

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (s266B)
Approved Conservation Advice (including listing advice) for
Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion

1. The Threatened Species Scientific Committee (the Committee) was established under the EPBC Act and has obligations to present advice to the Minister for the Environment (the Minister) in relation to the listing and conservation of threatened ecological communities, including under sections 189, 194N and 266B of the EPBC Act.
2. The Committee provided its advice on the *Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion* ecological community to the Minister as a draft of this approved conservation advice. In 2015, the Minister accepted the Committee's advice, adopting this document as the approved conservation advice.
3. The Minister amended the list of threatened ecological communities under section 184 of the EPBC Act to include the *Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion* ecological community in the **endangered** category. The equivalent ecological communities *Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion* and *Agnes Banks Woodland in the Sydney Basin Bioregion* are listed separately under the New South Wales *Threatened Species Conservation Act 1995*.
4. A draft conservation advice for this ecological community and likely conservation status was made available for expert and public comment for a minimum of 30 business days. The Committee and Minister had regard to all public and expert comment that was relevant to the consideration of the ecological community.
5. This approved conservation advice has been developed based on the best available information at the time it was approved; this includes scientific literature, advice from consultations, existing plans, records or management prescriptions for this ecological community.

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1 DESCRIPTION

1.1 Name of the ecological community

Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion

Castlereagh Scribbly Gum and Agnes Banks Woodlands of the Sydney Basin Bioregion (hereafter referred to as Castlereagh Scribbly Gum and Agnes Banks Woodlands or the ecological community) was nominated and placed on the 2011 Finalised Priority Assessment List as part of a broader ecological community, named the Hinterland Sand Flats Forest and Woodland of the Sydney Basin Bioregion. Following consultation with experts during the assessment process it was determined that an ecologically distinct assemblage is difficult to identify from the eight smaller vegetation units that were proposed to be combined.

Consequently, the definition of the ecological community has been narrowed to incorporate two vegetation units with similar floristics that are typically co-located in the Hawkesbury-Nepean region west of Sydney on sandy substrates.

The name of the ecological community reflects its structure and location and combines the names of the two vegetation units. The two vegetation units also correspond with two threatened ecological communities listed separately under the New South Wales (NSW) *Threatened Species Conservation Act 1995* (TSC Act). Information regarding the NSW listed ecological communities can be found at: <http://www.environment.nsw.gov.au/determinations/castlereaghscribblygumFD.htm> and <http://www.environment.nsw.gov.au/determinations/AgnesBanksWoodlandSydneyEndComListing.htm>

1.2 Location and physical environment

The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is located in the Sydney Basin Bioregion as defined by version 7 of the Interim Biogeographic Regionalisation of Australia (IBRA v 7, 2012). It occurs primarily in the Castlereagh area in the north-west of the Cumberland Plain (also referred to as the Cumberland sub-region), with other known occurrences near Holsworthy (some patches at Holsworthy are just outside the Cumberland sub-region), Kemps Creek and Longneck Lagoon (Tozer et al., 2010; NSW Scientific Committee, 2013).

The ecological community occurs mostly in the Cumberland (SYB08) IBRA sub-region, with small occurrences just outside the Cumberland sub-region in the Sydney Cataract (SYB10), Wollemi (SYB04) and Burragorang (SYB09) sub-regions.

1.2.1 Geology

The ecological community occurs primarily on Tertiary sands and gravels of the Hawkesbury-Nepean river system. These ancient alluvial soils were deposited by the rivers in sites that can be quite distant from the present-day flood zones (James, 1997; Keith, 2004). At Agnes Banks the ecological community primarily occurs on aeolian (wind-blown) sands overlying Tertiary alluvium.

The soils of the Castlereagh Scribbly Gum and Agnes Banks Woodlands are typically low in nutrients, unlike more recent alluvial deposits (Keith, 2004). The sediments on which the ecological community occurs may be almost pure sand. The sand deposits often transition to, and include, areas of gravel and clay.

1.2.2 Altitude and climate

The ecological community occurs primarily at low elevations up to 80 m above sea level (ASL) (NSW OEH, 2013), including old ridges, dunes and terraces. Outlier occurrences may be located at slightly higher elevation, up to 200 m ASL, such as in the Burragorang sub-region.

The ecological community is found on flat or gently undulating terrain in rain shadow areas of the Sydney Basin, typically receiving 700–900 mm annual rainfall (Keith, 2004).

The low altitude and hinterland position within the Cumberland sub-region provide the ecological community with a warmer and drier climate than surrounding landscapes on plateaux and escarpments.

1.3 Vegetation

The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is typically a low woodland, with canopy species reaching an average 15 m in height, but with some trees growing to around 20 m (Benson, 1981; Keith, 2004; Tozer et al., 2010).

The ecological community's understorey has a prominent and diverse mid-layer of sclerophyll shrubs. It typically has a patchy ground cover of sedges and grasses. However, in areas of poorly drained soil there may be less species diversity in the mid layer and the ground layer may contain a high diversity of sedges and grasses (Benson, 1981; Tozer et al., 2010).

The isolation of the alluvial deposits in the Hawkesbury-Nepean river valley and differences in the soil characteristics have led to the development of differences in species composition and abundance across the range of the ecological community (Keith, 2004). For example, this is expressed in differing abundance of *Melaleuca* and *Banksia* species in the mid stratum. In addition, the Agnes Banks vegetation occurs on aeolian sand and can contain a number of species reminiscent of communities closer to the coast, such as *Dillwynia glaberrima*, *Ricinocarpos pinifolius* (wedding bush) and *Banksia aemula* (wallum).

1.3.1 Canopy

The canopy is composed of trees with a mature height of 10 m to around 20 m. The canopy contains, and is often dominated by, one or more of the following species: *Angophora bakeri* (narrow leaved apple), *Eucalyptus racemosa* (syn. *E. sclerophylla*)¹ (scribbly gum, narrow-leaved scribbly gum) and *E. parramattensis* subsp. *parramattensis* (Parramatta red gum) (Keith, 2004; CHAH, 2006; Tozer et al., 2010). *Melaleuca* species including *M. decora* (paperbark) may also be prominent in the canopy (and/or mid layer) of the ecological community. *Eucalyptus fibrosa* (red ironbark) is also occasionally prominent in the canopy (Keith, 2004; Tozer et al., 2010).

1.3.2 Understorey - Mid layer (shrubs)

A shrub layer (average height approximately 2 m) is present and is sometimes dominated by either *Banksia* or *Melaleuca* species. Mid layer species often include: *Banksia aemula* (wallum) and *Conospermum taxifolium* (variable smoke bush) (particularly in Agnes Banks Woodland), *B. serrata* (old man banksia), *B. oblongifolia* (fern-leaved banksia), *B. spinulosa* (hairpin banksia), *Melaleuca decora* (paperbark), *Leptospermum trinervium* (flaky-barked tea-tree), *Dillwynia sericea* (showy parrot-pea), *Monotoca scoparia* (broom heath), *Platysace ericoides*, *Persoonia nutans* (nodding geebung), *Pimelea linifolia* subsp. *linifolia* (slender rice-flower) and *Hakea sericea* (silky hakea).

1.3.3 Understorey - Ground layer (graminoids and forbs)

The ground layer consists of a diverse range of graminoids and forbs including *Themeda triandra* syn. *T. australis* (kangaroo grass), *Entolasia stricta* (wiry panic), *Cyathochaeta diandra*, *Dianella revoluta* subsp. *revoluta* (blue flax-lily), *Lepidosperma urophorum* (at Agnes Banks), *Stylidium graminifolium* (grass triggerplant), *Lepyrodia scariosa*, *Mitrasacme polymorpha*, *Trachymene incisa* subsp. *incisa*, *Laxmannia gracilis* (slender wire lily),

¹A taxonomic review by the Council Heads of Australian Herbaria in 2006 determined *Eucalyptus sclerophylla* (Blakely) L.A.S. Johnson & Blaxell and *E. racemosa* Cav. subsp. *racemosa* to be synonyms of *Eucalyptus racemosa* Cav. (CHAH, 2006).

Lomandra spp. and *Aristida warburgii* (Keith, 2004; Tozer et al., 2010; NSW Scientific Committee, 2000, 2010).

1.4 Fauna

While there is no distinctive faunal assemblage confined solely to the Castlereagh Scribbly Gum and Agnes Banks Woodlands, the ecological community contributes substantially to the habitat used by the fauna of the region.

Common reptiles and mammals that use the ecological community for food or shelter include *Ctenotus taeniolatus* (striped skink), *Tiliqua scincoides* (eastern blue-tongued lizard), *Petaurus breviceps* (sugar glider), *Myotis macropus* (large-footed myotis) and *Trichosurus vulpecula* (common brushtail possum). Frogs such as *Litoria verreauxii verreauxii* (Verreaux's tree frog), *Crinia signifera* (common eastern froglet) and *Limnodynastes tasmaniensis* (spotted marsh frog) use areas of inundation in the ecological community for breeding (Jones et al., 1997). The ecological community also provides habitat for the nationally vulnerable *Litoria aurea* (green and golden bell frog) (Jones et al., 1997; NSW NPWS, 1999).

The avifauna is predominantly composed of small to medium sized insectivorous birds. Typical birds include *Smicrornis brevirostris* (weebill), *Acanthiza reguloides* and *A. nana* (buff-rumped and yellow thornbills), *Petrochelidon nigricans* (tree martin), *Artamus cyanopterus* (dusky woodswallow), *Colluricincla harmonica* (grey shrike-thrush), *Pachycephala rufiventris* and *P. pectoralis* (rufous and golden whistler), *Melanodryas cucullata* (hooded robin), *Pardalotus striatus* and *P. punctatus* (striated and spotted pardalote), *Ptilotula fuscus* (fuscous honeyeater) and NSW listed vulnerable *Daphoenositta chrysoptera* (varied sittella) (Jones et al., 1997). The locally rare *Petroica goodenovii* (red-capped robin) is mostly found in the ecological community. *Tyto javanica* (eastern barn owl) occurs in disturbed areas of the ecological community (Jones et al., 1997). There have also been sightings of the locally rare *Entomyzon cyanotis* (blue-faced honeyeater) in remnants of the ecological community in the Castlereagh area (NSW National Parks and Wildlife Service, 1997).

Some areas of the ecological community (i.e., at Agnes Banks) are similar to coastal heaths and this is reflected in the assemblage of bird species in these areas, which also contain elements of sandstone bird communities. *Phylidonyris niger* (white-cheeked honeyeater), *Hylacola pyrrhopygia* (chestnut-rumped heathwren) and *Malurus lamberti* (variegated fairy-wren) occur in this part of the ecological community (Jones et al., 1997).

A number of migrating birds use the ecological community, with most arriving in spring and departing in autumn. However, the nationally endangered *Lathamus discolor* (swift parrot) and rufous whistler are winter migrants (Jones et al., 1997).

The ecological community also provides important habitat for a high diversity of invertebrate species. For example, Castlereagh Nature Reserve and Windsor Downs Nature Reserve form part of the Castlereagh Jewel Beetle Habitat and Movement Corridor, which was listed on the Register of the National Estate due to its unique assemblage of jewel beetle (Family Buprestidae) (NSW NPWS, 1999). The site (place ID 19182) includes habitat for four nationally rare and eight nationally uncommon jewel beetle species (Department of the Environment, 2014).

Further details on flora and fauna species can be found at [**Appendix A**](#).

1.5 Key diagnostic characteristics and condition thresholds

National listing focuses legal protection on remaining patches of the ecological community that are most functional, relatively natural (as described by the 'Description') and in relatively good condition. Key diagnostic characteristics and condition thresholds assist in identifying a patch of the threatened ecological community, determine when the EPBC Act is likely to apply to the ecological community and to distinguish between patches of different quality. The ecological

community may exhibit various degrees of disturbance and degradation. This degree of degradation, and natural variation, has been taken into account in developing the condition thresholds.

1.5.1 Key diagnostic characteristics

The key diagnostic characteristics presented here summarise the main features of the ecological community. These are intended to aid the identification of the ecological community, noting that a broader description is given in the other sections. Key diagnostic characteristics for describing the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community are:

- Limited to the Sydney Basin Bioregion (IBRA v7).
- Occurs on flat or gently undulating terrain.
- Occurs on sandy soil (i.e. sand and sandy gravel), on deposits of Tertiary alluvium which are sometimes overlaid with aeolian deposits (i.e. parts of the Agnes Banks occurrences). The sand deposits often transition to and include areas of gravel and clay.
- The vegetation structure is typically woodland less than 20 m tall with a prominent shrub layer and a variable ground layer.
- The canopy contains, and is often dominated by, one or more of the following species: *Angophora bakeri*, *Eucalyptus racemosa* and *E. parramattensis* subsp. *parramattensis*. *Melaleuca* species including *M. decora* (paperbark) and *Eucalyptus fibrosa* (red ironbark) may also be prominent in the canopy (and/or mid layer). Other canopy and understorey species that may occur are listed in [Appendix A](#), Table A1.
- May contain fauna species presented in [Appendix A](#), Table A2.

1.5.2 Condition thresholds

Condition categories, classes and thresholds provide guidance for when a patch of a threatened ecological community retains sufficient conservation values to be considered as a Matter of National Environmental Significance, as defined under the EPBC Act. This means that the referral, assessment and compliance provisions of the EPBC Act are focussed on the most valuable elements of the ecological community. Very degraded patches that do not meet the minimum condition thresholds are excluded from national protection.

Although very degraded/modified patches are not protected as the ecological community listed under the EPBC Act, it is recognised that patches that do not meet the minimum condition thresholds may still retain important natural values and may be protected through State and local laws or schemes. These patches should not be excluded from recovery and other management actions. Suitable recovery and management actions may improve these patches to the point that they may be regarded as part of the ecological community fully protected under the EPBC Act. Management actions should, where feasible, also aim to restore patches to meet the high quality condition thresholds outlined below.

For Castlereagh Scribbly Gum and Agnes Banks Woodlands, categories A and B are considered a moderate quality condition class and the minimum thresholds for a patch of the ecological community to be subject to the referral, assessment and compliance provisions of the EPBC Act. Categories C and D are considered the minimum thresholds for a patch of Castlereagh Scribbly Gum and Agnes Banks Woodlands to be regarded as an example of high quality condition and provide a benchmark for the recovery of lower quality patches.

