Biodiversity Development Assessment Report
Concept Development Application

Detailed Civil Works, Southern Housing Precinct and Apartment Precinct

Lot 61 DP 737386
55 Coonara Avenue
West Pennant Hills
The Hills LGA

For: Mirvac

REF: HiSC 15-770

16th June 2022

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Date	Version	Detail
10.03.2021	1.0	Draft BDAR for MIRVAC review
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29.11.2021	2.1	Amended Figure 6, finalised BAM-C reports, minor formatting
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Team contributions:

Accredited Assessor	BOAMs Assessor number	Main role	BDAR contribution
Elizabeth Ashby	BAAS17045	Lead Assessor	• Field surveys – flora and fauna in accordance with BAM (2020) • Drafting and editing of BDAR • Final review of BDAR (all components) • Review of BAM-C • Finalising BDAR
Ashleigh McTackett	BAAS20028	Assisting Assessor	• Field surveys and survey assistant for BAM related surveys (BAM plots, Powerful Owl surveys) • Assembling BDAR in accordance with Appendix L of BAM • Input of data into BAM-C • Drafting of BDAR in accordance with Table 28 of BAM (Chapters 1 to 12 and Appendices).

CERTIFICATION

I certify that this BDAR has been prepared on the basis of the requirements of (and information provided under) the current Biodiversity Assessment Method (2020) and that I have no conflict of interest.

16th June 2022

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Cover photograph: View of some of the Planted Native Vegetation and car parks within the development footprint.

Photo: E. Ashby, 23rd July 2019

DEFINITIONS

Some terms require definition for the Biodiversity Development Assessment Report (BDAR) and largely include those as per the *Biodiversity Conservation Act 2016* and Biodiversity Assessment Method (2020) for matters listed under NSW legislation.

BAM (2020): The Biodiversity Assessment Method (2020).

Critically endangered ecological community (CEEC): an ecological community specified as critically endangered in the *Biodiversity Conservation Act 2016* and/or listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

Construction Footprint: the extent of proposed clearing and construction works and delineated by temporary fencing. This is a subset of the *development site*, *development footprint*, and *operational footprint* for the purposes of this BDAR.

Development: has the same meaning as development at section 4, or an activity in Part 5, or development as defined in section 115T of the *NSW Environmental Planning and Assessment Act 1979*.

Development footprint: is the area of land that is directly impacted by a proposed development, including access roads and areas used to store construction materials. The term development footprint is also taken to include the clearing footprint, except where the reference is to a small area development or a major project development. Development Footprint has the same meaning as *Operational Footprint* and *Development Site* for the purposes of this BDAR.

Development site: an area of land that is subject to a proposed development under the *NSW Environmental Planning and Assessment Act 1979*. The term development site is also taken to include clearing site, except where the reference is to a small area development or a major project development. For the purposes of this report Development Site has the same meaning as *Development Footprint*.

DIWA: Directory of Important Wetlands available at https://www.environment.gov.au/water/wetlands/australian-wetlands-database/directory-important-wetlands.

Endangered ecological community (EEC): an ecological community specified as endangered in Schedule 2 of the *Biodiversity Conservation Act 2016*, or listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

Habitat: an area or areas occupied, or periodically or occasionally occupied, by a species, population or ecological community, including any biotic or abiotic component.

Habitat component: the component of habitat that is used by a threatened species for either breeding, foraging, or shelter.

High threat exotic plant cover: plant cover composed of vascular plants not native to Australia that if not controlled will invade and outcompete native plant species. The list of High Threat Exotic species is curated by the NSW Department of Planning, Industry and Environment.

Hollow-bearing tree: a living or dead tree that has at least one hollow. A tree is considered to contain a hollow if: (a) the entrance can be seen; (b) the minimum entrance width is at least 5cm; (c) the hollow appears to have depth (i.e. you cannot see solid wood beyond the entrance); (d) the hollow is at least 1m above the ground. Trees must be examined from all angles.

IBRA region: a bioregion identified under the Interim Biogeographic Regionalisation for Australia (IBRA) system, which divides Australia into bioregions on the basis of their dominant landscape-scale attributes.

IBRA subregion: a subregion of a bioregion identified under the IBRA system.

Major project: State Significant Development and State Significant Infrastructure.

Native ground cover: all native vegetation below 1 metre in height, including all such species native to NSW (i.e. not confined to species indigenous to the area).

Native ground cover (grasses): native ground cover composed specifically of native grasses.

Native ground cover (other): native ground cover composed specifically of non-woody native vegetation (vascular plants only) less than 1 metre in height that is not a grass (e.g. herbs, ferns).

DEFINITIONS

Native ground cover (shrubs): native ground cover composed specifically of native woody vegetation less than 1 metre in height.

Native mid-storey cover: all vegetation between the over-storey stratum and a height of 1m (typically tall shrubs, understorey trees and tree regeneration) and including all species native to NSW (i.e. native species not local to the area can contribute to mid-storey structure).

Native over-storey cover: the tallest woody stratum present (including emergent) above 1m and including all species native to NSW (i.e. native species not local to the area can contribute to overstorey structure). In a woodland community the over-storey stratum is the tree layer, and in a shrubland community the over-storey stratum is the tallest shrub layer. Some vegetation types (e.g. grasslands) may not have an overstorey stratum.

Native vegetation: species endemic to NSW.

Number of trees with hollows: a count of the number of living and dead trees that are hollow- bearing.

Operational Footprint: the final area within which all direct impacts will occur as a result of the proposal, including Asset Protection Zones and any other works associated with the development.

Subject land: is land subject to a development, activity, clearing, biodiversity certification or a biodiversity stewardship proposal. It excludes the assessment area which surrounds the subject land (i.e. the area of land in the 1500 m buffer zone around the subject land or 500 m buffer zone for linear proposals). In the case of a biodiversity certification proposal, subject land includes the biodiversity certification assessment area. Subject land has the same meaning as *Subject Lot* for this BDAR and references the entire site (Lot 61 DP 737386) within which the development occurs.

Subject lot: The lot within proposed works as identified by the Lot number and Deposited Plan (DP) number see *Subject land*.

CONTENTS

STAGE 1 - BIODIVERSITY ASSESSMENT

1 INTRODUCTION

This Biodiversity Development Assessment Report (BDAR) has been prepared in accordance with the *Biodiversity Conservation (BC) Act 2016* and the *Biodiversity Conservation Regulation (BCR) 2017*, and follows the requirements detailed in *Biodiversity Assessment Method (BAM) 2020.*

The development site is located within Lot 61 DP 737386, 55 Coonara Avenue, West Pennant Hills, in The Hills LGA. It lies in the Cumberland IBRA subregion in the Sydney Basin IBRA Bioregion with the centre of the development area at approximate grid reference 318018 E 6264552 N (GDA2020 – MGA56) on the Hornsby (9130-4S) 1:25,000 topographic map sheet.

The subject lot is approximately 25.87 hectares in extent and houses the now-vacated offices for IBM, which was previously zoned as B7 Business Park. The subject lot is now rezoned with a mixture of R3 and R4 Residential, and E2 Environmental Conservation lands, reflecting the environmental values and development potential of the site.

The overall proposal is for a mixed residential community title development comprising houses and apartments, landscaped gardens, open spaces, and retained natural bushland. The development footprint is concentrated in the northern part of the site that is already developed, and most of the residual bushland will be dedicated to the NSW State Government as an extension to the adjacent Forestry lands. Due to the surrounding bushfire hazard, an Asset Protection Zone (APZ) is to be established around the development and is included as part of the development footprint for the purposes of this BDAR. Some areas of native vegetation outside of the APZ are to be retained within the community title lands; these will be managed for conservation under a Vegetation Management Plan, prepared by Cumberland Ecology.

The proposed operational / construction footprint is shown in a Concept Masterplan in Figure 1.

A proposal for initial works on site – to demolish existing office buildings, associated infrastructure and gardens in the immediate surrounds of the buildings – was approved by The Hills Local Planning Panel on 15th September 2021. That Development Application (DA585/2021/HC) was accompanied by a BDAR (Ashby and McTackett 2021) for those preliminary demolition works, and that subject area of 6.2 hectares is excised from consideration in this BDAR.

Biodiversity assessments pursuant to the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* were provided in a Referral (2021/8995) to the Commonwealth Department of Agriculture, Water and the Environment. The proposal included all works across the subject lot - demolition of existing office infrastructure and construction of housing and apartments – and was determined not to be a Controlled Action (Referral Decision dated 16th September 2021).

Figure 1: Concept Masterplan showing the proposed development footprint, bushland to be retained and managed under a VMP (inset), and bushland to be dedicated to State Forests (yellow). Impact area already assessed in the Demolition BDAR is outlined in red. VMP areas by Cumberland Ecology.

The subject lot is situated on a long steep south-facing slope with its highest point in the north near Castle Hill Road and its lowest point in the lot's south-eastern corner near Darling Mills Creek. The existing development footprint associated with the old IBM offices is concentrated in the subject lot's higher parts in the central and northern section of the site, occupying approximately 14 hectares. This comprises:

- several large purpose-built office buildings;
- car parking facilities for 1,670 vehicles across several open-air car parks and a multi-storey car park;
- a ring road circling the developed part;
- stormwater control features (dams and detention basins); and
- landscaped areas of Australian native trees and some understorey species in two general locations -
    - immediately surrounding the existing buildings; and
    - as narrow islands within and around the open-air car parks.

Prior to the development in the 1980s of the current commercial buildings and associated infrastructure, the site was used as a small farm, but primarily growing citrus trees, and contained a series of large orchards, open paddocks, small buildings, and bushland. The IBM Business Park was located mostly within the historically cleared parts of the site where aerial photography from 1943 shows a well-established orchard. This pattern is demonstrated in a series of aerial photographs at Figure 2.

Thus, the current pattern of development reflects the European land use history of the site, with approximately 12 hectares of the subject lot being occupied by natural vegetation of varying ages and disturbance history. The proposed redevelopment is a continuation of that concentration of impact within previously impacted areas.

The entire proposed development footprint at completion (including APZ) totals 10.44 hectares. Of this total footprint, the Demolition Stage occurs across 5.05 hectares of buildings and gardens that has been approved and addressed in a previous BDAR (Ashby and McTackett 2021). This current BDAR addresses potential impact to the residual areas of the footprint that possess biodiversity values, being approximately 3.15 hectares and primarily comprises the remaining car parks, gardens, and regrowth along the edges.

The proposal includes the following activities:

- Establishment of the works site and security fencing;
- Installation of stormwater and environmental controls to manage stormwater flows and sediment runoff, including treatment, prior to discharge into the creek downstream;
- Construction of civil infrastructure including bulk earthworks, sewer, stormwater, gas, electrical, telecommunication reticulation services, road pavement (including kerb and gutter), footpaths, and retaining walls;
- Removal of some existing trees and other associated vegetation required to safely facilitate the development works;
- Establishment of temporary construction facilities – including stockpiles - within the identified construction footprint;

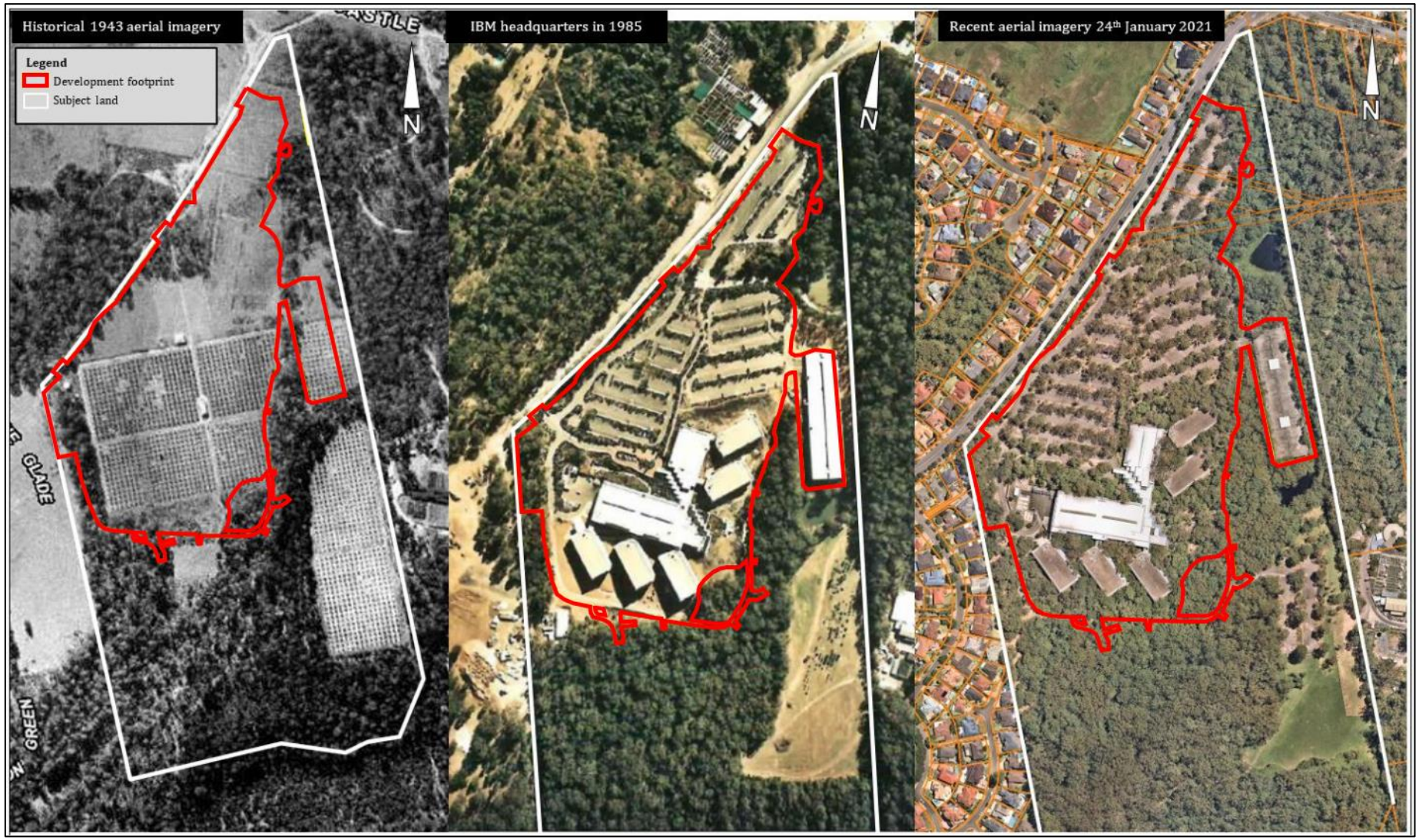

Figure 2: Aerial imagery in 1943, 1985, and 2021 of the subject lot (white) in relation to the proposed development footprint (red).

- Construction of the residential buildings and open spaces;
- Landscaping of street verges and public spaces;
- Ongoing management of vegetation within the APZ; and
- Ongoing conservation management of bushland retained within the development area.

The Biodiversity Values Map is the relevant trigger for the Biodiversity Offset Scheme (BOS) and this BDAR – see Figure 3. These particular "high value" areas are defined as representing "threatened species or communities with potential for serious and irreversible impacts", presumably arising from vegetation mapping that has mistakenly identified landscaped native gardens as Blue Gum High Forest, a Critically Endangered Ecological Community.

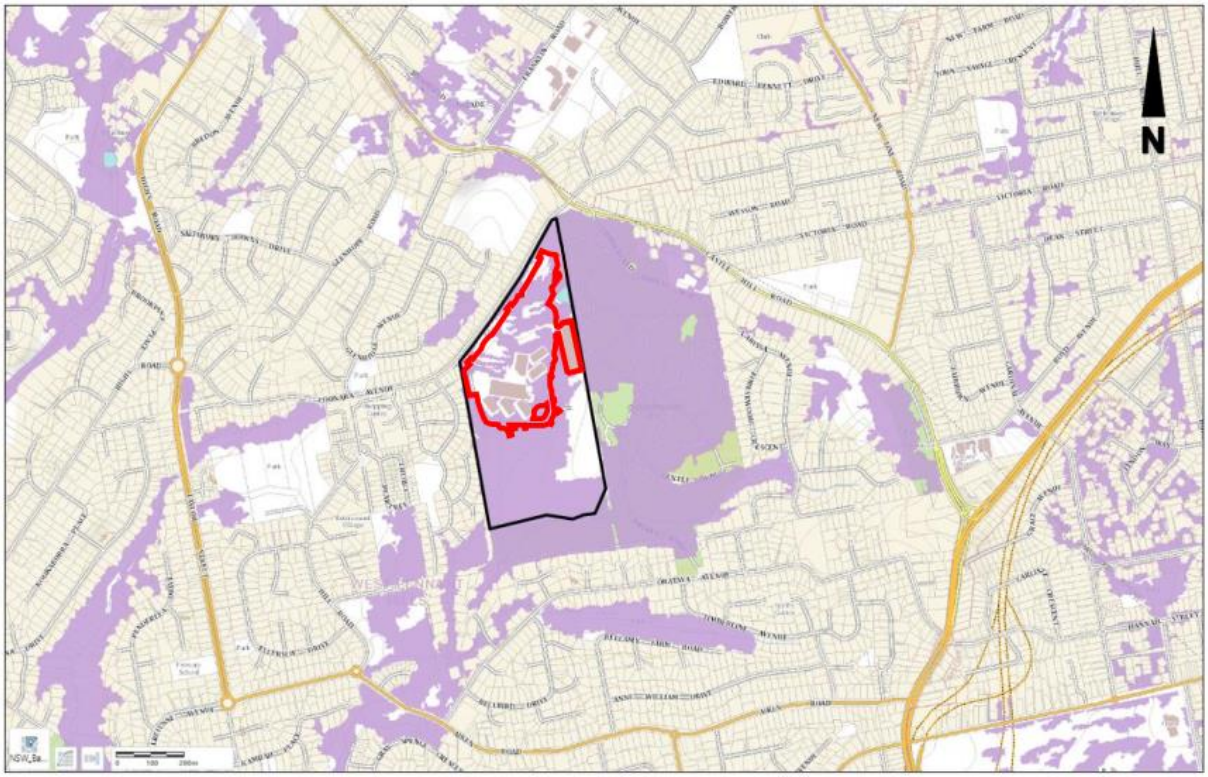

Figure 3: Biodiversity Values Map showing the relationship between the BV layer (purple), the subject lot (black outline) and the development footprint (red).

