

### 3. Landscape features

The BAM requires the assessment of landscape features to help describe the biodiversity values of the project site and assess the impacts of the project. Landscape features relevant to the BAM calculations are shown on Figure 3.1, discussed below and summarised in Table 3.1.

#### 3.1 Location and land uses

The study area is predominately located within the existing rail corridor from Cabramatta to Warwick Farm. Land uses adjoining the study area consist primarily of urban streetscapes and residential, commercial and industrial developments, interspersed with urban parklands.

The study area is located in the City of Fairfield and City of Liverpool local government areas (LGA).

#### 3.2 Bioregion and IBRA subregion

The project site occurs within the Cumberland IBRA (Interim Biogeographic Regionalisation for Australia) subregion of the Sydney Basin IBRA bioregion (refer to Figure 3.1). The Sydney Basin IBRA bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 ha which includes about 4.53 per cent of NSW. The region extends north from Batemans Bay to Nelson Bay and west to Mudgee and includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems.

#### 3.3 NSW landscape region (Mitchell Landscapes)

The study area is predominantly located within the Georges River Alluvial Plain Mitchell Landscape (DECC 2008a), within the Sydney Basin Bioregion (see Figure 3.1), which is described as follows:

*“Channel, floodplain and terraces of the Georges River on Quaternary and Tertiary alluvial sediments. Mostly clayey sand and sand with limited gravel on the highest terrace, general elevation 0 to 30m, local relief 10m. Massive uniform or gradational profiles on yellow brown to orange clayey sand...Forest and woodland of cabbage gum (Eucalyptus amplifolia), rough-barked apple (Angophora floribunda), broad-leaved ironbark (Eucalyptus fibrosa ssp. fibrosa), scribbly gum (Eucalyptus sclerophylla) and narrow-leaved apple (Angophora bakeri). Extensive swamp oak (Casuarina glauca) along the riverbanks and in low-lying areas often with prickly-leaved tea-tree (Leptospermum styphelioides), these extend to brackish estuarine swamps with grey mangrove (Avicennia marina) and limited saltmarsh.” (DECC 2008b).*

The DECC (2008a, 2008b) description of the geology and geomorphology at the study area was confirmed by GHD ecologists during the site inspection. The DECC (2008a, 2008b) description of native vegetation at the study area broadly matches the survey results present in section 4.1.2.

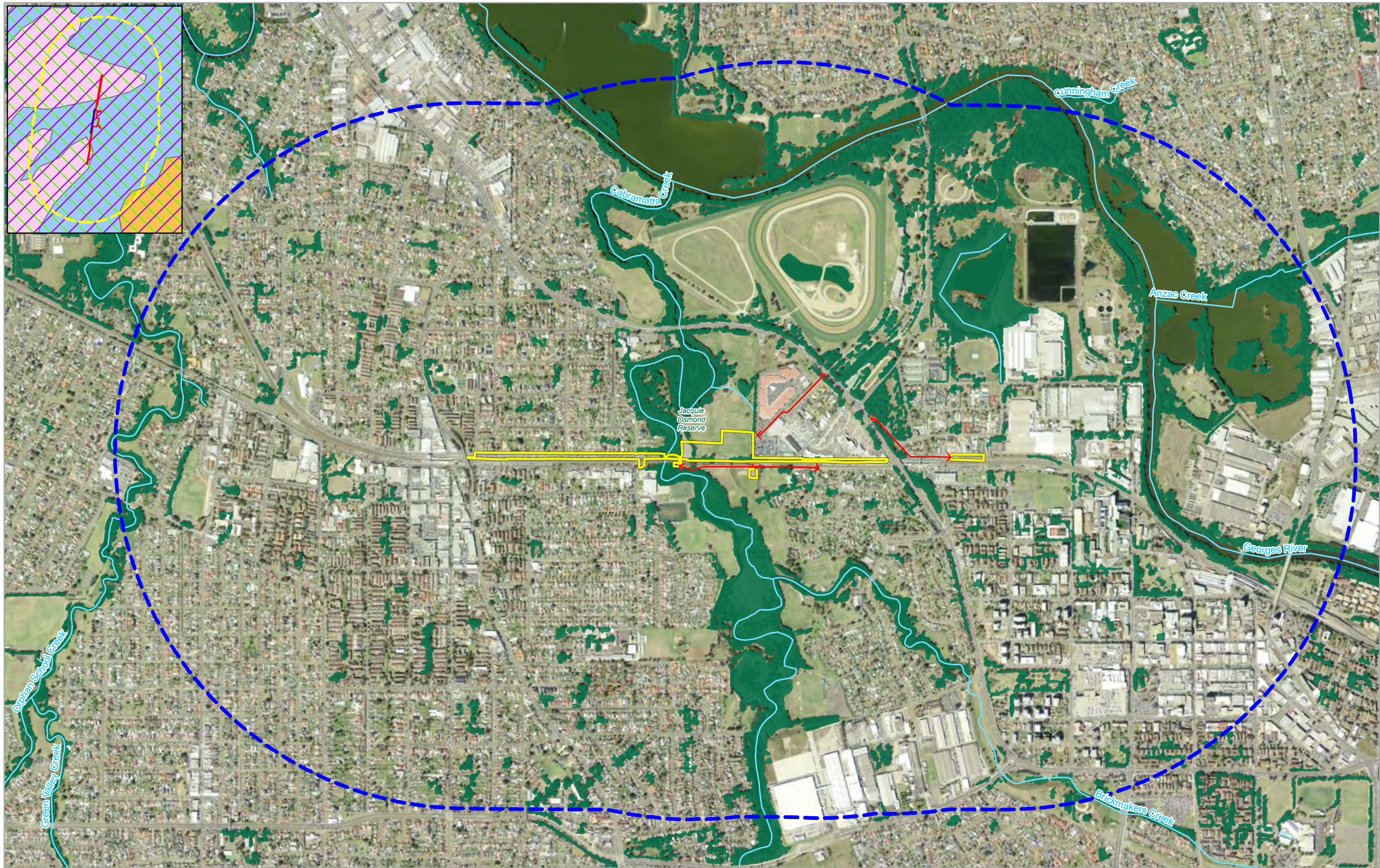
Based on the vegetation, land forms and soils observed during the field survey the Georges River Alluvial Plain Mitchell landscape is a good fit for the biophysical environment for the majority of native vegetation in the study area.

A small portion of the study area, at higher elevations in the far north and south of the rail corridor, occurs on the Cumberland Plain Mitchell Landscape (see Figure 3.1). This Mitchell Landscape is characterised by:

*“Low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones forming a down-warped block on the coastal side of the Lapstone monocline. Intruded by a small number of volcanic vents and partly covered by Tertiary river gravels and sands (Hawkesbury-Nepean Terrace Gravels landscape). Quaternary alluvium along the main streams. General elevation 30 to 120m, local relief 50m. and sometimes affected by salt in tributary valley floors..Woodlands and open forest of grey box (Eucalyptus moluccana), forest red gum (Eucalyptus tereticornis), narrow-leaved ironbark (Eucalyptus crebra), thin-leaved stringybark (Eucalyptus eugenioides), cabbage gum (Eucalyptus amplifolia) and broad-leaved apple (Angophora subvelutina). Grassy to shrubby understorey often dominated by Australian boxthorn (Bursaria spinosa), poorly drained valley floors, often salt affected with swamp oak (Casuarina glauca) and paperbark (Melaleuca sp.).” (DECC 2008b).*

Based on the experience and judgement of the assessor, the Cumberland Plain Mitchell landscape is a good fit for the original biophysical environment of higher elevation portions of the study area. However the natural vegetation, land forms and soils have been removed or extensively modified through these areas and they now comprise a developed environment associated with the rail corridor and suburban streets.

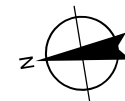




Legend

- |                          |                |                       |
|--------------------------|----------------|-----------------------|
| Project site             | IBRA region    | Watercourse           |
| 1500m buffer area        | Sydney Basin   | Compound access route |
| Native vegetation extent | IBRA subregion |                       |
|                          | Cumberland     |                       |

Paper Size ISO A3  
 0 90 180 270 360 450  
 Metres  
 Map Projection: Transverse Mercator  
 Horizontal Datum: Australian 1966  
 Grid: AGD 1966 ISG 56 1



ARTC  
 Cabramatta Rail Loop  
 Biodiversity Assessment Report

Project No. 22-19800  
 Revision No. 0  
 Date 17/04/2019

Location map

FIGURE 3.1



### 3.4 Climate

The site has a temperate climate. Based on data from the Bankstown Airport weather station (66137) located approximately 5 kilometres from the project site, the site has a mean annual rainfall of 868 mm, falling predominantly in summer and autumn. The site can reach mean daily maximum temperatures of 28.4 degrees and mean daily minimum temperature of 5.1 degrees celsius (BOM, 2019b).

### 3.5 Soils and geology

#### 3.5.1 Soil landscapes

The majority of the project site falls within the Blacktown soil landscape, with the middle portion of the site falling in the South Creek soil landscape where Cabramatta Creek is present (OEH, 2019d). These soil landscapes are described as follows:

- The Blacktown soil landscape is described as “Low hills and rises on Wianamatta Group Shale (shale, sandstone-lithic and sandstone quartz) in the Cumberland Plain, Hornsby Plateau and Picton Hills. Local relief 10-50 m; altitude 10-202 m; slopes 0-9%; rock outcrop nil. Extensively cleared woodland. Soils Red Kurosols (Red and Brown Podzolic Soils) Red and Yellow Sodosols (Soloths) and Yellow Chromosols (Yellow Podzolic Soils). Red Chromosols, Red Dermosols and Red Ferrosols (Krasnozems) on iron-rich parent material” (OEH, 2018d).
- The South Creek soil landscape is described as “Flat to gently sloping alluvial plain with occasional terraces or levees providing low relief. Slopes <5%. Local relief <10m... The vegetation of this soil landscape reflects its frequent inundation...” (OEH, 2019d).

The presence of both soil landscapes at the project site was confirmed by GHD ecologists during the site inspection. There are substantial volumes of fill materials in the study area, including railway ballast, gravel, building debris and excavated soil material. The majority of the study area is emplaced fill associated with railway embankments.

#### 3.5.2 Soil hazards

The erosion hazard for South Creek soil landscape is potentially very high to extreme. This is an active floodplain and is presently being reworked by fluvial processes. Apparent stability is probably short term. Streambank and gully erosion are common results of concentrated flow. (OEH 2019d).

The erosion hazard for non-concentrated flows in the Blacktown soil landscape is slight to moderate but ranges from low to very high. Calculated soil loss during the first twelve months of urban development for topsoil and exposed subsoil tends to be low (7–11 t/ha). Soil erosion hazard for concentrated flows is moderate to high.

There was no evidence of soil erosion in the project site given the modified nature of the landscape. Notably the riparian corridor of Cabramatta Creek has been extensively modified for erosion mitigation works where it intersects the project site and beneath the existing rail bridges. The channel through this reach of Cabramatta Creek is composed of imported sandstone, river pebble and basalt gravel. The banks are supported by gabions and pre-formed concrete bridge pylons and culverts. This modified landform would have substantially lower erosion hazard than the natural alluvial landforms of the South Creek soil landscape.

Evidence of streambank erosion was observed downstream of this reach of Cabramatta Creek, including undercut banks, bare earth and exposed tree roots.



There is minimal risk of acid sulphate soils as the site is not in a coastal location. Acid sulphate soil risk mapping indicates that acid sulphate soils are not known or expected to occur at the project site (OEH 2018d).

### 3.5.3 Areas of geological significance

There are no karst, caves, crevices, cliffs or other areas of geological significance located within the project site or buffer area surrounding the project site (see Figure 3.1).

## 3.6 Hydrology

Cabramatta Creek flows through the project site in an easterly direction beneath the existing railway bridge and shared path (see Figure 1.2). It has a highly modified geomorphology, with re-contoured banks in the project site with gabions, oversized sandstone and ballast. The reaches of Cabramatta Creek flow into the Georges River approximately 1 kilometre to the east of the site.

## 3.7 Groundwater dependent ecosystems

The *NSW State Groundwater Dependent Ecosystems Policy* defines groundwater dependent ecosystems (GDEs) as ecosystems which have their species composition, and their natural ecological processes determined by groundwater (DLWC 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC 2002).

Dependence (or interaction) of the vegetation communities identified within the study area on groundwater was determined by searching the Atlas of GDEs (BOM 2018a). This Atlas predicts the occurrence of groundwater dependent ecosystems and ecosystems that potentially use groundwater. It shows ecosystems that interact with the subsurface expression of groundwater (including vegetation ecosystems) or the surface expression of groundwater (such as rivers and wetlands). The Atlas also shows the likelihood that landscapes are accessing water in addition to rainfall, such as soil water, surface water or groundwater.

Native vegetation within the study area is not mapped as vegetation with a potential for being reliant on the subsurface presence of groundwater. It is also unlikely to be an in-flow dependant ecosystem, i.e. an ecosystem that is “*accessing a water source in addition to rainfall, such as water stored in the unsaturated zone, surface water or groundwater*” (Australian Government, 2012). Based on the field observations, experience and judgement of the assessor, the vegetation in the study area is likely to be reliant on rainfall and on surface water associated with Cabramatta Creek and areas of surface water accumulation on its floodplain. GDEs are not considered further in this BDAR.

## 3.8 Patch size and connectivity features

There is no native vegetation within the project site. Therefore no patch size polygon was mapped or calculated for this BDAR. Native vegetation in the study area is part of a larger patch that extends to the east and west of the site associated with the riparian corridor of Cabramatta Creek. This patch of connected vegetation is over several hundred hectares in area. Therefore for the purpose of the preliminary BAM credit calculations that were completed as an input to the threatened species assessment in this BDAR, the maximum patch size in the BAM of 100 hectares was entered.

There is a total of 212.9 hectares of native vegetation within the 1,500 metre buffer area surrounding the project site, which is around 14.8 per cent of the buffer area (see Table 3.1). Vegetation in the buffer area is associated with the riparian corridor of Cabramatta Creek, which in turn is connected to vegetation in the riparian corridor of the Georges River. There is a



separate vegetated corridor along Prospect Creek to the north of the project site and a number of very small, fragmented patches of vegetation within a matrix of cleared residential and light industrial land spread through the remainder of the buffer area.

Table 3.1 Summary of landscape features present within the project site

Landscape feature	Project site
Method applied for site context components	Site-based
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin
IBRA subregion	Cumberland
Mitchell landscapes	Georges River Alluvial Plain, Cumberland Plain
Rivers, streams and estuaries	The project site crosses Cabramatta Creek, which drains to the Georges River to the east.
Wetlands	None in the project site. There is a small, unnamed freshwater wetland surrounded by exotic grassland in the vicinity of the project site (see Figure 4.1b).
Connectivity features	The site is connected to a corridor of vegetation to the east and west associated with Cabramatta Creek and the Georges River. Vegetation within the buffer area is largely restricted to this patch, within a matrix of infrastructure, residential and light industrial land.
Areas of geological significance or soil hazard features	<p>The majority of the project site and surrounding buffer area is associated with the South Creek soil landscape, which has a very high to extreme potential for erosion (OEH 2019d). As described above, the project site and adjoining reach of Cabramatta Creek have been extensively modified and would feature a significantly lower erosion hazard than the natural landscape.</p> <p>Soils at higher elevations are associated with the Blacktown soil landscape, which have a low to high erosion hazard for non-concentrated flows and moderate to high erosion hazard for concentrated flows (OEH 2019d).</p> <p>Acid sulphate soil risk mapping indicates that there are no known occurrences at the project site (OEH 2018d).</p> <p>There are no karst, caves, crevices, cliffs or other areas of geological significance located within the project site or buffer area surrounding the site.</p>
Other landscape features	Nil
1500 metre buffer area	1441.2 ha
Current percent native vegetation cover in the buffer area	14.8 per cent (212.9 ha)
The future percent native vegetation cover in the buffer area	14.8 per cent (212.9 ha) as the project would not remove any native vegetation.



## 4. **Vegetation**

### 4.1 Native vegetation extent

There is no native vegetation in the project site. There are three non-native vegetation map units in the project site: planted native species; exotic vegetation; and cleared lands (see Figure 4.1 and refer to Table 4.1). These map units were not assigned a PCT because of the low cover and species richness of indigenous native plants and/or because they occur on highly modified soils and landforms (as prescribed in section 5.1.1.5 of the BAM (OEH 2017a)).

The channel floor and banks of Cabramatta Creek where it intersects the project site has been mapped as 'planted native species' and is non-native vegetation because this reach of the creek is confined by concrete or gabions and has a gravel or concrete bed. This is not representative of natural reaches of Cabramatta Creek up and downstream of the project site nor of the South Creek soil landscape (OEH 2019d) or the PCT that would be expected to have occurred in this context (Cumberland Riverflat Forest - PCT835) (OEH 2018c).

There is native vegetation outside of the project site but within the study area, comprising Cumberland River-flat Forest (PCT835) in moderate condition and Coastal Freshwater Wetland (PCT1071) in moderate condition (see Figure 4.1 and refer to Table 4.1). The project, construction laydown areas and construction access routes have been purposefully selected and designed to avoid impacts to these areas of native vegetation (see section 6.2).

#### 4.1.1 Flora species

A total of 94 flora species from 37 families were recorded within the study area, comprising 43 native and 51 exotic species. The Poaceae (grasses, 17 species, seven native) Fabaceae (12 species, 8 native) and Myrtaceae (10 species, all native) were the most diverse families recorded. A full list of flora species recorded within the study area is provided in Appendix B. Common species recorded are discussed below in relation to the vegetation map unit occurring within the study area. A proportion of the 43 native plant species recorded in the study area are not indigenous to Western Sydney. In most cases these non-indigenous native plants occur as planted individuals on road verges or other highly modified landscapes and so they have not been counted towards the native vegetation extent as described above.

#### 4.1.2 Vegetation map units

The structure, species composition and condition of each vegetation map unit within the study area is described below. Plot data is provided in Appendix B, along with benchmark values for the vegetation map unit.





Table 4.1 Vegetation in the study area

Vegetation map unit	PCT/NSW Veg. Type ID (OEH, 2016c)	Condition	Survey effort <sup>1</sup>	Conservation significance	Area in project site (hectares)
Cumberland River-flat Forest	835 / HN526	Medium	Plot/transect 3	EEC <sup>2</sup> listed under the BC Act (River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney basin and South East Corner Bioregion)	0
Coastal Freshwater Wetland	1071 / HN630	Medium	Plot/transect 5	EEC listed under the BC Act (Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions).	0
Planted native species	n/a	Cleared/non-native vegetation	Plot/transect 1,6		0.5
Exotic vegetation	n/a	Cleared/non-native vegetation	Plot/transects 2,4		3.0
Cleared land	n/a	Cleared/non-native vegetation	Area search 1, general observations		3.4
				<b>Total</b>	<b>6.9</b>

Notes:

1. Locations of plot/transects are shown in Figure 4.1.
2. EEC – Endangered ecological community.



Table 4.2 Vegetation – exotic vegetation

Exotic vegetation		
PCT (OEH, 2018c)	n/a	
PCT ID	n/a	
NSW Veg Type ID	n/a	
Equivalent Map Units	n/a	
Survey effort	Plot 2 and 4	<p>Mown exotic grassland at plot 4.</p>  <p>Exotic scrub at plot 2.</p>
Conservation significance	Exotic vegetation. Not listed as a TEC.	
Condition	<p>Low.</p> <p>Very low cover and species richness of indigenous native plants.</p> <p>Fallen logs and litter cover are sparse.</p>	
Evidence used to define vegetation unit	<p>Imported or extensively modified soil profiles and landforms. Frequent and ongoing human disturbance, such as mowing. Twenty two out of 38 species recorded in this map unit were exotic. Native vegetation cover was either absent or less than exotic plant cover for all plant life form groups. Up to 60% high threat exotic plant cover was recorded in plots.</p> <p>This vegetation map unit is not consistent with any PCTs (OEH, 2018c).</p>	
Landscape position	<p>Previously cleared or disturbed land in all landscape positions on gently undulating terrain throughout the study area. Includes mown sports fields and patches of exotic scrub adjacent to roads, railway bridges and pedestrian access paths.</p>	
Structure	<p>Variable, including both a grassland and a scrub form. The grassland form of this map unit contains an understorey dominated by exotic forbs and grasses and is regularly maintained (see photo 1 above). The scrub form of this map unit includes a midstorey of Privet (<i>Ligustrum</i> spp.) in addition to an exotic understorey (see plot 4 photo above).</p>	
Over storey	Absent.	



Exotic vegetation	
Mid storey	Absent in grassland form, very patchy in scrub form. Very occasional native shrubs and small trees such as Swamp Oak ( <i>Casuarina glauca</i> ), Large-leaved Hop-bush ( <i>Dodonaea triquetra</i> ) and Wedge-leaf Hop-bush ( <i>Dodonaea viscosa</i> subsp. <i>viscosa</i> ). Occasional dense patches of exotic shrubs and small trees such as Large-leaved Privet ( <i>Ligustrum lucidum</i> ) and Green Cestrum ( <i>Cestrum parquii</i> ).
Groundcover	<p>Dense and structurally variable but with low species richness. Where present native groundcover species include: moderate cover of grass and grass-like plants such as Common Couch (<i>Cynodon dactylon</i>), Common Reed (<i>Phragmites australis</i>) and Weeping Grass (<i>Microlaena stipoides</i> var. <i>stipoides</i>); low cover and species richness of herbs such as Lesser Joyweed (<i>Alternanthera denticulata</i>), <i>Geranium homeanum</i> and <i>Dianella caerulea</i> var. <i>producta</i>; and shrubs, including Australian Indigo (<i>Indigofera australis</i>).</p> <p>The grassland form comprises a very high, near continuous cover of Kikuyu Grass (<i>Pennisetum clandestinum</i>), interspersed with exotic herbs and grasses.</p> <p>The scrub form includes a highly variable mix of shrubs such as Small-leaved Privet (<i>Ligustrum sinense</i>), Fennel (<i>Foeniculum vulgare</i>) and Narrow-leaved Cotton Bush (<i>Gomphocarpus fruticosus</i>), grasses such as Kikuyu Grass and Rhodes Grass (<i>Chloris gayana</i>) and herbs such as Spear Thistle (<i>Cirsium vulgare</i>), Common Sowthistle (<i>Sonchus oleraceus</i>) Lamb's Tongues (<i>Plantago lanceolata</i>) and Wandering Jew (<i>Tradescantia fluminensis</i>).</p>
Exotic species	<p>There is high exotic plant cover, mainly consisting of herbaceous weeds in the groundcover layer and small trees in the midstorey.</p> <p>High threat weeds were recorded in this vegetation map unit, including Alligator Weed (<i>Alternanthera philoxeroides</i>), Kikuyu Grass, Rhodes Grass, Balloon Vine (<i>Cardiospermum grandiflorum</i>) and Green Cestrum.</p>



Table 4.3 Vegetation – planted native species

Planted native species		
PCT (OEH, 2018c)	n/a	
PCT ID	n/a	
NSW Veg Type ID	n/a	
Equivalent Map Units	n/a	
Survey effort	Plot 1 and 6	<p>Planted native species (Swamp Oak, <i>Casuarina glauca</i>) in plot 1.</p>  <p>Planted native species (Forest Red Gum, <i>Eucalyptus tereticornis</i>) in the project site</p>
Conservation significance	Planted vegetation. Not listed as a TEC.	
Condition	<p>Low.</p> <p>Low native species richness and cover, frequently made up of non-indigenous species.</p> <p>Very low fallen log and litter cover. Occasional hollow-bearing trees.</p>	
Evidence used to define vegetation unit	<p>Imported or extensively modified soil profiles and landforms. Minimal evidence of regeneration of indigenous native plant species. Linear arrangement of trees, stakes and plant guards around shrubs, and random mix of indigenous and non-indigenous native species that are not representative of any locally occurring PCT (OEH, 2018c). Tree species are often surrounded by a mulched garden bed (see photo above) or mown exotic grass.</p>	
Landscape position	Throughout the study area.	
Structure	Variable, including areas of broadly spaced trees above mown exotic grassland, closed forest, scrub and shrubland.	
Over storey	<p>Patchy, often consisting of lines of mature trees along streets or isolated individuals in parkland. Indigenous native over storey species include Swamp Oak, Spotted Gum (<i>Corymbia maculata</i>) and Forest Red Gum (<i>Eucalyptus tereticornis</i>) to around 20 metres in height. Non-indigenous native species include Narrow-leaved Black Pepper mint (<i>Eucalyptus nicholii</i>) and Brush Box (<i>Lophostemon confertus</i>).</p>	



Planted native species	
Mid storey	Patchy. The small section of midstorey plantings adjacent to Jacquie Osmond Reserve include Coast Banksia ( <i>Banksia integrifolia</i> ), Fern-leaved Banksia ( <i>Banksia integrifolia</i> ), Hakea spp. and Sydney Golden Wattle ( <i>Acacia longifolia</i> ).
Groundcover	Moderately dense, with very low native species richness and structurally variable. Groundcover species include: moderate cover of grass and grass-like plants such as, Common Couch; and low cover and species richness of herbs such as Climbing Saltbush ( <i>Einadia nutans</i> ).
Exotic species	There is high exotic plant cover, mainly consisting of herbaceous weeds in the groundcover layer. High threat weeds were recorded in this vegetation map unit and include Kikuyu Grass, Rhodes Grass, Green Cestrum, Moth Vine ( <i>Araujia sericifera</i> ) and Small-leaved Privet.

Table 4.4 Vegetation - Cumberland River flat forest

Cumberland River-flat Forest		
PCT (OEH, 2016c)	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	 <p>Cumberland River flat forest adjacent to the construction access road from Station Street.</p>  <p>Cumberland River flat forest understorey in plot 3.</p>
PCT ID	835	
NSW Veg Type ID	HN526	
Survey effort	Plot 3	
Condition (OEH, 2014b)	Medium. Remnant and regenerating native vegetation on natural landforms with hollow-bearing trees and other habitat resources but high exotic plant cover.	
Conservation significance	EEC listed under the BC Act (River-flat Eucalypt Forest on Coastal Floodplains).	
Evidence used to define vegetation unit	Open forest in better condition patches. Characteristic alluvial soil types and geomorphology. The dominant plant species described below are consistent with the VIS (OEH, 2016c) and the species list in the Scientific Committee determination for the associated EEC (NSWSC, 2011b). There are patches of this vegetation unit mapped in similar topographic positions within the study area and around Cabramatta Creek (OEH, 2016).	
Landscape position	Channel floor, banks and alluvial flats on gently undulating terrain.	

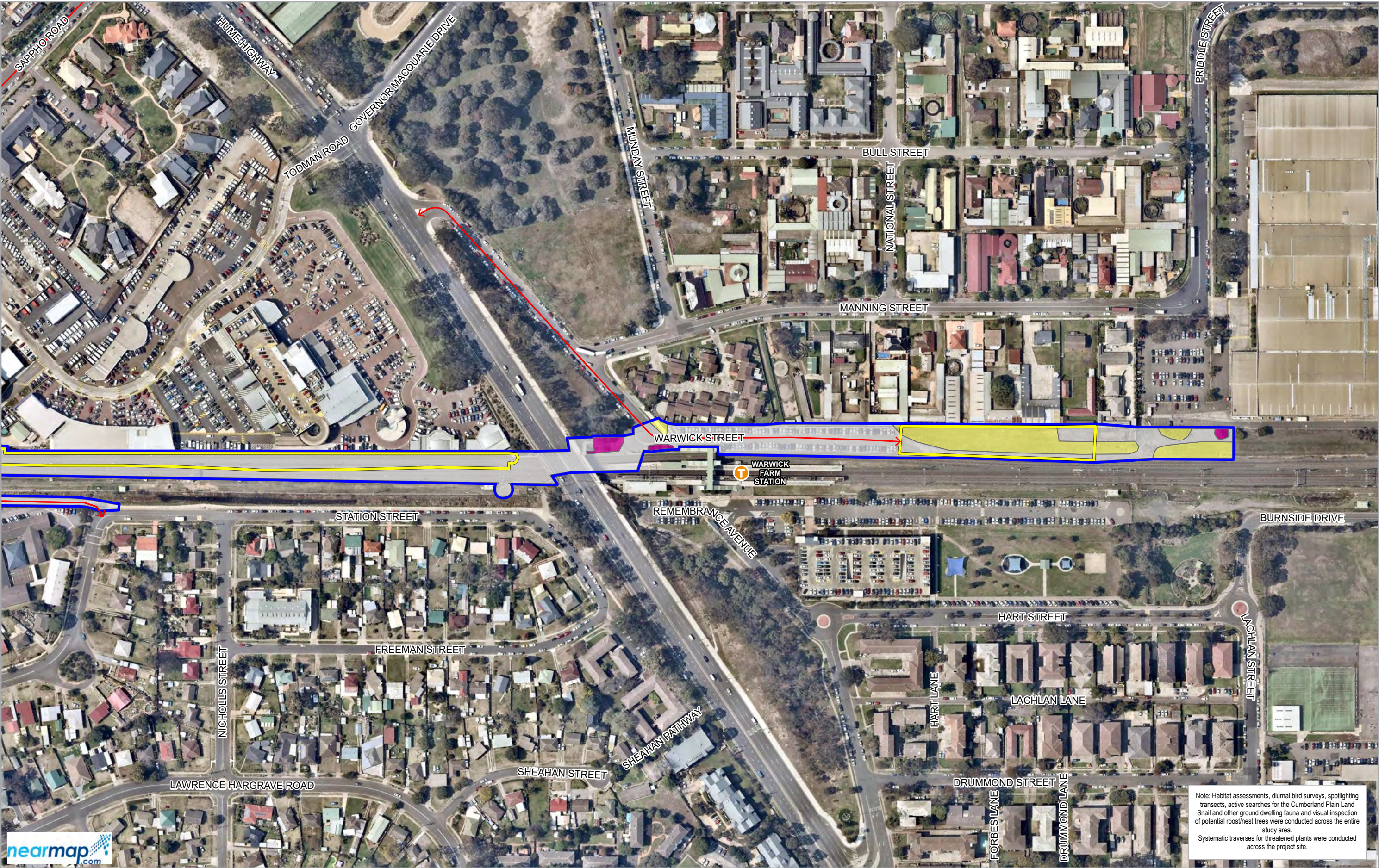
Cumberland River-flat Forest	
Structure	Open forest or derived scrub.
Over storey	Indigenous native over storey dominated by Swamp Oak ( <i>Casuarina glauca</i> ), Blue Box ( <i>Eucalyptus baueriana</i> ), <i>Angophora subvelutina</i> and Forest Red Gum ( <i>Eucalyptus tereticornis</i> ) to around 20 metres in height.
Mid storey	There is a locally dense but species poor mid-storey comprising patches of sub mature Swamp Oak or Parramatta Wattle ( <i>Acacia parramattensis</i> ) and Native Blackthorn ( <i>Bursaria spinosa</i> subsp. <i>spinosa</i> ).
Groundcover	Patchy and variable with moderate native species richness. Includes: grasses such as <i>Oplismenus aemulus</i> , Bushy Hedgehog Grass ( <i>Echinopogon caespitosus</i> ), Two-colour Panic ( <i>Panicum simile</i> ) and Weeping Grass ( <i>Microlaena stipoides</i> var. <i>stipoides</i> ); shrubs such as Native Peach ( <i>Trema tomentosa</i> var. <i>aspera</i> ); herbs such as Hill Fireweed ( <i>Senecio hispidulus</i> ) and Climbing Saltbush; and scramblers such as Variable Glycine ( <i>Glycine tabacina</i> ).
Exotic species	<p>There is moderate exotic plant cover, mainly consisting of herbs and grasses in the groundcover layer with occasional dense infestations of small trees or scramblers.</p> <p>High threat weeds were recorded in this vegetation map unit and include Kikuyu Grass, Rhodes Grass, Green Cestrum, Moth Vine, Small-leaved Privet, Bridal Creeper (<i>Asparagus asparagoides</i>), Fireweed (<i>Senecio madagascariensis</i>), Madeira Vine (<i>Anredera cordifolia</i>), Wandering Jew, African Lovegrass and Panic Veldt Grass (<i>Ehrharta erecta</i>).</p>



Table 4.5 Coastal freshwater wetland

Coastal Freshwater Wetland		
PCT (OEH, 2016c)	<i>Phragmites australis</i> and <i>Typha orientalis</i> coastal freshwater wetlands of the Sydney Basin Bioregion	 <p>Coastal freshwater wetland vegetation at plot 5.</p>  <p>Coastal freshwater wetland around 100 metres west of the construction access road from Station Street.</p>
PCT ID	1071	
NSW Veg Type ID	HN630	
Survey effort	Plot 5	
Condition (OEH, 2014b)	Medium. Remnant and regenerating native vegetation on natural landforms with high native cover.	
Conservation significance	EEC listed under the BC Act (Freshwater Wetlands on Coastal Floodplains).	
Evidence used to define vegetation unit	Occurs in a poorly drained depression on the floodplain of Cabramatta Creek. Contains high cover of representative plant species for the PCT listed in the VIS (OEH, 2019c) and the species list in the Scientific Committee determination for the associated EEC (NSWSC, 2011b).	
Landscape position	A poorly drained depression on the floodplain of Cabramatta Creek to the west of the rail line in Jacquie Osmond Reserve.	
Structure	Rushland and moist herb field.	
Over storey	Absent.	
Mid storey	Absent.	
Groundcover	Dense reedbeds with low native species richness. Dominated by Common Reed ( <i>Phragmites australis</i> ) and Tall Sedge ( <i>Carex appressa</i> ) with occasional <i>Juncus usitatus</i> . Grasses, including Common Couch ( <i>Cynodon dactylon</i> ), Paddock Lovegrass ( <i>Eragrostis leptostachya</i> ) and Swamp Dock ( <i>Rumex brownii</i> ) occur on the edges of the wetland.	
Exotic species	There is low exotic plant cover, mainly consisting of herbaceous weeds in the groundcover layer. High threat weeds recorded in this vegetation map unit and include Alligator Weed.	

