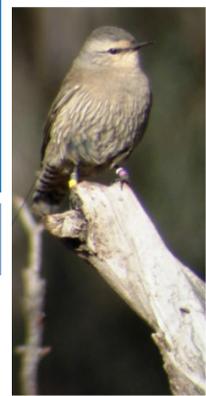




**ACT**  
Government



# THE EXTENT AND SIGNIFICANCE OF GUNGAHLIN'S BIODIVERSITY VALUES

Dr Michael Mulvaney

Technical Report 24

March 2012

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# **The Extent and Significance of Gungahlin's Biodiversity Values**

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## **Purpose of this report**

This report documents the extent and relative significance of the biodiversity values of the Gungahlin area in the ACT, particularly those that are matters of National Environmental Significance, as defined in the *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth). It provides the context against which proposed development and conservation actions within Gungahlin can be assessed.

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## Summary

The Gungahlin area occupies the north-eastern part of the ACT, bounded by the Federal and Barton highways and the ACT/NSW border. Gungahlin retains relatively large native grassland and lowland woodland remnants. These are vegetation types that have been extensively cleared in the ACT and more so in surrounding regions of New South Wales. The lowland woodlands are important habitat of the superb parrot, while the grasslands provide significant habitat for the striped legless lizard and golden sun moth. Horse Park Wetland is recognised as being of national importance, and is habitat for Latham's snipe and several regionally uncommon plant species. This report refers to box – gum woodlands and native grasslands that are listed as threatened ecological communities under both Commonwealth legislation (*Environment Protection and Biodiversity Conservation Act 1999*) (EPBC Act) and ACT legislation (*Nature Conservation Act 1980*) (NC Act). Similarly, it refers to a range of flora and fauna species that are listed under one or both of these Acts. The report gives particular attention to matters of 'national environmental significance', as defined in the EPBC Act. Under the Act, threatened species and ecological communities (that are not extinct) may be listed in a range of categories from 'conservation dependant' to 'critically endangered' (Australian Government 2011a).

Within Gungahlin, there are 1875 hectares (ha) of White Box – Yellow Box – Blakely's Red Gum Grassy Woodland and Derived Native Grasslands (box – gum woodland), which is listed as critically endangered under the EPBC Act. This equates to 23% of the total extent of the box – gum woodland in the ACT listed under the EPBC Act. Sixty-two per cent of the remaining woodland in Gungahlin listed under the Act is reserved (October 2011). The woodlands within Gungahlin are some of the biggest, best connected and most diverse patches of this vegetation type remaining across the former distribution of the community in south-eastern Australia. The woodlands that comprise Gorooyarroo and Mulligans Flat nature reserves to the north of Bonner form the largest patch remaining in the ACT. In the context of the distribution of the remaining box – gum woodland, these woodlands are a key area for maintaining functioning woodland systems due to their connectivity, size and diversity. The area is also a research site of international importance. There are about 180 ha of Natural Temperate Grassland and a further 166 ha of closely associated native pasture (that has the capacity to regenerate to Natural Temperate Grassland) remaining in Gungahlin. Natural Temperate Grassland is listed as an endangered ecological community in the ACT (NC Act) as well as in the Southern Tablelands of NSW (EPBC Act). Gungahlin contains about 18% of the total remaining area of Natural Temperate Grassland in the ACT. About 90% of the remaining area of this grassland in Gungahlin is reserved (October 2011) and no areas are currently proposed for development.

Five plant species listed under the EPBC Act occur in Gungahlin and all known occurrences are within areas subject to conservation management. In a regional context, the grasslands and woodlands in Gungahlin are of high floristic value and support many regionally rare plant species. Mulligans Flat, East Bonner, Mulanggari Grassland Reserve, Crace Nature Reserve, grassland within the National Transmission Station (Crace), north-west Taylor, parts of Kinlyside and the secondary grassland within Moncrieff are of particular floristic value.

Throsby ridge and the adjoining reserves is one of the major known breeding areas for the vulnerable superb parrot (EPBC Act, NC Act) in the ACT. There has been a rapid and recent rise in the number of superb parrots visiting the ACT. If this trend continues it is likely that the northern and eastern Throsby areas will become increasingly important. The protection of this major breeding habitat is important for the long-term viability of the species in the ACT region.

Recent surveys have located large and widespread populations of the vulnerable striped legless lizard (EPBC Act, NC Act) in Natural Temperate Grassland, exotic tussock grassland which had formerly been native grassland of varying quality, and open woodland adjoining grassland. Gungahlin contains about 60% of the known habitat of the striped legless lizard in the ACT, but probably supports a greater proportion of the ACT population, as the density of the species in Gungahlin has been found to be relatively high in comparison to the density in the Majura and Jerrabomberra valleys

The critically endangered/endangered golden sun moth (EPBC Act/NC Act) is known from 22 locations within Gungahlin, which is about one-third of the known locations in the ACT. It is difficult to determine relative population sizes at each of the locations. Nevertheless, it is apparent that there are significant populations within existing or proposed conservation areas (such as North Throsby, Goorooyarroo, Mulligans Flat and Crace), but that moderate to large populations also occur within the proposed Moncrieff, South Throsby and Taylor development areas.

Most of the records of regionally uncommon bird, mammal, frog and reptile species are from within existing reserves.

The key to maintaining Gungahlin's biodiversity and conservation values is to protect and maintain the large patches of woodland and native grassland and enhance their connectivity and functioning. This includes minimising the urban edge on reserved lands, and enhancing the connections and extent of habitat that rim the north-western, northern and north-eastern portions of Gungahlin, including woodlands in the Hall – Kinlyside area, the northern leases, Mulligans Flat Nature Reserve, North and east Throsby and Goorooyarroo areas. Grassland conservation within Gungahlin will be largely focused on enhancing existing reserves and restricting their further fragmentation.

# 1 Vegetation Values

## 1.1 Landscape Setting

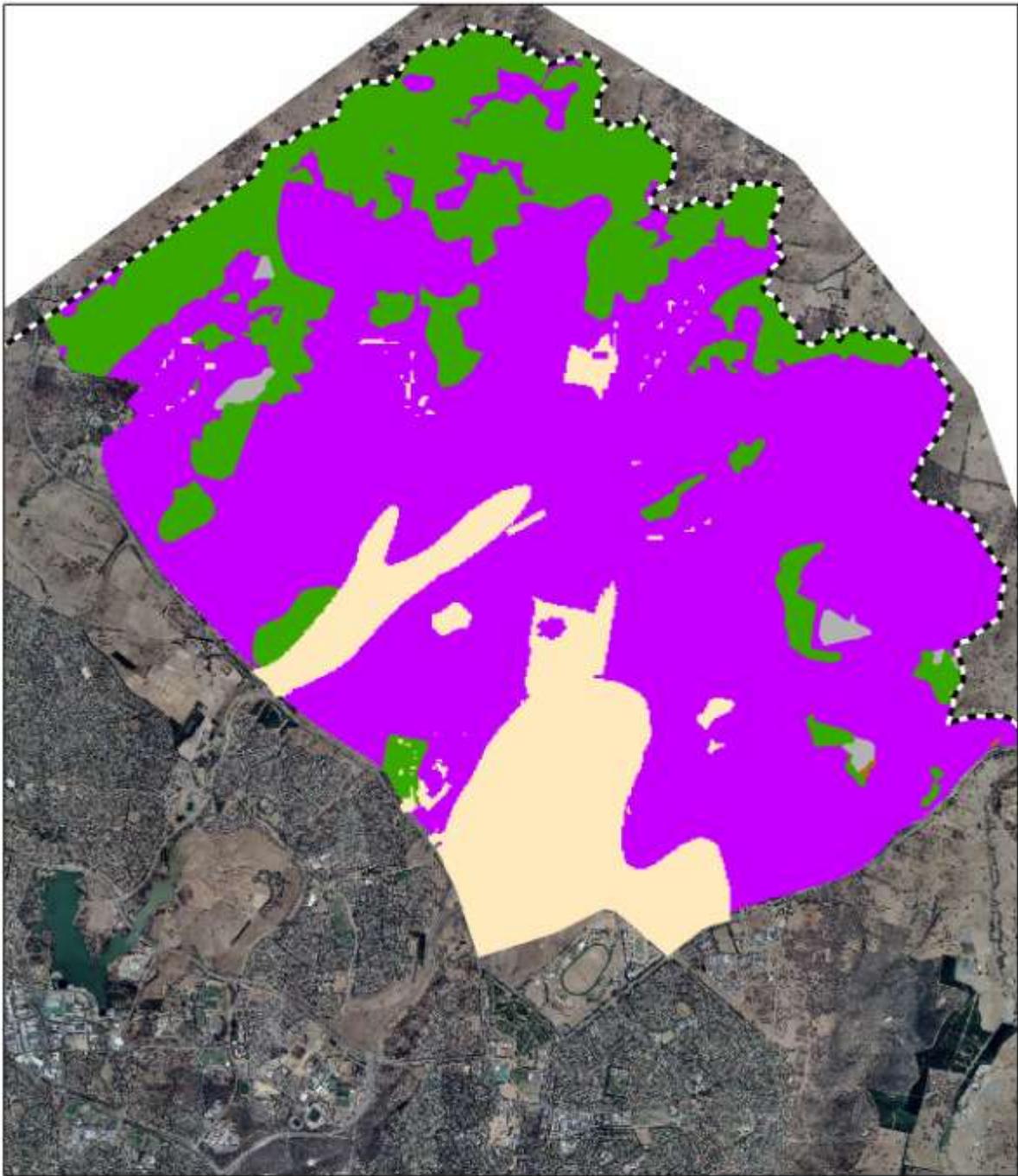
The Gungahlin area occupies the north-eastern part of the ACT, bounded by the Federal and Barton highways and the ACT/NSW border. Gungahlin covers about 85 square kilometres and is rimmed by volcanic and sedimentary hills, which form the northern boundary of the ACT. The hills rise to 876 m at One Tree Hill and in places may be steep with shallow soils. A series of ridges consisting of generally moderate slopes run from the north-east to the south-west across the area and are separated by wide flat-floored valleys at altitudes down to 600 m. Localised poorly drained areas, such as Horse Park Wetland, may occur on the valley floors. Gently sloping and wide plains occupy the lower south-east portion of Gungahlin. The moderate ridges, valleys and plains have a base of sedimentary rocks covered by rich soil deposits.

## 1.2 Native Vegetation: Overview

Prior to European settlement, the steeper hills with shallower soils at higher altitudes in Gungahlin largely supported Red Stringybark (*Eucalyptus macrorhyncha*) – Scribbly Gum (*E. rossii*) Tableland Forest. The moderate slopes and upper valleys were covered with Yellow Box (*E. melliodora*) – Blakely's Red Gum (*E. blakelyi*) Grassy Woodland, while Natural Temperate Grassland occupied the plains of the valley floors. Small areas of Drooping She Oak (*Allocasuarina verticillata*) Tableland Woodland and Broad-leaved Peppermint (*E. dives*) – Apple Box (*E. bridgesiana*) Tableland Woodland occupied some of the upper slopes. Ribbon Gum (*E. viminalis*) Tableland Riparian Woodland may have dominated some of the valley creek lines, while Snow Gum (*E. pauciflora*) – Candlebark (*E. rubida*) Tableland Woodland occurred on some of the lower land in the vicinity of the Natural Temperate Grassland (Eco Logical Australia 2011; Hogg and Nash 2011).

Figure 1 illustrates the pre-European vegetation of Gungahlin, while Table 1 indicates the estimated original extent of the major vegetation types. The maps and tables are based on recent mapping of remnant vegetation in North Gungahlin (Eco Logical Australia 2011) and Mulligans Flat – Goorooyarroo (Schweickle and Baines 2010); a reconstruction of Natural Temperate Grassland, undertaken by Conservation Planning and Research (ACT Government), based on altitude, soil type and present grassland location; and a reconstruction of Gungahlin vegetation by Hogg and Nash (2011).

European settlement of Gungahlin dates from the 1850s, when localised land clearing began in the valleys. There was some cropping on alluvial flats, but stock grazing has been the main rural activity. Evidence of early cropping is visible within a part of Throsby, where a small paddock still retains clear ridges and furrows running across the contour, deriving from animal-drawn ploughing. The establishment of the Australian Capital Territory in 1911 brought Commonwealth control of all land in the ACT, which then could only be held under lease. A consequence was that many rural leases were not subject to the extensive clearance and pasture improvement that occurred in other rural areas through the 20<sup>th</sup> century. Thus many of the rural leases in Gungahlin retained native vegetation cover, albeit simplified through stock grazing and tree thinning



**Figure 1**  
**Pre European**  
**Vegetation Cover**

**Legend**

**Vegetation Communities**

- Drooping She-Oak Woodland
- Broad-leaved Peppermint - Apple Box Woodland
- Red Stringybark - Scribbly Gum Forest
- Natural Temperate Grassland
- Yellow Box - Blakely's Red Gum Grassy Woodland



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**Table 1 Estimated extent of pre-European vegetation in Gungahlin**

Vegetation type	Area (ha)	% of total vegetation
Red Stringybark – Scribbly Gum Tableland Forest	1827	21
Yellow Box – Red Gum Grassy Woodland	5745	67
Natural Temperate Grassland	979	12

Urban development of Gungahlin began in the early 1990s, with the construction of Palmerston. Today urban development covers about one-third of the Gungahlin area (2950 ha), and is planned to expand over an additional 25% (2146 ha). No detailed vegetation community mapping predated Gungahlin's development, so the extent of native vegetation cleared by urban development within the area can only be inferred. Based on the vegetation surveys that were undertaken for specific developments and the extent of native vegetation present on remaining rural leases, it is estimated that at least 40% of the current urban area would have supported native vegetation (1170 ha) prior to development. Virtually all of this vegetation would have been box – gum woodland or Natural Temperate Grassland, which occupied the flatter lands.

The extent and condition of remaining lowland woodland in Gungahlin was surveyed during 2003–2004. This project also mapped the extent of box – gum woodland, which was a subset of the lowland woodland data (detailed in ACT Government 2004). Table 2 shows the amount and condition of lowland woodland cleared for urban development from 2003–2004 to mid-2010. Since 2003–2004, 540 ha of lowland woodland (including 138 ha of box – gum woodland) has been cleared during urban development. Over this same time period 606 ha of box – gum woodland, all of which meets the criteria for listing under the EPBC Act, has been added to the reserve network in Gungahlin.

**Table 2 Extent and type of lowland woodland cleared in Gungahlin since 2003–2004**

Vegetation Type	Vegetation condition	Cleared in urban development (ha)
Lowland woodland	Secondary grassland	97
	Partially modified woodland	9
	Moderately modified woodland	183
	Substantially modified woodland	260
	<b>Total</b>	<b>540</b>
Endangered box – gum woodland		138

Fuel wood plantations were established in Gungahlin in the 1980s, mainly on parts of the hills around the northern and north-western rim, and occupy an area of about three square kilometres (300 ha). The plantations consist of local eucalypt species including *Eucalyptus mannifera*, *E. blakelyi*, *E. macrorhyncha* and *E. viminalis* with a native understorey. Whilst the plantations contain remnant

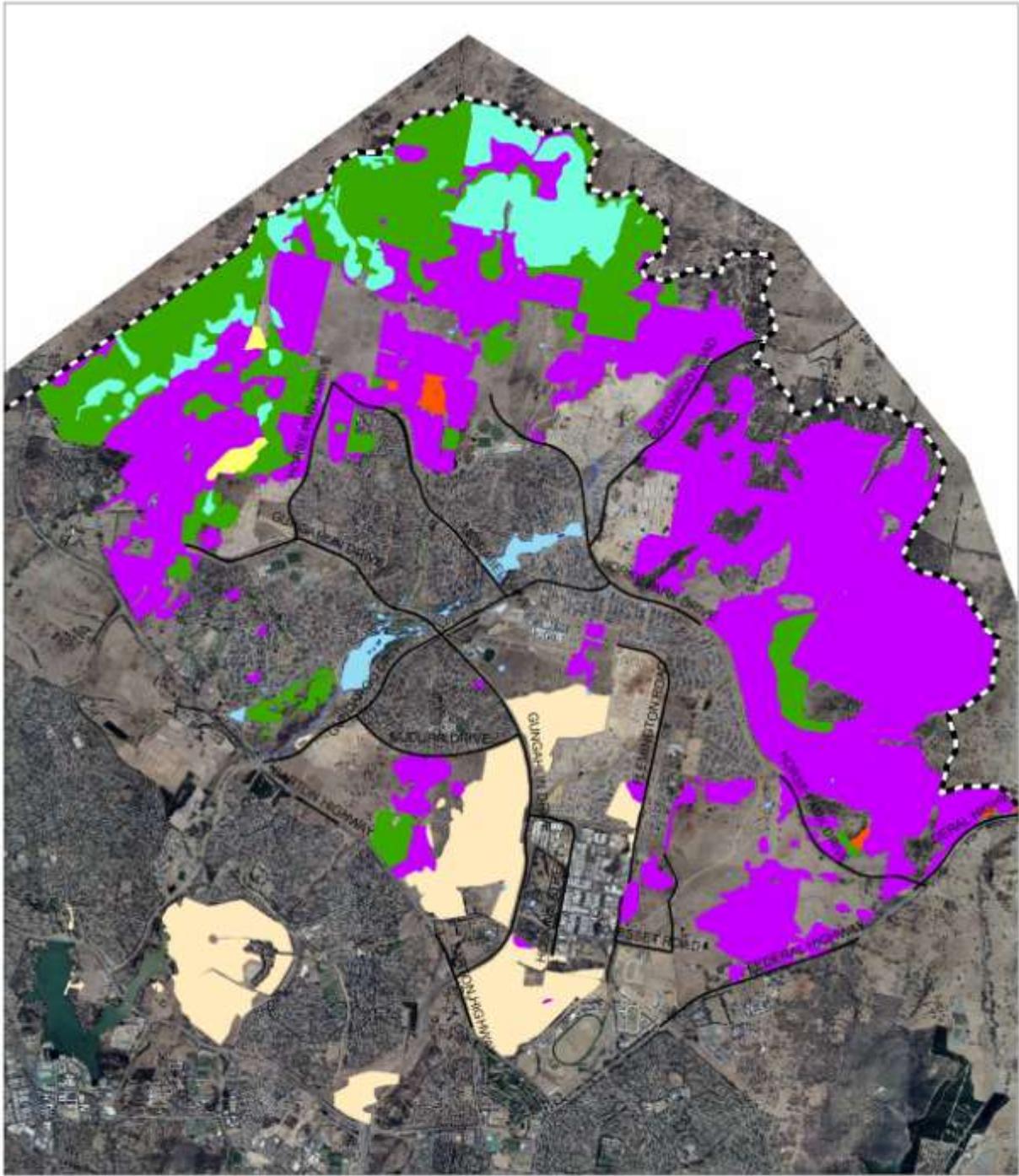
ground cover, they are considered highly modified environments as high tree densities and pre-planting rip-lines have affected surface hydrology, available sunlight and soil moisture. Many of the selected tree species, although known to grow in the region, were planted in areas inconsistent with soil types typically associated with these species. The plantations are highly unlikely to reach a climax community similar to any of the described communities and hence are not considered to be indigenous native vegetation. The plantations may however provide habitat to some native animals and contribute to the overall high connectivity of Gungahlin, and in some parts significant native understorey may remain.

Figure 2 illustrates the current extent of native vegetation in Gungahlin. Table 3 provides data on the extent of each major vegetation type, the extent within the existing Gungahlin conservation reserve network, and the extent within proposed future urban areas.

**Table 3 Current extent of native vegetation in Gungahlin**

Vegetation type	Area present today (ha)	Percentage of pre-1850 estimated extent	Area in reservation (ha)	Percentage reserved of original extent of vegetation	Percentage reserved of remaining vegetation	Area in proposed development areas * (ha)	Percentage of remaining vegetation in proposed development areas*
Red Stringybark – Scribbly Gum Tableland Forest	1483	81%	326	18%	22%	183	12%
Yellow Box – Red Gum Grassy Woodland	2324	40%	1200	23%	52%	939	26%
Natural Temperate Grassland	345	35%	328	34%	96%	0	0%
Drooping She-Oak Tableland Woodland	50	-	32	-	64%	0	0%

\*Proposed development area includes all of the proposed future suburbs of Kinlyside, Moncrieff, Jacka, Taylor, Throsby and Kenny.



**Figure 2**  
**Current**  
**Vegetation Cover**

**Legend**

- Red Stingybark - Scribbly Gum Forest
- Yellow Box - Blakely's Red Gum Grassy Woodland
- Drooping She-oak Woodland
- Eucalypt Plantation
- Natural Temperate Grassland
- Broad-leaved Peppermint - Apple Box Woodland



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### 1.3 Box – Gum Woodland: Endangered Ecological Community

Box – gum woodland is listed under both Commonwealth and ACT legislation as an endangered ecological community, as follows:

- White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grasslands (critically endangered) (*Environment Protection and Biodiversity Conservation Act 1999*, Commonwealth)
- Yellow Box – Blakely’s Red Gum Grassy Woodland (endangered) (*Nature Conservation Act 1980*, ACT).

Effectively, these listing are for the same ecological community; however, white box does not currently occur as a dominant tree in the ACT. The community is considered critically endangered under the EPBC Act as it has been cleared across about 92% of its former extent in south-eastern Australia. The remainder typically exists in small fragmented remnants, typically less than 10 ha (Australian Government 2006a; Gibbons and Boak 2002; Davidson 2005).

In contrast, the ACT retains over one-third of the estimated original extent of box – gum woodland, and that which remains is outstanding in relation to:

- the large size of the remaining patches (typically greater than 100 ha)
- the high level of connectivity of lowland woodland across the landscape
- the high botanical diversity, including many rare and threatened species
- the good condition in relation to vegetation structure, regeneration, and level of weed invasion. (ACT Government 2004)

The woodlands within Gungahlin are some of the largest, best connected and most diverse patches of this vegetation type remaining across the former distribution of the community in south-eastern Australia. In the context of the distribution of the remaining box – gum woodland, the Goorooyarroo – Mulligans Flat – North of Bonner woodland patch is the largest area remaining in the ACT and due to its high connectivity, size and diversity, is a key area for maintaining functioning box – gum woodlands. This patch is also a research site of international importance. Since 2004 a long term woodland experiment, involving nearly 1500 ha of woodland has been established in a partnership between the ACT Government, the Australian National University and associated collaborators. The research aims to provide a whole-of-ecosystem understanding of box – gum woodlands, particularly in relation to ways of restoring the structure and function of temperate woodlands to increase biodiversity. In 2008, the ACT Government built an 11.5 km, feral animal-proof fence around Mulligans Flat to allow removal and control of feral cats, foxes, rabbits and hares, and the reintroduction of locally extinct species. The ‘Mulligans Flat Woodland Sanctuary’ provides a valuable opportunity to experimentally reintroduce locally extinct species, observe effects of the experimental management in the absence of feral animals, and understand the effects of the reintroduction of locally extinct species that are considered to be ‘ecosystem engineers’ (Jones et al. 1994; Manning et al. 2009, 2011).

The woodland at Kenny is notable in that it supports old growth Yellow Box trees (300 – 450 years old) which are part of a Yellow Box on lowland valley flats (below 620m) vegetation type that has been extensively cleared and now has a highly restricted distribution.

The extent of box – gum woodland and the subset of this that meets the criteria established under the EPBC Act for listing as a threatened ecological community was mapped across the ACT (Maguire, Mulvaney and Frawley, in press), using vegetation surveys undertaken in various reserves across lowland ACT from 2006 to 2011; ecological reports and site inspection notes prepared as part of development application processes; and through re-interpretation of the data collected as part of the 2003 – 2004 lowland woodland mapping (Figure 3).

To qualify as White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grassland under the EPBC Act, at least 50% of the perennial vegetation in the ground layer (below 1 m) must comprise native species, and the canopy must be dominated by, or have previously been dominated by, one of the characteristic canopy species (yellow box, Blakely’s red gum and/or white box).

Under the EPBC Act, the community occurs in a range of condition types:

1. Patches greater than 0.1 ha, with a diverse ground layer made up of 12 or more native non-grass species, including a pre-defined ‘important’ species. A listing policy document details what an ‘important species’ is, and includes many species that are generally absent under prolonged grazing; and/or
2. Patches greater than 2 ha that include at least 20 mature trees per hectare; and/or
3. Patches greater than 2 ha, with regeneration of the canopy.

Gungahlin also retains box – gum woodland that does not currently meet the listing criteria under the EPBC Act. This includes situations where a tree canopy exists over exotic grassland, or native pasture, largely cleared of trees and only supporting a low level of plant diversity.

Gungahlin contains about 17% of the remaining box – gum woodland in the ACT and about 23% of the woodland meeting listing criteria under the EPBC Act. The Gungahlin area contains about 8% of the box – gum woodland remaining in the Southern Tablelands region (ACT Government 2004).