The following project plans and consultant reports were relied upon for this BDAR:

- **Civil Engineering Works plans prepared by Northrop,** revision P4, dated 25th May 2022.
- **Arboricultural reports prepared by Footprint Green:**
    - Arboricultural Impact Assessment Part 1, Preliminary Arboricultural Report - 55 Coonara Avenue, West Pennant Hills, Revision 5, dated 12th July 2021; and
    - Arboricultural Impact Assessment Part 2, Impact Assessment Associated with Demolition – 55 Coonara Avenue, West Pennant Hills, Revision 7, dated 24th September 2020;
    - Arboricultural Impact Assessment Part 3, Impact Assessment Associated with

Development Concept Plan Application – 55 Coonara Avenue, West Pennant Hills, version 10, dated 24th May 2022; and
    - Arboricultural Assessment – Proposed Sewer Repairs– 55 Coonara Avenue, West Pennant Hills, dated 25th May 2021.
- **Vegetation Management Plan** prepared by Cumberland Ecology, version 2, dated 8th June 2022.
- **Ecological reports prepared by Keystone Ecological:**
    - Development Constraints and Opportunities (Ashby, E. 2016);
    - Revised Ecological Assessment (Ashby, E. and McTackett, A. 2017);
    - Vegetation Zone Analysis (Ashby, E. and McTackett, A. 2018);
    - Biodiversity Assessment (Ashby, E. 2018); and
    - Flora and Fauna Assessment for Sewer Upgrade (Ashby, E. and McTackett, A. 2020).
    - BDAR Demolition Stage works (Ashby and McTackett, 2021).
    - Referral 2021/8995, lodged 18th August 2021.

The following external sources of information were relied upon for this BDAR:

- Biodiversity Assessment Method (October 2020)
- The Biodiversity Assessment Method Operational Manual – Stage 1 (December 2020)
- BioNet Vegetation Classification (formerly known as the NSW Vegetation Information System Classification Database).
- BioNet Threatened Biodiversity Data Collection (TBDC, formerly known as the Threatened Species Profile Database).
- BioNet Atlas (formerly known as the NSW Wildlife Atlas).
- Directory of Important Wetlands in Australia.
- BioNet NSW (Mitchell) Landscapes – Version 3.1.
- NSW Interim Biogeographic Regions of Australia (IBRA region and subregion) – Ver 7.
- NearMaps (2014-2021) NearMaps aerial imagery tool. Latest access of imagery 12th October 2021 (http://maps.au.nearmap.com/).
- NSW Government (2014-2020) SIXMaps Aerial Imagery Tool. Latest access of imagery 12th October 2021 (https://maps.six.nsw.gov.au/).
- SEED (2020) Sharing and enabling environmental data online portal. NSW Government, Sydney. (https://www.seed.nsw.gov.au/edphome/home.aspx).
- The Hills Shire Council (2020) Online mapping tool. (http://mapping.thehills.nsw.gov.au/IntraMaps90/).
- Published databases identified in section 1.4.1 of the BAM (2020).

2 LANDSCAPE CONTEXT

The subject land is located on the Hornsby Plateau and underlain by Wianamatta Group shales. In its natural form, the site would comprise a long steep south-facing slope. The site's highest point is at 170 metres ASL in the north near Castle Hill Road, and its lowest point is at 100 metres ASL in the lot's south-eastern corner near Darling Mills Creek. The upper part of the site was excavated into a series of terraces in the 1980s for the IBM development, interrupting the natural landform of most of the upper slope. A series of small creek lines remain in the natural part of the site that drain into Darling Mills Creek.

The value of the habitats provided by native vegetation in the project area are assessed in the context of a 1.5 kilometre buffer, measured from the outer boundaries of the development site. Relevant features of the site and assessment buffer are illustrated in Figures 4 (site map), 5 (location map), and 6 (assessment buffer).

Confirmation of the current extent of woody vegetation in the buffer region was made by:

- Analysis of vegetation mapping prepared by the Office of Environment and Heritage for the Sydney metropolitan area (OEH 2016, version 3.1);
- Analysis of the vegetation mapping of Hornsby LGA (2008 VIS 4471)
- Analysis of the vegetation mapping of the Hills LGA (2008);
- Inspection of the entire buffer area using the most current aerial photography, the latest at the time of writing being 17th October 2021 available from Nearmap at http://maps.au.nearmap.com/. Note that imagery from 18th April 2020 is also used in some Figures as background as it has less shadow; and
- Visiting and traversing some areas on foot. Such close inspection was undertaken in the bushland immediately to the east and south of the site in Cumberland State Forest lands.

The buffer is dominated by an urban complex of residential and commercial development, with major roadways in the north (Castle Hill Road), east (Pennant Hills Road), and south (M2 Motorway). Residential development is comprised of small to medium lots, and commercial areas include small community shopping districts.

The most significant area of vegetation in the buffer area (other than that on the development lot) is in Cumberland State Forest, immediately to the east. This is made up of natural and planted vegetation and is a managed forest. Other than this area, the extent and pattern of bushland in the buffer region is typical of this part of The Hills LGA, being largely restricted to creek lines and gullies. It includes the heads of gullies within the Bidjigal Reserve and George Thornton Reserve to the south west (based on Darling Mills Creek and Bellbird Creek respectively), gully vegetation in Currawong Reserve to the south (based on Bellamys Creek), and the top of the gullies of the Berowra Valley National Park to the north east (based on Berowra Creek and Nyrippin Creek). Small patches of ridge top vegetation occur in Koala Park and West Pennant Hills Park closer to the development lot to the east and north east.

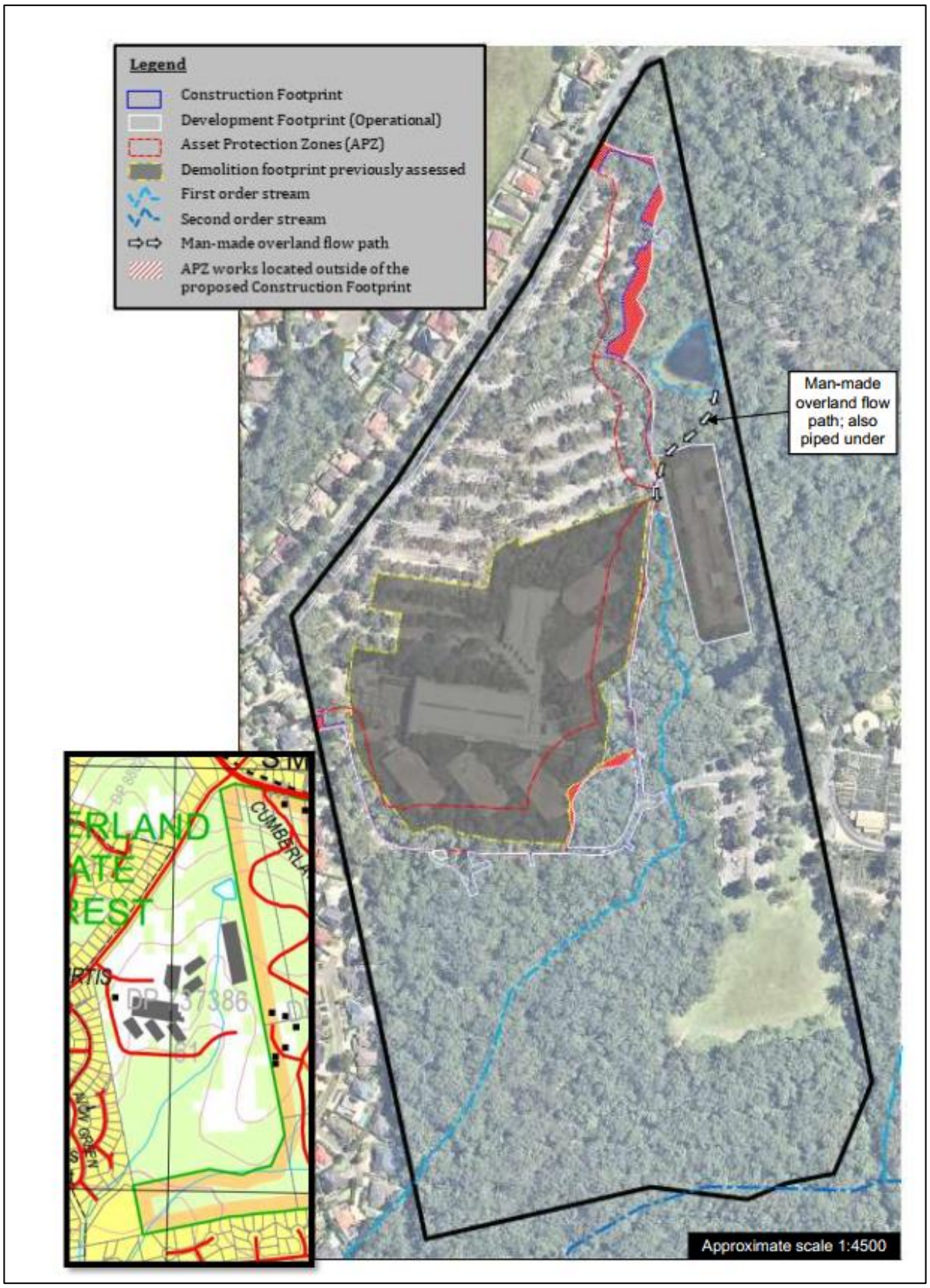

Figure 4 : Site Map (as described in Section 4.2 of the BAM) and the proposed development footprint (white outline), including construction footprint (blue outline) and Asset Protection Zones (red outline). Inset: extract from 9130-4S Hornsby topographic map.

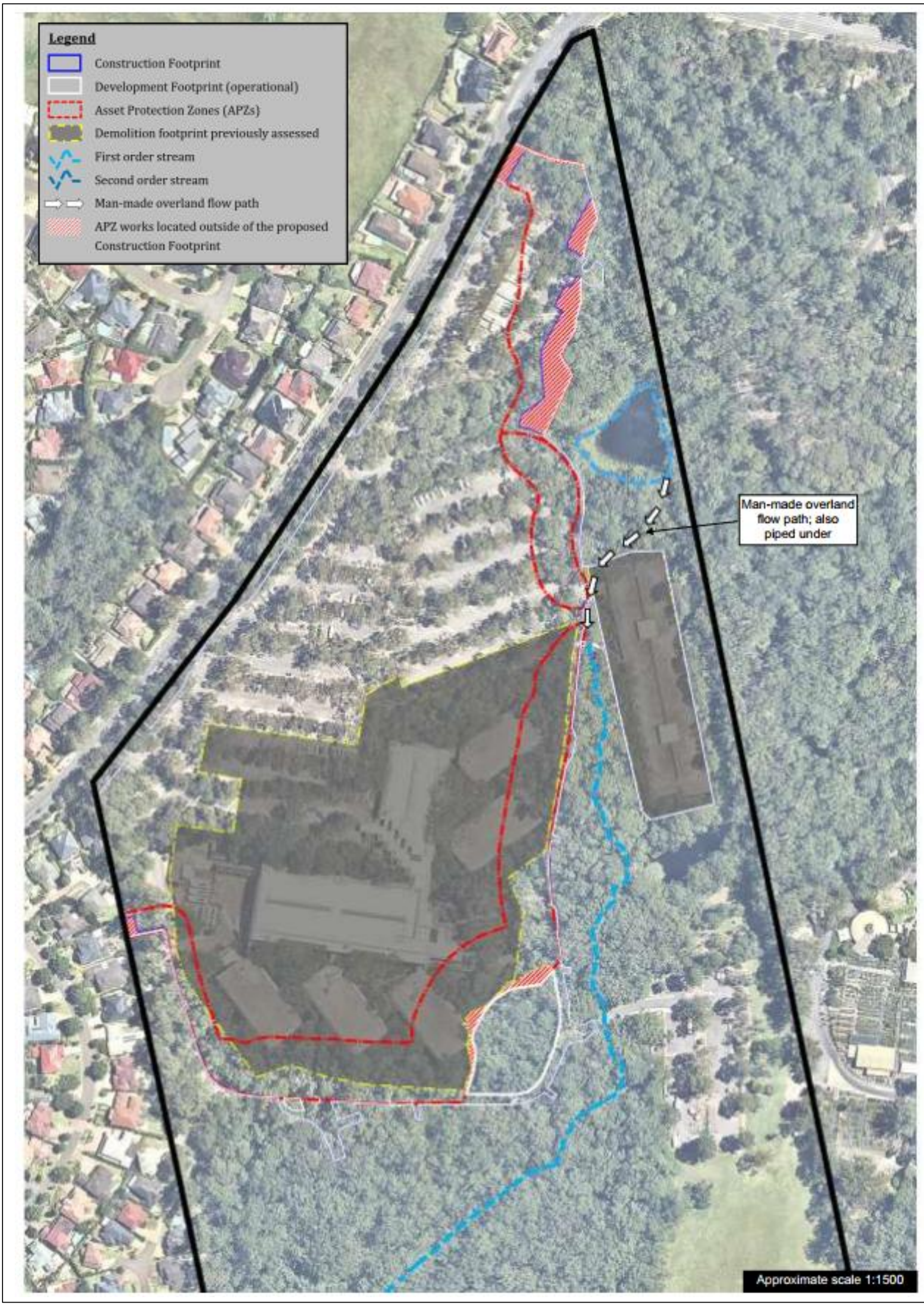

Figure 5: Location Map (A3 paper size).

INSET: Mapped native vegetation within the buffer area (red) per mapping produced by OEH (2016), Hornsby Shire Council (2008) and The Hills Shire Council (2008).

LEGEND OF MAPPED FEATURES

- Subject land
- 1.5 km buffer
- Movement corridor
- First order stream
- Second order stream
- Third order stream

LANDSCAPE FEATURES NOT MAPPED

IBRA Region: Sydney Basin

Subregion: Cumberland

NSW Landscape: Pennant Hills Ridges

Soil Hazard: none

Wetlands: none

Karsts, caves, cliffs: none

AOBV: none

Figure 6 : Map of the landscape features in the 1.5 km buffer.

Otherwise, native vegetation is highly fragmented, and restricted to occasional and isolated trees planted along street verges and in the larger gardens. Undoubtedly a significant proportion of the native trees evident in the urbanised parts is planted.

Native vegetation within the buffer area occurs on both private and public lands, and occupies approximately 23.2% (or 269.54 hectares) of the total buffer area (1,162.08 hectares). The percent native vegetation cover in the buffer area is therefore assigned to the cover class of >10% to 30%. Note that this may be an overestimate as it includes 71.95 hectares identified as "Urban: Native / Exotic".

The project area is wholly within the Sydney Basin IBRA bioregion, and the Cumberland IBRA subregion. The site is also entirely within the NSW Mitchell Landscape Pennant Hills Ridges, with the Port Jackson Mitchell Landscape occurring on the lower slopes to the south.

The Sydney Basin IBRA Bioregion[1] occupies over 3.6 million hectares and extends from just north of Batemans Bay to Nelson Bay on the central coast, and almost as far west as Mudgee. It includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems, all of the smaller catchments of Lake Macquarie, Lake Illawarra, Hacking, Georges and Parramatta Rivers, and smaller portions of the headwaters of the Clyde and Macquarie rivers.

The Cumberland IBRA subregion[2] contains low rolling hills and wide valleys in areas of rain shadows below the Blue Mountains on Triassic Wianamatta shales and sandstones. It has intrusions by small volcanic vents that are partly covered by tertiary river gravels and sands, with quaternary alluvial soils occurring along the main streams.

Soils are typically red and yellow with brown clays on volcanics. At least three terrace levels are evident in gravel splays with volcanics occurring from low hills in shale landscapes. Swamps and lagoons occur in floodplain areas of the Nepean River.

Vegetation is typically divided by soil influences. *Eucalyptus moluccana* Grey Box, *Eucalyptus tereticornis* Forest Red Gum, *Eucalyptus crebra* Narrow-leaved Ironbark woodland with some *Corymbia maculata* Spotted Gum occurs on rolling shale hills. *Eucalyptus sclerophylla* Hard-leaved Scribbly Gum, *Angophora floribunda* Rough-barked Apple and *Banksia serrata* Old Man Banksia occur on alluvial sands and gravels. *Angophora subvelutina* Broad-leaved Apple, *Eucalyptus amplifolia* Cabbage Gum, and *Eucalyptus tereticornis* Forest Red Gum with abundant *Casuarina glauca* Swamp Oak occur on river flats, with tall rushes and *Eucalyptus parramattensis* Parramatta Red Gum in lagoons and swamps.

The Pennant Hills Ridges Mitchell Landscape[3] occurs on rolling to moderately steep hills on horizontal shales and siltstones with an elevation between 10 metres to 90 metres ASL and a local relief of 60 metres ASL. Soils consist of deep red textured soils on narrow hillcrests with red to

[1] Sydney Basin Bioregion, at http://www.environment.nsw.gov.au/bioregions/SydneyBasinBioregion.htm
[2] Sydney Basin – subregions, at http://www.environment.nsw.gov.au/bioregions/SydneyBasin-Subregions.htm
[3] Department of Environment and Climate Change NSW (2002) Descriptions for NSW (Mitchell) landscapes, version 2, based on descriptions compiled by Dr. Peter Mitchell.

brown, yellow soils on slopes and becoming harsher in drainage areas.

Vegetation is generally made up of tall open forest comprising *Eucalyptus saligna* Sydney Blue Gum, *Syncarpia glomulifera* Turpentine, *Eucalyptus pilularis* Blackbutt, *Eucalyptus globoidea* White Stringybark, *Eucalyptus paniculata* Grey Ironbark, *Angophora floribunda* Rough-barked Apple, and *Allocasuarina torulosa* Forest Oak. Rainforest elements - including *Pittosporum undulatum* Sweet Pittosporum, *Glochidion ferdinandi* Cheese Tree, *Ficus coronata* Sandpaper Fig and *Callicoma serratifolia* Black Wattle - occur in the heads of protected moist gullies.

Rivers and streams recognised under the *Water Management Act 2010* are those shown as blue lines on 1:25,000 topographic maps. The significance of the streams and the protections they attract are determined by their stream order, according to the Strahler system. In essence, this is defined by the number and types of upper branches.

Within the buffer area of the development site there are a number of mapped streams, and their orders have been determined by inspection of the 9130-4S Hornsby 1:25,000 topographic map.

The development lot is mapped as containing a first order stream running from an existing dam in the north of the site to the south and south west, before joining Bellamys Creek, approximately 475 metres downslope of the lot. However, detailed investigations of the site's hydrology revealed that the upper parts of the first order stream mapped in the 1:25,000 topographic map are actually constructed, with overflow from the dam reaching the natural part of the gully via pipes and overland flow on a fill slope.

Overflow from a second dam located on the southern side of the multi storey car park is fed into this gully via overland flow down a series of concrete terraces. Stormwater collected from the existing IBM development is also fed into this gully via the detention basin that has been constructed on the southern side of the ring road.

A natural second order stream runs along the southern boundary of the site, arising in the adjacent Cumberland State Forest.

There are no wetlands within the buffer area or otherwise nearby recognised under the *State Environmental Planning Policy Coastal Management 2018*.

The nearest Wetlands of National Significance are the Newington Wetlands and Bicentennial Park Wetlands, 9 kilometres to the south east on the Parramatta River.

The more connected that habitats are, the more valuable they are to biodiversity. This is partially a result of a larger area of habitat being available, which may support more individuals simply due to its greater size. However, a larger area of habitat may also provide for a more diverse suite of species, due to the chance of it supporting a greater diversity of habitat niches. Larger areas may also cater for species that require large home ranges, such as owls.

