

Figure 13 Vegetation map of the Sweetwater site, showing all floristic variations present. See text for details.

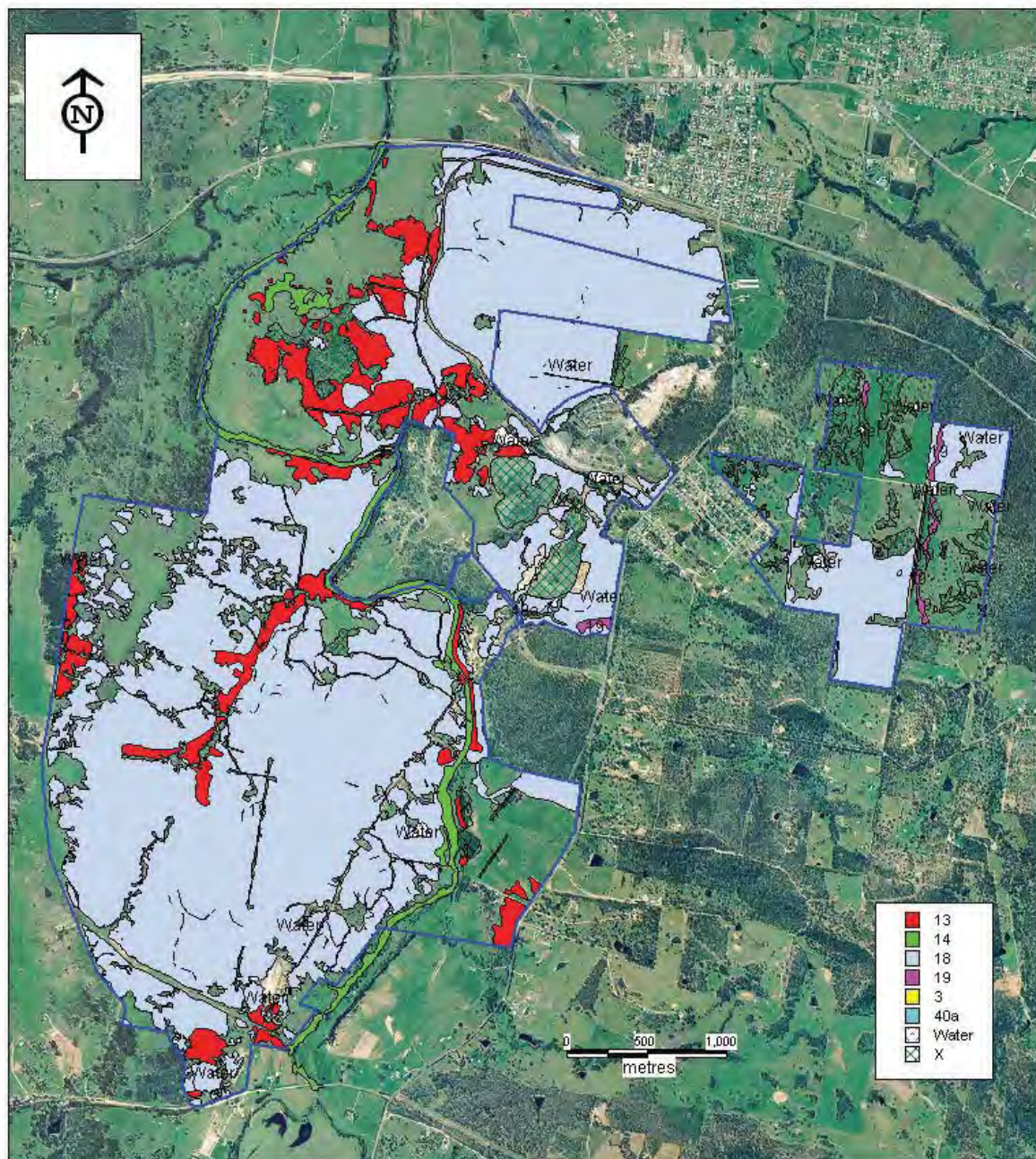


Figure 14 Vegetation map of the Sweetwater site, based on the NPWS (2000) classification. See text for details.

4.0 Discussion and Conservation Significance

4.1 *The Sweetwater flora*

The native vegetation of Sweetwater includes a range of vegetation communities and flora species that are generally poorly reserved throughout the lower Hunter Valley. Of particular interest is the number of plant species occurring which are more typical of western inland locations, and which occur as disjunct populations at Sweetwater. Survey and analysis undertaken for the current study has identified over three hundred and twenty-five plant taxa and six vegetation communities, the latter comprised of several sub-communities or associations. One endangered (*Persoonia pauciflora*), two vulnerable (*Eucalyptus glaucina*, *Eucalyptus parramattensis* subsp. *decadens*) and four rare (*Acacia bulgaensis*, *Eucalyptus fergusonii*, *Grevillea montana*, *Macrozamia flexuosa*) plant species are present on the site. In addition, the site supports suitable habitat for the undescribed *Diuris* sp aff. *dendrobioides* (Hunter Valley), and two locations supporting the species were located. Two Endangered Ecological Communities (Hunter Lowlands Redgum Forest, River-Flat Eucalypt Forest on Coastal Floodplains), as listed on the *Threatened Species Conservation Act 1995*, are present on the site.

The Sweetwater site also plays an important role in wildlife corridors in the mid-lower Hunter Region. In their regional corridor mapping, NPWS (2003, and see Scotts & Drielsma 2003) have identified two regional corridors (the Allandale and Sweetwater corridors) merging within the study area. The Allandale corridor links to Werakata National Park in the south-east, while the Sweetwater corridor links with Belford National Park to the north and Pokolbin State Forest in the south-west. In addition, two sub-regional corridors have been identified, the Rothbury Creek corridor running to the south, and the Branxton corridor running between the townships of Branxton and North Rothbury. Figure 15 shows these mapped corridors.

Corridors mapped by NPWS (2003) are broad in nature and, in general, have not been assessed on the ground for their suitability to facilitate the movement of plant pollinators and propagules and other fauna migrations. In addition, some sections of designated corridors require the co-operation of many landholders to either retain remnant vegetation that may occur on their properties, or to revegetate vital linkage areas. Consequently, any development proposed for the land at Sweetwater will need to address the issue of wildlife corridors previously identified in the area by NPWS (2003), including on-ground inspection of corridor proposals and collaboration with affected neighbours.

As mentioned, Sweetwater currently supports a number of plant taxa that more typically occur further inland, and which exist in the North Rothbury area as outliers or as remnants of their natural distribution prior to European settlement. Such species would include *Allocasuarina luehmannii*, *Allocasuarina verticillata*, *Brachychiton populneus*, *Callitris endlicheri*, *Canthium buxifolium*, *Chenopodium carinatum*, *Dodonaea truncatiales*, *Einadia nutans* subsp. *linifolia*, *Eucalyptus albens*, *Eucalyptus microcarpa*, *Maireana microphylla*, *Marsdenia viridiflora* subsp. *viridiflora*, *Myoporum montanum*, *Notelaea microcarpa* var. *microcarpa*, *Nyssanthe diffusa*, and *Sarcostemma brunonianum*.



Figure 15 Location of wildlife corridors (including corridor names) mapped by NPWS (2003).

4.2 Comparison with previous projects

Classification and mapping of the vegetation within Sweetwater has allowed direct comparisons to be made with the classification and modeling undertaken during the LHCCREMS project (NPWS 2000a), as well as that completed by the Hunter Catchment Management Trust (now the Hunter-Central Rivers CMA) (Peake 2005). In general, the finer scale of investigation allowable in the current study has greatly improved upon the LHCCREMS framework for the Cessnock LGA, while it has also confirmed or clarified the mapping of Peake (2005) for the Singleton LGA area.

Table 6 presents a comparison of the two existing classifications with that reported in the current work. As can be seen, the classification of Peake (2005) closely mirrors that reported here for Sweetwater, while both can be broadly included in the six broad NPWS (2000a) units.

In regard to the mapping outputs, the following points summarise the refinements:

- in the LHCCREMS mapping, Lower Hunter Spotted Gum – Ironbark Forest occupies virtually all of the Cessnock LGA portion of the site (Singleton LGA was not included within the LHCCREMS project). Data analysis for the current project has shown that this community can more accurately be depicted as Central Hunter Ironbark – Spotted Gum– Grey Box Forest, and conforms generally to the mapping of Peake (2005) for this area;
- a number of floristic variations are discernible in the field within the Central Hunter Ironbark – Spotted Gum– Grey Box Forest, and these could not be identified during the LHCCREMS project. Some of these have been noted in Peake (2005);
- the distribution of Hunter Lowlands Redgum Forest throughout most of the area as shown in the LHCCREMS mapping, while not spatially correct, does approximate the ground situation reasonably well.

The main consequences of this revised mapping for Sweetwater are that the large expanses of what was formally mapped as the Lower Hunter Spotted Gum – Ironbark Forest EEC cannot be supported by the current data. However, the Central Hunter Ironbark - Spotted Gum - Grey Box Forest, its replacement, is considered a regionally significant vegetation community with very poor reservation in formal conservation reserves (Peake 2005).

4.3 Threatened & Rare taxa

During the course of current and previous survey work, several species of conservation significance have been recorded for Sweetwater. In total, one endangered (*Persoonia pauciflora*), two vulnerable (*Eucalyptus glaucina*, *Eucalyptus parramattensis* subsp. *decadens*), four rare (*Acacia bulgaensis*, *Eucalyptus fergusonii* subsp. *dorsiventralis*, *Grevillea montana*, *Macrozamia*

flexuosa) and several species of regional significance (see Table 7) were detected. Regional significance is based on the listing of species maintained by the Rare Plants Subcommittee of the Hunter Region Botanic Gardens (Bell, Peake, Tame, Simpson & Curran in prep.). In addition, one undescribed and potential new taxa (*Diuris* sp aff *dendrobioides* Hunter Valley) was recorded, and additional surveys targeting this species are recommended for subsequent flowering seasons, as many orchid species do not flower consistently from year-to-year. Specimens of all significant species have been lodged at the National Herbarium, Sydney.

4.3.1 Undescribed Species

***Diuris* sp. aff. *dendrobioides* (Hunter Valley).**

Diuris sp. aff. *dendrobioides* (Hunter Valley) is a terrestrial Donkey Orchid restricted to the lower Hunter Valley (Figure 16). Bishop (1996) describes this taxon as a distinct entity occupying a restricted zone in the Belford-Branxton locality. Previous records for this taxon exist for the Belford National Park area (L. Copeland, pers. comm.) and in the vicinity of Stanford Merthyr within Kurri Sand Swamp Woodland (M. Roderick, pers. comm.). This species is currently not listed as threatened in New South Wales, however given its very restricted range and the extent of fragmentation to its habitat, it certainly qualifies for listing.



Figure 16 *Diuris* sp aff *dendrobioides*
(Hunter Valley) at Sweetwater

Table 6 A comparison of vegetation classifications for Sweetwater, the Hunter Valley remnant vegetation project (Peake 2005), and the LHCCREMS (NPWS 2000a).

Sweetwater (current classification)		Peake (2005)		NPWS (2000a)	
3	<i>Backhousia myrtifolia</i> Gallery Rainforest	1	Lower Hunter Dry Rainforest	3	Hunter Valley Dry Rainforest
13a	<i>Casuarina glauca</i> Riparian Forest (regrowth)	28	Central Hunter Swamp Oak Forest	13	Central Hunter Riparian Forest
13b	<i>Melaleuca decora</i> Floodplain Woodland	17	Central Hunter Paperbark Soaks Woodland		
13c	<i>Allocasuarina luehmianii</i> Floodplain Low Forest	32	Central Hunter Bullock Forest Regeneration		
13d	<i>Melaleuca nodosa</i> Floodplain Scrub	24	(?) Hunter Lowland Red Gum Forest (variant)		
14a	<i>C. cunninghamiana</i> – <i>C. glauca</i> Riparian Forest	30	Hunter Valley River Oak Forest	14	Wollombi Redgum - River Oak Woodland
14b	<i>A. floribunda</i> Dune Forest (greatly disturbed)	14	(?) Warkworth Sands Woodland (variant)		
14c	<i>E. amplifolia</i> Depression Forest	22	Wollombi Alluvial Redgum – Apple Forest (variant)		
18a	<i>Allocasuarina luehmianii</i> Low Forest	32	Central Hunter Bullock Forest Regeneration	18	Central Hunter Ironbark–Spotted Gum–Grey Box Forest
18b	<i>E. moluccana</i> Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18c	<i>E. crebra</i> – <i>C. maculata</i> Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18d	<i>C. maculata</i> – <i>Callitris endlicheri</i> Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18e	<i>E. crebra</i> – <i>E. tereticornis</i> Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18f	<i>E. eugenoides</i> Open Forest	22	(?) Wollombi Alluvial Redgum – Apple Forest (variant)		
18g	<i>C. maculata</i> – <i>E. punctata</i> – <i>E. crebra</i> Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18h	<i>E. fibrosa</i> – <i>C. maculata</i> Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18i	<i>Angophora floribunda</i> Open Forest (regrowth)	n/a			
18j	<i>C. maculata</i> – <i>Allocasuarina torulosa</i> Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18k	<i>Allocasuarina luehmianii</i> – <i>E. moluccana</i> Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18l	<i>C. maculata</i> – <i>E. fibrosa</i> - <i>Melaleuca nodosa</i> Scrub-Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18m	<i>C. maculata</i> – <i>E. crebra</i> – <i>Melaleuca nodosa</i> Scrub-Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18n	<i>E. crebra</i> Grassy Open Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18o	<i>E. glauca</i> Grassy Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
18p	<i>E. albens</i> Grassy Forest	27	Central Hunter Ironbark – Spotted Gum – Grey Box Forest		
19	<i>E. tereticornis</i> – <i>E. punctata</i> – <i>M. linearifolia</i> Riparian Forest	24	Hunter Lowland Red Gum Forest	19	Hunter Lowlands Redgum Forest
40a	<i>Phragmites</i> Rushland (old dams)	n/a		40a	<i>Phragmites</i> Rushland

While this species was targeted during field surveys, an underscrubbing program running concurrently meant that considerable areas of potential habitat could not be surveyed in time. Never-the-less, two locations were recorded supporting the species, centred around the open forest of Grey Box (*Eucalyptus moluccana*) in the west. However, it is recommended that further targeted surveys for this taxon be undertaken in the 2005-2006 flowering season (early September).

4.3.2 Endangered Species

***Persoonia pauciflora* P.H. Weston.**

Persoonia pauciflora (Figure 17) is a highly endemic species known only from the North Rothbury area (Weston 1999). It is currently listed as Critically Endangered on the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and Endangered (Schedule 1) on the NSW *Threatened Species Conservation Act 1995*, and is subject to a number of threats including land clearing and agricultural activities. There are currently no known populations within secure conservation reserves, and the total known population (of about 250 plants) occurs within a radius of 2 km of North Rothbury. Weston (1999) described the habitat for this species as dry sclerophyll forest dominated by *Eucalyptus fibrosa*, *Eucalyptus moluccana*, *Eucalyptus punctata* and *Corymbia maculata*, over a grassy understorey. Further studies on the ecology of this species are in progress (G. Patrick, pers. comm.).



Figure 17 *Persoonia pauciflora* at Sweetwater.

The bulk of the population of *Persoonia pauciflora* is centred adjacent to the Sweetwater site along Tuckers Lane. However, a small number of plants are present within the study area, mostly

occurring as single individuals or small, loose groups. All plants occur within the Central Hunter Ironbark – Spotted Gum – Grey Box Forest.

4.3.3 Vulnerable Species

***Eucalyptus glaucina* Blakely**

Hill (2002) describes *Eucalyptus glaucina* as a tree to 30 m in height, locally frequent but sporadic in grassy woodland on deep moderately fertile and well-watered soils near Casino and from Taree to Broke. This species is currently listed as Vulnerable on both the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and NSW *Threatened Species Conservation Act 1995*, and is also listed as 3VCa by Briggs & Leigh (1996). Populations of *Eucalyptus glaucina* are known from Selection Flat Flora Reserve on the NSW North Coast, where presumably more than 1000 individuals occur (Briggs & Leigh 1996), and also in part of Werakata National Park (Bell 2004a). In his survey of State Forests, Binns (1996) did not record *Eucalyptus glaucina* from anywhere within the Morisset forestry district, but suggested that if it did occur it would most likely be on the lower slopes or valley flats of Pokolbin State Forest. During studies undertaken at the Hunter Employment Zone near Cessnock, this species was considered by Ken Hill (National Herbarium of NSW) to occur within hybrid swarms with *Eucalyptus tereticornis* (see Bell 2004a).



Figure 18 *Eucalyptus glaucina* regrowth at Sweetwater.

A number of individuals and small populations of *Eucalyptus glaucina* were recorded in the western parts of the study area, often but not always occurring with *Eucalyptus tereticornis* or *Eucalyptus moluccana*. It is apparent that within the study area considerable hybridisation is occurring, which is indicated by the strongly glaucous juvenile leaves and branchlets, which progressively lose this character trait as trees mature. Regrowth throughout the areas of the study area underscrubbed during the survey period enabled a good indication of where populations of *Eucalyptus glaucina* may be found (see Figure 18).

As with most other occurrences of this species in the Hunter Valley, all sites have been grazed in the past, leaving an open grassy understorey with only scattered shrubs. As in the population of *Eucalyptus glaucina* near Mt Tomalpin (Bell 2004c), it would be a very difficult task to provide accurate population counts of the species without examining every tree, supported by genetic studies.

Eucalyptus parramattensis* subsp. *decadens L.A.S. Johnson & Blaxell

Eucalyptus parramattensis subsp. *decadens* is a small tree to 15m in height, occurring in dry sclerophyll woodland on sandy soils in low, often wet, sites, from Tomago to Kurri Kurri (Hill 2002). It is currently listed as Vulnerable on both the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* and NSW *Threatened Species Conservation Act 1995*, and is also listed as 2V by Briggs & Leigh (1996). Conserved populations occur within Werakata National Park near Cessnock (Bell 2004a), with the Tomago populations present within Crown Reserve but subject to water extraction activities by Hunter Water (Bell & Fallding 2002).

A single, healthy individual of *Eucalyptus parramattensis* subsp. *decadens* was discovered by Allan Richardson of HSO in the southern part of the study area, in a small drainage line associated with sandstone bedrock material, and surrounded by Central Hunter Ironbark – Spotted Gum – Grey Box Forest (see Figure 19). This find is considered to be very significant, as the specimen occurs well north (at least 10km) of the currently accepted distributional range of this taxon, and is also present in currently undocumented habitat for the species. The main populations of this taxon occur in the Cessnock-Kurri region to the south, and also on the Tomago Sandbeds to the east in Port Stephens Shire. At both of these locations, *Eucalyptus parramattensis* subsp. *decadens* occurs on deep sand or clay substrates, generally well above any bedrock material. The single specimen recorded for the Sweetwater site may represent a vestige of what may have occurred prior to European settlement, which may have been a small disjunct population at the northern limit of the main population.



Figure 19 *Eucalyptus parramattensis* subsp. *decadens* at Sweetwater

4.3.4 Rare Species

Acacia bulgaensis Tind. & S.J. Davies

Tindale, Kodala & Davies (1992) described *Acacia bulgaensis* as common in the vicinity of Bulga, Milbrodale and Broke on the edge of the sandstone escarpment south of Singleton. Subsequent to this work, extensive survey of the adjacent Yengo NP has revealed substantial populations of this species (Bell, Vollmer & Gellie 1993; Maryott-Brown & Wilks 1993), which suggests a revision of the ROTAP code of 2RC- applied by Briggs & Leigh (1996) can be made. Indeed, Maryott-Brown & Wilks (1993) state that all sites visited during their survey had large population levels (greater than 1000 plants). Bell (1998a) also reports the species for the north-eastern section of Wollemi NP, where it adjoins Yengo NP, while Binns (1996) notes this species as common in a portion of Pokolbin SF excluded from logging.

At Sweetwater, *Acacia bulgaensis* is represented by two individuals in the west, within open grassy forest of *Eucalyptus tereticornis*, *Eucalyptus moluccana* and *Eucalyptus crebra*. It is highly disjunct

from other known populations (25-30km to the south-west & west), and occurs on a different geological substrate material (Permian sediments vs Narrabeen Sandstones elsewhere).

Eucalyptus fergusonii* subsp. *dorsiventralis L. Johnson & K. Hill

Eucalyptus fergusonii subsp. *dorsiventralis* is an ironbark tree to 25m in height, growing in dry sclerophyll forest on sandstone ridges, in the Wollombi Valley and the Wollemi Wilderness (Hill 2002). This species is currently listed by Briggs & Leigh (1996) with a conservation risk code of 2RC-, indicating a rare species with a geographical distribution of less than 100km, and with unknown population sizes in conservation reserves. The species is known from Wollemi National Park (Briggs & Leigh 1996; Bell 1998a), Yengo National Park (Bell, Vollmer & Gellie 1993; Maryott-Brown & Wilks 1993), and Watagans National Park (Bell 2002), Pokolbin and Yango State Forests (Bell 1995; Binns 1996), and in the north-western sections of Heaton State Forest (Bell 2000). Bell (2001) has suggested that the increase in records of this species from throughout the Hunter region warrants downgrading of the conservation risk code to 2RCa (adequately conserved).

At Sweetwater, a small population of *Eucalyptus fergusonii* subsp. *dorsiventralis* was recorded along the rocky ridgeline in the south-west of the site, within Central Hunter Ironbark - Spotted Gum – Grey Box Forest. Note that the distinction between the two subspecies of this species (*fergusonii* and *dorsiventralis*) can be subtle in some areas, and it is likely that the two may be merged in the future (K. Hill, pers. comm.). Records of both subspecies exist for the general Rothbury locality.