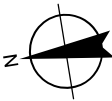




- Legend
- Project site
  - Study area
  - Sydney Trains station
  - Compound access route
  - Cleared land
  - Exotic vegetation
  - Planted native species

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Map Projection: Transverse Mercator  
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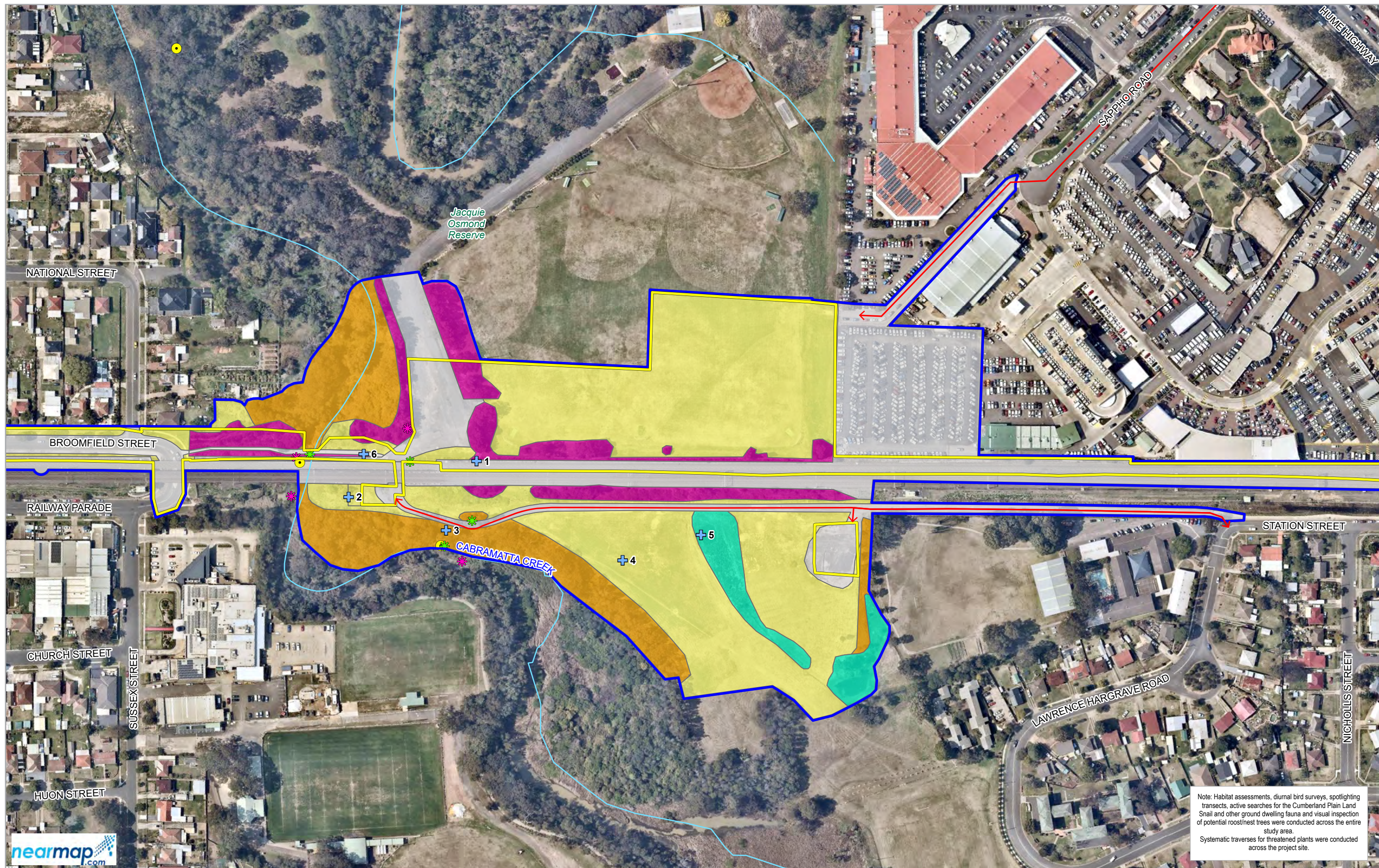
ARTC  
Cabramatta Rail Loop  
Biodiversity Assessment Report

Project No. 22-19800  
Revision No. 0  
Date 17/04/2019

Vegetation and survey effort

FIGURE 4.1a



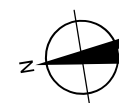


#### Legend

- |                       |               |  |             |
|-----------------------|---------------|--|-------------|
| Project site          | Anabat        | Cleared land   | Watercourse |
| Study area            | Call playback | Exotic vegetation  |             |
| Sydney Trains station | Plot/transect | Planted native species                                     |             |
| Compound access route | Stag watch    | Coastal freshwater wetland (PCT1071 in moderate condition) |             |
|                       |               | Cumberland Riverflat Forest (PCT835 in moderate condition) |             |

Paper Size ISO A3  
0 10 20 30 40  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: Australian 1966  
Grid: AGD 1966 ISG 56 1



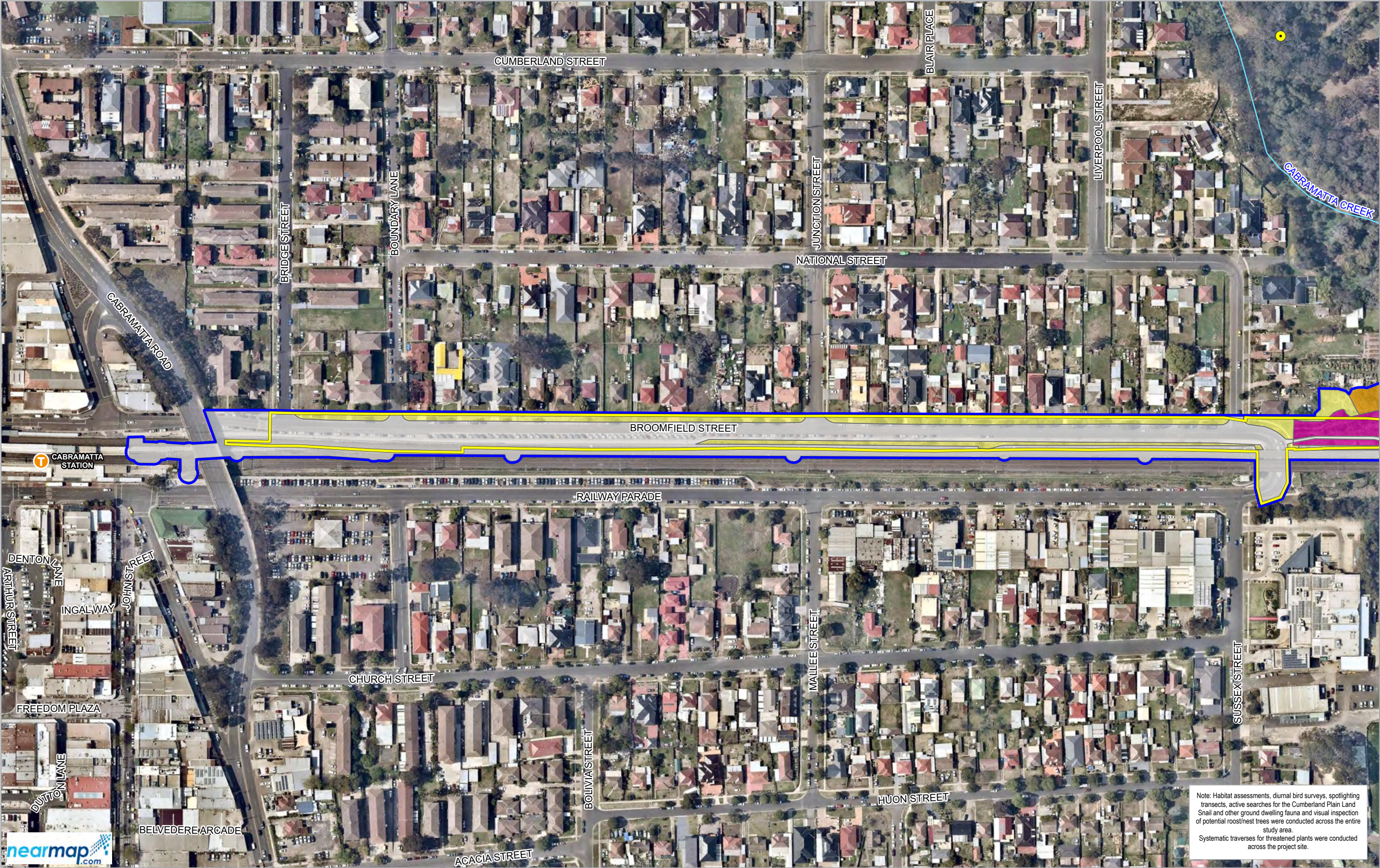
ARTC  
Cabramatta Rail Loop  
Biodiversity Assessment Report

**Vegetation and survey effort**

Project No. 22-19800  
Revision No. 0  
Date 17/04/2019

**FIGURE 4.1b**





Legend

	Project site		Compound access route		Exotic vegetation		Cumberland Riverflat Forest (PCT835 in moderate condition)
	Study area		Call playback		Planted native species		Watercourse
	Sydney Trains station		Cleared land				

Paper Size ISO A3  
0 10 20 30 40  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: Australian 1966  
Grid: AGD 1966 ISG 56 1

ARTC  
Cabramatta Rail Loop  
Biodiversity Assessment Report

Project No. 22-19800  
Revision No. 0  
Date 17/04/2019

Vegetation and survey effort

**FIGURE 4.1c**

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Print date: 17 Apr 2019 - 15:16

Data source: NearMap: Imagery, 2018. LPI:DCDB/DTDB, 2017. Created by: tmorton



## 4.2 Fauna and fauna habitats

### 4.2.1 Fauna species

A total of 61 species of fauna were recorded across the study area during the surveys, comprising 48 bird species, six mammals, three frogs, two fish and two reptiles (see Appendix B). Fauna observed included common and widespread species of suburban environments as well as some small woodland birds that rely on dense vegetation and large patch size. The study area contains potential habitat for a range of other native animals, including threatened fauna and migratory species known or predicted to occur in the locality as discussed below. Given the limited extent and quality of habitat in the project site, only a subset of the species occurring in the study area would occur in the project site and they would be unlikely to rely on any habitat resources contained within it.

### 4.2.2 Fauna habitats

Fauna habitat value within the project site is very low, reflecting the highly modified environment in the rail corridor and adjoining land. Habitat value is higher across the study area, despite its suburban context and the presence of human disturbance and edge effects. There are valuable fauna habitat resources associated with Jacquie Osmond Reserve and the riparian corridor of Cabramatta Creek, including permanent water, wetland and aquatic environments and a relatively large patch of mature, productive native vegetation. The project site is connected to a larger patch of habitat in the riparian corridor of Cabramatta Creek.

Fauna habitats in the study area are described in Table 4.6 below.

Table 4.6 Fauna habitats – planted native species

Fauna habitats: Planted native species	
Description	<p>Planted native species occurs along linear fragments adjacent to railway bridges and the rail corridor. Most of the planted native species comprises non-indigenous native species to the south of Cabramatta Creek. Large planted eucalyptus trees are present adjacent to a recreational oval as part of Jacquie Osmond Reserve. Many of the planted trees occur in small gardens with a base of mulch. Street trees north of Cabramatta Creek also include some planted non-indigenous native native species over a groundcover of mown exotic grass.</p> <p>The vegetation is poor in species richness but would provide habitat resources for a range of native fauna, including:</p> <ul style="list-style-type: none"><li>• mature canopy trees that provide nectar, fruits, leaves and foraging, roosting or nesting substrates</li><li>• habitat trees including a single hollow bearing tree and others with fissures and/or decorticated bark</li><li>• occasional small patches of dense understorey shrubs</li><li>• a range of fruiting and flowering small trees and shrubs.</li></ul>
Typical fauna species	<p>A mixture of bird species were observed, including those common to suburban parks and gardens such as the Australian Raven (<i>Corvus coronoides</i>), Rainbow Lorikeet (<i>Trichoglossus haematodus</i>), Crimson Rosella (<i>Platycercus elegans</i>), Australian Magpie (<i>Cracticus tibicen</i>), Grey Butcherbird (<i>Cracticus torquatus</i>), Eastern Rosella (<i>Platycercus eximius</i>) and Laughing Kookaburra (<i>Dacelo novaeguineae</i>).</p> <p>There was one hollow-bearing tree observed within planted vegetation in the project site which contained several small spout hollows. This could provide roosting habitat for a variety of hollow-dependant microbats that occur in the locality.</p>
Threatened or migratory biota	<p>N/a</p> <p>Planted vegetation has poor connectivity to larger patches of remnant native vegetation.</p>

## Fauna habitats: Planted native species

### Photographs



Shelter substrate for small ground dwelling fauna beneath planted native species.



A planted hollow-bearing Spotted Gum (*Eucalyptus maculata*) in the project site.



Table 4.7 Fauna habitats – exotic vegetation

Fauna habitats: Exotic vegetation	
Description	<p>Exotic vegetation occurs throughout the study area, including areas with a scrub and grassland structure and lines of street trees. It occurs as small linear fragments on the edges of near-intact woodland and forest and fauna would use this habitat as a transition between better quality habitats. These areas are heavily disturbed by past clearing activities for the railway, roads, residential and industrial areas, and recreation. Exotic grassland appears to have been recently mowed at the time of the survey, and is likely to be regularly maintained for recreational use. Areas of exotic vegetation adjacent to the rail corridor have a highly modified geomorphology and often occur above ballast and other artificial substrates.</p> <p>Exotic vegetation contains a low to moderate diversity of vegetation and provides the following habitat resources for native fauna:</p> <ul style="list-style-type: none"> <li>• scarce woody debris and leaf litter</li> <li>• locally dense patches of dense midstorey shrubs</li> <li>• some fruiting and flowering shrubs</li> <li>• grass seeds.</li> </ul>
Typical fauna species	<p>Grasses and herbs would provide foraging resources for relatively mobile and opportunistic native fauna, including birds such as the Australian Magpie (<i>Cracticus tibicen</i>) and Magpie-lark (<i>Grallina cyanoleuca</i>). Microbat species, including the threatened Eastern Bentwing Bat may forage over exotic vegetation. Common lizards such as the Eastern Water Skink (<i>Eulamprus quoyii</i>) were observed, particularly in areas where shelter such as ballast and shrubs were present.</p> <p>The Common Eastern Froglet (<i>Crinia signifera</i>) and other generalist native frog species, including the Brown Striped Frog (<i>Limnodynastes peronii</i>) would also likely utilise habitats present in these areas, particularly after rain.</p> <p>Patches of exotic trees and shrubs within the study area provide potential foraging habitat for a range of common bird species and mammal species. Bird species recorded included the Grey Butcherbird (<i>Cracticus torquatus</i>), Red Wattlebird (<i>Anthochaera carunculata</i>) and Rainbow Lorikeet (<i>Trichoglossus haemotodus</i>). Small birds such as the Superb Fairy-wren (<i>Malurus superbus</i>) were also observed.</p> <p>Small introduced mammals such as Black Rats (<i>Rattus rattus</i>) and House Mice (<i>Mus musculus</i>) were recorded in this habitat type.</p>
Threatened or migratory biota	<p>Given the proximity to larger patches of vegetation and habitat resources present in the study area, a wide variety of other threatened species could occur on occasion whilst moving better quality areas of habitat. This may include a range of microbats, owls, gliders and small woodland birds. Given the limited extent and quality of habitat in exotic vegetation, they would be unlikely to rely on any resources contained within it.</p>

## Fauna habitats: Exotic vegetation

### Photographs



Shelter substrate for small ground dwelling fauna associated with exotic grass and gravel in the project site.



Very limited habitat resources for fauna associated with mown exotic grassland.



Table 4.8 Fauna habitats – cleared land

Fauna habitats: Cleared land	
Description	<p>Cleared land includes bitumen roads, road ballast and associated rail infrastructure, including bridges within the study area.</p> <p>Areas of cleared land within the study area generally contain low habitat value for local fauna. Habitat resources for native fauna include:</p> <ul style="list-style-type: none"> <li>• nesting substrate under bridges for species such as the Fairy Martin</li> <li>• potential roosting habitat for microbats under bridge structure</li> <li>• some fruiting and flowering shrubs for nectar and fruit-eating species</li> <li>• grass seeds for seed-eating species.</li> </ul>
Typical fauna species	<p>Cleared land generally contains low habitat value for local fauna. Occasional grasses and herbs, invertebrates, and food waste would provide foraging resources for relatively mobile and opportunistic native fauna, including birds such as the Australian Magpie (<i>Cracticus tibicen</i>) and Magpie-lark (<i>Grallina cyanoleuca</i>). Microbat species, including the threatened Eastern Bentwing Bat may forage within the study area.</p> <p>Small, common lizards such as the Eastern Water Skink (<i>Eulamprus quoyii</i>) and other <i>Lampropholis</i> spp. would take shelter within ballast in the rail corridor. These lizards may also bask on bitumen although this was not observed at the time of the survey.</p> <p>The nests of Fairy Martins (<i>Petrochelidon ariel</i>) were observed under both rail bridges over Cabramatta Creek.</p> <p>The ARTC rail bridge immediately adjacent to the project site provides only limited potential roosting habitat for microbats. This bridge is of pre-cast concrete construction with smooth surfaces and few apertures. The apertures that are present are shallow or vertically aligned and open to the sky and as such would have poor thermal insulation and would be exposed to rainfall.</p> <p>The adjoining Sydney Trains bridge is of brick and sandstone construction with a range of apertures, including some which are deep, horizontally aligned and or closed to the sky and would be more suitable for bridge-roosting microbats such as Southern Myotis (<i>Myotis macropus</i>). No evidence of roosting bats or bat droppings was detected at either bridge despite purposeful inspection during the field surveys. No microbats were observed exiting roosts in the bridge during dedicated observation periods at dusk. A moderate diversity of microbat species and abundance of bat calls were recorded on Anabat call recorders targeting the flyways adjacent to the bridge (see results for Nosferatu 14/11/2018 and 15/11/2018 in Appendix Table 6). These results do not suggest that bats were roosting in the bridges over Cabramatta Creek or that habitat in the project site was of particular value to microbat species.</p>
Threatened or migratory biota	<p>Potential roost sites for the Southern Myotis or other threatened microbats associated with bridges and culverts.</p> <p>A variety of other threatened species could pass through cleared land on occasion whilst moving to better quality areas of habitat. This may include a range of owls, gliders and small woodland birds occurring in nearby patches of native vegetation. Given the limited extent and quality of habitat in exotic vegetation, they would be unlikely to rely on any resources contained within it.</p>

## Fauna habitats: Cleared land

### Photographs



Very limited habitat resources for fauna associated with mown exotic grassland and ballast in the rail corridor.



Potential bat and bird roosting habitat associated with the rail bridges.

Table 4.9 Fauna habitats – Cabramatta Creek and Wetlands

Fauna habitats: Cabramatta Creek and Wetlands	
Description	<p>The reach of Cabramatta Creek through the project site has a highly modified channel floor comprising oversized sandstone, ballast and shale gravels. Riffles are present where gravel has been manually placed. There are pools up to 0.3 m deep. Moderate quantities of rubbish is present but water quality was apparently good with low turbidity, minimal algal growth with resident fish and other aquatic fauna. Cabramatta Creek, in the project site, had low turbidity and fast flowing water at the time of the survey. Adjacent to the project site, replanted and/or regenerating riparian vegetation is present. There is some instream aquatic vegetation, including some reeds and sedges. Water flows into Cabramatta Creek are fed by a natural channel occurring upstream of the project site. A 5-bay box culvert with a 1000 mm stormwater drain discharges water from underneath a designated bike path.</p> <p>Cabramatta Creek is mapped as Key Fish Habitat (DPI, 2007). It is classified as Class 1 (major key fish habitat) as it is a permanently flowing river (DPI, 2013). No mudflats are present in the study area and there is no habitat for waders at this location.</p> <p>There is freshwater wetland around 20 metres to the west of the project site and construction access route (see Figure 4.1b). It contains dense aquatic vegetation mostly comprising a mix of <i>Typha</i> and <i>Carex</i> spp. It is located in the lowest part of the landscape in a drainage depression.</p>
Typical fauna species	<p>A Gudgeon (likely Cox's Gudgeon (<i>Gobiomorphus coxii</i>)) and a Long-fin Eel (<i>Anguilla reinhardtii</i>) were recorded in small pools within Cabramatta Creek. Cabramatta Creek would also provide habitat for a number of other common native fish species.</p> <p>Wetland birds, including the Pacific Black Duck (<i>Anas superciliosa</i>) and Australian White Ibis were observed downstream of the project site. A pair of Dusky Moorhen (<i>Gallinula tenebrosa</i>) were observed foraging within a platform of reeds upstream of the project site.</p> <p>Several frog species, including the Common Eastern Froglet (<i>Crinia signifera</i>), Peron's Tree Frog (<i>Litoria peronii</i>) and Tyler's Tree Frog (<i>Litoria tyleri</i>) were heard calling from areas of dense aquatic vegetation along Cabramatta Creek. They are also likely to occur within the small wetland on occasion.</p> <p>The wetland provides foraging habitat for a number of smaller wetland birds, including Baillon's Crake (<i>Porzana pusilla</i>) which was observed recorded taking refuge in a dense stand of <i>Carex</i> spp.</p>
Threatened or migratory biota	<p>Cabramatta Creek does not comprise habitat for any threatened species listed under the FM Act, BC Act or EPBC Act.</p> <p>The freshwater wetlands comprise potential habitat for a number of threatened frogs and wetland birds (see Appendix A).</p>



## Fauna habitats: Cabramatta Creek and Wetlands

### Photographs



Dense wetland vegetation around 50 metres west of the construction access road from Station Street.



Highly modified in-stream habitat with riffle of imported gravel and building rubble in the project site.

Table 4.10 Fauna habitats – native woodland and forest

Fauna habitats: Native woodland and forest	
Description	<p>Native woodland and forest does not occur within the project site, but does occur in the broader study area.</p> <p>The vegetation has moderate to high species richness and would provide habitat resources for a range of native fauna, including:</p> <ul style="list-style-type: none"> <li>• mature canopy trees that provide nectar, fruits, leaves and foraging, roosting or nesting substrates</li> <li>• habitat trees with hollows and/or decorticated bark</li> <li>• woody debris</li> <li>• patches of dense understorey shrubs</li> <li>• a range of fruiting and flowering small trees and shrubs.</li> </ul>
Typical fauna species	<p>A range of myrtaceous trees are present, including Forest Red Gum (<i>Eucalyptus tereticornis</i>) and Blue Box (<i>Eucalyptus baueriana</i>), that provide foraging resources for a range of birds, including cockatoos, parrots and honeyeaters, and arboreal mammals, such as the Common Brushtail Possum (<i>Trichosurus vulpecula</i>) and Common Ringtail Possum (<i>Pseudocheirus peregrinus</i>). This vegetation layer provides foraging substrate and shelter for small bird species that are reliant on dense vegetation for cover. There are a variety of acacias that would provide shelter and foraging resources.</p> <p>Occasional hollow-bearing trees, which could provide potential nesting habitat for arboreal mammals or birds, were observed in the study area. Around 300 vertebrate species use tree hollows and shedding bark in Australia, and the shelter provided by these habitat features is essential for the survival of many of these species (Gibbons &amp; Lindenmayer 2002). Hollows in the study area are most likely used by the common and introduced species observed in the study area. These include bird species such as the Rainbow Lorikeet, which was observed nesting in a hollow adjacent to the project site during the survey. A range of microbats have been recorded in the locality (OEH, 2018a), including a number of hollow-roosting species. Tree hollows and crevices could provide roost sites for tree-dwelling threatened microchiropteran bats such as the Eastern Freetail-bat. No large hollows suitable for threatened owls are present in the project site. Species such as the Powerful Owl (<i>Ninox strenua</i>) may forage for arboreal mammals such as possums on rare occasions in the project site.</p>
Threatened or migratory biota	<p>Grey-headed Flying Foxes were observed foraging in native woodland and forest during the survey. Native woodland and forest provide nectar and pollen resources for this species. The Cabramatta Creek Grey-headed Flying-fox roost camp is located around 350 metres to the east of the project site. Large numbers of Grey-headed Flying-fox were recorded flying over the study area.</p> <p>A 'probable' Anabat recording of the Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>) was made in forest just to the west of the project site (see Figure 4b).</p>



## Fauna habitats: Native woodland and forest

### Photographs



Native forest adjacent to the construction access road from Station Street.



Native forest with intact in stream and riparian habitat around 100 metres downstream (east) of the project site.



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## 5. **Conservation significance**

### 5.1 Identification of threatened species

#### 5.1.1 Predicted threatened species

Based on the bioregional context for the assessment and the PCTs, patch size, vegetation cover and habitat resources present at the project site, the BAM calculator generates a list of threatened fauna species that are predicted to utilise the project site. There is no native vegetation in the project site for this assessment. The BAM requires the assessment of 'prescribed impacts', which are impacts not directly related to the removal of native vegetation. Examples of prescribed impacts include removal of exotic vegetation, removal of habitat resources such as rocks or vehicle strike. To assist with identifying threatened species that could potentially be subject to prescribed or indirect impacts, the credit calculator was run based on the patch of native vegetation closest to the project site. The potential for these predicted species to occur within the site were further refined based on the desktop assessment, habitat resources observed during field surveys and the knowledge and experience of the assessor.

The suite of predicted threatened species associated with ecosystems and habitat resources at the study area are listed in Table 5.1. Targeted surveys are not required for these species because impacts and offset requirements for these species are captured in the calculation of ecosystem credits.

The Grey-headed Flying-fox was recorded within the study area during field surveys.



Table 5.1 Predicted threatened species (ecosystem-credit species)

Scientific name	Common name	BC Status	EPBC Status	Justification	Likelihood of impact
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Potential breeding and foraging habitat in wetland areas as part of Cabramatta Creek and also in the mapped wetland in Jacquie Osmond Reserve.	Low
<i>Ninox connivens</i> (foraging)	Barking Owl	V		Not recorded in the locality. Potential foraging and roosting habitat in dense midstorey along Cabramatta Creek.	Low
<i>Ixobrychus flavicollis</i>	Black Bittern	V		Low number of local records however potential breeding and foraging habitat in wetland areas as part of Cabramatta Creek and also in the mapped wetland in Jacquie Osmond Reserve.	Low
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		Absence of Box Gum Woodland and Box-Ironbark Forests and rarely recorded in the locality. Potential foraging habitat in Cumberland River-flat forest.	Very low
<i>Climacteris picumnus victorae</i>	Brown Treecreeper	V		Not recorded in the locality and likely to occur in larger undisturbed fragments of vegetation.	Very low
<i>Stagnopleura guttata</i>	Diamond Firetail	V		No local records and only broadly suitable habitat in the study area.	Very low
<i>Artamus cyanopterus</i>	Dusky Woodswallow	V		Potential breeding and foraging habitat in areas of Cumberland River-flat Forest with an open understorey in the study area. Moderate number of local records. Limited foraging habitat in planted native species in the project site.	Low
<i>Miniopterus schreibersii oceanensis</i> (foraging)	Eastern Bentwing-bat	V		Low number of records but suitable foraging habitat is present in vegetation along Cabramatta Creek and in open grassland areas.	Low
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along Cabramatta Creek.	Low
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along vegetation adjacent to Cabramatta Creek.	Low
<i>Pandion cristatus</i> (foraging)	Eastern Osprey	V		Few records in the locality and unlikely to forage within Cabramatta Creek in the study area.	Very low
<i>Petroica phoenicea</i>	Flame Robin	V		Suitable forest habitat present in Cumberland River-flat Forest. Important habitat components such as woody debris are present in the study area.	Low

Scientific name	Common name	BC Status	EPBC Status	Justification	Likelihood of impact
<i>Callocephalon fimbriatum</i> (foraging)	Gang-gang Cockatoo	V		Few local records however eucalypt open forests and woodlands with an acacia understorey are present in the study area and could be used as potential foraging habitat. Limited foraging habitat in planted native species in the project site.	Low
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along vegetation adjacent to Cabramatta Creek.	Low
<i>Pteropus poliocephalus</i> (foraging)	Grey-headed Flying-fox	V	V	Recorded foraging within Cumberland River-flat Forest in the study area. Foraging habitat in planted native species in the project site.	Low
<i>Melanodryas cucullata cucullata</i>	Hooded Robin	V		No local records and only broadly suitable habitat in the study area.	Very low
<i>Phascolarctos cinereus</i> (foraging)	Koala	V	V	Large number of local records and may forage in Cumberland River-flat Forest.	Low
<i>Miniopterus australis</i> (foraging)	Little Bentwing-bat	V		Low number of records but suitable foraging habitat is present in vegetation along Cabramatta Creek.	Low
<i>Hieraaetus morphnoides</i> (foraging)	Little Eagle	V		Large number of records and potential foraging habitat for this species in watercourse habitat within the study area. Limited foraging habitat is present in the project site.	Low
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		Large number of local records and potential foraging and breeding habitat in Cumberland River-flat Forest. One hollow-bearing tree that could comprise breeding habitat in the project site.	Low
<i>Tyto novaehollandiae</i>	Masked Owl	V		Not recorded in the locality however large hollow-bearing trees providing potential breeding habitat are present in adjacent Cumberland River-flat Forest in the study area. Potential foraging habitat is present on the edge of Cumberland River-flat Forest	Low
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Absence of Box Gum Woodland and Box-Ironbark Forests. Potential foraging habitat where mistletoes are present in the study area.	Very low
<i>Ninox strenua</i> (foraging)	Powerful Owl	V		Not recorded in the locality. Potential foraging and roosting habitat in dense midstorey along Cabramatta Creek.	Low
<i>Anthochaera phrygia</i> (foraging)	Regent Honeyeater	CE	E	Spotted Gum and Swamp Mahogany forests are absent from the study area. No local records. Limited foraging habitat in planted native species in the project site.	Very low
<i>Petroica boodang</i>	Scarlet Robin	V		Suitable forest habitat present in Cumberland River-flat Forest. Important habitat components such as woody debris are present in the study area.	Low
<i>Chthonicola sagittata</i>	Speckled Warbler	V		One local record only and likely to occur in larger undisturbed fragments of vegetation.	Very low



Scientific name	Common name	BC Status	EPBC Status	Justification	Likelihood of impact
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	Only one local record and unlikely to inhabit the study area as a relatively small area of potential habitat surrounded by urban development.	Very low
<i>Lophoictinia isura</i> (foraging)	Square-tailed Kite	V		Only one record however there is potential foraging habitat for this species in watercourse habitat within the study area. Limited foraging habitat is present in the project site.	Low
<i>Lathamus discolor</i> (foraging)	Swift Parrot	E	CE	Absence of <i>Eucalyptus robusta</i> , <i>Corymbia maculata</i> and <i>C. gummifera</i> dominated coastal forests that provide important foraging habitat.	Very low
<i>Neophema pulchella</i>	Turquoise Parrot	V		Only one local record. Potential habitat is present on the edge of Cumberland River-flat Forest and exotic vegetation in the study area. Limited foraging habitat in the project site.	Low
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		Large number of local records and potential foraging and breeding habitat in Cumberland River-flat Forest. Unlikely to occur in the project site given the absence of structural complexity.	Low
<i>Haliaeetus leucogaster</i> (foraging)	White-bellied Sea-Eagle	V		Major river systems, including the Georges River are present in the broader study area. Potential foraging habitat for this species in watercourse habitat within the study area. No foraging habitat is present in the project site.	Low
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tail-bat	V		Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along vegetation adjacent to Cabramatta Creek.	Low

Notes: V – vulnerable species; E – endangered species; CE – critically endangered species.