Linked habitats also provide movement corridors for dispersing young or plant propagules, or for refuge from catastrophic events such as fire. This is particularly so for species that have limited

mobility, such as snails or some plants.

Separated patches of habitat also have value as "stepping stones" for highly mobile species such as birds and bats.

The buffer area is overwhelmingly an urban landscape, with major barriers to movement of fauna and flora in the expanses of residential areas and major roads. The vegetated parts of the development lot and the adjacent Cumberland State Forest contain the most valuable areas for biodiversity by virtue of their size and diversity of habitats contained therein. Otherwise, direct connectivity of habitats is provided by narrow corridors of vegetation concentrated in riparian zones.

Information regarding soils and geology is maintained in a number of spatial databases, including SEED, eSPADE 2.0, and within the local council mapping. The available data are sourced mainly from the NSW Soil and Land Information System (SALIS) and includes soil hazards and soil landscape mapping.

The available soil landscape mapping of the Sydney 1:100,000 map sheet reveals the underlying patterns of geology and landform, and also describes the vegetation and land uses it supports.[4]

The subject lot is located on the upper slopes of a south-facing ridge. It contains a narrow band of West Pennant Hills soil landscape at the top, with Glenorie soil landscape across the remaining majority of the site down the slope, up to and including the creek line at its southern boundary.

The **West Pennant Hills** soil landscape is a stable colluvium soil type that occurs as steep, narrow, south-west facing hill slopes on the Hornsby plateau. It is is underlain by Wianamatta Group shales that give rise to friable clay loams.

Typical topography is steep-sided slopes generally greater than 20% and ranging up to 40%. This steep topography combined with the clay-loam soil gives rise to major limitations of the hazards of mass movement, soil erosion, localises seasonal waterlogging, and impermeable subsoil.

Natural vegetation on this soil landscape is tall open wet sclerophyll forest characterised by *Eucalyptus saligna* Sydney Blue Gum and *Eucalyptus pilularis* Blackbutt with other common species including *Syncarpia glomulifera* Turpentine, *Eucalyptus paniculata* subsp. *paniculata* Grey Ironbark and *Eucalyptus globoidea* White Stringybark. This vegetation has been extensively cleared, with the tall forests of the shale soils on the Hornsby Plateau being exploited by Europeans in the early days of the colony for the building of Sydney town.

The **Glenorie** soil landscape is an erosional soil landscape that occurs generally north of the Parramatta River on the Hornsby Plateau and is underlain by Wianamatta Group shales. Typical topography includes undulating to low rolling hills that support tall open-forest, most of which has been extensively cleared. It is often adjacent to West Pennant Hills soil landscape and contains

[4] Chapman and Murphy (1989) Soil landscapes of the Sydney 1:100,000 sheet.

similar soil materials. However, Glenorie soil landscape is less steep, and is not subject to mass movement.

The vegetation on this soil landscape is characteristically dominated by *Eucalyptus saligna* Sydney Blue Gum and *Eucalyptus pilularis* Blackbutt, although other species are common such as *Syncarpia glomulifera* Turpentine and *Eucalyptus paniculata* subsp. *paniculata* Grey Ironbark, *Eucalyptus globoidea* White Stringybark and *Angophora floribunda* Rough-barked Apple.

There are no areas of formally or informally recognised geological significance within the buffer area or on the development lot.

At the time of writing, declared Areas of Outstanding Biodiversity Values (AOBVs) are confined to those already declared as Critical Habitat under the *Threatened Species Conservation Act 1995*, being:

- Cabbage Tree Island, critical breeding habitat for Gould's Petrel near Port Stephens;
- Manly Cove, critical breeding habitat for Little Penguins;
- Stotts Island Nature Reserve, critical habitat for Mitchell's Rainforest Snail near Murwillumbah; and
- All known extant areas of the Wollemi Pine and the surrounding habitat in the catchment, occupying some 5,000 hectares within Wollemi National Park.

No areas of outstanding biodiversity value declared under the *Biodiversity Conservation Act 2016* occur within or near the site.

3 NATIVE VEGETATION

3.1 Sampling

This BDAR assessing the development footprint is part of a larger study across the subject lot that began in 2015. An initial desktop analysis was undertaken for the entire subject lot as well as for bushland in adjacent lands to help define the scope of on-ground assessment and survey. Preliminary site inspections and analyses of aerial photography followed, and these data were used to determine sampling locations across the subject lot and provide advice to the owner regarding the ecological constraints to the redevelopment of the site and opportunities and obligations for conservation action.

Floristic sampling occurred in all seasons over a 5-year period from September 2015 to April 2020. Vegetation zones were defined through sampling by extensive random meander, rapid data points (where dominant species in each structural layer were recorded), and full floristic quadrats and transects in accordance with the BAM, with at least one BAM plot located in each of the identified vegetation zones (see Figures 7 and 8).

It is noteworthy that plots were not all located randomly and therefore not strictly in accordance with the BAM methodology. This was due to the landscaped areas being generally too small to accommodate the 20 x 50 metre plot, and so plots were located in garden areas of sufficient size.

Data sheets for the relevant BAM plots used to assess the proposal (3, 10, 12, and 16) are provided at Tables 1 to 4.

The tree data collected by the Project Arborist were also used to supplement the floristic data collected in the BAM plots. These data were of particular assistance in determination of the presence of planted native vegetation.

Sampling was intended to:

- Compile a comprehensive species list;
- Determine boundaries of PCTs and vegetation zones;
- Identify the condition of vegetation across the site;
- Identify indicator species for the vegetation communities;
- Better understand the context of the development site's vegetation and habitats by inspection of surrounding areas;
- Determine the extent of locally native trees that have likely been planted within the existing IBM site;
- Identify threatening processes; and
- Understand the habitat features of the development site and its relationship with surrounding lands.

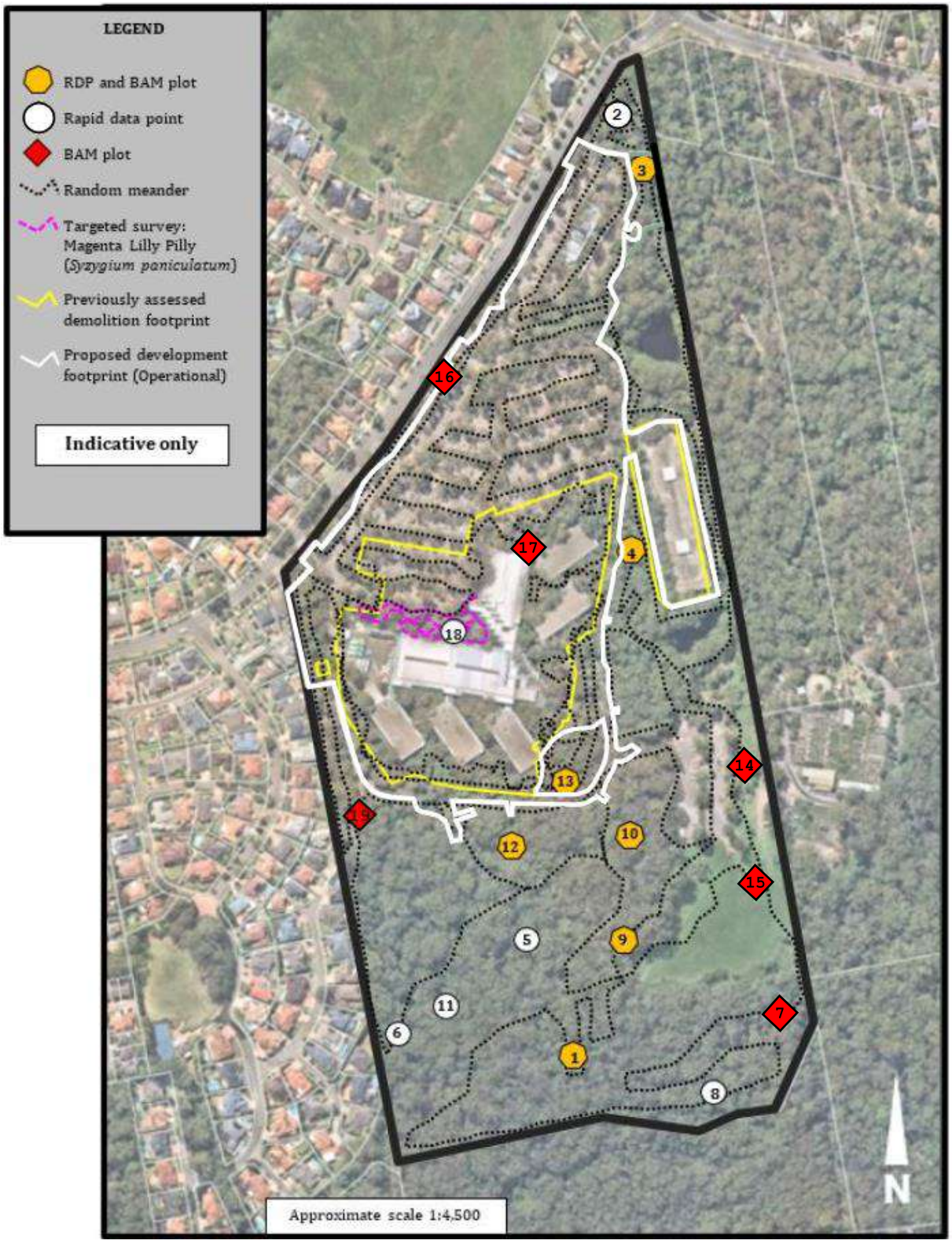

Figure 7: Floristic surveys undertaken across the subject lot (black outline) and within the development footprint (white outline).

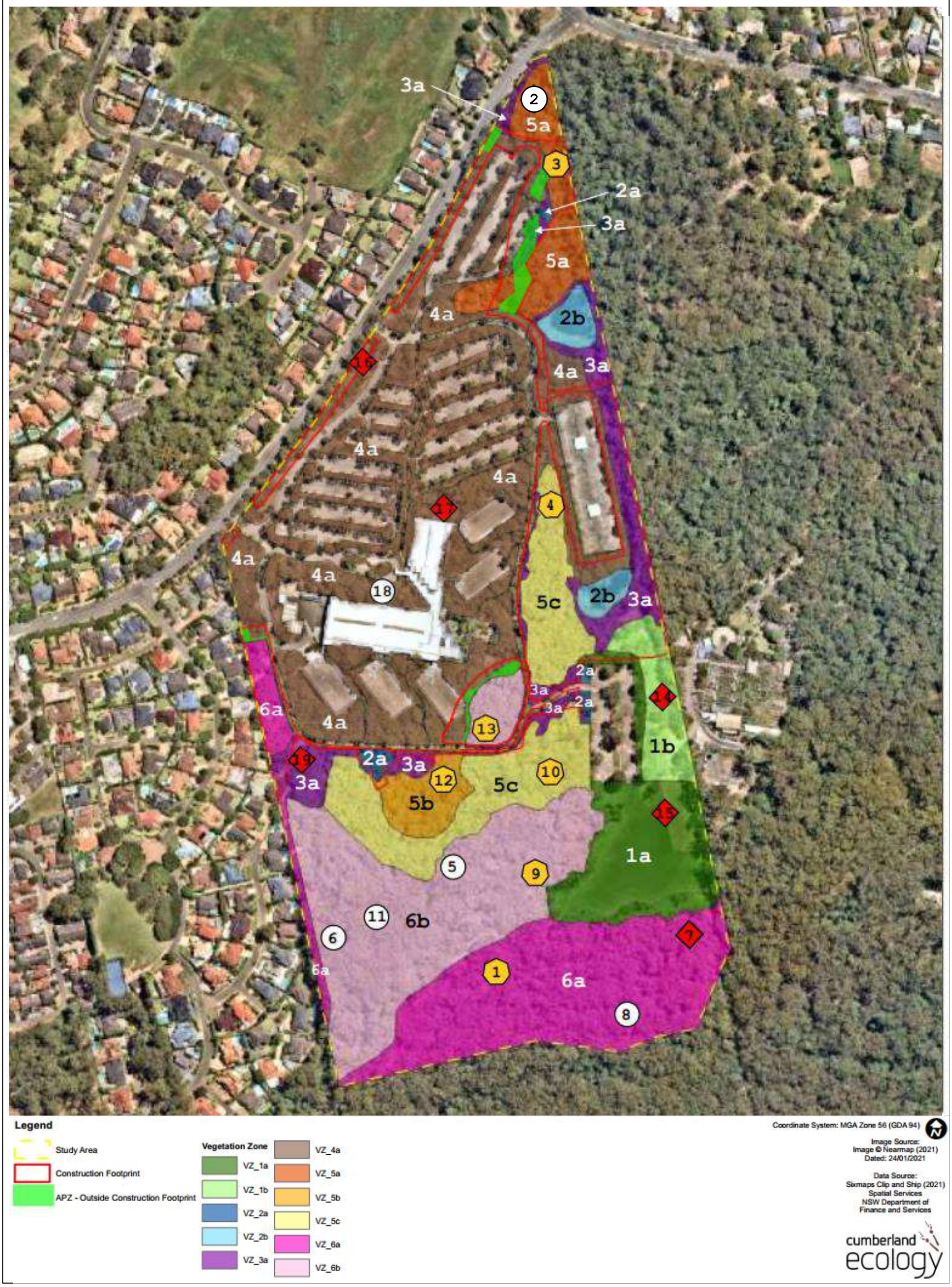

Figure 8: Vegetation Zones and vegetation plots in relation to the footprint.

Table 1 (T_PTP): Primary Plot data sheet for Vegetation Zone 3a.

Date	GPS	Survey Name		Plot identifier	Recorders
21.05.2022		55 Coonara Ave, West Pennant Hills		BAM19_VZ3a	E. Ashby
Zone 56	**Datum** GDA2020	**IBRA region** Sydney Basin	**IBRA subregion** Cumberland	**Photo#** 20220521_141739	**Zone ID** VZ3_a
Easting 317878	**Northing** 6264319	**Dimensions** 20m x 50m	**Mitchell landscape:** Pennant Hills Ridges	**Orientation of midline from 0m point:** 170⁰	
Vegetation Class					**Confidence** H M L
Plant Community Type (PCT)					**Confidence** H M L
EEC / CEEC	N/A				**Confidence** H M L

Record easting and north from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (shape) of 0.04ha base plot inside 0.1ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute	(400m² plot)	# of spp
Count of Native richness (composition)	Trees	7
	Shrubs	2
	Grasses etc	3
	Forbs	6
	Ferns	1
	Other	4
Sum of cover of native vascular plants by growth form group (Structure)	**Sum of cover (%)**	
	Trees	146.1
	Shrubs	5.1
	Grasses etc	25.3
	Forbs	7.9
	Ferns	0.1
	Other	0.4
High Threat Weed cover		25.7

Function (woody veg only. Palms are not trees)					
BAM Attribute (20x50m plot)		#Tree stems count			Record number of **living** eucalypt (Euc*) and **living** non-eucalypt (Non Euc) stems separately.
DBH		Euc*	Non euc	Hollows[D]	
Large trees for Euc* & Non Euc	80+cm	0	0	0	*includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*.
	50-79cm	4	0	0	
30 – 49cm		4	0	0	[D] Record total number of trees with hollows by size class with hollows (including dead stems/trees).
20 – 29cm		4	0	0	
10 – 19cm		10	4	0	
5 – 9cm		6	2	0	
<5cm		0	0	0	[D] = Dead tree/stag
Length of logs (m) (≥10cm diameter and >50cm in length)		45 metres – includes logs used as garden edging		Natural regen?	Yes / No
				Rocky outcrop?	Yes / No

Counts must apply to each size when the **number of living tree stems** within the size class is ≤ 10.
Estimates can be used when the number of living tree stems within a class is ≥ 10. Estimates should draw from the number of series 10, 20, 30…100, 200,300.
For a **multi-stemmed tree,** only the largest living stem is included in the count/estimate.
For **hollows,** count only the presence of a stem containing hollow, not the count of hollows in that stem.

BAM Attribute (1x1m plots)	Litter cover (%)					Bare ground cover (%)				Cryptogram cover (%)					Rock cover (%)				
Subplot score (% in each)	2	20	5	35	50														
Average of the 5 subplots	22.4																		

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots located on alternate sides and 5m from the plot midline at the locations 5, 15, 25, 35 and 45m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10cm in diameter). Within these 1m x 1m plots assessors may also record the cover of rock, bare ground and cryptogram soil crusts. Collection of these data is optional – the data do not currently contribute to assessment scores. They hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Plot disturbance	Severity code	Age code	Observational evidence
Clearing (incl. logging)			Present
Cultivation (incl. pasture)			
Soil erosion			Present
Firewood collection			
Grazing			
Fire damage			
Storm damage			
Weediness			Present
Other			Previously used as site depot, currently used for access to southern part of site

KEYSTONE ECOLOGICAL

Date: 21.05.2022 | **Recorders:** E. Ashby | **Survey Name** 55 Coonara Ave, West Pennant Hills | **Plot Identifier** BAM19_VZ3a | **Site sheet no.** 2 of 2

#	(native only. Leave blank for weeds) GF Code	BAM GF code	*Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable. Circle top 3 species in each layer.*	N, E or HTW	Cover (%)	Abund (stem count)	Stratum	Sample collect
1	E	EG	*Nephrolepis cordifolia*	N	0.1			
2	F	FG	*Commelina cyanea*	N	5			
3	F	FG	*Dichondra repens*	N	2			
4	F	FG	*Einadia hastata*	N	0.1			
5	F	FG	*Geranium homeanum*	N	0.2			
6	F	FG	*Plectranthus parviflorus*	N	0.5			
7	F	FG	*Tetragonia tetragonioides*	N	0.1			
8	D	GG	*Cynodon dactylon*	N	0.2			
9	R	GG	*Lomandra longifolia*	N	0.1			
10	D	GG	*Oplismenus aemulus*	N	25			
11	L	OG	*Cayratia clematidea*	N	0.1			
12	L	OG	*Clematis aristata*	N	0.1			
13	O	OG	*Eustrephus latifolius*	N	0.1			
14	S	SG	*Homalanthus populifolius*	N	0.1			
15	S	SG	*Pittosporum undulatum*	N	5			
16	T	TG	*Allocasuarina littoralis*	N	5			
17	T	TG	*Eucalyptus fibrosa*	N	30			
18	T	TG	*Eucalyptus microcorys*	N	40			
19	T	TG	*Eucalyptus paniculata*	N	20			
20	T	TG	*Eucalyptus saligna*	N	50			
21	T	TG	*Glochidion ferdinandi*	N	0.1			
22	T	TG	*Syncarpia glomulifera*	N	1			
23	P	OG	*Cordyline sp.*	N?	0.1			
24			*Araujia sericifera*	E, HTW	0.1			
25			*Asparagus aethiopicus*	E, HTW	0.2			
26			*Bidens pilosa*	E, HTW	0.1			
27			*Cyperus eragrostis*	E, HTW	0.2			
28			*Ehrharta erecta*	E, HTW	5			
29			*Lantana camara*	E, HTW	5			
30			*Ligustrum lucidum*	E, HTW	6			
31			*Ligustrum sinense*	E, HTW	1			
32			*Olea europaea subsp. cuspidata*	E, HTW	8			
33			*Solanum seaforthianum*	E, HTW	0.1			
34			*Agapanthus praecox*	E	0.1			
35			*Cerastium glomeratum*	E	0.1			
36			*Dietes bicolor*	E	0.1			
37			*Eleusine indica*	E	0.2			
38			*Fumaria muralis*	E	0.1			
39			*Modiola caroliniana*	E	0.1			
40			*Oxalis bowiei*	E	0.1			
41			*Oxalis latifolia*	E	0.1			
42			*Phyllanthus tenellus*	E	0.2			
43			*Rumex sagittatus*	E	0.2			
44			*Sida rhombifolia*	E	0.1			
45			*Sisymbrium officinale*	E	0.1			
46			*Solanum nigrum*	E	0.1			
47			*Soliva pterosperma*	E	0.1			
48			*Syagrus romanzoffiana*	E	0.1			
49			*Taraxacum officinale*	E	0.1			
50			*Trifolium repens*	E	0.1			