Grevillea montana R. Br.

Currently listed as a rare species by Briggs & Leigh (1996), with a conservation code of 2KC-, *Grevillea montana* is restricted to the southern rim of the Hunter Valley from Sandy Hollow to Kurri Kurri (Olde & Marriott 1994; Makinson 2002). In recent years, survey work in national parks (eg: Wollemi NP, Yengo NP, Werakata NP) and other semi-protected areas (eg: HEZ 7(b) lands, Myambat Logistics Company, Singleton Military Area) has revealed substantial populations which suggest the revision of this code to 2RCa (Bell 2001).

Grevillea montana occurs in a few key areas at Sweetwater, although it does not grow as prolifically as in some areas around Cessnock (eg Werakata NP, Bell 2004a). Areas in which the species is common in the understorey are on the northern, western and eastern ridgelines. The Sweetwater populations potentially occur at their northern limit of distribution in the North Rothbury area, although a disjunct population has been reported at Rosebrook Ridge near Maitland (Hill 2003).

***Macrozamia flexuosa* C. Moore**

Macrozamia flexuosa is a rare species currently listed with a conservation code of 2K (Briggs & Leigh 1996), and occurs generally from Bulahdelah to Lake Macquarie (Hill 1998). This species is currently known from Glenrock SRA (Bell 1998b), Lake Macquarie SRA and Pulbah Island NR (Bell 1998c), Werakata National Park (Bell 2004a), and Karuah and Wallaroo Nature Reserves (Bell 2002b). Additional populations exist in numerous other semi-protected areas in the region (eg: HEZ 7(b) lands).

A small number of locations of this species occur within Sweetwater, where it occurs in the Central Hunter Ironbark - Spotted Gum - Forest. Its occurrence at Sweetwater most likely represents its north-western distributional limit, as the availability of suitable habitat diminishes rapidly in lands to the north.

Other threatened or rare species potentially present

With continuing survey, it is considered reasonable that some additional threatened or rare species may occur within Sweetwater. For example, *Rutidosia heterogama* (Vulnerable) has been recently discovered in a number of locations on the Central Coast and lower Hunter Valley, particularly around Cessnock. Bell and Driscoll (2004) have documented the known populations of this species in the region, and although targeted during the current surveys, no specimens could be located.

4.3.5 Regionally significant species

A small number of additional taxa are present within Sweetwater that are considered to be regionally significant in the Hunter Valley (Bell *et al* in prep.). These taxa are summarised in Table 7. None of these species are legally protected, nor require addressing under threatened species legislation. However, all contribute to the diversity of vegetation present within the study area, and also allude to the vegetation present in the wider locality prior to European settlement.

4.4 Significant vegetation types

Much of the vegetation within Sweetwater supports vegetation of conservation significance, either through the presence of Endangered Ecological Communities or other communities considered to hold regional significance. These latter communities are considered important due to their general rarity, or their lack of adequate reservation in formal conservation reserves.

Table 7 Regionally significant taxa (excluding listed threatened, rare or undescribed species).

Species	Regional significance	Occurrence at Sweetwater
<i>Allocasuarina verticillata</i>	range extension; disjunct occurrence	western portions
<i>Angophora subvelutina</i>	uncommon, few regional records	two locations along old mine road
<i>Callitris endlicheri</i>	disjunct easterly occurrence	few locations in the south-west
<i>Crotalaria mitchellii</i> subsp. <i>mitcheilii</i>	southern distributional limit	sandy areas along Black Creek
<i>Eucalyptus albens</i>	easterly occurrence	western ridgeline
<i>Eucalyptus microcarpa</i>	disjunct occurrence	extreme south of the area
<i>Geijera salicifolia</i> var. <i>latifolia</i>	westerly distributional limit	single occurrence in west
<i>Gompholobium inconspicuum</i>	northerly extension of range	across the study area
<i>Hibbertia polyantha</i> ms	undescribed	scattered
<i>Maireana microphylla</i>	disjunct easterly occurrence	few locations in the west
<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	disjunct easterly occurrence	few locations
<i>Perotis rara</i>	southern distributional limit	sandy areas along Black Creek
<i>Sarcostemma brunonianum</i>	disjunct eastern occurrence	single location in the east

LHCCRBCS (2003) have assessed the conservation status of vegetation communities within the lower Hunter Valley and Central Coast, based on the classification and mapping of NPWS (2000a). They identified a number of vegetation communities that would qualify for listing on the Commonwealth EPBC Act, the NSW TSC Act, or that should be considered of regional significance. LHCCRBCS (2003) list the following communities of significance relevant to Sweetwater (see Table 4 in Section 4.2):

- Central Hunter Ironbark – Spotted gum – Grey Box Forest (Commonwealth, Regional)
- Hunter Lowlands Redgum Forest (Commonwealth, State)
- Wollombi Redgum – River Oak Forest (Commonwealth, Regional)
- Hunter Valley Dry Rainforest (Commonwealth, Regional)
- Central Hunter Riparian Forest (Commonwealth, Regional)
- Phragmites Rushland (Regional)

Following a similar assessment process, Peake (2005) has also assessed the conservation significance of his 35 vegetation communities occurring on the Hunter Valley floor. He identifies the

following vegetation communities considered equivalent to vegetation at Sweetwater (see Table 4 in Section 4.2) as meeting the criteria for listing on the EPBC Act:

- Lower Hunter Dry Rainforest
- Central Hunter Paperbark Soaks Woodland
- Wollombi Alluvial Redgum-Apple Forest
- Hunter Lowland Redgum Forest
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest
- Hunter Valley River Oak Forest
- Central Hunter Bull Oak Forest Regeneration

Both the LHCCREMS (2003) and Peake (2005) assessments indicate that virtually all of the remnant vegetation present at Sweetwater qualifies for listing on the EPBC Act as an endangered or vulnerable community, which would also translate to endangered ecological communities on the NSW TSC Act. At present, only the Hunter Lowlands Redgum Forest EEC and River Flat Eucalypt Forest on Coastal Floodplains EEC are present on the site; however, all other communities should be regarded as regionally significant.

4.4.1 Endangered Ecological Communities

Potentially, seven Endangered Ecological Communities occur within the Sweetwater study area. However, as has been demonstrated in Section 3.3, only two of these are present (see Figure 20):

- Hunter Lowlands Redgum Forest EEC
Unit 19: *E. tereticornis* – *E. punctata* – *M. linariifolia* Riparian Forest
- River Flat Eucalypt Forest on Coastal Floodplains EEC
Unit 13a: *Casuarina glauca* Riparian Forest (regrowth)
Unit 13b: *Melaleuca decora* Floodplain Woodland
Unit 13c: *Allocasuarina luehmannii* Floodplain Low Forest
Unit 13d: *Melaleuca nodosa* Floodplain Scrub
Unit 14a: *C. cunninghamiana* – *C. glauca* Riparian Forest
Unit 14b: *A. floribunda* Dune Forest (greatly disturbed)
Unit 14c: *E. amplifolia* Depression Forest

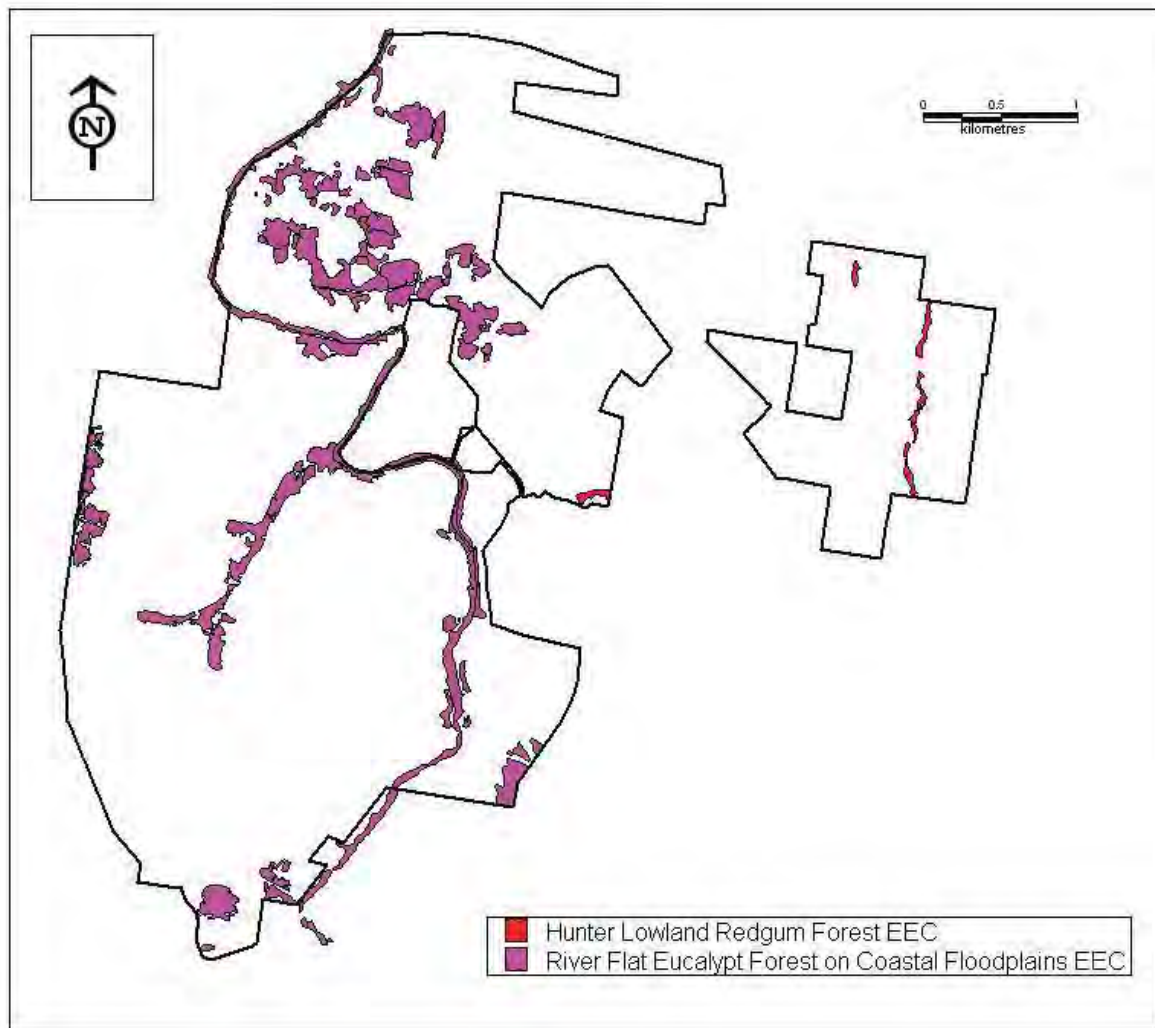


Figure 20 Distribution of Endangered Ecological Communities at Sweetwater.

Hunter Lowlands Redgum Forest

Hunter Lowlands Redgum Forest was originally identified as a regionally significant vegetation community by NPWS (2000a), and is now listed as an Endangered Ecological Community under the NSW *TSC Act 1995*. Within Sweetwater, only a few creeklines in the east support this vegetation type. This finding is in contrast to the conclusion reached by Ecotone Ecological Consultants (2003), who suggested that nearly all of the Sweetwater area supported this community. As far as is known, Werakata National Park (with 12ha, including recent additions) represents the only formal conservation reserve protecting examples of this vegetation type in the region (Bell 2004a; 2004c). However, other areas such as the HEZ 7(b) lands near Mt Tomalpin also conserve a further 70 ha of this community.

Within the region, there is considerable variation within the Hunter Lowlands Redgum Forest, much of it related to soil drainage and disturbance history (pers. obs.). Areas suffering from frequent fires and light-to-moderate grazing tend to support a higher component of grass species, while in other areas shrubs such as *Bursaria spinosa* and *Melaleuca nodosa* are prevalent. In poorly drained depressions where runoff forms small billabongs and ponds, *Melaleuca linariifolia* thickets occur offering specialised fauna habitat.

River Flat Eucalypt Forest on Coastal Floodplains

The recent listing of the River Flat Eucalypt Forest on Coastal Floodplains EEC is an attempt to protect all vegetation present on the major river systems in eastern New South Wales. As a consequence, there is a considerable amount of floristic variation evident across this large area. In the final determination to list this community, vegetation identified in the regional mapping study of NPWS (2000) is specified as being included within the EEC. In this case, the Central Hunter Riparian Forest (map unit 13), Wollombi Redgum – River Oak Woodland (map unit 14) and Redgum Rough-barked Apple Swamp Forest (map unit 38) of NPWS (2000) form part of this community in the lower Hunter Valley. At Sweetwater, sub-units of both units 13 and 14 are present and have been mapped, and are therefore included in this determination.

4.4.2 Regionally Significant Communities

In his major Hunter Valley remnant vegetation study, Peake (2005) identified a number of vegetation communities which meet the criteria for listing as endangered or vulnerable communities under the *EPBC Act 1999*. Until such time as those communities are assessed, nominated and listed, those that currently remain unlisted should be regarded as regionally significant. As the level of detail undertaken in classifying the vegetation at Sweetwater is greater than elsewhere in the region, it is imperative that all recognised variants within broader units be included as regionally significant, at least until certain forms can be shown to be more widespread. Consequently, in terms of the current work, such regionally significant communities would include (see also Figure 21):

- Hunter Valley Dry Rainforest
Unit 3: *Backhousia myrtifolia* Gallery Rainforest
- Central Hunter Ironbark – Spotted Gum – Grey Box Forest
Unit 18a: *Allocasuarina luehmannii* Low Forest
Unit 18b: *E. molucana* Open Forest

- Unit 18c: *E. crebra* – *C. maculata* Open Forest
- Unit 18d: *C. maculata* – *Callitris endlicheri* Open Forest
- Unit 18e: *E. crebra* – *E. tereticornis* Open Forest
- Unit 18g: *C. maculata* – *E. punctata* – *E. crebra* Open Forest
- Unit 18h: *E. fibrosa* – *C. maculata* Open Forest
- Unit 18j: *C. maculata* – *Allocasuarina torulosa* Open Forest
- Unit 18k: *Allocasuarina luehmannii* – *E. moluccana* Forest
- Unit 18l: *C. maculata* – *E. fibrosa* - *Melaleuca nodosa* Scrub-Forest
- Unit 18m: *C. maculata* – *E. crebra* – *Melaleuca nodosa* Scrub-Forest
- Unit 18n: *E. crebra* Grassy Open Forest
- Unit 18o: *E. glaucina* Grassy Forest
- Unit 18p: *E. albens* Grassy Forest

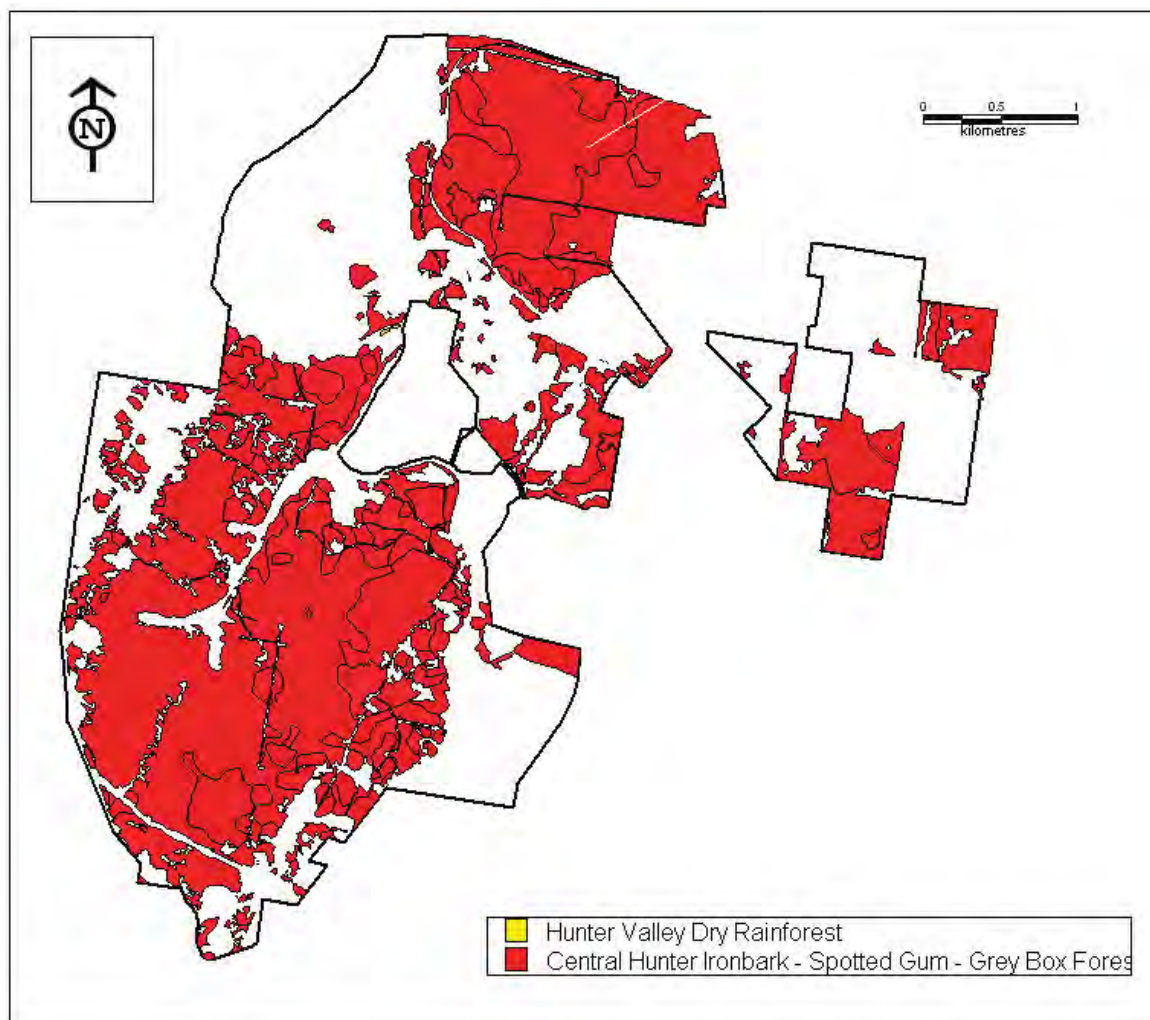


Figure 21 Distribution of regionally significant vegetation communities at Sweetwater, excluding EEC's.

Hunter Valley Dry Rainforest

The single occurrence of Hunter Valley Dry Rainforest within the study area is perhaps a good indication of the vegetation prior to European settlement. A number of rainforest plant species are present scattered along the banks of Black Creek, but only in one location does a distinct, closed low forest of *Backhousia myrtifolia* occur. Peake (2005) has identified Lower Hunter Dry Rainforest for the northern rim of the Hunter Valley floor, which although essentially equivalent to the Hunter Dry Rainforest defined by NPWS (2000a), does support several different species. NPWS (2000a) have mapped a total of 1326 ha of Hunter Valley Dry Rainforest extant in the region, while Peake (2005) indicates 25 ha extant. Connolly (2003) undertook a review of rainforest vegetation within the Hunter to southern Sydney regions and concluded that there was a distinct dry rainforest community within the lower Hunter Valley.

Note that the Lower Hunter Dry Rainforest vegetation community identified by Peake (2005) is stated by him to be restricted to the northern rim of the Hunter Valley floor, yet still equivalent to the Hunter Valley Dry Rainforest of NPWS (2000a). Peake's (2005) assessment of this community as regionally significant may or may not directly translate to the Hunter Valley Dry Rainforest (Unit 3) identified at Sweetwater. An alternate view may be that the Hunter Valley Dry Rainforest at Sweetwater is equivalent to the variant of Wollombi Redgum - River Oak Woodland (Unit 14) identified by NPWS (2000a), which supports stands of *Backhousia myrtifolia* on sheltered creek banks. The level of weed invasion at the Sweetwater site has prevented further clarification of this issue.

Central Hunter Ironbark – Spotted Gum – Grey Box Forest

Central Hunter Ironbark – Spotted Gum – Grey Box Forest was formerly widespread in the Hunter Valley, but has been heavily impacted upon by agricultural and mining activities. Indeed, Peake (2005) has estimated a pre-1750 distribution of 47000 ha for the Hunter Valley floor, which has been reduced by 60% to now occupy only 18000 ha, very little of which is in secure conservation reserve. Within Sweetwater, several variants of this community have been delineated and mapped, and until such time that these variants have been mapped elsewhere in the region, all should be regarded as regionally significant.

4.5 Management issues

Numerous trails and tracks are evident throughout the Sweetwater site, and rationalisation of these should be undertaken to assist in the control of rubbish dumping, firewood collection, arson and weed dispersal. Trail bike riding is also a common occurrence, which promotes erosion to fire

trails. Weed invasion is particularly problematic along Black Creek, where dense infestations of *Cestrum parqui*, *Tradescantia albiflora*, *Macfaydena unguis-cati*, and *Cardiospermum grandiflorum* are prevalent in the River Oak forests. However, it is unlikely that such weeds will be completely eradicated, as upstream influences are likely to maintain the presence of weed species.

