SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
FLORA SPECIES					
Acacia bynoeana	Bynoe's Wattle	E	V	The species is found in central eastern NSW, from the Hunter District (Morisset) south to the Southern Highlands and west to the Blue Mountains. It has recently been found in the Colymea and Parma Creek areas west of Nowra (DECC 2007). It is found in heath and dry sclerophyll forest, typically on a sand or sandy clay substrate, often with ironstone gravels (DECC 2007). The species seems to prefer open and sometimes slightly disturbed sites (DECC 2007). Characteristic overstorey species include: *Corymbia gummifera*, *Eucalyptus haemastoma*, *E. gummifera, E. parramattensis*, *E. sclerophylla*, *Banksia serrata* and *Angophora bakeri*. Shrubs often associated with the species include *B. spinulosa*, *B. serrata, A. oxycedrus*, *A. myrtifolia* and *Kunzea* spp. (Winning 1992; James 1997). It flowers from September to March and fruits mature in November.	Unlikely
Acacia pubescens	Downy Wattle	V	V	Associated with on Cumberland Plains Woodlands, Shale / Gravel Forest and Shale / Sandstone Transition Forest. Clay soils, often with ironstone gravel (NPWS 1997).	No
Acacia terminalis subsp. *terminalis*	Sunshine Wattle	E	-	Very limited distribution between Botany Bay to the northern foreshore of Port Jackson. Recent collections have only been made from the Quarantine Station, Clifton Gardens, Dover Heights, Parsely Bay, Nielson Park, Cooper Park, Chifley and Watsons Bays.	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Allocasuarina glareicola	*Allocasuarina glareicola*	E	E	*Allocasuarina glareicola* is primarily restricted to the Richmond district on the north-west Cumberland Plain, with an outlier population found at Voyager Point. It grows in Castlereagh woodland on lateritic soil (DECC 2007).	No
Asterolasia elegans	*Asterolasia elegans*	E	E	*Asterolasia elegans* is restricted to a few localities on the NSW Central Coast north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs. It is found in sheltered forests on mid- to lower slopes and valleys, in or adjacent to gullies (DECC 2007).	No
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Occurs in grassy sclerophyll woodland, often growing in well-structured clay loams or sandy soils south from Swansea (DECC 2007). Usually in sheltered moist places, in areas of increased sunlight. It flowers from September to November (DECC 2007).	No
Callistemon linearifolius	*Netted Bottlebrush*	V	-	Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Grows in dry sclerophyll forest on the coast and adjacent ranges (DECC 2007).	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Cryptostylis hunteriana	Leafless Tongue Orchid	V	V	It is known from a range of vegetation communities including swamp-heath and woodland (DECC 2007). The larger populations typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*E. sieberi*), Red Bloodwood (*Corymbia gummifera*) and Black Sheoak (*Allocasuarina littoralis*); where it appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*) (DECC 2007). Bell (2001) has identified Coastal Plains Scribbly Gum Woodland and Coastal Plains Smoothed-barked Apple Woodland as potential habitat on the Central Coast. Flowers between November and February, although may not flower regularly (DECC 2007; Bell 2001).	Unlikely
Darwinia biflora		V	V	Erect or spreading shrub to 80cm high. Associated with habitats where weathered shale capped ridges intergrade with Hawkesbury Sandstone, where soils have a higher clay content (NPWS 1997, Harden 1993).	Unlikely
Darwinia peduncularis		V	-	Dry sclerophyll forest on sandstone hillsides and ridges. A detailed description is provided in Harden 1994.	Unlikely
Deyeuxia appressa		E	E	Associated with wet ground (Harden 1994). Known from a single historical record made in 1930 (NPWS 2002).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Dillwynia tenuifolia		V	V	It has a core distribution within the Cumberland Plain, where it may be locally abundant within scrubby, dry heath areas within Castlereagh Ironbark Forest and Shale/Gravel Transition Forest on tertiary alluvium or laterised clays (DECC 2007). May also be common in the ecotone between these areas and Castlereagh Scribbly Gum Woodland (*ibid.*). Flowers sporadically from August to March.	No
Epacris purpurascens var. *purpurascens*		V	-	Sydney Sandstone Gully Forest and wet heath with strong clay influences (NPWS 1997). Recorded between Gosford in the north to Avon Dam in the south. Found in a range of habitats, but most have a strong shale soil influence. Killed by fire and re-establishes from soil stored seed (DECC 2007).	Unlikely
Eucalyptus camfieldii	Heart-leaved Stringybark	V	V	Associated with shallow sandy soils bordering coastal heath with other stunted or mallee eucalypts, often in areas with restricted drainage and in areas with laterite influenced soils, thought to be associated with proximity to shale (DECC 2007). Flowering is irregular and has been recorded throughout the year (DECC 2007).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Galium australe	Tangled Bedstraw	E	-	Once regarded as presumed extinct in NSW, this species is now known from the Towamba Valley near Bega, Lake Yarrunga near Kangaroo Valley, Cullendulla Creek Nature Reserve near Batemans Bay, Conjola National Park, Swan Lake near Swanhaven, and the Big Hole in Deua National Park. It was recorded historically from the Clyde River near Batemans Bay and the Mongarlowe area near Braidwood. The species also occurs beside Lake Windemere in the Australian Capital Territory at Jervis Bay. In NSW Tangled Bedstraw has been found in moist gullies of tall forest, *Eucalyptus tereticornis* forest, coastal Banksia shrubland, and *Allocasuarina nana* heathland.	No
Genoplesium baueri	Bauer's Midge Orchid	V	-	The species has been recorded from locations between Nowra and Pittwater and may occur as far north as Port Stephens. About half the records were made before 1960 with most of the older records being from Sydney suburbs including Asquith, Cowan, Gladesville, Longueville and Wahroonga. No collections have been made from those sites in recent years. The species has been recorded at locations now likely to be within the following conservation reserves: Berowra Valley Regional Park, Royal National Park and Lane Cove National Park. May occur in the Woronora, O'Hares, Metropolitan and Warragamba Catchments. Grows in sparse sclerophyll forest and moss gardens over sandstone. Flowers Dec to Mar.	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Genoplesium plumosum	Tallong Midge Orchid	E	E	The known locations of this species are characterised by having very shallow soils overlying flat to gently sloping sheets of sandstone. The vegetation is low scrub/heath dominated by Violet Kunzea (*Kunzea parvifolia*), Common Fringe-myrtle (*Calytrix tetragona*) and Eggs and Bacon (*Dillwynia* sp.), with scattered shrubs of Hairpin Banksia (*Banksia spinulosa*), Black She-oak (*Allocasuarina littoralis*), Bitter Cryptandra (*Cryptandra amara*), Slender Wattle (*Acacia elongata*), Narrow-leaf Geebung (*Persoonia linearis*), Coral Heath (*Epacris microphylla*) and a Beard Heath (*Leucopogon* sp.) (NPWS 2002). At all sites the habitat is surrounded by Brittle Gum (*Eucalyptus mannifera*) and Scribbly Gum (*E. rossii*) low woodland, with Argyle Apple (*E. cinerea*) present at some sites (*ibid*.).	Unlikely
Grammitis stenophylla	Narrow-leaf Finger Fern	E	-	In NSW it has been found on the south, central and north coasts and as far west as Mount Kaputar National Park near Narrabrai (DECC 2007). Moist places, usually near streams, on rocks or in trees, in rainforest and moist eucalypt forest (DECC 2007).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Grevillea caleyi	Caley's Grevillea	E	E	The natural distribution of *Grevillea caleyi* is centred approximately on the northern Sydney suburb of Terrey Hills and also includes the areas of Duffys Forest, Belrose and Ingleside (DECC 2007). Occurs on the ridgetop between elevations of 170 to 240 m asl, in association with laterite soils and a vegetation community of open forest, generally dominated by *Eucalyptus sieberi* and *E. gummifera* (DECC 2007). Occasionally, *G. caleyi* occurs at the boundaries of the laterite soils in low open forests of *E. gummifera* and *E. haemastoma* (DECC 2007). A recent record from Middle Brother near Port Macquarie is thought to be a cultivated specimen and recent searches have failed to find any *G. caleyi* near this record (DECC 2007).	No
Haloragodendron lucasii		E	E	Associated with low woodland on sheltered slopes near creeks on moist loamy sand on bench below small sandstone cliff lines, with continuous seepage.	Unlikely
Hibbertia puberula		E	-	Has not been seen for over 40 years. Early records of this species are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains.	No
Lasiopetalum joyceae		V	-	Ridgetop woodland, in heath, woodland or open scrub, often with a clay influence (NPWS 1997).	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Leptospermum deanei		V	V	Associated with lower hillsides & riparian vegetation communities and woodlands on Hawkesbury Sandstones (in NPWS 2003) and alluvial areas along the creeks (DECC 2007). Currently known to occur in areas such as Pennant Hills Park, Kuring-gai Chase, Garigal and Marramarra National Parks.	Unlikely
Melaleuca biconvexa	Biconvex Paperbark	V	V	Associated with damp habitats, such as Coastal Narrabeen Moist Forest, Riparian Melaleuca Swamp Woodland (LMCC 2001). This species may occur in dense stands forming a narrow strip adjacent to watercourses, in association with other *Melaleuca* species or as an understorey species in wet forest (NSW Scientific Committee 1998). Flowering occurs over just 3-4 weeks in September and October (DECC 2007).	No
Melaleuca deanei	Deane's Paperbark	V	V	Found in heath on sandstone and also associated with woodland on broad ridge tops and slopes on sandy loam and lateritic soils (DECC 2007).	No
Microtis angusii	Angus's Onion Orchid	E	E	Currently only known from one site at Ingleside in the north of Sydney (DECC 2007). The dominant species occurring on the highly disturbed Ingleside site are introduced weeds *Hyparrhenia hirta* (Coolatai grass) and *Acacia saligna* (*ibid.*). Most likely associated with the Duffys Forest vegetation community (*ibid.*). Exists as subterranean tubers during most of the year, producing leaves and then flowering stems in late winter and spring and flowers from May to October (*ibid.*). By summer, the above ground parts have withered leaving no parts above ground (*ibid.*).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Pelargonium sp. Straitellum (G.W. Carr 10345)		E		In NSW, *Pelargonium* sp. Straitellum (G.W. Carr 10345) is known from the Southern Tablelands (PlantNet 2011). Otherwise, only known from the shores of Lake Omeo near Benambra in Victoria where it grows in cracking clay soil that is probably occasionally flooded (Walsh & Entwisle 1999).	No
Persoonia hirsuta	Hairy Geebung	E	E	*Persoonia hirsuta* occurs from Singleton in the north, south to Bargo and the Blue Mountains to the west (DECC 2007). It grows in dry sclerophyll eucalypt woodland and forest on sandstone (PlantNet 2011).	Unlikely
Persoonia nutans	Nodding Geebung	E	E	Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. The species has a disjunct distribution, with the majority of populations (and 99% of individuals) occurring in the north of the species range in the Agnes Banks, Londonderry, Castlereagh, Berkshire Park and Windsor Downs areas. Core distribution occurs within the Penrith, and to a lesser extent Hawkesbury, local government areas, with isolated and relatively small populations also occurring in the Liverpool, Campbelltown, Bankstown and Blacktown local government areas (OEH 2011b). Confined to aeolian and alluvial sediments and occurs in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland (OEH 2011b).	Unlikely
Pimelea curviflora var. *curviflora*		V	V	Occurs on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands (OEH 2011b)	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Pimelea spicata	Spiked Rice-flower	E	E	In western Sydney, *Pimelea spicata* occurs on an undulating topography of well structured clay soils, derived from Wianamatta shale (DECC 2007). It is associated with Cumberland Plains Woodland (CPW), in open woodland and grassland often in moist depressions or near creek lines (*Ibid.*). Has been located in disturbed areas that would have previously supported CPW (*Ibid*.).	No
Pomaderris prunifolia	*P. prunifolia* (Population Parramatta, Auburn, Strathfield and Bankstown Local Government Areas)	E1	-	Shrub 1-3 metres high, stems with rusty stellate hairs. The species has been recorded from the tablelands and slopes of New South Wales, but is generally uncommon. The only recent collection from this area is from Rydalmere, where only 3 plants occur, on a road reserve adjacent to industrial sites.	No
Prostanthera junonis	Somersby Mintbush	E	E	Likely to be restricted to the Somersby plateau, found on the Somersby and Sydney Town soil landscapes (NPWS 2000). Occurs predominantly in the low woodland component of the Hawkesbury Sandstone Complex dominated by *Eucalyptus haemastoma* with *Banksia ericifolia* or *B. serrata* in the understorey (*ibid.*). Has been found in the ecotone between low woodland and open forest or the open scrub\heath components (*ibid.*). Not found in sedgelands or *Allocasuarina distyla* open heath (*ibid*.).	No
Prostanthera marifolia	Seaforth Mintbush	CE	CE	Occurs on deeply weathered clay-loam soils associated with ironstone and scattered shale lenses, a soil type which only occurs on ridge tops and has been extensively urbanised.	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Pterostylis nigricans	Dark Greenhood	V	-	The Dark Greenhood occurs in north-east NSW north from Evans Head, and in Queensland. Coastal heathland with Heath Banksia (*Banksia ericifolia*), and lower-growing heath with lichen-encrusted and relatively undisturbed soil surfaces, on sandy soils (OEH 2011b).	No
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Terrestrial orchid predominantly found in Hawkesbury Sandstone Gully Forest growing in small pockets of soil that have formed in depressions in sandstone rock shelves (NPWS 1997). Known from Georges River National Park, Ingleburn, Holsworthy, Peter Meadows Creek, St Marys Tower (NSW Scientific Committee 1999).	No
Sarcochilus hartmannii		V	V	Associated with cliff faces on steep narrow ridges supporting sclerophyll forest, growing in clefts on volcanic rock, occasionally epiphytic on grass trees at altitudes of 500 to 1000masl (Bishop 1996).	No
Streblus penduliuns	Siah's Backbone,		E	Siah’s Backbone is a tree or large shrub that grows to 6 m in height. Siah's Backbone occurs from Cape York Peninsula to Milton, south-east New South Wales (NSW), as well as Norfolk Island. On the Australian mainland, Siah’s Backbone is found in warmer rainforests, chiefly along watercourses. The altitudinal range is from near sea level to 800 m above sea level. The species grows in well developed rainforest, gallery forest and drier, more seasonal rainforest (ATRP 2010).	No

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		TSC ACT	EPBC ACT		
Syzygium paniculatum	Magenta Lilly Pilly	E	V	This species occupies a narrow coastal area between Bulahdelah and Conjola State Forests in NSW. On the Central Coast, it occurs on Quaternary gravels, sands, silts and clays, in riparian gallery rainforests and remnant littoral rainforest communities (Payne 1997). In the Ourimbah Creek valley, *S. paniculatum* occurs within gallery rainforest with *Alphitonia excelsa, Acmena smithii, Cryptocarya glaucescens, Toona ciliata, Syzygium oleosum* with emergent *Eucalyptus saligna*. At Wyrrabalong NP, *S. paniculatum* occurs in littoral rainforest as a co-dominant *with Ficus fraseri, Syzygium oleosum, Acmena smithii, Cassine australe*, and *Endiandra sieberi*. Payne (1991) reports that the species appears absent from Terrigal formation shales, on which the gully rainforests occur. *S. paniculatum* is summer flowering (November-February), with the fruits maturing in May (DECC 2007).	Unlikely
Tetratheca glandulosa	Glandular Pink-bell	V	V	Associated with ridgetop woodland habits on yellow earths (Travers Morgan 1991) also in sandy or rocky heath and scrub (NPWS 1997). Often associated with sandstone / shale interface where soils have a stronger clay influence (NPWS 1997). Flowers July to November.	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Tetratheca juncea	Black-eyed Susan	V	V	Occurs on predominantly low nutrient soils with a dense grassy understorey of grasses although it has been recorded in heathland and moist forest (DECC 2007). It is associated with dry open forest or woodland habitats dominated by *Corymbia gummifera*, *E. capitellata*, *E. haemastoma* and *Angophora costata* (Payne 1993). *Themeda australis* is generally the dominant ground cover (Payne 1993). *T. juncea* also displays a preference for southern aspect slopes, although is slopes with different aspects (DECC 2007). Flowers July to December.	No
Triplarina imbricata	Creek Triplarina	E	E	Found only in a few locations in the ranges south-west of Glenreagh and near Tabulam in north-east NSW. Along watercourses in low open forest with Water Gum (Tristaniopsis laurina) (DECC 2007).	No
Wahlenbergia multicaulis	Tadgell's Bluebell population, Auburn, Bankstown, Strathfield and Canterbury local government areas	E1	-	Found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open. In Western Sydney most sites are closely aligned with the Villawood Soil Series, which is a poorly drained, yellow podsolic extensively permeated with fine, concretionary ironstone (laterite). However, the sites in Hornsby LGA are on the 'Hawkesbury' soil landscape.	No
Wilsonia backhousei		V	-	Grows in coastal saltmarshes in the Sydney Region and Jervis Bay (Harden 1991)	No