GF Codes:** First letter represents GF code; code in bracket (e.g. (SG)) represents the BAM code for the calculator. **Circle if in Top 3 of layer.
A: Cycad (OG); **C:** Chenopod (SG); **D:** Other Grass (GG); **E:** Ferns (EG); **F:** Forb (FG); **G:** Tussock Grass (GG); **H:** Hummock Grass (GG); **K:** Epiphyte (OG); **L:** Vine (OG); **M:** Mallee Tree (TG); **P:** Palm (OG); **Q:** Tree Fern (OG); **R:** Rush (GG): **S:** Shrub (SG); **T:** Tree (TG); **V:** Sedge (GG); **X:** Xanthorrhoea (OG); **Y:** Mallee Shrub (SG); **Z:** Heath Shrub (SG)
N, E, HTW: N: native; **E:** exotic; **HTW:** high threat weed.
Cover: 0.1, 0.2, 0.3…1, 2, 3,…10, 15, 20, 25,…100% (foliage cover); **Note:** 0.1% cover represents approximately 63cm x 63cm or a circle about 71cm diameter. 0.1% cover is the lowes allowed – this may be an over estimate of the actual cover. 0.5% cover represents an area of approximately 1.4m x 1.4m, and 1% cover = 2m x 2m, 5% = 4m x 5x, 25% = 10m x 10m.
Abundance: 1, 2, 3,….10, 20, 30,….100, 200,….1000, … **grass abundance:** count fractional unit, i.e. runner = one plant. Abundance of 200 – 1000 has no effect in BAM calculator.
Stratum: T1: Upper (20m+); **T2:** Upper (15-20m); **T3:** Trees (10-15m); **S1:** Small trees (5-10m); **S2: Shrubs (≤5m); L1: ground (≤1m); L2:** Lower ground (≤0.5m)

Table 2 (T_PTP): Primary Plot data sheet for Vegetation Zone 5a.

Date	GPS	Survey Name		Plot identifier	Recorders
12.06.2019		Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills		BAM3_VZ5a	EA, AM
Zone 56	**Datum** GDA94	**IBRA region** Sydney Basin	**IBRA subregion** Cumberland	**Photo#**	**Zone ID** VZ_3a
Easting 318114	**Northing** 6264864	**Dimensions** 20x20m/20x50m	**Mitchell landscape:** Pennant Hills Ridges	**Orientation of midline from 0m point:** 345°	
Vegetation Class		North Coast Wet Sclerophyll Forests (Wet Sclerophyll forests (Shrubby sub formation))			**Confidence** H M L
Plant Community Type (PCT)		1237 Blue Gum High Forest			**Confidence** H M L
EEC / CEEC		Blue Gum High Forest			**Confidence** H M L

Record easting and north from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (shape) of 0.04ha base plot inside 0.1ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute	(400m² plot)	# of spp
Count of Native richness (composition)	Trees	8
	Shrubs	2
	Grasses etc	2
	Forbs	2
	Ferns	2
	Other	5
Sum of cover of native vascular plants by growth form group (Structure)	**Sum of cover (%)**	
	Trees	37.6
	Shrubs	1.5
	Grasses etc	0.3
	Forbs	0.2
	Ferns	7
	Other	70.3
High Threat Weed cover		91.5

Function (woody veg only, Palms are not trees)					
BAM Attribute (20x50m plot)		#Tree stems count			Record number of living eucalypt (Euc*) and living non-eucalypt (Non Euc) stems separately.
DBH		Euc*	Non euc	Hollows+	
Large trees for Euc* & Non Euc	80+cm	-			*includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*.
	50-79cm	1			
30 – 49cm		✓			+ Record total number of trees with hollows by size class with hollows (including dead stems/trees).
20 – 29cm		✓			
10 – 19cm		✓			
5 – 9cm		-			
<5cm		-			D = Dead tree/stag
Length of logs (m) (≥10cm diameter and >50cm in length)		60m		Natural regen?	Yes / No
				Rocky outcrop?	Yes / No

Counts must apply to each size when the **number of living tree stems** within the size class is ≤ 10.
Estimates can be used when the number of living tree stems within a class is ≥ 10. Estimates should draw from the number of series 10, 20, 30…100, 200,300.
For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate.
For **hollows**, count only the presence of a stem containing hollow, not the count of hollows in that stem.

BAM Attribute (1x1m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogram cover (%)					Rock cover (%)				
Subplot score (% in each)	92	95	99	85	82															
Average of the 5 subplots	90.6																			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots located on alternate sides and 5m from the plot midline at the locations 5, 15, 25, 35 and 45m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10cm in diameter). Within these 1m x 1m plots assessors may also record the cover of rock, bare ground and cryptogram soil crusts. Collection of these data is optional – the data do not currently contribute to assessment scores. They hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological type		**Landform element**		**Landform pattern**		**Microrelief**	
Lithology		**Soil surface texture**		**Soil colour**		**Soil depth**	
Slope		**Aspect**		**Site drainage**		**Distance to nearest water and type**	

Plot disturbance	Severity code	Age code	Observational evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil erosion	1	R/NR	
Firewood collection			
Grazing			
Fire damage			
Storm damage	2	R	
Weediness	2	R/NR	
Other	2	NR	Fill – soils pushed / moved for existing development

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe **Age:** R = recent (<3yrs); NR = not recent (3-10yrs); O = Old (>10yrs)

KEYSTONE ECOLOGICAL	Date: 12.06.2019	Survey Name	Plot Identifier	Site sheet no.
	Recorders: EA, AM	Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills	BAM3_VZ5a	2

#	(native only. Leave blank for weeds) GF Code	BAM GF code	*Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable. Circle top 3 species in each layer.*	N, E or HTW	Cover (%)	Abund (stem count)	Stratum	Sample collect
1	-	-	*Lantana camara* Lantana	E	80			
2	TG	Tree	*Glochidion ferdinandi* Cheese Tree	N	0.1			
3	-	-	*Ligustrum lucidum* Large-leaved Privet	HTW	40			
4	OG	Other	*Morinda jasminoides*	N	10			
5	SG	Shrub	*Pittosporum undulatum* Sweet Pittosporum	N	1			
6	SG	Shrub	*Polyscias sambucifolia*	N	0.5			
7	-	-	*Ligustrum sinense* Small-leaved Privet	HTW	40			
8	-	-	*Ehrharta erecta*	HTW	1			
9	GG	Grass	*Oplismenus aemulus*	N	0.2			
10	OG	Other	*Glycine clandestina*	N	0.1			
11	-	-	*Lonicera japonica* Japanese Honeysuckle	HTW	0.2			
12	-	-	*Veronica* sp.	E	0.1			
13	-	-	*Rubus* sp. agg Blackberry	HTW	0.2			
14	TG	Tree	*Eucalyptus saligna* Sydney Blue Gum	N	30			
15	FG	Forb	*Dichondra repens* Kidney Weed	N	0.1			
16	OG	Other	*Eustrephus latifolius* Wombat Berry	N	60			
17	-	-	*Passiflora* sp.	E	0.1			
18	-	-	*Stephania japonica*	E	0.2			
19	-	-	*Solanum mauritianum*	E	1			
20	-	-	*Asparagus aethiopicus*	HTW	10			
21	-	-	*Araujia sericifera* Moth Vine	E	0.2			
22	-	-	*Syagrus romanzoffiana* Cocos Palm	E	0.1			
23	TG	Tree	*Tristaniopsis laurina* Water Gum	N	0.1			
24	-	-	*Cordyline* sp.	E	0.2			
25	FB	Forb	*Dianella caerulea* Flax Lily	N	0.1			
26	EG	Fern	*Pteridium esculentum* Bracken	N	2			
27	OG	Other	*Pandorea pandorana*	N	0.1			
28	EG	Fern	*Doodia aspera*	N	5			
29	TG	Tree	*Alphitonia excelsa*	N	2			
30	TG	Tree	*Eucalyptus paniculata*	N	1			
31	TG	Tree	*Brachychiton acerifolius* Illawarra Flame Tree	N	1			
32	TG	Tree	*Acacia elata*	N	3			
33	TG	Tree	*Eucalyptus* sp.	N	0.4			
34	GG	Grass	*Lomandra longifolia*	N	0.1			
35	-	-	*Ochna serrulata*	HTW	0.1			
36	OG	Other	*Cayratia clematidea* Native Grape	N	0.1			
37								
38								
39								
40								
41								
42								
43								
44								
45								

GF Codes: *First letter represents GF code; code in bracket (e.g. (SG)) represents the BAM code for the calculator.* ***Circle if in Top 3 of layer.***

A: Cycad (OG); **C:** Chenopod (SG); **D:** Other Grass (GG); **E:** Ferns (EG); **F:** Forb (FG); **G:** Tussock Grass (GG); **H:** Hummock Grass (GG); **K:** Epiphyte (OG); **L:** Vine (OG); **M:** Mallee Tree (TG); **P:** Palm (OG); **Q:** Tree Fern (OG); **R:** Rush (GG); **S:** Shrub (SG); **T:** Tree (TG); **V:** Sedge (GG); **X:** Xanthorrhoea (OG); **Y:** Mallee Shrub (SG); **Z:** Heath Shrub (SG)
N, E, HTW: N: native; **E:** exotic; **HTW:** high threat weed.
Cover: 0.1, 0.2, 0.3…1, 2, 3,…10, 15, 20, 25,….100% (foliage cover); **Note:** 0.1% cover represents approximately 63cm x 63cm or a circle about 71cm diameter. 0.1% cover is the lowest allowed – this may be an over estimate of the actual cover. 0.5% cover represents an area of approximately 1.4m x 1.4m, and 1% cover = 2m x 2m, 5% = 4m x 5x, 25% = 10m x 10m.
Abundance: 1, 2, 3,….10, 20, 30,….100, 200,….1000, … **grass abundance**: count fractional unit, i.e. runner = one plant. Abundance of 200 – 1000 has no effect in BAM calculator.
Stratum: T1: Upper (20m+); **T2:** Upper (15-20m); **T3:** Trees (10-15m); **S1:** Small trees (5-10m); **S2:** Shrubs (≤5m); **L1:** ground (≤1m); **L2:** Lower ground (≤0.5m)

Table 3 (T_PTP): Primary Plot data sheet for Vegetation Zone 5c.

Date	GPS	Survey Name		Plot identifier	Recorders
28.04.2020		Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills		BAM10_VZ5c	EA, AM
Zone 56	**Datum** GDA94	**IBRA region** Sydney Basin	**IBRA subregion** Cumberland	**Photo#**	**Zone ID** VZ_5c
Easting 318103	**Northing** 6264282	**Dimensions** 20x20m/20x50m	**Mitchell landscape:** Pennant Hills Ridges	**Orientation of midline from 0m point:** 60⁰	
Vegetation Class		North Coast Wet Sclerophyll Forests (Wet Sclerophyll forests (Shrubby sub formation))			**Confidence** H M L
Plant Community Type (PCT)		1237 Blue Gum High Forest			**Confidence** H M L
EEC / CEEC		Blue Gum High Forest			**Confidence** H M L

Record easting and north from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (shape) of 0.04ha base plot inside 0.1ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute	(400m² plot)	# of spp
Count of Native richness (composition)	Trees	4
	Shrubs	8
	Grasses etc	4
	Forbs	0
	Ferns	0
	Other	6
Sum of cover of native vascular plants by growth form group (Structure)	Sum of cover (%)	
	Trees	92.6
	Shrubs	10.4
	Grasses etc	16.1
	Forbs	0
	Ferns	0
	Other	49.1
High Threat Weed cover		6.3

Function (woody veg only, Palms are not trees)					
BAM Attribute (20x50m plot)		#Tree stems count			Record number of living eucalypt (Euc*) and living non-eucalypt (Non Euc) stems separately.
DBH		Euc*	Non euc	Hollows^	
Large trees for Euc* & Non Euc	80+cm				*includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*.
	50-79cm	2			
30 – 49cm		✓			^ Record total number of trees with hollows by size class with hollows (including dead stems/trees).
20 – 29cm					
10 – 19cm		✓			
5 – 9cm		✓			
<5cm		✓			ᴰ = Dead tree/stag
Length of logs (m) (≥10cm diameter and >50cm in length)		25m		Natural regen?	Yes / No
				Rocky outcrop?	Yes / No

Counts must apply to each size when the **number of living tree stems** within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is ≥ 10. Estimates should draw from the number of series 10, 20, 30...100, 200,300.
For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate.
For **hollows**, count only the presence of a stem containing hollow, not the count of hollows in that stem.

BAM Attribute (1x1m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogram cover (%)					Rock cover (%)				
Subplot score (% in each)	90	70	95	50	40															
Average of the 5 subplots	69																			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots located on alternate sides and 5m from the plot midline at the locations 5, 15, 25, 35 and 45m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10cm in diameter). Within these 1m x 1m plots assessors may also record the cover of rock, bare ground and cryptogram soil crusts. Collection of these data is optional – the data do not currently contribute to assessment scores. They hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope	Very steep (>30 degrees)	Aspect		Site drainage		Distance to nearest water and type	

Plot disturbance	Severity code	Age code	Observational evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil erosion			
Firewood collection			
Grazing			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe

Age: R = recent (<3yrs); NR = not recent (3-10yrs); O = Old (>10yrs)

KEYSTONE ECOLOGICAL	Date: 28.04.2020	Survey Name	Plot Identifier	Site sheet no.
	Recorders: EA, AM	Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills	BAM10_VZ5c	2

#	(native only. Leave blank for weeds) GF Code	BAM GF code	*Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable. Circle top 3 species in each layer.*	N, E or HTW	Cover (%)	Abund (stem count)	Stratum	Sample collect
1		Other	*Parsonsia straminea* Common Silkpod	N	1			
2		Other	*Pandorea pandorana* Wonga Vine	N	5			
3		Shrub	*Denhamia silvestris*	N	0.1			
4		Grass	*Lepidosperma laterale* Variable Sword-sedge	N	0.1			
5		Shrub	*Leucopogon juniperinus* Prickly Beard-heath	N	0.1			
6		Shrub	*Breynia oblongifolia* Coffee Bush	N	5			
7		Shrub	*Glochidion ferdinandi* Cheese Tree	N	2			
8		Grass	*Lomandra longifolia* Spiky-headed Mat-rush	N	1			
9		Other	*Eustrephus latifolius* Wombat Berry	N	40			
10		Other	*Stephania japonica* var. *discolor* Snake Vine	N	1			
11		Tree	*Eucalyptus pilularis* Blackbutt	N	30			
12		Tree	*Eucalyptus saligna* Sydney Blue Gum	N	40			
13		Tree	*Syncarpia glomulifera* Turpentine	N	12			
14		-	*Ligustrum sinense** Small-leaved Privet	HTW	5			
15		Shrub	*Pittosporum revolutum* Yellow Pittosporum	N	1			
16		Shrub	*Pittosporum undulatum* Sweet Pittosporum	N	2			
17		Grass	*Entolasia marginata* Bordered Panic	N	10			
18		Grass	*Oplismenus aemulus* Basket Grass	N	5			
19		Other	*Clematis aristata* Old Man's Beard	N	0.1			
20		Tree	*Alphitonia excelsa* Red Ash	N	10.6			
21		Other	*Morinda jasminoides*	N	2			
22		Shrub	*Zieria smithii* Sandfly Zieria	N	0.1			
23		Shrub	*Maytenus silvestris*	N	0.1			
24								
25								
26								
27								
28								
29								
30								
31								
32								
33								
34								
35								
36								
37								
38								
39								
40								
41								
42								
43								
44								

GF Codes: *First letter represents GF code; code in bracket (e.g. (SG)) represents the BAM code for the calculator.* ***Circle if in Top 3 of layer.***

A: Cycad (OG); **C:** Chenopod (SG); **D:** Other Grass (GG); **E:** Ferns (EG); **F:** Forb (FG); **G:** Tussock Grass (GG); **H:** Hummock Grass (GG); **K:** Epiphyte (OG); **L:** Vine (OG); **M:** Mallee Tree (TG); **P:** Palm (OG); **Q:** Tree Fern (OG); **R:** Rush (GG): **S:** Shrub (SG); **T:** Tree (TG); **V:** Sedge (GG); **X:** Xanthorrhoea (OG); **Y:** Mallee Shrub (SG); **Z:** Heath Shrub (SG)
N, E, HTW: N: native; **E:** exotic; **HTW:** high threat weed.
Cover: 0.1, 0.2, 0.3...1, 2, 3,...10, 15, 20, 25,....100% (foliage cover); **Note:** 0.1% cover represents approximately 63cm x 63cm or a circle about 71cm diameter. 0.1% cover is the lowest allowed – this may be an over estimate of the actual cover. 0.5% cover represents an area of approximately 1.4m x 1.4m, and 1% cover = 2m x 2m, 5% = 4m x 5x, 25% = 10m x 10m.
Abundance: 1, 2, 3,....10, 20, 30,....100, 200,....1000, ... **grass abundance**: count fractional unit, i.e. runner = one plant. Abundance of 200 – 1000 has no effect in BAM calculator.
Stratum: T1: Upper (20m+); **T2:** Upper (15-20m); **T3**: Trees (10-15m); **S1**: Small trees (5-10m); **S2:** Shrubs (≤5m); **L1**: ground (≤1m); **L2:** Lower ground (≤0.5m).

Table 4 (T_PTP): Primary Plot data sheet for Vegetation Zone 5b.