5.0 Recommendations

Considering the extent and distribution of vegetation communities and significant plant species present within Sweetwater, and the levels of underscrubbing recently undertaken, it is recommended that:

- some areas of the site be set aside for conservation, particularly in view of the fact that much of it supports vegetation of at least regional conservation significance, and which has also been identified within existing key regional wildlife corridors;
- targeted seasonal surveys be undertaken in suitable habitat for *Diuris* sp aff *dendrobioides* (Hunter Valley) and other terrestrial orchid species;
- all individuals of *Persoonia pauciflora* present within the study area be protected within a buffering conservation area, to recognise the ecological importance of this narrow endemic;
- implementation of a weed management and bushland restoration program along Black Creek, which now forms part of a listed Endangered Ecological Community;
- investigations be undertaken into establishing ecological trade-offs or offset packages, to compensate for the loss of biodiversity that may potentially occur following development;

6.0 Acknowledgements

Thanks to Craig Anderson and Lucas Grenadier at Harper Somers O'Sullivan for logistical support and comments on an earlier draft of this report, and staff at the National Herbarium of NSW for plant identifications. Allan Richardson located the single *Eucalyptus parramattensis* subsp. *decadens* known from the site, the proverbial needle in a haystack...

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Appendix 1 Species list for Sweetwater

Plant taxa recorded from the study area between September 2004 and March 2005. Species marked “*” represent non-endemic taxa, and includes weed species and native species not endemic to the local area. Significant taxa are noted.

Family	Genus & Species	Status
CLASS FILICOPSIDA (Ferns)		
ADIANTACEAE	<i>Adiantum aethiopicum</i> <i>Adiantum hispidulum</i> <i>Cheilanthes austrotenuifolia</i> <i>Cheilanthes distans</i> <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	
ASPLENIACEAE	<i>Asplenium flabellifolium</i>	
CYATHEACEAE	<i>Cyathea australis</i> *	Non-endemic
DENNSTAEDTIACEAE	<i>Pteridium esculentum</i>	
DICKSONIACEAE	<i>Calochlaena dubia</i>	
POLYPODIACEAE	<i>Pyrrosia rupestris</i>	
CLASS CYCADOPSIDA (Cycads)		
ZAMIACEAE	<i>Macrozamia flexuosa</i>	ROTAP
CLASS CONIFEROPSIDA (Conifers)		
CUPRESSACEAE	<i>Callitris endlicheri</i> <i>Juniperus</i> sp * <i>Pinus elliotii</i> *	Disjunct eastern occurrence Non-endemic Non-endemic
CLASS MAGNOLIOPSIDA (Flowering Plants) Subclass Magnoliidae (Dicotyledons)		
ACANTHACEAE	<i>Brunoniella australis</i> <i>Brunoniella pumilio</i> <i>Pseuderanthemum variabile</i>	
AMARANTHACEAE	<i>Gomphrena celosioides</i> * <i>Nyssanthus diffusa</i>	Non-endemic
APIACEAE	<i>Platysace ericoides</i>	
ASCLEPIADACEAE	<i>Gomphocarpus fruticosus</i> * <i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i> <i>Sarcostemma brunonianum</i> <i>Tweedia coerulea</i> *	Non-endemic Disjunct, eastern range extension Non-endemic
ASPARAGACEAE	<i>Myrsiphyllum asparagoides</i> *	Non-endemic

	<i>Protasparagus aethiopicus</i> *	Non-endemic
ASTERACEAE	<i>Ambrosia tenuifolia</i> *	Non-endemic
	<i>Aster subulatus</i> *	Non-endemic
	<i>Bidens pilosa</i> *	Non-endemic
	<i>Brachyscome multifida</i> var. <i>multifida</i>	
	<i>Calotis dentex</i>	
	<i>Calotis lappulacea</i>	
	<i>Cassinia aculeata</i>	
	<i>Cassinia arcuata</i>	
	<i>Cassinia quinquefaria</i>	
	<i>Cassinia uncata</i>	
	<i>Chrysocephalum apiculatum</i>	
	<i>Cirsium vulgare</i> *	Non-endemic
	<i>Conyza</i> spp. *	Non-endemic
	<i>Conyza sumatrensis</i> *	Non-endemic
	<i>Epaltes australis</i>	
	<i>Gamochaeta spicata</i> *	Non-endemic
	<i>Glossogyne tannensis</i>	
	<i>Hypochaeris glabra</i> *	Non-endemic
	<i>Hypochaeris microcephala</i> var. <i>albiflora</i> *	Non-endemic
	<i>Lagenifera stipitata</i>	
	<i>Olearia elliptica</i>	
	<i>Ozothamnus diosmifolius</i>	
	<i>Schkuhria pinnata</i> *	Non-endemic
	<i>Senecio madagascariensis</i> *	Non-endemic
	<i>Sigesbeckia australiensis</i>	
	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>	
	<i>Solenogyne bellioides</i>	
	<i>Sonchus oleraceus</i> *	Non-endemic
	<i>Tagetes minuta</i> *	Non-endemic
	<i>Taraxacum officinale</i> *	Non-endemic
	<i>Vernonia cinerea</i> var. <i>cinerea</i>	
	<i>Vittadinia cuneata</i> var. <i>cuneata</i>	
	<i>Vittadinia sulcata</i>	
BIGNONIACEAE	<i>Jacaranda mimosifolia</i> *	Non-endemic
	<i>Macfaydena unguis-cati</i> *	Non-endemic
BRASSICACEAE	<i>Lepidium bonariense</i> *	Non-endemic
	<i>Sisymbrium orientale</i> *	Non-endemic
CACTACEAE	<i>Opuntia aurantiaca</i> *	Non-endemic
	<i>Opuntia stricta</i> var. <i>stricta</i> *	Non-endemic
CAMPANULACEAE	<i>Wahlenbergia communis</i>	
	<i>Wahlenbergia gracilis</i>	
	<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	
CAPRIFOLIACEAE	<i>Lonicera japonica</i> *	Non-endemic
CASUARINACEAE	<i>Allocasuarina littoralis</i>	
	<i>Allocasuarina luehmannii</i>	
	<i>Allocasuarina torulosa</i>	
	<i>Allocasuarina verticillata</i>	Disjunct eastern occurrence
	<i>Casuarina cunninghamiana</i> subsp. <i>cunninghamiana</i>	
	<i>Casuarina glauca</i>	
CELASTRACEAE	<i>Maytenus silvestris</i>	
CHENOPODIACEAE	<i>Chenopodium carinatum</i>	
	<i>Einadia hastata</i>	
	<i>Einadia nutans</i> ssp. <i>linifolia</i>	
	<i>Einadia trigonos</i> subsp. <i>leiocarpa</i>	
	<i>Maireana microphylla</i>	Eastern distributional limit

	<i>Notelaea microcarpa</i> var. <i>microcarpa</i>	disjunct easterly occurrence
	<i>Notelaea ovata</i>	
	<i>Olea europaea</i> subsp. <i>cuspidata</i> *	Non-endemic
ONAGRACEAE	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i> *	Non-endemic
	<i>Oenothera stricta</i> subsp. <i>stricta</i> *	Non-endemic
OXALIDACEAE	<i>Oxalis chnoodes</i>	
	<i>Oxalis perennans</i>	
PITTOSPORACEAE	<i>Billardiera scandens</i>	
	<i>Bursaria longisepala</i>	
	<i>Bursaria spinosa</i>	
	<i>Pittosporum undulatum</i>	
PLANTAGINACEAE	<i>Plantago debilis</i>	
	<i>Plantago gaudichaudii</i>	
	<i>Plantago lanceolata</i> *	Non-endemic
POLYGALACEAE	<i>Polygala japonica</i>	
POLYGONACEAE	<i>Persicaria decipiens</i>	
PROTEACEAE	<i>Grevillea montana</i>	ROTAP
	<i>Grevillea robusta</i> *	Non-endemic
	<i>Hakea sericea</i>	
	<i>Persoonia linearis</i>	
	<i>Persoonia pauciflora</i>	Endangered (TSC Act)
RANUNCULACEAE	<i>Clematis glycinoides</i>	
	<i>Ranunculus lappaceus</i>	
ROSACEAE	<i>Rubus ulmifolius</i> *	Non-endemic
RUBIACEAE	<i>Asperula conferta</i>	
	<i>Canthium buxifolium</i>	
	<i>Opercularia aspera</i>	
	<i>Opercularia diphylla</i>	
	<i>Pomax umbellata</i>	
	<i>Richardia humistrata</i> *	Non-endemic
	<i>Richardia stellaris</i> *	Non-endemic
RUTACEAE	<i>Geijera salicifolia</i> var. <i>latifolia</i>	Western distributional limit
SANTALACEAE	<i>Exocarpos strictus</i>	
SAPINDACEAE	<i>Cardiospermum grandiflorum</i> *	Non-endemic
	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>	
	<i>Dodonaea truncatiales</i>	
SCROPHULARIACEAE	<i>Veronica plebeia</i>	
SOLANACEAE	<i>Cestrum parqui</i> *	Non-endemic
	<i>Lycium ferocissimum</i> *	Non-endemic
	<i>Nicotiana suaveolens</i>	
	<i>Nicotiana debneyi</i> subsp. <i>debneyi</i>	
	<i>Solanum mauritanum</i> *	Non-endemic
	<i>Solanum nigrum</i> *	Non-endemic
	<i>Solanum prinophyllum</i>	
	<i>Solanum pungetium</i>	
STACKHOUSIACEAE	<i>Stackhousia viminea</i>	
STERCULIACEAE	<i>Brachychiton populneus</i>	
THYMELAEACEAE	<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	

VERBENACEAE	<i>Clerodendrum tomentosum</i> <i>Lantana camara</i> * <i>Verbena bonariensis</i> *	Non-endemic Non-endemic
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VITACEAE	<i>Cayratia clematidea</i>	
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CLASS MAGNOLIOPSIDA (Flowering Plants)

Subclass Liliidae (Monocotyledons)

ANTHERICACEAE	<i>Arthropodium milleflorum</i> <i>Arthropodium minus</i> <i>Caesia parviflora</i> var. <i>parviflora</i> <i>Laxmannia gracilis</i> <i>Tricoryne elatior</i>	
COMMELINACEAE	<i>Commelina cyanea</i> <i>Murdannia graminea</i> <i>Tradescantia albiflora</i> *	Non-endemic
CYPERACEAE	<i>Baumea juncea</i> <i>Carex inversa</i> <i>Cyperus aggregatus</i> * <i>Cyperus eragrostis</i> * <i>Cyperus gracilis</i> <i>Elaeocharis equisetina</i> <i>Elaeocharis sphacelata</i> <i>Fimbristylis dichotoma</i> <i>Gahnia aspera</i> <i>Lepidosperma laterale</i>	Non-endemic Non-endemic
HAEMODORACEAE	<i>Haemodorum planifolium</i>	
HYPOXIDACEAE	<i>Hypoxis hygrometrica</i> var. <i>hygrometrica</i> <i>Hypoxis hygrometrica</i> var. <i>villosisepala</i>	
IRIDACEAE	<i>Patersonia sericea</i>	
JUNCACEAE	<i>Juncus acutus</i> * <i>Juncus continuus</i> <i>Juncus usitatus</i>	Non-endemic
LOMANDRACEAE	<i>Lomandra confertifolia</i> subsp. <i>pallida</i> <i>Lomandra confertifolia</i> subsp. <i>rubiginosa</i> <i>Lomandra filiformis</i> subsp. <i>coriacea</i> <i>Lomandra filiformis</i> subsp. <i>filiformis</i> <i>Lomandra glauca</i> <i>Lomandra longifolia</i> <i>Lomandra multiflora</i> subsp. <i>multiflora</i>	
ORCHIDACEAE	<i>Caladenia alba</i> <i>Caladenia catenata</i> <i>Dendrobium linguiforme</i> <i>Dipodium punctatum</i> <i>Diuris</i> spp. aff <i>dendrobioides</i> (Hunter Valley) <i>Diuris sulphurea</i> <i>Pterostylis bicolor</i> <i>Pterostylis curta</i>	undescribed
PHORMIACEAE	<i>Dianella caerulea</i> var. <i>assera</i> <i>Dianella caerulea</i> var. <i>caerulea</i> <i>Dianella longifolia</i> var. <i>longifolia</i> <i>Dianella revoluta</i> var. <i>revoluta</i> <i>Dianella tasmanica</i>	

POACEAE	<i>Aristida ramosa</i>	
	<i>Aristida vagans</i>	
	<i>Aristida warburgii</i>	
	<i>Austrodanthonia caespitosa</i>	
	<i>Austrodanthonia fulva</i>	
	<i>Austrodanthonia setacea</i>	
	<i>Austrostipa ramosissima</i>	
	<i>Austrostipa verticillata</i>	
	<i>Axonopus fissifolius</i> *	Non-endemic
	<i>Bothriochloa decipiens</i>	
	<i>Chloris truncata</i>	
	<i>Cymbopogon refractus</i>	
	<i>Cynodon dactylon</i>	
	<i>Dichelachne micrantha</i>	
	<i>Digitaria diffusa</i>	
	<i>Digitaria ramularis</i>	
	<i>Echinopogon caespitosus</i> var. <i>caespitosus</i>	
	<i>Echinopogon ovatus</i>	
	<i>Ehrharta erecta</i> *	Non-endemic
	<i>Enteropogon acicularis</i>	
	<i>Entolasia stricta</i>	
	<i>Eragrostis brownii</i>	
	<i>Eragrostis leptostachya</i>	
	<i>Imperata cylindrica</i> var. <i>major</i>	
	<i>Melinis repens</i> *	Non-endemic
	<i>Microlaena stipoides</i> var. <i>stipoides</i>	
	<i>Notodanthonia longifolia</i>	
	<i>Oplismenus aemulus</i>	
	<i>Oplismenus imbecillis</i>	
	<i>Panicum effusum</i>	
	<i>Panicum maximum</i> var. <i>maximum</i> *	Non-endemic
	<i>Panicum simile</i>	
	<i>Paspalidium albobillosum</i>	
	<i>Paspalidium distans</i>	
	<i>Paspalum urvillei</i> *	Non-endemic
	<i>Perotis rara</i>	Southern distributional limit
	<i>Phragmites australis</i>	
	<i>Poa labillardierei</i> var. <i>labillardierei</i>	
	<i>Setaria gracilis</i> *	Non-endemic
	<i>Sporobolus africanus</i> *	Non-endemic
	<i>Themeda australis</i>	
TYPHACEAE	<i>Typha orientalis</i>	
XANTHORRHOEACEAE	<i>Xanthorrhoea media</i>	
TOTAL PLANT TAXA	328	

Appendix 2 Diagnostic species list - Cessnock vs Greta Spotted Gum – Ironbark Forests

The table below presents the results of a FIDEL analysis (at 50% group sites and C/A of 2 or more) between the Cessnock group of plots (designated here Lower Hunter Spotted Gum Ironbark Forest), and the Sweetwater plots (Central Hunter Spotted Gum – Grey Box - Ironbark Forest), based on the regional spotted gum analysis framework. All species occurring in <10% in either group have been omitted from table. Shaded species represent the core of the diagnostic species list for each community.

Life Form	Species	LHSGIF Group			CHSGGBIF Group		
		C/A	Freq.	Fidelity class	C/A	Freq.	Fidelity class
1 Trees	Corymacu	2	100.00%	constant	3	100.00%	constant
	Eucafibr	2	66.67%	positive	4	31.43%	negative
	Syncglol	1	41.67%	unique	0	0.00%	absent
	Eucaaggl	3	33.33%	unique	0	0.00%	absent
	Coryxim	3	25.00%	unique	0	0.00%	absent
	Eucapuca	3	16.67%	unique	0	0.00%	absent
	Corygumm	3	16.67%	unique	0	0.00%	absent
	Angoflor	4	16.67%	unique	0	0.00%	absent
	Meladeco	1	16.67%	uninformative	2	14.29%	uninformative
	Eucacreb	0	0.00%	negative	3	65.71%	unique
	Allolueh	0	0.00%	absent	2	28.57%	unique
	Eucapunc	0	0.00%	absent	3	25.71%	unique
	Allotoru	0	0.00%	absent	1	14.29%	unique
	Eucatere	0	0.00%	absent	3	11.43%	unique
2 Shrubs	Persline	2	83.33%	positive	1	40.00%	negative
	Grevmont	2	66.67%	positive	2	31.43%	negative
	Melanodo	4	58.33%	positive	6	11.43%	negative
	Daviulic	3	58.33%	positive	1	68.57%	negative
	Astrobov	2	58.33%	unique	0	0.00%	absent
	Lissstri	2	50.00%	positive	1	60.00%	negative
	Leptparv	2	50.00%	unique	0	0.00%	absent
	Grevparp	2	50.00%	unique	0	0.00%	absent
	Acaculic	2	50.00%	unique	0	0.00%	absent
	Lepttrin	2	41.67%	unique	0	0.00%	absent
	Monoscop	1	33.33%	unique	0	0.00%	absent
	Dillreto	2	33.33%	unique	0	0.00%	absent
	Isopanem	1	25.00%	unique	0	0.00%	absent
	Acaclonf	1	25.00%	unique	0	0.00%	absent
	Acacirri	1	25.00%	unique	0	0.00%	absent
	Rapavari	1	16.67%	unique	0	0.00%	absent
	Melathym	2	16.67%	unique	0	0.00%	absent
	Leptpolc	4	16.67%	unique	0	0.00%	absent
	Dillsptr	2	16.67%	unique	0	0.00%	absent
	Davisqua	4	16.67%	unique	0	0.00%	absent
	Burslong	2	16.67%	unique	0	0.00%	absent
	Bossobco	1	16.67%	unique	0	0.00%	absent
	Bankspio	3	16.67%	unique	0	0.00%	absent

	Acacalni	1	16.67% unique	0	0.00% absent
	Meliurce	1	50.00% uninformative	1	34.29% uninformative
	Hakeseri	1	50.00% uninformative	1	31.43% uninformative
	Podollic	1	41.67% uninformative	1	2.86% uninformative
	Jacksco	3	33.33% uninformative	2	31.43% uninformative
	Dendvite	1	33.33% uninformative	1	20.00% uninformative
	Bursspin	1	25.00% uninformative	1	42.86% uninformative
	Acacelon	2	25.00% uninformative	1	37.14% uninformative
	Pimelino	1	16.67% uninformative	2	5.71% uninformative
	Ozotdios	1	16.67% uninformative	1	14.29% uninformative
	Maytsilv	1	16.67% uninformative	1	22.86% uninformative
	Breyoblo	1	16.67% uninformative	1	34.29% uninformative
	Acacfala	1	16.67% uninformative	1	37.14% uninformative
	Acacbrown	1	16.67% uninformative	1	8.57% uninformative
	Pultspin	1	8.33% uninformative	2	34.29% uninformative
	Acacparv	0	0.00% absent	1	51.43% unique
	Indiaust	0	0.00% absent	1	25.71% unique
	Cassarcu	0	0.00% absent	1	25.71% unique
3 Herbs	Pomaumbe	2	91.67% constant	2	88.57% constant
	Phylhirt	2	91.67% positive	2	25.71% negative
	Plateric	2	33.33% unique	0	0.00% absent
	Gompunci	2	33.33% unique	0	0.00% absent
	Drospelt	2	33.33% unique	0	0.00% absent
	Oxylpult	2	16.67% unique	0	0.00% absent
	Linumarg	1	16.67% unique	0	0.00% absent
	Hibblin	2	16.67% unique	0	0.00% absent
	Gonotetr	2	16.67% unique	0	0.00% absent
	Gompminu	2	16.67% unique	0	0.00% absent
	Hibbpedu	2	41.67% uninformative	1	42.86% uninformative
	Verocinc	2	33.33% negative	2	85.71% positive
	Goodrotu	2	33.33% negative	2	74.29% positive
	Laxmgrac	1	16.67% negative	2	82.86% positive
	Pseuvari	2	25.00% uninformative	2	17.14% uninformative
	Chorparv	1	25.00% uninformative	1	11.43% uninformative
	Pratpurp	2	16.67% negative	2	80.00% negative
	Gaesparp	1	16.67% uninformative	1	20.00% uninformative
	Tricelat	1	8.33% uninformative	1	14.29% uninformative
	Poramicr	2	8.33% uninformative	1	11.43% uninformative
	Lagestip	2	8.33% uninformative	2	11.43% uninformative
	Brueaust	1	8.33% uninformative	2	31.43% uninformative
	Oxalpere	1	8.33% negative	2	85.71% positive
	Hibbdiff	0	0.00% absent	1	88.57% unique
	Solaprin	0	0.00% absent	1	57.14% unique
	Operdiph	0	0.00% absent	2	48.57% unique
	Chryapic	0	0.00% absent	1	48.57% unique
	Dichrepe	0	0.00% absent	2	31.43% unique
	Phylvirg	0	0.00% absent	1	31.43% unique
	Stacvimi	0	0.00% absent	2	28.57% unique
	Eremdebi	0	0.00% absent	2	28.57% unique
	Veropleb	0	0.00% absent	1	25.71% unique
	Calolapp	0	0.00% absent	2	22.86% unique

	Commcyan	0	0.00% absent	1	22.86% unique
	Wahlcomm	0	0.00% absent	1	20.00% unique
	Glostann	0	0.00% absent	1	20.00% unique
	Desmvari	0	0.00% absent	2	14.29% unique
	Zorndycd	0	0.00% absent	1	14.29% unique
	Murdgram	0	0.00% absent	2	11.43% unique
4 Grasses	Eragbrow	2	91.67% constant	2	71.43% constant
	Entostri	2	91.67% constant	2	71.43% constant
	Arisvaga	2	66.67% constant	3	85.71% constant
	Joycpall	2	75.00% unique	0	0.00% absent
	Anisaven	2	50.00% unique	0	0.00% absent
	Themaust	3	41.67% uninformative	2	22.86% uninformative
	Panisimi	2	33.33% uninformative	1	8.57% uninformative
	Impecylm	2	33.33% uninformative	1	2.86% uninformative
	Dicemicr	3	16.67% uninformative	1	14.29% uninformative
	Digiramu	1	16.67% uninformative	1	31.43% uninformative
	Austsetc	2	8.33% uninformative	2	22.86% uninformative
	Arisramo	2	33.33% negative	3	94.29% positive
	Cymbrefr	2	16.67% negative	2	91.43% positive
	Micrstis	2	33.33% negative	2	88.57% positive
	Pasidist	2	8.33% negative	2	54.29% positive
	Panieffu	0	0.00% absent	2	20.00% unique
	Echicaea	0	0.00% absent	2	11.43% unique
	Cynodact	0	0.00% absent	2	14.29% unique
	Chlotrun	0	0.00% absent	1	14.29% unique
5 Sedges	Dianrevr	2	50.00% constant	2	77.14% constant
	Lepilate	2	83.33% positive	2	45.71% negative
	Lomacyli	2	66.67% unique	0	0.00% absent
	Dianprun	1	25.00% unique	0	0.00% absent
	Xantglag	2	16.67% unique	0	0.00% absent
	Diancaeu	1	16.67% unique	0	0.00% absent
	Lomafilf	2	33.33% uninformative	2	28.57% uninformative
	Pateseri	2	16.67% uninformative	1	2.86% uninformative
	Lomalong	3	16.67% uninformative	1	8.57% uninformative
	Lomaglau	2	16.67% uninformative	2	5.71% uninformative
	Lomaconp	3	16.67% uninformative	2	42.86% uninformative
	Fimbdich	1	8.33% uninformative	2	48.57% uninformative
	Lomamulm	1	25.00% negative	2	88.57% positive
	Lomafilc	2	25.00% negative	2	62.86% positive
	Gahnaspe	0	0.00% absent	1	14.29% unique
6 Ferns	Cheisies	2	75.00% constant	2	100.00% constant
	Cheiaust	1	8.33% uninformative	1	25.71% uninformative
	Cheidist	0	0.00% absent	2	11.43% unique
7 Cycads	Macrflex	1	66.67% uninformative	1	5.71% uninformative
	Macrredu	2	41.67% unique	0	0.00% absent
8 Vines	Cassglag	2	58.33% positive	1	2.86% negative
	Hardviol	1	50.00% uninformative	1	17.14% uninformative
	Glycclan	1	50.00% negative	2	60.00% positive
	Billscan	1	33.33% uninformative	1	2.86% uninformative
	Glyctaba	2	8.33% uninformative	2	48.57% uninformative

Appendix 3 Supplementary Report of Extension Study Area

Vegetation survey of “*Sweetwater*”, North Rothbury, mid Hunter Valley, New South Wales.

