ST MARYS freight hub

Biodiversity Development Assessment Report

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1300 646 131
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Template 2.8.1

Executive Summary

Eco Logical Australia (ELA) were engaged by Pacific National Pty Ltd to prepare a Biodiversity Development Assessment Report (BDAR) in accordance with the *Biodiversity Conservation Act 2016* (BC Act) and the Biodiversity Assessment Method (BAM) at Lot 2 DP 876781 (2 Forrester Rd) St Marys. The proposed development is for the construction of the St Marys Freight Hub which is a State Significant Development (SSD) under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

The subject land is located in the City of Penrith Local Government Area (LGA) and is currently zoned IN1 – General Industrial under the Penrith Local Environmental Plan (LEP) 2010.

This BDAR addresses the Secretary's Environmental Assessment Requirements (SEARs) Application Number SSD – 7308 Part 15, which outlines the requirement for a BDAR to be submitted with the Environmental Impact Statement (EIS). This report has been prepared to meet the requirements of the Biodiversity Assessment Method (BAM) established under Section 6.7 of the NSW Biodiversity Conservation Act 2016 (BC Act).

Three Plant Community Types (PCTs) occurring in various conditions are present in the development site. The PCTs have been mapped as *PCT 835 – Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, PCT 1800 – Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley* and *PCT 1071 – Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion.*

PCT 835 and 1800 conform to the endangered ecological community (EEC) 'River-flat eucalypt forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions' listed under the BC Act. This EEC was generally in a degraded condition in the development site.

One threatened flora species, *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea), was recorded within the development site. Three threatened microchiropteran bats (microbats) were recorded during the Anabat survey within the development site including *Myotis macropus* (Southern Myotis), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) and *Mormopterus norfolkensis* (Eastern Freetail-bat). Possible calls of the threatened microbat *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat) were also recorded, however, the calls cannot be confidently attributed to this species due to overlapping calls with other species. Impacts on *Grevillea juniperina* subsp. *juniperina* and Southern Myotis habitat require species credit offsets. Impacts to Eastern False Pipistrelle, Eastern Freetail-bat and Eastern Bentwing-bat will be offset as ecosystem credits. Eastern Bentwing-bat is also a species credit species where breeding habitat will be impacted, however, breeding habitat for this species is not present within or in proximity to the development site.

This BDAR outlines the measures taken to avoid, minimise and mitigate impacts on the vegetation and species habitat present within the development footprint and measures to minimise impacts during construction and operation of the development. Following consideration of the above aspects, the residual unavoidable impacts of the project were calculated in accordance with BAM by utilising the Biodiversity Assessment Method Credit Calculator (BAMC).

A total of 16 ecosystem credits are required to offset the residual impacts of the proposed project:

PCT #	PCT Name	Condition	Vegetation Zone	Area (ha) or Number*	Vegetation Integrity Score	Credits
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Degraded	1	0.33	35.6	6
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Regrowth	2	0.33	44.6	7
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Degraded	3	0.07	28.1	1
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	5	0.09	36.8	2
Total Ecosystem Credits						16

A total of 18 species credits are required to offset the residual impacts of the proposed project:

Scientific Name	Common Name	Direct impact number of individuals / habitat (ha)	Credits required
Grevillea juniperina* subsp. *juniperina	Juniper-leaved Grevillea	0.71	11
Myotis macropus	Southern Myotis	0.86	7
Total Species Credits			18

Serious and Irreversible Impacts (SAII) values have been considered in this assessment. Eastern Bentwing-bat, which had potential calls identified during the Anabat survey, is a candidate entity for SAII for impacts to breeding habitat. No breeding habitat for this species will be impacted directly or indirectly by the development. No other candidate entities for SAII were recorded.

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Abbreviations

Abbreviation	Description
BAM	Biodiversity Assessment Method
BAMC	Biodiversity Assessment Method Credit Calculator
BC Act	NSW Biodiversity Conservation Act 2016
BDAR	Biodiversity Development Assessment Report
BSSAR	Biodiversity Stewardship Site Assessment Report
CEEC	Critically Endangered Ecological Community
DNG	Derived Native Grassland

Abbreviation	Description
DoEE	Commonwealth Department of Environment and Energy
DPE	NSW Department of Planning and Environment
EEC	Endangered Ecological Community
ELA	Eco Logical Australia Pty Ltd
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
FM Act	NSW Fisheries Management Act 1994
GIS	Geographic Information System
GPS	Global Positioning System
IBRA	Interim Biogeographic Regionalisation for Australia
LGA	Local Government Area
LLS	Local Land Service
NSW	New South Wales
NOW	NSW Office of Water
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SEPP	State Environmental Planning Policy
SSD	State Significant Development
SSI	State Significant Infrastructure
TEC	Threatened Ecological Community
VIS	Vegetation Information System
WM Act	NSW Water Management Act 2000

1. Stage 1: Biodiversity assessment

1.1 Introduction

This Biodiversity Development Assessment Report (BDAR) has been prepared by Kirsten Velthuis and Mike Lawrie who is an Accredited Person (BAAS18162) under the NSW Biodiversity Conservation Act 2016 (BC Act). The contents of this BDAR complies with the minimum requirements outlined in Table 25 of the Biodiversity Assessment Methodology (BAM: OEH, 2017).

1.1.1 General description of the development site

This report includes two base maps, the Site Map (Figure 1) and the Location Map (Figure 2). The subject land (site precinct) includes the following lots:

- Lot 196 DP31912
- Lot 2 & 3 DP876781

The development site has largely been cleared of native vegetation. Some remnant and regrowth vegetation is present, particularly around watercourses and at the fringes of the development site. This vegetation has been degraded by weed incursion. Cleared areas are dominated by exotic grasses and bare ground. Several soil and debris stockpiles are also present in the development site.

Three native Plant Community Types (PCTs) are present in the development site*:* PCT 835 – *Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain*, *Sydney Basin Bioregion,* PCT 1800 – *Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley* and PCT 1071 – *Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion.* These PCTs are in various condition states and make up a total of five vegetation zones. PCT 835 conform to the endangered ecological community (EEC) River Flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion (RFEF).

1.1.2 Development site footprint

The development site footprint is shown in Figure 1 which includes both the operational and construction footprint. The development includes:

- Use of existing rail infrastructure for loading and unloading of trains
- Construction of hardstand areas for container storage and laydown, rail and vehicle loading and unloading areas
- Construction of new internal access roads
- Construction of additional service areas, buildings and ancillary features

1.1.3 Sources of information used

The following data sources were reviewed as part of this report:

- Biodiversity Assessment Methodology Calculator
- BioNet Vegetation Classification
- BioNet / Atlas of NSW Wildlife 5 km database search (OEH 2018a)
- EPBC Act Protected Matters Search Tool 5 km database search (DotEE 2019)
- The Native Vegetation of the Sydney Metropolitan Area (OEH 2016)
- Aerial mapping (SIXMaps and Nearmap)

- Additional GIS datasets including soil, topography, geology and drainage
- Additional reports and threatened species information sources

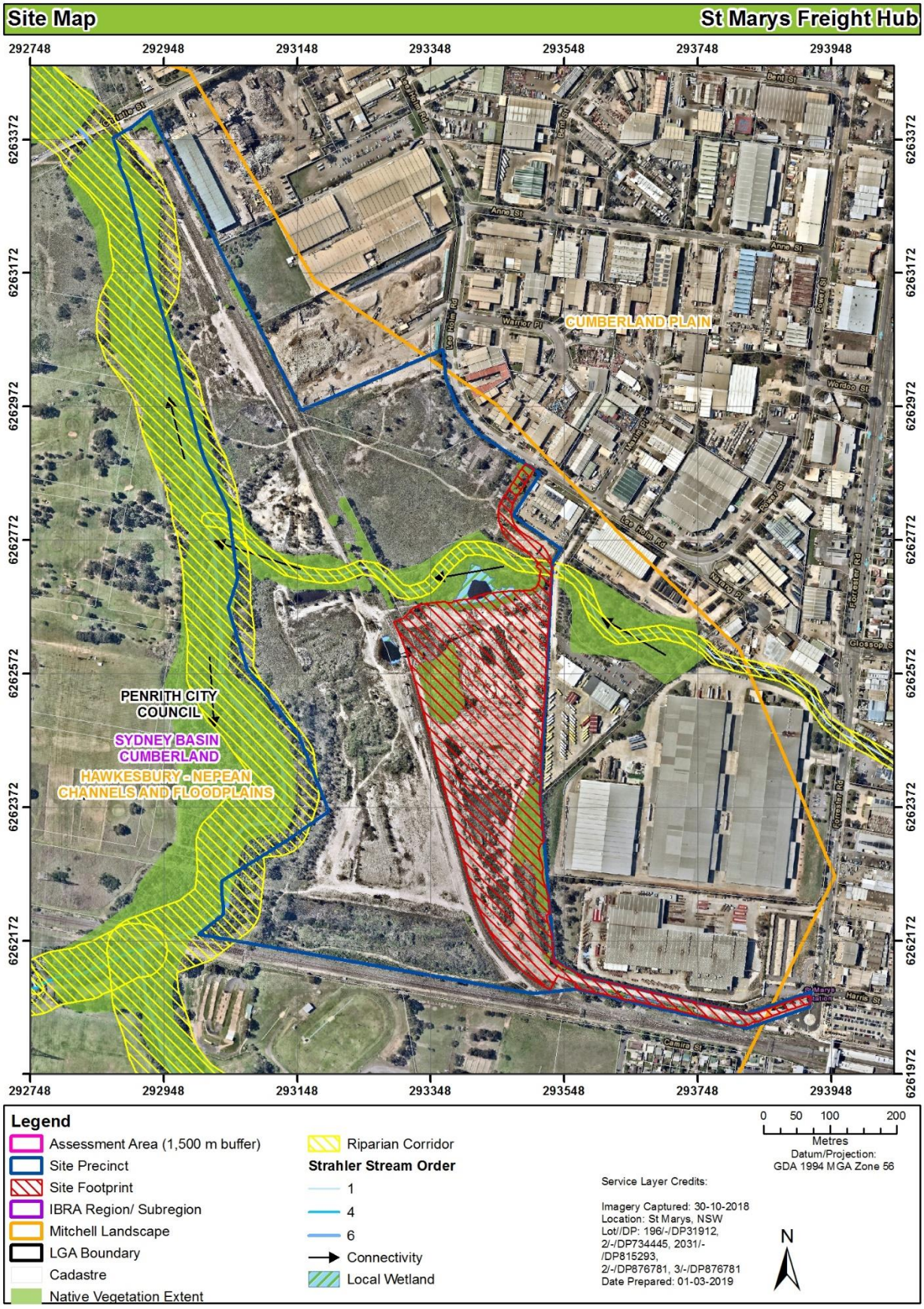

Figure 1: Site Map

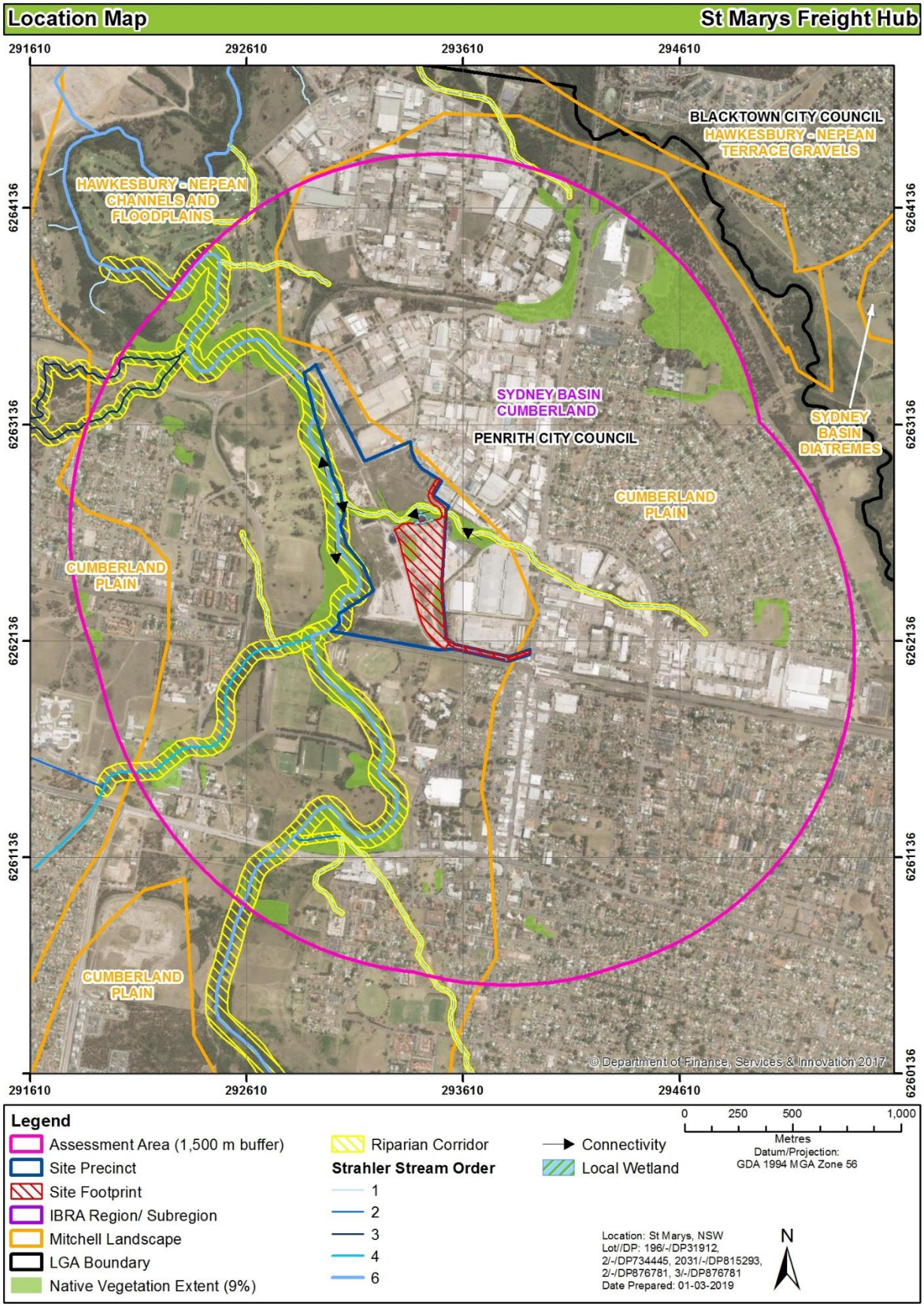

Figure 2: Location Map

1.2 Legislative context

Table 1: Legislative context

Name	Relevance to the project	Report Section
Commonwealth		
Environmental Protection and Biodiversity Conservation Act 1999	Matters of national Environmental Significance have been identified on or near the development site. This report assesses impacts to MNES and concludes that the development is not likely to have a significant impact on MNES.	2.6
State		
Environmental Planning and Assessment Act 1979	The proposed development is State Significant Development and is to be assessed under Part 4.1 of the EP&A Act.	N/A
Biodiversity Conservation Act 2016	The proposed development exceeds the BAM threshold and requires submission of a Biodiversity Development Assessment Report.	BDAR
Local land Services Amendment Act 2016	The LLS Act does not apply to this development.	N/A
Planning Instruments		
Vegetation SEPP	The Vegetation SEPP applies to development that does not require consent. As this project requires consent under the EP&A Act, the Vegetation SEPP is not relevant.	N/A
SEPP (Coastal Management) 2018	The proposed development is not located on land subject to SEPP (Coastal Management) 2018.	N/A
SEPP 44 – Koala Habitat Protection	The proposed development is not located within a Local Government Area to which SEPP 44 applies.	N/A
Penrith Local Environment Plan 2010	The subject site is zoned IN1 – General Industrial under the Penrith Local Environmental Plan (LEP) 2010. The development site is not mapped on the Natural Resources Sensitivity Land.	N/A

1.3 Landscape features

1.3.1 IBRA regions and subregions

The development site falls within the Sydney Basin IBRA region and Cumberland subregion.

1.3.2 Mitchell Landscapes

The Development Site falls within two Mitchell Landscapes as outlined in Table 2.

Table 2: Mitchell Landscapes

Mitchell landscape	% of Site Footprint	Description
Cumberland Plain	0.38%	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 ecosystem). Quaternary alluvium along the mains streams. General elevation 30 to 120m, local relief 50m. and sometimes affected by salt in tributary valley floors. Pedal uniform red to brown clays on volcanic hills. Red and brown texture-contrast soils on crests grading to yellow harsh texture-contrast soils in valleys Woodlands and open forest of grey box, forest red gum, narrow-leaved ironbark, thin-leaved stringybark, cabbage gum and broad-leaved apple. Grassy to shrubby understorey often dominated by blackthorn, poorly drained valley floors, often salt affected with swamp oak and paperbark.
Hawkesbury-Nepean Channels	99.62%	Meandering channel and moderately wide floodplain of the Hawkesbury and Nepean rivers on Quaternary sand and gravel. Sand is dominant upstream of the Warragamba River junction, general elevation 0 to 20m, local relief <10m. Undifferentiated alluvial sand to poorly structured gradation profiles of sandy loam or clay loam. Forests on the river flats include blue box (*Eucalyptus baueriana*), broad-leaved apple (*Angophora subvelutina*), manna gum (Eucalyptus viminalis), river peppermint (*Eucalyptus elata*) in upstream sectors and dominated by river oak (*Casuarina cunninghamiana*) possibly originally with rainforest species such as white cedar (*Melia azedarach*) in the lower sectors. Common reed (*Phragmites australis*), cumbungi (*Typha orientalis*) and other aquatic plants are found in the river. Deep organic loams and loamy sands on floodplain with river flat forest of Sydney blue gum (*Eucalyptus saligna*), round-leaved gum (*Eucalyptus deanei*), forest red gum (*Eucalyptus tereticornis*), cabbage gum (Eucalyptus amplifolia), broad-leaved apple, roughbarked apple (*Angophora floribunda*) and river oak. Water gum (*Tristaniopsis laurina*) in protected channel sections. Large swamps and lagoons on the floodplain and in tributary streams below Richmond dammed by levees on the main stream support tall spike rush (*Eleocharis sphacelata*), *Juncus* sp., *Melaleuca* sp., and *Lepidosperma* sp. Below Pitt Town the river is tidal and swamp oak (*Casuarina glauca*), common reed, river mangrove (*Aegiceras corniculatum*), grey mangrove (*Avicennia marina*) and limited salt marsh are found on the muddy sands of the inter-tidal zone.

1.3.3 Native vegetation extent

The extent of native vegetation within the development site and buffer is outlined in Table 3**.**

Table 3: Native vegetation extent

Area within the development site	Area within the 1,500 m buffer area (ha)	Percent cover within 1,500 m buffer area
1.51	92.91	8.71%

There are differences between the mapped vegetation extent and the aerial imagery. Several areas of regrowth native vegetation were identified in the development site which are not visible on the aerial imagery. These regrowth areas have been included in the assessment.

1.3.4 Patch size

All native vegetation within the study formed part of a single patch >100 ha.

1.3.5 Rivers and streams

The development site contains rivers and streams as outlined in Table 4.

Table 4: Rivers and streams

River/stream	Order	Riparian buffer
Unnamed	1	10 m

1.3.6 Wetlands

The development site does not contain any mapped important wetlands. PCT 1071, which has been mapped within and adjacent to the development site is a form of freshwater wetlands, and has been mapped as a local wetland.

1.3.7 Connectivity features

The development site contains areas of connecting habitat as shown in Figure 1 and Figure 2

1.3.8 Areas of geological significance and soil hazard features

The development site does not contain areas of geological significance and soil hazard features.

1.3.9 Method applied

The site based method has been applied to this development.

1.4 Native vegetation

1.4.1 Survey effort

Vegetation survey was undertaken within the development site by Mike Lawrie and Kirsten Velthuis on 6 December 2018 to identify Plant Community Types (PCTs) (Table 5 and Figure 3), collect plot data and note potential threatened species habitat. Four vegetation plots were collected in accordance with the Biodiversity Assessment Method (BAM) to assess the composition, condition and integrity of PCTs.

Additional field work was undertaken by Kirsten Velthuis and Griffin Taylor-Dalton on 29 and 30 January 2019 to collect data from one additional vegetation plot and conduct targeted surveys for threatened flora and *Meridolum corneovirens* (Cumberland Plain Land Snail) as part of the BAM requirements.

Microchiropteran bat (microbat) survey using Anabat detectors was undertaken over four nights between 11 and 15 February 2019. Microbat roost searches in culverts was undertaken by Mike Lawrie on 11 February 2019.

A total of five full-floristic and vegetation integrity plots were surveyed to identify PCTs and TECs on the development site (Table 5).

All field data collected at full-floristic and vegetation integrity plots is included in Appendix B.

Table 5: Full-floristic and vegetation integrity plots

Veg Zone	PCT ID	PCT Name	Condition	Area (ha)	Plots required	Plots surveyed
1	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Degraded	0.33	1	1
2	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Regrowth	0.33	1	1
3	1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Degraded	0.07	1	1
4	1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Poor	0.69	1	1
5	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	0.09	1	1

1.4.2 Plant Community Types present

A total of three PCTs were identified on the development site (Table 6, Figure 3). All three are listed TECs under the TSC Act (Table 7, Figure 5). The development site does not contain any listed TECs under the EPBC Act. Justification for the selection of PCTs occurring on the development site is based on a quantitative analysis of full-floristic plot data and is provided in Section 1.4.3.

Table 6: Plant Community Types

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area	Percent cleared
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland	Coastal Floodplain Wetlands	Forested Wetlands	0.66	93

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Area	Percent cleared
	Plain, Sydney Basin Bioregion				
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Coastal Floodplain Wetlands	Forested Wetlands	0.76	60
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Wetlands	0.09	75

Table 7: Threatened Ecological Communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Area (ha)	Listing status	Name	Area (ha)
835	EEC	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.66	Not Listed	N/A	N/A
1800	EEC	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.76	Not Listed	N/A	N/A
1071	EEC	Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South	0.09	Not Listed	N/A	N/A

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Area (ha)	Listing status	Name	Area (ha)
		East Corner Bioregions				

1.4.3 PCT selection justification

In determining the PCT for the Development Site, various attributes were considered in combination to assign vegetation to the best fit PCT. Attributes included dominant species in each stratum, community composition, soils and landscape position. Reference was made to the PCT descriptions in the BioNet Vegetation Classification, the final scientific determination and other published documents describing the vegetation community.

ELA considered the native vegetation within the development site comprises three native PCTs:

- PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion
- PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley
- PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

1.4.3.1 PCT 835 - Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion

PCT 835 makes up the majority of native vegetation within the development site. This community is generally located along drainage lines and riparian corridors. Previous vegetation mapping (OEH, 2013) mapped this PCT occurring along the drainage line and adjacent to the dam through the centre of the development site. This PCT within the development site was dominated by a canopy of *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus moluccana* (Grey Box) and *Angophora floribunda* (Rough-barked Apple). The midstorey contained *Casuarina glauca* (Swamp Oak), *Acacia parramattensis* (Parramatta Wattle) and *Bursaria spinosa* subsp. *spinosa* (Blackthorn). Parts of this community contained dense stands of the threatened species *Grevillea juniperina* subsp. *juniperina* (Small-flowered Grevillea). The ground layer has been degraded by weed incursion and is dominated by exotic species including *Eragrostis curvula* (African Love Grass) and *Sida rhombifolia* (Paddy's Lucerne). Several native groundcover species are also present including *Microlaena stipoides* (Weeping Meadow Grass), *Themeda triandra* (Kangaroo Grass) and *Dichondra repens* (Kidney Weed).

A quantitative analysis was undertaken for Plot 2 and Plot 4 which have been assigned to this PCT. Plot 2 had 2 diagnostic species matches with PCT 835 using the BioNet Vegetation Classification Community Identification tool. One other PCT was considered to be potentially consistent, PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, which had 3 diagnostic species matches. Plot 4 had 3 diagnostic species matches with PCT 835 and 2 diagnostic species matches with PCT 849. It was determined that PCT 835 was the best fit PCT based on the plot data in addition to the location of the PCT within drainage lines and riparian corridors,the presence of *Angophora floribunda* (Rough-barked Apple) and *Casuarina glauca* (Swamp Oak) which typically occur in alluvial woodlands and previous mapping within the study area (OEH, 2013).

1.4.3.2 PCT 1800 - Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley

PCT 1800 has been assigned to patches of vegetation consisting almost entirely of *Casuarina glauca*. These areas are generally located in disturbed drainage ditches and depressions in the landscape. This community does not contain remnant vegetation and is generally composed of disturbed regrowth. This PCT is similar in composition to and has been derived from PCT 835. Within the development site, this PCT has been separated from PCT 835 based on the descriptive attributes of PCT 1800 within BioNet Vegetation Classification which states "*the distinguishing feature is the prominent stands of swamp oak (Casuarina glauca) found along or near streams. Often these are relatively young trees, swarming amongst a mix of old and young eucalypts".* This differs from PCT 835 in the development site which is dominated by eucalypts with a lower abundance of swamp oak. Other species occurring within this PCT include *Acacia longifolia* subsp. *longifolia*, *Acacia parramattensis, Microlaena stipoides* and *Dichondra repens*. Exotic species are also prevalent within this PCT including *Eragrostis curvula, Sida rhombifolia, Ligustrum lucidum* (Large-leaf Privet) and *Ligustrum sinense* (Small-leaf Privet).