Category and Rationale	Thresholds
A. Moderate condition class Represented by medium to large-size patch as part of a larger native vegetation remnant and/or with mature trees	Patch size ≥ 0.5 ha And $\geq 30\%$ of the perennial understorey vegetation cover* is made up of native species And The patch is contiguous [^] with a native vegetation remnant (any native vegetation where cover in each layer present is dominated by native species) ≥ 1 ha in area.
B. Moderate condition class Represented by medium to large size patch with high quality native understorey	Patch size ≥ 0.5 ha And $\geq 50\%$ of the perennial understorey vegetation cover is made up of native species.
C. High condition class Represented by medium to large size patch with very high quality native understorey	Patch size ≥ 0.5 ha And $\geq 70\%$ of the perennial understorey vegetation cover is made up of native species.
D. High condition class Represented by large size patch with high quality native understorey	Patch size ≥ 2 ha And $\geq 50\%$ of the perennial understorey vegetation cover is made up of native species.
* <i>Perennial understorey vegetation cover</i> includes vascular plant species of the ground and mid/shrub layers with a lifecycle of more than two growing seasons. Measurements of perennial understorey vegetation cover exclude annuals, cryptogams, plant litter or exposed soil but include plants that are subject to dieback.	
[^] <i>Contiguous</i> means the patch of the ecological community is continuous with, or in close proximity (within 100 m), of another patch of vegetation (of the same or a different type) that is dominated by native species in each vegetation layer present.	

1.5.3 Further information to assist in determining the presence of the ecological community and significant impacts

Land use history will influence the state in which a patch of the ecological community is currently found. The structural form of the ecological community will influence its species richness and diversity. The following information should also be taken into consideration when evaluating the key diagnostic characteristics and condition thresholds (to assess a site that may include the ecological community and determine the potential impacts on a patch).

Defining a patch

A **patch**² is defined as a discrete and mostly continuous area of the ecological community. Patches can be spatially variable and often there are one or more areas within a patch that do not meet the condition threshold criteria that are surrounded by areas of higher quality that meet the condition thresholds. Therefore a patch may include small-scale disturbances, such as tracks or breaks (including exposed soil, leaf and other plant litter, cryptogams), watercourses/drainage lines or small-scale (up to 0.1 ha) variations in vegetation that do not significantly alter its overall functionality³.

² Note that NSW vegetation class assessment tools define 'patch' as an area of native vegetation (of one or more different communities that occur together, separated by a gap of no greater than a set distance (usually 100m)). However, the Threatened Species Scientific Committee uses the term 'patch' to describe any discrete remnant/area of the ecological community in question.

³ Functionality refers to processes such as the movement of wildlife and pollinators, the dispersal of plant propagules, activities of seed and plant predators, etc.

Where derived native grassland/shrubland⁴ connects discrete patches of the ecological community that are in close proximity (up to 100 m apart), this should be considered a single patch of the ecological community rather than individual patches.

Sampling protocol

On-ground surveys are essential to accurately assess the extent and condition of the ecological community. The recommended sampling protocol involves developing a simple map of the vegetation, landscape qualities and management history (where possible) of the site. The site should then be thoroughly and representatively sampled for vegetation cover and species richness. This should include the areas with the highest level of structural and species richness of native species.

The number of plots required will depend on the size of the patch: the plots should provide a good representation of the species present across the whole patch. The survey plot dimensions may also vary with the patch size, shape and variability but plots of 0.04ha (quadrats of 20m x 20m) are suggested as likely to be suitable (after Tozer, 2003; Tozer et al., 2010). Search effort should be recorded, identifying the number of person hours spent per plot and across the entire patch.

Seasonal variation

Timing of surveys is an important consideration because the ecological community can be variable in its appearance through the year, and between years, depending on drought-rain cycles. Assessment should occur in spring and summer to early autumn (i.e. when the greatest number of species is likely to be detectable and identifiable). Ideally, surveys should be undertaken during more than one season to maximise the chance of detecting all species present. In years of low rainfall, assessment should recognise that many species may not be detected. In these situations it is preferable that surveys are carried out over more than one year. Presence and detectability of some species may also be affected by the time since disturbance, such as fire or grazing, so surveys should be planned to occur after an adequate time for some recovery (for example, at least 18 months post fire).

Buffer zone

A buffer zone is a contiguous area adjacent to a patch that is important for protecting the integrity of the ecological community. The purpose of the buffer zone is to help protect and manage the national ecological community. As the risk of damage to an ecological community is usually greater for actions close to a patch, the buffer zone aims to minimise this risk by guiding land managers to be aware when the ecological community is nearby and take extra care around the edge of patches. The edges of a patch are considered particularly susceptible to disturbance and the presence of a buffer zone is intended to act as a barrier to further direct disturbance. For instance, a buffer zone will help protect the ecological community, including the root zone of edge trees and other components of the ecological community, from spray drift (fertiliser, pesticide or herbicide sprayed in adjacent land), weed invasion and other damage.

As the buffer zone lies to the outside, around the community, it is not part of the ecological community – so the buffer zone itself is not formally protected as a matter of national environmental significance. For EPBC Act approval, changes in use of the land that falls within the buffer zone must not have a significant impact on the ecological community, but there are exemptions for continuing use. Where the buffer is subject to existing land uses, such as cropping, grazing or fire breaks, these can continue. However, practical application of a buffer

⁴ In derived grassland/shrubland, the canopy layer has been substantially removed, or thinned to very scattered trees (<10% canopy cover); but the understorey (ground layer and/or shrub/mid layer) is intact (>70% native species cover).

zone is strongly recommended to avoid adverse impacts to the patch. It may also be a focus of revegetation initiatives, where practical.

The recommended minimum buffer zone is **30 m** from the outer edge of the patch. A larger buffer zone should be applied, where practical, to protect patches that are of very high conservation value, or if patches are down slope of drainage lines or a source of eutrophication.

Area critical to the survival of the ecological community

Areas that meet the minimum (moderate class) condition thresholds are considered critical to the survival of the ecological community. Additional areas such as adjoining native vegetation and areas that meet the description of the ecological community but not the condition thresholds are also considered important to the survival of the ecological community, for example, as buffers for higher condition areas, and should be considered in the surrounding environment and landscape context as outlined in the other considerations below.

Other considerations related to significance

Actions that may have ‘significant impacts’ on any patches of Castlereagh Scribbly Gum and Agnes Banks Woodlands (that meet the condition thresholds) require approval under the EPBC Act. The ecological importance of a patch is also influenced by its surrounding landscape, for example, if connected to, or near, other native vegetation it may contribute substantially to landscape connectivity and function. Similarly, actions beyond the boundary of any patch of Castlereagh Scribbly Gum and Agnes Banks Woodlands may have a significant impact on the patch. For this reason, when considering actions likely to have impacts on this ecological community, it is important to also consider the environment that surrounds any patches.

Other patches that meet the condition thresholds may occur in isolation, and, in addition to requiring protection, may also require management of the surrounding area to link them with other native vegetation.

In some cases patches might not currently meet condition thresholds, and so are not considered part of the nationally protected ecological community (i.e. not a Matter of National Environmental Significance). However, in the context of their surroundings, recovery may be possible, so these areas should be considered as a priority for management and funding.

The following indicators of the ecological context of areas surrounding patches of Castlereagh Scribbly Gum and Agnes Banks Woodlands should be considered, both when assessing the impacts of actions or proposed actions under the EPBC Act, or when considering priorities for recovery, management and funding:

- Large size and/or a large area to boundary ratio – patches with larger area to boundary ratios are less exposed and more resilient to edge effects (disturbances such as weed invasion and other anthropogenic impacts). However, patches that occur in areas where the ecological community has been most heavily cleared or degraded, or that are at the natural edge of its range may also have importance, due to their rarity, genetic significance, connectivity or because of the absence of some threats.
- Evidence of recruitment of key native plant species or the presence of a range of age classes (including through successful assisted regeneration). For example, tree canopy species are present, in ages ranging from saplings through to large hollow-bearing trees.
- Good faunal habitat – as indicated by diversity of landscape. For example, patches containing mature trees (particularly those with hollows) and logs.
- High native species richness, which may include many understorey plant species or native fauna species.
- Presence of EPBC Act or NSW TSC Act listed threatened species.

- Patches that contain a unique combination of species and/or rare or important species in the context of the particular ecological community or local region (e.g. a variant of the patch with unique fauna and/or understorey flora composition; or a patch that contains flora or fauna that has largely declined in the ecological community or region).
- Areas with minimal weeds and feral animals, or where these threats can be efficiently managed.
- Presence of cryptogams, soil crust and leaf litter on the soil surface, indicating low recent disturbance and potential for good functional attributes such as nutrient cycling.
- Derived native grasslands and shrublands that were formally the woodlands, particularly those adjacent or near to forest/woodland remnants. These can be important to the survival of the ecological community in a fragmented, modified landscape.
- Connectivity to other native vegetation remnants or restoration works (e.g. native plantings) in particular, a patch in an important position between (or linking) other patches in the landscape. This can contribute to movement of fauna and transfer of pollen and seeds.

Information on differences to similar or intergrading ecological communities can be found in **Appendix B**.

1.6 Geographic extent

Castlereagh Scribbly Gum and Agnes Banks Woodlands has been subjected to substantial clearing, fragmentation and degradation. Since European settlement, the ecological community has undergone a reduction in extent of at least around 51% (Table 1).

Table 1. Estimates of decline and extent for Castlereagh Scribbly Gum and Agnes Banks Woodlands based on vegetation units that correspond with the ecological community.⁵

Sub-community	Estimated area pre-1750 (ha)	Estimated area extant (ha)	% original extent remaining	Estimated area reserved (ha)	% of current extent reserved
Agnes Banks Woodland	615*	90	16* (15-25)	30	33.3%
Castlereagh Scribbly Gum Woodland	5852*	3100	53* (50-70)	390	12.6%
Total	6467*	3190	49%	420	13.2%

1.7 Other protection

The two components of Castlereagh Scribbly Gum and Agnes Banks Woodlands are listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act):

- Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion – vulnerable
- Agnes Banks Woodland in the Sydney Basin Bioregion – endangered.

In addition, there are a number of threatened species protected under state and national law. These are listed below in Table 2 and Table 3.

⁵ Figures in this table are taken from Tozer et al. (2010) unless marked with *, in which case they are from NSW NPWS (2002). Data are merged from polygon classification codes A, B, C and SA as defined in NSW NPWS (2002).

Table 2. Threatened flora species associated with Castlereagh Scribbly Gum and Agnes Banks Woodlands (NSW Scientific Committee, 2000, 2010). This is not an exhaustive list.

Scientific name	Common name	TSC Act [^]	EPBC Act [^]
<i>Acacia bynoeana</i>	Bynoe's wattle	E	V
<i>Allocasuarina glareicola</i>		E	E
<i>Dillwynia tenuifolia</i>		V	V
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>		V	-
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> ⁶	small-flowered Grevillea	V	V
<i>Micromyrtus minutiflora</i>		E	V
<i>Persoonia nutans</i>	nodding geebung	E	E
<i>Pultenaea parviflora</i>		E	V

[^]V – Vulnerable, E – Endangered, CE – Critically Endangered

Table 3. Threatened fauna species known or likely to occur in Castlereagh Scribbly Gum and Agnes Banks Woodlands (as at February 2015).

Scientific name	Common name	TSC Act*	EPBC Act*
<i>Calyptrorhynchus lathami</i>	glossy black cockatoo	V	-
<i>Climacteris picumnus victoriae</i>	brown treecreeper	V	-
<i>Daphoenositta chrysoptera</i>	varied sittella	V	-
<i>Grantiella picta</i>	painted honeyeater	V	-
<i>Lathamus discolor</i>	swift parrot	E	E
<i>Melanodryas cucullata</i>	hooded robin	V	-
<i>Petroica phoenicea</i>	flame robin	V	-
<i>Petroica boodang</i>	scarlet robin	V	-
<i>Pyrrholaemus sagittatus</i>	speckled warbler	V	-
<i>Xanthomyza phrygia</i>	regent honeyeater	CE	E
<i>Calyptrorhynchus lathami</i>	glossy black cockatoo	V	-
<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V
<i>Dasyurus maculatus</i>	spotted tailed quoll (SE mainland population)	V	E
<i>Miniopterus australis</i>	little bent-wing bat	V	-
<i>Miniopterus schreibersii oceanensis</i>	eastern free-tail bat, eastern bent-wing bat	V	-
<i>Myotis macropus</i>	large-footed myotis	V	-
<i>Petaurus norfolcensis</i>	squirrel glider	V	-
<i>Pteropus poliocephalus</i>	grey-headed flying fox	V	V
<i>Saccolaimus flaviventris</i>	yellow-bellied sheath-tail bat	V	-
<i>Scoteanax rueppellii</i>	greater broad-nosed bat	V	-
<i>Litoria aurea</i>	green and golden bell frog	E	V
<i>Meridolum corneovirens</i>	Cumberland land snail	E	-

*V – Vulnerable, E – Endangered, CE – Critically Endangered

⁶ May be present in the ecological community (NSW Scientific Committee, 2010).

Further details on non-threatened flora and fauna species associated with the ecological community can be found at **Appendix A**. Further details on national context are located at **Appendix B**.

2 SUMMARY OF THREATS

Vegetation clearance was, and continues to be, a major contributor to the decline of native vegetation across the Cumberland sub-region. The reduction in geographic distribution of the Castlereagh Scribbly Gum and Agnes Banks Woodlands was initially due to clearing for sand and gravel extraction, some timber cutting, and later, hobby farms and rural-residential development (Benson and Howell, 1990). Clearance continues due to the increasing urbanisation of western Sydney and the ecological community is highly fragmented as a result.

In addition to clearance and fragmentation of native vegetation, key threats to the ecological community occurring as a result of increasing urbanisation are:

- Inappropriate fire regimes, particularly increased fire frequency (e.g. due to arson).
- Weed invasion from escaped garden plants, agriculture and increased run-off. Weeds include Cootamundra wattle (*Acacia baileyana*) and African olive (*Olea europaea* subsp. *cuspidata*); herbs such as flat weed (*Hypochaeris radicata*); grasses, including African love grass (*Eragrostis curvula*), kikuyu (*Cenchrus clandestinus* syn. *Pennisetum clandestinum*), whisky grass (*Andropogon virginicus*) and panic veldt grass (*Ehrharta erecta*) (NSW Scientific Committee, 2010). Introduced vines include moth vine (*Araujia sericifera* syn. *A. hortorum*) and bridal creeper (*Asparagus asparagoides*).
- Hydrological changes and increased nutrient loads from urban run-off, rubbish and garden waste dumping and domestic pet excrement.
- Predation and displacement of native fauna by domestic pets, feral introduced species and aggressive native species adapted to an urban setting.

Other ongoing threats include:

- Climate change.
- Changes in faunal components and ecological function.
- Diseases, such as *Phytophthora cinnamomi* and myrtle rust (*Puccinia psidii* s.l.).

