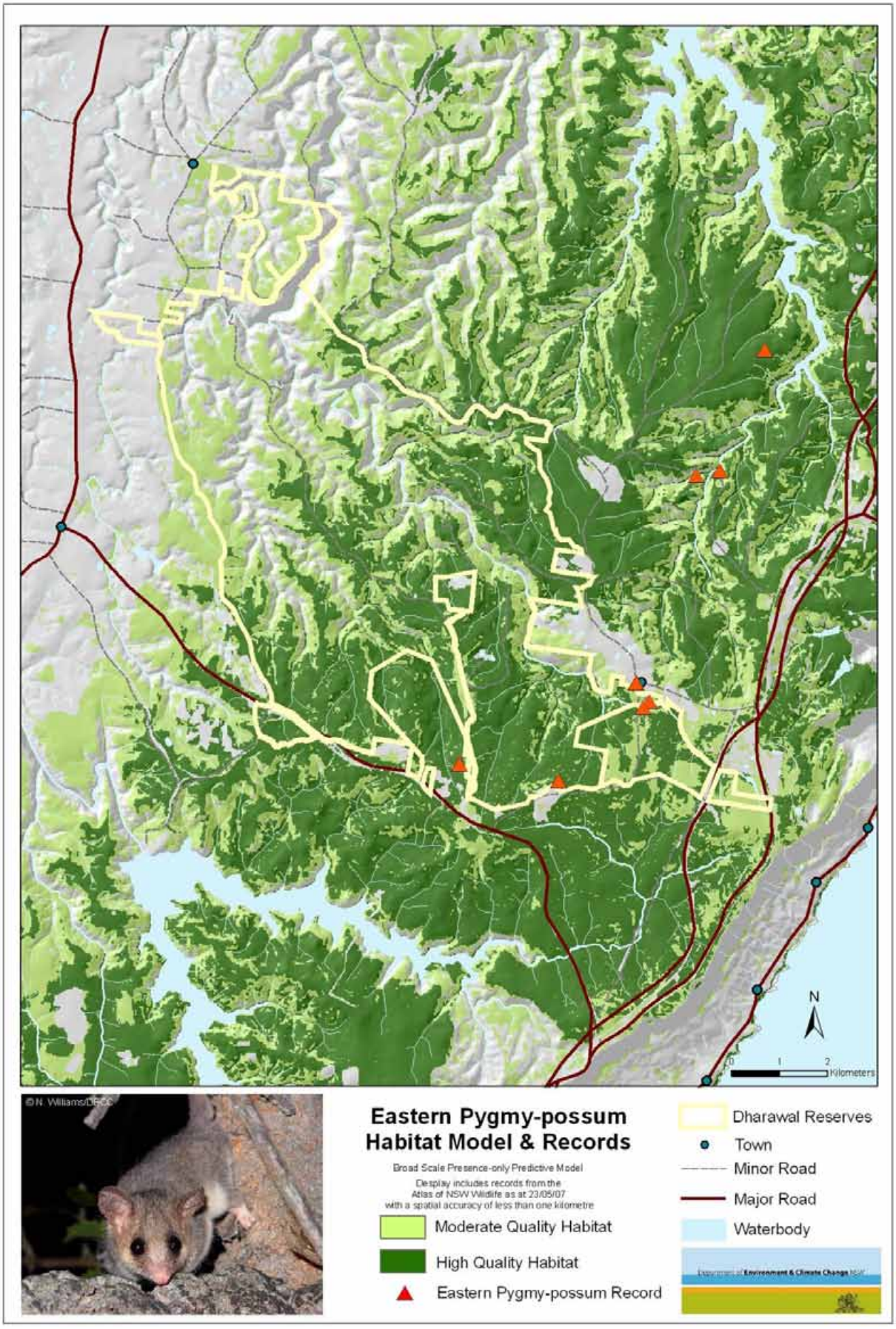
Map 14: Habitat model and records of Beautiful Firetail in Dharawal SCA and NR and adjacent lands



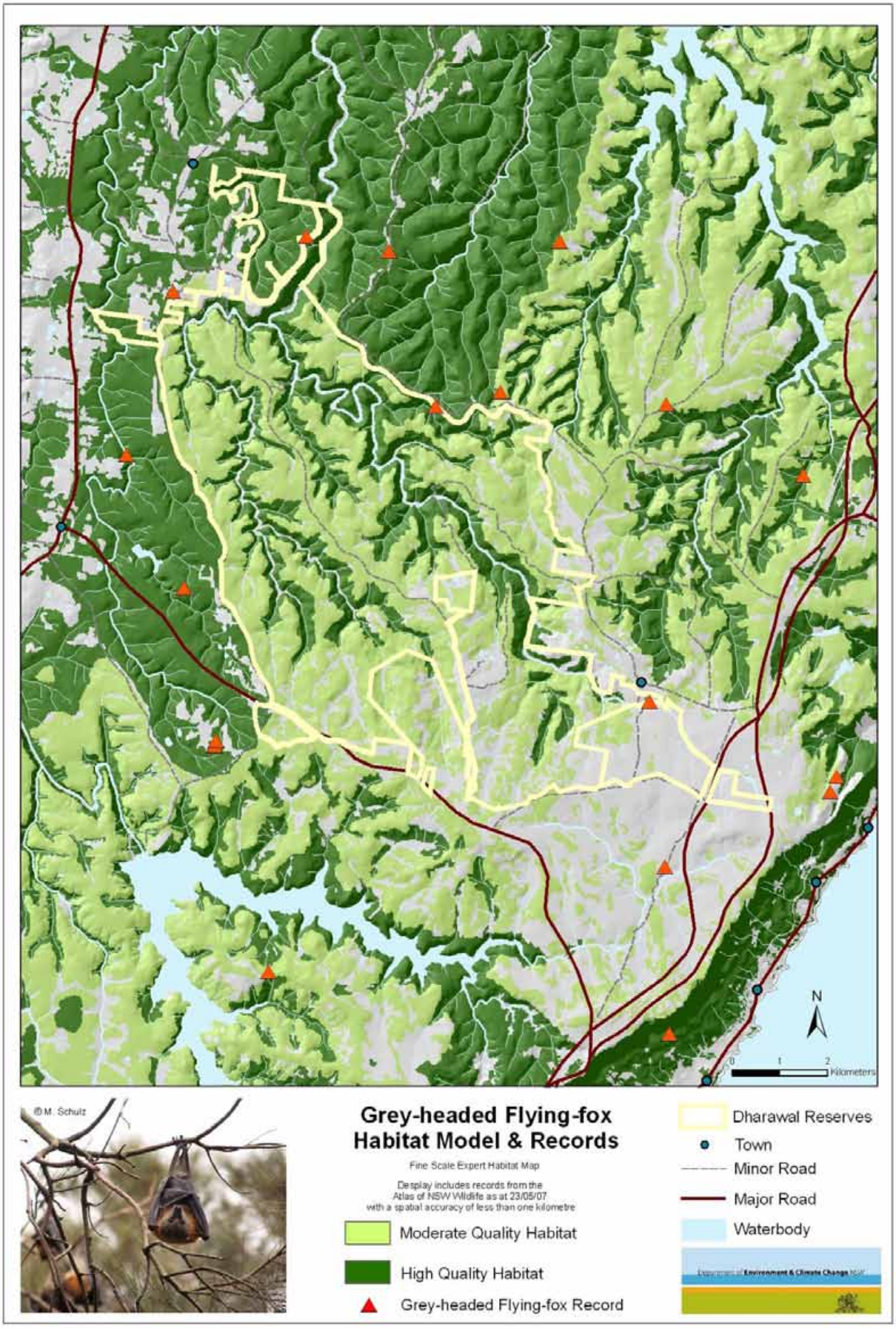
Map 15: Habitat model and records of Spotted-tailed Quoll in Dharawal SCA and NR and adjacent lands



