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JOHN HUNTER HEALTH INNOVATION PRECINCT PROJECT – PHASE 3

Biodiversity Development Assessment Report

FINAL

August 2022

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Biodiversity Development Assessment Report

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
Health Infrastructure

Project Director:	Allison Riley
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This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

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	Name	Date	Name	Date
2	Shaun Corry	23 June 2022	Allison Riley	23 June 2022
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Executive Summary

In June 2019, the NSW Government announced a significant expansion of the John Hunter Hospital with the $780 million John Hunter Health and Innovation Precinct (JHHIP) project (the Project). The aim of the JHHIP is to deliver updated facilities which provide additional capacity to meet the demand of the Greater Newcastle, Hunter New England, and northern NSW Regions.

The Acute Services Building and refurbishment of existing hospital facilities at John Hunter Hospital (Phase 1 and 2) has subsequently been approved, and this report addresses the approval being sought for an additional area to the west of the existing approved area, Phase 3, which is the interface between the JHHIP project and the Rankin Park to Jesmond Bypass project. Whilst approval for both projects has been granted, this Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt (Australia) Pty Limited (Umwelt) using the Biodiversity Assessment Method (BAM) in accordance with the *Biodiversity Conservation Act 2016* (BC Act) as an administrative process to determine the BAM credit required for Phase 3.

The area assessed by this BDAR supports two Plant Community Type (PCT) and 2 species credit species, being:

- PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
- PCT 1627 - Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
- squirrel glider (*Petaurus norfolcensis*)
- black-eyed Susan (*Tetratheca juncea*).

Following the application of avoidance and minimisation measures, the BAM assessment identified the following biodiversity credits required to offset the impacts of the Phase 3 of the Project:

- PCT 1619 - 59 credits
- PCT 1627 – 5 credits
- Black-eyed Susan (*Tetratheca juncea*) – 50 credits
- Squirrel glider (*Petaurus norfolcensis*) – 86 credits.

Health Infrastructure (HI) is committed to delivering a Biodiversity Offset Strategy that appropriately compensates for the unavoidable removal of biodiversity values as a result of the Project. The biodiversity offset strategy will be developed during the assessment process in consultation with the Biodiversity and Conservation Trust (BCT) and Department of Planning and Environment (DPE) and based on the following offset options available under the BC Act and Biodiversity Conservation Regulation using one or more of the following options:

- securing required credits through the open credit market and/or
- payments to the Biodiversity Conservation Fund.

Glossary of Acronyms

BAM	Biodiversity Assessment Methodology
BAM-C	BAM Calculator
BC Act	NSW *Biodiversity Conservation Act 2016*
BCD	NSW Biodiversity Conservation Division (formerly Office of Environment and Heritage) – part of NSW Department of Planning, Industry and Environment
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
CCS	Composition condition score
CEEC	Critically endangered ecological community
DAWE	Commonwealth Department of Agriculture, Water and the Environment (previously Department of the Environment and Energy)
DoEE	(Former) Commonwealth Department of the Environment and Energy (now DAWE)
DNG	Derived Native Grasslands
DPE	NSW Department of Planning and Environment (formerly DPIE)
DPIE	NSW Department of Planning, Industry and Environment (now DPE)
Ecosystem credit	A measurement of the value of threatened ecological communities and threatened species habitat for species that can be reliably predicted to occur with a PCT. Ecosystem credits measure the loss in biodiversity value at a development site and the gain in biodiversity value at an offset site.
EEC	Endangered Ecological Community
EP	Endangered Population
EP&A Act	NSW *Environmental Planning and Assessment Act 1979*
EPBC Act	Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*
FCS	Function condition score
GIS	Geographical Information System
HBT	Hollow bearing tree
HI	Health Infrastructure
IBRA	Interim Biogeographic Regionalisation for Australia (Version 7)
JHHIP	John Hunter Hospital Innovation Precinct
LLS Act	Local Land Services Act 2013
LEP	Local Environment Plan
LGA	Local Government Area
MGA	Map Grid of Australia
MNES	Matters of National Environmental Significance
NSW	New South Wales
PCT	Plant Community Type

PMST	Protected Matters Search Tool
SCS	Structure condition score
Species credit	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 database.
SSD	State Significant Development
Strahler Stream Order	Classification system that gives a waterway an 'order' according to the number of tributaries associated with it.
TEC	Threatened Ecological Community
TBDC	Threatened Biodiversity Data Collection
VIS	Vegetation Information System

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1.0 Introduction

In June 2019, the NSW Government announced a significant expansion of the John Hunter and John Hunter Children's Hospitals with the $780 million John Hunter Health and Innovation Precinct (JHHIP) project. The JHHIP will transform healthcare services for Newcastle, the greater Hunter region and northern NSW communities. The infrastructure will provide additional inpatient capacity to the John Hunter and John Hunter Children's Hospitals and create further opportunities for partnerships with industry and higher education providers.

The JHHIP will deliver an innovative and integrated precinct with industry-leading facilities working in collaboration with health, education and research partners to meet the current and future needs of the Greater Newcastle, Hunter New England and Northern NSW regions.

The John Hunter Health and Innovation Precinct Project is being planned and designed with ongoing communication and engagement with clinical staff, operational staff, the community and other key stakeholders with a strong focus on the following:

- patient-centred care
- contemporary models of care
- future economic, health and innovation development opportunities
- environmental sustainability.

The works to deliver the John Hunter Health and Innovation Precinct (JHHIP) by Health Infrastructure NSW under SSD-9351535 includes the construction of an internal road network connecting the future Rankin Park to Jesmond Bypass (RP2J) by Transport for NSW (SSI-6888) with the existing and proposed Hospital.

The RP2J project has notable interface with JHHIP, with the respective Government Agencies working collaboratively for the successful delivery of both Projects. Through this collaboration a previous complementing approach was undertaken, whereby the tree clearing within this interface area was included within RP2J. Therefore, the JHHIP aligned assessment areas to minimise unnecessary biodiversity impact/offset overlap. Refer to **Figure 1.2** showing alignment of the respective footprints.

This has resulted in SSD-9351535 including the approval for the internal road network, however it does not include an area of tree clearing required for these works to occur. This arrangement was recognised during the SSD assessment period, however at the time was recognised to be coordinated between the Government Agencies.

This report details the assessment undertaken within the area at the interface with the RP2J (SSI-6888) for incorporation into SSD-9351535. Whilst this BDAR presents a Development Footprint that incorporates two assessment areas, the area identified as part of the RP2J project (refer to **Figure 1.2**) forms part of the Development Footprint for administrative purposes only and, in accordance with section 7.17 (2) (c) of the BC Act (2016), as there is no additional biodiversity impacts to this area the BDAR for this modification is not required to assess that area. The biodiversity impacts from complete clearance of the JHHIP Assessment Area within the Development Footprint is subject to assessment in this BDAR. This area has been previously assessed under both NSW and Commonwealth legislation under the Framework for Biodiversity Assessment (FBA) and a current approval is in place for the development of the site however ongoing project refinements by TfNSW means that this area is unlikely to be required for their development. As such, this BDAR seeks to remain consistent with the BAR (GHD 2018) whilst applying the revised assessment approach (BAM) completed for the approved JHHIP SSD Application.

1.1 Summary of the Project

The John Hunter Health Campus (JHHC) is located on Lookout Road, Lambton Heights, within the City of Newcastle Local Government Area (LGA), approximately 8 km west of the Newcastle CBD (**Figure 1.1**). The hospital campus is located approximately 3.5 km north of Kotara railway station.

The JHHC comprises the John Hunter Hospital (JHH), John Hunter Children's Hospital (JHCH), Royal Newcastle Centre (RNC), the Rankin Park Rehabilitation Unit and the Nexus Unit (Children & Adolescent Mental Health). JHHC is a Level 6 Principal Referral and tertiary Hospital, providing the clinical hub for medical, surgical, child and maternity services within the Hunter New England Local Health District (HNELHD) and across northern NSW through established referral networks. Other services at the campus include the Hunter Medical Research Institute (HMRI), Newcastle Private Hospital and the HNELHD Headquarters.

Approval is being sought for tree removal and environmental clearing associated with the already SSD-9351535 approved infrastructure to the west of the JHHIP Project which comprises:

- site preparation including bulk earthworks, cut and fill
- construction of internal roads network and construction access roads and works to existing at-grade carparking
- campus wayfinding and signage
- landscape works.

This Biodiversity Development Assessment Report (BDAR) has been prepared by Umwelt for the Project using the Biodiversity Assessment Method (OEH 2020) (BAM) in accordance with the *Biodiversity Conservation Act 2016* (BC Act). The BDAR was prepared and approved by accredited BAM assessors Shaun Corry (BAAS17041) and Philippa Fagan (BAAS18117) with the final version issued to Health Infrastructure on 1 August 2022, within 14 days of the BAM Calculator being finalised and submitted.

1.2 Description of the Development Footprint

The Development Footprint (**Figure 1.2**) is 5.45 hectares (ha) in size and located approximately 8 km west of Newcastle. The Development Footprint is entirely encompassed by the Construction Footprint that was subject to biodiversity assessment for the RP2J project (GHD 2018) and afforded development consent under SSI-6888. The JHHIP Assessment Area is 2.7 ha in size.

The Development Footprint occurs within the Sydney Basin IBRA Bioregion and Wyong IBRA subregion. It is characterised by remnant bushland vegetation and habitats surrounding the existing John Hunter Hospital.

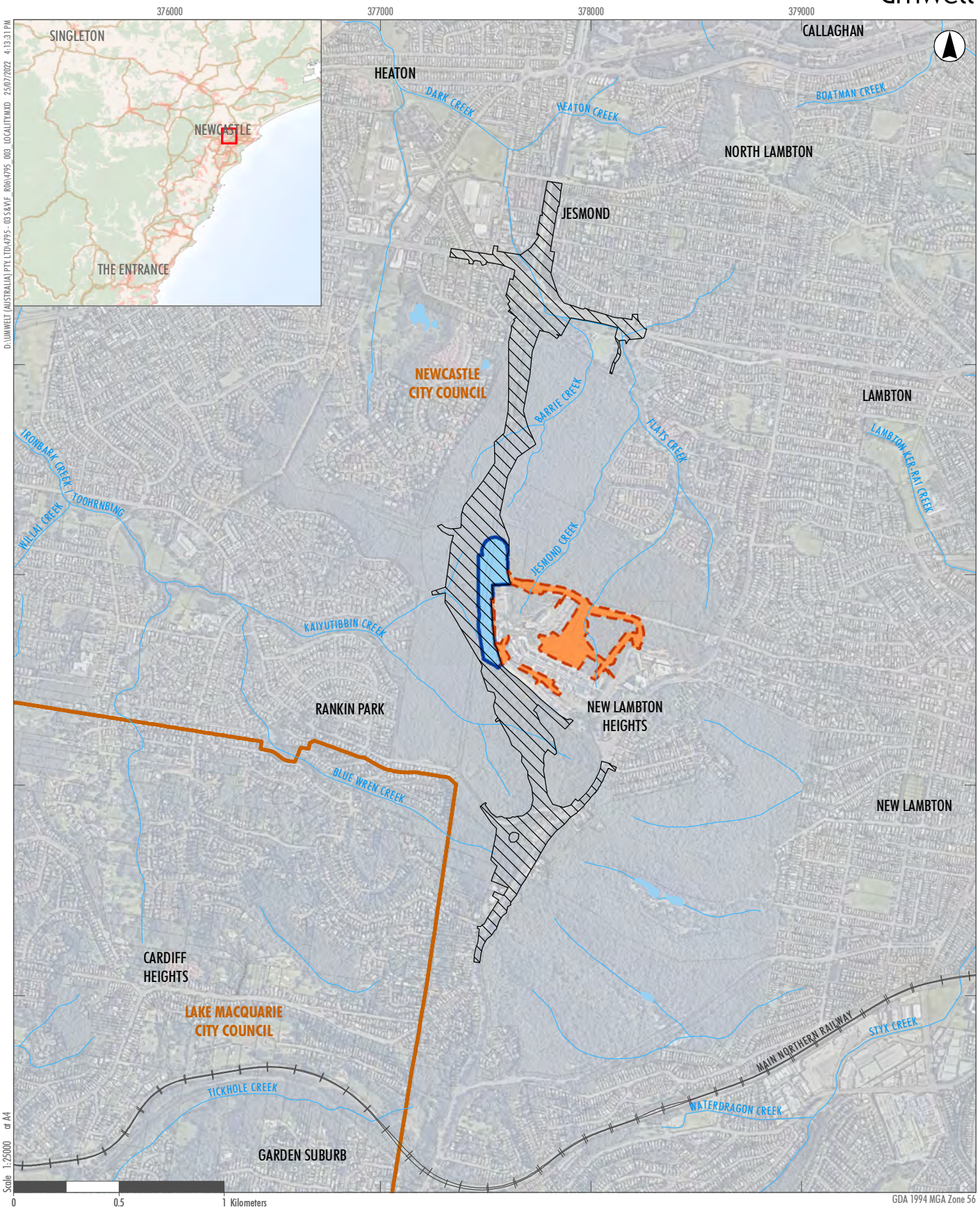
Table 1.1 provides details for the Development Footprint.

Table 1.1 Development Footprint Details

Development Footprint Details	
Name	JHHIP Project – Phase 3
Development Footprint	5.45 ha (JHHIP Assessment Area is 2.7 ha)
Lot and DP	A/DP344454 2/DP1228246 9/DP826092 11/DP826092 41/DP1176191
Current Land Use	Existing John Hunter Hospital infrastructure, with patches of the Jesmond Bushland Reserve bushland used for recreational activities.
LGA	Newcastle
LEP Zoning	Newcastle Local Environmental Plan (LEP) 2012
Assessment Type	State Significant Development (SSD)
Assessment ID	00032569

1.3 Development Footprint

The Development Footprint (**Figure 1.2**) represents areas which will be subjected to a range of disturbances (outlined in **Section 7.0**) resulting from the Project. This includes access roads and associated batters, carparking and other ancillary infrastructure. All areas of direct impact are confined to the Development Footprint.



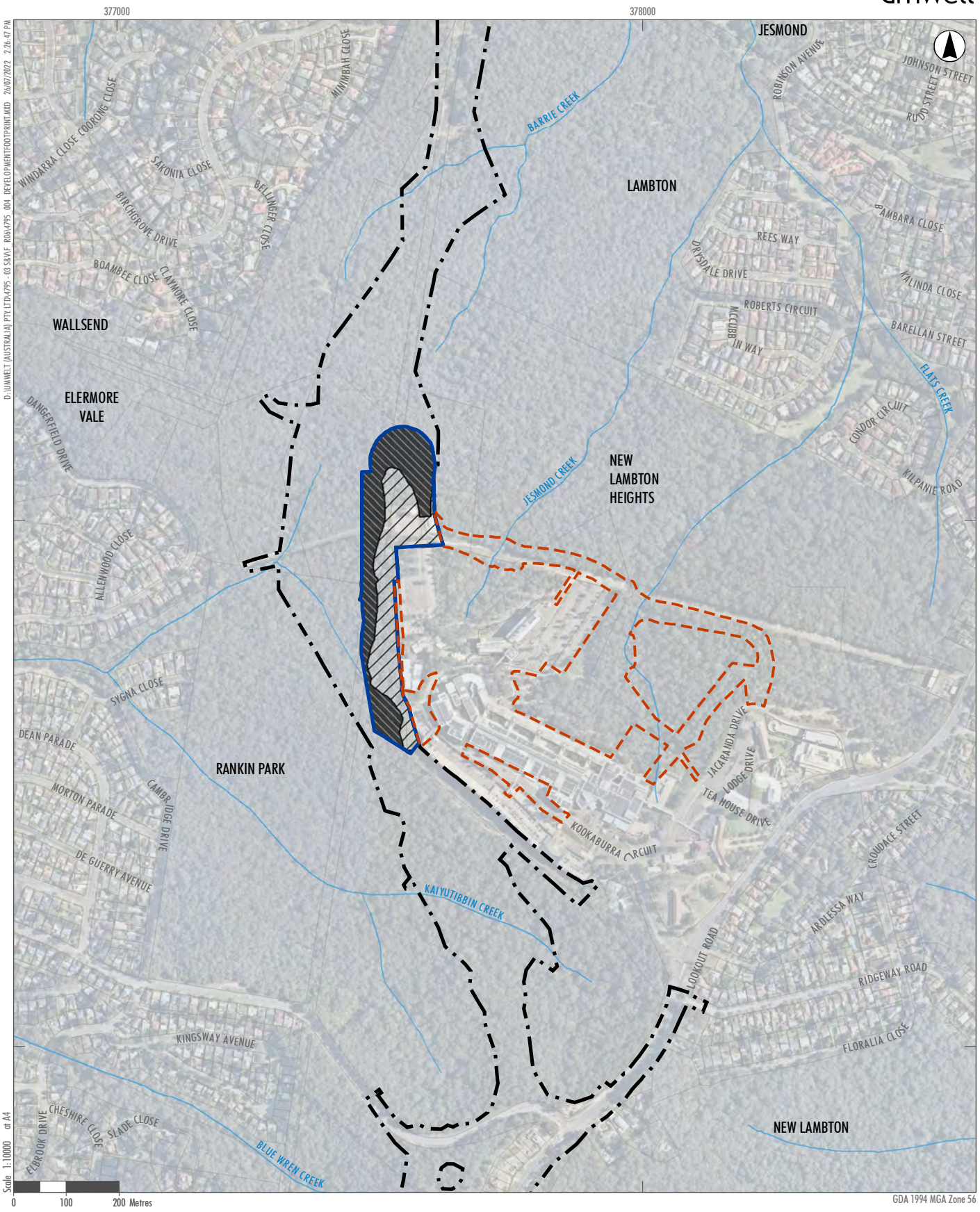
Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Local Government Boundary
- Property Boundaries
- Drainage Line
- Railway Line

FIGURE 1.1

Locality Map

Image Source: Nearmap (2020) Data source: DSFI (2020); GHD (2018); Umwelt (2021)



Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Property Boundaries
- Drainage Line

Interface Project Areas

- JHHIP Assessment Area
- TfNSW RP2J Assessment Area

Entirity of map area covered by:
IBRA Region: Sydney Basin
IBRA Sub-region: Wyong
Mitchell Landscapes: Gosford - Cooranbong Coastal Slopes

FIGURE 1.2

Development Footprint

Image Source: Nearmap (Aug 2021) Data source: DFSI (2020); Australian Government (2012); Department of Planning and Industry (2021); GHD (2018); Umwelt (2021)

1.4 Key Resources, Policies and Documents

The following key resources, policies and documents were used to prepare the BDAR:

- Biodiversity Assessment Methodology (BAM) 2020
- Biodiversity Assessment Method Operational Manuals – Stage 1 and Stage 2
- Version 1.2.7.4 BAM Calculator (BAM-C)
- Vegetation Information System (VIS) Classification Database
- Ecological Constraints for a Proposed New Route for State Highway 23 between Rankin Park and Jesmond Report (Umwelt 2006)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Preliminary Environmental Investigation (Parsons Brinckerhoff 2014)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Biodiversity Assessment Report (GHD 2016)
- DPE Bionet Atlas of NSW Wildlife
- Threatened Biodiversity Data Collection (TBDC)
- Department of Agriculture, Water and the Environment (DAWE) Protected Matters Database.