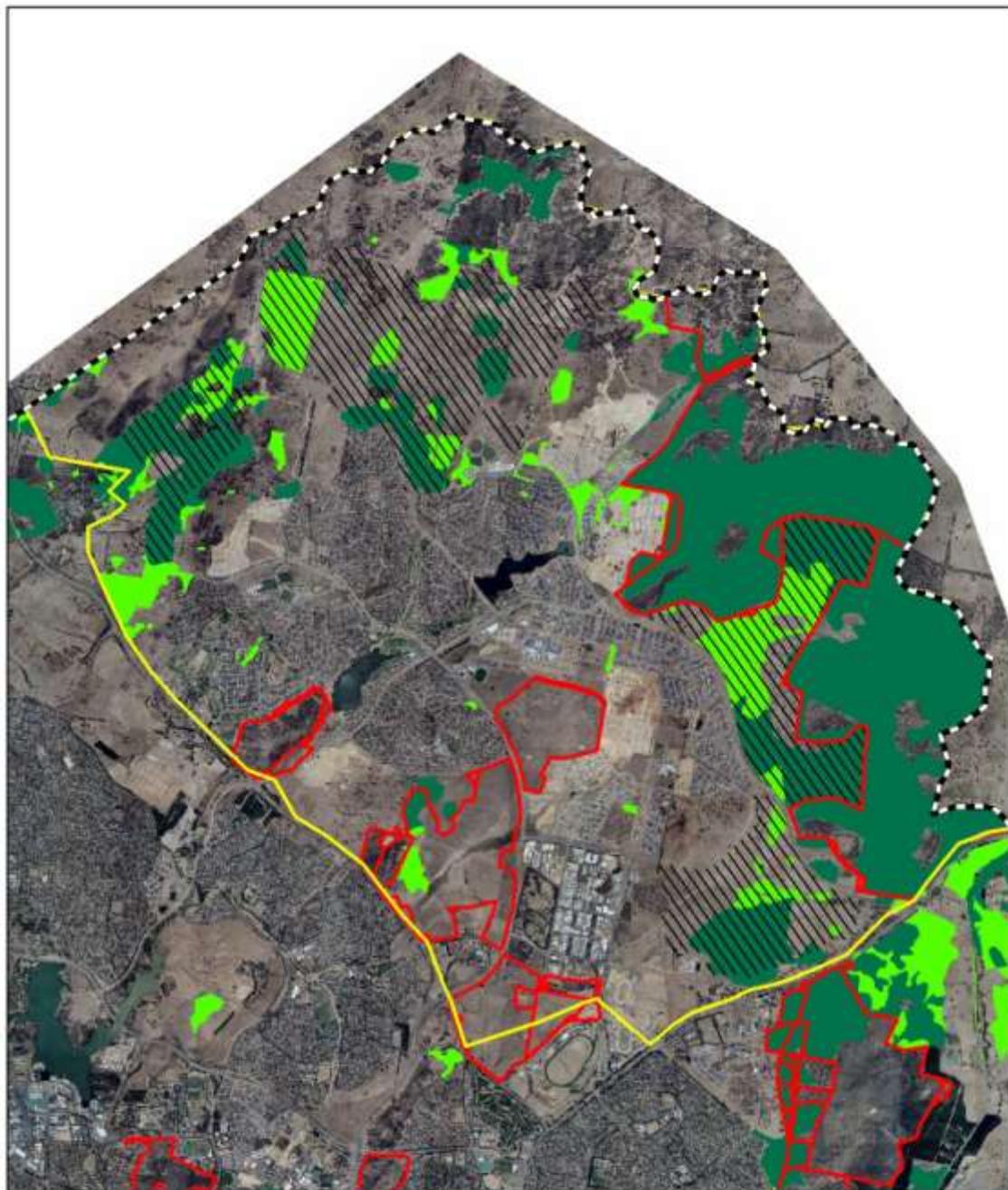
About two-thirds of the remaining box – gum woodland in Gungahlin that meets EPBC listing criteria is reserved.

**Table 4 Extent of box – gum woodland in the ACT and in ACT conservation reserves**

Location	Estimated pre-European extent (ha)	Area remaining (ha)	Area remaining, percentage of pre-European	Area of remaining woodland listed under EPBC Act (ha)	Area reserved (ha)	Area of woodland listed under EPBC Act reserved (ha)*	Percentage of remaining woodland reserved	Percentage of remaining woodland listed under EPBC reserved
Total ACT	32 000	13 765	43	7980	5699	3246	41	41
Gungahlin	5745	2324*	40	1875**	1200	1160	52	62

\* 17% of total remaining area in ACT (13 765 ha). \*\* 23% of area listed under the EPBC Act in the ACT (7980 ha).

The key conservation consideration in relation to Gungahlin's box – gum woodland is to protect and maintain the large patches and enhance their connectivity and functioning.



#### **1.4 Presence of Locally and Regionally Significant Woodland Plant Species**

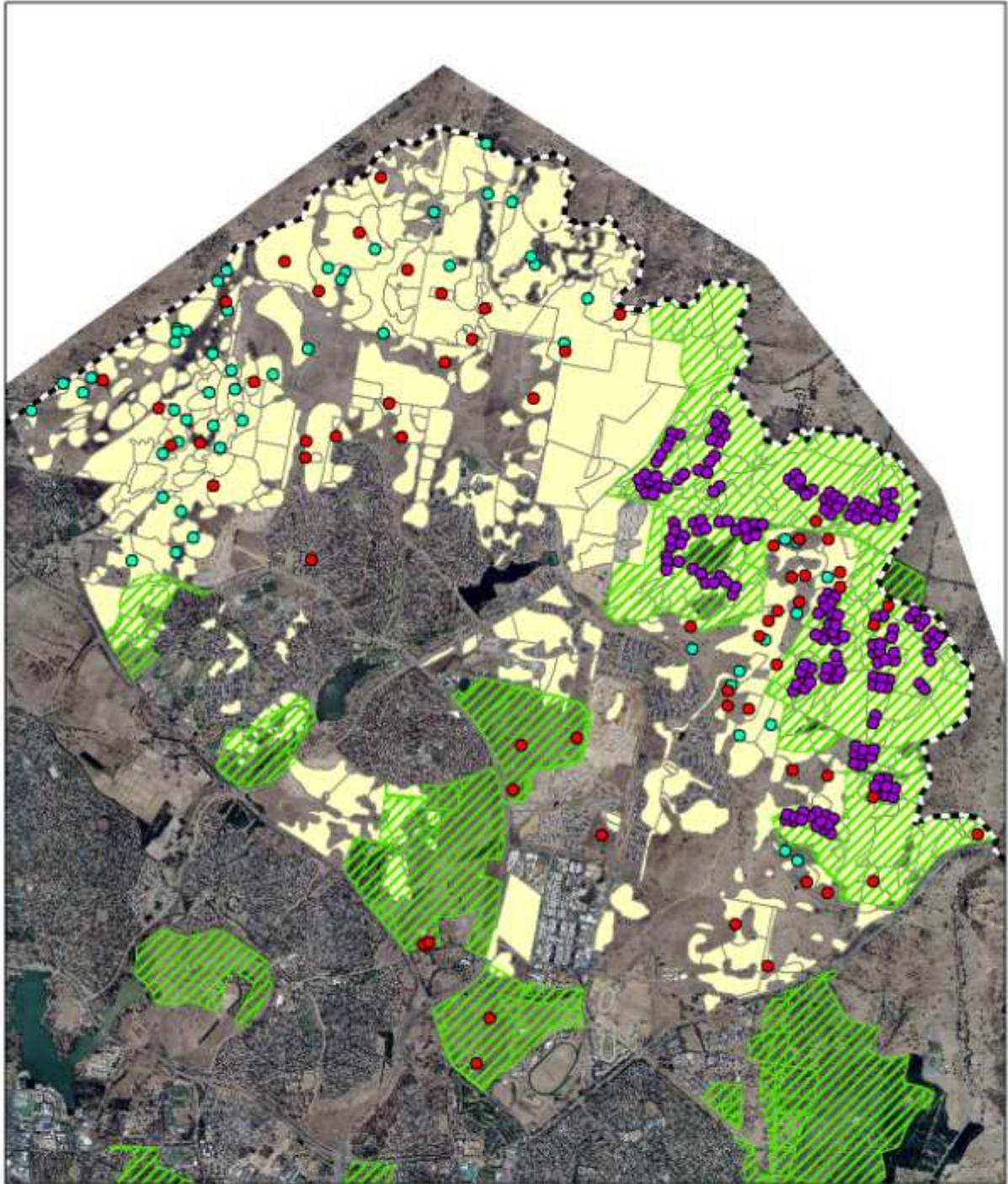
As part of the lowland woodland mapping program undertaken in 2003–2004, species lists were prepared for 310 woodland polygons in Gungahlin and around Hall. Surveys were generally undertaken during spring and included information on all lowland woodland types (about 50% of the polygons surveyed were box – gum woodland). Polygons indicate the extent of woodland patches of the same community type and condition. They are therefore not evenly sized, which makes comparisons between polygons problematic. Nevertheless, hot spots of floristic value across Gungahlin can be gauged by comparing the species composition of individual polygons, and whether species of particular conservation significance tend to be clustered in certain areas. Analysis of the polygons also enables consideration of how well the existing reserve network incorporates the plant diversity present across the whole of Gungahlin, particularly of plant species that occur in the box – gum woodland community. The location of the 310 polygons is shown in Figure 4.

Across the Gungahlin woodland polygons, 331 native plant species (indigenous to the ACT) have been recorded, with a total of about 10 000 records of individual native plants. Locally rare species of interest were determined to be those species which occurred in five or less of the 310 woodland polygons, or which occurred in 6–10 of the polygons, but only five or less of these polygons were within existing conservation reserves. Those genera, in which it is difficult to distinguish between species such as *Juncus* and *Wahlenbergia*, were excluded from the analysis. Locally rare species are listed in Table 5.

In addition to the plants listed in Table 5, consideration was given to species that, in an ACT context, are threatened, rare, have a highly restricted distribution, or are of biogeographic importance (e.g. endemic to the ACT or at their distribution limit). Such a list of important ACT plants, comprising 162 species, was recently compiled by Conservation Planning and Research (ACT Government). Of these ACT-wide significant species, 19 have recently been recorded in Gungahlin (Table 6).

In addition to the 310 woodland polygons surveyed as part of the lowland woodland survey, comprehensive plant species data was collected along 78 transects established in northern Gungahlin by Eco Logical Australia (2011); from 39 (20 m x 20 m) plots established by Conservation Planning and Research; and by Butler and Associates (2010). In addition, between 12/10/2007 and 27/11/2007, McIntyre et al. (2010) surveyed 96 sites within Mulligans Flat and Goorooyarroo nature reserves. At each site, 30 (0.5 m x 0.5 m) quadrats were used to determine the six plant species that contributed most to the understorey dry weight biomass. Thus the data from McIntyre et al. is not a comprehensive species list, but does provide a good indication of those species that have a common presence in the understorey within the two large Gungahlin woodland reserves.

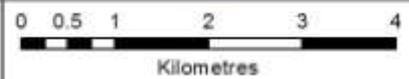
In total, the presence of locally uncommon species and those of significance in an ACT context were searched for within 523 polygon or plot locations across Gungahlin. These location points are shown in Figure 4. In the analysis, locally rare and significant species identified in plot or site data were added to the list of plant species recorded in the relevant woodland polygon, as per the lowland woodland survey.



**Figure 4**  
Analysed Data

**Legend**

- Ecological Transects (n=78)
- 20 m x 20 m Plots (n=39)
- McIntyre et al. sites (n=96)
- Reserve
- Surveyed Woodland Polygons (n=310)



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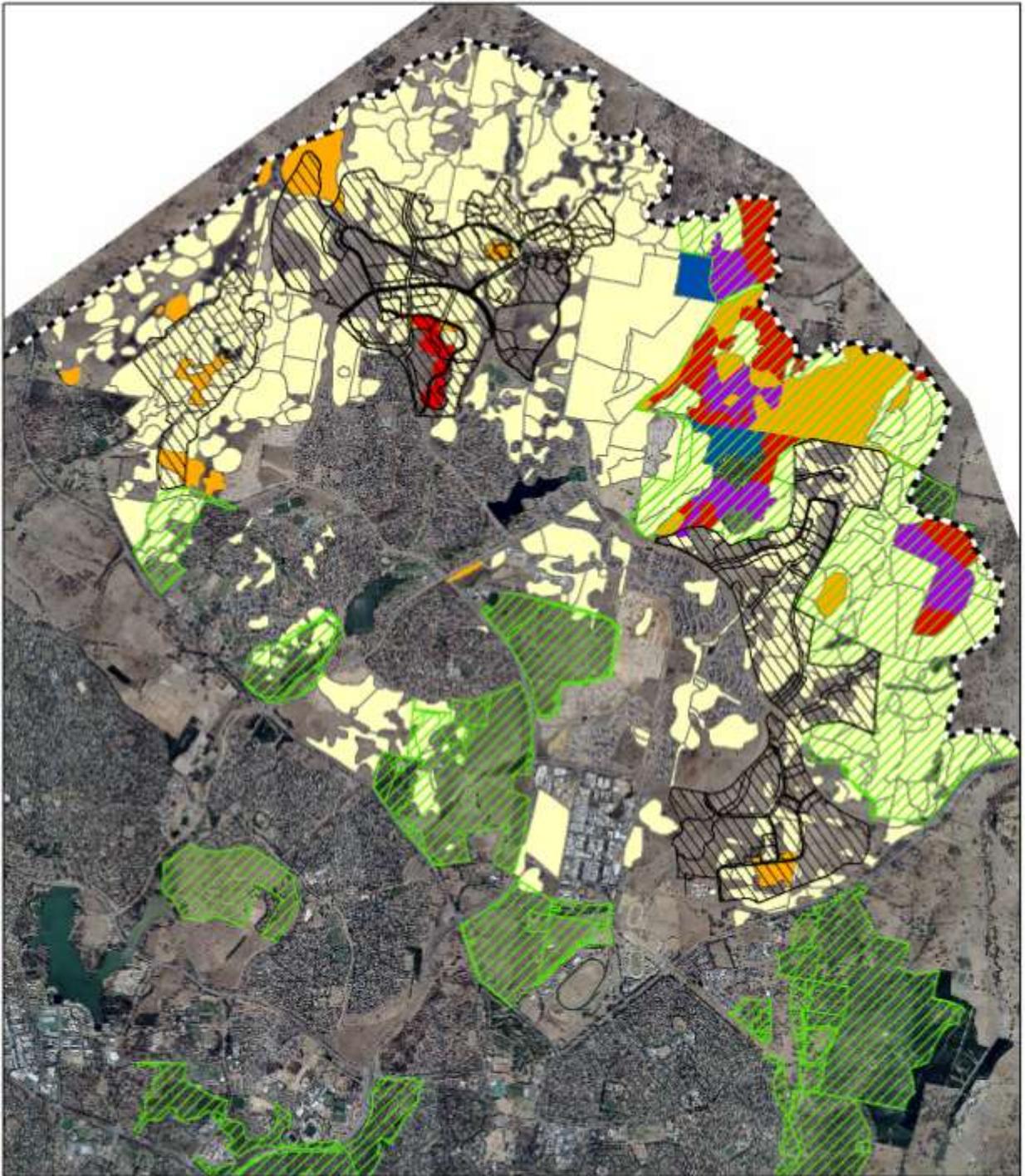
**Table 5 Locally rare plant species found in Gungahlin**

<i>Acacia buxifolia</i>	<i>Clematis microphylla</i>	<i>Gompholobium huegelii</i>	<i>Polygonium plebium</i>
<i>Acacia genistifolia</i>	<i>Cotula australis</i>	<i>Gonocarpus elatus</i>	<i>Pomaderris angustifolia</i>
<i>Acacia melanoxylon</i>	<i>Craspedia glauca</i>	<i>Grevillea juniperina</i>	<i>Poranthera microphylla</i>
<i>Acacia paradoxa</i>	<i>Crassula decumbens</i>	<i>Helichrysum scorpioides</i>	<i>Potamogeton tricarinatus</i>
<i>Acacia rubida</i>	<i>Cullen micocephalum</i>	<i>Hibbertia calycina</i>	<i>Pratia purpurascens</i>
<i>Acaena echinata</i>	<i>Cullen tenax</i>	<i>Hibbertia riparia</i>	<i>Pterostylis</i> sp.
<i>Acaena novae-zelandiae</i>	<i>Cymbopogon refractus</i>	<i>Indigofera adesmiifolia</i>	<i>Pultenaea microphylla</i>
<i>Ajuga australis</i>	<i>Cynoglossum australe</i>	<i>Isoetopsis graminifolia</i>	<i>Ranunculus inundatus</i>
<i>Alternanthera denticulate</i>	<i>Cyperus gunnii</i>	<i>Isolepis hookeriana</i>	<i>Ranunculus papulentus</i>
<i>Alternanthera</i> sp.	<i>Daviesia mimosoides</i>	<i>Leptospermum continentale</i>	<i>Ranunculus pumilio</i>
<i>Amphibromus neesii</i>	<i>Desmodium brachypodium</i>	<i>Leptospermum multicaule</i>	<i>Rubus parvifolius</i>
<i>Amphibromus nervosus</i>	<i>Deyeuxia quadriseta</i>	<i>Leptospermum myrtifolium</i>	<i>Rutidosis leptorrhynchoides</i>
<i>Aphanes australiana</i>	<i>Dianella longifolia</i>	<i>Leucochrysum albicans</i>	<i>Scleranthus diander</i>
<i>Aristida behriana</i>	<i>Dichelachne crinita</i>	<i>Leucopogon virgatus</i>	<i>Senecio hispidulus</i>
<i>Arthropodium milleflorum</i>	<i>Dichelachne hirtella</i>	<i>Limosella australis</i>	<i>Solenogyne gunnii</i>
<i>Asplenium flabellifolium</i>	<i>Dichelachne micrantha</i>	<i>Linum marginale</i>	<i>Sorghum leiocladum</i>
<i>Brachyscome dentata</i>	<i>Dillwynia phyllicoides</i>	<i>Lomandra bracteata</i>	<i>Sporobulus creber</i>
<i>Brachyscome rigidula</i>	<i>Diuris chryseopsis</i>	<i>Lomandra longifolia</i>	<i>Stypandra glauca</i>
<i>Burchardia umbellata</i>	<i>Diuris sulphurea</i>	<i>Lotus australis</i>	<i>Swainsona recta</i>
<i>Caesia calliantha</i>	<i>Eleocharis gracilis</i>	<i>Luzula campestris</i>	<i>Swainsona sericea</i>
<i>Petalochilus carnea</i>	<i>Eleocharis pusilla</i>	<i>Marsilea hirsuta</i>	<i>Thelymitra ixioides</i>
<i>Petalochilus dimorpha</i>	<i>Eriochilus cucullatus</i>	<i>Montia fontana</i>	<i>Thelymitra pauciflora</i>
<i>Petalochilus fuscata</i>	<i>Erodium crinitum</i>	<i>Myosotis australis</i>	<i>Thesium australe</i>
<i>Caladenia gracilis</i>	<i>Eucalyptus pauciflora</i>	<i>Oreomyrrhis eripoda</i>	<i>Thysanotus patersonii</i>
<i>Carex bichenoviana</i>	<i>Eucalyptus polyanthemus</i>	<i>Pentapogon quadrifidus</i>	<i>Tripogon loliiformis</i>
<i>Carex tereticaulis</i>	<i>Eucalyptus stellulata</i>	<i>Persicaria decipiens</i>	<i>Typha domingensis</i>
<i>Cassinia aculeata</i>	<i>Eucalyptus viminalis</i>	<i>Pimelea glauca</i>	<i>Velleia paradoxa</i>
<i>Centipeda cunninghamii</i>	<i>Geranium antrorsum</i>	<i>Pimelea linifolia</i>	<i>Veronica calycina</i>
<i>Centipeda minima</i>	<i>Geranium retrorsum</i>	<i>Poa induta</i>	<i>Veronica gracilis</i>
<i>Cheiranthra linearis</i>	<i>Glossodia major</i>	<i>Polygala japonica</i>	

**Table 7 Significant ACT plants recorded in Gungahlin**

<i>Aristida behriana</i>	<i>Desmodium brachypodium</i>	<i>Limosella australis</i>	<i>Rutidosis leptorhychoides</i>
<i>Bossiaea prostrata</i>	<i>Dianella longifolia</i>	<i>Lotus australis</i>	<i>Swainsona recta</i>
<i>Caesia calliantha</i>	<i>Hydrocotyle peduncularis</i>	<i>Microseris lanceolata</i>	<i>Thesium australe</i>
<i>Cheiranthra linearis</i>	<i>Indigofera adesmiifolia</i>	<i>Polygala japonica</i>	<i>Thysanotus patersonii</i>
<i>Cullen tenax</i>	<i>Leucochrysum albicans</i>	<i>Polygonium plebium</i>	

Figure 5 illustrates the number of different ACT significant plant species found within each of the 310 lowland woodland polygons. Most of the significant plants are found only in polygons within Mulligans Flat Nature Reserve. Significant plants are also found in a few polygons within Gorooyarroo Nature Reserve, at Bonner East, in the secondary grassland in the proposed urban area of Moncrieff, and in the Hall–Kinlyside area.



**Figure 5**  
**ACT**  
**Significant**  
**Plants**

**Legend**

- |  |   |   |   |   |
|--|---|---|---|---|
|  Future urban areas |  Reserve |   |   |   |
| Number of significant plants recorded in woodland polygons   |   |   |   |   |
|  0                  |  1       |  2 |  3 |  4 |

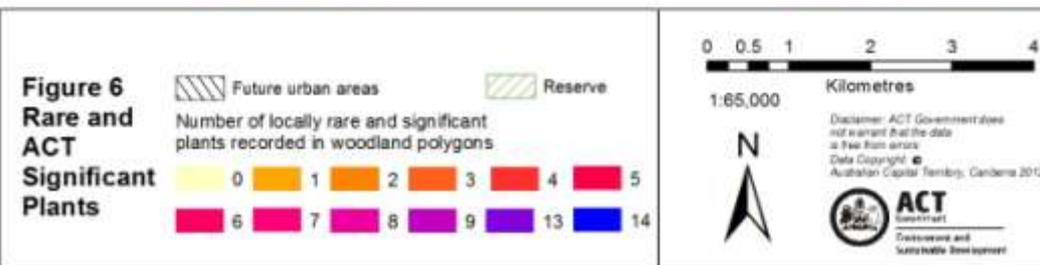
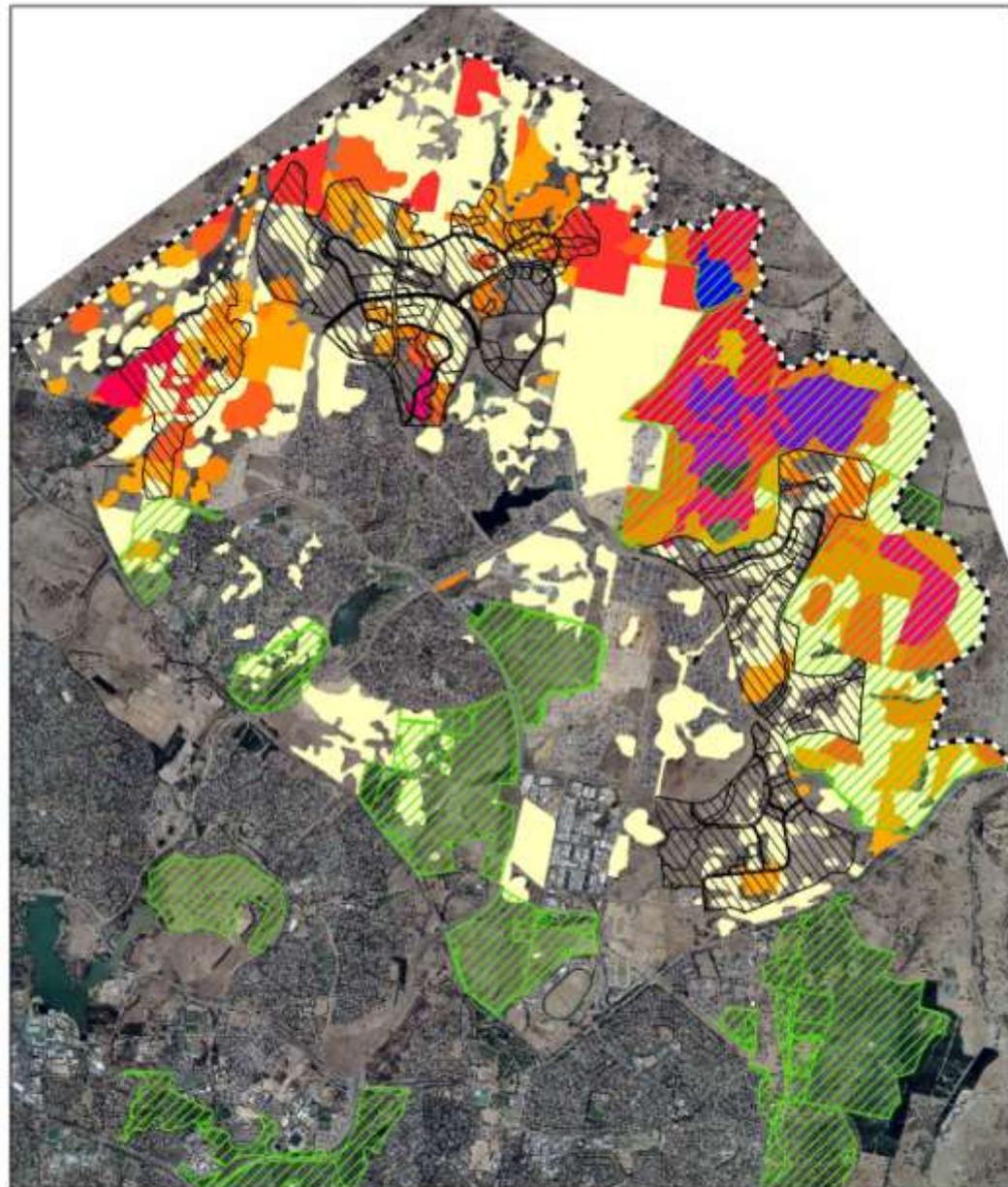
0 0.5 1 2 3 4  
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1:65,000



Disclaimer: ACT Government does not warrant that the data is free from errors  
Data Copyright © Australian Capital Territory, Canberra 2012  
 **ACT**  
Government  
Delivering and Sustaining Development

Figure 6 illustrates the number of ACT significant plants together with the number of locally rare species recorded in each of the 310 lowland woodland polygons. In addition to the areas highlighted by the analysis of significant species only, the rural lease to the north-west of Bonner, the north-eastern section of Jacka, and the north-western section of Taylor have a concentration of important plant species.