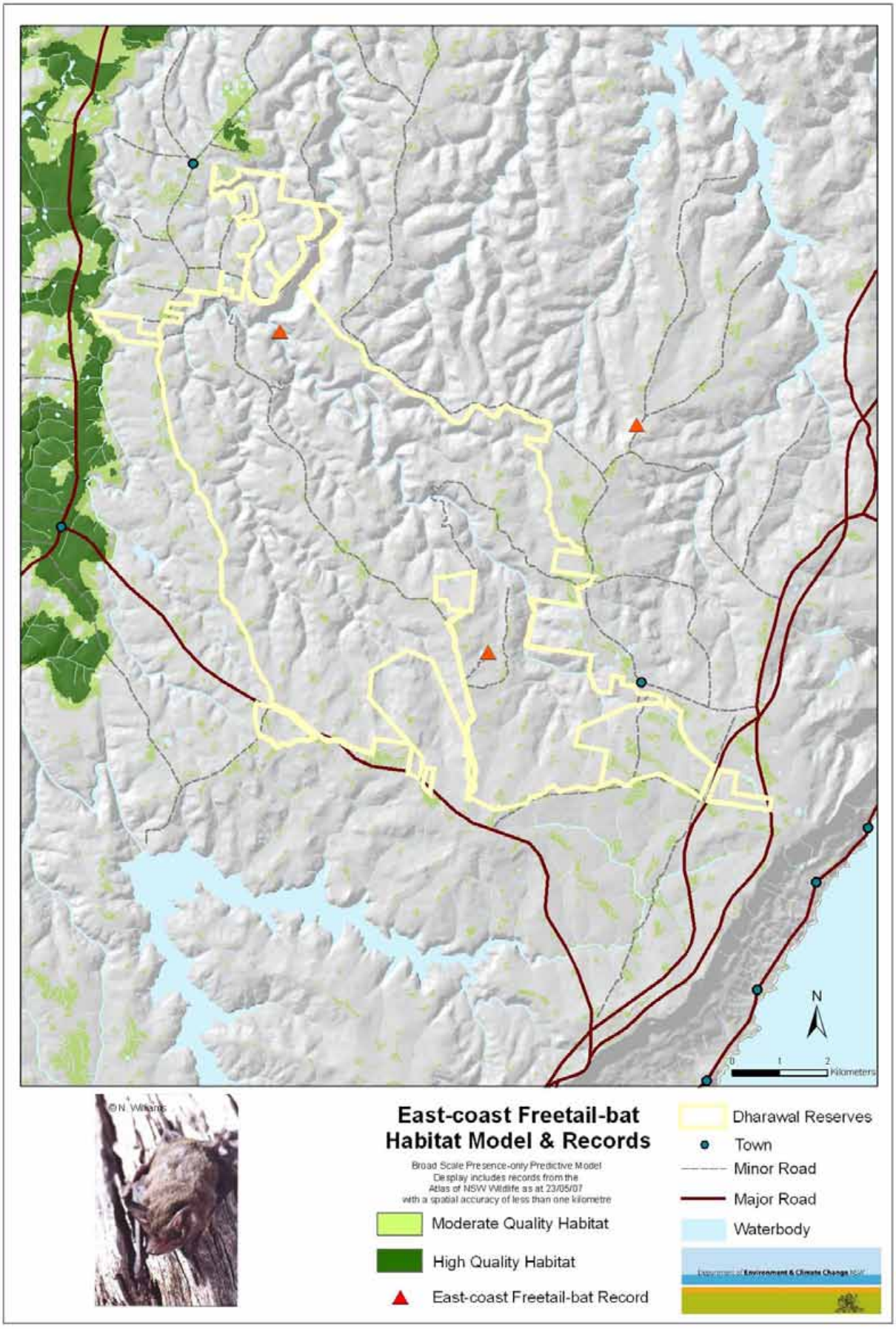
Map 16: Habitat model and records of Koala in Dharawal SCA and NR and adjacent lands



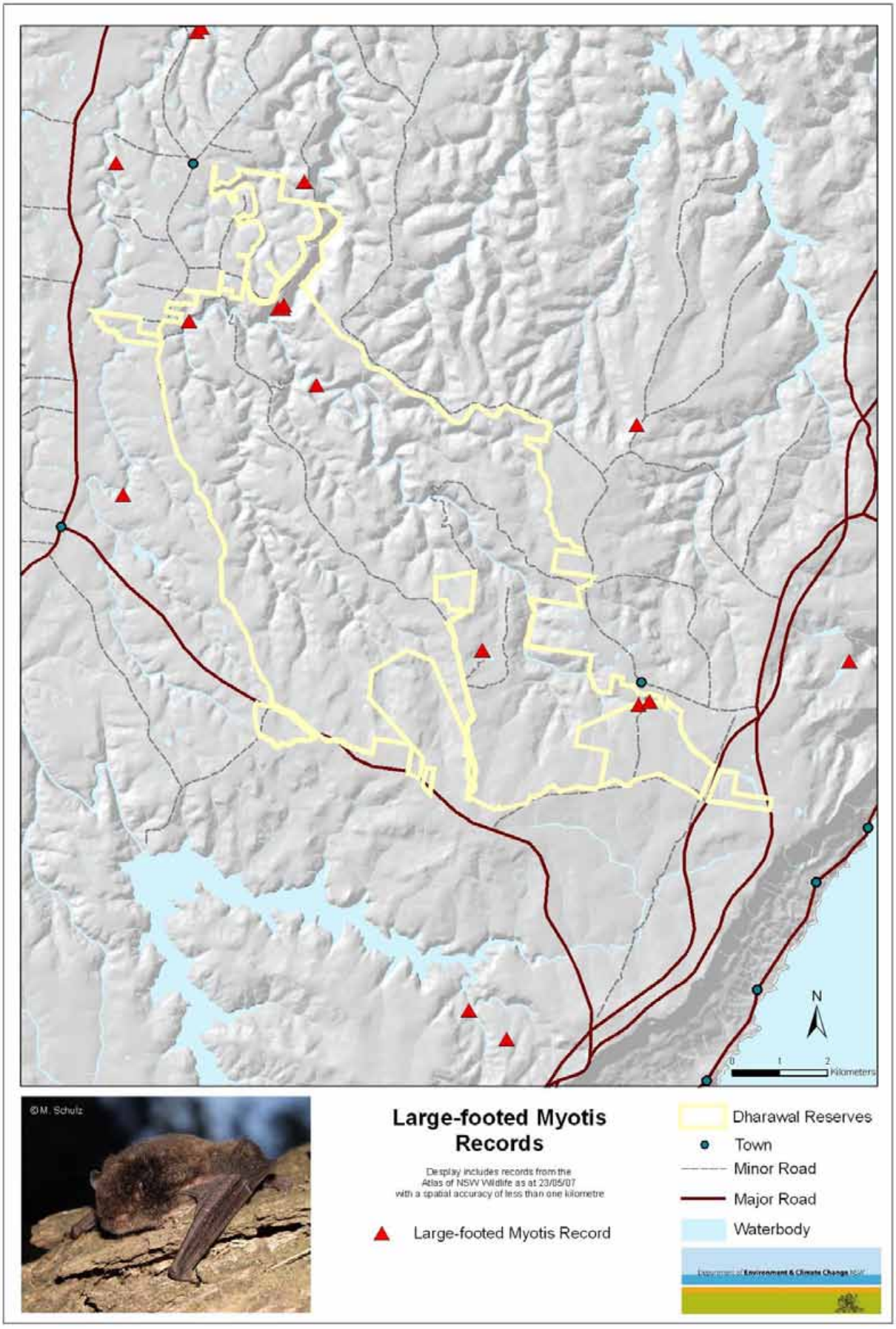
Map 17: Habitat model and records of Eastern Pygmy-possum in Dharawal SCA and NR and adjacent lands