1.4.3.3 PCT 1071 - Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion

This PCT occurs within dams and man-made waterlogged drainage ditches within the development site. This PCT is dominated by dense stands of *Typha orientalis* (Broad-leaf Cumbungi) and lower abundance of aquatic species including *Juncus acutus* (Sharp Rush) and *Persicaria decipiens* (Slender Knotweed). This PCT has been classified based on the BioNet Vegetation Classification descriptive attributes and landscape position which describes the PCT as occurring in *"man-made water bodies, drainage lines and depressions across a wide variety of environments".* This PCT is most consistent with vegetation in the development site compared to similar freshwater wetland communities based on the high level of modification of the drainage lines and dams in which it occurs, it does not constitute a remnant or naturally occurring freshwater wetland.

1.4.4 Threatened Ecological Community Justification

PCT 835 is listed as 'largely equivalent to' the TEC RFEF in BioNet Vegetation Classification. It was determined that both zones of PCT 835 are consistent with this TEC based on the BioNet classification in addition to dominant flora species which fits the description of the TEC. These characteristic species are *Eucalyptus tereticornis* and *Angophora floribunda* in the canopy, *Bursaria spinosa*, *Casuarina glauca* and *Acacia parramattensis* in the mid-storey and groundcovers including *Microlaena stipoides* and *Dichondra repens.*

PCT 1800 is listed as 'largely equivalent to' the TEC 'Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions' (SOFF) and 'wholly subset of' RFEF in BioNet Vegetation Classification. PCT 1800 within the development site has been classified as the TEC 835, given its location between patches of PCT 835 which is consistent with RFEF. These patches of PCT 1800 dominated by *Casuarina glauca* are likely the result of small scale disturbances or increased salinity. It must be noted that Zone 4 (PCT 1800 – Poor) has not been included as the TEC RFEF for this assessment. This zone is located on soil stockpiles and is characterised by scattered regrowth of Swamp Oak Floodplain Forest and some other native shrub and groundcover species, however, is dominated by exotic shrubs and groundcovers. This vegetation zone is the result of dumped soil containing some seedbank and was assigned a 'best fit PCT'.

1.4.5 Vegetation integrity assessment

A vegetation integrity assessment using the Credit Calculator (BAMC) was undertaken and the results are outlined in Table 8.

Table 8: Vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Composition Condition Score	Structure Condition Score	Function Condition Score	Current vegetation integrity score
1	835	Degraded	0.33	53.6	18.7	45	35.6
2	835	Regrowth	0.33	45.1	30.8	63.8	44.6
3	1800	Degraded	0.07	21.6	17.6	58.4	28.1
4	1800	Poor	0.69	35.7	0.4	17.3	6.5
5	1071	Degraded	0.23	32.7	41.4	-	36.8

1.4.6 Vegetation Zone Descriptions

VEGETATION ZONE 1	
PCT #	835
PCT Name	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
Condition	Degraded
TEC	River Flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion (BC Act)
Area	0.33 ha
Plot Number	2
Vegetation Integrity Score	35.6
Description / Justification	This PCT is characterised by a native canopy of semi-mature trees with a sparse shrub layer and grassy ground layer. Dominant canopy species are *Eucalyptus tereticornis, Eucalyptus moluccana* and *Angophora floribunda.* Mid-storey species include *Acacia parramattensis*, *Casuarina glauca* and *Bursaria spinosa* subsp. *spinosa.* Ground stratum species included *Microlaena stipoides* and *Dichondra repens.*

PCT 835: Plot 2

VEGETATION ZONE 2	
PCT #	835
PCT Name	River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions
Condition	Regrowth
TEC	River Flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion (BC Act)
Area	0.33 ha
Plot Number	4
Vegetation Integrity Score	44.6
Description / Justification	This PCT is characterised by a native canopy of juvenile regrowth eucalypt species including *Eucalyptus tereticornis* and *Angophora floribunda.* The mid-storey is dense with native and exotic shrubs and trees. Native mid-storey species include *Grevillea juniperina* subsp. *juniperina, Acacia parramattensis*, *Acacia longifolia, Acacia floribunda, Casuarina glauca* and *Bursaria spinosa* subsp. *spinosa.* Ground stratum species included *Themeda australis* and *Microlaena stipoides.*

PCT 835: Plot 4

VEGETATION ZONE 3	
PCT #	1800
PCT Name	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley
Condition	Degraded
TEC	River Flat Eucalypt Forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion (BC Act)
Area	0.07 ha
Plot Number	1
Vegetation Integrity Score	44.6
Description / Justification	This PCT is characterised by dense stands of *Casuarina glauca* in the canopy with a sparse mid-storey and ground layer. Native groundcover species included *Microlaena stipoides* and *Dichondra repens.*

PCT 1800: Plot 1

VEGETATION ZONE 4	
PCT #	1800
PCT Name	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley
Condition	Degraded
TEC	Not consistent with TEC
Area	0.69 ha
Plot Number	5
Vegetation Integrity Score	6.5
Description / Justification	This PCT is located in disturbed areas, generally where soil piles have been dumped. This zone is characterised by weeds and sparse native regrowth including *Casuarina glauca*, *Acacia parramattensis, Acacia longifolia* and *Lomandra longifolia.* The ground cover was dominated by *Cynodon dactylon.* Whilst this species can be native in some communities, within the development site and particularly this zone, it was evidently an exotic species resulting from dumped soil and disturbance. It has therefore been counted as an exotic species for the purpose of this assessment.

PCT 1800: Plot 5

VEGETATION ZONE 5	
PCT #	1071
PCT Name	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion
Condition	Moderate
TEC	Not consistent with TEC
Area	0.09
Plot Number	3
Vegetation Integrity Score	36.8
Description / Justification	This PCT is located around dams and waterlogged drainage lines. It is dominated by *Typha orientalis.* Other native species present include *Juncus acutus, Juncus usitatus* and *Persicaria decipiens*

PCT 1071

1.4.7 Use of local data

Use of local data instead of benchmark integrity scores is not proposed.

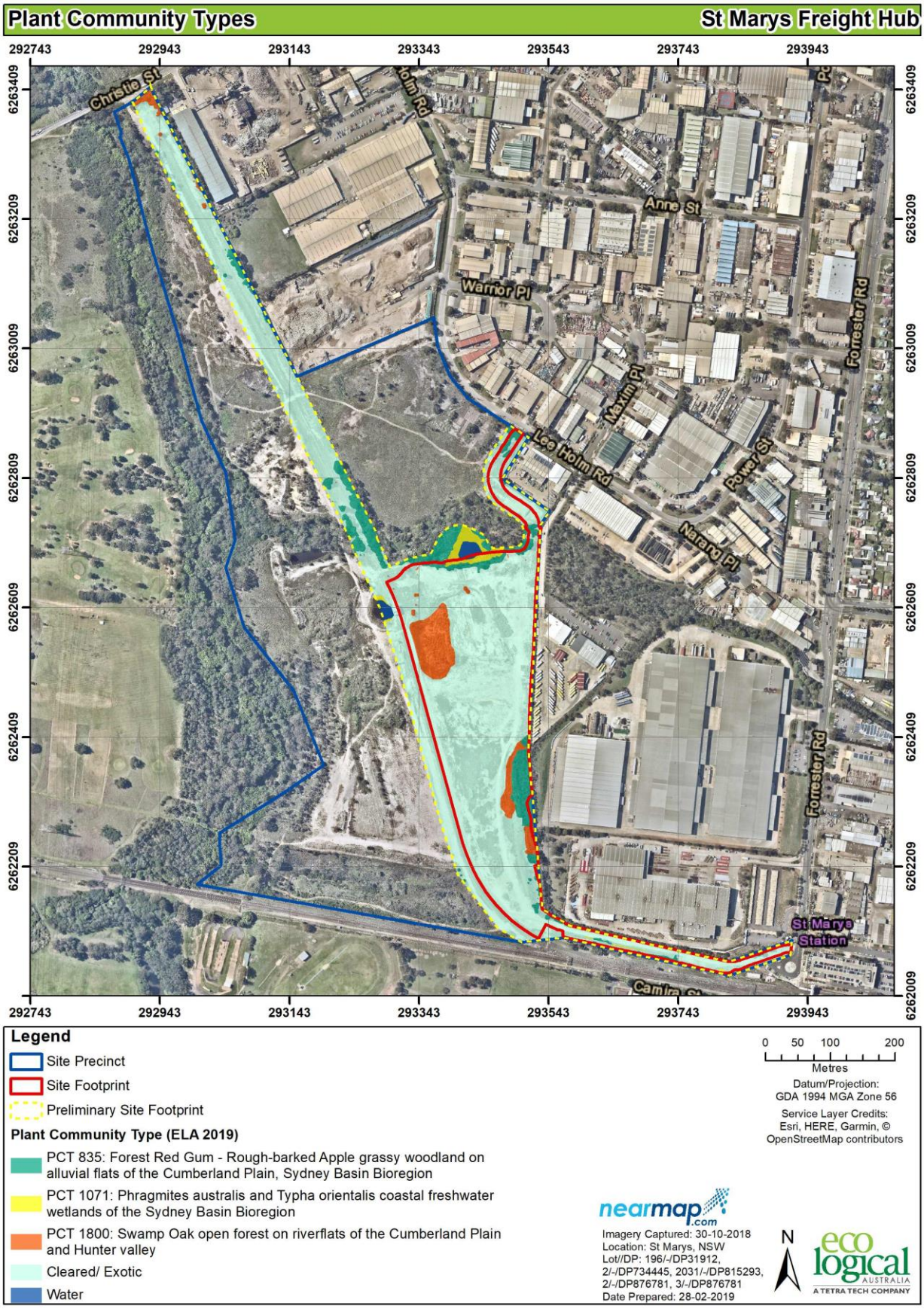

Figure 3: Plant Community Types

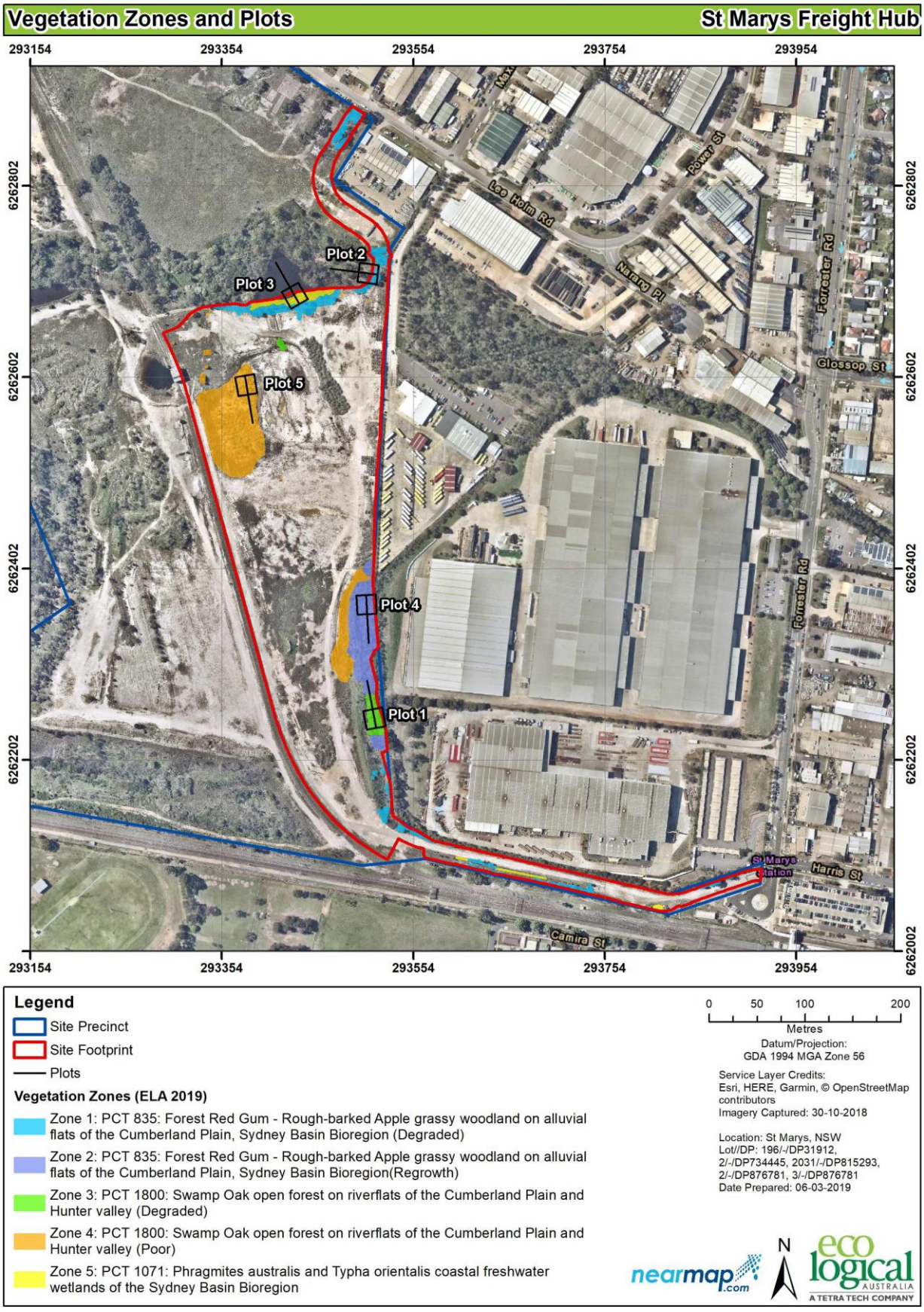

Figure 4: Plot locations

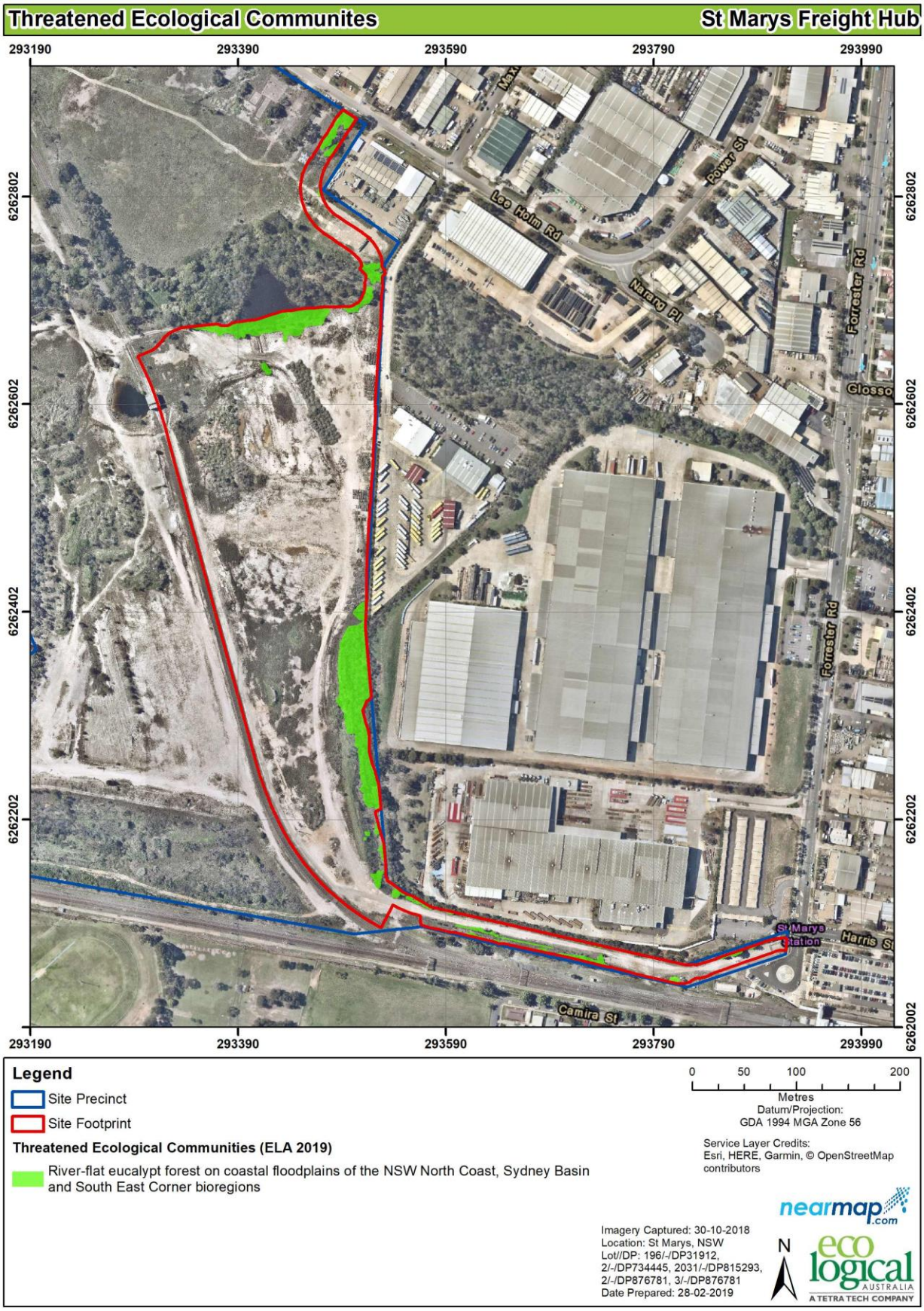

Figure 5: Threatened Ecological Communities

1.5 Ecosystem credit species

Ecosystem credit species predicted to occur at the development site, their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 9.

Three ecosystem credit species were recorded during the Anabat survey: *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Mormopterus norfolkensis* (Eastern Coastal Free-tailed Bat) and *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat) (potential). These species are all microchiropteran bats recorded during the Anabat survey. The calls potentially attributed to *M. schreibersii oceanensis* overlap with several other species and therefore cannot confidently be attributed to the species. Detailed results of the Anabat survey are provided in Appendix C.

Table 9: Predicted ecosystem credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status
Anthochaera phrygia	Regent Honeyeater			High	Critically Endangered	Critically Endangered
Artamus cyanopterus cyanopterus	Dusky Woodswallow			Moderate	Vulnerable	Not Listed
Botaurus poiciloptilus	Australasian Bittern	- Waterbodies - Brackish or freshwater wetlands		Moderate	Endangered	Endangered
Calidris ferruginea	Curlew Sandpiper (Foraging)			High	Endangered	Critically Endangered
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)			Moderate	Vulnerable	Not Listed
Chthonicola sagittata	Speckled Warbler			High	Vulnerable	Not Listed
Circus assimilis	Spotted Harrier			Moderate	Vulnerable	Not Listed
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)			High	Vulnerable	Not Listed
Daphoenositta chrysoptera	Varied Sittella			Moderate	Vulnerable	Not Listed
Dasyurus maculatus	Spotted-tailed Quoll			High	Vulnerable	Endangered
Ephippiorhynchus asiaticus	Black-necked Stork	- Swamps - Shallow, open freshwater of saline wetlands or shallow edges		Moderate	Endangered	Not Listed

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status
		of deeper wetlands within 300m of these Moderate swamps - Shallow lakes, lake margins and estuaries within 300m of these waterbodies				
Epthianura albifrons	White-fronted Chat			Moderate	Vulnerable	Not Listed
Glossopsitta pusilla	Little Lorikeet			High	Vulnerable	Not Listed
Grantiella picta	Painted Honeyeater	- Mistletoes present at a density of greater than five mistletoes per hectare		Moderate	Vulnerable	Vulnerable
Haliaeetus leucogaster	White-bellied Sea-Eagle			High	Vulnerable	Not Listed
Hieraaetus morphnoides	Little Eagle (foraging)			Moderate	Vulnerable	Not Listed
Irediparra gallinacea	Comb-crested Jacana	- Waterbodies - Land within 40m of freshwater and estuarine wetlands, in areas of permanent and dense vegetation		Moderate	Vulnerable	Not Listed
Ixobrychus flavicollis	Black Bittern	- Waterbodies - Land within 40m of freshwater and estuarine wetlands, in areas of permanent water and dense vegetation			Vulnerable	Not Listed
Lathamus discolor	Swift Parrot			Moderate	Endangered	Critically Endangered
Limicola falcinellus	Broad-billed Sandpiper			Moderate	Vulnerable	Not Listed
Limosa limosa	Black-tailed Godwit			High	Vulnerable	Not Listed

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status
Lophoictinia isura	Square-tailed Kite (Foraging)			High	Vulnerable	Not Listed
Melanodryas cucullata cucullata	Hooded Robin (south-eastern form)			Moderate	Vulnerable	Not Listed
Melithreptus gularis gularis	Black-chinned Honeyeater (eastern subspecies)			Moderate	Vulnerable	Not Listed
Miniopterus australis	Little Bentwing-bat (Foraging)			High	Vulnerable	Not Listed
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Foraging)			High	Vulnerable	Not Listed
Mormopterus norfolkensis	Eastern Freetail-bat			High	Vulnerable	Not Listed
Neophema pulchella	Turquoise Parrot			High	Vulnerable	Not Listed
Ninox connivens	Barking Owl (Foraging)			High	Vulnerable	Not Listed
Ninox strenua	Powerful Owl (Foraging)			High	Vulnerable	Not Listed
Pandion cristatus	Eastern Osprey			Moderate	Vulnerable	Not Listed
Petroica boodang	Scarlet Robin			Moderate	Vulnerable	Not Listed
Petroica phoenicea	Flame Robin			Moderate	Vulnerable	Not Listed
Phascolarctos cinereus	Koala			High	Vulnerable	Vulnerable
Pteropus poliocephalus	Grey-headed Flying-fox			High	Vulnerable	Vulnerable
Rostratula australis	Australian Pained Snipe			Moderate	Endangered	Endangered
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat			High	Vulnerable	Not Listed
Stagonopleura guttata	Diamond Firetail			Moderate	Vulnerable	Not Listed
Stictonetta naevosa	Freckled Duck			Moderate	Vulnerable	Not Listed
Tyto novaehollandiae	Masked Owl (Foraging)			High	Vulnerable	Not Listed

1.6 Species credit species

Species credit species predicted to occur at the development site (i.e. candidate species), their associated habitat constraints, geographic limitations and sensitivity to gain class is included in Table 10.

Two species credit species were recorded within the development site. *Grevillea juniperina* subsp. *juniperina* (Juniper-leaved Grevillea) was recorded during the flora survey. *Myotis macropus* (Southern Myotis) was recorded during the Anabat survey. Potential calls of *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat) were also recorded during the Anabat survey. *M. schreibersii oceanensis* is an ecosystem credit species and species credit species when impacting on breeding habitat. *M. schreibersii oceanensis* is known only to breed in a small number of locations in maternity caves which are not present in the development site. Therefore, *M. schreibersii oceanensis*, while potentially present, is excluded as a species credit species.