Further details about the threats to the ecological community can be found at [Appendix C](#) and a list of Key Threatening Processes relevant to the ecological community is at [Appendix D](#).

3 SUMMARY OF ELIGIBILITY FOR LISTING AGAINST EPBC ACT CRITERIA

Criterion 1 - Decline in geographic distribution

The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community has undergone a significant reduction in extent since European settlement (James, 1997; NSW NPWS, 2002; Tozer et al., 2010). The ecological community is estimated to have been reduced to approximately 49% of its original pre-European extent. This figure may be an underestimate as further clearance is likely to have occurred since the data were collected.

It is considered that the ecological community has undergone a ‘substantial’ decline (> 50%) in its geographic extent and is therefore **eligible** for listing as **vulnerable** under this criterion.

Criterion 2 - Limited geographic distribution coupled with demonstrable threat

Data presented in Tozer et al. (2010) indicate the present extent of the ecological community is approximately 3190 ha (i.e. ‘restricted’, where the total area of occupancy is less than 10 000 ha).

The ecological community is naturally restricted to sand and sandy gravel deposits. Any natural fragmentation has been exacerbated by the loss of extent through further human-caused impacts (including clearance and degradation from past and ongoing threats).

Mean patch size of the ecological is approximately 22.7 ha, with median patch size of 3.2 ha, thus it is considered ‘very restricted’ (analysis of data from SCIVI mapping data – taken from Tozer et al. (2006)).⁷ Most patches (78%) have an area of less than 10 ha. Gaps between some patches are likely to limit regeneration opportunities as some key species have restricted dispersal mechanisms.

As detailed in *Description of Threats* (Appendix E), the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is subject to a range of ongoing demonstrable threats, several of which interact. Key threats include clearance and fragmentation of remnants as well as weed invasion and altered fire regimes (particularly due to arson).

The loss, fragmentation and degradation of vegetation in the ecological community are increasingly associated with rural residential and urban development. This pressure is current and ongoing. In areas north of Penrith and south of Richmond, where the majority of the ecological community occurs, many patches are located on land zoned (or in some cases proposed to be zoned) as Primary Production Small Lots (RU4), or as ‘deferred matters’ (Penrith City Council, 2010; Penrith City Council, 2013).⁸ Primary Production Small Lots (RU4) are typically 2 ha in size. The patches of the ecological community at these sites are likely to be severely impacted due to tree clearance, under-scrubbing and spreading of weeds.

In addition to direct loss through clearance, threats associated with urbanisation and rural residential development include predation and competition by domestic and pest animals (including intense grazing from domestic stock such as horses), spread of weeds and disease and under-scrubbing (where under storey vegetation is cleared or flattened), arson, and changes to hydrology and pollution through wastewater management practices.

Climate change is expected to cause increasing damage to the ecological community, through changed temperature and rainfall patterns. In addition to direct stress on plants and animals, this is likely to result in changed habitat features and food availability, as well as being expected to compound other threats such as weeds and altered fire regimes.

⁷ Patch size analysis excludes records of <0.5 ha as these are considered to be an artefact of the mapping process and not representative of actual remnants (refer to Tozer et al. (2010) for more information).

⁸ Stage 1 of the Penrith Local Environmental Plan (LEP) 2010 has been finalised, but Stage 2 (which deals with areas not covered in Stage 1) is currently awaiting gazettal.

In summary, the ecological community is considered to be ‘very restricted’ in geographic distribution (based on median patch size), and is subject to a range of ongoing threats – the combination of which make it possible the ecological community could be lost in the ‘near future’. Therefore, the ecological community is **eligible** for listing as **endangered** under this criterion.

Criterion 3 - Loss or decline of functionally important species

Although studies that identify functionally important species in the Castlereagh Scribbly Gum and Agnes Banks Woodlands are not available, it is known that the relationship between many species is important for maintaining ecosystem function.

The ecological community supports several threatened species of plants, including at least six protected under the EPBC Act, and fragmentation and disturbance of the ecological community has reduced its ability to support a natural and complete faunal assemblage. The absence or rarity of some of these species in the ecological community has flow-on effects to other components. For example, eucalypt dieback in eastern Australia is usually caused by insect attack. In some locations a healthy bird community has been observed to remove 50-70% of leaf-feeding insects, thus playing an important role in maintaining the canopy of the ecological community (Ford, 1989 in Barrett, 2000). Where such an assemblage of birds is reduced or missing, eucalypts would be at higher risk of insect attack and dieback. Dieback has recently caused substantial impacts (including tree mortality) to vegetation on the Cumberland Plain.

Similarly, the observed loss of mammal species from the Cumberland sub-region (including areas of the ecological community) is likely to have had a negative effect on ecological function, particularly through the reduction of pollination, seed dispersal and soil engineering (Leary, 2007).

Although there has been a decline in certain species within the Castlereagh Scribbly Gum and Agnes Banks Woodlands, specific data related to the decline of functionally important species and subsequent impacts to the ecological community are not available. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 3.

Criterion 4 - Reduction in community integrity

The ecological community occurs almost exclusively on the highly cleared Cumberland sub-region. Clearing, severe fragmentation, urbanisation, weed invasion, altered fire regimes, changes to vegetation structure and loss of faunal components have severely reduced the integrity of the ecological community. These losses are compounded by climate change, and together with a range of ecological characteristics of the community, as well as the nature of the ongoing threats, severely limit the likelihood of recovery.

The change in integrity experienced by the ecological community is **severe** and regeneration is unlikely in the near future. Therefore, the ecological community is **eligible** for listing as **endangered** under this criterion.

Criterion 5 - Rate of continuing detrimental change

Although there has been continuing detrimental change to the ecological community, data are insufficient to determine an overall rate. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 5.

Criterion 6 - Quantitative analysis showing probability of extinction

There are no quantitative data available to assess this ecological community under this criterion. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 6.

A detailed assessment of eligibility against each of the EPBC Act criteria is provided at **Appendix E**.

4 PRIORITY CONSERVATION ACTIONS

4.1 Conservation objective

To mitigate the risk of extinction of the Castlereagh Scribbly Gum and Agnes Banks Woodlands, and help recover its biodiversity and function, through the protections provided under the *Environment Protection and Biodiversity Conservation Act 1999* and through the implementation of the following priority conservation actions.

4.2 Research, management, recovery and other conservation measures

Management and research priorities for Castlereagh Scribbly Gum and Agnes Banks Woodlands, that would inform future regional and local priority actions include:

4.2.1 High priorities

- Protect and conserve remnants that meet the condition thresholds for this ecological community to avoid further clearance and fragmentation.
- Identify high conservation value sites for conservation management (formal reserve and off-reserve protection), on private and public lands. These may include the 'priority conservation lands' identified in the NSW OEH Cumberland Plain priority conservation lands database (NSW OEH, 2011), as well as other remnants of Castlereagh Scribbly Gum and Agnes Banks Woodlands that meet the high quality condition thresholds⁹.
- Promote formal conservation arrangements, management agreements and covenants on private land. For crown and private land, promote inclusion in reserve tenure.

The following high priority measures should be undertaken consistent with *Recovering Bushland on the Cumberland Plain: best practice guidelines on the management and restoration of bushland* (NSW DEC, 2005):

- Avoid disturbances to native vegetation (e.g. under-scrubbing, slashing, mowing, grazing or burning), particularly during peak flowering and fruiting seasons of the ecological community.
- Protect the soil seedbank and support the regeneration of the ecological community through:
 - The appropriate use of fire and weed management;
 - The use of 'trigger' practices such as smoke water, brush matting and soil disturbance; and
 - Plantings from seedlings grown from seeds collected in the area, if the seedbank is gone and natural regeneration is not possible.
- Undertake weed control and restoration activities, including:
 - Identification and management of weeds that are emerging threats;
 - Manage and reduce weed infestations using best practice guidelines, with a focus on the species that pose the most threat to the ecological community. Note:
 - Broad-scale, non-selective herbicide use should be minimised wherever possible, with particular attention paid to avoiding areas that contain threatened flora or areas near waterways (NSW DECC, 2008);

⁹ It should be noted that a Strategic Assessment under the *Environment Protection and Biodiversity Conservation Act 1999* has been undertaken for the Sydney Growth Centres. As the Castlereagh Scribbly Gum and Agnes Banks Woodlands did not get added to the Finalised Priority Assessment List til October 2011 it was not considered in the strategic assessment.

- Sediment fences can be utilised to prevent some weeds from invading a remnant.
 - o Promote awareness about local weeds, their prevention and management;
 - o Keep vehicles and machinery out of remnants. If vehicles must be taken into remnants, ensure they are washed first to remove soil and weed seeds; and
 - o Where animals (including stock) are permitted within the ecological community, ensure they are purged of weed seeds.
- To limit weed infestation and spread:
 - o Do not plant potential or known environmental weeds in nearby gardens, from which they may spread into the remnant;
 - o Do not dump garden waste beyond the confines of the garden, on private or public land; and
 - o Avoid planting potential weeds in roadworks, landscaping and other development near the ecological community (plant local native species). Ensure development and production activities implement appropriate measures to prevent introduction and spread of weeds (e.g. during mowing, roadworks, adjacent development).
- Control introduced pest animals, including limiting access by domestic pets and feral animals, to allow natural regeneration and to manage other impacts (e.g. to threatened species).
- Undertake appropriate fire management practices that vary in frequency, intensity and seasonality, in order to maximise biodiversity outcomes. NSW DEC (2005) recommends burns every 6-20 years for Castlereagh Scribbly Gum Woodland and 7-25 years for Agnes Banks Woodland. Fire management plans (including hazard reduction) should be implemented in such a way as to account for recent/unplanned burns (for example, unplanned burns due to arson) (NSW DECCW, 2010).
- Control storm-water and other urban run-off to prevent:
 - o The further alteration of hydrological regimes in the ecological community;
 - o The infiltration of litter;
 - o The dispersal of weeds; and
 - o The introduction of unnaturally high nutrient levels and pollutants to the ecological community.
- Buffer zones with appropriate native species should be utilised to minimise ‘edge effects’ such as increased run-off, weed invasion, rubbish dumping and other disturbances. Buffers should be as large as possible, at a minimum 30 m from the outer edge of the patch.
- Prevent the spread of *Phytophthora cinnamomi*, a plant pathogen that can survive for long periods in soil. The spread of *Phytophthora* is a Key Threatening Process under the EPBC Act. Further information on avoiding further spread of the disease is in the national Threat Abatement Plan, available here: <http://www.environment.gov.au/biodiversity/invasive-species/diseases-fungi-and-parasites/phytophthora-cinnamomi-disease>.
- Ensure that all management and regeneration activities are undertaken in a manner that ensures the retention of a functional habitat for native fauna.

4.2.2 Other priorities

- Investigate and implement options for enhancing condition of remnants or establishing linkages, through enhanced management, or replanting of key ground layer and canopy

species, in areas that do not currently meet condition thresholds for the ecological community. Ensure appropriate seed collection and propagation methods, and appropriate species, are used.

- Ensure outcomes and feedback from previous management and research are adapted into future planning and management.
- Develop and promote educational materials for the community, organisations and agencies, which raise their understanding and appreciation of the ecological community.
- Liaise with individuals, organisations and agencies to ensure conservation of the ecological community is taken into account in activities such as infrastructure development and maintenance, and regional planning.
- Support and encourage land managers to implement monitoring of management actions.
- Support opportunities for Traditional Owners to manage the ecological community.

See **Appendix F** for existing management and recovery plans.

4.3 Recovery plan recommendation

The Threatened Species Scientific Committee recommends that a recovery plan is developed for the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community. This is because the actions required to conserve and promote recovery of the ecological community include short and long term activities that need to be co-ordinated at a landscape level and involve a range of stakeholder groups. A recovery plan would provide further guidance to land managers and raise public awareness of conservation actions.

It is suggested that the recovery plan for the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community could be part of a regional recovery plan for all relevant nationally threatened ecological communities that occur in or near the Cumberland sub-region. This is because these communities tend to have similar threats acting upon them and a coordinated, strategic and regional approach is likely to have improved overall conservation outcomes.

APPENDIX A - SPECIES LISTS

Table A1 lists vascular plant species that occur in the ecological community. It is not a comprehensive list of all plants present in the ecological community. A particular patch may not include all species on the list or may include other species not listed. Species that are considered characteristic are in **bold type** (Tozer et al., 2010; OEH, 2013).

At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers.

Table A1. List of plant species that occur in the ecological community (Tozer et al., 2010; NSW OEH, 2013). Scientific names are current to August 2014. Some local Indigenous names have also been provided.

