The freshwater wetland within the study area may not qualify as the 'Freshwater Wetland on Coastal Floodplains EEC', as this EEC typically occurs on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains.

- Shrubland:

Around the edges of the bare sand area in the central eastern portion of the study area, a shrubland comprising opportunistic shrub species such as *Acacia longifolia* occurs. The structural complexity is simple, with only a shrub layer to approximately two metres in height occurring. Floristic diversity is also very low.

4.2.2 Threatened Flora

The literature review and database searches undertaken in GHD (2007) indicate that a number of threatened flora species have been recorded, or have the potential to occur, within the locality lists those threatened flora that have been recorded in the locality (Table 4-2).

Earp's Red Gum (*Eucalyptus parramattensis subsp. decadens*) was recorded in the study area during the current investigations (Figure 4-3). The records of the species provided in Figure 4-3 are indicative only of the species' occurrence within the study area. A detailed survey to ascertain the extent of the distribution of this species across the study area was beyond the scope of the current investigations.

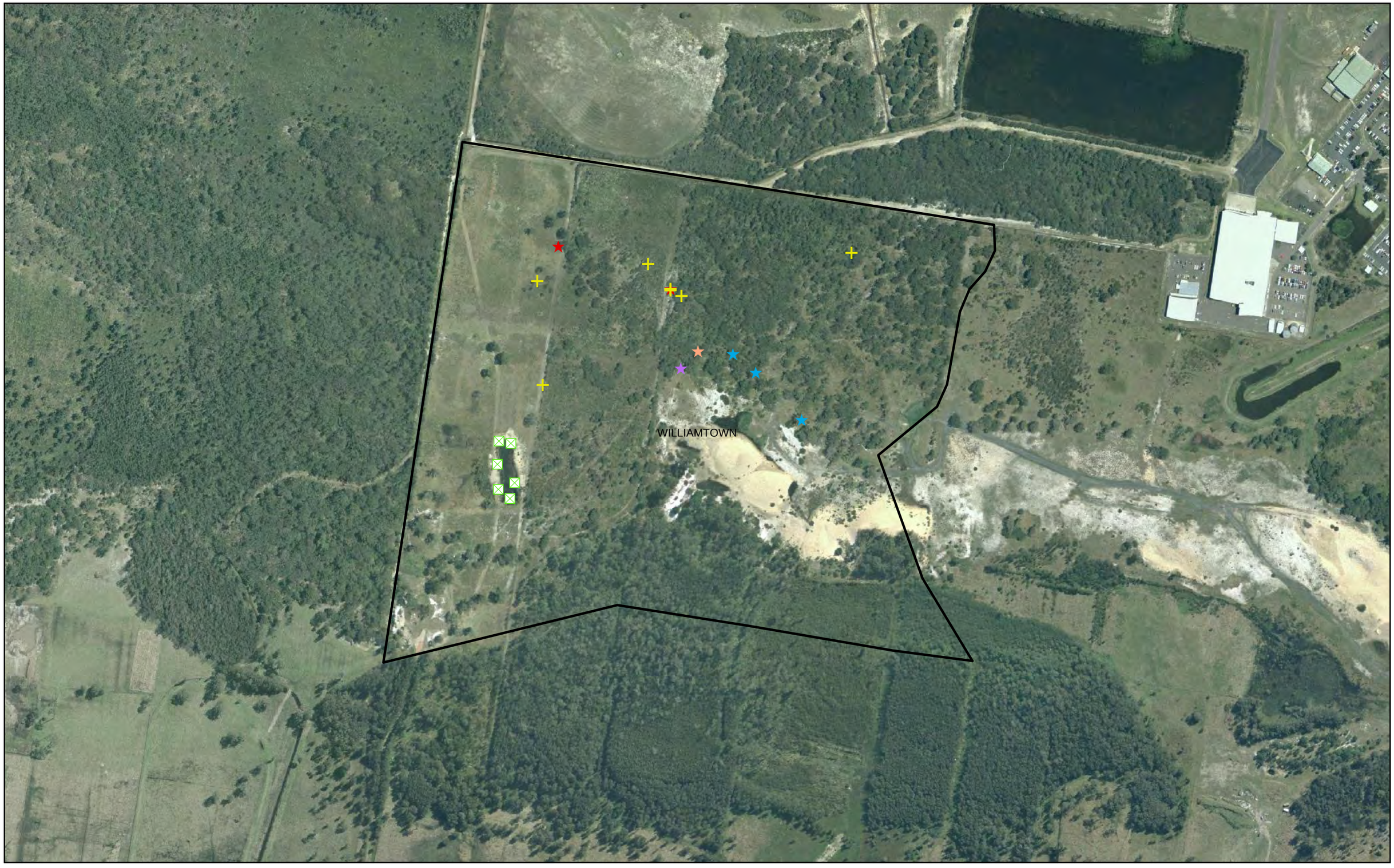
4.2.3 Endangered Ecological Communities

Field surveys undertaken for the supplementary assessment confirmed the occurrence of the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions Endangered Ecological Community (Swamp Sclerophyll Forest EEC) within the study area.

Table 4-2 Assessment of Likelihood of Threatened Flora Species Occurring Within Study Area

Common Name (Species Name)	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring in Study Area
Heart-leaved Stringybark (*Eucalyptus camfieldii*)	V	V	Occurs on poor coastal country in shallow sandy soils overlying Hawkesbury sandstone often in coastal heath mostly on exposed sandy ridges. Stands usually occur near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of Narrow-leaved Stringybark (*E. oblonga*), Brown Stringybark (*E. capitellata*) and Scribbly Gum (*E. haemastoma*) (DEC 2006e).	Unlikely. Suitable habitat absent from study area.
(*Eucalyptus parramattensis* subsp. *decadens*)	V	V	This species is a small woodland tree that generally occurs in dry sclerophyll woodland, or as an emergent in dry or wet heath land, and is often the community dominant. It occupies deep, low nutrient sands, often in areas subject to periodic inundation or where water tables are relatively high. Threats include habitat loss from development, weed invasion, changes to hydrology and too-frequent fire (DEC 2006f).	Recorded in sand swamp woodland habitat in study area.
Dwarf Kerrawang (*Rulingia prostrata*)	E	E	Occurs on sandy, sometimes peaty soils in a wide variety of habitats. This species is threatened by a poor understanding of responses to environmental conditions and management practices which could result in inappropriate management actions or inactions (DEC 2006g).	Likely. Potential habitat for this species is provided by woodland habitat on sandy soils within the study area.
Leafless Tongue Orchid (*Cryptostylis hunteriana*)	V	V	Potential habitat for this species is poorly understood and it is thought to typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*Eucalyptus sieberi*), Red Bloodwood and Black She-oak. It appears to prefer open areas in the understorey and is often found in association with the Large Tongue Orchid (*Cryptostylis subulata*) and the Tartan Tongue Orchid (*Cryptostylis erecta*). This species flowers between November and February (DEC 2006h).	Unlikely. Habitat for this species may occur to the west of the study area however it is unlikely to occur within the study area.

Common Name (Species Name)	TSC Act	EPBC Act	Habitat Association	Likelihood of Occurring in Study Area
Sand Double Tail (*Diuris arenaria*)	E		This species occurs in coastal heath and dry grassy eucalypt forest on sandy flats. It grows in gently undulating country in eucalypt forest with a grassy understorey on clay soil (DEC2006i)	Unlikely. Suitable habitat absent from study area.
Rough Double Tail (*Diuris praecox*)	V	V	This species is known to occur on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. This species flowers during winter and is only detectable during the flowering season. It has a restricted distribution between Ourimbah to Nelson Bay (DEC 2006j).	Unlikely. Suitable habitat absent from study area.



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Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Additional Land for Investigation
- Wallum Froglet
- Eucalyptus parramattensis subsp. decadens (Oct07)
- Koala, Heard calling from swamp forest to north
- Koala, Scats
- Koala, Spotlighted
- Sea-eagle, Calling site

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NSW Department of Planning
Airport Related Employment Zone (Williamtown)

job no. 22-12808
rev no. A

Threatened Species Recorded in Study Area

23 | October 2007

Figure 4.3

GIS Filename: \22\12808\GIS\MAPS\Ecology\Report Figs(Oct07)\Fig3_Threat_Species_231007.mxd

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4.2.4 Fauna Habitat and Associated Fauna Assemblage

The study area is characterized by a diversity in habitats, ranging from highly disturbed cleared areas to relatively undisturbed forest and woodland habitats.

Areas of dense heath understorey within the study area provide suitable shelter, nesting and foraging habitat for ground-dwelling mammals such as native rats, antechinus, bandicoots, kangaroos and wallabies. Numerous diggings within the sandy soils were observed in the Scribbly Gum / Smooth-barked Apple woodland in particular. Tree hollows are abundant in the Scribbly Gum / Smooth-barked Apple Woodland and Smooth-barked Apple Woodland, are of varying sizes and occur as limb hollows limbs as well as trunk cavities and spouts. These hollows provide suitable nesting and shelter sites for many arboreal mammals such as possums, gliders and tree-roosting bats.

Swamp Mahogany and Broad-leaved Paperbark present within the study area provide an important autumn / winter flowering resource for mammals and avifauna. The eastern portion of the study area has been mapped as Preferred Koala Habitat (Port Stephens Council 2002), with the remainder mapped as 'Link over cleared areas' and 'buffer over cleared areas'. These 'cleared areas' are in fact areas of dense regenerating Broad-leaved Paperbark.

The study area provides high quality habitat for microchiropteran and megachiropteran bat species. Tree hollows and decorticating bark provide roosting sites for many tree-roosting species, while the well-developed shrub layers within the forest and woodland communities support a substantial insect prey base.

The site provides habitat for a wide range of bird species. The substantial mid-storey and understorey throughout much of the study area provides nesting, sheltering and foraging habitat for smaller birds while the larger trees and canopy cover provide habitat for larger birds, including hollow-dependent species such as owls and parrots. Species recorded during the current survey included the Australian Owlet Nightjar, a range of nectarivorous birds including the Eastern Spinebill (*Acanthorhynchus tenuirostris*) and Yellow-faced Honeyeater and small White-throated Gerygone (*Gerygone olvacea*), Red-browed Firetail (*Neochmia temporalis*), Brown Thornbill, species reliant upon in dense undergrowth. The swampy areas and ephemeral water bodies provides suitable habitat for transitory as well as more permanent wader / wetland species.

The study area supports a range of suitable habitat for a variety of reptile and amphibian species. The moist and swampy areas with native riparian vegetation including *Eleocharis* spp. as well as the creek lines and drainage lines present throughout the study area provide ideal habitat for a range of frog species, a number of which were heard calling during the surveys, including the threatened Wallum Froglet. The presence of fallen logs and other vegetation debris, moist areas (likely to support frog numbers) with extensive ground coverage and areas with significant leaf litter within various portions of the study area would provide habitat for a range of lizards and snakes.

Tree use by arboreal mammals was evidenced by the presence of scratchings on many of the mature smooth-barked eucalypts and the presence of scats at the base of these trees. Evidence of macropods (scats and runways) was present within both the dense vegetation communities occurring within the site as well as in open grazing areas throughout the study area. Tracks were also noted on the open sanddune areas.

The main movement corridors through the study area are east to west in orientation. A fence along the northern boundary of the study area precludes the north to south movement of medium to large terrestrial fauna, as well as koalas, between habitat in the study area and areas of habitat to the north.

4.2.5 Threatened Fauna Recorded During Field Surveys

Koala

During the first and second nights of spotlighting, three Koalas were observed in Scribbly Gum / Smooth-barked Apple Woodland, while a fourth was heard calling from Wet Heath Forest (Figure 4-3). One individual was recorded feeding within the Swamp Mahogany / Paperbark Forest on the northern edge of the cleared sanddune area.

During field investigations undertaken for the previous assessment, a Koala was spotlighted within *Angophora costata / Corymbia gummifera* open forest adjoining the northeastern corner of the current study area. A search of DECC's Atlas of NSW Wildlife revealed a record for the current study area dated 1992, indicating historic use of the site. The location of the Atlas of NSW Wildlife database is in the same area as that in which Koala was recorded during the current study.

Further discussion of Koala habitat mapping is provided in Section 4.3.

Wallum Froglet

The permanent wetland in the western portion of the study area provides known habitat for the Wallum Froglet. Several individuals were heard calling from various locations around the wetland.

Water bodies on the edge of the cleared dunal areas contained Plague Minnow (*Gambusia holbrookii*). The Plague Minnow is an introduced freshwater fish that is an aggressive predator of native fauna, notably native frog eggs and tadpoles and is linked to the decline of a number of threatened frog species, including Wallum Froglet (*Crinia tinnula*), which is listed as 'vulnerable' on the TSC Act.

Predation by Plague Minnow is listed as a Key Threatening Process in NSW and a Threat Abatement Plan has been developed (NPWS 2003a). Proposed management measures outlined in the Threat Abatement Plan include the removal of this species in areas with key frog species where practical and prevention of further dispersal of this species.

Plague Minnow was not recorded in the permanent freshwater wetland in the western portion of the study area. Wallum Froglets were recorded calling from this wetland. An introduction of Plague Minnow into this wetland is likely to have detrimental impacts on this threatened species, as well as non-threatened frog species.

Ephemeral soaks and waterbodies around edges provide potential habitat for Wallum Froglet, however, no Wallum Froglets were heard calling within these areas at the same time that Wallum Froglets were calling in the permanent wetland in the western portion. Furthermore, the ephemeral habitats around the bare sand extraction are somewhat isolated from the area of known Wallum Froglet habitat in the study area.

White-Bellied Sea-Eagle

A pair of White-bellied Sea-eagles were recorded calling within Scribbly Gum / Smooth-barked Apple Woodland. A pair had previously been observed engaging in a courtship display over the study area. White-bellied Sea-eagle was also recorded during the previous field surveys undertaken by GHD (2007). The White-bellied Sea-eagle is listed as a 'migratory' species on the EPBC Act.

Table 4-3 Assessment of Likelihood of Threatened Fauna Species Occurring within the Study Area