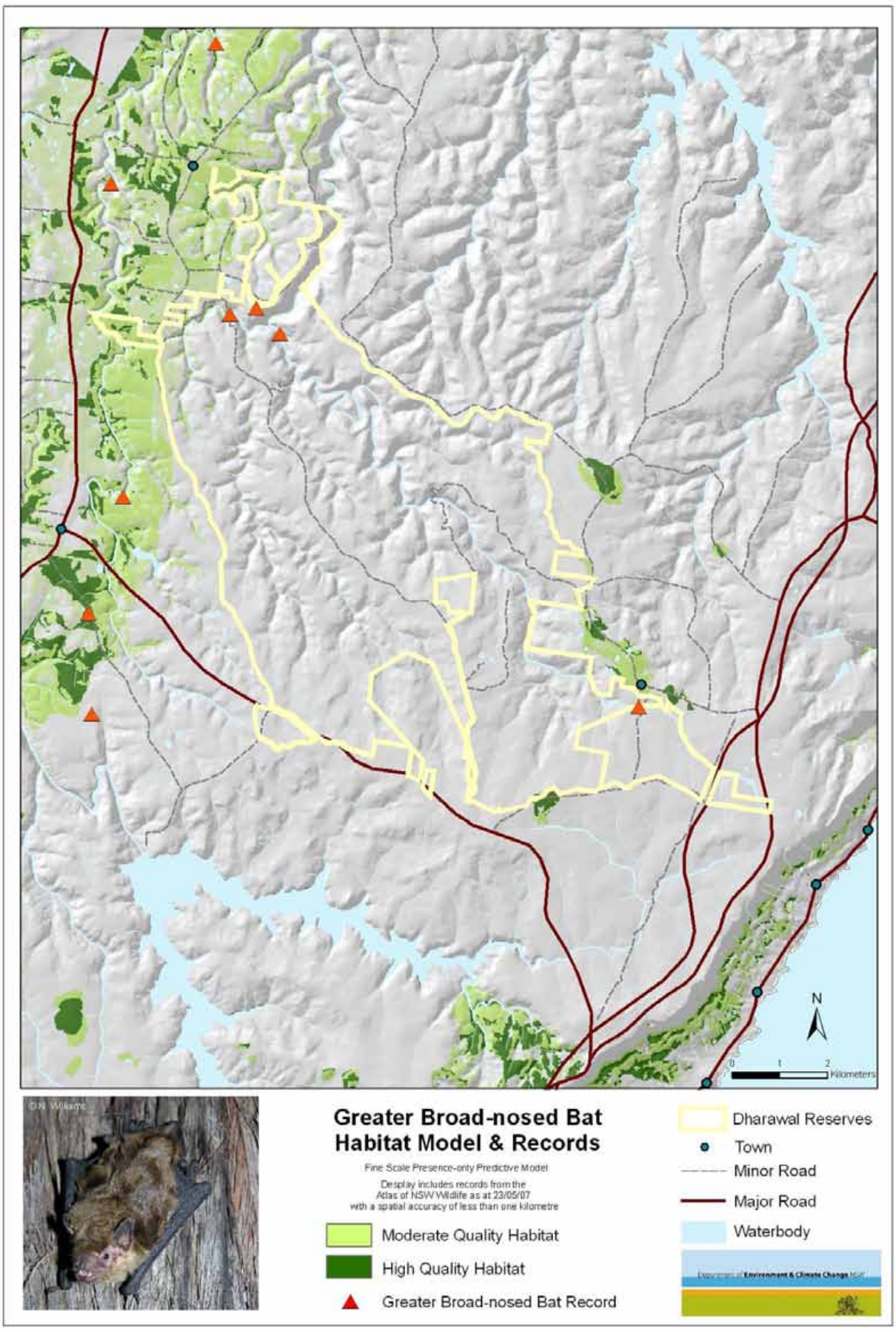
Map 18: Habitat model and records of Grey-headed Flying-fox in Dharawal SCA and NR and adjacent lands



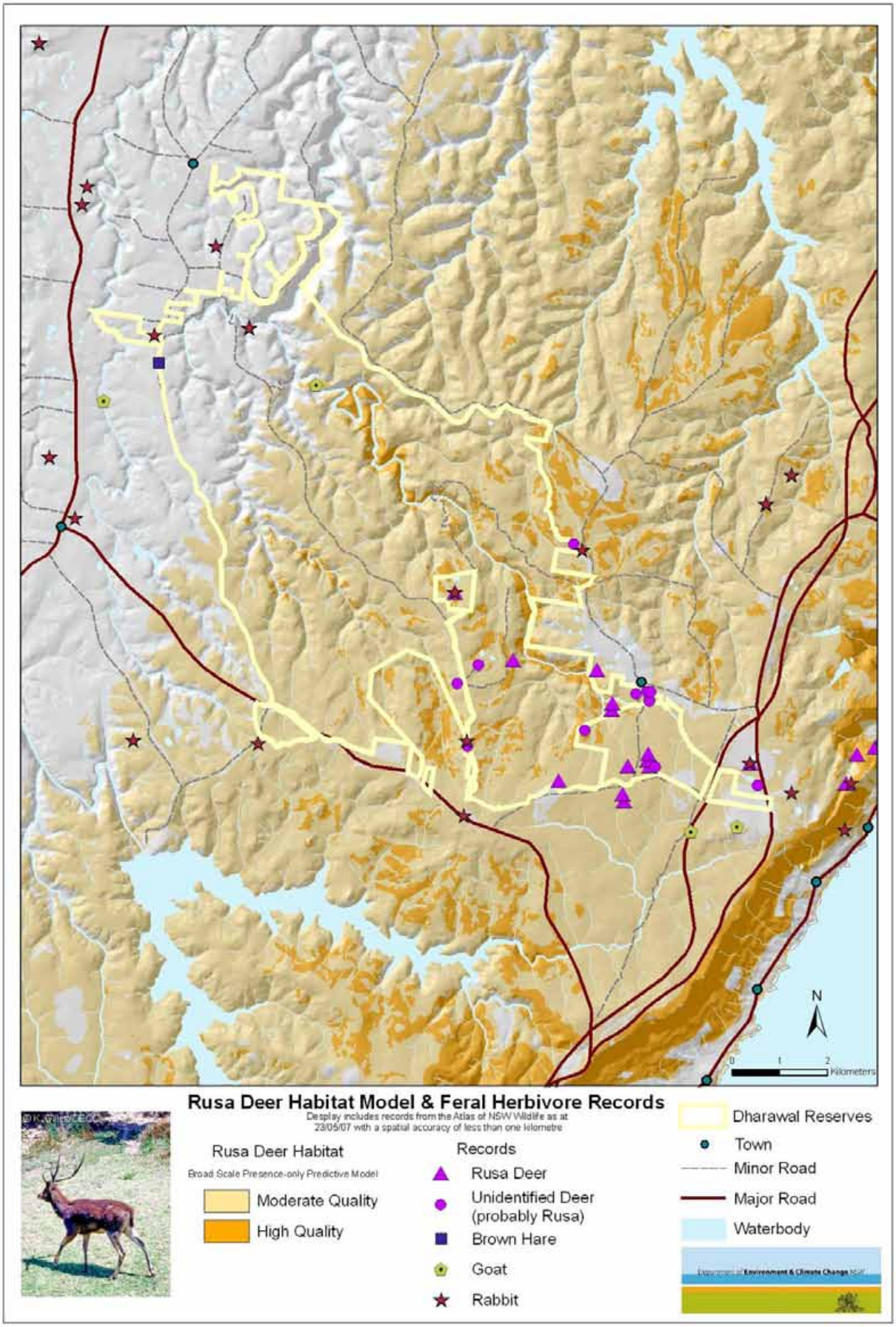
Map 19: Habitat model and records of East-coast Freetail-bat in Dharawal SCA and NR and adjacent lands