1.5 Accredited Assessors

Shaun Corry (Principal Ecologist) was the overseeing Accredited BAM Assessor for this BDAR**. Table 1.2** below outlines the details of the Accredited BAM Assessors involved in the survey, calculations and reporting for the BDAR.

Table 1.2 Accredited BAM Assessors and their Role on this Project

Name	Assessor ID	Role
Allison Riley ***Principal Ecologist***	BAAS17042	Review and technical direction
Shaun Corry ***Principal Ecologist***	BAAS17041	BAM calculator application BDAR preparation
Philippa Fagan ***Senior Ecologist***	BAAS18117	BAM calculator application BDAR preparation

1.6 Interaction with the Rankin Park to Jesmond Bypass

Rankin Park to Jesmond (RP2J) is the fifth and final stage of the Newcastle Inner City Bypass and passes to the west of the John Hunter Hospital. That project was approved in February 2019 and is currently going through a final design process with construction forecast to commence late 2022. The Biodiversity Assessment for RP2J (GHD 2018) was completed for a construction footprint that adjoins with the Development Footprint of the JHHIP project and this BDAR has been prepared to identify the direct and indirect impacts of the works in this overlapping area that hasn't already been offset by TfNSW, in accordance with the BAM.

2.0 Landscape Context

2.1 Site Context

The Development Footprint occurs within the Sydney Basin Bioregion, which extends from north of Batemans Bay to Nelson Bay, and West to Mudgee. It falls within the Gosford-Cooranbong Coastal Slopes Mitchell landscape, which comprises hills and sandstone plateau outliers of Triassic Narrabeen sandstones, with extensive rock outcrop and low cliffs along ridge margins (DECC 2008).

The 1:100,000 Soil Landscape Sheet of the Newcastle Region indicates that the Development Footprint is characterised mostly by the Killingworth (ki) soil landscape of undulating to rolling hills and low hills on the Newcastle Coal Measures of the Awaba Hills region. Dominant soil materials include brownish black pedal loam (topsoil), bleached hard setting loamy sand to sandy clay loam (topsoil) and pedal yellowish-brown clay (subsoil) (DPE 2022a).

The Development Footprint encompasses some of the existing John Hunter Hospital infrastructure and facilities. Vegetation in the surrounding area is characterised by open forest and woodland and is currently used for recreational activities such as cycling and bushwalking.

Several first order (Strahler 1952) streams occur within and around the Development Footprint, including Jesmond Creek, Barrie Creek and Kaiyutibbin Creek. The Hunter Estuary Wetlands (Ramsar) are located approximately 7 km to the northeast of the Development Footprint (DPE 2012).

Figure 2.1 provides the Landscape Features as required by Subsection 3.1 of the BAM.

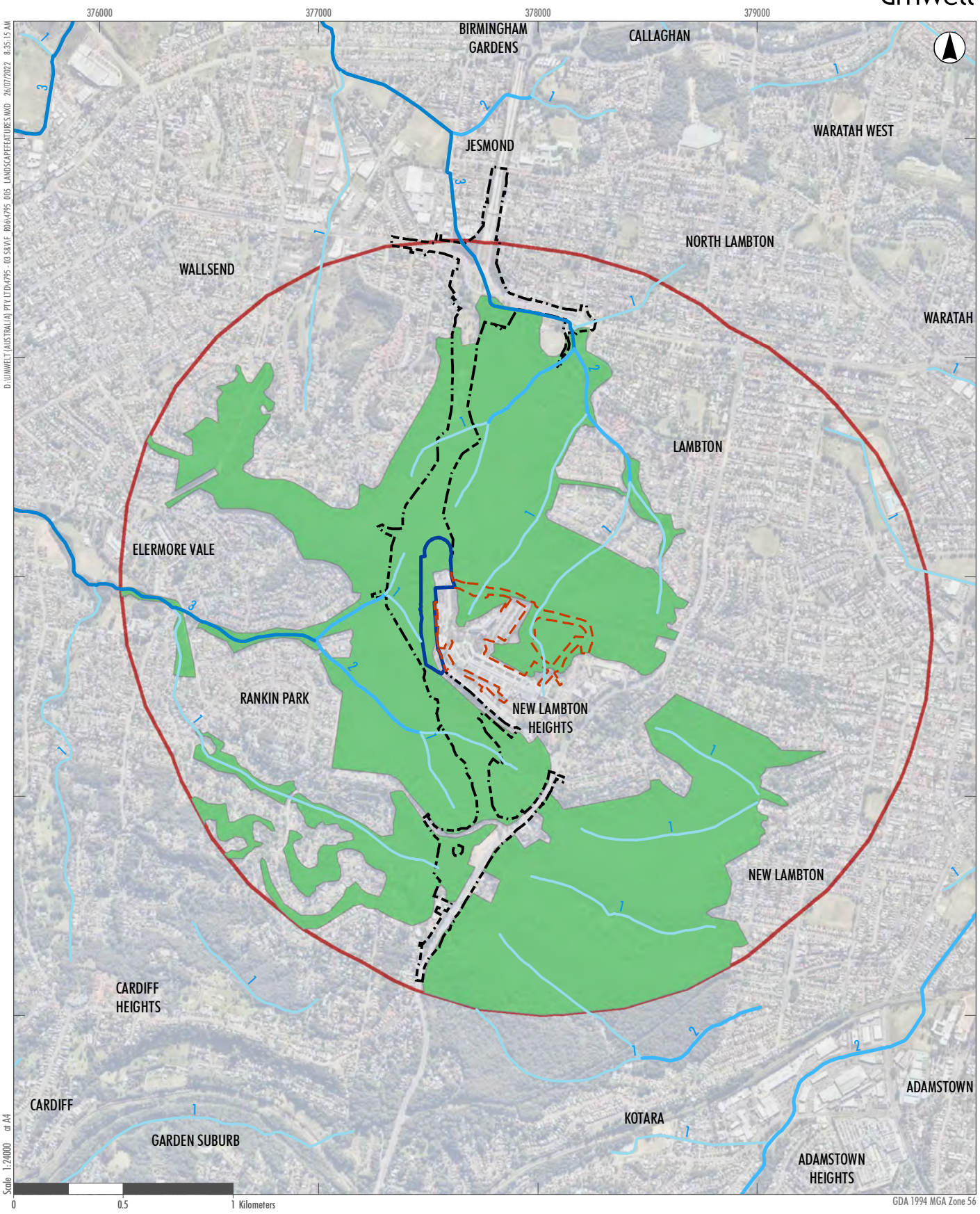
2.2 Landscape Features

The Development Footprint (refer to **Figure 1.2**) is 4.5 ha in size. Refer to **Table 2.1** for a summary of the other relevant landscape features that pertain to the BAM assessment.

Relevant landscape features are shown in **Figure 2.1**.

Table 2.1 Landscape Features within the Development Footprint

Landscape Features	
NSW Mitchell Landscape	Gosford - Cooranbong Coastal Slopes
Native Vegetation Cover	38%
Strahler Streams	Jesmond and Flats Creek – 1st Order
Important and Local Wetlands	Nil
Areas of Geological Significance and Soil Hazard Features	Nil
Areas of Outstanding Biodiversity Value	Nil
Connectivity Features	Remnant bushland in Jesmond Bushland Reserve provides a movement corridor for fauna to nearby Reserves including Blackbutt Nature Reserve to the southeast which comprises over 180 ha of native bushland.
Priority Investment Areas	Nil



Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Development Footprint 1500m Buffer
- Native Vegetation

Strahler Stream Order

- 1
- 2
- 3

FIGURE 2.1

Landscape Features

Image Source: Nearmap (2021) Data source: DFSI (2020); DPI (2015); GHD (2018); Umwelt (2021)

3.0 Native Vegetation

3.1 Methods

The methods documented herein are consistent with the JHHIP BDAR (Umwelt 2021), which was reviewed and accepted by DPE in 2021. The Development Footprint shown was surveyed as part of the wider Study Area for that project and also formed part of the Construction Footprint assessed for the RP2J project. To remain consistent with the approval for the RP2J project, vegetation mapping was aligned with that assessed in the BAR (GHD 2018) and a consistency inspection was completed by Umwelt in June 2022 to verify that that biodiversity value of the area, as documented in the BAR, is still accurate. In addition, floristic plots in accordance with the BAM were completed during the consistency inspection to allow for the calculation of ecosystem and species credits using the BAM calculator.

3.1.1 Literature and Database Review

A review of previous documents and reports relevant to the vegetation of the Development Footprint was undertaken. The information obtained was used to inform survey design and assist in the assessment of native vegetation and threatened ecological communities (TECs). Relevant documents included:

- Notice of decision – Newcastle Inner City Bypass Rankin Park to Jesmond (SSI6888) – Approval Document (February 2019)
- Newcastle Inner City Bypass Rankin Park to Jesmond (SSI6888) Secretary Assessment Report (2019)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Biodiversity Assessment Report (GHD 2018)
- Ecological Constraints for a Proposed New Route for State Highway 23 between Rankin Park and Jesmond Report (Umwelt 2006)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Preliminary Environmental Investigation (Parsons Brinckerhoff 2014)
- JHHIP Project BDAR (Umwelt 2021)
- BioNet Atlas of NSW Wildlife for known/predicted Threatened Ecological Communities (TECs) (DPE 2022b)
- Protected Matters Search Tool for known/predicted EPBC Act-listed TECs (DAWE 2022).

3.1.2 Digital Aerial Photograph Interpretation

Digital imagery (aerial photographs) of the Development Footprint was viewed to identify spatial patterns in vegetation, land use and landscape features. These informed field survey design and implementation, ecological assessment, and vegetation community mapping of the Development Footprint.

3.1.3 Floristic and Vegetation Integrity Survey

The Phase 3 Development Footprint has been subject to three rounds of floristic survey, having been assessed for the RP2J Project, JHHIP Phase 1 and 2 and now the Phase 3 assessment. Although previous surveys have been completed, four vegetation integrity plot surveys were conducted within the Development Footprint in accordance with the BAM (DPIE 2020) in June 2022 to determine current vegetation condition.

Table 3.1 below outlines the adequacy of the plot flora survey with respect to the BAM (2020). **Figure 3.1** show the locations of the plots used in this assessment.

Table 3.1 Adequacy of Vegetation Survey at the Development Footprint (JHHIP Assessment Area)

Veg Zone	PCT ID and Name *Condition Class*	Area in the Site (ha)*	Number of BAM Plots/Transects	
			Required (BAM 2020)	Undertaken
1	PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	1.78	2	2
2	PCT 1627 –- Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	0.20	1	1
-	Disturbed/Cleared/Hardstand	0.72	N/A	N/A
	TOTAL	2.7	3	3

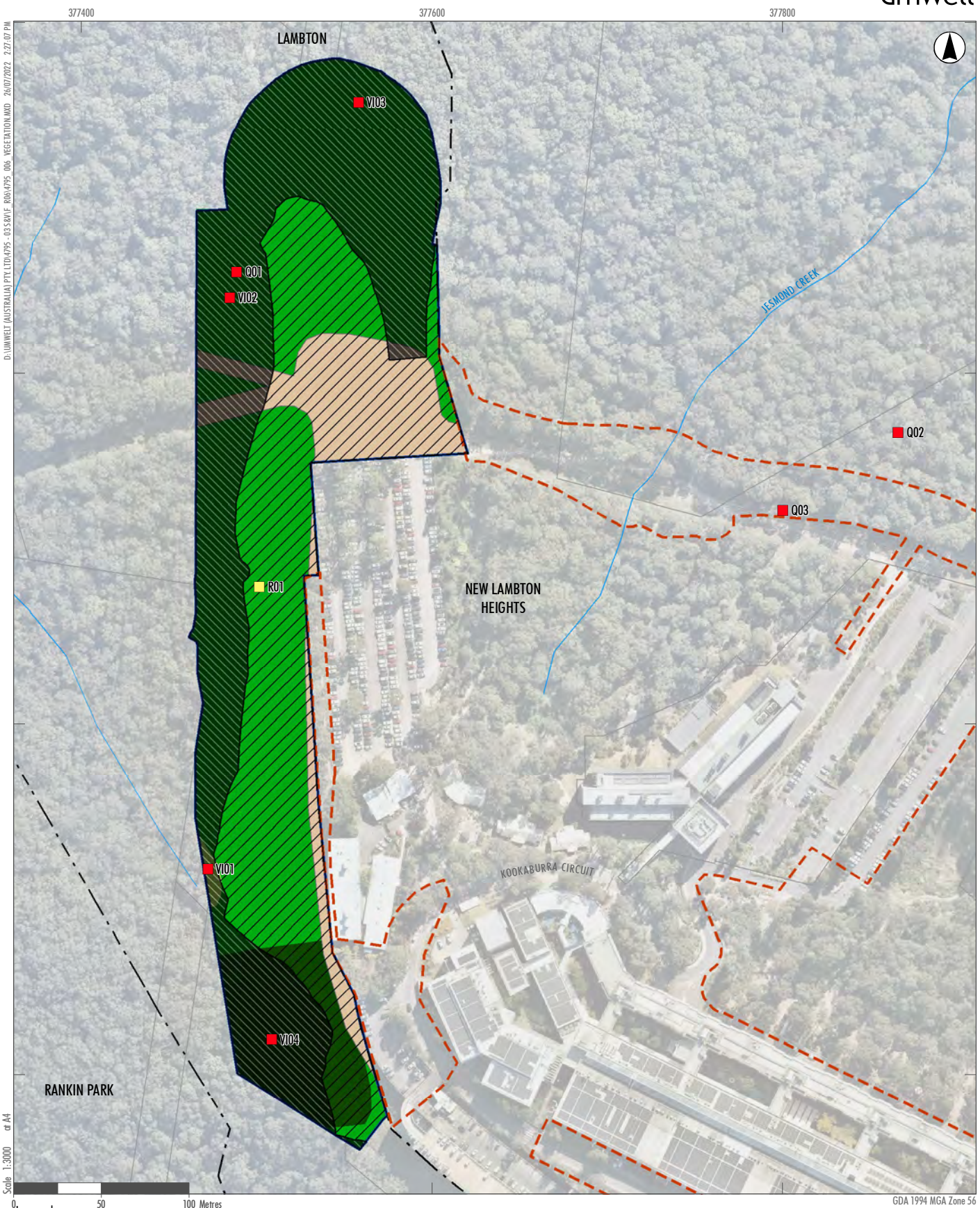
* Area numbers rounded to one decimal place. All values are subject to minor GIS based discrepancies.

3.1.3.1 Floristic Data Collected

At each plot data was recorded in accordance with BAM guidelines (DPIE 2020). A detailed description of the relevant methodologies is provided in **Appendix B**.

3.1.4 VIS Benchmarks

This BAM assessment used the standard benchmarks provided in VIS database and BAM-C. The assessment did not utilise any scaled benchmarks (i.e., drought benchmarks) or More Appropriate Local Data (MALD).



Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Property Boundaries
- Drainage Line
- BAM Flora Plot
- Rapid Vegetation Assessment

Interface Project Areas

- JHHIP Assessment Area
- TfNSW RP2J Assessment Area

Vegetation Communities

- PCT 1568 - Blackbutt - Turpentine - Sydney Blue Gum mesic tall open forest on ranges of the Central Coast
- PCT 1619 - Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
- PCT 1627 - Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
- Cleared or Exotic Vegetation

FIGURE 3.1

Vegetation Mapping and Integrity Plot Survey Locations

Image Source: Nearmap (Aug 2021) Data source: DFSI (2020); GHD (2018); Umwelt (2021)

3.1.5 Vegetation Mapping

Vegetation mapping was completed and approved within the Development Footprint as part of the RP2J Project (GHD 2018). As this is an administrative BDAR, the vegetation community mapping completed for that project has been used to inform this assessment. As detailed above, additional vegetation integrity plots were completed to collect data in accordance with the BAM and to ensure the current condition of the vegetation is reflected in the BAM calculator process.