Supplementary Report of Expanded Study Area

30 September 2005

Report to:

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1.0 Background

Detailed vegetation survey and mapping of 1500ha of land within the North Rothbury vicinity ("Sweetwater") has previously identified five vegetation communities (two of which are included within listed Endangered Ecological Communities on the *TSC Act 1995*), one endangered species (Schedule 1 of the *TSC Act 1995*), two vulnerable species (Schedule 2 of the *TSC Act 1995*) and four nationally rare species (see Bell & Driscoll 2005). Subsequent to the completion of that study, additional investigation areas have now been identified which significantly expand the Sweetwater study area to approximately 3750ha.

While negotiations with the current land owners within this revised study area are in progress, a brief study of the additional lands has been requested in order to highlight potentially significant areas prior to detailed study. This report (and the associated mapping) documents the results of this rapid assessment.

2.0 The Expanded Study Area

Figure 1 shows the original ('core') and expanded study area boundaries. Although large portions of the expanded area are cleared, important remnants of vegetation may still be present.

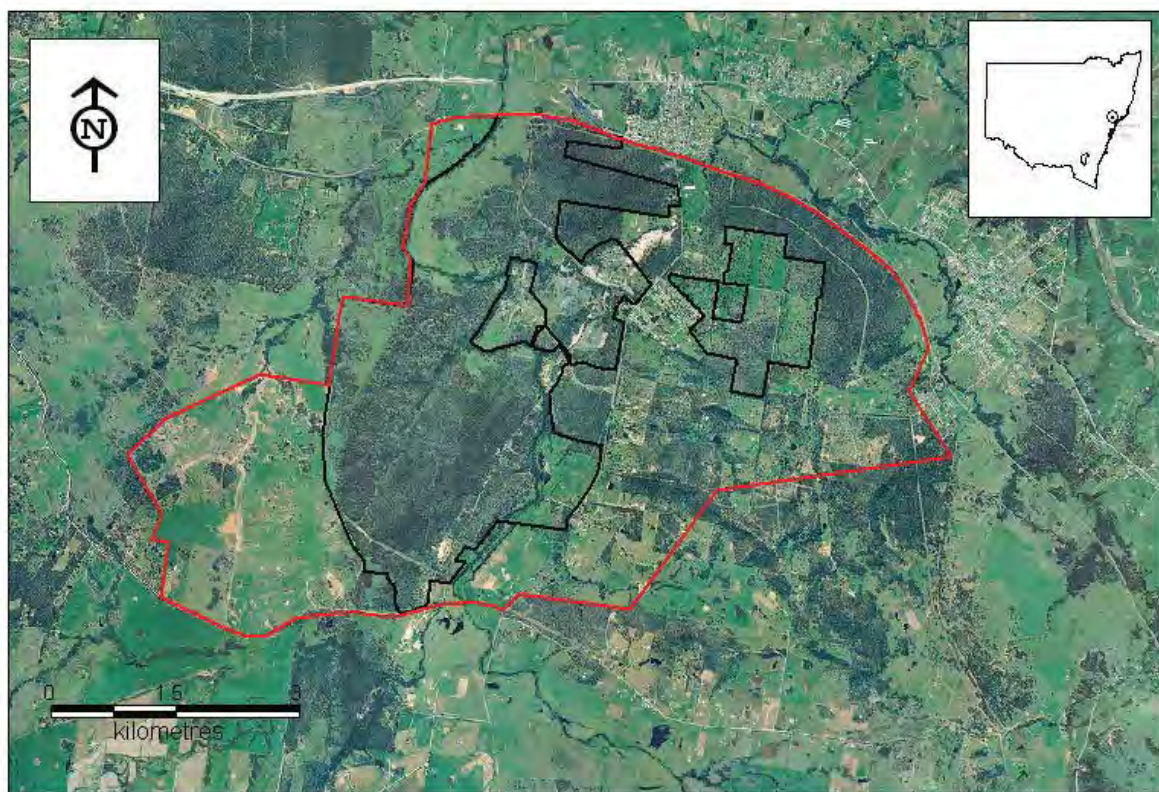


Figure 1 Original (black line) and expanded (red line) Sweetwater study area.

3.0 Methods

One day was spent driving around public access roads within the extended study area, viewing the remnant vegetation and making notes on a hard copy air photo of the area. In some locations waypoints were made on a hand-help GPS unit to assist in locating particular vegetation types. Where possible, foot traverses were also made to better assess the larger patches of vegetation. Significant plant species observed were waypointed with the GPS unit. No full floristic surveys were undertaken, and not all remnants were accessible due to private land tenures.

A preliminary vegetation map was prepared using the MapInfo GIS. Remnant vegetation was digitised directly on-screen using orthorectified, high resolution digital aerial photographs flown specifically for the project, and supplied by HSO. Vegetation polygons were attributed a community code using field notes and information extrapolated from previous mapping of the core Sweetwater study area. Apart from the single day assessing the area at the start of the project, no attempt has yet been made to ground truth the mapping (see Project Limitations in Section 6).

4.0 Results

4.1 Threatened and Rare Species

Seven significant plant species were recorded within the additional study area (Table 1). Two of these (*Acacia bynoeana* and *Eucalyptus* sp aff *agglomerata*) were not recorded within the core Sweetwater area.

Table 1 Significant species recorded within the additional Sweetwater study area.

Significance	Species
Undescribed	<i>Eucalyptus</i> sp. aff. <i>agglomerata</i>
Endangered	<i>Acacia bynoeana</i> <i>Persoonia pauciflora</i>
Vulnerable	<i>Eucalyptus glaucina</i>
Rare	<i>Eucalyptus fergusonii</i> subsp. <i>dorsiventralis</i> <i>Grevillea montana</i> <i>Macrozamia flexuosa</i>

Acacia bynoeana – this species was recorded at one location off Littlewood Road. This species is listed as Endangered under State and Vulnerable under Commonwealth legislation, and the population at North Rothbury is considered extremely significant, for two reasons:

- It extends the known distribution of this species a further 15km to the north of the previous limit at Kurri Kurri;
- It occurs in a completely new habitat type not previously recognised as supporting the species. Bell & Driscoll (in review) have documented the known population of this species from the Central Coast and lower Hunter Valley area, and no other known populations occur in a low woodland of *Eucalyptus* sp. aff. *agglomerata* (or related species). This new

habitat type has affinities to the Central Hunter & Lower Hunter Spotted Gum Ironbark Forest described by NPWS (2000), and it could be broadly included within either of these communities.

Eucalyptus fergusonii* subsp. *dorsiventralis – this rare species (ROTAP 2RC-) dominates the canopy in the area between Wine Country Drive and the existing rubbish dump, on the northern outskirts of North Rothbury. Although a small number of plants were previously noted in the west of the original Sweetwater study area, the occurrence adjacent to Cessnock Road is in a different habitat type. Patrick (1999) has previously noted this taxon in the area, although he referred to it as *E. fergusonii* subsp. *fergusonii*. Brooker et. al. (2002) briefly document the history of these two taxa, and they suggest that the type specimen for *E. fergusonii* subsp. *fergusonii* is possibly an obscure variant of *E. paniculata*, indicating that comparable material has not been collected for a long period of time. As a consequence, Brooker et. al. (2002) refer to this taxon as *Eucalyptus dorsiventralis*.

Eucalyptus glaucina – although not examined in detail, many individual redgum trees across the area show characteristics of the vulnerable *Eucalyptus glaucina*. This is evidenced by their general glaucousness on leaves and branchlets. The Sweetwater area has been previously identified as supporting various intergrading forms of this species with *Eucalyptus tereticornis* (Bell & Driscoll 2005), and conservation of this species is probably best achieved through a landscape approach of conserving larger stands of redgum eucalypts.

Eucalyptus* sp aff *agglomerata – a few locations within the study area support stunted trees that key out to *Eucalyptus capitellata*, but which have stronger affinities to *E. agglomerata*. Further taxonomic investigation may delineate a new species, however this is unlikely to occur in the near future due to the retirement of the NSW eucalypt specialist. *Eucalyptus agglomerata* (and the related *E. capitellata*) are unusual on the Hunter Valley floor (eg: not included in the species list for the mid to upper Hunter Valley; Peake 2005), although similar specimens occur in the Cessnock area (such as in the HEZ area, also documented as *Eucalyptus* sp aff *agglomerata*; Bell 2004). It is likely that the Sweetwater and Cessnock specimens represent the same taxon, but a full taxonomic review of this group of stringybark species is required. In the interim, it is recommended that this species be treated as 'threatened' in any land capability assessment.

Grevillea montana – this rare species (ROTAP 2RCa) is widespread in the eastern portions of the study area, particularly on the large vegetated ridge to the north-east. Elsewhere within the core Sweetwater site, only small concentrated populations are present, generally in the east (Bell & Driscoll 2005).

Macrozamia flexuosa – several specimens of this rare species (ROTAP 2K) were noted between the existing rubbish dump and Cessnock Road.

Persoonia pauciflora – A large concentration of this endangered species (TSC Act Schedule 1; Critically Endangered on EPBC Act 1999) was noted in the land immediately south of the existing Hanwood Estate, in the area proposed for Stage 5 of that development. Several tens of plants are present, including many young plants, and a large number of mature plants are fruiting well. Other specimens are present in the vicinity of Tuckers Lane and Littlewood Road.

4.2 Vegetation Communities

A preliminary vegetation map has been prepared for the expanded study area. This map has not been reproduced in this report, but has been supplied as a GIS map layer to HSO, using the same community nomenclature as that used in the original Sweetwater study area.

4.2.1 New Vegetation Types

As a consequence of the brief reconnaissance survey, four new vegetation types have been tentatively delineated for the study area. These are in addition to those identified during the detailed survey and mapping program for the core Sweetwater area (Bell & Driscoll 2005). Brief descriptions of each of these follow, and Table 2 shows all vegetation types described for the entire Sweetwater area:

Map Unit 13e: *Eucalyptus* sp. aff. *agglomerata* Gully Forest

A single gully dominated by a stringybark was observed to the south of Tuckers Lane. As this was on private property, it was not possible to closely examine the species involved, but from a distance it appeared to be the same *E. sp. aff. agglomerata* present on the broad ridges to the west. If this identification is correct, it would represent a very interesting habitat type, and possibly of some significance.

Map Unit 18q: *Eucalyptus fergusonii* – *Corymbia maculata* – *Melaleuca nodosa* Scrub-Forest

On the northern outskirts of North Rothbury, on the western side of Wine Country Drive, is an area of vegetation dominated by *Melaleuca nodosa* with emergent *Eucalyptus fergusonii*. *Corymbia maculata* and the occasional *Eucalyptus fibrosa* are also present. This vegetation type has not been observed elsewhere within the Sweetwater study area, although a similar form with emergent *Eucalyptus crebra* or *Eucalyptus fibrosa* has. *Eucalyptus fergusonii* is a listed rare species.

Map Unit 18r: *Eucalyptus tereticornis* – *Eucalyptus glaucina* Shrubby Open Forest

On some gentle rises in the north and east of the study area, a shrubby open forest dominated by redgum species occurs. The understorey is well developed and is dominated by *Pimelea linifolia* and *Daviesia ulicifolia*, together with a range of smaller shrubs, grasses and herbs. Without detailed survey, it is unclear how these areas relate to the drainage depressions elsewhere in the Sweetwater area that are also dominated by redgums. First impressions, however, suggest that the well-developed understorey may be significant. Specimens of redgum within this community are likely to include the vulnerable *Eucalyptus glaucina*.

Map Unit 18s: *Eucalyptus* sp. aff. *agglomerata* Heathy Low Forest

Three broad spurs running to the north off Littlewood Road support a distinctive low forest type dominated by *Eucalyptus* sp. aff. *agglomerata*. One of these spurs was traversed briefly on foot. This vegetation type is considered highly significant for a number of reasons, including the dominance of an as yet unknown stringybark species within the *E. agglomerata-capitellata* complex, neither of which have been recorded on the Hunter Valley floor previously. In addition, two plants of the Endangered *Acacia bynoeana* were noted within this vegetation type, extending the known geographical range of this species a further 15km north from Kurri Kurri. This vegetation type also supports a number of understorey species generally not present elsewhere within the Sweetwater study area, such as *Lomandra cylindrica* (another northerly range

extension), *Ptilothrix deusta*, and *Hibbertia pedunculata*. Further research into the floristic composition of this vegetation type is strongly recommended.

Table 2 Vegetation associations delineated for the entire Sweetwater site.

REMS Unit	REMS Community	Sweetwater Association
3	Hunter Valley Dry Rainforest	3 <i>Backhousia myrtifolia</i> Gallery Rainforest
13	Central Hunter Riparian Forest	13a <i>Casuarina glauca</i> Riparian Forest (regrowth) 13b <i>Melaleuca decora</i> Floodplain Woodland 13c <i>Allocasuarina luehmannii</i> Floodplain Low Forest 13d <i>Melaleuca nodosa</i> Floodplain Scrub 13e <i>E. sp. aff. agglomerata</i> Gully Forest
	<u>New</u>	
14	Wollombi Redgum - River Oak Woodland	14a <i>C. cunninghamiana</i> – <i>C. glauca</i> Riparian Forest 14b <i>A. floribunda</i> Dune Forest (greatly disturbed) 14c <i>E. amplifolia</i> Depression Forest
18	Central Hunter Ironbark – Spotted Gum – Grey Box Forest	18a <i>Allocasuarina luehmannii</i> Low Forest 18b <i>E. moluccana</i> Open Forest 18c <i>E. crebra</i> – <i>C. maculata</i> Open Forest 18d <i>C. maculata</i> – <i>Callitris endlicheri</i> Open Forest 18e <i>E. crebra</i> – <i>E. tereticornis</i> Open Forest 18f <i>E. eugenioides</i> Open Forest 18g <i>C. maculata</i> – <i>E. punctata</i> – <i>E. crebra</i> Open Forest 18h <i>E. fibrosa</i> – <i>C. maculata</i> Open Forest 18i <i>Angophora floribunda</i> Open Forest (regrowth) 18j <i>C. maculata</i> – <i>Allocasuarina torulosa</i> Open Forest 18k <i>Allocasuarina luehmannii</i> – <i>E. moluccana</i> Forest 18l <i>C. maculata</i> – <i>E. fibrosa</i> – <i>Melaleuca nodosa</i> Scrub-Forest 18m <i>C. maculata</i> – <i>E. crebra</i> – <i>Melaleuca nodosa</i> Scrub-Forest 18n <i>E. crebra</i> Grassy Open Forest 18o <i>E. glaucina</i> Grassy Forest 18p <i>E. albens</i> Grassy Forest 18q <i>E. fergusonii</i> – <i>C. maculata</i> – <i>M. nodosa</i> Scrub-Forest 18r <i>E. tereticornis</i> – <i>E. glaucina</i> Shrubby Open Forest 18s <i>E. aff. agglomerata</i> Heathy Low Forest
	<u>New</u>	
	<u>New</u>	
	<u>New</u>	
19	Hunter Lowlands Redgum Forest	19 <i>E. tereticornis</i> – <i>E. punctata</i> – <i>M. linariifolia</i> Riparian Forest
40a	<i>Phragmites</i> Rushland	40a <i>Phragmites</i> Rushland (old dams)

4.2.2 Significant Parcels of Land

The north-east Ridgeline - The ridgeline in the northeast immediately south of the Main Northern Railway supports vegetation considerably more complex than that depicted by NPWS (2000). In the regionally modeling project, NPWS (2000) mapped the entire area as supporting Lower Hunter Spotted Gum – Ironbark Forest. However, following the brief inspection at least four discernible associations are present in the area:

- *Eucalyptus fibrosa* – *Corymbia maculata* Shrubby Open Forest
- *Eucalyptus crebra* – *Corymbia maculata* Shrubby Open Forest
- *Eucalyptus tereticornis* Shrubby Open Forest

- *Melaleuca nodosa* – *Eucalyptus crebra* – *Corymbia maculata* Low Scrub-Forest

Without undertaking detailed plot data collection and subsequently analysing the data, it can only be assumed that, following the data analysis carried out for the main Sweetwater study area (Bell & Driscoll 2005), the area represents Central Hunter Spotted Gum – Grey Box – Ironbark Forest. This is based on the composition of grasses and herbs observed in the understorey during the brief inspection, and does not rely solely on the presence of *Eucalyptus fibrosa* and *Corymbia maculata*. However, it may eventuate that a new community becomes evident with future plot survey and analysis, dominated by *Eucalyptus fibrosa* and *Corymbia maculata*, over an understorey of species typical of the mid to upper Hunter Valley. A project currently in progress throughout the region may help to resolve this issue (Bell & Driscoll in prog.), provided access can be gained to adequately sample the area.

The vegetation along most of this ridge appears to be in excellent condition, and has not been grazed for some time. As a consequence, the understorey is well structured and reasonably diverse. In addition, this ridgeline also forms an important component of the Branxton sub-regional wildlife corridor identified by NPWS (2003). It is therefore considered that this ridgeline has very high conservation value. The proposed F3 freeway extension to Branxton passes through this parcel of land, and may detrimentally impact on these values by fragmenting the existing remnant.

Land south of the Hanwood Estate – the parcel of land west of Wine Country Drive and immediately south of the existing Hanwood Estate supports a large population of the endangered *Persoonia pauciflora*. Presumably, this is the reason that the expansion of that estate has not progressed, and protection of the entire parcel is warranted.

Land north of Littlewood Road – lands immediately north of Littlewood Road at the NW end of the Molly Morgan Ridge support a unique vegetation type dominated by the stringybark *Eucalyptus* sp. aff. *agglomerata*, with a disjunct and highly significant population of the endangered *Acacia bynoeana* also present. There is also some high quality forest dominated by *Eucalyptus fibrosa* to the east of the stringybark stand, which does not appear to have been disturbed for many years. Further investigation of these lands is recommended, particularly of the stringybark vegetation, as no other occurrence is known in this part of the Hunter Valley. This patch of vegetation also comprises part of the Molly Morgan Ridge, which provides a potential wildlife corridor to the larger remnants of the Sweetwater proposal and Werakata National Park to the south.

5.0 Conclusions and Recommendations

This brief assessment of the additional vegetation parcels within the expanded Sweetwater study area has revealed some perhaps surprising finds, given the rapid nature of the investigation. Two endangered (*Persoonia pauciflora*, *Acacia bynoeana*), one vulnerable (*Eucalyptus glaucina*), three rare (*Eucalyptus fergusonii* subsp. *dorsiventralis*, *Grevillea montana*, *Macrozamia flexuosa*) and one potential new species (*Eucalyptus* sp. aff. *agglomerata*) were identified. The *Acacia bynoeana* and *Eucalyptus* sp. aff. *agglomerata* were previously not recorded in the core Sweetwater study area, and both are considered highly significant. The habitat in which both were found also bears some strong similarities to some of the vegetation around Cessnock, 15km to the south, and requires further investigation.

Four potentially new vegetation types previously not mapped for the core Sweetwater study area were also uncovered. All four require detailed survey and mapping to gain a better understanding of their relationships to the surrounding vegetation elsewhere in the locality. Nowhere within the

expanded study area was there vegetation present that would fit within the Lower Hunter Spotted Gum – Ironbark Forest EEC, at least not within the definition documented in Bell and Driscoll 2005. Again, further sampling of representative areas and a re-analysis of all Spotted Gum – Ironbark data would be required to confirm this.