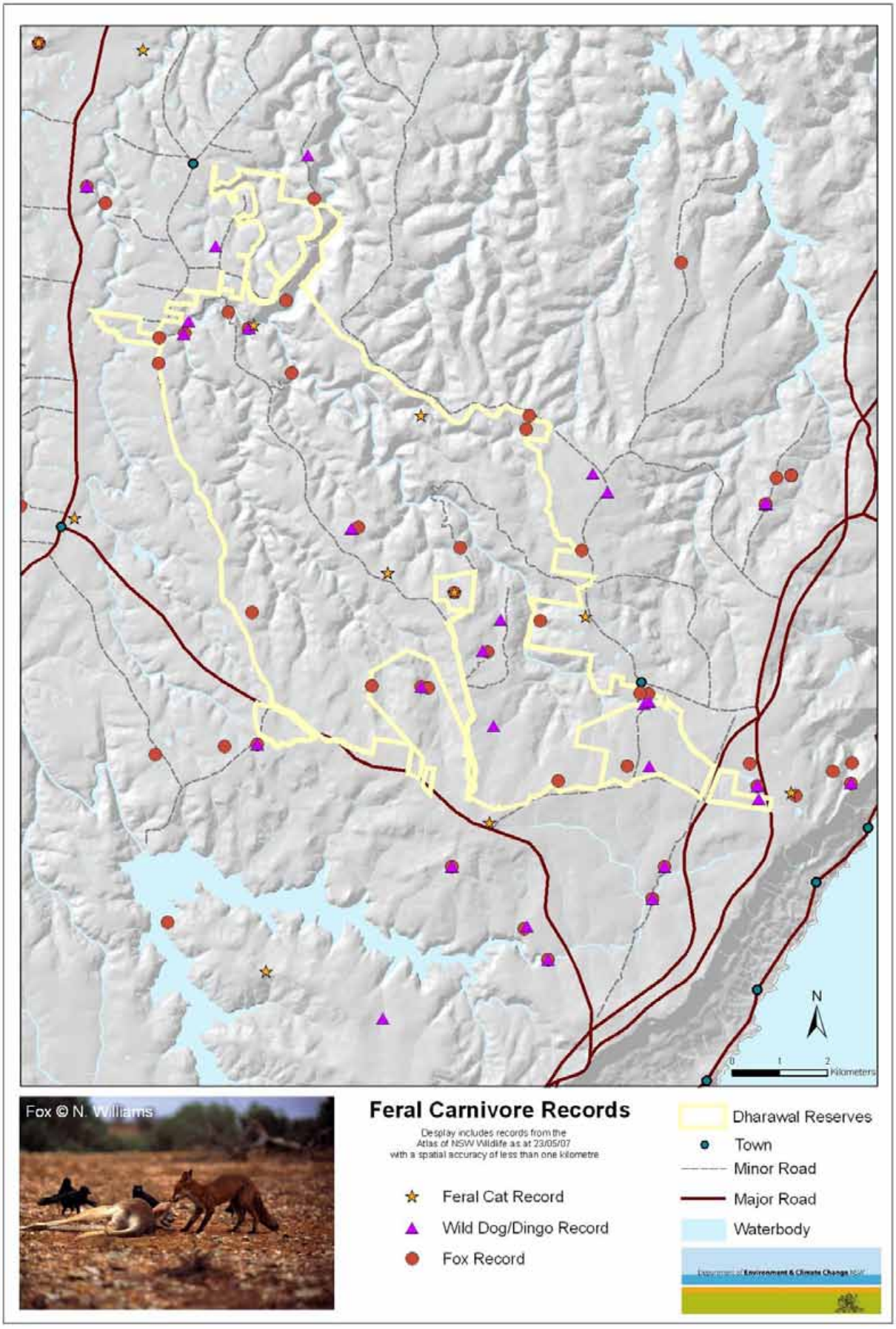
Map 20: Records of Large-footed Myotis in Dharawal SCA and NR and adjacent lands



Map 21: Habitat model and records of Greater Broad-nosed Bat in Dharawal SCA and NR and adjacent lands



Map 22: **Rusa Deer habitat model and records of feral herbivores in Dharawal SCA and NR and adjacent lands**



Map 23: Records of feral carnivores in Dharawal SCA and NR and adjacent lands

APPENDIX C: VERTEBRATE FAUNA IN DHARAWAL SCA AND NR

Below is a list of fauna species currently known to occur in the study area. The list is based on records from the Atlas of NSW Wildlife within 200 metres of Dharawal SCA and NR. The data was extracted from the Atlas on 23 May 2007. Following a review of records conducted for this project, several species have been removed from this list, in order to reflect the current state of fauna in the study area as accurately as possible. In addition, the list does not include records collected during the first Birds Australia survey, or records collected prior to 1950. Introduced species are indicated with the addition of an "".