3.1.6 Threatened Ecological Community Delineation Techniques

Vegetation communities identified in the Development Footprint were compared to TECs listed under the Commonwealth EPBC Act and NSW BC Act and an assessment of similarity with the NSW Scientific Committee Final Determinations and the Commonwealth Threatened Species Scientific Committee Listing and Conservation Advice. The following approach was used:

- full-floristic quadrat assessment, rapid assessments, and meandering survey to determine floristic composition and structure of each ecological community
- comparison with published species lists, including lists of 'important species' as identified on the listing advice provided by the NSW Scientific Committee and/or Commonwealth Threatened Species Scientific Committee
- comparison with habitat descriptions and distributions for listed TECs
- assessment using guidelines and recovery plans published by the Commonwealth DoEE and the NSW BCD
- comparison with other assessments of TECs in the region.

3.1.7 PCT Allocation

Biometric Vegetation Types (BVTs) were defined in the RP2J Project, and these have been changed to reflect their equivalent PCT for this assessment. None of the BVTs previously identified have become obsolete in the change to PCT classification system and as such the change from BVT to PCT required no further floristic analysis.

4.0 Results

4.1.1 Plant Community Types and Vegetation Zones

Two PCTs occur within the JHHIP Assessment Area of the Development Footprint, being:

- PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
- PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast.

These PCTs are consistent with those assessed by GHD (2018) in this same area for the RP2J Assessment and are shown on **Figure 3.1**. Information on these vegetation zones is provided in the sections below.

4.1.1.1 PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands

PCT Name	**Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands**	
Condition	**Good**	
PCT Formation	KF_CH5B Dry Sclerophyll Forests (Shrubby sub-formation)	
PCT Class	Sydney Coastal Dry Sclerophyll Forests	
PCT Percent Cleared	45.0	
Zone	1	
Area	1.78 ha	
Patch Size Class	>100 ha	
Canopy Description	The canopy of this vegetation zone ranges from 15 to 25 m in height and has a cover of approximately 30%. It is dominated by smooth-barked apple (*Angophora costata*) and red bloodwood (*Corymbia gummifera*), with occurrences of broad-leaved white mahogany.	

PCT Name	Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands
Condition	Good
Mid-storey Description	The mid-storey of this vegetation zone ranges from 1 to 2 m in height and has a cover of approximately 10%. It is dominated by hairpin banksia (*Banksia spinulosa*) and sunshine wattle (*Acacia terminalis*), with occurrences of other shrubs including tea tree (*Leptospermum* sp.), *Hovea linearis* and sweet pittosporum (*Pittosporum undulatum*).
Ground Cover Description	The ground cover of this vegetation zone is sparse and reaches up to 1 m in height. It is comprised of a range of rushes, herbs and native grasses, with dominant species including *Lomandra obliqua*, many-flowered mat-rush (*Lomandra multiflora* subsp. *multiflora*), blue flax-lily (*Dianella caerulea* var. *producta*), thyme spurge (*Phyllanthus hirtellus*), wiry panic (*Entolasia stricta*), kangaroo grass (*Themeda triandra*) and silvertop wallaby grass (*Rytidosperma pallidum*).
PCT Allocation	Vegetation Zone 2 has been attributed to PCT 1619 based on its position in the landscape and dominant species. It contains approximately 40% of the characteristic species for PCT 1619, including two of the three diagnostic canopy species being smooth-barked apple (*Angophora costata*) and red bloodwood (*Corymbia gummifera*). Other PCTs that were also considered during the allocation include PCT 1579 Smooth-barked Apple - Turpentine - Blackbutt open forest on ranges of the Central Coast and 1621 Smooth-barked Apple open forest on coastal lowlands of the Central Coast however landscape position, species assemblage and key diagnostic species were the determining factors and PCT 1619 was the best fit. In addition, this PCT (BVT equivalent) was also mapped in this location as part of the extensive studies completed for the RP2J project (GHD 2018).
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TECs listed under the EPBC Act.

4.1.1.2 PCT 1627 - Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast

PCT Name	Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	
Condition	Good	
PCT Formation	KF_CH5A Dry Sclerophyll Forests (Shrub/grass sub-formation)	
PCT Class	Hunter-Macleay Dry Sclerophyll Forests	
PCT Percent Cleared	9.0	
Zone	2	
Area	0.2 ha	
Patch Size Class	>100 ha	

PCT Name	Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast
Condition	Good
Canopy Description	The canopy of this vegetation zone ranges from 12 to 22 m in height and has a cover of approximately 30%. It is dominated by smooth-barked apple (*Angophora costata*), Sydney peppermint (*Eucalyptus piperita*) and brown stringybark (*Eucalyptus globoidea*).
Mid-storey Description	The mis-storey of this vegetation zone ranges from 1 to 1.5 m in height and has a cover of approximately 7%. It is dominated by regenerating eucalypts, hairpin banksia (*Banksia spinulosa* var. *collina*) and large-leaf hop-bush (*Dodonaea triquetra*), and blackthorn (*Bursaria spinosa*).
Ground Cover Description	The ground cover of this vegetation zone is very sparse and reaches up to 1 m in height. It is comprised of a range of rushes, herbs, sub-shrubs and native grasses, with dominant species including purple coral pea (*Hardenbergia violacea*), *Lomandra obliqua*, blue flax-lily (*Dianella caerulea* var. *producta*), wiry panic (*Entolasia stricta*), kangaroo grass (*Themeda triandra*) and silvertop wallaby grass (*Rytidosperma pallidum*).
PCT Allocation	Vegetation Zone 3 has been attributed to PCT 1627 based on its position in the landscape and dominant species. Approximately 40% of the characteristic species for PCT 1627, including two of the four diagnostic canopy species being smooth-barked apple (*Angophora costata*) and Sydney peppermint (*Eucalyptus piperita*) were recorded in this vegetation zone. Other PCTs that were also considered during the allocation include PCT 1579 Smooth-barked Apple - Turpentine - Blackbutt open forest on ranges of the Central Coast and 1181 Smooth-barked Apple - Red Bloodwood - Sydney Peppermint heathy open forest on slopes of dry sandstone gullies of western and southern Sydney, Sydney Basin Bioregion. While these PCTs share similar species, PCT 1627 was the best fit floristically and topographically. In addition, this PCT (BVT equivalent) was also mapped in in this area as part of the extensive studies completed for the RP2J project (GHD 2018)
BC Act Status	This vegetation zone is not consistent with any TECs listed under the BC Act.
EPBC Act Status	This vegetation zone is not consistent with any TECs listed under the EPBC Act.

4.1.2 Threatened Ecological Communities

No TECs were recorded in the Development Footprint. *Lower Hunter Spotted Gum Ironbark Forest in the Sydney Basin and NSW North Coast Bioregions* Endangered Ecological Community (EEC) listed under the BC Act occurs nearby but is not present within the Development Footprint.

4.1.3 Vegetation Integrity Score

Table 4.1 below details the vegetation integrity score for the vegetation zone in the Site. The vegetation integrity data is provided in **Appendix A**.

Table 4.1 Vegetation Zone Vegetation Integrity Scores

Veg Zone	PCT Name *Condition Class*	Composition	Structure	Function	Current Vegetation Integrity Score
1	PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands 11	73.9	96	99.8	**89.1**
2	PCT 1627 - Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	65.5	62.6	90.5	**71.9**

5.0 Threatened Species

5.1 Methods

5.1.1 Literature and Database Review

A review of previous documents and reports relevant to threatened species within the Development Footprint was undertaken. The information obtained was used to inform survey design and assist in the assessment of potentially occurring ecosystem-credit and species-credit species. Relevant documents included:

- Notice of decision – Newcastle Inner City Bypass Rankin Park to Jesmond (SSI6888) – Approval Document (February 2019)
- Newcastle Inner City Bypass Rankin Park to Jesmond (SSI6888) Secretary Assessment Report (2019)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Biodiversity Assessment Report (GHD 2018)
- Ecological Constraints for a Proposed New Route for State Highway 23 between Rankin Park and Jesmond Report (Umwelt 2006)
- Newcastle Inner City Bypass, Rankin Park to Jesmond Preliminary Environmental Investigation (Parsons Brinckerhoff 2014)
- JHHIP Project BDAR (Umwelt 2020)
- Threatened Biodiversity Data Collection (TBDC)
- DPE BioNet Atlas of NSW Wildlife
- PlantNET (Royal Botanic Gardens Sydney) database search for Rare or Threatened Australian Plant species
- DAWE Protected Matters Search Tool for known/predicted EPBC Act-listed species.

5.1.2 Species-credit Species Surveys

An assessment of candidate species-credit species was completed in accordance with Section 5 of the BAM. For those candidate species considered to have the potential to occur within the Development Footprint, targeted survey and opportunistic searches were undertaken. Species-credit species surveys were undertaken over multiple seasons, including:

- 24 and 25 September 2019
- 22 and 23 October 2019
- 16 December 2019
- 20 and 21 January 2020
- 11 and 12 February 2020
- 9, 10, 11, 19 and 20 March 2020

- 19, 21, 26 and 31 August 2020
- 15 September 2020
- 24 November 2020.

The species targeted for surveys and methods of survey are provided in **Appendix D** and survey tracks are shown in **Figure 5.1**. The species considered and surveys completed are consistent with those completed for the JHHIP Phase 1 and 2 BDAR (Umwelt 2021). In addition, following the identification of red helmet orchid (*Corybas dowlingii*) in nearby bushland in June 2022, further targeted surveys were completed on 29 June 2022 by three Umwelt ecologists. Surveys were completed in accordance with the Survey Guide for Identifying Threatened Flora Species and their Habitats (DPIE 2020) and consisted of 5m parallel transects across the Development Footprint.

5.1.2.1 Weather Conditions and Limitations

Table 5.1 below outlines the weather conditions for the surveys. Data is derived from the Newcastle University weather station (061390) from the Bureau of Meteorology (2020).

Table 5.1 Weather Conditions for Species-credit Surveys

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
24 September 2019	6.8-20.6	0	50	10.6-22.8	88.3	69
25 September 2019	8.4-21.2	0	49			
22 October 2019	NR	0	NR	13.1-25.3	32.2	65
23 October 2019	NR-27.2	0	NR			
16 December 2019	18.8-23.2	0	69	17.9-30.4	0.0	61
20 January 2020	19.6-31.2	0	76	21.3-30.7	39.8	73
21 January 2020	18.4-34.3	0.4	40			
11 February 2020	18.8-30.2	3.2	87	19.8-28.7	219.6	79
12 February 2020	21.2-27.2	0	92			
9 March 2020	16.8-23.8	0	92	16.9-26.6	182.4	79
10 March 2020	17.0-25.8	0	71			
11 March 2020	15.6-25.2	0	78			
19 March 2020	14.2-31.2	0	84			
20 March 2020	16.4-34.0	0	73			
19 August 2020	7.2-21.0	0	60	7.2-19.9	25.1	65
21 August 2020	7.8-NR	0	58			
26 August 2020	3.8-19.2	0	57			
31 August 2020	9.5-26.3	0	48			
15 September 2020	13.8-23.4	0	74	11.5-23.8	25.2	67
24 November 2020	18.6–22.2	0	75	17.3-24.1	42.6	34
9 September 2021	11.5-26.1	0	55	12.3-21.6	67.4	62

Date	Daily Data			Monthly Data		
	Min-Max Temp. (°C)	Rainfall (mm)	Relative Humidity (%)	Min-Max Temp (mean) (°C)	Rainfall (total) (mm)	Relative Humidity (mean) (%)
18 October 2021	12.1-22.3	0	68	14.1-23	54.8	66

NR= Not Recorded

During late 2019 and early-mid 2020 surveys were conducted during periods classed as "drought affected" and "drought", with a "recovery" period only occurring in September 2020 (DPI 2020). These ongoing drought conditions may have affected the growth of flora species and resulted in limited detection of some species when compared to periods of non-drought.

For some herbaceous and graminoid species, such as those belonging to the families Asteraceae, Orchidaceae, Cyperaceae and Poaceae, the allocation of specimens to sub-specific levels was affected by the availability of adequate flowering or fruiting material. Where specimens were of potential significance they were forwarded to the National Herbarium of New South Wales for identification.

5.1.3 State Environmental Planning Policy (Biodiversity and Conservation)

The land zoning for which the Project occurs is subject to the State Environmental Planning Policy (SEPP) (Biodiversity and Conservation), and there is currently no approved Koala Plan of Management for the LGA. The development assessment process therefore must consider the SEPP. The SEPP requires an appropriately qualified and experienced person to determine if the development footprint contains core koala habitat. Core koala habitat, as defined by the SEPP, is:

a) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or

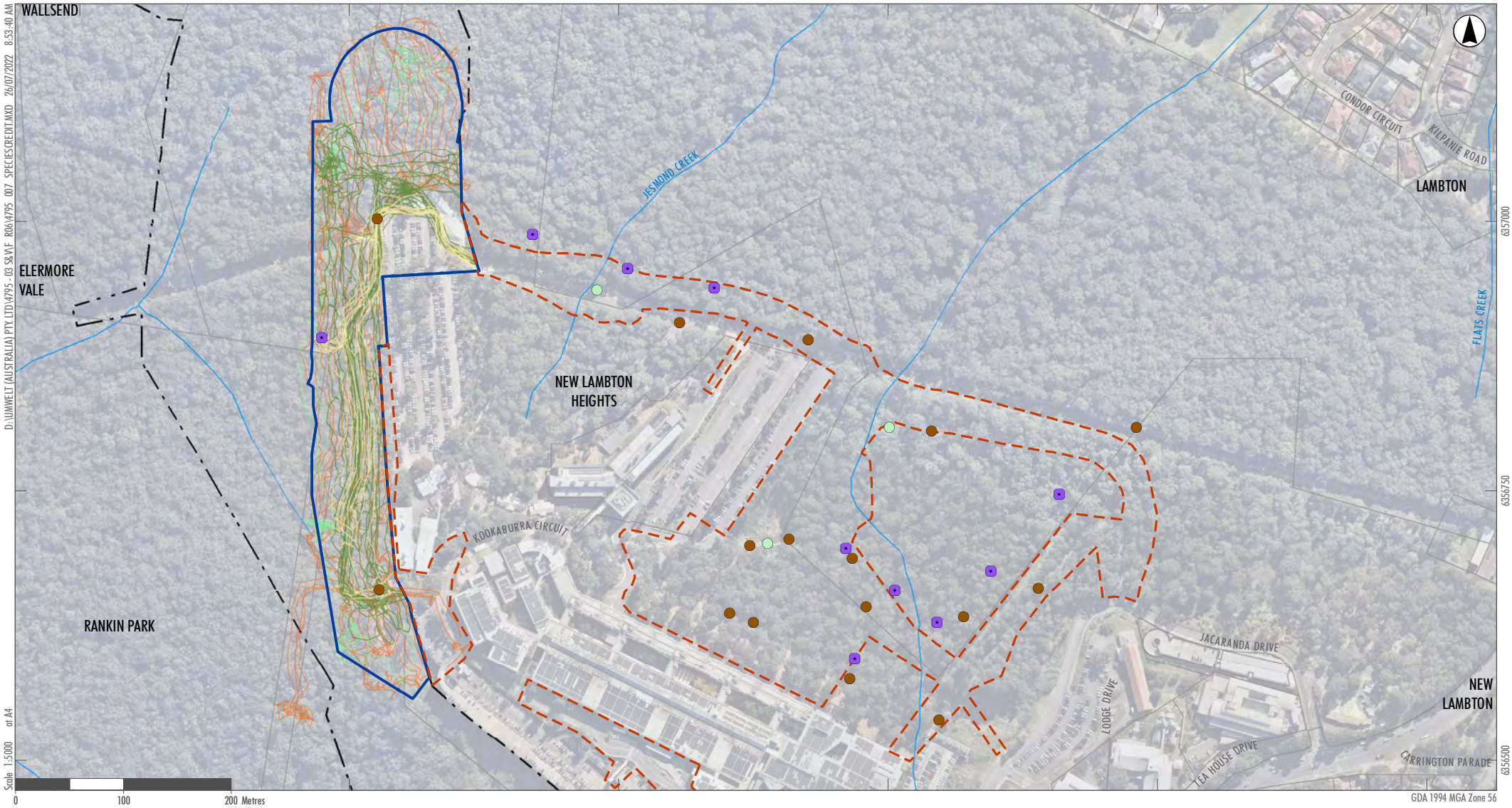
(b) an area of land which has been assessed by a suitably qualified and experienced person as being highly suitable koala habitat and where koalas have been recorded as being present in the previous 18 years.

Assessment of the development footprint and surrounds was completed during ecological surveys completed across the Development Footprint. Nocturnal and diurnal surveys were also completed as described in **Appendix E**.

5.2 Results

5.2.1 Ecosystem-credit Species

A list of the ecosystem-credit species predicted to occur by the BAM Calculator and literature review, and whether they have been recorded within the Development Footprint is provided in **Appendix C**.