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Wallum Froglet (*Crinia tinnula*)	V	—	Inhabits acid paperbark swamps and sedge swamps. This species can be heard calling at anytime throughout the year following rain but calls are more frequent during the breeding season that takes place during winter. Males call from tussocks or at the waters edge (DEC 2006a).	Recorded in the study area.
Green and Golden Bell Frog (*Litoria aurea*)	E	V	Marshes, natural and artificial freshwater to brackish wetlands, dams and in-stream wetlands. Prefers sites containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.), that are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby (DEC 2006b).	Unlikely. No recent local records, indicating the absent of a viable local population. Suitable habitat absent from the study area.
Australasian Bittern (*Botaurus poiciloptilus*)	V		Permanent freshwater wetlands with tall dense reedbeds particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.) with adjacent shallow, open water for foraging. No breeding population known from the Lower Hunter. It hides during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails (DEC 2006l).	Unlikely. Preferred habitat absent from study area.
Bush Stone-curlew (*Burhinus grallarius*)	E	—	Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights, it feed on insects and small vertebrates, such as frogs, lizards and snakes. Nests are on the ground in a scrape or small bare patch (DEC 2006m).	Unlikely. Suitable habitat absent. Absence of recent records for the Williamtown area suggests the absent of a viable local population.
Great Knot (*Calidris tenuirostris*)	V	M	Primarily a coastal species, favouring mudflats, harbours and lagoons DEC 2006n).	Unlikely. Suitable habitat absent.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V	E	Highly specialised species feeding almost exclusively on the seeds extracted from the cones of *Allocasuarina* species including Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*A. torulosa*) or Drooping She-oak (*Allocasuarina verticillata*). Requires suitable hollows in living and dead trees for nesting and breeds between March and August (DEC 2006o).	Unlikely. Suitable foraging & nesting habitat absent from study area.
Lesser Sandplover (*Charadrius mongolus*)	V	M	Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006p).	Unlikely. Suitable habitat absent.
Brown Treecreeper (*Climacteris picumnus*)	V		Inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey. Fallen timber is an important habitat component (DEC 2006q).	Unlikely. Suitable habitat absent from the study area.
Emu (*Dromaius novaehollandiae*)	EP		Open forest, woodland, coastal heath, coastal dunes, wetland areas, tea tree plantations and open farmland, and occasionally in littoral rainforest (DEC 2006r).	Likely. Suitable habitat present within the study area.
Black-necked Stork (*Ephippiorhynchus asiaticus*)	E		Primarily inhabits permanent freshwater wetlands but can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. This species breeds during summer, nesting in or near a freshwater swamp (DEC 2006s).	Likely. Potential habitat within study area provided by permanent drainage courses and intermittent wet swampy areas.
Pied Oystercatcher (*Haematopus longirostris*)	V		Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006t).	Unlikely. Suitable habitat absent.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Black Bittern (*Ixobrychus flavicollis*)	V		Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. This species may roost by day in trees or within reeds on the ground. Nests are located in branches overhanging water and breeding takes place from December to March (DEC 2006u).	Likely. Potential habitat within the study area.
Swift Parrot (*Lathamus discolor*)	E	E	This species migrates to the mainland during winter and occupies habitat with abundant winter flowering eucalypts (DEC 2006v).	Likely. Winter flowering eucalypts within the study area.
Broad-billed Sandpiper (*Limicola falcinellus*)	V	M	Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006w).	Unlikely. Suitable habitat absent.
Black-tailed Godwit (*Limosa limosa*)	V	M	Primarily a coastal species (DEC 2006x).	Unlikely. Suitable habitat absent.
Turquoise Parrot (*Neophema pulchella*)	V		Open eucalypt woodlands and forests, typically with a grassy understorey. It favours the edges of woodlands adjoining grasslands or timbered creek lines and ridges. A granivorous species, the Turquoise Parrot feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat for this species. This species nests in tree hollows, logs or posts from August to December (DEC 2006y).	Likely. Suitable habitat within the study area.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Powerful Owl (*Ninox strenua*)	V		This species occur in a number of vegetation types ranging from woodland and open sclerophyll forest to tall open wet forest and rainforest. However, this species does prefer large tracts of vegetation. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old with breeding taking place from late summer to late autumn. Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400 – 1,450 ha. It forages within open and closed woodlands as well as open areas (DEC 2006z).	Likely. Suitable foraging habitat within the study area.
Blue-billed Duck (*Oxyura australis*)	V		This species prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (DEC 2006za).	Unlikely. Suitable habitat absent from study area.
Osprey (*Pandion haliaetus*)	V		Marine species (DEC 2006zb).	Unlikely. Suitable habitat absent.
Grey-crowned Babbler (*Pomatostomus temporalis* subsp *temporalis*)	V		Inhabits woodlands and is considered unlikely to cross large open areas due to laborious flight (DEC 2006zc).	Unlikely. Suitable habitat absent.
Wompoo Fruitdove (*Ptilinopus magnificus*)	V		It occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests, feeding on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit; some of its feed trees rely on species such as the this to distribute their seeds. The Wompoo fruit-dove is most often seen in mature forests, but also found in remnant and regenerating rainforest (DEC 2006zd).	Unlikely. Suitable fruit-bearing trees absent from the study area.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Superb Fruit-dove (*Ptilinopus superbus*)	V	M	A small pigeon that 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. Breeding takes place from September to January (DEC 2006ze).	Unlikely. Suitable fruit-bearing trees absent from the study area.
Painted Snipe (*Rostratula benghalensis*)	E	V, M	This bird is a wetland species and is normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. This cryptic species nests on the ground amongst tall reed-like vegetation near water. It emerges from the dense growth at dusk to feed on mudflats and the water's edge taking insects, worm and seeds (DEC 2006zf). This species prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	Likely. Potential habitat for this species provided by permanent and ephemeral wetland areas within study area.
Little Tern (*Sterna albifrons*)	E		Primarily a coastal species (DEC 2006zg).	Unlikely. Suitable habitat absent.
Freckled Duck (*Stictonetta naevosa*)	V		This species prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. They generally rest in dense cover during the day, usually in deep water. They feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between October and December but can take place at other times when conditions are favourable and nests are usually located in dense vegetation at or near water level (DEC 2006zh). Potential habitat for this species exists in Vegetation Community 5 and the surrounding areas.	Likely. Potential habitat provided by wetland habitat in the western portion of the study area.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Masked Owl (*Tyto novaehollandiae*)	V		Occurs in dry eucalypt woodlands at altitudes from sea level to 1,100 m and roosts and breeds in hollows and sometime caves in moist eucalypt forested gullies. This species hunts along the edges of forests and roadsides and has a home range covering between 500 ha and 1 000 ha (DEC 2006zi).	Likely. Potential foraging habitat within the study area.
Regent Honeyeater (*Xanthomyza phrygia*)	E	E	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak where there are significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast (DEC 2006zj).	Unlikely. Suitable woodland habitat with substantial winter flowering eucalypts and high abundance of mistletoe in the study area.
Terek Sandpiper (*Xenus cinereus*)	V		Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006zk).	Unlikely. Suitable habitat absent.
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V		Inhabits moist forest generally with trees larger than 20 m and roosts in eucalypt hollows, underneath bark or in buildings. Diet consists of moths, beetles and other insects, which it collects within or just below the tree canopy. This species hibernates during winter and breeding takes place in late spring (DEC 2006zl).	Likely. Potential foraging and roosting habitat within the study area.
Little Bentwingbat (*Miniopterus australis*)	V		Inhabits moist eucalypt forest, rainforest or dense coastal Banksia scrub. This species primarily roosts in caves, tunnels and sometimes tree hollows. Breeding for this species occurs during winter at maternal roost sites (DEC 2006zm).	Likely. Potential foraging habitat within the study area.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Eastern Bentwingbat (*Miniopterus schreibersii oceanensis*)	V		This species is essentially a cave bat, but also utilises man-made habitats such as road culverts, storm-water tunnels and other man-made structures. It is known from a variety of habitats along the east coast including rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grasslands (Churchill 1998, DEC 2006zn). In forested areas, it flies above the canopy to hunt, while in open grassland areas, flight may be within six m of the ground.	Likely. Potential foraging habitat within the study area.
Eastern Freetailbat (*Mormopterus norfolkensis*)	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range and roosts primarily in tree hollows but also in man-made structures or under bark. This species is solitary and probably insectivorous (DEC 2006zo).	Likely. Suitable roosting and foraging habitat within the study area.
Large-footed Myotis (*Myotis adversus*)	V		Primarily a coastal species that forages over streams and watercourses feeding on fish and insects which it catches by raking its feet across the water surface. Breeding takes place during November or December, roosting in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage (DEC 2006zp).	Likely. Potential foraging and roosting habitat within the study area.
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	V		This species forages across a range of habitats including those with and without trees. This species roosts in tree hollows and buildings and in areas where trees are scarce or absent, this species has been known to utilise mammal burrows. Breeding takes place between December and mid-March (DEC 2006zq).	Likely. Potential foraging and roosting habitat within study area.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Greater Broadnosed Bat (*Scoteanax rueppellii*)	V		This species hunts from above rows of trees lining creeks and the edges of woodland in otherwise cleared paddocks, roosting in hollow tree trunks and branches as well as the roofs of old buildings (Churchill 1998). It prefers moist gullies in mature coastal forest or rainforest. The species is only found at low altitudes (below 500 m) (Churchill 1998; DEC 2006 zr).	Unlikely. Preferred habitat absent from the study area.
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are found in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, which are usually traversed along densely vegetated creeklines (DEC 2006zs).	Likely. Suitable habitat within the study area.
Squirrel Glider (*Petaurus norfolcensis*)	V		This species dens in tree hollows and utilises woodland and requires an abundant number of tree hollows for nesting. It feeds on nectar, pollen, flowers, acacia gum and insects and consequently requires a diverse mosaic of trees including eucalypts, acacias and banksias. Home ranges for this species have been estimated to vary from 0.65 and 8.55 ha depending on the type and quality of the habitat. Family groups are normally comprised of one male and two or more females and juveniles (DEC 2006zt).	Likely. Suitable nesting and foraging habitat is present throughout the study area.
Brush-tailed Phascogale (*Phascogale tapoatafa*)	V		This species prefers dry sclerophyll forest with a sparse groundcover of herbs, grasses, shrubs or leaf litter. They also inhabit heath, swamps, rainforest and wet sclerophyll forest. They forage mostly in rough barked trees and feed mostly on arthropods but will eat other invertebrates, nectar and sometimes-small vertebrates (DEC 2006zu).	Unlikely. Preferred habitat absent from the study area.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Koala (*Phascolarctos cinereus*)	V		Limited to areas of preferred food trees in eucalypt woodlands and forests (DEC 2006k).	Recorded in the study area.
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	Roosts in camps generally located within 20 km of a regular food source and are commonly found in gullies, close to water and in vegetation with a dense canopy. This species is known to forage in areas supporting subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps on the nectar and pollen of native trees, in particular eucalypts, melaleucas and banksias. This species will also forage in urban gardens and cultivated fruit crops (DEC 2006zv).	Recorded flying over the study area. Foraging habitat available within the study area.

4.3 Koala Habitat Mapping

Preferred Koala Habitat and associated links and buffers have been identified throughout the study area by the CKPoM (Port Stephens Council 2002). With the exception of the Heathland, Red Gum Woodland and the north-western extent of the Scribbly Gum / Smooth-barked Apple Woodland, all of the study area has been mapped by Port Stephens Council (2002) as 'Preferred Koala Habitat' with a 'Buffer over Cleared' (Figure 4-4).

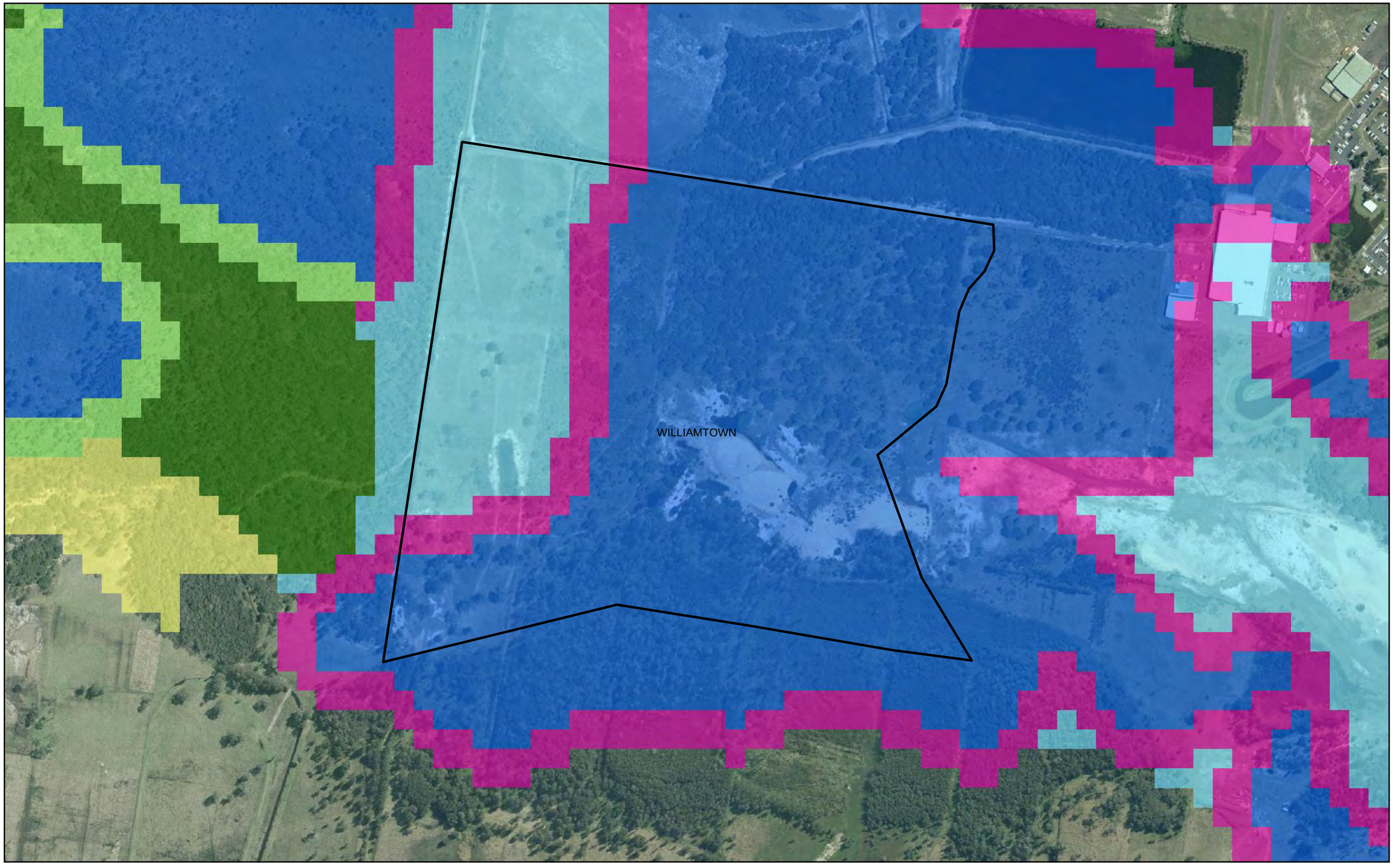
Preferred Koala food trees, as defined by the CKPoM include Swamp Mahogany (*Eucalyptus robusta*), Forest Red Gum (*E. tereticornis*) and Earp's Red Gum (*E. parramattensis*). The CKPoM also lists Broad-leaved Paperbark (*Melaleuca quinquenervia*), Scribbly Gum (*E. signata*) and Smooth-barked Apple (*Angophora costata*) as being potentially important to Koala in the Port Stephens area, based on anecdotal evidence. This correlates with the multiple observations of Koala in the study area within Scribbly Gum / Smooth-barked Apple woodland.

Earp's Red Gum, Swamp Mahogany and Broad-leaved Paperbark were recorded throughout the study area, with the latter two species being particularly common. Field investigations undertaken for this assessment identified the following vegetation communities as Preferred Koala Habitat:

- Swamp Mahogany / Paperbark Forest;
- Red Gum Woodland;
- Swamp Mahogany / Paperbark around Freshwater Wetland;
- Wet Heath Forest – Swamp Mahogany dominant; and
- Wet Heath Forest – Broad-leaved Paperbark dominant.

Three Koalas were spotlighted within Scribbly Gum / Smooth-barked Apple Woodland and Swamp Mahogany / Paperbark Forest. A fourth koala was heard calling from wet heath forest in the northwest portion of the study area.

The remaining parts of the study area qualify as 'buffer' and 'linking' habitat, including the cleared area in the center of the study area. Buffer areas serve to reduce possible edge effects on Preferred Koala Habitat as well as ensure development is not carried out directly adjacent to Preferred Koala Habitat and are therefore considered to require the highest level of protection. Habitat linking areas are considered essential for the conservation of Koala populations and may provide dispersal routes (which ensures genetic exchange between populations) and range extensions where necessary. All other vegetation communities within the study area qualify as buffer or linking habitat. Areas mapped as 'weeds / cleared / bare sand' qualify as '50 m Buffer Over Cleared' and / or 'Link over Cleared'.



1:4,500 for A3

0 25 50 100 150 200

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Additional Land for Investigation
- 50m Buffer Over Cleared
- Link Over Cleared
- Preferred Koala Habitat
- 50m Buffer Over Supplementary
- Link Over Supplementary
- Supplementary Koala Habitat

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Koala Habitat as mapped by Port Stephens CKPOM

23 | October 2007

Figure 4.4

GIS Filename: \22\12808\GIS\MAPS\Ecology\Report Figs(Oct07)\Fig4_Koala_Habitat_231007.mxd

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Appendix 2 of the CKPoM (Port Stephens Council 2002) specifies a number of performance criteria for Rezoning Requests made to Council for lands mapped as containing Koala habitat. Prior to approval of a rezoning request, Council must be satisfied that the rezoning would:

- Not result in development within areas of Preferred Koala Habitat or defined Habitat Buffers;
- Allow for only low impact development within areas of Supplementary Koala Habitat and Habitat Linking Areas;
- Minimise the removal of any individuals of preferred Koala food trees, wherever they occur on the site; and
- Not result in development, which would sever Koala movement across the site. This should include consideration of the need for maximising tree retention on the site generally and for minimising the likelihood of impediments to safe / unrestricted Koala movement.

The Performance Criteria specifies that the rezoning request would not result in development in areas mapped as Preferred Koala habitat. Under this condition, the majority of the extant vegetation within the study area would not be developable as it falls within areas mapped as Preferred Koala Habitat. Any proposed development would need to minimise the removal of preferred Koala food trees wherever they occur within the study area. Also, development within the area may hinder Koala movement through the area, particularly if the western half of the study area were to be developed. Although much of the heathland and Smooth-barked Apple woodland in the central western portion of the study area is highly disturbed, these areas still nonetheless function as important linking areas between Preferred Koala Habitat within the study and other areas of Preferred Koala Habitat to the west.

As stated in Appendix 2 of the CKPOM, an investigation of the site must be carried out under the Guidelines for Koala Habitat Assessment presented in Appendix 6 of the CKPOM. As Step 1 of this assessment process has established the presence of Preferred Koala Habitat and preferred food trees within the study area, further investigation to accompany the Rezoning Request would require detailed vegetation and preferred food tree mapping as well as detailed assessment of Koala usage of the study area and determination of high value linkage areas. If the results of this mapping are found to be inconsistent with existing LGA-wide vegetation maps it would be necessary to further assess the study area in relation to Koala habitat identification, assessment and production of a site-specific Koala Habitat Planning Map. These investigations would need to be carried out at a later stage to accompany the Rezoning Request.

5. Ecological Value Assessment

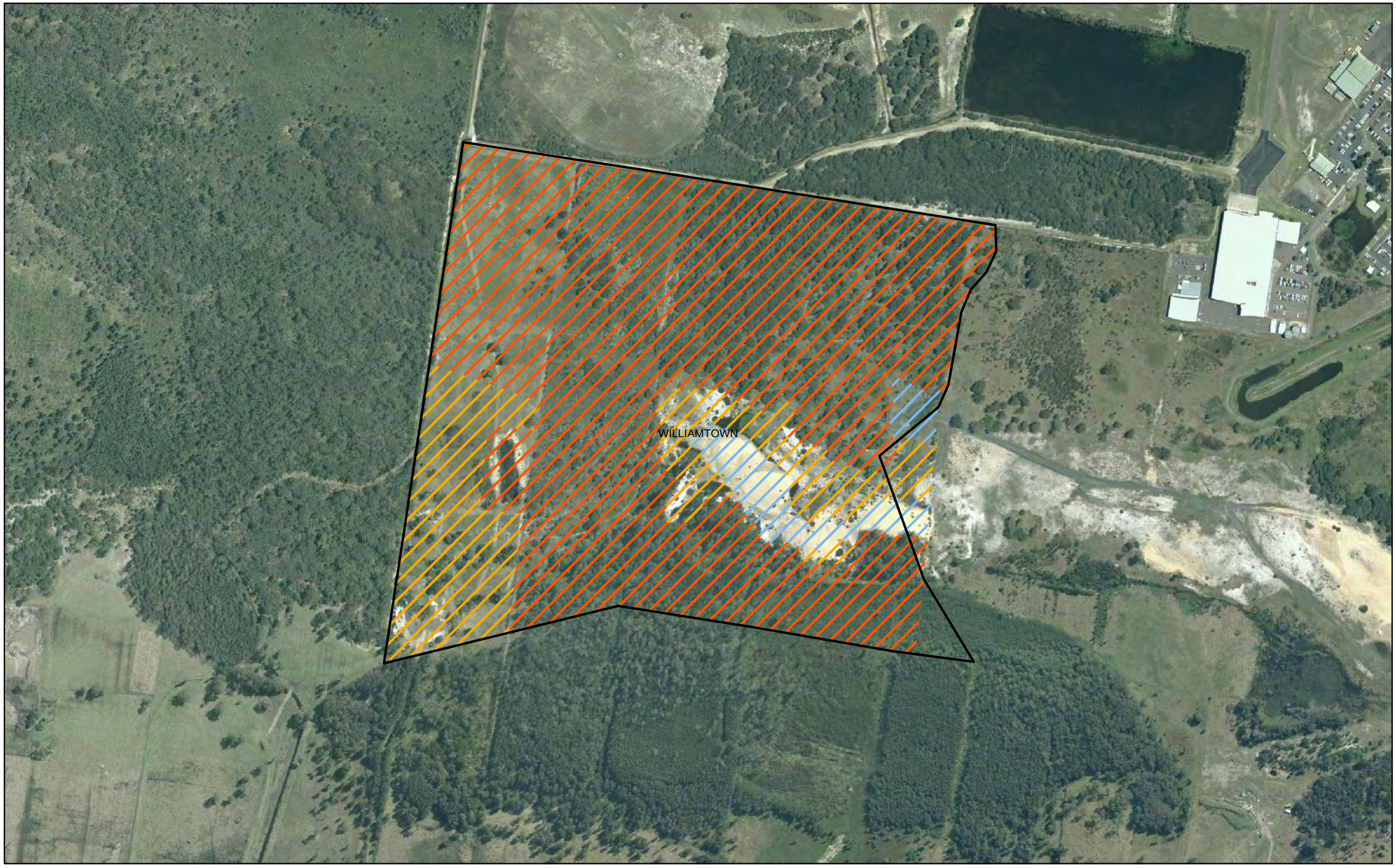
An analysis of ecological values across the study area was used to rate areas of high, medium and low value habitat. The analysis was undertaken in accordance with the assessment criteria presented in Table 5-1. The rating assigned to each area is illustrated in Figure 5-1. Ecological values across the study area are discussed in the following section.