Family	Scientific Name	Common Name	NSW Legal Status	Federal Legal Status	DECC 2006-07 Survey	Other recorders
Frogs						
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P		X	X
Myobatrachidae	*Heleioporus australiacus*	Giant Burrowing Frog	V	V	X	X
Myobatrachidae	*Limnodynastes dumerilii*	Eastern Banjo Frog	P		X	X
Myobatrachidae	*Limnodynastes peronii*	Striped Marsh Frog	P		X	X
Myobatrachidae	*Paracrinia haswelli*	Haswell's Froglet	P		X	X
Myobatrachidae	*Pseudophryne australis*	Red-crowned Toadlet	V			X
Myobatrachidae	*Pseudophryne bibronii*	Bibron's Toadlet	P			X
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P		X	X
Hylidae	*Litoria caerulea*	Green Tree Frog	P			X
Hylidae	*Litoria citropa*	Blue Mountains Tree Frog	P		X	X
Hylidae	*Litoria dentata*	Keferstein's Tree Frog	P		X	X
Hylidae	*Litoria fallax*	Eastern Dwarf Tree Frog	P		X	X
Hylidae	*Litoria freycineti*	Freycinet's Frog	P		X	X
Hylidae	*Litoria jervisiensis*	Jervis Bay Tree Frog	P		X	X
Hylidae	*Litoria latopalmata*	Broad-palmed Frog	P			X
Hylidae	*Litoria lesueuri*	Lesueur's Frog	P		X	X
Hylidae	*Litoria littlejohni*	Littlejohn's Tree Frog	V	V	X	X
Hylidae	*Litoria nudidigita*		P		X	
Hylidae	*Litoria peronii*	Peron's Tree Frog	P		X	X
Hylidae	*Litoria phyllochroa*	Green Stream Frog	P		X	X
Hylidae	*Litoria tyleri*	Tyler's Tree Frog	P		X	X
Hylidae	*Litoria verreauxii*	Verreaux's Tree Frog	P		X	X
Hylidae	*Litoria wilcoxii*	Stony Creek Frog	P		X	
Reptiles						
Chelidae	*Chelodina longicollis*	Eastern Snake-necked Turtle	P			X
Gekkonidae	*Diplodactylus vittatus*	Eastern Stone Gecko	P			X
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P		X	X
Gekkonidae	*Phyllurus platurus*	Broad-tailed Gecko	P		X	X
Gekkonidae	*Underwoodisaurus milii*	Thick-tailed Gecko	P			X
Pygopodidae	*Pygopus lepidopodus*	Southern Scaly-foot	P			X

Family	Scientific Name	Common Name	NSW Legal Status	Federal Legal Status	DECC 2006-07 Survey	Other recorders
Agamidae	*Amphibolurus muricatus*	Jacky Lashtail	P		X	X
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P		X	X
Agamidae	*Pogona barbata*	Eastern Bearded Dragon	P			X
Agamidae	*Rankinia diemensis*	Mountain Heath Dragon	P		X	X
Varanidae	*Varanus rosenbergi*	Rosenberg's Goanna	V		X	X
Varanidae	*Varanus varius*	Lace Monitor	P		X	X
Scincidae	*Acritoscincus duperreyi*	Eastern Three-lined Skink	P		X	
Scincidae	*Acritoscincus platynota*	Red-throated Cool-skink	P		X	X
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P		X	X
Scincidae	*Ctenotus robustus*	Robust Ctenotus	P			X
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Ctenotus	P		X	X
Scincidae	*Cyclodomorphus michaeli*	She-oak Skink	P			X
Scincidae	*Egernia cunninghami*	Cunningham's Spiny-tailed Skink	P			X
Scincidae	*Egernia whitii*	White's Rock-skink	P		X	X
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P		X	X
Scincidae	*Eulamprus tenuis*	Barred-sided Skink	P		X	X
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P		X	X
Scincidae	*Lampropholis guichenoti*	Pale-flecked Garden Sunskink	P		X	X
Scincidae	*Saproscincus mustelinus*	Weasel Shadeskink	P		X	
Scincidae	*Tiliqua scincoides*	Common Bluetongue	P			X
Typhlopidae	*Ramphotyphlops nigrescens*	Blackish Blind Snake	P		X	X
Boidae	*Morelia spilota spilota*	Diamond Python	P			X
Colubridae	*Dendrelaphis punctulatus*	Green Tree Snake	P			X
Elapidae	*Acanthophis antarcticus*	Southern Death Adder	P			X
Elapidae	*Cryptophis nigrescens*	Eastern Small-eyed Snake	P		X	
Elapidae	*Demansia psammophis*	Yellow-faced Whipsnake	P			X
Elapidae	*Drysdalia rhodogaster*	Mustard-bellied Snake	P		X	X
Elapidae	*Hemiaspis signata*	Marsh Snake	P		X	X
Elapidae	*Hoplocephalus bungaroides*	Broad-headed Snake	E	V		X
Elapidae	*Notechis scutatus*	Mainland Tiger Snake	P		X	X
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P		X	X
Elapidae	*Pseudonaja textilis*	Eastern Brown Snake	P			X
Elapidae	*Vermicella annulata*	Eastern Bandy-bandy	P			X
Birds						
Phasianidae	*Coturnix ypsilophora*	Brown Quail	P			X
Anatidae	*Anas superciliosa*	Pacific Black Duck	P		X	X
Anatidae	*Chenonetta jubata*	Australian Wood Duck	P		X	X
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe	P		X	
Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant	P		X	X
Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant	P			X

Family	Scientific Name	Common Name	NSW Legal Status	Federal Legal Status	DECC 2006-07 Survey	Other recorders
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P		X	X
Ardeidae	*Nycticorax caledonicus*	Nankeen Night Heron	P		X	X
Accipitridae	*Accipiter novaehollandiae*	Grey Goshawk	P			X
Accipitridae	*Accipiter cirrocephalus*	Collared Sparrowhawk	P		X	X
Accipitridae	*Accipiter fasciatus*	Brown Goshawk	P		X	X
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P		X	X
Accipitridae	*Circus approximans*	Swamp Harrier	P		X	X
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P		X	X
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	P		X	X
Accipitridae	*Haliastur sphenurus*	Whistling Kite	P			X
Accipitridae	*Hieraaetus morphnoides*	Little Eagle	P		X	X
Falconidae	*Falco berigora*	Brown Falcon	P		X	X
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P		X	X
Falconidae	*Falco peregrinus*	Peregrine Falcon	P		X	X
Turnicidae	*Turnix varia*	Painted Button-quail	P		X	X
Charadriidae	*Vanellus miles*	Masked Lapwing	P		X	X
Columbidae	*Geopelia humeralis*	Bar-shouldered Dove	P		X	X
Columbidae	*Geopelia placida*	Peaceful Dove	P		X	
Columbidae	*Lopholaimus antarcticus*	Topknot Pigeon	P		X	X
Columbidae	*Phaps chalcoptera*	Common Bronzewing	P		X	X
Columbidae	*Phaps elegans*	Brush Bronzewing	P		X	X
Columbidae	*Streptopelia chinensis*	Spotted Turtle-Dove [I]	U	U		X
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo	P		X	X
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V		X	X
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-cockatoo	P		X	X
Cacatuidae	*Calyptorhynchus lathami*	Glossy Black-cockatoo	V			X
Cacatuidae	*Eolophus roseicapillus*	Galah	P		X	X
Psittacidae	*Alisterus scapularis*	Australian King-parrot	P		X	X
Psittacidae	*Glossopsitta pusilla*	Little Lorikeet	P		X	
Psittacidae	*Neophema pulchella*	Turquoise Parrot	V		X	
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P		X	X
Psittacidae	*Platycercus elegans*	Crimson Rosella	P		X	X
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P		X	X
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P		X	X
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-cuckoo	P		X	X
Cuculidae	*Chalcites lucidus*	Shining Bronze-cuckoo	P		X	X
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	P			X
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo	P			X
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	P		X	X
Strigidae	*Ninox boobook*	Southern Boobook	P		X	X