Table 10: Candidate species credit species

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
Anthochaera phrygia	Regent Honeyeater	- OEH mapped areas		High	CE	CE	Excluded The development site does not contain mapped important areas.
Burhinus grallarius	Bush Stone-curlew	Fallen/standing dead timber including logs		High	E	Not Listed	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM.
Calidris ferruginea	Curlew Sandpiper (Breeding)	- OEH mapped areas		High	E	CE	Excluded Species credit species for Curlew Sandpiper are based on OEH mapped important areas. The development site does not contain mapped important areas.
Callistemon linearifolius	Netted Bottlebrush			High	V	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.
Callocephalon fimbriatum	Gang-gang Cockatoo	- Eucalypt tree species with hollows >9 cm diameter		High	V	Not Listed	Excluded No breeding habitat (Eucalypt tree species with hollows >9cm diameter) is present within the development footprint
Cercartetus nanus	Eastern Pygmy Possum			High	V	Not Listed	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM. Suitable habitat (well-developed mid-storeys containing

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							nectar-producing shrubs such as Banksia spp.) is not present.
Chalinolobus dwyeri	Large-eared Pied Bat	- Cliffs - Within 2km of rocky areas containing caves, overhangs, escarpments, outcrops or crevices, or within 2km of old mines or tunnels		Very High	V	V	Excluded No suitable cliffs, mines or tunnels are known to be within 2km of the development site.
Commersonia prostrata	Dwarf Kerrawang			High	E	E	Excluded The development site does not contain typical soils (sandy, peaty soil) or vegetation associated with this species. No records within 5km of the development site.
Cynanchum elegans	White-flowered Wax Plant			High	E	E	Excluded Associated habitat in the region (Dry Rainforest) not present within or adjacent to the development site. No records within 5km of the development site.
Deyeuxia appressa	Deyeuxia appressa			N/A	E	E	Included Due to lack of information this species was included in the assessment. No records within 5 km of the development site. No individuals were recorded.
Eucalyptus benthamii	Camden White Gum			High	V	V	Excluded Conspicuous species not recorded during field surveys.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea			High	V	Not Listed	Included This species was included in the targeted survey as it was recorded during vegetation surveys. No individuals were recorded.
Gyrostemon thesioides	Gyrostemon thesioides			High	E	Not Listed	Excluded Suitable habitat (hillsides and riverbanks) not present within development site. No records within 5 km of the development site.
Haliaeetus leucogaster	White-bellied Sea-eagle (Breeding)	- Living or mature dead trees within 1 km of rivers, lakes, large dams or creeks, wetlands and coastlines AND the presence of a large stick nest in the canopy		High	V	Not Listed	Excluded No breeding habitat (large stick nests) present in the development site.
Haloragis exalata subsp. *exalata*	Square Raspwort	- Edges of coastal lakes after flooding has removed other vegetation, creek banks within flood zone, areas close to these features subject to human disturbance including road verges and powerline easements or within 100m		Moderate	V	V	Excluded There are no known populations of this species in Sydney.
Hibbertia sp. *Bankstown*				N/A	CE	CE	Excluded Species known from only one population at Bankstown. Associated vegetation type

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							(Castlereagh Ironbark Forest/ Castlereagh Scribbly Gum Woodland) not present within development site. No records within 5 km of the development site.
Hieraaetus morphnoides	Little Eagle (Breeding)	- Nest trees – live (occasionally dead) large old trees within vegetation		Moderate	V	Not Listed	Excluded No large nests present within development site.
Lathamus discolor	Swift Parrot (Breeding)	- As per OEH mapped areas		Moderate	E	CE	Excluded Not within OEH mapped area.
Limicola falcinellus	Broad-billed Sandpiper (Breeding)	- As per OEH mapped areas		High	V	Not Listed	Excluded Not within OEH mapped area.
Limosa	Black-tailed Godwit (Breeding)	- As per OEH mapped areas		High	V	Not Listed	Excluded Not within OEH mapped area.
Litoria aurea	Green and Golden Bell Frog	- Within 1km of wet areas - Within 1km of swamp - Within 1km of waterbody		High	E	V	Included This species was included in the targeted survey. No individuals were recorded.
Lophoictinia isura	Square-tailed Kite (Breeding)	- Nest trees		Moderate	V	Not Listed	Excluded No large nests present within development site.
Marsdenia viridiflora subsp. *viridiflora* – *endangered population*	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd,		Those LGAs named in the population's listing	High	E2	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
	Liverpool and Penrith local government areas						
Maundia triglochinoides		- Swamps or shallow fresh water on clay		High	V	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.
Melaleuca biconvexa	Biconvex Paperbark	- Swamps - Swamp margins or creek edges		High	V	V	Included This species was included in the targeted survey. No individuals were recorded.
Meridolum corneovirens	Cumberland Plain Land Snail			High	E	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.
Miniopterus australis	Little Bentwing-bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding		Very High	V	Not Listed	Excluded Species known only to breed in maternity caves. No breeding habitat present in the development site.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat (Breeding)	Cave, tunnel, mine, culvert or other structure known or suspected to be used for breeding		Very High	V	Not Listed	Excluded Species known only to breed in maternity caves. No breeding habitat present in the development site.
Myotis macropus	Southern Myotis	- Hollow-bearing trees - Within 200m of a riparian zone - Bridges, caves or artificial structures within 200m of riparian zone		High	V	Not Listed	Included This species was recorded during the targeted survey.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
Ninox connivens	Barking Owl (Breeding)	Living or dead trees with hollows >20cm diameter and >4m above the ground		High	V	Not Listed	Excluded No breeding habitat (living or dead trees with hollows >20cm diameter and >4m above the ground) present in development site.
Ninox strenua	Powerful Owl (Breeding)	Living or dead trees with hollows >20cm		High	V	Not Listed	Excluded No breeding habitat (living or dead trees with hollows >20cm diameter) present in development site.
Pandion cristatus	Eastern Osprey (Breeding)	Living and dead trees (>15m) or artificial structures within 100m of a floodplain		Moderate	V	Not Listed	Excluded No large nests present in development site. No records within 5km of development site.
Persicaria elatior	Tall Knotweed	- Semi-permanent/ephemeral wet areas or within 50m - Swamps or within 50m - Waterbodies including wetlands, or within 50m		Moderate	V	V	Included This species was included in the targeted survey. No individuals were recorded.
Persoonia hirsuta	Hairy Geebung			High	E	E	Excluded No habitat is present in the development site for this species which occurs in woodland or heath on sandstone.
Petaurus norfolcensis	Squirrel Glider			High	V	Not Listed	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM. No hollow-bearing trees are present within the

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
							development site which are an important habitat component of Squirrel Gliders.
Phascolarctos cinereus	Koala (Breeding)	- Areas identified as important habitat via survey		High	V	V	Excluded Habitat within the development site is substantially degraded such that the species is unlikely to utilise the subject land in accordance with Section 6.4.1.17 of the BAM. Potential foraging trees (*Eucalyptus tereticornis*) occur in low abundance.
Pilularia novae-holandiae	Austral Pillwort			High	E	Not Listed	Included This species was included in the targeted survey. No individuals were recorded.
Pomaderris brunnea	Brown Pomaderris			High	E	V	Included This species was included in the targeted survey. No individuals were recorded.
Pteropus poliocephalus	Grey-headed Flying-fox (Breeding)	- Breeding camps		High	V	V	Excluded No camps present in development site.
Tyto novaehollandiae	Masked Owl (Breeding)	Living or dead trees within hollows >20cm diameter		High	V	Not Listed	Excluded No breeding habitat (living or dead trees with hollows >20cm diameter) present in development site.
Wahlenbergia multicaulis endangered population	Tadgell's Bluebell in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby,	- Land situated in damp, disturbed sites		High	E2	Not Listed	Excluded Development site not within LGA's of endangered population.

Species	Common Name	Habitat Constraints	Geographic limitations	Sensitivity to gain class	NSW listing status	EPBC Listing status	Justification for species to be included or excluded
	Parramatta and Strathfield						
Zannichellia palustris		- Waterbodies - Land containing freshwater bodies		High	E	Not Listed	Excluded This species was not included in the targeted survey. Only two known populations in NSW in the lower Hunter and Sydney Olympic Park. No local records.

1.6.1 Targeted surveys

Targeted surveys for species credit species were undertaken at the development site on the dates outlined in Table 11. The location of targeted surveys are shown in Figure 6, with the results of the surveys shown as individual species polygons on Figure 7.

Table 11: Targeted surveys and weather conditions

Date	Surveyors	Target species	Rainfall (mm)	Min temp (°C)	Max temp (°C)
3 December 2018	Danielle Adams-Bennett and Griffin Taylor-Dalton	*Litoria aurea*	0	14.4	31.4
4 December 2018	Danielle Adams-Bennett and Griffin Taylor-Dalton	*Litoria aurea*	0	14.7	27.6
5 December 2018	Kirsten Velthuis and Griffin Taylor-Dalton	*Litoria aurea*	1.0	15.9	20.8
6 December 2018	Kirsten Velthuis, Griffin Taylor-Dalton and Mike Lawrie	*Litoria aurea* Opportunistic fauna survey	0.2	13.6	30.4
29 January 2019	Kirsten Velthuis and Griffin Taylor-Dalton	Threatened flora	0.2	20.9	34.7
30 January 2019	Kirsten Velthuis and Griffin Taylor-Dalton	*Meridolum corneovirens*	0	21.4	34.8
11 February 2019	Mike Lawrie / Anabat	*Myotis macropus*	0	14.7	35.0
12 February 2019	Anabat	*Myotis macropus*	0	14.4	38.3
13 February 2019	Anabat	*Myotis macropus*	0	19.5	30.2
14 February 2019	Anabat	*Myotis macropus*	0	17.7	28.9

Survey effort undertaken at the development is outlined in Table 12.

Table 12: Survey effort

Candidate species	Survey method	Total effort within development site	BAM survey period	Species present
Litoria aurea	Habitat search, call playback	4 nights x 2 ecologists	November - March	No
Meridolum corneovirens	Targeted search	2 days x 2 ecologists	All year	No

Candidate species	Survey method	Total effort within development site	BAM survey period	Species present
Myotis macropus	Acoustic detection Roost search	16 nights (4 nights x 4 Anabats) 1 hour (30 minutes x 2 culverts)	October - March	**Yes**
Callistemon linearifolius	Parallel transect	2 days x 2 ecologists	September - March	No
Deyeuxia appressa	Parallel transect	2 days x 2 ecologists	Not Listed	No
Grevillea juniperina **subsp. *juniperina***	Parallel transect	2 days x 2 ecologists	All year	**Yes**
Haloragis exalata **subsp. *exalata***	Parallel transect	2 days x 2 ecologists	All year	No
Maundia triglochinoides	Parallel transect	2 days x 2 ecologists	November - March	No
Persicaria elatior	Parallel transect	2 days x 2 ecologists	December - May	No
Pilularia novae-hollandiae	Parallel transect	2 days x 2 ecologists	October - December	No

Following completion of targeted surveys, the species credit species included in the assessment are outlined in Table 13.

Table 13: Species credit species included in the assessment

Species	Common Name	Species presence	Geographic limitations	Habitat (ha)	Biodiversity Risk Weighting
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	Yes (surveyed)	None	0.7 ha	2.00
Myotis macropus	Southern Myotis	Yes (surveyed)	None	0.9 ha	2.00

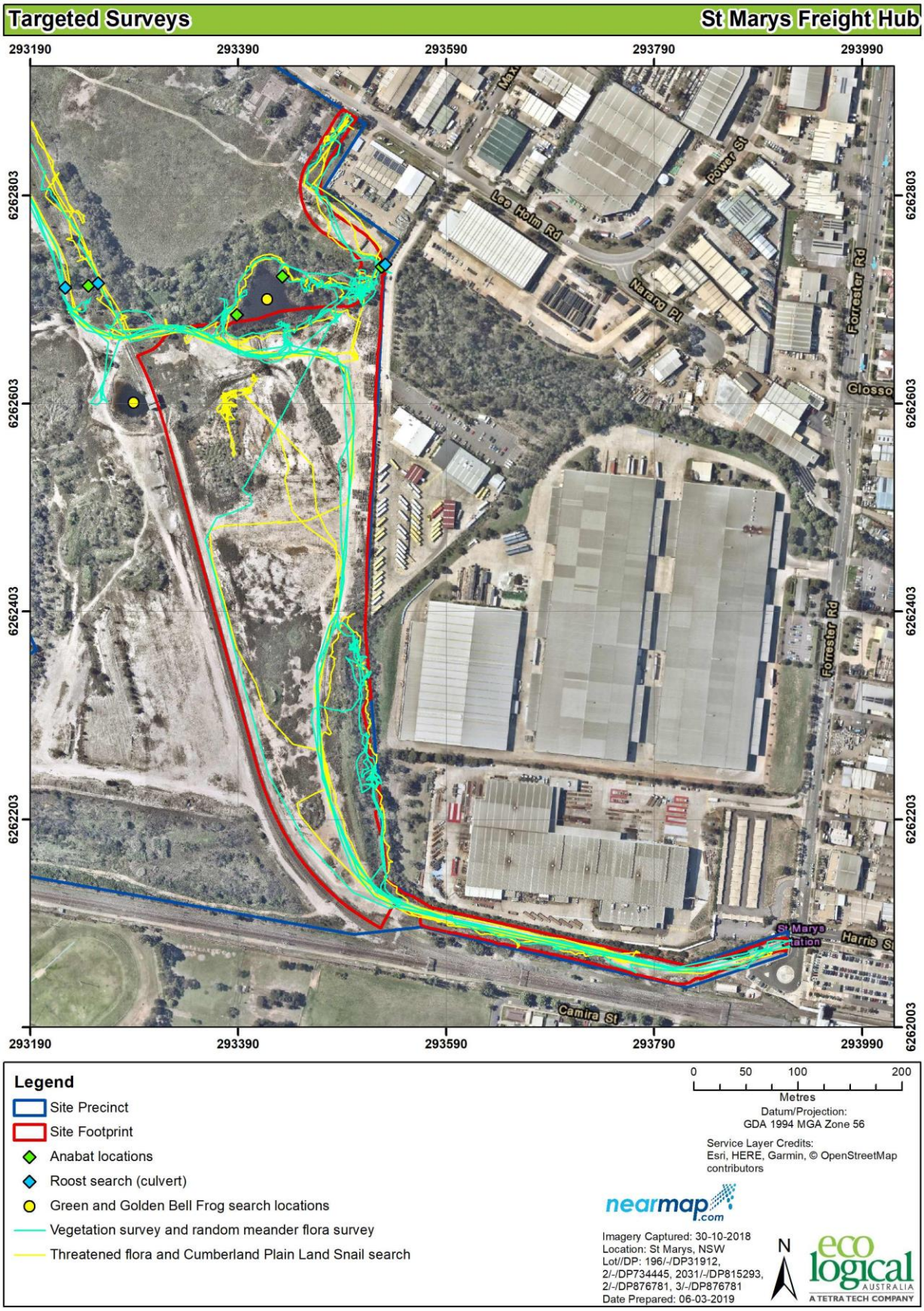

Figure 6: Targeted threatened species surveys

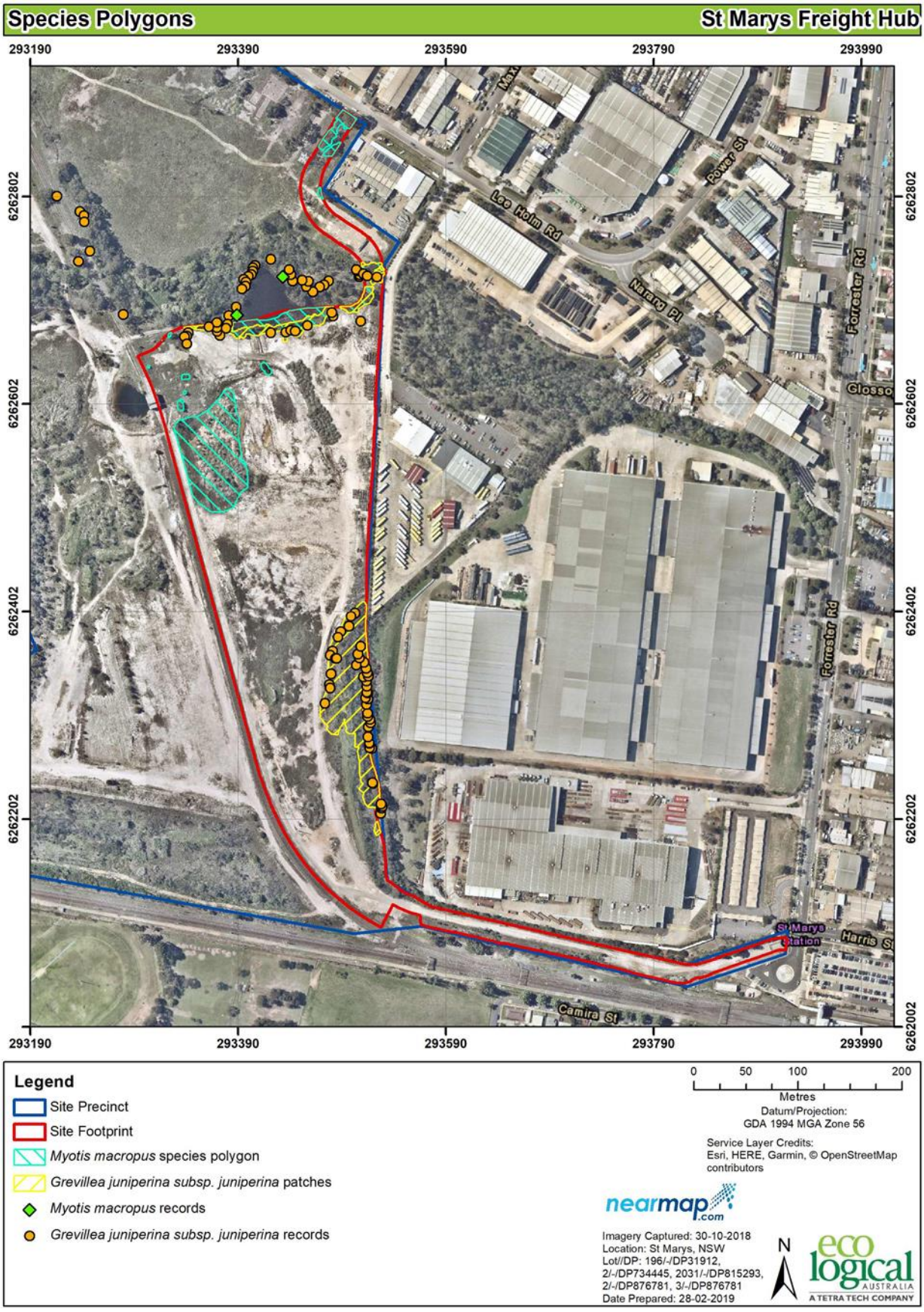

Figure 7: Species credit polygons

1.6.2 Use of local data

Use of local data is not proposed for this assessment.

1.6.3 Expert reports

Expert reports have not been used for this assessment.

2. Stage 2: Impact assessment (biodiversity values)

2.1 Avoiding impacts

2.1.1 Locating a project to avoid and minimise impacts on vegetation and habitat

The development has been located in a way which avoids and minimises impacts as outlined in Table 14.

Table 14: Locating a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
locating the project in areas where there are no biodiversity values	The project has been located predominantly in areas where there are no biodiversity values.	The project has been located predominantly in exotic grasslands and disturbed areas which do not contain biodiversity values. The project area has been reduced in size, resulting in a reduced impact on native vegetation from approximately 2.94 ha to 1.5 ha.
locating the project in areas where the native vegetation or threatened species habitat is in the poorest condition	The project is primarily located in areas where native vegetation is in poor condition.	The project is located predominantly in exotic grassland which does not contain native vegetation. The project has been relocated to minimise impacts to vegetation zones with higher vegetation integrity scores.
locating the project in areas that avoid habitat for species and vegetation in high threat categories (e.g. an EEC or CEEC), indicated by the biodiversity risk weighting for a species	The project is predominantly located in exotic grassland and has avoided impacts to vegetation in high threat categories where possible. Impacts to vegetation and species in high threat categories has been reduced.	The project is predominantly located in exotic grassland to avoid impacts to vegetation in high threat categories. Impacts to the EEC River Flat Eucalypt Forest has been reduced through revision of the development footprint size and location. Impacts to Southern Myotis and *Grevillea juniperina* subsp. *juniperina* (both species have high biodiversity risk weighting of 2.0) have been significantly reduced through revision of the building footprint.
locating the project such that connectivity enabling movement of species and genetic material between areas of adjacent or nearby habitat is maintained	Connectivity enabling movement of species and genetic material between areas of nearby habitat will be maintained.	Connectivity between areas of habitat will be maintained. The development site provides a marginal corridor from a small patch of vegetation along the riparian corridor to the east, to the large area of riparian vegetation to the west. This riparian corridor is well connected to several larger patches of habitat to the north. The project will result in the widening of gap between land to the east and the development site. However, these patches are already separated by an existing road and genetic material will still be able to

Approach	How addressed	Justification
		be transferred across the gap and along the stream. This connection is unlikely to be used by fauna except for mobile species which would not be impeded by the existing fencing. The development will not sever the connectivity of these mobile species.

2.1.2 Designing a project to avoid and minimise impacts on vegetation and habitat

The development has been designed in a way which avoids and minimises impacts as outlined in Table 15.

Table 15: Designing a project to avoid and minimise impacts on vegetation and habitat

Approach	How addressed	Justification
reducing the clearing footprint of the project	The clearing footprint has been reduced.	Redesign of the project footprint has resulted in significant reduction in the amount of clearing required. The redesign has resulted in the following clearing reductions: • Zone 1 PCT 835 – Degraded: 1.12 ha to 0.33 ha • Zone 2 PCT 835 – Regrowth: 0.71 ha to 0.33 ha • Zone 3 PCT 1800 – Degraded: 0.19 ha to 0.07 ha • Zone 4 PCT 1800 – Poor: No change • Zone 5 PCT 1071 – Moderate: 0.23 ha to 0.09 ha
locating ancillary facilities in areas where there are no biodiversity values	Ancillary facilities will be located where there are no biodiversity values.	Ancillary features for the purposes of construction will be located within the operational footprint, avoiding additional impacts to areas containing biodiversity values.
locating ancillary facilities in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower vegetation integrity score)	Ancillary facilities will be located within the operational footprint and will not result in removal of additional vegetation or threatened species habitat.	Ancillary features for the purposes of construction will be located within the operational footprint, avoiding additional impacts to areas of native vegetation or threatened species habitat.
locating ancillary facilities in areas that avoid habitat for species and vegetation in high threat status categories (e.g. an EEC or CEEC)	Ancillary facilities will be located within the operational footprint and will not result in removal of threatened species habitat or vegetation in in high threat categories.	Ancillary features for the purposes of construction will be located within the operational footprint, avoiding additional impacts threatened species habitat or vegetation in high threat categories.

Approach	How addressed	Justification
providing structures to enable species and genetic material to move across barriers or hostile gaps	The development will not include structures to enable species and genetic material to move across barriers or hostile gaps.	It is considered unnecessary to provide structures to allow movement of species and genetic material across gaps. A small gap exists between vegetation in the development site and vegetation to the east of the development site due to an existing road. This gap will be widened, however, genetic material and mobile species such as birds and bats will still be able to cross this gap. The existing culvert also provides a potential crossing point under the road for some species. This culvert will be extended with the construction of an additional road and this connectivity will be maintained.
making provision for the demarcation, ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on the development site.	Recommendations pertaining to the demarcation and maintenance of retained native vegetation have been provided.	The boundaries of the development footprint are to be clearly demarcated prior to commencement of construction to protect retained native vegetation. It is recommended that a Vegetation Management Plan (VMP) be prepared and implemented within the riparian corridor directly to the north of the development site to enhance retained native vegetation which has been degraded by weed infestation.
Efforts to avoid and minimise impacts through design must be documented and justified	Efforts to avoid and minimise impacts have been documented and justified.	Efforts to avoid and minimise impacts have been provided below in Figure 9, showing the original development footprint and updated footprint following advice from ELA to modify the development footprint.

2.1.3 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 16.

Table 16: Prescribed biodiversity impacts

Prescribed biodiversity impact	Description in relation to the development site	Threatened species or ecological communities effected
impacts of development on the habitat of threatened species or ecological communities associated with human made structures	The development will result in impacts to man-made structures which consists of a culvert at the eastern edge of the development site.	Potential roosting habitat for Southern Myotis, Little Bentwing-bat, Eastern Bentwing-bat and Yellow-bellied Sheathtail-bat.
impacts of development on the connectivity of different areas of	The development will increase the distance between to areas of	River Flat Eucalypt Forest.

Prescribed biodiversity impact	Description in relation to the development site	Threatened species or ecological communities effected
habitat of threatened species that facilitates the movement of those species across their range	vegetation from 10m to approximately 35 m.	
impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities	Construction of culvert over waterbody. Impact on small area of dams.	Southern Myotis

2.1.3.1 Locating a project to avoid and minimise prescribed biodiversity impacts

The development has been located in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 17.

Table 17: Locating a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
locating the envelope of surface works to avoid direct impacts on the habitat features	The proposed development has been revised to avoid impacts on man-made habitat features where possible.	The proposed development footprint has been realigned to minimise impacts on man-made habitat features including culverts. The original footprint included works to an existing trainline over the top of a culvert in the east of the site which would have indirect impacts on microchiropteran bat species which have potential roosting habitat in the culvert (note that Southern Myotis was not recorded adjacent to any culverts). A new road will be constructed adjacent to the culvert to the east of the development site which could have indirect noise, light and vibration impacts on potentially roosting Southern Myotis. Southern Myotis was not recorded in the eastern culvert despite targeted searches and only limited habitat is available. The culvert will be retained and an additional culvert will be constructed under the new proposed road providing additional roosting habitat.
locating the project to avoid severing or interfering with corridors connecting different areas of habitat, migratory flight paths to important habitat or preferred local movement pathways	The project has been located to minimise impacting connectivity of habitat.	The proposed development will have only minor impacts to connectivity of habitat. The gap between vegetation in the east of the site and that offsite will be increased from 10 m to approximately 35 m. This is unlikely to prevent the spread of genetic material or impact the movement of mobile species such as birds and bats across

Approach	How addressed	Justification
		the habitat. This area of connectivity is degraded and considering the fenced road currently between the patches, it is likely that only mobile species would currently rely on this connectivity. The existing culvert which may provide a pathway of movement for some species will be retained and extended allowing continued movement under the road.
locating the project to avoid direct impacts on water bodies	The project has been realigned to minimise impacts on waterbodies.	The development footprint has been revised to avoid impacts to two dams which provide foraging habitat for Southern Myotis. Only a small section of creekline (25 m) which contains ephemeral water will be impacted by the development.