## 1.5 Natural Temperate Grassland

Natural Temperate Grassland is a native ecological community that is dominated by native species of perennial grasses. There is also a diversity of other native herbaceous plants present. The community is naturally treeless or has a very small presence of trees, shrubs and sedges. Natural Temperate Grassland is declared an endangered ecological community under both the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) and the *Nature Conservation Act 1980* (ACT). A Recovery Plan has been prepared for the ecological community under the EPBC Act (Environment ACT 2005) and an Action Plan under the NC Act (ACT Government 2005).

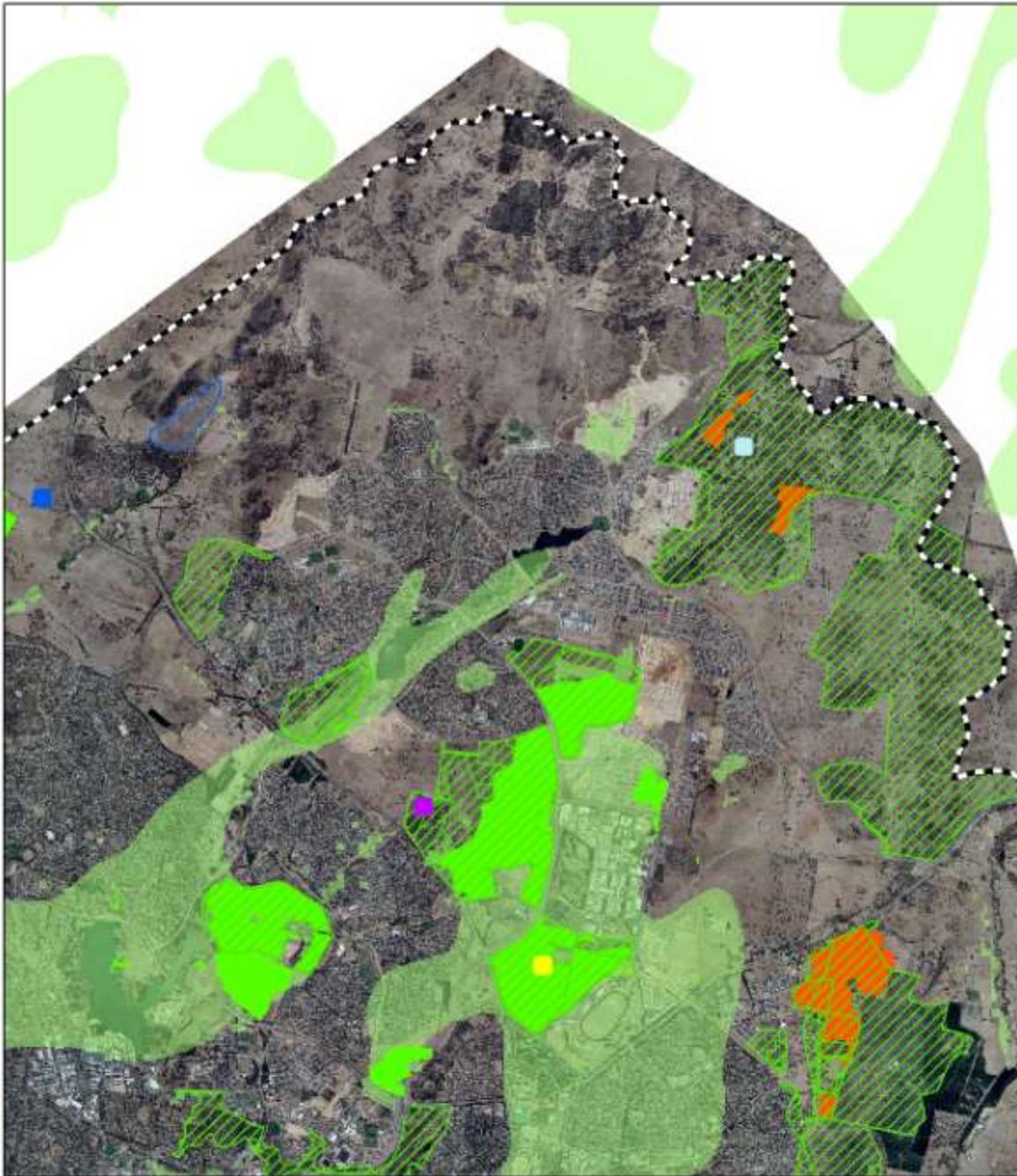
There are about 180 ha of Natural Temperate Grassland and a further 166 ha of closely associated native pasture (which may regenerate to the extent that it can be classified as Natural Temperate Grassland) remaining in Gungahlin. This is about 18% of the total remaining area of this grassland community in the ACT. In Gungahlin, 162 ha (90%) of Natural Temperate Grassland is within three nature reserves. Less than 2 ha of the remaining Natural Temperate Grassland is within a development zone. No mapped Natural Temperate Grassland occurs within a proposed urban development area, though a 0.2 ha site within the Wells Station Road reserve abuts the proposed suburb of Kenny. There may be further similar sized and low diversity patches of Natural Temperate Grassland in that part of Kenny which once supported grassland.

The current and estimated pre-European extent of Natural Temperate Grassland is shown in Figure 7. Table 7 indicates the size and current management of remaining patches. Overall, the proposed urban development in Gungahlin will not have a significant impact on Natural Temperate Grassland.

**Table 7 Natural Temperate Grassland (NTG) in Gungahlin**

Grassland site	NTG area (ha)	Area of native pasture*	Current management
Mulanghari Nature Reserve	58.6	9.4	Nature reserve
Gungaharra Nature Reserve	41.9	115.2	Nature reserve
Crace Nature Reserve	61.5	41.2	Nature reserve
North Mitchell	14.8	-	Non-urban, Hills, Ridges and Buffers (NCA 2011; ACTPLA 2011)
Mitchell	1.6	-	Vacant Land (General Use and Industrial) (ACTPLA 2011)
Canberra Riding Club	0.3	-	Community Lease
Wells Station Road	0.2	-	Road reserve
Nicholls	-	0.3	Nature reserve
<b>Total</b>	<b>179</b>	<b>166</b>	

\*May recover to the extent that it can be classified as Natural Temperate Grassland.



## 2 Threatened Plant Species

As detailed below, the known location of all threatened plant species that have been recorded in Gungahlin are within existing nature reserves, with populations being monitored and managed for conservation.

### 2.1 Hoary Sunray (*Leucochrysum albicans*)

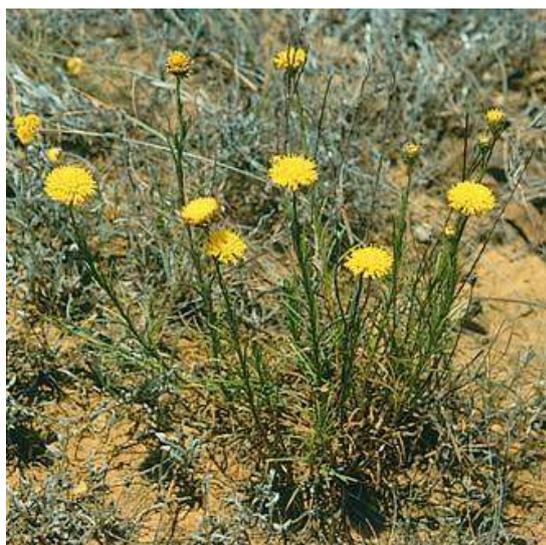
Status: Endangered (EPBC Act)



The hoary sunray is a low tufted to mounding perennial, to 30 cm tall, with silver foliage and usually a white everlasting daisy flower head, with a yellow centre. The only known occurrence of this daisy in Gungahlin is in Mulligans Flat Nature Reserve. Large populations occur to the east of Gungahlin in Majura Training Area and the Mt Ainslie and Mt Majura nature reserves. This is a distinctive perennial plant and as there has been a high level of woodland survey across Gungahlin, it is highly unlikely that the species occurs within proposed development areas. It is unlikely to occur outside of Mulligans Flat Nature Reserve. Figure 7 illustrates the distribution of hoary sunray habitat in Gungahlin.

### 2.2 Button Wrinklewort (*Rutidosis leptorrhynchoides*)

Status: Endangered (EPBC Act) Endangered (NCA Act)



The button wrinklewort is a slender perennial daisy, 25 –35 cm tall with up to 30 leafy green stems, branching mainly at the base. The plant has bright yellow button flowers (2 cm wide) from December to April. A population of about 5000 plants occurs in Crace Nature Reserve. This is the only known occurrence of the plant within Gungahlin. The plant is a distinctive perennial and is highly unlikely to occur in any of the proposed development areas and is unlikely to occur elsewhere in Gungahlin.

### 2.3 Tarengo Leek Orchid (*Prasophyllum petilum*)

Status: Endangered (EPBC Act) Endangered (NCA Act)



The Tarengo leek orchid is a slender ground orchid 15–30 cm in height with one or two dark green leaves. Flowers are pink mauve with greenish tinges, about 5–7 mm across in a spike of 4–8 cm long. Growing among taller grasses, it is inconspicuous even when in flower. Hall Cemetery, with a population of between 50 to 100 plants, is the only known ACT location of this orchid.

Tarengo leek orchid is known from three sites in NSW. The species occurs on fertile soils in grassy woodland or natural grassland. At Hall the orchid occurs in moist locations. Given the inconspicuous nature of the species it could possibly be present in Gungahlin. If it does occur it is highly likely that it would be in an area that supports a high diversity of understorey plants, including many of the sensitive species tabled previously. The Gungahlin grassland reserves, Mulligans Flat Nature Reserve and to a lesser extent the suburb of Moncrieff, have been subject to extensive and detailed flora surveys so it is unlikely that the orchid occurs in these areas. Just to the east of Hall, there is a diverse patch of moist secondary kangaroo grass (*Themeda triandra*) grassland, which appears to provide similar habitat to that of Hall Cemetery. Part of this patch is within the proposed Kinlyside future urban area. The location of this potential habitat is shown in Figure 7. This area will be subject to targeted survey for the orchid, during a time when flowering is occurring within the Hall Cemetery population. It is proposed that this area of Kinlyside will now not be developed and will instead form part of a biodiversity offset area.

## 2.4 Small Purple Pea (*Swainsona recta*)

Status: Endangered (EPBC Act) Endangered (NCA Act)



The small purple pea is a slender erect perennial plant producing several rigid stems 20–30 cm high. The leaves are pinnate, 5–7 cm long with 7–11 narrow leaflets.

The flowers are purple or bluish, borne in spikes numbering 10 to 21, which are 10–27 cm long. The plant is conspicuous in spring but outside of this time dies back to its root stock. In the spring of 1986, a number of seedlings of the species were recorded in grassland on the western slope of Mt Gungahlin, which is now within the Gungaherra Nature Reserve. The species has not been observed there since and may have been a mis-identification, or it is possible that the record relates to plantings of the species. Given the high level of spring survey across suitable habitats in Gungahlin, it is unlikely that the species occurs within any of the proposed development areas.

## 2.5 Austral Toadflax (*Thesium australe*)

Status: Vulnerable (EPBC Act)



Photo: Simon Allender NPWS

Austral toadflax is a semi-parasitic straggling perennial herb to 40 cm high that appears to be strongly associated with kangaroo grass (*Themeda triandra*) dominated groundcover. Leaves are pale green to yellow-green, somewhat succulent, 1–4 cm long and 0.5–1.5 mm wide. Flowers are minute and white, emerging where the leaves meet the stems and appearing in spring. Although perennial, this plant is fairly inconspicuous, often being hidden amongst grasses and other herbs. About 50 plants occur in one location within Mulligans Flat Nature Reserve. This is the only known location of the species in Gungahlin.

### 3 Relative Floristic Quality of Grasslands and Grassy Woodlands

Since the 1990s, floristic data (plant species lists and cover abundance) has been collected in a standard way from grassy ecosystem sites across southern New South Wales and the ACT. Grassy ecosystem sites are native grassland including Natural Temperate Grassland, and lowland woodlands including White Box – Yellow Box – Blakely’s Red Gum Grassy Woodland and Derived Native Grasslands. Information has been collected from over 1000 sites in the region using a standardised method and relative floristic value calculated for each site. Therefore, the data set enables the floristic value of grassland and woodland sites within Gungahlin to be compared with one another and across the wider region. The assessment method is described in detail by Rehwinkel (2007).

In summary, floristic value is determined by the number and cover abundance of the significant species present. The method requires that within polygons or vegetation patches of similar condition and type, 20 m x 20 m quadrats are located. Quadrats are placed in locations that are in the best condition in terms of native species cover and richness. A small polygon or vegetation patch will usually only require one quadrat, but multiple quadrats may be required in larger areas. Within each 20 m x 20 m quadrat all plant species are recorded and their cover abundance assessed according to the Braun – Blanquet scale:

r	<5% cover and solitary (<4 individuals)
+	<5% cover and few (4–15 individuals)
1	<5% cover and numerous/scattered (>15 individuals)
2	5% – 25% cover
3	26% – 50% cover
4	51% – 75% cover
5	>75% cover

The floristic value of the quadrat is determined by the number, type and cover abundance of significant species in each quadrat. Rehwinkel (2007) applied a significance score to the 650 plant species that occur within the grassy ecosystems of the region. Each species was placed into one of the following three groups:

1. Common or increaser species, which do not add much to the value of a site, and are not included in the analysis of floristic value
2. ‘Indicator species, level 1’, which indicate that the site has value
3. ‘Indicator species, level 2’, which are the highly significant species. These are the rarest of the grassy ecosystem species and have the highest significance scores.

Increaser (or no value) species may be rarely or commonly recorded in quadrats across the region, but are characterised by reacting positively to disturbance such as stock grazing and are common in disturbed sites. Common species are found in more than 20% of the total number of quadrats

surveyed across the region. Indicator species are rarely recorded in quadrats and are also referred to as 'grazing-intolerant' or 'declining' species. It is thought that these species are rare for two reasons:

- Some species have always been rare, particularly some species which are restricted in distribution.
- Many species are thought to have undergone serious declines since European settlement, from disturbances such as over-grazing and application of fertilisers. This is based upon analysis of the data and observations of where such species still occur. The sites with the greatest concentrations of significant species today include cemeteries, road and rail reserves, and sites such as travelling stock reserves and on private land where grazing has been either non-existent or light.

Floristic value is determined by adding the total number of indicator species found within a quadrat, except for indicator level 1 species that have 4 or less plants occurring within a quadrat. There is also an additional score according to the total number of indicator species (both level 1 and 2) that occur within a quadrat at cover abundance greater than 5% or with more than 4 occurrences. A data sheet from a site in Moncrieff is attached at Appendix 1. The sheet illustrates the species classifications and scoring.

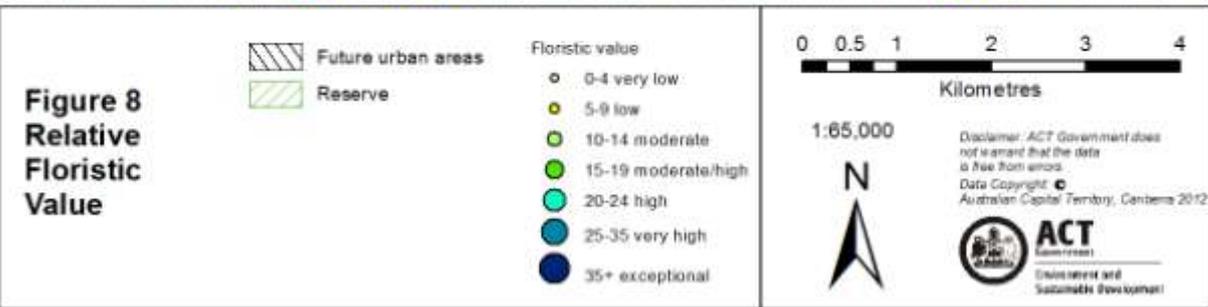
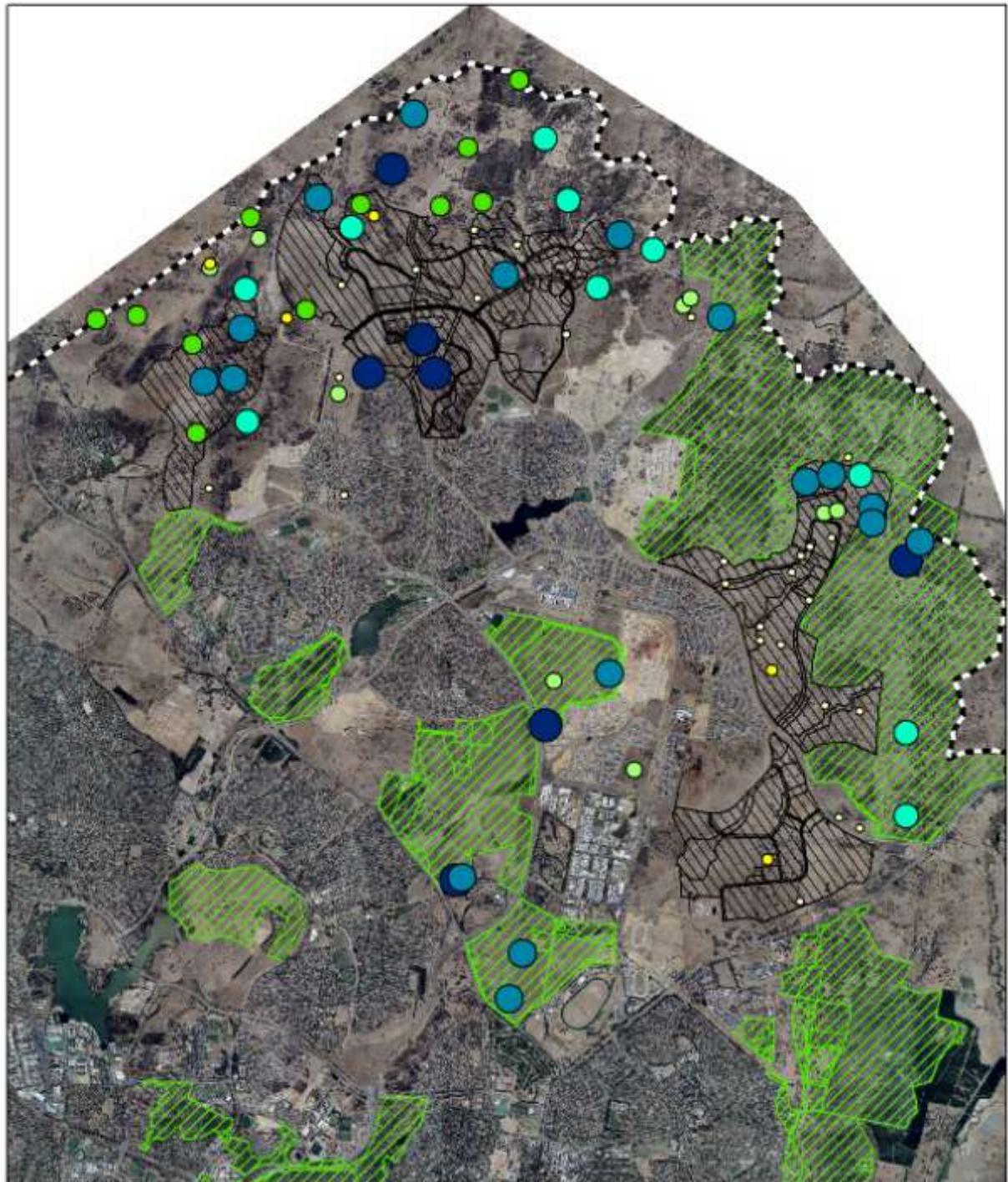
Across the ACT and north-western sub-region of the Southern Tablelands covering part of the Murrumbidgee River and Lachlan River catchments (including Boorowa, Crookwell, Yass, Gunning, Gundaroo and Queanbeyan Local Government Areas), floristic scores range from 0 to about 60. In terms of relative floristic value the scores refer to the following:

<5	little floristic value, and dominated by exotic species and/or common native species
5–9	low floristic value
10–14	moderate floristic value with a few significant species
15–19	moderate to high floristic value
20–24	high floristic value, many significant species present
25–35	very high floristic value
35+	exceptional floristic value, site of very high diversity with numerous significant species present.

Plot data according to the Rehwinkel (2007) method has been collected from 88 grassy ecosystem sites across Gungahlin. The location of these sites together with the floristic value scored at each site is shown in Figure 8.

In general much of the native vegetation within Gungahlin, particularly that around the northern and north-eastern rim, has high floristic value in comparison to that found within grassy ecosystems across the wider ACT and south-east NSW region. Amongst the Gungahlin plot locations there is a concentration of plots with exceptional floristic quality in the southern half of Moncrieff, Mulanggari Grassland Reserve, Goorooyaroo Nature Reserve, the National Transmission Station on Bellenden

Street, and on a rural lease north of Taylor. Areas of high and very high floristic diversity include North Throsby, much of Kinlyside, Crace Nature Reserve, the rural lease to the north of Bonner, some of the patches of woodland remaining in Jacka, and the north-western part of Taylor. Only one plot, consistent with the Rehwinkel method, has been established in Mulligans Flat Nature Reserve, and it records very high floristic value. It is probable that if more plots were placed across this reserve they would record high, very high or exceptional floristic value. Across Gungahlin, areas with relatively low floristic value include much of Jacka, Taylor, Kenny and the southern section of Throsby.



## 4 Horse Park Wetland

Horse Park Wetland is considered to be of national importance and is listed in the *Directory of Important Wetlands in Australia* (Australian Government 2011b). The wetland is also listed in the Register of the National Estate as important habitat of Latham's snipe and as containing one of the best regional examples of a permanent, lowland freshwater marsh. (Note that the Register of the National Estate ceases to have a statutory basis from February 2012.) A draft provisional statement on the cultural and natural values of the wetland have been prepared as part of the consideration to add the wetland onto the ACT Heritage Register.

The Horse Park Wetland covering 40 ha was formed by Horse Park Creek flowing through a valley constricted by two ridgelines. Alluvium, originating from the eroding ridgelines and from reduced creek flow velocity within the low lying area has created a flat valley, which forms a wide flood plain for the creek. The wetland is fed from local rainfall over a small catchment of about 685 ha. The site is inundated after heavy rain and provides a temporary wetland habitat which attracts many waterbirds, including Latham's snipe. The latter is covered by international agreements for the protection of migratory birds (s. 5) and is seen at only a small number of locations in and around the ACT.

The present wetland is a relic of a larger hydrological system. The effects of more than a century of farming and land clearing have reduced an area that once occupied much of the valley of Horse Park Creek and its tributaries to the small Y shape wetland of today, that is largely associated with the main channel. Grazing by sheep and cattle continues on the wetland and surrounding land, which has facilitated weed invasion.

The vegetation of the wetland is an open sedgeland dominated by *Carex* and *Juncus* species including *J. australis*, *J. vaginatus*, *J. sarophorus* and the introduced *J. articulatus*. Tall sedge (*Carex appressa*) and *C. tereticaulis* form clumps over a metre high with *C. appressa* dominating the wetland area. Isolated ponds, farm dams, creek channels and wet hollows carry *Myriophyllum*, *Potamogeton* and aquatic plants (Lintermans and Ingwersen 1996).

Wetlands of this size and integrity are rare in Gungahlin and the site supports several plants that are locally rare including *Baumea* sp., *Typha domingensis*, *Carex tereticaulis*, *Potamogeton tricarinatus*, *Myriophyllum crispatum*, *Phragmites australis*, *Cotula australis* and *Nymphoides crenata*.

There are significant Aboriginal sites associated with the wetland and it is the only known remaining area in the ACT where Aboriginal artefact scatters are associated with lowland wetland food resources (National Trust of Australia (ACT) 2000). These artefact scatters have not been previously excavated and are relatively undisturbed, providing an excellent opportunity for investigative studies. There is also a complex of historic buildings associated with the wetland. This complex includes an original stone residence dating from 1853, a weatherboard extension, a slab building, woolshed and other rural structures which demonstrate the evolution of building practices. Horse Park is one of the oldest continuously occupied residences in the ACT.