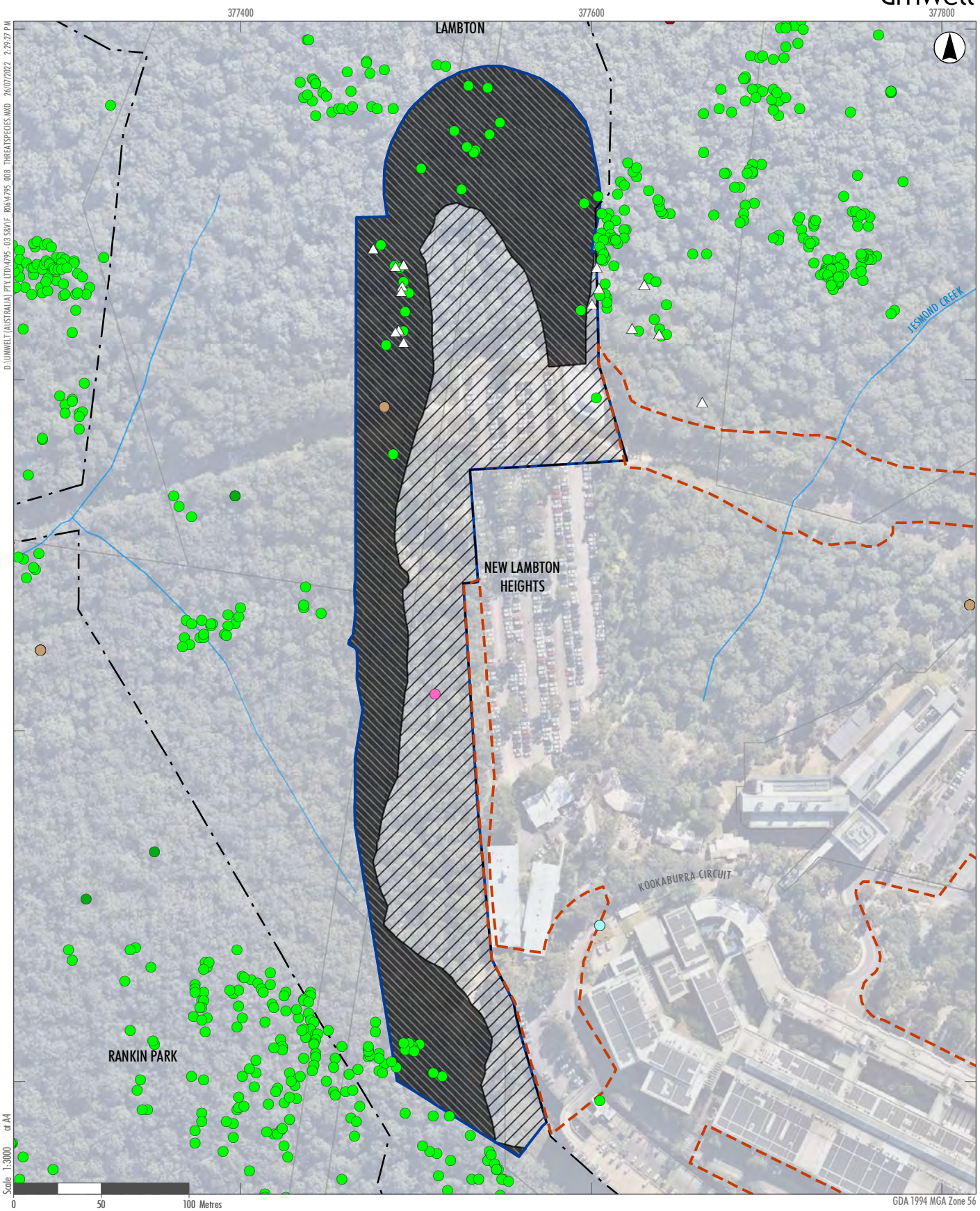
Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Property Boundaries
- Drainage Line
- Targeted Species-credit Flora Transects
- Targeted Corybas dowlingii Search June 2022
- Vegetation Integrity Inspection – June 2022
- Spotlight Survey
- Targeted Forest Owl Call Playback and Stag Watch
- Targeted Threatened Amphibian Survey
- Remote Cameras

FIGURE 5.1

Species-credit Species Survey Locations

Image Source: Nearmap (Aug 2021) Data source: DFSI (2020); GHD (2018); Umwelt (2021)



Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Property Boundaries
- Drainage Line

Interface Project Areas

- JHHIP Assessment Area
- TfNSW RP2J Assessment Area

Umwelt Threatened Species:

- Black-eyed Susan *(Tetratheca juncea)*

Bionet ATLAS Threatened Species:

- Black-eyed Susan
- Eastern Coastal Free-tailed Bat
- Glossy Black-Cockatoo
- Grey-headed Flying-fox
- Large Bent-winged Bat
- Little Bent-winged Bat
- Masked Owl
- Powerful Owl
- Small-flower Grevillea
- Squirrel Glider

FIGURE 5.2

Threatened Species Records

Image Source: Nearmap (Aug 2021) Data source: DFSI (2020); NSW OEH (2021); GHD (2018); Umwelt (2021)

5.2.2 Species-credit Species

Targeted species-credit surveys were undertaken across the Development Footprint and surrounds as described in **Appendix D**. In addition, extensive threatened species surveys were also completed across the same area as part of biodiversity assessment for the RP2J project (GHD 2018). **Table 5.2** outlines the species-credit species predicted to occur by the BAM Calculator and/or the literature review and whether they were recorded or are considered likely to occur in the Development Footprint.

Table 5.2 Species-credit Species

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
Flora			
Bynoe's wattle *Acacia bynoeana*	High	-	**Absent** – not recorded during surveys.
Charmhaven apple *Angophora inopina*	High	-	**Absent** – not recorded during surveys.
trailing woodruff *Asperula asthenes*	High	-	**Absent** – not recorded during surveys.
thick-leaf star-hair *Astrotricha crassifolia*	Very High	-	**Absent** – not recorded during surveys.
netted bottle brush *Callistemon linearifolius*	Moderate	-	**Absent** – not recorded during surveys.
Corunastylis **sp. Charmhaven (NSW896673)**	High	-	**Absent** – not recorded during surveys.
red helmet orchid *Corybas dowlingii*	Moderate	-	**Absent** – not recorded during surveys.
leafless tongue-orchid *Cryptostylis hunteriana*	Moderate	-	**Absent** – not recorded during surveys.
rough doubletail *Diuris praecox*	Moderate	-	**Absent** – not recorded during surveys.
Eucalyptus oblonag **– endangered population**	High	-	**Absent** – not recorded during surveys.
variable midge orchid *Genoplesium insigne*	High	-	**Absent** – not recorded during surveys.
small-flower grevillea *Grevillea parviflora* **subsp.** *parviflora*	High	-	**Absent** – not recorded during surveys. Recorded in RP2J footprint but outside the Development Footprint
Grove's paperbark *Melaleuca groveana*	High	-	**Absent** – not recorded during surveys.
tranquillity mintbush *Prostanthera askania*	High	-	**Absent** – not recorded during surveys.
heath wrinklewort *Rutidosis heterogama*	High	-	**Absent** – not recorded during surveys.
Tetratheca glandulosa	High	-	**Absent** – not recorded during surveys.
black-eyed Susan *Tetratheca juncea*	High	-	**Present** – recorded during surveys and previously by GHD (2018).

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
Fauna			
bush stone-curlew ***Burhinus grallarius***	High	Fallen/standing dead timber including logs.	**Absent** – not recorded during surveys.
glossy black-cockatoo ***Calyptorhynchus lathami***	High	Breeding habitat only. Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.	**Absent** – breeding behaviour not recorded during surveys.
gang-gang cockatoo ***Callocephalon fimbriatum***	High	Breeding habitat only. Eucalypt tree species with hollows greater than 9 cm diameter.	**Absent** – breeding behaviour not recorded during surveys.
eastern pygmy-possum ***Cercartetus nanus***	High	-	**Absent** – not recorded during surveys.
large-eared pied bat ***Chalinolobus dwyeri***	Very High	Breeding habitat only. Within 2 km of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within 2 km of old mines or tunnels.	**Absent** – no suitable breeding habitat occurs within the Development Footprint.
Wallum froglet ***Crinia tinnula***	Moderate	-	**Absent** – not recorded during surveys.
white-bellied sea-eagle ***Haliaeetus leucogaster***	High	Breeding habitat only. Living or dead mature trees within suitable vegetation within 1 km of a rivers, lakes, large dams or creeks, wetlands, and coastlines.	**Absent** – not recorded during surveys.
little eagle ***Hieraaetus morphnoides***	Moderate	Breeding habitat only. Nest trees - live (occasionally dead) large old trees within vegetation.	**Absent** – not recorded during surveys.
pale-headed snake ***Hoplocephalus bitorquatus***	High	-	**Absent** – not recorded during surveys.
swift parrot ***Lathamus discolor***	Moderate	Important habitat only (as defined by mapping products supplied by the BCD)	**Absent** – no breeding habitat recorded during surveys. Surveys are not required for this species under the BAM due to lack of important habitat within the Development Footprint being confirmed through BCD mapping products.

Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
green and golden bell frog ***Litoria aurea***	High	Semi-permanent/ephemeral wet areas and within 1 km of swamps and waterbodies.	**Absent** – not recorded during surveys.
green-thighed frog ***Litoria brevipalmata***	Moderate	-	**Absent** – not recorded during surveys.
square-tailed kite ***Lophoictinia isura***	Moderate	Breeding habitat only. Nest trees.	**Absent** – not recorded during surveys.
little bent-winged bat ***Miniopterus australis***	Very High	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	**Absent** – no suitable breeding habitat occurs within the Development Footprint.
large bentwing-bat ***Miniopterus orianae oceanensis***	Very High	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	**Absent** – no suitable breeding habitat occurs within the Development Footprint.
southern myotis ***Myotis macropus***	High	Breeding habitat only. Hollow bearing trees within 200 m of riparian zone. Bridges, caves, or artificial structures within 200 m of riparian zone.	**Absent** – no suitable breeding habitat occurs within the Development Footprint.
barking owl ***Ninox connivens***	High	Breeding habitat only. Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	**Absent** – not recorded during surveys.
powerful owl ***Ninox strenua***	High	Breeding habitat only. Living or dead trees with hollow greater than 20cm diameter.	**Absent** – known to occur proximate to Development Footprint however breeding behaviour not recorded during surveys. Recorded during surveys for RP2J however nest trees identified outside Development Footprint
eastern osprey ***Pandion cristatus***	Moderate	-	**Absent** – not recorded during surveys.
greater glider ***Petauroides volans***	High	Hollow-bearing trees.	**Absent** – not recorded during surveys.
squirrel glider ***Petaurus norfolcensis***	High	-	**Present** – Previously recorded within the Development Footprint (DPE 2020b).

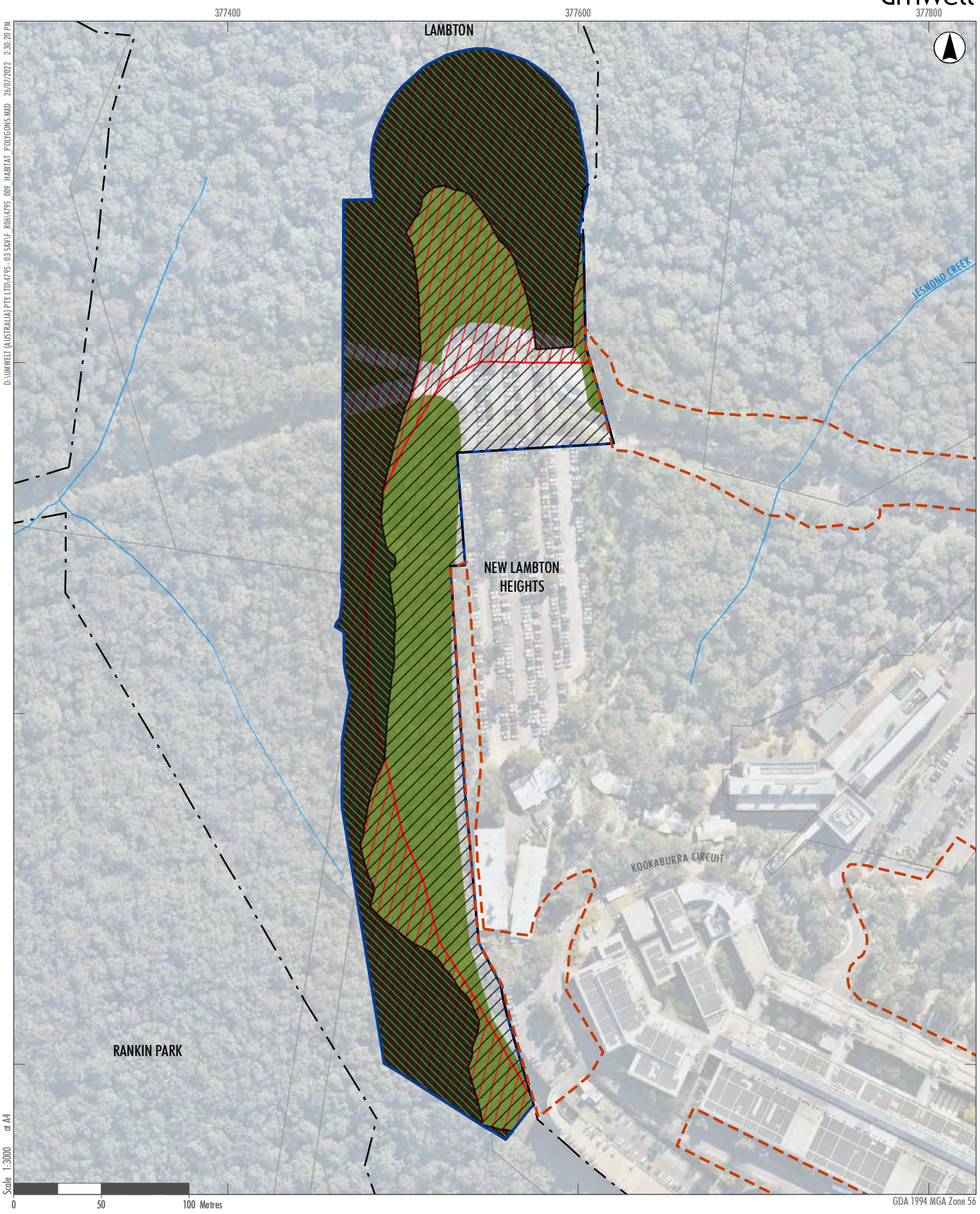
Species Name	Sensitivity to Gain	Habitat and/or Geographic Constraint	Presence/Absence
brush-tailed rock-wallaby ***Petrogale penicillata***	Very High	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	**Absent – Habitat Degraded** - no suitable habitat identified during surveys.
brush-tailed phascogale ***tapoatafa***	High	-	**Absent** – not recorded during surveys.
koala ***Phascolarctos cinereus***	High	Important habitat only	**Absent** – not recorded during surveys.
common planigale ***Planigale maculata***	High	-	**Absent** – not recorded during surveys.
grey-headed flying-fox ***Pteropus poliocephalus***	High	Breeding camps.	**Absent** – no breeding camps occur within the Development Footprint.
masked owl ***Tyto novaehollandiae***	High	Breeding habitat only. Living or dead trees with hollows greater than 20 cm diameter.	**Absent** – not recorded during surveys.
Mahony's toadlet ***Uperoleia mahonyi***	High	-	**Absent** – not recorded during surveys.

5.2.2.1 Species Habitat Polygons

Species polygons have been prepared for the species outlined in **Table 5.3** below. Habitat polygons are shown on **Figure 5.3.**

Table 5.3 Species-credit Species Habitat Polygons and Risk Weightings

Species	Biodiversity Risk Weighting	Species Habitat Polygon Area (ha)	Species Habitat Polygon Description
black-eyed Susan ***Tetratheca juncea***	2	1.06	Species detected. Species polygon boundary aligns species polygon prepared by GHD (2018).
squirrel glider ***Petaurus norfolcensis***	2	1.98	Species assumed present due to previous record on site (NSW Bionet 2022). Species polygon boundaries aligns with all PCTs within the site to which the species is associated in the TBDC.



Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Property Boundaries
- *Tetratheca juncea* Species Polygon
- Squirrel Glider Species Polygon
- Drainage Line

Interface Project Areas

- JHHIP Assessment Area
- TfNSW RP2J Assessment Area

FIGURE 5.3

Species Habitat Polygons

Image Source: Nearmap (Aug 2021) Data source: DFSI (2020); GHD (2018); Umwelt (2021)

5.2.3 State Environmental Planning Policy (Biodiversity and Conservation)

5.2.3.1 Assessment of Core Habitat

Core koala habitat, as defined by the SEPP, is:

a. an area of land which has been assessed by a suitably qualified and experienced person as being *highly suitable koala habitat* and where koalas are recorded as being present at the time of assessment of the land as highly suitable koala habitat, or

b. an area of land which has been assessed by a suitably qualified and experienced person as being *highly suitable koala habitat* and where koalas have been recorded as being present in the previous 18 years.

Six of the tree species listed in Schedule 3 of the SEPP (Central Coast Koala Management Area) have been recorded within or in the surrounds of the Development Footprint. These tree species represent 15% or greater of the total number of trees within any Plant Community Type (PCT) and as such, the PCT in the Development Footprint represents *highly suitable habitat* for the koala.

Despite the Development Footprint representing *highly suitable habitat*, the koala was not recorded in the Development Footprint despite extensive ecological survey. In addition, a review of the BioNet Atlas of NSW Wildlife reveals two records of this species within 2.5 km of the Development Footprint. Both of these records are proximate to Blackbutt Reserve and the observation date on both records is 1986 (35 years old).