2.1.3.2 Designing a project to avoid and minimise prescribed biodiversity impacts

The development has been designed in a way which avoids and minimises prescribed biodiversity impacts as outlined in Table 18.

Table 18: Designing a project to avoid and minimise prescribed biodiversity impacts

Approach	How addressed	Justification
design of project elements to minimise interactions with threatened and protected species and ecological communities, e.g. designing turbines to dissuade perching and minimise the diameter of the rotor swept area, designing fencing to prevent animal entry to transport corridors	Design controls should be implemented during construction to prevent impacts on any microbats within the culvert to be impacted.	Controls should be implemented during construction to prevent impacts on any microbats within the culvert to be impacted, if microbats are recorded during pre-clearance surveys.
design of the project to maintain environmental processes critical to the formation and persistence of habitat features not associated with native vegetation	The project will minimise impacts on microbat habitat not associated with native vegetation (i.e. culverts and dams).	The project has been redesigned resulting in avoiding impacting on one additional culvert and minimising impacts on waterbodies. Impacts to microbats associated with direct and indirect impacts to the culvert will be minimised through mitigation measures including pre-clearance surveys and control measures for potentially roosting bats (if found during pre-clearance surveys).
design of the project to avoid and minimise downstream impacts on rivers, wetlands and estuaries by control of the quality of water released from the site.	The proposed development will implement measures to avoid downstream impacts to waterbodies.	Appropriate sediment and stormwater control measures are to be implemented during construction and operation to prevent sedimentation and contamination of downstream waterbodies.

2.2 Assessment of Impacts

2.2.1 Direct impacts

The direct impacts of the development on:

- native vegetation are outlined in Table 19
- threatened ecological communities are outlined in Table 20
- threatened species and threatened species habitat is outlined in Table 21
- prescribed biodiversity impacts is outlined in Section 2.2.2

Direct impacts including the final project footprint (construction and operation) are shown on Figure 8.

Table 19: Direct impacts to native vegetation

PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Floodplain Wetlands	Forested Wetlands	0.66
1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Coastal Floodplain Wetlands	Forested Wetlands	0.76
1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Wetlands	0.09

Table 20: Direct impacts on threatened ecological communities

PCT ID	BC Act			EPBC Act		
	Listing status	Name	Direct impact (ha)	Listing status	Name	Direct impact (ha)
835, 1800	EEC	River-Flat Eucalypt Forest of Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions	0.72	Not Listed	N/A	N/A

Table 21: Direct impacts on threatened species and threatened species habitat

Species	Common Name	Direct impact on habitat (ha)	NSW listing status	EPBC Listing status
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	0.71	Vulnerable	Not Listed
Myotis macropus	Southern Myotis	0.86	Vulnerable	Not Listed

2.2.2 Change in vegetation integrity

The change in vegetation integrity as a result of the development is outlined in Table 22.

Table 22: Change in vegetation integrity

Veg Zone	PCT ID	Condition	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	Change in vegetation integrity
1	835	Degraded	0.33	35.6	0	-35.6
2	835	Regrowth	0.33	44.6	0	-44.6
3	1800	Degraded	0.07	28.1	0	-28.1
4	1800	Poor	0.69	6.5	0	-6.5
5	1071	Moderate	0.09	36.8	0	-36.8

2.2.3 Indirect impacts

The indirect impacts of the development are outlined in Table 23.

Table 23: Indirect impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
sedimentation and contaminated and/or nutrient rich run-off	Construction	Runoff during construction and operation	Potential sedimentation and contaminated runoff into adjacent creek and dams	During heavy rainfall or storm events	Throughout construction and operation period	Potentially long-term impacts
noise, dust or light spill	Construction	Noise and dust from machinery. Light spill during operational phase	Adjacent vegetation and culverts	Daily, during construction works and operational phases	Throughout construction and operation period	Potentially long-term impacts
inadvertent impacts on adjacent habitat or vegetation	Construction	Damage to adjacent habitat or vegetation	Adjacent vegetation and culverts	Daily, during construction works and	Throughout construction and	Potentially long-term impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
				operational phases	operation period	
transport of weeds and pathogens from the site to adjacent vegetation	Construction	Spread of weed seed and pathogens from incoming machinery and equipment	Potential spread into nearby habitat	Daily, during construction and operational phases	Throughout construction and operation period	Potentially long-term impacts
vehicle strike	Construction / operation	Potential for native fauna to be struck by working machinery and moving vehicles	Within development site and adjacent	Daily, during construction and operational phases	Throughout construction and operation period	Potentially long-term impacts
trampling of threatened flora species	Construction / operation	Potential impacts to *Grevillea juniperina* subsp. *juniperina*	Within and adjacent to development site	Daily, during construction and operational phases	Throughout construction and operation period	Potentially long-term impacts
rubbish dumping	Construction / operation	Illegal dumping by workers	Potential for rubbish to spread into adjacent vegetation and outside development site	Daily, during construction and operational phases	Throughout life of project	Potentially long-term impacts
wood collection	Construction / operation	Removal of wood in vegetation adjacent to development site	Throughout adjacent vegetation	Potential to occur at any time during construction or operational phases	Throughout life of project	Short-term impacts
bush rock removal and disturbance	Construction / operation	Removal of rocks in vegetation adjacent to development site	Potential for disturbance in adjacent vegetation and area surrounding the development site	Potential to occur at any time during construction or operational phases	Throughout life of project	Short-term impacts
increase in predatory species populations	Construction / operation	Potential for an increase in predatory species in the locality through	Throughout adjacent vegetation	Potential to occur gradually after disturbance to habitat	During construction phase of project	Potentially long-term impacts

Indirect impact	Project phase	Nature	Extent	Frequency	Duration	Timing
		disturbance to vegetation		and vegetation takes place		
increase in pest animal populations	Construction / operation	Potential to increase if food scraps/rubbish is left on site. Potential to increase -/+ decrease due to disturbance to existing vegetation.	Throughout adjacent vegetation	Potential to occur gradually after disturbance to habitat and vegetation takes place	During construction phase of project	Potentially long-term impacts
increased risk of fire	Construction / operation	Potential for fire to spark during construction and operation from any machinery or electrical works	Throughout adjacent vegetation	Potential to occur at any time throughout the operational or construction phases	During operating/ construction hours	During operational /construction hours
disturbance to specialist breeding and foraging habitat, e.g. beach nesting for shorebirds.	Construction / operation	Potential to impact potential breeding habitat of Southern Myotis and roosting habitat of several microchiropteran bats within culverts. Potential to impact Southern Myotis foraging habitat within dams/creeks	Within and adjacent to culverts. Within and adjacent to waterbodies	Potential to occur at any time throughout the operational or construction phases	Throughout life of project	Potentially long-term impacts

2.2.4 Prescribed biodiversity impacts

The development site has the prescribed biodiversity impacts as outlined in Table 24. An assessment of impacts of the development on prescribed biodiversity impacts is outlined in Table 25 in accordance with Section 9.2.1 of the BAM.

Table 24: Direct impacts on prescribed biodiversity impacts

Prescribed biodiversity impact	Nature	Extent	Frequency	Duration	Timing
impacts of development on the habitat of threatened species or ecological communities associated with human made structures	Indirect impacts on culvert including noise, vibration and lighting.	Single culvert adjacent to development site.	During construction of new road/culvert.	During construction of new road/culvert.	Short-term impacts
impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range	Increased gap in connectivity between River Flat Eucalypt Forest in the east of the development site.	Increase distance between vegetation from 10m to 35m.	One off event	Permanent	Long-term impact
impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities (including from subsidence or upsidence resulting from underground mining)	Potential sedimentation and runoff into creek. Reduction in area of water due to construction of road.	25m section of creek and 0.01 ha of the dam	One off event	Permanent	Long-term impact

Table 25: Assessment of prescribed biodiversity impacts

BAM Criteria	Assessment
9.2.1.3 The assessment of the impacts of the development on the habitat of threatened species or ecological communities associated with human made structures	
a) identify the human made structures with potential to be habitat for threatened species or ecological communities	One culvert is present adjacent to the eastern edge of the development site and provides potential roosting habitat for threatened microchiropteran bat species including Southern Myotis, Eastern Bentwing-bat, Little Bentwing-bat and Eastern Free-tail Bat.
b) identify the species and ecological communities likely to use the habitat	The culvert provides potential roosting habitat for threatened microchiropteran bat species including Southern Myotis, Eastern Bentwing-bat, Little Bentwing-bat and Eastern Free-tail Bat.

BAM Criteria	Assessment
c) describe the nature, extent and duration of short and long-term impacts	A proposed road and culvert will be built directly adjacent to the existing culvert. This will result in impacts to the potential roosting habitat including vibration, noise, lighting and temporary obstruction of the culvert. This could disrupt potential breeding for Southern Myotis and winter roosting for species such as Eastern Bentwing-bat and Little Bentwing-bat. Following completion of the road the culvert will remain in place with an additional adjacent culvert.
d) describe, with reference to relevant literature the importance within the bioregion of the habitat of these species or ecological communities	Eastern Bentwing-bat and Little Bentwing-bat are known to utilise culverts and similar man-made structures temporarily during winter months. These species breed in maternity caves during summer and are not know to roost in small culverts such as that present in the development site. Southern Myotis is known to utilise culverts for breeding in the Sydney region and was recorded foraging in the riparian corridor within which the culvert is located. While none of the above species were observed within the impacted culvert during the survey, potential roosting habitat is available within narrow seams and the Fairy Martin mud nests in the culvert. It is considered unlikely that the culvert is currently used as a breeding site for the above species, however, may be temporarily utilised as a roost throughout the year for different microbat species. Two similar culverts are also present adjacent to the development site which provide higher quality roosting habitat due to deeper seams in the culvert.
e) predict the consequences of the impacts for the local and bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.	The proposed development, which involves the construction of a road and culvert directly adjacent to the existing culvert would result in temporary impacts including vibration, noise, lighting and blockage of the culvert during construction. This could have impacts on microchiropteran bats (if present) during construction including disruption to seasonal roosting for those microchiropteran bat species and potential injury to bats. Given the presence of higher quality roosting culverts in the vicinity and unlikely disruption to breeding, it is unlikely that impacts on the culvert would have significant impacts for the local and bioregional persistence of the above listed microchiropteran bats. Mitigation measures are proposed in Section 2.2.5 to minimise potential impacts on roosting microbats during construction.
9.2.1.5 The assessment of the impacts of development on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range must:	
(a) identify the area/s of connectivity joining different areas of habitat that intersect with the subject land and the areas of habitat that are connected according to Paragraph 4.2.1.3	The vegetation in the north of the development site forms part of a connective corridor from vegetation to the east of the development site to the riparian corridor to the west which connects to large patches of native vegetation and habitat to the north and south.
(b) identify the species and ecological communities likely to benefit from the connectivity	The species most likely to utilise the connectivity would be mobile species such as *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) Southern Myotis, Eastern Bentwing-bat, Little Bentwing-bat, Eastern Free-tail Bat and *Pteropus poliocephalus* (Grey-headed Flying-fox). The corridor also creates a connective patch of the EEC River Flat Eucalypt Forest.

BAM Criteria	Assessment
(c) describe the nature, extent and duration of short and long-term impacts	At the eastern edge of the site there is a current gap of approximately 10m in the corridor of vegetation across an internal road in the adjacent land. The construction of a new road within the development site will widen this gap between vegetation patches to approximately 35 m.
(d) describe, with reference to relevant literature and other reliable published sources of information, the importance of the area of connectivity within the bioregion	The development site connects vegetation to the east with the vegetation riparian corridor to the west, which connects to large patches of native vegetation to the north and south. Vegetation within the development site which forms part of the corridor is highly degraded, as is the vegetation directly to the east. Only a small fragment of the entire corridor is located to the east of the development site (approximately 3 ha), located primarily along a narrow riparian corridor between industrial developments which is likely degraded and modified from its original vegetation. While this corridor would provide a passage for movement for mobile species and dispersal of genetic material for River Flat Eucalypt Forest, it is not considered important on a bioregional scale.
(e) predict the consequences of the impacts for the bioregional persistence of the suite of threatened species and communities currently benefitting from the connectivity with reference to relevant literature and other published sources of information and taking into consideration mobility, abundance, range and other relevant life history factors.	A variety of mobile threatened species are likely to utilise the connective habitat within and adjacent to the development site, particularly microchiropteran bats and Grey-headed Flying-fox. The development will result in a widened gap in the vegetated corridor from 10 m to 35 m. However, given the high mobility of these species and the relatively small decrease in connectivity, this impact would be insignificant on a local and bioregional scale. The widened gap will also result in a minor increase in fragmentation of the EEC River Flat Eucalypt Forest. This EEC is highly degraded and the section to be impacted is dominated by weeds in the understorey and relatively young canopy trees. The increased gap to 35 m will not prevent the movement of genetic material by birds and Grey-headed Flying-fox between the patches. The impacts are not significant for this community on a local or bioregional scale.
9.2.1.7 The assessment of the impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened species and threatened ecological communities must:	
(a) identify water bodies with potential to be habitat for threatened species or threatened ecological communities likely to use the habitat	The proposed development will impact on a small section of the dam in the north of the development site (0.01 ha) and a small section of creek line in the east of the development site.
(b) identify the threatened species and threatened ecological communities likely to use the habitat.	The waterbodies are utilised by Southern Myotis for foraging.
(c) identify the hydrological processes that sustain threatened species or ecological communities and the species and communities that area dependent on them	Southern Myotis rely on waterbodies for foraging habitat.
(d) describe, with reference to relevant literature and other reliable published sources of information, the importance within the bioregion of the	Southern Myotis is known to utilise the water bodies within the site for foraging, including the dam to be impacted. The habitat to be impacted makes up only a very small portion of similar habitat available in the wider study area and bioregion. Given the small area

BAM Criteria	Assessment
waterbody or hydrological process to these species or ecological communities.	to be impacted (0.01 ha) it is not considered important on a local or bioregional scale.
(e) describe the nature, extent and duration of short-term impact and long-term impacts on water quality.	Proposed development controls should be implemented during construction and operation to prevent runoff and sedimentation which could affect water quality in the short term or long term.
(g) predict the consequences of the impacts for the bioregional persistence of the suite of threatened species and communities likely to use these areas as habitat, with reference to relevant literature and other published sources of information.	The proposed development will result in the loss of 0.01 ha of water foraging habitat for Southern Myotis. Given the small area, relative to the larger areas to be retained within the subject land and larger areas in the locality and bioregion, the proposed development would be unlikely to impact the persistence of Southern Myotis in the locality or bioregion.
The proposed development is unlikely to effect the short-term or long-term persistence of any water dependent communities as a result of changes to water quality, and therefore, no further parts of this clause have been addressed. Controls should be put in place through a VMP which would prevent additional impacts.	

2.2.5 Mitigating and managing impacts

Measures proposed to mitigate and manage impacts at the development site before, during and after construction are outlined in Table 26.

Table 26: Measures proposed to mitigate and manage impacts

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
Displacement of resident fauna and microbat controls	High	Low	- Pre-clearance surveys for microbats in culverts should be undertaken several weeks prior to construction commencing. If microbats are present within the culvert, a Microbat Management Plan should be prepared to minimise impacts to bats during construction. Measures may include exclusion of bats from culverts for duration of works. - Additional pre-clearance survey should be undertaken	Prevent injury to any resident microbats within culverts	Prior to and during construction	Project Manager, Project Ecologist

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			immediately before construction. - Monitor response of bats to works/noise at nearby culverts			
timing works to avoid critical life cycle events such as breeding or nursing	Medium	Low	- Avoid impacts on culverts during breeding season of Southern Myotis (November-March) if Myotis are recorded roosting within culverts during the breeding season	Avoid impacts to breeding Southern Myotis	During construction	Project Manager
instigating clearing protocols including pre-clearing surveys, daily surveys and staged clearing, the presence of a trained ecological or licensed wildlife handler during clearing events	Medium	Low	- Pre-clearance survey for microbats in culverts and any bird/other nests present. - Monitor response of bats to works/noise.	Prevent injury to any microbats within culverts or nesting birds	During construction	Project Manager, Project Ecologist
clearing protocols that identify vegetation to be retained, prevent inadvertent damage and reduce soil disturbance; for example, removal of native vegetation by chain-saw, rather than heavy machinery, is preferable in situations	High	Low	- Boundaries of the impact area to be clearly delineated with fencing, retained areas marked with "No Go" signage, in particular for TECs and areas containing *Grevillea juniperina* subsp. *juniperina* - Where possible, removal of vegetation with chainsaw to prevent inadvertent damage to vegetation outside of the development footprint	Protection of vegetation outside development footprint	During construction	Project Manager

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
where partial clearing is proposed						
sediment barriers or sedimentation ponds to control the quality of water released from the site into the receiving environment	Medium	Low	- Install sediment barriers and erosion control during and post construction to prevent runoff into adjacent creeklines. Maintain controls throughout construction and undertake weekly inspections.	Control of erosion, sedimentation and runoff of contaminated substances into adjacent waterways	Throughout life of project	Project Manager
noise barriers or daily/seasonal timing of construction and operational activities to reduce impacts of noise	Low	Very Low	Microbat Management Plan as discussed above (if required) to outline mitigation measures relating to noise.	Minimise potential noise related impacts on microbats.	For the duration of construction works	Project Manager
staff training and site briefing to communicate environmental features to be protected and measures to be implemented	Low	Very Low	All staff working on the development will undertake an environmental induction as part of their site familiarisation. Site briefings should be updated based on phase of the work. This induction will include items such as: 1. Site environmental procedures (vegetation management, sediment and erosion control, exclusion fencing and noxious weeds) 2. What to do in case of environmental emergency (chemical spills, fire, injured fauna)	All staff entering the site are fully aware of all environmental aspects relating to the development and know what to do in case of any environmental emergencies	To occur for all staff entering / working at the site and when environmental issues become apparent	Project Manager, all staff

Measure	Risk before mitigation	Risk after mitigation	Action	Outcome	Timing	Responsibility
			3. Key contacts in case of environmental emergency			
making provision for the ecological restoration, rehabilitation and/or ongoing maintenance of retained native vegetation habitat on or adjacent to the development site	Medium	Low	- Preparation and implementation of a VMP is recommended to protect and enhance retained vegetation	Protection of flora and fauna outside of the development footprint	Prior to the commencement of construction	Client

2.2.6 Serious and Irreversible Impacts (SAII)

Serious and Irreversible Impacts (SAII) values have been considered in this assessment. Eastern Bentwing-bat, which had potential calls identified during the Anabat survey, is a candidate entity for SAII for impacts to breeding habitat. No breeding habitat for this species will be impacted directly or indirectly by the development. No other candidate entities for SAII were recorded.

2.3 Risk assessment

A risk assessment has been undertaken for any residual impacts likely to remain after the mitigation measures have been applied. Likelihood criteria, consequence criteria and the risk matrix are provided in Table 27, Table 28 and Table 29 respectively.

Table 27: Likelihood criteria

Likelihood criteria	Description
Almost certain (Common)	Will occur, or is of a continuous nature, or the likelihood is unknown. There is likely to be an event at least once a year or greater (up to ten times per year). It often occurs in similar environments. The event is expected to occur in most circumstances.
Likely (Has occurred in recent history)	There is likely to be an event on average every one to five years. Likely to have been a similar incident occurring in similar environments. The event will probably occur in most circumstances.
Possible (Could happen, has occurred in the past, but not common)	The event could occur. There is likely to be an event on average every five to twenty years.

Likelihood criteria	Description
Unlikely (Not likely or uncommon)	The event could occur but is not expected. A rare occurrence (once per one hundred years).
Remote (Rare or practically impossible)	The event may occur only in exceptional circumstances. Very rare occurrence (once per one thousand years). Unlikely that it has occurred elsewhere; and, if it has occurred, it is regarded as unique.

Table 28: Consequence criteria

Consequence category	Description
Critical (Severe, widespread long-term effect)	Destruction of sensitive environmental features. Severe impact on ecosystem. Impacts are irreversible and/or widespread. Regulatory and high-level government intervention/action. Community outrage expected. Prosecution likely.
Major (Wider spread, moderate to long term effect)	Long-term impact of regional significance on sensitive environmental features (e.g. wetlands). Likely to result in regulatory intervention/action. Environmental harm either temporary or permanent, requiring immediate attention. Community outrage possible. Prosecution possible.
Moderate (Localised, short-term to moderate effect)	Short term impact on sensitive environmental features. Triggers regulatory investigation. Significant changes that may be rehabilitated with difficulty. Repeated public concern.
Minor (Localised short-term effect)	Impact on fauna, flora and/or habitat but no negative effects on ecosystem. Easily rehabilitated. Requires immediate regulator notification.
Negligible (Minimal impact or no lasting effect)	Negligible impact on fauna/flora, habitat, aquatic ecosystem or water resources. Impacts are local, temporary and reversible. Incident reporting according to routine protocols.

Table 29: Risk matrix

Consequence	Likelihood				
	Almost certain	Likely	Possible	Unlikely	Remote
Critical	Very High	Very High	High	High	Medium
Major	Very High	High	High	Medium	Medium
Moderate	High	Medium	Medium	Medium	Low
Minor	Medium	Medium	Low	Low	Very Low
Negligible	Medium	Low	Low	Very Low	Very Low

Table 30: Risk assessment

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post mitigation)
Vegetation clearing	Construction	Medium	Low

Potential impact	Project phase	Risk (pre-mitigation)	Risk (post mitigation)
	/ operation		
sedimentation and contaminated and/or nutrient rich run-off	Construction	Medium	Low
noise, dust or light spill	Construction	Medium	Low
inadvertent impacts on adjacent habitat or vegetation	Construction	High	Low
trampling of threatened flora species	Construction / operation	High	Low
rubbish dumping	Construction / operation	Low	Very Low
wood collection	Construction / operation	Low	Very Low
disturbance to specialist breeding and foraging habitat (culverts)	Construction / operation	High	Low

2.4 Adaptive management strategy

Adaptive Management Strategy is required for those impacts that are infrequent, cumulative or difficult to predict. Impacts associated with the proposed development have been considered and addressed in Section 2 and no further impacts are required to be addressed.