The following recommendations are made with regard to the additional parcels of land:

- Detailed survey be undertaken in the newly-identified *Eucalyptus* sp aff *agglomerata* Gully Forest (Unit 13e), to ascertain its relationship to other communities in the area;
- Detailed survey be undertaken in the newly-identified *Eucalyptus fergusonii* – *Corymbia maculata* – *Melaleuca nodosa* Scrub-Forest (Unit 18q), to ascertain its relationship to other scrubby forests dominated by *Melaleuca nodosa*;
- Detailed survey be undertaken in the newly-identified *Eucalyptus tereticornis* – *Eucalyptus glaucina* Shrubby Open Forest (Unit 18r), to ascertain its relationship to other communities dominated by redgum species;
- Detailed survey and mapping be undertaken for the newly-identified *Eucalyptus* sp aff *agglomerata* Heathy Low Forest (Unit 18s), to ascertain its relationship to similar vegetation in the Cessnock district, and also to gain a better appreciation of the size of the *Acacia bynoeana* population;
- Measures be taken to conserve the large remnant of vegetation in the north-east of the study area, immediately south of the Main Northern Railway, recognising the excellent condition of this vegetation and its role as a wildlife corridor. Current proposals to fragment this remnant via the F3 freeway extension may warrant revision to lessen the impacts on this parcel;
- Exclusion from potential development of the parcel of land immediately west of the Cessnock Road, and south of the existing Hanwood Estate, to protect the large population of *Persoonia pauciflora*.

6.0 Project Limitations

This report and the associated mapping of vegetation communities has been undertaken as a rapid assessment only and has not relied on detailed floristic survey, data analysis or ground truthing. Mapping has been assisted by field reconnaissance over the course of one day, largely restricted to public roads, together with extrapolation from the detailed mapping undertaken within the core Sweetwater area. Many parcels of land in private ownership were not inspected in the field. As a consequence, this report and the associated mapping should not be taken as a final assessment of the area.

7.0 References

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Appendix 3

Fauna Species Lists

EXPECTED FAUNA SPECIES LIST

Below are tabulated lists of fauna species (separated into class guilds) that could be *reasonably* expected to be found within the study area at some time. Such an approach has been taken given the unlikelihood to record *all* potentially occurring species within an area during formal fauna surveys (due to seasonality of certain species, climatic limitations, crypticism etc).

Family sequencing and taxonomy follow for each fauna class:

Birds – Christidis and Boles (1994).

Herpetofauna - Cogger (2000).

Mammals - Strahan (ed) (1995) and Churchill (1998).

KNOWN AND EXPECTED BIRD LIST

Appendix Key:	# = introduced species	? = species unable to be confirmed
	(E) = listed as Endangered in NSW.	(V) = listed as Vulnerable in NSW.
Data Source:	(J) = listed as JAMBA species	(EE) = Species listed under the
	(C) = listed as CAMBA species	Commonwealth EPBC Act as Endangered
	(EV) = Species listed under the	(EM) = Species listed under the
	Commonwealth EPBC Act as Vulnerable	Commonwealth EPBC Act as Migratory
	1 = Species recorded during surveys by RPS 2005-2010	
	2 = Species previously recorded (CT records, 2001-2004 Lot 1 DP 658074, Lot 102 DP 1040618 & Lot 300 DP 1029733)	
	3 = Species previously recorded on site (Ecotone 2003)	
	4 = Species previously recorded on site (Atlas of NSW Wildlife, 2010)	
	5 = Species reported to authors by personal communication	

Family	Scientific Name	Common Name	1	2	3	4	5
Casuariidae (Emu)	<i>Dromaius novaehollandiae</i>	Emu					
Megapodiidae (Mound Builders)	<i>Alectura lathamii</i>	Australian Brush-turkey					
Phasianidae (Quails, Pheasants and Fowls)	<i>Coturnix pectoralis</i>	Stubble Quail		✓			
	<i>Coturnix ypsilophora</i>	Brown Quail					
Anatidae (Swans, Geese and Ducks)	<i>Anas castanea</i>	Chestnut Teal		✓			
	<i>Anas gracilis</i>	Grey Teal					
	<i>Anas platyrhynchos</i>	*Mallard					
	<i>Anas rhynchotis</i>	Australian Shoveller					
	<i>Anas superciliosa</i>	Pacific Black Duck	✓				
	<i>Aythya australis</i>	Hardhead	✓				
	<i>Chenonetta jubata</i>	Australian Wood Duck	✓	✓			
	<i>Cygnus atratus</i>	Black Swan	✓				
	<i>Oxyura australis</i>	Blue-billed Duck (V)					
	<i>Stictonetta naevosa</i>	Freckled Duck (V)					
	<i>Biziura lobata</i>	Musk Duck	✓				
Podicipedidae (Grebes)	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	✓				
	<i>Poliocephalus</i>	Hoary-headed Grebe					

	<i>poliocephalus</i>			
Anhingidae (Darters)	<i>Anhinga melanogaster</i>	Darter		
Phalacrocoracidae (Cormorants)	<i>Phalacrocorax carbo</i>	Great Cormorant		
	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	✓	
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant		✓
	<i>Phalacrocorax varius</i>	Pied Cormorant		
Pelecanidae (Pelicans)	<i>Pelecanus conspicillatus</i>	Australian Pelican	✓	✓
Ardeidae (Heron, Bitterns and Egrets)	<i>Ardea alba</i>	Great Egret (C,J, EM)		
	<i>Ardea ibis</i>	Cattle Egret (C,J, EM)		
	<i>Ardea intermedia</i>	Intermediate Egret		
	<i>Ardea pacifica</i>	White-necked Heron	✓	✓
	<i>Botaurus poiciloptilus</i>	Australasian Bittern (V)		
	<i>Butorides striatus</i>	Striated Heron		
	<i>Egretta garzetta</i>	Little Egret		
	<i>Egretta novaehollandiae</i>	White-faced Heron	✓	✓
	<i>Ixobrychus flavicollis</i>	Black Bittern (V)		
	<i>Nycticorax caledonicus</i>	Nankeen Night Heron		
Threskiornithidae (Ibises and Spoonbills)	<i>Platalea flavipes</i>	Yellow-billed Spoonbill		
	<i>Platalea regia</i>	Royal Spoonbill		
	<i>Threskiornis molucca</i>	Australian White Ibis	✓	
	<i>Threskiornis spinicollis</i>	Straw-necked Ibis	✓	✓
Accipitridae (Hawks, Kites and Eagles)	<i>Accipiter fasciatus</i>	Brown Goshawk	✓	
	<i>Accipiter cirrhocephalus</i>	Collared Sparrowhawk	✓	
	<i>Accipiter novaehollandiae</i>	Grey Goshawk		
	<i>Aquila audax</i>	Wedge-tailed Eagle	✓	✓
	<i>Aviceda subcristata</i>	Pacific Baza	✓	✓
	<i>Circus approximans</i>	Swamp Harrier		
	<i>Circus assimilis</i>	Spotted Harrier (V)	✓	
	<i>Elanus axillaris</i>	Black-shouldered Kite	✓	
	<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle (C, EM)		
	<i>Haliastur sphenurus</i>	Whistling Kite	✓	✓
	<i>Hamirostra melanosternon</i>	Black-breasted Buzzard (V)		
	<i>Hieraaetus morphnoides</i>	Little Eagle (V)	✓	
	<i>Lophoictinia isura</i>	Square-tailed Kite (V)		✓
Falconidae (Falcons)	<i>Falco berigora</i>	Brown Falcon	✓	
	<i>Falco cenchroides</i>	Nankeen Kestrel	✓	
	<i>Falco longipennis</i>	Australian Hobby	✓	✓
	<i>Falco peregrinus</i>	Peregrine Falcon		
	<i>Falco subniger</i>	Black Falcon		
Rallidae (Crakes, Rails and Gallinules)	<i>Fulica atra</i>	Eurasian Coot	✓	
	<i>Gallinula philippensis</i>	Buff-banded Rail		
	<i>Gallinula tenebrosa</i>	Dusky Moorhen	✓	
	<i>Porphyrio porphyrio</i>	Purple Swampphen	✓	
	<i>Porzana fluminea</i>	Australian Spotted Crane		
	<i>Porzana pusilla</i>	Baillon's Crane		
	<i>Porzana tabuensis</i>	Spotless Crane		
	<i>Rallus pectoralis</i>	Lewin's Rail		

Turnicidae (Button-Quail)	<i>Turnix pyrrhothorax</i>	Red-chested Button-quail					
	<i>Turnix varia</i>	Painted Button-quail	✓				
Rostratulidae (Snipe)	<i>Rostratula benghalensis</i>	Painted Snipe (EM, V)					
	<i>Gallinago hardwickii</i>	Latham's Snipe					
Jacanidae (Jacanas)	<i>Irediparra gallinacea</i>	Comb-crested Jacana (V)					
Burhinidae (Stone-curlews)	<i>Burhinus grallarius</i>	Bush Stone-curlew (E)					
	<i>Tringa stagnatilis</i>	Marsh Sandpiper (C, J)					
Recurvirostridae (Stilts and Avocets)	<i>Himantopus himantopus</i>	Black-winged Stilt					
Charadriidae (Lapwings, Plovers and Dottrels)	<i>Erythronyx cinctus</i>	Red-kneed Dotterel					
	<i>Euseyonis melanops</i>	Black-fronted Dotterel					
	<i>Vanellus miles</i>	Masked Lapwing	✓		✓		
Columbidae (Pigeons and Doves)	<i>Columba livia</i>	Rock Dove #					
	<i>Macropygia amboinensis</i>	Brown Cuckoo Dove					
	<i>Columba leucomela</i>	White-headed Pigeon					
	<i>Streptopelia chinensis</i>	Spotted Turtle-Dove #					
	<i>Chalcophaps indica</i>	Emerald Dove					
	<i>Phaps chalcoptera</i>	Common Bronzewing	✓	✓			
	<i>Phaps elegans</i>	Brush Bronzewing					
	<i>Ocyphaps lophotes</i>	Crested Pigeon	✓	✓	✓	✓	
	<i>Geopelia striata</i>	Peaceful Dove	✓				
	<i>Geopelia humeralis</i>	Bar-shouldered Dove	✓				
	<i>Leucosarcia melanoleuca</i>	Wonga Pigeon					
	<i>Ptilinopus magnificus</i>	Wompoo Fruit-dove (V)					
	<i>Ptilinopus regina</i>	Rose-crowned Fruit-dove (V)					
	<i>Ptilinopus superbus</i>	Superb Fruit-dove (V)					
	<i>Lopholaimus antarcticus</i>	Topknot Pigeon	✓				
	<i>Calyptorhynchus funereus</i>	Yellow-tailed Black-Cockatoo	✓				
	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo (V)		✓			✓
	<i>Cacatua roseicapilla</i>	Galah	✓	✓	✓		
	<i>Cacatua tenuirostris</i>	Long-billed Corella	✓				
	<i>Cacatua sanguinea</i>	Little Corella					
Psittacidae (Parrots)	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	✓				
	<i>Callocephalon fimbriatum</i>	Gang-gang Cockatoo (V)					
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	✓				
	<i>Trichoglossus chlorolepidotus</i>	Scaly-breasted Lorikeet	✓	✓			
	<i>Trichoglossus concinna</i>	Musk Lorikeet	✓				
	<i>Glossopsitta pusilla</i>	Little Lorikeet (V)	✓				
	<i>Alisterus scapularis</i>	Australian King Parrot	✓	✓			
	<i>Lathamus discolor</i>	Swift Parrot (E, EE)	✓				✓
	<i>Platycercus elegans</i>	Crimson Rosella	✓	✓			
	<i>Platycercus eximius</i>	Eastern Rosella	✓	✓	✓	✓	
	<i>Neophema pulchella</i>	Turquoise Parrot (V)	✓				
	<i>Psephotus haematonotus</i>	Red-rumped Parrot	✓	✓			
Cuculidae (Old World Cuckoos)	<i>Cuculus saturatus</i>	Oriental Cuckoo (C,J, EM)					
	<i>Cuculus pallidus</i>	Pallid Cuckoo					

	<i>Cacomantis variolosus</i>	Brush Cuckoo	✓		
	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	✓		✓
	<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo	✓	✓	
	<i>Chrysococcyx lucidus</i>	Shining Bronze-Cuckoo	✓		
	<i>Eudynamys scolopacea</i>	Common Koel	✓		
	<i>Scythrops novaehollandiae</i>	Channel-billed Cuckoo			
Centropodidae (Coucals)	<i>Centropus phasianinus</i>	Pheasant Coucal			
Strigidae (Hawk Owls)	<i>Ninox strenua</i>	Powerful Owl (V)			✓
	<i>Ninox connivens</i>	Barking Owl (V)			✓
	<i>Ninox boobook</i>	Southern Boobook	✓	✓	
Tytonidae (Barn Owls)	<i>Tyto alba</i>	Barn Owl			
	<i>Tyto novaehollandiae</i>	Masked Owl (V)			
Podargidae (Frogmouths)	<i>Podargus strigoides</i>	Tawny Frogmouth	✓		
Caprimulgidae (Nightjars)	<i>Eurostopodus mystacalis</i>	White-throated Nightjar			
Aegothelidae (Owlet-nightjars)	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	✓	✓	
Apodidae (Typical Swifts)	<i>Hirundapus caudacutus</i>	White-throated Needletail (C,J, EM)	✓	✓	
	<i>Apus pacificus</i>	Fork-tailed Swift (C,J, EM)			
Alcedinidae (True Kingfishers)	<i>Alcedo azurea</i>	Azure Kingfisher	✓		✓
Halcyonidae (Kingfishers and Kookaburras)	<i>Dacelo novaeguineae</i>	Laughing Kookaburra	✓	✓	✓
	<i>Todiramphus sanctus</i>	Sacred Kingfisher	✓	✓	
Meropidae (Bee-eaters)	<i>Merops ornatus</i>	Rainbow Bee-eater (J,EM)	✓	✓	
Coraciidae (Typical Rollers)	<i>Eurystomus orientalis</i>	Dollarbird	✓		
Menuridae (Lyrebirds)	<i>Menura novaehollandiae</i>	Superb Lyrebird			
Climacteridae (Australo-Papuan Treecreepers)	<i>Cormobates leucophaeus</i>	White-throated Treecreeper	✓	✓	
	<i>Climacteris erythroptus</i>	Red-browed Treecreeper			
	<i>Climacteris picumnus</i>	Brown Treecreeper (V)	✓		
Maluridae (Fairy-Wrens and Emu-Wrens)	<i>Malurus cyaneus</i>	Superb Fairy-wren	✓	✓	✓
	<i>Malurus lamberti</i>	Variegated Fairy-wren	✓	✓	
	<i>Stipiturus malachurus</i>	Southern Emu-wren			
Pardalotidae (Pardalotes, Scrubwrens, Thornbills)	<i>Pardalotus punctatus</i>	Spotted Pardalote	✓	✓	✓
	<i>Paradallotus striatus</i>	Striated Pardalote	✓	✓	✓
	<i>Sericornis frontalis</i>	White-browed Scrubwren	✓		
	<i>Sericornis magnirostris</i>	Large-billed Scrubwren			
	<i>Chthonicola sagittata</i>	Speckled Warbler (V)	✓	✓	
	<i>Smicromis brevirostris</i>	Weebill	✓		
	<i>Gerygone mouki</i>	Brown Gerygone			
	<i>Gerygone fusca</i>	Western Gerygone	✓		
	<i>Gerygone olivacea</i>	White-throated Gerygone	✓	✓	
	<i>Acanthiza pusilla</i>	Brown Thornbill	✓	✓	✓
	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill	✓	✓	
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	✓		

	<i>Acanthiza nana</i>	Yellow Thornbill	✓	✓	✓
	<i>Acanthiza lineata</i>	Striated Thornbill	✓		
	<i>Hylacola pyrrhopygia</i>	Chestnut-rumped Heathwren			
Meliphagidae (Honeyeaters)	<i>Anthochaera carunculata</i>	Red Wattlebird	✓		✓
	<i>Plectrhncha lanceolata</i>	Striped Honeyeater	✓		
	<i>Anthochaera chrysoptera</i>	Brush Wattlebird		✓	
	<i>Philemon corniculatus</i>	Noisy Friarbird	✓	✓	
	<i>Philemon citreogularis</i>	Little Friarbird	✓		
	<i>Xanthomyza phrygia</i>	Regent Honeyeater (E, EE, EM)			✓
	<i>Manorina melanophrys</i>	Bell Miner			
	<i>Manorina melanocephala</i>	Noisy Miner	✓	✓	✓
	<i>Meliphaga lewinii</i>	Lewin's Honeyeater			
	<i>Lichenostomus chrysops</i>	Yellow-faced Honeyeater	✓	✓	✓
	<i>Lichenostomus melanops</i>	Yellow-tufted Honeyeater			
	<i>Lichenostomus fuscus</i>	Fuscous Honeyeater	✓	✓	
	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater	✓		✓
	<i>Lichenostomus leucotis</i>	White-eared Honeyeater	✓		
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	✓	✓	
	<i>Melithreptus lunatus</i>	White-naped Honeyeater	✓		
	<i>Melithreptus gularis</i>	Black-chinned Honeyeater (V)			✓
	<i>Entomyzon cyanotis</i>	Blue-faced Honeyeater	✓		
	<i>Lichmera indistincta</i>	Brown Honeyeater			
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater			
	<i>Phylidonyris nigra</i>	White-cheeked Honeyeater			
	<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill	✓	✓	✓
	<i>Grantiella picta</i>	Painted Honeyeater (V)			✓
	<i>Myzomela sanguinolenta</i>	Scarlet Honeyeater	✓		
	<i>Epthianura albifrons</i>	White-fronted Chat			
Eopsaltriidae (Robins)	<i>Melanodryas cucullata</i>	Hooded Robin (V)			
	<i>Microeca fascians</i>	Jacky Winter	✓		
	<i>Petroica multicolor</i>	Scarlet Robin (V)	✓	✓	
	<i>Petroica phoenicea</i>	Flame Robin (V)			
	<i>Petroica rosea</i>	Rose Robin	✓	✓	✓
	<i>Eopsaltria australis</i>	Eastern Yellow Robin	✓	✓	
Pomatostomidae (Australo-Papuan Babblers)	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler (V)	✓	✓	✓
Cinclosomidae (Quail-thrushes and allies)	<i>Psophodes olivaceus</i>	Eastern Whipbird			✓
	<i>Cinclosoma punctatum</i>	Spotted Quail-thrush			
Neosittidae (Sittellas)	<i>Daphoenositta chrysoptera</i>	Varied Sittella (V)	✓	✓	
Pachycephalidae (Whistlers, Shrike-tit and Shrike-thrushes)	<i>Falcunculus frontatus</i>	Crested Shrike-tit	✓		
	<i>Pachycephala pectoralis</i>	Golden Whistler	✓		✓
	<i>Pachycephala rufiventris</i>	Rufous Whistler	✓	✓	
	<i>Colluricincla harmonica</i>	Grey Shrike-thrush	✓	✓	
Dicruridae (Monarchs, Fantails and Drongo)	<i>Monarcha melanopsis</i>	Black-faced Monarch			

	<i>Myiagra rubecula</i>	Leaden Flycatcher	✓		
	<i>Myiagra inquieta</i>	Restless Flycatcher			
	<i>Myiagra cyanoleuca</i>	Satin Flycatcher			
	<i>Grallina cyanoleuca</i>	Magpie-lark	✓		
	<i>Rhipidura rufifrons</i>	Rufous Fantail		✓	
	<i>Rhipidura fuliginosa</i>	Grey Fantail	✓	✓	✓
	<i>Rhipidura leucophrys</i>	Willie Wagtail	✓	✓	✓
	<i>Dicrurus bracteatus</i>	Spangled Drongo			
Campephagidae (Cuckoo-shrikes and Trillers)	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	✓	✓	✓
	<i>Coracina papuensis</i>	White-bellied Cuckoo-shrike	✓		
	<i>Coracina tenuirostris</i>	Cicadabird	✓		
	<i>Lalage sueurii</i>	White-winged Triller			
Oriolidae (Orioles and Figbird)	<i>Oriolus sagittatus</i>	Olive-backed Oriole	✓	✓	
	<i>Sphecotheres viridis</i>	Figbird			
Artamidae (Woodswallows, Butcherbirds and Currawongs)	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow			
	<i>Artamus cyanopterus</i>	Dusky Woodswallow	✓		
	<i>Artamus personatus</i>	Masked Woodswallow	✓		
	<i>Cracticus torquatus</i>	Grey Butcherbird	✓	✓	✓
	<i>Cracticus nigrogularis</i>	Pied Butcherbird	✓	✓	✓
	<i>Gymnorhina tibicen</i>	Australian Magpie	✓	✓	✓
	<i>Strepera graculina</i>	Pied Currawong	✓	✓	
Corvidae (Crows and allies)	<i>Corvus coronoides</i>	Australian Raven	✓	✓	✓
Cororacidae (Mud-nesters)	<i>Corcorax melanorhamphos</i>	White-winged Chough	✓	✓	✓
	<i>Grallina cyanoleuca</i>	Magpie-lark	✓	✓	✓
Ptilinorhynchidae (Bowerbirds)	<i>Ptilonorhynchus violaceus</i>	Satin Bowerbird	✓		
Motacillidae (Old World Wagtails and Pipits)	<i>Anthus novaeseelandiae</i>	Richard's Pipit	✓	✓	
Passeridae (Sparrows, Weaverbirds, Waxbills and allies)	<i>Passer domesticus</i>	House Sparrow #			
	<i>Taeniopygia guttata</i>	Zebra Finch			
	<i>Taeniopygia bichenovii</i>	Double-barred Finch	✓	✓	
	<i>Stagonopleura guttata</i>	Diamond Firetail (V)			
	<i>Aegintha temporalis</i>	Red-browed Firetail	✓	✓	
	<i>Neochmia modesta</i>	Plum-headed Finch			
	<i>Neochmia temporalis</i>	Red-browed Finch	✓		
	<i>Lonchura castaneothorax</i>	Chestnut-breasted Mannikin			
Dicaeidae (Flowerpeckers)	<i>Dicaeum hirundinaceum</i>	Mistletoebird	✓		
Hirundinidae (Swallows and Martins)	<i>Hirundo neoxena</i>	Welcome Swallow	✓	✓	
	<i>Hirundo nigricans</i>	Tree Martin	✓	✓	
	<i>Hirundo ariel</i>	Fairy Martin	✓		
	<i>Cheramoeca leucosternus</i>	White-backed Swallow			
Sylviidae (Old World Warblers)	<i>Acrocephalus stentoreus</i>	Clamorous Reed Warbler	✓		
	<i>Cincloramphus mathewsi</i>	Rufous Songlark			
	<i>Cisticola exilis</i>	Golden-headed Cisticola			
	<i>Megalurus gramineus</i>	Little Grassbird	✓		

	<i>Megalurus timorensis</i>	Tawny Grassbird		
Zosteropidae (White-eyes)	<i>Zosterops lateralis</i> <i>lateralis</i>	Silvereye	✓	
	<i>Zosterops lateralis</i> <i>familiaris</i>	Silvereye	✓	✓
Muscicapidae (Thrushes)	<i>Zoothera lunulate</i>	Bassian Thrush		
Sturnidae (Starlings and allies)	<i>Sturnus vulgaris</i>	Common Starling #	✓	
	<i>Acridotheres tristis</i>	Common Myna #	✓	

KNOWN AND EXPECTED MAMMAL LIST

Appendix Key: # = introduced species (E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.