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		TSC ACT	EPBC ACT		
Zannichellia palustris	Zannichellia palustris	E		*Zannichellia palustris* inhabits shallow, still to slowly moving, waterbodies which contain either fresh or brackish waters (Greenwood 2001). The species appears to prefer ephemeral habitats which dry out completely. Winning (1992) suggests the species prefers fresh to brackish water adjacent to tidal estuaries, as both known populations occurred in previously estuarine areas which had been separated from tidal flows by control structures.	No
FUNGI					
Camarophyllopsis kearneyi		E1	-	Known only from its type locality in Lane Cove Bushland Park in the Lane Cove local government area in the Sydney metropolitan region.	Unlikely
Hygrocybe anomala var. ianthinomarginata		V	-	Occurs in gallery warm temperate forests dominated by Lilly Pilly (Acmena smithii), Grey Myrtle (Backhousia myrtifolia), Cheese Tree (Glochidion ferdinandi) and Sweet Pittosporum (Pittosporum undulatum).	Unlikely
Hygrocybe aurantipes		V	-	See Hygrocybe anomola var. ianthinomarginata	Unlikely
Hygrocybe austropratensis		E1	-	See Hygrocybe anomola var. ianthinomarginata	Unlikely
Hygrocybe collucera		E1	-	See Hygrocybe anomola var. ianthinomarginata	Unlikely
Hygrocybe griseoramosa		E1	-	See Hygrocybe anomola var. ianthinomarginata	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Hygrocybe lanecovensis		E1	-	See Hygrocybe anomola var. ianthinomarginata	Unlikely
Hygrocybe reesiae		V	-	See Hygrocybe anomola var. ianthinomarginata	Unlikely
Hygrocybe rubronivea		V	-	See *Hygrocybe anomola var. ianthinomarginata*	Unlikely
FISH					
Maccullochella peelii peelii	Murray Cod	-	V	Widespread throughout the Murray-Darling system originally being found in virtually all waterways of that system. Habitat varies greatly, from quite small clear, rocky, upland streams with riffle and pool structure on the upper western slopes of the Great Dividing Range to large, meandering, slow-flowing, often silty rivers in the alluvial lowland reaches of the Murray-Darling Basin. Prefer deep holes with cover in the form of large rocks, fallen trees, stumps, clay banks and overhanging vegetation.	No
Macquarie australasica	Macquarie Perch	-	E	Habitat for the Macquarie perch is bottom or mid-water in slow-flowing rivers with deep holes, typically in the upper reaches of forested catchments with intact riparian vegetation. Macquarie perch also do well in some upper catchment lakes. In some parts of its range, the species is reduced to taking refuge in small pools which persist in midland–upland areas through the drier summer periods.	No

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		TSC ACT	EPBC ACT		
Prototroctes maraena	Australian Grayling	-	V	The historic distribution of the Australian Grayling included coastal streams from the Grose River southwards through NSW, Vic. and Tas. On mainland Australia, this species has been recorded from rivers flowing east and south of the main dividing ranges. This species spends only part of its lifecycle in freshwater, mainly inhabiting clear, gravel-bottomed streams with alternating pools and riffles, and granite outcrops but has also been found in muddy-bottomed, heavily silted habitat. Grayling migrate between freshwater streams and the ocean and as such it is generally accepted to be a diadromous (migratory between fresh and salt waters) species.	No
AMPHIBIANS					
Heleioporus australiacus	Giant Burrowing Frog	V	V	Forages in woodlands, wet heath, dry and wet sclerophyll forest (Ehmann 1997). Associated with semi-permanent to ephemeral sand or rock based streams (Ehmann 1997), where the soil is soft and sandy so that burrows can be constructed (Environment Australia 2000).	No

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		TSC ACT	EPBC ACT		
Litoria aurea	Green and Golden Bell Frog	E	V	This species has been observed utilising a variety of natural and man-made waterbodies such as coastal swamps, marshes, dune swales, lagoons, lakes, other estuary wetlands, riverine floodplain wetlands and billabongs, stormwater detention basins, farm dams, bunded areas, drains, ditches and any other structure capable of storing water (DECC 2007). Fast flowing streams are not utilised for breeding purposes by this species . Preferable habitat for this species includes attributes such as shallow, still or slow flowing, permanent and/or widely fluctuating water bodies that are unpolluted and without heavy shading (DECC 2007). Large permanent swamps and ponds exhibiting well-established fringing vegetation (especially bulrushes–Typha sp. and spikerushes–Eleocharis sp.) adjacent to open grassland areas for foraging are preferable (Ehmann 1997; Robinson 1993). Ponds that are typically inhabited tend to be free from predatory fish such as Mosquito Fish (Gambusia holbrooki) (DECC 2007).	Unlikely
Litoria littlejohni	Littlejohn's Tree Frog		V	Littlejohn's Tree Frog has a distribution that includes the plateaus and eastern slopes of the Great Dividing Range from Watagan State Forest (90 km north of Sydney) south to Buchan in Victoria (DECC 2007). It occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops. I t appears to be restricted to sandstone woodland and heath communities at mid to high altitude (NSW Scientific Committee 2000). It forages both in the tree canopy and on the ground, and it has been observed sheltering under rocks on high exposed ridges during summer (NSW Scientific Committee 2000). Males call from low vegetation close to slow flowing pools. Eggs and tadpoles are mostly found in slow flowing pools that receive extended exposure to sunlight, but will also use temporary isolated pools (DECC 2007).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Mixophyes balbus	Stuttering Frog	E	V	A variety of forest habitats from rainforest through wet and moist sclerophyll forest to riparian habitat in dry sclerophyll forest (DECC 2007) that are generally characterised by deep leaf litter or thick cover from understorey vegetation (Ehmann 1997). Breeding habitats are streams and occasionally springs. Not known from streams disturbed by humans (Ehmann 1997) or still water environments (NSW Scientific Committee 2002).	No
Mixophyes iteratus	Giant Barred Frog	E	E	Found on forested slopes of the escarpment and adjacent ranges in riparian vegetation, subtropical and dry rainforest, wet sclerophyll forests and swamp sclerophyll forest (DECC 2007; Ehmann 1997). This species is associated with flowing streams with high water quality, though habitats may contain weed species (Ehmann 1997). This species is not known from riparian vegetation disturbed by humans (NSW Scientific Committee 1999). During breeding eggs are kicked up onto an overhanging bank or the streams edge (DECC 2007).	No
Pseudophryne australis	Red-crowned Toadlet	V	-	Red-crowned Toadlets are found in steep escarpment areas and plateaus, as well as low undulating ranges with benched outcroppings on Triassic sandstones of the Sydney Basin (DECC 2007). Within these geological formations, this species mainly occupies the upper parts of ridges, usually being restricted to within about 100 metres of the ridgetop. However they may also occur on plateaus or more level rock platforms along the ridgetop (DECC 2007). Associated with open forest to coastal heath (Ehmann 1997). Utilises small ephemeral drainage lines which feed water from the top of the ridge to the perennial creeks below for breeding, and are not usually found in the vicinity of permanent water (Ehmann 1997). Breeding sites are often characterised by clay-derived soils and generally found below the first sandstone escarpment in the talus slope (NPWS 1997).	Previously recorded on land adjoining the M2 Site, but habitat on the M2 Site itself is poor and unlikely to provide long-term habitat for the species

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		TSC ACT	EPBC ACT		
REPTILES					
Hoplocephalus bungaroides	Broad-Headed Snake	E	V	Typical sites consist of exposed sandstone outcrops and benching where the vegetation is predominantly woodland, open woodland and/or heath on Triassic sandstone of the Sydney Basin (DECC 2007). They utilise rock crevices and exfoliating sheets of weathered sandstone during the cooler months and tree hollows during summer (Webb & Shine 1998). Some of the canopy tree species found to regularly co-occur at known sites include *Corymbia eximia, C. gummifera, Eucalyptus sieberi, E. punctata* and *E.piperita* (DECC 2007).	No
Varanus rosenbergi	Rosenberg's Goanna	V	-	Rosenberg's Goanna occurs on the Sydney Sandstone in Wollemi National Park to the north-west of Sydney, in the Goulburn and ACT regions and near Cooma in the south. There are records from the South West Slopes near Khancoban and Tooma River. Also occurs in South Australia and Western Australia (OEH 2011b). Found in heath, open forest and woodland. Associated with termites, the mounds of which this species nests in; termite mounds are a critical habitat component. Shelters in hollow logs, rock crevices and in burrows, which they may dig for themselves, or they may use other species' burrows, such as rabbit warrens (OEH 2011b).	No
DIURNAL BIRDS					