As a result, the Development Footprint does not represent core koala habitat as the koala was not recorded in the Development Footprint and koalas have not been recorded nearby (within 2.5 km in the Central Coast Koala Management Area) within the last 18 years. No further provisions of the SEPP apply.

Notwithstanding, the koala is a dual ecosystem and species credit species under the BAM and has been further considered in **Appendix C**.

6.0 Avoidance and Minimisation

6.1 Avoidance Measures in Project Design

The Project has sought, as far as practicable, to avoid and minimise potential impacts on the ecological values of the Development Footprint throughout the Project planning process. While the Project changes described below refer to the overarching JHHIP Project, these changes are also relevant to the design of the enabling works that are the subject of this assessment. This included several changes to the Northern Access Road to reduce cut/fill requirements and biodiversity impacts associated with large batters. In addition, the design applies Acceptable Solutions of Planning for Bushfire Protection 2019 to minimise disturbances associated with Asset Protection Zones (APZs).

6.2 Minimisation and Mitigation Measures during Construction

The JHHIP Project has committed to the design and implementation of a comprehensive biodiversity mitigation strategy to mitigate the unavoidable impacts of the Project. The following specific control measures are considered to be integral to the mitigation of impacts on the biodiversity features of the JHIPP Project Area and the Development Footprint:

- salvage of biodiversity features, including habitat resources (e.g., hollow logs, tree hollows, fallen timber and rocks/boulders)
- a pre-clearing procedure will be implemented to minimise the potential for impacts on native fauna species (focusing on threatened species) as a result of the clearing of hollow-bearing trees. The pre-clearing procedure is designed to minimise impacts to hollow-dependent and ground-dwelling fauna.
- weed management
- fencing and access control
- bushfire management
- erosion and sedimentation control
- workforce education and training.

Each of these control measures will contribute to the maintenance of habitat quality in proximity to the Development Footprint.

6.2.1 Pre-clearance and tree-felling

Pre-clearance surveys and tree-felling supervision recommendations will be implemented to minimise the potential for impacts on native fauna species (including threatened species) as a result of the clearing of hollow-bearing trees.

6.2.1.1 Pre-clearance surveys

Pre-clearance surveys are to be undertaken prior to tree felling works, be undertaken by suitably qualified and experienced persons/personnel and include:

- the demarcation of areas approved for clearing to reduce risk of accidental clearing
- habitat resources and habitat trees should be identified and marked (Note: habitat trees are those containing hollows, cracks or fissures and spouts, active nests, dreys or other signs of recent fauna usage. Other habitat features to be identified include fallen timber/hollow logs, burrows, and boulder piles)
- the potential presence of threatened flora and fauna species, endangered populations and TECs should be identified
- the identification of threatened species or habitat features that are suitable for translocation or salvage
- disturbance activities should be targeted to specific times of the year to minimise impacts to threatened species usage of habitat features for breeding and roosting, where practicable.

Nest boxes previously installed within the Development Footprint will be removed and relocated (where relevant) (in accordance with the relevant consent requirements) during this process.

6.2.1.2 Tree-felling supervision

Tree felling will be completed as close to the completion of pre-clearance surveys as practicable to limit the potential for new issues to arise (such as new active nests being built). Tree felling supervision will be undertaken by an appropriately qualified and experienced person after pre-clearance surveys have identified potential habitat features.

The tree-felling process will include the following:

Prior to Felling Habitat Trees

- Completion of actions recommended from the pre-clearing surveys, including (but not limited to) salvage of identified habitat features, additional surveys to determine threatened fauna usage of the area (if required), identification of active dens or burrows, any actions required to discourage fauna occupation and weed or feral fauna management requirements.
- Removal of non-habitat trees/vegetation as close to the habitat tree felling date as possible in order to create disturbance to discourage fauna usage of the habitat trees.
- Shaking of habitat trees (with heavy machinery) as appropriate to encourage fauna to abandon trees.

On the Day of Felling Habitat Trees

- All habitat trees will be subject to a visual inspection to survey for threatened species.
- Trees previously identified as containing fauna will be shaken and then felled, providing no threatened species are identified.

- The lowering of hollow-bearing trees will be done as gently as possible with heavy machinery.
- If a threatened species is identified in a habitat tree on the day of felling, the supervising person is to advise the most appropriate method to minimise potential harm. This may include leaving the tree overnight, further shaking to encourage the animal to vacate the tree, gradual removal of branches to discourage ongoing use, soft felling of the tree with the animal in the tree, or measures to capture and relocate the animal to secure habitats.
- Uninjured animals should be released on the day of capture into nearby suitable secure habitat and should not be held for extended periods of time.
- Injured animals will be taken to the nearest veterinary clinic or wildlife carer as soon as possible for assessment and treatment.
- Felled trees are to be rolled where appropriate so that the number of hollows blocked against the ground is minimised.
- All felled habitat trees should remain in place for a least one night to allow any remaining fauna to escape, and
- Habitat features identified for translocation or salvage operations should be extracted and stored appropriately.

6.2.2 Weed management

Weed species could be inadvertently brought into the Development Footprint or surrounding habitats with imported materials or could invade naturally through removal of native vegetation. The presence of weed species has the potential to decrease the value of vegetation for native species, particularly threatened species.

Weed management controls will include:

- All machinery and equipment will be cleaned thoroughly prior to entering the Development Footprint. Cleaning must include the removal of all mud and plant matter, followed by washing with high pressure water.
- Mulch containing weeds is to be placed in piles separate from clean mulch, removed from site, and disposed of in accordance with weed management guidelines as soon as practicable.

6.2.3 Fencing and access control

During construction, fencing will be used to demarcate vegetation where required to avoid accidental damage to areas outside of the Development Footprint.

Access control is an important feature in protecting and demarcating areas outside the Development Footprint from vehicle access, human access, and accidental disturbance. Measures include:

- appropriate fencing and signposting of areas to prevent the uncontrolled entry of people, accidental disturbance and to minimise vehicular and human traffic
- clear and visible signage is to be appropriately located to inform the workforce and others of the restricted access or otherwise of areas outside the Development Footprint and
- locking of gates to prevent unwanted vehicle, person access and disturbance.

6.2.4 Erosion and sediment control

A Stormwater Management Plan has been prepared for the JHIPP Project to appropriately limit post development flows and manage downstream water quality as part of the SSDA for site establishment and clearing works.

Measures to be implemented include:

- minimising the area of disturbance
- diverting run-off water around disturbed areas
- installation and ongoing maintenance of erosion and sediment controls (e.g., sediment fencing) throughout the duration of the Project
- stabilisation (i.e., sealing, landscaping) of all disturbed areas to reduce the potential for future erosion.

6.2.5 Workforce education and training

The development of education packages and training can help to mitigate anthropogenic impacts on biodiversity. The ability of non-ecological personnel to identify key threatened species or key ecological threats can help to mitigate impacts on threatened species. The following mitigation actions will be implemented for the Project to develop a greater understanding and awareness of biodiversity issues in non-ecological trained personnel:

- Inductions for the workforce will be undertaken to make them aware of the key ecological issues present in the Development Footprint and so that they know their role and responsibilities in the protection and/or minimisation of impacts to all native biodiversity.
- Inductions will identify the location of sensitive flora and fauna and the policies being implemented to protect the biodiversity values of such areas.

6.2.6 Summary of Measures, Timing and Responsibility

Management including the timing, action, outcome and responsibility of these measures is outlined in **Table 6.1.**

Table 6.1 Recommended Avoidance and Minimisation Measures

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Before				
Workforce education and training	Pre-construction and during construction	Site Manager	• Environmental induction	• Environmental awareness for construction crews
During				
Implement Construction Environmental Management Plan	Prior to clearance and during clearance activities	Site Manager	• Develop plan to adequately manage environmental impacts during construction including fencing and access control, weed management and erosion and sediment control	• Minimal impacts to environmental values
Demarcation of approved clearance boundaries	Prior to clearance and during clearance activities	Site Manager	• Clearly identify areas not proposed for clearance.	• Minimisation of unnecessary impacts to surrounding vegetation and habitats.
Preclearance and tree felling supervision	Prior to clearance and during clearance activities	Project ecologist and site manager	• Pre-clearance and tree felling in accordance with **Section 6.2.1**.	• Minimal impacts to local fauna and their habitats
After				
Weed management	Construction and operation	Site Manager	• Chemical and physical removal of invasive weed species in accordance with the *Noxious and Environmental Weeds Handbook* (DPI 2014). • Regular inspection to identify potential weed infestations.	• Minimisation of environmental and noxious weeds within the site • Minimisation of weed spread from and into the wider locality.

Measure	Timing	Responsibility	Proposed Techniques	Outcome
Fencing and access control	Construction and operation	Site Manager	• temporary fencing to manage access to existing tracks and paths during construction	• Provides for access control to avoid unwanted human interference and disturbance to non-operational areas. • Minimisation of impacts to native fauna species from avoiding the use of barbed-wire fences.
Erosion and sedimentation control	Construction and operation	Site Manager	• Adequate controls during works for erosion and sediment control	• Avoid sediment entering local creeks

7.0 Assessment of Impacts

7.1 Direct Impacts

The Project will result in direct impacts on biodiversity values within the JHHIP assessment Area Development Footprint. Direct impacts include the loss of native vegetation and fauna habitats as a result of clearance works.

Table 7.1 below outlines these impacts as they were entered into the BAM calculator, which totals approximately 1.98 ha of direct impacts to native vegetation communities.

Avoidance and mitigation measures associated with minimising the impacts of these direct impacts are discussed in **Sections 6.1** and **6.2** above.

Table 7.1 Direct Impacts of the Project on Native Biodiversity Features

Ecological Feature	Area within the Development Footprint (ha)
PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	1.78
PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	0.20
black-eyed Susan *Tetratheca juncea*	1.06
squirrel glider *Petaurus norfolcensis*	1.98

7.2 Indirect Impacts

The Project is not expected to result in any substantial indirect impacts on the biodiversity values of surrounding locality. However, some minor indirect impacts associated with habitat connectivity, fugitive light emissions, air quality, noise and weeds may occur during the construction of the Project. This is further discussed in the sections below in accordance with Section 8.2 of the BAM. Whilst Section 8.2 of the BAM identifies a range of potential indirect impacts to be considered, only those relevant to the Project are discussed below.

7.2.1 Fugitive light emissions

Fugitive light emissions resulting from the Project may result in adverse impacts on adjacent habitats and, particularly nocturnal birds and bats. Behavioural changes in animals can occur in response to the physical presence of a development and include changes in foraging locations and mating behaviour (Gleeson and Gleeson 2012). This may lead to changes in species composition in the landscape.

Research into the impacts of altered lighting indicates that it can trigger behavioural and physiological responses including changes in foraging behaviour, disruptions of seasonal day length trigger cues for critical behaviour, disorientation and temporary blindness and interference with predator prey relationships. Appropriate lighting controls to minimise impacts will be implemented as part of the Project including minimisation of fugitive lighting emissions following Australian Standards. There will be no

substantial change to fugitive light emission impacts on the surrounding fauna habitat given that the proposed JHHIP will become a part of existing JHH operations with existing lighting impacts.

7.2.2 Noise impacts

Noise impacts have the potential to adversely impact native species. Potential impacts include:

- noise disturbing the roosting and foraging behaviour of fauna species
- noise reducing the occupancy of areas of otherwise suitable habitat.

Noise impacts can affect fauna physiology and behaviour, particularly by causing disruption to communication including mating calls, territorial calls, and alarm calls (Gleeson and Gleeson 2012).

There will be no substantial change to noise impacts on fauna given that the proposed JHHIP will become a part of existing JHH operations with existing noise impacts. Any additional impacts resulting from noise emissions are not expected to be substantial for threatened species, populations, and communities.

7.2.3 Air quality impacts

Air quality impacts have the potential to adversely impact native species from dust generating activities during ground disturbing works. Potential impacts include dust covering vegetation thereby potentially reducing vegetation health and growth and increased air pollutants for native species (flora and fauna) making them more susceptible to environmental stresses.

The construction of the Project will include inherent measures to minimise the potential for adverse air quality impacts however additional controls, such as the use of a water truck to suppress dust created by construction works will be implemented where required.

Any additional air quality impacts are not expected to be of any level of significance in relation to threatened species, populations, and communities.

7.2.4 Weed encroachment

Weed species could be inadvertently brought into the Development Footprint with imported materials and could invade adjoining remnant vegetation. The introduction of weed species has the potential to decrease the biodiversity value of extant vegetation through competition with native species, particularly threatened species and as such weed encroachment and invasion represents a potential indirect impact.

Weed management measures to minimise the potential for weed encroachment into areas surrounding the Development Footprint are provided in **Section 6.2.2** and will effectively manage the risks during construction activities. Therefore, any additional impacts resulting from weeds are not expected to be of any level of significance in relation to threatened species, populations, and communities.

7.2.5 Mitigation and onsite management of indirect impacts

Section 7.0 of the BAM relates to onsite avoidance and minimisation measures required for consideration for impacts related to the operational phase of the Project. **Section 6.2** outlines the mitigation measures proposed for the Project for direct and indirect impacts including:

- implementation of clearing procedures to minimise the impacts of the clearing process and maximise the recovery of any valuable biodiversity resources (e.g., re-use of hollow logs and hollows where appropriate)

- high threat weed control
- fencing and access control
- bushfire management
- erosion and sediment control
- workforce education and training.

As part of the approval for the JHHIP Project, a Biodiversity Management Plan will be developed by the construction contractors as part of the Construction Environmental Management Plan to ensure these measures are adhered to during the construction of the entire Project.

7.3 Prescribed Impacts

Prescribed impacts have been considered for the Development Footprint. The following impacts are considered 'prescribed impacts' under the BC Regulation:

- impacts on the habitat of threatened species or ecological communities associated with karst, caves, crevices, cliffs and other geological features of significance, rocks, human-made structures or non-native vegetation
- impacts on the connectivity of different areas of habitat of threatened species that facilitates the movement of those species across their range
- impacts to non- native vegetation
- impacts on movement of threatened species that maintains their life cycle
- impacts of development on water quality, water bodies and hydrological processes that sustain threatened species and threatened ecological communities
- impacts of wind turbine strikes on protected animals
- impacts of vehicle strikes on threatened species or on animals that are part of a TEC.

The removal of native vegetation from within the Development Footprint will reduce the area currently used by local fauna species to move through the landscape. The vegetation in Jesmond Bushland Reserve forms part of a larger remnant patch which connects to several other reserves including Sygna Close Reserve, Dangerfield Drive Reserve, and the locally significant Blackbutt Reserve. The vegetation to be removed is on the edge of existing development and the Project will not sever or increase fragmentation of the existing reserve network of biodiversity connectivity pathways.

As such, the relative loss of connectivity and movement corridors for native flora and fauna as a result of the proposed Project is considered minor and unlikely to impede, beyond that already experienced, the movement of fauna species across the already fragmented landscape.

The Project will not involve impacts related to wind farms, substantial changes to vehicle strike risk, or on karst ecosystems and will not remove any non- native vegetation.

Groundwater dependent ecosystems (GDEs), hydrology and environmental flows are unlikely to be impacted by the Project due to the absence of any waterways in the Development Footprint, and the implementation of measures outline in **Section 6.2.4**.

7.4 Serious and Irreversible Impacts

Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles prescribed in the BC Regulation. The principles have been designed to capture those impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in NSW. These are impacts that:

- will cause a further decline of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to be in a rapid rate of decline, or
- will further reduce the population size of the species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very small population size, or
- impact on the habitat of a species or ecological community that is currently observed, estimated, inferred, or reasonably suspected to have a very limited geographic distribution, or
- impact on a species or ecological community that is unlikely to respond to measures to improve habitat and vegetation integrity and is therefore irreplaceable.

A total of eight species-credit species predicted by the BAM calculator for this Project are listed as potential serious and irreversible impact (SAII) entities in the TBDC (DPE 2022c). Reasons for listing in the *Guidance to Assist a Decision-Maker to Determine a Serious and Irreversible Impact* (DPIE 2019b) and DPE Threatened Species Profiles are shown in **Table 7.2** below:

Table 7.2 Likelihood of impacts to SAII entities

Species	Reason for Listing	Likelihood of Impact
Flora		
thick-leaf star-hair (*Astrotricha crassifolia*)	Number of mature individuals is very low. Geographic distribution is very highly restricted. Reproductive strategy severely limits recruitment – sterile or primarily clonal.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
Corunastylis sp. Charmhaven (NSW896673)	The estimated total number of mature individuals of the species is very low. The species is experiencing a high rate of decline. Geographic distribution is very highly restricted.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.
variable midge orchid (*Genoplesium insigne*)	Number of mature individuals is very low. Geographic distribution is very highly restricted.	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive targeted surveys. The Project is not expected to result in a serious and irreversible impact on this species.

Species	Reason for Listing	Likelihood of Impact
Fauna		
large-eared pied bat (*Chalinolobus dwyeri*)	Species dependent on non-responding attribute (maternity caves). This species is considered unlikely to respond to management.	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in **Figure 3.1**, extensive walking transects have been completed across the Development Footprint and wider JHHIP Project Area by accredited assessors and ecologists with more than 10 years experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required. The Project is not expected to result in a serious and irreversible impact on this species.
swift parrot (*Lathamus discolor*)	Numbers have been reduced to such a critical level and habitats have been so drastically reduced that the species is in immediate danger of extinction.	The Development Footprint does not occur in the area mapped as "important habitat" and the species has not been recorded in the Development Footprint. The Project is not expected to result in a serious and irreversible impact on this species.
little bent-winged bat (*Miniopterus australis*)	The species is dependent on non-responding attribute (breeding habitat only). This species is considered unlikely to respond to management.	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in **Figure 3.1**, extensive walking transects have been completed across the Development Footprint and JHHIP Project Area by accredited assessors and an ecologist with more than 10 years' experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required. The Project is not expected to result in a serious and irreversible impact on this species.