Family	Scientific Name	Common Name	NSW Legal Status	Federal Legal Status	DECC 2006-07 Survey	Other recorders
Strigidae	*Ninox strenua*	Powerful Owl	V		X	X
Tytonidae	*Tyto alba*	Barn Owl	P			X
Podargidae	*Podargus strigoides*	Tawny Frogmouth	P		X	X
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P		X	X
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P		X	X
Apodidae	*Apus pacificus*	Fork-tailed Swift	P		X	X
Apodidae	*Hirundapus caudacutus*	White-throated Needletail	P			X
Alcedinidae	*Alcedo azurea*	Azure Kingfisher	P		X	X
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P		X	X
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	P		X	X
Coraciidae	*Eurystomus orientalis*	Dollarbird	P		X	X
Menuridae	*Menura novaehollandiae*	Superb Lyrebird	P		X	X
Climacteridae	*Climacteris erythrops*	Red-browed Treecreeper	P		X	X
Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper	P		X	X
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P		X	X
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P		X	X
Maluridae	*Stipiturus malachurus*	Southern Emu-wren	P		X	X
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P		X	X
Pardalotidae	*Pardalotus striatus*	Striated Pardalote	P		X	X
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P		X	X
Acanthizidae	*Acanthiza nana*	Yellow Thornbill	P			X
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P		X	X
Acanthizidae	*Acanthiza reguloides*	Buff-rumped Thornbill	P		X	X
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P		X	X
Acanthizidae	*Gerygone mouki*	Brown Gerygone	P		X	X
Acanthizidae	*Gerygone olivacea*	White-throated Gerygone	P		X	X
Acanthizidae	*Origma solitaria*	Rockwarbler	P		X	X
Acanthizidae	*Pycnoptilus floccosus*	Pilotbird	P		X	X
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P		X	X
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P		X	X
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P		X	X
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P		X	X
Meliphagidae	*Gliciphila melanops*	Tawny-crowned Honeyeater	P		X	X
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		X	X
Meliphagidae	*Lichenostomus fuscus*	Fuscous Honeyeater	P		X	
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P		X	X
Meliphagidae	*Lichenostomus melanops*	Yellow-tufted Honeyeater	P		X	X
Meliphagidae	*Manorina melanocephala*	Noisy Miner	P		X	
Meliphagidae	*Manorina melanophrys*	Bell Miner	P		X	
Meliphagidae	*Meliphaga lewinii*	Lewin's Honeyeater	P		X	X

Family	Scientific Name	Common Name	NSW Legal Status	Federal Legal Status	DECC 2006-07 Survey	Other recorders
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P		X	X
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		X	X
Meliphagidae	*Myzomela sanguinolenta*	Scarlet Honeyeater	P			X
Meliphagidae	*Philemon corniculatus*	Noisy Friarbird	P		X	X
Meliphagidae	*Phylidonyris nigra*	White-cheeked Honeyeater	P		X	X
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P		X	X
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P		X	X
Petroicidae	*Microeca fascinans*	Jacky Winter	P			X
Petroicidae	*Petroica boodang*	Scarlet Robin	P		X	X
Petroicidae	*Petroica rosea*	Rose Robin	P		X	X
Eupetidae	*Cinclosoma punctatum*	Spotted Quail-thrush	P		X	X
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P		X	X
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	P		X	X
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P		X	X
Pachycephalidae	*Falcunculus frontatus*	Eastern Shrike-tit	P		X	X
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P		X	X
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P		X	X
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	P		X	X
Dicruridae	*Monarcha melanopsis*	Black-faced Monarch	P		X	X
Dicruridae	*Myiagra rubecula*	Leaden Flycatcher	P		X	X
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P		X	X
Dicruridae	*Rhipidura leucophrys*	Willie Wagtail	P		X	X
Dicruridae	*Rhipidura rufifrons*	Rufous Fantail	P		X	X
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P		X	X
Campephagidae	*Coracina tenuirostris*	Cicadabird	P			X
Oriolidae	*Oriolus sagittatus*	Olive-backed Oriole	P			X
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P		X	X
Artamidae	*Artamus superciliosus*	White-browed Woodswallow	P			X
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P		X	X
Artamidae	*Gymnorhina tibicen*	Australian Magpie	P			X
Artamidae	*Strepera graculina*	Pied Currawong	P		X	X
Artamidae	*Strepera versicolor*	Grey Currawong	P		X	X
Corvidae	*Corvus coronoides*	Australian Raven	P		X	X
Ptilonorhynchidae	*Ptilonorhynchus violaceus*	Satin Bowerbird	P		X	X
Motacillidae	*Anthus australis*	Australian Pipit	P		X	X
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P		X	X
Estrildidae	*Stagonopleura bella*	Beautiful Firetail	P		X	X
Estrildidae	*Taeniopygia bichenovii*	Double-barred Finch	P		X	X
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P		X	X
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P		X	X

Family	Scientific Name	Common Name	NSW Legal Status	Federal Legal Status	DECC 2006-07 Survey	Other recorders
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P		X	X
Sylviidae	*Cincloramphus mathewsi*	Rufous Songlark	P		X	X
Zosteropidae	*Zosterops lateralis*	Silvereye	P		X	X
Muscicapidae	*Turdus merula*	Eurasian Blackbird [I]	U	U	X	X
Sturnidae	*Acridotheres tristis*	Common Myna [I]	U	U		X
Sturnidae	*Sturnus vulgaris*	Common Starling [I]	U	U	X	X
Mammals						
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		X	X
Dasyuridae	*Antechinus stuartii*	Brown Antechinus	P		X	X
Dasyuridae	*Dasyurus maculatus*	Spotted-tailed Quoll	V	E		X
Dasyuridae	*Sminthopsis murina*	Common Dunnart	P		X	
Peramelidae	*Perameles nasuta*	Long-nosed Bandicoot	P			X
Phascolarctidae	*Phascolarctos cinereus*	Koala	V		X	X
Vombatidae	*Vombatus ursinus*	Common Wombat	P		X	X
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V		X	X
Petauridae	*Petaurus australis*	Yellow-bellied Glider	V			X
Petauridae	*Petaurus breviceps*	Sugar Glider	P		X	X
Pseudocheiridae	*Petauroides volans*	Greater Glider	P			X
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P		X	X
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	P		X	X
Macropodidae	*Macropus giganteus*	Eastern Grey Kangaroo	P		X	X
Macropodidae	*Macropus robustus*	Common Wallaroo	P			X
Macropodidae	*Macropus rufogriseus*	Red-necked Wallaby	P		X	X
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P		X	X
Pteropodidae	*Pteropus poliocephalus*	Grey-headed Flying-fox	V	V	X	X
Molossidae	*Mormopterus norfolkensis*	East-coast Freetail-bat	V		X	X
Molossidae	*Mormopterus* species 2 (Adams et al. 1988)	Eastern Freetail-bat	P		X	X
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P		X	X
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P		X	X
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P		X	X
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V		X	X
Vespertilionidae	*Myotis adversus*	Large-footed Myotis	V		X	X
Vespertilionidae	*Nyctophilus gouldi*	Gould's Long-eared Bat	P		X	X
Vespertilionidae	*Scoteanax rueppellii*	Greater Broad-nosed Bat	V		X	X
Vespertilionidae	*Scotorepens orion*	Eastern Broad-nosed Bat	P		X	X
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	P		X	X
Vespertilionidae	*Vespadelus vulturnus*	Little Forest Bat	P		X	X
Muridae	*Rattus fuscipes*	Bush Rat	P		X	X
Muridae	*Rattus lutreolus*	Swamp Rat	P		X	X