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Anthochaera phrygia (aka *Xanthomyza phrygia)*	Regent Honeyeater	E	E, M	Associated with temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts, and riparian forests of River Oak (*Casuarina cunninghamiana*) (Garnett 1993). Areas containing Swamp Mahogany (*Eucalyptus robusta*) in coastal areas have been observed to be utilised (NPWS 1997). The Regent Honeyeater primarily feeds on nectar from box and ironbark eucalypts and occasionally from banksias and mistletoes (NPWS 1995). As such it is reliant on locally abundant nectar sources with different flowering times to provide reliable supply of nectar (Environment Australia 2000).	Unlikely
Botaurus poiciloptilus	Australasian Bittern	V	-	Terrestrial wetlands with tall dense vegetation, occasionally estuarine habitats (Marchant & Higgins 1993). Reedbeds, swamps, streams, estuaries (Simpson & Day 1999).	No
Burhinus grallarius	Bush Stone-curlew	E	-	Associated with dry open woodland with grassy areas, dune scrubs, in savanna areas, the fringes of mangroves, golf courses and open forest / farmland (Pittwater Council 2000; Marchant & Higgins 1993). Forages in areas with fallen timber, leaf litter, little undergrowth and where the grass is short and patchy (Environment Australia 2000; Marchant & Higgins 1993). Is thought to require large tracts of habitat to support breeding, in which there is a preference for relatively undisturbed in lightly disturbed.	No
Calidris ferruginea	Curlew Sandpiper	E1	M	Intertidal mudflats of estuaries, lagoons, mangrove channels; around lakes, dams, floodwaters, flooded saltbush surrounds of inland lakes (Morcombe, 2004).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Calidris tenuirostris	Great Knot	V	M	Sheltered coastal habitats containing large intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons (DECC 2007). Often recorded on sandy beaches with mudflats nearby, sandy spits and inlets, or exposed reefs or rock platforms (Morris 1989; Higgins & Davies 1996).	No
Callocephalon fimbriatum	Gang-gang Cockatoo population in the Hornsby and Ku-ring-gai Local Government Areas	V1	-	During summer in dense, tall, wet forests of mountains and gullies, alpine woodlands (Morcombe 2004). In winter they occur at lower altitudes in drier more open forests and woodlands, particularly box-ironbark assemblages (Shields & Chrome 1992). They sometimes inhabit woodland, farms and suburbs in autumn/winter (Simpson & Day 2004). This endangered population is found in the Ku-ring-gai and Hornsby local government areas. The population is believed to be largely confined to an area bounded by Thornleigh and Wahroonga in the north, Epping and North Epping in the south, Beecroft and Cheltenham in the west and Turramurra/South Turramurra to the east. It is known to inhabit areas of Lane Cove National Park, Pennant Hills Park and other forested gullies in the area (OEH 2011b).	Potential – foraging habitat
Calyptorhynchus lathami	Glossy Black-Cockatoo	V	-	Associated with a variety of forest types containing Allocasuarina species, usually reflecting the poor nutrient status of underlying soils (Environment Australia 2000; NPWS 1997; DECC 2007). Intact drier forest types with less rugged landscapes are preferred (DECC 2007). Nests in large trees with large hollows (Environment Australia 2000).	No
Charadrius leschenaultii	Greater Sand Plover	V1	M	Entirely coastal in NSW, foraging on intertidal sand and mudflats in estuaries, roosting during high tide on sandy beaches or rocky shores (DECC 2007)	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Charadrius mongolus	Lesser Sand Plover	V1	M	Favours coastal areas including beaches, mudflats and mangroves where they forage (DECC 2007). They may be seen roosting during high tide on sandy beaches or rocky shores (DECC 2007).	No
Circus assimilis	Spotted Harrier	V	—	The Spotted Harrier is found in mainland Australia and Indonesia. It is widespread but sparsely distributed. The Spotted Harrier is found in open wooded country in tropical and temperate Australia, particularly in arid and semi-arid areas (Birdlife Australia 2014).	Unlikely
Daphoenositta chrysoptera	Varied Sittella	V	-	Varied Sitellas are endemic and widespread in mainland Australia. Varied Sitellas are found in eucalypt woodlands and forests throughout their range. They prefer rough-barked trees like stringybarks and ironbarks or mature trees with hollows or dead branches (Birdlife Australia 2014)	Unlikely
Dasyornis brachypterus	Eastern Bristlebird	E1	E1	Habitat is characterised by dense, low vegetation and includes sedgeland, heathland, swampland, shrubland, sclerophyll forest and woodland, and rainforest, as well as open woodland with a heathy understorey. In northern NSW occurs in open forest with tussocky grass understorey. All of these vegetation types are fire prone, aside from the rainforest habitats utilised by the northern population as fire refuge. Age of habitat since fires (fire-age) is of paramount importance to this species; Illawarra and southern populations reach maximum densities in habitat that has not been burnt for at least 15 years; however, in the northern NSW population a lack of fire in grassy forest may be detrimental as grassy tussock nesting habitat becomes unsuitable after long periods without fire; northern NSW birds are usually found in habitats burnt five to 10 years previously.	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Diomedea exulans	Wandering albatross	E	V	The Wandering Albatross visits Australian waters extending from Fremantle, Western Australia, across the southern water to the Whitsunday Islands in Queensland between June and September. It has been recorded along the length of the NSW coast. At other times birds roam the southern oceans and commonly follow fishing vessels for several days. Breeding takes place on exposed ridges and hillocks, amongst open and patchy vegetation (OEH 2011b). Wandering Albatross breed bienially in small, loose colonies among grass tussocks, using a large mud nest. They feed in pelagic, offshore and inshore waters, often at night, taking fish and cephalopods such as squid, crustaceans and carrion, and will often follow ships feeding on the refuse they trail (OEH 2011b).	No
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Associated with tropical and warm temperate terrestrial wetlands, estuarine and littoral habitats, and occasionally woodlands and grasslands floodplains (Marchant & Higgins 1993). Forages in fresh or saline waters up to 0.5m deep, mainly in open fresh waters, extensive sheets of shallow water over grasslands or sedgeland, mangroves, mudflats, shallow swamps with short emergent vegetation and permanent billabongs and pools on floodplains (Marchant & Higgins 1993; DECC 2007).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Epthianura albifrons	White-fronted Chat/ in the Sydney CMA	E1	-	In NSW, it occurs mostly in the southern half of the state, in damp open habitats along the coast, and near waterways in the western part of the state. Along the coastline, it is found predominantly in saltmarsh vegetation but also in open grasslands and sometimes in low shrubs bordering wetland areas. Two isolated sub-populations of White-fronted Chats are currently known from the Sydney Metropolitan Catchment Management Authority (CMA) area; one at Newington Nature Reserve on the Parramatta River and one at Towra Point Nature Reserve in Botany Bay. These sub-populations are separated from each other by 25 km of urbanised land, across which the Chats are unlikely to fly (OEH 2011b). Gregarious species, usually found foraging on bare or grassy ground in wetland areas, singly or in pairs. They are insectivorous, feedin mainly on flies and beetles caught from or close to the ground. Have been observed breeding from late July through to early March, with 'open-cup' nests built in low vegetation. Nests in the Sydney region have also been seen in low isolated mangroves. Nests are usually built about 23 cm above the ground (but have been found up to 2.5 m above the ground) (OEH 2011b).	No
Falco hypoleucos	Grey Falcon	E	-	The Grey Falcon is sparsely distributed in NSW, chiefly throughout the Murray-Darling Basin, with the occasional vagrant east of the Great Dividing Range. The breeding range has contracted since the 1950s with most breeding now confined to arid parts of the range. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast. Also occurs near wetlands where surface water attracts prey (OEH 2011b).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Falco subinger	Black Falcon	V		The Black Falcon has broad range across inland regions New South Wales, where it has a sparse distributed. However, there are reports of 'Black Falcons' occurring on the tablelands and along the NSW coast. These reports are likely to represent Brown Falcons. In New South Wales there is assumed to be a single population that is continuous with a broader continental population, given that falcons are highly mobile, commonly travelling over hundreds of kilometres (Marchant & Higgins 1993).	No
Glossopsitta pusilla	Little Lorikeet	V	-	In New South Wales Little Lorikeets are distributed in forests and woodlands from the coast to the western slopes of the Great Dividing Range, extending westwards to the vicinity of Albury, Parkes, Dubbo and Narrabri. Little Lorikeets mostly occur in dry, open eucalypt forests and woodlands. They have been recorded from both old-growth and logged forests in the eastern part of their range, and in remnant woodland patches and roadside vegetation on the western slopes. They feed primarily on nectar and pollen in the tree canopy, particularly on profusely-flowering eucalypts, but also on a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands White Box Eucalyptus albens and Yellow Box E. melliodora are particularly important food sources for pollen and nectar respectively.	Potential – foraging habitat. Some roosting habitat in stags.
Haematopus fuliginosus	Sooty Oystercatcher	V	-	A coastal species that inhabits rock coastlines, coral cays, reefs and occasionally sandy beaches and Marchant & Higgins 1993; Simpson & Day 1999).	No
Haematopus longirostris	Pied Oystercatcher	V	-	Roosts and forages on sandy beaches, sand banks, mudflats and estuaries (Marchant & Higgins 1993, Simpson & Day 1999).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Hieraaetus morphnoides	Little Eagle	V	-	The Little Eagle is widespread in mainland Australia, central and eastern New Guinea. The Little Eagle is seen over woodland and forested lands and open country, extending into the arid zone. It tends to avoid rainforest and heavy forest (BIB, 2006).	Unlikely
Ixobrychus flavicollis	Black Bittern	V	-	Occurs in both terrestrial and estuarine wetlands generally in areas of permanent water and dense vegetation (DECC 2007). In areas with permanent water it may occur in flooded grassland, forest, woodland, rainforest and mangroves (DECC 2007).	No
Lathamus discolour	Swift Parrot	E	E	Breeds in Tasmania between September and January. Migrates to mainland in autumn, where it forages on profuse flowering Eucalypts (Blakers et al. 1984 and Schodde and Tidemann 1986). Hence, in this region, autumn and winter flowering eucalypts are important for this species. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*) (DECC 2007).	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Limicola falcinellus	Broad-billed Sandpiper	V1	M	The eastern form of the Broad-billed Sandpiper breeds in northern Siberia before migrating southwards in winter to Australia (DECC 2007). In Australia, Broad-billed Sandpipers over-winter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast (DECC 2007). In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary (DECC 2007). There are few records for inland NSW (DECC 2007). Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat (DECC 2007). Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons (DECC 2007). Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.	No
Limosa limosa	Black-tailed Godwit	V1	M	Primarily found along the coast on sandspits, lagoons and mudflats (DECC 2007). The species has also been found to occur inland on mudflats or shallow receding waters of portions of large muddy swamps or lakes (Pizzey and Knight 1997; Higgins & Davies 1996).	No
Nettapus coromandelianus	Cotton Pygmy-goose	E	-	The Cotton Pygmy-goose is a small surface-feeding duck with a goose-like bill. The male has a white head, neck and underparts, dark glossy green upperparts and a narrow dark breast band. Females are duskier and have a dark stripe through the eye and a white eyebrow. Although once found from north Queensland to the Hunter River in NSW, the Cotton Pygmy-goose is now only a rare visitor to NSW. Uncommon in Queensland. Freshwater lakes, lagoons, swamps and dams, particularly those vegetated with waterlilies and other floating and submerged aquatic vegetation. The Cotton Pygmy-goose uses standing dead trees with hollows close to water for roosting and breeding (OEH 2011b).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Pandion cristatus (Pandion haliaetus)	Eastern Osprey	V	M	Associated with waterbodies including coastal waters, inlets, lakes, estuaries, beaches, offshore islands and sometimes along inland rivers (Schodde and Tidemann 1986). Osprey may nest on the ground, on sea cliffs or in trees (Olsen 1995). Osprey generally prefer emergent trees, often dead or partly dead with a broken off crown (Schodde and Tidemann 1986).	No
Petroica boodang	Scarlet Robin	V	-	The Scarlet Robin is found in south-eastern and south-western Australia, as well as on Norfolk Island. In Australia, it is found south of latitude 25°S, from south-eastern Queensland along the coast of New South Wales (and inland to western slopes of Great Dividing Range) to Victoria and Tasmania, and west to Eyre Peninsula, South Australia; it is also found in south-west Western Australia. The Scarlet Robin lives in open forests and woodlands in Australia, while it prefers rainforest habitats on Norfolk Island. During winter, it will visit more open habitats such as grasslands and will be seen in farmland and urban parks and gardens at this time (BIB, 2006).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Polytelis swainsonii	Superb Parrot	V	V	The Superb Parrot is found throughout eastern inland NSW. On the South-western Slopes their core breeding area is roughly bounded by Cowra and Yass in the east, and Grenfell, Cootamundra and Coolac in the west. Birds breeding in this region are mainly absent during winter, when they migrate north to the region of the upper Namoi and Gwydir Rivers. The other main breeding sites are in the Riverina along the corridors of the Murray, Edward and Murrumbidgee Rivers where birds are present all year round. It is estimated that there are less than 5000 breeding pairs left in the wild. Inhabit Box-Gum, Box-Cypress-pine and Boree Woodlands and River Red Gum Forest. In the Riverina the birds nest in the hollows of large trees (dead or alive) mainly in tall riparian River Red Gum Forest or Woodland. On the South West Slopes nest trees can be in open Box-Gum Woodland or isolated paddock trees. Species known to be used are Blakely's Red Gum, Yellow Box, Apple Box and Red Box.	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Ptilinopus superbus	Superb Fruit-dove	V	-	The Superb Fruit-dove occurs principally from north-eastern in Queensland to north-eastern NSW. It is much less common further south, where it is largely confined to pockets of suitable habitat as far south as Moruya. There are records of vagrants as far south as eastern Victoria and Tasmania. Inhabits rainforest and similar closed forests where it forages high in the canopy, eating the fruits of many tree species such as figs and palms. It may also forage in eucalypt or acacia woodland where there are fruit-bearing trees. Part of the population is migratory or nomadic. There are records of single birds flying into lighted windows and lighthouses, indicating that birds travel at night. At least some of the population, particularly young birds, moves south through Sydney, especially in autumn. Breeding takes place from September to January. The nest is a structure of fine interlocked forked twigs, giving a stronger structure than its flimsy appearance would suggest, and is usually 5-30 metres up in rainforest and rainforest edge tree and shrub species.	No
Rostratula australis *(a.k.a. R. benghalensis)*	Painted Snipe (Australian subspecies)	E	V	Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber (DECC 2007). Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds (ibid.). Breeding is often in response to local conditions; generally occurs from September to December (DECC 2007). Roosts during the day in dense vegetation (NSW Scientific Committee 2004). Forages nocturnally on mud-flats and in shallow water (DECC 2007). Feeds on worms, molluscs, insects and some plant-matter (ibid.).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Sterna albifrons	Little Tern	E	-	Almost exclusively coastal, preferring sheltered areas (DECC 2007), however may occur several kilometres inland in harbours, inlets and rivers (Smith 1990). Australian birds breed on sandy beaches and sand spits (Simpson & Day 1999).	No
Stictonetta naevosa	Freckled Duck	V	-	Associated with a variety of plankton-rich wetlands, such as heavily vegetated, large open lakes and their shores, creeks, farm dams, sewerage ponds and floodwaters (DECC 2007).	No
Xenus cinereus	Terek Sandpiper	V1	M	A rare migrant to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. The latter has been identified as nationally and internationally important for the species. In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries. Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools. Generally roosts communally amongst mangroves of dead trees, often with related wader species (OEH 2011b).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
NOCTURNAL BIRDS					
Ninox connivens	Barking Owl	V	-	Associated with a variety of habitats such as savanna woodland, open eucalypt forests, wetland and riverine forest. The habitat is typically dominated by Eucalypts (often Redgum species), however often dominated by Melaleuca species in the tropics (DECC 2007). It usually roosts in dense foliage in large trees such as River She-oak (*Allocasuarina cunninghamiana*), other Casuarina and Allocasuarina, eucalypts, Angophora, Acacia and rainforest species from streamside gallery forests. It usually nests near watercourses or wetlands, in large tree hollows with entrances averaging 2-29 metres above ground, depending on the forest or woodland structure and the canopy height (Debus 1997).	Unlikely
Ninox strenua	Powerful Owl	V	-	Powerful Owls are associated with a wide range of wet and dry forest types with a high density of prey, such as arboreal mammals, large birds and flying foxes (Environment Australia 2000, Debus & Chafer 1994). Large trees with hollows at least 0.5m deep are required for shelter and breeding (Environment Australia 2000).	Likely – foraging habitat
Tyto longimembris (syn. *T. capensis*)	Eastern Grass Owl	V1		The Eastern Grass Owl is a medium-sized, ground-dwelling bird (35 cm) with a facial disc typical of the *Tyto* owls. Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains (DECC 2007).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
MAMMALS (EXCLUDING BATS)					
Cercartetus nanus	Eastern Pygmy-possum	V	-	Found in wet and dry eucalypt forest, subalpine woodland, coastal banksia woodland and wet heath (Menkhorst & Knight 2004). Pygmy-Possums feed mostly on the pollen and nectar from banksias, eucalypts and understorey plants and will also eat insects, seeds and fruit (Turner & Ward 1995). The presence of Banksia sp. and Leptospermum sp. are an important habitat feature (DECC 2007). Small tree hollows are favoured as day nesting sites, but nests have also been found under bark, in old birds nests and in the branch forks of tea-trees (Turner & Ward 1995).	No
Dasyurus maculatus *Dasyurus maculatus Maculates*	Spotted-tailed Quoll Spotted-tailed Quoll (SE Mainland Population)	V	E	The Spotted-tailed Quoll inhabits a range of forest communities including wet and dry sclerophyll forests, coastal heathlands and rainforests (Mansergh 1984; DECC 2007j), more frequently recorded near the ecotones of closed and open forest. This species requires habitat features such as maternal den sites, an abundance of food (birds and small mammals) and large areas of relatively intact vegetation to forage in (DECC 2007). Maternal den sites are logs with cryptic entrances; rock outcrops; windrows; burrows (Environment Australia 2000).	No
Dasyurus viverrinus	Eastern Quoll	E1	V	Associated with a variety of habitats, including dry sclerophyll forest, shrub, heath land, riparian forests and agricultural areas. Requires features such as hollow logs and rock piles for shelter (DECC 2007).	No
Isoodon obesulus obesulus	Southern Brown Bandicoot	E	E	They are generally only found in heath or open forest with a heathy understorey on sandy or friable soils (OEH 2011b). This species is thought to display a preference for newly regenerating heathland and other areas prone to fire (Menkhorst & Seebeck 1990).	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Perameles nasuta	Long-nosed bandicoot population in inner western Sydney	E1	-	The exact area occupied by the population is not clearly defined, and includes the local government areas (LGA) of Marrickville and Canada Bay, with the likelihood that it also includes Canterbury, Ashfield and Leichhardt LGAs. Future research may better define the population and possibly indicate a wider distribution. This population is disjunct from the nearest records of the Long-nosed Bandicoot, which occur north of the Parramatta River or much further south at Holsworthy Military Reserve (OEH 2011b). Shelter mostly under older houses and buildings and Forage in parkland and back-yards. There are apparently no large blocks of suitable habitat, likely to support a large source population, on the Cooks River to the south, or along the southern foreshore of Parramatta River and Sydney Harbour to the north (OEH 2011b).	No
Petaurus australis	Yellow-bellied Glider	V	-	This species is restricted to tall mature forests, preferring productive tall open sclerophyll forests with a mosaic of tree species including some that flower in winter (Environment Australia 2000, Braithwaite 1984, Davey 1984, Kavanagh 1984; DECC 2007). Large hollows within mature trees are required for shelter, nesting and breeding (Henry and Craig 1984; DECC 2007).	No
Petrogale penicillata	Brush-tailed Rock Wallaby	E	V	Rocky areas in a variety of habitats, typically north facing sites with numerous ledges, caves and crevices (Strahan 1995).	No
Phascolarctos cinereus	Koala	V1	-	Associated with both wet and dry Eucalypt forest and woodland that contains a canopy cover of approximately 10 to 70% (Reed et al. 1990), with acceptable Eucalypt food trees. Some preferred Eucalyptus species are: Eucalyptus tereticornis, E. punctata, E. cypellocarpa, E. viminalis	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Potorous tridactylus tridactylus	Long-nosed Potoroo	V	V	Associated with dry coastal heath and dry and wet sclerophyll forests (Strahan 1998). Dense understorey with occasional open areas is an essential part of habitat, and may consist of grass-trees, sedges, ferns or heath, or of low shrubs of tea-trees or melaleucas. A sandy loam soil is also a common feature (OEH 2011b).	No
Pseudomys novaehollandiae	New Holland Mouse	-	V	New Holland Mouse is known to inhabit open heathlands, open woodlands with a heathland understorey, and vegetated sand dunes.	No
MAMMALS (BATS)					
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	The Large-eared Pied Bat has been recorded in a variety of habitats, including dry sclerophyll forests, woodland, sub-alpine woodland, edges of rainforests and wet sclerophyll forests (Churchill 1998; DECC 2007). This species roosts in caves, rock overhangs and disused mine shafts and as such is usually associated with rock outcrops and cliff faces (Churchill 1998; DECC 2007).	Potential
Miniopterus australis	Little Bent-wing Bat	V	-	Prefers well-timbered areas including rainforest, wet and dry sclerophyll forests, Melaleuca swamps and coastal forests (Churchill 1998). This species shelter in a range of structures including culverts, drains, mines and caves (Environment Australia 2000). Relatively large areas of dense vegetation of either wet sclerophyll forest, rainforest or dense coastal banksia scrub are usually found adjacent to caves in which this species is found (DECC 2007). Breeding occurs in caves, usually in association with M. schreibersii (Environment Australia 2000, DECC 2007).	Potential

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Miniopterus schreibersii oceanensis	Eastern Bent-wing Bat	V	-	Associated with a range of habitats such as rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland (Churchill 1998). It forages above and below the tree canopy on small insects (AMBS 1995, Dwyer 1995, Dwyer 1981). Will utilise caves, old mines, and stormwater channels, under bridges and occasionally buildings for shelter (Environment Australia 2000, Dwyer 1995).	Yes – this species was recorded as probable via echolocation within the study area
Mormopterus norfolkensis	East Coast Freetail-bat	V	-	Most records of this species are from dry eucalypt forest and woodland east of the Great Dividing Range (Churchill 1998). Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Environment Australia 2000; Allison & Hoye 1998). Primarily roosts in hollows or behind loose bark in mature eucalypts, but have been observed roosting in the roof of a hut (Environment Australia 2000; Allison & Hoye 1998).	Likely
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	Inhabits a wide range of habitats including rainforest, mangroves, paperbark forests, wet and dry sclerophyll forests and cultivated areas (Churchill 1998, Eby 1998). Camps are often located in gullies, typically close to water, in vegetation with a dense canopy (Churchill 1998).	Likely
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Found in almost all habitats, from wet and dry sclerophyll forest, open woodland (Churchill 1998). Roosts in tree hollows; may also use caves; has also been recorded in a tree hollow in a paddock (Environment Australia 2000) and in abandoned sugar glider nests (Churchill 1998). The Yellow-bellied Sheathtail-bat is dependent on suitable hollow-bearing trees to provide roost sites, which may be a limiting factor on populations in cleared or fragmented habitats (Environment Australia 2000).	Potential

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
MIGRATORY TERRESTRIAL SPECIES LISTED UNDER EPBC ACT					
Anthochaera phrygia	Regent Honeyeater	E	E, M	See *Anthochaera phrygia above*	SEE DIURNAL BIRDS ABOVE
Apus pacificus	Fork-tailed Swift	-	M	Sometimes travels with Needletails. Varied habitat with a possible tendency to more arid areas but also over coasts and urban areas (Simpson & Day 1999).	Potential
Haliaeetus leucogaster	White-bellied Sea-Eagle	-	M	Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Marchant & Higgins 1993, Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1993).	Unlikely
Hirundapus caudacutus	White-throated Needletail	-	M	Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Marchant & Higgins 1993; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Marchant & Higgins 1993).	Potential – foraging/flying overhead
Merops ornatus	Rainbow Bee-eater	-	M	Resident in coastal and subcoastal northern Australia; regular breeding migrant in southern Australia, arriving September to October, departing February to March, some occasionally present April to May. Occurs in open country, chiefly at suitable breeding places in areas of sandy or loamy soil: sand-ridges, riverbanks, road-cuttings, sand-pits, occasionally coastal cliffs (ibid). Nest is a chamber at the end of a burrow, up to 1.6 m long, tunnelled in flat or sloping ground, sandy back or cutting (*ibid*).	Unlikely

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Monarcha melanopsis	Black-faced Monarch	-	M	Rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984).	Unlikely
Monarcha trivirgatus	Spectacled Monarch		M	Wet forests, mangroves (Simpson and Day 1999).	No
Myiagra cyanoleuca	Satin Flycatcher	-	M	Wetter, denser forest, often at high elevations (Simpson & Day 2004).	No
Rhipidura rufifrons	Rufous Fantail	-	M	The Rufous Fantail is a summer breeding migrant to southeastern Australia (Morcombe, 2004). The Rufous Fantail is found in rainforest, dense wet eucalypt and monsoon forests, paperbark and mangrove swamps and riverside vegetation (Morcombe, 2004). Open country may be used by the Rufous Fantail during migration (Morcombe, 2004).	Unlikely
Sterna albifrons	Little Tern	E	M	Almost exclusively coastal, preferring sheltered areas (DECC 2007), however may occur several kilometres inland in harbours, inlets and rivers (Smith 1990). Australian birds breed on sandy beaches and sand spits (Simpson & Day 1999).	No
MIGRATORY WETLAND SPECIES LISTED UNDER EPBC ACT					
Ardea alba	Great Egret	-	M	The Great Egret is common and widespread in Australia (McKilligan, 2005). It forages in a wide range of wet and dry habitats including permanent and ephemeral freshwaters, wet pasture and estuarine mangroves and mudflats (McKilligan, 2005).	No

SCIENTIFIC NAME	COMMON NAME	STATUS		HABITAT ASSOCIATIONS	LIKELIHOOD OF OCCURRENCE
		TSC ACT	EPBC ACT		
Ardea ibis	Cattle Egret	-	M	Cattle Egrets forage on pasture, marsh, grassy road verges, rain puddles and croplands, but not usually in the open water of streams or lakes and they avoid marine environments (McKilligan, 2005). Some individuals stay close to the natal heronry from one nesting season to the next, but the majority leave the district in autumn and return the next spring. Cattle Egrets are likely to spend the winter dispersed along the coastal plain and only a small number have been recovered west of the Great Dividing Range (McKilligan, 2005).	No
Gallinago hardwickii	Latham's Snipe	-	M	A variety of permanent and ephemeral wetlands, preferring open fresh water wetlands with nearby cover (Marchant and Higgins 1999). Occupies a variety of vegetation around wetlands (Marchant and Higgins 1999) including wetland grasses and open wooded swamps (Simpson and Day 1999).	No
Rostratula benghalensis (a.k.a. R. Australis)	Painted Snipe	-	M	See: *Rostratula australis*	No
Tringa stagnatilis	Marsh Sandpiper		M	Coastal - Permanent or ephemeral wetlands of varying degrees of salinity, commonly inland (DEH 2005). Breeds Eastern Europe to Eastern Siberia (ibid).	No

Disclaimer: Data extracted from the Atlas of NSW Wildlife and EPBC Protected Matters Report are only indicative and cannot be considered a comprehensive inventory. 'Migratory marine species' and 'listed marine species' listed on the EPBC Act (and listed on the SEWPAC protected matters report) have not been included in this table, since they are considered unlikely to occur within the study area due to the absence of marine habitat.