### 5.1.2 Species credit species

Threatened species that cannot reliably be predicted to occur on a development site based on PCT, distribution and habitat criteria are identified by the Threatened Biodiversity Data Collection as 'species credit species'. In some circumstances, the particular habitat components of species assessed for ecosystem credit species, such as the breeding habitat of a cave roosting bat or forest owls, are also assessed for species credits. The credit calculator references geographic, vegetation and habitat data for the project site to generate a list of the species credit entities predicted to occur and requiring targeted survey.

Searches of threatened species databases were also completed to determine any additional species to those generated by the credit calculator that are known or predicted to occur in the locality (refer to Appendix A). These results were reviewed giving consideration to the habitats available on site, to determine the candidate species credit species that may potentially occur at the project site. The full list of species credit species considered is presented in the threatened species assessment table in Appendix A. A number of species could be reliably discounted as occurring within the study area based on the habitat types present and/or the known distribution of the species. These species are not 'confirmed predicted species' for this assessment. Detailed justification for the conclusion is provided Appendix A.

Candidate species (i.e. species credit entities that could occur at the project site and that require targeted survey) are identified in Table 5.2. Surveys were conducted in the appropriate season for the majority of species credit-type species and so the targeted survey results can be considered a reliable indicator of their presence or absence at the project site (see Table 5.2). The field surveys included full coverage of the project site with systematic, targeted flora and fauna survey techniques. The November field survey was just outside of the nominated September-October field survey period for Little Eagle (*Hieraaetus morphnoides*) breeding habitat. The project site and surrounding area contains very few potential nest trees. If the project site contained occupied Little Eagle breeding habitat then the preceding season's nest (or candidate nests of other similar sized birds such as raptors or ravens) would have been detected in the field surveys. No nests or roosts of this type were detected in the project site and so the field surveys can be considered a reliable indicator that this species credit entity is not present. Further, Little Eagle nest trees and other threatened species entities such as threatened forest owl and cockatoo breeding habitat are more likely to occur in larger vegetated remnants away from human disturbance than in isolated remnant trees adjacent to a heavy rail corridor like those present in the project site.

No species credit entities were recorded within the project site. A Grey-headed Flying-fox (*Pteropus poliocephalus*) roost camp containing breeding individuals is located around 350 metres to the east of the project site (see Figure 5.1 and section 5.2.2).



Table 5.2 Candidate threatened species and survey time matrix

Common name	Scientific name	BC Act Status	EPBC Act Status	Predicted by Credit calculator <sup>1</sup>	BioNet records in locality <sup>2</sup>	Date of most recent BioNet record	Jan	Feb	Oct	Nov	Dec	Recorded at site ?
Bush Stone-curlew	<i>Burhinus grallarius</i>	E		Yes	3	30/08/2017	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort.
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i> (breeding)	V	C	Yes	16	15/05/2018	No	No	Yes	Yes	Yes	Not recorded despite targeted survey effort.
Little Eagle	<i>Hieraaetus morphnoides</i> (breeding)	V		Yes	28	16/02/2016	No	No	Yes	No	No	Not recorded despite targeted survey effort. <sup>1</sup>
Square-tailed Kite	<i>Lophoictinia isura</i> (breeding)	V		Yes	1	15/11/2010	Yes	No	Yes	Yes	Yes	Not recorded despite targeted survey effort.
Eastern Osprey	<i>Pandion cristatus</i> (breeding)	V		Yes	4	8/07/2014	No	No	Yes	Yes	No	Not recorded despite targeted survey effort.
Green and Golden Bell Frog	<i>Litoria aurea</i>	E	V	Yes	5	15/11/2010	Yes	Yes	No	Yes	Yes	Not recorded despite targeted survey effort.
Cumberland Plain Land Snail	<i>Meridolum corneovirens</i>	E		Yes	187	15/07/2016	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort.
Southern Myotis	<i>Myotis macropus</i>	V		Yes	28	30/08/2017	Yes	Yes	Yes	Yes	Yes	Tentatively recorded at the study area based on identification of calls to species group level (see Appendix B).
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i> (breeding)	V	V	Yes	146	6/06/2018	No	No	Yes	Yes	Yes	Not recorded in the project site despite targeted survey effort. Roost camp identified around 350 metres to the east of the project site.
Downy Wattle	<i>Acacia pubescens</i>	V	V	No	4006	25/01/2018	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort. Was recorded in the vicinity of the project site at two locations.
Netted Bottle Brush	<i>Callistemon linearifolius</i>	V		Yes	30	2/06/2014	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort.

Common name	Scientific name	BC Act Status	EPBC Act Status	Predicted by Credit calculator1	BioNet records in locality2	Date of most recent BioNet record	Jan	Feb	Oct	Nov	Dec	Recorded at site ?
<i>Marsdenia viridiflora</i> R. Br. subsp. <i>viridiflora</i> population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	EP		Yes	348	13/11/2017	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort.
Tall Knotweed	<i>Persicaria elatior</i>	V	V	Yes	n/a	n/a	Yes	Yes	No	No	Yes	Not recorded despite targeted survey effort.
Spiked Rice-flower	<i>Pimelea spicata</i>	E	E	No	415	12/11/2017	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort.
Rufous Pomaderris	<i>Pomaderris brunnea</i>	E	V	Yes	n/a	n/a	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort.
	<i>Pultenaea parviflora</i>	E	V	No	4	24/10/2017	Yes	Yes	Yes	Yes	Yes	Not recorded despite targeted survey effort.
Matted Bush-pea	<i>Pultenaea pedunculata</i>	E		No	15	2/05/2014	No	No	Yes	Yes	No	Not recorded despite targeted survey effort.

Notes: Yellow highlight denotes that a targeted survey for the species was conducted in a given calendar month. 1) survey was not recorded at an ecologically appropriate time of year to detect birds at the nest however if the project site contained occupied Little Eagle breeding habitat then the preceding season's nest (or candidate nests of other similar sized birds such as raptors or ravens) would have been detected in the field surveys. No nests or roosts of this type were detected in the project site and so the field surveys can be considered a reliable indicator that this species credit entity is not present.



## 5.2 Threatened species survey results

### 5.2.1 Threatened flora

Downy Wattle (*Acacia pubescens*) was recorded in the study area; a single stem in slashed open space in the rail corridor just north of Warwick Farm station; and a patch of six individuals in an area of exotic grassland on the outside edge of the rail corridor, south of Warwick Farm station (see Figure 5.1). *Acacia pubescens* is listed as a vulnerable species under the BC and EPBC Acts. This species is endemic to the Cumberland Plain (OEH 2018b) and is possibly a naturally occurring or regenerating population within the rail corridor in the study area. No *Acacia pubescens* were recorded in the project site and the project design, construction laydown areas and construction access routes have been purposefully selected and designed to avoid impacts to the species. No species credits calculations are required for *Acacia pubescens*.

A Narrow-leaved Black Peppermint (*Eucalyptus nicholii*) was recorded in the project site and would be removed for construction of the project. *Eucalyptus nicholii* is listed as a vulnerable species under the BC and EPBC Acts. This species naturally occurs only in the New England Tablelands from Nundle to north of Tenterfield but is widely planted as an urban street tree (OEH 2018b). The project site is well outside the species' natural distribution and the individual at the project site and other records in the locality are clearly of planted individuals of uncertain provenance and outside of natural habitat. In this context, the *Eucalyptus nicholii* at the project site has not been treated as a threatened species requiring assessment under the BAM.

The project site was traversed on foot, with no notable barriers to human movement or visibility encountered during the field survey. Field staff were able to traverse all areas of potential threatened flora habitat on foot within the project site. Given the lack of obstacles to accurate and definitive survey, the remaining candidate threatened flora species can be excluded from occurring at the project site.

### 5.2.2 Threatened fauna

Threatened fauna species that were recorded in the study area are summarised in Table 5.3. The locations of threatened fauna observations and habitat resources are shown on Figure 5.1.

The Grey-headed Flying-fox was recorded foraging within the study area and was regularly observed flying above it, including several thousand individuals seen flying from east to west of the project site after dusk each evening. The Grey-headed Flying-fox is listed as a vulnerable species under the BC and EPBC Acts. The project site contains some foraging resources for this species associated with mature fruit or blossom-bearing trees in mapped areas of planted native species and exotic vegetation. The Cabramatta Creek Grey-headed Flying-fox roost camp is located around 350 metres to the east of the project site (see Figure 5.1b). Additional assessment of this roost camp is provided in section 6.7.

It is not always possible to confidently identify microbat species based on Anabat call recordings because of short or poorer quality recordings or similarities between species. The Eastern Freetail-bat (*Mormopterus norfolkensis*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*) and Southern Myotis (*Myotis macropus*) may potentially be present at the study area based on identification of recorded calls to 'probable' or 'species group' level (see Table 5.3 and Appendix B). The study area contains aerial foraging habitat and potential roost sites for these and other microbat species in hollow bearing trees, bridges and culverts.

Table 5.3 Threatened fauna species recorded in the study area

Common name	Scientific name	Observation type	BC Act status	EPBC Act status	Credit type
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	Seen	V	V	Ecosystem (foraging) / Species (roosting)
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	Probable Anabat recording	V	Not listed	Ecosystem
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Species group Anabat recording	V	Not listed	Ecosystem
Southern Myotis	<i>Myotis macropus</i>	Species group Anabat recording	V	Not listed	Species

Notes: V – vulnerable species.

The location of the ‘probable’ Anabat recording of the Eastern Freetail-bat (*Mormopterus norfolkensis*) is shown on Figure 5.1. The locations of ‘possible’ and ‘species group’ only level call identifications are not considered positive records of a given species (DEC, 2004) and as such have not been mapped. The threatened microbat species in question have been considered in this BDAR along with other threatened biota that are considered a moderate or higher likelihood of occurring at the study area based on the outcomes of the desktop assessment and habitat assessment.

Of the three microbat species listed in Table 5.3, the Southern Myotis (*Myotis macropus*) is a species credit entity. Southern Myotis habitat requiring calculation of species credits is defined in the BAM microbat survey guide as all occupied habitat within 200 metres of a waterbody with open water stretches greater than three metres wide (OEH 2018e). There are reaches of Cabramatta Creek with open water stretches greater than three metres wide within 200 metres of the central portion of the project site. The Southern Myotis species polygon boundaries should align with PCTs at the project site with which the species is associated and that are within 200 metres of waterbodies (OEH 2018e). There are no PCTs with which the species is associated at the project site (and no other native vegetation) and so a Southern Myotis species polygon cannot be mapped according to the BAM. Prescribed impacts on the Southern Myotis (i.e. impacts that are not associated with the removal of native vegetation) are assessed in section 6.7.

There is broadly suitable habitat for each of the candidate threatened fauna species listed in Table 5.2 within the project site. Targeted field surveys were undertaken at a suitable time of year to detect these species if present at the project site, including spotlighting, call play back, and Anabat detector surveys as well as systematic targeted searches for nests, roosts or evidence of fauna occupation of habitat. These candidate threatened fauna species can be reliably discounted as occurring at the project site based on the survey effort employed, and noting the very limited extent and quality of habitat resources in the project site.

### 5.2.3 Threatened ecological communities

Cumberland River-flat Forest in the riparian corridor of Cabramatta Creek comprises a local occurrence of ‘River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions’ (River-Flat Eucalypt Forest) which is listed as an EEC under the BC Act and the subject of a preliminary listing as a critically endangered ecological community (CEEC) under the EPBC Act (see Figure 5.1). River-Flat Eucalypt Forest in the study area was identified and mapped based on:



- landscape position on stream banks and alluvial flats on a coastal floodplain and evidence of periodic inundation such as flood debris
- characteristic alluvial soils
- dominant plant species which are consistent with the species list in the Scientific Committee determination for the EEC (NSWSC, 2011a) and the equivalent PCT in the VIS (OEH, 2019c).

There is no River-Flat Eucalypt Forest within the project site. The project design, construction compounds, work sites and construction access routes have been purposefully selected and designed to avoid impacts to this ecological community.

### 5.3 Matters of National Environmental Significance

#### 5.3.1 Protected places

The protected matters search (DEE, 2018a) did not identify any World Heritage properties, National Heritage places or Wetlands of International Importance within the locality. As such, these particular MNES are not relevant to this biodiversity assessment report and are not considered further in this report.

#### 5.3.2 Migratory species

Three migratory species were predicted by the Protected Matters Search Tool (PMST) and have the potential to occur within the study area on an occasional or transient basis: the Satin Flycatcher (*Myiagra cyanoleuca*), Rufous Fantail (*Rhipidura rufifrons*) and Yellow Wagtail (*Motacilla flava*). Habitat resources for these migratory species are mainly associated with Cumberland River-flat Forest adjacent to Cabramatta Creek. They are unlikely to rely on any habitat resources associated with the planted native species and exotic vegetation in the project site.

There is no potential habitat for migratory shorebird species at the study area.

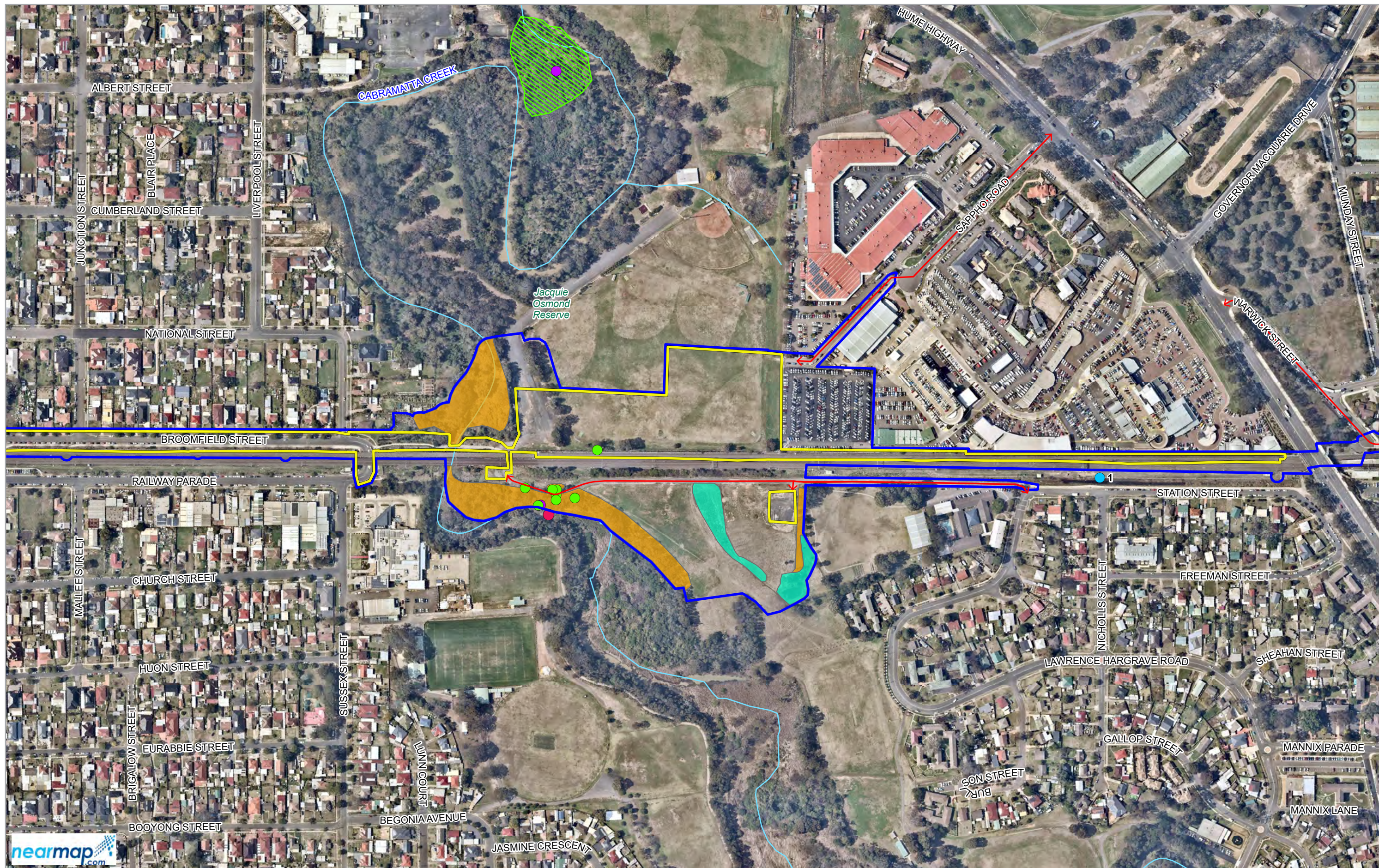
Vegetation within the project site is highly modified, fragmented and would have only limited value for migratory species listed under the EPBC Act. Habitat in the study area is not likely to support an ecologically significant proportion of the population of any of these species, be of critical importance to the species at particular life-cycle stages, is not located at the limit of any of the species' range, and/or located within an area where the species is declining. As such, potential habitat in the study area is not 'important habitat' for any of these species, as defined in DotE (2013).





Data source: NearMap: Imagery, 2018. LPI:DCDB/DTDB, 2017. Created by: tmorton



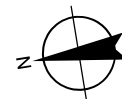


#### Legend

- ↔ Compound access route
- Project site
- Sydney Trains station
- Study area
- Freshwater Wetlands on Coastal Floodplains (EEC under the BC Act)
- River-Flat Eucalypt Forest on Coastal Floodplains (EEC under the BC Act)
- Cabramatta Creek Grey-headed Flying-fox roost camp
- *Acacia pubescens* (vulnerable species under the BC and EPBC Acts)
- Grey-headed flying fox (vulnerable species under the BC and EPBC Acts)
- Hollow-bearing tree
- Eastern Freetail-bat (vulnerable species under the BC Act)
- Watercourse

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Metres

Map Projection: Transverse Mercator  
Horizontal Datum: Australian 1966  
Grid: AGD 1966 ISG 56 1



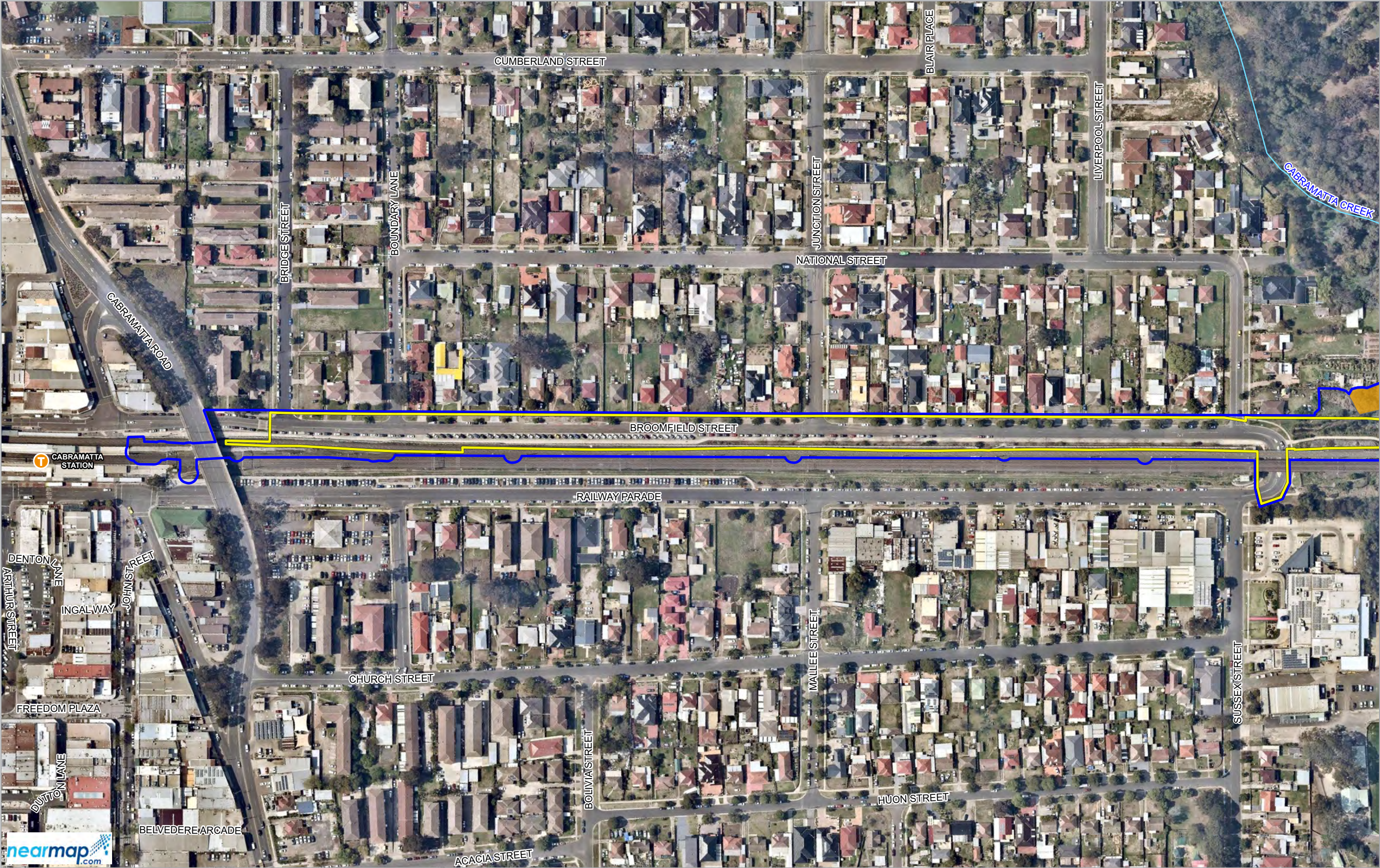
ARTC  
Cabramatta Rail Loop  
Biodiversity Assessment Report

Threatened biota and  
habitat resources

Project No. 22-19800  
Revision No. 0  
Date 17/04/2019

FIGURE 5.1b





Legend

- Compound access route
- Project site
- Sydney Trains station
- Study area
- Freshwater Wetlands on Coastal Floodplains (EEC under the BC Act)
- River-Flat Eucalypt Forest on Coastal Floodplains (EEC under the BC Act)
- Watercourse

Paper Size ISO A3  
0 10 20 30 40  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: Australian 1966  
Grid: AGD 1966 ISG 56 1

ARTC  
Cabramatta Rail Loop  
Biodiversity Assessment Report

Threatened biota and  
habitat resources

Project No. 22-19800  
Revision No. 0  
Date 17/04/2019

FIGURE 5.1c



## 5.4 Sensitivity to climate change

'Loss of climatic habitat caused by anthropogenic emissions of greenhouse gases' is listed as a key threatening process (KTP) under the EPBC act and consists of reductions in the bioclimatic range within which a given species or ecological community exists due to emissions induced by human production of greenhouse gases (DEE 2018c). Ecosystems in which the KTP occurs include: alpine habitats; coral reefs; wetlands and coastal ecosystems; polar communities; tropical forests; temperate forests; and arid and semi-arid environments (DEE 2018c). The species ecosystems which are most at risk are those which function within a limited range of climatic parameters such as tropical coral reefs or alpine environments (Steffen et. al 2009). The climate of Western Sydney includes pronounced seasonal and multi-annual variability in temperature and especially rainfall. It is widely accepted that the ecological communities associated with *Eucalyptus* woodlands of south eastern Australia are tolerant to this variability, such as Cumberland River-flat Forest which is present in the study area. This indicates some resilience to projected climatic changes, due to the ability to tolerate a broad range of current weather fluctuations.

Human-induced climate change is projected to impact the study area such that the future climate will be broadly hotter and drier, with more frequent hot days, warm spells and extreme weather events (CSIRO BOM 2015). Rainfall projections are typically less confident, but it is projected that the climate of the project site and study area will experience a decrease in rainfall and corresponding decrease in soil moisture (CSIRO BOM 2015). As there is no native vegetation in the project site (see section 4.1) there are no climate change impacts identified for native vegetation which are able to be mitigated or managed by the project in its construction or operations.

However, climate change trends have the potential to impact native vegetation and biodiversity values in the wider study area, and to impact threatened fauna species in a number of ways. Climate change threats posed to threatened species in the Liverpool and Fairfield LGAs as identified by the OEH *NSW Threatened Species & Communities* search tool are identified in Table 5.4 below, with all search results provided excluding those relating to migratory shorebird species previously identified as not applicable for this project. These impacts demonstrate that loss of habitat and food availability are influenced by climate change, making the retention of habitat and foraging resources more important when considered in the context of climate change.



Table 5.4 Climate change threats to threatened species

Climate change threat	Species potentially impacted	Applicable LGA
Altered hydrology (reduced flows)	Australasian Bittern <i>Botaurus poiciloptilus</i>	Liverpool, Fairfield
Changes to precipitation (drought)	Regent Honeyeater <i>Anthochaera phrygia</i>	Liverpool, Fairfield
Changes to precipitation (reduced)	Australasian Bittern <i>Botaurus poiciloptilus</i>	Liverpool, Fairfield
Extreme weather events (increased frequency and duration of drought)	White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	Liverpool, Fairfield
Food availability (reduced due to drought)	Regent Honeyeater <i>Anthochaera phrygia</i>	Liverpool, Fairfield
Reduction in extent of preferred habitat (habitat loss)	Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	Liverpool, Fairfield
Sea-level rise (inundation of low lying coastal areas)	White-bellied Sea-eagle <i>Haliaeetus leucogaster</i>	Liverpool, Fairfield
Unfavourable vegetation changes	Gang-gang Cockatoo <i>Callocephalon fimbriatum</i>	Liverpool, Fairfield

Additional searches of climate change impacts to the threatened communities and species observed at the project site or the broader study area were performed using the *NSW Threatened Species & Communities* tool. This indicated that Cumberland River-flat Forest (PCT835) in the study area is likely to be impacted by the climate change threat of altered hydrology and flooding regimes (OEH Macquarie University 2019). Similarly, Coastal Freshwater Wetland (PCT1071) in the study area is likely to be impacted by climate change threats of altered hydrology and flooding regimes and sea level rise. The design of the project site will not influence these risks from climate change to either community, as the project design mitigates flooding impacts for nearby infrastructure but will not impact the hydrology of these plant communities in the study area.

Climate change is recognised as a threat, priority unknown, in the recovery plan for the Grey-headed Flying-fox due to the potential for changes in the distribution or reproduction of some *Eucalyptus* food tree species or the increased occurrence of extremely high temperatures (DECCW 2009). No climate change threats have been determined for *Acacia pubescens* (OEH Macquarie University 2019).

The biodiversity values of the broader study area may be impacted by changes to exotic species distribution and extent as a result of increasing habitat suitability for some exotic species in the Liverpool and Fairfield LGAs as a result of climate change (Duursma et al. 2013). As the project site is entirely cleared land, exotic vegetation or planted native species, the existing environment already includes a large proportion of exotic species and highly modified vegetation (see section 4.1.2). Therefore, development of the project site will promote the removal of weeds and revegetation, and therefore mitigate the potential risk of weed expansion to the surrounding study area which has the potential to be exacerbated by climate change.



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## 6. Impact assessment

### 6.1 Introduction

The project has adopted the following 'avoid, minimise and offset' approach to mitigate impacts to biodiversity values in accordance with the BAM, the BC Act and associated policy. In line with this approach, a project should in order of consideration, endeavour to:

- avoid impacts on habitat, through the project planning and design process
- minimise impacts on habitat, through the use of a range of environmental management and impact mitigation measures
- offset any residual impact that could not be avoided or mitigated.

There would be no direct impact on native vegetation within the project site. The project would result in direct impacts on some native plant and animal species and their habitats within the project site. There is also the potential for indirect impacts on retained areas of native vegetation adjacent to the project site, both during construction and from the resulting operation of the project.

### 6.2 Avoidance of impacts

A significant portion of the project site is located within the existing rail corridor, which has been cleared and substantially modified through earthworks and construction. The project's impacts are substantially less than would be associated with an undisturbed 'green field' site. The project has been purposefully designed to avoid or further reduce impacts on biodiversity values as far as is practicable. The existing rail corridor contains primarily cleared land and exotic vegetation which have low biodiversity value.

The study area contains some features with biodiversity value, including around seven stems of *Acacia pubescens*. The proponent recognises the value of this threatened plant population and has designed the project to avoid direct impacts on any *Acacia pubescens*. No *Acacia pubescens* is anticipated to be removed or otherwise directly affected by the project (see Figure 5.1a).

There is an occurrence of the EEC River-flat Eucalypt Forest in the study area. The project site has been purposefully designed to avoid any vegetation removal in the area of occupancy of this ecological community (see Figure 5.1b). Notably, options for the realignment of the shared path over Cabramatta Creek during construction would have required the removal of River-flat Eucalypt Forest. The project site and construction methods were carefully developed in this area to ensure that the disturbance footprint was entirely limited to cleared land or non-native vegetation. This included: limiting the size of the work area for bridge installation to maximise the length of the current shared path that could be used throughout construction; and placement of temporary sections of shared path through areas of non-native vegetation.

There is no native vegetation in the project site. Construction of the project would remove 3.0 hectares of exotic vegetation and 0.5 hectares of planted native species within an overall disturbance footprint of 6.9 hectares. Much of the project site (3.4 hectares) is cleared land, comprising existing rail infrastructure, concrete paths, bitumen roads and other infrastructure.

The most sensitive portion of the study area with respect to potential impacts on biodiversity values is the proposed construction of the Cabramatta Creek bridge (adjacent to the existing bridge) and associated construction access, crane pads and temporary shared path. This



portion of the project would be constructed as follows to ensure that impacts to biodiversity values are avoided:

- Diverting the shared pathway around the perimeter of the works to a temporary shared path that would be constructed only through non-native vegetation. This would include continuous use of the existing shared path bridge over Cabramatta Creek to avoid impacts associated with construction of a temporary creek crossing.
- Constructing access ramps to the bridge work areas for the piling rigs and cranes, a crane pad at the north western corner of the proposed bridge location and boring piles - no works would be undertaken within the creek bed or in any native vegetation.
- Constructing pile caps to join between the piles, erecting pre-cast piers, installing the headstock and bearings and installing girders by crane during possession periods – as above, no works would be undertaken within the creek bed or in any native vegetation.
- Reinstating the shared pathway along its original alignment.