Family	Scientific Name	Common Name	NSW Legal Status	Federal Legal Status	DECC 2006-07 Survey	Other recorders
Leporidae	*Lepus capensis*	Brown Hare [I]	U	U	X	
Leporidae	*Oryctolagus cuniculus*	Rabbit [I]	U	U	X	X
Canidae	*Canis lupus*	Wild Dog/Dingo [I]	U	U	X	X
Canidae	*Vulpes vulpes*	Fox [I]	U	U	X	X
Felidae	*Felis catus*	Feral Cat	U	U	X	X
Bovidae	*Capra hircus*	Feral Goat [I]	U	U	X	
Cervidae	*Cervus timorensis*	Rusa Deer [I]	U	U	X	X

APPENDIX D: FAUNA RECORDED IN ADJACENT LANDS

Below is a list of fauna species that have been recorded in the new area proposals adjacent to Dharawal SCA and NR. The list is based on data that was extracted from the Atlas of NSW Wildlife on 23 May 2007. Following a review of records conducted for this project, several species have been removed from this list, in order to reflect the current state of fauna in the study area as accurately as possible. In addition, the list does not include records collected during the first Birds Australia survey, or records collected prior to 1950. Introduced species are indicated with the addition of an "I".

MADDENS PLAIN CROWN LAND

Family	Scientific Name	Common Name	Conservation Status	DECC 2006-07 Survey	Other surveys/incidental records
Frogs					
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P	X	
Myobatrachidae	*Limnodynastes dumerilii*	Eastern Banjo Frog	P	X	
Myobatrachidae	*Paracrinia haswelli*	Haswell's Froglet	P	X	
Hylidae	*Litoria dentata*	Keferstein's Tree Frog	P	X	
Hylidae	*Litoria jervisiensis*	Jervis Bay Tree Frog	P	X	
Hylidae	*Litoria peronii*	Peron's Tree Frog	P	X	
Hylidae	*Litoria verreauxii*	Verreaux's Tree Frog	P	X	
Reptiles					
Scincidae	*Eulamprus quoyii*	Eastern Water-skink	P	X	
Birds					
Anatidae	*Chenonetta jubata*	Australian Wood Duck	P	X	
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P	X	
Accipitridae	*Circus approximans*	Swamp Harrier	P	X	
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P	X	
Falconidae	*Falco cenchroides*	Nankeen Kestrel	P	X	
Rallidae	*Porzana tabuensis*	Spotless Crake	P	X	
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P	X	
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P	X	
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	P		X
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P	X	
Halcyonidae	*Todiramphus sanctus*	Sacred Kingfisher	P	X	
Maluridae	*Stipiturus malachurus*	Southern Emu-wren	P	X	
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P	X	
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P	X	
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P	X	
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P	X	
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P	X	
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P	X	

Family	Scientific Name	Common Name	Conservation Status	DECC 2006-07 Survey	Other surveys/incidental records
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P	X	
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P	X	
Dicruridae	*Grallina cyanoleuca*	Magpie-lark	P	X	
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P	X	
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P	X	
Artamidae	*Gymnorhina tibicen*	Australian Magpie	P	X	
Motacillidae	*Anthus australis*	Australian Pipit	P	X	
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P	X	
Mammals					
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P	X	
Muridae	*Rattus fuscipes*	Bush Rat	P	X	
Canidae	*Canis lupus*	Wild Dog/Dingo [I]	U	X	
Canidae	*Vulpes vulpes*	Fox [I]	U	X	
Cervidae	*Cervus sp.*	Unidentified Deer [I]	U	X	

STOKES CREEK CROWN RESERVE

Family	Scientific Name	Common Name	Conservation Status	DECC 2006-07 Survey	Other surveys/incidental records
Frogs					
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P	X	
Myobatrachidae	*Limnodynastes dumerilii*	Eastern Banjo Frog	P		X
Hylidae	*Litoria citropa*	Blue Mountains Tree Frog	P	X	
Hylidae	*Litoria freycineti*	Freycinet's Frog	P	X	X
Hylidae	*Litoria lesueuri*	Lesueur's Frog	P	X	
Hylidae	*Litoria peronii*	Peron's Tree Frog	P		X
Hylidae	*Litoria phyllochroa*	Green Stream Frog	P	X	
Reptiles					
Gekkonidae	*Oedura lesueurii*	Lesueur's Velvet Gecko	P	X	X
Agamidae	*Rankinia diemensis*	Mountain Heath Dragon	P		X
Varanidae	*Varanus rosenbergi*	Rosenberg's Goanna	V		X
Varanidae	*Varanus varius*	Lace Monitor	P	X	
Scincidae	*Acritoscincus platynota*	Red-throated Cool-skink	P	X	
Scincidae	*Cryptoblepharus virgatus*	Cream-striped Shinning-skink	P	X	
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Ctenotus	P	X	X
Scincidae	*Egernia whitii*	White's Rock-skink	P	X	
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P	X	
Elapidae	*Cacophis squamulosus*	Golden Crowned Snake	P	X	
Birds					
Accipitridae	*Aquila audax*	Wedge-tailed Eagle	P	X	
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P	X	
Psittacidae	*Platycercus elegans*	Crimson Rosella	P	X	
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P		X
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P	X	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P	X	
Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper	P	X	X
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P	X	
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote	P	X	X
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P	X	
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P	X	X
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P	X	
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P	X	
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P	X	X
Meliphagidae	*Anthochaera carunculata*	Red Wattlebird	P	X	
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P		X
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		X
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P		X
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P	X	
Meliphagidae	*Melithreptus lunatus*	White-naped Honeyeater	P		X
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P		X
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P	X	X
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P	X	

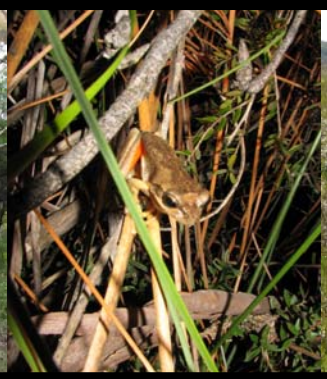
Family	Scientific Name	Common Name	Conservation Status	DECC 2006-07 Survey	Other surveys/incidental records
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella	P	X	
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P	X	X
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P	X	X
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P	X	X
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P	X	X
Dicruridae	*Rhipidura rufifrons*	Rufous Fantail	P	X	
Artamidae	*Cracticus torquatus*	Grey Butcherbird	P	X	
Artamidae	*Strepera graculina*	Pied Currawong	P	X	X
Artamidae	*Strepera versicolor*	Grey Currawong	P	X	X
Corvidae	*Corvus coronoides*	Australian Raven	P		X
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P	X	
Estrildidae	*Stagonopleura bella*	Beautiful Firetail	P	X	
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P	X	
Zosteropidae	*Zosterops lateralis*	Silvereye	P		X
Mammals					
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		X
Peramelidae	*Perameles nasuta*	Long-nosed Bandicoot	P		X
Vombatidae	*Vombatus ursinus*	Common Wombat	P	X	
Burramyidae	*Cercartetus nanus*	Eastern Pygmy-possum	V		X
Petauridae	*Petaurus breviceps*	Sugar Glider	P	X	
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P		X
Macropodidae	*Wallabia bicolor*	Swamp Wallaby	P	X	
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P	X	
Canidae	*Canis lupus*	Wild Dog/Dingo [I]	U	X	
Canidae	*Vulpes vulpes*	Fox [I]	U	X	