CE = Critically Endangered, E = Endangered; E1 = Endangered Population, V = Vulnerable, V1 = Vulnerable Population, M = Migratory

Appendix B: Flora List

SPECIES NAME	COMMON NAME	WESTERN SECTION	DRAINAGE LINE	BIOBANKING PLOT IN SANDSTONE RIDGETOP WOODLAND)	BIOBANKING PLOT IN DRAINAGE LINE	PROPOSED LAND SWAP SITE	RMS SITE (NORTHERN SECTION)
*Abies sp.**						x	
Acacia linifolia	White Wattle	x					
Acacia longifolia		x	x	x			
Acacia parramattensis	Parramatta Wattle	x	x	x			
*Acetosa sagittata**	Rambling Rose	x				x	
Adiantum aethiopicum	Common Maidenhair				x		
Adiantum hispidulum	Rough Maidenhair Fern				x		
*Ageratina adenophora**	Crofton Weed				x		
Allocasuarina littoralis	Black She-oak	x		x			
Allocasuarina torulosa	Forest Oak						x
Angophora costata	Smooth Barked Apple						x
Anisopogon avenaceus				x			
*Araujia sericifera **	Moth Vine		x				
Aristea ecklonii	Blue Stars					x	
*Asparagus aethiopicus **	Asparagus Fern				x	x	x
Austrostipa pubescens		x?					
Baeckea sp.				x			
Banksia ericifolia	Heath-leaved Banksia	x		x			
Banksia oblongifolia	Fern-leaved Banksia	x					
Banksia spinulosa	Hairpin Banksia	x		x			
*Bidens pilosa **	Cobbler's Pegs	x	x				
Billardiera scandens	Hairy Apple Berry			x			
*Briza subaristata**						x	
*Bromeliaceae var.**						x	
Brunoniella australis	Blue Trumpet						x
*Bryophyllum delagoense**	Mother-of-millions		x				
Bursaria spinosa	Native Blackthorn			x			
Callistemon salignus	Willow bottlebrush			x			

SPECIES NAME	COMMON NAME	WESTERN SECTION	DRAINAGE LINE	BIOBANKING PLOT IN SANDSTONE RIDGETOP WOODLAND)	BIOBANKING PLOT IN DRAINAGE LINE	PROPOSED LAND SWAP SITE	RMS SITE (NORTHERN SECTION)
Cassytha glabella				x			
Cassytha pubescens				x			
*Cestrum parqui**	Green Cestrum	x	x				
*Cinnamomum camphora**	Camphor Laurel	x	x		x	x	
*Cirsium vulgare **	Spear Thistle	x	x				
Clematis sp.							X
Clerodendrum tomentosum	Hairy Clerodendrum						x
*Conyza sp. **			x			x	
*Cortaderia selloana**	Pampas Grass		x				
*Cotoneaster sp.**						x	
Cyathochaeta diandra		x		x			
*Cynodon dactylon**	Couch					x	
*Cyperus sp.**					x		
Cytisus sp.			x				
Dianella caerulea	Blue Flax-lily	x		x	x		x
Dichondra repens	Kidney Weed						x
Dodonaea triquetra	Large-leaf Hop-bush	x		x			
*Echium plantagineum**	Paterson's Curse		x				
*Ehrharta erecta **	Panic Veldtgrass				x	x	x
Elaeocarpus reticulatus	Blueberry Ash						x
Entolasia stricta	Wiry Panic	x		x	x		
*Eragrostis curvula **	African Lovegrass		x				
Eucalyptus pilularis	Blackbutt						x
Eucalyptus resinifera	Red Mahogany	x		x	x		x
Eucalyptus sideroxylon	Mugga Ironbark		x				
Eucalyptus tereticornis	Forest Red Gum		x				
Gahnia sp.				x			
Fumaria sp.							x
*Gamochaeta sp.**	Cudweed					x	
Geranium solanderi	Native Geranium						x
Glycine clandestina							x
*Gomphocarpus physocarpus**	Balloon Cotton Bush		x				

SPECIES NAME	COMMON NAME	WESTERN SECTION	DRAINAGE LINE	BIOBANKING PLOT IN SANDSTONE RIDGETOP WOODLAND)	BIOBANKING PLOT IN DRAINAGE LINE	PROPOSED LAND SWAP SITE	RMS SITE (NORTHERN SECTION)
Grevillea buxifolia	Grey Spider Flower	x					
Grevillea robusta+	Silky Oak	x		x			x
Grevillea var.						x	
Hakea propinqua		x		x			
Hakea salicifolia	Willow-leaved Hakea	x					
Hakea teretifolia	Needlebush	x					
Hardenbergia violacea	False Sarsaparilla						x
*Hedera helix**	English Ivy	x			x		
Hibbertia aspera	Rough Guinea Flower	x					
Hibbertia dentata	Trailing Guinea Flower						x
Hibbertia empetrifolia		x		x			
Imperata cylindrica			x				
Ipomoea sp.			x				
Kunzea ambigua	Tick Bush	x		x			
Lambertia formosa	Mountain Devil	x		x			
*Lantana camara**	Lantana	x	x	x	x		
Lepidosperma filiforme		x			x		
Leptospermum trinervium	Flaky-barked Tea-tree			x			
Lepyrodia scariosa		x		x			
Leucopogon juniperinus	Prickly Beard-heath	x		x			
*Ligustrum lucidum **	Large-leaved Privet	x	x	x	x	x	
*Ligustrum sinense **	Small-leaved Privet	x		x	x	x	
Lindsaea linearis	Screw Fern	x		x			
Lomandra longifolia	Spiny-head Mat-rush	x		x	x		
Lomandra obliqua				x			
Lomatia silaifolia	Fern-leaved Lomatia	x		x			
*Macadamia sp.**	Macadamia				x		
*Medicago sp. **			x				
Melaleuca armillaris	Bracelet Honey-myrtle		x				
Melaleuca linariifolia	Flat-leaved Paperbark	x		x	x		
Melaleuca styphelioides	Prickly-leaved Tea tree						x
Microlaena stipoides					x		x
*Modiola caroliniana **	Red-flowered Mallow		x				

SPECIES NAME	COMMON NAME	WESTERN SECTION	DRAINAGE LINE	BIOBANKING PLOT IN SANDSTONE RIDGETOP WOODLAND)	BIOBANKING PLOT IN DRAINAGE LINE	PROPOSED LAND SWAP SITE	RMS SITE (NORTHERN SECTION)
Notelaea venosa	Veined Mock-olive						x
*Ochna serrulata**	Mickey Mouse Plant	x		x	x	x	
*Olea europaea subsp. cuspidata**	African Olive					x	
Oplismenus aemulus	Wavy Beard Grass						x
Oxalis perennans							x
Ozothamnus diosmifolius	White Dogwood	x		x			
*Paspalum dilatatum**	Paspalum					x	
*Passiflora sp.**					x		
*Phyllostachys sp.**	Bamboo		x				
Pittosporum undulatum	Native Daphne	x	x	x	x	x	x
*Plantago lanceolata **	Lamb's Tongues	x				x	
Polyscias sambucifolia	Elderberry Panax	x		x			
*Prunus sp.**					x		
Pteridium esculentum	Common Bracken	x		x	x		
Pterostylis nutans	Nodding Greenhood	x		x			
Ptilothrix deusta		x		x			
*Ricinus communis**	Castor Oil Plant		x				
*Rubus sp.**	Blackberry		x				
Schizaea dichotoma	Branched Comb Fern	x					
*Senecio madagascariensis **	Fireweed		x				
*Senna pendula**		x		x	x		x
*Solanum nigrum**	Black-berry Nightshade		x				
*Solanum seaforthianum**	Climbing Nightshade					x	
*Sonchus oleraceus**	Common Sowthistle						x
*Syagrus romanzoffiana**	Cocos Palm					x	
Syncarpia glomulifera	Turpentine						x
*Taraxacum officinale**	Dandelion					x	
*Tradescantia fluminensis**	Wandering Jew	x			x	x	x
Trifolium sp.			x				
*Vinca major**	Greater Periwinkle					x	
Xanthorrhoea sp.				x			

SPECIES NAME	COMMON NAME	WESTERN SECTION	DRAINAGE LINE	BIOBANKING PLOT IN SANDSTONE RIDGETOP WOODLAND)	BIOBANKING PLOT IN DRAINAGE LINE	PROPOSED LAND SWAP SITE	RMS SITE (NORTHERN SECTION)
Zieria sp.		x					

Appendix C: Fauna List

SCIENTIFIC NAME	COMMON NAME
AVES	
Cacatua galerita	Sulphur-crested Cockatoo
Cacatua roseicapillus	Galah
Corvus coronoides	Australian Raven
Grallina cyanoleuca	Magpie-lark
Gymnorhina tibicen	Magpie
Manorina melanocephala	Noisy minor
Strepera graculina	Pied Currawong
Trichoglossus haematodus	Rainbow Lorikeet
Vanellus miles	Masked Lapwing
AMPHIBIANS	
Crinia signifera	Eastern Common Froglet
Litoria peronii	Peron's Tree Frog
NON-FLYING MAMMALS	
Trichosurus vulpecula	Brush-tailed possum
Oryctolagus cuniculus *	Rabbit
Pseudocheirus peregrinus	Ring-tailed Possum
BATS	
Miniopterus schreibersii oceanensis ^	Eastern Bentwing-bat (probable via echolocation)
Chalinolobus gouldii	Gould's wattled Bat (probable via echolocation)
Vespadelus regulus	Southern Forest Bat (possible via echolocation)
REPTILES	
Physignathus lesueurii	Eastern Water Dragon
Eulamprus quoyii	Eastern Water Skink

^ denotes threatened species. * denotes introduced species

Appendix D: Anabat Analysis

Anabat 1 was located on the OSL site and Anabat 3 was located on the M2 site.

Bat Call Analysis by...Anna Lloyd | AB.N. 16 941 530 991 | 40 Fishermans Drive | Emerald Beach NSW 2456
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Echolocation Call Sequences from the corner of Wicks Road and the M2 near Ryde in the Sydney Basin Region

Introduction and Methodology

Bat calls were analysed using the program AnalookW (Version 3.3q 03 October 2006, written by Chris Corben, www.hoarybat.com). Identifications were made using a regional based guide to the echolocation calls of microbats in New South Wales NSW (Pennay *et al.* 2004) and the accompanying reference library of over 200 calls from the Sydney Basin area of NSW (http://www.forest.nsw.gov.au/research/bats/default.asp). In addition, a reference library of 269 calls from NSW (Law, State Forests of NSW) and a local reference library consisting of 42 calls recorded within 150km of Coffs Harbour (Lloyd & Tolhurst).

Bat calls can be difficult to identify due to intra-specific and geographic variation, therefore a reference library of local calls is a valuable tool for bat call identification.

Bat call analysis is reliant upon the presence of species-specific parameters such as call shape, characteristic frequency, initial slope and time between calls (de Oliveira 1998, Rinehold *et al.* 2001). Without the presence of definitive species-specific characteristics, a reliable identification cannot be made. In addition, some species can never be distinguished (eg. *Nyctophilus* species), while others, such as *Rhinolophus megaphyllus,* are distinctive.

To ensure reliable and accurate results the following protocols *(*adapted from *Lloyd et. al. 2006)* were followed:

1. Recordings containing less than three pulses were not analysed (Law *et al.* 1999, Law & Chidel 2002).

2. Only search phase calls were analysed (McKenzie *et al.* 2002).

3. Four categories of confidence in species identification were used (Mills *et al.* 1996):
    a. definite – identity not in doubt
    b. probable – low probability of confusion with species of similar calls
    c. possible – medium to high probability of confusion with species with similar calls; and
    d. unknown bat – calls made by bats which cannot be identified to even a species group.

4. *Nyctophilus* spp. are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay *et al.* 2004, Law & Chidel 2002).

5. Other species found within the Sydney Basin Region of NSW are difficult to differentiate confidently on recordings of poor quality. These calls are assigned to the following species groups (Mills *et al.* 1996, Pennay *et al.* 2004) and are included under each species as a possible call:
    a. Miniopterus schreibersii oceanensis / Vespadelus darlingtoni
    b. Miniopterus schreibersii oceanensis/ Vespadelus regulus
    c. Vespadelus regulus / Vespadelus darlingtoni
    d. Vespadelus troughtoni / Vespadelus vulturnus / Vespadelus pumilus
    e. Chalinolobus gouldii / Mormopterus spp.
    f. Mormopterus sp.2 / Mormopterus norfolkensis
    g. Nyctophilus spp. / Myotis macropus
    h. Scotorepens orion / Scoteanax rueppellii
    i. Scotorepens orion / Falsistrellus tasmaniensis

Results and Discussion

Two Anabats surveyed for two nights each. A total of 121 files were submitted for identification. Results are presented for each night for each Anabat separately (Tables 2 and 3).

Of the 121 files submitted, 37 contained bat calls of sufficient length and quality that enabled an attempt at analysis. The files received that were determined too low in quality for attempt at analysis were so due to the faint nature of the recorded calls. The bats calls which met the protocols for attempt at identification unfortunately failed to meet criteria for identification to a definite confidence level. In particular, it was impossible to clarify to a definite level the bat calls that belonged to the Miniopterus schreibersii oceanensis and Vespadelus regulus group. These species have similar call characteristics and, in this instance, the calls provided contained pulses that were particularly short in duration and steep in frequency variation (but not feeding buzzes), possibly due to a cluttered environment in which the bats may have been navigating. No distinct feeding buzzes and social interactions were evident in the calls.

Table 1 below shows a summary of the number and quality of files submitted from this survey.

Table 1: Summary of files received for analysis.

ID	Night	No bat call on file	Bat call too short to attempt ID	Bat call but quality too low or not a search phase call	Total number of files received
Anabat1	5-6/10/2011	12	30	17	77
Anabat1	6-7/10/2011	10	-	-	10
Anabat3	5-6/10/2011	3	1	-	18
Anabat3	6-7/10/2011	6	1	4	16

Table 2: Species identified from Anabat recordings from Anabat 1.

	5-6/10/2011			6-7/10/2011		
	Identification confidence			Identification confidence		
Species	Definite	Probable	Possible	Definite	Probable	Possible
Chalinolobus gouldii	-	2	16	-	-	-
Mormopterus norfolkensis[#]	-	-	16	-	-	-
Mormopterus sp.2	-	-	16	-	-	-

[#] Listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act 1995.

Table 3: Species identified from Anabat recordings from Anabat 3.

	5-6/10/2011			6-7/10/2011		
	Identification confidence			Identification confidence		
Species	Definite	Probable	Possible	Definite	Probable	Possible
Chalinolobus gouldii	-	1	1	-	-	-
Miniopterus schreibersii oceanensis[#]	-	2	10	-	-	4
Vespadelus regulus	-	-	10	-	1	4

[#] Listed as Vulnerable under Schedule 2 of the Threatened Species Conservation Act 1995.