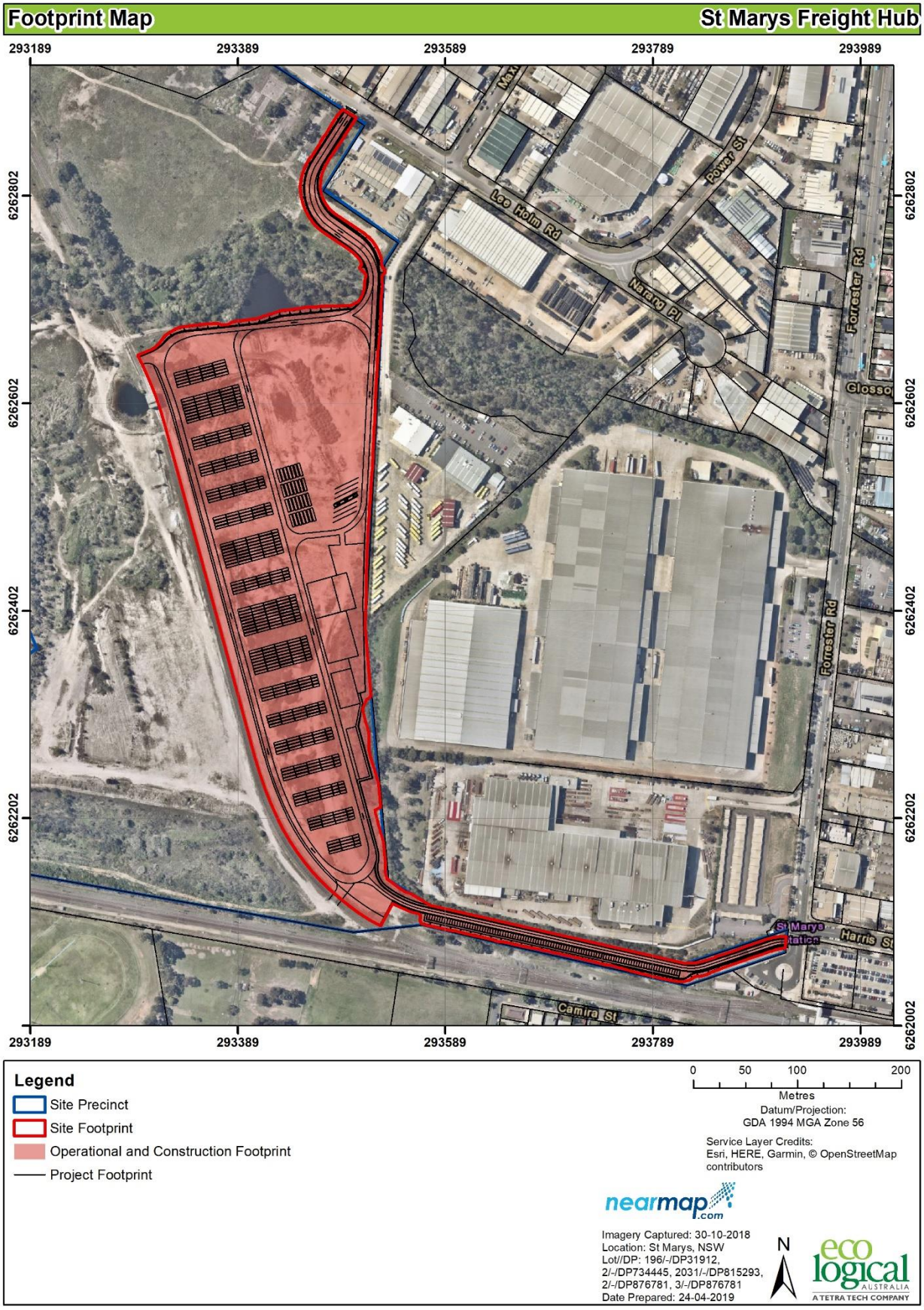

Figure 8: Final project footprint including construction and operation

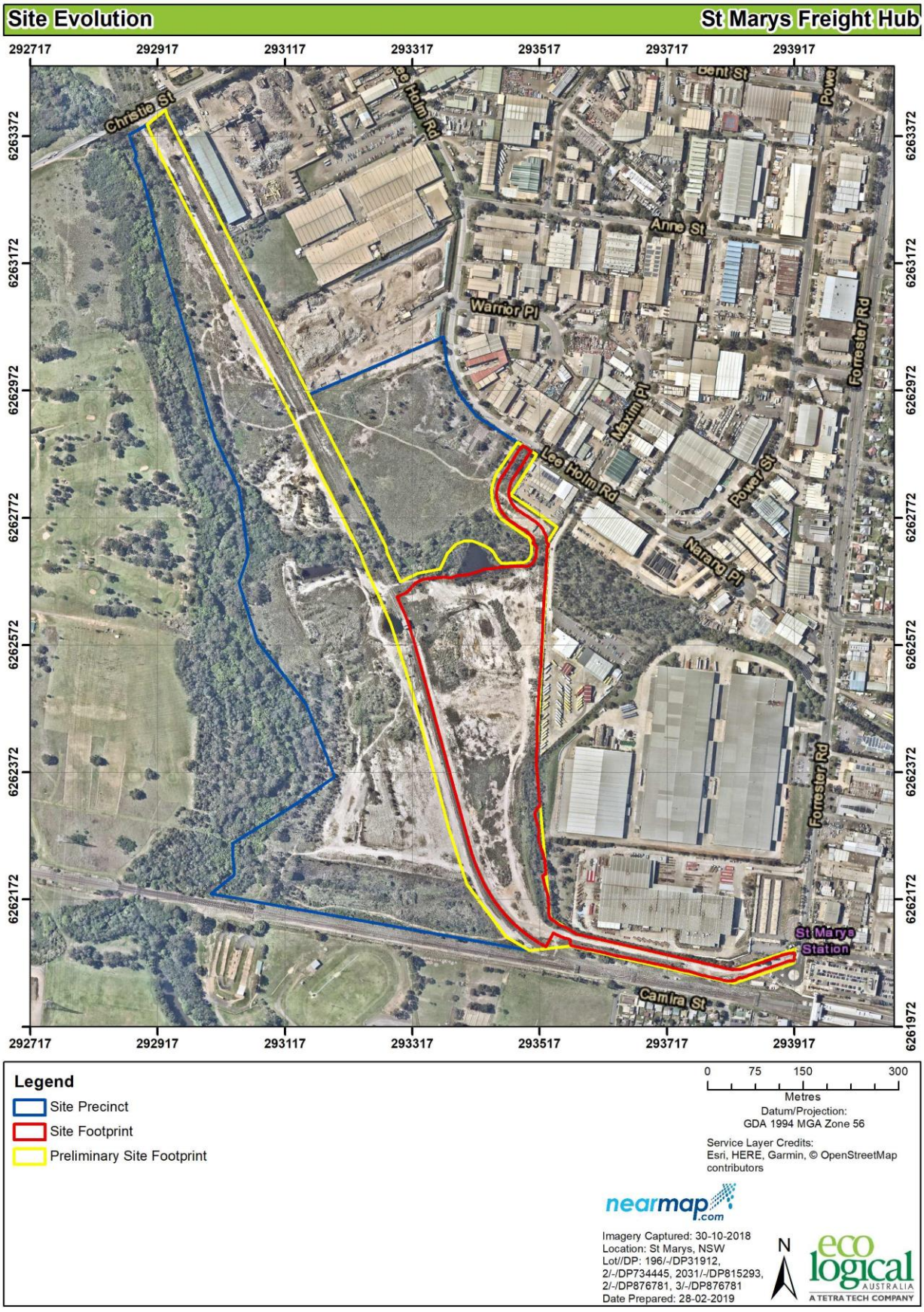

Figure 9: Preliminary and final development footprint

2.5 Impact summary

Following implementation of the BAM and the BAMC, the following impacts have been determined.

2.5.1 Serious and Irreversible Impacts (SAII)

The development does not have any Serious and Irreversible Impacts (SAII).

2.5.2 Impacts requiring offsets

The impacts of the development requiring offset for native vegetation are outlined in Table 31 and shown on Figure 10. The impacts of the development requiring offset for threatened species and threatened species habitat are outlined in Table 32 and on Figure 10.

Table 31: Impacts to native vegetation that require offsets

Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)
1	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Floodplain Wetlands	Forested Wetlands	0.33
2	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Coastal Floodplain Wetlands	Forested Wetlands	0.33
3	1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Coastal Floodplain Wetlands	Forested Wetlands	0.07
5	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Freshwater Wetlands	Coastal Freshwater Wetlands	0.09

Table 32: Impacts on threatened species and threatened species habitat that require offsets

Species	Common Name	Direct impact number of individuals / habitat (ha)	NSW listing status	EPBC Listing status
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	0.71	Vulnerable	Not Listed
Myotis macropus	Southern Myotis	0.86	Vulnerable	Not Listed

2.5.3 Impacts not requiring offsets

The impacts of the development not requiring offset for native vegetation are outlined in Table 33 and shown on Figure 11.

Table 33: Impacts to native vegetation that do not require offsets

Zone	PCT ID	PCT Name	Vegetation Class	Vegetation Formation	Direct impact (ha)	Rationale
4	1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Coastal Floodplain Wetlands	Forested Wetlands	0.69	Vegetation integrity score (6.5) lower than threshold

2.5.4 Areas not requiring assessment

Areas not requiring assessment are shown on Figure 12. These areas have been cleared of native vegetation and do not contain habitat for threatened species. These areas are dominated by exotic species such as *Eragrostis curvula* (African Love Grass), *Chloris gayana* (Rhodes Grass) and *Sida rhombifolia* (Paddy's Lucerne).

2.5.5 Credit summary

The number of ecosystem credits required for the development are outlined in Table 34. The number of species credits required for the development are outlined in Table 35. A biodiversity credit report is included in Appendix D.

Table 34: Ecosystem credits required

Zone	PCT ID	PCT Name	Condition	Vegetation Formation	Direct impact (ha)	Credits required
1	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland	Degraded	Forested Wetlands	0.33 ha	6

Zone	PCT ID	PCT Name	Condition	Vegetation Formation	Direct impact (ha)	Credits required
		Plain, Sydney Basin Bioregion				
2	835	Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	Regrowth	Forested Wetlands	0.33 ha	7
3	1800	Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley	Degraded	Forested Wetlands	0.07 ha	1
5	1071	Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion	Moderate	Coastal Freshwater Wetlands	0.09 ha	2

Table 35: Species credit summary

Species	Common Name	Direct impact number of individuals / habitat (ha)	Credits required
Grevillea juniperina subsp. *juniperina*	Juniper-leaved Grevillea	0.71 ha	11
Myotis macropus	Southern Myotis	0.86 ha	7

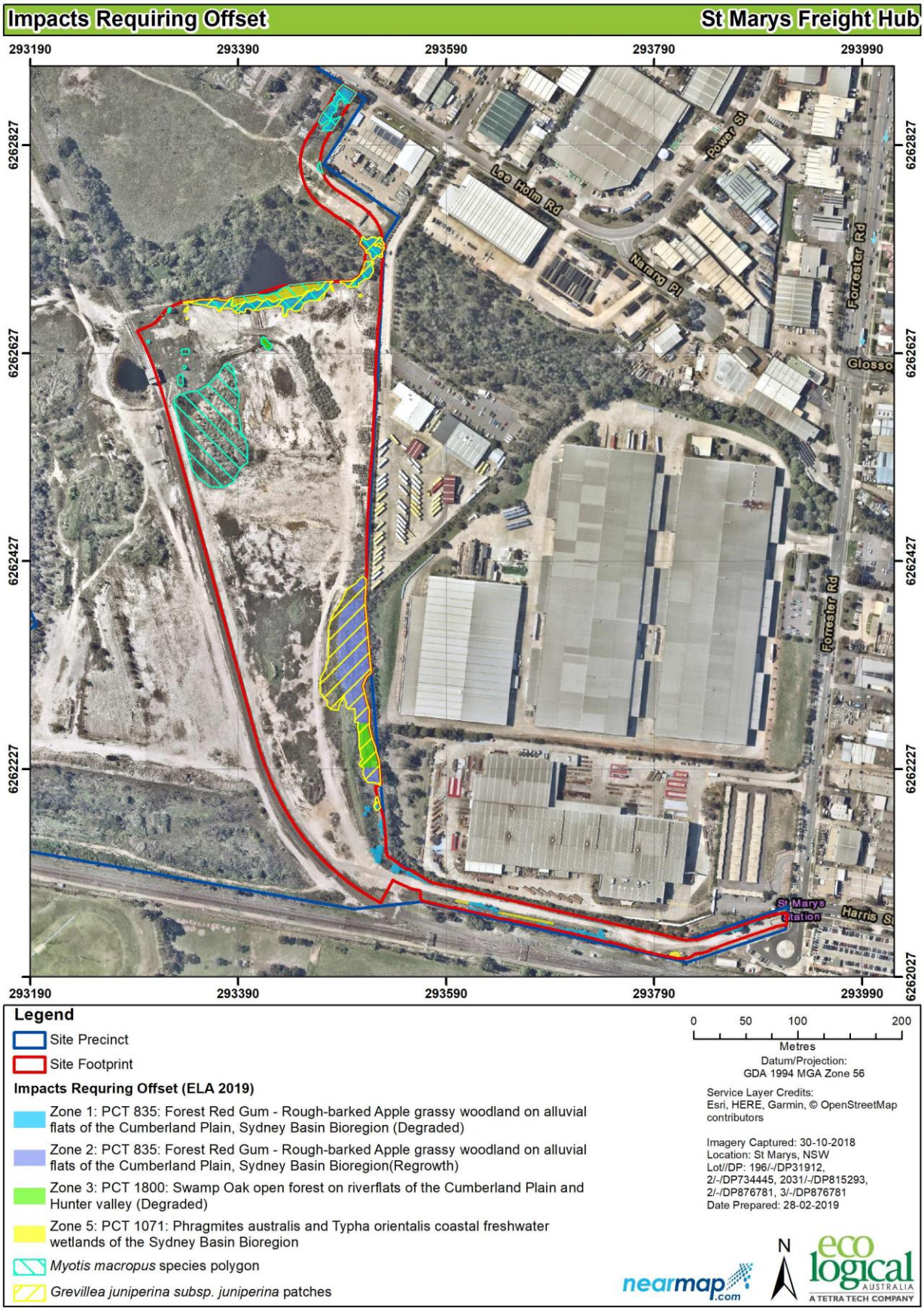

Figure 10: Impacts requiring offset

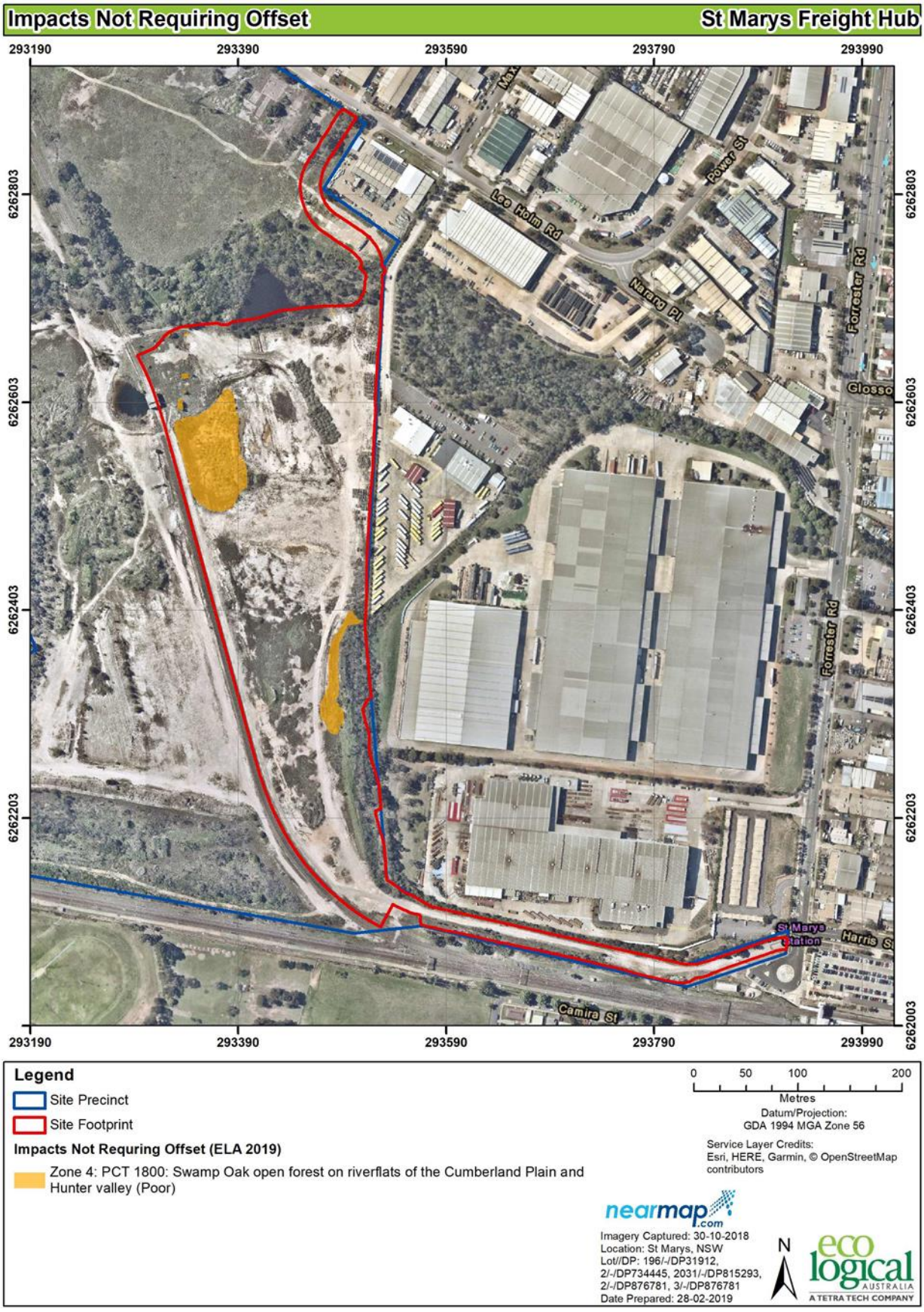

Figure 11: Impacts not requiring offset

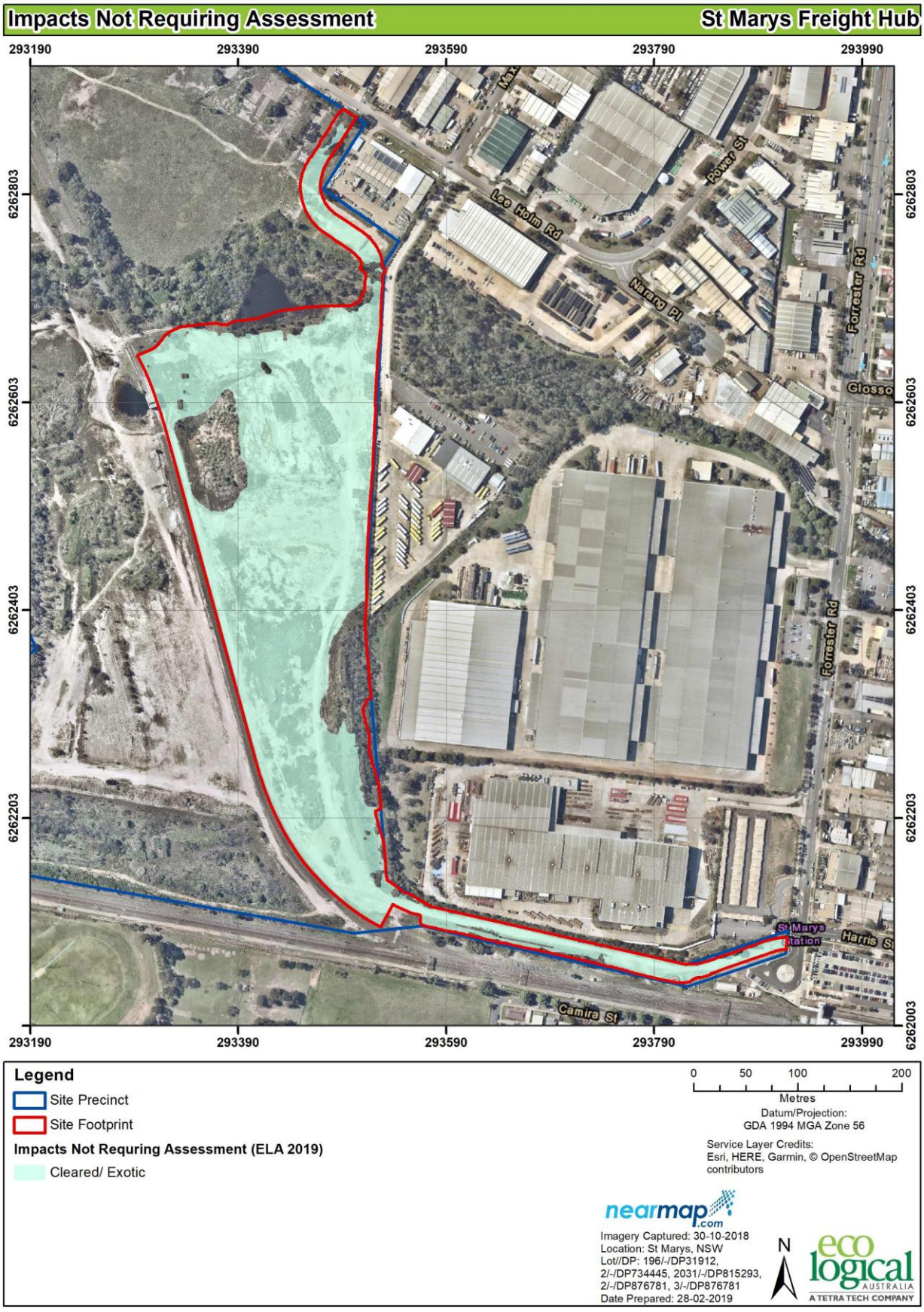

Figure 12: Areas not requiring assessment

2.6 Consistency with legislation and policy

Additional matters relating to impacts on flora and fauna which are not covered by the BC Act must also be addressed for the proposed development. Potential impacts on Matters of National Environmental Significance (MNES) in accordance with the EPBC Act have been addressed below.

2.6.1 Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999.

The EPBC Act establishes a process for assessing the environmental impact of activities and developments where MNES may be affected. Under the Act, any action which 'has, will have, or is likely to have a significant impact on a matter of MNES' is defined as a 'controlled action', and requires approval from the Commonwealth Department of the Environment and Energy (DotE), which is responsible for administering the EPBC Act (DotE 2013).

The process includes an assessment for listed threatened species and ecological communities that will be affected as a result of the proposed action. The Commonwealth has developed Significant impact guidelines (DotEE 2013) and species-specific referral guidelines that outline a number of criteria to provide assistance in assessing impacts on MNES and help decide whether or not a referral to the Commonwealth is required.

Two MNES were originally considered as having the potential to occur based on a desktop review, including NSW BioNet Records, Atlas of Living Australia records, aerial imagery and the BAMC. These MNES include:

- *Litoria aurea* (Green and Golden Bell Frog)
- *Pteropus poliocephalus* (Grey-headed Flying-fox)

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

Green and Golden Bell Frog is listed as a vulnerable species under the EPBC Act. It inhabits marshes, dams and stream-sides, particularly those containing *Typha* spp. (bullrushes) or *Eleocharis* spp. (spikerushes). Some populations occur in highly disturbed areas. Potential habitat is present within the development footprint within drainage ditches dominated by *Typha orientalis* (Broadleaf Cumbungi) and the creekline. Suitable habitat is also present within the two dams which are now outside of the development site after revision of the development footprint. Green and Golden Bell Frog has been previously recorded approximately 1.3 km to the north west of the development site in 1998 and more recently in 2005 approximately 3.5 km from the development site. There are a total of 11 records within 5 km of the development site.

Four nights of targeted survey were undertaken for the Green and Golden Bell Frog in accordance with EPBC Act policy statement 3.19 (DEWHA, 2009). The survey included nocturnal call-playback survey and targeted habitat searches. No individuals were recorded during the survey and therefore this species is assumed not present. Furthermore, an impact assessment for this species as outlined in the Significant impact guidelines (DotE 2013) and/or a referral is not required.

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

Grey-headed Flying-fox is listed as a vulnerable species under the EPBC Act. This species utilises a wide variety of habitats (including disturbed areas) for foraging, and has been recorded travelling long distances on feeding forays. Fruits and flowering plants of a wide variety of species are the main food source. The species roosts in large 'camps' of up to 200 000 individuals. Camps are usually formed close

to water and along gullies, however, the species has been known to form camps in urban areas. Grey-headed Flying-foxes may travel up to 50 km from camps to forage.

There are 23 Grey-headed Flying-fox records within 5 km of the development site. The vegetation within the site provides potential foraging habitat in the form of seasonally flowering myrtaceous tree species including *Eucalyptus tereticornis* (Forest Red Gum), *Eucalyptus moluccana* (Grey Box) and *Angophora floribunda* (Rough-barked Apple). It is considered likely that this species would use the site and adjacent areas on occasion for foraging purposes. No roosting camps are located within the site.

The closest Grey-headed Flying-fox camp is located at Ropes Creek approximately 3.5 km to the south-east. Another camp is located at Emu Plains approximately 8km to the west. The Ropes Creek population was last estimated to contain 500 – 2,499 individuals in February 2017. The Emu Plains population was last estimated to contain 1 – 499 individuals in May 2018, however, has been previously estimated at 16,000 – 49,000 in February 2015.