Data Source: (EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
1 = Species recorded during surveys by RPS 2005-20010
2 = Species previously recorded (CT records, 2001-2004 Lot 1 DP 707207, Lot 300 DP 1029733 & Lot 102 DP 1040618)
3 = Species previously recorded on site (Ecotone 2003)
4 = Species previously recorded on site (Atlas of NSW Wildlife, 2010)
5 = Species reported to authors by personal communication

Sub-Class	Family Name	Scientific Name	Common Name	1	2	3	4	5
Proteheria (Monotremes)	Tachyglossidae (Echidnas)	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	✓		✓		
		<i>Ornithorhynchus anatinus</i>	Platypus			✓		
Marsupalia (Marsupials)	Dasyuridae (Dasyurids)	<i>Antechinus flavipes</i>	Yellow-footed Antechinus	✓	✓			
		<i>Antechinus stuartii</i>	Brown Antechinus	✓	✓			
		<i>Antechinus swainsonii</i>	Dusky Antechinus					
		<i>Dasyurus maculatus</i>	Tiger Quoll (V)					
		<i>Phascogale tapoatafa</i>	Brush-tailed Phascogale (V)					
		<i>Planigale maculata</i>	Common Planigale (V)					
		<i>Sminthopsis murina</i>	Common Dunnart					
	Peramelidae (Bandicoots and Bilbies)	<i>Isodon macrourus</i>	Northern Brown Bandicoot					
		<i>Peremeles nasuta</i>	Long-nosed Bandicoot	✓				
	Phascolarctidae (Koala)	<i>Phascolarctos cinereus</i>	Koala (V)				✓	?
	Vombatidae	<i>Vombatus ursinus</i>	Common Wombat	✓		✓		
	Petauridae (Wrist-winged Gliders)	<i>Petaurus breviceps</i>	Sugar Glider					✓
		<i>Petaurus norfolcensis</i>	Squirrel Glider (V)	✓	✓			
		<i>Petaurus australis</i>	Yellow-bellied Glider (V)					
	Pseudocheiridae (Ringtail Possums and Greater Glider)	<i>Petauroides volans</i>	Greater Glider					
		<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum	✓				
	Acrobatidae (Feathertail Glider)	<i>Acrobates pygmaeus</i>	Feathertail Glider					
	Phalangeridae (Brushtail Possums and Cuscuses)	<i>Trichosurus vulpecula</i>	Common Brushtail Possum	✓	✓	✓		
	Macropodidae (Wallabies and Kangaroos)	<i>Macropus giganteus</i>	Eastern Grey Kangaroo	✓	✓	✓		
		<i>Macropus robustus</i>	Common Wallaroo					
		<i>Macropus rufogriseus</i>	Red-necked Wallaby	✓	✓	✓		
		<i>Wallabia bicolor</i>	Swamp Wallaby	✓		✓		
	Pteropodidae (Flying-foxes, Fruit-bats and)	<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox (V, EV)				✓	

Blossum-bats)						
	Rhinolophidae (Horseshoe-bats)	<i>Rhinolophus megaphyllus</i>	Eastern Horseshoe- bat			
	Emballonuridae (Sheath-tail-bats)	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat (V)	✓		
	Molossidae (Freetail-bats)	<i>Mormopterus norfolkensis</i>	East Coast Freetail- bat (V)	✓		✓
		<i>Mormopterus planiceps</i>	Southern Freetail-bat	✓		
		<i>Mormopterus</i> sp.1	Little Freetail-bat		✓	
		<i>Mormopterus</i> sp.2	Eastern Freetail-bat			
		<i>Tadarida australis</i>	White-striped Freetail-bat	✓		
	Vespertilionidae (Vespertilionid Bats)	<i>Miniopterus australis</i>	Little Bentwing-bat (V)	✓	✓	
		<i>Miniopterus schreibersii</i>	Eastern Bentwing- bat (V)	✓	✓	
		<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			
		<i>Nyctophilus gouldii</i>	Gould's Long-eared Bat		✓	
		<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat (V)			
		<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	✓		
		<i>Chalinolobus morio</i>	Chocolate Wattled Bat	✓		
		<i>Falsistrellus tasmaniensis</i>	Eastern Falsistrelle (V)			
		<i>Myotis adversus</i>	Large-footed Myotis (V)	✓		
		<i>Scoteanax orion</i>	Eastern Broad- nosed Bat		✓	
		<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat (V)		✓	
		<i>Scotorepens balstoni</i>	Little Broad-nosed Bat	✓		
		<i>Vespadelus darlingtoni</i>	Large Forest Bat			
		<i>Vespadelus regulus</i>	Southern Forest Bat			
		<i>Vespadelus troughtoni</i>	Eastern Cave Bat (V)			
		<i>Vespadelus pumilus</i>	Eastern Forest Bat		✓	
		<i>Vespadelus vulturnus</i>	Little Forest Bat	✓	✓	
Eutheria (Non-Flying Placental Mammals)	Muridae (Murids)	<i>Hydromys chrysogaster</i>	Water Rat			
		<i>Melomys burtoni</i>	Grassland Melomys			
		<i>Mus musculus</i>	House Mouse #			
		<i>Pseudomys novaehollandiae</i>	New Holland Mouse			
		<i>Rattus fuscipes</i>	Bush Rat		✓	
		<i>Rattus lutreolus</i>	Swamp Rat			
		<i>Rattus norvegicus</i>	Brown Rat #			
		<i>Rattus rattus</i>	Black Rat #			
	Canidae (Dogs)	<i>Canis familiaris</i>	Dog #	✓	✓	✓
		<i>Canis familiaris dingo</i>	Dingo	✓		
		<i>Vulpes vulpes</i>	Red Fox #	✓		✓
	Felidae (Cats)	<i>Felis catus</i>	Feral Cat #			
	Leporidae (Rabbit and Hare)	<i>Oryctolagus cuniculus</i>	European Rabbit #	✓		✓

	<i>Lepus capensis</i>	Brown Hare #	✓	✓	
Equidae (Horse Donkey)	and				
	<i>Equus caballus</i>	Horse #	✓		✓
	<i>Equus asinus</i>	Donkey			
Suidae (Pigs)	<i>Sus scrofa</i>	Pig #			
Bovidae (Horned Ruminants)	<i>Bos taurus</i>	Cow #	✓	✓	✓
	<i>Capra hircus</i>	Goat #	✓		
Cervidae (Deer)	<i>Cervus timorensis</i>	Rusa Deer #			

KNOWN AND EXPECTED REPTILE LIST

Appendix Key: (EV) = listed under the Commonwealth EPBC Act as Vulnerable (E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.

Data Source: 1 = Species recorded during surveys by RPS 2005-2010
2 = Species previously recorded (CT records, 2001-2004 Lot 1 DP 707207, Lot 300 DP 1029733 & Lot 102 DP 1040618)
3 = Species previously recorded on site (Ecotone 2003)
4 = Species previously recorded on site (Atlas of NSW Wildlife, 2010)

Order	Family Name	Scientific Name	Common Name	1	2	3	4
Testudines	Chelidae (Tortoises)	<i>Chelodina longicollis</i>	Long-necked Tortoise	✓			
Squamata (Sauria)	Agamidae (Dragons)	<i>Amphibolurus muricatus</i>	Jacky Lizard				
		<i>Physignathus lesuerii</i>	Eastern Water Dragon	✓			
		<i>Pogona barbata</i>	Eastern Bearded Dragon	✓	✓		
	Pygopodidae (Legless Lizards)	<i>Lialis burtonis</i>	Burton's Snake Lizard				
		<i>Pygopus lepidopus</i>	Common Scaly-foot				
		<i>Delma plebeia</i>	Leaden Delma				
	Varanidae (Monitors)	<i>Varanus gouldii</i>	Gould's Monitor				
		<i>Varanus rosenbergi</i>	Heath Monitor (V)				
		<i>Varanus varius</i>	Lace Monitor	✓	✓		
	Scincidae (Skinks)	<i>Cryptoblepharus virgatus</i>					
		<i>Ctenotus taeniolatus</i>	Copper-tailed Skink				
		<i>Ctenotus robustus</i>	Striped Skink				
		<i>Cyclodomorphus casuarinae</i>	She-oak Skink				
		<i>Egernia cunninghamii</i>	Cunningham's Skink				
		<i>Egernia major</i>	Land Mullet				
		<i>Egernia modesta</i>					
		<i>Egernia striolata</i>	Tree-crevice Skink				
		<i>Egernia saxatilis</i>	Black Rock Skink				
		<i>Egernia whitii</i>	White's Skink				
		<i>Eulamprus quoyii</i>	Eastern Water Skink	✓			
		<i>Eulamprus tenuis</i>					
		<i>Lampropholis delicata</i>	Grass Skink	✓			
		<i>Lampropholis guichenoti</i>	Garden Skink		✓		
		<i>Lygisaurus foliorum</i>	Tree-base Litter-skink				
		<i>Morethia boulengeri</i>	South-eastern Morethia				
		<i>Pseudomoia platynota</i>	Red-throated Skink				
		<i>Saiphos equalis</i>					
		<i>Saproscincus mustelinus</i>	Weasel Skink				
		<i>Tiliqua scincoides</i>	Eastern Blue-tongued Lizard	✓			
Squamata (Serpente)	Typhlopidae (Blind Snakes)	<i>Ramphotyphlops bituberculatus</i>	Prong-snouted Blind Snake				
		<i>Ramphotyphlops weidii</i>	Brown-snouted Blind Snake				
		<i>Ramphotyphlops nigrescens</i>	Black Blind Snake				
	Boidae (Pythons)	<i>Morelia spilota</i>	Diamond Python				
	Colubridae	<i>Boiga irregularis</i>	Brown Tree Snake				

(Tree Snakes)					
	<i>Dendralaphis punctulata</i>	Green Tree Snake			
Elapidae (Venomous Snakes)	<i>Furina diadema</i>	Red-naped Snake			
	<i>Acanthopis antarcticus</i>	Death Adder			
	<i>Cacophis krefftii</i>	Dwarf Crowned Snake			
	<i>Cacophis squamulosus</i>	Golden Crowned Snake			
	<i>Demansia psammophis</i>	Yellow-faced Whip Snake			
	<i>Furina diadema</i>	Red-naped Snake			
	<i>Hoplocephalus bungaroides</i>	Broad-headed Snake (V, EV)			
	<i>Hoplocephalus bitorquatus</i>	Pale-headed Snake (V)			
	<i>Notechis scutatus</i>	Eastern Tiger Snake			
	<i>Pseudonaja textilis</i>	Eastern Brown Snake	✓		✓
	<i>Rhinoplocephalus nigrescens</i>	Eastern Small-eyed Snake			
	<i>Vermicella annulata</i>	Bandy Bandy			
	<i>Hemiaspis signata</i>	Black-bellied Swamp Snake			
	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	✓		✓

KNOWN AND EXPECTED FROG LIST

Appendix Key: (EV) = Species listed under the (E) = listed as Endangered in NSW.
Commonwealth EPBC Act as Vulnerable (V) = listed as Vulnerable in NSW.

Data Source: 1 = Species recorded during surveys by RPS 2005 – 2010.
2 = Species previously recorded (CT records, 2001-2004 Lot 1 DP 707207, Lot 300 DP 1029733 & Lot 102 DP 1040618)
3 = Species previously recorded on site (Ecotone 2003)
4 = Species previously recorded on site (Atlas of NSW Wildlife, 2010)

Family Name	Scientific Name	Common Name	1	2	3	4
Hylidae (Tree Frogs)	<i>Litoria aurea</i>	Green and Golden Bell Frog (E, EV)				
	<i>Litoria brevipalmata</i>	Green-thighed Frog (V)				
	<i>Litoria caerulea</i>	Green Tree Frog				
	<i>Litoria chloris</i>	Red-eyed Green Tree Frog				
	<i>Litoria dentata</i>	Bleating Tree Frog	✓			
	<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	✓	✓		
	<i>Litoria latopalmata</i>	Broad-palmed Frog	✓			
	<i>Litoria lesueuri</i>	Lesueur's Frog				
	<i>Litoris nasuta</i>	Rocket Frog		✓		
	<i>Litoria peronii</i>	Peron's Tree Frog	✓			
	<i>Litoria phyllochroa</i>	Leaf Green Tree Frog				
	<i>Litoria tyleri</i>	Tyler's Tree Frog				
	<i>Litoria verreauxii</i>	Verreaux's Frog	✓	✓		
Myobatrachidae (Ground Frogs)	<i>Crinia signifera</i>	Common Eastern Froglet	✓	✓	✓	
	<i>Limnodynastes dumerilli</i>	Eastern Banjo Frog				
	<i>Limnodynastes ornatus</i>	Ornate Burrowing Frog	✓			
	<i>Limnodynastes peronii</i>	Striped Marsh Frog		✓		
	<i>Limnodynastes tasmaniensis</i>	Spotted Grass Frog	✓			
	<i>Pseudophryne coriacea</i>	Red-backed Toadlet				
	<i>Pseudophryne bibronii</i>	Brown Toadlet				
	<i>Uperoleia fusca</i>	Dusky Toadlet	✓	✓		
	<i>Uperoleia laevisgata</i>	Smooth Toadlet	✓			

Appendix 4

Persoonia pauciflora Report

Appendix 5

RPS Key Staff Qualifications



Curriculum Vitae

MATTHEW DOHERTY

Manager - Ecology & GIS

Newcastle, NSW

Bachelor of Landscape Management and Conservation (Land & Water Conservation Major), University of Western Sydney, 2002

Bushland Regeneration Certificate II, Western Sydney Institute of TAFE, 1999

Spikeless Tree Climbing Techniques, Total Height Safety, 2004

OH&S Induction Training (Green Card)

NPWS Scientific Investigation Licence

NSW Animal Ethics Research Authority

Senior First Aid

AREAS OF EXPERTISE:

Matt has seven years experience in the environmental industry with key skills in project management, survey design, GIS and client relations. In his position as Ecology & GIS Manager, Matt manages environment department including the day to day running of projects, verification of reports and other outputs and ensures clients are well informed of project progress and key findings. Matthew's background in local government, state government and private consultancy gives him a high level of appreciation of the environmental and consultancy sector, thus allowing him to take a pragmatic approach to providing successful conservation and development outcomes whilst meeting the aims and objectives of clients and determining authorities.

SELECTED PROJECT EXPERIENCE:

Ecology and GIS

- **Various large-scale land development, mining, energy and infrastructure projects** – Matt has project managed and/or participated in numerous large-scale land development, mining, energy and infrastructure projects including Queensland Hunter Gas Pipeline (850km); Hunter Gas Pipeline; Rio Tinto Lower Hunter Lands Project; GIS biodiversity, large scale vegetation, habitat and predictive modelling mapping works; wind farms and coordination of environmental monitoring programs for mines

PREVIOUS EXPERIENCE:

Ecologist – Andrews Neil Pty Ltd

2004 - 2005

Duties included: preparation of Fee Proposals for Ecological Services; General and Targeted Flora and Fauna Surveys including Flora and Fauna Identification; Desktop Studies and Literature Searches; Interpretation and Application of Legislation; report preparation including Threatened Species Assessments (8 part test), Vegetation Management Plans (Riparian Restoration/ Rehabilitation, Bush Regeneration), Species Impact Statements, Weed Management Strategies, Habitat Management Strategies and Tree Assessments; GIS/ Spatial Analysis and Database Management; Liaison with Client, Stakeholder Groups, State and Local Governing Bodies; Site Supervision of Ecological Conditions; Tree Climbing for installation, maintenance and monitoring of nestboxes.

Project Officer / Horticultural Services – Gosford City Council

06/2003 – 05/2004

Comprehensively reviewed noxious weed management; performed vegetation surveys on GCC landfills to identify the presence of noxious weeds; quantify the extent of infestation of each noxious weeds species and map the



Curriculum Vitae

- CONTINUED -

affected areas; developed a management plan for the control of NW species identified in the survey in accordance with relevant legislation; maintained Japanese Gardens along with City Wide Gardens and Streetscapes.

Various Roles whilst at University

1997 - 2002

Environmental Officer - Dept of Land & Water Conservation, Newcastle

01/1999 – 12/1999

Liaised with relevant agency and stakeholder groups; researched and prepared an extensive literature review of issues pertaining to riparian vegetation; assessed current best practice for revegetation and rehabilitation of degraded sites; prepared a Riparian Revegetation Management Strategy

Volunteer – Maitland City Council

07/1999 – 12/1999

Assisted with Rivercare implementation throughout LGA. Utilised primary, secondary and field research to prepare a River Plan under 'Rivercare' guidelines.

Volunteer – Brisbane Waters & Gosford Lagoons Catchment Management Committee

03/1998 – 05/1998

Prepared Riparian Zone Rehabilitation Plan for Degraded Creek Management, Research and prepared a Riparian Zone Rehabilitation Project. Member on several Gosford City Council steering committees and working groups.

MEMBERSHIPS & ACHIEVEMENTS:

- Fire Protection Association Australia (FPAA)



Curriculum Vitae

CRAIG ANDERSON

Senior Ecologist – Senior Project Manager

Newcastle, NSW

Bachelor Applied Science (Environmental Assessment & Management), University of Newcastle, 1994

Graduate Diploma in Archaeological Heritage, UNE, Current

RFS/PIA NSW Consulting Planners Bushfire Training

AREAS OF EXPERTISE:

Craig has over 15 years experience in a wide range of environmental consulting. He has undertaken and managed commissions for a diverse range of projects within land development, energy, mining, infrastructure and conservation, including State Significant developments.

Craig has an extensive background in ecological field surveys, encompassing all aspects of flora and fauna identification, targeted surveying and mapping. He was involved in the initial formulation of an Association of Consulting Ecologists for NSW in 1998 and has acted as an expert witness in several Land and Environment Court matters relating to ecology and bushfire assessment. He is an experienced negotiator of ecological / development outcomes, and has a detailed understanding of legislation related to ecological matters.

Craig has been actively involved in representations to the Department of Environment on behalf of the NSW Urban Taskforce in regards to proposed changes to the NSW Threatened Species Conservation Act, and for the Urban Development Institute of Australia (UDIA) on matters relating to issues such as the proposed listing of endangered ecological communities, regional environmental biodiversity strategies, and the Native Vegetation Act and the operations of the Catchment Management Authority (CMA).

SELECTED PROJECT EXPERIENCE:

Ecology

- **Buttaba Hills (336 Lots) – Species Impact Statement**
- **Hunter Economic Zone (800+ ha industrial estate) – Species Impact Statement**
- **Pelaw Main By-Pass to Hunter Economic Zone – Species Impact Statement**
- **Residential development / Eco-Resort / Fauna Sanctuary at Paxton - Flora and Fauna Assessment incorporating Seven Part Tests of Significance of Impact under Threatened Species Legislation**
- **SEPP 5 Aged Care facilities, Kariong, Hawks Nest, Wallsend, Glenhaven - Flora and Fauna Assessment incorporating Seven Part Tests of Significance of Impact under Threatened Species Legislation**
- **Caravan Park extensions, Fern Bay - Flora and Fauna Assessment incorporating Seven Part Tests of Significance of Impact under Threatened Species Legislation**
- **Road & Rail Infrastructure for the Hunter Economic Zone - Flora and Fauna Assessment incorporating Seven Part Tests of Significance of Impact under Threatened Species Legislation**
- **Alignments for Hunter Gas Pipeline Infrastructure - Flora and Fauna Assessment incorporating Seven Part Tests of Significance of Impact under Threatened Species Legislation**
- **Landscape Concept Plan, rural subdivision at Oakhampton Heights - Vegetation Management Plan**
- **Creek Rehabilitation Plan, Warners Bay - Vegetation Management Plan**
- **Vegetation Management Plan for a retained creek line with Sugar Valley Golf Course, West Wallsend - Vegetation Management Plan**
- **Individual Koala Plan of Management under SEPP 44 at Hawks Nest – Management Plan**



Curriculum Vitae

- CONTINUED -

- **Ecological Constraints Management Plan, Hawks Nest North** - Management Plan
- **Management Plan for the Green & Golden Bell Frog at Culburra** - Management Plan
- **Fuel Management Plan over lots within a rural-residential estate at Glen Oak** - Management Plan
- **Ecological Constraints Master Plan for Hunter Economic Zone** - Management Plan
- **Environmental Plan of Management for Residential / Tourism Sanctuary Project at Paxton** - Management Plan
- **Green and Golden Bell Frog Survey and Management Plan, Gillieston Heights** - Targeted Species Study
- Targeted Species Studies as part of the Ecological Constraints Master Plan for the Hunter Economic Zone

PREVIOUS EXPERIENCE:

Senior Ecologist, Wildthing Environmental Consulting

1995 – 2000

Oversaw operations in NSW and Qld, and project managed and undertook numerous ecological and bushfire assessments for a diverse array of clients / projects.