Species name	Common name	Characteristic for Agnes Banks Woodland (ABW) or Castlereagh Scribbly Gum Woodland (SGW)
<i>Acacia brownii</i>	heath wattle, Brown's acacia	AGW, CSGW
<i>Acacia bynoeana</i>	Bynoe's wattle	
<i>Acacia decurrens</i>	boo'kerrinkin (D'harawal), black wattle, green wattle, Sydney green wattle	
<i>Acacia elongata</i>	swamp wattle, slender wattle	ABW
<i>Acacia falcata</i>	hickory wattle	CSGW
<i>Acacia linifolia</i>	flax-leaved acacia, white wattle	
<i>Acacia longifolia</i>	Sydney golden wattle	
<i>Acacia myrtifolia</i>	myrtle acacia, myrtle wattle, red-stemmed wattle	
<i>Acacia ulicifolia</i>	prickly Moses, juniper wattle	
<i>Allocasuarina glareicola</i>		
<i>Amperea xiphoclada</i>	broom spurge	
<i>Amphipogon strictus</i>	grey-beard grass, bearded-head grass	
<i>Angophora bakeri</i>	narrow-leaved apple	AGW, CSGW
<i>Angophora floribunda</i>	apple, rough-barked apple	
<i>Aristida vagans</i>	three-awned spear grass	
<i>Aristida warburgii</i>		CSGW
<i>Austrostipa pubescens</i>		CSGW
<i>Baeckea diosmifolia</i>	fringed baeckea	ABW
<i>Baloskion pallens</i>		
<i>Banksia aemula</i>	wallum, banyalla	ABW
<i>Banksia oblongifolia</i>	dwarf banksia, fern-leaved banksia	ABW
<i>Banksia serrata</i>	wiriyagan (Cadigal), old-man banksia, honeysuckle	
<i>Banksia spinulosa</i>	hairpin banksia, golden candle-sticks	CSGW

Species name	Common name	Characteristic for Agnes Banks Woodland (ABW) or Castlereagh Scribbly Gum Woodland (SGW)
<i>Billardiera scandens</i>	apple berry, hairy apple berry, common apple-berry	
<i>Boronia polygalifolia</i>	dwarf boronia	
<i>Bossiaea heterophylla</i>	variable bossiaea	
<i>Bossiaea prostrata</i>	creeping bossiaea	
<i>Bossiaea rhombifolia</i>		ABW
<i>Brachyloma daphnoides</i>	daphne heath	
<i>Brunoniella pumilio</i>	dwarf brunoniella, dwarf blue trumpet	
<i>Burchardia umbellata</i>	milkmaids	CSGW
<i>Bursaria spinosa</i>	kurwan (D'harawal), sweet bursaria, boxthorn, blackthorn	
<i>Caesia parviflora</i>	grass-lily, pale grass-lily	
<i>Caleana major</i>	large duck orchid, flying duck orchid	ABW
<i>Callistemon citrinus</i>	crimson bottlebrush, common red bottlebrush	ABW
<i>Callistemon linearis</i>	narrow-leaved bottlebrush	AGW, CSGW
<i>Callistemon pinifolius</i>	pine-leaved bottlebrush	CSGW
<i>Cassytha glabella</i>	slender devil's twine	CSGW
<i>Cassytha pubescens</i>	devil's twine, dodder-laurel	
<i>Casuarina glauca</i>	grey bulloak, swamp oak, swamp buloke, guman	
<i>Centrolepis strigosa</i> subsp. <i>strigosa</i>	hairy centrolepis	
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	mulga fern, poison rock fern	CSGW
<i>Chrysocephalum apiculatum</i>	common everlasting, yellow buttons	
<i>Conospermum taxifolium</i>	variable smoke-bush, devil's rice, paint brushes	ABW
<i>Coronidium scorpioides</i>	button everlasting	CSGW
<i>Cuscuta australis</i>	Australian dodder	
<i>Cyanthillium cinereum</i>	ironweed	
<i>Cyathochaeta diandra</i>	sheath rush, sheath sedge	CSGW
<i>Dampiera stricta</i>	blue dampiera	
<i>Daviesia ulicifolia</i>	gorse bitter pea	CSGW
<i>Dianella revoluta</i>	black-anther flax-lily, blue flax-lily	CSGW
<i>Dichelachne micrantha</i>	short-haired plume grass, shorthair plume grass	CSGW
<i>Dichondra repens</i>	yilibili (D'harawal), kidney	

Species name	Common name	Characteristic for Agnes Banks Woodland (ABW) or Castlereagh Scribbly Gum Woodland (SGW)
	weed	
<i>Dillwynia floribunda</i>	many-flowered dillwynia	ABW
<i>Dillwynia glaberrima</i>	smooth-leaved dillwynia	
<i>Dillwynia parvifolia</i>	small dillwynia	CSGW
<i>Dillwynia sericea</i>	showy parrot-pea	AGW, CSGW
<i>Dillwynia tenuifolia</i>		
<i>Drosera spatulata</i>	rosy sundew, spoon-leaf sundew	
<i>Echinopogon caespitosus</i>	bearded grass	
<i>Entolasia marginata</i>	bordered panic	
<i>Entolasia stricta</i>	wiry panic	CSGW
<i>Epacris microphylla</i>	coast coral heath, coral heath	
<i>Epaltes australis</i>	spreading nut-heads, epaltes, nut-heads	
<i>Eragrostis brownii</i>	Brown's lovegrass, brown love grass, common love grass, Bentham's love-grass	
<i>Eragrostis leptostachya</i>	paddock love-grass	
<i>Eucalyptus crebra</i>	muggago (D'harawal), narrow-leaved ironbark, narrow-leaved red ironbark	
<i>Eucalyptus eugenioides</i>	thin-leaved stringybark, pink blackbutt	
<i>Eucalyptus fibrosa</i>	red ironbark, blue-leaved ironbark, broad-leaved ironbark	
<i>Eucalyptus globoidea</i>	white stringybark	
<i>Eucalyptus parramattensis</i> subsp. <i>parramattensis</i>	Parramatta red gum	CSGW
<i>Eucalyptus racemosa</i>	narrow-leaved scribbly gum	AGW, CSGW
<i>Euryomyrtus ramosissima</i> subsp. <i>ramosissima</i>	rosy baeckea	
<i>Exocarpos strictus</i>	dwarf cherry, pale-fruit ballart	
<i>Fimbristylis dichotoma</i>	common fringe-rush, common fringe-sedge	
<i>Gahnia aspera</i>	rough saw-sedge	
<i>Glycine clandestina</i>	twining glycine	
<i>Glycine microphylla</i>	small-leaf glycine	
<i>Gompholobium glabratum</i>	dainty wedge pea	
<i>Gompholobium huegelii</i>	pale wedge pea	ABW
<i>Gompholobium minus</i>	dwarf wedge pea	
<i>Gompholobium pinnatum</i>	pinnate wedge pea	CSGW
<i>Gonocarpus micranthus</i>	fire plant, smoke bush	

Species name	Common name	Characteristic for Agnes Banks Woodland (ABW) or Castlereagh Scribbly Gum Woodland (SGW)
<i>Gonocarpus tetragynus</i>	common raspwort	CSGW
<i>Gonocarpus teucroides</i>	raspwort, germander raspwort	
<i>Goodenia bellidifolia</i> subsp. <i>bellidifolia</i>	daisy goodenia	CSGW
<i>Goodenia hederacea</i>	ivy goodenia	CSGW
<i>Goodenia paniculata</i>	branched goodenia	CSGW
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	juniper-leaved grevillea	
<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	small-flower grevillea	
<i>Grevillea sericea</i>	pink spider flower, silky grevillea	
<i>Haemodorum corymbosum</i>	bloodroot	ABW
<i>Hakea dactyloides</i>	finger hakea, broad-leaved hakea	
<i>Hakea sericea</i>	silky hakea, needlebrush	CSGW
<i>Hardenbergia violacea</i>	purple coral pea, false sarsparilla, waraburra	
<i>Harmogia densifolia</i>		
<i>Hemarthria uncinata</i>	matgrass	
<i>Hibbertia aspera</i>	rough guinea flower	
<i>Hibbertia fasciculata</i>	a guinea flower	ABW
<i>Hibbertia pedunculata</i>	heart-leaved hibbertia	
<i>Hibbertia serpyllifolia</i>	hairy guinea flower	
<i>Hydrocotyle sibthorpioides</i>		
<i>Hypericum japonicum</i>	matted St John's wort	
<i>Hypoxis hygrometrica</i>	golden weather-grass, golden star	
<i>Imperata cylindrica</i>	blady grass	
<i>Isolepis inundata</i>	swamp club rush	
<i>Isopogon anemonifolius</i>	broad-leaf drumsticks, anemone-leaved isopogon	
<i>Isopogon anethifolius</i>	narrow-leaf drumsticks	ABW
<i>Jacksonia scoparia</i>	winged broom-pea, dogwood	
<i>Juncus planifolius</i>	broad-leaved rush	
<i>Kunzea ambigua</i>	tick bush	
<i>Kunzea capitata</i>		ABW
<i>Lachnagrostis filiformis</i>	blown grass	
<i>Lagenophora gracilis</i>	slender lagenophora, slender bottle-daisy	

Species name	Common name	Characteristic for Agnes Banks Woodland (ABW) or Castlereagh Scribbly Gum Woodland (SGW)
<i>Lambertia formosa</i>	mountain devil	
<i>Laxmannia gracilis</i>	slender wire-lily	CSGW
<i>Lepidosperma gunnii</i>	little sword-sedge	
<i>Lepidosperma laterale</i>	variable sword-sedge	
<i>Lepidosperma longitudinale</i>	pithy sword-sedge	
<i>Lepidosperma urophorum</i>	tailed rapier-sedge, tailed sword-sedge	ABW
<i>Leptocarpus tenax</i>	slender twine rush	ABW
<i>Leptospermum arachnoides</i>		
<i>Leptospermum continentale</i>	prickly tea-tree	
<i>Leptospermum parvifolium</i>		CSGW
<i>Leptospermum polygalifolium</i>	tantoon	
<i>Leptospermum squarrosum</i>		
<i>Leptospermum trinervium</i>	flaky-barked tea-tree, slender tea-tree	ABW
<i>Lepyrodia scariosa</i>	chaffy scale-rush	
<i>Leucopogon virgatus</i>	common beard-heath	
<i>Lindsaea linearis</i>	screw fern	
<i>Lissanthe strigosa</i>	peach heath, peach berry	CSGW
<i>Lobelia purpurascens</i>	white root	
<i>Lomandra filiformis</i>	wattle mat-rush	
<i>Lomandra glauca</i>	pale mat-rush	
<i>Lomandra multiflora</i> subsp. <i>multiflora</i>	many-flowered mat-rush	CSGW
<i>Lomandra obliqua</i>	twisted matrush	
<i>Melaleuca decora</i>	paperbark	CSGW
<i>Melaleuca diosmatifolia</i>	rosy paperbark	CSGW
<i>Melaleuca ericifolia</i>	swamp paperbark	CSGW
<i>Melaleuca nodosa</i>	prickly-leaved paperbark	CSGW
<i>Melaleuca thymifolia</i>	thyme honey-myrtle	CSGW
<i>Melichrus procumbens</i>	jam tarts	
<i>Microlaena stipoides</i> var. <i>stipoides</i>	meadow rice-grass	
<i>Micromyrtus ciliata</i>	fringed heath-myrtle	
<i>Micromyrtus minutiflora</i>		
<i>Mirbelia rubifolia</i>	heathy mirbelia	
<i>Mitrasacme polymorpha</i>	varied mitrewort	ABW
<i>Monotoca scoparia</i>	broom heath	ABW
<i>Olox stricta</i>	olax	ABW

Species name	Common name	Characteristic for Agnes Banks Woodland (ABW) or Castlereagh Scribbly Gum Woodland (SGW)
<i>Olearia microphylla</i>		
<i>Opercularia diphylla</i>		CSGW
<i>Panicum simile</i>	two colour panic, hairy panic	
<i>Patersonia glabrata</i>	bugulbi (Cadigal), leafy purple-flag	
<i>Patersonia sericea</i>	silky purple-flag	
<i>Persoonia lanceolata</i>	lance-leaf geebung	
<i>Persoonia laurina</i>	laurel geebung	
<i>Persoonia linearis</i>	narrow-leaved geebung	
<i>Persoonia nutans</i>	nodding geebung	ABW
<i>Petrophile pedunculata</i>	conesticks	CSGW
<i>Petrophile sessilis</i>		CSGW
<i>Philothea myoporoides</i>	long-leaf wax flower	
<i>Philothea salsolifolia</i> subsp. <i>salsolifolia</i>	philothea	ABW
<i>Phyllanthus hirtellus</i>	thyme spurge	
<i>Pimelea linifolia</i> subsp. <i>linifolia</i>	slender rice flower	AGW, CSGW
<i>Platysace ericoides</i>		ABW
<i>Poa labillardierei</i> var. <i>labillardieri</i>	tussock	CSGW
<i>Poa sieberiana</i>	fineleaf tussock grass, snow grass	
<i>Pomax umbellata</i>	pomax	
<i>Poranthera ericifolia</i>		
<i>Pteridium esculentum</i>	gurgi (Cadigal), bracken	
<i>Ptilothrix deusta</i>		CSGW
<i>Pultenaea parviflora</i>	Sydney bush-pea	
<i>Pultenaea retusa</i>	blunt bush-pea	CSGW
<i>Pultenaea tuberculata</i>	wreath bush-pea	
<i>Pultenaea villosa</i>	hairy bush-pea	CSGW
<i>Ricinocarpos pinifolius</i>	wedding bush	ABW
<i>Rytidosperma pallidum</i>	silver-top wallaby grass, redanther wallaby grass	
<i>Rytidosperma tenuius</i>	short-awn wallaby-grass	CSGW
<i>Schizaea bifida</i>	forked comb fern	ABW
<i>Schoenus apogon</i>	common bog-rush	CSGW
<i>Schoenus brevifolius</i>	zig-zag bog-rush, zigzag bogsedge	
<i>Schoenus imberbis</i>	beardless bog-rush	ABW

Species name	Common name	Characteristic for Agnes Banks Woodland (ABW) or Castlereagh Scribbly Gum Woodland (SGW)
<i>Senecio hispidulus</i>	hill fireweed	
<i>Solenogyne bellioides</i>		
<i>Stackhousia viminea</i>	slender stackhousia	
<i>Stylidium graminifolium</i>	grass trigger-plant	AGW, CSGW
<i>Thelymitra aristata</i>	scented sun orchid, great sun orchid	
<i>Themeda triandra</i>	kangaroo grass	CSGW
<i>Thysanotus tuberosus</i>	common fringe lily	
<i>Trachymene incisa</i> subsp. <i>incisa</i>		AGW, CSGW
<i>Tricoryne elatior</i>	yellow autumn-lily, yellow rush-lily	
<i>Wahlenbergia communis</i>	tufted bluebell	CSGW
<i>Wahlenbergia gracilis</i>	sprawling bluebell, Australian bluebell	
<i>Wahlenbergia stricta</i> subsp. <i>stricta</i>	tall bluebell	
<i>Xanthorrhoea concava</i>		
<i>Xanthorrhoea minor</i> subsp. <i>minor</i>	small grass tree	AGW, CSGW
<i>Xyris complanata</i>	hatpins	

Table A2 lists fauna that may occur, are likely to occur or known to occur in the ecological community and where applicable, includes threatened status. This is not a comprehensive list of animal species in the ecological community.

Table A2. Fauna species that may occur, are likely to occur or known to occur in the ecological community (Jones et al., 1997; Benson & McDougall, 1998; NSW NPWS, 1999; Leary, 2007; NSW OEH, 2013; Cumberland Bird Observers Club, 2014). Scientific names are as at August 2014.