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Appendix E: Impact Assessments (TSC Act listed species)

An assessment of the impacts of the proposal on species, populations and ecological communities listed under Schedules 1 and 2 of the TSC Act has been completed in accordance with the *Guidelines for threatened species assessment* (DEC and DPI 2005).

The study area is unlikely to support any threatened flora species. The study area supports native vegetation with potential and known habitat for a number of threatened fauna species. A full list of species recorded within a 10 km radius of the study area is found in Appendix A; however, not all of these species or their habitats are likely to be impacted. Potentially impacted items are listed below.

Endangered Ecological Communities

- Sydney Turpentine Ironbark Forest / Turpentine-Ironbark Forest in the Sydney Basin Bioregion

Threatened Fauna

Bats

- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Miniopterus australis* (Little Bentwing-bat)
- *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat)
- *Mormopterus norfolkensis* (East Coast Free-tail Bat)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)
- *Saccolaimus flaviventris* (Yellow-bellied Sheathtail-bat)

Birds

- *Callocephalon fimbriatum* (Gang-gang Cockatoo population)
- *Glossopsitta pusilla* (Little Lorikeet)
- *Ninox strenua* (Powerful Owl)

Amphibians

- *Pseudophryne australis* (Red-crowned Toadlet).

Sydney Turpentine Ironbark Forest

Sydney Turpentine Ironbark Forest (STIF) is listed as an Endangered Ecological Community (EEC) under the TSC and a Critically Endangered Ecological Community under the EPBC Acts, although to meet the criteria under the EPBC Act the patch needs to have intact vegetation structure, a tree canopy cover greater than 10% and an area greater than 1 hectare.

The structure of the community was originally forest, but the community can also exist as woodland or as remnant trees. Species composition varies between sites depending on geographical location and local conditions (e.g. topography, rainfall, exposure). However, characteristic tree species in STIF are *Syncarpia glomulifera*, *Eucalyptus globoidea*, *Eucalyptus resinifera*, *Eucalyptus paniculata*, *Angophora costata* and *Angophora floribunda* (NSW Scientific Committee 1998).

STIF typically occurs on areas with clay soils derived from Wianamatta Shale, or shale layers within Hawkesbury Sandstone. Occurrences of STIF may also occur on plateaus and hillsides and on the margins of shale cappings over sandstone (NSW Scientific Committee 1998).

STIF is present within the Local Government Areas (LGAs) of Ashfield, Auburn, Canterbury, Concord, Drummoyne, Leichhardt, Marrickville, Bankstown, Ryde, Hunters Hill, Baulkham Hills, Ku-ring-gai, Hornsby, Parramatta, Bankstown, Rockdale, Kogarah, Hurstville, and Sutherland. The area is within the County of Cumberland and entirely within the Sydney Basin Bioregion (NSW Scientific Committee 1998).

Large areas of STIF have been cleared for agriculture and urban development. Remnants are small and scattered. Identified threats include: clearing, physical damage from recreational activities, rubbish dumping, grazing, mowing, weed invasion. Only small areas of STIF are presently included in conservation reserves (NSW Scientific Committee 1998). Only about 0.489 ha of this community occurs in the study area. Approximately 0.02 ha of this community will be directly impacted by trimming of branches.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Not applicable, STIF is not a threatened species or population.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Construction of the pedestrian bridge will result in the trimming of branches. This has been estimated at 0.02 hectare of STIF in the north east corner of the RMS Site. This is approximately only 4% of the STIF in the locality (0.489 ha) which includes Bundara Reserve. It is anticipated that works will include selective pruning of branches overhanging from Bundara Reserve.

There is little likelihood of the development having indirect effects such as changed hydrological regime as long as drainage from the pedestrian bridge is directed away from the remainder of the community in Bundara Reserve. Construction of buildings elsewhere on the M2 Site is downslope of Bundara Reserve and will therefore not impact on the STIF.

Weeds and Phytophthora spread would be managed through inspection and washing of construction machinery to prevent the introduction of weeds or Phytophthora to the RMS Site.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Not applicable, STIF is not a threatened species or population. However, STIF is present within the

LGAs of Ashfield, Auburn, Canterbury, Concord, Drummoyne, Leichhardt, Marrickville, Bankstown, Ryde, Hunters Hill, Baulkham Hills, Ku-ring-gai, Hornsby, Parramatta, Bankstown, Rockdale, Kogarah, Hurstville, and Sutherland (NSW Scientific Committee 1998). Thus, STIF is not at the limit of its known distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The Project may increase disturbances to this community by increasing the amount of foot traffic and noise as a result of workers using footpaths between the pedestrian bridge and the buildings on the RMS Site.

The Project would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the Project would be unlikely to alter the current fire regime at the study area.

The Project has the potential to increase erosion, sedimentation and runoff through the construction of the pedestrian bridge if mitigation measures such as sedimentation and erosion control are not implemented.

How is the proposal likely to affect habitat connectivity?

The Project would not result in the fragmentation of STIF as the patch of STIF in Bundara Reserve is not being removed.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat has not been declared for this community

Large-eared Pied Bat

The Large-eared Pied Bat is listed as a vulnerable species under both the TSC Act and EPBC Act. It is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes (OEH 2012).

The Large-eared Pied Bat is found in well-timbered areas containing gullies. It frequents low to mid-elevation dry open forest and woodland close to caves, crevices in cliffs, old mine workings and disused mud nests of the Fairy Martin. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy (OEH 2012).

The Large-eared Pied Bat roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the Fairy Martin (*Hirundo ariel*). It is possible that the species also roosts in trees hollows (DSEWPAC 2012). They are likely to hibernate during the cooler months of the year. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years (OEH 2012).

Large-eared Pied Bat has previously been recorded in the vicinity of the study area (OEH 2011b). Despite not being recorded during field survey, Large-eared Pied Bat has the potential to be present in the study area.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Large-eared Pied Bat by reducing the amount of foraging, roosting and breeding habitat available to the species, or degrading its habitat. Large-eared Pied Bat is predominantly cave-roosting and breeding (Churchill 2008) and the proposal would not impact on caves. The study area contains foraging habitat that would likely be marginal to this species which prefers well-timbered areas close to gullies (OEH 2012). Thus, only marginal foraging and marginal roosting (tree hollows) habitat would be reduced / degraded by the proposal for the species which could impact on its life cycle.

The habitat of Large-eared Pied Bat would be reduced directly through the clearing of 0.72 ha of native vegetation and six hollow-bearing trees representing marginal foraging and marginal roosting habitat, respectively. Retained marginal foraging habitat of Large-eared Pied Bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove potential habitat for the Large-eared Pied Bat, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of marginal habitat would not represent a significant loss to Large-eared Pied Bat. The removal of habitat could result in the reduction of a territorial range but is unlikely to affect the entire territory. The majority of vegetation within the riparian corridor would be retained and is considered marginal foraging habitat for the species. The proposal would not significantly fragment the habitat of the species, which is highly mobile. Where the removal of trees is required, a pre-clearance protocol is to be adopted (**Section 7.3**). If roosts (disused Fairy Martin nests) are present in any trees proposed for clearing or if any individuals of Large-eared Pied bat are present in tree hollows, an ecologist is to be present to capture

and re-release individuals (where appropriate).

Little is documented on how Large-eared Pied Bat would respond to increased noise disturbance. Overseas studies on bats that listen for their prey in addition to using echolocation have found that these bats avoid areas with noise disturbance while foraging (Schaub *et al.* 2008, Siemers and Schaub 2011). It is possible that Large-eared Pied Bat forages in a similar manner to the bat species investigated as they forage under the canopy and close to the ground (Churchill 2008). As such, it is possible that Large-eared Pied Bat would avoid areas of noise disturbance while foraging. However, foraging habitat in the study area is marginal habitat, likely to be used only occasionally. It is already noise affected and is not likely to be important habitat which the species would rely on.

Regarding artificial light, overseas studies have found that some bats are attracted to higher densities of prey species around lights while other species avoid lights (Jones 2000). As Large-eared Pied Bats forage below the canopy and sometimes on the ground, it is likely that this species would avoid areas of light disturbance. However, as stated above, foraging habitat in the study area is marginal habitat, likely to be used only occasionally. It is already light affected and is not likely to be important habitat which the species would be reliant on. To reduce the potential impacts on foraging activities, artificial lighting of the passive recreation infrastructure is not recommended as this will likely deter the species. Mitigation measures (**Section 7.3**) to reduce light spillage would also be implemented to minimise impacts from artificial light.

The proposal would not indirectly impact on foraging habitat supporting prey species within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not introduce large quantities of pesticides or increase the incidence of predators which would impact on the species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.72 ha of native vegetation and six hollow-bearing trees representing marginal foraging and marginal roosting habitat for the Large-eared Pied Bat, respectively, would be removed. Remaining marginal foraging habitat of Large-eared Pied Bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

However, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging and roosting resources would become limited within the study area. The majority of riparian vegetation in the north of the study area will be retained and improved. The proposal would not significantly fragment the habitat of the species, which is highly mobile. Where the removal of trees is required, a pre-clearance protocol is to be adopted (**Section 7.3**). If roosts (disused Fairy Martin nests) are present in any trees proposed for clearing or if any individuals of Large-eared Pied bat are present in tree hollows, an ecologist is to be present to capture and re-release individuals (where appropriate). No breeding habitat (maternity roosts) would be impacted by the proposal.

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads and buildings, and produce conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented. A Vegetation Management Plan for the rehabilitation of the riparian corridor will

improve condition of vegetation within this area.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes. The species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events within the study area in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels are unlikely to be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise during nocturnal foraging periods. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Little Bentwing-bat

Little Bentwing-bat is listed as a vulnerable species under the TSC Act. It is found on the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW (OEH 2012). In tropical Queensland, the species occurs from the coast to higher elevations along the ranges and tablelands, with its distribution becoming increasingly coastal towards the southern part of its range in NSW (Hoye and Hall 2008a).

Little Bentwing-bat is generally found in well-timbered areas, occurring in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and *Banksia* scrub which support prey species (beetles, moths, flies, spiders, wasps and ants) (Churchill 2008; Hoye and Hall 2008a).

Roosting and breeding habitat for Little Bentwing-bat are more specific. Caves are the primary roosting habitat, with the largest colony recorded at Mount Etna in central coastal Queensland (Churchill 2008; Hoye and Hall 2008a), but the species also uses derelict mines, storm-water tunnels, culverts, bridges, and buildings (OEH 2012). The species has also been recorded roosting in tree hollows, with Shultz (1997) reporting a colony of 30 bats in a hollow of *Citronella moorei* in north-eastern NSW.

Breeding habitat is used by female Little Bentwing-bats in spring and summer. During these months, females congregate to form large maternal colonies in maternity roosts. These maternity roosts have very specific temperature and humidity regimes, and are generally dome-shaped to retain heat within the cave. In NSW, Little Bentwing-bat share maternity roosts with the larger Eastern Bentwing-bat (Hoye and Hall 2008a; OEH 2012).

Little Bentwing-bat have not been detected in the study area, but there is potential foraging and roosting habitat in the northern portion of the area in the SRW.

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Little Bentwing-bat by reducing the amount of foraging, roosting and breeding habitat available to the species, or degrading its habitat. Little Bentwing-bat uses caves for roosting and breeding, although stormwater drains and culverts are also used for roosting (Churchill 2008, Hoye and Hall 2008a) and the proposal would not impact on caves or these structures. The study area contains foraging habitat that would likely be marginal to this species which prefers well-timbered areas such as moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, *Melaleuca* swamps, dense coastal forests and *Banksia* scrub (OEH 2012). Thus, only marginal foraging habitat for the species would be reduced / degraded by the proposal which could impact on its life cycle.

The habitat of Little Bentwing-bat would be reduced directly through the clearing of 0.75 ha of native vegetation representing marginal foraging habitat. Retained marginal foraging habitat of Little Bentwing-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove potential habitat for the Little Bentwing-bat, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of marginal habitat would not represent a significant loss to Little Bentwing-bat. The removal of habitat could result

in the reduction of a territorial range but is unlikely to affect the entire territory. The majority of riparian vegetation in the north of the study area would be retained. The proposal would not significantly fragment the habitat of the species, which is highly mobile.

Little is documented on how Little Bentwing-bat would respond to increased noise disturbance. Overseas studies on bats that listen for their prey in addition to using echolocation have found that these bats avoid areas with noise disturbance while foraging (Schaub *et al.* 2008, Siemers and Schaub 2011). Little Bentwing-bat is a fast flier and as such probably uses echolocation as its primary means of finding prey while foraging. Thus, it is unlikely that Little Bentwing-bat would avoid areas of noise disturbance while foraging. Foraging habitat in the study area is marginal habitat, likely to be used only occasionally. It is already noise affected and is not likely to be important habitat which the species would rely on.

Regarding artificial light, overseas studies have found that some bats are attracted to higher densities of prey species around lights while other species avoid lights (Jones 2000). Little Bentwing-bat could be similar to the larger Eastern Bentwing-bat which has been observed foraging around artificial lights (Churchill 2008). As such, the proposal could benefit the species in terms of concentrating prey around additional lights, although it could also increase the species' risk of being predated upon. However, the main predators of Little Bentwing-bat are cats and foxes and the species is most at risk from predation while roosting / breeding rather than while foraging. Despite the potential benefits of increased artificial light in the study area for the species, mitigation measures to reduce light spillage and avoid lighting the passive recreation infrastructure in the riparian corridor would be implemented to minimise impacts from artificial light to the environment.

The proposal would not indirectly impact on foraging habitat supporting prey species within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not introduce large quantities of pesticides or increase the incidence of predators which would impact on the species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.72 ha of native vegetation representing marginal foraging habitat for the Little Bentwing-bat would be removed. Remaining marginal foraging habitat of Little Bentwing-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

However, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging resources would become limited within the study area. Vegetation within the riparian corridor would be rehabilitated in accordance with a Vegetation Management Plan. The proposal would not significantly fragment the habitat of the species, which is highly mobile. No breeding habitat (maternity roosts) would be impacted by the proposal.

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads and buildings, and produce conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Little Bentwing-bat is found on the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW (OEH 2012). In tropical Queensland, the species occurs from the coast to higher elevations along the ranges and tablelands, with its distribution becoming increasingly coastal towards the southern part of its range in NSW (Hoye and Hall 2008a). The species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise during nocturnal foraging periods. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads, retaining walls and passive recreation infrastructure, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Eastern Bentwing-bat

The Eastern Bentwing-bat is listed as a vulnerable species under the TSC Act. The species has recently been revised to *Miniopterus orianae oceanensis* (Churchill 2008), recognising the subspecies to full species status. Eastern Bentwing-bat occupies a range of forested environments (including wet and dry sclerophyll forests, monsoon forest, open woodland, *Melaleuca* forests and open grasslands) along the coastal portion of eastern Australia, from Cape York in north Queensland to Castlemaine in Victoria. It occurs mainly east of the Great Dividing Range (Churchill 2008).

This species has a fast, level flight exhibiting swift shallow dives. It forages from just above the tree canopy, to many times the canopy height in forested areas, and will utilise open areas where it is known to forage at lower levels. It can travel up to 65 km in one night. Moths appear to be the main dietary component, with other prey items including flies, cockroaches and beetles (Churchill 2008, OEH 2012).

This highly mobile species is capable of large regional movements in relation to seasonal differences in reproductive behaviour and winter hibernation. Though individuals often use numerous roosts, it congregates in large numbers at a small number of nursery caves to breed and hibernate (breeding or roosting colonies can number from 100 to 150,000 individuals). Although roosting primarily occurs in caves, it has also been recorded in mines, culverts, stormwater channels, buildings, and occasionally tree-hollows. This species occupies a number of roosts within specific territorial ranges usually within 300 km of the maternity cave, and may travel large distances between roost sites (Hoye and Hall 2008b, OEH 2012).

The Eastern Bentwing-bat has been identified within the study area. The study area provides foraging and roosting habitat for this species. The species is likely to use the culvert in the Northern Bushland Park as an overwintering roost. The bat is unlikely to use the culvert as a maternity roost. The species is known to travel up to 20 km in a night and use a variety of roosts. It is understood that temporary exclusion from a non-maternity roost will not result in deleterious impacts (A. Scanlon pers. comm. October 2014).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Eastern Bentwing-bat by reducing the amount of foraging, roosting and breeding habitat available to the species, or degrading its habitat. Eastern Bentwing-bat was recorded as 'probable' via echolocation during the field survey within the study area. It is cave-roosting and breeding although stormwater drains and culverts are also used for roosting (Churchill 2008, Hoye and Hall 2008b) and the proposal would not impact on caves or these structures. Thus, only foraging habitat would be reduced / degraded by the proposal for the species which could impact on its life cycle.