Environmental Officer, Pulver Cooper & Blackley / Kel Nagle Cooper & Associates

1994 - 1995

Undertook a range of environmental, planning and survey investigations; fieldwork; reporting for a range of land development; and golf course development projects.

MEMBERSHIPS & ACHIEVEMENTS:

- Frog and Tadpole Study Group (FATS)
- Hunter Birds Observers Club (HBOC). Committee Member 2009. Records Appraisal Committee, 2008 – present
- Bird Observers Club of Australia (BOCA)
- Donaldson Conservation Trust. Board member (independent environmental expert). 2009 – present.

Curriculum Vitae

Name: Paul Hillier

Office: RPS Newcastle

Position in Company: Ecologist

Qualifications / Awards

- B.Env.Sc. (Environmental Management)
- OH&S Induction Training (Green Card)
- NSW Driver's Licence (Class C)
- St John Ambulance Senior First Aid Certificate
- Dive Master (PADI Scuba Diver)

Areas of Expertise:

- Targeted and general Terrestrial flora and fauna surveys
- Threatened Flora & Fauna Assessment, Reporting and Legislation
- GPS Survey and GIS Mapping Projects

Recent Experience Includes:

Paul Hillier has broad range of Ecological Assessment reporting experience from 5 years of professional ecological work both in Australia and abroad. Project experience has primarily included a range of flora and fauna assessment disciplines as required by a wide range of corporate and domestic client requirements. Paul has been employed both within the private and public sector, providing a strong knowledge and understanding of the role of both developers and government in legislation and planning.

Paul has the majority of his experience within the consultancy industry, primarily focussing on the preparation of Flora and Fauna Assessments, Environmental Assessments, Environmental Impact Statements, Review of Environmental Factors and Statement of Environmental Effects. Paul has experience with targeted threatened flora and fauna surveys, including a strong knowledge of Geographic Information Systems mapping and analyses.



Curriculum Vitae

Name: Allan Richardson

Office: RPS Harper Somers O'Sullivan

Position in Company: Senior Ecologist

Qualifications / Awards

- B.Env.Sc. (Environmental Management)
- B.Env.Sc. (Hons) (Biology) – Migratory Wading Bird Study
- 2002 Hunter Environmental Institute Scholarship
- Waterways Authority Boating Licence
- OH&S Induction Training (Green Card)
- NSW Driver's Licence (Class C)
- NPWS Scientific Licence
- NSW Animal Ethics Research Authority
- St John Ambulance Senior First Aid Certificate

Memberships:

- Hunter Bird Observers Club
- Victorian Wader Study Group

Areas of Expertise:

- Ornithological Surveys and Research
- Targeted and general Terrestrial flora and fauna surveys
- Threatened Flora & Fauna Assessment, Reporting and Legislation
- GPS Survey and GIS Mapping Projects
- High Level Nature Photography
- Tertiary and General Ecological Tutoring, Demonstrating and Presenting

Recent Experience Includes:

Allan Richardson has broad range of Ecological Assessment reporting experience underpinned by over 27 years of ecological field experience. Over four and a half years of project experience has primarily included a range of flora and fauna assessment disciplines as required by a wide range of corporate and domestic client requirements. Allan has a strong grounding in threatened species ecology in both coastal and western NSW regional areas, with specialist migratory wader studies expertise in Central NSW and Roebuck Bay in North Western Australia.

Allan's wide ranging interest across different ecological disciplines, has been a central part of important threatened species projects, including, the Critically Endangered North Rothbury Persoonia, Hunter Estuary Green and Golden Bell Frog populations, Migratory Wader habitat usage surveys, seasonal Swift Parrot movements and specialised Avifauna Wind Farm Surveys on the east and west coast. Allan's broad ecological experience also represents an important part of RPS HSO's threatened flora and vegetation community mapping, targeted fauna survey works and threatened species habitat assessments over both small and large spatial areas for a range of client needs. His depth of experience and a strong knowledge of Australian fauna and regional vegetation contribute strongly to RPS HSO's ability to meet the consultation and regulatory needs of the development community.

Individual Profiles of *Persoonia pauciflora* (North Rothbury Persoonia) Occurring within the Huntlee New Town Study Area





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Executive Summary

RPS has undertaken extensive flora and fauna surveys in the North Rothbury area on behalf of Huntlee Pty Ltd. Ecological assessments have culminated in the production of an Ecological Constraints Master Plan (ECMP) and derived Ecological Assessment Report (EAR) over lands known collectively as Huntlee. Early in the Huntlee ecological assessment process it became clear that the North Rothbury locality was ecologically significant in respect to the limited distribution of *Persoonia pauciflora*; a shrubby plant, which is listed as Critically Endangered under State Environmental Legislation (*TSC Act 1995*) and under Federal Environmental Legislation (*EPBC Act 1999*).

In response to the status of *P. pauciflora* in the North Rothbury locality, in October 2005 the proponent commissioned RPS (then known as HSO) to undertake a detailed inventory of individual plants occurring within or immediately adjacent to lands under the control of the proponent. This survey effort culminated in the production of a report detailing the status of the species within the Huntlee lands.

The inventory of *P. pauciflora* plants was undertaken as an initial component of a conservation strategy, initiated by the proponent, to secure the long-term viability of *P. pauciflora* within other land-use / development strategies planned for the area. Although the report is currently limited to the documentation of *P. pauciflora* occurring within lands under the control of the proponent, it is hoped, with the support of other local landholders, that a full inventory of all plants within the North Rothbury population may be made. The information gathered is designed and intended to contribute information pertinent to the recovery process for *P. pauciflora*.

Key to the conservation strategy envisioned by the proponent was the establishment of a 'Persoonia Park' reserve, which would be maintained to guarantee a secure and viable future for this species. Retention of existing plants in the site with minimum 30m buffers would occur as long as such plants remain in situ.

Since the initial *Persoonia* Inventory in 2005, and in view of the critical state of *P. pauciflora*, the proponent has commissioned several update surveys of the status of the species within lands under their control (namely 2007, 2009, 2010). This report represents the findings of the 2005 & 2007 surveys, with addendum information provided for the 2009 and 2010 surveys.

The August 2010 *Persoonia pauciflora* survey, of all known plants within Huntlee at North Rothbury, found that out of the existing 28 plants, 21 had increased in size or foliage cover, 1 had decreased in size or foliage cover or exhibit no improvement and six additional plants (the same plants as recorded in 2007) were found to be dead. Investigation of the plant not increasing in condition suggests that the main cause for loss of condition is likely grazing pressures by macropods or to a lesser degree grazing by domestic stock. Despite reconnaissance surveys throughout Huntlee in 2010, no additional specimens of *P. pauciflora* have been located.

The overall status of *P. pauciflora* plants occurring within or in close proximity to Huntlee is that, of the original 28 plants identified, 15 extant plants occur within Huntlee lands (3 within the proposed Persoonia Park conservation area, a further 9 plants occurring within retained riparian habitat and conservation area north of Hanwood Estate, and 3 plants occurring within proposed habitat retention areas in the central northern area of the site), four (4) extant plants occur as offsite individuals in close proximity to Huntlee, two (2) extant potential hybrid plants occur within Huntlee, one (1) extant potential hybrid plant occurs as an offsite individual in close proximity and six (6) plants are dead.

Conservation initiatives representing the setting aside of land for *P. pauciflora*, as initially undertaken and carried forward by the proponent, will be critical to maintaining viable habitat for this species.

Preface

Persoonia pauciflora (North Rothbury Persoonia) has a highly limited distribution and population density. All known individuals occur within 2.5km of the original specimen plant within the North Rothbury locality. Consequently, within environmental legislation, it is listed as Critically Endangered in NSW (*Threatened Species Conservation Act 1995*) and nationally (*Environment Protection and Biodiversity Conservation Act 1999*).

In November 2005 an inventory was taken of those individual *P. pauciflora* plants occurring on lands (and those close to boundaries) under the control of the proponent at that time. The purpose of that report was to provide detailed data for each plant, which constituted a body of baseline data that could be used to enable ongoing monitoring of health and viability of individual plants, identify possible divisions within the population and act as a guide for land-use / land management strategies for the area.

At the time of the commissioning of the initial 2005 *P. pauciflora* report an estimated maximum population of approximately 550 individual plants (Patrick 2006) existed within the North Rothbury population. Updated survey results in 2006 reported some 631 extant plants (Patrick 2006). Since 2006 some 277 plants have been lost from the population as a result of actions of an unrelated third party. It is therefore estimated that approximately 354 individual plants, often isolated in context to other members of the population, remained extant at that stage, of which the majority occurred within private land holdings with a small number of plants occurring in roadside Local Government managed lands. The Draft National Recovery Plan (DECC 2009) has since estimated that “less than 350 mature individuals remain”. Therefore conservation initiatives representing the setting aside of land for *P. pauciflora*, as initially undertaken and carried forward by the proponent, will be critical to maintaining viable habitat for this species.

Persoonia Note Definitions.

ID N^o – Identification number given to each plant.

Grid of Occurrence - Represents the grid number in the Huntlee New Town ECMP Grid survey in which the plant occurs.

Description – Refers to the plant’s size, position in relation to topographical features and its position in relation to exposure to environmental elements.

Vegetation Community – As per NPWS (2000); House (2003) nomenclature and mapping units (MU) used to describe vegetation communities is derived from LHCCREMS.

Dimensions – Height and spread of the plant given in centimetres (the measurements represent the maximum dimensions observed).

Evidence of Hybridisation – Gordon Patrick (pers. comm.) has reported the occurrence of hybrids (presumably with *P. linearis*) within the North Rothbury population area (see DECC 2009, Page 1).

Reproductive Status – notes the presence of flowers/fruits/seeds.

Health – represented as one of six characteristics on a nominal scale relating to the condition of growing foliage – very good; good; moderate; poor; dying; dead.

Condition – relates to any damage that is detectable upon the plant e.g. grazed, broken branches or fire damage.

Notes – general notes and may refer to environmental conditions that appear to contributing to the condition of the plant.

July 2007 Update – represents comments with regard to plant condition and status as noted during a survey of *P. pauciflora* plants conducted during July 2007.

2009 Addendum – findings of reconnaissance surveys in 2009.

2010 Addendum – findings of reconnaissance surveys in 2010.

ID N°: 1 Grid of Occurrence: U7 Photos

Description: Medium sized spreading plant on west facing slope and receiving filtered light.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (predominantly *Eucalyptus crebra* and *Corymbia maculata*).

Dimensions:

Height – 62.5cm **Spread** – 90cm

Evidence of Hybridisation: None.

Reproductive Status: Many buds, no fruit (31/10/05).

Health: Very Good.

Condition: One broken main branch, otherwise entire with good leaf cover.

Notes: Plant shows damage from the past but has recovered well. Current absence of fruit appears due to the lack of flowers during the Autumn. The hypothesis for hybridisation in some of these northern plants is based upon the apparent lack of fruit in previous years (Gordon Patrick pers. comm.). This plant does not exhibit any evidence of shared morphological characters with *P. linearis* (the only other *Personia* sp. in area) and this plant is now flowering well. Therefore hybridisation due to lack of fruit may be tested in this plant next season.

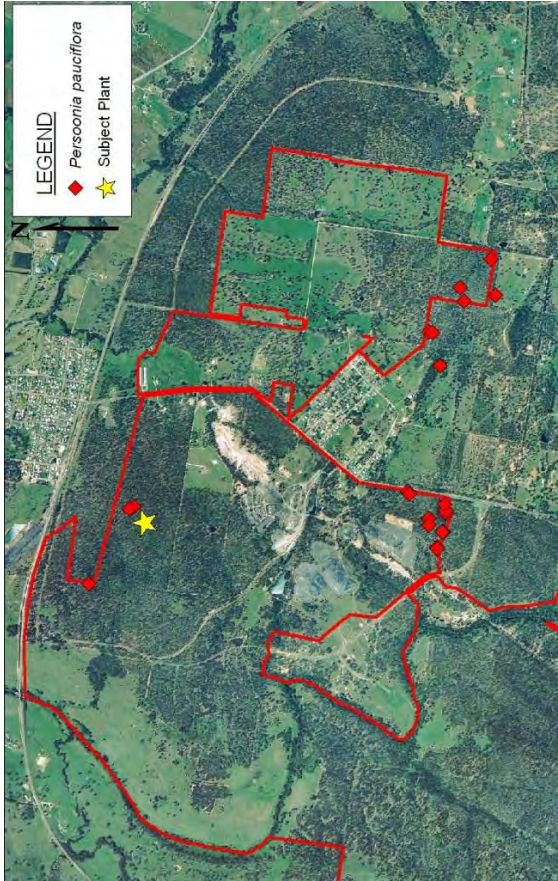
July 2007 Update: Plant found to be of increased size and bearing fruit during July 2007 survey. The presence of fruit suggests that this plant is fertile and therefore unlikely to be a hybrid based on fertility criteria.



Detail October 2005



Habitat October 2005



Map showing position Plant N° 1.



Plant Condition July 2007

ID N°: 2 Grid of Occurrence: V6 **Photos**

Description: Large sized spreading plant on dry ridge receiving filtered light.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (predominantly *Eucalyptus crebra* and *Corymbia maculata*).

Dimensions:

Height – 110cm **Spread** – 170cm

Evidence of Hybridisation: None.

Reproductive Status: Small number of buds coming (31/10/05).

Health: Moderate.

Condition: Appears to be an old plant. Yellowing foliage limited to the ends of the branches, plant entire.

Notes: The size and condition of the plant suggests it is an old individual. The sparse foliage at the ends of the branches is likely an indication that the plant is in decline and may die within a short

period of time (Gordon Patrick pers. comm.). Continued monitoring is required to determine if this hypothesis holds true. The hypothesis for hybridisation in some of these northern plants is based upon the apparent lack of fruit in previous years (Gordon Patrick pers. comm.). This plant does not exhibit any evidence of shared morphological characters with *P. linearis* (the only other *Personia* sp. in area) and this plant is flowering, although not strongly. Therefore it may be possible to check this plant for hybridisation on fruiting grounds next season.

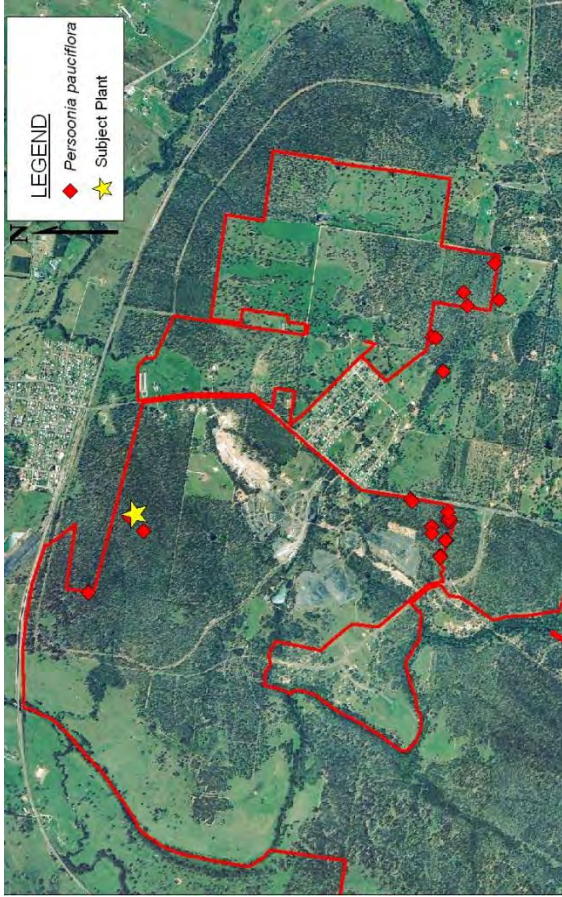
July 2007 Update: As previously expected Plant N° 2, when initially surveyed, was in the last stages of its life and during the July 2007 survey was found to be dead. The plants form remains intact and there was no evidence that it has been disturbed or interfered with.



Detail October 2005



Habitat October 2005



Map showing position Plant N° 2.



Plant Condition July 2007

ID N^o: 3
Grid of Occurrence: U6
Photos

Description: Medium sized spreading plant on dry ridge receiving filtered light.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted

Gum - Grey Box Forest (predominantly *Eucalyptus crebra* and *Corymbia maculata*).

Dimensions:

Height – 70cm
Spread – 120cm

Evidence of Hybridisation: None.

Reproductive Status: Many buds (31/10/05).

Health: Very Good.

Condition: All branches intact, plant entire with good leaf coverage.

Notes: Plant appears vigorous and healthy, in contrast to the old plant to the southeast (Plant N^o 2). May be a daughter plant of Plant N^o 2?

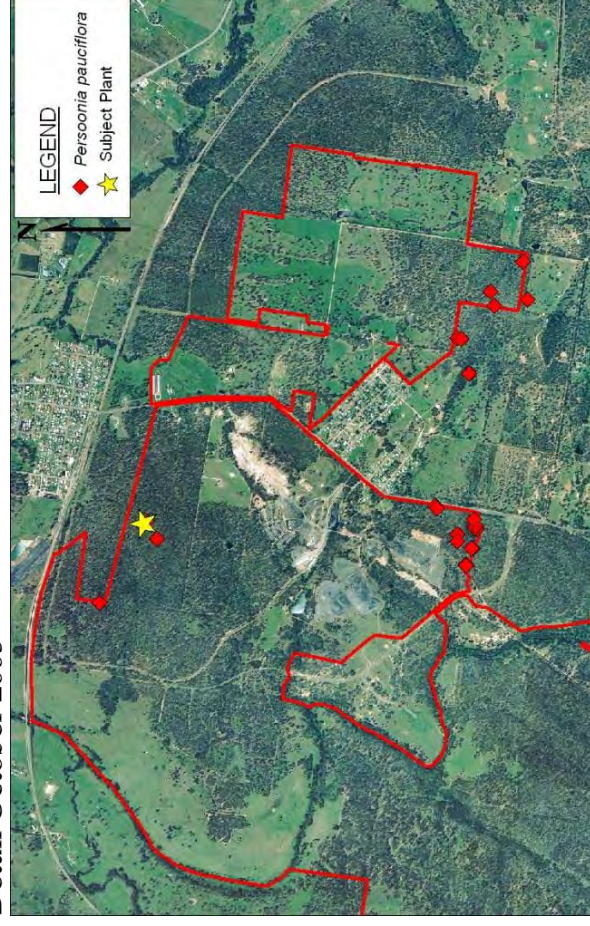
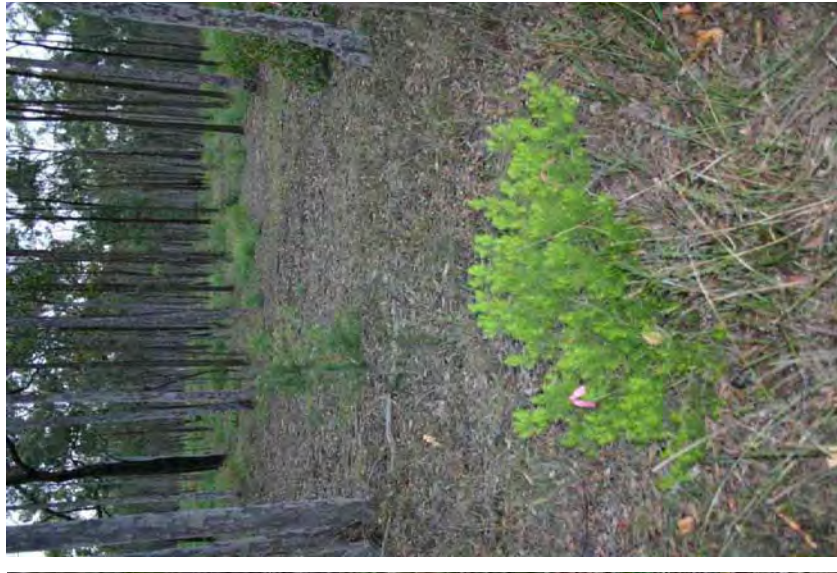
The hypothesis for hybridisation in some of these northern plants is based upon the apparent lack of fruit in previous years (Gordon

Patrick pers. comm.). This plant does not exhibit any evidence of

shared morphological characters with *P. linearis* (the only other

Persoonia sp. in area) and this plant is now flowering well. Therefore hybridisation due to lack of fruit may be tested in this plant next season.

July 2007 Update: The plant has put on a considerable amount of foliage and has increased its height slightly to approximately 75cm. No fruit was evident upon the plant, but comparison of its morphological features with hybrid plants elsewhere in the region strongly suggests that this plant is not a hybrid individual.



ID N^o: 4 Grid of Occurrence: S6 **Photos**

Description: Medium to large sized plant receiving filtered light on a south-facing hillside.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (predominantly *Corymbia maculata*).