5.1 Factors Influencing Ecological Values Across the Study Area

Factors influencing the distribution of ecological values across the study area include:

- The diversity of vegetation structure, floristics and habitat resources;
- Connectivity with other areas of habitat in the surrounding landscape;
- Representativeness and intactness of the vegetation communities occurring on-site;
- The occurrence of an endangered ecological community (EEC) listed on the TSC Act within the study area, namely Swamp Sclerophyll Forest on Coastal Floodplains;
- Known habitat for the threatened Wallum Froglet occurs within the study area. The Wallum Froglet is associated with acid paperbark swamps and is likely to disperse throughout wet heath forest and heathland habitat throughout the study area during substantial rainfall events in the breeding season, including regenerating wet heath habitats around the cleared sand extraction area;
- The occurrence of Earp's Red Gum (*Eucalyptus parramattensis subsp. decadens*), a species listed as 'vulnerable' on both the TSC Act and the EPBC Act;
- The occurrence of Tomago Sand Swamp Woodland, a regionally vulnerable and regionally specialized vegetation community, within the study area;
- Potential habitat for Wallum Froglet occurs in low-lying habitats such as sand swamp woodland/heath and swamp sclerophyll forest throughout the study area;
- Ephemeral soaks and water-bodies provide habitat for threatened species and are of high ecological value. In particular, the threatened Wallum Froglet is likely to exploit temporary ponds formed after significant rainfall as breeding habitat;
- Vegetation removal and changes in landscape values are likely to alter the hydrological regime and seasonal waterlogging patterns and therefore affect the vegetation composition, hence habitat values of these areas;
- Much of the study area is mapped as Preferred Koala Habitat, Buffer Habitat or Link Over Cleared habitat, all of which are considered important habitat for the protection of the threatened Koala;
- Linkages between areas of Preferred Koala Habitat occur within cleared areas, including the sand-mined area;
- DECC Atlas of NSW Wildlife database record dated 1992 indicates historic use of the site by the threatened Koala;

- Koalas directly observed and heard calling within the study area confirm current use of the site by the species;
- Scribbly Gum / Smooth-barked Apple Woodland within the study area supports an abundance of hollow-bearing trees, providing potential nesting and/or roosting habitat for many threatened species, including the Squirrel Glider and tree-roosting microchiroptan bats. ‘Loss of hollow-bearing trees’ is now listed as a ‘key threatening process’ under the TSC Act; and
- The disturbance history across the site and its impact on habitat condition.



1:4,500 for A3

0 25 50 100 150 200

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

- Additional Land for Investigation
- high ecological value
- medium ecological value
- low ecological value

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Distribution of Ecological Values across the Study Area

Figure 5.1

23 | October 2007

GIS Filename: \22\12808\GIS\MAPS\Ecology\Report Figs(Oct07)\Fig5_Eco_Values_231007.mxd

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Table 5-1 Assessment of Ecological Values Across Study Area

Ecological Value →	High								Medium		Low	
Vegetation Community	**FW**	**SF**	**WHs**	**WHb**	**SG**	**RG**	**H**	**AW[1]**	**Hd**	**WHr**	**SH**	**CL**
Factors used in Assessment												
Endangered Ecological Community on the TSC Act.		√										
Confirmed presence of Koalas.			√	√	√							
Confirmed presence of Wallum Froglet.	√											
Occurrence of *Eucalyptus parramattensis subsp. decadens.*			√	√		√	√					
Regionally vulnerable vegetation community.		√				√	√		√			
Regionally specialised vegetation community.						√	√		√			
Preferred Koala Habitat.	√	√	√	√		√						
Koala Buffer and Linking Habitat.					√		√	√	√	√	√	
Presence of hollow-bearing trees.			√		√			√				
High diversity of native plant species.	√		√	√	√	√	√	√				
Connectivity with other native vegetation.	√	√	√	√	√	√	√	√	√			
Winter-flowering eucalypts.	√	√	√	√								

Ecological Value →	High								Medium		Low	
Vegetation Community	**FW**	**SF**	**WHs**	**WHb**	**SG**	**RG**	**H**	**AW[1]**	**Hd**	**WHr**	**SH**	**CL**
Factors used in Assessment												
Evidence of glider feeding.					√			√				
Abundance of termite nests with evidence of fauna occupation.					√							
Potential habitat for Wallum Froglet.		√	√	√		√	√		√	√		
Foraging habitat for threatened microchiropteran bats.	√	√	√	√	√	√	√	√	√			
Potential habitat for threatened woodland birds such as Brown Treecreeper and Grey-crowned Babbler.					√	√		√				
Potential habitat for Port Stephens endangered population of Emu.			√	√	√	√	√	√	√	√	√	
Suitable foraging habitat for Grey-headed Flying-fox.	√	√	√	√	√			√				
White-bellied Sea-eagle breeding pair present. Potential nesting habitat within study area.					√							
Dense ground cover for terrestrial mammals; numerous runways of various sizes through understorey & groundcover.		√	√	√		√	√	√	√			
Structural complexity – canopy, mid-strata, understorey, groundcover well developed.	√	√	√	√	√	√	√	√				

Ecological Value →	High								Medium		Low	
Vegetation Community	**FW**	**SF**	**WHs**	**WHb**	**SG**	**RG**	**H**	**AW[1]**	**Hd**	**WHr**	**SH**	**CL**
Factors used in Assessment												
Linkage between areas of high value habitat within study area and similar habitat to west.			√	√		√	√	√	√			
Koala Habitat Linking Areas and Buffer Areas over Cleared (includes open grass / slashed areas linking vegetation communities).												√
Groundcover dominated by bracken, blady grass and/or whisky grass.									√			
Open grassy areas for macropods.												√
Areas support poor quality habitat for threatened fauna.												√

5.2 Areas of Conservation Priority for Study Area

Vegetation communities and habitats across the study area were assigned a 'conservation priority' ranking, based on the ecological values discussed in Section 5-1 and illustrated in Figure 5-1. The conservation priority rankings provide guidance on how development may proceed in the study area, in consideration of the degree and distribution of ecological values present.

There is opportunity for staging future development within the study area in such a way that areas considered to be of low ecological value are developed first, with those areas of highest conservation priority either protected in the long term from development, or developed in the latter stages of the project.

Table 5-2 provides explanation of how each area illustrated in Figure 5-2 was assigned its conservation priority, with '1' indicating highest conservation priority and '5' indicating lowest conservation priority. Priority '1" areas have been broken down into 1a, 1b, 1c, 1d and 1e, as it is considered that these areas all have similar conservation priority (for different reasons) and warrant long-term protection.

Table 5-2 Attributes Contributing to the Allocation of Conservation Priorities across the Study Area

Conservation Priority	Attributes Contributing to Conservation Priority
1a	Link between Swamp Sclerophyll Forest at southern end of study area with vegetation to west. This connectivity is crucial to maintaining the wildlife corridor function between habitats in the southern portion of the study area and habitats to the west, particularly for Koalas.
1b	Abundance of hollow-bearing trees. Presence of Koalas. Occurrence of Tomago Sand Swamp Woodland. Occurrence of Earp's Red Gum (a threatened species and preferred Koala feed tree). Occurrence of Swamp Mahogany (preferred Koala feed tree). Occurrence of Scribbly Gum, Broad-leaved Paperbark and Smooth-barked Apple (important Koala feed tree species). Linkage with vegetation and habitats to west. This connectivity is crucial to maintaining the ecological corridor function between habitats in the northern portion of the study area and habitats to the west. Structural complexity and floristic diversity.

Conservation Priority	Attributes Contributing to Conservation Priority
1c	Swamp Sclerophyll Forest EEC. Occurrence of Swamp Mahogany (preferred Koala feed tree). Occurrence of Broad-leaved Paperbark (important Koala feed tree species). Hollow-bearing trees along northern edge of Swamp Sclerophyll Forest.
1d	Hollow-bearing trees, adjacent to Swamp Sclerophyll Forest. Potential open space area.
1e	Confirmed permanent habitat for the Wallum Froglet. Regenerating wet heath forest dominated by Swamp Mahogany and Broad-leaved Paperbark.
2	Linkage between northern and southern vegetation and habitats. Regenerating wet heath forest, including Swamp Mahogany, Broad-leaved Paperbark and Smooth-barked Apple.
3	Remnant mature trees providing linkage between study area and habitats to west. Trees present are not considered important for Koala or hollow-dependent fauna. Lack of structural complexity and floristic diversity.
4	Lack of structural complexity and floristic diversity. A few, scattered, mature trees present. Groundcover dominated by Bracken Fern and Whisky Grass. Trees present are not considered important for Koala or hollow-dependent fauna.
5	Cleared, bare sand with poorly developed structure. Vegetation dominated by opportunistic species and weeds. Ephemeral soaks and waterbodies isolated from permanent wetland habitat in the western portion of the study area.

habitat linkage

1 b

4

2

habitat linkage

WILLIAMTOWN

1 e

5

3

1 c

1 d

1 a

habitat linkage

1:4,500 for A3

0 25 50 100 150 200

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

N

LEGEND

Additional Land for Investigation
1
2
3
4
5

Conservation Priorty Ranking
1 high — 5 low

Habitat Linkage

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Ranking of Conservation Priorities across the Study Area

Figure 5.2

26 | October 2007

GIS Filename: \22\12808\GIS\MAPS\Ecology\Report Figs(Oct07)\Fig6_Consv_Rank_261007.mxd

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6. Conclusion

Based on the distribution of high ecological values across the site, it is considered that the majority of the site has long-term conservation value. This would serve to offset loss of biodiversity within those areas that are appropriate for development.

The study area is characterised by a complex mosaic of vegetation communities and habitats. Those parts of the study area considered having the highest priority for conservation support one or more of the following ecological features:

- Tomago Sand Swamp Woodland, a regionally specialised and regionally vulnerable community;
- Earp's Red Gum (*Eucalyptus parramattensis subsp. decadens*), a species listed as 'vulnerable' on both the TSC Act and EPBC Act. Earp's Red Gum is characteristic of Tomago Sand Swamp Woodland. It is also recognised by the Port Stephens Comprehensive Koala Plan of Management as one of three feed tree species preferred by the Koala;
- Vegetation dominated by Swamp Mahogany (*Eucalyptus robusta*), another of the three feed tree species preferred by the Koala;
- Confirmed habitat for Koala, which is listed as 'vulnerable' on the TSC Act;
- Vegetation communities dominated by tree species considered important for the Koala, such as Broad-leaved Paperbark (*Melaleuca quinquenervia*), Scribbly Gum (*E. signata*) and Smooth-barked Apple (*Angophora costata*);
- Permanent habitat for the Wallum Froglet, a frog species listed as 'vulnerable' on the TSC Act;
- Potential breeding habitat for the Wallum Froglet in the form of ephemeral waterbodies;
- Swamp Sclerophyll Forest on Coastal Floodplains EEC which is listed on the TSC Act;
- Hollow-bearing trees and stags, which provide a critical habitat resource for hollow-dependent fauna;
- Structural complexity and floristic diversity, providing habitat resources for a broad range of flora and fauna; and
- Connectivity with contiguous vegetation and habitats to west of study area.

It is understood that areas of moderate to high ecological value will be lost as a result of development within the study area. Development undertaken in areas of moderate to high ecological value within the study area will require off-setting in accordance with the off-setting principles contained within the *Draft Lower Hunter Regional Conservation Plan* (DEC 2006).

There is opportunity for staging future development within the study area in such a way that areas considered to be of low ecological value are developed first, with those areas of highest conservation priority either protected in the long term from development, or developed in the latter stages of the project.

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		Name	Signature	Name	Signature	Date
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0	A Finegan	S Cahill	S Cahill	A Brownlie	A Brownlie	17/12/07

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Airport/Defence Related Employment Zone (Williamtown)

Ecology Report

February 2007

Contents

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Appendices

1. Introduction

1.1 Explanatory Note

This Ecological Report is a site specific analysis intended to confirm the Study Area's ecological significance under the Environmental Planning and Assessment Act 1979, the Port Stephens Comprehensive Koala Plan of Management, the Threatened Species Conservation Act 1995 and the Environment Protection and Biodiversity Conservation Act 1999. This Report is to provide input to the findings and recommendations of the Stage 2 Suitability and Capability Report, which will also include discussion of the local, sub-regional and regional contexts. It will be included as an appendix to the Stage 2 Report.

1.2 Description of Proposal

A partnership between the Department of Planning (DoP), Port Stephens Council (PSC), Department of Defence, Newcastle Airports Limited, Hunter Water Corporation, Premiers Department and the Department of State and Regional Development was established in order to develop a land use development strategy for land adjoining the current RAAF Base Williamtown. The development of an employment zone in this area is identified in the Lower Hunter Regional Strategy and is proposed to complement the activities of both the Department of Defence and Newcastle Airports Limited.

1.3 Purpose

GHD Pty Ltd (GHD) were engaged by DoP to undertake a preliminary assessment across the proposed lands to assess the ecological values within the land identified for an aviation industry employment zone of approximately 100 ha.

The key ecological issues that required clarification through field investigations included:

- Whether the study area contains potential habitat for species, populations or ecological communities listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- Confirmation of the conservation significance of areas of Koala habitat identified in the Port Stephens Council Comprehensive Koala Plan of Management (Port Stephens Council 2002); and
- The distribution of ecological values across the study area, which can then be used to inform the strategy for net improvement of biodiversity assets in the local area.

Data from the above was used to identify areas that:

- Are potentially constrained by high ecological values (while at the same time offering opportunities for on-site conservation);
- Offer opportunities for offsetting any biodiversity impacts to ensure net improvement of biodiversity assets in the study area; and
- Offer opportunities for development without compromising local biodiversity, particularly threatened species, populations and ecological communities.

This report documents findings relating to the above, together with recommendations for further investigations required to undertake an assessment of the ecological impacts of the proposal.

1.4 Description of Study Area

1.4.1 Location

The study area is located at Williamtown, approximately 16 km northeast of Newcastle in the Port Stephens Local Government Area (LGA). It is located directly to the south of the RAAF Base Williamtown, bounded by Cabbage Tree Drive and Nelson Bay Road on the south and east and on the west by private property (Figure 1). The study area is approximately 113 ha and constitutes the area selected in the Stage 1 preliminary investigations phase of the Proposal.

1.4.2 Soils and Geology

The 1:100 000 Soil Landscape Sheet indicates that the study area falls on estuarine landscapes with deep, poorly drained Humic Clay soils. The area is defined as having limitations relating to permanently high watertables with seasonal waterlogging, foundation hazard, flooding hazard and potential acid sulphate soils (Matthei 1995).

1.4.3 Climate

The study area has a warm temperate climate with warm wet summers and mild dry winters. The average annual rainfall in the area is 1000 to 1,200 mm. During summer the temperatures range from between an average maximum of 26 - 29^{o}C and an average minimum of 17 - 20^{o}C. In winter the average maximum drops to 16 - 19^{o}C and the average minimum to 6 - 9 ^{o}C (Bureau of Meteorology 2006).

1.4.4 Land Use

The study area comprises privately owned rural land characterised by private residencies and small-scale agricultural activities such as horse agistment and cattle grazing. Part of the study area also comprises Commonwealth land.