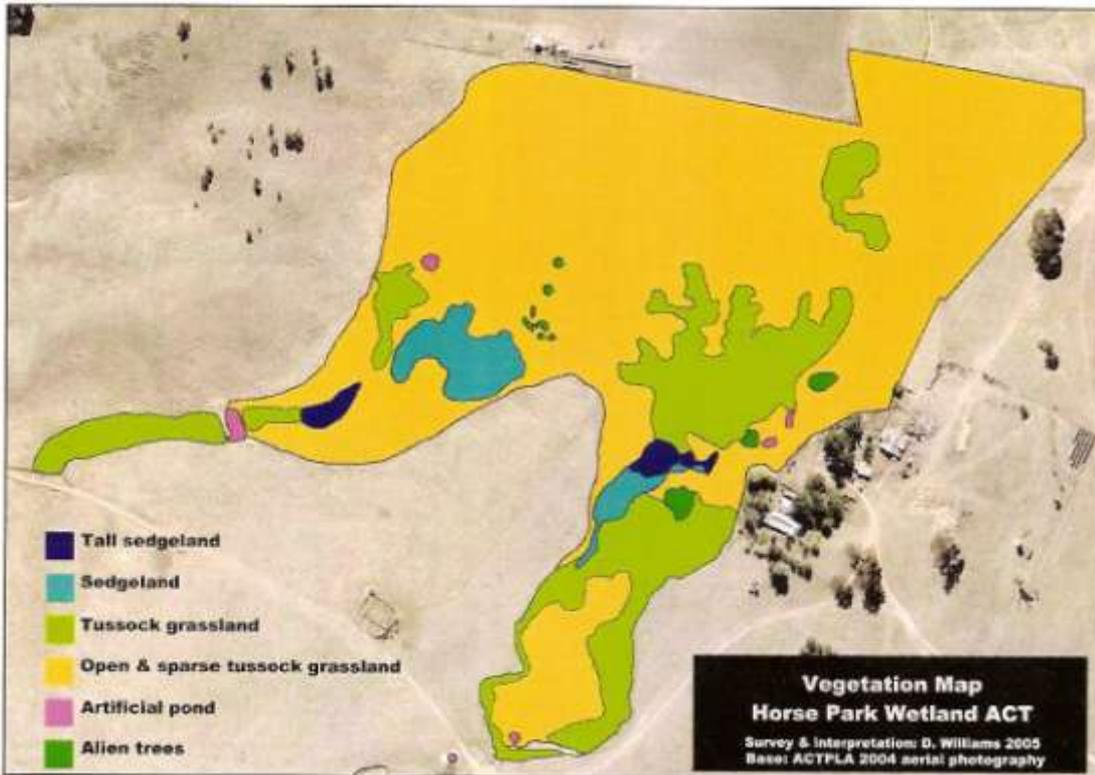


Figure 9 Horse Park Wetland ACT: vegetation map

## 5 Threatened, Migratory and Uncommon Bird Species

This section contains species that are listed as threatened under the Environment Protection and Biodiversity Conservation Act and the Nature Conservation Act, as well as uncommon species. It also contains those bird species included in the Migratory Bird Agreement between Japan and Australia (JAMBA); the Migratory Bird Agreement between the People’s Republic of China and Australia (CAMBA); the Migratory Bird Agreement between the Republic of Korea and Australia (ROKAMBA); and the Convention on the Conservation of Migratory species of Wild Animals (The Bonn Convention) (Australian Government 2011c, 2011d). The EPBC Act provides for protection of migratory bird species as a matter of ‘national environmental significance’. The status of migratory species referred to below (s. 5.1, s. 5.3) is based on *EPBC Migratory Species Lists* (Australian Government 2011d).

### 5.1 Migratory Wetland Birds

#### 5.1.1 Latham’s Snipe (*Gallinago hardwickii*)

**Status: JAMBA, CAMBA, ROKAMBA, Bonn Convention; migratory species (EPBC Act)**

Latham’s snipe are seasonal migrants, leaving their breeding grounds in Japan to overwinter in Australia. Snipe arrive in the ACT in mid-August and depart in late-February/March. In the lowland Canberra region, the preferred habitat of Latham’s snipe is shallow freshwater marshes and bogs (Lintermans 1993). Basic habitat requirements for Latham’s Snipe include suitable night-time and day-time feeding habitat, and roosting sites. A study of snipe feeding ecology in the lower Hunter

Valley found that the most commonly used foraging habitat of Latham's snipe was firm mud, and the most common food items were Coleoptera adults/larvae (beetles) and Diptera larvae (Todd 2000).

Snipe surveys were conducted at Horse Park Wetland between 1992 and 2000. Five surveys were undertaken per season (September, October, November, January and February). During the initial surveys in 1992–93, one transect was walked through the wetland on four occasions in each month. However, in the following site visits, the number of surveys per month was reduced to one, because the maximum count was almost always achieved on the first occasion (Barlow et al. 2005). Annual maximum counts at Horse Park Wetland ranged from six to 20 birds between 1992 and 2000 with the species recorded at the wetland in each year of the surveys. This compares to annual maximum counts of between three and 19 birds at the Jerrabomberra Wetlands over the same period (Barlow et al. 2005).

Snipe prefer different areas of the Horse Park Wetland at different times of the year (Lintermans 1993). They have been recorded from the main wetland adjacent to the homestead, the western drainage line, the bull paddock, and the northern extremity of the wetland along the drainage line (Lintermans 1993).

Latham's snipe utilises other wetland and flooded grassland areas within Gungahlin and has been recorded along Sullivans Creek in the vicinity of Kenny and the Gungahlin Ponds near the town centre. Most of the recent records have been from ponds within Mulligans Flat Nature Reserve.

The key habitat areas for this species in Gungahlin are Horse Park Wetland and Mulligans Flat Nature Reserve, both of which will be protected from development.

### **5.1.2 Australian Painted Snipe (*Rostratula australis*)**

**Status: Vulnerable (EPBC Act)**

The Australian painted snipe is a rare visitor to the ACT (Canberra Ornithologists Group 2011). Three birds visited Jerrabomberra Wetlands in the spring of 2011. Prior to this, the species was last recorded in the ACT in 2007. There are no records of the species from Gungahlin over the last 20 years. The area does not contain significant habitat for this species.

### **5.1.3 Great Egret (*Ardea alba*)**

**Status: JAMBA, CAMBA; migratory species (EPBC Act)**

The great egret is an uncommon visitor to the ACT (Canberra Ornithologists Group 2011). There are 20 records of the species, usually single birds, recorded from Gungahlin. The majority of records are from Yerrabi Ponds. This is a widespread species that nests in colonies outside of the ACT. Gungahlin does not contain significant habitat for this species.

### **5.1.4 Cattle Egret (*Ardea ibis*)**

**Status: CAMBA; migratory species (EPBC Act)**

The cattle egret is an uncommon visitor to the ACT (Canberra Ornithologists Group 2011). There are five records of this species, usually of a few birds, recorded at Yerrabi Ponds and near the crematorium in Gungahlin. This is a widespread species, whose prime breeding locations are distant from the ACT. Gungahlin does not contain significant habitat for this species.

### 5.1.5 White-bellied Sea-eagle (*Haliaeetus leucogaster*)

**Status:** CAMBA; migratory species (EPBC Act)

The white-bellied sea-eagle is an uncommon visitor to the ACT. Sightings are usually only of one bird and are close to a major water body (Canberra Ornithologists Group 2011). The only recorded sightings within the Gungahlin area are of two birds near Hall in 2006. Gungahlin does not contain significant habitat for this species.

## 5.2 Threatened Woodland Birds

Section 5.2 contains woodland birds that are listed under both the Environment Protection and Biodiversity Conservation Act and the Nature Conservation Act (s. 5.2.1 to s. 5.2.3), and those that are listed only under the Nature Conservation Act (s. 5.2.4).

### 5.2.1 Superb Parrot (*Polytelis swainsonii*)

**Status:** Vulnerable (EPBC Act); Vulnerable (NCA Act)



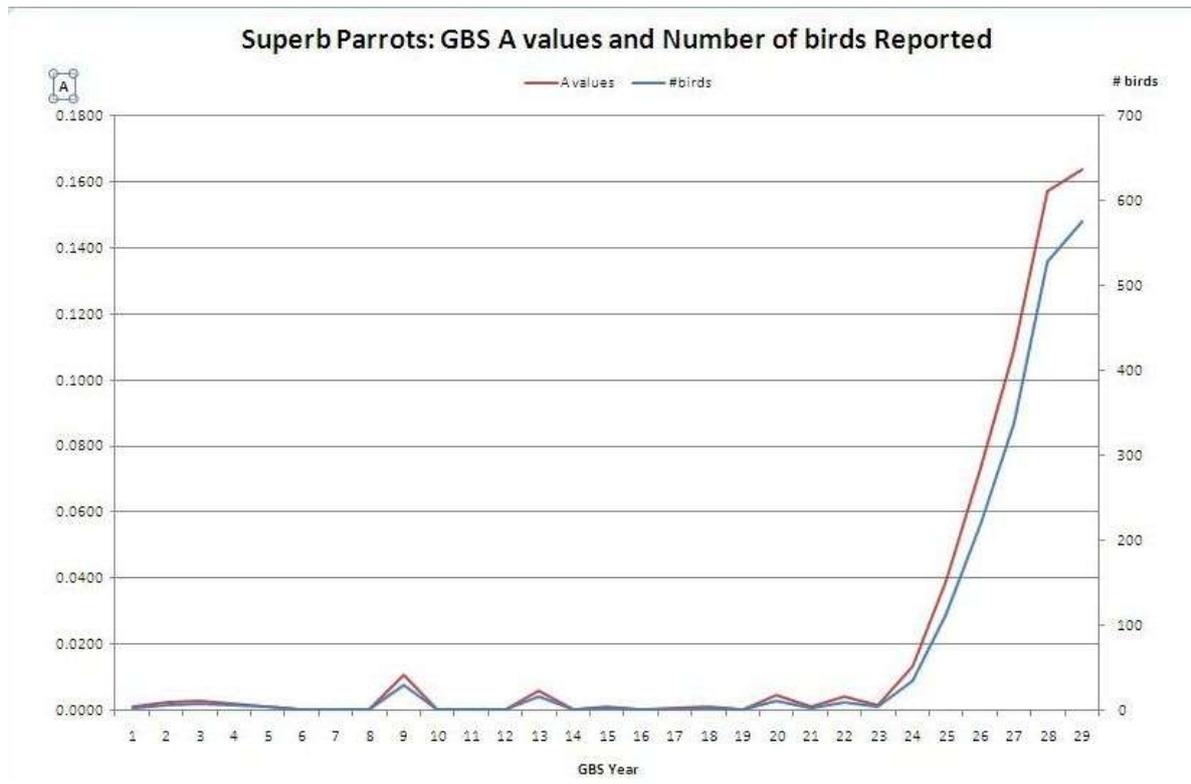
The ACT is on the edge of the summer breeding range for this species, whose distribution is mainly to the west of the ACT. In the summer of 2005–2006 an unprecedented number of superb parrots, including many dependent young, were recorded in north Belconnen. Since then, increasing numbers have been reported from the northern suburbs of Canberra and the Gorooyaroo and Mulligans Flat nature reserves. The rapid rise in the number of birds is evident in the garden bird sighting database (GBS) of the Canberra Ornithologists Group (Figure 10). The reason for the increase is uncertain. It may be due to a real increase in the population size of the species, or to a larger proportion of the superb parrot population being attracted to the ACT to breed because of relatively favourable conditions compared to further west. It could possibly be in response to changing climate.

The garden sightings of superb parrots over the last 6 years are concentrated in Belconnen, mainly focussed in Page, Cook and Fraser (Table 8). Most garden sightings in Gungahlin have been recorded in Harrison. These sightings

include birds that were observed flying overhead. The peak time for garden sightings of the superb parrot is from mid to late December when adults and young birds hatched in that year forage within the Belconnen suburbs.

Across its range the superb parrot usually nests in hollow limbs or holes deep in the trunk of large woodland or riparian eucalypts, usually near a permanent water source. The species nests singly or in small colonies and tends to return to traditional nest sites, though use within a particular year will

depend on conditions. Suitable nesting trees are a critical resource. During nesting (about 10 continuous days from September to December) males travel to and from foraging sites where they collect food for the brooding females. Males and females will both forage for chicks, and frequently join small foraging flocks, which may also consist of non-breeding birds. Superb parrots will forage up to at least 10 km from a nesting site and prefer to utilise vegetated corridors to move between breeding and foraging habitat.



GBS year 20 = 2001/2002, GBS year 24 = 2004/2005, A value = average number of birds of a species recorded at a site for each week of the year.

**Figure 10 Sightings of superb parrots in Garden Bird Surveys by the Canberra Ornithologists Group (Butterfield 2011)**

**Table 8 Sightings of superb parrots in Garden Bird Surveys (Canberra Ornithologists Group), by location (Butterfield 2011)**

SSD	Number of birds	Suburb	Number of birds
BELCONNEN	1151	PAGE	291
GUNGHALIN-HALL	98	COOK	274
KAMBAH	1	FRASER	125
NORTH CANBERRA	26	HARRISON	96
OTHER TUGGERANONG	5	ARANDA	92
WESTON CREEK	1	SCULLIN	87
WODEN	5		

During the breeding seasons of 2009 and 2010 all large hollow bearing trees were searched for signs of breeding activity within the areas of Throsby, Jacka, Kinlyside, Moncrieff, Kenny and Taylor. Parts of Mulligans Flat and Gorooyaroo nature reserves were also searched, where superb parrot activity had been observed during a spring survey for woodland birds, undertaken as part of the Fenner School Research project (Davey 2010, 2011). Records of superb parrot observations were also collated from the general woodland bird surveys, garden bird surveys and bird atlas of the Canberra Ornithologists Group. During spring 2011 further survey of suitable nesting trees was undertaken in the Hall and north Majura Valley areas.

The recorded locations of nesting trees within Gungahlin are shown in Table 9. Breeding is concentrated in the Throsby and Gorooyaroo areas. Of the 38 recorded nesting trees, 22 are within the proposed future suburb of Throsby and 10 are within the adjoining Gorooyaroo Nature Reserve. No nest trees were observed in Kinlyside, Moncrieff, Taylor, Jacka, Hall, north Majura or in the vicinity of the Throsby playing fields and proposed school site.

During spring and summer 2011, woodland between Belconnen and the Molonglo River was searched for superb parrot nesting activity. A similar nesting population to that of the Throsby and Gorooyaroo areas was recorded in Central Molonglo. Some birds may also be nesting in the Pine Ridge – Uriarra area, immediately to the south of the lower Molonglo River. Nesting activity of a single pair had previously been recorded in Central Molonglo in 2006 and 2008.



**Nest Tree at Throsby**

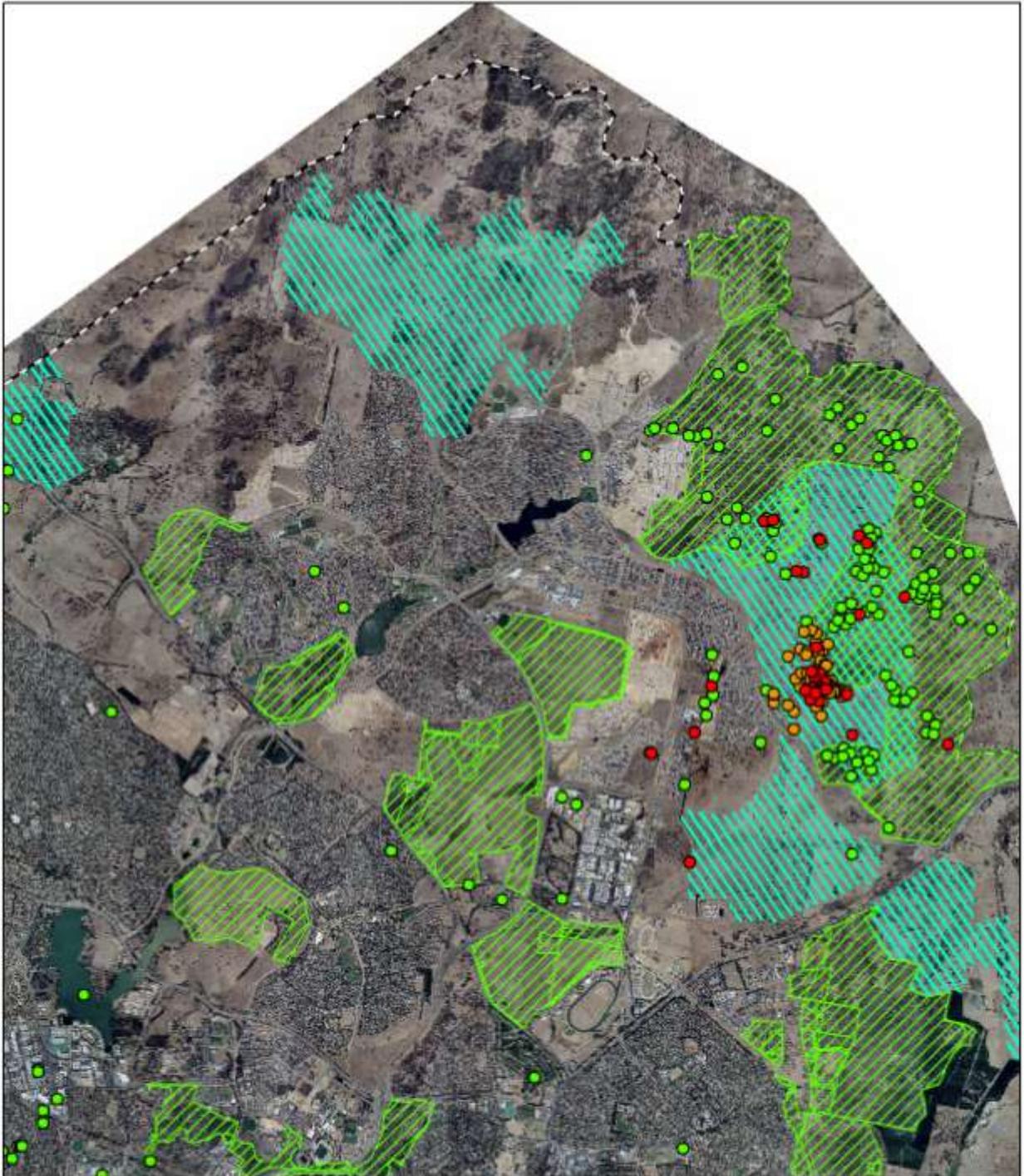
Throsby and Central Molonglo are the two major current breeding locations of this species in the ACT. Breeding has increased in these areas over recent years and is likely to continue to increase, particularly within the colonial nesting areas on Throsby Ridge and the Blakely's red gum areas of Central Molonglo. Figure 11 shows the location of all known Gungahlin nesting trees, those trees in the Throsby Ridge area which have potential nesting hollows, all known locations at which birds have been observed, and areas subject to nest tree survey.

The vegetation along Gungaderra Creek has been observed by the Canberra Ornithologists Group as an important link for foraging parrots moving from nest sites to feeding sites in Gungahlin and Belconnen. The parrots prefer to follow wooded links. Figure 12 shows those components of the tree canopy, in the vicinity of the Throsby nest sites, which are within 100 m of other tree patches and maybe the most likely routes to be utilised by superb

parrots moving across the Throsby landscape. Figure 12 also illustrates the key regional woodland habitat linkages in the Throsby area, as explained in s. 9 of this report.

**Table 9 Superb parrot nest tree locations**

<b>Location</b>	<b>Number of breeding records</b>	<b>Dates of records</b>
Throsby Ridge	17 (42.5% of records)	2009–2010
Goorooyarroo Nature Reserve (within 200 m of Throsby Ridge)	3 (7.5% of records)	2009–2010
Throsby Neck	4 (10% of records)	2009–2010
Goorooyarroo Nature Reserve (within 200 m of Throsby Neck)	1	2010
Throsby south-east	1	2006
Goorooyarroo Nature Reserve	6 (15% of records)	2008, 2009, 2010
Mulligans Flat Nature Reserve	2	2009
Harrison	1	2009
Harrison School	1	2009, 2010?
Franklin Woods	1	2009
Old Wells Kenny	1	2009
<b>Total breeding records</b>	<b>38</b>	



**Figure 11  
Superb  
Parrot  
Records**

**Legend**

- Nesting tree
- Potential nesting tree (Throsby Ridge area)
- Superb Parrot Sighting
- Nature reserve
- Area subject to nest tree survey

0 0.5 1 2 3 4  
Kilometres

1:65,000

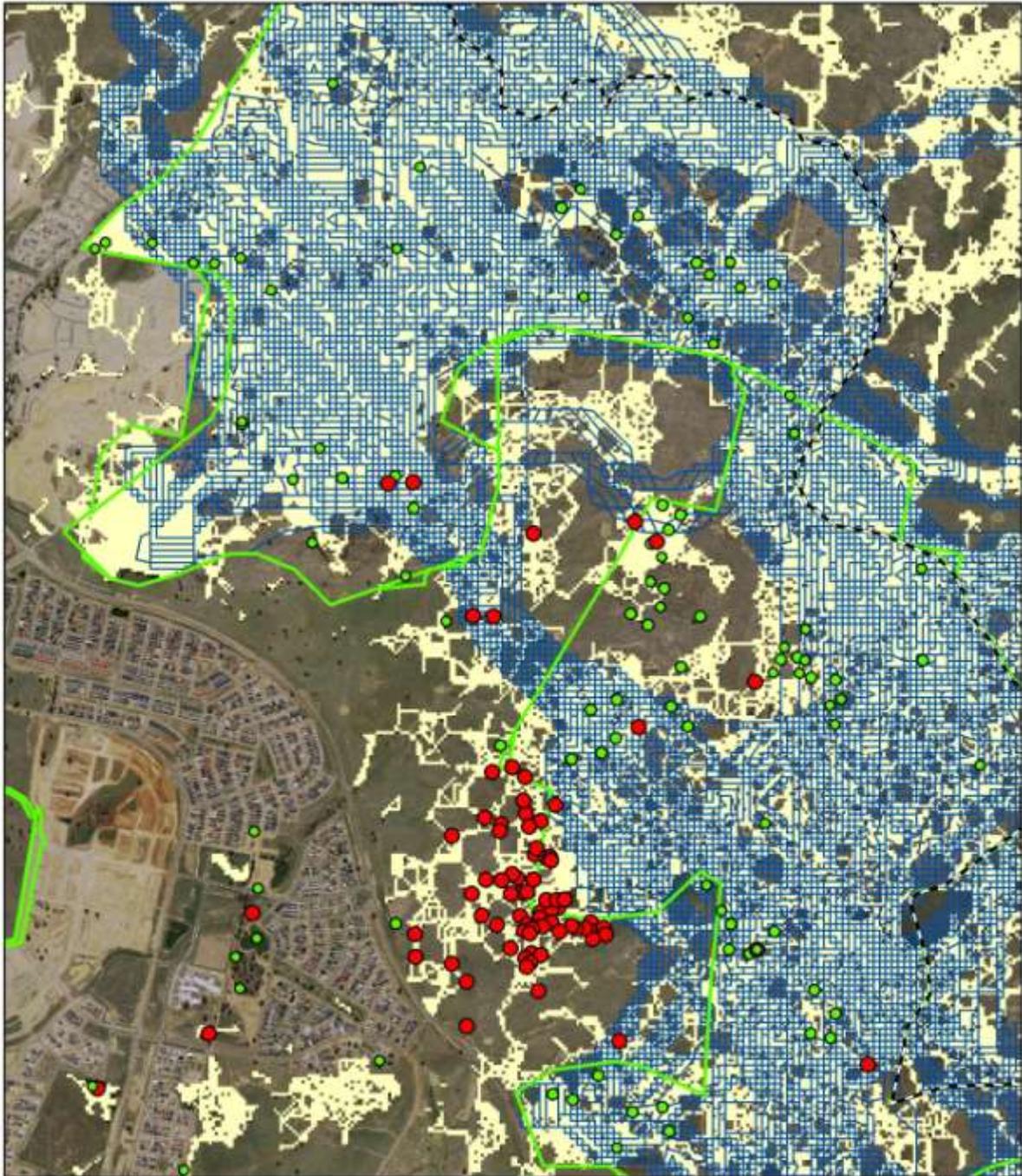


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**Figure 12  
Tree Linkages**

**Legend**

-  Reserve
-  Nesting tree
-  Superb parrot sighting
-  Key regional movement linkage
-  Maximum gap between trees 100 m

0 250 500 1,000 1,500

Metres

1:25,000



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### 5.2.2 Regent Honeyeater (*Xanthomyza phrygia*)

Status: Endangered (EPBC Act); Endangered (NCA Act)



The regent honeyeater has a broad range across south-eastern Australia. It is an irruptive and partly migratory species moving in response to the flowering of a small group of eucalypts. The species requires locally abundant nectar and associated insect food sources. The ACT is at the altitudinal limit for the species. Up until the 1960s, it was regularly recorded across the ACT lowlands from Tharwa, along the Murrumbidgee River, across suburban Canberra and on the lower slopes of Black Mountain (ACT Government 2004). The regent honeyeater is now a rare visitor to the ACT.

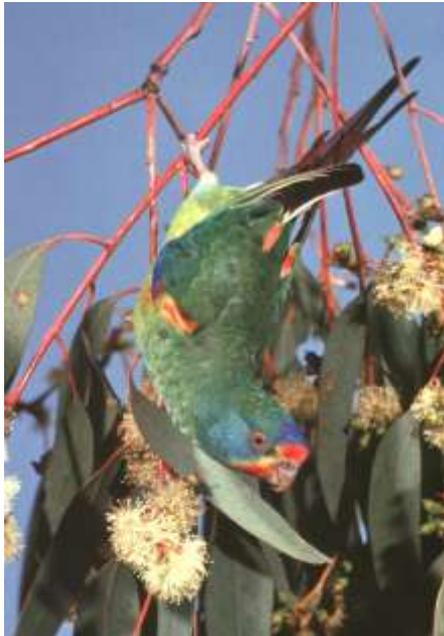
Since the 1970s the species has only generally been recorded in the ACT as single birds or pairs, except for small flocks in 1995, 1998 and 2004. In January 1994 two birds successfully fledged three young

in the grounds of CSIRO, Gungahlin, which were later recorded in the grounds of the Norwood Park Crematorium. In 1995, four pairs bred in the North Watson area and in 1998 three pairs nested in Mulligans Flat and Gorooyarroo nature reserves. The bird has mainly been sighted in woodland extending from Mulligans Flat to Campbell Park on the southern end of the Mt Majura and Mt Ainslie nature reserves, but records also exist from Belconnen and Coleman Ridge in south Canberra. It is usually seen foraging in flowering yellow box or suburban ironbarks.