Date	GPS	Survey Name		Plot identifier	Recorders
28.04.2020		Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills		BAM12_VZ5b	EA, AM
Zone 56	**Datum** GDA94	**IBRA region** Sydney Basin	**IBRA subregion** Cumberland	**Photo#**	**Zone ID** VZ_5b
Easting 317997	**Northing** 6264270	**Dimensions** 20x20m/20x50m	**Mitchell landscape:** Pennant Hills Ridges	**Orientation of midline from 0m point:** 30[0]	
Vegetation Class		North Coast Wet Sclerophyll Forests (Wet Sclerophyll forests (Shrubby sub formation))			**Confidence** H M L
Plant Community Type (PCT)		1237 Blue Gum High Forest			**Confidence** H M L
EEC / CEEC		Blue Gum High Forest			**Confidence** H M L

Record easting and north from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline.
Dimensions (shape) of 0.04ha base plot inside 0.1ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute	(400m² plot)	# of spp
Count of Native richness (composition)	Trees	2
	Shrubs	3
	Grasses etc	2
	Forbs	1
	Ferns	2
	Other	5
Sum of cover of native vascular plants by growth form group (Structure)	Sum of cover (%)	
	Trees	90
	Shrubs	15.5
	Grasses etc	1.2
	Forbs	0.2
	Ferns	5.1
	Other	43.5
High Threat Weed cover		22.3

Function (woody veg only, Palms are not trees)					
BAM Attribute (20x50m plot)		#Tree stems count			Record number of living eucalypt (Euc*) and living non-eucalypt (Non Euc) stems separately.
DBH		Euc*	Non euc	Hollows[D]	
Large trees for Euc* & Non Euc	80+cm	-			*includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*.
	50-79cm	-			
30 – 49cm		✓			[•] Record total number of trees with hollows by size class with hollows (including dead stems/trees).
20 – 29cm		✓			[D] = Dead tree/stag
10 – 19cm		✓			
5 – 9cm		✓			
<5cm		✓			
Length of logs (m) (≥10cm diameter and >50cm in length)		15m		Natural regen?	Yes / No
				Rocky outcrop?	Yes / No

Counts must apply to each size when the **number of living tree stems** within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is ≥ 10. Estimates should draw from the number of series 10, 20, 30...100, 200,300.
For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate.
For **hollows**, count only the presence of a stem containing hollow, not the count of hollows in that stem.

BAM Attribute (1x1m plots)	Litter cover (%)	Bare ground cover (%)	Cryptogram cover (%)	Rock cover (%)
Subplot score (% in each)	75 50 50 60 65			
Average of the 5 subplots	60			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots located on alternate sides and 5m from the plot midline at the locations 5, 15, 25, 35 and 45m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10cm in diameter). Within these 1m x 1m plots assessors may also record the cover of rock, bare ground and cryptogram soil crusts. Collection of these data is optional – the data do not currently contribute to assessment scores. They hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Plot disturbance	Severity code	Age code	Observational evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil erosion			
Firewood collection			
Grazing			
Fire damage			
Storm damage			
Weediness			
Other			

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe **Age:** R = recent (<3yrs); NR = not recent (3-10yrs); O = Old (>10yrs)

KEYSTONE ECOLOGICAL

Date: 28.04.2020	Survey Name	Plot Identifier	Site sheet no.
Recorders: EA, AM	Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills	BAM12_VZ5b	2

#	(native only. Leave blank for weeds) GF Code	BAM GF code	*Top 3 native species in each growth form group: Full species name mandatory. All other native and exotic species: Full species name where practicable. Circle top 3 species in each layer.*	N, E or HTW	Cover (%)	Abund (stem count)	Stratum	Sample collect
1		Tree	*Eucalyptus saligna* Sydney Blue Gum	N	50			
2		Tree	*Glochidion ferdinandi* Cheese Tree	N	40			
3		Shrub	*Pittosporum undulatum* Sweet Pittosporum	N	15			
4		-	*Ligustrum sinense* Small-leaved Privet*	HTW	20			
5		Other	*Morinda jasminoides*	N	40			
6		Grass	*Lomandra longifolia* Mat Rush	N	0.2			
7		Grass	*Entolasia marginata*	N	1			
8		Other	*Parsonsia straminea*	N	0.3			
9		Forb	*Dianella caerulea*	N	0.2			
10		Shrub	*Pittosporum revolutum*	N	0.5			
11		Other	*Pandorea pandorana* Wonga Vine	N	1			
12		Other	*Eustrephus latifolius* Wombat Berry	N	2			
13		Fern	*Pellaea falcata*	N	5			
14		-	Cordyline stricta*	E	0.2			
15		-	*Passiflora subpeltata* White Passionflower*	E	0.1			
16		-	*Asparagus aethiopicus* Ground Asparagus*	HTW	0.1			
17		-	*Adiantum aethiopicum* Maiden Hair	N	0.1			
18		-	*Schefflera actinophylla* Umbrella Tree*	HTW	0.1			
19		-	*Lantana camara Lantana**	HTW	1			
20		-	*Celtis sinensis* Japanese Hackberry*	E	0.1			
21		-	*Rubus* sp. agg Blackberry*	HTW	1			
22		Shrub	*Leucopogon juniperinus* Prickly Beard-heath	N	0.1			
23		-	*Cinnamomum camphora* Camphor laurel*	HTW	0.1			
24								
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GF Codes: *First letter represents GF code; code in bracket (e.g. (SG)) represents the BAM code for the calculator.* ***Circle if in Top 3 of layer.***

A: Cycad (OG); **C:** Chenopod (SG); **D:** Other Grass (GG); **E:** Ferns (EG); **F:** Forb (FG); **G:** Tussock Grass (GG); **H:** Hummock Grass (GG); **K:** Epiphyte (OG); **L:** Vine (OG); **M:** Mallee Tree (TG); **P:** Palm (OG); **Q:** Tree Fern (OG); **R:** Rush (GG); **S:** Shrub (SG); **T:** Tree (TG); **V:** Sedge (GG); **X:** Xanthorrhoea (OG); **Y:** Mallee Shrub (SG); **Z:** Heath Shrub (SG)
N, E, HTW: N: native; **E:** exotic; **HTW:** high threat weed.
Cover: 0.1, 0.2, 0.3...1, 2, 3,...10, 15, 20, 25,....100% (foliage cover); **Note:** 0.1% cover represents approximately 63cm x 63cm or a circle about 71cm diameter. 0.1% cover is the lowest allowed – this may be an over estimate of the actual cover. 0.5% cover represents an area of approximately 1.4m x 1.4m, and 1% cover = 2m x 2m, 5% = 4m x 5x, 25% = 10m x 10m.
Abundance: 1, 2, 3,....10, 20, 30,....100, 200,....1000, ... **grass abundance**: count fractional unit, i.e. runner = one plant. Abundance of 200 – 1000 has no effect in BAM calculator.
Stratum: T1: Upper (20m+); **T2:** Upper (15-20m); **T3:** Trees (10-15m); **S1:** Small trees (5-10m); **S2:** Shrubs (≤5m); **L1:** ground (≤1m); **L2:** Lower ground (≤0.5m)

Table 5 (T_PTP): Primary Plot data sheet for Vegetation Zone 4a.

Date	GPS	Survey Name		Plot identifier	Recorders
22.04.2020		Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills		BAM16_VZ3a	EA, AM
Zone 56	**Datum** GDA94	**IBRA region** Sydney Basin	**IBRA subregion** Cumberland	**Photo#**	**Zone ID** VZ_4a
Easting 317945	**Northing** 6264681	**Dimensions** 20x20m/20x50m	**Mitchell landscape:** Pennant Hills Ridges	**Orientation of midline from 0m point:** 188°	
Vegetation Class		NA			**Confidence** H M L
Plant Community Type (PCT)		PCT NA – Planted Native Vegetation			**Confidence** H M L
EEC / CEEC		NA			**Confidence** H M L

Record easting and north from the plot marker. If applicable, orient picket so that perforated rib points along direction of midline. Dimensions (shape) of 0.04ha base plot inside 0.1ha FA plot should be identified, magnetic bearing taken along midline.

BAM Attribute	(400m² plot)	# of spp
Count of Native richness (composition)	Trees	10
	Shrubs	6
	Grasses etc	3
	Forbs	6
	Ferns	0
	Other	8
Sum of cover of native vascular plants by growth form group (Structure)	Sum of cover (%)	
	Trees	32.3
	Shrubs	2.3
	Grasses etc	0.4
	Forbs	0.6
	Ferns	0
	Other	11.9
High Threat Weed cover		11.2

Function (woody veg only, Palms are not trees)					
BAM Attribute (20x50m plot)		#Tree stems count			Record number of living eucalypt (Euc*) and living non-eucalypt (Non Euc) stems separately.
DBH		Euc*	Non euc	Hollows+	
Large trees for Euc* & Non Euc	80+cm	-			*includes all species of *Eucalyptus, Corymbia, Angophora, Lophostemon* and *Syncarpia*.
	50-79cm	2			
30 – 49cm		✓			+ Record total number of trees with hollows by size class with hollows (including dead stems/trees).
20 – 29cm		✓			
10 – 19cm		✓			D = Dead tree/stag
5 – 9cm		✓			
<5cm		✓			
Length of logs (m) (≥10cm diameter and >50cm in length)		2m		Natural regen?	Yes / No
				Rocky outcrop?	Yes / No

Counts must apply to each size when the **number of living tree stems** within the size class is ≤ 10. Estimates can be used when the number of living tree stems within a class is ≥ 10. Estimates should draw from the number of series 10, 20, 30...100, 200,300.
For a **multi-stemmed tree**, only the largest living stem is included in the count/estimate.
For **hollows**, count only the presence of a stem containing hollow, not the count of hollows in that stem.

BAM Attribute (1x1m plots)	Litter cover (%)					Bare ground cover (%)					Cryptogram cover (%)					Rock cover (%)				
Subplot score (% in each)	100	99	80	100	99															
Average of the 5 subplots	95.6																			

Litter cover is assessed as the average percentage ground cover of litter recorded from five 1m x 1m plots located on alternate sides and 5m from the plot midline at the locations 5, 15, 25, 35 and 45m along the midline. Litter cover includes leaves, seeds, twigs, branchlets and branches (less than 10cm in diameter). Within these 1m x 1m plots assessors may also record the cover of rock, bare ground and cryptogram soil crusts. Collection of these data is optional – the data do not currently contribute to assessment scores. They hold potential value for future vegetation integrity assessment attributes and benchmarks, and for enhancing PCT description.

Physiography + site features that may help in determining PCT and Management Zone (optional)

Morphological type		Landform element		Landform pattern		Microrelief	
Lithology		Soil surface texture		Soil colour		Soil depth	
Slope		Aspect		Site drainage		Distance to nearest water and type	

Plot disturbance	Severity code	Age code	Observational evidence
Clearing (incl. logging)			
Cultivation (incl. pasture)			
Soil erosion	1	R/NR	
Firewood collection			
Grazing			
Fire damage			
Storm damage	2	R	
Weediness	2	R/NR	
Other	2	NR	Fill – soils pushed / moved for existing development

Severity: 0 = no evidence; 1 = light; 2 = moderate; 3 = severe **Age:** R = recent (<3yrs); NR = not recent (3-10yrs); O = Old (>10yrs)

KEYSTONE ECOLOGICAL

Date: 22.04.2020 **Recorders:** E.Ashby, A.McTackett **Survey Name** Lot 61 DP 737386, 55 Coonara Ave, West Pennant Hills **Plot Identifier** BAM16_VZ4a **Site sheet no.** 1 of 1

#	(native only. Leave blank for weeds) GF Code	BAM GF code	*Top 3 native species in each growth form group: Full species name mandatory.* *All other native and exotic species: Full species name where practicable. Circle top 3 species in each layer.*	N, E or HTW	Cover (%)	Abund (stem count)	Stratum	Sample collect
1		Shrub	*Pittosporum undulatum* Sweet Pittosporum	N	0.5			
2		Other	*Hardenbergia violacea* Coral pea	N	0.5			
3		Other	*Clematis* sp.	N	10			
4		Tree	*Eucalyptus pilularis* Blackbutt	N	1			
5		Tree	*Corymbia citriodora* Lemon-scented Gum	N	5			
6		Tree	*Eucalyptus paniculata* Grey Ironbark	N	1			
7		-	*Ligustrum lucidum* Large-leaved Privet	HTE	0.5			
8		Other	*Glycine clandestina*	N	0.1			
9		Tree	*Syncarpia glomulifera* Turpentine	N	12			
10		Other	*Eustrephus latifolius* Wombat Berry	N	0.5			
11		Forb	*Brunoniella australis* Blue Trumpet	N	0.1			
12		Forb	*Lobelia pedunculata*	N	0.1			
13		Grasses	*Lomandra longifolia* Mat Rush	N	0.1			
14		Other	*Cayratia clematidea* Native Grape	N	0.1			
15		Forb	*Pseuderanthemum variabile* Pastel Flower	N	0.1			
16		Grasses	*Entolasia marginata*	N	0.2			
17		-	*Phytolacca octandra* Inkweed*	E	0.1			
18		-	*Ehrharta erecta**	HTE	0.1			
19		-	*Thunbergia alata* Black-eyed Susan*	E	0.1			
20		-	*Ligustrum sinense* Small-leaved Privet*	HTE	10			
21		Tree	*Alphitonia excelsa*	N	2			
22		Grasses	*Oplismenus aemulus*	N	0.1			
23		Shrub	*Acacia elata*	N	0.1			
24		-	*Sonchus oleraceus* Common Sowthistle*	E	0.1			
25		-	*Celtis sinensis* Japanese Hackberry*	E	0.1			
26		Forb	*Dianella caerulea* Flax Lily	N	0.1			
27		-	*Bidens pilosa* Cobbler's Pegs*	HTE	0.5			
28		-	*Bromeliad* sp.*	E	0.1			
29		Tree	*Eucalyptus punctata* Grey Gum	N	1			
30		Shrub	*Bursaria spinosa*	N	0.5			
31		Tree	*Allocasuarina littoralis*	N	0.2			
32		-	*Ochna serrulata* Mickey Mouse Plant*	HTE	0.1			
33		Other	*Doryanthes excelsa* Gymea Lily	N	0.5			
34		Tree	*Callistemon viminalis* Bottlebrush	N	0.2			
35		Forb	*Solanum prinophyllum*	N	0.1			
36		-	*Syagrus romanzoffiana* Cocos Palm*	E	0.1			
37		-	*Solanum nigrum* Nightshade*	E	0.1			
38		Tree	*Brachychiton acerifolius* Illawarra Flame Tree	N	0.1			
39		Shrub	*Polyscias sambucifolia* Elderberry Ash	N	0.1			
40		Tree	*Eucalyptus tereticornis* Forest Red Gum	N	10			
41		-	*Cordyline* sp*	E	0.1			
42		Other	*Glycine tabacina*	N	0.1			
43		Shrub	*Acacia* sp.	N	1			
44								
45								

GF Codes: *First letter represents GF code; code in bracket (e.g. (SG)) represents the BAM code for the calculator.* ***Circle if in Top 3 of layer.***

A: Cycad (OG); **C:** Chenopod (SG); **D:** Other Grass (GG); **E:** Ferns (EG); **F:** Forb (FG); **G:** Tussock Grass (GG); **H:** Hummock Grass (GG); **K:** Epiphyte (OG); **L:** Vine (OG); **M:** Mallee Tree (TG); **P:** Palm (OG); **Q:** Tree Fern (OG); **R:** Rush (GG); **S:** Shrub (SG); **T:** Tree (TG); **V:** Sedge (GG); **X:** Xanthorrhoea (OG); **Y:** Mallee Shrub (SG); **Z:** Heath Shrub (SG)
N, E, HTW: N: native; **E:** exotic; **HTW:** high threat weed.
Cover: 0.1, 0.2, 0.3...1, 2, 3,...10, 15, 20, 25,....100% (foliage cover); **Note:** 0.1% cover represents approximately 63cm x 63cm or a circle about 71cm diameter. 0.1% cover is the lowest allowed – this may be an over estimate of the actual cover. 0.5% cover represents an area of approximately 1.4m x 1.4m, and 1% cover = 2m x 2m, 5% = 4m x 5x, 25% = 10m x 10m.
Abundance: 1, 2, 3,....10, 20, 30,....100, 200,....1000, ... **grass abundance**: count fractional unit, i.e. runner = one plant. Abundance of 200 – 1000 has no effect in BAM calculator.
Stratum: T1: Upper (20m+); **T2:** Upper (15-20m); **T3**: Trees (10-15m); **S1**: Small trees (5-10m); **S2:** Shrubs (≤5m); **L1**: ground (≤1m); **L2:** Lower ground (≤0.5m)

All of the plant species observed during survey, as well as those tree species reported in the arboricultural assessment report, are provided in Table 5.

In addition to vegetation survey data, a number of additional sources of information were used to aid in the sampling and identification of vegetation types and vegetation zones:

- Recent high quality aerial photography;
- The published scientific literature, particularly papers and reports that refer to vegetation mapping of the area (including Cumberland State Forest); and
- Scientific databases, particularly
    - BioNet atlas of NSW Wildlife - for records of common and threatened species; and
    - BioNet Vegetation Classification – formerly known as the Vegetation Information System (VIS). This is the standard database for plant community types for NSW, and underpins the analytical tools applied as part of the BAM. The database facilitates vegetation classification by a series of queries of critical features (e.g. structure, location, canopy dominants), and inspection of all related data relevant to each recognised plant community type.

The true nature of the landscaped areas were further elucidated by the following:

- Land use history as indicated by historical records including old survey plans, parish maps, and land grant records;
- Historical aerial photography from 1943 through to the 1980s;
- A discussion with the David Louden, the Landscape Architect for the IBM development project;
- High resolution aerial photography dated 1943 of the western boundary vegetation;
- Site Sustainability Study (1979) prepared by Devine Erby and Mazlin, architects / landscape consultants for the original IBM proposal;
- Extracts of landscape treatments around headwalls and drainage pits attached to letter dated 6 March 1984to Baulkham Hills Shire Council from Landscan;
- Landscape Plan (1985) for the Phase 3 Carpark (the multi-storey car park) prepared by Landscan landscape architects;
- Technical Specifications for Landscape Works Phase 3 (October 1985) prepared by Landscan landscape architects;
- Plan extracted from IBM Environmental and Services Manual (1987) titled Management Areas Landscaped Area, drawing number 8, prepared by Landscan;
- Detail and Contour Survey (1993 or earlier) prepared by McNiff Dive and Associates;
- Other literature produced by the National Trust specific to the management of the vegetation of the IBM site;

Table 6: All flora species recorded during all survey activities. FG = Footprint Green (Project Arborist), RM = Random Meander, RDP = Rapid Data Point, BAM = 20x20m plot sampled in accordance with the BAM.