1.5 Regional Context

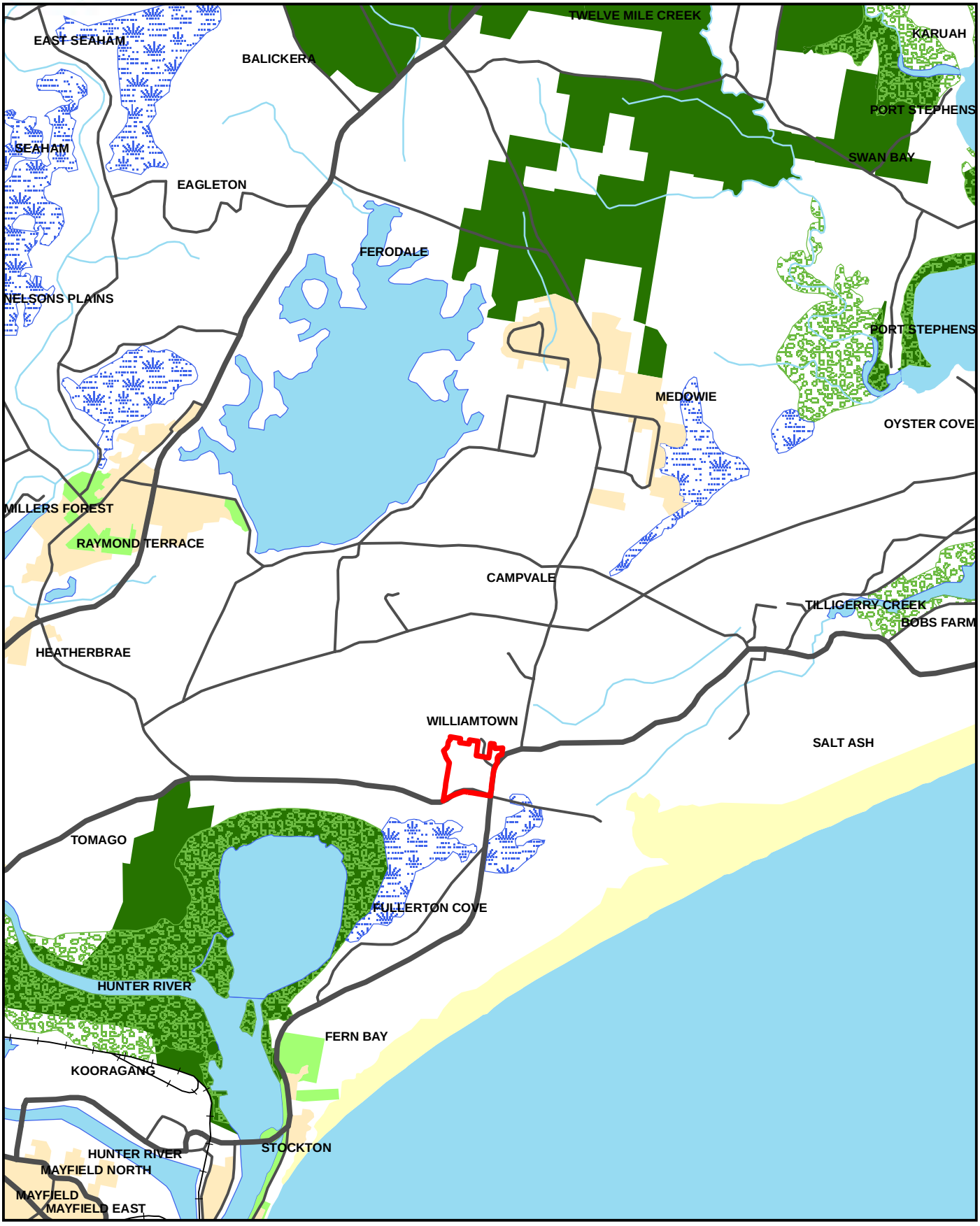
The Lower Hunter Regional Strategy (LHRS) identifies the site as a specialised centre for proposed airport related employment. This Strategy operates at a Regional level alongside the Draft Lower Hunter Regional Conservation Plan (Draft RCP) (DEC 2006). The Draft RCP recognises that a major role of the LHRS is to focus and constrain the development footprint across the landscape, while at the same time ensuring an adequate supply of employment land within identified centres and other specialised/industrial lands to accommodate the 66,000 new jobs projected in the Strategy.

Although the development footprint within the Strategy has been located to maximise use of already cleared or degraded land, the Draft RCP recognises there will be losses of biodiversity values as the strategy is implemented, including areas of high conservation value vegetation. Mechanisms that will contribute to offsetting the anticipated biodiversity impacts resulting from development in the Lower Hunter, including employment lands identified in the LHRS, are provided by the Draft RCP.

The Port Stephens Comprehensive Koala Plan of Management provides an assessment of the Port Stephens Koala population and habitat at an LGA scale, and allows for site by site assessment of Koala habitat within a sub-regional context.

One of the objectives of the CKPOM is to evaluate and rank koala habitat throughout the Port Stephens LGA. The Koala Habitat Planning Map therefore provides the basis for identifying areas that are considered to warrant the highest level of habitat protection. These areas include all Preferred Koala Habitat (as defined by certain tree species) and Habitat Buffers.

GHD CLIENTS | PEOPLE | PERFORMANCE



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0 500 1,000 2,000 3,000

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

- Drainage
- Main Road
- Road
- Built area
- Park
- Water
- Mangrove
- Wetland
- Reserves
- Sand dunes, beach
- Study Area

Spatial layers courtesy of Port Stephens Council and Geoscience Australia

//2212808/GIS/Maps/EcologyReport Figures_Sept06/Fig1_Site_Location_271106.mxd

20 September 2006

Site Location

Williamtown Employment Zone - Stage 2

Figure 1

2. Methods

2.1 Approach to Study

This preliminary assessment incorporated the following project tasks:

- Literature Review and Database Searches;
- Field Investigations;
- Identification of ecological values across the study area; and
- Mapping of ecological constraints to development across the study area.

The findings of the literature review and database search were broadly ground verified over two days. Ground-truthing of existing vegetation mapping was carried out as well as broad-scale habitat assessment to determine the potential for threatened species and communities to occur within the study area. Targeted surveys for the Wallum Froglet (*Crinia tinnula*) and Green and Golden Bell Frog (*Litoria aurea*) were carried out on separate occasions. Two ecologists undertook surveys on 21 to 22 August, 12 to 13 September and 31 October to 1 November 2006.

2.2 Literature Review and Database Searches

Available literature and database records regarding the ecological features of the study area and locality (i.e. 10 km radius) were reviewed. Those of particular relevance are listed below, with a complete reference list provided in Section 7.

- Department of Environment and Conservation (DEC) Atlas of NSW Wildlife Database Search for threatened species recorded within the locality;
- Department of Environment and Heritage (DEH) Protected Matters Search Tool for Matters of National Environmental Significance with particular reference to nationally listed threatened species likely to occur in the locality;
- *Lower Hunter and Central Coast Extant Vegetation Map 2003* (LHCCREMS 2003);
- *Lower Hunter Regional Strategy* (DoP 2006)*;*
- *Draft Lower Hunter Regional Conservation Plan* (DEC 2006);
- *Port Stephens Council Comprehensive Koala Plan of Management (CKPoM) –2002* (Port Stephens Council 2006); and
- *Port Stephens Council Comprehensive State of the Environment Report* (Port Stephens Council 2004).

The results of the literature review and database searches were used to guide the field surveys and assessment of ecological values across the site.

2.3 Flora Surveys

Vegetation Mapping

Broad-scale vegetation mapping, including ground-verification of existing vegetation mapping (LHCCREMS 2003), was undertaken across the study area involving a general walk through the study area and accessible vegetation stands. Vegetation communities were identified based on the dominant canopy species and structural characteristics and the boundaries marked using a Global Positioning System (GPS). The likelihood of vegetation communities to qualify as an Endangered Ecological Community (EEC) listed under the TSC Act and/or the EPBC Act was assessed and boundaries were broadly mapped. Accurate survey of community boundaries was not undertaken, as this was not part of the brief. Boundary mapping was primarily based on air photo interpretation and collection of point data in the field using handheld GPS.

Threatened Flora

The likelihood of threatened or rare flora species occurring within the study area was assessed through analyses of their habitat requirements and availability of suitable habitat within the study area.

2.4 Fauna Surveys

The study area provides habitat for a range of fauna, with certain areas providing potential habitat for threatened species. The fauna fieldwork focussed on habitat assessment and was aimed at ascertaining the potential importance of these areas for native fauna, and in particular threatened species. This then facilitated the assignment of ecological value ratings across the study area.

Habitat Assessment

A broad scale fauna habitat assessment to determine current habitat value's across the site was undertaken and focussed on the requirements of threatened species with the potential to occur on the site. Specific resources such as shelter, basking, roosting, nesting and foraging sites for amphibians, birds, bats, arboreal mammals, ground-dwelling mammals and reptiles were noted. Any other important physical features such as areas supporting hollow-bearing trees were noted.

Opportunistic Records

Incidental records of bird, amphibian, reptile and mammal species were collected during the entire survey period.

2.4.1 Amphibian Surveys

A call during the survey was provisionally identified as the threatened Wallum Froglet (*Crinia tinnula*). As such, targeted surveys were carried out on separate occasions for those species for which suitable habitat was present.

*Wallum Froglet (*Crinia tinnula*)*

The Wallum Froglet is a small frog that breeds in late winter when males call after heavy rain from within sedge tussocks or at the water's edge. This species is best identified during the breeding season during the day and after heavy rain (DEC 2006a).

Targeted surveys for the Wallum Froglet were conducted on 12 and 13 September 2006. Prior to the surveys, a habitat assessment was undertaken across the study area to determine suitable survey and search sites. Listening for calls and call playback techniques were utilised to determine the presence of this species. Call playback involved broadcasting a pre-recorded call of this species at a site and then listening for a response. Quantification of Wallum Froglet numbers was also carried out using the call playback technique and then a five minute listening period where calls were counted and grouped into a density range (e.g. 0-5, 5-10 *etc*.). Call playback locations are shown in Figure 2.

*Green and Golden Bell Frog (*Litoria aurea*)*

The Green and Golden Bell Frog inhabits marshes, dams and streams, particularly those containing *Typha* spp. and *Eleocharis* spp. This species breeds in summer when conditions are warm and wet (DEC 2006b). A habitat assessment was carried out to determine suitable survey sites. Listening for calls and call playback techniques were utilised to determine the presence of this species as well as diurnal searches for tadpoles and basking adults and metamorphs. Call playback involved broadcasting a pre-recorded call of this species at a site and then listening for a response. Nocturnal spotlighting was also carried out over two separate nights. Survey locations are shown in Figure 3.

2.4.2 Koala Habitat Assessment

The study area falls within the Port Stephens LGA, consequently State Environmental Planning Policy No. 44 – Koala Habitat (SEPP 44) applies. PSC has prepared a Comprehensive Koala Plan of Management (CKPoM) (Port Stephens Council 2002) which supersedes the requirements of SEPP 44. As is the case with SEPP 44, the CKPoM aims to encourage conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent population over their present range and to reverse the current trend of Koala population decline.

The CKPoM sets out survey guidelines for Koala Habitat (as defined in Lunney *et al.* 1998) Assessments in the form of a four-step process as described below:

1. Preliminary assessment. The presence of habitat, habitat buffers or habitat linking areas is determined by referral to the Koala Habitat Planning Map (Port Stephens Council 2002) as well as inspection of the study area to determine the presence of preferred food trees (as defined by the CKPoM) outside areas previously mapped as Preferred Koala Habitat.

2. Vegetation mapping. Vegetation mapping of the site should be undertaken showing the distribution of vegetation associations throughout the study area as well as the location of individuals of preferred food trees located outside areas already mapped as Preferred Koala Habitat

3. Koala Habitat Identification. If inconsistencies with the existing LGA vegetation maps arise it is necessary to further identify and describe the Koala habitat in detail.

4. Assessment of Proposal. Using the information gathered in Steps 1 to 3 the appropriateness of the proposal is assessed. This must include reference to the Performance Criteria for rezoning proposals and development applications contained within the CKPoM.

Vegetation surveys undertaken within the study area assessed the likelihood of areas constituting Preferred Koala Habitat by noting dominant canopy species and determining the presence of preferred and important food trees (as defined by the CKPoM). The Koala Habitat Planning Map presented in the CKPOM was used as a background reference, with the field surveys designed to identify inconsistencies in the CKPOM mapping.

2.5 Weather Conditions and Limitations

The weather during the initial survey (21 and 22 August) was generally fine and warm. No rain fell during the surveys but substantial rainfall had occurred in the days and weeks prior. Daytime temperatures were in the mid 20 ^{o}C. In the four days preceding the targeted Wallum Froglet surveys (12 and 13 September) over 100 mm rain had fallen in the area. During the surveys the weather was fine and sunny with daytime temperatures in the low 20 ^{o}C. The weather conditions during the targeted surveys for the Green and Golden Bell Frog were mostly warm and fine, excluding a heavy shower on 31 October.

This survey was not designed to enable all species, either resident or transitory to the study area, to be detected. Surveys were undertaken outside the optimal survey period for some species and therefore it is possible that some species utilise the study area but were not detected during the survey period. These species are likely to include cryptic species and threatened flora such as orchids. Some fauna species are also mobile and transient in their use of resources. Instead it was aimed at providing an overall assessment of the ecological values of the site and study area with particular emphasis on threatened species to allow an assessment of the impacts of the proposal. For those species of conservation significance that were not detected but with the potential to occur on the site, an assessment of the likelihood of their occurrence was made based on known habitat requirements.

GHD CLIENTS | PEOPLE | PERFORMANCE

3
2
6
5a
1
5c
4
5b
7
8
7
7

Vegetation Communities

- 1: Banksia aemula/ Banksia integrifolia subsp. integrifolia - Woodland
- 2: Melaleuca linariifolia/ Eucalyptus robusta/ Angophora costata - Swamp Forest (Possible EEC)
- 3: Angophora costata/ Corymbia gummifera - Forest
- 4: Banksia aemula - Open Forest
- 5a: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 5b: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 5c: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 6: Leptospermum juniperinum - Shrubland
- 7: Casuarina glauca - Woodland (Possible EEC)
- 8: Scattered Melaleuca quinquenervia

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0 30 60 120 180 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

Study Area

Call Playback Locations

20 September 2006

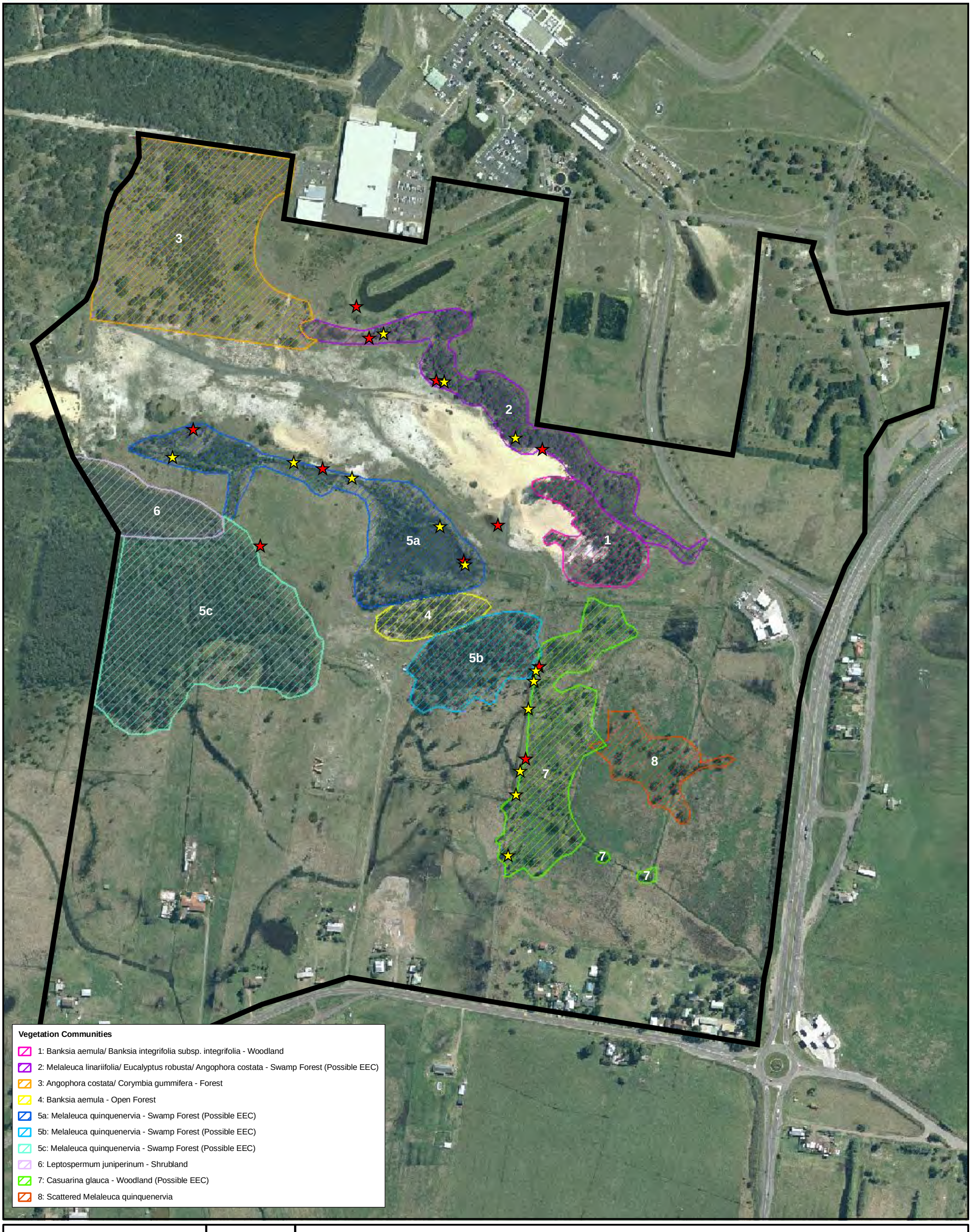
Wallum Froglet Survey Location

Williamtown Employment Zone - Stage 2

Figure 2

//2212808/GIS/Maps/Ecology/Report_Figures_Sept06/Fig2_Wallum_Frog_Survey_271106.mxd

GHD CLIENTS | PEOPLE | PERFORMANCE



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Horizontal Datum: Geodetic Datum of Australia 1994
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GRID N

LEGEND

Study Area

Green and Golden Bell Frog Call Playback

Targeted Tadpole Searches

9 November 2006

Green and Golden Bell Frog Surveys

Williamtown Employment Zone - Stage 2

Figure 3

3. Results

3.1 Vegetation Communities Across the Study Area

3.1.1 LHCCREMS Vegetation Mapping

As discussed in the Stage 1 Site Selection Report (GHD ???), LHCCREMS (2003) vegetation mapping depicts four vegetation communities across the study area, as listed below and illustrated in Figure 4.

- Coastal Sand Wallum Woodland / Heath;
- Swamp Mahogany Paperbark Forest;
- Tomago Sand Swamp Woodland; and
- Coastal Sand Apple – Blackbutt Forest

Canopy species characterising each of the above communities are detailed in Table 1.

Based on the LHCCREMS mapping and information from the Port Stephens Council Comprehensive State of the Environment Report (2004) regarding which LHCCREMS map units are likely to correspond with State and Commonwealth listed Endangered Ecological Communities (EECs) one vegetation community mapped within the study area, Swamp Mahogany Paperbark Forest, may correspond to the EEC: Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions. However, other EECs may occur within the study area and ground verification of the LHCCREMS mapping was carried out during the surveys and these results are presented below.