The woodlands in Mulligans Flat and Gorooyarroo and the connection of these woodlands to the Mt Majura and Mt Ainslie woodland complex are probably of importance to the continued visits and breeding of this species in the ACT. Successful breeding requires locally abundant nectar and insect resources. Where food is scarce, competition with other honeyeaters such as red wattlebirds or noisy friar birds may disrupt the breeding of regent honeyeaters. Breeding occurs in spring/early summer at a time when yellow box is flowering. Large productive yellow box trees low in the landscape on deep and relatively moist soils are likely to be a key resource. Such trees comprise most of the woodland at Kenny. The Kenny woodland lies about half a kilometre to the south of the 1995 regent honeyeater breeding locations, and trees at Kenny were in flower during the breeding event (Bounds et al. 2006). As Kenny woodlands were not surveyed for the regent honeyeater in 1995 it is not known if they were actually foraging there during nesting. Nevertheless, the Kenny woodlands would have been a significant component of the local nectar and associated insect resources and may have reduced competition and harassment from other honeyeaters in the local area towards the nesting regent honeyeaters.

### 5.2.3 Swift Parrot (*Lathamus discolor*)

Status: Endangered (EPBC Act); Vulnerable (NCA Act)



The swift parrot breeds only in Tasmania and migrates during winter to mainland south-east Australia, where it feeds on nectar and lerps in box – ironbark forests, box – gum woodlands and coastal forests. It is a highly mobile species with movements varying between years and responding to the winter flowering of eucalypts. Most of the recent records for the ACT are from the Mt Majura and Mt Ainslie area. In April 1989 four birds were observed within Mulligans Flat Nature Reserve. Retaining and enhancing woodland connectivity across Gungahlin may be of importance to this species

### 5.2.4 Other Threatened Woodland Birds

Status refers to listings under the *Nature Conservation Act 1980* (ACT).

- |   |                    |
|---|--------------------|
| • Painted honeyeater ( <i>Grantiella picta</i> ).         | Status: Vulnerable |
| • Varied sittella ( <i>Daphoenositta chrysoptera</i> )    | Status: Vulnerable |
| • White-winged triller ( <i>Lalage sueurii</i> )          | Status: Vulnerable |
| • Brown treecreeper ( <i>Climacteris picumnus</i> )       | Status: Vulnerable |
| • Hooded robin ( <i>Melanodryas cucullata</i> )           | Status: Vulnerable |
| • Little eagle ( <i>Hieraaetus morphnoides</i> )          | Status: Vulnerable |
| • Glossy black cockatoo ( <i>Calyptorhynchus latham</i> ) | Status: Vulnerable |

Figure 13 plots the observed and breeding locations of the above threatened species, from the records of the Canberra Ornithologists Group (COG). A large majority of the total records, including breeding records, are located in the Mulligans Flat and Goorooyarroo nature reserves. This is also true for all of the species except for the little eagle, which has been recorded at four locations within Gungahlin, including three times at Gungahlin Hill which is now part of the reserve network.

In general, maintaining and enhancing the structure, condition and connectivity of the Mulligans Flat and Goorooyarroo woodland complex is the key conservation action that can be undertaken in Gungahlin to support the ongoing viability of threatened woodland birds listed under ACT legislation.

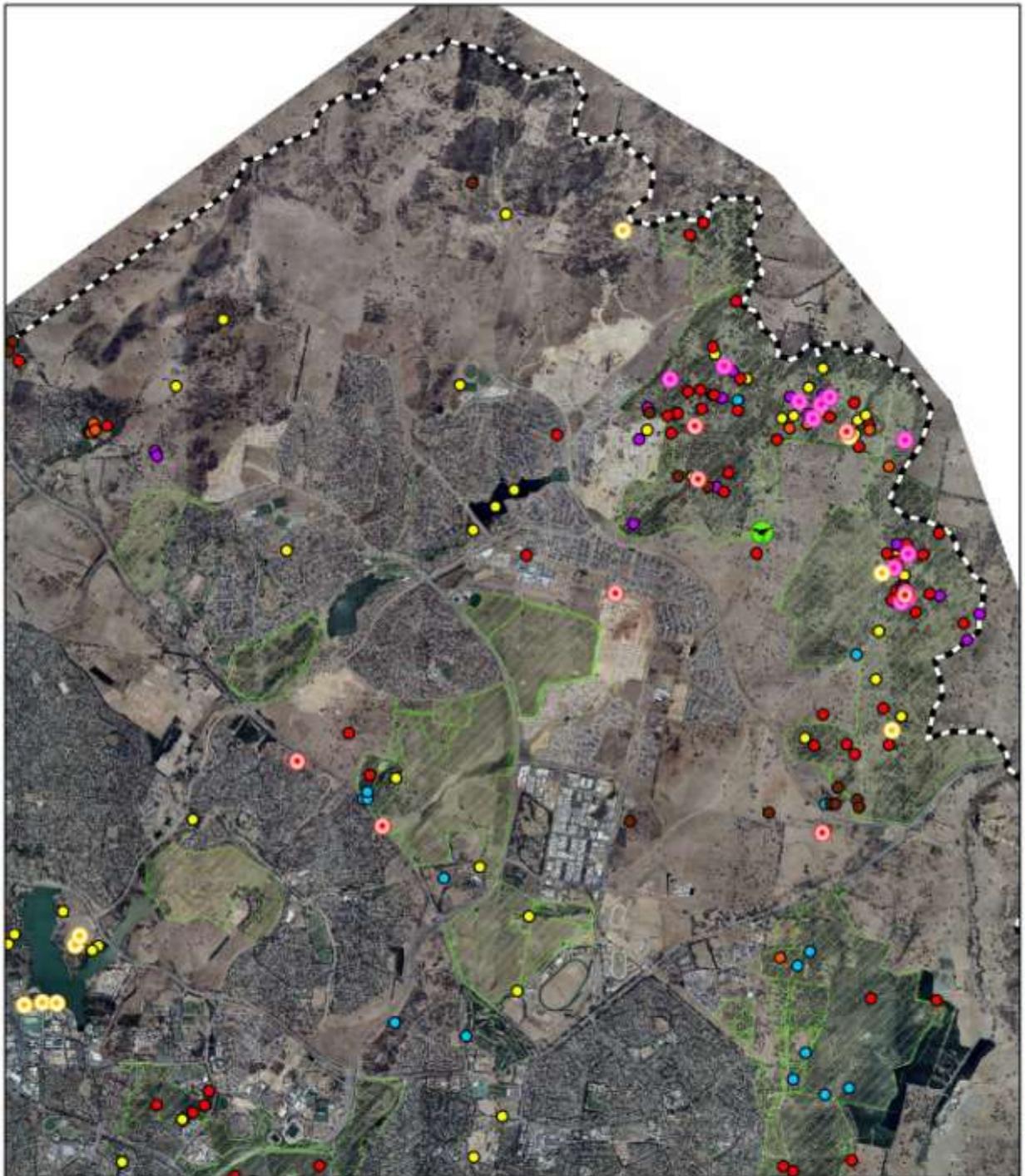
**Hooded Robin**



**Brown Treecreeper**



The hooded robin and brown treecreeper are more territorial than the other species so that individual observations of these species are more likely to indicate the presence of important habitat. In this regard, at least part of Kinlyside can be regarded as providing significant habitat for the hooded robin, where it has been observed from 2005 - 2011 (Eco Logical Australia 2011). Surveys conducted as part of development proposals in Jacka have observed brown treecreeper at locations additional to those in the Canberra Ornithologists Group database. Parts of Jacka, or the rural lease area to the north, may have significance for this species. The brown treecreeper and a breeding pair of varied sittella were also observed in 2011 in a woodland patch opposite the Mitchell Waste Facility, to the west of Kenny. Between 2003 and 2006 there are several records of the brown treecreeper on and just outside the south-western boundary of Goorooyarro Nature Reserve. This was one of the last records of this species prior to it becoming extinct within the Mulligans Flat and Goorooyarro nature reserves. A program of re-introduction of the species has been undertaken within this woodland, and habitat to the south-west of Goorooyarro may aid the recovery of the brown treecreeper within the complex.



## 5.3 Other Migratory Bird Species

This section refers to species that are summer migrants to the ACT or, in the case of the banded lapwing, may occur in the Territory during nomadic breeding movements following rain.

### 5.3.1 Banded Lapwing (*Vanellus tricolour*)

**Status: Uncommon breeding visitor to ACT**

The banded lapwing has a large range across Australia, except for the far north. The species is fairly common in suitable habitats, especially in temperate Australia (Simpson et al. 1999), but is an uncommon, breeding visitor to the ACT (COG 2011). While the species has been observed in some of the intervening years, it was last recorded as breeding in the ACT in 1982. During the wet summer of 2010–2011, two pairs successfully bred in the Throsby neck area, both pairs in an area dominated by *Austrodanthonia* grasses just to the north of the historic Throsby ploughlands.

### 5.3.2 White-throated Needletail (*Hirundapus caudacutus*)

**Status: JAMBA, CAMBA; migratory species (EPBC Act)**

The white-throated needletail is a mainly aerial species, occurring in eastern Australia, usually over coastal and mountain regions. It is an uncommon migrant to the ACT (COG 2011). All Gungahlin records for the last ten years are from the Mulligans Flat and Goorooyaroo nature reserves.

### 5.3.3 Fork-tailed Swift (*Apus pacificus*)

**Status: JAMBA, CAMBA, ROKAMBA; migratory species (EPBC Act)**

The fork-tailed swift is a mainly aerial species, occurring over a range of habitats. It is a rare migrant to the ACT (COG 2011). It has not been recorded in Gungahlin in the last 10 years.

### 5.3.4 Rainbow Bee-eater (*Merops ornatus*)

**Status: JAMBA; migratory species (EPBC Act)**

The rainbow bee-eater is a common breeding summer migrant to the ACT (COG 2011). All Gungahlin records of this species over the last 20 years have been from Mulligans Flat and Goorooyaroo nature reserves or the woodlands near Hall. The greatest concentrations of the species in the ACT are along the Murrumbidgee, and other major rivers, where they nest in soft sedimentary soils (Taylor and COG 1992). None of the Gungahlin records of the Canberra Ornithologists Group include breeding observations. Maintaining and enhancing the extent and connectivity of the large remnant blocks of native vegetation present in Gungahlin is likely to be favourable for the movement of this species and the production of flying insects on which it feeds.

### 5.3.5 Satin Flycatcher (*Myiagra cyanoleuca*)

**Status: Bonn convention; migratory species (EPBC Act)**

The satin flycatcher is a common breeding summer migrant to the ACT (COG 2011). This species is rarely recorded in Gungahlin, with only one record at Hall in the atlas data of the Canberra

Ornithologists Group. The ACT stronghold of the species is the tall wet forests of the Brindabella Range. Gungahlin does not contain significant habitat for the species.

### **5.3.6 Rufous Fantail (*Rhipidura rufifrons*)**

**Status: Bonn Convention; migratory species (EPBC Act)**

The rufous fantail is an uncommon breeding summer migrant to the ACT (COG 2011). The species is occasionally recorded in Gungahlin, with records from the Mulligans Flat and Percival Hill reserves, and woodlands around Hall. The ACT stronghold of the species is the tall wet forests of the Brindabella Range. Gungahlin does not contain significant habitat for the species.

## **6 Reptiles and Frogs**

### **6.1 Reptiles**

This section contains reptile species recorded from Gungahlin that are listed as threatened under the Environment Protection and Biodiversity Conservation Act and the Nature Conservation Act, as well as some species that are of local or regional significance. Significant reptile records from Gungahlin are shown in Figure 14.

#### **6.1.1 Striped Legless Lizard (*Delma impar*)**

**Status: Vulnerable (EPBC Act); Vulnerable (NC Act)**

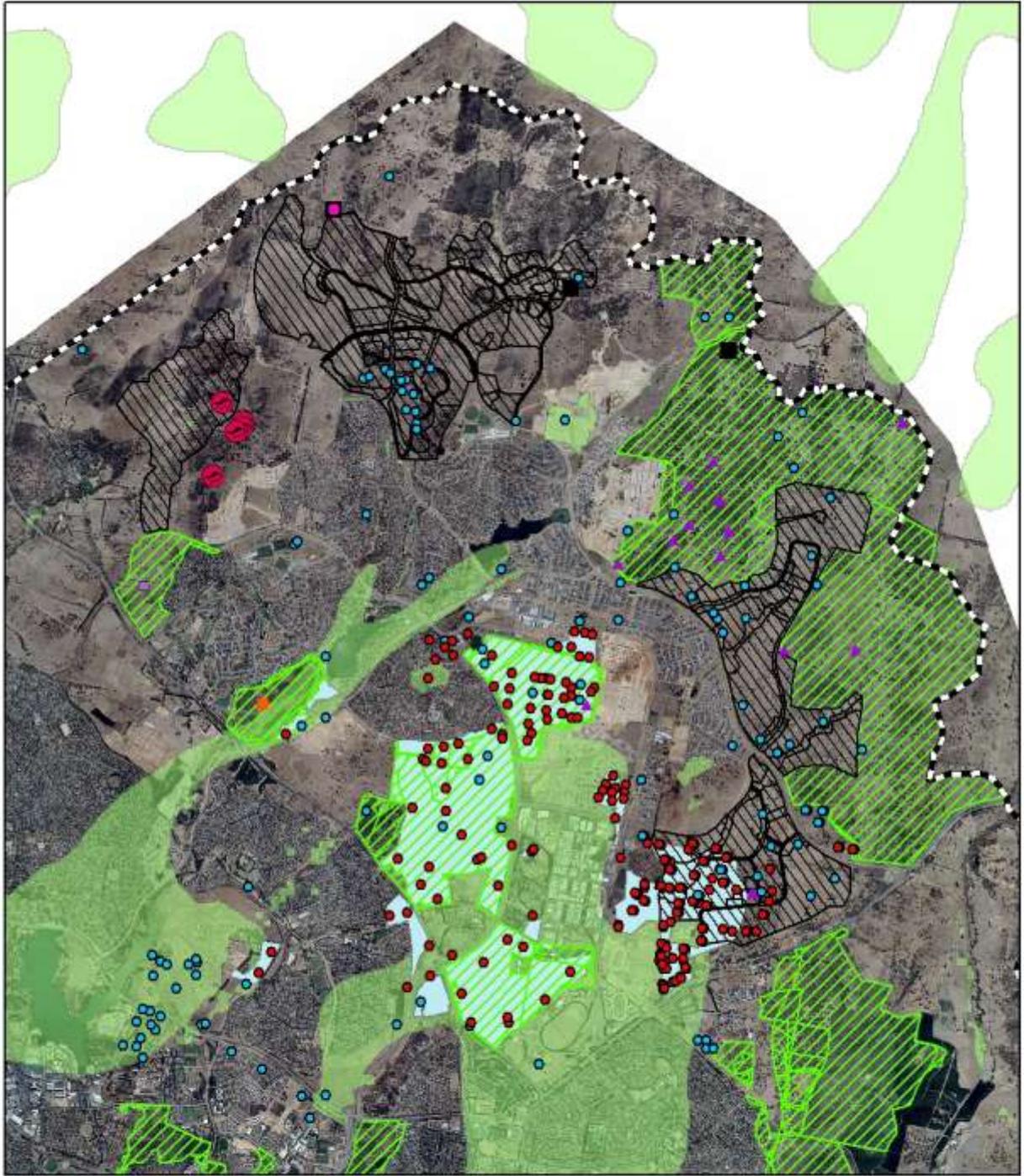
Prior to European settlement, the striped legless lizard (*Delma impar*) probably occurred across about 20 000 ha of Natural Temperate Grassland (Environment ACT 2005). The current distribution of the species is fragmented as a result of past rural land use and urban development. The species is now only found within Natural Temperate Grassland or in exotic or native pasture with a tall tussock structure that is also in the close vicinity of present or former Natural Temperate Grassland.

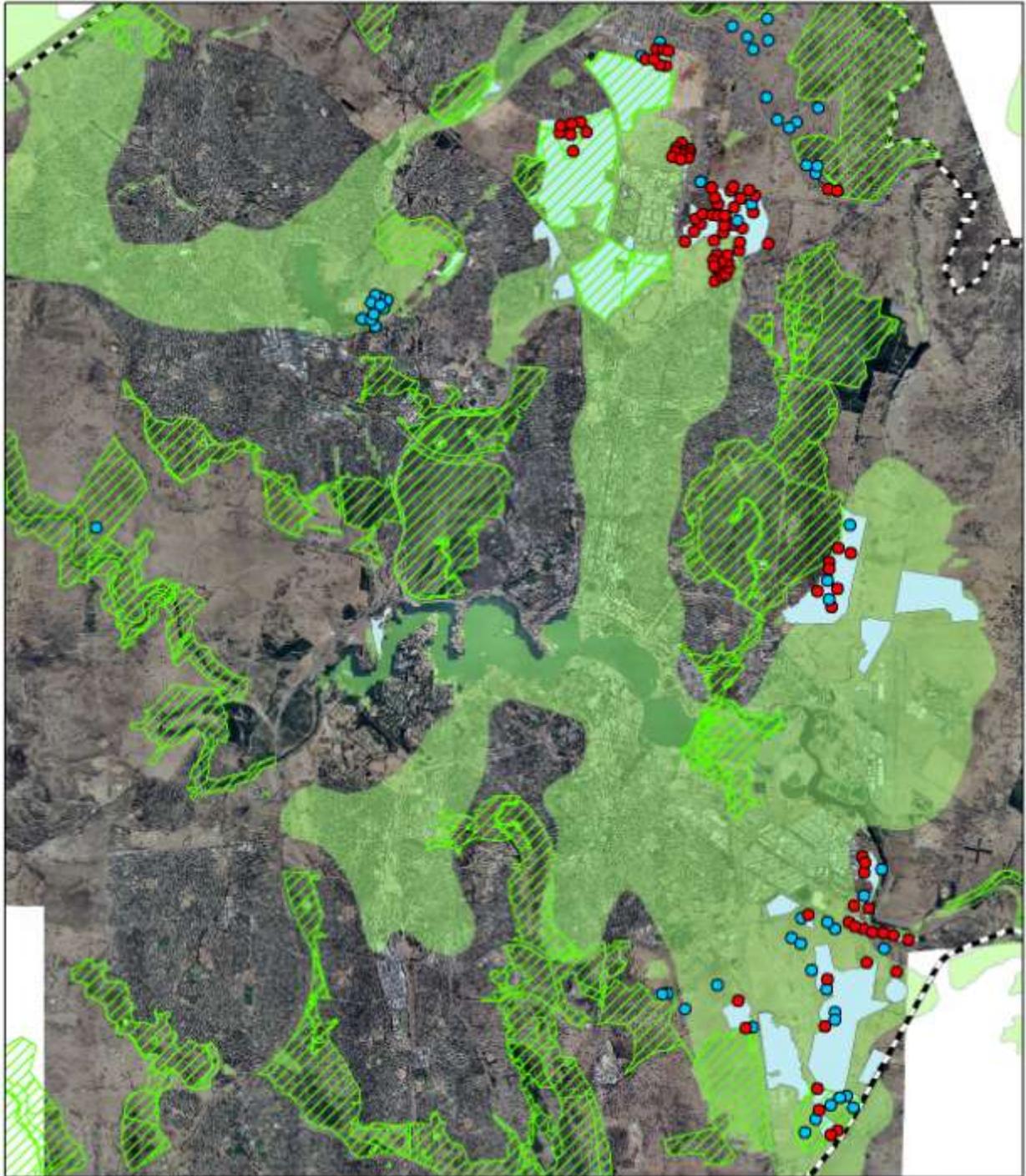
A relatively large population of the striped legless lizard was observed in spring 2011 at and around the Crace asbestos dump (just to the south of Palmerston). Until the late 1980s, this was a quarry into which containers of asbestos were placed and covered with at least two metres of soil. This soil was then sown with exotic pasture species, into which some native grasses, such as corkscrew grass (*Austrostipa* sp.) have subsequently invaded. The surrounding area is highly cleared box – gum woodland which adjoins the Gungahlin Grasslands Nature Reserve. The presence of the species at the dump and in the surrounding woodland indicates that it is capable of moving into new habitat when it becomes available and that it can also occupy box –gum woodland from which the trees have been substantially removed.

Figure 14 indicates known striped legless lizard locations across Gungahlin and those sites where appropriate survey failed to find them. A spring 2010 tile survey of potential habitat across Moncrieff did not observe any. An extensive survey program for striped legless lizards occurred during spring and early summer 2011 in the Jerrabomberra, Majura and Gungahlin valleys. At survey sites, grids of 50 or 25 roof tiles (usually 5 x 10 tiles, each tile 5 m apart) were laid out in August and September and checked 12 times up until the end of December. The location of the grids is shown on Figure 15. Lizards were observed sheltering under tiles across the whole survey period. Those

under tiles were captured, measured, weighed, photographed and then released. Recaptures can be identified by distinctive head scales. Most recaptures were under the same or an adjoining tile, suggesting a small home range. The limited movement information available indicates the species can move 20 m in a day, and 50 m over some weeks, suggesting a short-term home range of around 30 to 50 m in diameter. If half a home range diameter (20 m on all sides) is added around the perimeter of a shelter grid (this allows for capture of individuals living at the edge of the grid) an estimate can be gained of the number of lizards per hectare. Density of the species varies from site to site, with the Gungahlin populations having the highest densities in the 2011 survey (Table 10).







**Figure 15**  
**Tile Survey Locations for**  
**Striped LegLess Lizard**

**Legend**

- Tile array at which SLL was recorded
- Tile array at which SLL was not recorded
- Reserve
- Striped legless lizard habitat
- 1850 grasslands

0 0.5 1 2 3 4  

 Kilometres

1:100,000



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**Table 10 Captures of striped legless lizard in roof tile surveys, 2011**

Survey site	Size of habitat area (ha)	No. of lizard captures	No. of individual lizards	Lizards per tile grid (5100 m <sup>2</sup> )	Lizards/ha	Population estimate
Gungahlin Town Centre	13.63	224	137	19.6	35.46	483
North Mitchell (3 checks only)	14	87			11.7	165
Crace asbestos dump	33.91	148	98	14	28.33	859
Block 799 EPIC	14			8.67	17	240
South-West Kenny	244	128	86	Different shape of grid	7.7 (moderate to high habitat)  3.6 (low to marginal habitat)	1400
Throsby	300	0				0
University of Canberra	40	0				0
Nicholls	4	0				0
West Majura	97.01	58	42	4.2	7.6	737
East Fyshwick	57.61	171	86	6.6	11.94	688
North Jerrabomberra Valley	550	20	13	0.65	1.27	700
East Jerrabomberra	72.05	12	9	0.9	1.63	117
RSPCA site Callum Brae	6	0				0

If we assumed a similar density of lizards within Mulanggari and Gungaderra nature reserves as were observed at the adjoining Gungahlin Town Centre and Crace asbestos dump, then populations of these areas would both be around 4500. In 2010, as part of a PhD project Brett Howland (using a few widely separated tiles) confirmed a relatively high density of lizards at Mulanggari Nature Reserve, and the presence of lizards at Campbell Park, the Majura Training Area (the fenced area), Crace Nature Reserve, and on Commonwealth Land at Jerrabomberra East. He failed to find the species at Kama Grasslands, unfenced portions of the Majura Training Area, Jerrabomberra West and Googong Foreshores.

There are about 800 ha of habitat suitable for the striped legless lizard remaining in Gungahlin, of which 567 ha (70%) is conserved within the Crace Grassland, Mulanggari and Gungaderra Grassland nature reserves. There are a further 11 ha of habitat in urban open space in Mitchell, and 37 ha in Crace, over an old asbestos dump, which is managed as part of Mulanggari Nature Reserve. There are 244 ha in the Kenny area, of which about 180 ha are in areas zoned for urban or tourist development.

The striped legless lizard has been recorded in grasslands across the Majura and Jerrabomberra valleys, with at least 1600 ha of habitat remaining in the ACT. Thus Gungahlin contains about 50% of the known habitat in the ACT, while within that, Kenny contains about 10% of the known habitat. However, as densities of the striped legless lizard are highest in Gungahlin, the area is likely to support much more than 50% (possibly 75%) of the ACT population of the species.

### **6.1.2 Pink-tailed Worm Lizard (*Aprasia parapulchella*)**

**Status: Vulnerable (EPBC Act)**

A detailed survey for pink-tailed worm lizard was undertaken across the western part of Gungahlin in Spring 2012. Three live animals and two sloughed skins were observed close to each other in the Kinlyside - Casey area. There is a further 2008 record of a shed skin by an ACT Government conservation ranger in part of what is now the suburb of Casey. However, the skin was not deposited, so some doubt remains as to the accuracy of identification. The Casey - Kinlyside records are 10 km from the next nearest records at the Pinnacle in Belconnen or along the Murrumbidgee River in NSW. The pink-tailed worm lizard was not recorded in any of the pit or tile surveys undertaken for the striped legless lizard across Gungahlin and was not found in a targeted rock rolling surveys in Moncrieff, Jacka or Taylor.

Suitable rocky habitat for this species is generally uncommon in Gungahlin and the largest extent is on the eastern side of Kinlyside, the location of observations. Other potential habitat occurs on One Tree Hill, the rural lease to the north of Taylor, and the Throsby Ridge area. None of the remaining known or most likely potential habitat areas are planned for development.