Species name	Common name	TSC Act*	EPBC Act*
Birds			
<i>Acanthiza lineata</i>	striated thornbill		
<i>Acanthiza nana</i>	yellow thornbill		
<i>Acanthiza pusilla</i>	brown thornbill		
<i>Acanthiza reguloides</i>	buff-rumped thornbill		
<i>Acanthorhynchus tenuirostris</i>	eastern spinebill		
<i>Accipiter cirrocephalus</i>	collared goshawk		
<i>Accipiter fasciatus</i>	brown goshawk		
<i>Aegotheles cristatus</i>	Australian owlet-nightjar		
<i>Anthochaera carunculata</i>	red wattlebird		
<i>Anthochaera chrysoptera</i>	little wattlebird		

Species name	Common name	TSC Act*	EPBC Act*
<i>Anthochaera phrygia</i>	regent honeyeater	CE	E
<i>Artamus cyanopterus</i>	dusky woodswallow		
<i>Cacatua galerita</i>	sulphur-crested cockatoo		
<i>Cacomantis flabelliformis</i>	fan-tailed cuckoo		
<i>Cacomantis pallidus</i>	pallid cuckoo		
<i>Caligavis chrysops</i>	yellow-faced honeyeater		
<i>Calyptorhynchus funereus</i>	yellow-tailed black-cockatoo		
<i>Calyptorhynchus lathami</i>	glossy black-cockatoo	V	
<i>Chrysococcyx basalis</i>	Horsfield's bronze-cuckoo		
<i>Chrysococcyx lucidus</i>	shining bronze-cuckoo		ma
<i>Chthonicola sagittata</i>	speckled warbler	V	
<i>Climacteris picumnus victoriae</i>	brown treecreeper	V	
<i>Colluricincla harmonica</i>	grey shrike-thrush		
<i>Coracina novaehollandiae</i>	black-faced cuckoo-shrike		
<i>Coracina papuensis</i>	white-bellied cuckoo-shrike		ma
<i>Corcorax melanorhamphos</i>	white-winged chough		
<i>Cormobates leucophaea</i>	white-throated tree-creeper		
<i>Corvus coronoides</i>	Australian raven		
<i>Coturnix ypsilophora</i>	brown quail		
<i>Cracticus nigrogularis</i>	pied butcherbird		
<i>Cracticus tibicen</i>	Australian magpie		
<i>Cracticus torquatus</i>	grey butcherbird		
<i>Dacelo novaeguineae</i>	laughing kookaburra		
<i>Daphoenositta chrysoptera</i>	varied sittella	V	
<i>Dicaeum hirundinaceum</i>	mistletoebird		
<i>Elanus axillaris</i>	black-shouldered kite		
<i>Entomyzon cyanotis</i>	blue-faced honeyeater		
<i>Eolophus roseicapillus</i>	galah		
<i>Eopsaltria australis</i>	eastern yellow robin		
<i>Eudynamys orientalis</i>	eastern koel		
<i>Falco longipennis longipennis</i>	Australian hobby		
<i>Falcunculus frontatus</i>	crested shrike-tit		
<i>Geopelia striata</i>	peaceful dove		
<i>Gerygone olivacea</i> syn. <i>Gerygone albogularis</i>	white-throated gerygone		
<i>Gliciphila melanops</i>	tawny-crowned honeyeater		
<i>Glossopsitta concinna</i>	musk lorikeet		
<i>Glossopsitta pusilla</i>	little lorikeet	V	
<i>Grallina cyanoleuca</i>	magpie-lark		

Species name	Common name	TSC Act*	EPBC Act*
<i>Grantiella picta</i>	painted honeyeater	V	
<i>Haliastur sphenurus</i>	whistling kite		
<i>Hirundapus caudacutus</i>	white-throated needletail		ma, mi
<i>Hirundo neoxena neoxena</i>	welcome swallow		
<i>Hylacola pyrrhopygia</i>	chestnut-rumped heathwren		
<i>Lathamus discolor</i>	swift parrot	E	E
<i>Lichenostomus melanops</i>	yellow tufted honeyeater		
<i>Malurus cyaneus</i>	superb fairy-wren		
<i>Malurus lamberti</i>	variegated fairy-wren		
<i>Manorina melanocephala</i>	noisy miner		
<i>Melanodryas cucullata</i>	hooded robin	V	
<i>Meliphaga lewinii</i>	Lewin's honeyeater		
<i>Melithreptus brevirostris</i>	brown-headed honeyeater		
<i>Melithreptus gularis gularis</i>	black-chinned honeyeater	V	
<i>Melithreptus lunatus</i>	white-naped honeyeater		
<i>Merops ornatus</i>	rainbow bee-eater		
<i>Microeca fascinans</i>	jacky winter		
<i>Myzomela sanguinolenta</i>	scarlet honeyeater		
<i>Neochmia temporalis</i>	red-browed finch		
<i>Nesoptilotis leucotis</i>	white-eared honeyeater		
<i>Ninox strenua</i>	powerful owl		
<i>Ocyphaps lophotes</i>	crested pigeon		
<i>Oriolus sagittatus</i>	olive-backed oriole		
<i>Pachycephala pectoralis</i>	golden whistler		
<i>Pachycephala rufiventris</i>	rufous whistler		
<i>Pardalotus punctatus</i>	spotted pardalote		
<i>Pardalotus striatus</i>	striated pardalote		
<i>Petrochelidon nigricans</i>	tree martin		
<i>Petroica boodang</i>	scarlet robin	V	
<i>Petroica goodenovii</i>	red-capped robin		
<i>Petroica phoenicea</i>	flame robin	V	
<i>Petroica rosea</i>	rose robin		
<i>Phaps chalcoptera</i>	common bronzewing		
<i>Philemon corniculatus</i>	noisy friarbird		
<i>Phylidonyris niger</i>	white-cheeked honeyeater		
<i>Phylidonyris novaehollandiae</i>	New Holland honeyeater		
<i>Phylidonyris pyrrhopterus</i>	crescent honeyeater		
<i>Platycercus eximius</i>	eastern rosella		
<i>Podargus strigoides</i>	tawny frogmouth		

Species name	Common name	TSC Act*	EPBC Act*
<i>Psephotus haematonotus</i>	red-rumped parrot		
<i>Psophodes olivaceus</i>	eastern whipbird		
<i>Ptilotula fusca</i>	fuscous honeyeater		
<i>Ptilotula penicillata</i>	white-plumed honeyeater		
<i>Pyrrholaemus sagittatus</i>	speckled warbler	V	
<i>Rhipidura albiscapa</i>	grey fantail		
<i>Rhipidura leucophrys</i>	willie wagtail		
<i>Sericornis frontalis</i>	white-browed scrubwren		
<i>Smicrornis brevirostris</i>	weebill		
<i>Stagonopleura bella</i>	beautiful firetail		
<i>Strepera graculina</i>	pieb currawong		
<i>Streptopelia chinensis</i>	spotted dove, spotted turtle-dove		
<i>Sturnus tristis</i>	common myna		
<i>Taeniopygia bichenovii</i>	double-barred finch		
<i>Threskiornis spinicollis</i>	straw-necked ibis		
<i>Trichoglossus haematodus</i>	rainbow lorikeet		
<i>Turnix varius</i>	painted button-quail		
<i>Tyto javanica</i>	eastern barn owl		
<i>Turnix varius varius</i>	painted button-quail		
<i>Zosterops lateralis</i>	silveryeye		
Mammals			
<i>Chalinolobus dwyeri</i>	large-eared pied bat	V	V
<i>Chalinolobus gouldii</i>	Gould's wattled bat		
<i>Dasyurus maculatus</i>	spotted tailed quoll (SE mainland population), Bindjulang	V	E
<i>Macropus giganteus</i>	eastern grey kangaroo		
<i>Miniopterus australis</i>	little bent-wing bat	V	
<i>Miniopterus schreibersii oceanensis</i>	eastern free-tail bat, eastern bent-wing bat	V	
<i>Myotis macropus</i>	large-footed myotis	V	
<i>Nyctophilus geoffroyi</i>	lesser long-eared bat		
<i>Nyctophilus gouldi</i>	Gould's long-eared bat		
<i>Petaurus breviceps</i>	sugar glider		
<i>Petaurus norfolcensis</i>	squirrel glider	V	
<i>Pteropus poliocephalus</i>	grey-headed flying fox	V	V
<i>Saccolaimus flaviventris</i>	yellow-bellied sheath-tail bat	V	
<i>Scoteanax rueppellii</i>	greater broad-nosed bat	V	
<i>Trichosurus vulpecula</i>	common brush-tailed possum		
Reptiles and Amphibians			
<i>Crinia signifera</i>	common eastern froglet		

Species name	Common name	TSC Act*	EPBC Act*
<i>Ctenotus taeniolatus</i>	striped skink		
<i>Furina diadema</i>	red-naped snake		
<i>Limnodynastes dumerilii</i>	eastern banjo frog		
<i>Limnodynastes ornatus</i>	ornate burrowing frog, ornate frog		
<i>Limnodynastes peroni</i>	striped marsh frog, brown-striped frog		
<i>Limnodynastes tasmaniensis</i>	spotted marsh frog, spotted grass frog		
<i>Litoria aurea</i>	green and golden bell frog	E	V
<i>Litoria caerulea</i>	green tree frog		
<i>Litoria dentata</i>	bleating tree frog		
<i>Litoria peroni</i>	Peron's tree frog		
<i>Litoria verreauxii</i>	Verreaux's tree frog, whistling tree frog		
<i>Tiliqua scincoides</i>	eastern blue-tongue		
Invertebrates			
<i>Meridolum corneovirens</i>	Cumberland land snail	E	
<i>Meridolum duralensis</i>	land snail		
<i>Stigmodera</i> spp.	jewel beetles		
<i>Ogmograptis scribula</i>	scribble moth		

*V – Vulnerable, E – Endangered, CE – Critically Endangered, ma – marine, mi – migratory

Table A3 lists weed species known to occur in the ecological community. It is not a complete list of all known and likely weed species in the ecological community.

Table A3. Weed species known to occur in the Castlereagh Scribbly Gum and Agnes Banks Woodlands. Scientific names are as at August 2014.

Species	Common name
<i>Acacia baileyana</i>	Cootamundra wattle
<i>Andropogon virginicus</i>	whisky grass
<i>Araujia sericifera</i>	moth vine
<i>Asparagus aethiopicus</i>	asparagus fern
<i>Asparagus asparagoides</i>	bridal creeper
<i>Cenchrus clandestinus</i> (syn. <i>Pennisetum clandestinum</i>)	kikuyu
<i>Chloris gayana</i>	Rhodes grass
<i>Ehrharta erecta</i>	panic veldt grass
<i>Eragrostis curvula</i>	African lovegrass
<i>Grevillea robusta</i>	silky oak
<i>Hyparrhenia hirta</i>	Coolatai grass
<i>Hypochaeris radicata</i>	flat weed

APPENDIX B - NATIONAL CONTEXT

Distribution

The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community occurs almost exclusively on the Cumberland Plain, in the Castlereagh area in the north-west, and smaller occurrences near Holsworthy (some patches at Holsworthy are just outside the Cumberland Plain), Kemps Creek and Longneck Lagoon (Tozer et al., 2010; NSW Scientific Committee, 2013).

The ecological community occurs only in the Sydney Basin Bioregion (IBRA v. 7), and across four sub-regions: Cumberland (SYB08), Sydney Cataract (SYB10), Wollemi (SYB04) and Burratorang (SYB09).

Castlereagh Scribbly Gum and Agnes Banks Woodlands occurs in the following local government areas: Blacktown, Hawkesbury, Liverpool and Penrith and small patches may occur in nearby local government areas.

Relationships to other vegetation classifications

The ecological community corresponds, entirely or in part, to the following vegetation classifications:

- Benson (1992) and James (1997)
 - 14a Castlereagh Scribbly Gum Woodland
 - 14b Agnes Banks Woodland
- Keith (2002) - Hinterland Sand Flats Dry Sclerophyll Forest (in part, only)
- Keith (2004) - Sydney Sand Flats Dry Sclerophyll Forest (in part, only)
- Tozer et al. (2010)
 - DSF p7 Castlereagh Scribbly Gum Woodland
 - DSF p239 Agnes Banks Woodland
- VIS Vegetation Classification
 - 883 Hard-leaved Scribbly Gum - Parramatta Red Gum Heathy Woodland of the Cumberland Plain, Sydney Basin Bioregion
 - 958 Narrow-leaved Apple - Hard-leaved Scribbly Gum Heathy Woodland on Sand at Agnes Banks, Sydney Basin Bioregion
- National Vegetation Information System (NVIS)
 - Major Vegetation Group (MVG):
 - MVG 5 - Eucalypt Woodlands
 - MVG 3 - Eucalypt Open Forests
 - Major Vegetation Subgroup (MVS):
 - MVS 4 - Eucalyptus open forests with a shrubby understorey
 - MVS 5 - Eucalyptus open forests with a grassy understorey
 - MVS 8 - Eucalyptus open woodlands with a shrubby understorey
 - MVS 9 - Eucalyptus open woodlands with a grassy understorey.

If a patch mapped as DSF p7 or DSF p239 (Tozer et al., 2010) meets the description of the Castlereagh Scribbly Gum and Agnes Banks Woodlands, it is considered the ecological

community. Note that examples of the ecological community may not be mapped so ground truthing is essential to determine the presence of the ecological community.

Differences to similar or intergrading ecological communities

The following vegetation types occur on sand, gravel or clay in the Sydney Basin Bioregion. Their generally sandy substrate affords them varying degrees of similarity with Castlereagh Scribbly Gum and Agnes Banks Woodlands. Several occur outside the Cumberland sub-region and at higher altitudes, resulting in a range of differences in their attributes (including floristic composition and structure). Others occur adjacent the ecological community and, although distinctive enough to differentiate from the ecological community are known to, or likely to form intergrading areas with Castlereagh Scribbly Gum and Agnes Banks Woodlands.

Similar communities

Mellong Woodland (Map Unit 10me) (Ryan et al., 1996)

Mellong Woodland is a eucalypt woodland with two distinctive sub-components – *Eucalyptus parramattensis* woodland (on poorly drained sites) and *Eucalyptus racemosa/Angophora bakeri* woodland (on well-drained sites) (Ryan et al., 1996). It occurs on the Mellong Plateau near Putty. The Mellong Plateau has younger, Quaternary alluvial deposits of deeply leached sands at a higher elevation than the ecological community (340 m ASL).

The proximity of this vegetation type to surrounding sandstone vegetation is reflected in its similarity to sandstone ridge-top flora of the Sydney Basin found at higher elevations. Like Castlereagh Scribbly Gum and Agnes Banks Woodlands it has a shrubby under-storey, which may include *Melaleuca thymifolia*, *Leptospermum trinervium*, *Isopogon anemonifolius*, *Bossiaea heterophylla*, *Hakea dactyloides*, *Banksia spinulosa*, *Monotoca scoparia* and *Platysace ericoides*. While Ryan et al. (1996) do not identify characteristic or common species, it is possible to distinguish Mellong Woodland from the ecological community by differences in under-storey floristics, elevation, location and geology.