Considering that Grey-headed Flying-fox is likely to forage within the development site on an occasional basis, a significance assessment has been undertaken in accordance with Significant impact guidelines 1.1 under the EPBC Act (Table 36)

Table 36: EPBC Act Significance Assessment for Pteropus poliocephalus (Grey-headed Flying-fox)

Criterion	Assessment
Criterion a: lead to a long-term decrease in the size of an important population of a species	The closest camp is located at Ropes Creek approximately 3.5 km to the south-east of the development site. Another occurs 8 km to the west at Emu Plains. Foraging for this species occurs within 50 km radius around the camps. Available foraging resources include: street trees, urban bushland and conservation reserves. Only a relatively small area of potential foraging habitat would be removed under the proposed action. The amount of habitat to be affected is small given the extensive amount of similar or better quality habitat available in the local area. No individuals or camps of P. poliocephalus were recorded on the site. The proposed action will not impact on any part of any known camps for this species. Given that other foraging habitat exists in the surrounding landscape, and that this species is wide-ranging (traveling up to 50 km in one night), the proposal is unlikely to affect any important populations of this species that would lead to a long-term decrease in the size of an important population of the Grey-headed Flying-fox.
Criterion b: reduce the area of occupancy of an important population	The Australian population of Grey-headed Flying-fox is an important population. The area of occupancy for this population is dynamic, and individuals move between bat camps throughout the Australian east coast. This species is highly mobile and camp sizes may change during seasonal fluctuations. The proposal is unlikely to reduce the area of occupancy for this population given the availability of foraging and roosting habitat present in adjacent areas and the highly mobile nature of this species.
Criterion c: fragment an existing important population into two or more populations	The Grey-headed Flying-fox population across Sydney is highly dynamic and individuals move between permanent camps to utilise foraging resources. They will return to permanent camps to rear offspring. Individuals are highly mobile and populations are not static. No known camp or important population will be fragmented under the proposed action. The proposed action will result in up to 1.42 ha of potential foraging habitat for the Grey-headed Flying-fox (remnant and planted vegetation). Large amounts

Criterion	Assessment
	of similar habitat are available in the wider locality. Therefore, the proposed action is unlikely to fragment the existing important population into two or more populations.
Criterion d: adversely affect habitat critical to the survival of a species	As the proposal would not involve the removal of any camp, it would be unlikely to create a barrier to movement or remove breeding habitat. The proposal would remove 1.42 ha of potential foraging habitat. Abundant foraging habitat of higher quality would remain in the wider locality. Larger areas of foraging habitat are present nearby the development site along Wianamatta Creek and significant areas of intact bushland are also available approximately 12 km to the west alongside the Nepean River and into the Blue Mountains. Therefore, it is unlikely that habitat critical to the survival of this species would be adversely affected by the development. While it is likely that this species utilises foraging resources in the site on an occasional basis, it is unlikely to rely on such resources for survival.
Criterion e: disrupt the breeding cycle of an important population	As no roosting habitat would be removed or disturbed, it is unlikely the proposed work would disrupt the breeding cycle of an important population.
Criterion f: Adversely affect habitat critical to the survival of a species; modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	As no campsites would be removed or disturbed, and large areas foraging habitat exist outside of the subject site, the proposal would be unlikely to modify, destroy, remove, or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Criterion g: Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The proposal would not result in the establishment or increase of invasive species, such as weeds, that would be harmful to Grey-headed Flying-fox .
Criterion h: Introduce disease that may cause the species to decline	Grey-headed Flying-fox are reservoirs for the Australian bat lyssavirus (ABL) and can cause clinical disease and mortality in GHFF (DECCW, 2009). The proposal is unlikely to present significant ecological stress on known individuals or camps utilizing the subject site and is therefore unlikely to affect this species. The proposal would be unlikely to introduce a disease that may cause this species to decline.
Criterion i: Interfere substantially with the recovery of the species	A Draft National Recovery Plan for the Grey-headed Flying-fox was developed in 2009. As no maternity camps would be removed the proposal would only remove some potential resting habitat consisting of exotic trees it is unlikely that the proposal works interfere with the recovery of this species.
Conclusion	In consideration of the above, the proposed works considered unlikely to have a significant impact on the Grey-headed Flying-fox, and therefore, an EPBC Act referral is not required.

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Appendix A: Definitions

Terminology	Definition
Biodiversity credit report	The report produced by the Credit Calculator that sets out the number and class of biodiversity credits required to offset the remaining adverse impacts on biodiversity values at a development site, or on land to be biodiversity certified, or that sets out the number and class of biodiversity credits that are created at a biodiversity stewardship site.
BioNet Atlas	The BioNet Atlas (formerly known as the NSW Wildlife Atlas) is the OEH database of flora and fauna records. The Atlas contains records of plants, mammals, birds, reptiles, amphibians, some fungi, some invertebrates (such as insects and snails) and some fish
Broad condition state:	Areas of the same PCT that are in relatively homogenous condition. Broad condition is used for stratifying areas of the same PCT into a vegetation zone for the purpose of determining the vegetation integrity score.
Connectivity	The measure of the degree to which an area(s) of native vegetation is linked with other areas of vegetation.
Credit Calculator	The computer program that provides decision support to assessors and proponents by applying the BAM, and which calculates the number and class of biodiversity credits required to offset the impacts of a development or created at a biodiversity stewardship site.
Development	Has the same meaning as development at section 4 of the EP&A Act, or an activity in Part 5 of the EP&A Act. It also includes development as defined in section 115T of the EP&A Act.
Development footprint	The area of land that is directly impacted on by a proposed development, including access roads, and areas used to store construction materials.
Development site	An area of land that is subject to a proposed development that is under the EP&A Act.
Ecosystem credits	A measurement of the value of EECs, CEECs and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity values at a development site and the gain in biodiversity values at a biodiversity stewardship site.
High threat exotic plant cover	Plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species.
Hollow bearing tree	A living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5 cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1 m above the ground. Trees must be examined from all angles.
Important wetland	A wetland that is listed in the Directory of Important Wetlands of Australia (DIWA) and SEPP 14 Coastal Wetlands
Linear shaped development	Development that is generally narrow in width and extends across the landscape for a distance greater than 3.5 kilometres in length
Local population	The population that occurs in the development site. In cases where multiple populations occur in the development site or a population occupies part of the development site, impacts on each subpopulation must be assessed separately.
Local wetland	Any wetland that is not identified as an important wetland (refer to definition of Important wetland).
Mitchell landscape	Landscapes with relatively homogeneous geomorphology, soils and broad vegetation types, mapped at a scale of 1:250,000.

Terminology	Definition
Multiple fragmentation impact development	Developments such as wind farms and coal seam gas extraction that require multiple extraction points (wells) or turbines and a network of associated development including roads, tracks, gathering systems/flow lines, transmission lines
Operational Manual	The Operational Manual published from time to time by OEH, which is a guide to assist assessors when using the BAM
Patch size	An area of intact native vegetation that: a) occurs on the development site or biodiversity stewardship site, and b) includes native vegetation that has a gap of less than 100 m from the next area of native vegetation (or ≤30 m for non-woody ecosystems). Patch size may extend onto adjoining land that is not part of the development site or stewardship site.
Proponent	A person who intends to apply for consent to carry out development or for approval for an activity.
Reference sites	The relatively unmodified sites that are assessed to obtain local benchmark information when benchmarks in the Vegetation Benchmarks Database are too broad or otherwise incorrect for the PCT and/or local situation. Benchmarks can also be obtained from published sources.
Regeneration	The proportion of over-storey species characteristic of the PCT that are naturally regenerating and have a diameter at breast height <5 cm within a vegetation zone.
Remaining impact	An impact on biodiversity values after all reasonable measures have been taken to avoid and minimise the impacts of development. Under the BAM, an offset requirement is calculated for the remaining impacts on biodiversity values.
Retirement of credits	The purchase and retirement of biodiversity credits from an already-established biobank site or a biodiversity stewardship site secured by a biodiversity stewardship agreement.
Riparian buffer	Riparian buffers applied to water bodies in accordance with the BAM
Sensitive biodiversity values land map	Development within an area identified on the map requires assessment using the BAM.
Site attributes	The matters assessed to determine vegetation integrity. They include native plant species richness, native over-storey cover, native mid-storey cover, native ground cover (grasses), native ground cover (shrubs), native ground cover (other), exotic plant cover (as a percentage of total ground and mid-storey cover), number of trees with hollows, proportion of over-storey species occurring as regeneration, and total length of fallen logs.
Site-based development	a development other than a linear shaped development, or a multiple fragmentation impact development
Species credits	The class of biodiversity credits created or required for the impact on threatened species that cannot be reliably predicted to use an area of land based on habitat surrogates. Species that require species credits are listed in the Threatened Biodiversity Data Collection.
Subject land	Is land to which the BAM is applied in Stage 1 to assess the biodiversity values of the land. It includes land that may be a development site, clearing site, proposed for biodiversity certification or land that is proposed for a biodiversity stewardship agreement.
Threatened Biodiversity Data Collection	Part of the BioNet database, published by OEH and accessible from the BioNet website.
Threatened species	Critically Endangered, Endangered or Vulnerable threatened species as defined by Schedule 1 of the BC Act, or any additional threatened species listed under Part 13 of the EPBC Act as Critically Endangered, Endangered or Vulnerable.

Terminology	Definition
Vegetation Benchmarks Database	A database of benchmarks for vegetation classes and some PCTs. The Vegetation Benchmarks Database is published by OEH and is part of the BioNet Vegetation Classification.
Vegetation zone	A relatively homogenous area of native vegetation on a development site, land to be biodiversity certified or a biodiversity stewardship site that is the same PCT and broad condition state.
Wetland	An area of land that is wet by surface water or ground water, or both, for long enough periods that the plants and animals in it are adapted to, and depend on, moist conditions for at least part of their life cycle. Wetlands may exhibit wet and dry phases and may be wet permanently, cyclically or intermittently with fresh, brackish or saline water
Woody native vegetation	Native vegetation that contains an over-storey and/or mid-storey that predominantly consists of trees and/or shrubs

Appendix B: Vegetation plot data

Table 37: Species matrix (species recorded by plot)

Form	Species name	Common name	Exotic (*)	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5
SG	*Acacia falcata*	Hickory Wattle							1
SG	*Acacia longifolia* subsp. *longifolia*	Sydney Golden Wattle						0.1	1
TG)	*Acacia parramattensis*	Parramatta Wattle			0.5	2		25	
	Ageratina adenophora	Crofton Weed	*	*			0.1		
TG	*Allocasuarina littoralis*	Black She-oak						5	
OG	*Amyema spp.*	Mistletoe				0.5			
	Anagallis arvensis	Scarlet Pimpernel	*			0.1			
TG	*Angophora floribunda*	Rough-barked Apple						1	
GG	*Anisopogon avenaceus*	Oat Speargrass			0.1				
	Araujia sericifera	Moth Vine	*	*	0.1	0.1		0.5	
OG	*Archontophoenix cunninghamiana*	Bangalow Palm				0.2			
	Asparagus asparagoides	Bridal Creeper	*	*		0.1		0.1	
	Bidens pilosa	Cobblers Pegs	*	*		0.2			
	Brassica rapa	Field Mustard	*		0.2	0.1		2	0.1
	Briza subaristata		*	*				0.2	
SG	*Bursaria spinosa*	Blackthorn						2	

Form	Species name	Common name	Exotic (*)	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5
TG	*Casuarina glauca*	Swamp Oak			50	1	1		0.1
FG	*Centella asiatica*	Indian Pennywort				0.3		0.1	
	Centaurea spp.		*			0.1			
	Cestrum parqui	Green Cestrum	*	*	0.1	0.1		0.5	
EG	*Cheilanthes sieberi*	Mulga Fern			0.1				
	Chloris gayana	Rhodes Grass	*	*	1				0.3
	Cirsium vulgare	Spear Thistle	*			1			5
	Conyza bonariensis	Flax-leaf Fleabane	*					0.2	
GG	*Cymbopogon refractus*	Barbed-wire Grass							0.1
	Cynodon dactylon	Couch	*			2			10
	Daucus carota	Wild Carrot	*						0.1
SG	*Daviesia ulicifolia*	Gorse Bitter Pea						0.5	
OG	*Desmodium varians*				0.1				
FG	*Dianella caerulea*	Blue Flax Lily				0.1		0.1	
GG	*Dichelachne spp.*								0.1
FG	*Dichondra repens*	Kidney Weed			0.3	0.1		0.1	0.2
FG	*Einadia nutans*	Climbing Saltbush							0.1
	Eragrostis curvula	African Lovegrass	*	*	10	30	0.5	60	10
TG	*Eucalyptus moluccana*	Grey Box				20			
TG	*Eucalyptus spp.*								0.2
TG	*Eucalyptus tereticornis*	Forest Red Gum					1		
	Euphorbia spp.		*						0.5
	Foeniculum vulgare	Fennel	*			0.1			
	Gomphocarpus fruticosus	Narrow-leaved Cotton Bush	*			0.1	0.1		0.1
SG	*Grevillea juniperina* subsp. *juniperina*	Juniper-leaved Grevillea						10	
OG	*Hardenbergia violacea*	False Sarsaparilla					0.1		
	Juncus acutus	Sharp Rush	*	*			0.5		
GG)	*Juncus usitatus*					0.1	0.1		
	Lactuca serriola	Prickly Lettuce	*						0.2
	Lantana camara	Lantana	*	*				0.2	
	Ligustrum lucidum	Broad-leaf Privet	*	*		0.5			10
	Ligustrum sinense	Small-leaf Privet	*	*	0.2	1	0.1	0.2	8
	Linum trigynum	French Flax	*					0.2	
	Lolium perenne	Perennial Ryegrass	*						2

Form	Species name	Common name	Exotic (*)	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5
GG	*Lomandra longifolia*	Spiny-headed Mat-rush							0.2
	Melinis repens	Red Natal Grass	*						0.12
GG	*Microlaena stipoides*	Weeping Meadow Grass			0.1	0.5			
	Modiola caroliniana	Red-flowered Mallow	*			0.2			
	Najas browniana	Water nymph							
	Ochna serrulata	Mickey Mouse Plant	*	*	0.1				
	Olea europaea subsp. *cuspidata*	African Olive	*	*		0.1			
FG)	*Oxalis spp.*				0.1	0.2		0.1	0.2
	Paspalum dilatatum		*	*		0.1			0.2
	Paspalum urvillei	Vasey Grass	*				2	0.1	
	Pavonia hastata		*		0.2	0.5		0.2	
FG	*Persicaria decipiens*	Slender Knotweed					0.1		
FG	*Phyllanthus virgatus*					0.1			
	Plantago lanceolata	Plantain	*			0.1			
	Robinia pseudoacacia	Black Locust	*	*					10
	Rubus fruticosus sp. agg.	Blackberry	*	*				15	0.1
	Senecio madagascariensis	Fireweed	*	*		0.1		0.1	0.1
	Senecio pterophorus		*						4
GG	*Setaria spp.*		*			0.1			2
	Sida rhombifolia	Paddy's Lucerne	*		0.1	2		0.2	
OG	*Smilax glyciphylla*	Sweet Sarsaparilla						0.1	
	Solanum linnaeanum	Apple of Sodom	*		0.1			0.1	2
	Solanum nigrum	Blackberry Nightshade	*					0.1	
	Sonchus oleraceus	Common Sowthistle	*			0.1			
	Stellaria spp.		*		0.2				
	Stenotaphrum secundatum	Buffalo Grass	*	*					10
	Taraxacum officinale	Dandelion	*			0.1			
GG	*Themeda triandra*	Kangaroo Grass						0.2	

Form	Species name	Common name	Exotic (*)	High Threat Weed	Cover (%) Plot 1	Cover (%) Plot 2	Cover (%) Plot 3	Cover (%) Plot 4	Cover (%) Plot 5
	Trifolium repens	White Clover	*		0.1	0.1			
GG	*Typha orientalis*	Broadleaf Cumbungi					50		
	Verbena bonariensis	Purple Tops	*		0.1	0.2		0.1	2
	Verbena rigida	Veined Verbena	*					0.1	1

Tree (TG), Shrub (SG), Grass & Grasslike (GG), Forb (FG), Fern (EG), Other (OG)

Table 38: Vegetation integrity data (Composition, Structure and function)

Plot location data						
Plot no.	PCT	Vegetation Zone	Condition	Eastings	Northings	Bearing
1	1800	3	Degraded	293525	6262237	340
2	835	1	Degraded	293518	6262709	270
3	1071	5	Degraded	293435	6262678	345
4	835	2	Regrowth	293505	6262374	155
5	1800	4	Low			178

Composition (number of species)						
Plot no.	Tree	Shrub	Grass	Forb	Fern	Other
1	2	0	2	2	1	1
2	3	0	3	5	0	2
3	2	0	2	1	0	1
4	3	4	1	4	0	1
5	2	2	4	3	0	0

Structure (Total cover)						
	Tree	Shrub	Grass	Forb	Fern	Other
1	50.5	0	0.2	0.4	0.1	0.1
2	23.0	0	0.7	0.8	0	0.7
3	2.0	0	50.1	0.1	0	0.1
4	31.0	12.6	0.2	0.4	0	0.1
5	0.3	2	2.4	0.5	0	0

Function											
Plot no.	Large Trees	Hollow trees	Litter Cover	Length Fallen Logs	Tree Stem 5- 9 cm	Tree Stem 10-19 cm	Tree Stem 20-29 cm	Tree Stem 30-49 cm	Tree Stem 50-79 cm	Tree Regen	High Threat Weed Cover
1	0	0	85	7	1	1	1	0	0	1	11.5
2	0	0	50	0	1	1	1	1	0	1	32.3
3	0	0	0	0	0	0	0	0	0	0	1.2
4	0	0	56	17	1	1	1	0	0	1	62.0
5	0	0	2.4	0	1	0	0	0	0	1	49.0

Appendix C: Ultrasonic Analysis Report

Methods

16 Anabat survey nights

Two Anabat recorders and two Anabat Swifts were placed in four locations within the St Marys Intermodal Facility. One Anabat and one Anabat Swift were placed on either side of the large dam and the other two devices were placed within small creek lines near two culverts for four nights between 11 and 16 February 2019.

Data Analysis

Bat calls were analysed by Danielle Adams-Bennett using the program AnalookW (Version 4.2n 16 March 2017, written by Chris Corben, www.hoarybat.com). Call identifications were made using regional based guides to the echolocation calls of microbats in New South Wales (Pennay et al 2004); and south-east Queensland and north-east New South Wales (Reinhold et al 2001) and the accompanying reference library of over 200 calls from Sydney Basin, NSW (which is available at http://www.forest.nsw.gov.au/research/bats/default.asp). Danielle has over four years of experience in the identification of ultrasonic call recordings. This report and a sample of the calls was reviewed by Alicia Scanlon from Eco Logical Australia, who has over eleven years of experience in the identification of ultrasonic call recordings.

Bat calls were analysed using species-specific call profile parameters including call shape, characteristic frequency, initial slope and time between pulses (Reinhold et al. 2001). To ensure reliable and accurate results the following protocols (adapted from Lloyd et al 2006) were followed:

Search phase calls were used in the analysis, rather than cruise phase calls or feeding buzzes (McKenzie et al 2002). Cruise phase or feeding calls were labelled as being unidentifiable.

Recorded calls containing less than three pulses were not analysed and these sequences were labelled as unidentifiable, being too short to confidently determine the identity of the species making the call (Law et al 1999).

For those calls that were useful to identify the species making the call, two categories of confidence were used (Mills et al1996):

Definitely present – the quality and structure of the call profile is such that the identity of the bat species making the calls is not in doubt

Potentially present – the quality and structure of the call profile is such that there is some / low probability of confusion with species that produce similar calls profiles

Calls made by bats which cannot be used for identification purposes such as social calls, short and low-quality calls, cruise and approach phase calls were labelled as unidentifiable.

Sequences labelled as unidentifiable were of inferior quality and therefore not able to be identified to any microbat species, they can however be used as an indicator of microbat activity at the site.

Nyctophilus spp. (Long-eared bats) are difficult to identify confidently from their calls and no attempt was made to identify this genus to species level (Pennay et al 2004). There are two potential *Nyctophilus* species that could occur in the study area. Both species; *N. geoffroyi* (Lesser Long-eared Bat) and *N. gouldii* (Gould's Long-eared Bat) are relatively common and widely distributed across NSW.

The Free-tailed Bats (previously referred to as the genus *Mormopterus*) have recently undergone taxonomic revision (Reardon et al 2014) and published reference calls for this group of species (Pennay et al 2004) are believed to contain errors (Greg Ford pers comm.). This report uses nomenclature for Free-tailed bat species as referred to in Jackson and Groves (2015). The correlation between nomenclature used in this report and that used in NSW State legislation is presented in Table 39 below.

Sequences not attributed to microbat echolocation calls (e.g. insect buzzes, wind, train and vehicle movement) were dismissed from the analysis.

Table 39: Correlations between current and previous nomenclature for the Free-tailed bats of NSW

Jackson and Groves 2015	Previously known as	Common Name	BC Act
Austronomus australis	*Tadarida australis*	White-striped Free-tailed Bat	
Micronomus norfolkensis	*Mormopterus norfolkensis*	Eastern Coastal Free-tailed Bat	Vulnerable
Ozimops petersi	*Mormopterus species* 3 (small penis)	Inland Free-tailed Bat	
Ozimops planiceps	*Mormopterus species 4* (long penis eastern form)	Southern Free-tailed Bat	
Ozimops ridei	*Mormopterus* species 2	Ride's Free-tailed Bat	
Setirostris eleryi	*Mormopterus* species 6	Bristle-faced Free-tailed Bat	Endangered

Results

There were 307 sequences recorded from two Anabat detectors and two Anabat Swifts placed at four separate locations (Sites 1, 2, 3 and 4) for a total of sixteen (16) detector-nights within the study area at St Marys between 11 and 16 February 2019. Approximately 53% of sequences (163) submitted were able to be identified to genus or species with the remainder being too short or of low quality preventing positive identification.

High insect activity was recorded across all the devices which could have contributed to the low number of microbat calls recorded on the detectors.

There were at least nine and up to 14 species recorded in this survey (Table 40). Up to four species listed as vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act) were recorded (Table 40 and Figure 15 to Figure 26). Three threatened species were confidently identified;

- ***Falsistrellus tasmaniensis*** **(Eastern False Pipistrelle)**
- ***Micronomus norfolkensis*** **(Eastern Coastal Free-tailed Bat)**
- ***Myotis macropus*** **(Southern Myotis)**

One other threatened species were recorded as being potentially present, because this species has calls that overlap with other more common species. There were no defining call characteristics present in the recorded sequences that could be confidently attributed to the following species;

- ***Miniopterus schreibersii oceanensis*** **(Eastern Bent-winged Bat)**

Eastern False Pipistrelles are primarily a tree roosting species that prefers wet sclerophyll and coastal mallee forests (Churchill, 2008). This species is known from the Sydney Basin, forages over the St Mary's Internodal site and may roost in hollow baring trees on site.

Eastern Coastal Free-tailed Bats are primarily a tree roosting species that has also been known to roost in buildings (Churchill, 2008). This species prefers dry sclerophyll forest and woodland and forages over open spaces. It is known from the Sydney Basin, particularly from the open woodlands and forests of the Cumberland Plain. This species forages over the St Mary's Intermodal site and may roost within hollow bearing trees or buildings on the site.

Southern Myotis is known from the Sydney Basin, particularly on the Cumberland Plain in western Sydney. Southern Myotis will roost in hollow bearing tress (generally within 200 m of permanent water) as well as subterranean structures such as old railway tunnels, military bunkers, culverts, bridges, stormwater drains and mines (Churchill, 2008; Campbell, 2014). This species is resident year round in the Sydney Basin with a breeding season that runs from October to March. It has a unique feeding strategy amongst Australian bats in that it forages exclusively over water, trawling the surface for small insects and aquatic species such as fish and crustaceans. Suitable waterbodies generally contain at least 3m of open water and include farm dams. Southern Myotis forages across waterbodies on site and may roost within hollow bearing trees or culverts on site.

Eastern Bent-winged Bats are known to occur in the Sydney Basin. This species is a subterranean roosting species that is only known to breed in a small number of caves in NSW (Churchill, 2008). These caves provide the perfect microclimatic conditions for rearing of young. Breeding occurs over the summer months and bats disperse to other non-breeding winter and hibernation roosts between March and August each year (Churchill, 2008). There are several Eastern Bent-winged Bat winter roosts within the Sydney basin. These roosts are found in a range of man-made structures such as old railway tunnels, military bunkers, culverts, bridges, stormwater drains, mines and sea caves. It is likely that Eastern Bent-winged Bats will forage over the St Mary's Intermodal site and possible that it could roost in culverts or other man-made structures on site.

The most commonly recorded species were *Chalinolobus gouldii* (Gould's Wattled Bat) and *Ozimops ridei* (Ride's Free-tailed Bat) either individually or as a species combination, accounting for 35% of all recorded calls (including unidentifiable sequences), and 65% of identifiable call sequences (Figure 13). Calls from the four threatened species accounted for less than 12% of recorded calls (including unidentifiable sequences) and less than 25% of identifiable sequences recorded (Figure 14).

There was very little microbat activity recorded at the culverts at dusk and dawn (Table 43 and Table 44). A couple of Gould's Wattled Bat calls were recorded at the western culvert and one Gould's Wattled Bat / Ride's Free-tailed Bat recorded at the eastern culvert at dawn. Gould's Wattled Bats have been recorded roosting in culverts but commonly prefer tree hollows. Ride's Free-tailed Bats commonly roost in tree hollows and have also been recorded in buildings but not in culverts. It is not possible to

determine whether the recorded calls were made by bats flying overhead close to the culvert or by bats entering or leaving the culvert.

See the Survey Limitations section provided below for further information.

Table 40: Summary of microbat species recorded at St Marys during surveys on 11-16 February 2019.