### **6.1.3 Reptile Records of Local or Regional Significance**

- **Spotted Back Skink (*Ctenotus uber orientalis*)**
- **Stone Gecko (*Diplodacytlus vittatus*)**
- **Shingleback (*Trachydosaurus rugosus*)**
- **Blind Snake (*Ramphotyphlops nigrescens*)**
- **Marbled Gecko (*Christinus marmoratus*)**
- **Three lined skink (*Bassiana duperreyi*)**
- **Black-headed snake (*Suta spectabilis dwyeri*)**

The Mulligans Flat – Goorooyarroo woodland complex is a stronghold both within a Gungahlin and ACT context for several species of woodland lizards; including the spotted-back skink (*Ctenotus uber orientalis*, only known from a few scattered populations in the ACT), stone gecko (*Diplodacytlus vittatus*), and shingleback (*Trachydosaurus rugosus*). It is also the area of highest recorded lizard diversity in Gungahlin, but there is yet to be a systematic reptile survey across the area.

Harcourt Hill Nature Reserve is the only recorded location of the marbled gecko (*Christinus marmoratus*) in Gungahlin, while Percival Hill nature reserve is the only recorded location of the blind snake (*Ramphotyphlops nigrescens*).

There are three records of the black-headed snake (*Suta spectabilis dwyeri*) in Gungahlin, one from Mulligans Flat, one from a rural lease on the eastern boundary of Jacka, and one from a rural lease on the north-western side of Taylor. This last site is the only recorded location of the three-lined skink (*Bassiana duperreyi*) in Gungahlin.

## **6.2 Frog Diversity**

Since 2002 a community survey of frogs in the ACT and region has been undertaken in spring. In 2009, 161 sites were surveyed, including 13 sites within Gungahlin, eight of which were in Mulligans Flat Nature Reserve, one at Nicholls, three near the town centre, and one on Horse Park Drive. Sites in Gungahlin generally have a high frog diversity (5 or more species), with sites in Mulligans Flat Nature Reserve having some of the highest levels of frog diversity in the region (seven species). As the survey is of frog calls, it only records those species that call in spring (13 out of the 19 species found in or around the ACT).

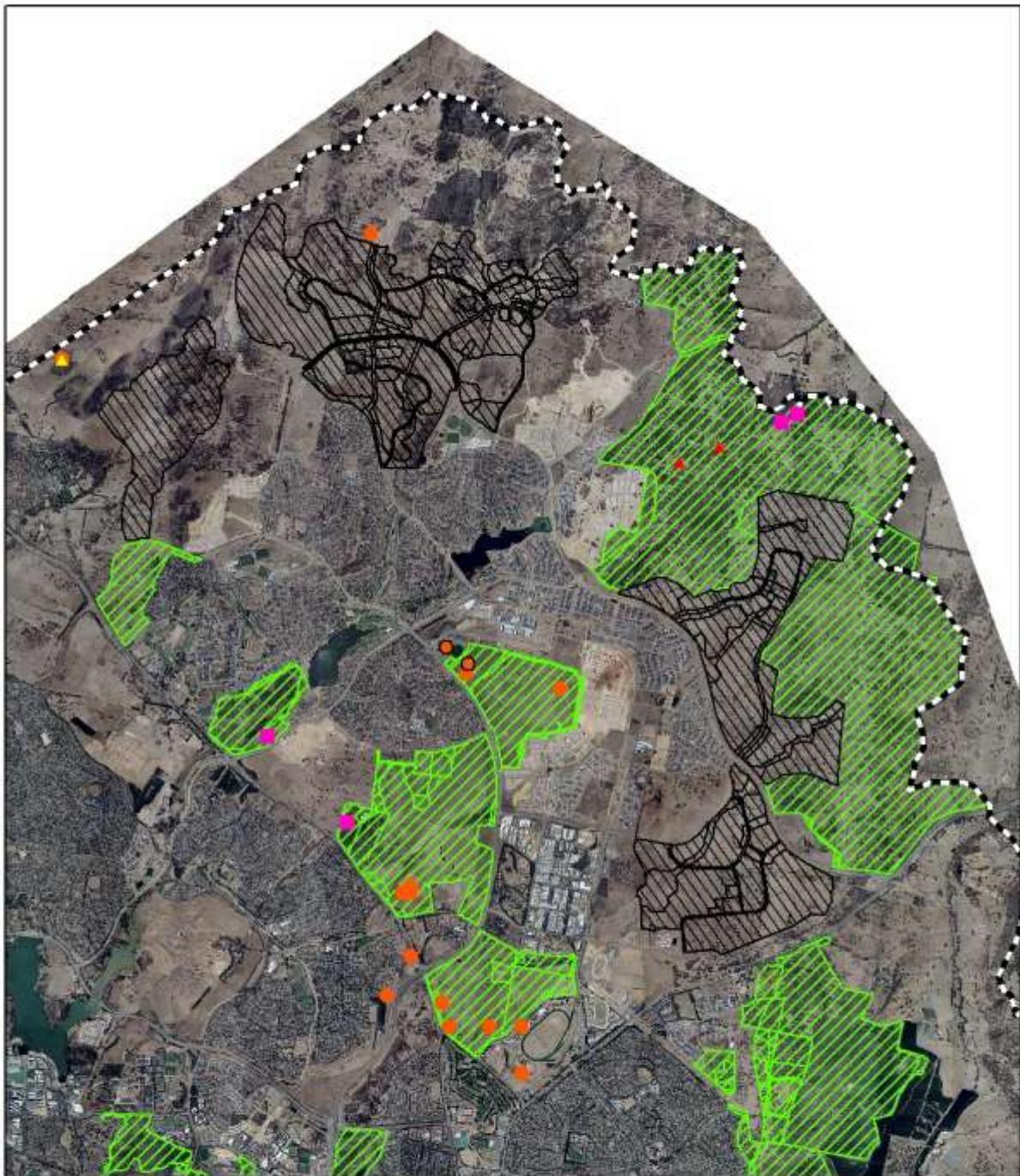
No threatened frog species have been recorded in Gungahlin during Frogwatch surveys, in extensive pitfall trapping of Natural Temperate Grassland areas, or pitfall and rock rolling surveys of Gungahlin hills during the 1990s. There are also no records of threatened frog species in the opportunistic sightings recorded on the ACT Wildlife Atlas.

The striped marsh-frog (*Limnodynastes peronii*) was once very common across the ACT, but in 2009 was recorded in only 17% of the Frogwatch survey sites (Frogwatch 2009). Rauhala (1997), in a review of the frog fauna of the ACT, concluded then, that this species should be regarded as having a localised and uncommon distribution in the ACT, where it is close to its western distribution limit. It is a common species in coastal NSW. The species is occasionally recorded at the Frogwatch sites in Mulligans Flat Nature Reserve. It was fairly frequently recorded in pitfall trapping in the Gungahlin grasslands in the 1990s. It has also been recorded on One Tree Hill and northern rural leases and at both the Gungahlin scout dam and dams to the south-east of the Burgman Anglican College (see Figure 16). It has not recently been recorded within areas proposed for development.

## 7 Mammal Records from Gungahlin

There have been very few mammal surveys conducted in Gungahlin, and records are either from Mulligans Flat Nature Reserve or are of small mammals captured as part of a 1990 pitfall survey of Gungahlin hills. Seven bat species have been recorded within Mulligans Flat. One of these, the white-striped freetail bat (*Astrononus australis*) has been recognised by the ACT Flora and Fauna Committee, as a species of concern in the ACT. The Committee has recommended that this bat species should be considered in any biodiversity offset arrangement in the ACT when clearing or other development threatens its potential habitat. This species nests and roosts in tree-hollows, which are a key habitat requirement.

Small mammals that were once regularly trapped in Black Mountain and Mt Ainslie nature reserves are now seemingly extinct or very rare in these areas. A 1990 pitfall trap survey of the Gungahlin hills, together with small mammal trapping on a few of the hills in 1992, located the common dunnart (*Smithopsis murina*) in Mulligans Flat and what are now Harcourt Hill and Percival Hill nature reserves. The yellow-footed antechinus (*Antechinus flavipes*) was also recorded on the One Tree Hill rural lease and at Mulligans Flat. Research is currently underway to determine whether these species are present at the experimental sites within the Mulligans Flat and Goorooyarloo nature reserves and if so whether manipulations can improve the habitat for them (Manning 2011). The cat and fox exclusion fence at Mulligans Flat may provide suitable conditions for small mammals to flourish, and will enable re-introduction of now locally extinct species such as the Tasmanian bettong (*Bettongia gaimardi*).



**Figure 16  
Frogs and  
Mammals**

**Legend**

- Common dunnart
- ▲ White-striped freetail-bat
- Yellow-footed antechinus
- Brown-striped frog
- ▨ Future urban areas
- ▨ Reserve



Kilometres

1:65,000



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## 8 Threatened and Uncommon Invertebrate Species

### 8.1 Threatened Invertebrate Species

Four significant invertebrate species have been recorded in Gungahlin, of which two are listed as threatened and two are uncommon (s. 8.2). Systematic surveys have only been undertaken for the threatened golden sun moth (*Synemon plana*) and Key's matchstick grasshopper (*Keyacris scurra*).

#### 8.1.1 Golden Sun Moth (*Synemon plana*)

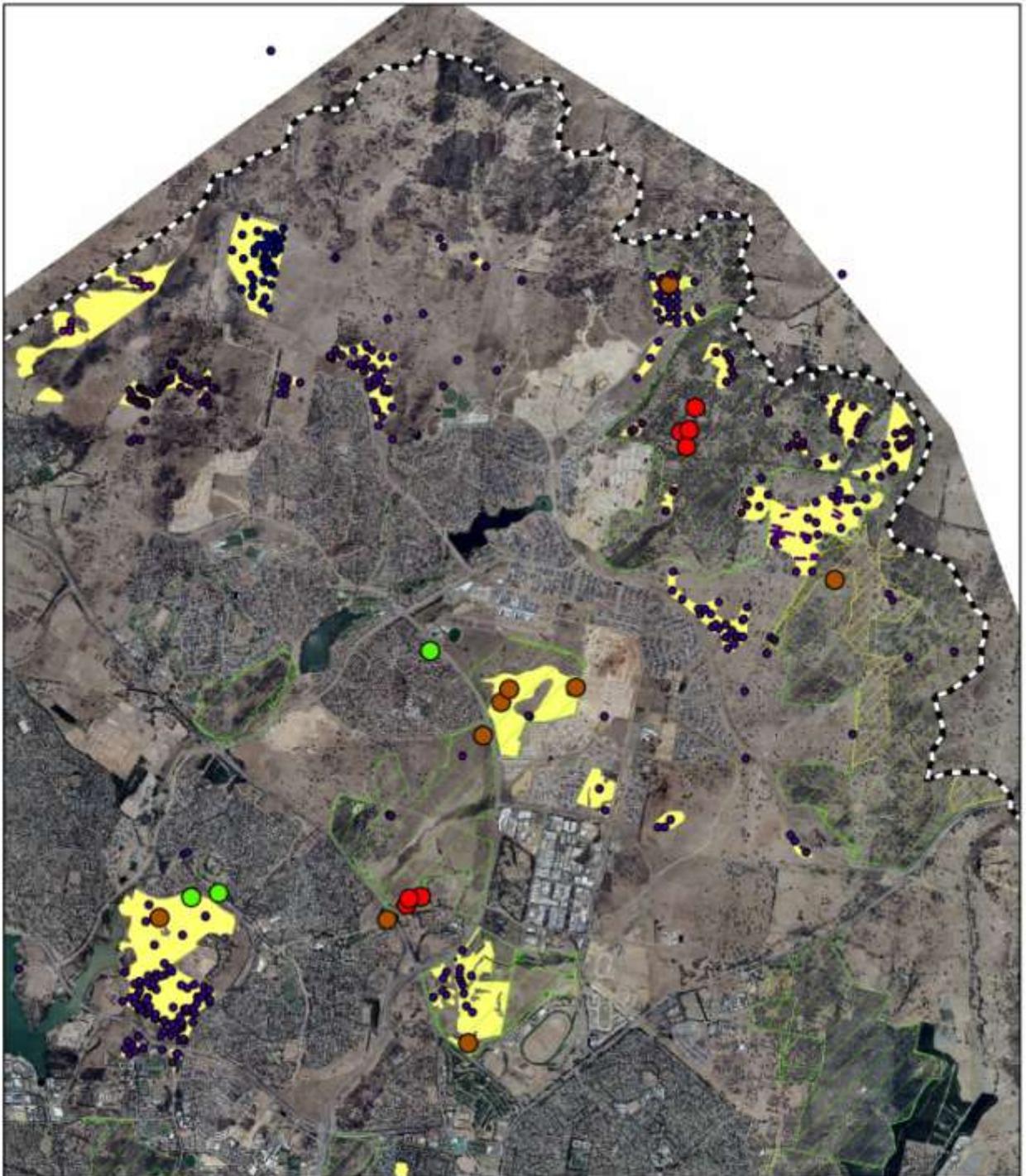
**Status: Critically endangered (EPBC Act); endangered (NC Act)**



Conservation of the golden sun moth in the ACT was addressed first through Action Plan No. 7 (ACT Government 1998), then in a more integrated context through the *ACT Lowland Native Grassland Conservation Strategy* (ACT Government 2005). Since those Action Plans were prepared, the number of sites where the golden sun moth has been recorded in the ACT has increased substantially, to over 70 sites. There are 22 locations within Gungahlin where the golden sun moth has been recorded. These habitat locations are shown in Figure 17. The size of a habitat area is not a reflection of the degree of golden sun moth activity or population size. For

example, in Gungahra Grassland Nature Reserve there are 187 ha of potential habitat, but within this reserve only two or three moths have been sighted at a given time, while some smaller patches of high quality habitat (such as Moncrieff) may have records of many tens of moths on a favourable day. Table 11 provides an indication of the moth population size typically recorded at a particular location.

Surveys during the spring and summer of 2010–2011 and 2011–2012 across Crace, Mulanggari, Goorooyaroo, Mulligans Flat and Gungahra nature reserves as well as the Jacka, Taylor, Throsby, Kinlyside and One Tree Hill areas helped to fairly well define the extent of occupied habitat across Gungahlin. However, 2010 and 2011 only had a relative low level of moth emergence across the ACT, so results in relation to population size should be regarded as preliminary estimates only.



From mid-November 2011 to mid-January 2012 a survey program involving four days of survey effort in each of the Mulligans Flat and Goorooyaroo nature reserves was undertaken. In Mulligans Flat 127 moths were observed over about 115 ha, while around 100 moths were observed over about 150 ha in Goorooyaroo. The 2011–2012 moth season was cool and wet, and only relatively low levels of emergence (at best tens of moths) have been observed at reference sites such as York Park and Canberra Airport, where hundreds of moths are observed in a good season. The numbers of moths observed within the two Gungahlin reserves were amongst the highest numbers observed anywhere in the ACT during the 2011–2012 season. Golden sun moth habitat in both reserves is continuous with that of North Throsby. Therefore, the combined Throsby, Goorooyaroo and Mulligans Flat areas support a large golden sun moth population spread over around 350 ha of continuous habitat. All of this area is already within or is proposed to be added to the conservation reserve network.

**Table 11 Records of the golden sun moth in Gungahlin (after Hogg and Moore 2011)**

(Note that the column 'Golden sun moth records' contains a summary description (e.g. 'low'), survey years, records (two numbers indicate records from different days))

Site	Habitat area	Golden sun moth records	Land use
G1. Mulanggari Nature Reserve	Large (68 ha)	Moderate 2010 (28); 2008 (2, 2); 2005 (2)	Nature reserve
G2. Crace Hill Nature Reserve	Large (136 ha)	Large 2011 (30+); 2010 (163) 2008 (13, 30)	Nature reserve
G3. Gungaderra Nature Reserve	Large (187 ha)	Low 2011 (0); 2008 (0, 4)	Nature reserve
G4. North Mitchell grasslands	Medium (15 ha)	Moderate 2008 (28)	Urban open space, grassland reserve
G5. Bonner 4	Medium/large (20 ha)	Moderate 2008 (24); 2009 (33)	Nature reserve
G6. Mulligans Flat North-West	Medium (12 ha)	Moderate 2011 (20)	Nature reserve
G7. Mulligans Flat East	Large (103 ha)	Large 2011 (107)	Nature reserve

<b>G8.</b> Moncrieff South	Large (28 ha)	Moderate 2009 (60, 11 )	Proposed urban, open space, conservation reserve
<b>G9a.</b> Goorooyaroo Nature Reserve (central)	Large (125 ha)	Large 2011 (80); 2005 (100)	Nature reserve
<b>G9b.</b> Goorooyaroo Nature Reserve (south-east)	Large (25 ha)	Moderate 2011 (20); 2008 (30); 2005 ('a few')	Nature reserve
<b>G10.</b> Jacka North	Large (up to 50 ha) but disjointed habitat of five close-by, but discontinuous patches	Low 2006 and 2009 (15 moths in total at 5 sites over the two years)	Rural, proposed urban
<b>G11.</b> Jacka South/Moncrieff North	Large (up to 50 ha) but disjointed habitat of five close-by, but discontinuous patches	Low (8 moths in total at 4 sites)	Rural, proposed urban
<b>G12.</b> Throsby residential	Large (180 ha)	High 2010 'Throsby neck' area (49); southern area (3) 2009 central southern area (50+, 86)	Northern (neck) and eastern populations to be added to new reserve  Southern area to be cleared for new suburb
<b>G13.</b> Throsby District playing Fields (effectively a subset of G12)	Connected to large habitat area	Moderate 2008 (20); 2009 (13)	Urban
<b>G14.</b> Wells Station Drive (hill)	Small (a few hectares)	Low 2009 (5)	Proposed urban, possible open space
<b>G15.</b> Harrison 4	Medium (6 ha)	Low 2009 (3)	Proposed urban
<b>G16.</b> Forde North	Small (5 ha)	Moderate 2009 (30)	Proposed urban
<b>G17.</b> Ngunnawal 2C	Medium (8 ha)	High	Proposed urban

		2009 (60+)	
<b>G18.</b> Kinlyside	Large (45 ha)	High 2011 (119); 2010 (3)	Proposed for reservation
<b>G19.</b> Block 799 North-east of the EPIC showground, Kenny	Small (2.4 ha)	Low 2009 (19)	Proposed tourist accommodation
<b>G20.</b> Taylor West	Large (60 ha)	High 2011 (90); 2010 (5)	Proposed urban
<b>G21.</b> One Tree Hill North	Medium (10 ha)	Low 2010 (13)	Broadacre (rural lease)
<b>G22.</b> One Tree Hill South	Medium (11 ha)	Moderate 2010 (22)	Broadacre (rural lease)

Hogg and Moore (2011) rank golden sun moth habitat in decreasing importance depending on whether it is:

- Natural Temperate Grassland/high quality native pasture – large area (Habitat type A)
- Natural Temperate Grassland/high quality native pasture – smaller remnant (Habitat type B)
- Mixed native and exotic grasses in former Natural Temperate Grassland (Habitat type C)
- Secondary grassland (box – gum woodland community) (Habitat type D)
- Chilean needle grass or other exotic grasses (Habitat type E).

Figure 18 shows the location of these habitat types across the ACT and a rating by Hogg (2010) as to the relative moth activity at each site. Since this report was prepared, several more golden sun moth populations have been located; however, the mapping in Figure 18 provides a sound representation of the ACT distribution of the golden sun moth and the relative significance of sites across the ACT. The moth populations in the Majura and Jerrabomberra valleys are likely to be larger than in Gungahlin. It is likely that only the Mulligans Flat – Throsby –Goorooyarroo population in Gungahlin is comparable to larger populations elsewhere in the ACT; at the Canberra Airport, the former Belconnen Naval Transmission Station, and West McGregor – Dunlop.

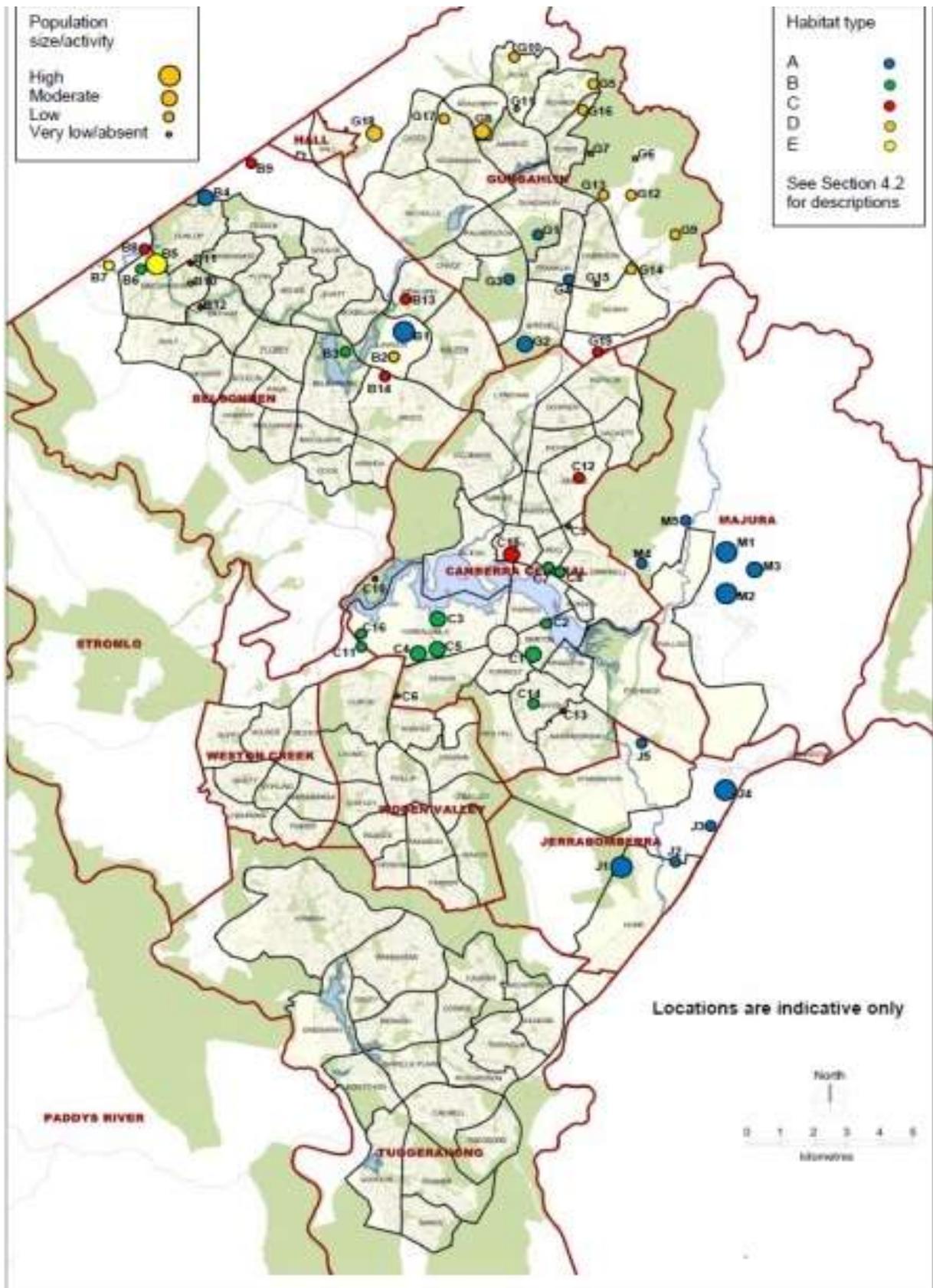


Figure 18 Distribution, habitat type and population size/activity of the golden sun moth across the ACT

### 8.1.2 Perunga Grasshopper (*Perunga ochracea*)

Status: Vulnerable (NC Act)



This species of flightless grasshopper has been recorded in Natural Temperate Grassland, native pasture and open box – gum woodland. It could occur in any part of Gungahlin that supports native grassland or woodland vegetation, including most of Throsby and Kinlyside, and parts of Kenny, Jacka, Taylor and Moncrieff. Due to its cryptic nature it has been difficult to establish a survey method for the species, and is usually spotted when disturbed by walkers. Distinguishing features include a cross on the top of its mid section, reduced wings and blue colouring on its feet. It ranges from dark brown to fluorescent green in colouring. The perunga grasshopper is a powerful jumper rising to a metre or more when disturbed. In Gungahlin it has been recorded in the Mulanggari, Crace, Gungaderra and Goorooyaroo nature reserves as well as at East Bonner. All recorded locations are, or will shortly be, under conservation management.

## 8.2 Uncommon Invertebrate Species

Species not listed under Commonwealth or ACT legislation may be also of conservation concern and it is important that their status be monitored over time and threats minimised (ACT Government 2005). Some animal species in grassy ecosystems may be naturally rare or have become uncommon due to loss or degradation of their habitat. The following invertebrates are two such species.

### 8.2.1 Canberra raspy cricket (*Cooraboorama canberrae*)

This cricket is only found in Natural Temperate Grassland and has only been collected from within the ACT, with most records being from the Majura Valley and Belconnen areas. There is one Gungahlin record in the ACT Wildlife Atlas, but this location is now developed as part of the town centre. There are unconfirmed reports of the species from the existing Gungahlin grassland reserves. There is little potential habitat for the species outside of these reserves. Of the proposed development areas, only Kenny is likely to be within the former natural range of the species, and the degradation of the grassland that has occurred there may have destroyed suitable habitat.