Dimensions:

Height – 83cm **Spread** – 94cm

Evidence of Hybridisation: None.

Reproductive Status: Many buds (31/10/05).

Health: Very Good.

Condition: Plant with all branches intact, entire and good leaf coverage.

Notes: Relatively isolated plant from other individuals in this area. The hypothesis for hybridisation in some of these northern plants is based upon the apparent lack of fruit in previous years (Gordon Patrick pers. comm.). This plant does not exhibit any evidence of shared morphological characters with *P. linearis* (the only other *Persoonia* sp. in area) and this plant is now flowering well. Therefore hybridisation due to lack of fruit may be tested in this plant next season.

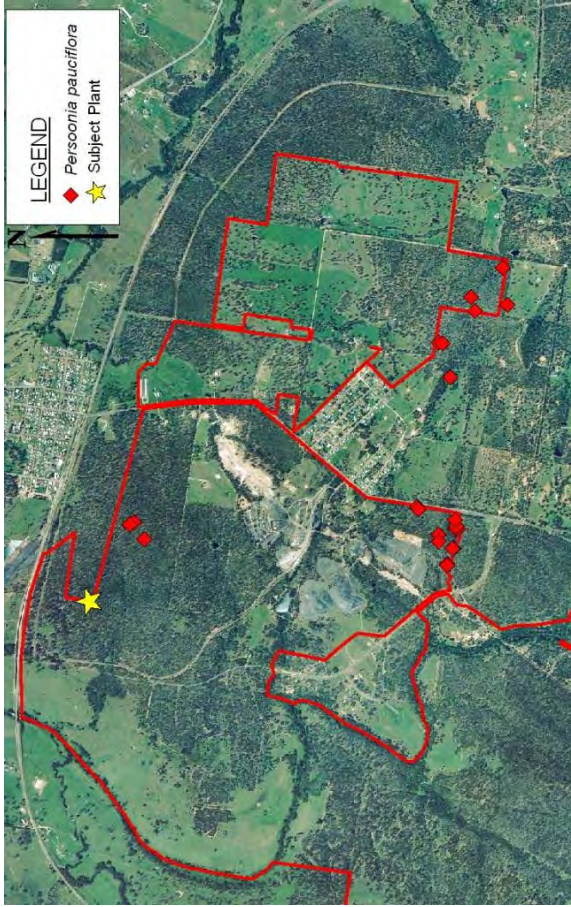
July 2007 Update: Plant has grown and increased its width to approximately 120cm and was found to be carrying an abundance of fruit.



Detail October 2005



Habitat October 2005



Map showing position Plant N^o 4.



Plant Condition July 2007

ID N^o: 5 Grid of Occurrence: AD19 **Photos**

Description: Medium to large erect located on a northeast facing slope receiving filtered light.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (predominantly *Eucalyptus punctata* and *E. crebra* with understorey of *Melaleuca nodosa* and *Allocasuarina torulosa*).

Dimensions:

Height – 94cm **Spread** – 135cm

Evidence of Hybridisation: None.

Reproductive Status: 31/10/05, Holding fruit with buds appearing (flower photograph from March 2005).

Health: Very Good.

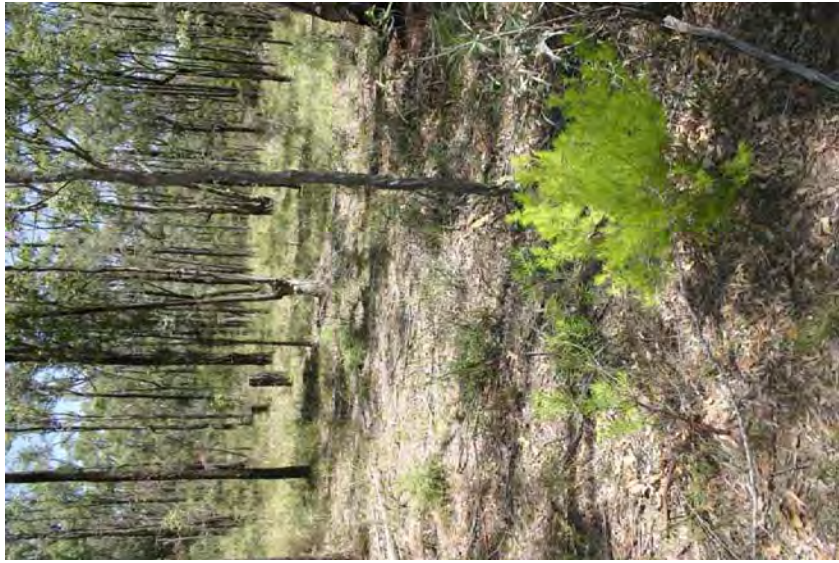
Condition: All branches intact, plant entire with a good cover of leaves.

Notes: Single plant, one of a well spaced grouping of plants.

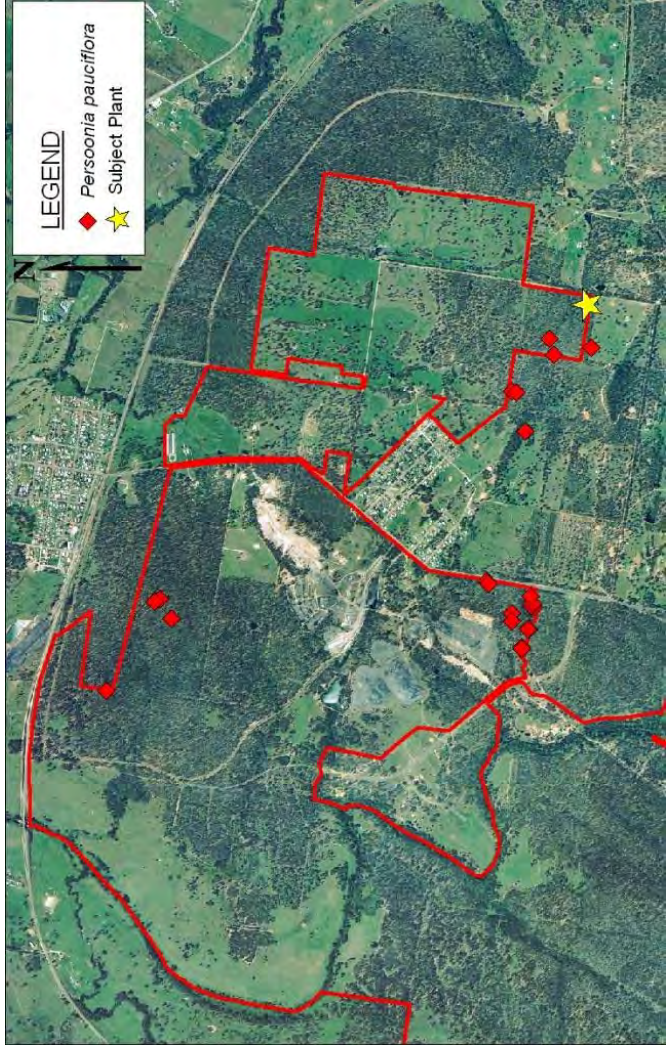
July 2007 Update: During the time of the 2007 survey the plant exhibited a lower foliage density than during the 2005 survey. The plant was in flower during July 2007.



Detail October 2005



Habitat October 2005



Map showing position Plant N^o 5



Plant Condition July 2007

ID N°: 6 Grid of Occurrence: AC18 **Photos**

Description: Small sized plant receiving filtered light on a north sloping ridge.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (mix of *Eucalyptus punctata*, *E. crebra* and *Corymbia maculata*).

Dimensions:

Height – 35cm **Spread** – 46cm

Evidence of Hybridisation: None.

Reproductive Status: None (31/10/05).

Health: Good.

Condition: Yellow foliage with a good cover of leaves. Plant entire but two scars on base of trunk suggest that the plant has lost branches in the past.

Notes: Isolated plant in widely spaced grouping of plants.

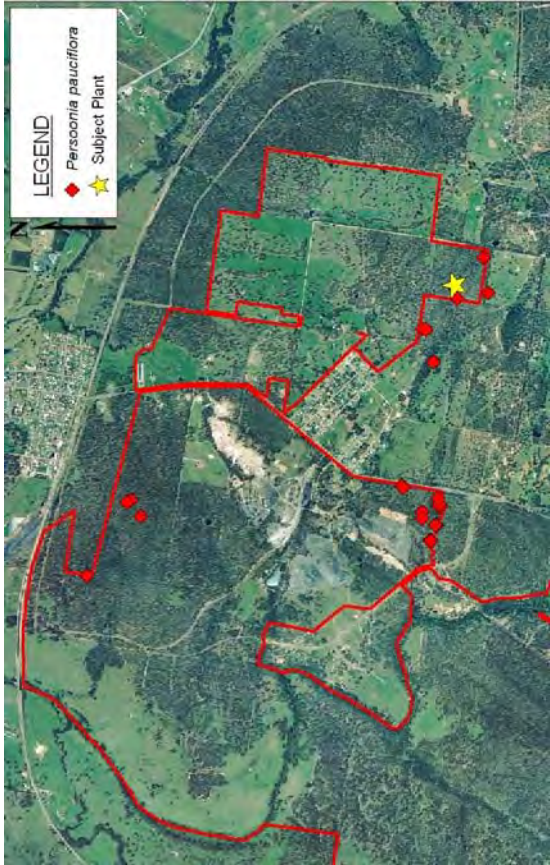
July 2007 Update: Plant has increased its size slightly and its form appears more open that observed during the 2005 survey. The foliage also appears slightly more yellow during the 2007 survey, suggesting the plant may be reduced in condition.



Detail October 2005



Habitat October 2005



Map showing position Plant N° 6



Plant Condition July 2007

ID N^o: 7

Grid of Occurrence: AC19

Photos

Description: Medium to large spreading plant receiving unfiltered light on northeast facing slope.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest, now cleared with saplings and remnant mature *Eucalyptus crebra* individuals.

Dimensions:

Height – 79cm

Spread – 112cm

Evidence of Hybridisation: None.

Reproductive Status: Plant holding and dropping many fruit with many buds, some close to opening (31/10/05).

Health: Very Good.

Condition: Plant with good leaf cover mostly entire with one branch broken off in centre of the plant.

Notes: Plant is off site by approximately 20m.

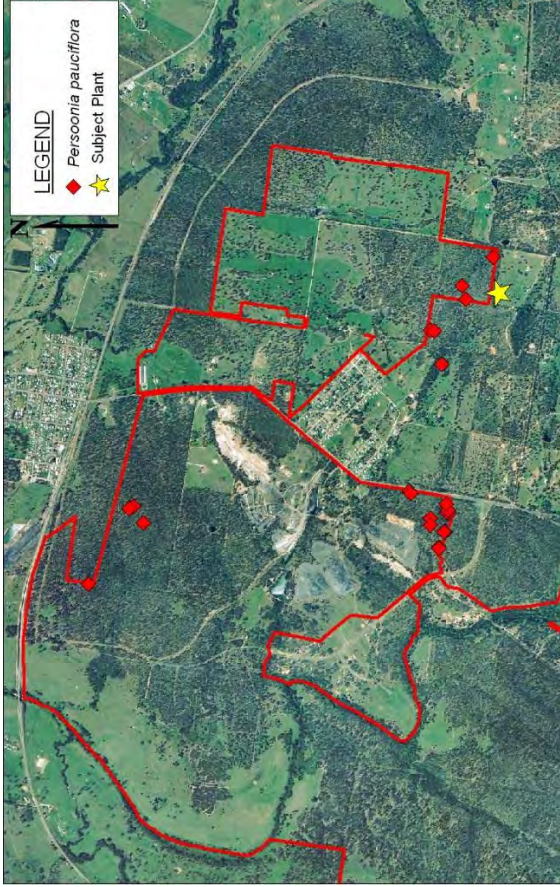


Detail October 2005 October 2005



Habitat October 2005 October 2005


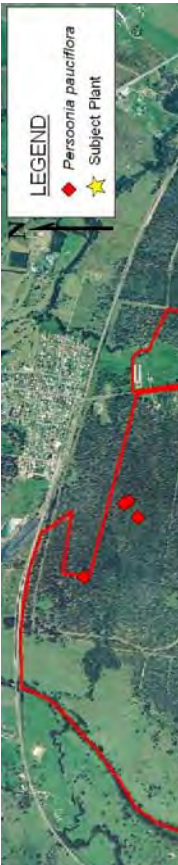
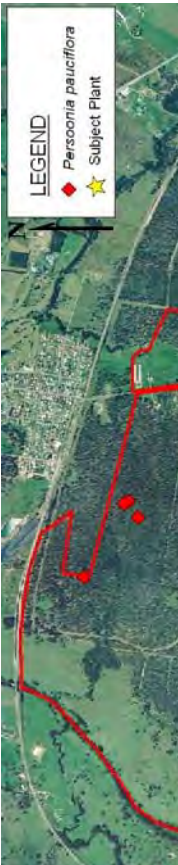
July 2007 Update: The plant has lost a considerable amount of condition during the intervening period between the 2005 and 2007 surveys. The plant is currently carrying a reduced density of foliage, which may be a function of reduced condition or grazing by domestic stock and / or kangaroos. Of note is a marked increase in the density and size of eucalypt saplings surrounding the plant, which may be contributing to its loss of condition through competition for resources.



Map showing position Plant N^o 7



Plant Condition July 2007

ID N ^o : 8	Grid of Occurrence: AC18	Photos	
Description: Large sized plant receiving filtered light on north facing slope.			
Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (Predominantly <i>Eucalyptus crebra</i> with occasional <i>Corymbia maculata</i>).			
Dimensions:		Plant Condition July 2007	
Height – 97cm	Spread – 156cm		
Evidence of Hybridisation: None.			
Reproductive Status: Plant holding and dropping many fruit with many buds, some close to opening (31/10/05).		Map showing position Plant N^o 8	
Health: Very Good.		July 2007 Update: Plant appears to be carrying less foliage giving a more open appearance. Plant carrying only a small number of fruit during July 2006.	
Condition: Plant entire with a good cover of leaves.			
Notes: Plant is off site by approximately 4m in single age cohort woodland with a well-developed understorey.			

ID N^o: 9 Grid of Occurrence: AB17

Description: Large spreading to erect mature plant receiving filtered light on a north facing slope.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (predominantly *Eucalyptus crebra* with occasional *Corymbia maculata* upslope and *E. tereticornis* down slope).

Dimensions:

Height – 96cm **Spread** – 135cm

Evidence of Hybridisation: None.

Reproductive Status: Plant carrying fruit and buds (31/10/05).

Health: Very Good.

Condition: Plant largely entire with evidence of tip browsing, but possessing good leaf cover.

Notes: Plant is off site by approximately 5m.

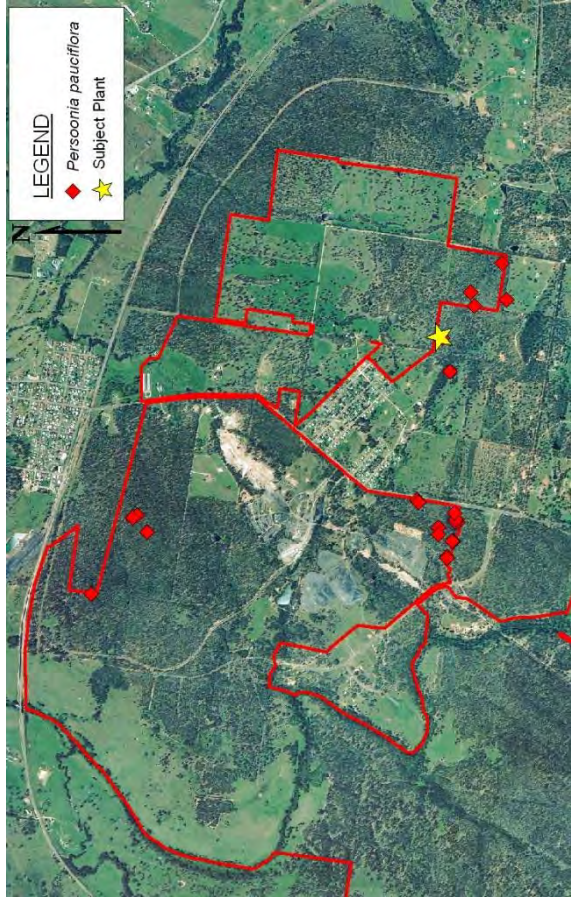
Photos



Detail October 2005



Habitat October 2005



Map showing position Plant N^o 9.



Plant Condition July 2007

ID N°: 10 **Grid of Occurrence:** AB17

Description: Medium sized plant receiving filtered light on north facing hillside.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (predominantly *Eucalyptus crebra* with occasional *Corymbia maculata* upslope and *E. tereticornis* down slope).

Dimensions:

Height – 64cm	Spread – 90cm
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Evidence of Hybridisation: None.

Reproductive Status: Plant carrying fruit and buds appearing (31/10/05).

Health: Very Good.

Condition: Plant largely entire with some evidence of tip browsing. Good cover of leaves.

Notes: Plant off site by approximately 25m.

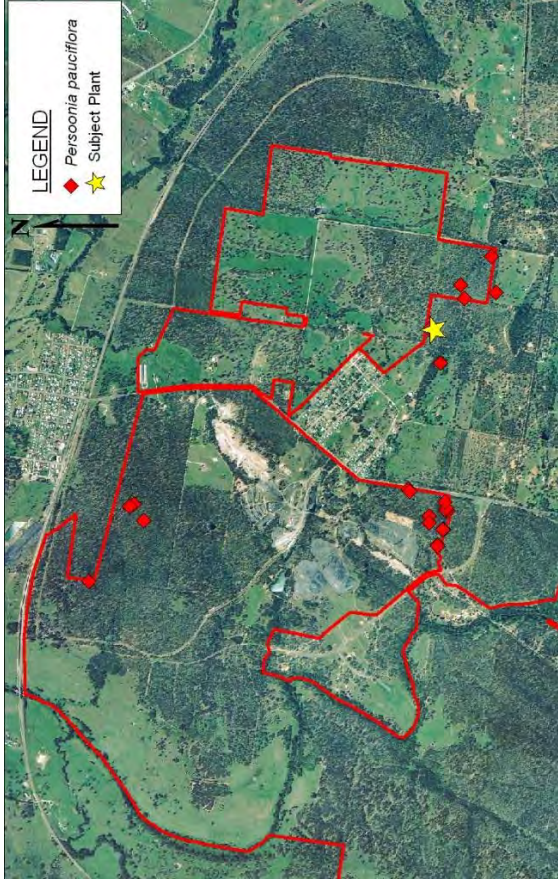
Photos



Detail October 2005



Habitat October 2005



Map showing position Plant N° 10.



Plant Condition July 2007

ID N°: 11 **Grid of Occurrence:** AA17 **Photos**

Description: Small sized plant receiving filtered light situated at the bottom of a south facing slope.

Vegetation Community: MU 18 - Central Hunter Ironbark - Spotted Gum - Grey Box Forest (predominantly *Corymbia maculata*).

Dimensions:

Height – 34cm **Spread** – 20cm

Evidence of Hybridisation: None.

Reproductive Status: Budding with one open flower (31/10/05).

Health: Moderate.

Condition: Top of main stem has been broken in the past, but branches below show new flushes of growth.

Notes: Plant appears to have been grazed in the past and remains in an area where horses are enclosed.

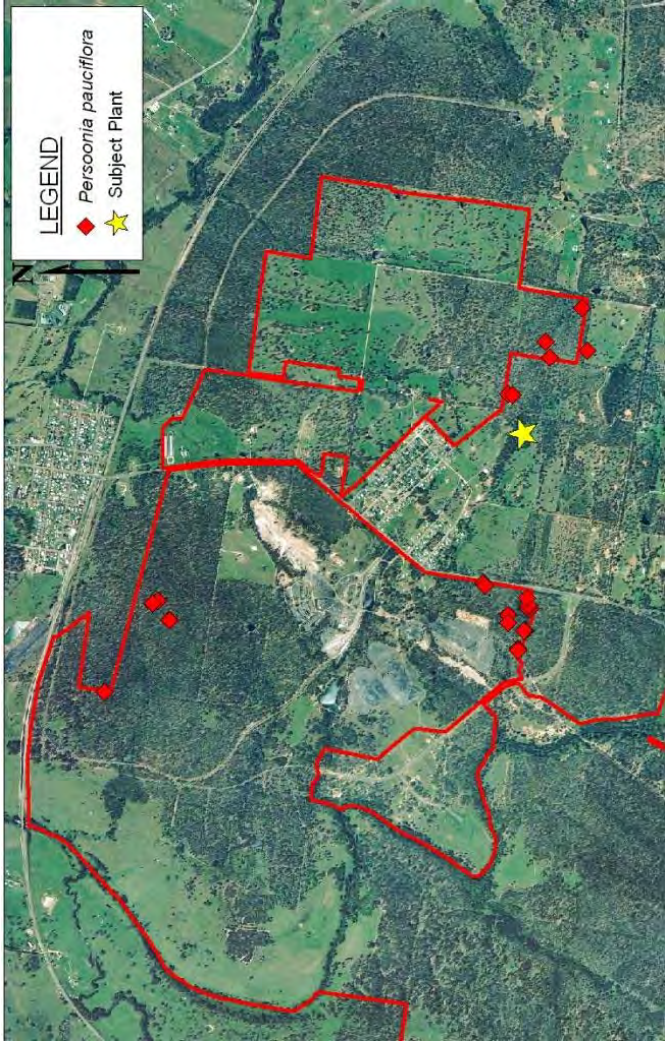
July 2007 Update: Plant in original position with only the central stem remaining, but the plant was found to be dead. It is possible that the plant has been grazed beyond its capacity to regenerate.



Detail October 2005



Habitat October 2005



Map showing position Plant N° 11.



Plant Condition July 2007