The project would have limited impacts on aquatic habitats. The design of the new bridge over Cabramatta Creek would match the pier arrangement of the existing bridge to minimise hydraulic impacts on flow along the creek, and associated potential for biodiversity impacts. There would be no earthworks or other direct disturbance within the main channel. Existing flow widths would be maintained. The proposed bridge design would minimise the footprint of the project in this area. The proposed bridge would partially interrupt flow during high flow events (i.e periods when water is flowing outside and above the main channel) however this interruption to flow would be in line with the existing bridge pylons and would comprise a very minor impact in the context of the existing degree of modification of the catchment.

Cabramatta Creek is mapped as Key Fish Habitat (DPI, 2007) there is limited instream vegetation at the location where the project site crosses the rail corridor. As described in section 4.1, the channel floor and banks of Cabramatta Creek where it intersects the project site has been mapped as non-native vegetation because this reach of the creek is confined by concrete or gabions and has a gravel or concrete bed. This is not representative of natural reaches of Cabramatta Creek nor of the EEC River-flat Eucalypt Forest. There would be no direct impacts on aquatic habitat or fish passage at this location. No threatened species listed under the FM Act have potential habitat in Cabramatta Creek (refer to section 4.2.2). Impacts on aquatic habitats have been generally avoided. Drainage measures to be implemented as part of project are predicted to provide effective mitigation of major flood impacts, and water quality impacts would be managed through implementation of water sensitive urban design measures. Further consideration of proposed changes against the design criteria would be undertaken at all stages of design to ensure that flooding, drainage and water quality impacts for a range of flood events would be managed and minimised (refer to Technical Paper 8 – Hydrology, flooding and water quality assessment).

There would be some ancillary works undertaken outside of the defined project site. These include signalling works and utility relocation/protection works. These works would be undertaken within the rail corridor and would affect only cleared land or exotic vegetation within this highly modified environment. The final location and design of the ancillary works would consider and avoid impacts to any areas of native vegetation or other biodiversity values as shown on Figure 4.1 and Figure 5.1, including specific avoidance of the *Acacia pubescens* identified in the rail corridor. The construction and environmental control measures proposed to mitigate impacts identified in section 6.3 are considered sufficient to manage any potential indirect impacts of the signalling works within the rail corridor (as per the indicative locations provided within the EIS) or utility/relocation works within the study area.



## 6.3 Minimisation of impacts

### 6.3.1 Construction phase

In order to address the potential impacts of the project on biodiversity values, the recommended mitigation measures outlined in Table 6.1 would be implemented. In accordance with 3.2(e) of the Secretary's Environmental Assessment Requirements, Table 6.1 details how likely impacts that have not been avoided through design will be minimised, and the predicted effectiveness of these measures.



Table 6.1 Recommended mitigation measures

Impact	Mitigation	Predicted effectiveness <sup>1</sup>
General	<ul style="list-style-type: none"> <li>• Ensure all workers are provided with an environmental induction prior to starting work in the project site. This will include information on the ecological values of the study area, protection measures to be implemented to protect biodiversity and penalties for breaches.</li> <li>• Include the flora and fauna management actions listed below as part of the Construction Environmental Management Plan (CEMP).</li> </ul>	<ul style="list-style-type: none"> <li>• Medium – communication of environmental values and responsibilities to construction staff is likely to ensure that mitigation measures are implemented. Measures will meet best practice for management of construction projects.</li> <li>• Medium – the CEMP will be prepared by a qualified and experienced professional.</li> </ul>
Vegetation clearing	<ul style="list-style-type: none"> <li>• Avoid impacts to <i>A. pubescens</i>. The locations of <i>Acacia pubescens</i> will be marked on plans, outlined in the CEMP, fenced on site, and avoided. Signage will be placed on relevant fencing to inform of prohibited activities in that area as part of the works.</li> <li>• Limit the disturbance of vegetation to the minimum necessary to construct works. Micrositing of infrastructure will be undertaken during detailed design where practicable to minimise or avoid impacts on planted native species.</li> <li>• Where the project site adjoins native vegetation, the limits of clearing will be clearly marked. Temporary fencing will be installed around the vegetated area prior to the commencement of construction activities to avoid unnecessary vegetation and habitat removal.</li> <li>• No equipment storage or stockpiling will be undertaken outside areas identified as compound sites or work sites on cleared land.</li> <li>• The design and placement of any associated ancillary works such as utilities or signalling outside of the project site will avoid impacts to <i>Acacia pubescens</i>. These works will affect only cleared land or exotic vegetation.</li> </ul>	<ul style="list-style-type: none"> <li>• High – locations of <i>A. pubescens</i> have been mapped and the project design refined to exclude these stems from the project site. The need to avoid impacts will be communicated to all construction staff.</li> <li>• High – exclusion areas will be established and maintained around native vegetation adjoining the project site. Measures will meet best practice management of flora and fauna on construction projects.</li> </ul>
Weeds	<ul style="list-style-type: none"> <li>• Weed management actions will be included in the CEMP to manage weeds in accordance with the NSW Weed Control Handbook (DPI, 2018). This will include the management and disposal of the weeds that were recorded within the project site including priority weeds in accordance with the biosecurity duties under the <i>Biosecurity Act 2015</i>.</li> <li>• Ensure vehicles are considered clean of seed and plant material prior to entering the work site to prevent the introduction of further exotic plant species or disease. This will include the use of vehicle</li> </ul>	<ul style="list-style-type: none"> <li>• High - measures will meet best practice management of flora and fauna on construction projects. Existing road access to the project site, gentle terrain and tracks will allow relatively easy management of weed infestations. There is minimal native vegetation adjoining the project site.</li> </ul>

Impact	Mitigation	Predicted effectiveness <sup>1</sup>
	wash bays or portable vehicle wash equipment such as high pressure wash units, shovels, crow bars or stiff brushes.	
Fauna habitat	<ul style="list-style-type: none"> <li>The CEMP will include the locations of potential roost sites as identified in this report (eg. hollow-bearing trees, disused buildings, bridges and culverts). The CEMP will include measures to manage potential impacts to roost sites such as:               <ul style="list-style-type: none"> <li>Any potential roost sites that will be removed or modified will be checked for roosting bats immediately prior to work.</li> <li>Culverts are to remain open on at least one side at all times to allow any roosting bats to fly in or out.</li> <li>Habitat to be identified for the release of mibrobats or any fauna encountered during clearing surveys</li> <li>Habitat trees will be felled using equipment that allows the trees to be lowered wo the ground with minimal impact (eg claw extension)</li> <li>Animals that emerge from felled trees will be captured, inspected for injury, then relocated to pre-determined habitat identified for fauna release.</li> </ul> </li> </ul> <p>Where the presence or potential presence of roosting bats is noted then management actions for managing bats will be implemented in accordance with the CEMP.</p> <ul style="list-style-type: none"> <li>An unexpected finds procedure will be developed specifying measures for the management of any threatened biota or habitat resources identified during construction. The unexpected finds procedure will include the requirement for work to stop immediately if any threatened fauna is encountered and the Construction Environmental Manager to be notified. Work will recommence only once relevant approvals have been obtained as required. The species will be included in subsequent toolbox talks.</li> <li>Protocols to prevent introduction or spread of chytrid fungus will be implemented following OEH Hygiene protocol for the control of disease in frogs (DECC, 2008b).</li> <li>A suitably qualified person will be present during the removal of potential fauna habitat (i.e. the hollow-bearing tree in Jacqui Osmond Reserve and areas of planted native species) to avoid impacts on resident fauna and to salvage habitat resources as far as is practicable. Clearing surveys should include:</li> </ul>	<ul style="list-style-type: none"> <li>High - measures will meet best practice management of flora and fauna on construction projects. There is no native vegetation and limited habitat resources present within the project site.</li> </ul>



Impact	Mitigation	Predicted effectiveness <sup>1</sup>
	<ul style="list-style-type: none"> <li>– inspections of vegetation for resident fauna and/or nests or other signs of fauna occupancy</li> <li>– capture and relocation or captive rearing of less mobile fauna (such as nestling birds) by a trained fauna handler and with assistance from Wildlife Information Rescue and Education Service (WIRES) as required</li> <li>– inspection and identification/marketing of hollow-bearing trees or other habitat resources adjacent to the project site to help ensure against accidental impacts</li> <li>– salvage of habitat features such as mature tree trunks and woody debris within the project site and placement within revegetation areas as far as is practicable (e.g. if vegetated areas are not separated by fences).</li> </ul>	
Water Quality	<ul style="list-style-type: none"> <li>• Erosion and sediment control measures will be prepared in accordance with Volume 2D of Managing Urban Stormwater: Soils and Construction (DECC, 2008c). The erosion and sediment control measures would be established prior to the commencement of construction and be updated and managed throughout as relevant to the activities during the construction phase.</li> <li>• Erosion and sediment control measures will be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality.</li> <li>• Stabilised surfaces will be reinstated as quickly as practicable after construction.</li> <li>• All stockpiled material will be kept away from waterways and/or isolated by control measures to avoid sediment entering the waterway.</li> <li>• Water will be applied to exposed surfaces that are causing dust generation. Surfaces may include unpaved roads, stockpiles, hardstand areas and other exposed surfaces (for example recently graded areas).</li> <li>• Vehicles will follow appropriate speeds to limit dust generation.</li> </ul>	<ul style="list-style-type: none"> <li>• High - measures will meet best practice management of water quality on construction projects. Sensitive receptors for impacts are limited in extent and quality.</li> </ul>

Notes: <sup>1</sup> Medium- predicted effectiveness of risk based on administrative mitigation measures which minimise but may not entirely eliminate the risk.  
High- predicted effectiveness of risk based on physical mitigation measures which would largely eliminate the risk.

### 6.3.2 Operation phase

The project would have a minor increase in existing impacts on native biodiversity values during operation through a slight increase in the frequency and duration of train movements through the project site. Little mitigation of the project is therefore likely to be required for biodiversity during this phase. Weeds that are present in the rail corridor would continue to be managed as per the recommendations in Table 6.1.

There are likely to be opportunities to enhance ecological features and values in the study area after the construction phase of the project. Revegetation is proposed to achieve a functional natural ecosystem in areas that are temporarily disturbed for the project such as construction laydown areas and the temporary shared use path in Jacquie Osmond reserve. This would be the subject of an agreement between ARTC and Fairfield City Council and explored through the ongoing stakeholder management and community engagement process outlined in Section 2.3. Suitable areas of cleared land and exotic vegetation will be cleared of exotic plants as required and then revegetated with an appropriate mix of indigenous native plants of local provenance. A revegetation plan will be developed in consultation with Council and other stakeholders.

## 6.4 Residual impacts

### 6.4.1 Construction phase

#### **Direct impacts**

#### **Clearing of vegetation**

Construction and operation of the project within the project site would result in direct impacts on 3.5 ha of non-native vegetation as summarised in Table 6.2 and shown on Figure 6.1. This vegetation has low biodiversity value given its context and habitat value for threatened species. The impacts on this vegetation are associated with clearing for the new rail track and associated infrastructure and for construction compounds and laydown areas. Residual direct impacts would be restricted to the project site. Construction access would be via existing formed roads. The project site is shown along with vegetation on Figure 4.1 and with threatened biota and habitat resources on Figure 5.1.

The clearing of non- native vegetation would involve the removal of some individual native plants, including mature planted street trees and trees in parkland. Mature trees have particular value within plant populations because they take longer to replace and are sources of pollen and seed. The project would remove a small proportion of individual plant species and associated habitat resources compared to the extent of both species and resources in the surrounding area.



Table 6.2 Extent of residual impacts in the project site

Vegetation type	PCT/NSW Veg. Type ID (OEH, 2016c)	Condition	Area within project site (ha)
Planted native species	n/a	Non-native vegetation	0.5
Exotic vegetation	n/a	Non-native vegetation	3.0
<b>Total area of vegetation</b>			<b>3.5</b>
Cleared land	n/a	Cleared land	3.4
<b>Total direct impact</b>			<b>6.9</b>

### Removal of habitat and habitat resources

Construction of the project would remove a very small area of fauna habitat, as most of the project site is already cleared land. The vegetation that would be removed or modified would have little value for native fauna species given its structure, condition and proximity to the heavy rail corridor.

There is one hollow-bearing tree in the project site (see Figure 5.1b). This hollow-bearing tree is within the disturbance footprint for the proposed retaining wall between the new rail track and sports fields in Jacquie Osmond Reserve. This is an essential element of the project design at this location and so there was no potential to avoid impacts to this habitat resource. Given its context and surrounding land uses this hollow-bearing tree is highly unlikely to be occupied by a threatened species of owl, parrot or microbat. Individuals of these threatened species are more likely to roost or nest in larger patches of vegetation away from human disturbance than in an isolated tree adjacent to a heavy rail corridor.

Other fauna habitat resources that would be removed include foraging and shelter resources for widespread and generalist native fauna typical of urban environments. It is highly unlikely that any threatened species or any fauna populations would rely on the habitat resources within the project site for their survival. Removal of fauna habitat resources would include:

- up to 0.5 hectares of planted native species which would provide foraging habitat for the threatened Grey-headed Flying-fox, Eastern False Pipistrelle, Southern Myotis and other threatened fauna species with known or potential habitat in the study area (comprised entirely of planted native species).
- up to 3.0 hectares of exotic vegetation, including both grassland and forest and scrub structural forms, which provides nesting and foraging habitat for small birds, as well as shelter and foraging habitat for reptiles and frogs. Impacts associated with removal of vegetation for construction compounds and laydown areas would be temporary. These areas would be revegetated as appropriate to their future land use and would have similar habitat value to their current state in the longer term.
- an additional 3.4 hectares of shelter substrate for small ground dwelling fauna such as reptiles and frogs and foraging substrate for generalist birds of open country associated with woody debris, railway ballast etc in cleared land.

### Fauna injury and mortality

As described above, the project site provides limited habitat resources for native fauna species and these resources are more likely to be utilised by common and widespread species of urban environments. Some individual possums or native birds may nest or shelter in vegetation within the rail corridor. Groundcover vegetation, leaf litter and woody debris would provide shelter and foraging substrate for reptiles, frogs and invertebrates. Construction may result in the injury or mortality of some individuals of these less mobile fauna species and other small terrestrial fauna that may be occupying habitat within the project site during clearing or construction activities.

Small lizards and frogs can occur throughout the 3.5 hectares of non-native vegetation and potentially also in up to 3.0 hectares of cleared land (noting that much of this land contains railway ballast, gravel and other shelter substrate). This habitat would have significantly lower value to fauna populations than an equivalent area of native vegetation and would contain much lower species richness and abundance of native fauna.

As described above, there is one hollow-bearing tree in the project site. Given its context and surrounding land uses this hollow-bearing tree is highly unlikely to be occupied by a threatened species of owl, parrot or microbat. Pre clearing surveys and least-impact tree felling procedures supervised by a qualified spotter catcher would be implemented in order to minimise the risk of impact to any resident fauna (see Table 6.1).

The potential injury or mortality of individuals within a maximum of 6.9 hectares of poor quality habitat is highly unlikely to affect an ecologically significant proportion of any local populations. More mobile native fauna such as native birds, bats, terrestrial and arboreal mammals that may be sheltering in vegetation in the project site are likely to evade injury during construction activities. Displaced individuals may however suffer stress, increased energy costs relating to foraging over a wider area or increased risk of predation.

The mitigation measures outlined in section 6.3 would help minimise the risk of vegetation clearing activities resulting in the injury or mortality of resident fauna.

#### **Fragmentation or isolation of habitat**

The project would not create any significant or new barriers to the movement of native biota.

Impacts resulting from the construction of the project would increase gaps in habitat within the landscape by removing planted native species and exotic vegetation along the edge of a large patch of intact native vegetation in the Cabramatta Creek riparian corridor. This impact would continue through the operational life of the project due to the increased width of the rail corridor. This would comprise a very minor impact on the degree of habitat fragmentation in the local area given the limited extent and quality of habitat to be removed and because the project site is parallel to an existing significant barrier to fauna movement associated with the rail corridor and associated fencing. The design of the new bridge over Cabramatta Creek (adjacent to the existing bridge) would match the pier arrangement of the existing bridge to minimise hydraulic impacts on flow along the creek, and would maintain habitat connectivity under the bridge.

The remainder of the project site adjoins cleared and developed land that would not have any value as a fauna movement corridor.

#### **Indirect impacts**

##### **Weed invasion and edge effects**

'Edge effects' can include increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators. Edge effects would result from construction activities through a slight expansion in the extent of cleared land in the study area and then continue to affect vegetation and habitats adjoining the project site.

Vegetation adjoining the project site is in medium condition, comprising remnant native vegetation with severe weed infestation around disturbed edges and tracks and moderate weed infestation throughout. This pattern is typical of Cumberland River-flat Forest with floodwaters



periodically spreading weed propagules and high soil fertility and soil moisture generally conducive to the growth of exotic plant species (pers. obs.). In this context, there is only a moderate risk of construction activities increasing the degree of weed infestation in adjoining vegetation and a negligible risk of any new weeds being introduced. Management measures including the development of a weed management sub-plan as part of the project CEMP would be implemented to mitigate potential impacts (refer to Table 6.1). Other relevant mitigation measures to reduce the impacts of edge effects include dust suppression and erosion and sediment measures during construction.

### Introduction and spread of weeds, pests and pathogens

Disturbance associated with vegetation clearing, vehicle traffic and general day to day operations of the project during construction increase the potential for the spread, introduction and establishment of weed and pest species, and diseases and pathogens.

Weed species are effective competitors for food and habitat resources and have the potential to exclude native species and modify the composition and structure of vegetation communities.

Construction activities within the project site may, in general, have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangellii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into adjacent native vegetation through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus may harm frog populations once introduced into an area.

Diseases and pathogens can be introduced or spread to site via dirt or organic material attached to machinery, vehicles, equipment and employees. The potential for significant or new impacts associated with these pathogens is relatively low, given the suburban context and extent of human visitation across the project site. To help mitigate the risk of pathogens being brought onto and/or spread through the study area:

- all machinery brought to site will be washed down and inspected to be free of soils, seeds and other organic material in accordance with section 6.3.1.
- vehicles and personnel will be entirely restricted to the project site and construction access routes and outside of native vegetation.

### Noise and light impacts on fauna

Construction noise would be temporary and the majority of works confined to daylight hours. There would be a minor and short term increase above existing background levels from activities such as installation of concrete piles. The majority of construction activities would not generate noise that is above current background levels associated with the rail corridor. Fauna occupying the study area would be habituated to background noise, including noise associated with the rail corridor. The generation of construction noise is unlikely to reduce the value of habitat in the study area or otherwise significantly affect any fauna species that occur in the study area. Additional assessment of potential noise and light impacts on the Cabramatta Creek Grey-headed Flying-fox roost camp is provided in section 6.7.

Construction activities would not substantially increase the extent or intensity of artificial lighting above current background artificial light levels associated with the rail corridor, pedestrian and bike track across Cabramatta Creek, street lighting and sports fields in Jacquie Osmond reserve. Artificial lighting is unlikely to reduce the value of habitat in the study area or otherwise significantly affect any fauna species that occur in the study area.

### **Aquatic disturbance and impacts on fish habitat**

The potential introduction of pollutants such as vehicle fuel or mobilised sediments from the project into the surrounding environment, if uncontrolled, could potentially impact on water quality further downstream. There is minor potential for water quality impacts on Cabramatta Creek within the project site or reaches downstream. Potential water quality impacts would be managed through the implementation of mitigation measures, including the provision of sedimentation basins, silt fences and other structures to intercept runoff (refer to Table 6.1).

No endangered aquatic communities, aquatic fauna or marine vegetation listed under the FM Act or EPBC Act occur in the project site and no significant impacts on riparian vegetation or habitats downstream of the project site are anticipated as a result of the project. As described in section 6.2, construction work methods have been prescribed that would ensure that there are no direct impacts to the creek bed or to aquatic habitat. There would be minor, if any impacts on Key Fish Habitat in Cabramatta Creek as a result of the project.

#### **6.4.2 Operation phase**

### **Overview of operational impacts**

Impacts on biodiversity values would be largely restricted to the construction phase of the project. Some potential impacts that would occur as a result of the operation of the project include:

- generation of additional light and noise
- erosion and sedimentation as a result of runoff from hard stand areas
- introduction of weed propagules by vehicles or maintenance staff
- overshadowing of vegetation by noise walls
- fauna mortality as a result of collision with trains.

### **Impacts on flora species**

The project site is located within or immediately adjoining the existing rail corridor which is dominated by infrastructure and highly modified environments. Each of the potential operational impacts listed above would already be occurring in the project site and affecting the surrounding study area. Vegetation adjoining the project site is already subject to weed infestation and other edge effects.

### **Impacts on fauna species**

Fauna that occupy habitats within the project area and adjacent areas are likely to be accustomed to existing noise originating from trains, road traffic and the urban environment. Additional train movements are unlikely to significantly increase the risk of collisions above current levels, given the highly modified habitats present. In this context, the project is likely to comprise only a minor increase in any of these potential negative effects. The project is unlikely to increase the extent, duration or magnitude of any of these impacts to the extent that would result in a significant negative effect on biodiversity values.

The potential for these operational impacts can be further minimised through the implementation of appropriate mitigation measures as outlined in section 6.3.2.

### **Aquatic disturbance and impacts on fish habitat**

The design of the new bridge over Cabramatta Creek would match the pier arrangement of the existing bridge to minimise hydraulic impacts on flow along the creek, and would maintain habitat connectivity under the bridge. As described in section 6.2, construction work methods



have been prescribed that would ensure that there are no direct impacts to the creek bed or to aquatic habitat. There would be minor, if any impacts on Key Fish Habitat in Cabramatta Creek as a result of the project.

## 6.5 Key threatening processes

A KTP is as an action, activity or project that:

- adversely affects two or more threatened species, populations or ecological communities
- could cause species, populations or ecological communities that are not currently threatened to become threatened.

KTPs listed under the BC Act, FM Act and/or EPBC Act relevant to this project are listed in Table 6.3 below.

Construction of the project will increase the operation of the KTPs 'loss of hollow-bearing trees', 'removal of dead wood and dead trees', and 'human-induced climate change'. The latter KTP will continue to occur under operation of the project.

The project design and purposeful measures to avoid or minimise impacts have ensured that the project would not increase the operation of the KTPs 'clearing of native vegetation', 'alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands, or 'the degradation of native riparian vegetation along NSW water courses'.

Mitigation measures to limit the impacts of these KTPs (where possible) are discussed in section 6.3.

Table 6.3 Key threatening process

KTP	Status	Comment
Loss of hollow-bearing trees	BC Act	The project would remove one hollow bearing tree (see Figure 5.1b). As a single tree, in an area of planted native species surrounded by exotic grassland and immediately adjacent to the existing rail corridor this would comprise a very minor increase in the operation of this KTP.
Removal of dead wood and dead trees	BC Act	The project site contains very little fallen timber. The project may result in the removal or disturbance of small amounts of woody debris, during construction of the project. The implementation of habitat management procedures is recommended to limit impacts on fauna and their habitats and to at least partially maintain the value of these resources by reinstating woody debris in revegetation areas (see section 6.3.2).

KTP	Status	Comment
Human-caused climate change	BC Act EPBC Act	Combustion of fuels associated with construction and operation of the project would contribute to anthropogenic emissions of greenhouse gases. The project does not pass through any areas mapped as coastal corridors for climate change that provide for the latitudinal movement of species. The increase in greenhouse gases as a result of the project may impact climatic habitat elsewhere in NSW over the long-term. This contribution is likely to be minor in the context of regional and global anthropogenic emissions of greenhouse gases.
Clearing of native vegetation	BC Act EPBC Act	The project does not include the clearing of any native vegetation. Concept design of the project has ensured that there is no native vegetation within the project site (see Figure 6.1 and section 6.2).
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	BC Act	The design of the new bridge over Cabramatta Creek would match the pier arrangement of the existing bridge to minimise hydraulic impacts on flow along the creek, and would maintain habitat connectivity under the bridge. Construction work methods have been prescribed that would ensure that there are no direct impacts to the creek bed or to aquatic habitat (see section 6.2).
The degradation of native riparian vegetation along NSW water courses	BC Act	As described above, the project does not include the clearing of any native vegetation, including riparian vegetation.

## 6.6 Assessment of serious and irreversible impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles set up in section 6.7 of the BC Regulation.

The principles are aimed at capturing impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales. A set of criteria have been developed and are included in the *OEH Guidelines to assist a decision-maker to determine a SAIL* (OEH 2017c). Threatened biota that meet the criteria under one or more of the above principles have been identified as SAIL entities and are listed in the fore mentioned document. Each potential SAIL entity has an impact threshold identified which can be used to help determine if a development will result in SAIL.

There are no SAIL entities at the project site or likely to be affected by the project.

## 6.7 Impacts on the Cabramatta Creek Grey-headed Flying-fox roost camp

### 6.7.1 Background

The Grey-headed Flying-fox is listed as a vulnerable species under the EPBC Act and the BC Act. The Grey-headed Flying-fox is a large, nomadic fruit and blossom-feeding bat. It occupies forests and woodlands in the coastal lowlands, tablelands and slopes of southeast Australia.



The Grey-headed Flying-fox is a highly mobile, nomadic species that relies on food sources with largely irregular patterns of productivity. When assessed at a local scale, the species is generally present intermittently and irregularly however broad trends in the distribution of plants with similar flowering and fruiting times coincide with annual cycles of movement and habitat use that are apparent at regional scales (DECCW, 2009).

The species is colonial and roosts in large aggregations in the exposed branches of canopy trees (camps). When the camps are undisturbed their locations are generally stable through time and several camps have been known to persist for over 100 years. Camp size fluctuates, and many camps may be empty for extended periods. Camps provide resting habitat, sites of social interactions and refuge for animals during significant phases of their annual cycle, such as birth, lactation and conception (DECCW, 2009).

The Cabramatta Creek Grey-headed Flying-fox roost camp is located around 350 metres to the east of the project site and was identified as requiring specific consideration in the project SEARs with a particular focus on potential effects of noise and lighting (see Table 1.1 and Table 1.2). The Grey-headed Flying-fox was recorded foraging within the study area and was regularly observed flying above it, including several thousand individuals seen flying from east to west of the project site after dusk each evening. The project site contains some foraging resources for this species associated with mature fruit or blossom-bearing trees in mapped areas of planted native species and exotic vegetation.

The Cabramatta Creek Grey-headed Flying-fox roost camp is roosting habitat which is critical to the survival of the species as identified in the recovery plan for the species (DECCW, 2009) based on the following criteria:

- it is used as a camp either continuously or seasonally in > 50% of years
- it has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 10 000 individuals
- it has been used as a camp at least once in 10 years (beginning in 1995) and is known to have contained > 2 500 individuals, including reproductive females during the final stages of pregnancy, during lactation, or during the period of conception (i.e. September to May) (ANU, undated).

The study area, including the roost camp site was extensively cleared for agriculture as indicated by an aerial photo from 1930 (ANU, undated). It is understood that fruit, vegetables and grapes were grown on the rich alluvial soils of the Cabramatta site from the early settlement of Sydney - until about 1950 when cultivation was abandoned. Vegetation started growing back once cultivation was abandoned, including some native species but predominantly noxious and environmental weeds. By 1988, canopy cover had regenerated and a roost camp had become established. By 1995 groups of over 20,000 animals had started using the Cabramatta Creek Grey-headed Flying-fox roost camp (ANU, undated).

The current location and approximate extent of the Cabramatta Creek Grey-headed Flying-fox roost camp was confirmed by GHD ecologists during the November 2018 field surveys and is shown on Figure 5.1b. The camp is located around 500 metres to the east of the rail corridor and around 350 metres to the northeast of the outer edge of the project site (see Figure 5.1b).

The camp is located in an area of dense Broad-leaved Privet scrub with occasional emergent Swamp Oak (*Casuarina glauca*), Forest Red Gum (*Eucalyptus tereticornis*) and stags. No attempt was made to estimate the current population of the camp given health, safety and environmental constraints, including the risk of disturbing resident flying foxes. Several hundred individuals were observed in an approximately 300 metre squared area of vegetation visible from the north-western edge of the camp. Based on this density, the approximate area of

occupancy and the number of individuals observed flying overhead at nightfall it is assumed that there are at least 10,000 individuals in the camp as previously reported

#### 6.7.2 Avoidance of impacts

A significant portion of the project site is located within the existing rail corridor. The project's impacts are substantially less than would be associated with an undisturbed 'green field' site. As described in section 6.2 the project has been purposefully designed to avoid or further reduce impacts on biodiversity values as far as is practicable. There is no native vegetation in the project site. Given the distance of the Cabramatta Creek Grey-headed Flying-fox roost camp from the project site (500 metres to the east of the rail corridor and around 350 metres to the northeast of the outer edge of temporary construction site) no particular measures to further avoid impacts to the roost camp or foraging habitat for the species are required.

#### 6.7.3 Minimisation of impacts

In order to address the potential impacts of the project on biodiversity values, the mitigation measures outlined in Table 6.1 would be implemented. Management measures that would help avoid or minimise impacts to the Cabramatta Creek Grey-headed Flying-fox roost camp and on foraging habitat for the species include:

- delineation of work areas and exclusion of construction personnel and vehicles from native vegetation
- hygiene protocols to reduce the risk of transmission of weeds, pest species or pathogens
- measures to reduce the risk of indirect impacts on habitat, including dust suppression and erosion and sediment control measures during construction.

Given the distance of the Cabramatta Creek Grey-headed Flying-fox roost camp from the project site and the minor magnitude of noise and other residual impacts arising from the project as described below, no particular measures to further minimise impacts to the roost camp are required.

#### 6.7.4 Residual impacts

Flying-foxes are generally noted to be undeterred by the presence of people and the undertaking of human activities (SEQ, 2012). Flying-fox management activities at various locations have included purposeful attempts to disperse roost camps, which is not easily achieved because of the tolerance of the Grey-headed Flying-fox to noise or other disturbance. Dispersal efforts are more effective when a wide range of tools are used on a randomised schedule with animals less likely to become tolerant of disturbance. Dispersal methods have included explosive cartridges, lights, noise, physical deterrents, smoke, extensive vegetation modification, water cannons, paintball guns and helicopters (Ecosure pers. obs. 1997 – 2015 cited in Tamworth Regional Council 2017). The results of 17 camp dispersal attempts at various locations in NSW indicated that although forced dispersals sometimes caused animals to move from the original camp, in all cases, dispersed animals did not abandon the local area; and in 16 of the 17 cases, dispersals did not reduce the number of flying-foxes in the local area (ABS undated).

A number of urban camp locations are subject to significant noise impacts (>74 dBA), such as the Balgowlah camp beside the Burnt Bridge Creek deviation, the Burdekin Park camp, Singleton, which is established beside the New England Highway (WSP, 2017) and the Clyde camp on the Duck River within 50 metres of an operating heavy rail corridor(pers. obs.). Transport for NSW undertook ambient noise monitoring at a number of known Grey-headed Flying-fox roost camps near construction sites to understand the tolerance level of the species



for various noise levels. Monitoring of the Balgowlah camp indicates adaptation of the camp to noise levels at least equivalent to construction noise of 50 to 60 dBA (DPE, 2018).

A noise and vibration assessment of construction and operational activities associated with the project has been undertaken (GHD, 2019). Noise and vibration sensitive receivers (NVSRS) were identified within the construction and operational assessment study areas. The NSVR 'R2740' is located around 20 metres to the northeast of the Cabramatta Creek Grey-headed Flying-fox roost camp (GHD, 2019) and provides a suitable estimate of likely noise impacts at the roost camp.