### 8.2.2 Key's matchstick grasshopper (*Keyacris scurra*)

This flightless grasshopper was once common in grasslands and grassy woodlands in south-eastern Australia, but is sensitive to habitat modification by sheep and cattle grazing and is now uncommon in the ACT region. In Gungahlin it has been recorded at the National Transmission Authority land at Crace, Mulligans Flat Nature Reserve and Crace Nature Reserve. The species has also been observed at Hall Cemetery. Rowell and Crawford (1995) estimated populations of 470 at Mulligans Flat and 1330 at the Transmission site grassland. The latter is one of the largest populations recorded in the ACT. All of the known locations in Gungahlin are under conservation management. This species may also occur within the diverse *Themeda* understorey that occurs at the base of One Tree Hill, within Kinlyside, at Moncrieff and to the north of Bonner.

## 9 Habitat and Ecological Connectivity

Connectivity conservation seeks to allow wildlife to move across the landscape and to maintain functioning ecological processes. Climate change, and fragmentation of vegetation and ecological processes resulting from clearing and intensive land uses, means that maintaining and enhancing connectivity through planning and conservation action is becoming increasingly important. Manning et al. (2010) (pp. 9–11) make the following summary:

There is a growing body of evidence that rapid climate change is having profound impacts on biodiversity. A major effect is to force species to shift their ranges. In response to climate change, communities are expected to disassemble and organisms will respond in different ways, with differing rates of movement; some will want to move laterally across landscape, others will want to relocate altitudinally. There is already growing evidence that climate change is having major effects on some species leading to range shifts, as well as shifts in/effects on other key biological functions such as commencement of breeding. As climate change proceeds, these effects are expected to be exacerbated and become more widespread.

Fragmentation (breaking up into smaller pieces), loss (total destruction) and modification (changes to remaining habitat) of ecosystems are widely recognised as negative ecological processes.

(T)he interaction of (climate change and fragmentation) is expected to have a far more detrimental effect on biodiversity than either factor in isolation. This is because many landscapes are an evolutionary novelty to organisms because the environments in which they evolved were considerably less fragmented than modern landscapes. This makes it difficult for many organisms to respond and adapt by movement across modified landscapes.

For Gungahlin the key questions are:

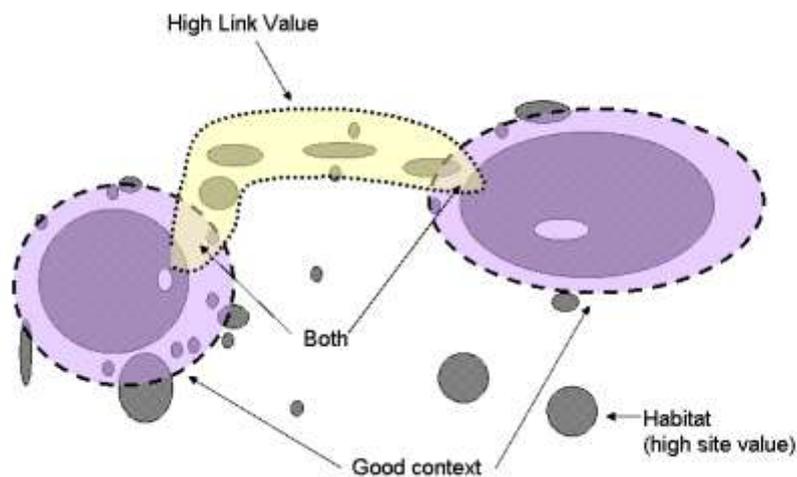
- Where are the largest most ecologically intact areas?
- Are these patches large enough to support species sub-populations and maintain ecological processes?

- How easy is it for species to move between the areas of high integrity and to move across Gungahlin? (Note the ability of a particular species to move across the landscape will vary according to such factors as mobility, habitat specialisation and social organisation.)
- How can we best protect and enhance areas of connectivity importance?

Relative connectivity value across a landscape can be assessed and inferred through use of the Spatial Links Tool (following Drielsma et al. 2007). This tool integrates the benefits a habitat supplies to an organism with the costs associated with movement between habitats (Manning et al. 2010). The tool produces two complementary views of connectivity:

- high connectivity to neighbouring habitat (good context of habitat arrangement in the landscape)
- link-value – the contribution to the connectivity between other habitats.

Figure 19 represents the two different approaches of measuring connectivity value across a landscape.



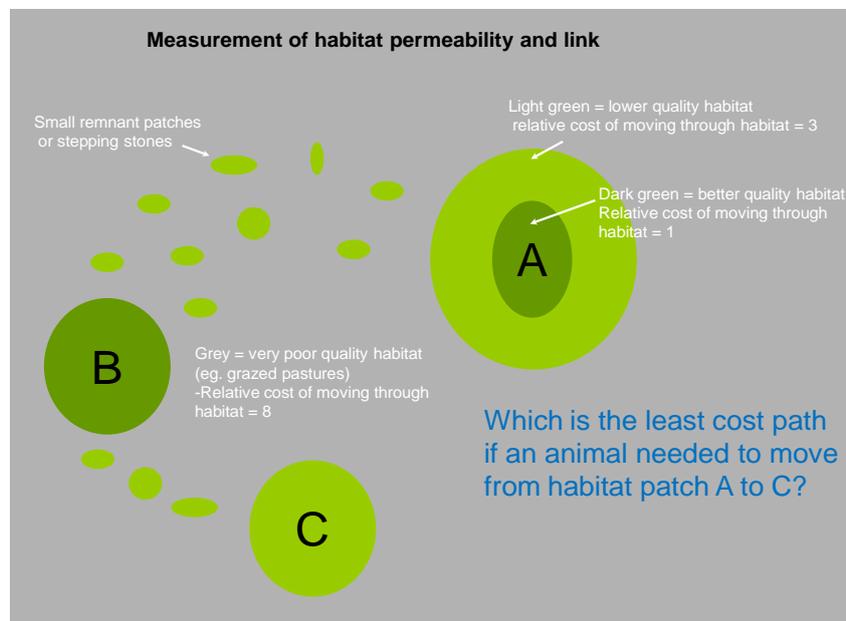
**Figure 19 Measuring connectivity value across a landscape** (after Tom Barrett 2010, NSW Office of the Environment and Heritage, Pers Comm)

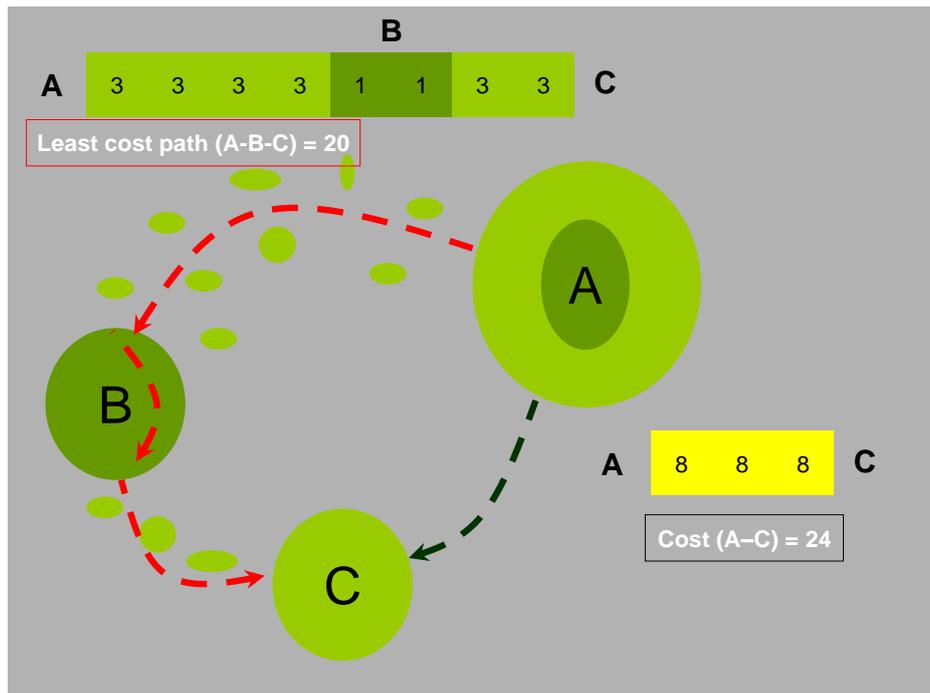
Manning et al. (2010), with ACT Government funding, applied the two approaches to the ACT and surrounding NSW through the preparation of gridded data layers of habitat value and movement costs according to the following five steps:

1. Amalgamation of various datasets to create a digital ecological communities map, comprising major vegetation and land cover types. At a 15 m resolution, each grid cell was assigned the dominant vegetation/land cover category. The data also incorporated street tree information as many wildlife species can move through or utilise urban vegetation. (However, lack of computer availability meant that amalgamated grid cells of 90 m resolution were used in the analysis.)
2. Selection of six 'model animals' to be used in the analysis of connectivity. The modelled animals included a small woodland bird, a strong flying bird, an arboreal mammal, a ground dwelling mammal, a grassland reptile, and an amphibian.

3. For each modelled animal, assignment of a habitat suitability score (on a scale of 10 (not suitable) to 0 (most suitable), and a permeability (ease of movement) score (on a scale of 0 (most permeable) to 10 (least permeable) to each vegetation/land cover type (see Figure 20 for a graphical interpretation).
4. For each model animal, determination of the range of day to day movement abilities through low quality and high quality habitat. This effectively set the maximum limit as to how far an animal may travel across the different habitat qualities.
5. Random selection of 5000 grid cells to act as source and destination points for the links analysis.

The good context and link analysis were run separately for each model animal to produce gridded layers of neighbourhood habitat area and link value.





**Figure 20 Measurement of habitat permeability and link (after Barrett et al 2010)**

Manning et al. (2010) caution that their work should be regarded as indicative only, as it is based on model data and is sensitive to the choice of model parameters, ratings for habitat quality and permeability, and to grid resolution. As part of a woodland biodiversity offset, further funding was provided for the Landscape Modelling & Decision Support Section, Department for Environment Climate Change and Water (DECCW) NSW (led by Tom Barrett and involving Michael Drielsma) to build on the work of Manning *et al.* (2010), to produce an analysis that enables the current and potential relative connectivity value of a particular site to be determined at a fine scale. This analysis is now essentially complete and a report is being prepared.

The latest analysis is based on:

- the 15 m grid vegetation and land use mapping of Manning et al. (2010)
- tree canopy mapping of the ACT and surrounding 20 km of NSW that utilises Spot 5, 2007, satellite imagery and maps the canopy to a 15 m scale, which is sufficient to identify individual paddock trees
- use of data on wood biomass density derived from the Advanced Land Observing Satellite (ALOS), which improved the ability to separate woodland from forest habitat
- 550 000 runs between random points in suitable habitat across the ACT region, which determined for each random pair of points the least cost pathway (habitat linkage/permeability) between them
- utilisation of information on barriers to wildlife movement, derived from a review of 80 studies, involving up to 66 bird, mammal and reptile species, primarily inhabiting woodland in southern Australia. This study by Doerr et al. (2010) determined from literature review, threshold values beyond which a species would not disperse. Figure 21 shows the average threshold values, which were utilised in the Gungahlin analysis
- separate connectivity analysis for woodland habitat and forest habitat respectively, and an amalgam of woodland and forest habitat. This was done as woodland and dry forest are the key vegetation structures in lowland ACT. As indicated in Figure 22, certain species, such as

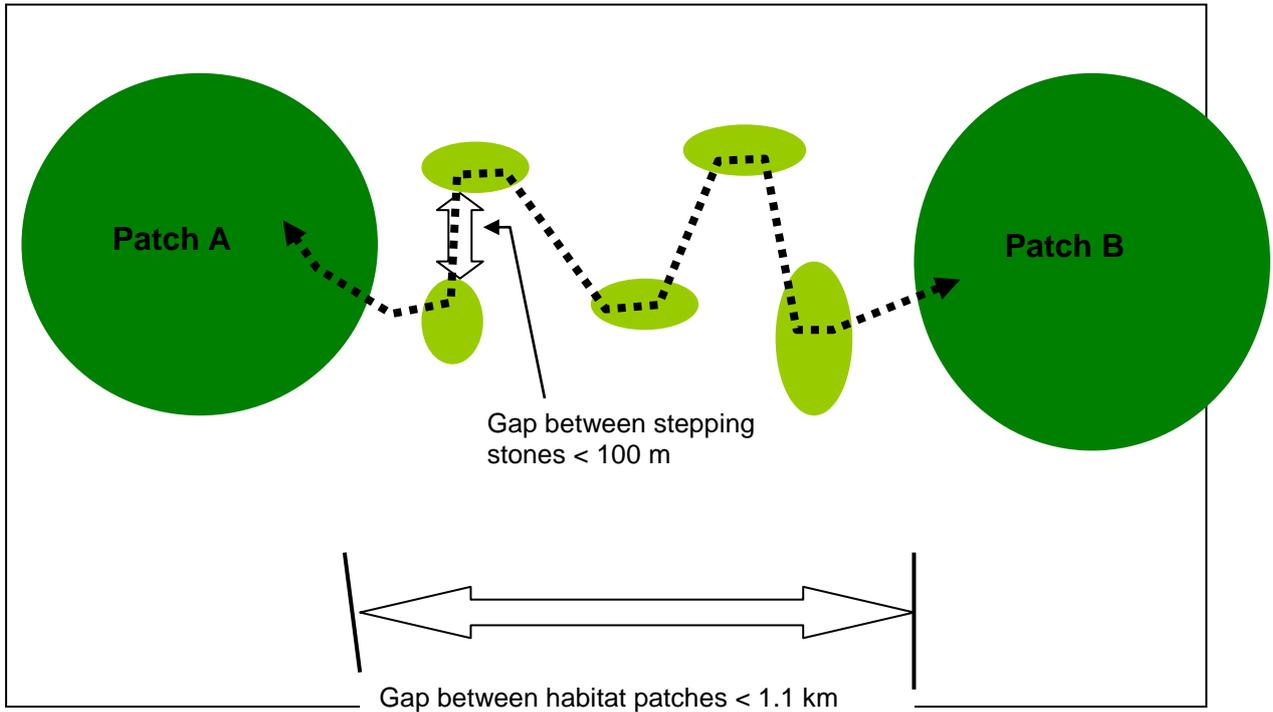


Figure 21 Average Threshold Movement Barriers (from Doerr et al. 2010)

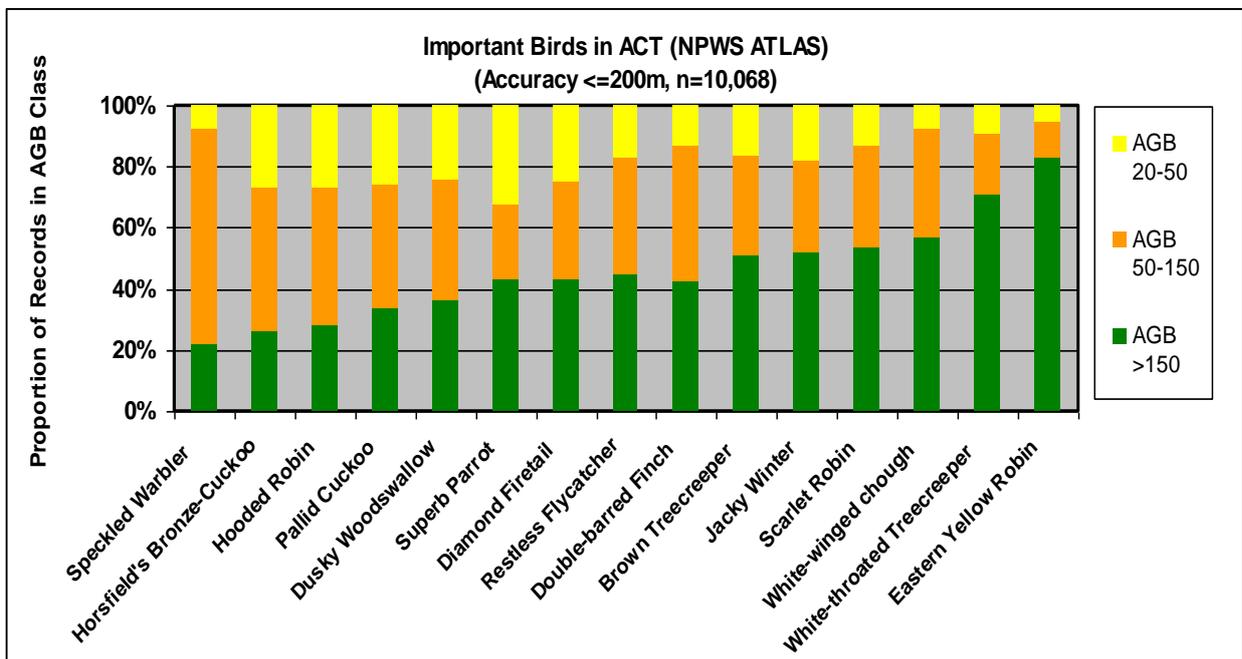
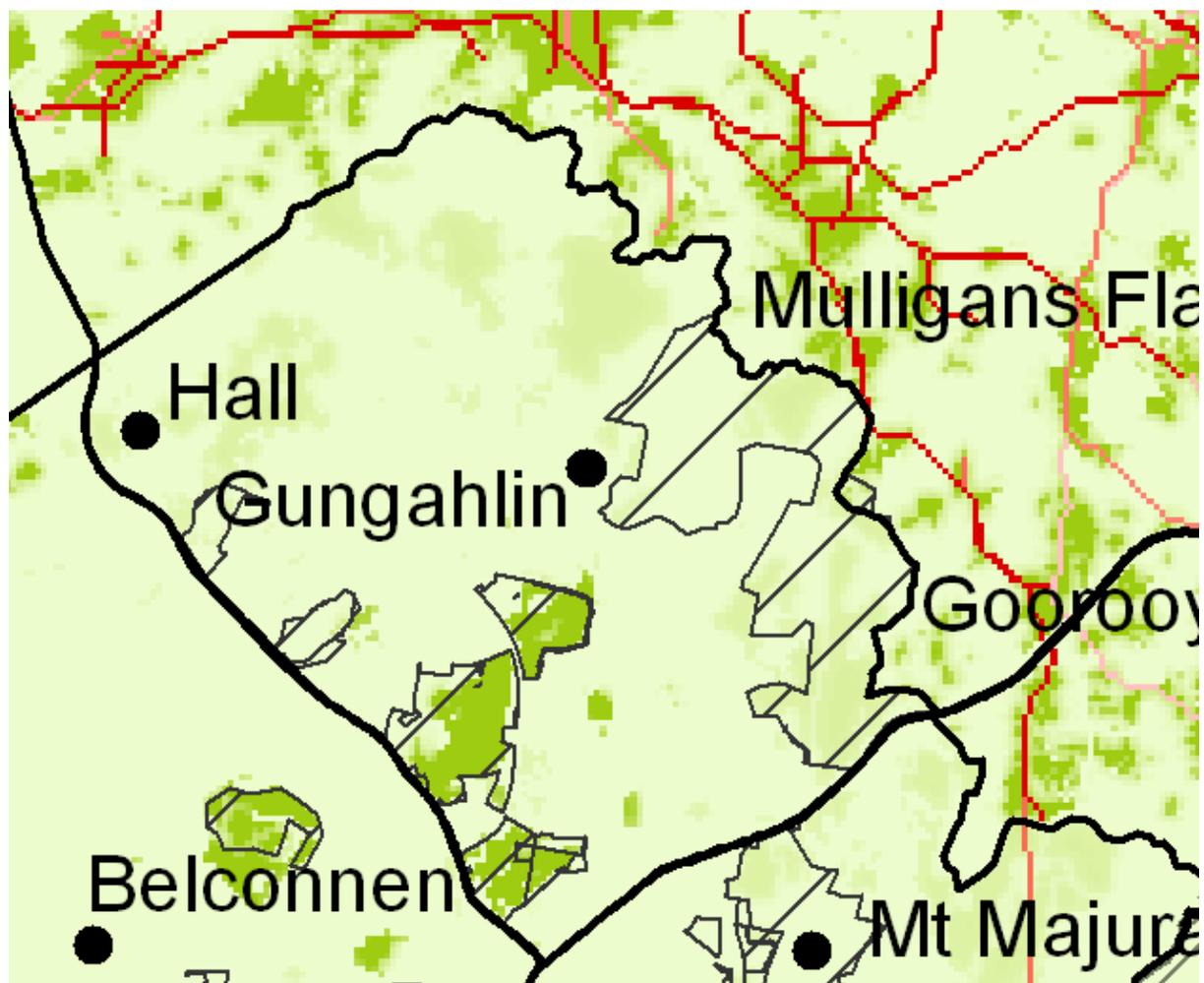


Figure 22 Differences in woodland and forest habitat preference displayed by threatened and declining 'woodland' bird species.

(Note: AGB = Above Ground Biomass: 20–50 = open woodland; 50–150 = woodland; >150 = forest. The analysis is based on records of the Canberra Ornithologists Group and NPWS Wildlife Atlas.)

the speckled warbler, are woodland specialists for which forest may pose a barrier, while for a species like the eastern yellow robin the reverse may be true. More generalist species such as the superb parrot would have the ability to utilise both woodland and forest habitat while moving through a landscape. As the connectivity analysis by Barrett is essentially of tree canopy and woodland and forest habitat it is unsuitable for considering the movement across Gungahlin of grassland specialist species, such as striped legless lizard or golden sun moth. The study by Manning et al. (2010) suggests that Gungahlin grassland reserves and remaining grassland habitat is essentially isolated and that the key conservation actions for grassland connectivity would be to prevent further fragmentation by road or other infrastructure development and to improve the condition of the existing reserves (see Figure 23).



**Legend**

**Link Value**



**N'brhood Habitat Area**



-  River
-  Highway
-  Reserve

Figure 23 Grassland Connectivity within the Gungahlin area (from Manning et al. 2010)

## 9.1 Forest and Woodland Connectivity across Gungahlin

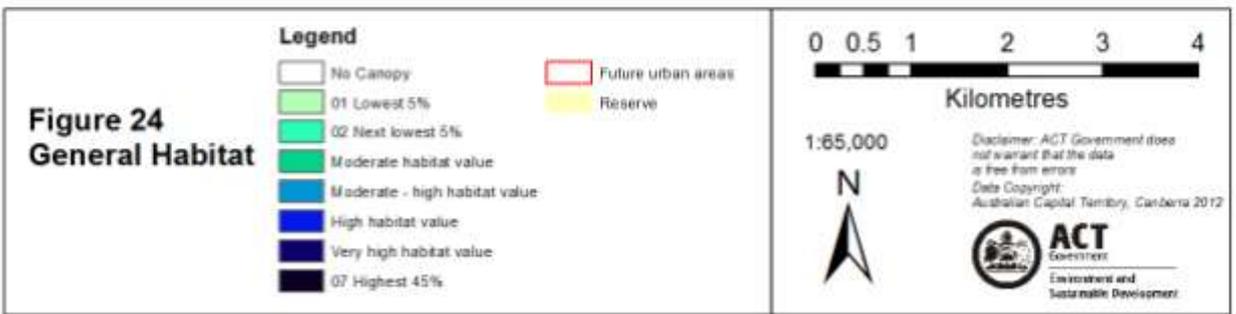
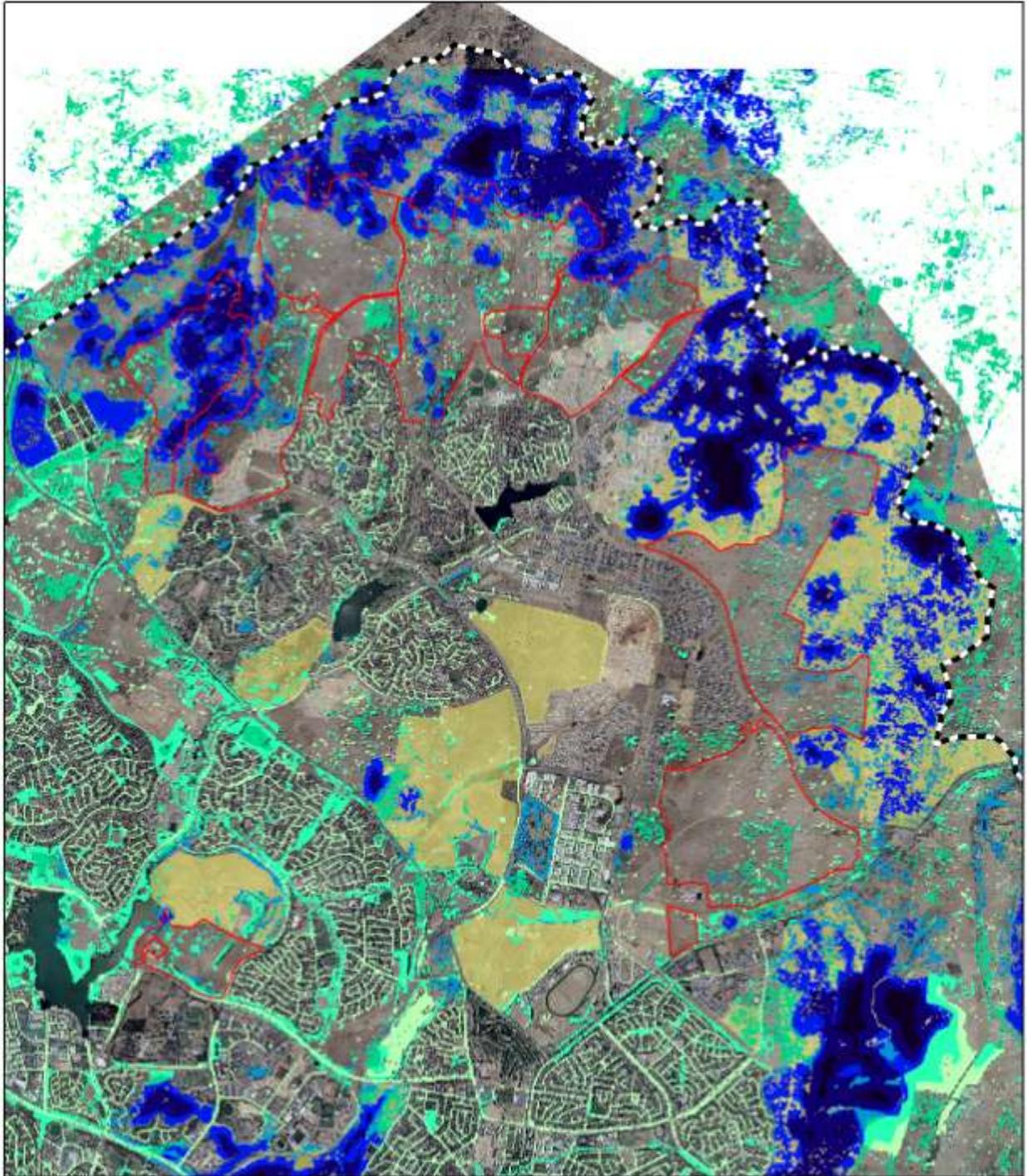
Figures 24, 25 and 26 indicate areas of high habitat value across Gungahlin for woodland, forest, and combined woodland/forest or general habitat. Habitat value is determined for each 15 m grid. It is a measure of the size of suitable patches, how close they are to one another (spatial configuration), and habitat condition (assessed according to a combination of land use and vegetation map layers such as the woodland and native street tree/plantation mapping utilised by Manning et al. 2010).