MADDENS PLAINS SYDNEY CATCHMENT AUTHORITY LAND

Family	Scientific Name	Common Name	Conservation Status	DECC 2006-07 Survey	Other records
Frogs					
Myobatrachidae	*Crinia signifera*	Common Eastern Froglet	P	X	
Myobatrachidae	*Limnodynastes dumerilii*	Eastern Banjo Frog	P	X	
Myobatrachidae	*Limnodynastes peronii*	Striped Marsh Frog	P	X	
Myobatrachidae	*Uperoleia laevigata*	Smooth Toadlet	P	X	
Hylidae	*Litoria dentata*	Keferstein's Tree Frog	P	X	
Hylidae	*Litoria freycineti*	Freycinet's Frog	P	X	
Hylidae	*Litoria jervisiensis*	Jervis Bay Tree Frog	P	X	
Hylidae	*Litoria peronii*	Peron's Tree Frog	P	X	
Reptiles					
Agamidae	*Physignathus lesueurii*	Eastern Water Dragon	P		X
Agamidae	*Rankinia diemensis*	Mountain Heath Dragon	P	X	
Scincidae	*Ctenotus taeniolatus*	Copper-tailed Ctenotus	P	X	
Scincidae	*Egernia whitii*	White's Rock-skink	P	X	
Scincidae	*Lampropholis delicata*	Dark-flecked Garden Sunskink	P	X	
Elapidae	*Drysdalia rhodogaster*	Mustard-bellied Snake	P	X	
Elapidae	*Pseudechis porphyriacus*	Red-bellied Black Snake	P	X	
Birds					
Ardeidae	*Egretta novaehollandiae*	White-faced Heron	P		X
Accipitridae	*Circus approximans*	Swamp Harrier	P	X	
Accipitridae	*Elanus axillaris*	Black-shouldered Kite	P	X	
Falconidae	*Falco berigora*	Brown Falcon	P		X
Turnicidae	*Turnix varia*	Painted Button-quail	P	X	
Charadriidae	*Vanellus miles*	Masked Lapwing	P	X	
Columbidae	*Lopholaimus antarcticus*	Topknot Pigeon	P	X	
Columbidae	*Phaps chalcoptera*	Common Bronzewing	P		X
Cacatuidae	*Callocephalon fimbriatum*	Gang-gang Cockatoo	V		X
Cacatuidae	*Calyptorhynchus funereus*	Yellow-tailed Black-Cockatoo	P	X	
Psittacidae	*Platycercus adscitus eximius*	Eastern Rosella	P	X	X
Psittacidae	*Platycercus elegans*	Crimson Rosella	P	X	X
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet	P	X	X
Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo	P	X	X
Cuculidae	*Cuculus pallidus*	Pallid Cuckoo	P		X
Centropodidae	*Centropus phasianinus*	Pheasant Coucal	P	X	
Strigidae	*Ninox boobook*	Southern Boobook	P	X	
Caprimulgidae	*Eurostopodus mystacalis*	White-throated Nightjar	P	X	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar	P	X	
Halcyonidae	*Dacelo novaeguineae*	Laughing Kookaburra	P		X
Climacteridae	*Cormobates leucophaeus*	White-throated Treecreeper	P	X	X
Maluridae	*Malurus cyaneus*	Superb Fairy-wren	P	X	X
Maluridae	*Malurus lamberti*	Variegated Fairy-wren	P	X	X
Maluridae	*Stipiturus malachurus*	Southern Emu-wren	P	X	X
Acanthizidae	*Acanthiza lineata*	Striated Thornbill	P	X	

Family	Scientific Name	Common Name	Conservation Status	DECC 2006-07 Survey	Other records
Acanthizidae	*Acanthiza pusilla*	Brown Thornbill	P	X	X
Acanthizidae	*Calamanthus pyrrhopygius*	Chestnut-rumped Heathwren	P	X	X
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren	P	X	X
Meliphagidae	*Acanthorhynchus tenuirostris*	Eastern Spinebill	P	X	X
Meliphagidae	*Anthochaera chrysoptera*	Little Wattlebird	P	X	X
Meliphagidae	*Gliciphila melanops*	Tawny-crowned Honeyeater	P	X	X
Meliphagidae	*Lichenostomus chrysops*	Yellow-faced Honeyeater	P		X
Meliphagidae	*Lichenostomus leucotis*	White-eared Honeyeater	P		X
Meliphagidae	*Melithreptus brevirostris*	Brown-headed Honeyeater	P	X	
Meliphagidae	*Phylidonyris nigra*	White-cheeked Honeyeater	P	X	X
Meliphagidae	*Phylidonyris novaehollandiae*	New Holland Honeyeater	P	X	X
Petroicidae	*Eopsaltria australis*	Eastern Yellow Robin	P	X	X
Eupetidae	*Psophodes olivaceus*	Eastern Whipbird	P	X	X
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush	P	X	X
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler	P	X	
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler	P	X	X
Dicruridae	*Rhipidura albiscapa*	Grey Fantail	P	X	X
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	P	X	
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow	P	X	X
Artamidae	*Strepera versicolor*	Grey Currawong	P		X
Corvidae	*Corvus coronoides*	Australian Raven	P	X	X
Motacillidae	*Anthus australis*	Australian Pipit	P		X
Estrildidae	*Neochmia temporalis*	Red-browed Finch	P	X	X
Estrildidae	*Stagonopleura bella*	Beautiful Firetail	P	X	X
Dicaeidae	*Dicaeum hirundinaceum*	Mistletoebird	P	X	
Hirundinidae	*Hirundo neoxena*	Welcome Swallow	P	X	X
Hirundinidae	*Petrochelidon nigricans*	Tree Martin	P	X	X
Zosteropidae	*Zosterops lateralis*	Silvereye	P		X
Mammals					
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna	P		X
Pseudocheiridae	*Pseudocheirus peregrinus*	Common Ringtail Possum	P	X	
Molossidae	*Mormopterus* species 2 (Adams *et al*. 1988)	Eastern Freetail-bat	P	X	
Molossidae	*Tadarida australis*	White-striped Freetail-bat	P	X	
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	P	X	
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat	P	X	
Vespertilionidae	*Miniopterus schreibersii oceanensis*	Eastern Bentwing-bat	V	X	
Vespertilionidae	*Vespadelus darlingtoni*	Large Forest Bat	P	X	
Bovidae	*Capra hircus*	Feral Goat [I]	U	X	X



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