Species	Reason for Listing	Likelihood of Impact
large bent-winged bat (*Miniopterus orianae oceanensis*)	The species is dependent on non-responding attribute (breeding habitat only). This species is considered unlikely to respond to management.	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in **Figure 3.1**, extensive walking transects have been completed across the Development Footprint and JHHIP Project Area by accredited assessors and an ecologist with more than 10 years' experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required. The Project is not expected to result in a serious and irreversible impact on this species.
brush-tailed rock-wallaby (*Petrogale penicillata*)	Species dependent on non-responding attribute (rocky habitat).	This species has not been historically recorded within the wider locality and was not recorded within the Development Footprint despite extensive surveys. Suitable habitat, land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines (DPE 2022c), is not present within the Development Footprint. The Project is not expected to result in a serious and irreversible impact on this species.

For the reasons discussed above, the Project is not expected to have any impact that is serious and irreversible.

8.0 Impact Summary

8.1 Impacts not requiring assessment

Impacts not requiring further assessment under the BAM include areas of land without native vegetation. The JHHIP Assessment Area contains approximately 0.72 ha of cleared land/non-native vegetation that will be removed as a result of the project. This impact does not require further assessment under the BAM.

In addition, the RP2J Assessment Area (refer to **Figure 8.1**) has been approved for development (SSI-6888) and offsets retired for this area. In accordance with section 7.17 (2) (c) of the BC Act (2016), as there are no additional biodiversity impacts to this area the BDAR for this modification is not required to assess that area and impacts to that area do not require offsets.

8.2 Impacts not requiring offset

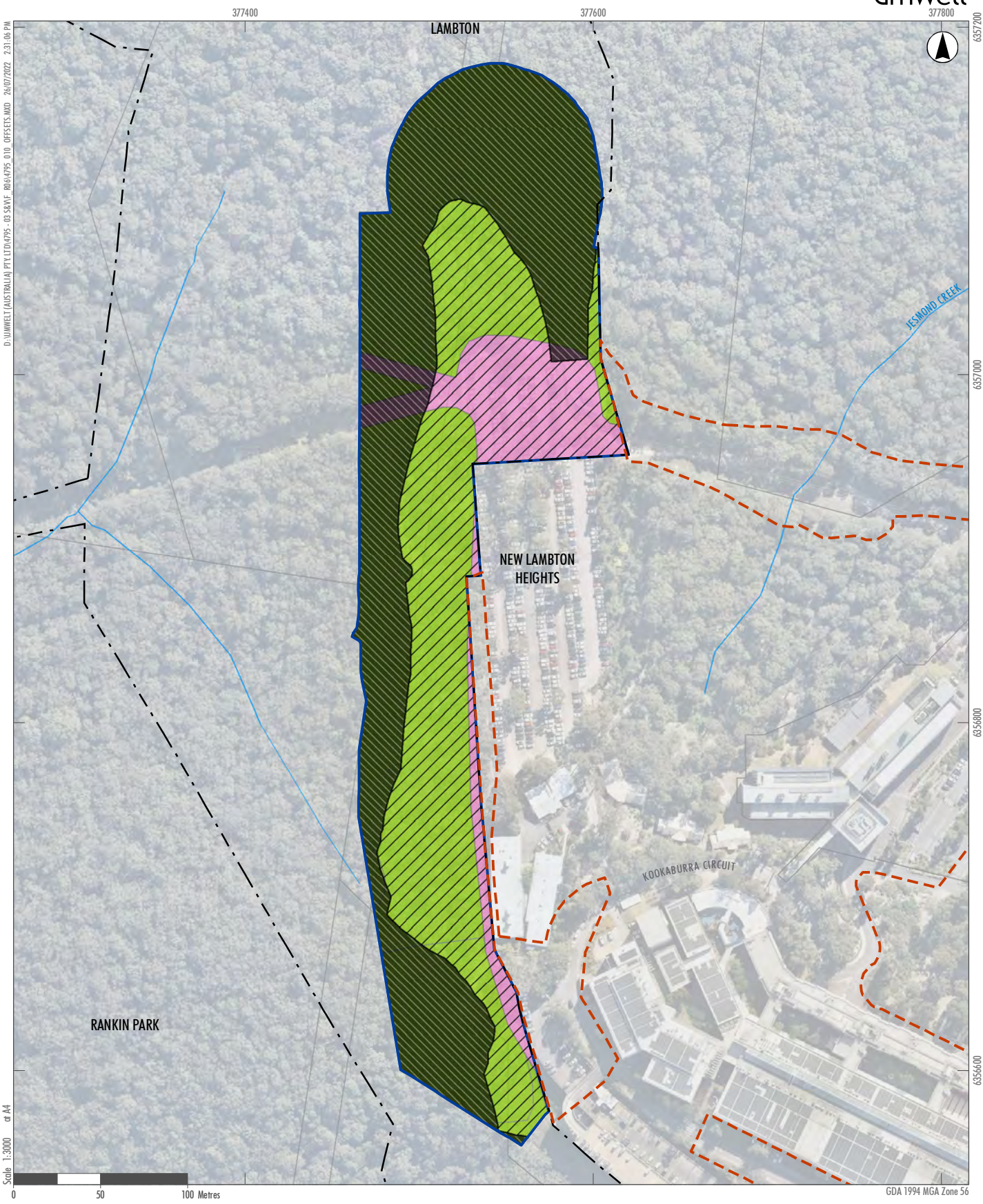
Impacts on native vegetation not requiring offsets under the BAM include native vegetation that has a vegetation integrity score of less than 20 (where it is not associated with ecosystem-credit species habitat or a TEC), less than 17 (where it is not associated with ecosystem-credit habitat or a VEC) or less than 15 (where it is representative of an EEC or CEEC). No such areas exist within the Development Footprint.

8.3 Impacts requiring offset

Table 8.1 summarises the offsetting requirements for PCTs and species-credit species habitat impacted by the Project as calculated in accordance with the BAM (refer to **Figure 8.1**)

Table 8.1 Impacts requiring offset

Vegetation Zone	PCT/Species-credit	Total Area (ha)	Vegetation Integrity Score		
			Current	Future	Change
1	PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	1.78	89.1	0	-89.1
2	PCT 1627 – Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	0.20	71.9	0	-71.9
-	black-eyed Susan *Tetratheca juncea*	1.06	N/A	N/A	N/A
-	squirrel glider *Petaurus norfolcensis*	1.98	N/A	N/A	N/A



Legend

- Development Footprint
- JHHIP Development Footprint (Umwelt 2021)
- Rankin Park to Jesmond Bypass Construction Footprint (GHD 2018)
- Areas Requiring Offsets
- Areas Not Requiring Assessment
- Property Boundaries
- Drainage Line

Interface Project Areas

- JHHIP Assessment Area
- TfNSW RP2J Assessment Area

FIGURE 8.1

Impacts Requiring Offset

Image Source: Nearmap (Aug 2021) Data source: DFSI (2020); GHD (2018); Umwelt (2021)

9.0 Biodiversity Credit Report

The full Biodiversity Credit Report is included in **Appendix E**. In addition, credit summary reports are also provided in **Appendix E.**

Table 9.1 below provides a summary of the ecosystem credits and their credit classes, and the species credits required. The credit classes outlined in **Table 9.1** identify the types of offsets that can be used to meet an offset obligation under the Biodiversity Offsets Scheme ('Like for Like' Rules).

Table 9.1 Ecosystem and Species Credits Generated

Name	Credit Class	Phase 3 Credits
PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group	**59**
PCT 1627 - Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Sydney Coastal Dry Sclerophyll Forests - < 50% cleared group	**5**
black-eyed Susan *Tetratheca juncea*	N/A	**50**
squirrel glider *Petaurus norfolcensis*	N/A	**86**

10.0 Biodiversity Offset Strategy

The Project is committed to delivering a biodiversity offset strategy that appropriately compensates for the unavoidable loss of ecological values as a result of the Project.

As discussed in **Section 1.0**, The Development Footprint is located solely within areas approved for development and as such, the assessment outcomes presented and credit requirements shown are commensurate, albeit BAM rather than FBA, with the findings and assessment from the RP2J BAR submitted by GHD (2018) and approved by the DPE as part of the SSI-6888. The offset requirements for the Project, as calculated in accordance with the BAM are identified in **Section 9.0**.

The current intention is to relinquish the credit obligation through either:

- purchasing credits from the market (if they are available during the timeframe conditioned in the consent), and/or
- payment into the Biodiversity Conservation Fund.

11.0 References

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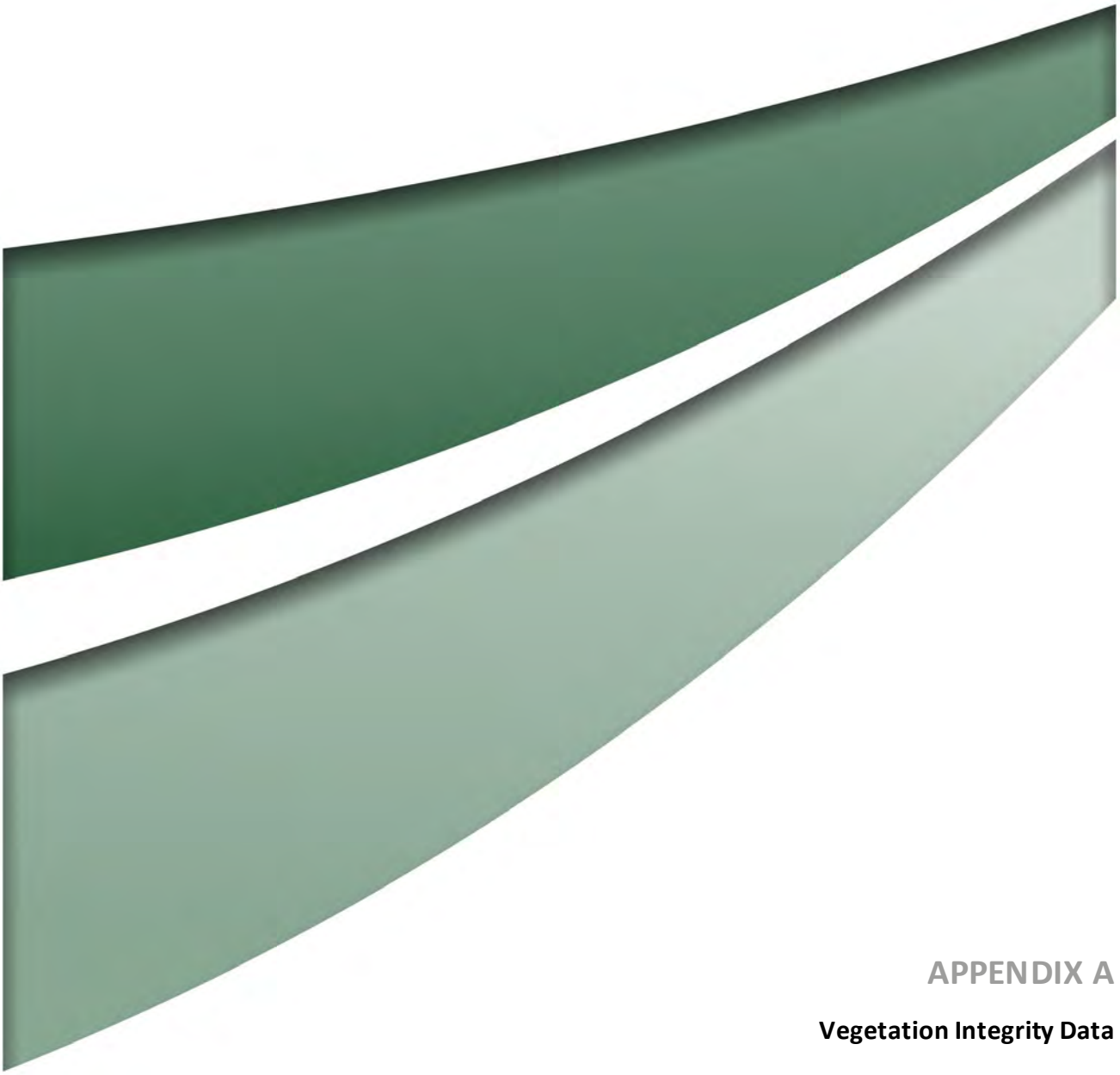


APPENDIX A

Vegetation Integrity Data

Vegetation Integrity Data

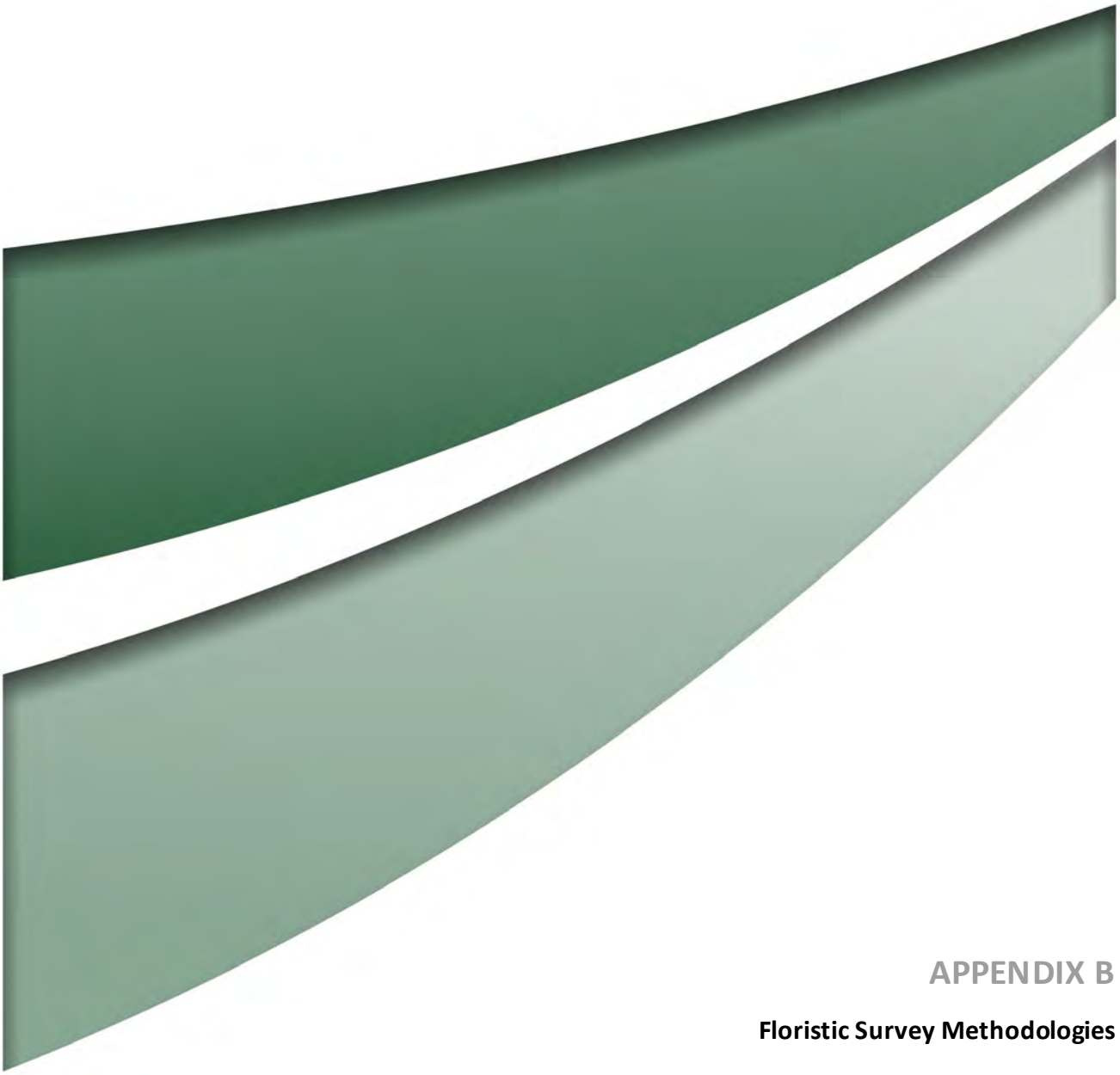
The following vegetation integrity data was collected from surveys of the Development Footprint. It includes the composition, structure and function attributes that are recorded in each BAM plot. This data is assessed against benchmark data for PCTs and entered into the BAM-C to assess the condition of each PCT in the Site.

The following abbreviations are used in the table below:

Tr	Tree (growth form)
Sh	Shrub (growth form)
Gr	Grass (growth form)
Fb	Forb (growth form)
Fn	Fern (growth form)
Ot	Other (growth form).