Scientific Name	Common Name	Definitely present	Potentially present
Austronomus australis	White-striped Free-tailed Bat	x	
Chalinolobus gouldii	Gould's Wattled Bat	x	
Chalinolobus morio	Chocolate Wattled Bat	x	
*Falsistrellus tasmaniensis**	Eastern False Pipistrelle	x	
*Micronomus norfolkensis**	Eastern Coastal Free-tailed Bat	x	
*Miniopterus schreibersii oceanensis**	Eastern Bent-winged Bat		x
*Myotis macropus**	Southern Myotis	x	
Ozimops ridei	Ride's Free-tailed Bat	x	
Nyctophilus sp.	Long-eared Bats		x
Scotorepens orion	Eastern Broad-nosed Bat	x	x
Vespadelus darlingtoni	Large Forest Bat		x
Vespadelus regulus	Southern Forest Bat		x
Vespadelus vulturnus	Little Forest Bat	x	

* Threatened species listed under BC Act

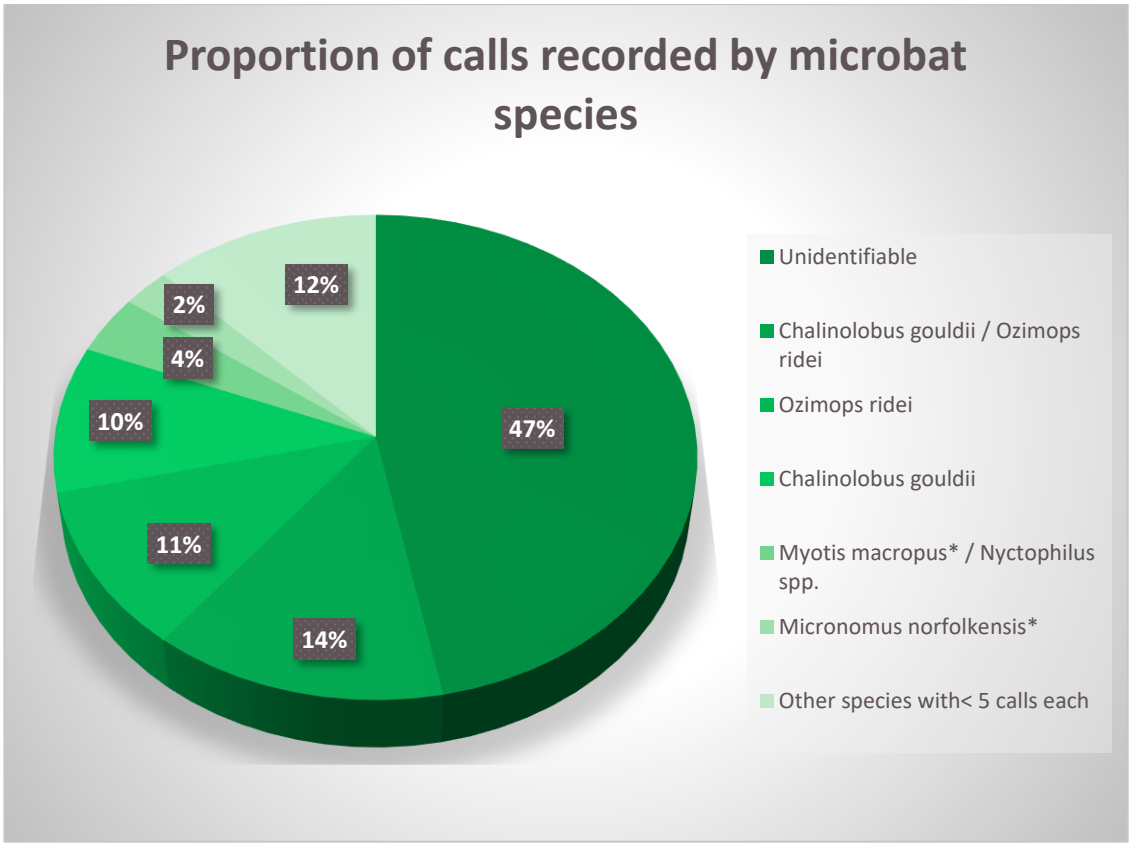

Figure 13: Proportion of microbat calls recorded by species at St Mary's Intermodal Facility 11 – 16 February 2019.

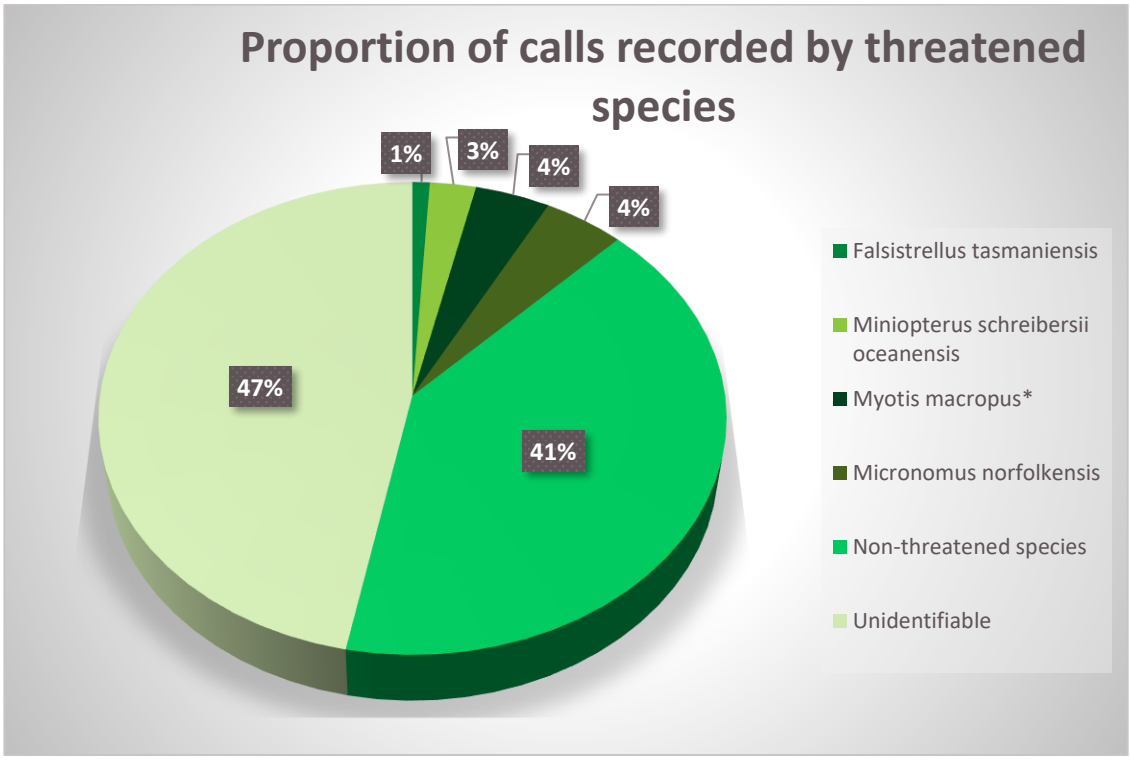

Figure 14: Proportion of calls recorded by threatened species at St Mary's Intermodal Facility 11- 16 February 2019.

Survey Limitations

Calls can only be positively identified when the defining characteristics are present and there is no chance of confusion between species with overlapping and/or similar calls. In this survey, there were some call sequences that could not be positively identified to species level because they were too unclear or too short.

The calls of *Chalinolobus gouldii* (Gould's Wattled Bat) and *Ozimops* ridei (Ride's Free-tailed Bat) can be difficult to separate. Calls were identified as Ride's Free-tailed Bat when the call shape was flat (slope S1 of less than 100 OPS generally) and the frequency was between 24 – 36 kHz. Gould's Wattled Bat was distinguished by a frequency of 27.5 – 32.5 kHz and alternation in call frequency between pulses. When no distinguishing characteristics were present calls were assigned to multi-species groups.

The calls of **Eastern False Pipistrelle, *Scoteanax rueppellii* (Greater Broad-nosed Bat)**, and Scotorepens orion (Eastern Broad-nosed Bat) can be difficult to separate as their call frequencies and some other call characteristics overlap.

Greater Broad-nosed Bats can be distinguished by a frequency of 32.5 – 36 kHz, lack of a tail or short down-sweeping tail, frequency of the knee greater than 37 kHz, and drop of more than 3 kHz from the knee to the characteristic section.

Eastern False Pipistrelle bat calls have a characteristic frequency between 35.5 and 40.5 kHz, display curved, often steep pulses without up-sweeping tails and sometimes with down-sweeping tails. The pre-characteristic section is often long. This species can only be separated from Eastern Broad-nosed Bat when calls are above 37 kHz.

Eastern Broad-nosed Bat calls fall between 34.5 and 37 kHz with the frequency of the knee > 38 kHz. They can only be separated from Eastern False Pipistrelle when calls are between 34 and 35 kHz, and the frequency of the knee is above 38 kHz. Distinguished from Greater Broad-nosed Bat when there is less than a 3 kHz drop between the knee and characteristic section.

Eastern Bent-winged Bats have call profiles that overlap with other species in the Sydney Basin, including *Vespadelus darlingtoni* (Large Forest Bat) and *Vespadelus regulus* (Southern Forest Bat). Eastern Bent-winged Bat calls can be identified by a characteristic frequency of 43.5 – 47.5 kHz, a down-sweeping tail, uneven time between call pulses and pulse shape within a sequence and a drop of more than 2 kHz between the knee and characteristic section of the call. Large Forest Bat calls have a characteristic frequency of 40 - 44 kHz, have no tail or up-sweeping tails and often have a long characteristic section. Southern Forest Bats call between 43.5 and 46 kHz, and generally have up-sweeping tails with even consecutive pulses. Some of the calls recorded during this survey displayed a drop of more than 2 kHz, downward sweeping tails and variability between the pulses leading to an identification of Eastern Bent-winged Bat.

The calls of Southern Myotis are very similar to all *Nyctophilus* (Long-eared Bat) species and it is often difficult to separate these species on call characteristics alone. Calls can be identified as *Nyctophilus spp*. when the time between calls (TBC) is higher than 95ms and the initial slope S1 is lower than 300 octaves per second (OPS). Calls can be identified as Southern Myotis when the time between calls (TBC) is lower than 75ms and the initial slope S1 is greater than 400 (OPS). Where the TBC is between 75 and

95ms and the OPS is between 300 and 400 calls are assigned a mixed species label of Southern Myotis / Long-eared Bats.

Table 41: Combined Anabat results for four nights 11-16 February 2019, Site 1 (western side of dam), St Marys.

Scientific name	Common name	Definitely present	Potentially potential	Total
Austronomus australis	White-striped Free-tailed Bat	4		4
Chalinolobus gouldii	Gould's Wattled Bat	11		11
Chalinolobus gouldii / Ozimops ridei	Gould's Wattled Bat / Ride's Free-tailed Bat			19
*Falsistrellus tasmaniensis**	Eastern False Pipistrelle	1		1
*Falsistrellus tasmaniensis** / *Scotorepens orion*	Eastern False Pipistrelle / Eastern Broad-nosed Bat			1
*Micronomus norfolkensis**	Eastern Coastal Free-tailed Bat	4		4
Micronomus norfolkensis / Ozimops ridei*	Eastern Coastal Free-tailed Bat / Ride's Free-tailed Bat			3
***Miniopterus schreibersii oceanensis** / *Vespadelus darlingtoni* / *Vespadelus regulus*	**Eastern Bent-winged Bat** / Large Forest Bat / Southern Forest Bat			5
Myotis macropus / Nyctophilus spp.*	**Southern Myotis** / Long-eared Bats			5
Ozimops ridei	Ride's Free-tailed Bat	25		25
Vespadelus darlingtoni / Vespadelus regulus	Large Forest Bat / Southern Forest Bat			1
Unidentifiable				66
Total identified calls				79
Total calls				145
Percentage identifiable				54.5%

*Threatened species listed under BC Act

Table 42: Combined Anabat results for four nights 11-16 February 2019, Site 2 (north eastern side of dam), St Marys.

Scientific name	Common name	Definitely present	Potentially present	Total
Austronomus australis	White-striped Free-tailed Bat	3		3
Chalinolobus gouldii	Gould's Wattled Bat	14		14
Chalinolobus gouldii / Ozimops ridei	Gould's Wattled Bat / Ride's Free-tailed Bat			7
Chalinolobus morio	Chocolate Wattled Bat	2		2
*Micronomus norfolkensis**	Eastern Coastal Free-tailed Bat	4		4
Micronomus norfolkensis / Ozimops ridei*	Eastern Coastal Free-tailed Bat / Ride's Free-tailed Bat			2
***Miniopterus schreibersii oceanensis** / Vespadelus darlingtoni / Vespadelus regulus*	**Eastern Bent-winged Bat** / Large Forest Bat / Southern Forest Bat			1
*Miniopterus schreibersii oceanensis * / Vespadelus regulus*	Eastern Bent-winged Bat / Southern Forest Bat			2
*Myotis macropus**	Southern Myotis	1		1
Myotis macropus / Nyctophilus spp.*	**Southern Myotis** / Long-eared Bats			5
Ozimops ridei	Ride's Free-tailed Bat	5		5
Vespadelus darlingtoni / Vespadelus regulus	Large Forest Bat / Southern Forest Bat			1
Vespadelus vulturnus	Little Forest Bat	2		2
Unidentifiable				44
Total identified calls				49
Total calls				93
Percentage identifiable				52.7%

*Threatened species listed under BC Act

Table 43: Combined Anabat results for four nights 11-16 February 2019, Site 3 (eastern culvert), St Marys.

Scientific name	Common name	Definitely present	Potentially present	Total
Chalinolobus gouldii	Gould's Wattled Bat	2		2
Chalinolobus gouldii / Ozimops ridei	Gould's Wattled Bat / Ride's Free-tailed Bat			11
Micronomus norfolkensis / Ozimops ridei*	Eastern Coastal Free-tailed Bat / Ride's Free-tailed Bat			1
Ozimops ridei	Ride's Free-tailed Bat	1		1
Unidentifiable				29
Total identified calls				15
Total calls				44
Percentage identifiable				34.1%

*Threatened species listed under BC Act

Table 44: Combined Anabat results for four nights 11-16 February 2019, Site 4 (western culvert), St Marys.

Scientific name	Common name	Definitely present	Potentially present	Total
Chalinolobus gouldii	Gould's Wattled Bat	3		3
Chalinolobus gouldii / Ozimops ridei	Gould's Wattled Bat / Ride's Free-tailed Bat			5
Chalinolobus morio / Vespadelus vulturnus	Chocolate Wattled Bat / Little Forest Bat			2
*Falsistrellus tasmaniensis**	Eastern False Pipistrelle	1		1
Myotis macropus / Nyctophilus spp.*	**Southern Myotis** / Long-eared Bats			2
Ozimops ridei	Ride's Free-tailed Bat	2		2
Vespadelus darlingtoni / Vespadelus regulus	Large Forest Bat / Southern Forest Bat			4
Vespadelus vulturnus	Little Forest Bat	1		1
Unidentifiable				5
Total identified calls				20
Total calls				25
Percentage identifiable				80%

*Threatened species listed under BC Act

Call Profiles

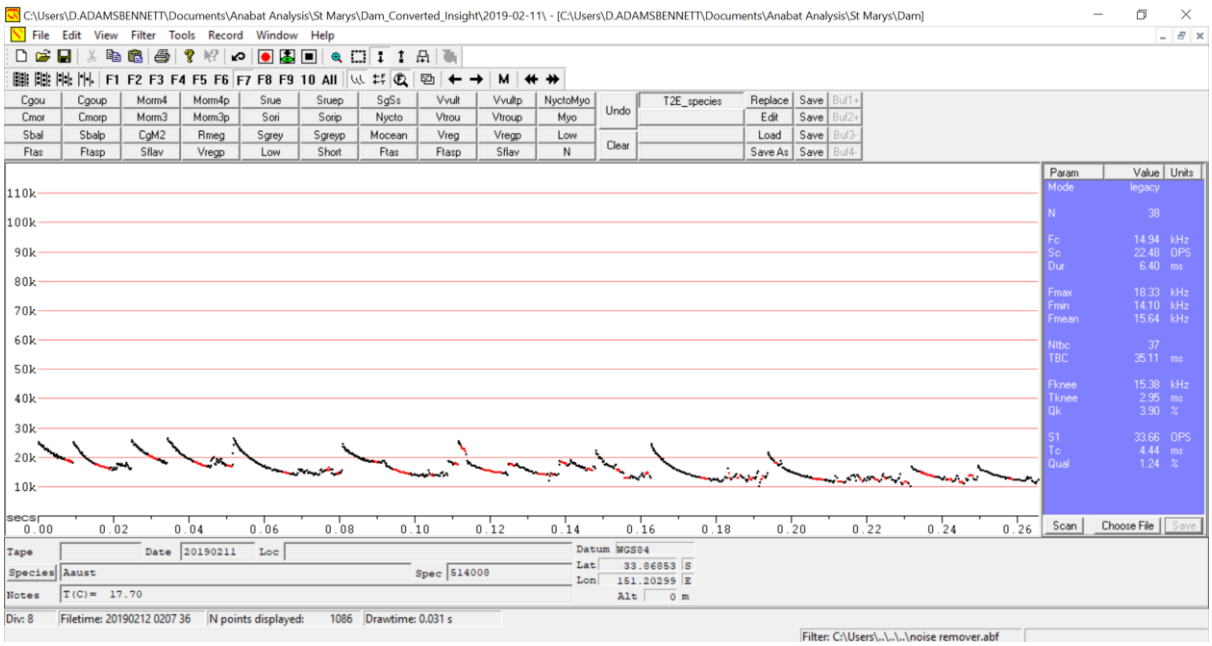

Figure 15: Call profile for *Austronomus australis* (White-striped Free-tailed Bat) recorded at Site 1, St Marys at 02:07 (2:07am) on 12 February 2019.

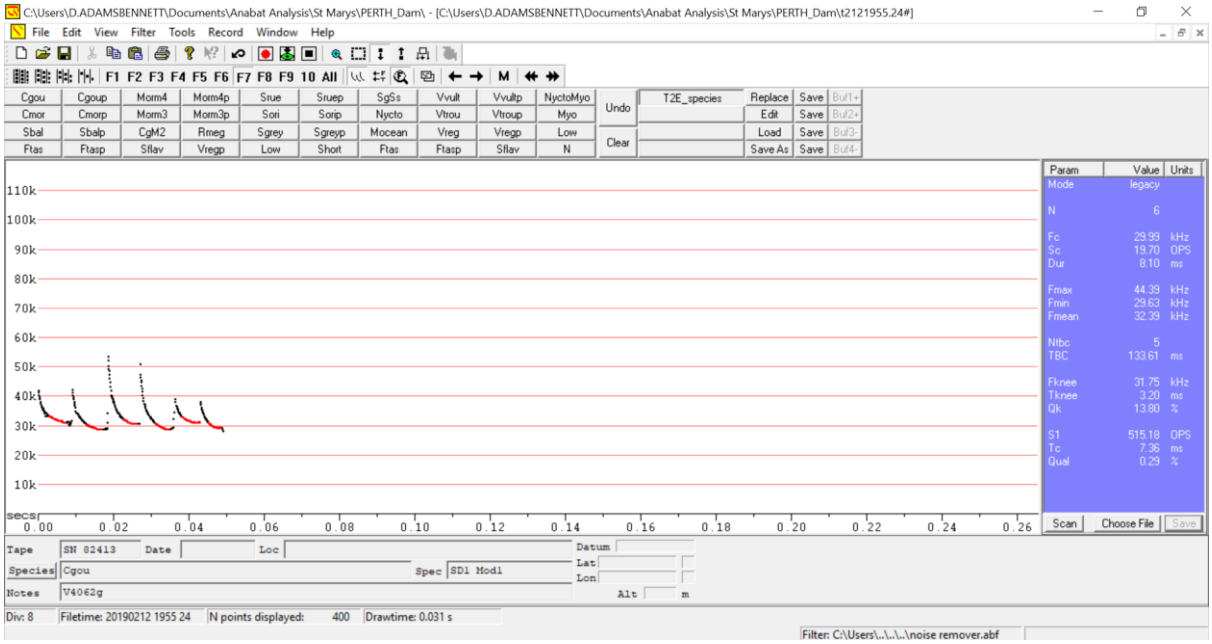

Figure 16: Call profile for *Chalinolobus gouldii* (Gould's Wattled Bat) recorded at Site 2, St Marys at 19:55 (7:55pm) on 12 February 2019.

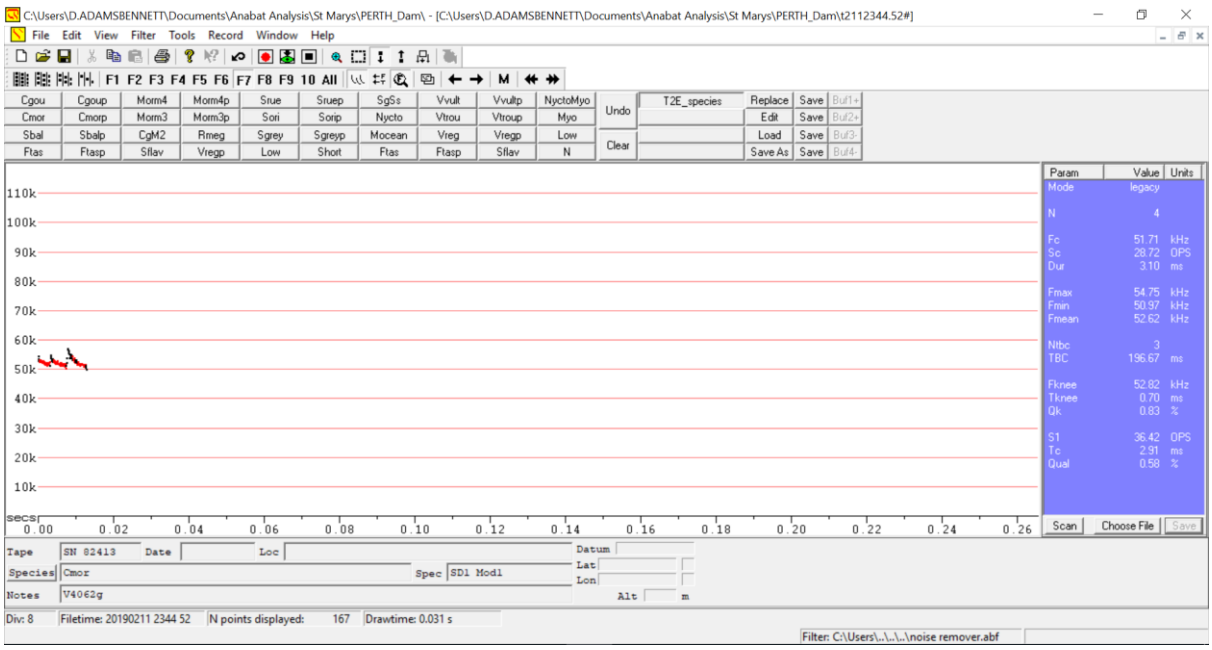

Figure 17: Call profile for *Chalinolobus morio* (Chocolate Wattled Bat) recorded at Site 2, St Marys at 23:44 (11:44pm) on 11 February 2019.

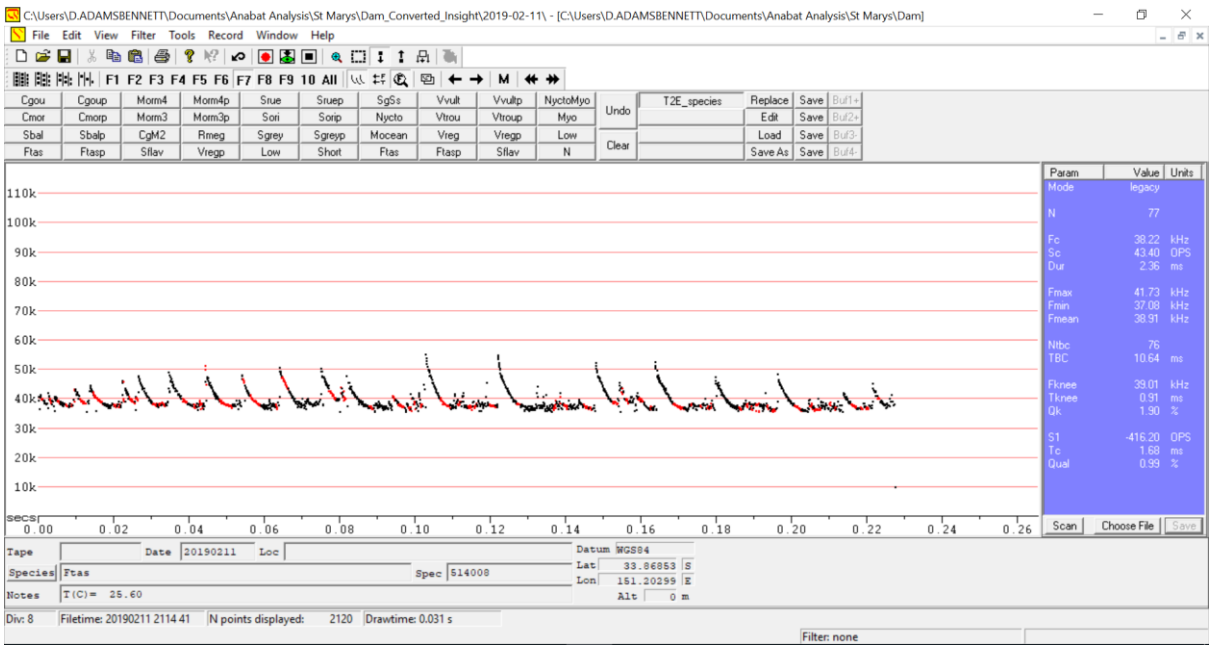

Figure 18: Call profile for *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) recorded at Site 1, St Marys at 21:14 (9:14pm) on 11 February 2019.