Based on the most severe noise modelling scenario (CS03 - Road earthworks Stage 1/2) the project would generate peak energy averaged construction noise levels of up to 55 to 60 dBA at the roost camp (GHD 2019b). The construction noise modelling is conservative and assumes that, for each construction scenario, all equipment will be operating simultaneously. Therefore, the predicted energy averaged results would be equivalent to likely maximum noise level impacts from individual construction equipment. This is a conservative upper limit because the construction noise impact assessment:

- included an additional 2.5 dBA of impact associated with 'façade correction' (i.e. additional noise amplification associated with sound reflected off buildings) whereas the roost camp is a 'free field' receiver without reflective surfaces
- excluded the effect of dense vegetation in attenuating noise impacts because of the variability of this factor across their study area and uncertainty about whether a given patch of vegetation would be retained between a noise source and receiver over the life of the project (GHD 2019b; pers. comm. Pandey, P., GHD). The roost camp is separated from the project site by at least 250 metres of dense vegetation in Jacquie Osmond Reserve which would substantially reduce the magnitude of noise impacts. As a patch of vegetation in a Council-managed reserve that contains significant biodiversity values, this vegetation is likely to be retained and to continue to act as a buffer through the construction and operational life of the project.

The likely maximum construction noise levels of up to 55 to 60 dBA at the roost camp (GHD 2019b) is likely to be equivalent or less than current ambient noise levels which would include the generation of expected traffic noise levels of 60-65 dBA from the Hume Highway, located around 100 metres to the east of the roost camp (pers. comm. Pandey, P., GHD).

Operational noise modelling was carried out for scenarios with and without the project operating ('build' and 'no build'). The likely operational noise levels of 54 dBA at the roost camp are only marginally above the modelled 'no build' noise levels of 53 dBA. The likely maximum construction noise levels would be 74 dBA under the 'build' and 'no build' scenarios though the frequency of likely maximum noise events may increase with operation of the project (GHD 2019b). This is a very minor increase in noise impacts arising from operation of the additional rail line and, as described above for construction noise impacts, would be less than noise levels previously demonstrated to be tolerated by roost camps. Values of greater than >74 dBA associated with near-continuous daytime traffic noise have been recorded in monitoring of the Balgowlah camp beside the Burnt Bridge Creek deviation (DPE, 2018). This shows that Grey-headed Flying-foxes will tolerate loud and prolonged noise in the vicinity of roost camps once they have become habituated to these noise levels.

Individuals within the Cabramatta Creek Grey-headed Flying-fox roost camp appear to be habituated to human activity and to elevated noise levels, including traffic noise from the Hume Highway. This is consistent with observations from several other roost camps which occur in urban areas in close proximity to roads, rail corridors and other areas of intense human activity and noise generation (WSP, 2017, DPE 2018). Construction and operational noise impacts of the project would not exceed current noise levels at the roost camp and are therefore unlikely to

alter the temporal activity patterns of flying-foxes on a diurnal or seasonal basis and would not threaten the continued occupancy of the roost camp by the Grey-headed Flying-fox.

Temporary lighting would be used during night time work for brief periods during construction of the project. Trains and signals would generate light during the operational life of the project. The roost camp is separated from the project site by at least 250 metres of dense vegetation in Jacquie Osmond reserve. Light from the project site would not reach the roost camp. Further, individuals within the Cabramatta Creek Grey-headed Flying-fox roost camp would be habituated to artificial light, including from sources associated with the Hume Highway, a hotel adjoining the roost camp and sports field lighting in Jacquie Osmond reserve. Construction and operational light impacts of the project would not exceed current levels at the roost camp and would not threaten the continued occupancy of the roost camp by the Grey-headed Flying-fox.

## 6.8 Prescribed impacts

Prescribed biodiversity impacts of relevance to the project have been considered along with other residual impacts in section 6.4 and with reference to section 9.2 of the BAM as follows:

- 'Impacts on habitat of threatened species or ecological communities associated with human made structures' through consideration of potential indirect impacts of noise and other disturbance on potential roost sites in bridges and culverts in the study area.
- 'Impacts on habitat associated with areas of non-native vegetation' through consideration of impacts associated with removal of non-native vegetation and potential injury or mortality of fauna.
- 'Impacts on connectivity and movement of threatened species' through consideration of potential impacts of removal or fragmentation of habitat and operation of the proposed rail infrastructure.
- 'Impacts on water quality' through consideration of impacts on aquatic habitats in Cabramatta Creek.'

Additional consideration of prescribed impacts as they apply specifically to the Cabramatta Creek Grey-headed Flying-fox roost camp is provided in section 6.7.

Measures to minimise these prescribed impacts are described in section 6.3.

Given the scale and context of the project there are unlikely to be any substantial impacts on threatened species and their habitats beyond those associated with the removal of non-vegetation and habitat resources in the project site. There is no evidence that the non-native vegetation and other habitat resources in the project site would have any particular value to any threatened biota. The project is unlikely to result in any other significant direct or indirect impacts to threatened biota. Notably, there would be minor, if any impacts, on aquatic habitat downstream of the project site and there is no evidence that aquatic habitat in the vicinity of the project site would be occupied by any threatened biota (see section 6.4.1 and Appendix A).

## 6.9 Cumulative impacts

### 6.9.1 Direct impacts to biodiversity values

The study area and surrounding region have been extensively cleared and developed. The Cabramatta Creek riparian corridor is one of the few extensive patches of native vegetation and associated biodiversity value in the locality (see section 3). Other planned and potential infrastructure developments in the region include the Moorebank Intermodal Terminal, the proposed Western Sydney Airport at Badgerys Creek, implementation of the Western Sydney Infrastructure Plan (which includes the M12 motorway and The Northern Road upgrades,



potential future orbital road links, realignment of transmission lines and potential extension of the South West Rail Link) and the Parramatta Light Rail Link (DoP 2010; DPE, 2018; DPE 2019).

These major projects, residential development and other activities would result in cumulative and facilitated impacts, including:

- additional removal of native vegetation and habitat resources
- additional injury, displacement or mortality of individuals within local flora and fauna populations
- increased fragmentation of habitat and creation of novel edge effects in remnant native vegetation
- increased generation of noise and light and increased risk of vehicle strike associated with transport infrastructure
- increased risk of the spread of weeds, pathogens or pest fauna and/or increased negative impacts arising from these factors
- increased risk of toxicity or degradation of habitat due to the generation of contaminants
- further alterations to the hydrology of catchments.

The biodiversity values that are likely to be affected by major projects and other development in the region have relatively low ecosystem resilience because of the existing cumulative impacts of development in Western Sydney. At least 90% of the estimated pre-European extent of each of the native vegetation types in the study area and surrounding shale environments of the Cumberland Plain have been removed (OEH 2018c). Remnant vegetation is also severely fragmented at a regional scale, with more than half of the remaining tree cover mapped by Tozer et al (2010) occurring in patches of less than 80 hectares and half of all mapped patches of Cumberland Plain Woodland being smaller than three hectares (NSW Scientific Committee 2009). Future biodiversity assessments and development approvals will need to consider carefully the avoidance, mitigation and offsetting of impacts in order to ensure that cumulative impacts do not result in unacceptable impacts such as the local or regional extinction of any biota.

The project would make a negligible impact to the cumulative impacts on biodiversity values arising from development in Western Sydney. As summarised in Section 7 below, the project would not involve the removal of any native vegetation or important habitat resources that would require the provision of biodiversity offsets. Operational impacts of the project would comprise a minor addition to the existing activities in the rail corridor and extent of development in the locality. The project is unlikely to increase the extent, duration or magnitude of any of the cumulative impacts on biodiversity values occurring in the study area and region to the extent that would result in a significant negative effect on biodiversity values.

#### 6.9.2 Impacts of climate change

Cumulative impacts and risks connected to the project would occur in the context of human induced climate change, which is recognised as a serious threat to biodiversity values. Climate change threatens biodiversity values directly, by affecting ecosystem processes and habitats, and indirectly, by compounding the impacts of existing and ongoing pressures on biodiversity values (Steffen et. al 2009; DoE 2015).

In addition to the direct climate change impacts to threatened flora and fauna as a result of decreasing rainfall and increasing temperatures (see section 5.4), indirect climate change impacts for the study area include exacerbation of altered fire and hydrology regimes and weed management. The biodiversity values of sclerophyllous vegetation in south-eastern Australia

may be at risk of negative impacts as a result of increased wild fire frequency or intensity due to climate change, with pockets of fire-sensitive vegetation that occur in flammable matrices most at risk (Steffen et. al 2009). This also reduces the ability of land managers to maintain hollow-bearing trees in the event of unplanned or high intensity fires (OEH 2011).

Climate change trends, including reduction in annual rainfall are likely to exacerbate the KTP of alterations to aquatic habitat connectivity and natural flow regimes in addition to direct impacts to the Cumberland River-flat Forest and Coastal Freshwater Wetland plant communities as previously discussed (see section 5.4).

The potential to manage climate change impacts to biodiversity is minimal for the project due to the modified and cleared nature of the project site. The identified mitigation measure of weed management would assist to reduce the climate change threat of increasing exotic plant habitat suitability to the broader study area. Overall, climate change is likely to have a relatively minor effect on ecosystem resilience and biodiversity values in the study area when compared to the cumulative impacts of vegetation and habitat removal in Western Sydney.

## 6.10 Consideration of MNES

### 6.10.1 Threatened ecological communities

There are no TECs listed under the EPBC Act in the study area.

### 6.10.2 Threatened species

The study area contains around seven stems of *Acacia pubescens*, which is listed as a vulnerable species under the EPBC Act and BC Act. The project has been purposefully designed to avoid impacts on the population of this threatened plant. There are no *Acacia pubescens* stems in the project site. The population in the study area comprises:

- a single stem in slashed open space around 25 metres from the project site, on the opposite side of the rail corridor
- a patch of six individuals around 60 metres from the project site on the outside edge of the rail corridor (see Figure 5.1).

The project would not directly harm any individuals of this species and construction and environmental management measures are likely to avoid any indirect impacts. The project would not remove any native vegetation that could provide potential habitat for this species. The local population of *Acacia pubescens* has persisted in a highly modified environment adjacent to heavy rail infrastructure. The post-construction environment of the study area would be very similar to the current situation. Based on these considerations, the project is not likely to have a significant impact on *Acacia pubescens*.

The project footprint is not fixed and the project approval would allow for ancillary works such as utilities or temporary signalling outside of the project site. The design and placement of these ancillary works would purposefully avoid impacts to these *Acacia pubescens* or other biodiversity values.

As described in section 5.2.2, there is a Grey-headed Flying-fox roost camp around 350 metres to the east of the project site, a small number of Grey-headed Flying-foxes were recorded foraging within the study area, and several thousand were observed flying over the project site during surveys. The project would remove foraging habitat for this species. An assessment of the likely significance of impacts on the Grey-headed Flying-fox has been prepared in accordance with the EPBC Act significant impact guidelines 1.1 (DoE, 2013) and is provided in Appendix C. The outcome of this assessment of significance is that the project would not be



likely to result in a significant impact on the Grey-headed Flying-fox based on the following considerations:

- The project is unlikely to affect the occupancy of the Cabramatta Creek roost camp, would not disrupt this local population through the removal of habitat or generation of noise and light that is significantly above ambient levels and would not otherwise have a significant direct or indirect impact on the Cabramatta Creek Grey-headed Flying-fox roost camp (see section 6.7).
- Removal of foraging habitat would be restricted to the loss of 0.5 hectares of small, linear patches of planted native species and occasional exotic tree species along the rail corridor, existing roads and in urban areas.
- It would not fragment any important areas of habitat, create a barrier or otherwise affect movements between breeding camps and foraging grounds.

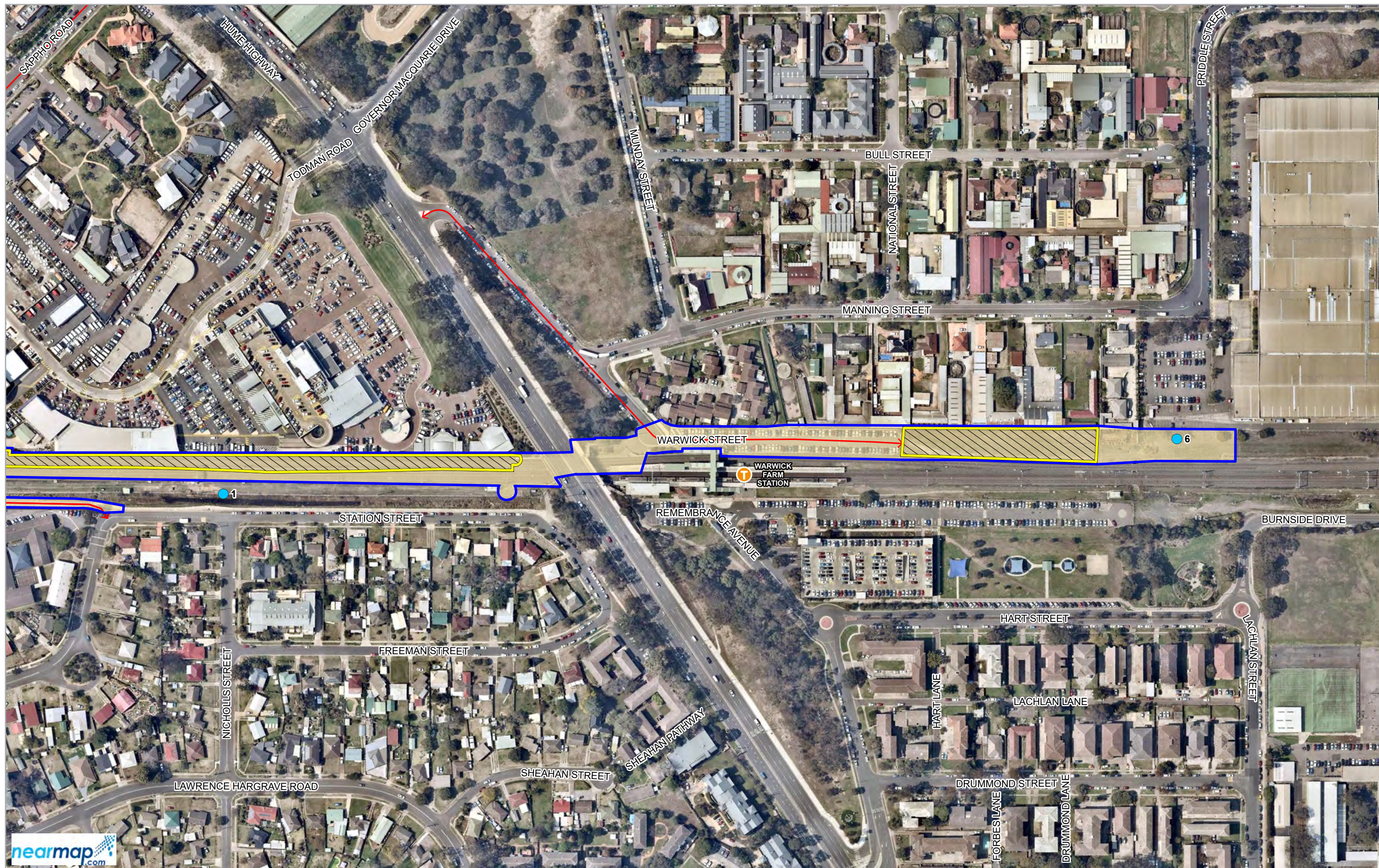
No other threatened fauna species listed under the EPBC Act are likely to be impacted by the project. Given the minor magnitude of impacts on threatened fauna and their habitats further assessment or approval under the EPBC Act is highly unlikely to be required and a referral is not recommended.

#### 6.10.3 Migratory species

No migratory bird species listed under the EPBC Act were recorded during field surveys; however, there is potential habitat for migratory terrestrial species in the study area. As discussed previously, the study area is highly modified, fragmented and would have limited value for these migratory species. Any individuals that may occur would occur on a transient basis only.

The study area is not considered important habitat for any migratory species according to the significant impact criteria for migratory species (DotE, 2013) (see section 5.3.2). The proposal would result in very minor residual impacts on native biota and their habitats in general, and would not substantially fragment or isolate any areas of habitat (see section 6.4). Based on the above considerations the project is unlikely to impose 'a significant effect' on any of the listed migratory fauna species that may occur at the study area.

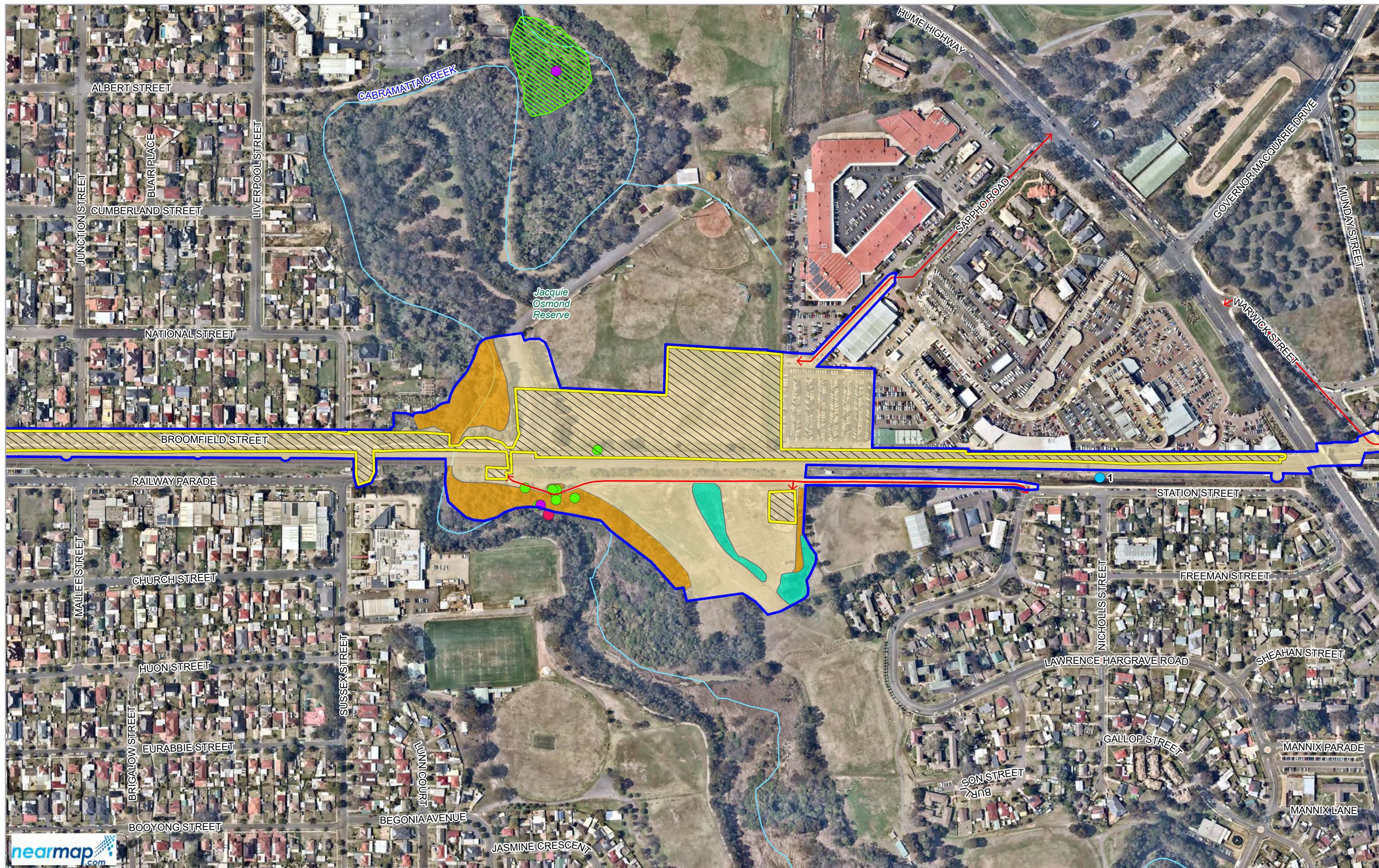




<b>Legend</b> Project site Study area Sydney Trains station Compound access route <i>Acacia pubescens</i> (vulnerable species under the BC and EPBC Acts) Non-native vegetation and cleared land		Paper Size ISO A3 0 10 20 30 40 Metres Map Projection: Transverse Mercator Horizontal Datum: Australian 1966 Grid: AGD 1966 ISG 56 1		ARTC Cabramatta Rail Loop Biodiversity Assessment Report	Project No. 22-19800 Revision No. 0 Date 17/04/2019
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**Impact summary**  
**FIGURE 6.1a**

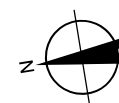




#### Legend

- Project site
- Impacts not requiring offsets
- Study area
- Sydney Trains station
- Compound access route
- Acacia pubescens* (vulnerable species under the BC and EPBC Acts)
- Grey-headed flying fox (vulnerable species under the BC and EPBC Acts)
- Eastern Freetail-bat (vulnerable species under the BC Act)
- Freshwater Wetlands on Coastal Floodplains (EEC under the BC Act)
- River-Flat Eucalypt Forest on Coastal Floodplains (EEC under the BC Act)
- Non-native vegetation and cleared land
- Cabramatta Creek Grey-headed Flying-fox roost camp
- Watercourse
- Hollow-bearing tree

Paper Size ISO A3  
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Metres  
Map Projection: Transverse Mercator  
Horizontal Datum: Australian 1966  
Grid: AGD 1966 ISG 56 1



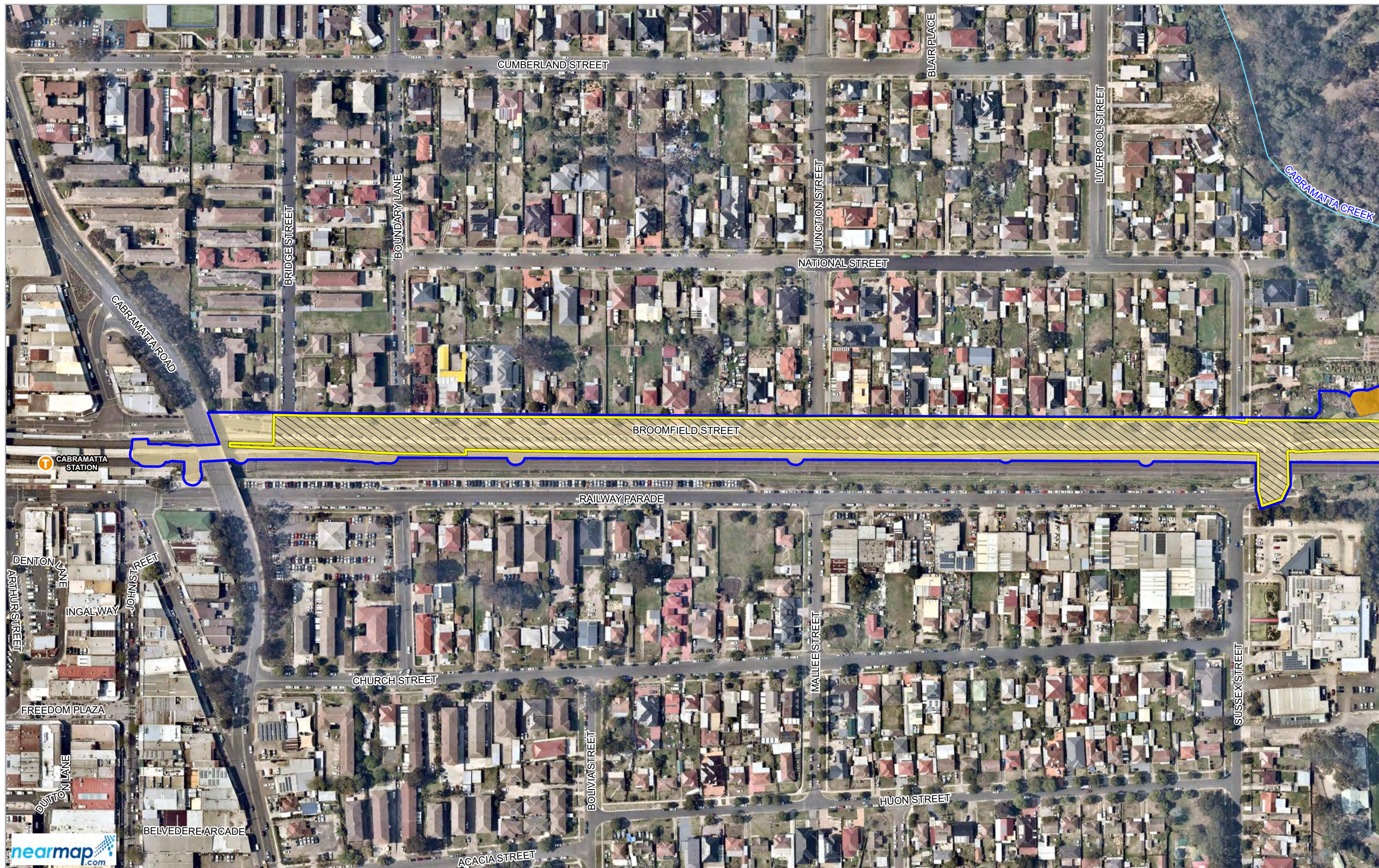
ARTC  
Cabramatta Rail Loop  
Biodiversity Assessment Report

Impact summary

Project No. 22-19800  
Revision No. 0  
Date 17/04/2019

FIGURE 6.1b

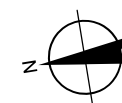




- Legend
- Project site
  - Study area
  - Sydney Trains station
  - Compound access route
  - Impacts not requiring offsets
  - River-Flat Eucalypt Forest on Coastal Floodplains (EEC under the BC Act)
  - Non-native vegetation and cleared land
  - Watercourse

Paper Size ISO A3  
0 10 20 30 40  
Metres

Map Projection: Transverse Mercator  
Horizontal Datum: Australian 1966  
Grid: AGD 1966 ISG 56 1



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Impact summary

FIGURE 6.1c



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## 7. Offset requirements

### 7.1 Impacts requiring offset

There is no native vegetation in the project site. Construction of the project would remove 3.5 hectares of non-native vegetation (comprising 3.0 hectares of exotic vegetation and 0.5 hectares of planted native species) within an overall disturbance footprint of 6.9 hectares. Much of the project site (3.4 hectares) is cleared land, comprising existing rail infrastructure, concrete paths, bitumen roads and other infrastructure. The project would not remove or otherwise impact any native vegetation or threatened species and as such would not result in any impacts requiring offsets. As such, no BAM credit calculations need to be completed and submitted to accompany this BDAR.

The project site is located within or immediately adjoining the existing rail corridor which is dominated by infrastructure and highly modified environments. Potential operational impacts of the project are already occurring in the project site and affecting the surrounding study area. The project is unlikely to increase the extent, duration or magnitude of any of these impacts to the extent that would result in a significant negative effect on biodiversity values.

There would be some ancillary works undertaken outside of the defined project site including signalling works and utility relocation/protection works. These works would be undertaken within the rail corridor and would affect only cleared land or exotic vegetation within this highly modified environment. The construction and environmental control measures proposed to mitigate impacts identified in section 6.3 are considered sufficient to manage any potential indirect impacts of ancillary works.

Preliminary BAM credit calculations were completed prior to field surveys so that the suite of threatened species predicted by the BAM credit calculator could be included as an input to the threatened species assessment presented in section 5 and Appendix A.

The study area contains some land with biodiversity value, including around seven stems of *Acacia pubescens*. The proponent recognises the value of this threatened plant population and has designed the project to avoid direct or indirect impacts on any *Acacia pubescens*. No *Acacia pubescens* would be removed or otherwise affected by the project (see Figure 5.1a). There is an occurrence of the EEC River-flat Eucalypt Forest in the study area. The project site has been purposefully designed to avoid any vegetation removal in the area of occupancy of this ecological community (see Figure 5.1b) and environmental management measures are likely to mitigate against any substantial indirect impacts to the community.

Further detail about measures to avoid impacts to biodiversity values and the need for biodiversity offsets is provided in section 6.2.

### 7.2 Impacts not requiring offset

The project would result in direct impacts on 3.5 hectares of non-native vegetation and a further 3.4 hectares of cleared land as summarised in Table 6.2 and shown on Figure 6.1. This area has low biodiversity value given its context and habitat value for threatened species. Impacts on non-native vegetation and cleared land do not require the provision of biodiversity offsets according to the BAM.

### 7.3 Offset for impacts on MNES

Under the *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy* (DSEWPaC, 2012) (the EPBC Act Environmental Offsets Policy) biodiversity offsets are required to compensate for significant residual impacts on MNES. This BDAR



includes the identification and assessment of potentially affected MNES, including an assessment of the likely significance of impacts on the Grey-headed Flying-fox pursuant to the EPBC Act significant impact guidelines 1.1 (DotE, 2013). The outcome of these assessments of significance is that the project would not be likely to result in a significant impact on the Grey-headed Flying-fox or on any other MNES. No biodiversity offsets for impacts on MNES are therefore required in accordance with the EPBC Act Environmental Offsets Policy.

## 8. Conclusion

This Biodiversity Development Assessment Report (BDAR) has been prepared in accordance with the Biodiversity Assessment Method (BAM) to describe the biodiversity values present at the project site, outline the approach to avoiding or minimising impacts, assess residual impacts of the project and determine the need or otherwise for biodiversity offsets.

The majority of the project site is located within the existing rail corridor, which has been cleared and substantially modified through earthworks and construction. The project's impacts are therefore substantially less than would be associated with an undisturbed 'green field' site. The project has been purposefully designed to avoid or further reduce impacts on biodiversity values as far as is practicable.

Specific mitigation measures are recommended to minimise impacts on the natural environment and threatened biota, including:

- exclusion of native vegetation and a population of the threatened plant *Acacia pubescens* from the project site
- erosion and sediment control measures to avoid indirect impacts on native vegetation and aquatic habitats
- restriction of access into adjacent remnant vegetation during construction and machinery hygiene protocols, washing of vehicles and erection of appropriate barriers to reduce the risk of transmission of weeds, contaminants or pathogens
- management of environmental weeds
- clearing surveys and fauna management during vegetation clearing activities.

Despite measures taken to avoid and mitigate impacts, the project would result in some unavoidable residual adverse impacts imposed upon some elements of the natural environment, including removal of a single hollow-bearing tree, other native plants and habitat resources, and imposition of edge effects on adjoining areas of native vegetation. These residual impacts are small in extent and magnitude and would comprise a minor reduction in biodiversity values in the study area.

The project would remove a very small proportion of available habitat resources for local populations of native fauna. Impacts would include the removal of 0.5 hectares of foraging habitat for mobile threatened fauna species, including the Grey-headed Flying-fox, birds and microbats. The site is unlikely to contain any important breeding, roosting or nesting habitat for native fauna. No, wetlands, permanent aquatic habitat, rock outcrops, woody debris or any other important habitat resources would be removed.

The impact and offset assessment has been completed in accordance with the BAM and concluded that the project would only result in 'impacts not requiring offset', comprising clearing of non-native vegetation and construction within previously cleared land. Impacts on biodiversity values have been avoided or minimised to the extent that no biodiversity offsets are required. A supplementary assessment of potential direct or indirect impacts on the Cabramatta Creek Grey-headed Flying-fox roost camp has concluded that the project would have a minor effect on this roost camp.

The desktop assessment, field surveys and habitat assessments undertaken for this biodiversity assessment report have been used to identify MNES listed under the EPBC Act that may be affected by the project, through either direct or indirect impacts. The project would result in the removal of a small area of foraging habitat (0.5 hectares of planted native species) for the Grey-headed Flying-fox and construction within around 500 metres of a roost camp. An assessment



of significance of impacts on the Grey-headed Flying-fox has been prepared based on the consideration of the criteria contained in the EPBC Act *assessment of significance guidelines 1.1* (DoE, 2013).

The outcome of this assessment is that the project is unlikely to have a significant impact on the Grey-headed Flying-fox or on any other MNES. Given the minor magnitude of impacts, further assessment or approval under the EPBC Act is highly unlikely to be required and a referral is not recommended. The project would not result in any significant impacts on any threatened biota listed under the EPBC Act and so there is no requirement for biodiversity offsets under the EPBC Act and associated policy (DSEWPaC, 2012).