Table 1 Description and Significance of LHCCREMS Vegetation Communities Mapped for the Study Area

LHCCREMS Map Unit	Map Unit Name	Canopy Species	Possible Endangered Ecological Community	Regionally Vulnerable Vegetation Communities	Regionally Specialised Vegetation Communities	NPWS Significant Vegetation Communities
34	Coastal Sand Wallum Woodland / Heath	*Banksia aemula / Corymbia gummifera / Angophora costata*				
37	Swamp Mahogany Paperbark Forest	*Melaleuca quinquenervia / Eucalyptus robusta / Casuarina glauca*	Swamp Sclerophyll Forest on Coastal Floodplains	X		X
33	Coastal Sand Apple Blackbutt Forest	*Angophora costata / Eucalyptus pilularis*				
36	Tomago Sand Swamp Woodland	*E. parramattensis subsp decadens*[1], *Leptospermumn polygalifolium*		X	X	

[1]: *Eucalyptus parramattensis subsp. decadens* also listed as 'vulnerable' under the TSC Act and EPBC Act.

3.1.2 Vegetation Communities

Seven vegetation communities were recorded within the study area, as well as areas of high disturbance due to urban and rural property practices. Drainage lines are scattered throughout the southern portion of the study area and much of the study area is prone to flooding. Hydrology is therefore an important determining factor in the vegetation communities present in the study area and the fauna habitat that they provide. It is therefore recommended that a separate hydrology report be undertaken. The vegetation communities recorded within the study area and a brief description of each is provided below. The location of communities within the study area is shown in Figure 5.

1 *Banksia aemula* / *Banskia integrifolia* subsp. *integrifolia* Woodland

This community comprises approximately 1.3 ha of the study area and occurs on a sand dune on the eastern side of the site. Dominant species include Wallum Banksia (*Banksia aemula*) and Coastal Banksia (*Banksia integrifolia* subsp *integrifolia*), with scattered Smooth-barked Apple (*Angophora costata*). Midstorey species include Slender Tea-tree (*Leptospermum trinervium*), Wattles (*Acacia ulicifolia*, *Acacia longifolia*) and an understorey including Spiny-headed Matt-rush (*Lomandra longifolia*) and Tall Saw Sedge (*Gahnia clarkei*). This community most closely relates to the LHCCREMS vegetation map unit Coastal Sand Wallum Woodland-Heath.

2 *Melaleuca linariifolia* / *Eucalyptus robusta* / *Angophora costata* Swamp Forest

This community comprises approximately 2.7 ha of the study area and occurs along a creek line in the northeast corner of the site. Dominant species include Snow-in-Summer (*Melaleuca linariifolia)*, Swamp Mahogany (*Eucalyptus robusta)*, Smooth-barked Apple, and Red Bloodwood (*Corymbia gummifera*). The midstorey includes Wallum Banksia, Bleeding Heart (*Omalanthus diosmifolium*) with an understorey of Tall Saw Sedge, Bracken Fern (*Pteridium esculentum*) and vine species including Dusky Coral Pea (*Kennedia rubicunda)* and Common Silkpod (*Parsonsia straminea*). The floristic composition of this community is characteristic of Swamp Sclerophyll Forest on Coastal Floodplains, an endangered ecological community listed under the TSC Act.

3 *Angophora costata* / *Corymbia gummifera* Forest

This community comprises approximately 6.3 ha of the study area and consists of scattered mature canopy species including Smooth-barked Apple, Red Bloodwood, and Scribbly Gum (*Eucalyptus* sp.) and Forest Red Gum (*Eucalyptus tereticornis*). While areas within this privately owned portion of the study area appear to have been cleared and maintained for some time, the portion of this private property containing this community appears to have been recently under-scrubbed.

4 *Banksia aemula* Open Forest

This community comprises approximately 0.7 ha of the study area and occurs along a bank between *Melaleuca quinquenervia* Swamp Forest sub-communities A and B. The dominant species is Wallum Banksia with scattered Tea-trees. This may be a highly disturbed remnant of Coastal Sand Wallum Woodland-Heath as indicated by the LHCCREMS vegetation mapping.

5 *Melaleuca quinquenervia* Swamp Forest

The fifth vegetation community identified on-site comprises approximately 11.6 ha of the study area and displays 'within-community' variation based on localised drainage and/or disturbance history. This community has therefore been divided into the following sub-communities.

A) (approximately 3.6 ha)

This area was very wet at the time of the field survey and appears to be an ephemeral wetland / swamp area. Dominant species include Broad-leaved Paperbark (*Melaleuca quinquenervia*), with Prickly Tea-tree (*Leptospermum juniperinum*) in the mid storey and an understorey of Tall Saw Sedge, Bracken, ferns and sedges. A watercourse runs along the northern edge of this community and contains native rushes and sedges.

B) (approximately 1.8 ha)

This sub-community is also dominated by Broad-leaved Paperbark but is quite disturbed from cattle grazing.

C) (approximately 6.3 ha)

This sub-community is also dominated by Broad-leaved Paperbark and is very similar in composition to *Melaleuca quinquenervia* Swamp Forest sub-community A. However, it also contained midstorey species including Bleeding Heart (*Omalanthus diosmifolium*), particularly along the northern edge of the community, and Snow-in-Summer, near the boundary of *Leptospermum juniperinum* / *Acacia longifolia* Shrubland. Swamp Oak (*Casuarina glauca*) also occurs on the eastern edge of this community. It has a disturbed understorey comprising grasses, sedges and ferns, particularly on the southern side where a number of urban properties back into this area.

The three separate areas of this community were very wet during the site visit, some inundated with water. Therefore, portions of sub-community C could not be accessed.

The floristic composition of this community most closely relates to the LHCCREMS vegetation map unit Swamp Mahogany-Paperbark Swamp Forest. Swamp Mahogany was not observed in these areas, however this community contained numerous other characteristic species of this LHCCREMS map unit. This community is also considered to correlate with Swamp Sclerophyll Forest on Coastal Floodplains, an endangered ecological community listed under the TSC Act.

Sub-community C encompasses the area mapped as the LHCCREMS map unit Tomago Sand Swamp Woodland. This community's dominant canopy species is the threatened *Eucalyptus parramattensis subsp. decadens*. While potential habitat for *Eucalyptus parramattensis* subsp. *decadens* occurs within the study area the preliminary assessment did not detect this species, however we recommend that detailed surveys be undertaken at a later stage if impact assessments become required.

6 *Leptospermum juniperinum* / *Acacia longifolia* Shrubland

This shrubland community comprises approximately 1.3 ha of the study area and is dominated by Prickly Tea-tree, *Acacia longifolia* and Honey Myrtle (*Melaleuca armillaris*). On the southern boundary of this community, on the ecotone between Vegetation Community 6 and Vegetation Community 5C, Snow-in-Summer begins to emerge.

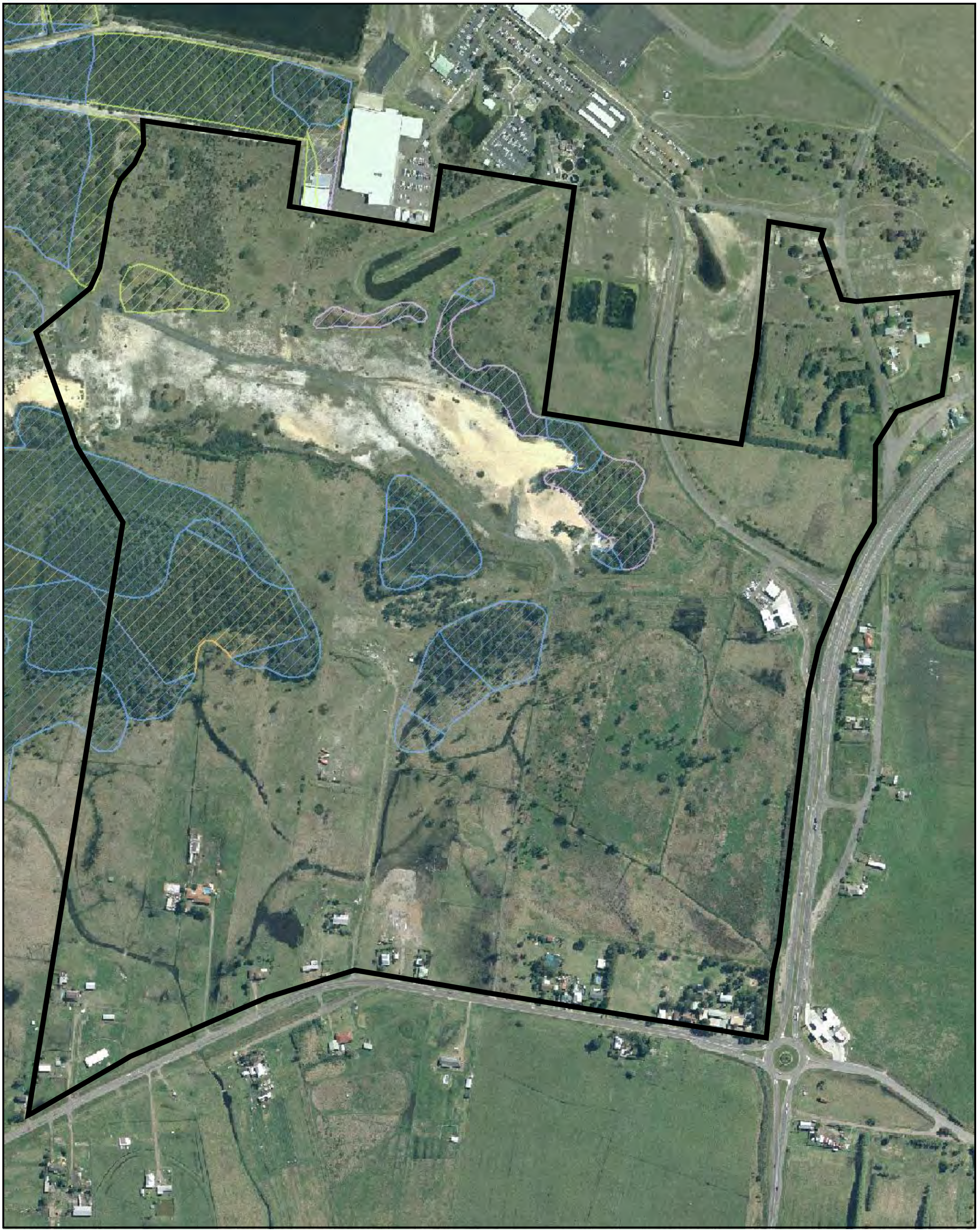
7 *Casuarina glauca* Woodland

This community comprises approximately 3.2 ha of the study area. It is degraded, highly modified and characterised by regenerating Swamp Oak. The understorey contains a mix of introduced species such as Blackberry (*Rubus ulmifolius*), Paspalum (*Paspalum dilatatum*), Kurnell Curse (*Hydrocotyle bonariensis*), Kikuyu (*Pennisetum clandestinum*) and Buffalo Grass (*Stenotaphrum secundatum*), as well as natives such as *Juncus continuus*, Buttercup (*Ranunculus inundatus)* and Spike-rush (*Eleocharis* spp.). Introduced species dominate the southern end of the community, while in other areas the understorey is dominated by natives. This area is considered likely to represent a remnant of Swamp Oak Floodplain Forest, an endangered ecological community listed under the TSC Act.

8 Scattered *Melaleuca quinquenervia*

This area comprises approximately 1.2 ha of the study area and contains approximately 35 scattered large mature Broad-leaved Paperbark trees. The understorey consists almost entirely of introduced species, predominately Blackberry and Kurnell Curse. This area is highly modified, with a number of artificial drainage lines constructed through it.

GHD CLIENTS | PEOPLE | PERFORMANCE



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0 30 60 120 180 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

- Study Area
- LHCCREMS Vegetation
  - Coastal Sand Apple - Blackbutt Forest
  - Coastal Sand Wallum Woodland - Heath
  - Swamp Mahogany - Paperbark Forest
  - Tomago Sand Swamp Woodland

20 September 2006

LHCCREMS Vegetation Mapping

Williamtown Employment Zone

Figure 4

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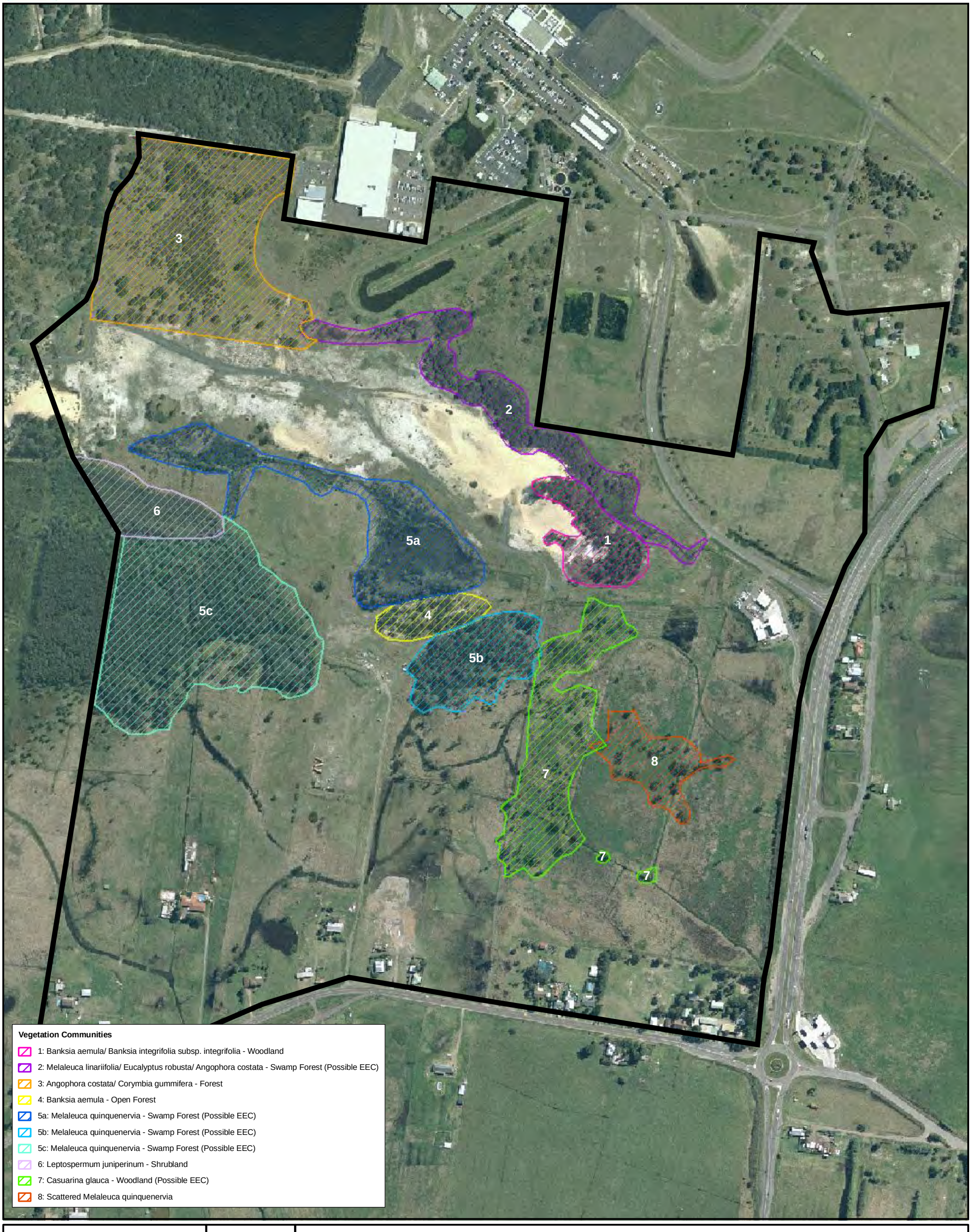
GHD CLIENTS | PEOPLE | PERFORMANCE



Vegetation Communities

- 1: Banksia aemula/ Banksia integrifolia subsp. integrifolia - Woodland
- 2: Melaleuca linariifolia/ Eucalyptus robusta/ Angophora costata - Swamp Forest (Possible EEC)
- 3: Angophora costata/ Corymbia gummifera - Forest
- 4: Banksia aemula - Open Forest
- 5a: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 5b: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 5c: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 6: Leptospermum juniperinum - Shrubland
- 7: Casuarina glauca - Woodland (Possible EEC)
- 8: Scattered Melaleuca quinquenervia

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0 30 60 120 180 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

Study Area

20 September 2006

Vegetation Communities

Williamtown Employment Zone - Stage 2

Figure 5

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3.2 Threatened Flora

3.2.1 Literature Review and Database Searches

Results of the literature review and database searches indicate that a number of threatened flora and fauna have been recorded within the locality or have the potential to occur within the locality. The results of the DEC search are shown in Figure 6. Not all species listed are likely to occur within the study area. Species that have been recorded and their potential to occur within the study area are listed in Table 2 and Table 3.

Table 2 lists those threatened flora that have been recorded in the locality (based on 10 km radius search of Atlas of NSW Wildlife (DEC 2006)), or are likely to occur within the locality (based on DEH Protected Matters Report (DEH 2006)), together with their conservation status and likelihood of occurring at the site.