The foraging habitat of Eastern Bentwing-bat would be reduced directly through the clearing of 0.79 ha of native vegetation. Remaining foraging habitat of Eastern Bentwing-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove foraging habitat for the Eastern Bentwing-bat, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of foraging habitat would not represent a significant loss to Eastern Bentwing-bat. The removal of habitat could result in the reduction of a territorial range but is unlikely to affect the entire territory. Riparian vegetation

represents foraging habitat and will be mostly retained and management in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile; the species has been recorded foraging up to 65 km away from roost sites (Churchill 2008).

Little is documented on how Eastern Bentwing-bat would respond to increased noise disturbance. Overseas studies on bats that listen for their prey in addition to using echolocation have found that these bats avoid areas with noise disturbance while foraging (Schaub *et al.* 2008, Siemers and Schaub 2011). Eastern Bentwing-bat is a fast flier and as such probably uses echolocation as its primary means of finding prey while foraging. It has been recorded in many urban areas disturbed by noise. Thus, it is unlikely that Eastern Bentwing-bat would avoid areas of noise disturbance while foraging. Even if Eastern Bentwing-bat avoided areas of habitat disturbed by increased noise, the species would be able to move to undisturbed areas easily.

Regarding artificial light, overseas studies have found that some bats are attracted to higher densities of prey species around lights while other species avoid lights (Jones 2000). Eastern Bentwing-bat has been observed foraging around artificial lights (Churchill 2008). As such, the proposal could benefit the species in terms of concentrating prey around additional lights, although it could also increase the species' risk of being predated upon. However, the main predators of Eastern Bentwing-bat are cats and foxes and the species is most at risk from predation while roosting / breeding rather than while foraging. Despite the potential benefits of increased artificial light in the study area for the species, mitigation measures to reduce light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor would be implemented to minimise impacts from artificial light to the environment.

The proposal would not indirectly impact on foraging habitat supporting prey species within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not introduce large quantities of pesticides or increase the incidence of predators which would impact on the species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.79 ha of native vegetation representing known foraging habitat for the Eastern Bentwing-bat would be removed. Remaining foraging habitat of Eastern Bentwing-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

It is thought that the culvert is likely to be used as an overwintering roost. Construction works should be completed prior to winter to ensure animals in torpor are not disturbed. If works cannot be completed by winter (May), then exclusion of the working entrance of the culvert should be undertaken. Advice is that this type of temporary exclusion of a non-maternity roost will not result in a significant impact to the Eastern Bentwing-bat.

These bats are known to travel up to 20 km in a night and to use a variety of roosts. It would appear that fidelity to an occasionally used roost is not high. There are likely to be suitable roosts within a 20 km radius of this site.

However, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging resources would

become limited within the study area. Riparian vegetation represents foraging habitat and will be mostly retained and improved in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile; the species has been recorded foraging up to 65 km away from roost sites (Churchill 2008). No breeding habitat (maternity roosts) would be impacted by the proposal.

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation, proposed construction within and outside the riparian corridor, and thereby produces conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Eastern Bent-wing Bat occupies a range of forested environments (including wet and dry sclerophyll forests), along the coastal portion of eastern Australia (predominantly east of the divide), and through the Northern Territory and Kimberley area (subject to subdivision of this species) (Churchill 2008; OEH 2012). The species is not at the limit of its distribution at the study area.

The Eastern Bentwing-bat is a highly mobile species with some individuals travelling over 300 km to their maternity sites (OEH 2012). The proposed works will not limit the ability of this species to move through the landscape such that is known distribution will be restricted.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. The proposed high pressure gas pipeline may result in the temporary disturbance to the soil profile, increase in sediments, erosion and nutrient flow into Porters Creek during construction. Mitigation measures would be implemented to manage for the impacts such as directing artificial light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise during nocturnal foraging periods. The VMP will be implemented after the construction works and will result in a better biodiversity outcome than the current condition of the riparian habitat through erosion control and weed removal works. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space. The removal of rubbish already present within the study area will occur under the VMP during the 3 years of implementation.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads, retaining walls and passive recreation infrastructure, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. Some temporary disturbance is likely to occur during the construction of the gas pipeline within the Northern Bushland Park. Approximately 0.07 ha of poor condition SRW will be removed. These areas will be revegetated as per the VMP.

The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

East Coast Freetail Bat

East Coast Freetail-bat is listed as a vulnerable species in NSW under the TSC Act. It is found along the east coast from south Queensland to southern NSW. The species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range (OEH 2012).

The East Coast Freetail-bat roosts mainly in tree hollows but would also roost under bark or in man-made structures. The species is solitary and probably insectivorous (OEH 2012).

Threats to the species include the loss of hollow-bearing trees, loss of foraging habitat and the application of pesticides in or adjacent to foraging areas (OEH 2012).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of East Coast Freetail-bat by reducing the amount of foraging, roosting and breeding habitat available to the species, or degrading its habitat. East Coast Freetail-bat was recorded during the field survey on the OSL site. It is predominantly tree hollow-roosting and breeding (OEH 2012) and the proposal would remove six hollow-bearing trees. Thus, both known foraging and potential breeding / roosting habitat would be reduced / degraded by the proposal for the species which could impact on its life cycle.

The habitat of East Coast Freetail-bat would be reduced directly through the clearing of 0.75 ha of native vegetation and six hollow-bearing trees representing known foraging and potential breeding / roosting habitat, respectively. Remaining foraging habitat of East Coast Freetail-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove habitat for the East Coast Freetail-bat, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of habitat would not represent a significant loss to East Coast Freetail-bat. The removal of habitat could result in the reduction of a territorial range but is unlikely to affect the entire territory. Riparian vegetation represents foraging habitat and will be mostly retained and management in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile. Where the removal of habitat trees is required, a pre-clearance protocol would be developed and implemented to determine if any individuals of East Coast Freetail-bat were present in tree hollows. An ecologist would be present during clearing to capture and re-release individuals (where appropriate).

Little is documented on how East Coast Freetail-bat would respond to increased noise disturbance. Overseas studies on bats that listen for their prey in addition to using echolocation have found that these bats avoid areas with noise disturbance while foraging (Schaub *et al.* 2008, Siemers and Schaub 2011). East Coast Freetail-bat is a fast flier and as such probably uses echolocation as its primary means of finding prey while foraging. It has been recorded in many urban areas disturbed by noise. Thus, it is unlikely that East Coast Freetail-bat would avoid areas of noise disturbance while foraging. Even if East Coast Freetail-bat avoided areas of habitat disturbed by increased noise, the species would be able to move to undisturbed areas easily.

Regarding artificial light, overseas studies have found that some bats are attracted to higher densities of prey species around lights while other species avoid lights (Jones 2000). It is not known whether East Coast Freetail-bat would avoid areas of light disturbance. However, the study area is already light affected and the species was recorded, suggesting that the species does not avoid areas impacted by

artificial light. Even if East Coast Freetail-bat avoided areas of habitat disturbed by increased artificial light, the species would be able to move to undisturbed areas easily. To reduce the potential impacts on foraging activities, artificial lighting of the passive recreation infrastructure is not recommended as this will likely deter the species. Mitigation measures (**Section 7.3**) to reduce light spillage would also be implemented to minimise impacts from artificial light.

The proposal would not indirectly impact on foraging habitat supporting prey species within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not introduce large quantities of pesticides or increase the incidence of predators which would impact on the species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.72 ha of native vegetation and six hollow-bearing trees representing known foraging and potential breeding/roosting habitat for the East Coast Freetail-bat, respectively, would be removed. Remaining foraging habitat of East Coast Freetail-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

However, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging and roosting resources would become limited within the study area. Riparian vegetation represents foraging habitat and will be mostly retained and improved in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile. Where the removal of habitat trees is required, a pre-clearance protocol would be developed and implemented to determine if any individuals of East Coast Freetail-bat were present in tree hollows. An ecologist would be present during clearing to capture and re-release individuals (where appropriate).

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads and buildings, and produce conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented. A Vegetation Management Plan for the rehabilitation of the riparian corridor will improve condition of vegetation within this area.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

East Coast Freetail-bat is found along the east coast from south Queensland to southern NSW. The species occurs in dry sclerophyll forest and woodland east of the Great Dividing Range (OEH 2012). The species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events within the study area in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise during nocturnal foraging periods. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads, retaining walls and passive recreation infrastructure, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Grey-headed Flying-fox

Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria. They occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy (OEH 2012).

Individual camps may have tens of thousands of animals and are used for mating, birth and the rearing of young. Annual mating commences in January and a single young is born each October or November. Site fidelity to camps is high with some camps being used for over a century. They travel up to 50 km to forage (OEH 2012).

This species feeds on the nectar and pollen of native trees, in particular *Eucalyptus*, *Melaleuca* and *Banksia*, and fruits of rainforest trees and vines. They also forage in cultivated gardens and fruit crops and can inflict severe crop damage (OEH 2012).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Grey-headed Flying-fox by reducing the amount of foraging, roosting and breeding habitat available to the species, or degrading its habitat. Grey-headed Flying-fox was recorded during the field survey on the nearby OSL site. The species roosts and breeds in camps and the proposal would not impact on any camps. Thus, only foraging habitat would be reduced/degraded by the proposal for the species which could impact on its life cycle. The proposal could also impact on the life cycle of Grey-headed Flying-fox through electrocution on powerlines.

Potential foraging habitat of Grey-headed Flying-fox would be reduced directly through the clearing of 0.72 ha of native vegetation. Remaining potential foraging habitat of Grey-headed Flying-fox would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove potential foraging habitat for the Grey-headed Flying-fox, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of potential foraging habitat would not represent a significant loss to Grey-headed Flying-fox. The removal of potential habitat could result in the reduction of a territorial range but is unlikely to affect the entire territory. Riparian vegetation will be mostly retained, rehabilitated and managed in accordance with a VMP. The proposal would not significantly fragment the potential habitat of the species, which is highly mobile and able to travel up to 50 km during foraging excursions.

Little is documented on how Grey-headed Flying-fox would respond to increased noise and light disturbance, but loud and constant noise is used to discourage Grey-headed Flying-foxes from foraging and roosting in certain areas. It is possible that Grey-headed Flying-fox would avoid areas of noise disturbance while foraging. However, the study area is already noise and light affected and Grey-headed Flying-fox has been recorded in many urban areas disturbed by noise and light. Even if Grey-headed Flying-fox avoided areas of potential habitat disturbed by increased noise and light, the species would be able to move to undisturbed areas easily. Mitigation measures to reduce light spillage and avoid lighting the passive recreation infrastructure in the riparian corridor would be implemented to minimise impacts from artificial light to the environment. Noise during the construction period is likely to

be louder, however this will only occur during daytimes when Grey-headed Flying Fox are unlikely to utilise the site.

The proposal would not indirectly impact on potential foraging habitat within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not increase the incidence of electrocution of the species as overhead powerlines are not proposed.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.72 ha of native vegetation representing potential foraging habitat for the Grey-headed Flying-fox would be removed. Remaining potential foraging habitat of Grey-headed Flying-fox would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels

However, the amount of potential foraging habitat being removed would be minimal with respect to the amount of habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging resources would become limited within the study area. Vegetation within the riparian corridor would be rehabilitated in accordance with a Vegetation Management Plan. The proposal would not significantly fragment the habitat of the species, which is highly mobile. There is no roosting habitat within the study area that would be impacted by the proposal.

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads and buildings, and produce conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Grey-headed Flying-fox is found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria (OEH 2012). The species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise during nocturnal foraging periods. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to

improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads, retaining walls and passive recreation infrastructure, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the highly mobile species, and it is unlikely to impact on the species utilisation of available potential foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Yellow-bellied Sheathtail Bat

The Yellow-bellied Sheathtail-bat is listed as a vulnerable species under the TSC Act. It is a wide-ranging species found across northern and eastern Australia, and occurs across NSW. In the most southerly part of its range, most of Victoria, south-western NSW and adjacent South Australia, it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes (OEH 2012).

Yellow-bellied Sheathtail-bat forages in most habitats across its very wide range, with and without trees (wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert; Churchill 2008, OEH 2012). The species appears to defend an aerial territory. While foraging for insects, the species flies high and fast over the forest canopy, but lower in more open country and at the forest edge (Churchill 2008, OEH 2012).

The species roosts singly or in groups of up to six, in tree hollows and buildings. In treeless areas the species is known to use mammal burrows. Breeding has been recorded from December to mid-March, when a single young is born. Seasonal movements are unknown; there is speculation about a migration to southern Australia in late summer and autumn (OEH 2012).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Yellow-bellied Sheathtail-bat by reducing the amount of foraging, roosting and breeding habitat available to the species, or degrading its habitat. Yellow-bellied Sheathtail-bat is predominantly tree hollow-roosting and breeding (Churchill 2008) and the proposal would impact on hollow-bearing trees. The study area contains potential foraging habitat. Thus, both potential foraging and breeding/roosting (tree hollows) habitat would be reduced/degraded by the proposal for the species which could impact on its life cycle.

Potential habitat of Yellow-bellied Sheathtail-bat would be reduced through the clearing of 0.75 ha of vegetation and six hollow-bearing trees representing potential foraging and breeding/roosting habitat, respectively. Remaining potential foraging habitat of Yellow-bellied Sheathtail-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove potential habitat for the Yellow-bellied Sheathtail-bat, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of potential habitat would not represent a significant loss to Yellow-bellied Sheathtail-bat. The removal of habitat could result in the reduction of a territorial range but is unlikely to affect the entire territory. The majority of riparian vegetation will be retained and managed in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile. Where the removal of habitat trees is required, a pre-clearance protocol would be developed (see section 7.2) and implemented to determine if any individuals of Yellow-bellied Sheathtail-bat were present in tree hollows. An ecologist would be present during clearing to capture and re-release individuals (where appropriate).

Little is documented on how Yellow-bellied Sheathtail-bat would respond to increased noise disturbance. Overseas studies on bats that listen for their prey in addition to using echolocation have found that these bats avoid areas with noise disturbance while foraging (Schaub *et al.* 2008, Siemers and Schaub 2011). Yellow-bellied Sheathtail-bat is a fast flier and as such probably uses echolocation

as its primary means of finding prey while foraging. Thus, it is unlikely that Yellow-bellied Sheathtail-bat would avoid areas of noise disturbance while foraging. Even if Yellow-bellied Sheathtail-bat avoided areas of habitat disturbed by increased noise, the species would be able to move to undisturbed areas easily.

Regarding artificial light, overseas studies have found that some bats are attracted to higher densities of prey species around lights while other species avoid lights (Jones 2000). It is not known whether Yellow-bellied Sheathtail-bat would avoid areas of light disturbance. However, even if Yellow-bellied Sheathtail-bat avoided areas of habitat disturbed by increased artificial light, the species would be able to move to undisturbed areas easily. Despite the potential benefits of increased artificial light in the study area for the species, mitigation measures to reduce light spillage and avoid lighting the passive recreation infrastructure in the riparian corridor would be implemented to minimise impacts from artificial light to the environment.

The proposal would not indirectly impact on foraging habitat supporting prey species within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not introduce large quantities of pesticides or increase the incidence of predators which would impact on the species.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.72 ha of native vegetation and six hollow-bearing trees representing potential foraging and breeding/roosting habitat for the Yellow-bellied Sheathtail-bat, respectively, would be removed. Remaining foraging habitat of Yellow-bellied Sheathtail-bat would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels

However, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging and roosting resources would become limited within the study area. Vegetation within the riparian corridor would be rehabilitated in accordance with a Vegetation Management Plan. The proposal would not significantly fragment the habitat of the species, which is highly mobile. Where the removal of habitat trees is required, a pre-clearance protocol would be developed and implemented to determine if any individuals of Yellow-bellied Sheathtail-bat were present in tree hollows (see mitigation measures in section 7.2). An ecologist would be present during clearing to capture and re-release individuals (where appropriate).

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads and buildings, and produce conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia, and occurs across NSW. In the most southerly part of its range, most of Victoria, south-western NSW and adjacent South Australia, it is a rare visitor in late summer and autumn. There are scattered records of this species across the New England Tablelands and North West Slopes (OEH 2012). The

species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events within the study area in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise during nocturnal foraging periods. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads, retaining walls and passive recreation infrastructure, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Gang-gang Cockatoo

The Gang-gang Cockatoo is listed as vulnerable under the TSC Act. It is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (OEH 2012).

The Gang-gang Cockatoo is generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests in summer. In winter, the species may occur at lower altitudes in drier more open eucalypt forests and woodlands, particularly in box-ironbark assemblages, or in dry forest in coastal areas, and is often found in urban areas. Gang-gang Cockatoo may also occur in sub-alpine Snow Gum *Eucalyptus pauciflora* woodland and occasionally in temperate rainforests, and as the species undertakes nomadic as well as seasonal movements, may occur at apparently random points within their range (OEH 2012).