Family	Scientific Name	FG	RM	RDP 1	BAM 1	RDP 2	RDP 3	BAM 3	RDP 4	BAM 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	BAM 9	RDP 10	BAM 10	RDP 11	RDP 12	BAM 12	RDP 13	BAM 13	BAM 16	BAM 17	RDP 18	BAM 19
Mimosaceae	*Acacia binervia*																										
Mimosaceae	*Acacia decurrens*	x																									
Mimosaceae	*Acacia elata*	x				x		x																x			
Mimosaceae	*Acacia floribunda*		x																								
Mimosaceae	*Acacia implexa* STIF	x			x																					x	
Mimosaceae	*Acacia longissima*			x										x									x				
Mimosaceae	*Acacia parramattensis*	x			x																						
Mimosaceae	*Acacia* sp.																							x	x		
Orchidaceae	*Acianthus* sp.		x																								
Myrtaceae	*Acmena smithii* BGHF	x																									
Adiantaceae	*Adiantum aethiopicum* BGHF			x	x						x	x	x	x				x			x		x				
Agapanthaceae	*Agapanthus praecox* *																										x
Casuarinaceae	*Allocasuarina littoralis*				x					x					x	x		x						x			x
Casuarinaceae	*Allocasuarina torulosa* BGHF, STIF			x																							
Rhamnaceae	*Alphitonia excelsa* BGHF	x		x	x			x		x						x	x	x				x		x			
Poaceae	*Andropogon virginicus**		x																								
Myrtaceae	*Angophora costata* BGHF, STIF	x		x	x				x	x	x	x	x	x	x	x						x				x	
Myrtaceae	*Angophora floribunda*	x																									
Apocynaceae	*Araujia sericifera**							x		x																	x
Arecaceae	*Archontophoenix cunninghamiana*	x																									
Asparagaceae	*Asparagus aethiopicus**					x		x					x									x			x	x	x
Asparagaceae	*Asparagus asparagoides**									x											x					x	
Asparagaceae	*Asparagus scandens**																					x					
Aspleniaceae	*Asplenium australasicum*								x																		
Asteraceae	*Bidens pilosa**																							x			x
Pittosporaceae	*Billardiera scandens*				x											x											
Blechnaceae	*Blechnum cartilagineum* BGHF		x																								
Malvaceae	*Brachychiton acerifolius*	x			x			x		x														x			
Malvaceae	*Brachychiton populneus*																					x					
Euphorbiaceae	*Breynia oblongifolia* BGHF, STIF		x	x	x					x			x		x	x	x					x					
Poaceae	*Briza maxima**		x																								
Poaceae	*Briza minor**		x																								
Bromeliaceae	*Bromeliad* sp.*																							x			
Acanthaceae	*Brunoniella australis*				x					x						x							x	x			
Pittosporaceae	*Bursaria spinosa* var. *spinosa* STIF			x	x							x				x								x			
Myrtaceae	*Callistemon viminalis*	x																								x	
Myrtaceae	*Callistemon viminalis* 'Captain Cook'	x																						x			
Dicksoniaceae	*Calochlaena dubia*															x											
Casuarinaceae	*Casuarina glauca*	x																							x	x	
Vitaceae	*Cayratia clematidea*					x		x		x												x	x	x	x	x	x
Cannabaceae	*Celtis australis**	x																									
Cannabaceae	*Celtis sinensis* *																	x			x		x	x			

Family	Scientific Name	FG	RM	RDP 1	BAM 1	RDP 2	RDP 3	BAM 3	RDP 4	BAM 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	BAM 9	RDP 10	BAM 10	RDP 11	RDP 12	BAM 12	RDP 13	BAM 13	BAM 16	BAM 17	RDP 18	BAM 19
Cunoniaceae	*Ceratopetalum gummiferum*		x																								
Caryophyllaceae	*Cerastium glomeratum* *																										x
Thelypteridaceae	*Christella dentata*		x																x								
Lauraceae	*Cinnamomum camphora**	x																			x					x	
Vitaceae	*Cissus antarctica*																					x				x	
Ranunculaceae	*Clematis aristata* BGHF, STIF			x	x		x			x		x	x			x	x						x				x
Ranunculaceae	*Clematis glycinoides* var. *glycinoides*												x									x		x	x		
Lamiaceae	*Clerodendrum tomentosum* BGHF, STIF				x							x	x														
Commelinaceae	*Commelina cyanea*																						x				x
Asteraceae	*Conyza* sp.*																								x		
Asteliaceae	*Cordyline* species complex[1]				x			x	x	x	x		x	x	x				x		x	x	x	x	x	x	x
Myrtaceae	*Corymbia citriodora**	x	x																					x	x	x	
Myrtaceae	*Corymbia gummifera*	x																									
Myrtaceae	*Corymbia maculata*	x																								x	
Lauraceae	*Cryptocarya glaucescens*												x														
Orchidaceae	*Cryptostylis subulata*				x							x				x											
Cyatheaceae	*Cyathea australis*	x	x																								
Poaceae	*Cynodon dactylon*																										x
Cyperaceae	*Cyperus eragrostis**																								x		x
Celastraceae	*Denhamia silvestris* BGHF										x		x			x	x	x									
Phormiaceae	*Dianella caerulea* BGHF, STIF			x	x			x			x	x				x					x	x		x			
Phormiaceae	*Dianella prunina*												x	x	x	x												
Convolvulaceae	*Dichondra repens*							x		x															x		x
Iridaceae	*Dietes bicolor**		x																						x	x	x
Orchidaceae	*Dipodium variegatum*		x																								
Sapindaceae	*Dodonaea triquetra*				x										x	x											
Blechnaceae	*Doodia aspera* BGHF							x						x					x								
Doryanthaceae	*Doryanthes excelsa*																						x	x			
Solanaceae	*Duboisia myoporoides*		x							x																	
Poaceae	*Echinopogon caespitosus* var. *caespitosus*		x																							x	
Poaceae	*Echinopogon ovatus*		x																								
Poaceae	*Eleusine indica**																										x
Poaceae	*Ehrharta erecta**						x	x		x												x	x	x	x	x
Chenopodiaceae	*Einadia hastata*																										x
Elaeocarpaceae	*Elaeocarpus reticulatus* BGHF, STIF	x																				x					
Poaceae	*Entolasia marginata* BGHF, STIF			x	x				x	x			x	x		x	x	x		x	x	x	x	x			
Poaceae	*Entolasia stricta*														x												
Myrtaceae	*Eucalyptus fibrosa*																										x
Myrtaceae	*Eucalyptus microcorys*																										x
Myrtaceae	*Eucalyptus paniculata* BGHF, STIF					x		x															x				x

[1] Cordylines were planted extensively during the IBM development in the landscaped gardens and in the adjacent bushland. The seeds within the shiny soft fruits are spread by birds and the seeds germinate readily. The leaf shapes and widths observed are highly variable, indicating the presence of more than one species. These may include the locally native *Cordyline stricta*, but may also include species from the north coast, and exotics. This group hybridises easily and needs further study (personal communication Dr Karen Wilson, Royal Botanic Gardens).

Family	Scientific Name	FG	RM	RDP 1	BAM 1	RDP 2	RDP 3	BAM 3	RDP 4	BAM 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	BAM 9	RDP 10	BAM 10	RDP 11	RDP 12	BAM 12	RDP 13	BAM 13	BAM 16	BAM 17	RDP 18	BAM 19
Myrtaceae	*Eucalyptus pilularis* BGHF			x	x				x	x	x	x	x	x	x	x	x	x	x			x	x	x			
Myrtaceae	*Eucalyptus punctata*	x	x																					x			
Myrtaceae	*Eucalyptus resinifera* subsp. *resinifera*												x														
Myrtaceae	*Eucalyptus saligna* BGHF	x				x	x	x	x	x	nearby						x	x	x	x	x	x	x			x	x
Myrtaceae	*Eucalyptus saligna x botryoides* STIF	x																									
Myrtaceae	*Eucalyptus tereticornis*	x	x																					x			
Eupomatiaceae	*Eupomatia laurina*																									x	
Luzuriagaceae	*Eustrephus latifolius* BGHF		x	x	x			x		x			x		x	x	x	x	x		x	x	x	x		x	x
Moraceae	*Ficus coronata* BGHF	x	x							x									x								
Moraceae	*Ficus rubiginosa*	x																									
Papaveraceae	*Fumaria muralis* *																										x
Geraniaceae	*Geranium homeanum*																								x		x
Euphorbiaceae	*Glochidion ferdinandi* var. *ferdinandi* BGHF				x	x		x			x	x	x		x	x	x	x	x	x	x		x		x	x	x
Fabaceae	*Glycine clandestina*							x																x			
Fabaceae	*Glycine tabacina*																							x			
Proteaceae	*Grevillea robusta*	x																									
Proteaceae	*Hakea salicifolia*	x																									
Fabaceae	*Hardenbergia violacea*																							x			
Araliaceae	*Hedera helix**								x										x								
Dilleniaceae	*Hibbertia aspera*		x											x													
Dilleniaceae	*Hibbertia dentata*				x																						
Euphorbiaceae	*Homalanthus populifolius*																						x		x	x	x
Araliaceae	*Hydrocotyle* sp.									x																	
Asteraceae	*Hypochaeris radicata*																								x		
Poaceae	*Imperata cylindrica* var. *major*		x																								
Bignoniaceae	*Jacaranda mimosifolia**	x																									
Verbenaceae	*Lantana camara**				x	x	x	x			x	x	x		x	x		x			x		x				x
Cyperaceae	*Lepidosperma laterale* STIF												x	x	x	x	x										
Myrtaceae	*Leptospermum* sp.	x																									
Ericaceae	*Leucopogon juniperinus* BGHF, STIF			x	x							x	x		x	x	x				x						
Oleaceae	*Ligustrum lucidum**	x				x	x	x	x	x			x					x	x	x		x	x	x		x	x
Oleaceae	*Ligustrum sinense**					x		x		x	x	x	x			x	x	x	x	x	x		x	x	x	x	x
Lindsaeaceae	*Lindsaea linearis*													x													
Arecaceae	*Livistona australis*		x										x												x		
Campanulaceae	*Lobelia purpurascens*				x											x							x	x			
Lomandraceae	*Lomandra filiformis*				x									x	x	x											
Lomandraceae	*Lomandra longifolia* BGHF, STIF				x			x	x	x	x		x	x		x	x	x	x	x	x		x	x	x	x	x
Proteaceae	*Lomatia silaifolia*			x										x	x												
Caprifoliaceae	*Lonicera japonica**				x	x		x																			
Myrtaceae	*Melaleuca armillaris*	x																									
Meliaceae	*Melia azedarach*	x								x													x			x	
Poaceae	*Microlaena stipoides* var. *stipoides* STIF		x		x											x											
Malvaceae	*Modiola caroliniana* *																										x

Family	Scientific Name	FG	RM	RDP 1	BAM 1	RDP 2	RDP 3	BAM 3	RDP 4	BAM 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	BAM 9	RDP 10	BAM 10	RDP 11	RDP 12	BAM 12	RDP 13	BAM 13	BAM 16	BAM 17	RDP 18	BAM 19
Rubiaceae	*Morinda jasminoides* BGHF			x			x	x	x	x	x	x	x	x		x	x	x	x	x	x	x		x	x	
Musaceae	*Musa* sp.*																					x					
Myrsinaceae	*Myrsine variabilis* BGHF	x		x																							
Lomariopsidaceae	*Nephrolepis cordifolia*								x																	x	x
Oleaceae	*Notelaea longifolia* BGHF, STIF			x								x	x		x			x									
Ochnaceae	*Ochna serrulata**			x	x	x		x								x		x					x	x			
Oleaceae	*Olea europaea* subsp. *cuspidata**	x	x		x																x						z
Poaceae	*Oplismenus aemulus* BGHF, STIF		x		x			x		x						x	x	x				x	x				x
Oxalidaceae	*Oxalis bowiei **																										x
Oxalidaceae	*Oxalis latifolia **																										x
Asteraceae	*Ozothamnus diosmifolius*		x												x												
Bignoniaceae	*Pandorea jasminoides*		x																								
Bignoniaceae	*Pandorea pandorana* BGHF, STIF			x	x			x			x	x	x	x	x	x	x	x	x		x	x				x	
Apocynaceae	*Parsonsia straminea*			x	x							x	x	x	x	x	x	x			x	x					
Passifloraceae	*Passiflora edulis**									x																	
Passifloraceae	*Passiflora herbertiana*														x							x					
Passifloraceae	*Passiflora subpeltata**							x		x										x	x		x				
Passifloraceae	*Passiflora tarminiana**						x																				
Pteridaceae	*Pellaea falcata*																				x						
Proteaceae	*Persoonia levis*		?																								
Proteaceae	*Persoonia linearis* STIF		x		x											x											
Phyllanthaceae	*Phyllanthus tenellus **																										x
Phytolaccaceae	*Phytolacca octandra**																							x	x		
Thymelaeaceae	*Pimelea linifolia*		x																								
Pittosporaceae	*Pittosporum revolutum*				x			x		x				x	x	x	x	x			x	x					
Pittosporaceae	*Pittosporum undulatum* BGHF, STIF	x		x	x	x	x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x
Plantaginaceae	*Plantago lanceolata**		x																								
Lamiaceae	*Plectranthus parviflorus*																										x
Polypodiaceae	*Platycerium superbum*												x														
Fabaceae	*Platylobium formosum*				x											x											
Araliaceae	*Polyscias sambucifolia* subsp. long leaflets STIF			x	x		x	x			x				x	x							x				
Rhamnaceae	*Pomaderris intermedia*												x									x					
Euphorbiaceae	*Poranthera microphylla* STIF		x																								
Acanthaceae	*Pseuderanthemum variabile* BGHF, STIF														x	x		x				x		x			
Dennstaedtiaceae	*Pteridium esculentum*							x																			
Pteridaceae	*Pteris tremula*		?																								
Orchidaceae	*Pterostylis concinna*		x																								
Rosaceae	*Rubus moluccanus*									x																	
Rosaceae	*Rubus fruticosis* sp. agg.*							x					x								x						
Polygonaceae	*Rumex sagittatus **																										x
Menispermiaceae	*Sarcopetalum harveyanum*									x	x			x				x				x					
Araliaceae	*Schefflera actinophylla*	x																			x					x	

Family	Scientific Name	FG	RM	RDP 1	BAM 1	RDP 2	RDP 3	BAM 3	RDP 4	BAM 4	RDP 5	RDP 6	RDP 7	RDP 8	RDP 9	BAM 9	RDP 10	BAM 10	RDP 11	RDP 12	BAM 12	RDP 13	BAM 13	BAM 16	BAM 17	RDP 18	BAM 19
Fabaceae	*Senna pendula* var. *glabrata**																								x	
Malvaceae	*Sida rhombifolia* *																							x	x	x
Asteraceae	*Sigesbeckia orientalis*																							x		
Brassicaceae	*Sisymbrium officinale* *																									x
Smilacaceae	*Smilax australis*												x	x												
Smilacaceae	*Smilax glyciphylla* BGHF, STIF										x															
Solanaceae	*Solanum mauritianum**		x					x		x											x				x	
Solanaceae	*Solanum nigrum* *																						x	x		x
Solanaceae	*Solanum prinophyllum*									x													x	x		
Solanaceae	*Solanum pseudocapsicum**									x																
Solanaceae	*Solanum seaforthianum**						x																			z
Asteraceae	*Soliva pterosperma* *																									x
Asteraceae	*Sonchus oleraceus**																						x	x		
Poaceae	*Sporobolus africanus**																									
Caryophyllaceae	*Stellaria media**																							x		
Menispermiaceae	*Stephania japonica* var. *discolor*						x	x		x							x				x			x		
Strelitzeaceae	*Strelitzea nicolai**		x																			x			x	
Arecaceae	*Syagrus romanzoffiana* *							x															x		x	x
Myrtaceae	*Syncarpia glomulifera* STIF	x		x	X						x	x	x	x			x		x			x	x	x	x		x
Myrtaceae	*Syzygium paniculatum*	x																								x	
Asteraceae	*Taraxacum officinale* *																										x
Aizoaceae	*Tetragonia tetragonioides*																										x
Poaceae	*Themeda triandra* STIF		x											x	x												
Acanthaceae	*Thunbergia alata**																							x			
Fabaceae	*Trfolium repens* *																										x
Euphorbiaceae	*Triadica sebifera**	x																									
Myrtaceae	*Tristaniopsis laurina*							x																			
Plantaginaceae	*Veronica plebeia*		x					x																			
Xanthorrhoeaceae	*Xanthorrhoea media*			x	x											x											
Rutaceae	*Zieria smithii* STIF		x												x	x	x	x									

3.2 European Land Use History

European settlement of the Pennant Hills area was early, swift, and destructive. The extensive stands of tall forests that occurred on the rich shale soils of the Hornsby plateau were cleared and turned into farmland within 30 to 50 years of the Europeans claiming and distributing land to ex-convicts, settlers, and their offspring.

Despite its distance from Sydney town, land grants were first made in this district in 1799 - only 11 years after the arrival of the First Fleet. For example, 100 acre (40 hectare) parcels were granted to the Reverend Samuel Marsden and Dr Thomas Arndell near the present day Thompsons Corner (Rowland 2008).

This area came to European attention due to its extensive forests of tall straight construction timber (Blue Gum, Blackbutt), timber for marine applications (Turpentine), timber for roof shingles (Forest Oak), and timber for fine joinery and furniture (Red Cedar). A government logging camp was set up in 1816 less than 2 kilometres to the east of the development lot, and clearing of the surrounding forest was rapid. By 1830 the majority of the best timber of the tall forests of the shale soils had been cut for the construction of Sydney town (Benson and Howell 1990). Timber-getting then gave way to the establishment of farms and orchards (Rowland 2008), which was the general pattern of land use until the rapid post-war urbanisation in the second half of the twentieth century.

The subject site was undoubtedly part of the extensive Bellamy landholdings in the local area, which began in 1804 with the granting of 100 acres (40 hectares) to William Bellamy after he gained his ticket of leave. The southern part of this grant was located where modern-day Aiken Road occurs, and so the landholding may have incorporated some of the southern bushland of the subject site and / or Cumberland State Forest.[2] By 1807 he had 27 acres under cultivation and 103 acres of pasture; he subsequently accumulated more land grants and distributed them amongst his children, including his son James.

Some time prior to 1824, James Bellamy had also been granted - and had cleared - 60 acres (24 hectares) and at that time he petitioned for and was granted a further 60 acres (24 hectares) to provide more pasture for his cattle and horses.[3]

William Bellamy became a well-known and influential orchardist, and at least part of his son James' landholding contained fruit orchards. James' landholding and orchards most likely included the subject site, as his homestead was built in the 1880s on the crown of the hill on the corner of Coonara Avenue and Castle Hill Road, opposite the current development lot (Hornsby Shire Council, no date).

[2] Australian Royalty, historical database curated by Marion Purnell, available at https://australianroyalty.net.au/tree/purnellmccord.ged/individual/I49105/William-Bellamy, viewed 27 June 2020

[3] Australian Royalty, historical database curated by Marion Purnell, available at https://australianroyalty.net.au/tree/purnellmccord.ged/individual/I44714/James-Zadok-Bellamy, viewed 27 June 2020

Aerial photography from 1943 (the earliest available for this site) shows clearly that the northern half of the subject lot was a well-established orchard with the southern half occupied by bushland (see Figure 2). Given the pattern of land grants and the reported areas under cultivation and / or grazing land, this bushland is almost certainly regrowth and not remnant forest, having been cleared at least once, and most probably initially by the Bellamy clan.