Table A-1 Vegetation Integrity Data

Plot Name	COMPOSITION						STRUCTURE						FUNCTION										
	Tr	Sh	Gr	Fb	Fn	Ot	Tr	Sh	Gr	Fb	Fn	Ot	Regen	Stem Classes (cm)					No. Large Trees	No. Hollow Trees	Litter (%)	Fallen Logs (m)	High Threat Weeds
													>5	5-10	10-20	20-30	30-50	50-80					
Veg Zone 1– PCT 1619 – Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands – *Good*																							
VI02	4	19	6	3	1	4	35.5	71.1	30.1	2.3	5	4.7	1	1	1	1	1	1	10	4	66	30	0.0
VI03	5	16	5	3	1	4	41	48.9	45	0.9	10	5.5	1	1	1	1	1	1	7	2	45	80	0.0
Veg Zone 2 – PCT 1627																							
VI04	6	11	5	7	3	9	32	24.3	24	2.3	10.4	3.9	1	1	1	1	1	1	11	3	58	22	0



APPENDIX B

Floristic Survey Methodologies

Floristic and Vegetation Integrity Survey

This involved setting out a 20 x 20 m plot and a 20 x 50 m plot with a 50 m transect. The location of each quadrat was recorded using a hand-held GPS with accuracy of ± 5 m. The Map Grid of Australia (MGA) coordinate system was used.

At each plot, roughly 45 to 60 minutes was spent searching for all vascular flora species present within the 20 x 20 m plot. Searches of each 20 x 20 m plot were generally undertaken through parallel transects from one side of the plot to another. Most effort was spent on examining the groundcover, which consistently supported well over half of the species present. Effort was made to search the tree canopy and tree trunks for mistletoes, vines, and epiphytes.

For each flora species recorded in the plot, the following data was collected in accordance with BAM guidelines (DPIE 2020):

- scientific name and common name of the species
- whether the species is native, exotic, or high threat exotic
- the growth form to which the species belongs
- cover and abundance of the species.

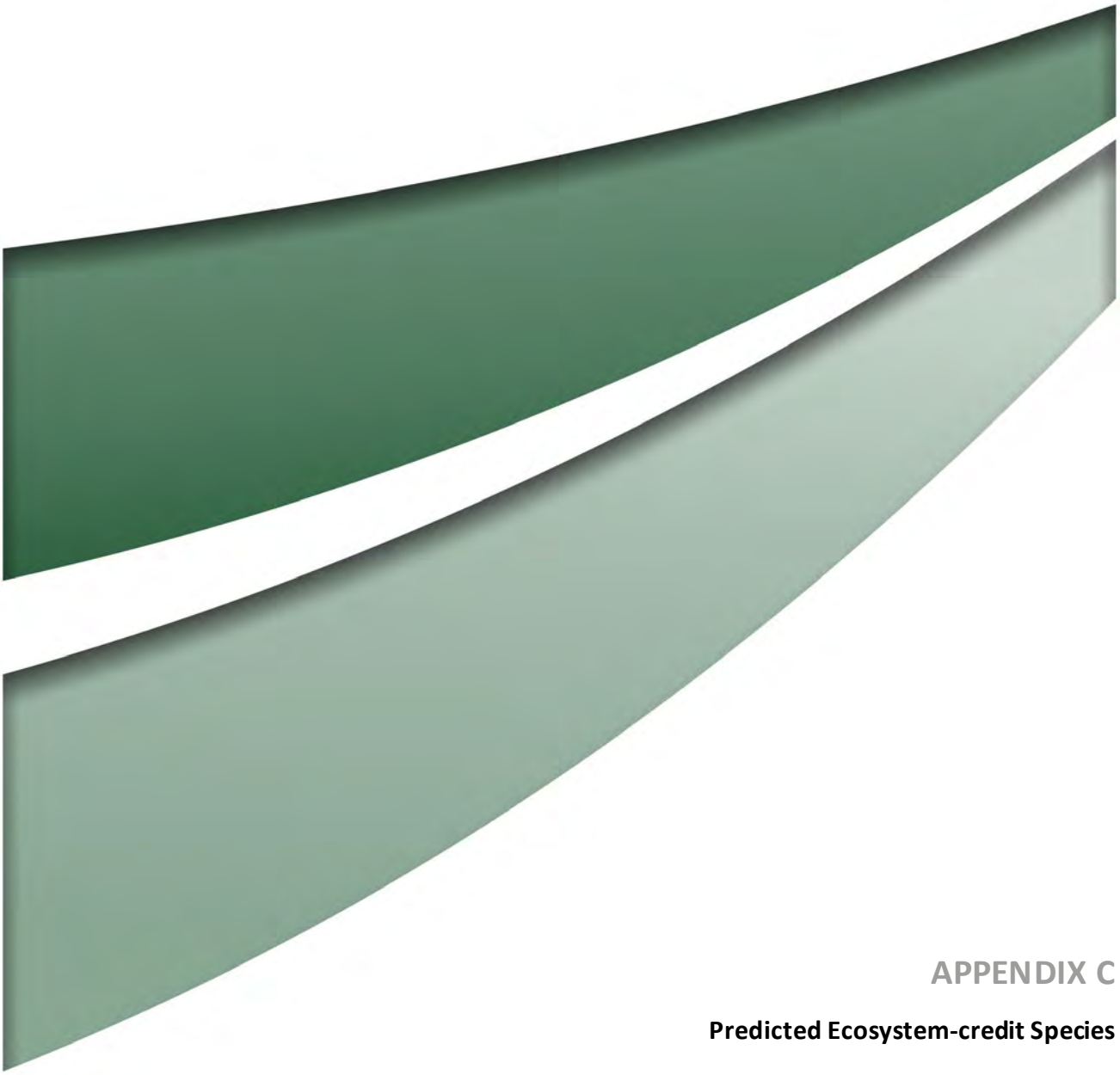
At each vegetation integrity plot the following attributes were recorded in accordance with the BAM (DPIE 2020) to determine the condition of the vegetation zone:

- ***Composition*** - native plant species richness by growth form (within the 20 x 20 m plot)
- ***Structure*** – estimate foliage cover of native and exotic species by growth form (within the 20 x 20 m plot)
- ***Function*** (within the 20 x 50 m plot) including, number of large trees, presence or otherwise of tree stem size classes, presence or otherwise of canopy species regeneration, length of fallen logs, percentage cover for litter (recorded from five 1 x 1 m plots), number of trees with hollows and high threat exotic cover.

Meandering Transects

Meandering transects were undertaken through vegetation units across much of the Development Footprint, particularly for the delineation and refinement of vegetation mapping and searching for threatened and otherwise significant species, endangered populations and TECs. Meandering transects enabled floristic sampling across a much larger area than systematic plots, allowing the survey to achieve a combination of detailed observation and broader appreciation. Records along transects supplemented floristic sampling carried out as part of plot survey, however, the data collected was in the form of presence records. Where meandering transects revealed significant variation within a vegetation unit, or a potential new vegetation community, additional plot survey was undertaken.

Meandering transects provided invaluable information on spatial patterns of vegetation that informed vegetation community mapping of the Development Footprint.



APPENDIX C

Predicted Ecosystem-credit Species

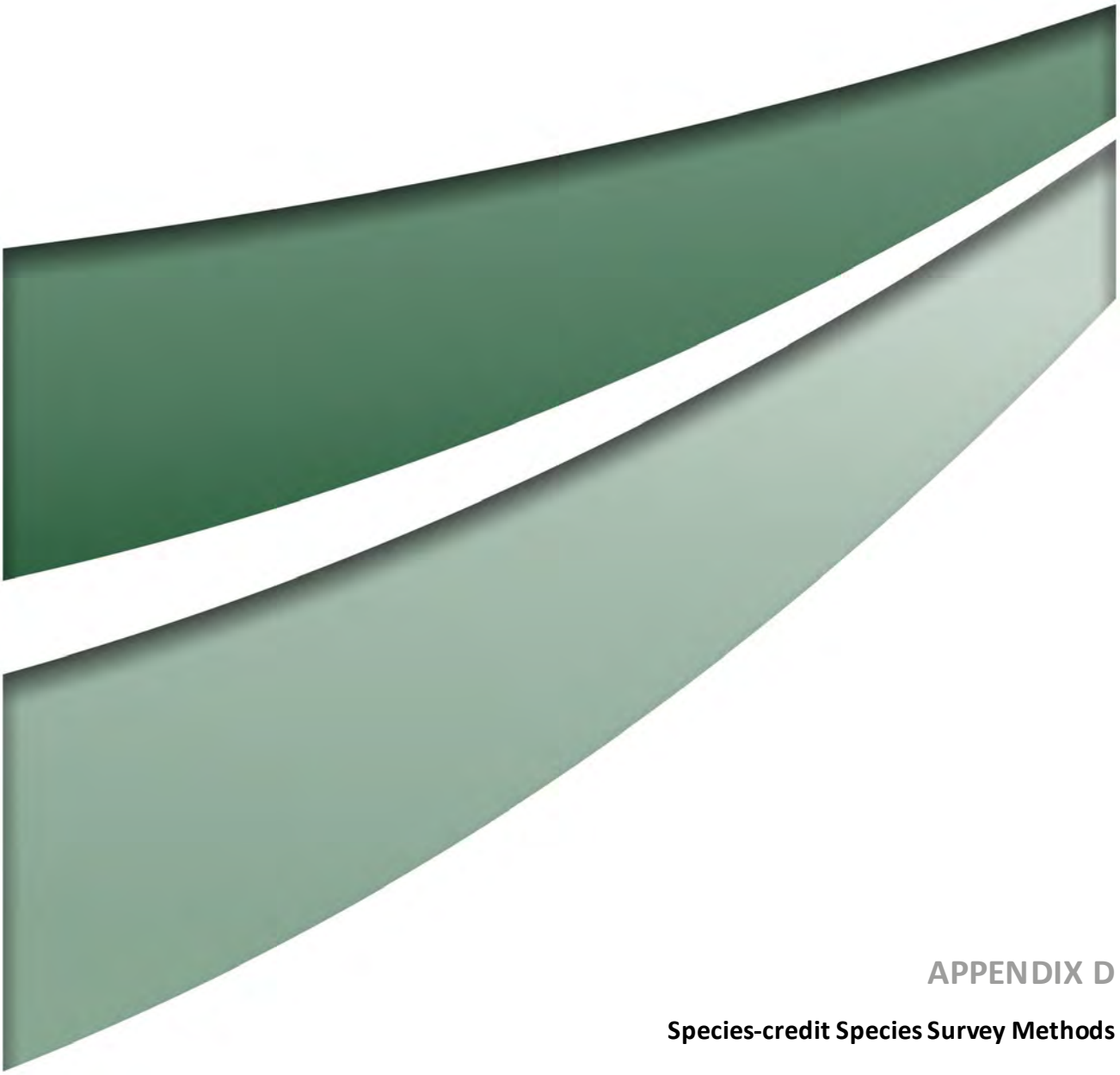
Table C-1 identifies the candidate ecosystem-credit species predicted by the BAM calculator or identified in the literature review, and documents recorded presence/absence from surveys undertaken within the Development Footprint. Marine, pelagic and wetland fauna species have been excluded due to lack of suitable habitat in the Development Footprint.

Table C-1 Ecosystem-credit Species Occurrence

Species	BC Act	EPBC Act	Previously Recorded in Development Footprint (BioNet Atlas)	Recorded in Development Footprint During Survey	Predicted Vegetation Zones (BAM-C)
gang-gang cockatoo *Callocephalon fimbriatum*	V	-	No	No	All zones
glossy black-cockatoo *Calyptorhynchus lathami*	V	-	No	No	All zones
speckled warbler *Chthonicola sagittata*	V	-	No	No	All zones
brown treecreeper (eastern subspecies) *Climacteris picumnus victoriae*	V	-	No	No	All zones
varied sittella *Daphoenositta chrysoptera*	V	-	No	No	All zones
spotted-tailed quoll *Dasyurus maculatus*	V	E	No	No	All zones
eastern false pipistrelle *Falsistrellus tasmaniensis*	V	-	No	No	-
little lorikeet *Glossopsitta pusilla*	V	-	No	No	All zones
painted honeyeater *Grantiella picta*	V	V	No	No	All zones
white-bellied sea-eagle *Haliaeetus leucogaster*	V	-	No	No	All zones
little eagle *Hieraaetus morphnoides*	V	-	No	No	All zones

Species	BC Act	EPBC Act	Previously Recorded in Development Footprint (BioNet Atlas)	Recorded in Development Footprint During Survey	Predicted Vegetation Zones (BAM-C)
White-throated needletail *Hirundapus caudacutus*	-	V	No	No	-
swift parrot *Lathamus discolor*	E	CE	No	No	All zones
square-tailed kite Lophoictinia isura	V	-	No	No	All zones
Black-chinned honeyeater (south-eastern form) *Melithreptis gularis gularis*	V	-	No	No	-
eastern coastal free-tailed bat *Micronomus norfolkensis*	V	-	No	No	All zones
little bent-winged bat *Miniopterus australis*	V	-	No	No	All zones
large bent-winged bat *Miniopterus orianae oceanensis*	V	-	No	No	All zones
turquoise parrot *Neophema pulchella*	V	-	No	No	All zones
powerful owl *Ninox strenua*	V	-	No	No	All zones
eastern osprey *Pandion cristatus*	V	-	No	No	All Zones
Yellow-bellied glider *Petaurus australis*	V	-	No	No	All zones
scarlet robin *Petroica boodang*	V	-	No	No	All zones
koala *Phascolarctos cinereus*	V	V	No	No	All zones

Species	BC Act	EPBC Act	Previously Recorded in Development Footprint (BioNet Atlas)	Recorded in Development Footprint During Survey	Predicted Vegetation Zones (BAM-C)
golden-tipped bat *Phoniscus papuensis*	V	-	No	No	All zones
grey-crowned babbler (eastern subspecies) *Pomatostomus temporalis*	V	-	No	No	All zones
grey-headed flying-fox *Pteropus poliocephalus*	V	V	No	No	All zones
yellow-bellied sheathtail-bat *Saccolaimus flaviventris*	V	-	No	No	All zones
greater broad-nosed bat *Scoteanax rueppellii*	V	-	No	No	-
masked owl *Tyto novaehollandiae*	V	-	No	No	All zones