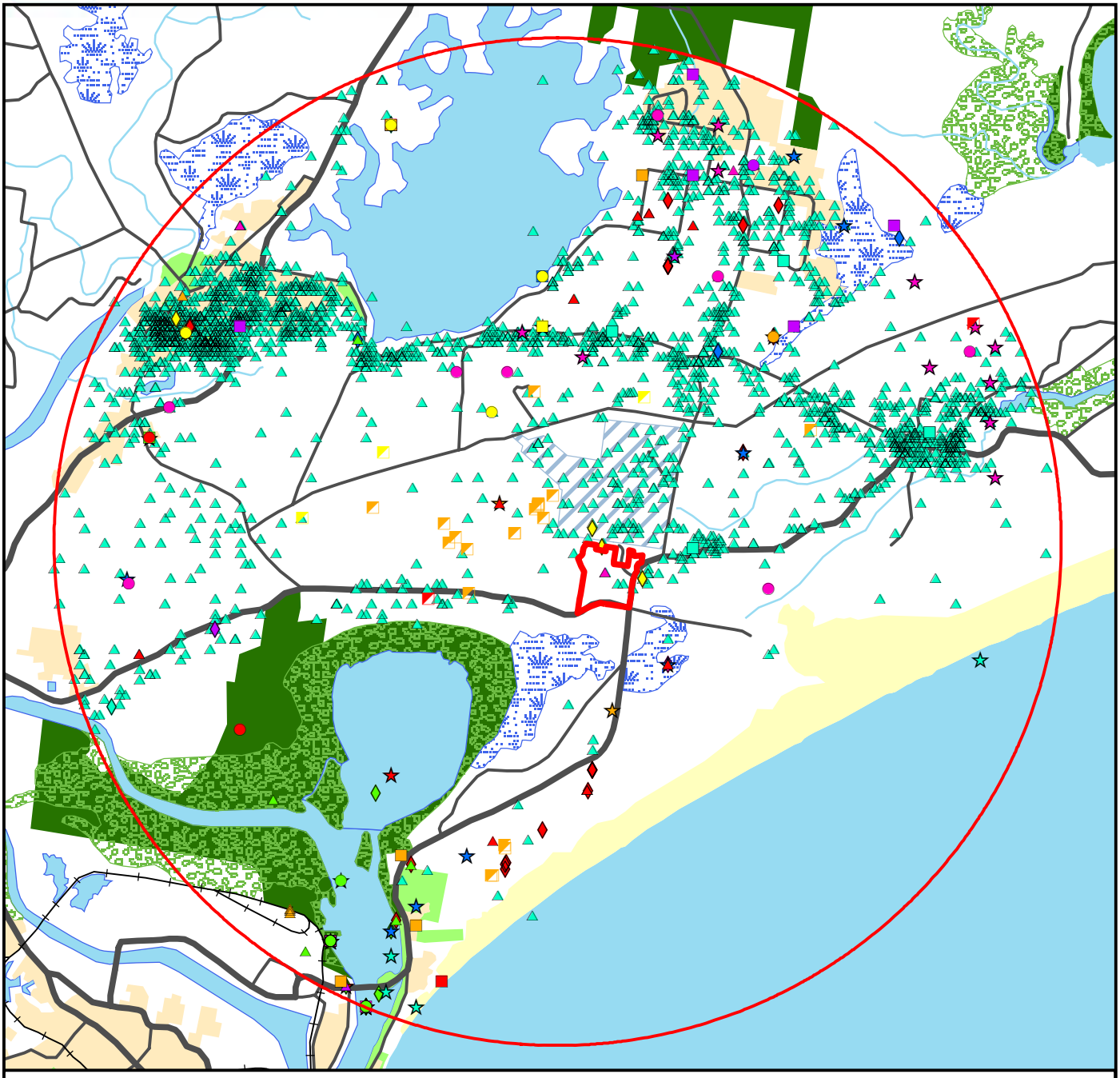
3.2.2 Endangered Ecological Communities

Two endangered ecological communities listed under the TSC Act were identified within the study area during the surveys. These included:

- Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (DEC 2006c); and
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner Bioregions (DEC 2006d).

Melaleuca linariifolia / *Eucalyptus robusta* / *Angophora costata* Swamp Forest and *Melaleuca quinquenervia* Swamp Forest contain species characteristic of Swamp Sclerophyll Forest on Coastal Floodplains, while the *Casuarina glauca* woodland appears to represent a remnant of Swamp Oak Forest on Coastal Floodplains. Detailed survey of the boundaries of these communities would be required to determine their extent across the study area.

GHD CLIENTS | PEOPLE | PERFORMANCE



Threatened Flora

- Eucalyptus camfieldii
- Eucalyptus parramattensis decadens
- Rulingia prostrata

Threatened Fauna

- Australasian Bittern
- Black Bittern
- Black-necked Stork
- Black-tailed Godwit
- Blue-billed Duck
- Broad-billed Sandpiper
- Brown Treecreeper
- Brush-tailed Phascogale
- Bush Stone-curlew
- Eastern Bentwing-bat
- Eastern False Pipistrelle
- Eastern Freetail-bat
- Emu
- Freckled Duck
- Glossy Black-Cockatoo
- Great Knot
- Greater Broad-nosed Bat
- Green and Golden Bell Frog
- Grey-crowned Babbler
- Grey-headed Flying-fox
- Koala
- Large-footed Myotis
- Lesser Sand-plover
- Little Bentwing-bat
- Little Tern
- Masked Owl
- Osprey
- Painted Snipe
- Pied Oystercatcher
- Powerful Owl
- Regent Honeyeater
- Spotted-tailed Quoll
- Squirrel Glider
- Superb Fruit-Dove
- Swift Parrot
- Terek Sandpiper
- Turquoise Parrot
- Wallum Froglet
- Wompoo Fruit-Dove
- Yellow-bellied Sheathtail-bat

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0 600 1,200 2,400 3,600

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

- Study Area
- Site location buffer
- Sand dunes, beach
- Rail
- Main Road
- Road
- Drainage
- Water
- Mangrove
- Wetland
- Restricted Area
- Reserves
- Built area
- Park

Spatial layers courtesy of Geoscience Australia, Department of Environment and Conservation

20 September 2006

DEC Threatened Species Records (2006)

Williamtown Employment Zone - Stage 2

Figure 6

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Table 2 Assessment of Likelihood of Occurrence of Threatened Flora within the Study Area

Common Name (Species Name)	Conservation Status TSC Act	Conservation Status EPBC Act	Habitat Association	Likelihood of Occurring in Study Area
Heart-leaved Stringybark (*Eucalyptus camfieldii*)	V	V	This species occurs on poor coastal country in shallow sandy soils overlying Hawkesbury sandstone often in coastal heath mostly on exposed sandy ridges. Stands usually occur near the boundary of tall coastal heaths and low open woodland of the slightly more fertile inland areas. Associated species frequently include stunted species of Narrow-leaved Stringybark (*E. oblonga*), Brown Stringybark (*E. capitellata*) and Scribbly Gum (*E. haemastoma*) (DEC 2006e).	**Likely**. Potential habitat for this species is provided by heath and woodland habitat on sandy soils within the study area.
Earp's Gum (*Eucalyptus parramattensis* subsp. *decadens*)	V	V	This species is a small woodland tree that generally occurs in dry sclerophyll woodland, or as an emergent in dry or wet heath land, and is often the community dominant. It occupies deep, low nutrient sands, often in areas subject to periodic inundation or where water tables are relatively high. Threats include habitat loss from development, weed invasion, changes to hydrology and too-frequent fire (DEC 2006f).	**Likely.** Potential habitat for this species is provided by woodland and heath habitats within the study area which are on deep sands and prone to periodic inundation.
Dwarf Kerrawang (*Rulingia prostrata*)	E	E	This species is a prostrate shrub that forms mats to more than 1 m across, occurring on sandy, sometimes peaty soils in a wide variety of habitats. This species is threatened by a poor understanding of responses to environmental conditions and management practices which could result in inappropriate management actions or inactions (DEC 2006g).	**Likely.** Potential habitat for this species is provided by woodland habitat on sandy soils within the study area.

Common Name (Species Name)	Conservation Status: TSC Act	Conservation Status: EPBC Act	Habitat Association	Likelihood of Occurring in Study Area
Leafless Tongue Orchid (*Cryptostylis hunteriana*)	V	V	Potential habitat for this species is poorly understood and it is thought to typically occur in woodland dominated by Scribbly Gum (*Eucalyptus sclerophylla*), Silvertop Ash (*Eucalyptus sieberi*), Red Bloodwood and Black She-oak. It appears to prefer open areas in the understorey and is often found in association with the Large Tongue Orchid (*Cryptostlyis subulata*) and the Tartan Tongue Orchid (*Cryptostylis erecta*). This species flowers between November and February (DEC 2006h).	**Unlikely.** Habitat for this species may occur to the west of the study area however it is unlikely to occur within the study area.
Sand Double Tail (*Diuris arenaria*)	E		This species occurs in coastal heath and dry grassy eucalypt forest on sandy flats. It grows in gently undulating country in eucalypt forest with a grassy understorey on clay soil (DEC2006i)	**Unlikely.** Given that surveys were undertaken during the flowering period for these species and the current high disturbance management regime and monospecific, grassy nature of habitat adjacent to vegetated areas it is considered that *D.arenaria* and *D.praecox* are unlikely to occur within the study area.
Rough Double Tail (*Diuris praecox*)	V	V	This species is known to occur on hills and slopes of near-coastal districts in open forests which have a grassy to fairly dense understorey. This species flowers during winter and is only detectable during the flowering season. It has a restricted distribution between Ourimbah to Nelson Bay (DEC 2006j).	

E = Endangered, V = Vulnerable, TSC Act = *Threatened Species Conservation Act 1995*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*

3.3 Fauna

3.3.1 General Fauna

Ground-dwelling and Arboreal Mammals

Areas of dense heath understorey within the study area provide suitable shelter, nesting and foraging habitat for ground-dwelling mammals such as native rats, antechinus, bandicoots, kangaroos and wallabies. Numerous diggings within the sandy soils were observed in the *Bansia aemula/Banksia integrifolia* woodland and surrounding habitat. Evidence of macropods (scats and trails) was present within both the dense vegetation communities occurring within the site as well as in open grazing areas throughout the study area. Tree use by arboreal mammals was evidenced by the presence of scratchings on many of the larger eucalypts in the northwest corner of the study area and the presence of scats at the base of these trees. Tree hollows were present in many eucalypts and melaleucas within the study area. These hollows may provide suitable nesting and shelter sites for many arboreal mammals such as possums, gliders and tree-roosting bats. The Swamp Mahogany and Broad-leaved Paperbark present within the study area provide an important autumn-winter flowering resource for mammals and avifauna. A proportion of the study area and adjacent vegetated areas are mapped as Preferred Koala Habitat (Port Stephens Council 2002) and this species was heard calling and observed within the study area during the current surveys (Figure 8).

Bats

Suitable foraging habitat was present for a number of insectivorous bats both within forested areas as well as in open areas, both above and surrounding wet, swampy areas and water bodies. Tree hollows and decorticating bark provide possible roosting habitat for many species. These resources were available within the forested and woodland communities within the study area.

Avifauna

The site provided habitat for a large number of species. The substantial midstorey in areas would provide nesting, sheltering and foraging habitat for smaller birds while the larger trees and canopy cover would provide habitat for larger birds. Species recorded during the current survey included the Eastern Whipbird (*Psophodes olivaceus*) and Spangled Drongo (*Dicrurus bracteatus*) within Vegetation Community 2 along the creek line, numerous small birds including the Eastern Spinebill (*Acanthorhynchus tenuirostris*), White-throated Gerygone (*Gerygone olvacea*) and Red-browed Firetail (*Neochmia temporalis*) in denser midstorey and the Black Swan (*Cygnus atratus*) with cygnets in an open water body in the central northern region of the study area.

The swampy areas and ephemeral water bodies may provide suitable habitat for transitory as well as more permanent wader / wetland species.

Open grass areas may provide foraging habitat for larger birds of prey. Some large birds of prey were observed circling above and flying through the study area during the current surveys including the Whistling Kite (*Haliastur sphenurus*) and the White-bellied Sea-eagle (*Haliaeetus leucogaster*).

Reptiles and Amphibians

The study area supports a range of suitable habitat for a variety of reptile and amphibian species. The moist and swampy areas with native riparian vegetation including *Eleocharis* spp. as well as the creek lines and drainage lines present throughout the study area provide ideal habitat for a range of frog species, a number of which were heard calling during the surveys, including the threatened Wallum Froglet. The presence of fallen logs and other vegetation debris, moist areas (likely to support frog numbers) with extensive ground coverage and areas with significant leaf litter within various portions of the study area would provide habitat for a range of lizards and snakes. During the current survey a dead Blue-tongue Lizard (*Tiiqua scincoides*) and the shell of a turtle (Family Cheluidae) was observed in the slashed grasslands.

The artificial water channel in the northern centre of the study area was found to contain Plague Minnow (*Gambusia holbrookii*). This is an introduced freshwater fish that is an aggressive predator of native fauna, notably native frog eggs and tadpoles and is linked to the decline of a number of threatened frog species. Predation by this species is listed as a Key Threatening Process in NSW and a Threat Abatement Plan has been developed (NPWS 2003a). Proposed management measures outlined in the Threat Abatement Plan include the removal of this species in areas with key frog species where practical and prevention of further dispersal of this species. Other water bodies within the study area were not found to contain the Plague Minnow. Much of the ephemeral water habitat within the study area occupied by frog species may protect these species due to the inability of the Plague Minnow to occupy such ephemeral habitats, however their presence within the artificial channel would preclude substantial habitation by frog species from this permanent water body. Dispersal of this species into the creek line and other drainage lines would be detrimental to existing populations of threatened and non-threatened frog species.

A complete list of fauna recorded within the study area is provided in Appendix A.

3.3.2 Amphibian Surveys

Eight frog species were recorded during the amphibian surveys which were conducted following heavy rain, conditions considered suitable for detecting frogs. Four of the species recorded belong to the tree frog family Litoridae, while the remaining four belong to the 'Southern Frog' family Myobatrachidae. Wallum Froglet (*Crinia tinnula*), which is listed as 'vulnerable' on the TSC Act, was recorded in various habitats across the study area (Figure 7). This species is discussed further under 'Threatened Fauna' in Section 3.4.

Despite targeted surveys including call playback, diurnal searches and tadpole searches the Green and Golden Bell Frog (*Litoria aurea*), which is listed as 'endangered' on the TSC Act and 'vulnerable' on the EPBC Act, was not recorded in the study area.

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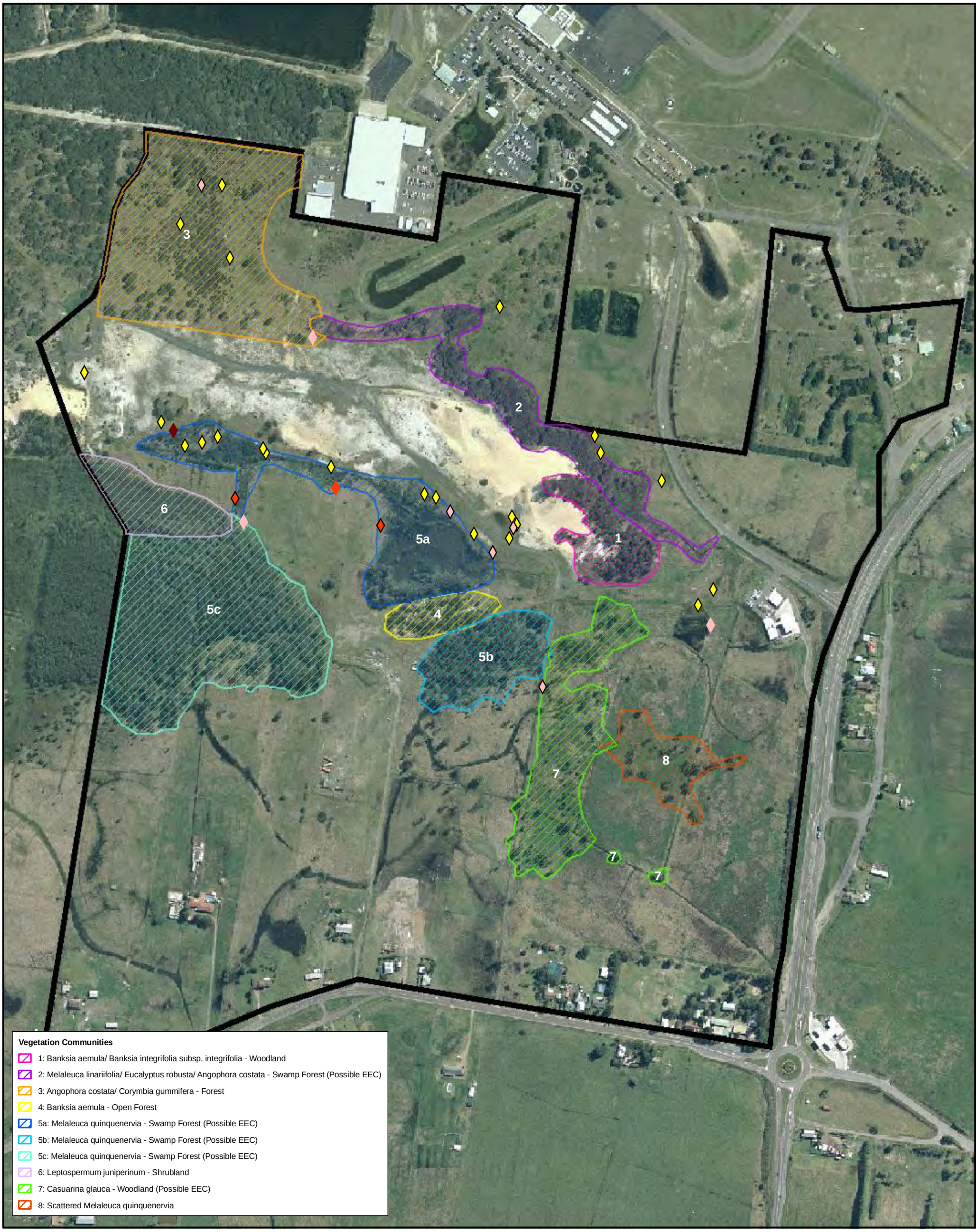

Vegetation Communities

- 1: Banksia aemula/ Banksia integrifolia subsp. integrifolia - Woodland
- 2: Melaleuca linariifolia/ Eucalyptus robusta/ Angophora costata - Swamp Forest (Possible EEC)
- 3: Angophora costata/ Corymbia gummifera - Forest
- 4: Banksia aemula - Open Forest
- 5a: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 5b: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 5c: Melaleuca quinquenervia - Swamp Forest (Possible EEC)
- 6: Leptospermum juniperinum - Shrubland
- 7: Casuarina glauca - Woodland (Possible EEC)
- 8: Scattered Melaleuca quinquenervia

1:5,000

0 30 60 120 180 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

- Study Area
- **Wallum Froglet Records**
  - Individual Location
  - 0-5
  - 1-5
  - 5-10
  - 10-15
  - >20

20 September 2006

Wallum Froglet Records

Williamtown Employment Zone - Stage 2

Figure 7

//2212808/GIS/Maps/Ecology/Report_Figures_Sept06/Fig7_Wallum_Frog_271106.mxd

3.4 Threatened Fauna

3.4.1 Literature Review and Database Searches

A number of threatened fauna have been recorded within the locality (DEC 2006) and potential habitat is present within the study area for a number of these species. Threatened fauna species that have been recorded within a 10 km radius of Williamtown (DEC 2006), or for which potential habitat may exist in the locality (DEH 2006), their legal status, habitat requirements and likelihood of occurring within the study area are listed in Table 3. Threatened species recorded within the study area during the current surveys are discussed below.