Eastern Suburbs Banksia Scrub

Eastern Suburbs Banksia Scrub of the Sydney Region is listed as endangered under both the EPBC Act and the TSC Act (NSW) (as Eastern Suburbs Banksia Scrub of the Sydney Region and Eastern Suburbs Banksia Scrub in the Sydney Basin Bioregion consecutively). It occurs in Sydney's eastern and south-eastern suburbs, on a sandy (aeolian), nutrient poor substrate (NSW DEC, 2004). Eastern Suburbs Banksia Scrub has a low scrub or heath structure, with small areas of woodland and wet areas (NSW DEC, 2004). It shares several distinctive species with the ecological community (particularly the Agnes Banks Woodland component), including wallum (at its southern limit), wedding bush and *Dillwynia glaberrima* (NSW DEC, 2004). However, it is easily distinguished from the ecological community by its lack of a eucalypt/*Angophora* canopy, other characteristic flora of the ecological community, and its more coastal location.

Thirlmere Lakes Swamp Woodland (Map Unit 28b ii) Benson & Howell (1994)

Thirlmere Lakes Swamp Woodland occurs south of Picton on laterised Cretaceous sandy alluvium. It has a canopy layer of *Eucalyptus parramattensis* subsp. *parramattensis* (Parramatta red gum) and *Melaleuca linariifolia* (flax-leaved paperbark), shrubs of *Acacia longifolia* (Sydney golden wattle), *Melaleuca thymifolia* (thyme honey myrtle) and a ground layer of *Lepyrodia muelleri*. Although Benson & Howell (1994) liken it to woodlands around Agnes Banks (particularly areas with sedgy understorey) it does not contain characteristic species such as *Angophora bakeri* in the canopy.

Kurri Sand Swamp Woodland

Kurri Sand Swamp Woodland occurs outside the Cumberland Plain in the Hunter Valley. Like the ecological community, this vegetation type also occurs on sand, but it has a different species composition, notably lacking the characteristic narrow-leaved scribbly gum and having a different subspecies of *Eucalyptus parramattensis* (the nationally threatened *Eucalyptus parramattensis* subsp. *decadens*).

Warkworth Sands Woodland

On sand deposits at Warkworth in the Hunter Valley, the vegetation has a canopy dominated by *Angophora floribunda* (rough-barked apple), *Eucalyptus tereticornis* (forest red gum), *Acacia filicifolia* (fern-leaved wattle), *Banksia integrifolia* subsp. *integrifolia* (coastal banksia) and *Pteridium esculentum* (common bracken). The occurrence of *Callitris endlicheri* (black cypress pine) and *Exocarpos cupressiformis* (native cherry), *Brachychiton populneus* subsp. *populneus* (kurrajong), *Allocasuarina luehmannii* (bulloke) and the lack of the same dominant canopy species make it distinct from Castlereagh Scribbly Gum and Agnes Banks Woodlands.

Elderslie Banksia Scrub Forest (or Nepean Sand Scrub Forest)

This low scrub forest is listed under the NSW TSC Act as endangered. Although it occurs on sand deposits within the Cumberland Plain, it is easily differentiated from Castlereagh Scribbly Gum and Agnes Banks Woodlands by its species composition, including canopy species such as *Banksia integrifolia* and *Eucalyptus botryoides*.

Intergrading communities

Cooks River/Castlereagh Ironbark Forest in the Sydney Basin Bioregion

The sand and gravel deposits where the ecological community occurs are usually adjacent to gravel-clay soils. These soils support ironbark vegetation communities such as Cooks River/Castlereagh Ironbark Forest, listed as endangered under the NSW TSC Act (NSW Scientific Committee, 2002). Although species composition is distinctive between the two ecological communities, notably red ironbark trees (*Eucalyptus fibrosa*) can also occur sporadically in the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community.

Castlereagh Swamp Woodland

The ecological community is also adjacent and may intergrade with Castlereagh Swamp Woodland (listed as endangered under the NSW TSC Act), which occurs on poorly draining clay soils. Castlereagh Swamp Woodland shares some similarities in vegetation, however the canopy is characterised by *Melaleuca decora* (paperbark) and *Eucalyptus parramattensis* subsp. *parramattensis*, with a typically sparse shrub layer and a grassy/herbaceous ground layer prone to substantial water-logging (NSW Scientific Committee, 1999).

Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest

Castlereagh Scribbly Gum and Agnes Banks Woodlands may also intergrade with the nationally listed Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, particularly the Shale-Gravel Transition Forest component (listed as a single ecological community under the NSW TSC Act). Several species are good indicators of this transitional forest, such as *Eucalyptus moluccana* (grey box), *E. fibrosa* (red ironbark), *E. eugenioides* (thin-leaved stringybark), *E. longifolia* (woollybutt), *Angophora floribunda* (rough-barked apple), *Melaleuca nodosa* (prickly-leaved paperbark), *Dillwynia tenuifolia*, *Grevillea juniperina* and *Cryptandra spinescens* (James, 1997).

Level of protection in reserves

Parts of the ecological community occur in nature reserves in western Sydney, including Scheyville National Park, Agnes Banks Nature Reserve, Castlereagh Nature Reserve and

Windsor Downs Nature Reserve (NSW Scientific Committee, 2000, 2010). It is estimated that approximately 420 ha (13.2%) of its current extent is located within reserves (NSW NPWS 2002; Tozer et al., 2010).

APPENDIX C - DESCRIPTION OF THREATS

The ecological community has suffered substantial damage in the past, largely associated with the direct clearance and degradation of vegetation. The main threats are: vegetation clearance due to agriculture and, more recently, urban expansion; altered fire regimes; and weed invasion. A number of these threats are ongoing, and are likely to interact in complex ways to reduce the integrity, function and resilience of the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community.

Clearing and fragmentation

The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community has a naturally restricted distribution (Tozer et al., 2006, 2010). In addition to this, the ecological community has been extensively cleared (NSW NPWS, 2002; Tozer 2003; Tozer et al. 2006, 2010; Keith, 2004). It is estimated that only around 50% of the estimated pre-1750 extent remains and much of this is fragmented (NSW NPWS, 2002; Tozer et al., 2010).

Vegetation clearance was, and continues to be, a major contributor to the decline of native vegetation across the Cumberland Plain, including this ecological community. While the ecological community occurs on relatively poor grazing land it has been cleared for sand and gravel extraction, some timber cutting, followed by hobby farms and rural-residential development from the 1960s (Benson & Howell, 1990).

The two sub-components of the ecological community – Castlereagh Scribbly Gum Woodland and Agnes Banks Woodland – are listed for protection under the TSC Act – the former in 2010 and the latter in 2000. Despite this, the ecological community is under ongoing pressure, like many threatened communities on the Cumberland Plain, due to the ongoing effects of past disturbance and new land-use demands (NSW DECCW, 2010; Tozer et al., 2010).

Sand and gravel mining (e.g. for concrete production) was one of the primary causes of past clearance of the ecological community (particularly the Agnes Banks Woodland component). It is estimated that sand mining, together with clearing for rural-residential development has depleted the Agnes Banks Woodland by up to 96% of its original range (NSW Scientific Committee, 2000). Extraction usually completely removes the vegetation from the extraction zone, and post extraction revegetation is not able to replace those communities in their original form (NSW National Parks and Wildlife Service, 1997). Sand and gravel extraction represents a current and ongoing threat to the ecological community, though the full extent of the threat is not clear.

The loss, fragmentation and degradation of vegetation in the ecological community are increasingly associated with rural-residential and urban development. This pressure is current and ongoing. In areas north of Penrith and south of Richmond, where the majority of the ecological community occurs, many patches are located on land zoned (or in some cases proposed to be zoned) as small (2 ha) rural-residential lots (Penrith City Council, 2010; Penrith City Council, 2013). The patches of the ecological community at these sites are likely to be severely impacted due to tree clearance, weed spread and under-scrubbing.

In terms of other known future development impacts, the Sydney Growth Centres are the largest coordinated land release in the history of NSW and cover around 27 000 ha (approximately 10 000 ha in the North West Growth Centre and around 17 000 ha in the South West Growth Centre) (NSW Government, 2013). The growth centres will provide more than 180 000 homes for around 500 000 people (NSW Government, 2013). In order to mitigate the impact of the development, the NSW Cumberland Plain Recovery Plan (NSW DECCW, 2010) identified 73 ha of the remaining approximately 88 ha (i.e. approximately 83%) of the NSW listed Agnes Banks Woodland to be included in 'priority conservation lands'. Priority conservation lands are areas to be prioritised for voluntary acquisition for reservation, or for the

establishment of conservation agreements with landholders in order to offset the impact of the growth areas on environmental assets such as the ecological community.

The other component of the ecological community, Castlereagh Scribbly Gum Woodland, does not have any priority conservation lands mentioned in the NSW Cumberland Plain Recovery Plan. However, the NSW Office of Environment and Heritage database of Cumberland Plain priority conservation lands identifies priority conservation lands for Castlereagh Scribbly Gum Woodland (NSW OEH, 2011). Because the priority conservation lands are earmarked for voluntary acquisition, protection of the ecological community in these areas cannot be assured. Some priority areas have already been impacted by development projects since the NSW Cumberland Plain Recovery Plan was released. Some other areas are Commonwealth land dedicated for Defence purposes. In addition, some areas marked as priority conservation lands are already held in national parks and nature reserves, so these areas would not constitute an additional conservation gain.

In addition to likely direct impacts to the ecological community from the land release for the North West and South West growth centres (up to 25 ha may be cleared), the Draft Metropolitan Strategy for Sydney proposes the investigation of a potential south west expansion (the 'Western Sydney Employment Area'), which would develop up to 10 000 ha to support employment through the release of land for industries such as freight, logistics, agribusiness and food production (NSW Government, 2013). Mapping data indicates that approximately 40 ha of Castlereagh Scribbly Gum and Agnes Banks Woodlands that is likely to meet condition thresholds is present within the Western Sydney Employment Area (Eco Logical Australia, 2013). There are also expected to be a number of other ongoing clearing impacts due to development throughout the range of the ecological community but the amount of hectares likely to be lost is not available.

The ecological community is also highly fragmented due to extensive clearing. Using Tozer et al. (2006) SCIVI spatial model data¹⁰, and excluding patches under 0.5 ha¹¹, there are 138 patches of the ecological community – the average (mean) patch size is 22.7 ha, the median patch size is 3.2 ha and the largest patch is 1180.7 ha.

The majority of patches in this ecological community are small and isolated, created in part by clearing and fragmentation. Such patches are less buffered against disturbances, such as invasion by weeds (Tozer, 2003; Cuneo et al., 2009), or other impacts from surrounding agricultural and urban activities such as spray drift. Loss of connectivity through increased fragmentation is also likely to result in a decrease in biological and genetic diversity, and an increase in predator pressure on native fauna (Anderson & Burgin, 2002).

Altered fire regimes

The vegetation composition of Castlereagh Scribbly Gum and Agnes Banks Woodlands is influenced by a range of factors including its recent disturbance history and patch size (NSW Scientific Committee, 2000, 2010). Due to its proximity to urban and peri-urban areas frequent fire from arson is a major threat to the ecological community (NSW DECCW, 2010). Frequent fire can also be caused by hazard reduction burning (NSW Scientific Committee, 2010).

Burning the Castlereagh Scribbly Gum and Agnes Banks Woodlands too often may result in the loss of species diversity if native species do not have enough time to mature and set seed. The NSW Scientific Committee (2010) noted that low seedling recruitment observed in Castlereagh Scribbly Gum Woodland is thought to be associated with too frequent fire and extended dry periods. The nationally endangered nodding geebung and *Allocasuarina*

¹⁰ Note the majority of SCIVI is model data and ground truthing is variable across the landscape.

¹¹ Many of the smallest patches of vegetation shown on the mapped output were identified as artefacts of the spatial intersection process.

glareicola are present in the ecological community and are particularly sensitive to frequent burns (NSW DECC, 2008).

Conversely, the exclusion of fire for greater than 30 years may have a detrimental impact on the ecological community, particularly through loss of understorey plant diversity (NSW DEC, 2005). This can be exacerbated by measures to avoid large fires as more residential areas are being built near the ecological community.

Further information about fire management is included in section 4 *Priority Conservation Actions*.

Invasion by weeds

Alteration of the pre-European fire regimes of woodland ecological communities in western Sydney can lead to the accumulation of leaf litter (i.e. through infrequent fire). In combination with nutrient-rich urban runoff, this creates the high nutrient conditions that support the growth of soft-leaved, moisture and nutrient adapted weeds that have escaped from nearby farms and gardens (NSW DECC, 2008).

Weed incursion in the Cumberland sub-region region is associated with grazing and agricultural land uses as well as urbanisation. Weeds are known to occur in the Cumberland sub-region (including within the ecological community) in densities that displace native plants and lead to a decline in native species diversity and regenerative capacity.

Weeds that occur in the Castlereagh Scribbly Gum and Agnes Banks Woodlands include: mid-storey species such as Cootamundra wattle (*Acacia baileyana*); herbs such as flat weed (*Hypochaeris radicata*); grasses, including African love grass (*Eragrostis curvula*), kikuyu (*Cenchrus clandestinus* syn. *Pennisetum clandestinum*), whisky grass (*Andropogon virginicus*) and panic veldt grass (*Ehrharta erecta*) (NSW Scientific Committee, 2010). Introduced vines include moth vine (*Araujia sericifera* syn. *A. hortorum*) and bridal creeper (*Asparagus asparagoides*).

Changes in fauna composition and associated ecological functions

Due to the highly fragmented nature of Castlereagh Scribbly Gum and Agnes Banks Woodlands, its disturbance history and the fact that it is surrounded by cleared land, the ecological community no longer supports several native fauna species (including the loss of the majority of ground-dwelling mammals). The fragmentation of the ecological community and the loss of habitat for local flora and fauna continue to impact on the ecological processes and species composition of the ecological community.

Some remnants no longer support a diverse range of native fauna due to a loss of large hollow bearing trees, modifications to the understorey, and isolation and fragmentation of remaining stands (Lindenmayer & Fischer, 2006; Leary, 2007). However, such remnants still hold value for more disturbance-tolerant or highly mobile species, including as stepping-stone habitat in otherwise cleared or developed landscapes (Doerr et al., 2010).

A 1997 survey by NSW National Parks and Wildlife Service (NPWS) found that of the 62 mammal species known from the western Sydney region at the time of European settlement only 15 of these species had stable populations in the region at the time of the survey. Ten years later, further intensive surveys across the Cumberland sub-region found that reserves maintained some fauna but many species had been lost or were in decline (Leary, 2007). In particular, as in many other temperate locations in Australia, the small and medium sized ground dwelling mammals have suffered disproportionate losses. Through the intensive survey effort only one native rodent species, *Rattus fuscipes* (bush rat) and one dasyurid, *Antechinus stuartii* (brown antechinus) were found (neither were found in the ecological community). Bandicoots were almost completely absent, with only one *Perameles nasuta* (long-nosed bandicoot) found in the region (Leary, 2007).