APPENDIX D

Species-credit Species Survey Methods

Table D-1 Species-credit Species Survey Methods

Table D-1 identifies the candidate species-credit species predicted by the BAM calculator or identified in the literature review, and documents the surveys undertaken within the Development Footprint for each species. Marine, pelagic and wetland fauna species have been excluded due to lack of suitable habitat in the Development Footprint.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
Flora Species							
Bynoe's wattle *Acacia bynoeana*	E	V	All year	-	BAM-C	-	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
Charmhaven apple *Angophora inopina*	V	V	All year	-	BioNetAtlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
Trailing woodruff *Asperula asthenes*	V	V	Oct-Dec	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
thick-leaf star-hair *Astrotricha crassifolia*	V	V	Jul-Dec	-	BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
netted bottle brush ***Callistemon linearifolius***	V	-	Oct- Jan	-	BioNet Atlas, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in October and December 2019 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
***Corunastylis* sp. Charmhaven (NSW896673)**	CE	CE	Nov-April	-	BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in December 2019, and March 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
Red helmet orchid ***Corybas dowlingii***	V	-	June-July	-	DPE 2022	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in June 2022 (refer to **Figure 5.1**).
leafless tongue-orchid ***Cryptostylis hunteriana***	V	V	Nov-Jan	-	PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in December 2019 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
***Eucalyptus oblonga – endangered* population**	EP	-	All year	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
variable midge orchid ***Genoplesium insigne***	CE	CE	Sept-Nov	-	BAM-C	Yes	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
small-flower grevillea ***Grevillea parviflora* subsp. *parviflora***	V	V	Aug- Nov	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and August and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
Grove's paperbark ***Melaleuca groveana***	V	-	All year	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
Tranquility mintbush ***Prostanthera askania***	E	E	Sept-Nov	-	BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in October and December 2019 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
heath wrinklewort ***Rutidosis heterogama***	V	V	All year	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September, October and December 2019, and March, August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.
Tetratheca glandulosa	V	-	Aug-Nov	-	BioNet Atlas, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and August, and September 2020 (refer to **Figure 5.1**). Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
black-eyed Susan ***Tetratheca juncea***	V	V	Sep-Oct	-	BioNet Atlas, PMST, BAM-C	No	Targeted threatened flora walking transects were undertaken in suitable habitat areas within the Development Footprint in September and October 2019, and September 2020 (refer to **Figure 5.1**). Species detected. Opportunistic observations were completed throughout all Umwelt survey periods.
Fauna Species							
bush stone-curlew ***Burhinus grallarius***	E	-	All year	Fallen/standing dead timber including logs.	BioNet Atlas, BAM-C	No	A total of 18km of walking transects were completed across the Development Footprint. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. In addition, opportunistic observations were completed throughout all Umwelt survey periods.
glossy black-cockatoo ***Calyptorhynchus lathami***	V	-	Mar-Aug	Breeding habitat only. Living or dead tree with hollows greater than 15cm diameter and greater than 5m above ground.	BioNet Atlas, BAM-C	No	Targeted diurnal surveys were completed in August 2020 during flora transects. The Development Footprint was walked across two days searching for this species and potential breeding behaviour. Opportunistic observations were also completed throughout all Umwelt survey periods.
gang-gang cockatoo ***Callocephalon fimbriatum***	V	-	Oct-Jan	Breeding habitat only. Eucalypt tree species with hollows greater than 9 cm diameter.	BioNet Atlas, BAM-C	No	Targeted diurnal surveys were completed in October and December 2019 and January and October 2020 during flora transects. The Development Footprint was walked across six days and searching for this species and potential breeding behaviour. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
eastern pygmy-possum ***Cercartetus nanus***	V	-	Oct-Mar	-	BioNet Atlas, BAM-C	No	Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to **Figure 5.1**) for between 15-30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. Opportunistic observations were completed throughout all Umwelt survey periods.
large-eared pied bat ***Chalinolobus dwyeri***	V	V	Nov-Jan	Breeding habitat only. Within two kilometres of rocky areas containing caves, overhangs, escarpments, outcrops, or crevices, or within two kilometres of old mines or tunnels.	BioNet Atlas, PMST	Yes	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in **Figure 3.1**, extensive walking transects have been completed across the Development Footprint and JHHIP Project Area by accredited assessors and ecologists with more than 10 years experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
Wallum froglet ***Crinia tinnula***	V	-	All year	-	BioNet Atlas, BAM-C	No	No permanent water or paperbark swamps were identified within the Development Footprint. Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in the JHHIP Project Area in September 2019, and January and February 2020 (refer to **Figure 5.1**). Auditory surveys of 15-minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species. Opportunistic observations were completed throughout all Umwelt survey periods.
white-bellied sea-eagle ***Haliaeetus leucogaster***	V	-	Jul-Dec	Breeding habitat only. Living or dead mature trees within suitable vegetation within 1km of a rivers, lakes, large dams or creeks, wetlands, and coastlines.	BioNet Atlas, BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019. Opportunistic observations were completed throughout all Umwelt survey periods.
little eagle ***Hieraaetus morphnoides***	V	-	Aug-Oct	Breeding habitat only. Nest trees - live (occasionally dead) large old trees within vegetation.	BioNet Atlas, BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
pale-headed snake ***Hoplocephalus bitorquatus***	V	-	Nov-March	-	BAM-C	No	Whilst the pale-headed snake cannot be considered a vagrant as records exist in the Wyong IBRA subregion, records in the lower Hunter Valley are very scarce and old. Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to **Figure 5.1**) for between 15-30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Opportunistic observations were completed throughout all Umwelt survey periods.
swift parrot ***Lathamus discolor***	E	CE	N/A	Important habitat only (as defined by mapping products supplied by the BCD)	BioNet Atlas, PMST, BAM-C	Yes	Surveys are not required for this species under the BAM as it is not mapped as important habitat within the Development Footprint. As such, it is assessed as an ecosystem credit species.
green and golden bell frog ***Litoria aurea***	E	V	Nov-Mar	Semi-permanent/ephemeral wet areas and within 1km of swamps and waterbodies.	BioNet Atlas, PMST, BAM-C	No	No permanent water or paperbark swamps were identified within the Development Footprint. Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in the JHHIP Project Area in September 2019, and January and February 2020 (refer to **Figure 5.1**). Auditory surveys of 15-minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
green-thighed frog ***Litoria brevipalmata***	V	-	Oct-March	-	BAM-C	No	No permanent water or paperbark swamps were identified within the Development Footprint. Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in the JHHIP Project Area in September 2019, and January and February 2020 (refer to **Figure 5.1**). Auditory surveys of 15-minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species. Opportunistic observations were completed throughout all Umwelt survey periods.
square-tailed kite ***Lophoictinia isura***	V	-	Sept-Jan	Breeding habitat only. Nest trees.	BioNet Atlas, BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
little bent-winged bat ***Miniopterus australis***	V	-	Dec-Feb	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	BioNet Atlas	Yes	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in **Figure 3.1**, extensive walking transects have been completed across the Development Footprint and JHHIP Project Area by accredited assessors and ecologists with more than 10 years experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required. No breeding habitat for this species was recorded in nearby areas during the Rankin Park to Jesmond Bypass project (GHD 2018) and there are no documented breeding sites nearby on any threatened species databases. As such, no further surveys were completed.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
large bentwing-bat ***Miniopterus orianae oceanensis***	V	-	Dec-Feb	Breeding habitat only. Caves, tunnels, mines, culverts, or other structures known or suspected to be used for breeding.	BioNet Atlas	Yes	As per the Species credit threatened bat NSW Survey Guideline (OEH 2018), in accordance with Section 2, a candidate species list was prepared and areas of potential habitat (as defined by the guidelines) were identified. This species is a species credit for breeding habitat only. While the Development Footprint may contain foraging habitat for this species, no rocky areas or other habitat features such as caves, tunnels, mines, culverts, or other local, manufactured structures (buildings) supporting breeding habitat are present. As shown in **Figure 3.1**, extensive walking transects have been completed across the Development Footprint and JHHIP Project Area by accredited assessors and ecologists with more than 10 years experience. As no potential habitat was identified, in accordance with the guidelines, no additional surveys were required. No breeding habitat for this species was recorded in nearby areas during the Rankin Park to Jesmond Bypass project (GHD 2018) and there are no documented breeding sites nearby on any threatened species databases. As such, no further surveys were completed.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
barking owl ***Ninox connivens***	V	-	May-Dec	Breeding habitat only. Living or dead trees with hollows greater than 20 cm diameter and greater than 4m above the ground.	BioNet Atlas	No	Potential breeding habitat (as defined by the TBDC) was observed within the Development Footprint during the extensive walking surveys. As per the BAM, breeding habitat is defined by the presence of potential habitat and evidence of breeding (observation or duetting). As potential bereding habitat was identified, stag watches and call playback were undertaken at 16 locations within the Development Footprint and JHHIP Project Area in September 2019 and August 2020. This involved watching the hollows of potential breeding habitat at dusk for emergence of fauna followed by the broadcasting of owl calls. These sessions began with a period of quiet listening for approximately 5 minutes. Barking owl calls were played using a 15-watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of survey were conducted across the JHHIP Project Area and Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods and no secondary signs of presence or breeding (whitewash or prey carcasses) were identified during any of the survey periods. This coverage was considered appropriate both in terms of timing and spatial extent to ensure that should breeding activities be occurring within the potential habitat on site that this would have been recorded either through observations or heard.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
powerful owl ***Ninox strenua***	V	-	May-Aug	Breeding habitat only. Living or dead trees with hollow greater than 20cm diameter.	BioNet Atlas, BAM-C	No	Potential breeding habitat (as defined by the TBDC) was observed within the Development Footprint during the extensive walking surveys. As per the BAM, breeding habitat is defined by the presence of potential habitat and evidence of breeding (observation or duetting). As potential bereding habitat was identified, stag watches and call playback were undertaken at 16 locations within the JHHIP Project Area and Development Footprint in September 2019 and August 2020. This involved watching the hollows of potential breeding habitat at dusk for emergence of fauna followed by the broadcasting of owl calls. These sessions began with a period of quiet listening for approximately 5 minutes. Powerful owl calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of survey were conducted across the Project Area. Opportunistic observations were completed throughout all Umwelt survey periods and no secondary signs of presence or breeding (whitewash or prey carcasses) were identified during any of the survey periods. This coverage was considered appropriate both in terms of timing and spatial extent to ensure that should breeding activities be occurring within the potential habitat on site that this would have been recorded either through observations or heard.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
eastern osprey *Pandion cristatus*	V	-	April-Nov	Breeding habitat only. Presence of stick-nests in living and dead trees (>15m) or artificial structures within 100m of a floodplain for nesting.	BAM-C	No	Targeted hollow-bearing trees, nest box and stick nest searches were completed during the threatened species searches in October 2019.Extensive searches completed across the broader Project Area on foot (refer to **Figure 5.1**) failed to identify any large stick nest that could be attributed to the eastern osprey or any other large raptor species. As no breeding habitat is present, no additional surveys were required. Opportunistic observations were completed throughout all Umwelt survey periods.
greater glider *Petauroides volans*	-	V	All year	Hollow-bearing trees.	BioNet Atlas, PMST	No	Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to **Figure 5.1**) for between 15-30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. Opportunistic observations were completed throughout all Umwelt survey periods.

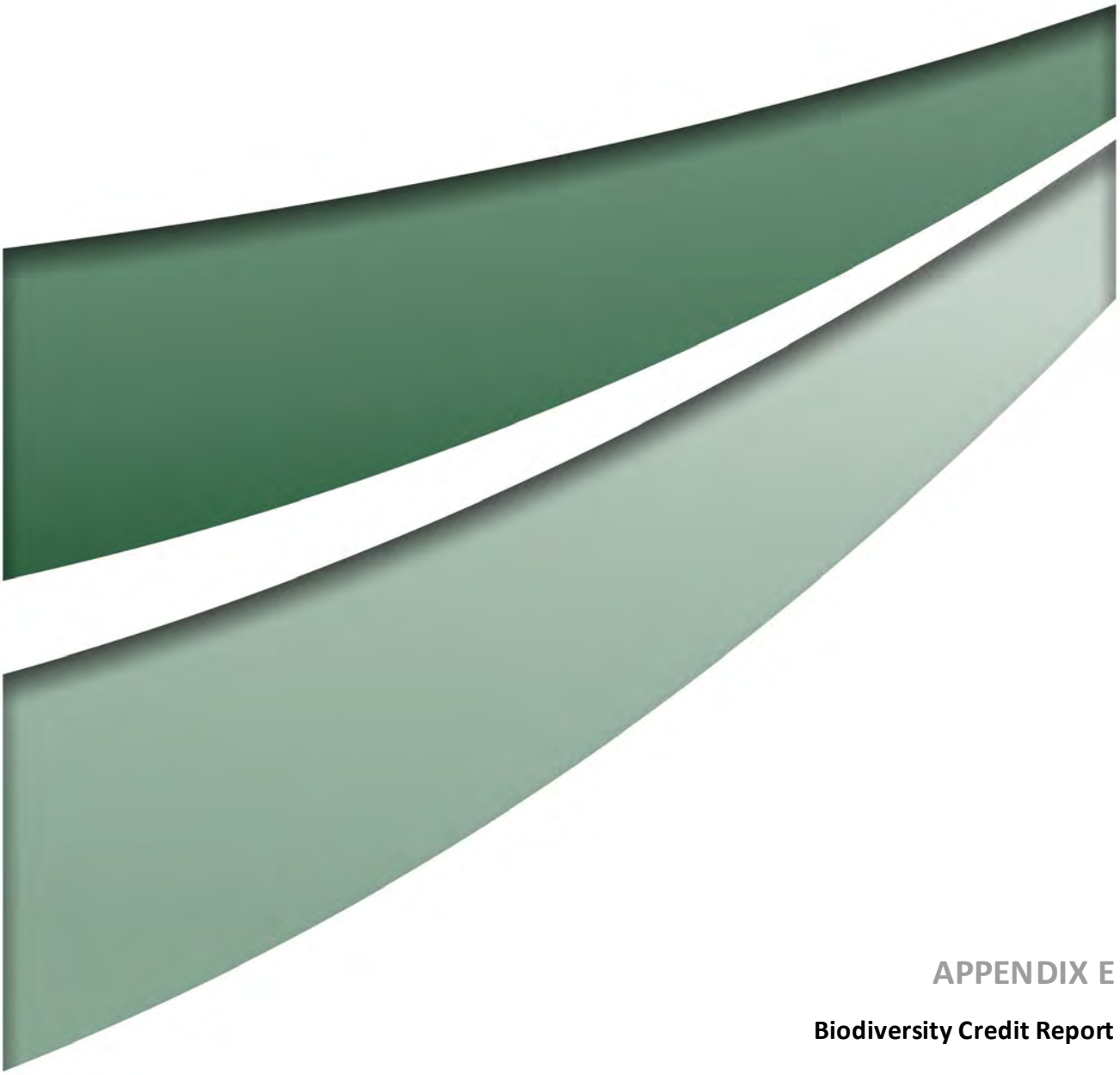
Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
squirrel glider ***Petaurus norfolcensis***	V	-	All year	-	BioNet Atlas, BAM-C	No	Species assumed present. Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to **Figure 5.1**) for between 15-30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. Opportunistic observations were completed throughout all Umwelt survey periods.
brush-tailed rock-wallaby ***Petrogale penicillata***	E	V	All year	Land within 1 km of rocky escarpments, gorges, steep slopes, boulder piles, rock outcrops or clifflines.	PMST	Yes	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
brush-tailed phascogale *tapoatafa*	V	-	Dec-June	-	BAM-C	No	Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to **Figure 5.1**) for between 15-30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
koala ***Phascolarctos cinereus***	V	V	All year	Important habitat only (as defined by mapping products supplied by the BCD).	BioNet Atlas, PMST	No	The Development Footprint is not located in an area of important habitat and defined by BCD as it contained a very low density of koala feed trees. Assessment using the Koala Spot Assessment was completed at the four floristic plot location (refer to **Figure 3.1**) Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to **Figure 5.1**) for between 15-30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. Opportunistic observations were completed throughout all Umwelt survey periods.

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
common planigale ***maculata***	V	-	All year	-	BAM-C	No	Spotlighting searches were undertaken across the Development Footprint in September 2019, and January, February, and August 2020. Nocturnal spotlighting searches were conducted along fire trails and easements and at each forest owl call playback site (refer to **Figure 5.1**) for between 15-30 minutes and involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of nocturnal survey were conducted across the Development Footprint for this species. Bushnell Trophy Cam HD cameras were installed at 10 locations within and surrounding the Development Footprint from 21 January 2020 to 11 February 2020 (21 nights). At each site, a remote camera was mounted approximately one metre above the ground on a tree trunk and positioned towards a bait station containing peanut butter, honey, and tuna. Cameras were set to take three photos in quick succession when movement was detected. Opportunistic observations were completed throughout all Umwelt survey periods.
grey-headed flying-fox ***Pteropus poliocephalus***	V	V	Oct-Dec	Breeding camps.	BioNet Atlas, PMST	No	The Development Footprint does not contain the habitat described in the habitat constraint for this species and as such no further assessment is required

Species	BC Act	EPBC Act	Survey Period	Habitat Constraint	Source	SAII Entity	Survey Method
masked owl ***Tyto novaehollandiae***	V	-	May-Aug	Breeding habitat only. Living or dead trees with hollows greater than 20cm diameter.	BioNet Atlas, BAM-C	No	Stag watches and call playback were undertaken at 16 locations within the JHHIP Project Area and Development Footprint in September 2019 and August 2020. This involved watching the hollows of potential breeding trees at dusk for emergence of fauna followed by the broadcasting of owl calls. These sessions began with a period of quiet listening for approximately 5 minutes. Masked owl calls were played using a 15 watt directional loud hailer for approximately four minutes, followed by a listening period of five minutes. Following call playback sessions, nocturnal spotlighting searches were conducted at each site for between 15-30 minutes. This involved walking a meandering transect and recording any fauna species seen or heard calling. Species were visually identified using 10 x 40 magnification binoculars or by call recognition. A total of approximately 8 person hours of survey were conducted across the JHHIP Project Area and Development Footprint. Opportunistic observations were completed throughout all Umwelt survey periods.
Mahony's toadlet ***Uperoleia mahonyi***	E	-	Oct-March	-	BAM-C	No	No habitat within the Development Footprint. Nocturnal surveys targeting threatened amphibians were undertaken across the Development Footprint at three locations in September 2019, and January and February 2020 (refer to **Figure 5.1**). Auditory surveys of 15-minute duration were completed at each of the three locations during each of the nocturnal survey periods and 15 minutes of active searching in and around areas holding any water was completed during January and February 2020. A total of approximately 6 person hours of survey were conducted across the Development Footprint for this species. Opportunistic observations were completed throughout all Umwelt survey periods.



APPENDIX E

Biodiversity Credit Report

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id 00032568/BAAS18117/22/00032569	Proposal Name JHHIP Modification Phase 3	BAM data last updated * 16/06/2022
Assessor Name Philippa Fagan	Assessor Number BAAS18117	BAM Data version * 54
Proponent Names Nicholas Rayner	Report Created 01/08/2022	BAM Case Status Finalised
Assessment Revision 5	Assessment Type Major Projects	Date Finalised 01/08/2022

* 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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Nil		

Species
Nil

Additional Information for Approval

PCT Outside Ibra Added

None added

PCTs With Customized Benchmarks

PCT
No Changes

Predicted Threatened Species Not On Site

Name
No Changes

Ecosystem Credit Summary (Number and class of biodiversity credits to be retired)

Name of Plant Community Type/ID	Name of threatened ecological community	Area of impact	HBT Cr	No HBT Cr	Total credits to be retired
1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	Not a TEC	1.8	59	0	59
1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	Not a TEC	0.2	5	0	5

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1619-Smooth-barked Apple - Red Bloodwood - Brown Stringybark - Hairpin Banksia heathy open forest of coastal lowlands	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1619_Good	Yes	59	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1627-Smooth-barked Apple - Turpentine - Sydney Peppermint heathy woodland on sandstone ranges of the Central Coast	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	Sydney Coastal Dry Sclerophyll Forests This includes PCT's: 1083, 1138, 1156, 1181, 1183, 1250, 1253, 1619, 1620, 1621, 1623, 1624, 1625, 1627, 1632, 1636, 1638, 1642, 1643, 1681, 1776, 1777, 1778, 1780, 1782, 1783, 1785, 1786, 1787	Sydney Coastal Dry Sclerophyll Forests <50%	1627_Good	Yes	5	Wyong, Hunter, Pittwater and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

Species	Vegetation Zone/s	Area / Count	Credits
Petaurus norfolcensis / Squirrel Glider	**1619_Good, 1627_Good**	2.0	86.00
Tetratheca juncea / Black-eyed Susan	**1619_Good**	1.1	50.00

Credit Retirement Options

Like-for-like credit retirement options

	Spp	IBRA subregion
Petaurus norfolcensis / Squirrel Glider	**Petaurus norfolcensis /** Squirrel Glider	Any in NSW

Tetratheca juncea / Black-eyed Susan	Spp	IBRA subregion
	Tetratheca juncea / Black-eyed Susan	Any in NSW

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