***Wallum Froglet* (Crinia tinnula)**

The Wallum Froglet was recorded at a number of locations during the current surveys (Figure 7). Individuals were heard calling throughout the two survey days and GPS readings were taken at each location where one or more individuals were heard. Due to the heavy rainfall in the preceding days, water bodies had formed in a number of new locations throughout the study area, notably in the northwest of the study area within *Angophora costata/Corymbia gummifera* Forest and in the northern centre of the study area in the low sand bed areas around *Banksia aemula/B.integrifolia* Woodland. Individuals were heard calling and responded to call playback in these areas. One individual was located and observed in the water body just west of the *Angophora costata/Corymbia gummifera* Forest. A number of sites were chosen to estimate densities and these are represented in Figure 7 by the varying density ranges (individual records are implied at these locations). The highest density was recorded within *Melaleuca quinquenervia* Swamp Forest sub-community A, with lower densities recorded in surrounding communities, including the new water bodies scattered throughout the study area.

The recent heavy rain made it apparent that this species not only utilises the main suitable vegetated habitat (*Melaleuca linariifolia/Eucalyptus robusta/Angophora costata* Swamp Forest, *Melaleuca quinquenervia* Swamp Forest sub-community A, and *Casuarina glauca* woodland) within the study area but also utilises temporary water bodies throughout the study area for breeding as they become available after heavy rain. This species is dependent on ephemeral water bodies for breeding and is sensitive to changes in pH. As such, the hydrology and flooding pattern of the study area are likely to be important factors in the survival of this population within the study area and any change / disruption to the existing hydrological process in the area may impact on this population and affect its long-term survival.

Koala (Phascolarctos cinereus)

The Koala is listed as vulnerable under the TSC Act and Koala habitat is protected under SEPP 44 which aims to conserve habitat within its current distribution. The Koala has a fragmented distribution throughout eastern Australia, since it is limited to areas of preferred feed trees in eucalypt woodlands and forests. Along the coastal fringe these areas are becoming more fragmented and isolated as urbanisation continues. Koalas are generally inactive for 20 hours a day, with activity peaking just after sunset when they begin to forage (Martin & Handasyde 1995). The size of their home range varies depending on quality of habitat, ranging from less than two hectares to several hundred hectares in size. Females breed at two years of age and produce one young per year (DEC 2006k). NPWS have developed a draft Recovery Plan (NPWS 2003b) for this species and Port Stephens Council have developed a Comprehensive Koala Plan of Management (Port Stephens Council 2002). A proportion of vegetation surrounding the study area and within the study area has been mapped as Preferred Koala Habitat with a 50 m buffer zone and these areas are linked by areas mapped as Link Over Cleared in the Port Stephens CKPoM (Port Stephens Council 2002) and records from the locality are numerous. This species was observed and heard calling within the study area during the current surveys (Figure 8).

Table 3 Assessment of Likelihood of Occurrence of Threatened Fauna within the Study Area

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Wallum Froglet (*Crinia tinnula*)	V	—	Inhabits acid paperbark swamps and sedge swamps. This species can be heard calling at anytime throughout the year following rain but calls are more frequent during the breeding season that takes place during winter. Males call from tussocks or at the waters edge (DEC 2006a).	**Recorded in the study area.**
Green and Golden Bell Frog (*Litoria aurea*)	E	V	Marshes, natural and artificial freshwater to brackish wetlands, dams and in-stream wetlands. Prefers sites containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.), that are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby (DEC 2006b).	**Unlikely.** No recent local records, indicating the absent of a viable local population. Not recorded in the study area despite targeted searches during appropriate conditions.
Australasian Bittern (*Botaurus poiciloptilus*)	V		Permanent freshwater wetlands with tall dense reedbeds particularly bullrushes (*Typha* spp.) and spikerushes (*Eleoacharis* spp.) with adjacent shallow, open water for foraging. No breeding population known from the Lower Hunter. It hides during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails (DEC 2006l).	**Unlikely.** Preferred habitat absent from study area.
Bush Stone-curlew (*Burhinus grallarius*)	E	—	Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights, it feed on insects and small vertebrates, such as frogs, lizards and snakes. Nests are on the ground in a scrape or small bare patch (DEC 2006m).	**Unlikely.** Suitable habitat absent. Absence of recent records for the Williamtown area suggests the absent of a viable local population.
Great Knot (*Calidris tenuirostris*)	V	M	Primarily a coastal species, favouring mudflats, harbours and lagoons DEC 2006n).	**Unlikely.** Suitable habitat absent.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Glossy Black-Cockatoo (*Calyptorhynchus lathami*)	V	E	Highly specialised species feeding almost exclusively on the seeds extracted from the wooden cones of *Allocasuarina* species including Black She-oak (*Allocasuarina littoralis*), Forest She-oak (*Allocasuarina torulosa*) or Drooping She-oak (*Allocasuarina verticillata*). This species needs suitable hollows in living and dead trees for nesting and breeds between March and August (DEC 2006o).	**Unlikely.** Suitable foraging & nesting habitat absent from study area.
Lesser Sand-plover (*Charadrius mongolus*)	V	M	Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006p).	**Unlikely.** Suitable habitat absent.
Brown Treecreeper (*Climacteris picumnus*)	V		Inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey. Fallen timber is an important habitat component (DEC 2006q).	**Unlikely.** Suitable habitat may be present to the west of the study area however suitably structured woodland habitat with is absent from the study area.
Emu (*Dromaius novaehollandiae*)	EP	—	Open forest, woodland, coastal heath, coastal dunes, wetland areas, tea tree plantations and open farmland, and occasionally in littoral rainforest (DEC 2006r).	**Likely**. Suitable habitat present within the study area.
Black-necked Stork (*Ephippiorhynchus asiaticus*)	E		Primarily inhabits permanent freshwater wetlands but can also be found occasionally on inter-tidal shorelines, mangrove margins and estuaries. This species breeds during summer, nesting in or near a freshwater swamp (DEC 2006s).	**Likely**. Potential habitat within study area provided by permanent drainage courses and intermittent wet swampy areas.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Pied Oystercatcher (*Haematopus longirostris*)	V		Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006t).	**Unlikely**. Suitable habitat absent.
Black Bittern (*Ixobrychus flavicollis*)	V		Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. This species may roost by day in trees or within reeds on the ground. Nests are located in branches overhanging water and breeding takes place from December to March (DEC 2006u).	**Likely.** Potential habitat within *Melaleuca quinquenervia* Swamp Forest.
Swift Parrot (*Lathamus discolor*)	E	E	This species migrates to the mainland during winter and occupies habitat with abundant winter flowering eucalypts (DEC 2006v).	**Unlikely**. Habitat supporting abundant winter flowering eucalypts is absent from the study area.
Broad-billed Sandpiper (*Limicola falcinellus*)	V	M	Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006w).	**Unlikely**. Suitable habitat absent.
Black-tailed Godwit (*Limosa limosa*)	V	M	Primarily a coastal species (DEC 2006x)	**Unlikely**. Suitable habitat absent.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Turquoise Parrot (*Neophema pulchella*)	V		Open eucalypt woodlands and forests, typically with a grassy understorey. It favours the edges of woodlands adjoining grasslands or timbered creek lines and ridges. A granivorous species, the Turquoise Parrot feeds on the seeds of native and introduced grasses and other herbs. Grasslands and open areas provide important foraging habitat for this species while woodlands provide important roosting and breeding habitat for this species. This species nests in tree hollows, logs or posts from August to December (DEC 2006y).	**Likely**. Suitable habitat may exist in the northwest region of the study area.
Powerful Owl (*Ninox strenua*)	V		This species occur in a number of vegetation types ranging from woodland and open sclerophyll forest to tall open wet forest and rainforest. However, this species does prefer large tracts of vegetation. Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old with breeding taking place from late-summer to late-autumn. Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400 – 1,450 ha. It forages within open and closed woodlands as well as open areas (DEC 2006z).	**Likely**. Suitable foraging habitat may be present within the study area.
Blue-billed Duck (*Oxyura australis*)	V		This species prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (DEC 2006za).	**Unlikely**. Suitable habitat absent.
Osprey (*Pandion haliaetus*)	V		Marine species (DEC 2006zb).	**Unlikely.** Suitable habitat absent.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Grey-crowned Babbler (*Pomatostomus temporalis* subsp *temporalis*)	V		Inhabits woodlands and is considered unable to cross large open areas due to laborious flight (DEC 2006zc).	**Unlikely.** Suitable habitat absent.
Wompoo Fruit-dove (*Ptilinopus magnificus*)	V		It occurs in, or near rainforest, low elevation moist eucalypt forest and brush box forests, feeding on a diverse range of tree and vine fruits and is locally nomadic - following ripening fruit; some of its feed trees rely on species such as the this to distribute their seeds. The Wompoo fruit-dove is most often seen in mature forests, but also found in remnant and regenerating rainforest (DEC 2006zd).	**Unlikely**. Suitable fruit-bearing trees are not present within the study area.
Superb Fruit-dove (*Ptilinopus superbus*)	V	M	A small pigeon that 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. Breeding takes place from September to January (DEC 2006ze).	**Unlikely**. Suitable fruit-bearing trees are not present within the study area.
Painted Snipe (*Rostratula benghalensis*)	E	V, M	This bird is a wetland species and is normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. This cryptic species nests on the ground amongst tall reed-like vegetation near water. It emerges from the dense growth at dusk to feed on mudflats and the water's edge taking insects, worm and seeds (DEC 2006zf). This species prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber.	**Likely**. Potential habitat for this species exists in Vegetation Community 5 and the surrounding areas.
Little Tern (*Sterna albifrons*)	E		Primarily a coastal species (DEC 2006zg).	**Unlikely.** Suitable habitat absent.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Freckled Duck (*Stictonetta naevosa*)	V		This species prefers permanent freshwater swamps and creeks with heavy growth of Cumbungi, Lignum or Tea-tree. During drier times they move from ephemeral breeding swamps to more permanent waters such as lakes, reservoirs, farm dams and sewage ponds. They generally rest in dense cover during the day, usually in deep water. They feed at dawn and dusk and at night on algae, seeds and vegetative parts of aquatic grasses and sedges and small invertebrates. Nesting usually occurs between October and December but can take place at other times when conditions are favourable and nests are usually located in dense vegetation at or near water level (DEC 2006zh). Potential habitat for this species exists in Vegetation Community 5 and the surrounding areas.	**Likely**. Potential habitat for this species exists in Vegetation Community 5 and the surrounding areas.
Masked Owl (*Tyto novaehollandiae*)	V		Occurs in dry eucalypt woodlands at altitudes from sea level to 1,100 m and roosts and breeds in hollows and sometime caves in moist eucalypt forested gullies. This species hunts along the edges of forests and roadsides and has a home range covering between 500 ha and 1 000 ha (DEC 2006zi).	**Likely**. Foraging habitat for this species may be present in the northwest portion of the study area.
Regent Honeyeater (*Xanthomyza phrygia*)	E	E	Inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River She-oak where there are significantly large numbers of mature trees, high canopy cover and abundance of mistletoes. Every few years non-breeding flocks are seen foraging in flowering coastal Swamp Mahogany and Spotted Gum forests, particularly on the central coast and occasionally on the upper north coast (DEC 2006zj).	**Unlikely.** Suitable woodland habitat with substantial winter flowering eucalypts and high canopy cover is not present in the study area.
Terek Sandpiper (*Xenus cinereus*)	V		Primarily a coastal species, favouring mudflats, harbours and lagoons (DEC 2006zk).	**Unlikely.** Suitable habitat absent.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)	V		Inhabits moist forest generally with trees larger than 20 m and roosts in eucalypt hollows, underneath bark or in buildings. Diet consists of moths, beetles and other insects, which it collects within or just below the tree canopy. This species hibernates during winter and breeding takes place in late spring (DEC 2006zl).	**Likely**. Suitable foraging habitat may exist within the study area.
Little Bentwing-bat* (*Miniopterus australis*)	V		Inhabits moist eucalypt forest, rainforest or dense coastal Banksia scrub. This species primarily roosts in caves, tunnels and sometimes tree hollows. Breeding for this species occurs during winter at maternal roost sites (DEC 2006zm).	**Likely.** Has been recorded previously within the study area.
Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*)	V		This species is essentially a cave bat, but also utilises man-made habitats such as road culverts, storm-water tunnels and other man-made structures. It is known from a variety of habitats along the east coast including rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grasslands (Churchill 1998, DEC 2006zn). In forested areas, it flies above the canopy to hunt, while in open grassland areas, flight may be within six m of the ground.	**Likely.** Suitable foraging habitat may exist within forested areas in the study area.
Eastern Freetail-bat (*Mormopterus norfolkensis*)	V		Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range and roosts primarily in tree hollows but also in man-made structures or under bark. This species is solitary and probably insectivorous (DEC 2006zo).	**Unlikely**. Suitable habitat absent.
Large-footed Myotis (*Myotis adversus*)	V		Primarily a coastal species that forages over streams and watercourses feeding on fish and insects which it catches by raking its feet across the water surface. Breeding takes place during November or December, roosting in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage (DEC 2006zp).	**Likely**. Foraging habitat for this species may be present as open areas with bodies of water are present in the study area although the depth of this water may be a limiting factor in the suitability for this species.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)	V		This species forages across a range of habitats including those with and without trees. This species roosts in tree hollows and buildings and in areas where trees are scarce or absent, this species has been known to utilise mammal burrows. Breeding takes place between December and mid-March (DEC 2006zq).	**Likely**. Suitable foraging habitat may exist within more open areas.
Greater Broad-nosed Bat (*Scoteanax rueppellii*)	V		This species hunts from above rows of trees lining creeks and the edges of woodland in otherwise cleared paddocks, roosting in hollow tree trunks and branches as well as the roofs of old buildings (Churchill 1998). It prefers moist gullies in mature coastal forest or rainforest. The species is only found at low altitudes (below 500 m) (Churchill 1998; DEC 2006 zr).	**Likely.** This species is most commonly found in tall wet forest, present in the southeast of the study area.
Spotted-tailed Quoll (*Dasyurus maculatus*)	V	E	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are found in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, which are usually traversed along densely vegetated creeklines (DEC 2006zs).	**Unlikely.** This species requires large areas of undisturbed habitat and is therefore considered unlikely to occur within the study area.
Squirrel Glider (*Petaurus norfolcensis*)	V		This species dens in tree hollows and utilises woodland and requires an abundant number of tree hollows for nesting. It feeds on nectar, pollen, flowers, acacia gum and insects and consequently requires a diverse mosaic of trees including eucalypts, acacias and banksias. Home ranges for this species have been estimated to vary from 0.65 and 8.55 ha depending on the type and quality of the habitat. Family groups are normally comprised of one male and two or more females and juveniles (DEC 2006zt). This species can tolerate and move across fragmented landscapes.	**Likely.** Suitable nesting and foraging habitat is present throughout the study area.

Common Name (Species Name)	TSC Act Status	EPBC Act Status	Habitat Association	Likelihood of Occurring in Study Area
Brush-tailed Phascogale (*Phascogale tapoatafa*)	V		This species prefers dry sclerophyll forest with a sparse groundcover of herbs, grasses, shrubs or leaf litter. They also inhabit heath, swamps, rainforest and wet sclerophyll forest. They forage mostly in rough barked trees and feed mostly on arthropods but will eat other invertebrates, nectar and sometimes small vertebrates (DEC 2006zu).	**Likely.** Potential habitat for this species may exist in Vegetation Communities 2, 5 and 6.
Koala* (*Phascolarctos cinereus*)	V		Limited to areas of preferred food trees in eucalypt woodlands and forests (DEC 2006k).	**Recorded in the study area.**
Grey-headed Flying-fox (*Pteropus poliocephalus*)	V	V	This species roosts in camps generally located within 20 km of a regular food source and are commonly found in gullies, close to water and in vegetation with a dense canopy. This species is known to forage in areas supporting subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps on the nectar and pollen of native trees, in particular eucalypts, melaleucas and banksias. This species will also forage in urban gardens and cultivated fruit crops (DEC 2006zv).	**Likely.** Suitable foraging habitat for this species exists in Vegetation Community 5.

E = Endangered, V = Vulnerable, M = Migratory, TSC Act = *Threatened Species Conservation Act 1995*, EPBC Act = *Environment Protection and Biodiversity Conservation Act 1999*; * = Species previously recorded within the study area

3.5 Koala

Preferred Koala Habitat and associated links and buffers have been identified within the study area by the CKPoM (Port Stephens Council 2002) and confirmed by field investigations undertaken for this assessment. The CKPoM mapping is shown in Figure 8. Note that due to mapping constraints, the Koala Habitat areas may appear misaligned with the vegetation, however it should be noted that Preferred Koala Habitat generally occurs within the native vegetation remnants occurring on-site. Preferred Koala food trees, as defined by the CKPoM include Swamp Mahogany, Forest Red Gum and Parramatta Red Gum (*Eucalyptus parramattensis*). Two of these species (Forest Red Gum and Swamp Mahogany) were identified in the northwest corner of the study area within *Angophora costata/Corymbia gummifera* Forest. In addition, a Koala was observed during spotlighting in this area. Swamp Mahogany occurs in the east of the study site along the creek line within *Melaleuca linariifolia/Eucalyptus robusta/Angophora costata* Swamp Forest, from which a Koala was heard calling. These communities were mapped as Preferred Koala Habitat (Port Stephens Council 2002) and data from the current surveys confirm this mapping.

Melaleuca quinquenervia is listed by the CKPoM as an "important" tree for Koala habitat. *Melaleuca quinquenervia* Swamp Forest has also been mapped as Preferred Koala Habitat as have areas encompassing portions of *Casuarina glauca* woodland and scattered *Melaleuca quinquenervia*. Current surveys confirm the presence of *Melaleuca quinquenervia* within these areas and therefore highlight the likely importance of these vegetation communities as Koala habitat.

A 50 m Buffer Over Cleared area is mapped around all Preferred Koala Habitat and areas between these Preferred Koala Habitat stands have been mapped as Link Over Cleared. Buffer areas serve to reduce possible edge effects on Preferred Koala Habitat as well as ensure development is not carried out directly adjacent to Preferred Koala Habitat and are therefore considered to require the highest level of protection. Habitat linking areas are considered essential for the conservation of Koala populations and may provide dispersal routes (which ensures genetic exchange between populations) and range extensions where necessary.