The 2007 NPWS survey found there had been a severe depletion of habitat features needed to support fauna of the region. For example, large hollow-bearing trees were largely absent, while the additional ground habitat provided by these trees as fallen timber had also been reduced. Across the Cumberland sub-region survey sites the diameter of trees measured was small (mean 22 cm), while fewer than 3% contained hollows or fissures, indicating limited current value in providing nesting habitat for hollow-dependent fauna (such as some bird species, bats and some other arboreal mammals) (Leary, 2007). While specific information on hollow development is limited, modelling of grassy box woodland in south west NSW indicates that the lag time for development is likely to have severe implications for species such as parrots and arboreal mammals, in the absence of immediate intervention (Manning et al., 2013).

Leary (2007) also comments on the substantial reduction and modification of ground cover, due to the alteration of fire regimes. Implications of this include the reduction of habitat for small reptiles, invertebrates and mammals.

Loss of fauna and ecosystem function can also be caused by a range of feral and domestic introduced species including dogs, cats, foxes, black rat, house mouse, numerous introduced birds and the European wasp and honeybee. These are all present in large numbers in the remnant bushland of the region, and impact on native wildlife through predation and competition for resources (Jones et al., 1997).

Fauna species that are native to Australia but previously occurred less frequently in western Sydney are also associated with loss of native fauna and ecosystem function. Sulphur crested cockatoos have significantly increased in numbers following urban development and displaced rarer local species by aggressively competing for nesting hollows (Jones et al., 1997).

Climate change

Climate change is now understood to pose a serious long-term threat to terrestrial and aquatic ecosystems and to have the potential to change the ecology of these environments, through changed species composition and function (Dunlop et al., 2012). The fragmented nature of the Castlereagh Scribbly Gum and Agnes Banks Woodlands greatly increases its vulnerability to the effects of a rapidly changing climate, as the resilience of the ecological community is already compromised. It could also influence the future distribution and extent of the ecological community. Not only does climate change directly threaten species that cannot adapt, it is also likely to exacerbate existing threats, including loss of habitat, altered hydrological regimes, altered fire regimes and invasive species.

Eco Logical Australia (2010) investigated the vulnerability of various natural and cultural assets in the Hawkesbury-Nepean catchment to climate change. That report did not include the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community. However, many of the findings reported for that community can be sensibly extrapolated to this ecological community. In summary, these include:

- Continued clearing, degradation, and fragmentation will limit the ability of the ecological community to adapt and/or migrate in response to climate change;
- Invasion by non-native plant species is likely to increase in intensity, spread, and diversity, with some such species taking advantage of climate change-induced effects such as periodic depletion of ground cover due to drought and over-grazing;
- Altered native flora and fauna species mix; and
- Altered fire regimes due to changed climate and weather, and due to changed vegetation structure and composition.

The vegetation of the ecological community is also important as a means of mitigating extreme temperatures in the local area through its evaporative and cooling influences, mitigating the 'urban heat island effect' operating in western Sydney (Beshara, 2008).

Other threats

Urbanisation of the landscapes that adjoin the ecological community has significant hydrological effects. The ‘hardening’ of surfaces through road building surrounding the ecological community results in increased runoff. This can change stream flow patterns, causing erosion and often penetrates the ecological community and carries high nutrient and sediment loads, which can encourage weed invasion and impact on habitat for fauna such as frogs (NSW DEC, 2005; NSW DECCW, 2010; Hore, pers. comm., 2014).

Soil compaction and erosion, damage to riparian areas and altered drainage patterns can occur through recreational vehicle use, including 4WDs and trail bikes (NSW NPWS, 1999; NSW Scientific Committee, 2010). Vehicle tracks also increase fragmentation of the ecological community – such tracks can create new watercourses and ponds which can harm less water tolerant species. Vehicles are also well known vectors for the introduction and spread of weeds and soil pathogens.

Domestic pets and rubbish dumping are additional threats associated with urban development that are impacting the ecological community (NSW Scientific Committee, 2010; Steenbeeke, pers. comm., 2014).

Grazing and mowing associated with rural-residential, rather than agricultural use, is impacting Castlereagh Scribbly Gum and Agnes Banks Woodlands – the ground layer of the ecological community was spared from impacts of large-scale stock grazing due to its nutrient-poor substrate. Remnants of the ecological community are often mowed, slashed or scrubbed for bushfire fuel reduction, grazing and perceived aesthetics (NSW Scientific Committee, 2010; Steenbeeke, pers. comm., 2014). These activities can deplete the soil seed bank (James, 1994).

Transmission of plant pathogens occurs through various vectors such as humans and kangaroos, and on larger scales, through contaminated vehicles and machinery. Effective hygiene practices can help to manage human and mechanical transmission. *Phytophthora* is a known threat to the ecological community with at least one outbreak at Kemps Creek (NSW Scientific Committee, 2010). ‘Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*)’ is a nationally listed Key Threatening Process under the EPBC Act, and is also listed in NSW as a Key Threatening Process under the TSC Act. Dieback (in this case caused by *Cardiaspina* psyllid insects) has recently caused substantial impacts (including tree mortality) to vegetation in the Cumberland sub-region (Steenbeeke, pers. comm., 2014).

The ecological community is also at risk of infection by myrtle rust (*Puccinia psidii* s.l.), a serious fungal pathogen which affect plants belonging to the family Myrtaceae. Myrtle rust is now widely distributed in coastal areas across New South Wales, including the Sydney region (NSW DPI, 2012).

APPENDIX D - KEY THREATENING PROCESSES

Key Threatening Processes identified under the NSW TSC Act and EPBC Act that are affecting Castlereagh Scribbly Gum and Agnes Banks Woodlands (or are likely to affect the community in the future) are:

- Land clearance (EPBC Act); Clearing of native vegetation (NSW TSC Act)
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants (NSW TSC Act/EPBC Act); Invasion of native plant communities by exotic perennial grasses (NSW TSC Act); Invasion and establishment of exotic vines and scramblers (NSW TSC Act)
- Infection of native plants by *Phytophthora cinnamomi* (NSW TSC Act); Dieback caused by the root-rot fungus (*Phytophthora cinnamomi*) (EPBC Act)
- Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (NSW TSC Act)
- Loss of hollow-bearing trees (NSW TSC Act)
- Removal of dead wood and dead trees (NSW TSC Act)
- Competition from feral honeybees (NSW TSC Act)
- Aggressive exclusion of birds from woodland and forest habitat by abundant Noisy Miners *Manorina melanocephala* (NSW TSC Act)
- Predation by European red fox (EPBC Act); Predation by the European red fox (*Vulpes vulpes*) (NSW TSC Act)
- Predation by feral cats (EPBC Act); Predation by the feral cat (*Felis catus*) (NSW TSC Act)
- Loss of terrestrial climatic habitat caused by anthropogenic emissions of greenhouse gases (EPBC Act); Anthropogenic climate change (NSW TSC Act)
- High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition (NSW TSC Act).

APPENDIX E - ELIGIBILITY FOR LISTING AGAINST THE EPBC ACT CRITERIA

Criterion 1 - Decline in geographic distribution

The Castlereagh Scribbly Gum and Agnes Banks Woodlands have undergone a significant reduction in extent since European settlement (James, 1997; NSW NPWS, 2002; Tozer et al., 2010). The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is estimated to have been reduced to at most around 49% of its original pre-European extent (Table F1). This figure may be an underestimate as further clearance is likely to have occurred since the data were collected.

The decline in the area of occupancy is due largely to clearing and degradation of remaining patches (driven by a range of threats as described in section 2 *Summary of Threats* and Appendix E).

Table F1. Estimates of decline and extent for Castlereagh Scribbly Gum and Agnes Banks Woodlands based on vegetation units that correspond with the ecological community.¹²

Sub-community	Estimated area pre-1750 (ha)	Estimated area extant (ha)	% original extent remaining	Estimated area reserved (ha)	% of current extent reserved
Agnes Banks Woodland	615*	90	16* (15-25)	30	33.3%
Castlereagh Scribbly Gum Woodland	5852*	3100	53* (50-70)	390	12.6%
Total	6467*	3190	49%	420	13.2%

The Committee considers that, the ecological community has undergone a ‘substantial’ decline (> 50%) in its geographic extent and is therefore **eligible** for listing as **vulnerable** under this criterion.

Criterion 2 - Limited geographic distribution coupled with demonstrable threat

The purpose of this criterion is to recognise that an ecological community with a distribution that is currently limited has an inherently higher risk of extinction if it is subject to a threatening process. Thresholds to identify terrestrial vegetation communities with limited distributions are typically based on three indicative measures; area of occupancy, total extent of occurrence and patch size (indicative of fragmentation). If any of the three measures is demonstrated to apply to the ecological community it is considered to have a limited geographic distribution.

Data presented in Tozer et al. (2010) indicate the present extent of the ecological community is approximately 3190 ha (i.e. ‘restricted’, where the total area of occupancy is less than 10 000 ha).

The Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is restricted to sand and sandy gravel deposits and its distribution is therefore naturally restricted. Any natural fragmentation has been exacerbated by the loss of extent through further human-caused impacts (including clearance and degradation from past and ongoing threats).

¹² Figures in this table are taken from Tozer et al. (2010) unless marked with *, in which case they are from NSW NPWS (2002). Data are merged from polygon classification codes A, B, C and SA as defined in NSW NPWS (2002).

The ecological community is now highly fragmented, with a mean patch size of approximately 22.7 ha and median patch size of 3.2 ha, and is considered to be ‘very restricted’ (analysis of data from SCIVI mapping data – taken from Tozer et al. (2006)).¹³ Most patches (78%) now have an area of less than 10 ha (Table F2). Gaps between some patches are likely to limit regeneration opportunities as some key species have restricted seed dispersal mechanisms (for example, the dominant canopy species are dispersed locally by ants, wind and gravity) (Benson and McDougall, 1998).

Table F2. Patch size distribution (data from the SCIVI database – taken from Tozer et al. (2006))

Thresholds		Size range (ha)	No. patches	% patches	Cumulative %	
Restricted	Very Restricted	0.5 - 10	108	78	78	97
		> 10-100	26	19		
		> 100	4	3		
		Total	138	100		

As detailed in *Description of Threats* (Appendix E), the Castlereagh Scribbly Gum and Agnes Banks Woodlands ecological community is subject to a range of ongoing demonstrable threats, several of which interact. Key threats include clearance and fragmentation of remnants as well as weed invasion and altered fire regimes (particularly due to arson) (NSW Scientific Committee, 2010; Steenbeeke, pers. comm., 2014). The loss of area and condition can have compounding impacts through the loss of fauna that play important ecological roles in the ecological community. The loss of mammal species has been noted across the Cumberland sub-region, removing their functions as soil engineers and dispersers of pollen and seeds. Similarly, the bird assemblage has been simplified by vegetation loss and fragmentation, limiting pollination, seed dispersal and control of invertebrate populations.

The loss, fragmentation and degradation of vegetation in the ecological community are increasingly associated with rural residential and urban development. This pressure is current and ongoing, with the expectation that the Sydney North West and South West Growth Centres for instance will accommodate up to half a million additional people in the next 30 years (NSW Government, 2013).

In areas north of Penrith and south of Richmond, where the majority of the ecological community occurs, most patches are located on land zoned – or in some cases proposed to be zoned – as Primary Production Small Lots (RU4) (Penrith City Council, 2010; Penrith City Council, 2013).¹⁴ The patches of the ecological community at these sites are likely to be severely impacted (due to clearance, spread of weeds and under-scrubbing).

In addition to direct loss through clearance, threats associated with urbanisation and rural residential development include predation and competition by domestic and pest animals, spread of weeds and disease, under-scrubbing (where under storey vegetation is cleared or flattened), arson, and changes to hydrology and pollution through wastewater management practices.

Because the ecological community has contracted in extent, this makes it more susceptible to the impacts of climate change, which is expected to cause increasing damage to the ecological

¹³ Patch size analysis excludes records of <0.5 ha as these are considered to be an artefact of the mapping process and not representative of actual remnants (refer to Tozer et al. (2010) for more information).

¹⁴ Stage 1 of the Penrith Local Environmental Plan (LEP) 2010 has been finalised, but Stage 2 (which deals with areas not covered in Stage 1) is currently awaiting gazettal.

community, through changed temperature and rainfall patterns. In addition to direct stress on plants and animals, this is likely to result in changed habitat features and food availability, as well as being expected to compound other threats such as weeds and altered fire regimes.

In summary, the ecological community is considered to be ‘very restricted’ in geographic distribution (based on median patch size¹⁵), and is subject to a range of ongoing threats that are likely to cause further clearance, fragmentation and loss of integrity – the combination of which make it possible the ecological community could be lost in the ‘near future’. Therefore, the ecological community is **eligible** for listing as **endangered** under this criterion.

Criterion 3 - Loss or decline of functionally important species

Although studies that identify functionally important species in the Castlereagh Scribbly Gum and Agnes Banks Woodlands are not available, it is known that the relationship between many species is important for maintaining ecosystem function.

Plant diversity in the ecological community is important as it ensures food and habitat for a range of fauna; habitat and microclimatic control for other plant species; and maintenance of the abiotic aspects of the ecosystem. Decline in plant diversity in the ecological community correlates with several threatened species of plants, including at least six protected under the EPBC Act: *Acacia bynoeana* (Bynoe's wattle), *Allocasuarina glareicola*, *Dillwynia tenuifolia*, *Persoonia nutans* (nodding geebung), *Micromyrtus minutiflora*, *Pultenaea parviflora* and possibly *Grevillea parviflora* subsp. *parviflora* (NSW Scientific Committee, 2000, 2010).

Benefits to fauna of diverse and healthy plant assemblages within the ecological community include provision of food for nomadic nectarivores during winter (Leary, 2007) and as hosts for many species of invertebrates (Benson & McDougall, 1998). However, the ability of the ecological community to provide these resources has been diminished in areas where the ecological community is in poor condition or consists entirely of regrowth (e.g. as a result of substantial disturbance). For example, large old eucalypts are a critical resource for several fauna species due to their production of hollows. Many hollow-bearing trees have been lost from patches of the ecological community and the long delay in replacing them limits the capacity for the ecological community to recover.

Fragmentation of the ecological community has also reduced its ability to support a natural and complete faunal assemblage, likely to include pollinators, seed-dispersers and soil engineers. Ground-dwelling mammals are noticeably absent from the ecological community, as are many woodland birds (Jones et al., 1997; Leary, 2007). The absence or rarity of some of these species in the ecological community has flow-on effects to other components. For example, eucalypt dieback in eastern Australia is usually caused by insect attack. In some locations a healthy bird community has been observed to remove 50–70% of leaf-feeding insects, thus playing an important role in maintaining the canopy of the ecological community (Ford, 1989 in Barrett, 2000). Where such an assemblage of birds is reduced or missing, eucalypts are at higher risk of insect attack and dieback.