## 9. References

- ANU (undated). *Flying Foxes at Cabramatta: a new camp-site in Western Sydney*. Accessed at: <https://fennerschool-associated.anu.edu.au/batatlas/cabramatta.htm>
- Australian Bat Society (ABS) undated *ABS Position Statement Flying--fox camp dispersal*. Accessed at: [usbats.org.au/.../ABS%20Position%20statement\\_Flying%20Fox%20Camp%20Disper...](http://usbats.org.au/.../ABS%20Position%20statement_Flying%20Fox%20Camp%20Disper...)
- Australian Government (2012). Atlas of Groundwater Dependent Ecosystems (GDE Atlas), Phase 2 Task 5 Report: Identifying and mapping GDEs. Final report prepared by CSIRO and SKM. <http://www.bom.gov.au/water/groundwater/gde/reports.shtml>
- BOM (2018a). Atlas of Groundwater Dependent Ecosystems <http://www.bom.gov.au/water/groundwater/gde/map.shtml>
- BOM (2018b). Climate Data Online. [http://www.bom.gov.au/climate/averages/tables/cw\\_067084.shtml](http://www.bom.gov.au/climate/averages/tables/cw_067084.shtml)
- Cropper, S.C. (1993). *Management of Australian Plants*. CSIRO, Melbourne.
- CSIRO BOM (2015). *Climate Change in Australia Projections, Cluster Report – East Coast*
- DECC (2008a). *NSW (Mitchell) Landscapes Version 3*. Department of Environment and Climate Change
- DECC (2008b). *Descriptions for NSW (Mitchell) Landscapes Version 2*. Based on descriptions compiled by Dr. Peter Mitchell. DECC, NSW. Department of Environment and Climate Change
- DECC (2008c). *Hygiene protocol for the control of disease in frogs*. <http://www.environment.nsw.gov.au/resources/nature/hyprfrog.pdf>
- DECC (2008d). *Managing Urban Stormwater – Soils and Construction. Volume 2D – Main road construction*. Department of Environment and Climate Change NSW. <http://www.environment.nsw.gov.au/resources/stormwater/08207soilsconststorm2d.pdf>
- DEE (2017). Australia's bioregions (IBRA) <http://www.environment.gov.au/land/nrs/science/ibra>
- DEE (2018a). *Protected Matters Online Search Tool*. Department of the Environment. Accessed at <http://www.environment.gov.au/arcgis-framework/apps/pmst/pmst.jsf>
- DEE (2018b). Species profiles and threats database (SPRAT). Department of the Environment. Accessed at <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>
- DEE (2018c). *Key threatening processes under the EPBC Act*. Department of the Environment. Accessed at <http://www.environment.gov.au/biodiversity/threatened/key-threatening-processes>
- Department of Environment, Climate Change and Water (DECCW) (2010). NSW Interim Vegetation Extent Remote Sensing Imagery. Database. <http://www.environment.nsw.gov.au/BioBanking/VegTypeDatabase.htm>
- Department of Environment, Climate Change and Water NSW (DECCW) (2009). *Draft National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus*. Prepared by Dr Peggy Eby. DECCW, Sydney  
<<http://www.environment.nsw.gov.au/resources/threatenedspecies/08214dnrpflyingfox.pdf>>
- DLWC (2002). *The NSW State Groundwater Dependent Ecosystem policy: A component policy of the NSW State Groundwater Policy Framework Document*. NSW Department for Land and Water Conservation.



DoE (2013). *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment.

DoE (2015). *Independent review of the Environment Protection and Biodiversity Conservation Act 1999. Fact Sheet 5 Climate Change*. Department of the Environment. Accessed at <http://www.environment.gov.au/system/files/resources/5f3fdad6-30ba-48f7-ab17-c99e8bcc8d78/files/fact-sheet-5-climate-change.pdf>

DoP (2016). *Sydney Growth Centres Strategic Assessment - Program Report*. New South Wales Department of Planning

DPE (2018). *CRITICAL STATE SIGNIFICANT INFRASTRUCTURE ASSESSMENT: Parramatta Light Rail (Stage 1) – Westmead to Carlingford via Parramatta CBD and Camellia (SSI 8285)*. NSW Department of Planning & Environment.

DPE (2018). Secretary's Environmental Assessment Requirements (SEARs); Cabramatta Rail Loop (SSI 9186)

DPE (2019). *Major Projects, Department of Planning and Environment NSW Planning Portal* <https://www.planningportal.nsw.gov.au/major-projects>

DPI (2015). *Myrtle Rust Factsheet*. Department of Primary Industries. [https://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0011/573707/primefact-myrtle-rust.pdf](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0011/573707/primefact-myrtle-rust.pdf)

DPI (2018a). Freshwater threatened species distribution maps. [http://www.dpi.nsw.gov.au/\\_\\_data/assets/pdf\\_file/0007/669589/fish-communities-and-threatened-species-distributions-of-nsw.pdf](http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0007/669589/fish-communities-and-threatened-species-distributions-of-nsw.pdf)

Duursma DE, Gallagher RV, Roger E, Hughes L, Downey PO, Leishman MR (2013). *Next-Generation Invaders? Hotspots for Naturalised Sleeper Weeds in Australia under Future Climates*, <http://www.weedfutures.net/>

GHD (2019a). *Cabramatta Loop DRAFT Environmental Impact Statement Technical Report 11 - Social Impact Assessment*. Report prepared for Australian Rail Track Corporation.

GHD (2019b). *ARTC - NSW-TC-05541-00 Cabramatta Loop Noise and Vibration Impact Assessment*. Report prepared for Australian Rail Track Corporation.

Kuginis L., Byrne G., Serov P, Williams J.P., (2012). *Risk assessment guidelines for groundwater dependent ecosystems, Volume 3 – Identification of high probability groundwater dependent ecosystems on the coastal plains of NSW and their ecological value*, NSW Department of Primary Industries, Office of Water, Sydney. <http://www.water.nsw.gov.au/Water-management/Water-availability/Risk-assessment/Groundwater-dependent-ecosystems/Risk-assessment-guidelines-for-groundwater-dependent-ecosystems>

Landcom (2004). *Managing Urban Stormwater: Soils and Construction, Volume 1*, 4th Edition.

NPWS (2002a). *Interpretation Guidelines for the Native Vegetation Maps of the Cumberland Plain, Western Sydney. Final Edition* NSW NPWS Hurstville. <http://www.environment.nsw.gov.au/resources/nature/cumbPlainMappingInterpguidelines.pdf>

NPWS (2002b). *Native Vegetation of the Cumberland Plain, Western Sydney*. <http://www.environment.nsw.gov.au/surveys/GetHoldOfMapsDataAndReports.htm>

O'Gara, E, Howard K, Wilson B and GESTJ Hardy (2005). Management of *Phytophthora cinnamomi* for Biodiversity Conservation in Australia: Part 2 . National Best Practice Guidelines. A report funded by the Commonwealth Government Department of the Environment and Heritage by the Centre for *Phytophthora* Science and Management, Murdoch University, Western Australia

- OEH (2011). *Loss of Hollow-bearing Trees – key threatening process determination*, <https://www.environment.nsw.gov.au/determinations/lossofhollowtreesktp.htm>
- OEH (2016). *NSW Guide to Surveying Threatened Plants*. Office of Environment and Heritage. February 2016.
- OEH (2017a). *Biodiversity Assessment Method*. Published by the Office of Environment and Heritage on behalf of the NSW Government.
- OEH (2017b). *Biodiversity Assessment Method Calculator Users Guide*, Office of Environment and Heritage
- OEH (2017c). *Guidance to assist a decision-maker to determine a serious and irreversible impact*, Office of Environment and Heritage
- OEH (2017d). *Ancillary rules: Biodiversity conservation actions – published under clause 6.5 of the Biodiversity Conservation Regulations*, Office of Environment and Heritage.
- OEH (2017e). *Biodiversity Assessment Method Calculator Version 1.2.1.*, Office of Environment and Heritage,  
<https://customer.lmbc.nsw.gov.au/assessment/s/userlogin?startURL=%2Fassessment%2Fs%2F>
- OEH (2018a). *NSW BioNet Atlas*. <http://www.bionet.nsw.gov.au/>
- OEH (2018b). *Threatened biodiversity profile search*  
<http://www.environment.nsw.gov.au/threatenedspecies/>
- OEH (2018c). *NSW BioNet Vegetation Classification*.  
<http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx>
- OEH (2018d). eSPADE. NSW Soil and Land Information.  
<http://www.environment.nsw.gov.au/eSpade2WebApp#>
- OEH (2018e). *'Species credit' threatened bats and their habitats, NSW survey guide for the Biodiversity assessment Method*. Office of Environment and Heritage, Sydney, NSW.
- OEH, Macquarie University (2019). *NSW Threatened Species & Communities search*,  
<http://www.nswthreatenedspecies.net/index.php>
- RGBT (2018). *PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia*. Royal Botanic Gardens and Domain Trust. Accessed at <http://plantnet.rbgsyd.nsw.gov.au>
- SEQ (2012). *Management and restoration of flying-fox Camps: Guidelines and Recommendations*. Accessed at:  
<https://www.environment.nsw.gov.au/resources/animals/flying-fox-2014-sub/flyingfoxsub-jenny-beatson-part3.pdf>
- Serov P, Kuginis L, Williams J.P., (2012). *Risk assessment guidelines for groundwater dependent ecosystems, Volume 1 – The conceptual framework*, NSW Department of Primary Industries, Office of Water, Sydney. <http://www.water.nsw.gov.au/Water-management/Water-availability/Risk-assessment/Groundwater-dependent-ecosystems/Risk-assessment-guidelines-for-groundwater-dependent-ecosystems>
- Steffen, W., Burbidge, A.A., Hughes, L., Kitching, R., Lindenmayer, D., Musgrave, W., Stafford-Smith, M. and Werner, P.A. (2009). *Australia's biodiversity and climate change: a strategic assessment of the vulnerability of Australia's biodiversity to climate change*. A report to the Natural Resource Management Ministerial Council commissioned by the Australian Government. CSIRO Publishing. Accessed at <http://www.environment.gov.au/climate-change/adaptation/publications/australias-biodiversity-climate-change>



Tamworth Regional Council (2017) Flying-fox Camp Management Plan Peel River Camp

Accessed at:

<https://www.environment.nsw.gov.au/resources/threatenedspecies/s91ands95/s91appA07564-2017-Attachment1.pdf>

Thackway R. and Cresswell I. (1995). *An Interim Biogeographic Regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program Version 4*, Australian Nature Conservation Agency, Canberra.

WSP (2017). *Biodiversity Assessment Report, Parramatta Light Rail*. Report prepared for Transport for NSW.

# Appendices



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# Appendix A – Threatened species for assessment



Appendix Table 1 Threatened species for assessment

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<b>FAUNA</b>												
<b>Birds</b>												
<i>Anthochaera phrygia</i> (foraging)	Regent Honeyeater	CE	E	Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Ecosystem	Yes	Yes	n/a	Low	Spotted Gum and Swamp Mahogany forests are absent from the study area. No local records. Limited foraging habitat in planted native species in the project site.	Very low
<i>Anthochaera phrygia</i> (breeding)	Regent Honeyeater	CE	E	Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Species	Yes	n/a	No	Nil	No breeding habitat is present within the Sydney region. No local records.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Artamus cyanopterus</i>	Dusky Woodswallow	V		25 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	The Dusky Woodswallow is widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Although Dusky Woodswallows have large home ranges, individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Dusky Woodswallows prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners ( <i>Manorina melanoccephala</i> ) is a significant threat to this species.	Ecosystem	Yes	Yes	n/a	Moderate	Potential breeding and foraging habitat in areas of Cumberland Riverflat Forest with an open understorey in the study area. Moderate number of local records. Limited foraging habitat in planted native species in the project site.	Low
<i>Botaurus poiciloptilus</i>	Australasian Bittern	E	E	Species or species' habitat known to occur within 10km (DEE 2018a)	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reedbeds particularly <i>Typha</i> spp. and <i>Eleocharis</i> spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Ecosystem	Yes	Yes	n/a	Moderate	Potential breeding and foraging habitat in wetland areas as part of Cabramatta Creek and also in the mapped wetland in Jacquie Osmond Reserve.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Burhinus grallarius</i>	Bush Stone-curlew	E		3 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (DEC 2006).	Species	Yes	n/a	Yes	Moderate	Few local records however grassy woodland and open forest areas in Cumberland Riverflat Forest and mangroves present in the study area could be used as potential foraging habitat. The project site does not contain habitat for this species.	Low
<i>Callocephalon fimbriatum</i> (foraging)	Gang-gang Cockatoo	V		2 records within 10km, last recorded 2007 (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes, south to and contiguous with the Victorian population. Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	Ecosystem	Yes	Yes	n/a	Moderate	Few local records however eucalypt open forests and woodlands with an acacia understorey is present in the study area and could be used as potential foraging habitat. Limited foraging habitat in planted native species in the project site.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Callocephalon fimbriatum</i> (breeding)	Gang-gang Cockatoo	V		2 records within 10km, last recorded 2007 (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the Southwestern Slopes, south to and contiguous with the Victorian population. Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	Species	Yes	n/a	No	Moderate	Few local records however areas of Cumberland Riverflat forest with an acacia understorey and containing suitable hollows for breeding is present in the study area. No breeding habitat in the project site.	Low
<i>Calyptorhynchus lathami</i> (foraging)	Glossy Black-Cockatoo	V		5 records within 10km (OEH 2018a)	Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	Ecosystem	No	No	n/a	Low	Few local records and only limited Allocasuarina spp. present in Cumberland Riverflat Forest in the study area. No foraging habitat in the project site.	Very low
<i>Calyptorhynchus lathami</i> (breeding)	Glossy Black-Cockatoo	V		5 records within 10km (OEH 2018a)	Widespread but uncommon from coast to southern tablelands and central western plains. Feeds almost exclusively on the seeds of Allocasuarina species. Prefers woodland and open forests, rarely away from Allocasuarina. Roost in leafy canopy trees, preferably eucalypts, usually <1km from feeding site. Nests in large (approx. 20cm) hollows in trees, stumps or limbs, usually in Eucalypts (Higgins 1999).	Species	No	n/a	No	Moderate	Few local records and only a limited number of suitable hollows for breeding is present in the study area. No breeding habitat in the project site.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Chthonicola sagittata</i>	Speckled Warbler	V		1 record within 10km, last recorded 2003 (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits a wide range of Eucalyptus-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of a low dense plant.	Ecosystem	Yes	Yes	n/a	Low	One local record only and likely to occur in larger undisturbed fragments of vegetation.	Very low
<i>Circus assimilis</i>	Spotted Harrier	V		5 records within 10km (OEH 2018a)	Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	Ecosystem	No	No	n/a	Moderate	Few local records however could forage in Cumberland Riverflat Forest and open grassland. No nests observed in the project site.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Climacteris picumnus victoriae</i>	Brown Treecreeper	V		Predicted by BAM calculator (OEH 2018c)	Occurs from Corowa, Wagga Wagga, Temora, Forbes, Dubbo and Inverell to the east coast, in areas such as the Snowy River Valley, Cumberland Plain, Hunter Valley and parts of the Richmond and Clarence Valleys. Most common on the inland slopes and plains. Inhabits eucalypt woodlands and dry open forest, usually dominated by stringybarks or rough-barked species with open grassy understorey. Fallen timber is important foraging habitat. Nests in hollows in standing trees or stumps.	Ecosystem	Yes	Yes	n/a	Low	Not recorded in the locality and likely to occur in larger undisturbed fragments of vegetation.	Very low
<i>Daphoenositta chrysoptera</i>	Varied Sittella	V		37 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Ecosystem	Yes	Yes	n/a	Moderate	Large number of local records and potential foraging and breeding habitat in Cumberland Riverflat Forest. Unlikely to occur in the project site given the absence of structural complexity.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Dasyornis brachypterus</i>	Eastern Bristlebird	E	E	Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Species	No	n/a	No	Nil	Study area is outside the known distribution range for the species. No local records.	Nil
<i>Ephippiorhynchus asiaticus</i>	Black-necked Stork	E		1 record within 10km (OEH 2018a)	In NSW, becomes increasingly uncommon south of the Northern Rivers region, and rarely occurs south of Sydney. Breeding recorded as far south as Buladelah, though most breeding in NSW occurs in the north-east. Primarily inhabits permanent freshwater wetlands and surrounding vegetation including swamps, floodplains, watercourses and billabongs, freshwater meadows, wet heathland, farm dams and shallow floodwaters. Will also forage in inter-tidal shorelines, mangrove margins and estuaries. Feeds in shallow, still water. Breeds during summer, nesting in or near a freshwater swamp.	Ecosystem	No	No	n/a	Moderate	Only one local record however could forage within Cabramatta Creek where mangroves and wetlands are present. No habitat within the project site.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Falco subniger</i>	Black Falcon	V		1 record within 10km, last recorded 2000 (OEH 2018a)	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. Occurs in plains, grasslands, foothills, timbered watercourses, wetland environs, crops, and occasionally over towns and cities. Breeding occurs along timbered waterways in in land areas.	Ecosystem	No	No	n/a	Moderate	Only one local record however could forage and breed within Cumberland Riverflat Forest in the study area. No habitat within the project site.	Low
<i>Glossopsitta pusilla</i>	Little Lorikeet	V		45 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands Eucalyptus albens and E. melliodora are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3cm) hollows in living, smooth-barked eucalypts, especially Eucalyptus viminalis, E. blakelyi and E. dealbata. Most breeding records are from the western slopes.	Ecosystem	Yes	Yes	n/a	Moderate	Large number of local records and potential foraging and breeding habitat in Cumberland Riverflat Forest. Limited breeding habitat in the one hollow-bearing tree in the project site.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Grantiella picta</i>	Painted Honeyeater	V	V	Species or species' habitat likely to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the <i>Amyema</i> genus. Nests in outer tree canopy.	Ecosystem	Yes	Yes	n/a	Low	Absence of Box Gum Woodland and Box-Ironbark Forests. Potential foraging habitat where mistletoes are present.	Very low
<i>Haliaeetus leucogaster</i> (foraging)	White-bellied Sea-Eagle	V	C	16 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Ecosystem	Yes	Yes	n/a	Moderate	Major river systems including the Georges River is present in the broader study area. Potential foraging habitat for this species in watercourse habitat within the study area. No foraging habitat is present in the project site.	Low
<i>Haliaeetus leucogaster</i> (breeding)	White-bellied Sea-Eagle	V	C	16 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Species	Yes	n/a	Yes	Moderate	Major river systems including the Georges River is present in the broader study area. Potential breeding habitat for this species in the study area and close to water. Breeding habitat unlikely to occur in the project site.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Hieraaetus morphnoides</i> (foraging)	Little Eagle	V		28 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Ecosystem	Yes	Yes	n/a	Moderate	Large number of records and potential foraging habitat for this species in watercourse habitat within the study area. Limited foraging habitat is present in the project site.	Low
<i>Hieraaetus morphnoides</i> (breeding)	Little Eagle	V		28 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Species	Yes	n/a	Yes	Moderate	Large number of local records and potential breeding habitat in Cumberland Riverflat Forest. No breeding habitat in the project site.	Low
<i>Ixobrychus flavicollis</i>	Black Bittern	V		8 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from southern NSW to Cape York and the Kimberley, and southwest WA. Inhabits terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. May occur in flooded grassland, forest, woodland, rainforest and mangroves as long as there is permanent water. Roosts by day in trees or within reeds on the ground. Nests in branches overhanging water and breeds from December to March.	Ecosystem	Yes	Yes	n/a	Moderate	Low number of local records however potential breeding and foraging habitat in wetland areas as part of Cabramatta Creek and also in the mapped wetland in Jackie Osmond Reserve.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Lathamus discolor</i> (foraging)	Swift Parrot	E	CE	10 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	Ecosystem	Yes	Yes	n/a	Low	Absence of important Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests foraging habitat. Limited foraging habitat in the project site.	Very low
<i>Lathamus discolor</i> (important area)	Swift Parrot	E	CE	10 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. Eucalyptus robusta, Corymbia maculata and C. gummifera dominated coastal forests are also important habitat.	Species	Yes	n/a	No	Nil	No breeding habitat is present within the Sydney region. No local records.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Lophoictinia isura</i> (foraging)	Square-tailed Kite	V		1 record within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km <sup>2</sup> .	Ecosystem	Yes	Yes	n/a	Moderate	Only one record however there is potential foraging habitat for this species in watercourse habitat within the study area. Limited foraging habitat is present in the project site.	Low
<i>Lophoictinia isura</i> (breeding)	Square-tailed Kite	V		1 record within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100m of ephemeral/permanent watercourse. Large home range > 100 km <sup>2</sup> .	Species	Yes	n/a	Yes	Moderate	Only one record however there is potential breeding habitat in Cumberland Riverflat Forest. Breeding habitat unlikely to occur in the project site.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Melanodryas cucullata cucullata</i>	Hooded Robin	V		Predicted by BAM calculator (OEH 2018c)	Considered a sedentary species, but local seasonal movements are possible. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Nests on low, live or dead forks or branches of trees or stumps, or occasionally on fallen trees or limbs.	Ecosystem	Yes	Yes	n/a	Low	No local records and only broadly suitable habitat in the study area.	Very low
<i>Melithreptus gularis gularis</i>	Black-chinned Honeyeater (eastern subspecies)	V		3 records within 10km, last recorded 2007 (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Widespread in NSW, but rarely recorded east of Great Dividing Range except in Richmond and Clarence River areas and scattered sites in the Hunter, Central Coast and Illawarra regions. Mostly in upper levels of drier open forests /woodlands dominated by box and ironbark eucalypts, or less commonly smooth-barked gums, stringybarks and tea-treas. Forage over home range of >5 ha. Tend to occur within largest woodland patches in the landscape. They forage for insects, nectar and honeydew. The nest is hidden by foliage high in the crown of a tree.	Ecosystem	Yes	Yes	n/a	Low	Absence of Box Gum Woodland and Box-Ironbark Forests and rarely recorded in the locality. Potential foraging habitat in Cumberland Riverflat forest.	Very low
<i>Neophema chrysogaster</i>	Orange-bellied Parrot	CE	CE	Species or species' habitat may occur within 10km (DEE 2018a)	Breeds in Tasmania and migrates in winter to SE South Australia and southern Victoria. There are occasional reports from NSW, including Shellharbour, Maroubra and the Shoalhaven. In winter, usually found within 3 km of the coast in saltmarsh and strandline/ foredune vegetation. May also occur on golf-courses and other grassy areas, including improved pasture.	Species	No	n/a	No	Nil	Foredune habitat is not present in the study area.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Neophema pulchella</i>	Turquoise Parrot	V		1 record within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from coast to inland slopes. In coastal area, most common between Hunter and Northern Rivers, and further south in S Coast. Inhabits open eucalypt woodlands and forests, typically with a grassy understorey. Favours edges of woodlands adjoining grasslands or timbered creek lines and ridges. 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. Nests in tree hollows, logs or posts from August to December.	Ecosystem	Yes	Yes	n/a	Moderate	Only one local record. Potential habitat is present on the edge of Cumberland Riverflat Forest and exotic vegetation. Limited foraging habitat in the project site.	Low
<i>Ninox connivens</i> (foraging)	Barking Owl	V		Predicted by BAM calculator (OEH 2018c)	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including Eucalyptus camaldulensis, Eucalyptus albens, Eucalyptus polyanthemos and Eucalyptus blakelyi. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	Ecosystem	Yes	Yes	n/a	Moderate	Not recorded in the locality. Potential foraging and roosting habitat in dense midstorey along Cabramatta Creek.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Ninox connivens</i> (breeding)	Barking Owl	V		Predicted by BAM calculator (OEH 2018c)	Occurs from coast to inland slopes and plains, though is rare in dense, wet forests east of the Great Dividing Range and sparse in higher parts of the tablelands and in the arid zone. Inhabits eucalypt woodlands, open forest, swamp woodlands, and, especially in inland areas, timber along watercourses. Roosts along creek lines in dense, tall understorey foliage (e.g. in Acacia and Casuarina), or dense eucalypt canopy. Nests in hollows of large, old eucalypts including Eucalyptus camaldulensis, Eucalyptus albens, Eucalyptus polyanthemos and Eucalyptus blakelyi. Birds and mammals important prey during breeding. Territories range from 30 to 200 hectares.	Species	Yes	n/a	No	Moderate	Not recorded in the locality however large hollow-bearing trees providing potential breeding habitat is present in adjacent Cumberland Riverflat Forest in the study area. No breeding habitat is present within the project site.	Low
<i>Ninox strenua</i> (foraging)	Powerful Owl	V		21 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	Ecosystem	Yes	Yes	n/a	Moderate	Not recorded in the locality. Potential foraging and roosting habitat in dense midstorey along Cabramatta Creek.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Ninox strenua</i> (breeding)	Powerful Owl	V		21 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	Species	Yes	n/a	No	Moderate	Not recorded in the locality however large hollow-bearing trees providing potential breeding habitat is present in adjacent Cumberland Riverflat Forest in the study area. No breeding habitat is present within the project site.	Low
<i>Pandion cristatus</i> (foraging)	Eastern Osprey	V		4 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea, though there are a handful of records from inland areas.	Ecosystem	Yes	Yes	n/a	Low	Few records in the locality and unlikely to forage within Cabramatta Creek in the study area.	Very low
<i>Pandion cristatus</i> (breeding)	Eastern Osprey	V		4 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Favours coastal areas, especially the mouths of large rivers, lagoons and lakes. They feed on fish over clear, open water. Breeding takes place from July to September in NSW, with nests being built high up in dead trees or in dead crowns of live trees, usually within one kilometre of the sea, though there are a handful of records from inland areas.	Species	Yes	n/a	Yes	Moderate	Few records in the locality however there is potential breeding habitat along Cabramatta Creek in Cumberland Riverflat Forest. No breeding habitat is present within the project site.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Petroica boodang</i>	Scarlet Robin	V		6 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	In NSW occurs from coast to inland slopes. Breeds in drier eucalypt forests and temperate woodlands, often on ridges and slopes, within open understorey of shrubs and grasses and sometimes in open areas. In autumn and winter it migrates to more open habitats such as grassy open woodland or paddocks with scattered trees. Abundant logs and coarse woody debris are important habitat components.	Ecosystem	Yes	Yes	n/a	Moderate	Suitable forest habitat present in Cumberland Riverflat Forest. Important habitat components such as woody debris is present in the study area.	Low
<i>Petroica phoenicea</i>	Flame Robin	V		1 record within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	Ecosystem	Yes	Yes	n/a	Moderate	Suitable forest habitat present in Cumberland Riverflat Forest. Important habitat components such as woody debris is present in the study area.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Rostratula australis</i>	Australian Painted Snipe	E	E	Species or species' habitat likely to occur within 10km (DEE 2018a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Ecosystem	No	No	n/a	Moderate	Low number of local records however potential breeding and foraging habitat in wetland areas adjoining Cabramatta Creek and also in the mapped wetland in Jacquie Osmond Reserve. No habitat in the project site.	Low
<i>Stagnopleura guttata</i>	Diamond Firetail	V		Predicted by BAM calculator (OEH 2018c)	Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.	Ecosystem	Yes	Yes	n/a	Low	No local records and only broadly suitable habitat in the study area.	Very low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Tyto novaehollandiae</i>	Masked Owl	V		2 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	Ecosystem	Yes	Yes	n/a	Moderate	Not recorded in the locality however large hollow-bearing trees providing potential breeding habitat is present in adjacent Cumberland Riverflat Forest in the study area. No breeding habitat is present within the project site. Potential foraging habitat is present on the edge of Cumberland Riverflat Forest	Low
<b>Fish</b>												
<i>Epinephelus daemeli</i>	Black Rockcod	V (FM Act)	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Found in warm temperate/sub-tropical parts of south-western Pacific. Naturally occur along NSW Coast incl. Lord Howe Island. Adults generally found on rocky reefs. Juveniles found in coastal rock pools and around rocky shores in estuaries. (DPI 2013).	n/a	No	n/a	n/a	Nil	Rocky reefs are absent within the study area.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Macquaria australasica</i>	Macquarie Perch	E (FM Act)	E	Species or species' habitat known to occur within 10km (DEE 2018a)	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	n/a	No	n/a	n/a	Nil	Cabramatta Creek in the study area does not contain appropriate habitat for this species.	Nil
<i>Prototroctes maraena</i>	Australian Grayling		V	Species or species' habitat may occur within 10km (DEE 2018a)	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse et al 2008).	n/a	No	n/a	n/a	Nil	Cabramatta Creek in the study area does not contain appropriate habitat for this species.	Nil



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<b>Frogs</b>												
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Species	No	n/a	No	Nil	No local records. Small intermittent streams with pools are not present in the study area.	Nil
<i>Litoria aurea</i>	Green and Golden Bell Frog	E	V	5 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by the BAM calculator (OEH 2018c)	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (Typha spp.) or spike rushes (Eleocharis spp.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. Gambusia holbrooki is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	Species	Yes	n/a	Yes	Moderate	Low number of local records however potential breeding and foraging habitat in wetland areas as part of Cabramatta Creek and also in the mapped wetland in Jacquie Osmond Reserve. No habitat present within the project site.	Low
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V	V	Species or species' habitat may occur within 10km (DEE 2018a)	Occurs on plateaus and eastern slopes of the Great Dividing Range south from Watagan State Forest. Occurs along permanent rocky streams with thick fringing vegetation associated with eucalypt woodlands and heaths among sandstone outcrops, hunting either in shrubs or on the ground.	Species	No	n/a	No	Nil	No local records or appropriate rocky stream habitat is present in the study area.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Litoria raniformis</i>	Growling Grass Frog	E	V	Species or species' habitat may occur within 10km (DEE 2018a)	Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat (OEH 2013).	Species	No	n/a	No	Nil	No local records and occurs outside the known distribution range for this species.	Nil
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V		3 records within 10km (OEH 2018a)	Restricted to Sydney Basin, from Nowra to Pokolbin and west to Mt Victoria. Inhabits heathland and open woodland on Hawkesbury and Narrabeen Sandstones, within 100m of ridgelines. Breeds in ephemeral feeder creeks or flooded depressions, requiring unpolluted water between 5.5 and 6.5 pH. Shelters under rocks, amongst masses of dense vegetation or leaf litter. Populations restricted to immediate vicinity of breeding areas.	Species	No	n/a	No	Nil	Few local records however the study area does not contain sandstone ridgelines, ephemeral feeder creeks or flooded depressions.	Nil
<b>Gastropods</b>												
<i>Meridolum corneovirens</i>	Cumberland Plain Land Snail	E		187 records within 10km (OEH 2018a); Predicted by the BAM calculator (OEH 2018c)	Occurs within a small area of the Cumberland Plain, from Richmond and Windsor to Picton. Found primarily under litter of bark, leaves and logs, or in loose soil around grass clumps within Cumberland Plain Woodland. Has also been found under rubbish. Feeds on fungus. During periods of drought can burrow into the soil to escape the dry conditions.	Species	Yes	n/a	Yes	Moderate	Large number of local records and potential habitat in dense leaf litter within Cumberland Riverflat Forest in the study area. Unlikely to occur in the project site.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Pommerhelix duralensis</i>	Dural Land Snail	E	E	Species or species' habitat likely to occur within 10km (DEE 2018a)	This species is a shale-influenced habitat specialist, which occurs in low densities along the northwest fringes of the Cumberland Plain on shale-sandstone transitional landscapes. The majority of confirmed records for the species occur within The Hills Shire Local Government Area. The species is also found within the Local Government Areas of Blue Mountains City, Penrith City, Hornsby Shire and Parramatta City	Species	No	n/a	No	Nil	No local records and the study area does not contain preferred shale sandstone transition habitat.	Nil
<b>Mammals</b>												
<i>Cercartetus nanus</i>	Eastern Pygmy-possum	V		1 record within 10km, last recorded 1999 (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs along the east coast of NSW, and inland to the Pillaga, Dubbo, Parkes and Wagga Wagga. Inhabits range of habitats from coastal heath and woodland through open and closed forests, subalpine heath and rainforest (Tulloch and Dickman 1995). Inhabits rainforest, sclerophyll forests and heath. Banksia spp. and myrtaceous shrubs and trees are favoured food sources and nesting project sites in drier habitats. Diet mostly pollen and nectar from Banksia spp., Eucalyptus spp., Callistemon spp. and insects (Ward and Turner 2008). Nests in hollows in trees, under the bark of Eucalypts, forks of tea-trees, abandoned bird nests and Xanthorrhoea bases (Ward and Turner 2008, Tulloch and Dickman 2006).	Species	Yes	n/a	No	Low	Only one local record and the study area does not contain the appropriate myrtaceous midstorey species required for this species.	Very low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Chalinolobus dwyeri</i> (breeding)	Large-eared Pied Bat	V	V	4 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	Species	Yes	n/a	No	Low	Low number of local records and the study area does not occur adjacent to sandstone escarpments which this species prefers.	Very low
<i>Dasyurus maculatus</i>	Spotted-tailed Quoll	V	E	1 record within 10km, last recorded 2002 (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	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 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, usually traversed along densely vegetated creek lines.	Ecosystem	Yes	Yes	n/a	Low	Only one local record and unlikely to inhabit the study area comprising a narrow linear vegetated corridor in urban areas of Sydney.	Very low
<i>Falsistrellus tasmaniensis</i>	Eastern False Pipistrelle	V		30 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs on southeast coast and ranges. Prefers tall (>20m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12km foraging movements recorded) (Churchill 2008, Law et al 2008).	Ecosystem	Yes	Yes	n/a	Moderate	Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along Cabramatta Creek.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Miniopterus australis</i> (foraging)	Little Bentwing-bat	V		7 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Hoyer and Hall 2008).	Ecosystem	Yes	Yes	n/a	Moderate	Low number of records but suitable foraging habitat is present in vegetation along Cabramatta Creek.	Low
<i>Miniopterus australis</i> (breeding)	Little Bentwing-bat	V		7 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from Cape York to Sydney. Inhabits rainforests, wet and dry sclerophyll forests, paperbark swamps and vine thickets. Only one maternity cave known in NSW, shared with Eastern Bentwing-bats at Willi Willi, near Kempsey. Outside breeding season roosts in caves, tunnels and mines and has been recorded in a tree hollow on one occasion. Forages for insects beneath the canopy of well-timbered habitats (Churchill 2008, Hoyer and Hall 2008).	Species	Yes	n/a	No	Nil	No breeding habitat is present in the study area.	Nil
<i>Miniopterus schreibersii oceanensis</i> (foraging)	Eastern Bentwing-bat	V		57 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	Ecosystem	Yes	Yes	n/a	Moderate	Low number of records but suitable foraging habitat is present in vegetation along Cabramatta Creek and in open grassland areas.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Miniopterus schreibersii oceanensis</i> (breeding)	Eastern Bentwing-bat	V		57 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	Species	Yes	n/a	No	Nil	No breeding habitat is present in the study area.	Nil
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat	V		44 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark (Churchill 2008).	Ecosystem	Yes	Yes	n/a	Moderate	Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along vegetation adjacent to Cabramatta Creek.	Low
<i>Myotis macropus</i>	Southern Myotis	V		28 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).	Species	Yes	n/a	Yes	High	Moderate number of local records and may forage within Cabramatta Creek. Habitat in Cumberland Riverflat Forest and in planted native species within 300m of Cabramatta Creek in the study area.	Low