The species favours old growth attributes for nesting and roosting, requiring hollows in the trunks or large limbs of large trees in which to breed. Breeding usually occurs in tall mature sclerophyll forests that have a dense understorey, and occasionally in coastal forests. Nests are most commonly recorded in eucalypt hollows in live trees close to water. Breeding usually occurs between October and January, and individuals are likely to breed from around four years of age (OEH 2012).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Gang-gang Cockatoo by reducing the amount of foraging habitat available to the species, or degrading its habitat. Gang-gang Cockatoo breeds in tall mountain forests and woodlands in high altitude, migrating to the Sydney area outside of its breeding season (OEH 2012). Thus, only foraging habitat would be reduced/degraded by the proposal for the species which could impact on its life cycle.

Potential habitat of Gang-gang Cockatoo would be reduced through the clearing of 0.72 ha of native vegetation representing potential foraging habitat. Remaining foraging habitat of Gang-gang Cockatoo would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove potential habitat for the Gang-gang Cockatoo, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of potential habitat would not represent a significant loss to Gang-gang Cockatoo. The majority of riparian vegetation will be retained and rehabilitated (see section 7.2 for mitigation measures). The proposal would not significantly fragment the habitat of the species, which is highly mobile and regularly makes large migratory movements.

Little is documented on how Gang-gang Cockatoo would respond to increased noise and light disturbance. However, Gang-gang Cockatoo is often observed in urban environments experiencing noise and light disturbance. Even if Gang-gang Cockatoo avoided areas of habitat disturbed by increased noise and light, the species would be able to move to undisturbed areas easily. Mitigation measures to reduce light spillage and to avoid lighting of the passive recreation infrastructure within the

riparian corridor would be implemented to minimise impacts from artificial light to the environment.

The proposal would not indirectly impact on foraging habitat within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not alter the existing fire regime or increase the incidence of weeds. Weeds are present in high densities in the study area but weed spread would be prevented from retained habitat in and outside of the study area.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.72 ha of native vegetation representing potential foraging habitat for the Gang-gang Cockatoo would be removed. Remaining foraging habitat of Gang-gang Cockatoo would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels

However, the amount of foraging habitat being removed would be minimal with respect to the amount of habitat present for this species within the locality e.g. within Lane Cove National. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging resources would become limited within the study area. The majority of riparian vegetation, representing foraging habitat for the species would be retained. The proposal would not significantly fragment the habitat of the species, which is highly mobile.

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads and buildings, and produce conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Gang-gang Cockatoo is distributed from southern Victoria through south- and central-eastern New South Wales. In New South Wales, the Gang-gang Cockatoo is distributed from the south-east coast to the Hunter region, and inland to the Central Tablelands and south-west slopes. It occurs regularly in the Australian Capital Territory. It is rare at the extremities of its range, with isolated records known from as far north as Coffs Harbour and as far west as Mudgee (OEH 2012). The species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise at night. The incidence of

rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads, retaining walls and passive recreation infrastructure, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Little Lorikeet

The Little Lorikeet is listed as vulnerable under the TSC Act. It is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs.

The species feeds mostly on nectar and pollen and forage primarily on Eucalypts in open woodland but also utilise other trees such as *Angophora* and *Melaleuca*. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. Isolated flowering trees in open country, e.g. paddocks, roadside remnants and urban trees also help sustain viable populations of the species.

The species is gregarious, travelling and feeding in small flocks (<10), though often with other lorikeets. Flocks numbering hundreds are still occasionally observed and may have been the norm in past centuries. The species roosts in treetops, most typically selecting hollows in the limb or trunk of smooth-barked Eucalypts. The entrance to hollows is small (3 cm) and usually high above the ground (2–15 m). These nest sites are often used repeatedly for decades, suggesting that preferred sites are limited. Riparian trees are often chosen, including *Allocasuarina*.

Nesting season extends from May to September. In years when flowering is prolific, Little Lorikeet pairs can breed twice, producing 3-4 young per attempt. However, the survival rate of fledglings is unknown (OEH 2012).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Little Lorikeet by reducing the amount of potential foraging and breeding habitat available to the species, or degrading its habitat. Little Lorikeet breeds in tree hollows with small entrances (3 cm) usually high above the ground (2–15 m) near riparian areas (OEH 2012), and the proposal would impact on hollow-bearing trees with small hollows. The study area contains potential foraging habitat. Thus, both potential foraging and breeding (tree hollows) habitat would be reduced/degraded by the proposal for the species which could impact on its life cycle.

Potential habitat of Little Lorikeet would be reduced through the clearing of 0.72 ha of vegetation and six hollow-bearing trees representing potential foraging and breeding habitat, respectively. Remaining foraging habitat of Little Lorikeet would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove potential habitat for the Little Lorikeet, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. The loss of a small proportion of potential habitat would not represent a significant loss to Little Lorikeet. The majority of riparian vegetation will be retained and managed in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile and can be locally nomadic.

Little is documented on how Little Lorikeet would respond to increased noise and light disturbance. However, Little Lorikeet is often observed in urban environments experiencing noise and light disturbance. Mitigation measures to reduce light spillage and avoid lighting the passive recreation infrastructure in the riparian corridor would be implemented to minimise impacts from artificial light to the environment.

The proposal would not indirectly impact on foraging habitat within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not alter the existing fire regime or increase the incidence of weeds. Weeds are present in high densities in the study area but weed spread would be prevented from retained habitat in and outside of the study area.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 2.3 ha of vegetation including weeds and exotics (approximately 86% of vegetation in the study area) and six hollow-bearing trees representing potential foraging and breeding habitat for the Little Lorikeet, respectively, would be removed. Remaining foraging habitat of Little Lorikeet would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels

However, the amount of habitat being removed would be minimal with respect to the amount of habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging resources would become limited within the study area. Riparian vegetation represents foraging habitat and will be mostly retained and improved in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile and can be locally nomadic.

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation, proposed construction within and outside the riparian corridor, and thereby produces conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury (OEH 2012). The species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of infrastructure within and outside of the riparian corridor, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the Little Lorikeet, a highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Powerful Owl

The Powerful Owl is listed as a vulnerable species under Schedule 2 of the TSC Act. It is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria and occurs at low densities. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains (OEH 2012).

Powerful Owls occur primarily in densely vegetated gullies of open and tall open forest, but they are also found in a wider range of habitats, including forests and woodlands within the metropolitan regions of cities. However, optimal habitat requires large tracts of forest or woodland habitat, including a tall shrub layer and abundant hollows supporting high densities of arboreal marsupial prey species (OEH 2012).

This species roosts in dense mid-canopy trees (such as Turpentines, She-oaks and rainforest trees), or tall shrubs in sheltered gullies, typically on wide creek flats and at the heads of minor drainage lines (DEC 2006). Nesting occurs from late autumn to mid winter in large hollows (greater than 45 cm wide and greater than 100 cm deep) in eucalypts in unlogged, unburnt gullies and lower slopes within 100 m of streams or minor drainage lines (DEC 2006). Nest trees are typically emergent, and are often the largest and oldest in a stand (Debus and Chafer 1994). Powerful Owls are faithful to traditional nesting hollows but can also use other hollows within the nesting gully.

Pairs of birds occupy large home ranges (300-1500 ha; DEC 2006), utilising various portions of this area at different times, depending on the local abundance of arboreal mammals as a food source (Debus and Chafer 1994). Powerful Owls prey particularly on the Greater Glider and Ringtail Possum although the relative importance of prey items appears to vary regionally, with other prey such as Sugar Gliders, Brushtail Possums, Grey-headed Flying-foxes, insects and birds also used (Debus and Chafer 1994; DEC 2006).

This species is threatened by a number of processes including loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development, which also affects the populations of arboreal prey species (DEC 2006). Other threats include loss of hollow-bearing trees suitable for nesting, disturbance around nest sites (particularly during pre-laying, laying and downy chick stages), high frequency hazard reduction burning (affecting prey availability), secondary poisoning, road kills, and predation of fledglings by foxes, dogs and cats (OEH 2012).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

The proposal could impact on the life cycle of Powerful Owl by reducing the amount of foraging habitat available to the species, or degrading its habitat. Powerful Owl prefers to nest in large emergent trees that are within gullies or lower slopes within 100 m of streams (OEH 2012). The proposal would not impact on hollow-bearing trees of this type. Thus, only foraging habitat would be reduced/degraded by the proposal for the species which could impact on its life cycle.

Habitat of Powerful Owl would be reduced through the clearing of 0.72 ha of native vegetation representing potential foraging habitat. Remaining foraging habitat of Powerful Owl would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels.

While the proposal would remove potential habitat for the Powerful Owl, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within

the locality e.g. within Lane Cove National Park. The loss of a small proportion of potential habitat would not represent a significant loss to Powerful Owl. The majority of riparian will be retained and managed in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile.

Little is documented on how Powerful Owl would respond to increased noise and light disturbance. However, Powerful Owl is often observed in urban environments experiencing noise and light disturbance. Mitigation measures (**Section 7.2**) to reduce light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor would be implemented to minimise impacts from artificial light to the environment.

The proposal would not indirectly impact on foraging habitat within and outside of the study area through the introduction of contaminated water or sediments from construction works given sedimentation and stormwater controls (for water quality). Also, the proposal would not alter the existing fire regime or increase the incidence of weeds. Weeds are present in high densities in the study area but weed spread would be prevented from retained habitat in and outside of the study area.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Approximately 0.72 ha of vegetation representing potential foraging habitat for the Powerful Owl would be removed. Remaining foraging habitat of Powerful Owl would be degraded during construction works which would introduce noise, ground vibrations, and some artificial light. Following construction, there would be higher traffic levels, and increased noise and artificial light levels

However, the amount of habitat being removed would be minimal with respect to the amount of habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging resources would become limited within the study area. The majority of riparian vegetation within the study area will be retained and managed in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile.

The proposal could increase erosion, sedimentation and runoff through the clearing of vegetation, proposed construction within and outside the riparian corridor, and thereby produces conditions favourable to weed invasion impacting on the species' habitat. However, sediment and erosion controls and stormwater controls mimicking pre-construction water quality would be implemented. Procedures for controlling the spread of weeds would be implemented.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria and occurs at low densities. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains (OEH 2012). The species is not at the limit of its distribution at the study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and grazing by feral animals

including the European Rabbit are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to exacerbate grazing impacts from European Rabbit at the site. It would also be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime within the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of infrastructure within and outside of the riparian corridor, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

How is the proposal likely to affect habitat connectivity?

The vegetation communities in the study area are already highly fragmented from surrounding vegetated areas, due to previous disturbance of the study area and urban development i.e. immediately adjacent the M2. The proposal will retain 0.32 ha SRW riparian vegetation in the north of the study area, which has limited habitat connectivity to patches of vegetation to the west of the M2 and further to Lane Cove National Park. The narrow strip of Weeds and Exotics along the western boundary of the study area is marginal foraging habitat for the Powerful Owl, a highly mobile species, and it is unlikely to impact on the species utilisation of available foraging habitat within the broader locality.

How is the proposal likely to affect critical habitat?

Not applicable - critical habitat cannot be declared for vulnerable species.

Red-crowned Toadlet

The Red-crowned Toadlet (*Pseudophryne australis*) is listed as a Vulnerable Species on Schedule 2 of the TSC Act. The Red-crowned Toadlet has a restricted distribution, known only from a relatively small area of mid-eastern New South Wales.

The species has been recorded from near sea level to about 1000 metres elevation, but most sites are on fairly low coastal ranges under 200 m in elevation. Favoured microhabitats for shelter sites are under flat sandstone rocks ('bush-rock') either resting on bare rock or damp loamy soils. They have also been found under logs on soil, beneath thick ground litter, particularly near large trees and in horizontal rock crevices near the ground.

The Red-crowned Toadlet has a unique terrestrial reproductive strategy. Small nests are formed within decomposing accumulated leaf matter; clutch sizes are small, consisting of around 20-24 large eggs (Thumm and Mahony 1997); nests retain the eggs through the early stages of tadpole development, which occurs within a water-filled membranous capsule. Rainfall events flush the embryos from the nest, and tadpoles complete development within transient pools.

Recent studies have revealed a less than 0.1% reproductive success rate or only 1 clutch in 50 achieves any survival from tadpole to metamorphling. Consequently, changes to flow regimes, frequency of rainfall and availability of breeding sites all play a role in successful breeding and ultimate recruitment into local populations.

Red-crowned Toadlet has been recorded on land adjoining the study area over the last 12 years including 10 individuals recorded by Ambrose Ecological Services (2001), an unstated number heard by Biosphere Environmental Consultants in 2005, 2006 and 2007 and 4 individuals recorded by ELA in 2009. All records were from the rear of commercial properties adjoining the M2 Site. ELA (2009) mapped part of the M2 Site as core habitat and potential habitat, although it acknowledged that this area was moderate to poor quality with a high level of disturbance and weed infestation. The proposed development will be set back 8 m from the western property boundary near the Red-crowned Toadlet habitat (2.4 m of which has been designated as a drainage easement).

How is the proposal likely to affect the lifecycle of a threatened species and/or population?

Factors that may have an adverse effect on the life cycle of Red-crowned Toadlet include a substantial loss and/or fragmentation of foraging and breeding habitat and impacts to water quality. The M2 Site is highly unlikely to provide breeding habitat as it is essentially Weeds and Exotics. All records of Red-crowned Toadlet have been from further into the adjoining land on the western boundary where drains and tussock grass appear to have provided habitat. In terms of fragmentation, the location of Red-crowned Toadlet is already significantly fragmented from other potential habitat (known records along the length of the Lane Cove River to the north). This will not be exacerbated by the proposal.

How is the proposal likely to affect the habitat of a threatened species, population or ecological community?

Previous surveys for the Red-crowned Toadlet identified potential core habitat area on adjoining land which is moderate to poor quality. The proposed development will not directly affect this habitat. ELA (2009) mapped part of the M2 Site as core habitat and potential habitat, although it acknowledged that this area was moderate to poor quality with a high level of disturbance and weed infestation. The proposal will impact on this core and potential habitat. Core potential habitat areas will be retained as part of the 2.4 m wide proposed drainage easement area. Approximately 0.29 ha of potential habitat

within along the western boundary of the study area will be cleared for the proposal, with exception of the potential habitat within the 3 m drainage easement.

Surveys completed in 2011 on the M2 Site identified the high amount of weeds on the strip of land that adjoins the area where Red-crowned Toadlet have been recorded in previous years. Despite the poor quality, Red-crowned Toadlet could conceivably use the area on the M2 site as foraging habitat. Building footprints on the M2 Site will be set back 8 m from the property boundary.

While the proposal would remove potential foraging / refuge habitat for the Red-crowned Toadlet, the amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. However connectivity to this habitat is low and would be available via stormwater drains. The loss of a small proportion of potential habitat would not represent a significant loss to the survival of the Red-crowned Toadlet if this species is still in the area. Similar vegetation is available and will be retained within the Porters Creek riparian corridor in the north of the study area and will be improved by a VMP. The proposal is unlikely to significantly fragment the habitat of the species due to the highly disturbed nature of the study area, although it will reduces the width of potential habitat in the locality.

Does the proposal affect any threatened species or populations that are at the limit of its known distribution?

The Red-crowned Toadlet has a restricted distribution, known only from a relatively small area of mid-eastern New South Wales. The study area is contained wholly within this range distribution of the Red-crowned Toadlet.

The species is not at the limit of its distribution at this study area.

How is the proposal likely to affect current disturbance regimes?

The study area is located in an urban, built up area. Current disturbances at the site include disturbances associated with urban areas (e.g. noise and light disturbance, changed hydrology from impervious surfaces, rubbish dumping). However, some soil disturbance and weed infestation are present, and it is likely that introduced predators are present in the study area. There have been no major fire events on the site in the last decade.

The proposal would increase disturbances associated with urban areas, with increased traffic levels estimated. However, increases in traffic and noise and light levels would not be significant. Mitigation measures would be implemented to manage for the impacts of artificial light by directing light to where it is needed to avoid light spillage and to avoid lighting of the passive recreation infrastructure within the riparian corridor; which may also reduce human disturbance and noise. The incidence of rubbish dumping within the riparian corridor vegetation may increase due to improved access to this area; litter management would need to be incorporated into management of the open space.

The proposal would be unlikely to increase the density of introduced predators which would lead to increased predation by species such as feral cats and European Red Fox. As well, the proposal would be unlikely to alter the current fire regime at the study area.

The proposal has the potential to increase erosion, sedimentation and runoff through the clearing of vegetation and the construction of roads, retaining walls and passive recreation infrastructure, and produce conditions favourable to weed invasion. However, stormwater management would be implemented to control stormwater quality by adopting stormwater treatment measures to remove pollutants, including sediments, from urban runoff to mimic pre-construction water quality, minimising

impacts on downstream receiving waters. Soil erosion and run-off control measures and weed control would be implemented as part of the mitigation measures undertaken for the proposal.

Short term potential impacts to water quality during the construction of the retaining wall and timber boardwalk and landings would be managed via soil and erosion control measures, sensitive to the potential use of the area by the Red-crowned Toadlet.

How is the proposal likely to affect habitat connectivity?