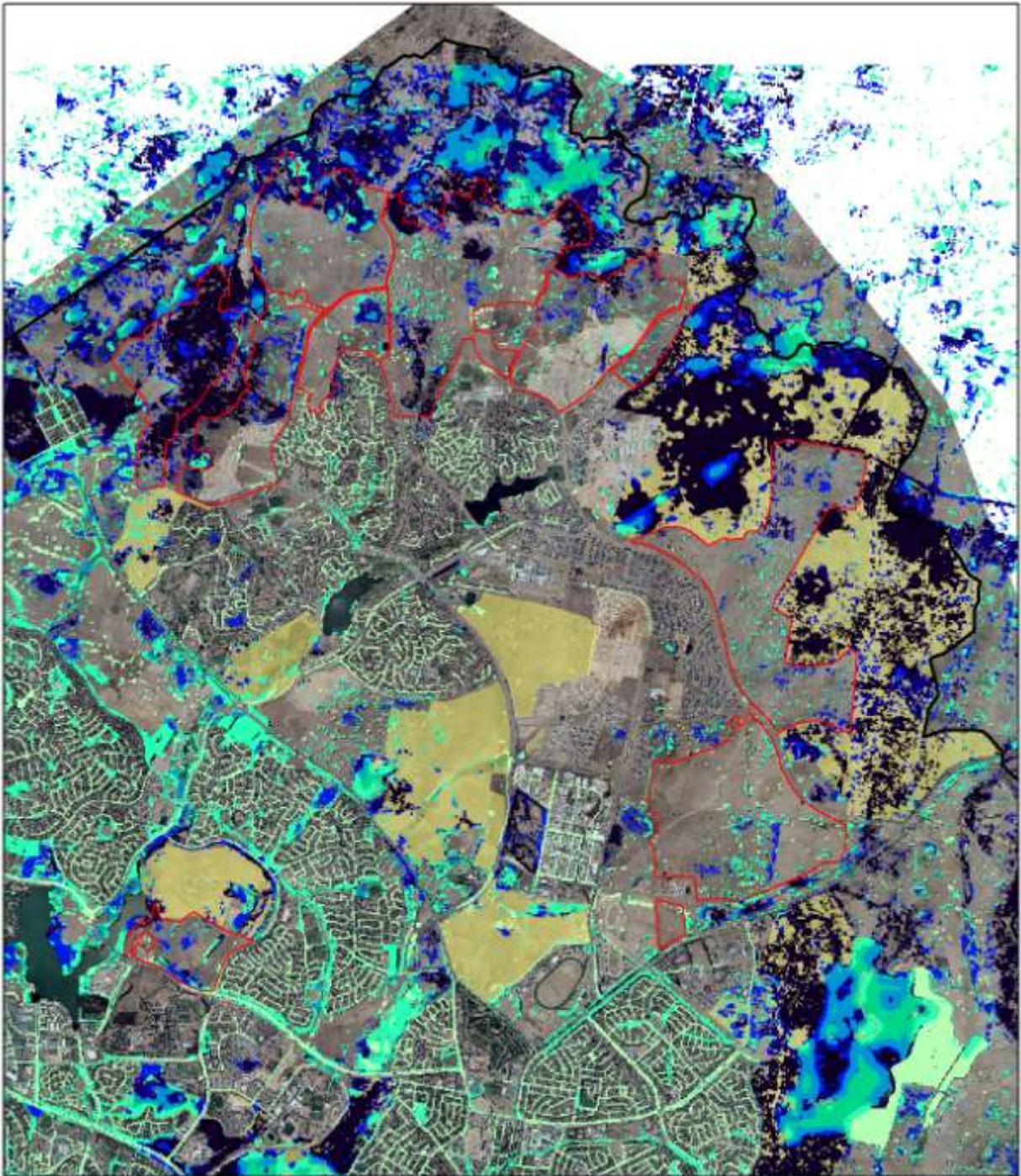
In Figures 24, 25 and 26, the darker the blue shading the higher the habitat value. Most of the high value habitat in Gungahlin is in Mulligans Flat and Goorooyaroo nature reserves, the northern lease area and Kinlyside.

Figure 27 illustrates the main regional movement links (least cost pathways) across Gungahlin. The analysis is based on 'join the dots' least cost pathway links analysis of 550 000 paths between point pairs across the ACT region. The point pairs were randomly selected from 15 m grids within high value woodland habitat patches only (a separate analysis for forest habitat and a combined woodland and forest habitat was also undertaken). High values (darker shading) indicate that a grid at this location was frequently crossed as a least cost path between points. Most grids were not utilised in any least cost path between random points in high quality woodland. Figure 28 illustrates the least cost pathways across the whole of the ACT. The analysis reinforces the importance of north and east Gungahlin for woodland connectivity within the region. This analysis is useful in focusing restoration efforts intended to enhance connectivity at the regional level.

The links indicate the least cost (or best available) pathway, and may not necessarily indicate functioning pathways. The work of Doerr et al. (2010) suggests that most animals will not cross a canopy gap of 100 m or more and that most will not travel more than 1.1 km without locating a patch of suitable habitat at least 10 ha in size. Figure 29 is an analysis that recognises these barriers. It provides a stepping stone or tree patch to tree patch connectivity picture, where a least cost pathway is conducted between all trees that are within 105 m of each other and occur within a 200 m window. This window was moved across the whole ACT landscape, so that connections between all individual tree clumps and trees across the ACT were considered, but focused on the local connection. High values (dark shading) in Figure 29 indicate that this is an important tree link at a local scale. The analysis portrayed is just for woodland habitat, and indicates high quality woodland habitat of over 10 ha in size. The red areas are those areas that act as functional linkages for species that are able to cross gaps of 100 m to 200 m (these are key areas to target for woodland restoration works, as they are sites where a small amount of planting/regeneration can have a significant impact in enhancing habitat).

The analysis suggests that specialist woodland species may have trouble crossing the northern lease area, but shows there is good connectivity between the woodland patches of East Bonner, Little Mulligans Flat, Mulligans Flat, the mid to northern section of Throsby neck, Goorooyaroo, and then onto Mount Majura, Mt Ainslie and the Majura Training Area. The woodland in Kenny also has some local connectivity value.





**Figure 25  
Woodland habitat**

**Legend**

- |  |   |
|--|---|
|  Future urban areas |  No Canopy           |
|  Reserve            |  01 Lowest 5%        |
|  |  02 Next highest 5%  |
|  |  03 Next highest 20% |
|  |  04 Next highest 25% |
|  |  05 Next highest 10% |
|  |  06 Next highest 15% |
|  |  07 Highest 15%      |

0 0.5 1 2 3 4



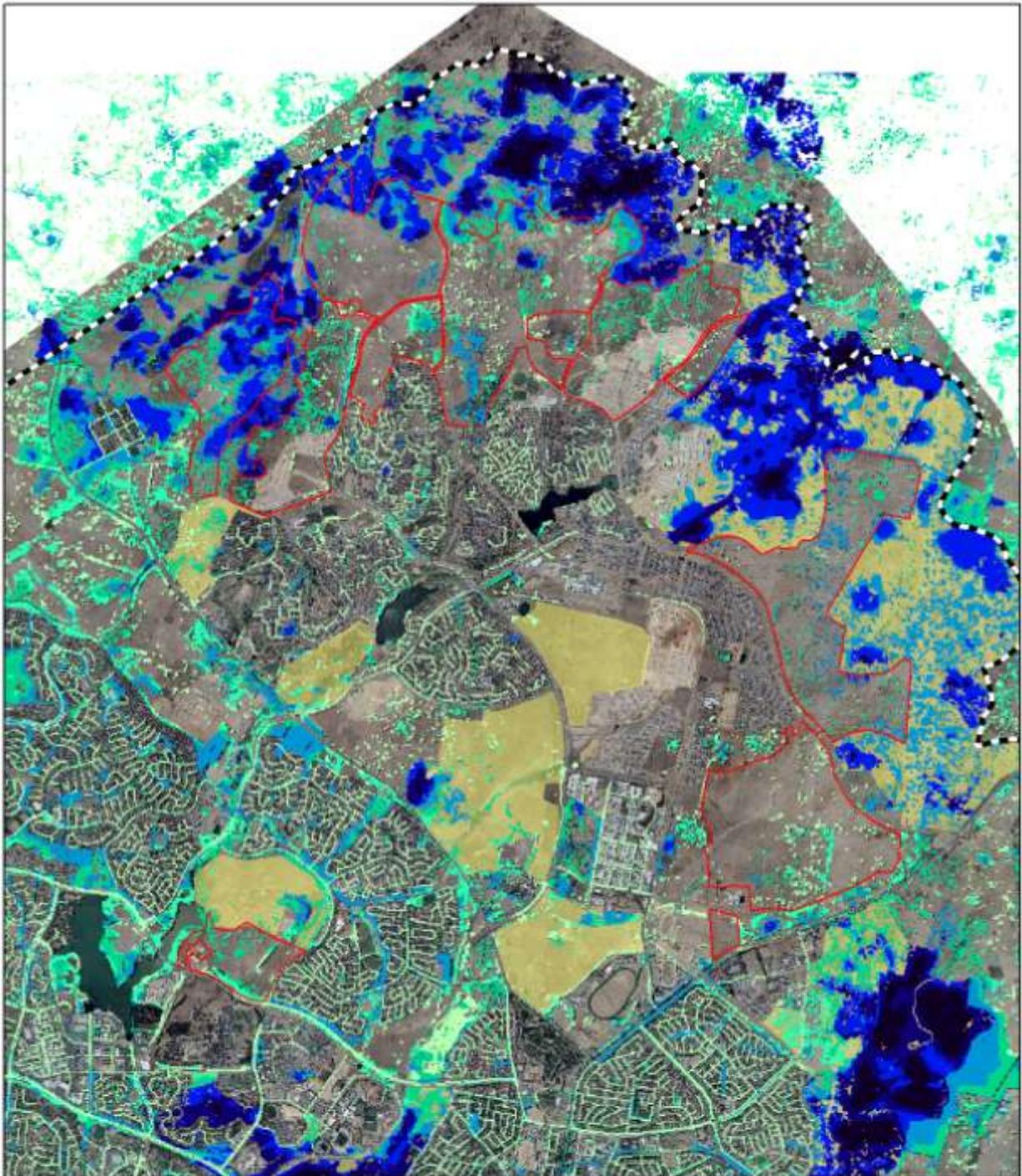
Kilometres

1:65,000

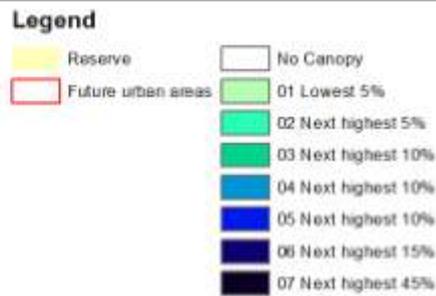


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**Figure 26  
Forest Habitat**



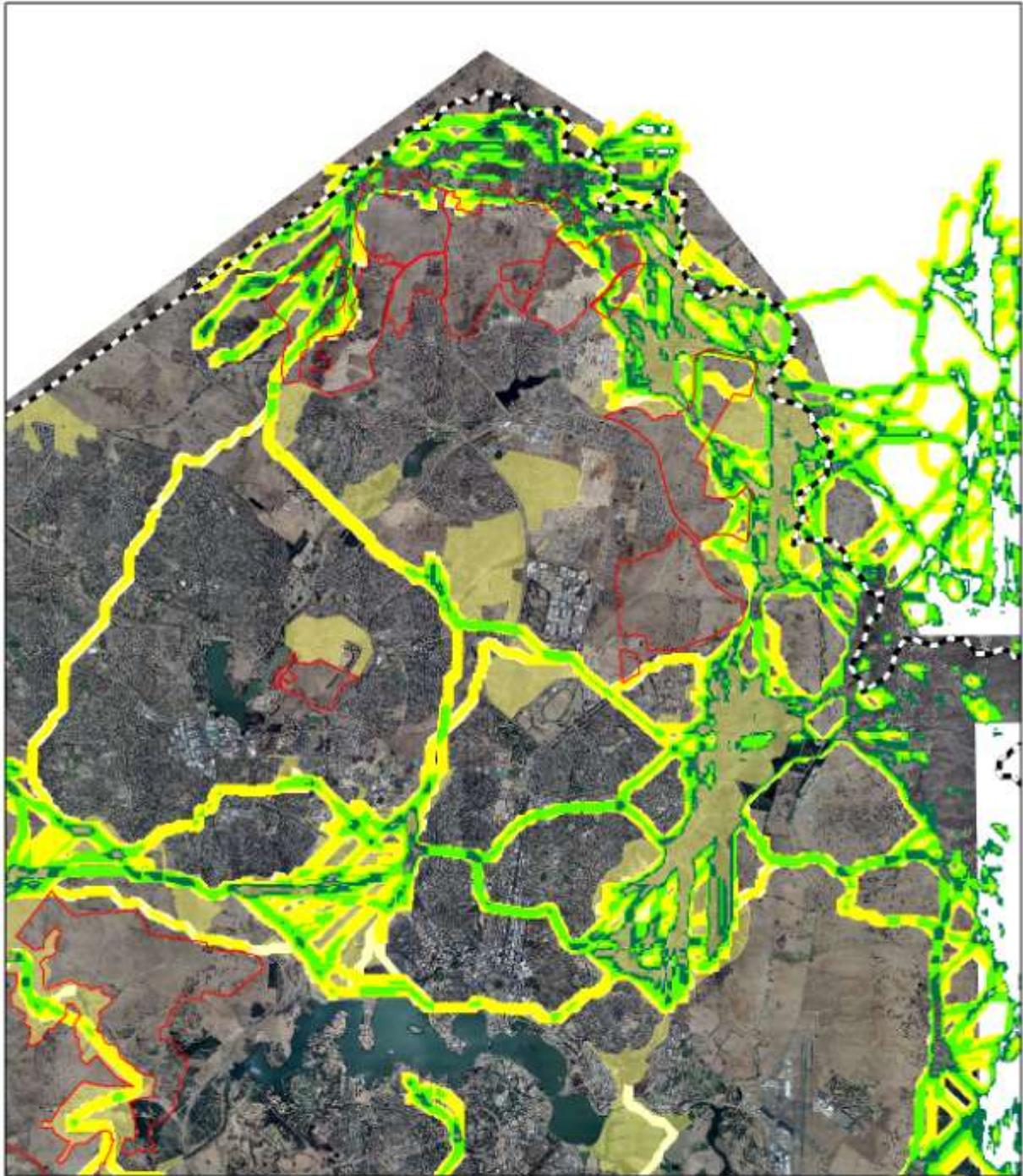
Kilometres

1:65,000



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**Figure 28  
Regional  
Linkage Value**

**Legend**

- |                      |  |
|----------------------|--|
| <b>Linkage Value</b> |  Future urban areas |
| Very low             |  Reserve            |
| Low                  |  ACT Border         |
| Moderate             |  |
| High                 |  |
| Very high            |  |

0 2.5 5 10 15 20

Kilometres

1:400,000

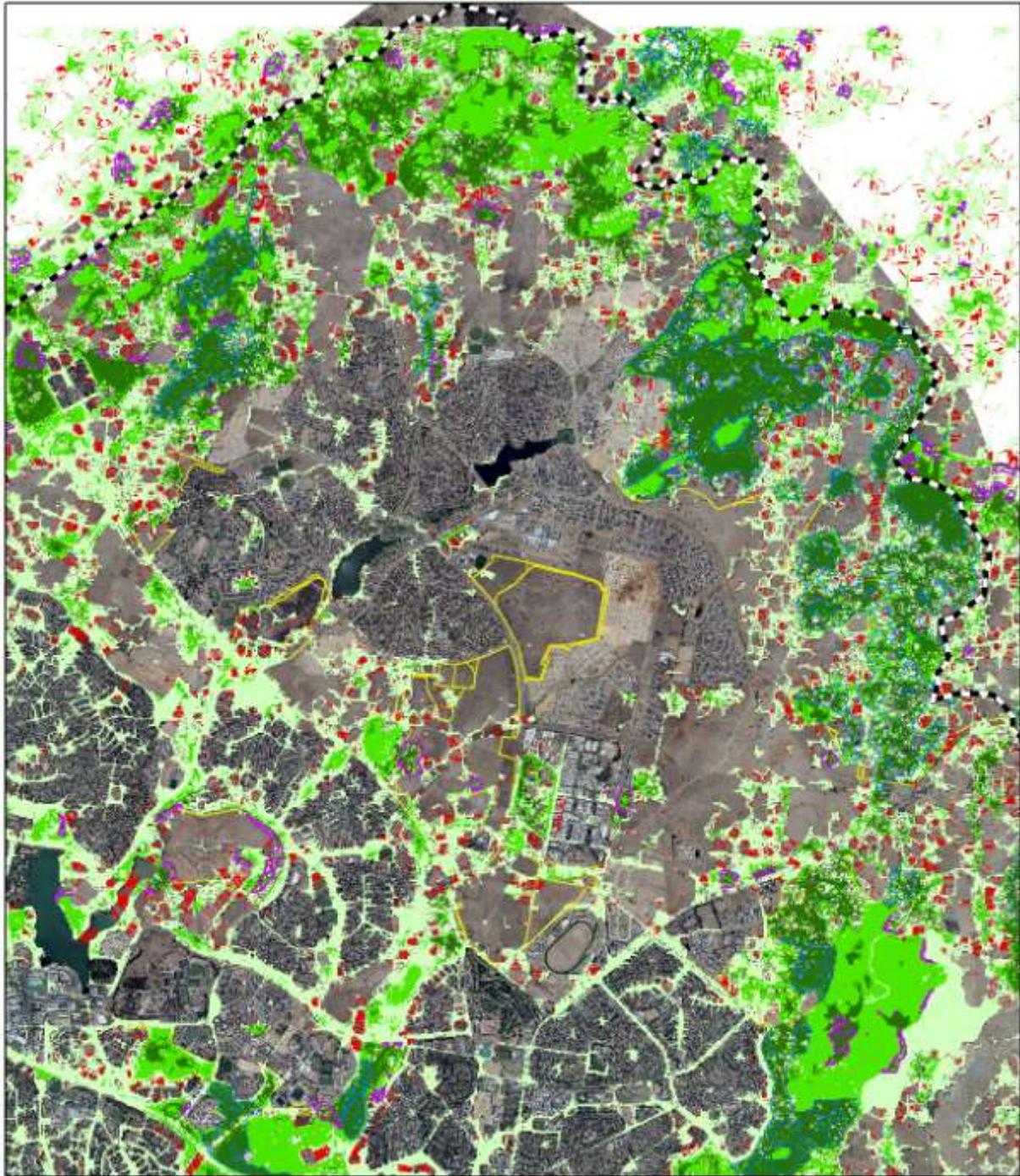
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Government

Environment and Sustainable Development



**Figure 29**  
**Functioning**  
**Connectivity**  
**across Gungahlin**

- Reserve
- Extra path found when using gap threshold of 195 m
- Habitat patch size**
- < 10 ha
- > 10 ha
- Woodland corridors (105m threshold)**
- Low link value (lowest 20%)
- Medium link value (next highest 60%)
- High link value (highest 20%)

0 0.5 1 2 3 4

Kilometres

1:65,000



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The habitat and linkage connectivity analysis confirms that Kinlyside – Hall, the northern lease area, and the Mulligans Flat – Gorooyaroo grassy woodland complex are the key and best connected habitat areas within Gungahlin, and that there are good connections to other woodland areas to the south and east across the Majura Valley and into New South Wales.

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# Appendix 1 Floristic Value Data Sheet

Datasheet for the North-western sub-region sites											
Only fill in <span style="background-color: #e0f0ff;">pale blue</span> cells											
Date of survey: 8/10/10	Site name: Moncrieff	Site Id. Code: Mon2	Species code	Braun-Blanquet code		PATCHY	DOM/SUB_CO	Indic_2_r	Indic_2_no_r	Indic_1_r	Indic_1_no_r
			Aust scab	+	Austrostipa scabra	c		0	0	0	0
			aira sp		Aira sp.	e		0	0	0	0
			briz maxi	+	Briza maxima	e		0	0	0	0
			cent eryt	+	Centaurium erythraea	e		0	0	0	0
			hype perf	+	Hypericum perforatum	s		0	0	0	0
			hypo glab	+	Hypochaeris glabra	e		0	0	0	0
			hypo radi	+	Hypochaeris radicata	e		0	0	0	0
			petr nant	+	Petromagla nanteuilli	e		0	0	0	0
			aris ramo	+	Aristida ramosa	c		0	0	0	0
			Vulp sp	+	Vulpia sp.	e		0	0	0	0
			tolp umbe	+	Tolpis umbellata	e		0	0	0	0
			Trif sp	+	Trifolium sp.	e		0	0	0	0
			Acae ovin	+	Acaena ovina	c		0	0	0	0
			Aust sppd	+	Austrodanthonia spp.	c		0	0	0	0
			boss buxi	+	Boeslaea buxifolia	c	2	1	0	0	0
			bulb bulb	+	Bulbine bulbosa	c	2	1	1	0	0
			Cras vari	+	Crassedia variabilis	c	2	1	1	0	0
			Cras sieb	+	Crassula siebertiana	c		0	0	0	0
			cymb laeas	+	Cymbonotus laeasontianus	c		0	0	0	0
			ophi lusi	+	Ophioglossum lusiaticum (syn. Ophioglossum lu	c	2	1	0	0	0
			apha sp	+	Aphanes sp.	c		0	0	0	0
			pter cyon	+	Pterostylis cyanocephala	c	2	1	0	0	0
			desm vari	+	Desmodium varians	c	2	1	0	0	0
			dros peit	+	Drosera peltata	c		0	0	0	0
			elym scab	+	Elymus scaber	c		0	0	0	0
			mlor stlp	+	Microlaena stipoides	c		0	0	0	0
			Gera sola	+	Geranium solanderi	c		0	0	0	0
			Gono tetr	+	Gonocarpus tetragynus	c	1	0	0	1	1
			isoe gram	+	Isoetopsis graminifolia	c	2	1	1	0	0
			loma mult	+	Lomandra multiflora	c	2	1	1	0	0
			loma fili cort	+	Lomandra filiformis subsp. cortacea	c	1	0	0	1	1
			luzu dens	+	Luzula densiflora	c	2	1	1	0	0
			mlor sp	+	Microtis sp.	c	2	1	1	0	0
			oxal pere	+	Oxalis perennans	c		0	0	0	0
			scie bifl	+	Scieranthus biflorus	c	2	1	0	0	0
			sole domi	+	Solenogyne dominii	c		0	0	0	0
			Them aust (3 or ->)	+	Themeda australis (syn Themeda triandra)	c	2	1	1	0	0
			Tripl pygm	+	Tripliodiscus pygmaeus	c	2	1	1	0	0
			diur chry	+	Diuris chryseopsis	c	2	1	1	0	0
			wurm diol	+	Wurmba diolca	c	2	1	1	0	0
			boss pros	+	Boeslaea prostrata	c	2	1	0	0	0
			joyc pall	+	Joycea pallida (syn. Chionochoia pallida)	c		0	0	0	0
			Seba ovat	+	Sebaea ovata	c	2	1	0	0	0
			Aspe conf	+	Aspenula conferta	c	2	1	1	0	0
			arth mili	+	Arthropodium milleforium	c	2	1	1	0	0
					#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
							19	12	2	2	

Site value score:	45
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Plot information:	zone 55
Datum	
AMG Easting	652845
AMG Northing	6107563

Number of common species	13
Number of indicator level 1 species	2
Number of indicator level 2 species	19
Total number of native species	34
Number of exotic species	10
Number of significant weed species	1

Notes: To ensure that the formulae are picked up, select a row between rows 8 and 12 and insert the required number of rows that will ensure correspondence with the number of species recorded. Then ensure that the formulae from the original cell directly above are copied down to the new rows (see cell reference T:6). You will know that the formulae have been copied down correctly as "#N/A" will appear in the white cells.