The orchard evident in the 1943 aerial photograph was still a going concern in the early 1980s at the time of its redevelopment as headquarters for IBM (personal communication, David Louden, Landscape Architect for the IBM project). The pattern of clearing established for the orchard was largely mirrored by the IBM development, although the landscape was altered considerably with deep excavation, substantial terracing down the slope, the building of a perimeter road around the development, and the establishment of two dams and other stormwater management infrastructure (see Figure 2).

3.3 Vegetation Mapping

The vegetation of this area has been addressed partially by NSW NPWS (Tozer 2003), then by the Hills Shire Council (2008), and most recently by the NSW Office of Environment and Heritage (2013 and 2016).

The most recent of these mapping exercises is the latest attempt at a comprehensive and standardised treatment of the vegetation of the Sydney Metropolitan Area, with version 2 of the reports (OEH 2013) and version 3.1 of the digital maps (OEH 2016) referred to in this BDAR. This version of the mapping depicts the development lot and the project area as dominated by Plant Community Type (PCT) 1237 *Sydney Blue Gum – Blackbutt – Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby plateau, Sydney Basin Bioregion*. This PCT is representative of the Critically Endangered Ecological Community (CEEC) Blue Gum High Forest (BGHF). This mapping also includes PCT 1281 *Turpentine – Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion*, which is representative of Sydney Turpentine Ironbark Forest (STIF) CEEC in the southern part of the development lot.

An extract of this mapping is provided in Figure 9 and is the basis for the Biodiversity Values Map (see Figure 3) which triggered this BDAR.

This mapping was used to inform the sampling, but was not relied upon uncritically as it was clearly incorrect across most of the footprint, where it captured built form and landscaped gardens as BGHF CEEC.

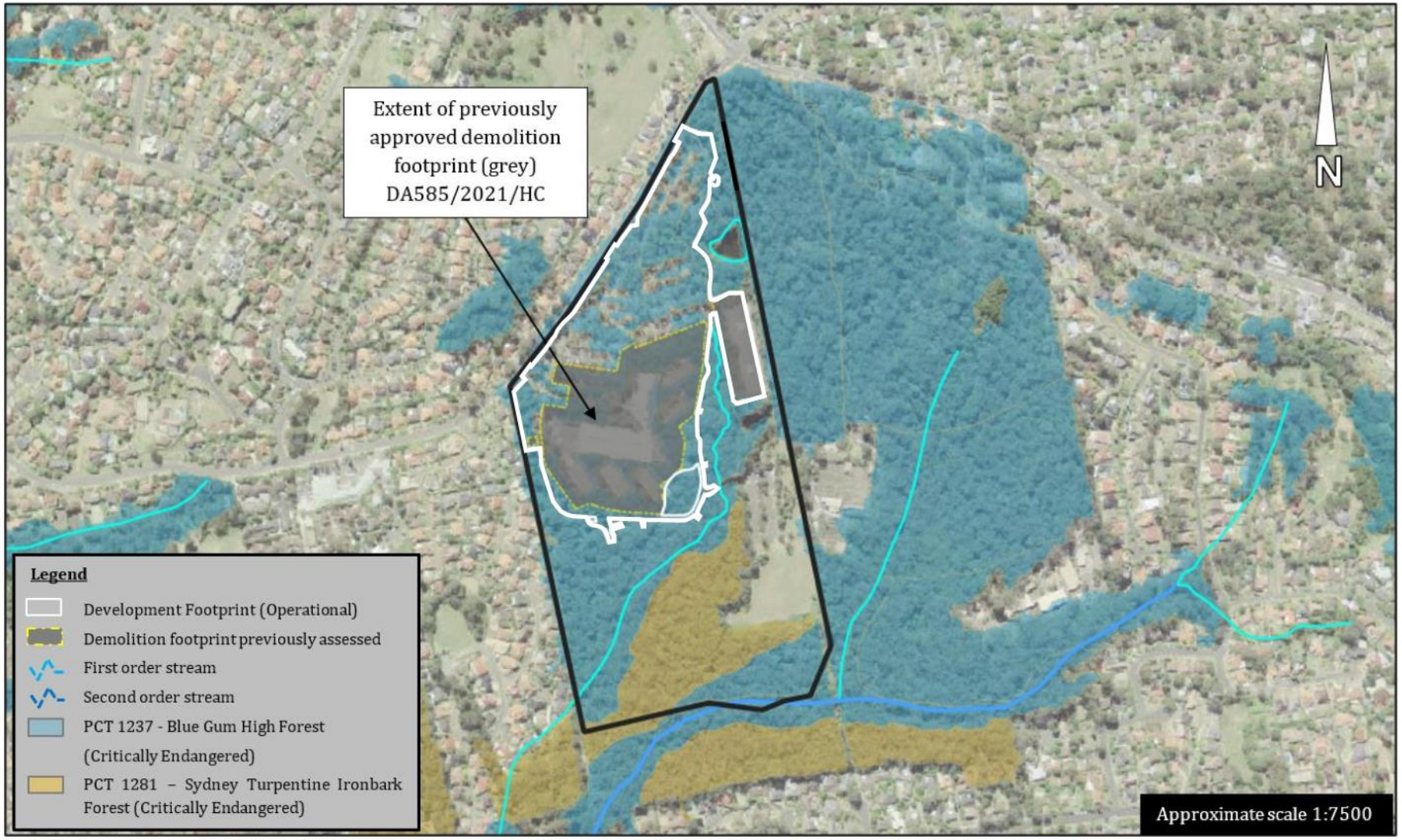

Figure 9: Vegetation map of the site and surrounds produced for the Sydney Metropolitan Area by the NSW Office of Environment and Heritage (V3.1 2016 E_VIS 4489) (available at https://geo.seed.nsw.gov.au/Public_Viewer/index.html?viewer=Public_Viewer&locale=en-AU). This shows the previously developed and landscaped parts of the site as supporting Blue Gum High Forest, a Critically Endangered Ecological Community.

3.4 Native Vegetation

A map of Vegetation Zones across the entire subject lot has been produced as part of the larger study of the entire site and relies on all of the information gathered as detailed above – including land use history, soil landscape, landscape position, and floristic composition. The delineation of the boundary between the zones on natural ground from those zones on non-natural ground relied heavily on detailed site inspection, guided by the land survey outputs. This was particularly helpful when the natural floristics were compromised by heavy weed infestation and / or ambiguous historical aerial photography.

The distribution of these Vegetation Zones (VZ) across the site is shown in Figure 8, and the details of each VZ is provided in Table 6. Native vegetation across the subject lot is restricted to VZ 3a, 4a, 5a, 5b, 5c, 6a, and 6b.

Other than built form, the Development Concept Stage project area comprises:

- 0.06 hectares of Vegetation Zone 2a – basins and dams
- 0.08 hectares of Vegetation Zone 3a – highly modified edges
- 2.40 hectares of Vegetation Zone 4a – planted native vegetation
- 0.20 hectares of Vegetation Zone 5a – BGHF regrowth
- 0.01 hectares of Vegetation Zone 5b – even-aged BGHF regrowth
- 0.01 hectares of Vegetation Zone 5c – BGHF

Thus, the Development footprint contains 2.7 hectares of vegetation made up of 5 Vegetation Zones.

Table 7: Vegetation Zones details.

Vegetation Zone	Subject Lot Total Area (ha)	Impact / Project Area		Description
		Demolition Stage (previous BDAR)	Development Concept Stage (this BDAR)	
1a Cleared Land	1.60	**0**	**0**	• **Habitat**: Exotic grassland • **Substrate**: Natural ground • **PCT**: NA • **Composition, management and history:** o Mostly exotic ground covers. o Regularly mown / slashed. o Previously part of the orchard.
1b Cleared Land	0.55	**0**	**0**	• **Habitat**: Exotic grassland with scattered planted trees • **Substrate**: Natural ground • **PCT**: NA • **Composition, management and history:** o Mostly exotic ground covers. o Regularly mown / slashed. o Previously part of the orchard. o Small number of native trees planted.
2a Basins and Dams	0.13	**0**	**0.06**	• **Habitat**: Aquatic – intermittent (detention basins) • **Substrate**: Not natural ground • **PCT**: NA – vegetation generally weeds establishing on structures • **Composition, management and history**: o Built structures that occasionally contain water. o Some exotic vegetation established.
2b Basins and Dams	0.33	**0**	**0**	• **Habitat**: Aquatic – permanent (dams) • **Substrate**: Not natural ground • **PCT**: NA – generally open water • **Composition, management and history**: o Built structures that permanently contain water. o Supports some aquatic vegetation (native and exotic). o Exotic vegetation includes infestation of the exotic Water Primrose.

Vegetation Zone	Subject Lot Total Area (ha)	Impact / Project Area		Description
		Demolition Stage (previous BDAR)	Development Concept Stage (this BDAR)	
3a Highly Modified Edges	1.63	**0**	**0.08**	• **Habitat**: Planted and regrowth forest species • **Substrate**: Not natural ground • **PCT**: 1237 BGHF - not CEEC • **Composition, management and history**: o Very disturbed vegetation reflecting land use history. o Underlying ground is not natural and includes spoil, batters around roads and dams, excavated land, constructed banks near bridges, reshaped slopes to facilitate water movement, and the cleared and compacted area used for the compound during construction of IBM facility. o Overwhelmingly dominated by exotic species, particularly transformer weeds such as Lantana and Large-leaved Privet. o Includes areas not part of the formal landscape plan but probably planted out or "enriched" with Australian native plantings as part of IBM rehabilitation works. o Contains some locally-native species of trees and understorey plants that may have self-seeded.
4a Landscaped Gardens	5.40	**2.90**	**2.40**	• **Habitat**: Planted mixed garden • **Substrate**: Not natural ground • **PCT**: NA - planted • **Composition, management and history**: o Planted gardens around the car parks and buildings. o Original plantings predominantly Australian native species, but not necessarily locally native – provenance unknown. o Contains some locally-native trees and understorey plants that may have self-seeded. o Primarily comprised of trees over bare ground / leaf litter, trees over sparse shrubs, or trees over ground covers. o Weed infestations relatively rare due to regular landscape maintenance.

Vegetation Zone	Subject Lot Total Area (ha)	Impact / Project Area		Description
		Demolition Stage (previous BDAR)	Development Concept Stage (this BDAR)	
5a BGHF	0.98	**0**	**0.20**	• **Habitat**: Regrowth forest • **Substrate**: Natural ground • **PCT**: 1237 BGHF CEEC • **Composition, management and history**: o Highly modified post-1943 and / or post-1961 regrowth forest. o Comprises some locally-native canopy trees over dense weed infestations, especially transformer weeds Lantana and Large-leaved Privet. o Likely to have been impacted by past works in accordance with infrastructure easements. o Likely to contain some planted vegetation.
5b BGHF	0.42	**0**	**0.01 (55.86 m²)**	• **Habitat**: Regrowth forest • **Substrate**: Natural ground • **PCT**: 1237 BGHF CEEC • **Composition, management and history**: o Even-aged natural regrowth forest with a simplified structure. o Cleared for orchard in 1943 and while some woody regrowth is visible 1970, the regrowth today may be post-1980s.
5c BGHF	2.09	**0**	**0.01 (78.96 m²)**	• **Habitat**: Remnant / old regrowth forest • **Substrate**: Natural ground • **PCT**: 1237 BGHF CEEC • **Composition, management and history**: o No evidence of past clearing from earliest available aerial photography (1943), however given the early land grant history in this area, some or all is likely to have been cleared as early as the 1800s for farming.

Vegetation Zone	Subject Lot Total Area (ha)	Impact / Project Area		Description
		Demolition Stage (previous BDAR)	Development Concept Stage (this BDAR)	
6a STIF	3.44	**0**	**0**	• **Habitat**: Regrowth forest • **Substrate**: Natural ground • **PCT**: 1281 STIF CEEC • **Composition, management and history**: o Natural canopy over a simplified understorey due to past fire management regime (southern section), or mechanical removal of understorey for bushfire hazard control (western boundary).
6b STIF	3.65	**0**	**0**	• **Habitat**: Remnant / old regrowth forest • **Substrate**: Natural ground • **PCT**: 1281 STIF CEEC • **Composition, management and history**: o No evidence of past clearing from earliest available aerial photography (1943), however given the early land grant history in this area, some or all is likely to have been cleared as early as the 1800s for farming.
		2.90 ha	**2.76 ha total area 2.70 ha vegetation**	

3.5 Plant Community Types (PCTs)

For the purposes of the BAM, PCTs are to be assigned (and offsets determined) for native vegetation that is to be removed, being in this case in Vegetation Zones 3a, 4a, 5a, 5b, and 5c. The relationship of each of these VZs and PCTs are discussed below.

3.5.1 Vegetation Zone 3a

Vegetation Zone 3a is located on non-natural substrate – such as battered slopes around dams and roadways, or areas of spoil. VZ 3a has been sampled in BAM plot (BAM19). The species recorded and other characteristics of VZ 3a are detailed in Tables 1 and 6 and illustrated in Figures 10, 11, and 12.

Figure 10: Vegetation Zone 3a at the south western corner of the perimeter road. In this location VZ 3a is characterised by a pile of spoil and an open compacted area that was used for the works compound during the IBM construction. The spoil is partially planted (as evidenced by a small group of Tallowwoods) and partially naturally vegetated (mostly by weeds). The old compound and accessway has been mostly allowed to regenerate naturally, but its soil structure has precluded much growth. Photo by E. Ashby, 20th June 2014.

Figure 11: Vegetation Zone 3a above the detention basin to the south of the perimeter road. This clearly shows the battered nature of this zone, leading down from and supporting the road.
Photo by E. Ashby, 20th June 2014.

Figure 12: Vegetation Zone 3a, sample plot BAM19.
Photo by E. Ashby, 21st May 2022.

Some planting occurred in VZ 3a as part of the landscaping for the IBM development, but these areas are generally regarded to be outside of the garden areas and have not been maintained to the same standard, instead having occasional bush regeneration works only. As a result, understorey plants and at least some trees have also grown naturally in this ecotone between the development and the bushland in the 40 years since the IBM development was completed. This is particularly so for weed species such as *Lantana camara* Lantana and *Ligustrum lucidum* Large-leaved Privet, as well as for native understorey species that are very common across the site such as *Morinda jasminoides* and *Eustrephus latifolius* Wombat Berry.

Therefore, although VZ 3a is at least partially planted native vegetation, it is considered inappropriate to treat it wholly as such for the purposes of impact assessment, and nor should it be considered as wholly natural given its profound substrate modifications and at least partial horticultural origins.

Consequently, the search for the most appropriate PCT to characterise Vegetation Zone 3a has been undertaken by filtering the naturally-occurring locally-native species recorded in BAM plot BAM 19 through the BioNet Vegetation Classification database, and comparison with candidate PCTs known to occur on and around the site.

Although the PCT with the greatest number of matches is PCT 694 Illawarra Escarpment Blackbutt Forest, it is rejected as a candidate PCT based on its natural geographic distribution.

PCT 1237 Blue Gum High Forest and PCT 1281 Sydney Turpentine Ironbark Forest were equal second-best match. PCT 1237 is preferred however, as it better reflects the PCT accepted by Council as a best-fit for the adjacent landscaped areas around the buildings.

It is important to note that PCTs are not directly equivalent to vegetation communities; instead they are the currency of the BAM-C that act as a proxy for vegetation for the purposes of the offset models. Therefore, a PCT may by associated with one or more Threatened Ecological Community (TEC), or none of them.

While *PCT 1237 Blue Gum high forest* is considered the best-fit PCT for VZ 3a based on dominant floristics and geographical and topographical location, it is not considered to represent the Critically Endangered Ecological Community associated with this PCT due to its history, floristic composition, and soil characteristics.

The Final Determination of Blue Gum High Forest as a Critically Endangered Ecological Community states that *"at any one time, above ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species; the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented"* (NSW Scientific Committee 2007).

The highly compacted fill of the batters provides a significantly different substrate to that of natural ground: it must be profoundly different to the natural friable clay-loams of this community

in order to maintain their structural integrity and continue to support the roadways and dam walls. These differences undoubtedly manifest in turn in fundamental differences in soil chemistry, water-holding capacity, and soil biota, all of which contribute to the definition of the Critically Endangered Ecological Community.

In addition, although there are a number of potentially naturally-occurring trees of BGHF species, there are also significant numbers of planted trees. The most obvious among them is the 9% of trees in Vegetation Zone 3a that are *Eucalyptus microcorys* Tallowwood. These are a horticultural species in Sydney, as its natural distribution extends from Newcastle north to Queensland (Brooker and Kleinig 1983). Also, a significant proportion of the locally-native species (including *Eucalyptus saligna* Sydney Blue Gum and *Syncarpia glomulifera* Turpentine) may also be planted from unknown provenance material and therefore strictly are not contributing to the definition of the PCT.

3.5.2 Vegetation Zone 4a

Vegetation Zone 4a has been sampled in BAM plots (BAM16, BAM17) and all trees located and identified by the Project Arborist. The species recorded and other characteristics of VZ 4a are detailed in Tables 5 and 6 and illustrated in Figures 13 and 14.

Figure 13: Vegetation Zone 4a, in the open car park, showing the suppression of growth of planted trees and absence of understorey.
Photo by E. Ashby, 4th December 2018.

Figure 14: Vegetation Zone 4a, near the western boundary, where some underplantings have been maintained.
Photo by E. Ashby, 25th May 2021.

The recent development history of the site helps to explain the distribution and nature of VZ 4a.

As part of the original IBM development, the areas surrounding the buildings were extensively landscaped and integrated with their function in the surrounding landscape (such as amenity plantings around the outdoor eating area, or an ersatz rocky gully for stormwater control). These areas were principally planted out with Australian native species, with some of the species selection guided by the nursery staff at the adjoining Cumberland State Forest (personal communication David Louden, Landscape Architect for the IBM project). Some parts of the natural riparian area adjacent to the buildings were also "enriched" with plantings of tree ferns and other terrestrial ferns, and understorey plantings were generally restricted to fast-growing species such as *Acacia* (probably *fimbriata*) (personal communication David Louden, Landscape Architect for the IBM project). The preponderance of *Cordyline* species also indicates that this may have also been a dominant component in the planting palette. Additional information regarding the planting schedules for the landscape works revealed the use of some locally-native species characteristic of surrounding natural vegetation, as well as species outside of their ecological range (e.g. *Casuarina glauca* Swamp Oak) or geographic range (e.g. *Corymbia citriodora* Lemon-scented Gum).

Although these gardens have been regularly maintained by grounds staff, some areas now support high weed loads, and many exotic understorey species have also been subsequently planted (such as species of the African Iris *Dietes* in place of *Lomandra longifolia*). The understorey is generally sparse in the landscaped gardens.