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<i>Petauroides volans</i>	Greater Glider		V	Species or species' habitat likely to occur within 10km (DEE 2018a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Species	No	n/a	No	Low	No local records and generally associated with taller, moister, more productive forest types.	Very low
<i>Petaurus norfolcensis</i>	Squirrel Glider	V		1 record within 10km, last recorded 2006 (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs along the drier inland slopes as well as coastal habitats. Inhabits woodland and open forest with a Eucalyptus, Corymbia or Angophora overstorey and a shrubby understorey of Acacia or Banksia. Key habitat components include reliable winter and early-spring flowering Eucalypts, Banksia or other nectar sources, and hollow-bearing trees for roost and nest sites (van der Ree and Suckling 2008, Quin et al 2004), with social groups moving between multiple hollows. Social groups include one or two adult males and females with offspring, and have home ranges of 5-10ha within NSW (van der Ree and Suckling 2008, Kavanagh 2004).	Species	Yes	n/a	No	Low	Only one local record and the study area does not contain the appropriate myrtaceous midstorey species required for this species.	Very low
<i>Petrogale penicillata</i>	Brush-tailed Rock-wallaby	E	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Species	No	n/a	No	Nil	Rocky escarpment habitat is not present in the study area.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Phascolarctos cinereus</i> (foraging)	Koala	V	V	46 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	Ecosystem	Yes	Yes	n/a	Moderate	Large number of local records and may forage in Cumberland Riverflat Forest.	Low
<i>Phascolarctos cinereus</i> (breeding)	Koala	V	V	46 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred hectares.	Species	Yes	n/a	No	Moderate	Large number of local records though the majority are in large patches of native vegetation in the far south of the locality and are separated from the project site by several kilometres of cleared land and multiple hostile gaps such as the M5, Georges River and East Hills railway line. Foraging and potential breeding habitat in Cumberland Riverflat Forest in the study area. No important habitat in the project site.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Pseudomys novaehollandiae</i>	New Holland Mouse		V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Ecosystem	No	No	n/a	Nil	No local records and no suitable habitat present in the study area.	Nil
<i>Pteropus poliocephalus</i> (foraging)	Grey-headed Flying-fox	V	V	146 records within 10km (OEH 2018a); Roosting known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Ecosystem	Yes	Yes	n/a	Present	Recorded foraging within Cumberland Riverflat Forest in the study area. Potential foraging habitat in planted native species in the project site.	Low
<i>Pteropus poliocephalus</i> (breeding)	Grey-headed Flying-fox	V	V	146 records within 10km (OEH 2018a); Roosting known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Species	Yes	n/a	Yes	Low	The Cabramatta roost camp was recorded to the north east of the study area. Roost camp habitat is not present in the project site.	Very low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheathtail-bat	V		16 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Migrates from tropics to SE Aus in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings (Churchill 2008).	Ecosystem	Yes	Yes	n/a	Moderate	Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along vegetation adjacent to Cabramatta Creek.	Low
<i>Scoteanax rueppellii</i>	Greater Broad-nosed Bat	V		33 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).	Ecosystem	Yes	Yes	n/a	Moderate	Moderate number of local records and the study area contains hollow-bearing trees suitable for breeding and suitable foraging habitat along vegetation adjacent to Cabramatta Creek.	Low
<b>Reptiles</b>												
<i>Hoplocephalus bungaroides</i> (foraging)	Broad-headed Snake	E	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Ecosystem	No	No	n/a	Nil	Exposed cliff habitat is absent from the study area.	Nil

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<i>Hoplocephalus bungaroides</i> (breeding)	Broad-headed Snake	E	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Species	No	n/a	No	Nil	Exposed cliff habitat is absent from the study area.	Nil
<b>Migratory Species</b>												
<i>Cuculus optatus</i>	Oriental Cuckoo		C,J,K	Species or species' habitat may occur within 10km (DEE 2018a)	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	n/a	No	n/a	n/a		Potential habitat in mangroves, roadsides and planted native canopy vegetation in the study area on occasion.	Very low
<i>Hirundapus caudacutus</i>	White-throated Needletail			Species or species' habitat known to occur within 10km (DEE 2018a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	n/a	No	n/a	n/a	Moderate	Potential habitat above the canopy of Cumberland Riverflat Forest on occasion.	Very low
<i>Monarcha melanopsis</i>	Black-faced Monarch			Species or species' habitat known to occur within 10km (DEE 2018a)	Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	n/a	No	n/a	n/a	Low	Preferred rainforest habitat is not present in the study area.	Very low



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<i>Motacilla flava</i>	Yellow Wagtail		C,J,K	Species or species' habitat likely to occur within 10km (DEE 2018a)	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	n/a	No	n/a	n/a	Moderate	Potential habitat in grassland areas on occasion.	Very low
<i>Myiagra cyanoleuca</i>	Satin Flycatcher			Species or species' habitat known to occur within 10km (DEE 2018a)	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	n/a	No	n/a	n/a	Moderate	Potential habitat in Cumberland Riverflat Forest on occasion.	Very low
<i>Rhipidura rufifrons</i>	Rufous Fantail			Species or species' habitat known to occur within 10km (DEE 2018a)	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	n/a	No	n/a	n/a	Moderate	Potential habitat in Cumberland Riverflat Forest, mangroves and grassland areas on occasion.	Very low
<b>PLANTS</b>												
<i>Acacia bynoeana</i>	Bynoe's Wattle	E	V	21 records within 10km (OEH 2018a); Species or species' habitat may occur within 10km (DEE 2018a)	Endemic to central eastern NSW, currently known from only 34 locations, many of only 1-5 plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Species	No	n/a	No	Low	Moderate number of local records however the study area does not contain heath or dry sclerophyll forest required by this species.	Very low

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<i>Acacia pubescens</i>	Downy Wattle	V	V	4006 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a)	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	Species	No	n/a	Yes	Moderate	Large number of local records. Was recorded in the vicinity of the project site at two locations.	Low
<i>Allocasuarina glareicola</i>		E	E	Species or species' habitat known to occur within 10km (DEE 2018a)	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Species	No	n/a	No	Nil	No local records and Castlereagh open woodland is not present in the study area.	Nil
<i>Asterolasia elegans</i>		E	E	Species or species' habitat may occur within 10km (DEE 2018a)	Occurs north of Sydney, in the Baulkham Hills, Hawkesbury and Hornsby LGAs, may also occur in the western part of Gosford LGA. 7 known populations. Occurs on Hawkesbury sandstone, commonly amongst rocky outcrops and boulders in sheltered forests on mid- to lower slopes and valleys.	Species	No	n/a	No	Nil	No local records and the study area does not contain the appropriate geomorphology required by this species.	Nil
<i>Caesia parviflora</i> var. <i>minor</i>	Small Pale Grass-lily	E		1 record within 10km, last recorded 2001 (OEH 2018a)	In NSW occurs in Barcoongere State Forest between Grafton and Coffs Harbour. May be more widely distributed as not often identified to subspecies level. Grows in damp open places in open forest on sandstone.	Species	No	n/a	No	Low	Only one local record and the study area does not contain the appropriate geomorphology required by this species.	Very low

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<i>Caladenia tessellata</i>	Thick Lip Spider Orchid	E	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs from Central Coast NSW to southern Victoria. Mostly coastal but extends inland to Braidwood in southern NSW. In NSW grows in grassy dry sclerophyll woodland on clay loam or sandy soils, and less commonly in heathland on sandy loam soils (Duncan 2010).	Species	No	n/a	No	Low	Not recorded in the locality and the study area contains only broadly suitable habitat for this species in Cumberland Riverflat Forest.	Very low
<i>Callistemon linearifolius</i>	Netted Bottle Brush	V		30 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. In Sydney, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Species	Yes	n/a	Yes	Moderate	Moderate number of local records and the study area contains broadly suitable habitat for this species in Cumberland Riverflat Forest.	Low
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V	V	Species or species' habitat may occur within 10km (DEE 2018a)	Occurs in coastal areas from East Gippsland to southern Queensland. Habitat preferences not well defined. Grows mostly in coastal heathlands, margins of coastal swamps and sedgelands, coastal forest, dry woodland, and lowland forest. Prefers open areas in the understorey and is often found in association with Large Tongue Orchid and the Bonnet Orchid. Soils include moist sands, moist to dry clay loam and occasionally in accumulated eucalypt leaves. Flowers November-February.	Species	No	n/a	No	Low	Not recorded in the locality and the study area contains only broadly suitable habitat for this species in Cumberland Riverflat Forest.	Very low
<i>Cynanchum elegans</i>	White-flowered Wax Plant	E	E	Species or species' habitat known to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	Species	Yes	n/a	No	Low	Not recorded in the locality and the study area contains only broadly suitable habitat for this species in Cumberland Riverflat Forest.	Very low



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<i>Deyeuxia appressa</i>		E	E	Species or species' habitat likely to occur within 10km (DEE 2018a)	Known only from two pre-1942 records in Sydney, at Saltpan Creek and Killara. May be extinct in the wild. Thought to occur in moist conditions.	Species	No	n/a	No	Low	Not recorded within the last ~80 years in Sydney. Little is known of its ecology.	Very low
<i>Dillwynia tenuifolia</i>		V		1 record within 10km, last recorded 2003 (OEH 2018a)	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	Species	No	n/a	No	Nil	Only one record and the study area does not contain Castlereagh Ironbark Forest or Shale Gravel Transition Forest this species is known to occur within.	Nil
<i>Eucalyptus benthamii</i>	Camden White Gum	V	V	Predicted by BAM calculator (OEH 2018c)	Occurs on the alluvial flats of the Nepean River and its tributaries. Known distribution from The Oaks (south) to Grose Wold (north) and Kedumba Valley (west). Two major subpopulations in Kedumba Valley and Bents Basin State Recreation Area. Occurs in wet open forest on alluvial flats, in well drained alluvial sands and gravels to 1 m deep.	Species	Yes	n/a	No	Low	Not recorded in the locality and the study area contains only broadly suitable habitat for this species in Cumberland Riverflat Forest.	Very low
<i>Eucalyptus camfieldii</i>	Camfield's Stringybark	V	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs from Raymond Terrace to Waterfall, with populations known from Norah Head (Tuggerah Lakes), Peats Ridge, Mt Colah, Elvina Bay Trail (West Head), Terrey Hills, Killara, North Head, Menai and the Royal NP. Occurs in exposed situations on sandstone plateaus, ridges and slopes near the coast, often on the boundary of tall coastal heaths or low open woodland. It grows in shallow sandy soils overlying Hawkesbury sandstone.	Species	No	n/a	No	Low	Not recorded in the locality. No sandstone habitat in the study area.	Very low

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<i>Eucalyptus nicholii</i>	Narrow-leaved Black Peppermint	V	V	4 records within 10km (OEH 2018a)	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Species	No	n/a	No	Nil	The project site is well outside the species' natural distribution. Records in the locality are of planted individuals of uncertain provenance and outside of natural habitat.	Nil
<i>Eucalyptus scoparia</i>	Wallangarra White Gum	E	V	2 records within 10km, last recorded 2005 (OEH 2018a)	Occurs mostly in Queensland with only three known occurrences in NSW near Tenterfield. In NSW it is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	Species	No	n/a	No	Nil	The project site is well outside the species' natural distribution. Records in the locality are of planted individuals of uncertain provenance and outside of natural habitat.	Nil
<i>Genoplesium baueri</i>	Bauer's Midge Orchid	E	E	Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Species	No	n/a	No	Nil	Not recorded in the locality. No sandstone habitat in the study area.	Nil
<i>Grevillea beadleana</i>	Beadle's Grevillea	E	E	1 record within 10km, last recorded 2002 (OEH 2018a)	Four disjunct populations in north-east NSW: Torrington west of Tenterfield, Oxley Wild Rivers NP, Guy Fawkes River NP and Shannon Creek southwest of Grafton. Grows in open eucalypt forest with shrubby understorey, usually on steep granite slopes at high altitudes.	Species	No	n/a	No	Nil	Not recorded in the locality. No habitat associated with steep granite slopes at high altitudes in the study area.	Nil

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<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Small-flower Grevillea	V	V	919 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a)	Occurs between Moss Vale/Bargo and lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. Broad habitat range including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks.	Species	No	n/a	No	Low	No habitat on light clay or sandy soils of Castlereagh landscapes in the study area.	Very low
<i>Hibbertia fumana</i>		CE		110 records within 10km (OEH 2018a)	Currently only known from a single population at Moorebank. Generally found in areas of woodland with a more open understorey, in a long intergrade between Castlereagh Scribbly Gum Woodland. Has the potential to occur in similar intergrade alluvial habitats rich in sands and laterite in other parts of western Sydney.	Species	No	n/a	No	Low	No habitat on alluvials sands or laterites of Castlereagh landscapes in the study area.	Very low
<i>Hibbertia puberula</i>		E	CE	858 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a)	Distribution extending from Wollemi National Park south to Morton National Park and the south coast near Nowra. It favours low heath on sandy soils or rarely in clay, with or without rocks underneath. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied.	Species	No	n/a	No	Low	Not recorded in the locality. No sandstone habitat in the study area.	Very low
<i>Hibbertia</i> sp. <i>Bankstown</i>		CE	CE	4 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Listed under EPBC Act as <i>Hibbertia puberula</i> subsp. <i>glabrescens</i> . Known only from Bankstown airport. Habitat is very heavily modified, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content.	Species	Yes	n/a	No	Low	No habitat on sandy, Tertiary alluvium of Castlereagh landscapes in the study area.	Very low



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<i>Hibbertia stricta</i> subsp. <i>furcatula</i>		E		4 records within 10km (OEH 2018a)	2 known populations: one either side of the Woronora River gorge including the Menai-Bangor, Alfords Point and Illawong areas in the north and Maandowie Reserve, Loftus on the southern side; and west and southwest of Nowra. Occurs in dry sclerophyll forest and woodland. Northern metapopulation occurs on upper slopes and above the Woronora escarpment, at or near the interface of Hawkesbury sandstone and the Lucas Heights soil landscape. Southern population appears to occur in sandy soils on sandstone, with one record from gravelly clay soil.	Species	No	n/a	No	Low	Not recorded in the locality. No sandstone habitat in the study area.	Very low
<i>Leucopogon exolasius</i>	Woronora Beard-heath	V	V	2 records within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs along the upper Georges River and in Heathcote NP, Royal NP and is also known from the Blue Mountains along the Grose River. Grows in woodland on sandstone and prefers rocky hillsides along creek banks up to 100 m altitude. Associated species include Sydney Peppermint and Silvertop Ash and Graceful Bush-pea, Flaky-barked Tea-tree and Dillwynia retorta.	Species	No	n/a	No	Low	Not recorded in the locality. No sandstone habitat in the study area.	Very low

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<i>Marsdenia viridiflora</i> subsp. <i>viridiflora</i>	Marsdenia viridiflora R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP		348 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	Species	Yes	n/a	Yes	Moderate	Moderate number of local records and the study area contains broadly suitable habitat for this species in Cumberland Riverflat Forest.	Low
<i>Melaleuca biconvexa</i>	Biconvex Paperbark	V	V	Species or species' habitat may occur within 10km (DEE 2018a)	Scattered, disjunct populations in coastal areas from Jervis Bay to Port Macquarie, with most populations in the Gosford-Wyong areas. Grows in damp places, often near streams or low-lying areas on alluvial soils of low slopes or sheltered aspects.	Species	No	n/a	No	Low	Not recorded in the locality. No near coastal swampland habitat at the study area.	Very low
<i>Pelargonium</i> sp. <i>Striatellum</i>	Omeo Storksbill	E	E	Species or species' habitat may occur within 10km (DEE 2018a)	Omeo Storksbill <i>Pelargonium</i> sp. (G.W. Carr 10345), syn. <i>P. striatellum</i> , is a tufted perennial forb known from only 3 locations in NSW, with two on lake-beds on the basalt plains of the Monaro and one at Lake Bathurst. It has a narrow habitat that is usually just above the high-water level of irregularly inundated or ephemeral lakes, in the transition zone between surrounding grasslands or pasture and the wetland or aquatic communities.	Species	No	n/a	No	Nil	The study area is well outside the species' known distribution.	Nil

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<i>Persicaria elatior</i>	Tall Knotweed	V	V	Predicted by BAM calculator (OEH 2018c)	Tall Knotweed has been recorded in south-eastern NSW (Mt Dromedary (an old record), Moruya State Forest near Turlinjah, the Upper Avon River catchment north of Robertson, Bermagui, and Picton Lakes. In northern NSW it is known from Raymond Terrace (near Newcastle) and the Grafton area (Cherry Tree and Gibberagee State Forests). This species normally grows in damp places, especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance.	Species	Yes	n/a	Yes	Moderate	The study area contains broadly suitable habitat for this species in Cumberland Riverflat Forest, wetlands and instream habitats in Cabramatta Creek.	Low
<i>Persoonia hirsuta</i>	Hairy Geebung	E	E	Predicted by BAM calculator (OEH 2018c)	Occurs within the Blue Mountains, Southern Highlands and Sydney coastal regions from Hilltop to Glen Davis and Royal NP to Gosford. Population within the Hills Shire particularly important due to high density of plants. Grows on sandy soils in dry sclerophyll open forest, woodland and heath on sandstone up to 600m above sea level.	Species	Yes	n/a	No	Low	Not recorded in the locality. No sandstone habitat in the study area.	Very low
<i>Persoonia nutans</i>	Nodding Geebung	E	E	268 records within 10km (OEH 2018a); Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Species	No	n/a	No	Low	No habitat on sandy, Tertiary alluvium of Castlereagh landscapes in the study area.	Very low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Pilularia novae-hollandiae</i>	Austral Pilwort	E		Predicted by BAM calculator (OEH 2018c)	Only known extant populations in NSW are at Lake Cowal and Oolambeyan NP, but the species is obscure and may be overlooked elsewhere. Grows in shallow swamps and waterways, often among grasses and sedges. Previous records in Albury-Urana were from table drains beside roads, whereas the only record in the ACT was from a subalpine grassy plain.	Species	Yes	n/a	No	Low	The study area is well outside the species' known distribution.	Very low
<i>Pimelea curviflora</i> var. <i>curviflora</i>		V	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Species	No	n/a	No	Low	Not recorded in the locality. No sandstone or shale/laterite - sandstone transition habitat in the study area.	Very low
<i>Pimelea spicata</i>	Spiked Rice-flower	E	E	415 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a)	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	Species	No	n/a	Yes	Moderate	The study area contains broadly suitable habitat for this species in Cumberland Riverflat Forest and potentially also modified environments in the project site.	Low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Pomaderris brunnea</i>	Rufous Pomaderris	E	V	Species or species' habitat likely to occur within 10km (DEE 2018a); Predicted by BAM calculator (OEH 2018c)	Mainly occurs in SW Sydney (Wollondilly and Camden LGAs), with other populations in the Hawkesbury-Wollemi region, near Walcha in the New England tablelands and Gippsland in VIC. In NSW, grows in moist woodland or open forest on clay and alluvial soils on flood plains and creek lines. Near Sydney occurs in open woodland dominated by Cabbage Gum with Allocasuarina sp. and Bursaria sp. understorey, or on alluvial flats with eucalypts including River Peppermint, Sydey Peppermint and Grey Gum (Sutter 2011).	Species	Yes	n/a	Yes	Moderate	The study area contains broadly suitable habitat for this species in Cumberland Riverflat Forest and potentially also modified environments in the project site.	Low
<i>Pomaderris prunifolia</i>	P. prunifolia in the Parramatta, Auburn, Strathfield and Bankstown Local Government Areas	EP		2 records within 10km, last recorded 2001 (OEH 2018a)	Known from only 3 sites within population range: at Rydalmere, within Rookwood Cemetery and at The Crest of Bankstown. At Rydalmere occurs along a road reserve near a creek, among grass species on sandstone. At Rookwood Cemetery occurs in small gully of degraded Cooks River / Castlereagh Ironbark Forest on shale soils.	Species	No	n/a	No	Low	The study area is well outside the species' known, limited distribution.	Very low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Pterostylis gibbosa</i>	Illawarra Greenhood	E	E	Species or species' habitat known to occur within 10km (DEE 2018a)	Known from a small number of populations in the Illawarra, Nowra and Hunter regions. First collected in western Sydney. Only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum, Woollybutt and Melaleuca decora. Near Nowra, the species grows in an open forest of Spotted Gum, Forest Red Gum and Grey Ironbark. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark, Forest Red Gum and Black Cypress Pine.	Species	No	n/a	No	Low	The study area is well outside the species' known, limited distribution.	Very low
<i>Pterostylis saxicola</i>	Sydney Plains Greenhood	E	E	11 records within 10km (OEH 2018a); Species or species' habitat known to occur within 10km (DEE 2018a)	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Species	No	n/a	No	Low	No sandstone rock shelves in the study area.	Very low
<i>Pultenaea parviflora</i>		E	V	4 records within 10km (OEH 2018a)	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	Species	No	n/a	Yes	Moderate	The study area contains broadly suitable habitat for this species in Cumberland Riverflat Forest and potentially also modified environments in the project site.	Low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Pultenaea pedunculata</i>	Matted Bush-pea	E		15 records within 10km (OEH 2018a)	Three disjunct populations in NSW: in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). NSW populations typically among woodland vegetation but also found on road batters and coastal cliffs. In Windellama it is largely confined to loamy soils in dry gullies.	Species	No	n/a	Yes	Moderate	The study area contains broadly suitable habitat for this species in Cumberland Riverflat Forest and potentially also modified environments in the project site.	Low
<i>Syzygium paniculatum</i>	Magenta Lilly Pilly	E	V	1 record within 10km, last recorded 2002 (OEH 2018a); Species or species' habitat likely to occur within 10km (DEE 2018a)	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Species	No	n/a	No	Low	The study area does not contain any near coastal dune sand habitats.	Very low
<i>Thelymitra</i> sp. <i>Kangaloon</i>	Kangaloon Sun Orchid	CE	CE	Species or species' habitat may occur within 10km (DEE 2018a)	Only known from three locations near Robertson in the Southern Highlands. Grows in seasonally swampy sedgeland on grey silty clay loam at 600–700 m above sea level. Flowers in late October and early November.	Species	No	n/a	No	Nil	The study area is well outside the species' known, limited distribution.	Nil
<i>Thesium australe</i>	Austral Toadflax	V	V	Species or species' habitat may occur within 10km (DEE 2018a)	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Species	No	n/a	No	Low	Not recorded in the locality. No natural grassland or grassy woodland habitat in the study area.	Very low

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield	EP		7 records within 10km (OEH 2018a); Predicted by BAM calculator (OEH 2018c)	Found in disturbed sites and grows in a variety of habitats including forest, woodland, scrub, grassland and the edges of watercourses and wetlands. Typically occurs in damp, disturbed sites (with natural or human disturbance of various forms), typically amongst other herbs rather than in the open.	Species	Yes	n/a	No	Nil	The study area is outside the bounds of the endangered population.	Nil
<i>Wilsonia backhousei</i>	Narrow-leafed Wilsonia	V		1 record within 10km (OEH 2018a)	In NSW it is scattered along the coast with a northern limit of Wamberal, north of Sydney. Most extensive stands at Jervis Bay. Grows on the margins of saltmarshes and lakes.	Species	No	n/a	No	Nil	One local record only and no saltmarsh or lake habitat is present in the study area.	Nil
<b>REPTILES</b>												
<i>Hoplocephalus bungaroides</i> (foraging)	Broad-headed Snake	E	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Ecosystem	No	No	n/a	Nil	Exposed cliff habitat is absent from the study area.	Nil
<i>Hoplocephalus bungaroides</i> (breeding)	Broad-headed Snake	E	V	Species or species' habitat likely to occur within 10km (DEE 2018a)	Nocturnal, sheltering in rock crevices and under flat sandstone rocks on exposed cliff edges during autumn, winter, and spring, moving to shelters in hollows of large trees within 200m of escarpments in summer. Feeds mostly on geckos and small skinks, and occasionally on frogs and small mammals.	Species	No	n/a	No	Nil	Exposed cliff habitat is absent from the study area.	Nil

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<b>MIGRATORY SPECIES</b>												
<i>Cuculus optatus</i>	Oriental Cuckoo		C,J,K	Species or species' habitat may occur within 10km (DEE 2018a)	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	n/a	n/a	n/a	n/a		Potential habitat in mangroves, roadsides and planted native canopy vegetation in the study area on occasion.	Very low
<i>Hirundapus caudacutus</i>	White-throated Needletail			Species or species' habitat known to occur within 10km (DEE 2018a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	n/a	n/a	n/a	n/a	Moderate	Potential habitat above the canopy of Cumberland Riverflat Forest on occasion.	Very low
<i>Monarcha melanopsis</i>	Black-faced Monarch			Species or species' habitat known to occur within 10km (DEE 2018a)	Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	n/a	n/a	n/a	n/a	Low	Preferred rainforest habitat is not present in the study area.	Very low
<i>Motacilla flava</i>	Yellow Wagtail		C,J,K	Species or species' habitat likely to occur within 10km (DEE 2018a)	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	n/a	n/a	n/a	n/a	Moderate	Potential habitat in grassland areas on occasion.	Very low



Scientific name	Common name	BC Status	EPBC Status	Source	Habitat association	Credit type	Predicted by BAM calculator	Confirmed predicted species	Confirmed candidate species	Likelihood of occurrence in the study area	Justification	Likelihood of impact
<i>Myiagra cyanoleuca</i>	Satin Flycatcher			Species or species' habitat known to occur within 10km (DEE 2018a)	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	n/a	n/a	n/a	n/a	Moderate	Potential habitat in Cumberland Riverflat Forest on occasion.	Very low
<i>Rhipidura rufifrons</i>	Rufous Fantail			Species or species' habitat known to occur within 10km (DEE 2018a)	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	n/a	n/a	n/a	n/a	Moderate	Potential habitat in Cumberland Riverflat Forest, mangroves and grassland areas on occasion.	Very low

Notes: E = endangered, V = vulnerable, CE =critically endangered, C= migratory under the China-Australia migratory bird agreement, J= migratory under the Japan-Australia migratory bird agreement, K= migratory under the Korea-Australia migratory bird agreement.