Adjacent habitat available to Red-crowned Toadlet is available within Lane Cove National Park. Due to the already fragmented landscape and built environment of the study area, connectivity to alternative habitat is available via stormwater drains. The proposal is unlikely to further fragment or isolate other habitat for the Red-crowned Toadlet.

Lot 109 is proposed as a future road which traverses the drainage easement along the western boundary approximately 17.5 m in length. The design of the drainage easement would need to be sensitive to the movement of Red-crowned Toadlets, such that the species can continue along the drainage line to the south and north.

How is the proposal likely to affect critical habitat?

Critical habitat has not been declared for the Red-crowned Toadlet.

Appendix F: Impact Assessments (EPBC Act listed species)

An assessment of the impacts of the proposal on species, populations and ecological communities listed under the EPBC Act has been completed in accordance with the *EPBC Act Policy Statement 1.1 – Significant Impact Guidelines* (DEWHA 2009).

The study area does not support any threatened ecological communities and is unlikely to support any threatened flora species. The study area supports native vegetation with potential and known habitat for a number of threatened and migratory fauna species. A full list of species recorded within a 10 km radius of the study area is found in Appendix A; however, not all of these species or their habitats are likely to be impacted. Potentially impacted species are listed below.

Threatened Species

Bats

- *Chalinolobus dwyeri* (Large-eared Pied Bat)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

Migratory Species

Birds

- *Apus pacificus* (Fork-tailed Swift)
- *Hirundapus caudacutus* (White-throated Needletail)

Threatened Species

Large-eared Pied Bat

Large-eared Pied Bat is listed as a vulnerable species under the EPBC Act. A description for the species is provided in the impact assessment for the species in Appendix E.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

a) lead to a long-term decrease in the size of an important population of a species;

Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- **Key source populations either for breeding or dispersal;**
- **Populations that are necessary for maintaining genetic diversity, and/or;**
- **Populations that are near the limit of the species range;**

The Large-eared Pied Bat was not recorded during the field surveys. It is possible that the population in the area represents an important population of the species given the largest concentration of populations for breeding appears to be in the sandstone escarpments of the Sydney basin and northwest slopes of NSW (DSEWPAC 2012); the local population could be a key source population for breeding or dispersal.

However, should an important population be present at the study area, the proposal is unlikely to lead to a long-term decrease in the size of an important population. The amount of habitat being removed would be minimal with respect to the amount of potential habitat present for this species within the locality e.g. within Lane Cove National Park. It is unlikely that the proposed vegetation clearance would impact on this species such that foraging and roosting resources would become limited within the study area. The majority of riparian vegetation would be retained and managed in accordance with a VMP. The proposal would not significantly fragment the habitat of the species, which is highly mobile. Where the removal of habitat trees is required, a pre-clearance protocol would be implemented (see section 7.2) to determine if roosts (disused Fairy Martin nests) were present in any trees proposed for clearing or if any individuals of Large-eared Pied bat were present in tree hollows. An ecologist would be present during clearing to capture and re-release individuals (where appropriate). No breeding habitat (maternity roosts) would be impacted by the proposal.

b) reduce the area of occupancy of an important population;

As outlined above, it is possible that a Large-eared Pied Bat population in the area represents an important population of the species based on the local population being a key source population for breeding or dispersal. However, the proposal is unlikely to reduce the area of occupancy of Large-eared Pied Bat. Under the proposal, approximately 0.72 ha of foraging habitat and marginal roosting habitat (six hollow-bearing trees) for the species would be removed. This represents a small proportion relative to what is present in the locality. The Large-eared Pied Bat is a mobile species and will be able to access remaining foraging and roosting resources in the study area and locality.

c) fragment an existing important population into two or more populations;

As outlined above, it is possible that a Large-eared Pied Bat population in the area represents an important population of the species based on the local population being a key source population for breeding or dispersal. However, the proposal is unlikely to fragment an existing important population into two or more populations. The Large-eared Pied Bat is a mobile species and would be able to access remaining foraging resources in the study area and the locality.

d) adversely affect habitat critical to the survival of a species;

Note: Habitat critical to the survival of a species refers to areas that are necessary:

- **For activities such as foraging, breeding, roosting, or dispersal;**
- **For the long-term maintenance of the species (including the maintenance of species essential to the survival of the species such as pollinators);**
- **To maintain genetic diversity and long-term evolutionary development;**
- **For the reintroduction of populations or recovery of the species;**

The action would remove habitat for the Large-eared Pied Bat. However, this habitat does not constitute habitat critical to the survival of a species, as it represents habitat used only periodically for foraging, and does not represent breeding habitat for the species (breeding habitat is necessary for

maintaining sustainable populations and the genetic diversity of the species). Some potential roosting habitat, hollow-bearing trees and possibly disused nests of Fairy Martins, would be impacted, but the species roosts and breeds primarily in caves, crevices in cliffs, and old mine workings (DSEWPAC 2012).

Regarding foraging habitat to be removed, it is unlikely that the proposed vegetation clearance would impact on this species such that foraging resources would become limited within the study area i.e. the proposal is unlikely to substantially reduce the amount of foraging habitat for this species present within the proposal site. The action would remove approximately 0.72 ha of potential foraging habitat for the species. This amount is considered to be minimal relative to other higher quality foraging habitat in the locality.

The habitat proposed to be removed does not constitute habitat identified in a recovery plan for the species, habitat critical for that species, or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

e) disrupt the breeding cycle of an important population;

As outlined in part a), it is possible that a Large-eared Pied Bat population in the area represents an important population of the species based on the local population being a key source population for breeding or dispersal. However, no Large-eared Pied Bat breeding habitat would be impacted by the proposal, as Large-eared Pied Bat breed primarily in caves, crevices in cliffs, and disused mines (DSEWPAC 2012). Only a small amount of foraging and marginal roosting habitat would be impacted. As such, the breeding cycle of any important population is unlikely to be impacted.

f) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The action would remove foraging habitat and some marginal roosting habitat for the Large-eared Pied Bat. However, only a small amount of potential foraging and marginal roosting habitat would be impacted (approximately 0.72 ha of foraging habitat and six hollow-bearing trees). The removal of a relatively small amount of habitat within the study area is unlikely to decrease the availability or quality of habitat to the extent that the species is likely to decline.

The proposal is also unlikely to isolate or modify habitat for the species (eg. through changed disturbance regimes) to the extent that the species is likely to decline. Potential impacts from the proposal on foraging habitat e.g. soil movement, weed spread, increased run off would be managed.

g) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

Note: An invasive species is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.

No invasive species that are harmful to the Large-eared Pied Bat have been identified. Introduced predators and weeds are not identified as a threat to Large-eared Pied Bat in the Action Plan for Australian Bats (Duncan *et al.* 1999). Even so, the proposal is unlikely to contribute to any increased feral animal activity or weed invasion across the study area.

h) introduce disease that may cause the species to decline, or

The Action Plan for Australian Bats (Duncan *et al.* 1999) does not identify any diseases that threaten Large-eared Pied Bat. The action is not expected to introduce any disease to the study area.

i) interfere substantially with the recovery of the species.

Given the proposal would not impact on the breeding habitat of the Large-eared Pied Bat, the proposal is unlikely to interfere with the recovery of the species. Foraging and roosting habitat would remain available for the species in the locality, despite the removal of 0.72 ha of foraging habitat within the study area for the species.

***Pteropus poliocephalus* (Grey-headed Flying-fox)**

The Grey-headed Flying-fox is listed as a vulnerable species under the EPBC Act. A description for the species is provided in the impact assessment for the species in Appendix E.

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

j) lead to a long-term decrease in the size of an important population of a species;

Note: An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- **Key source populations either for breeding or dispersal;**
- **Populations that are necessary for maintaining genetic diversity, and/or;**
- **Populations that are near the limit of the species range;**

The study area does not contain any current or historic campsites for this species and it is likely that the study area would only be used on occasion as foraging habitat. Grey-headed Flying Fox in the study area are not part of an important population as they are not near the limit of the species' range or represent key source populations for breeding or dispersal. Thus, the proposal is unlikely to lead to a long-term decrease in the size of an important population.

k) reduce the area of occupancy of an important population;

This is not an important population. The proposed action would not further reduce the area of potential occurrence for the Grey-headed Flying Fox. The area of occupancy is unlikely to be affected for any populations given that no campsites have been recorded within the study area and that extensive foraging habitat exists in the surrounding landscape.

l) fragment an existing important population into two or more populations;

This is not an important population. The proposal would not fragment any populations into two or more populations given the area is already disturbed, and the proposal would only remove a small amount of foraging habitat. The highly mobile nature of this species means that the proposed work would not be a barrier to movement.

m) adversely affect habitat critical to the survival of a species;

Note: Habitat critical to the survival of a species refers to areas that are necessary:

- **For activities such as foraging, breeding, roosting, or dispersal;**
- **For the long-term maintenance of the species (including the maintenance of species essential to the survival of the species such as pollinators);**
- **To maintain genetic diversity and long-term evolutionary development;**
- **For the reintroduction of populations or recovery of the species;**

As the proposal would not involve the removal of any campsites, it would be unlikely to create a barrier to movement, and would result only in the removal of a small amount of foraging habitat relative to the availability of foraging habitat in surrounding lands, it is unlikely that habitat critical to the survival of this species would be adversely affected.

The habitat proposed to be removed does not constitute habitat identified in a recovery plan for the species, habitat critical for that species, or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

n) disrupt the breeding cycle of an important population;

This is not an important population. As no roosting habitat would be removed or disturbed, and some foraging habitat would be retained in the study area with foraging habitat also present in the locality, it is unlikely the proposal would disrupt the breeding cycle of the local population.

o) modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

As no campsites would be removed or disturbed, and foraging habitat exists in the study area, the proposed work would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

p) result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat

Note: An invasive species is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation.

The proposal would not result in invasive species, such as weeds, that would be harmful to Grey-headed Flying Fox. Vegetation in the study area is already degraded with weeds, but this would not be increased as a result of the proposal. Vegetation within the riparian corridor would be treated for weed management and rehabilitation to protect Porters Creek.

q) introduce disease that may cause the species to decline, or

The Action Plan for Australian Bats (Duncan *et al.* 1999) identifies Australian bat Lyssavirus, Bat Paramyxovirus and Menangle Pig virus as diseases that may affect Grey-headed Flying-fox. The proposal is not expected to introduce any disease to the study area.

r) interfere substantially with the recovery of the species.

Given the proposal would not impact on the breeding or roosting habitat of the Grey-headed Flying-fox, the proposal is unlikely to interfere with the recovery of the species. Foraging habitat would remain available for the species in the study area and locality. The proposal would not introduce disease to the study area, which would otherwise interfere with the recovery of the Grey-headed Flying-fox.

Migratory Species

Fork-tailed Swift

The Fork-tailed Swift is listed as a migratory marine species under the EPBC Act, and is included in the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) (DotE, 2014).

In Australia, they mostly occur over inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities. They mostly occur over dry or open habitats, including riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. The sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines (Higgins, 1999).

In NSW, the Fork-tailed Swift is recorded in all regions. Many records occur east of the Great Divide, however, a few populations have been found west of the Great Divide. These are widespread but scattered further west of the line joining Bourke and Dareton. Sightings have been recorded at Milparinka, the Bulloo River and Thurloo Downs (Higgins, 1999). The species has been recorded as occasionally travelling with Needletails (e.g. *Hirundapus caudacutus*).

They forage aerially, up to hundreds of metres above ground, but also less then 1 m above open areas or over water. The species food items within Australia are not well known, however, the Fork-tailed Swift is known to be insectivorous. Studies have recorded the Swift eating small bees, wasps, termites and moths (DotE, 2014).

The Fork-tailed Swift does not breed in Australia, they breed in Siberia from August toSeptember. They migrate to Australia following breeding and are commonly seen in NSW between October and March (DotE, 2014).

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will meet any of the following criteria:

d) substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

Note: An "area of important habitat for a migratory species" is defined as:

- **Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or**
- **Habitat that is of critical importance to the species at particular life-cycle stages; and/or**

- **Habitat utilised by a migratory species which is at the limit of the species' range; and/or**
- **Habitat within an area where the species is declining.**

The study area does not represent important habitat for Fork-tailed Swift as it does not occur on the limit of the species' range, and does not support an ecologically significant proportion of the population of the species, is not of critical importance to the species at particular life cycle stages and is not within an area where the species is declining.

The proposal would result in the removal of foraging habitat for the species. However, removal of vegetation would not represent a substantial loss and / or fragmentation of foraging habitat for the species, with the species unlikely to be reliant on the resources present in the study area and able to use other areas due to its highly mobile nature. Therefore, the proposed loss of 0.72 ha of potential habitat is not likely to substantially modify, destroy, or isolate an area of important habitat for the species.

In terms of breeding habitat, the proposal would not substantially impact any breeding habitat for the species as it breeds in Siberia. Thus, areas of critical habitat of importance to the Fork-tailed Swift would not be affected.

e) result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species;

The proposal would not result in the establishment of an invasive species that is harmful to Fork-tailed Swift.

f) seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Note: An "ecological significant proportion" of the population varies with the species and each circumstance will need to be evaluated. Some factors include the species' population status, genetic distinctiveness and species specific behavioural patterns. Eg. site fidelity.

A "population of a migratory species" is the entire population or any geographically separate part of the population, a significant proportion of whose members cyclically and predictably cross one or more nationally jurisdictional boundaries including Australia.

The proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of Fork-tailed Swift. Fork-tailed Swifts do not breed in Australia, they breed in Sibera. The removal and fragmentation of vegetation in the study area would be unlikely to affect the species, which forages aerially over a range of habitats including cleared areas.

White-throated Needletail

The White-throated Needletail is listed as a migratory species under the EPBC Act, and is included in the Japan-Australia Migratory Bird Agreement (JAMBA), the China-Australia Migratory Bird Agreement (CAMBA), and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) (DSEWPAC 2012).

In Australia, the White-throated Needletail is almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. Because they are aerial, it has been stated that conventional habitat descriptions are inapplicable, but there are, nevertheless, certain preferences exhibited by the species. Although they occur over most types of habitat, they are probably recorded most often above wooded areas, including open forest and rainforest, and may also fly between trees or in clearings, below the canopy, but they are less commonly recorded flying above woodland. They also commonly occur over heathland, but less often over treeless areas, such as grassland or swamps. When flying above farmland, they are more often recorded above partly cleared pasture, plantations or remnant vegetation at the edge of paddocks. In coastal areas, they are sometimes seen flying over sandy beaches or mudflats, and often around coastal cliffs and other areas with prominent updraughts, such as ridges and sand-dunes (DSEWPAC 2012).

During the non-breeding season in Australia, the White-throated Needletail has been recorded eating a wide variety of insects, including beetles, cicadas, flying ants, bees, wasps, flies, termites, moths, locusts and grasshoppers. The White-throated Needletail almost always forage aerially, at heights up to 'cloud level' though usually much lower (DSEWPAC 2012).

The species has been recorded roosting in trees in forests and woodlands, both among dense foliage in the canopy or in hollows. It has been suggested that they also sometimes roost aerially (DSEWPAC 2012).

The species breeds in wooded lowlands and sparsely vegetated hills, as well as mountains covered with coniferous forests in Asia, from central and south-eastern Siberia and Mongolia, east to the Maritime Territories of Russia, Sakhalin and the Kuril Islands and south to northern Japan and north-eastern China (DSEWPAC 2012).

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will meet any of the following criteria:

g) substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

Note: An "area of important habitat for a migratory species" is defined as:

- **Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or**
- **Habitat that is of critical importance to the species at particular life-cycle stages; and/or**
- **Habitat utilised by a migratory species which is at the limit of the species' range; and/or**
- **Habitat within an area where the species is declining.**

The study area does not represent important habitat for White-throated Needletail as it does not occur on the limit of the species' range, and does not support an ecologically significant proportion of the population of the species, is not of critical importance to the species at particular life cycle stages and is not within an area where the species is declining.

The proposal would result in the removal of foraging habitat for the species. However, removal of vegetation would not represent a substantial loss and/or fragmentation of foraging habitat for the

species, with the species unlikely to be reliant on the resources present in the study area and able to use other areas due to its highly mobile nature. Therefore, the proposed loss of potential habitat is not likely to substantially modify, destroy, or isolate an area of important habitat for the species.

In terms of breeding habitat, the proposal would not substantially impact any breeding habitat for the species as it breeds in Asia. Thus, areas of critical habitat of importance to the White-throated Needletail would not be affected.

h) result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species;

The proposal would not result in the establishment of an invasive species that is harmful to White-throated Needletails.

i) seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

Note: An "ecological significant proportion" of the population varies with the species and each circumstance will need to be evaluated. Some factors include the species' population status, genetic distinctiveness and species specific behavioural patterns. Eg. site fidelity.

A "population of a migratory species" is the entire population or any geographically separate part of the population, a significant proportion of whose members cyclically and predictably cross one or more nationally jurisdictional boundaries including Australia.

The proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of White-throated Needletail. White-throated Needletails do not breed in Australia. The removal and fragmentation of vegetation in the study area would be unlikely to affect the species, which forages aerially over a range of habitats including cleared areas.

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