In addition to the Preferred Koala Habitat mapped across various portions of the study area, an individual of this species was heard calling within the study area during the current surveys. The call was recorded in the northeast of the site within Vegetation Community 2. Another individual was observed during spotlighting in the canopy of a Red Bloodwood within Vegetation Community 3. These records indicate current use of the site by Koalas.

Appendix 2 of the CKPoM (Port Stephens Council 2002) specifies a number of performance criteria for Rezoning Requests made to Council for lands mapped as containing Koala habitat. Prior to approval of a rezoning request, Council must be satisfied that the rezoning would:

- Not result in development within areas of Preferred Koala Habitat or defined Habitat Buffers;
- Allow for only low impact development within areas of Supplementary Koala Habitat and Habitat Linking Areas;
- Minimise the removal of any individuals of preferred Koala food trees, where ever they occur on the site; and
- Not result in development which would sever Koala movement across the site. This should include consideration of the need for maximising tree retention on the site generally and for minimising the likelihood of impediments to safe / unrestricted Koala movement.

Appendix 2 of the CKPoM also states that the information required to support a rezoning proposal must include an investigation of the site by an appropriately qualified individual in accordance with the Guidelines for Koala Habitat Assessment provided in Appendix 6 of the CKPoM.

All these matters are relevant to the current study area. As a large proportion of the study area is mapped as Preferred Koala Habitat, Habitat Buffer or Habitat Linking Areas, under the performance criteria any resulting development could not occur within the Preferred Koala Habitat or Buffer Habitat, with only low impact development within the Habitat Linking Areas.

Preferred food trees were present in *Melaleuca linariifolia/Eucalyptus robusta/Angophora costata* Swamp Forest and *Angophora costata/Corymbia gummifera* Forest. The Performance Criteria specifies that the rezoning request would not result in development in areas mapped as Preferred Koala habitat. Under this condition, the majority of the extant vegetation within the study area would not be developable as it falls within areas mapped as Preferred Koala Habitat. Any proposed development would need to minimise the removal of preferred Koala food trees wherever they occur within the study area. Also, development within the area may hinder Koala movement through the area. Stands of Preferred Koala Habitat present in the eastern portion of the study area are largely separated from other larger stands of Preferred Koala Habitat by large areas of open cleared land. Use of this eastern habitat by Koalas was confirmed during the current surveys as an individual was heard calling in the area. Development between these Preferred Koala Habitat stands may provide an impediment to the unrestricted (by way or buildings, fences etc.) and safe (by way of roads and vehicle movement) movement of resident Koalas. Any development would need to maintain a substantial area of intact habitat without impediments to maintain linkage between areas of suitable habitat. Movement between the Preferred Koala Habitat in the north and south of the study area is likely to be facilitated by continuous vegetation between these areas to the west of the study area.

As stated in Appendix 2, an investigation of the site must be carried out under the Guidelines for Koala Habitat Assessment presented in Appendix 6. As Step 1 of this assessment process has established the presence of Preferred Koala Habitat and preferred food trees within the study area, further investigation to accompany the Rezoning Request would require detailed vegetation and preferred food tree mapping as well as detailed assessment of Koala usage of the study area and determination of high value linkage areas. If the results of this mapping are found to be inconsistent with existing LGA-wide vegetation maps it would be necessary to further assess the study area in relation to Koala habitat identification, assessment and production of a site-specific Koala Habitat Planning Map. These investigations would need to be carried out at a later stage to accompany the Rezoning Request.

GHD CLIENTS | PEOPLE | PERFORMANCE

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0 30 60 120 180 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

- Study Area
- **Koala Habitat**
  - Preferred Koala Habitat
  - 50m Buffer Over Cleared
  - Link Over Cleared
- Koala spotlighted during surveys
- Survey position at time of koala call

Source: Port Stephens Comprehensive Koala Plan of Management (PSC 2002)

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9 November 2006

Koala Habitat

Williamtown Employment Zone - Stage 2

Figure 8

4. Ecological Value Assessment

An analysis of ecological values across the study area was used to rate areas of high, medium and low value habitat. The analysis was undertaken in accordance with the assessment criteria presented in Table 4. The rating assigned to each area is illustrated in Figure 9. Ecological values across the study area are discussed in the following section.

4.1 Factors Influencing Ecological Values Across the Study Area

Factors influencing the distribution of ecological values across the study area include:

- Substantial areas of vegetation have been identified as remnants of two EECs listed on the TSC Act;
- The threatened Wallum Froglet is present throughout the study area and disturbance to the existing hydrological regime and / or removal of any habitat would be considered likely to affect the long-term survival of this local population;
- Much of the study area is mapped as Preferred Koala Habitat, Buffer Habitat or Link Over Cleared habitat, all of which are considered important habitat for the protection of the threatened Koala;
- Linkages between areas of Preferred Koala Habitat occur within cleared areas, including the sand-mined area;
- Koalas heard calling and directly observed within the study area indicate current use of the site;
- Drainage lines are present throughout the study area and are essential in the maintenance of the current hydrological regime of the study area. The existing hydrological regime is likely to play a key role in the survival of existing species and communities. Disruption of this drainage system may have a significant effect on the long-term survival of these species and communities;
- Swampy areas and ephemeral water-bodies provide habitat for threatened species and are of high ecological value. In particular, the threatened Wallum Froglet is likely to exploit temporary ponds formed after significant rainfall as breeding habitat. Vegetation removal and changes in landscape values are likely to alter the hydrological regime and seasonal waterlogging patterns and therefore affect the vegetation composition, hence habitat values of these areas; and
- Hollow-bearing trees, stags and mature eucalypts present within *Melaleuca linariifolia/Eucalyptus robusta/Angophora costata* Swamp Forest and *Angophora costata/Corymbia gummifera* Forest provide potential habitat for many threatened arboreal species, including the Squirrel Glider, certain microchiroptan bats, and are a limited resource.

4.2 Opportunities for Offsets

The study area provides little opportunity to offset the biodiversity loss on-site. This is due in large part to the proximity of the areas of high ecological value to the existing Airport facility as well as the extent of developable land required. Most of the vegetation communities which are of high ecological value occur at the northwestern end of the study area. It is likely that development will progress in stages from north to south.

One area which may present an opportunity for on-site conservation is the *Melaleuca quinquenervia* Swamp Forest (indicated on Figure 9 as Community 5c) on the mid-western boundary of the study area. This area is subject to high inundation and may present engineering constraints to development.

Another opportunity for on-site conservation may be the creation of habitat suitable for Wallum Froglet, eg through 'soft' engineering design which incorporates constructed wetlands into on-site stormwater treatment.

The greatest degree of biodiversity offset is likely to be achieved through off-site measures. The extent and distribution of ecological values across the study area, as identified within this report, provide valuable baseline data upon which to identify the extent of off-site habitat to be conserved to meet the objective of 'net improvement of biodiversity' for the local area. Offsetting principles, as presented in the *Draft Lower Hunter Regional Conservation Plan* (DEC 2006) have been included as Appendix C to this report.

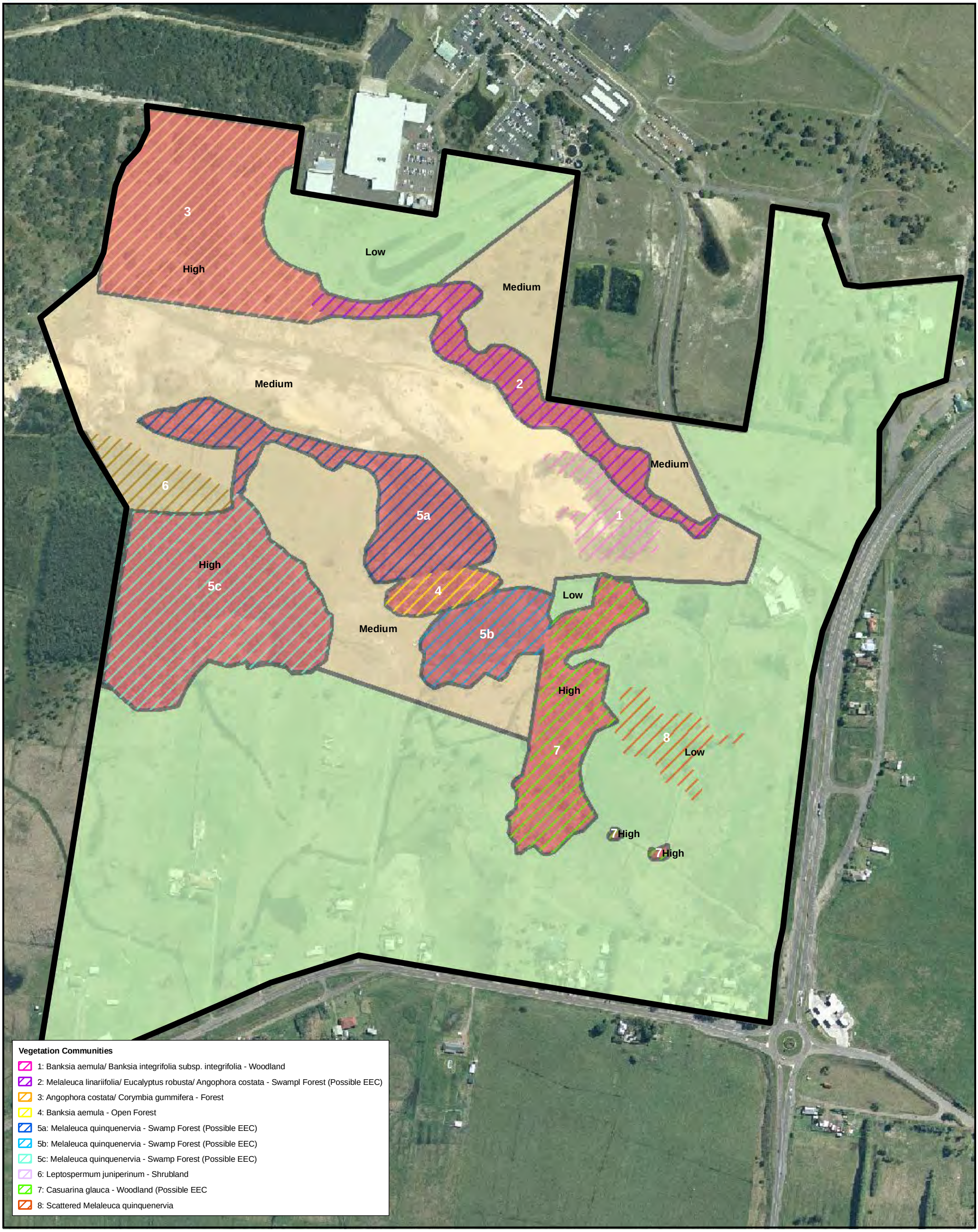
Table 4 Ecological Assessment Criteria

Community codes: **1** = *Banksia aemula/B.integrifolia* woodland; **2** = *Melaleuca linariifolia/Eucalyptus robusta/Angophora costata* Swamp Forest; **3** = *A.costata/Corymbia gummifera* Forest; **4** = *B.aemula* Open Forest; **5a,b,c** = *M.quinquenervia* Swamp Forest; **6** = *Leptospermum juniperinum/Acacia longifolia* Shrubland; **7** = *Casuarina glauca* woodland; **8** = scattered *M.quinquenervia*; **SM** = sand-mined area.

	Relevant communities/areas										
Assessment Criteria (listed under ratings of High, Medium and Low)	**1**	**2**	**3**	**4**	**5a**	**5b**	**5c**	**6**	**7**	**8**	**SM**
HIGH											
Endangered Ecological Community on the TSC Act.		√			√	√	√		√		
Vegetation contains hollow-bearing trees (critical resource for hollow-dependent fauna such as microchiropteran bats, gliders, owls, glossy black-cockatoo)		√	√								
Confirmed habitat for Wallum Froglet.		√	√		√		√		√		√
Drainage Lines - potential habitat for Wallum Froglet; essential for the maintenance of the current hydrological regime of the area.		√	√	√	√	√	√	√	√	√	√
Presence of Koalas		√	√								
Preferred Koala Habitat		√	√		√	√	√		√		
MEDIUM											
Ephemeral ponds which fill during inundation of the site (provide suitable breeding habitat for the Wallum Froglet).											√
Koala Linking Habitat											√

	Relevant communities/areas										
Assessment Criteria (listed under ratings of High, Medium and Low)	**1**	**2**	**3**	**4**	**5a**	**5b**	**5c**	**6**	**7**	**8**	**SM**
Potential foraging habitat for threatened microchiropteran bats.	√	√	√	√	√	√	√		√	√	
Potential habitat for threatened woodland birds such as Brown Treecreeper and Grey-crowned Babbler.		√	√		√	√	√		√	√	
Potential habitat for Port Stephens endangered population of Emu.	√		√	√					√	√	√
Suitable foraging habitat for Grey-headed Flying-fox	√	√	√	√	√	√	√	√		√	
Vegetated areas with sufficient ground cover and foraging areas for small terrestrial mammals and open grassy areas for macropods.	√	√	√	√	√	√	√	√	√	√	√
Potential ephemeral habitat for threatened wetland birds, within swampy and moist areas, extending throughout the study area during flooding.		√	√	√	√	√	√	√	√	√	√
Koala Habitat Linking Areas and Buffer Areas over Cleared (includes open grass / slashed areas linking vegetation communities)	√	√	√	√	√	√	√	√	√	√	√
LOW											
Areas support poor quality habitat for threatened fauna.	Highly modified lands devoid of intact native vegetation.										

CLIENTS | PEOPLE | PERFORMANCE



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0 30 60 120 180 240

Metres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geodetic Datum of Australia 1994
Grid: Map Grid of Australia, Zone 56

GRID N

LEGEND

Study Area

Ecological Value Rating

High

Medium

Low

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21 September 2006

Ecological Value Rating

Williamtown Employment Zone - Stage 2

Figure 9

5. Conclusions

The subject site is one of six specialised centres identified in the Lower Hunter Regional Strategy (LHRS). This particular centre was identified as proposed land for airport related employment. The Strategy operates at a regional level alongside the Draft Lower Hunter Conservation Plan (Draft RCP) (DEC 2006). These documents direct future land use and conservation planning and inform Draft Local Environmental Plans and the underlying Local Environmental Studies.

Three factors contribute significantly to the high ecological values attributed to much of the study area. Firstly, much of the study area provides suitable habitat for threatened flora, fauna and ecological communities. Development within those parts of the study area assessed as having medium to high ecological value is expected to have significant impacts on certain threatened species, endangered populations and ecological communities. Secondly, any changes to the existing hydrological regime of the area is likely to significantly affect the vegetation communities present in the area as well as threatened species habitat, and in turn affect the long-term survival of some local populations.

The third factor is that much of the study area contains Preferred Koala Habitat as well as other buffer and linking habitats. The CKPoM 2002 (PSC 2006) considers these habitats as essential and deserving of the highest level of protection.

The employment lands identified in the LHRS encompass valuable ecological habitat. The development of the site for airport related employment is likely to significantly impact this habitat. However, the regional framework identifies the site as one of only six specialised centres, unique in its proximity to the Newcastle Airport and Williamtown RAAF Base. In addition, the primary objectives of the Draft RCP are to complement the Government's Planning Strategy. The Draft RCP identifies mechanisms for biodiversity conservation through investment in the Lower Hunter (at a regional landscape level).

Where appropriate, opportunities to incorporate and preserve the ecological integrity of valuable habitat within the site should be considered. Where this is not effective, appropriate ecological offsets may need to include the conservation of habitat off-site. The determination of appropriate offsets would require the consideration of a broader, regional scale. Thus some of the impacts on habitat within the site, may be potentially off-set by the conservation of land containing habitat outside of the site through the mechanisms identified in the Draft RCP, providing the outcome is of net biodiversity gain in the area. Such an assessment would include lands outside the site, and is therefore beyond the scope of the brief for this assessment.

The process to be followed and associated ecological considerations at a local, sub-regional, and regional level are discussed in detail in the Stage 2 Suitability and Capability Report to which this report is appended.

In general terms, the ecological considerations associated with the rezoning process will be as follows:

1 Completion of the Land Capability/Suitability Assessment Report (Stage 2)

This will involve the evaluation of the constraints applying to the land in order to make an informed decision about the suitability of the land for development purposes, an examination of development options (preliminary structure planning) and the likely impacts arising from such development on ecologically sensitive areas within the Study Area. It will include recommendations drawn from the Draft RCP in relation to suitable opportunities for offsetting any potential biodiversity impacts associated with the proposed change of land use. The Stage 2 report will take the form of a draft Local Environmental Study required to rezone the area selected for future use as an employment zone.

2 Preparation of Detailed Structure Plan and associated Development Control Framework for the Aviation Industry Employment Zone (Stage 3)

Based on the findings and recommendations of the Stage 1 and 2 investigations, a recommended strategy for the rezoning and development of land suitable for that purpose will be prepared. It is anticipated that there will be some loss of habitat as a result of the development of the land and that some areas within the site will be conserved due to their high habitat value. The Stage 3 Report will include an anticipated off-set package to compensate for the loss of habitat on-site based on discussions with DEC. A potential management regime will also be recommended for that land containing proposed off-sets, and for areas of ecological value to be preserved within the site.

3 Rezoning of the Land

Subject to receiving agreement in principle from the relevant authorities to a proposed development scenario and the conservation initiatives as proposed in the above reports, Port Stephens Council and the Department of Planning will then consider initiating the rezoning of the land.

It should be noted that prior to development (i.e prior to rezoning or alternatively the issuing of any consent for the subdivision)of the land, it will be necessary to:

- Accurately establish the extent and quality of habitat to be lost as a result of the development of the land;
- Establish the criteria to be used in the assessment of off-sets;
- Identify and secure appropriate offsets;
- Prepare and have adopted detailed management strategies to ensure the long term survival of retained habitat; and
- To accurately delineate the boundaries between areas to be developed and those areas to be protected.

In this regard a future developer proponent will need to consult with the Department of Environment and Conservation (DEC). DEC will also advise on any additional ecological survey work that may be required. The developer will be responsible for commissioning any additional surveys required.

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