## Appendix B – Field survey results

Appendix Table 2 Flora species recorded in the study area

Family	Common name	Scientific name	Exotic	Area Search X	Plot 1 Cover	Plot 2 Cover	Plot 3 Cover	Plot 4 Cover	Plot 5 Cover	Plot 6 Cover
Vegetation				n/a	Planted native species	Exotic vegetation	Cumberland Riverflat Forest (PCT 835 in moderate condition)	Exotic vegetation	Coastal freshwater wetland (PCT1071 in moderate condition)	Planted native species
Amaranthaceae	Alligator Weed	<i>Alternanthera philoxeroides</i>	*			0.2			0.1	0.1
Amaranthaceae	Lesser Joyweed	<i>Alternanthera denticulata</i>				0.1		0.1		
Apiaceae	Fennel	<i>Foeniculum vulgare</i>	*			0.1				
Apocynaceae	Moth Vine	<i>Araujia sericifera</i>	*	X	0.5		0.2			
Apocynaceae	Narrow-leaved Cotton Bush	<i>Gomphocarpus fruticosus</i>	*	X		0.2	0.2			
Asparagaceae	Bridal Creeper	<i>Asparagus asparagoides</i>	*				0.1			
Asteraceae	Cobbler's Pegs	<i>Bidens pilosa</i>	*	X	2		0.2			2
Asteraceae	Common Sowthistle	<i>Sonchus oleraceus</i>	*		0.1	0.2	0.2			1
Asteraceae	Dandelion	<i>Taraxacum officinale</i>	*				0.1			0.1
Asteraceae	Fireweed	<i>Senecio madagascariensis</i>	*	X			0.1			
Asteraceae	Flaxleaf Fleabane	<i>Conyza bonariensis</i>	*	X						
Asteraceae	Hill Fireweed	<i>Senecio hispidulus</i>					0.1			
Asteraceae	Prickly Lettuce	<i>Lactuca serriola</i>	*		0.1		0.2			1
Asteraceae	Spear Thistle	<i>Cirsium vulgare</i>	*	X	0.1	1	0.2			
Basellaceae	Madeira Vine	<i>Anredera cordifolia</i>	*				5			
Boraginaceae	Patterson's Curse	<i>Echium plantagineum</i>	*	X						
Brassicaceae		<i>Sisymbrium</i> spp.	*				0.2			
Brassicaceae	A Peppercross	<i>Lepidium</i> spp.	*	X						1
Casuarinaceae	Swamp Oak	<i>Casuarina glauca</i>		X	10					10
Chenopodiaceae	Climbing Saltbush	<i>Einadia nutans</i>			0.2		0.1			



Family	Common name	Scientific name	Exotic	Area Search X	Plot 1 Cover	Plot 2 Cover	Plot 3 Cover	Plot 4 Cover	Plot 5 Cover	Plot 6 Cover
Chenopodiaceae	Fat Hen	<i>Chenopodium album</i>	*				0.1			
Commelinaceae	Wandering Jew	<i>Tradescantia fluminensis</i>	*			0.2	1			
Convolvulaceae	Kidney Weed	<i>Dichondra repens</i>		X						
Cyperaceae	Tall Sedge	<i>Carex appressa</i>							65	
Dennstaedtiaceae	Bracken	<i>Pteridium esculentum</i>				0.1				
Fabaceae (Faboideae)		<i>Vicia monantha</i> subsp. <i>monantha</i>	*						0.1	
Fabaceae (Faboideae)	A Medic	<i>Medicago</i> spp.	*					1		
Fabaceae (Faboideae)	Australian Indigo	<i>Indigofera australis</i>								0.1
Fabaceae (Faboideae)	Burr Medic	<i>Medicago polymorpha</i>	*					5		5
Fabaceae (Faboideae)	False Sarsaparilla	<i>Hardenbergia violacea</i>		X						
Fabaceae (Faboideae)	Subterranean Clover	<i>Trifolium subterraneum</i>	*	X	0.5			0.1	0.1	
Fabaceae (Faboideae)	Variable Glycine	<i>Glycine tabacina</i>					0.5	0.1		
Fabaceae (Mimosoideae)		<i>Acacia falcata</i>		X						10
Fabaceae (Mimosoideae)	Downy Wattle	<i>Acacia pubescens</i>		X						
Fabaceae (Mimosoideae)	Parramatta Wattle	<i>Acacia parramattensis</i>		X		0.2	1			
Fabaceae (Mimosoideae)	Sydney Golden Wattle	<i>Acacia longifolia</i> subsp. <i>Longifolia</i>			0					
Fabaceae (Mimosoideae)	White Sally	<i>Acacia floribunda</i>		X						
Geraniaceae		<i>Geranium homeanum</i>				0.1				1
Juncaceae		<i>Juncus usitatus</i>							0.2	
Lamiaceae		<i>Scutellaria racemosa</i>	*						0.5	
Malaceae	Japanese Photinia	<i>Photinia glabra</i>	*	X						
Malvaceae	Paddy's Lucerne	<i>Sida rhombifolia</i>	*	X	0.1					0.1

Family	Common name	Scientific name	Exotic	Area Search X	Plot 1 Cover	Plot 2 Cover	Plot 3 Cover	Plot 4 Cover	Plot 5 Cover	Plot 6 Cover
Malvaceae	Red-flowered Mallow	<i>Modiola caroliniana</i>	*	X				10		0.2
Malvaceae	Small-flowered Mallow	<i>Malva parviflora</i>	*		0.2					
Myrsinaceae	Scarlet Pimpernel	<i>Lysimachia arvensis</i>	*		0.1	0.2		0.1		
Myrtaceae		<i>Melaleuca nodosa</i>		X						0.1
Myrtaceae	Blue Box	<i>Eucalyptus baueriana</i>					20			
Myrtaceae	Broad-leaved Paperbark	<i>Melaleuca quinquenervia</i>		X						
Myrtaceae	Crimson Bottlebrush	<i>Callistemon citrinus</i>		X						
Myrtaceae	Flax-leaved Paperbark	<i>Melaleuca linariifolia</i>		X						
Myrtaceae	Forest Red Gum	<i>Eucalyptus tereticornis</i>		X			5			
Myrtaceae	Narrow-leaved Bottlebrush	<i>Callistemon linearis</i>								2
Myrtaceae	Spotted Gum	<i>Corymbia maculata</i>			5					
Myrtaceae	Tantoon	<i>Leptospermum polygalifolium</i>								0.2
Myrtaceae	Thyme Honey-myrtle	<i>Melaleuca thymifolia</i>								0.1
Oleaceae	Large-leaved Privet	<i>Ligustrum lucidum</i>	*			10				
Oleaceae	Small-leaved Privet	<i>Ligustrum sinense</i>	*	X	0.1	0.2	0.5			
Oxalidaceae	Creeping Oxalis	<i>Oxalis corniculata</i>	*					0.1		
Phormiaceae		<i>Dianella caerulea</i> var. <i>producta</i>								0.1
Pittosporaceae	Native Blackthorn	<i>Bursaria spinosa</i> subsp. <i>spinosa</i>					0.1			
Plantaginaceae	Lamb's Tongues	<i>Plantago lanceolata</i>	*	X	0.2	0.1		10		0.2
Poaceae		<i>Briza subaristata</i>	*						0.1	
Poaceae		<i>Oplismenus aemulus</i>					0.1			
Poaceae		<i>Setaria parviflora</i>	*	X						
Poaceae		<i>Triticum</i> spp.	*							0.1

Family	Common name	Scientific name	Exotic	Area Search X	Plot 1 Cover	Plot 2 Cover	Plot 3 Cover	Plot 4 Cover	Plot 5 Cover	Plot 6 Cover
Poaceae	African Lovegrass	<i>Eragrostis curvula</i>	*	X			0.1			
Poaceae	Bushy Hedgehog-grass	<i>Echinopogon caespitosus</i>					0.2			
Poaceae	Common Couch	<i>Cynodon dactylon</i>			10	20		40	0.5	5
Poaceae	Common Reed	<i>Phragmites australis</i>				0.2			30	0.1
Poaceae	Kikuyu Grass	<i>Pennisetum clandestinum</i>	*	X	60	40	5	10		
Poaceae	Paddock Lovegrass	<i>Eragrostis leptostachya</i>							0.2	
Poaceae	Panic Veldtgrass	<i>Ehrharta erecta</i>	*				20			
Poaceae	Perennial Ryegrass	<i>Lolium perenne</i>	*			20				
Poaceae	Quaking Grass	<i>Briza maxima</i>	*						0.1	
Poaceae	Rhodes Grass	<i>Chloris gayana</i>	*	X	0.2		20			5
Poaceae	Two-colour Panic	<i>Panicum simile</i>					0.5			
Poaceae	Weeping Grass	<i>Microlaena stipoides</i> var. <i>stipoides</i>					1			5
Poaceae	Wheat	<i>Triticum aestivum</i>	*	X						
Polygonaceae	Curled Dock	<i>Rumex crispus</i>	*	X						
Polygonaceae	Swamp Dock	<i>Rumex brownii</i>							0.1	
Polygonaceae	Wireweed	<i>Polygonum aviculare</i>	*					10		
Proteaceae		<i>Hakea</i> spp.			0.1					
Proteaceae	Coast Banksia	<i>Banksia integrifolia</i>		X	0.5					
Proteaceae	Fern-leaved Banksia	<i>Banksia oblongifolia</i>		X	0.1					
Rubiaceae	Goosegrass	<i>Galium aparine</i>	*			0.2	0.5			0.1
Rutaceae		<i>Murraya paniculata</i>	*	X						
Sapindaceae	Balloon Vine	<i>Cardiospermum grandiflorum</i>	*							1
Sapindaceae	Large-leaf Hop-bush	<i>Dodonaea triquetra</i>		X						0.5



Family	Common name	Scientific name	Exotic	Area Search X	Plot 1 Cover	Plot 2 Cover	Plot 3 Cover	Plot 4 Cover	Plot 5 Cover	Plot 6 Cover
Sapindaceae	Wedge-leaf Hop-bush	<i>Dodonaea viscosa</i> subsp. <i>cuneata</i>								2
Solanaceae		<i>Solanum sisymbriifolium</i>	*	X						
Solanaceae	Green Cestrum	<i>Cestrum parqui</i>	*	X	0.5	10	20			1
Solanaceae	Madeira Winter Cherry	<i>Solanum pseudocapsicum</i>	*				0.2			
Ulmaceae	Native Peach	<i>Trema tomentosa</i> var. <i>aspera</i>					1			
Verbenaceae	Purpletop	<i>Verbena bonariensis</i>	*	X	1		0.1		0.5	0.1

Notes- Cover: 0.1, 0.2, 0.3...1, 2, 3...10, 15, 20, 25...100%, X=recorded

Appendix Table 3 Vegetation integrity plot data

				Composition (species richness)							Structure (% cover)							Function														
	PCT	Condition	Plot	TG	SG	GG	FG	EG	OG	Total	TG	SG	GG	FG	EG	OG	Large trees	Hollow trees	Litter cover (%)	Fallen logs (m)	Tree DBH5-10(cm)	TreeDBH10-20(cm)	TreeDBH20-30(cm)	TreeDBH30-50(cm)	TreeDBH50-80(cm)	Tree regen	HTE cover (total)	Zone	Easting	Northing	Bearing	
Vegetation				TG	SG	GG	FG	EG	OG	Total	TG	SG	GG	FG	EG	OG	Large trees	Hollow trees	Litter cover (%)	Fallen logs (m)	Tree DBH5-10(cm)	TreeDBH10-20(cm)	TreeDBH20-30(cm)	TreeDBH30-50(cm)	TreeDBH50-80(cm)	Tree regen	HTE cover (total)	Zone	Easting	Northing	Bearing	
Cumberland Riverflat Forest (PCT835 in moderate condition)			Bench-mark	4	8	8	7	2	3	32	21	21	73	3	1	1	1		40	12												
	835	Mod	3	3	2	4	2	0	1	12	26.0	1.1	1.8	0.2	0.0	0.5	2	2	20.0	3.0	Y	Y	Y	Y	Y	Y	72	56	294018	1246972	180	
Coastal freshwater wetland (PCT1071 in moderate condition)			Bench-mark	1	2	5	4	1	1	14	0	0	122	2	0	0	0		0	0												
	1071	Mod	5	0	0	5	1	0	0	6	0	0	95.9	0	0	0	0	0	0.0	0.0	N	N	N	N	N	N	0.1	56	293986	1246793	230	
Planted native species		n/a	Bench-mark	n/a																												
			1	3	2	1	1	0	0	7	16	0.2	10	0	0	0	1	1	4.0	2.0	N	Y	Y	Y	Y	Y	61.3	56	294064	1246943	190	
			6	1	8	3	2	0	0	14	10	15	10.1	1	0	0	0	0	10.4	0.0	N	Y	N	N	N	Y	7.1	56	294082	1247022	340	
Exotic vegetation		n/a	Bench-mark	n/a																												
			2	1	0	2	2	1	0	6	0.2	0	20.2	0	0.1	0	0	0	1.2	4.0	N	N	N	N	N	N	60.6	56	294053	1247037	180	
			4	0	0	1	1	0	1	3	0.0	0.0	40.0	0.1	0.0	0.1	0	0	0.0	0.0	N	N	N	N	N	N	10.0	56	293977	1246851	180	

\* TG=Tree; SG=Shrub; GG=Grass and grass-like; FG=forb; EG=Fern; OG=Other; HTE=High Threat Exotic

Appendix Table 4 Fauna species recorded in the study area

Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Observation Type
Fish					
<i>Anguilla reinhardtii</i>	Longfin Eel				O
<i>Gobiomorphus coxii</i>	Cox's Gudgeon				O
Frogs					
<i>Crinia signifera</i>	Common Eastern Froglet		P		W
<i>Litoria peronii</i>	Peron's Tree Frog		P		W
<i>Litoria tyleri</i>	Tyler's Tree Frog		P		W
Birds					
<i>Acanthorhynchus tenuirostris</i>	Eastern Spinebill		P		O
<i>Alisterus scapularis</i>	Australian King-parrot		P		O
<i>Anas superciliosa</i>	Pacific Black Duck		P		O
<i>Anthochaera carunculata</i>	Red Wattlebird		P		OW
<i>Anthochaera chrysoptera</i>	Little Wattlebird		P		OW
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo		P		OW
<i>Cacatua sanguinea</i>	Little Corella		P		O
<i>Cacatua tenuirostris</i>	Long-billed Corella		P		O
<i>Colluricincla harmonica</i>	Grey Shrike-thrush		P		OW
<i>Columba livia</i>	Rock Dove	*			OW
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		P		OW
<i>Corvus coronoides</i>	Australian Raven		P		OW
<i>Cracticus tibicen</i>	Australian Magpie		P		OW
<i>Cracticus torquatus</i>	Grey Butcherbird		P		O
<i>Dacelo novaeguineae</i>	Laughing Kookaburra		P		W
<i>Eolophus roseicapillus</i>	Galah		P		OW
<i>Eopsaltria australis</i>	Eastern Yellow Robin		P		OW
<i>Eurystomus orientalis</i>	Dollarbird		P		W
<i>Falco cenchroides</i>	Nankeen Kestrel		P		O
<i>Gallinula tenebrosa</i>	Dusky Moorhen		P		O
<i>Gallus sp.</i>	Domestic fowl	*			O
<i>Grallina cyanoleuca</i>	Magpie-lark		P		OW
<i>Hirundo neoxena</i>	Welcome Swallow		P		O
<i>Malurus cyaneus</i>	Superb Fairy-wren		P		OW
<i>Manorina melanocephala</i>	Noisy Miner		P		OW
<i>Manorina melanophrys</i>	Bell Miner		P		W
<i>Neochmia temporalis</i>	Red-browed Finch		P		OW
<i>Ocyphaps lophotes</i>	Crested Pigeon		P		OW
<i>Oriolus sagittatus</i>	Olive-backed Oriole		P		W
<i>Pardalotus punctatus</i>	Spotted Pardalote		P		W
<i>Petrochelidon ariel</i>	Fairy Martin		P		O
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater		P		OW



Scientific Name	Common Name	Exotic	NSW Status	EPBC Status	Observation Type
<i>Platycercus eximius</i>	Eastern Rosella		P		OW
<i>Porzana pusilla</i>	Baillon's Crane		P		O
<i>Psephotus haematonotus</i>	Red-rumped Parrot		P		O
<i>Psophodes olivaceus</i>	Eastern Whipbird		P		W
<i>Ptilotula penicillatus</i>	White-plumed Honeyeater		P		OW
<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul	*			OW
<i>Rhipidura leucophrys</i>	Willie Wagtail		P		OW
<i>Sericornis frontalis</i>	White-browed Scrubwren		P		OW
<i>Strepera versicolor</i>	Grey Currawong		P		OW
<i>Streptopelia chinensis</i>	Spotted Turtle-dove	*			OW
<i>Sturnus tristis</i>	Common Myna	*			OW
<i>Sturnus vulgaris</i>	Common Starling	*			OW
<i>Threskiornis molucca</i>	Australian White Ibis		P		O
<i>Todiramphus sanctus</i>	Sacred Kingfisher		P		OW
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet		P		OW
<i>Zosterops lateralis</i>	Silvereye		P		W
Mammals					
<i>Felis catus</i>	Cat	*			O
<i>Mus musculus</i>	House Mouse	*			O
<i>Pseudocheirus peregrinus</i>	Common Ringtail Possum		P		O
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox		V,P	V	OW
<i>Rattus rattus</i>	Black Rat	*			O
<i>Trichosurus vulpecula</i>	Common Brushtail Possum		P		O
<i>Austronomus australis</i>	White-striped Freetail-bat		P		D
<i>Mormopterus planiceps</i>	Little Mastiff-bat		P		PR
<i>Myotis macropus/Nyctophilus</i> spp.			P		SG
<i>Scotorepens. orion/Falsistrellus tasmaniensis</i>			P		SG
<i>Chalinolobus. gouldii/Mormopterus</i> sp.			P		SG
<i>Mormopterus norfolkensis</i>	Eastern Freetail-bat		V,P		(blank)
Reptiles					
<i>Eulamprus quoyii</i>	Eastern Water-skink		P		O
<i>Intellagama lesueurii</i>	Eastern Water Dragon		P		O

Observation type- O=observed, W=heard, OW= observed and heard, D= definite call identified through Anabat analysis, PR= probable call identified through Anabat analysis, SG= call identified to species guild through Anabat analysis

## Anabat analysis

### Anabat analysis – 221980032

#### Analysis method

Bat calls were recorded during field surveys using Anabat Express detectors (Titley Scientific).

Calls were identified using zero-crossing analysis and Anabat Insight (version 1.8.2, Titley Scientific, 2019) by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material.

The *Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay et al. 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for possible species (Pennay et al 2011; Churchill 2008; Van Dyck et al. 2013) and records from BioNet (1/02/2019). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in Table 5. Due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows van Dyck et al. (2013) and Reardon et al (2104).

#### Appendix Table 5 Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species e.g. <i>Chalinolobus gouldii</i> / <i>Mormopterus ozimops</i> sp. <i>Nyctophilus</i> sp. The calls of <i>Nyctophilus geoffroyi</i> / <i>gouldi</i> cannot be distinguished during the analysis process and are therefore lumped together. <i>Nyctophilus</i> sp / <i>Myotis Macropus</i> . The calls of these species can be easily confused during the analysis process and are therefore often lumped together.

#### Summary of results and survey effort

GHD completed surveys ultrasonic detector surveys at 2 sites for 2 nights at Cabramatta, NSW, totalling 4 survey nights. Approximately 1,100 Anabat files were recorded and analysed (all sites combined). One species were positively (Definite) identified of the 19 or so species that are known to occur from the locality of the study area (BioNet 2019, Pennay et al, 2011; Van Dyck et al. 2013). As many as 10 other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

Appendix Table 6 Summary of Anabat analysis 221980032

Species / group name	Nosferatu		Selene	
	14/11/2018	15/11/2018	14/11/2018	15/11/2018
<i>Austronomus australis</i>	D		D	
<i>Mormopterus planiceps</i>	PR	PR		
<i>Myotis macropus/Nyctophilus spp.</i>				SG
<i>Mormopterus norfolkensis</i>			PR	
<i>S. orion/Falsistrellus tasmaniensis</i>		SG	SG	SG
<i>C. gouldii/Mormopterus sp.</i>	SG	SG	SG	SG
No of files	43	144	769	144
Approx. survey effort (hrs:min)	10.6	10.6	10.6	10.6

Table Notes:

Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one *Nyctophilus* species where recorded.

See Table 1 for confidence rating e.g. D or Pr

ce, e, v - species listed under the *NSW Biodiversity Conservation Act 2016*.

CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Survey effort: estimate of time between sunset and sunrise for a successful night of Anabat detection based on first and last files recorded.

## References

BioNet- NSW Government, Department of Environment and Heritage (2019) BioNet – the website for the Atlas of NSW wildlife. <http://www.bionet.nsw.gov.au/> - accessed 1/02/2019

Churchill, S 2008. Australian Bats, Allen and Unwin, Australia.

Duffy, AM, Lumsden, LF, Caddle, CR, Chick, RR & Newell, GR 2000. The efficacy of Anabat ultrasonic detectors and harp traps for surveying microchiropterans in southeastern Australia, *Acta Chiropterologica* 2: 127-144.

Law, B, Anderson, J & Chidel, M 1998. A bat survey in State Forests on the south-west slopes of New South Wales with suggestions of improvements for future surveys, *Australian Zoologist* 30(4): 467-479.

Law, B, Anderson, J Chidel, M 1999. Bat communities in a fragmented forest landscape on the south-west slopes of New South Wales, Australia, *Biological Conservation* 88(3): 333-345.

Mills, DJ, Norton, TW, Parnaby, HE, Cunningham, RB & Nix, HA 1996, Designing surveys for microchiropteran bats in complex forest landscapes – a pilot study from south-east Australia. *Forest Ecology and management* 85 (1-3):149-161.

Pennay, M., Law, B., and Lunney, D. 2011. Review of the Distribution and status of the bat fauna of NSW and the ACT. Pp. 226-256 in *The Biology and Conservation of Australian Bats*, edited by Law., B, Eby., P, and Lunney., D.

Pennay, M, Law, B, Reinhold, L 2004. Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats, NSW Department of Environment and Climate Change, Hurstville.

Reardon, T. B., McKenzie, N. L., Cooper, S. J. B., Appleton., B., Carthew, S. and Adams, M 2014 A molecular and morphological investigation of species boundaries and phylogenetic relationships in Australian free-tailed bats *Mormopterus* (Chiroptera : Molossidae). *Australian Journal of Zoology* 62: 109-136.

Reinhold, L, Law, B, Ford, G & Pennay, M 2001. Key to the bat calls of south-east Queensland and north-east New South Wales, NRM, NRM, Indooroopilly.

Van Dyke, S, Gynther, I, and Baker, A. 2013. Field Companion To The Mammals of Australia. New Holland Publishers.



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## Appendix C – EPBC Act assessment of significance

## Assessment of significance - Grey-headed Flying-fox (*Pteropus poliocephalus*)

*An 'important population' of a vulnerable species is defined by DotE (2013) as '...a population that is necessary for the species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:*

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

The Cabramatta Creek Grey-headed Flying-fox roost camp is located around 350 metres to the east of the project site (see Figure 5.1b). The Grey-headed Flying-fox was recorded foraging within the study area and was regularly observed flying above it, including several thousand individuals seen flying from east to west of the project site after dusk each evening. The project site contains some foraging resources for this species associated with mature fruit or blossom bearing trees in mapped areas of planted native species and exotic vegetation.

The Cabramatta Creek Grey-headed Flying-fox roost camp is roosting habitat which is critical to the survival of the species as identified in the recovery plan for the species (DECCW, 2009). As such the Grey-headed Flying-fox individuals observed in the study area and potentially affected by the project are part of an important population. It should be noted that this particular consideration of the assessment of significance criteria is less relevant to the Grey-headed Flying-fox because it is generally accepted that all individuals of the species in south-eastern Australia are part of a single population that may move intermittently between regional areas of foraging habitat and roost camps (DECCW, 2009).

*According to the DotE (2013) 'significant impact criteria' for vulnerable species, an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:*

*Lead to a long-term decrease in the size of an important population*

The Cabramatta Creek Grey-headed Flying-fox roost camp was identified as requiring specific consideration in the project SEARs with a particular focus on potential effects of noise and lighting. The camp is located around 500 metres to the east of the rail corridor and around 350 metres to the northeast of the outer edge of the project site. The project would not clear any vegetation within the area of occupation of the roost camp or otherwise directly affect the camp. Given the distance of the roost camp from the project site, several hundred metres of dense vegetation that and the implementation of environmental management measures during construction, the project would not result in any tangible indirect impacts on the roost camp.

A noise and vibration assessment of construction and operational activities associated with the project has been undertaken (GHD 2019b). The likely maximum construction noise levels of up to 55 to 60 dBA at the roost camp (GHD 2019b) is likely to be equivalent or less than current ambient noise levels which would include the generation of expected traffic noise levels of 60-65 dBA from the Hume Highway, located around 100 metres to the east of the roost camp (pers. comm. Pandey, P., GHD). The likely operational noise levels of 54 dBA at the roost camp are only marginally above the modelled 'no build' noise levels of 53 dBA (GHD 2019b). This is a very minor increase in noise impacts arising from operation of the additional rail line and, as described above for construction noise impacts, would probably be less than current ambient noise levels (pers. comm. Pandey, P., GHD).

Individuals within the Cabramatta Creek Grey-headed Flying-fox roost camp appear to be habituated to human activity and to elevated noise levels, including traffic noise from the Hume Highway. This is consistent with observations from several other roost camps which occur in urban areas in close proximity to roads, rail corridors and other areas of intense human activity and noise generation (WSP, 2017, DPE 2018). Construction and operational noise impacts of the project would not exceed current noise levels at the roost camp and would not threaten the continued occupancy of the roost camp by the species.

Temporary lighting would be used during night time work for brief periods during construction of the project. Trains and signals would generate light during the operational life of the project. The roost camp is separated from the project site by at least 250 metres of dense vegetation in Jacquie Osmond reserve. Light from the project site would not reach the roost camp. Further, individuals within the Cabramatta Creek roost camp would be habituated to artificial light, including from sources associated with the Hume Highway, a hotel adjoining



#### Assessment of significance - Grey-headed Flying-fox (*Pteropus poliocephalus*)

the roost camp and sports field lighting in Jacquie Osmond reserve. Construction and operational light impacts of the project would not exceed current levels at the roost camp and would not threaten the continued occupancy of the roost camp by the Grey-headed Flying-fox.

The project would remove about 0.5 hectares of planted native tree species and various planted exotic tree species that would be used on occasion as a foraging resource by Grey-headed Flying-foxes. This would comprise the loss of critical foraging habitat relied upon by the Cabramatta Creek roost camp and other roost camps within a 50 kilometre radius of the project study area. This is the expected maximum foraging distance of the species from roost sites (Eby, 1996).

Individuals from various roost camps are likely to forage in the project site on an opportunistic basis when food trees are flowering or fruiting. This vegetation is similar to vegetation throughout the locality, which is predominantly scattered trees located in gardens, parks and roadsides. There is an extensive patch of native vegetation in Jacquie Osmond reserve and along the Cabramatta Creek and Georges River riparian corridors (see Figure 5.1b). Individuals would regularly forage in urban vegetation in the locality, as well as flying further afield.

Whilst Grey-headed Flying-foxes are likely to forage in the project area on occasion when seasonal foraging resources are available, the relatively small patches of planted vegetation to be removed comprise only a small component of the resources available in the wider locality, and are not likely to comprise habitat critical to the survival of the local population as discussed below. The vegetation within the study area occurs as isolated patches within an already highly fragmented urban landscape and the project will not create a barrier to the movements of the Grey-headed Flying-foxes between roost camps and foraging grounds. Given the above considerations, the project is highly unlikely to affect the occupancy of the Cabramatta Creek roost camp or otherwise result in a long-term decline in an important population of the species.

#### *Reduce the area of occupancy of the species*

As described above, the project is unlikely to affect the occupancy of the Cabramatta Creek roost camp. The impacts of construction of the proposed action on the Grey-headed Flying-fox population would be primarily confined to loss of foraging habitat through clearing or damage to 0.5 hectares of planted native species and various exotic trees during the construction phase. No notable impacts are anticipated during operation.

The project would remove a very minor proportion of the foraging habitat available in a 50 kilometre radius of local camp sites for the Grey-headed Flying-fox. No intact areas of highly productive forage trees would be removed. Similar urban foraging habitat is present throughout the locality.

The project will not affect the ability of this highly mobile and wide-ranging species to move between local camps and foraging habitats. Extensive areas of habitat are present in the locality and wider area, including various national parks and reserves throughout Sydney, as well as planted trees in residential areas. Given the widespread nature and abundance of potential foraging habitat within the feeding range of the local population, the project would not reduce the area of occupancy of an important population of the Grey-headed Flying-fox.

#### *Fragment an existing important population into two or more populations*

As described above, the project is unlikely to affect the occupancy of the Cabramatta Creek roost camp, and will not fragment this local population through the removal of habitat or displacement of individual flying foxes.

The Grey-headed Flying-fox is a highly mobile species that is capable of accessing isolated patches of foraging habitat within urban areas. The species is known to regularly travel distances of 50 kilometres from roost sites to access seasonal foraging resources (Eby, 1996). The project will not tangibly increase the gap between any areas of habitat or otherwise form a barrier to the movement of the species between any local camps and foraging habitat. The existing rail corridor does not comprise a barrier to the movement of this highly mobile and wide ranging species. Several thousand individuals were seen flying from east to west of the project site after dusk each evening during GHD field surveys and were clearly habituated to noise and light associated with train movements.

The project would therefore not fragment an existing important population of the Grey-headed Flying-fox into two or more populations.

## Assessment of significance - Grey-headed Flying-fox (*Pteropus poliocephalus*)

### *Adversely affect habitat critical to the survival of a species*

The Cabramatta Creek Grey-headed Flying-fox roost camp is roosting habitat which is critical to the survival of the species as identified in the recovery plan for the species (DECCW, 2009). As described above, the project is highly unlikely to affect the extent or quality of habitat in the Cabramatta Creek roost camp.

The project would remove about 0.5 hectares of planted native tree species and various planted exotic tree species that would be used on occasion as a foraging resource by Grey-headed Flying-foxes. This would comprise the loss of critical foraging habitat relied upon by the Cabramatta Creek roost camp and other roost camps within a 50 kilometre radius of the project study area. The area of habitat adversely affected by the project represents a minor proportion of available critical habitat present within a 50 kilometre radius of local camps. As such, the project would result in a very minor adverse effect on habitat critical to the survival of the species.

### *Disrupt the breeding cycle of an important population*

As described above, the project is highly unlikely to affect the occupancy of the Cabramatta Creek roost camp, and will not disrupt this local population through the removal of habitat or generation of noise and light that is significantly above ambient levels. The project will not form a barrier to the movement of Grey-headed Flying-foxes between any local camps and foraging habitat throughout the locality.

As described above, the project would remove about 0.5 hectares of foraging habitat that would be of minor value to the species. The loss of this foraging habitat is not likely to disrupt the breeding cycle of the local population of this highly mobile species.

### *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

As described above, the project is highly unlikely to affect the occupancy of the Cabramatta Creek roost camp, and will not disrupt this local population through the removal of habitat or generation of noise and light that is significantly above ambient levels.

The area of habitat removed for the project represents a minor proportion of the potential foraging habitat for the Grey-headed Flying-fox within travelling distance of local roost camps and will not isolate areas of foraging habitat for this highly mobile species through this urban landscape.

Given the above considerations the proposed action is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat for the Grey-headed Flying-fox to the extent that the species is likely to decline.

### *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Construction may, in general, increase the degree of weed infestation through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water) and via visitor shoes, clothing or vehicles. Given the limited scale and duration of works and the extent of existing disturbance in the study area the project is unlikely to tangibly increase the degree of weed infestation. The project will include measures to further reduce this risk such as cleaning of construction vehicles before entering and exiting the site and exclusion of access from native vegetation outside of the project site.

The project does not involve the transport of animals and would introduce new feral animals that could harm the Grey-headed Flying-fox or encourage the spread of feral animals.

### *Introduce disease that may cause the species to decline*

The project has the potential to introduce or spread pathogens such as *Phytophthora* (*Phytophthora cinnamomi*) through vegetation and soil disturbance and vehicle and foot traffic. There is little available information about the distribution of plant diseases within the locality, and no evidence of disease was observed during surveys.

The potential for impacts associated with disease is low, given the disturbed nature and long term use of the project site as a heavy rail corridor. Exclusion of access from native vegetation outside of the project site would substantially mitigate against the risk of spreading disease. As a precautionary measure a 'clean on entry, clean on exit' policy should be implemented during the project as outlined under the Environment Management Plan (detailed further in section 6) to prevent the introduction or spread of these pathogens.

#### Assessment of significance - Grey-headed Flying-fox (*Pteropus poliocephalus*)

No diseases that may cause the Grey-headed Flying-fox to decline are likely to become established in the study area as a result of the project.

#### *Interfere with the recovery of the species*

As described above, the project is highly unlikely to affect the occupancy of the Cabramatta Creek roost camp, and will not disrupt this local population through the removal of habitat or generation of noise and light that is significantly above ambient levels.

The draft recovery plan for the Grey-headed Flying-fox (DECCW, 2009) identifies the protection of foraging resources as a key recovery objective. The project is located in a highly urbanised environment, and would involve the removal of small, linear patches of mostly planted trees. This habitat loss represents a minor proportion of the potential foraging habitat for the Grey-headed Flying-fox within travelling distance of local roost camps. As such, the removal and modification of this foraging habitat is not likely to interfere substantially with the recovery of the species.

#### *Conclusion*

Based on the above considerations the project is unlikely to have a significant impact on the Grey-headed Flying-fox most notably because:

- the project is unlikely to affect the occupancy of the Cabramatta Creek roost camp, and will not disrupt this local population through the removal of habitat or generation of noise and light that is significantly above ambient levels
- removal of foraging habitat would be restricted to the loss of 0.5 hectares of small, linear patches of planted native species and occasional exotic tree species along the rail corridor, existing roads and in urban areas
- it would not fragment any important areas of habitat, create a barrier or otherwise affect movements between breeding camps and foraging grounds.



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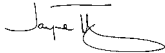

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#### Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	B. Harrington M. Weerakoon H Urwin	J Tipping		S Page		08/08/19

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