Similarly, the observed loss of mammal species from the Cumberland Plain reserves (including reserved areas of the ecological community) is likely to have had a negative effect on ecological function, through the reduction of pollination, seed dispersal and soil engineering (Leary, 2007).

¹⁵ The Threatened Species Scientific Committee's *Guidelines for Nominating and Assessing the Eligibility for Listing of Ecological Communities as Threatened* state that: 'Average patch size would typically use the mean value, unless the median value is smaller, in which case the median value is to be used for the assessment of eligibility under this criterion.'

Although significant threats will have impacted upon functionally important species within the Castlereagh Scribbly Gum and Agnes Banks Woodlands, and continue to do so, specific data related to the decline of such species in this ecological community are not available. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 3.

Criterion 4 - Reduction in community integrity

This ecological community occurs almost exclusively in the highly cleared Cumberland sub-region, with clearing and encroaching development the primary cause of loss of its integrity. The remaining area is severely fragmented and many remnants have been and remain subject to impacts from pastoral activities, mining, feral invasion and urbanisation. Loss of structural integrity has also occurred due to under-scrubbing, inappropriate fire regimes and a variety of other impacts from rural-residential development and recreational use. These are causing patches of the ecological community to degrade to an extent that they may no longer meet the condition thresholds.

While little specific information is available on the roles played by species that were formerly present, it is likely that the ecological function of the Castlereagh Scribbly Gum and Agnes Banks Woodlands has been compromised by the loss of many of its soil engineers, pollinators and seed dispersers. The intractability of such issues reduces the likelihood of recovery of the ecological community.

Reduction in integrity through clearing, fragmentation and under-scrubbing

The ecological community has been extensively cleared across its range (for a variety of purposes, including mining, agriculture and urban development), severely compromising its integrity. The total remaining extent is estimated to be approximately 49% of the original extent (a loss of around 51%). This figure may be an underestimate as further clearance is likely to have occurred since the data were collected. Such a decline is likely to have caused a fundamental change in function both within the boundaries of the community as well as in the role it plays in the wider landscape. As noted under criterion 2, it is likely that loss and fragmentation through land clearing will continue in the immediate and longer term future, as indicated by a number of development plans (based on current local government zoning and planning, the growth plan for the nearby North West Growth Centre and population growth projected by the NSW Department of Planning) (NSW Government, 2013).

The majority of the remaining remnants are small and isolated, with 78% of patches being less than 10 ha in size (analysis of data from Tozer et al., 2006).¹⁶ This fragmentation (and resulting loss of connectivity) is likely to reduce rates of survival and dispersal by individuals, interrupt population processes such as genetic exchange as well as other ecological processes that sustain the ecological community. Fragmentation also increases the proportion of the remaining area of the ecological community that is vulnerable to threats from predation, degradation of habitat, changed microclimates, altered fire regimes and weed incursion (known as ‘edge effects’). In addition, the limited dispersal ability of the dominant canopy eucalypt species restricts their ability to support regeneration of the ecological community where the gaps between fragments are wide.

Declining integrity and connectivity of native vegetation due to fragmentation are widely recognised issues impacting native species in the western Sydney region (NSW DECCW, 2010). Different species and faunal groups are impacted in different ways, with some able to persist in remnants, while others disappear altogether. Ground-dwelling mammals are

¹⁶ Patch size analysis excludes records of < 0.5 ha as these are considered to be an artefact of the mapping process and not representative of actual remnants.

noticeably absent from the ecological community, as are many woodland birds (Jones et al., 1997; Leary, 2007). Larger patches are particularly important for retaining woodland birds, herpetofauna and mammals as these patches are less easily monopolised by aggressive fauna and weeds. Conversely, small, fragmented remnants can be more susceptible to catastrophic events (such as extreme weather events), weed and feral animal incursion, and potential impacts from climate change (NSW DECCW, 2010).

Reduction in integrity through altered fire regimes

While some areas of the ecological community are being managed with fire regimes that aim to protect biodiversity (NSW NPWS, 2006, 2007), historic fire management practices and those on private lands are likely to have ongoing negative impacts on the ecological community. Remnants are also at risk due to arson and accidental ignition of fires (Steenbeeke, pers. comm., 2014).

Too frequent fire is likely to have modified the structural and floristic characteristics of the ecological community, and contributed to a loss of species diversity (e.g. due to the reduced amount of time for some species to mature and set seed, or a loss of essential habitat elements). Some species are particularly sensitive to frequent fire, including the nationally endangered nodding geebung and *Allocasuarina glareicola* (NSW DECC, 2008).

In addition, the NSW Scientific Committee (2010) noted that low seedling recruitment observed in the Castlereagh Scribbly Gum Woodland component is thought to be associated with too frequent fire and extended dry periods.

Reduction in integrity through weed invasion

Weed invasion is an ongoing threat that contributes to the degradation of the Castlereagh Scribbly Gum and Agnes Banks Woodlands. The highly invasive weeds are able to spread into relatively intact patches of native vegetation, while other species establish after some form of disturbance. Disturbances and invasion are facilitated by fragmentation of remnants as well as altered hydrological flows and increased nutrient run-off that occurs as a result of increasing urbanisation. Once established weeds adversely affect native species through direct competition or by altering ecosystem processes, such as disrupting food webs or dispersal agents (as when natural pollinators visit weeds rather than native species) or changing fire regimes (for instance the establishment of more flammable invasive grass species into a patch).

There are at least 34 emerging weeds reported in the Hawkesbury-Nepean region (NSW DECCW, 2010). The high number of emerging weeds, along with the current invasion of several species (including African lovegrass (*Eragrostis curvula*), Coolatai grass (*Hyparrhenia hirta*) and African olive (*Olea europaea* subsp. *cuspidata*)) highlights the ongoing threat of weeds to the integrity of the ecological community.

Reduction in integrity through introduced animals and aggressive native species

Similar to invasive plant species, invasive animals compete with native species for food, nest sites and other resources. Domestic animals (such as cats and dogs) and pest animals (such as foxes, rats, house mice and rabbits) are likely to have contributed to the decline in woodland birds, reptiles and small mammals in remnants of the ecological community. Aggressive native species (particularly birds) pose similar problems for native species, particularly in smaller remnants or poor condition remnants, and on the edges of larger remnants of this ecological community (Jones et al., 1997; NSW DECCW, 2010). Such species use resources and behave aggressively to native species, inhibiting proper functioning and retention of native faunal components in the ecological community.

Reduction in integrity through changes in faunal components and function

The integrity of the ecological community is being impacted through: changes to vegetation structure; loss of habitat elements; loss of fauna and disruptions to ecological function.

As a result of impacts (such as those from clearing, fragmentation, mowing and too frequent fire) the structure of vegetation across the ecological community has been, and continues to be modified. Impacts include fewer large, old trees (which limits ecological community's provision of specific habitat features such as hollows) and removal of mid storey and ground cover components. The loss of these features is likely to continue and compromise the ecological community's capacity to support key fauna – such as hollow-nesting parrots and gliders, small woodland birds, ground-dwelling mammals and herpetofauna.

Changes in faunal components, such as increases in aggressive native birds (e.g. *Cacatua galerita* (sulphur-crested cockatoo), *Manorina melanocephala* (noisy miner)) and introduced birds (e.g. the common myna (*Acridotheres tristis*)), are also impacting the ecological community, particularly in the smaller patches (Jones et al., 1997; NSW DECCW, 2010). These species drive out many of the smaller woodland bird species through their aggressive behaviour and competition for resources.

With the reduction and loss of native species, such as insectivorous woodland birds, arboreal and ground-dwelling mammals, important functions are also lost, including consumption of herbivorous insects (possibly helping to prevent tree dieback), pollination, seed dispersal and soil modification/conditioning.

Many remnants of the ecological community are now unlikely to support a natural and complete faunal assemblage, due to a loss of large old hollow bearing trees, modifications to the understorey, and isolation and fragmentation (Lindenmayer et al., 2006). However, such remnants may still be of value to disturbance-tolerant or highly mobile species, particularly as stepping-stone habitat in otherwise cleared or developed landscape (Doerr et al., 2010).

Reduction in integrity through climate change

As described in Appendix C *Description of Threats*, climate change is likely to compromise the integrity of the community both directly and by altering the survival rates of constituent species. It is also likely to interact with other threats, such as changed fire regimes or the invasion of weeds. The long generation time and limited dispersal ability of some key species, such as the canopy eucalypts, together with the unique position of the Cumberland Plain, is likely to limit adaptation through range shift.

Reduction in integrity through urbanisation

In addition to the direct threats of urban development such as vegetation clearance, the ecological community is also under threat from urban and peri-urban activities on adjacent land. A surrounding landscape of modified land provides greater opportunity for weeds and exotic species to encroach into remnants, especially if they are small and narrow. Damage also occurs through:

- increased soil phosphorous levels from fertiliser use
- dumped refuse and garden waste
- stormwater and sewer discharges
- predation on native fauna by domestic pets and feral animals and
- recreational activities (i.e. trail bike and 4WD use).

This pressure is likely to increase in the future.

Restorability of the ecological community

Due to the reduction in community integrity that has already occurred, including a substantial reduction in extent, the ecological community cannot be restored to its pre-1750 extent and condition. All remnants of the ecological community will require ongoing active management,

with some requiring substantial restoration efforts (such as weed suppression, feral animal control, exclusion of domestic species and reintroduction/planting of native species) to safeguard their component species and function. For the best restoration outcomes active management would also need to include linking remnants of the ecological community with other remnants or other native vegetation.

Large areas of the remaining extent are zoned for urban, peri-urban or industrial land uses and the expense in acquiring these for conservation purposes can be prohibitive (NSW DECCW, 2010). Therefore land owners are an essential element of restoration success.

Fragmentation of the ecological community is also a factor impacting restorability, with urban areas and roads dividing remnant vegetation. This fragmentation is likely to result in ongoing loss of species that cannot persist in small patches. Natural regeneration is limited by the short distance that tree canopy seeds are dispersed, as well as the overall pattern of clearing across the region, limiting sources of genetic material. Competition for light and nutrients due to the spread of weeds limits the survival and regeneration of understorey species while adequate controls are not in place.

The loss of fauna is also region-wide problem, further impacting recovery. The associated loss of services provided by this fauna also compromises the regeneration of the native vegetation.

Summary

Substantial clearing, severe fragmentation, urbanisation, weed invasion, altered fire regimes, changes to vegetation structure and loss of faunal components have substantially reduced the integrity of the ecological community across its range. These losses are compounded by climate change, and together with a range of ecological characteristics of the community, as well as the nature of the ongoing threats, severely limit the likelihood of recovery.

The change in integrity experienced by the ecological community across most of its geographic distribution is **severe** and regeneration is unlikely in the near future. Therefore, the ecological community is **eligible** for listing as **endangered** under this criterion.

Criterion 5 - Rate of continuing detrimental change

Although there has been continuing detrimental change to the ecological community, data are insufficient to determine an overall rate. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 5.

Criterion 6 - Quantitative analysis showing probability of extinction

There are no quantitative data available to assess this ecological community under this criterion. As such there is **insufficient information to determine the eligibility** of the ecological community for listing under any category of Criterion 6.

APPENDIX F - EXISTING MANAGEMENT AND RECOVERY PLANS

A number of existing plans relate to management and/or recovery of the ecological community or its component species. These prescriptions were current at the time of publishing. Please refer to the relevant agency's website for any updated versions or new information that has been published.

Plans prepared for the management and or recovery of Castlereagh Scribbly Gum and Agnes Banks Woodlands (or its component vegetation units) include:

- NSW National Parks and Wildlife Service (1999). *Castlereagh, Agnes Banks and Windsor Downs Nature Reserves Plan of Management*. Accessed 18 August 2014. Available on the internet at:
<http://www.environment.nsw.gov.au/resources/parks/pomFinalAgnesCastlereagh.pdf>
- NSW Department of Environment and Conservation (2005). *Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland*. Sydney. Accessed 14 August 2014. Available on the internet at:
<http://www.environment.nsw.gov.au/threatenedspecies/CumberlandPlainManagementGuidelines.htm>
- NSW Department of Environment, Climate Change and Water (2010). *Cumberland Plain Recovery Plan*. Author: Sydney. [Addresses Agnes Banks Woodland, does not include Castlereagh Scribbly Gum Woodland]. Accessed 19 August 2014. Available on the internet at:
<http://www.environment.nsw.gov.au/resources/threatenedspecies/20100501CumberlandPlain.pdf>

Recovery plans prepared for species occurring in Castlereagh Scribbly Gum and Agnes Banks Woodlands include:

- NSW Department of Environment and Conservation (2005). Draft Recovery Plan for the Green and Golden Bell Frog (*Litoria aurea*). DEC NSW, Hurstville, NSW. Accessed 19 August 2014. Available on the internet at:
<http://www.environment.nsw.gov.au/resources/nature/recoveryplangreengoldbellfrogdraft.pdf>
- NSW Department of Environment and Conservation (2005). *Persoonia nutans* R Br (Nodding Geebung) Recovery Plan. NSW Department of Environment and Conservation, Hurstville NSW.
- NSW Department of Environment, Climate Change and Water (2009). Draft National Recovery Plan for the Grey-headed Flying-fox *Pteropus poliocephalus*. Prepared by Dr Peggy Eby. Department of Environment, Climate Change and Water NSW, Sydney. Accessed 14 August 2014. Available on the internet at:
<http://www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpfflyingfox.pdf>
- QLD Department of Environment and Resource Management (2011). National recovery plan for the large-eared pied bat *Chalinolobus dwyeri*. Report to the Department of Sustainability, Environment, Water, Population and Communities, Canberra. Accessed 14 August 2014. Available on the internet at:
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- VIC Department of Natural Resources and Environment (1999). *Regent Honeyeater Recovery Plan 1999-2003*. Accessed 14 August 2014. Available on the internet at: <http://www.environment.gov.au/resource/regent-honeyeater-xanthomyza-phrygia-recovery-plan-1999-2003>

SPRAT profiles prepared for species occurring in Castlereagh Scribbly Gum and Agnes Banks Woodlands as at August 2014 include:

- *Allocasuarina glareicola* and
- *Dasyurus maculatus maculatus* (SE mainland population).

SPRAT profiles are available on the internet by searching the SPRAT database: <http://www.environment.gov.au/sprat>.

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