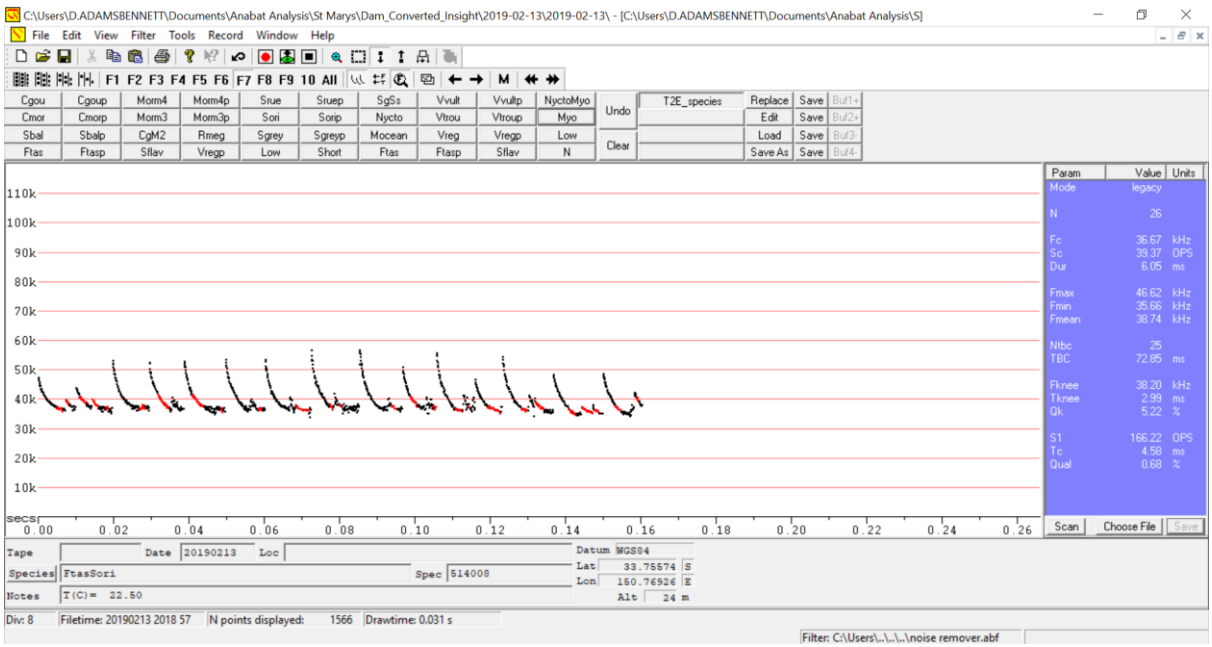

Figure 19: Call profile for *Falsistrellus tasmaniensis* (Eastern False Pipistrelle) / *Scotorepens orion* (Eastern Broad-nosed Bat) recorded at Site 1, St Marys at 20:18 (8:18pm) on 13 February 2019.

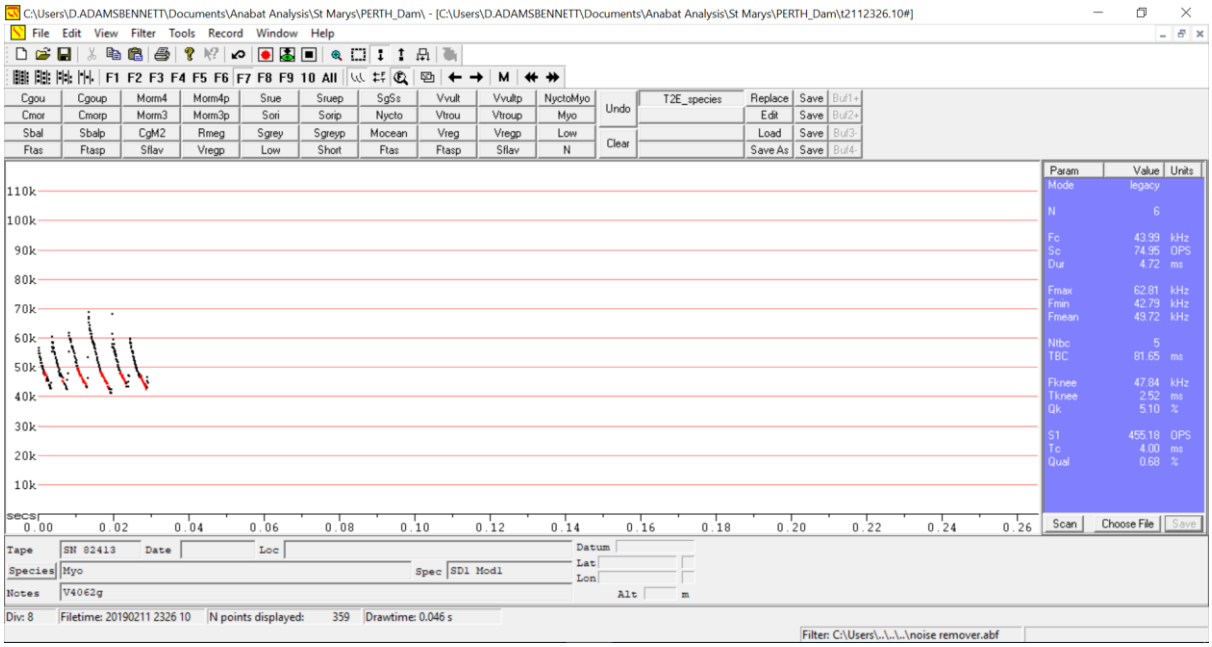

Figure 20: Call profile for *Myotis macropus* (Southern Myotis) recorded at Site 2, St Marys at 23:26 (11:26pm) on 11 February 2019.

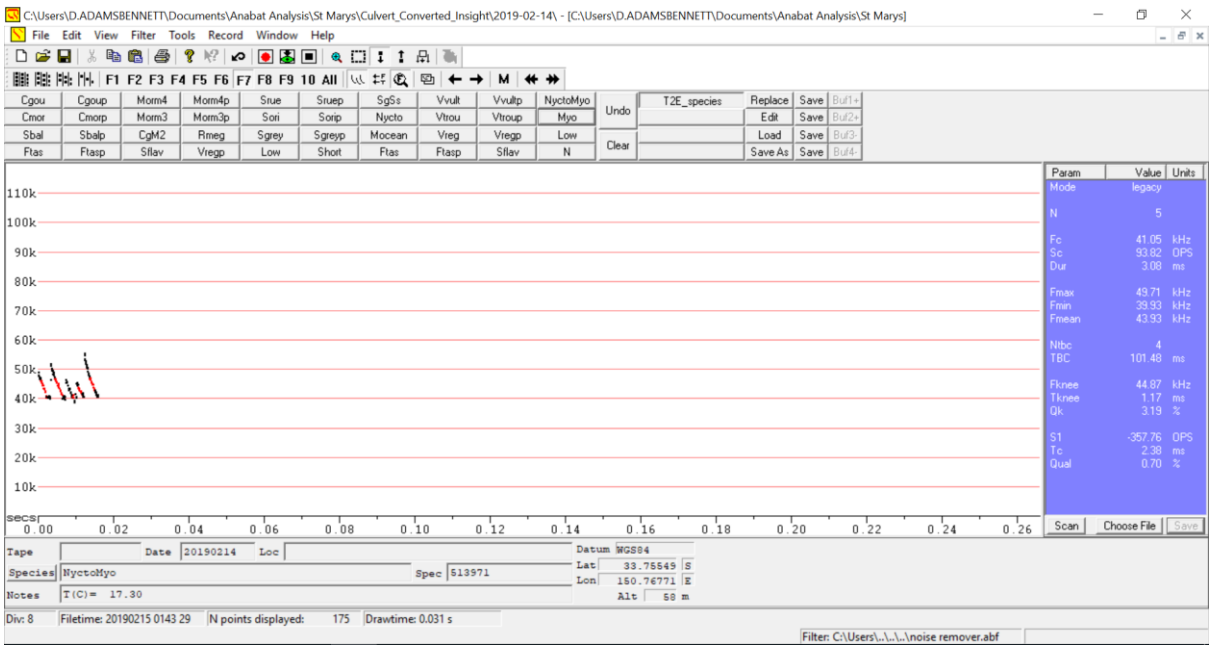

Figure 21: Call profile for *Myotis macropus* (Southern Myotis) / *Nyctophilus* sp. (Long-eared Bat) recorded at Site 4, St Marys at 01:43 (1:43am) on 15 February 2019.

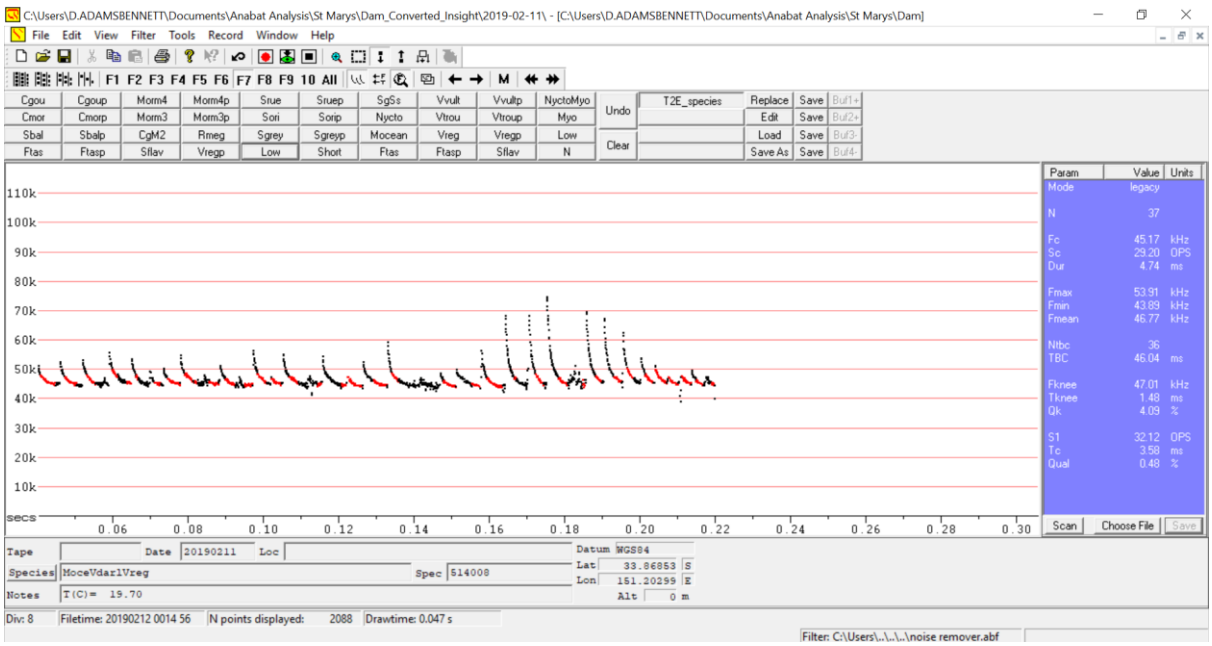

Figure 22: Call sequence for *Miniopterus schreibersii oceanensis* (Eastern Bent-winged Bat) / *Vespadelus darlingtoni* (Large Forest Bat) / *Vespadelus regulus* (Southern Forest Bat) recorded at Site 1, St Marys at 00:14 (12:14am) on 12 February 2019.

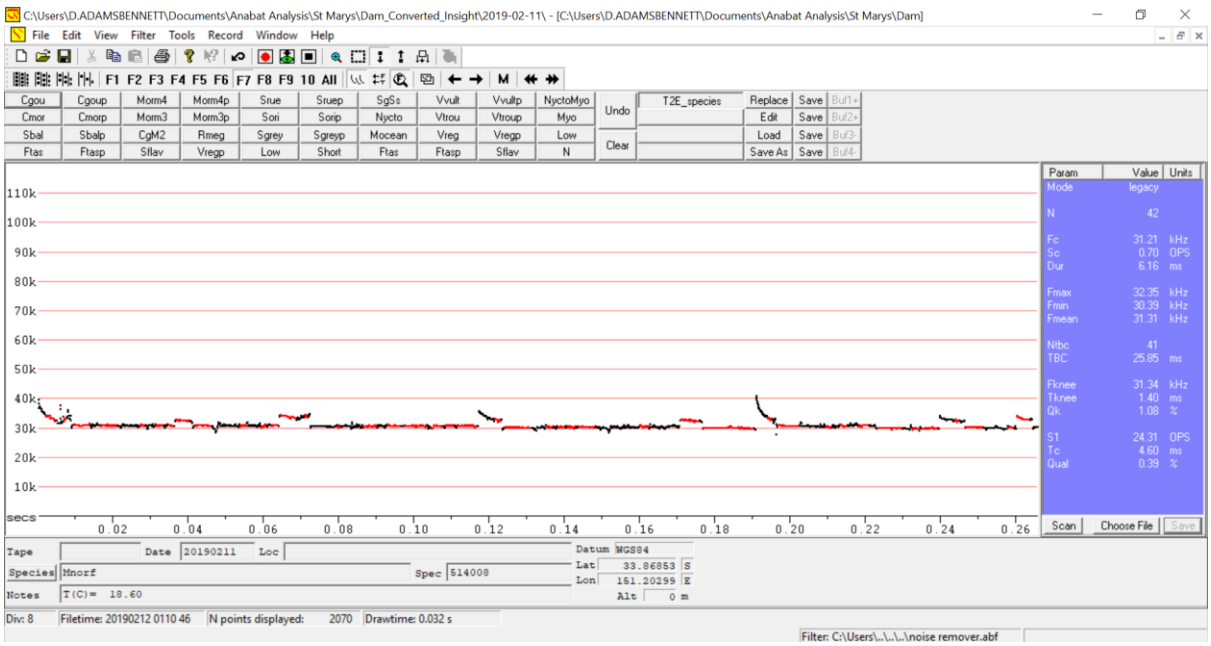

Figure 23: Call profile for *Micronomus norfolkensis* (Eastern Coastal Free-tailed Bat) recorded at 0110 (1:10am) at Site 1 St Marys on 12 February 2019.

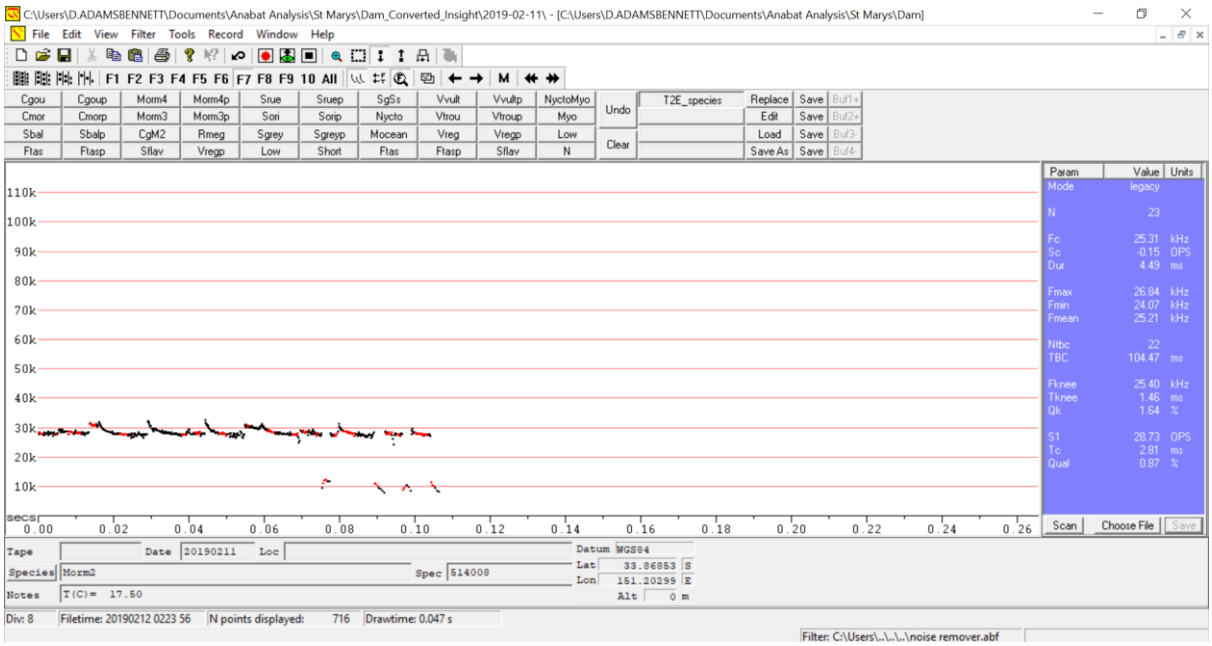

Figure 24: Call profile for *Ozimops ridei* (Ride's Free-tailed Bat) recorded at Site 1, St Marys at 02:23 (2:23am) on 12 February 2019.

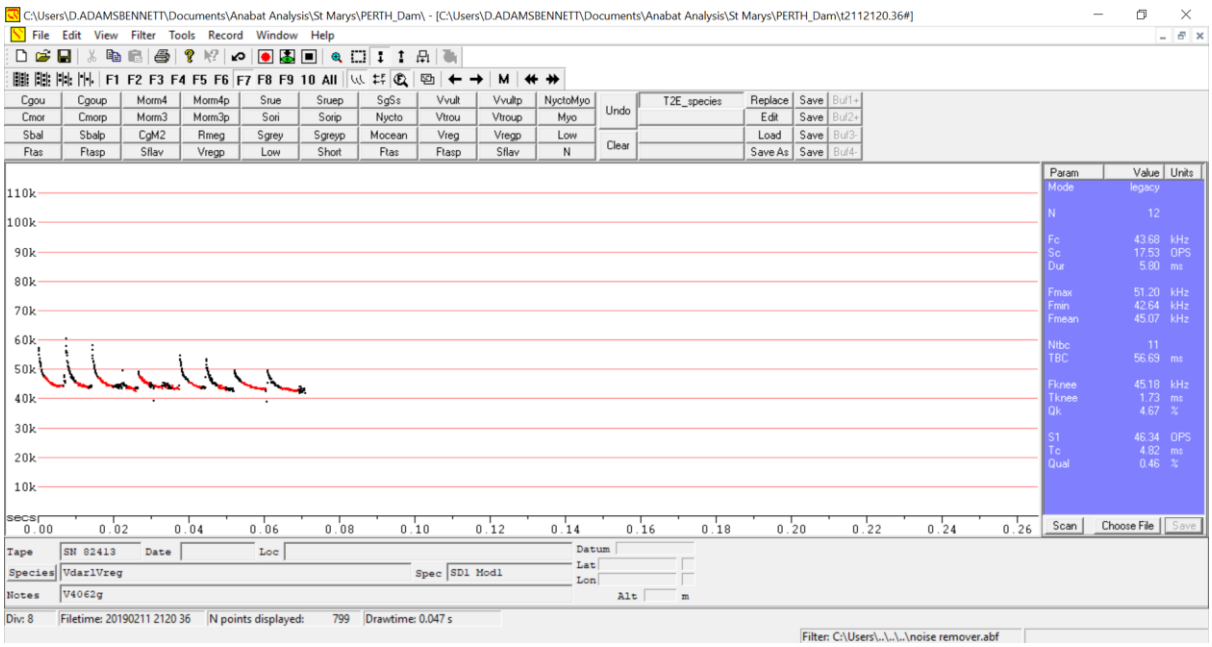

Figure 25: Call profile for *Vespadelus darlingtoni* (Large Forest Bat) / *Vespadelus regulus* (Southern Forest Bat) recorded at Site 2, 21:20 (9:20pm) on 11 February 2019.

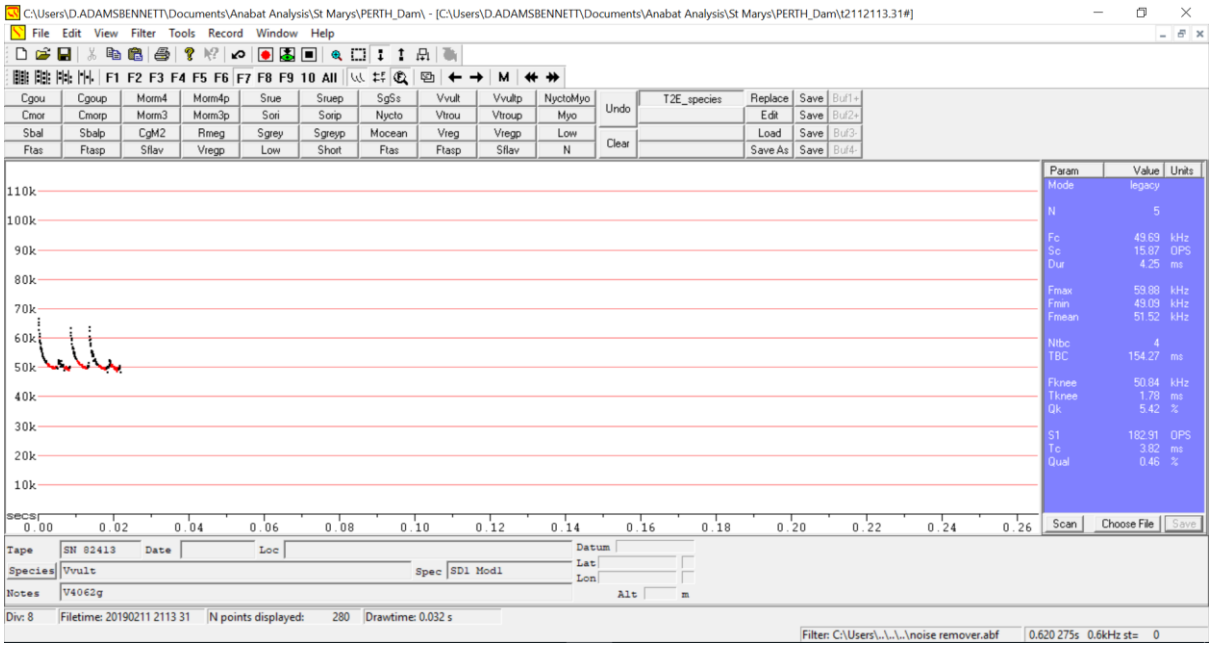

Figure 26: Call profile for *Vespadelus vulturnus* (Little Forest Bat) recorded at Site 2, St Marys at 21:13 (9:13pm) on 11 February 2019.

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Appendix D: Biodiversity credit report

NSW GOVERNMENT

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00013531/BAAS18162/19/00013532	St Marys Intermodal Facility	04/01/2019
Assessor Name	**Report Created**	**BAM Data version ***
Mike Lawrie	28/02/2019	6
Assessor Number	* Disclaimer: BAM data last updated may indicate either complete or partial update of the BAM calculator database. BAM calculator database may not be completely aligned with Bionet.	
BAAS18162		

Ecosystem credits for plant communities types (PCT), ecological communities & threatened species habitat

Zone	Vegetation zone name	Vegetation integrity loss / gain	Area (ha)	Constant	Species sensitivity to gain class (for BRW)	Biodiversity risk weighting	Candidate SAII	Ecosystem credits
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion								
1	835_Degraded	35.6	0.3	0.25	High Sensitivity to Potential Gain	2.00		6
2	835_Regrowth	44.6	0.3	0.25	High Sensitivity to Potential Gain	2.00		7
							Subtotal	**13**

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BAM Credit Summary Report

Phragmites australis and Typha orientalis coastal freshwater wetlands of the Sydney Basin Bioregion								
4	1071_Moderate	36.8	0.1	0.25	High Sensitivity to Potential Gain	2.00		2
							Subtotal	**2**
Swamp Oak open forest on riverflats of the Cumberland Plain and Hunter valley								
3	1800_Degraded	28.1	0.1	0.25	High Sensitivity to Potential Gain	2.00		1
5	1800_Poor	6.5	0.7	0.25	High Sensitivity to Potential Gain	2.00		0
							Subtotal	**1**
							Total	**16**

Species credits for threatened species

Vegetation zone name	Habitat condition (HC)	Area (ha) / individual (HL)	Constant	Biodiversity risk weighting	Candidate SAII	Species credits
Grevillea juniperina subsp. juniperina / Juniper-leaved Grevillea (Flora)						
835_Degraded	35.6	0.18	0.25	2	False	3
835_Regrowth	44.6	0.33	0.25	2	False	7
1800_Degraded	28.1	0.06	0.25	2	False	1
1800_Poor	6.5	0.14	0.25	2	False	0
					Subtotal	**11**

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BAM Credit Summary Report

Myotis macropus / Southern Myotis (Fauna)						
835_Degraded	35.6	0.23	0.25	2	False	4
1800_Degraded	28.1	0.01	0.25	2	False	0
1071_Moderate	36.8	0.07	0.25	2	False	1
1800_Poor	6.5	0.55	0.25	2	False	2
					Subtotal	**7**

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