Almost as an afterthought as part of the IBM development, the opportunity was taken to soften the open-air car parks and counteract some of the heat island effect of the extensive areas of hard surfaces by planting trees in a series of narrow garden beds (personal communication David Louden, Landscape Architect for the IBM project). The car parking bays were interrupted by a series of narrow and shallow excavated troughs that were back-filled with (probably) 200 millimetres of soil and (probably) 500 millimetres of mulch, within which shade trees were planted (personal communication David Louden, Landscape Architect for the IBM project).

These troughs effectively formed impermeable sandstone containers: they were not designed to accommodate the growth of large trees, but were instead designed by engineers principally for civil works. Together with the impact of the surrounding hard surfaces (e.g. heat generation, further restriction of root growth, prevention of percolation of water, prevention of gaseous exchange), and the addition of polluted runoff, tree growth has been constrained.

While natural regeneration has had the opportunity to occur in the landscaped areas, it is unlikely to have originated from the topsoil used in the IBM landscape works and therefore cannot be considered to be remnant. The available landscape technical specifications[4] detailed the collection, treatment, and re-use of topsoil. The topsoil was stripped from the orchard and paddocks, and at the time of clearing there was *"prolific weed growth"*; these weeds were turned into the topsoil stockpiles.

The excavated areas intended for planting were filled with a mixture of screened orchard topsoil, mixed with sand, gypsum, bark, and an organic matter admix (comprising composted bark, duck manure, coffee grounds, spent mushroom compost, and composted hardwood sawdust). The sub-grade was broken up by backhoe, and the soil mixture filled to a depth of 150 millimetres, into which the plants were installed, and then mulched with pine bark to a depth of 75 millimetres.

The Site Sustainability Study[5] describes the areas that were developed for the IBM facility variously as a cleared gully with weeds, a grazing paddock with Kikuyu and horses, a crop paddock with poor soil structure due to overcropping, and a neglected orchard overrun with Lantana and Rabbits. No forested areas were cleared, and this topsoil source is not likely to have included a native forest seedbank of consequence if any at all, and its subsequent treatment was not particularly conducive to germination of locally-native species.

Given this well-documented history of the genesis of the native vegetation in the landscaped parts of the site, the potential for it to be "Planted Native Vegetation" *sensu* BAM 2020 was explored by application of the decision-making key in Appendix D of BAM 2020 – see extracts overleaf with highlighted responses.

[4] Technical Specifications for Landscape Works Phase 3 (October 1985) prepared by Landscan landscape architects.

[5] Site Sustainability Study (1979) prepared by Devine Erby and Mazlin, architects / landscape consultants for the original IBM proposal

Appendix D: Streamlined assessment module – Planted native vegetation

The decision-making key below provides a framework for the assessment of planted native vegetation using the BAM.

Where only part of the subject land contains planted native vegetation, this module may be used to assess that part of the development, activity, clearing or biodiversity certification proposal. The standard BAM is then used to assess the remaining areas.

D.1 Decision-making key

1. **Does the planted native vegetation occur within an area that contains a mosaic of planted and remnant native vegetation and which can be reasonably assigned to a PCT known to occur in the same IBRA subregion as the proposal?**

   i. Yes.... The planted native vegetation must be allocated to the best-fit PCT and the BAM must be applied.

   ii. No..... Go to 2.

2. **Is the planted native vegetation:**

   a. **planted for the purpose of environmental rehabilitation or restoration under an existing conservation obligation listed in BAM Section 11.9(2.), and**

   b. **the primary objective was to replace or regenerate a plant community type or a threatened plant species population or its habitat?**

   i. Yes.... The planted native vegetation must be assessed in accordance with Chapters 4 and 5 of the BAM.

   ii. No..... Go to 3.

3. **Is the planted/translocated native vegetation individuals of a threatened species or other native species planted/translocated for the purpose of providing threatened species habitat under one of the following:**

   a. **a species recovery project**

   b. ***Saving our Species* project**

   c. **other types of government funded restoration project**

   d. **condition of consent for a development approval that required those species to be planted or translocated for the purpose of providing threatened species habitat**

   e. **legal obligation as part of a condition or ruling of court. This includes regulatory directed or ordered remedial plantings (e.g. Remediation Order for clearing without consent issued under the BC Act or the Native Vegetation Act)**

   f. **ecological rehabilitation to re-establish a PCT or TEC that was, or is carried out under a mine operations plan, or**

   g. **approved vegetation management plan (e.g. as required as part of a Controlled Activity Approval for works on waterfront land under the NSW *Water Management Act 2000*)?**

   i. Yes.... The planted native vegetation must be assessed in accordance with Chapters 4 and 5 of the BAM.

ii. No..... Go to 4.

4. **Was the planted native vegetation (including individuals of a threatened flora species) undertaken voluntarily for revegetation, environmental rehabilitation or restoration without a legal obligation to secure or provide for management of the native vegetation?**

   i. Yes..... Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied).

   ii. No..... Go to 5.

5. **Is the native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, horticultural or plantation forestry purposes? This includes examples such as: windbreaks in agricultural landscapes, roadside plantings (including street trees, median strips, roadside batters), landscaping in parks, gardens and sport fields/complexes, macadamia plantations or teatree farms?**

   i. Yes.... Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied).

   ii. No..... Go to 6.

6. **Is the planted native vegetation a species listed as a widely cultivated native species on a list approved by the Secretary of the Department (or an officer authorised by the Secretary)?**

   i. Yes.... Go to D.2 Assessment of planted native vegetation for threatened species habitat (the use of Chapters 4 and 5 of the BAM are not required to be applied).

   ii. No..... There may be other types of occurrences of planted native vegetation that do not easily fit into the decision-making key above. Assessors should contact the BAM Support mailbox at bam.support@environment.nsw.gov.au for further advice on using the BAM to assess other types of occurrences of planted native vegetation.

Evidence demonstrating the application of the decision-making key to the areas of planted native vegetation must be provided in the BDAR or BCAR.

D.2 Assessment of planted native vegetation for threatened species habitat

The assessor must assess the suitability of the planted native vegetation for use by threatened species and record any incidental sightings or evidence (e.g. scats, stick nests) of threatened species credit species (flora and fauna) using, inhabiting or being part of the planted native vegetation.

If there is evidence that threatened species are using the planted native vegetation as habitat, the assessor must apply Section 8.4 of the BAM to mitigate and manage impacts on these species. Species credits are not required to offset the proposed impacts.

The steps taken to assess threatened species habitat and all reasonable measures proposed to be taken to mitigate or minimise impacts must be set out in the BDAR or BCAR.

Question 1 requires consideration of the presence of remnant vegetation and whether a best-fit PCT is appropriate.

The absence of remnant vegetation is clear from the aerial photographs and ground photographs taken at the time of construction – see Figures 2 and 15.

Figure 15: Looking north east from the works compound near the south western corner of the perimeter road. This photograph shows that the profound disturbances wrought during construction of the IBM buildings did not allow for the retention of any remnant vegetation.
Photo source: Mirvac.

In order to determine if the observed vegetation can be reasonably assigned to a PCT, the floristics and structure of the relevant BAM plots along with the tree species mix recorded by the Project Arborist in Vegetation Zone 4a were compared to candidate PCTs in the BioNet Vegetation Classification database, using the filtering tools available in that module. The database was filtered sequentially, adding factors and species at each step from tree data and BAM plot data, with the resultant PCTs interrogated at each stage for best fit.

Of the 3,527 native trees of 49 species identified by the Project Arborist within Vegetation Zone 4a (including the Demolition Stage), almost three quarters (74%) are represented by only 6 dominant tree species:

- 774 x *Corymbia citriodora* Lemon-scented Gum - 22%
- 457 x *Corymbia maculata* Spotted Gum - 13%
- 425 x *Casuarina glauca* Swamp Oak – 12%

- 355 x *Eucalyptus tereticornis* Forest Red Gum – 10%
- 346 x *Pittosporum undulatum* Sweet Pittosporum – 10%
- 257 x *Syncarpia glomulifera* Turpentine – 7%

The BAM plots in Vegetation Zone 4a reflected this mix:

- BAM16 dominated by *Syncarpia glomulifera* Turpentine (12% cover) and *Corymbia citriodora* Lemon-scented Gum (10% cover)
- BAM17 dominated by *Casuarina glauca* Swamp Oak (40% cover) and *Corymbia citriodora* Lemon-scented Gum (12% cover)

The understorey across VZ 4a was more variable than the canopy, being reflective of the degree and type of horticultural management. Some areas were tended less regularly and had a very weedy understorey; this is evident in RDP 17 with the high threat weed *Ehrharta erecta* Panic Veldtgrass at 50% cover and *Sonchus oleraceus* Common Sowthistle at 25% cover. Rain prior to the plot sampling also resulted in germination of a number of species in some areas not previously recorded in the gardens. This is evidenced in the high species diversity in BAM16, with the ground layer dotted by small young plants.

There are no PCTs in NSW that contain *Corymbia citriodora* Lemon-scented Gum, as it is a species native to Queensland. Therefore, no best fit PCT for VZ 4a can take into account the most dominant species.

The natural soils on this protected south-facing slope are moderately fertile (see soil landscape descriptions), the site experiences relatively high rainfall (1,003 mm annual average),[6] and the surrounding natural vegetation is of the Wet Sclerophyll Forest formation. Therefore the first filter imposed was of Wet Sclerophyll Forest PCTs within the Sydney Basin Bioregion.

The next filters added were the next three most common canopy species: *Corymbia maculata* Spotted Gum, *Casuarina glauca* Swamp Oak, and *Eucalyptus tereticornis* Forest Red Gum. None of the resultant PCTs matched all factors (formation plus 3 dominant species within the Bioregion), primarily because *Corymbia maculata* Spotted Gum occurs naturally in open forest on somewhat infertile and drier sites on shales and slates, while *Casuarina glauca* Swamp Oak occurs naturally in saline soils, and principally in wetlands and swamp forests. *Eucalyptus tereticornis* Forest Red Gum is more catholic in its habitats, but in this part of Sydney is more likely to occur naturally in grassy woodlands on shale soils of the Cumberland Plain.

The presence of *Pittosporum undulatum* Sweet Pittosporum adds little information to the vegetation analysis as it is a very weedy species, spreading into all vegetation types due to to profound changes wrought on urban bushland by surrounding development - the absence of fire, and the addition of nutrients.

The addition of *Pittosporum undulatum* Sweet Pittosporum and *Syncarpia glomulifera* Turpentine

[6] Rainfall data from Castle Hill (Kathleen Avenue) Station number 067100, latitude 33.72^{0}S longitude 150.99^{0}E, elevation 90 metres ASL, sourced from Climate Data Online, Bureau of Meteorology http://www.bom.gov.au/climate/data

to the species filters returned the same set of 3 PCTs from the Cumberland subregion with the highest number of matches (being 4). These PCTs are described below:

- PCT 1245 Illawarra Escarpment Blue Gum wet forest (Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion). This PCT extends southwards from the Hacking River valley along the escarpment to Nowra, where it is distributed between 60 and 300 metres above sea level on Narrabeen group sediments or Illawarra Coal Measures. It occurs on sheltered slopes in gullies and on escarpments with loamy soils. It is a very tall eucalypt forest marked by multiple layers of rainforest trees, palms and shrubs. It is not associated with any listed threatened ecological communities;
- PCT 1841 Coastal enriched sandstone moist forest (Smooth-barked Apple - Turpentine - Blackbutt tall open forest on enriched sandstone slopes and gullies of the Sydney region). It is a tall open forest on Hawkesbury sandstone slopes and gullies, enriched by the presence of shale bands on the slope or on the ridges above. It occurs at elevations between 10 and 120 metres ASL, with mean annual rainfall of 850-1,250 millimetres. It is not associated with any listed threatened ecological communities; and
- PCT 1915 Coastal Flats tall moist forest (Blue Gum-Bangalay - Turpentine / Cheese Tree - Lilly Pilly tall moist forest on coastal flats of the northern Sydney basin). This is a tall eucalypt community with layers of small rainforest trees and mesic shrubs that is found on coastal flats and adjoining toe slopes. This tall forest receives more than 1,150 millimetres of mean annual rainfall and is situated on elevations less than 40 metres above sea level. The alluvial soils on which it grows are sourced from Narrabeen sediments and are clay rich. Outside the Sydney area it is found along the larger coastal river systems north to Newcastle. It is not associated with any listed threatened ecological communities.

Additional permutations were also explored using other filtering factors such as the Cumberland subregion, understorey species from the BAM plots, and canopy species mix from the BAM plots only. However, no other PCTs resulting from these investigations were considered to be a better fit than the three PCTs listed above.

Nevertheless, none of these three candidate PCTs are considered to be a reasonable fit as they do not reflect the combination of biotic and abiotic factors observed on site.

The most parsimonious decision is that VZ 4a cannot be reasonably assigned to a PCT known to occur in the same IBRA subregion.

Questions 2, 3, and 4 require consideration of the objectives behind the planting of the subject vegetation. Specifically, whether it was planted:

- as a restoration project
- to acquit a conservation obligation, condition of consent, other legal obligation, or as part of an approved vegetation management plan
- to replace or regenerate a community or threatened plant or its habitat
- as part of a formal recovery project
- to re-establish vegetation under a mine operations plan

- voluntary planting program to secure or provide for management of the native vegetation

The vegetation within the proposed development footprint has not been planted for any of these purposes. Rather it is "*native vegetation (including individuals of a threatened flora species) planted for functional, aesthetic, [or] horticultural … purposes*" (per **Question 5**).

The evidence for the vegetation in question being planted and not natural has come from a number of credible sources detailed above. Therefore, as Vegetation Zone 4a is planted native vegetation with no reasonable PCT or specific conservation value, losses need not be offset. Only the potential impacts to fauna need be addressed, per Section D.2 of Appendix D of BAM 2020:

> *'The assessor must assess the suitability of the planted native vegetation for use by threatened species and record any incidental sightings or evidence (e.g. scats, stick nests) of threatened species credit species (flora and fauna) using, inhabiting or being part of the planted native vegetation.*
> *If there is evidence that threatened species are using the planted native vegetation as habitat, the assessor must apply Section 8.4 of the BAM to mitigate and manage impacts on these species. Species credits are not required to offset the proposed impacts.'*

3.5.3 Vegetation Zone 5a

Vegetation Zone 5a is located in the northern part of the site on very steep slopes and in a highly modified form. VZ 5a has been sampled in a BAM plot (BAM3) and Rapid Data Point RDP 2. The species recorded and other characteristics of VZ 5a are detailed in Tables 2 and 6 and illustrated in Figures 16, 17, and 18.

Figure 16: Vegetation Zone 5a, BAM3 in the northern end of the site, showing the predominance of weeds in the understorey. Photo by E. Ashby, 12th June 2019.

Figure 17: The overwhelming character of Vegetation Zone 5a is dense coverage of weeds in the understorey. This area is within an electricity easement along the eastern boundary in the northern part of the site and has probably experienced past clearing and subsequent rampant weed growth.
Photo by E. Ashby, 12th June 2019.

Figure 18: Vegetation Zone 5a on the steep slope at the northern corner of the lot is dominated by an understorey of Large-leaved Privet, with occasional native canopy trees.
Photo by E. Ashby, 12th June 2019.

The most appropriate PCT to characterise Vegetation Zone 5a has been determined by filtering the plot data through the BioNet Vegetation Classification database, and comparison with candidate PCTs known to occur on and around the site.

Supplementary data were also used for comparison and included:

- composition and relative abundance of tree species as determined by the arboricultural assessment;
- distribution of dominant species in each structural layer collected in the Rapid Data Point;
- floristics, structure, and function data collected within the relevant BAM plot; and
- topographic and other landscape features.

The assessment identified 3 PCTs that were considered as being the possible 'best-fit' for VZ 5a:

- ***PCT 1237 – Blue Gum high forest (Sydney Blue Gum - Blackbutt - Smooth-barked Apple moist shrubby open forest on shale ridges of the Hornsby Plateau, Sydney Basin Bioregion).*** This PCT is within the North Coast Wet Sclerophyll Forest Class, and occurs elsewhere on site and in surrounding areas;
- ***PCT 1245 Illawarra Escarpment Blue Gum wet forest (Sydney Blue Gum x Bangalay - Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin Bioregion).*** This PCT extends southwards from the Hacking River valley along the escarpment to Nowra, where it is distributed between 60 and 300 metres above sea level on Narrabeen group sediments or Illawarra Coal Measures. It occurs on sheltered slopes in gullies and on escarpments with loamy soils. It is a very tall eucalypt forest marked by multiple layers of rainforest trees, palms and shrubs. This PCT is within the North Coast Wet Sclerophyll Forest Class and is not associated with any listed threatened ecological communities;
- ***PCT 1284 – Turpentine – Smooth-barked Apple moist shrubby forest of the lower Blue Mountains, Sydney Basin Bioregion.*** This PCT is a tall open forest with a moist open understorey of shrubs and climbers, and a ground layer of ferns, slender vines and forbs.; It occurs on sheltered sandstone slopes and in gullies up to an altitude of 700m. This PCT is within the North Coast Wet Sclerophyll Forest Class and is associated with listed threatened ecological communities Blue Mountains Shale Cap Forest EEC and Sydney Turpentine Ironbark Forest CEEC.

Of these candidate PCTS, it is considered that *PCT 1237 Blue Gum high forest* (CEEC) is the best fit for VZ 5a for the purposes of the BDAR. This decision is based on:

- the dominance of *Eucalyptus saligna* Sydney Blue Gum. Not all of the trees observed were of a sufficient size to indicate that they were planted in the 1980s, and so a proportion of this species in VZ 3a are likely to have "volunteered" i.e. germinated from trees on site and grown naturally
- the dominance of *Pittosporum undulatum*, a species that was planted but is also naturally common with weedy characteristics
- the nearest surrounding natural vegetation being PCT 1237

3.5.4 Vegetation Zone 5b

Vegetation Zone 5b occurs in an area that was clear of woody vegetation in 1970 - presumably for an expansion of the orchard - but was instead allowed to regrow. VZ 5b has been sampled in a Rapid Data Point plot (RDP 12) and a BAM plot (BAM12). The species recorded and other characteristics of VZ 5b are detailed in Tables 4 and 6 and illustrated in Figure 19.

The vegetation in this area is almost entirely made up of a single-aged stand of *Eucalyptus saligna* Sydney Blue Gum in the canopy. The mid storey is comprised of *Glochidion ferdinandi* Cheese Tree and *Pittosporum undulatum* Sweet Pittosporum, with the lower layers almost entirely made up of the vine *Morinda jasminoides* and the terrestrial fern *Pellaea falcata.*

It is situated on the south facing slope above the first order stream that runs through the site, approximately half way down the long slope.

Given its recent clearing history and surrounding lands, there is a significant weed load of *Ligustrum sinense* Small-leaved Privet and a mix of other serious transformer weeds such as *Lantana camara* Lantana.

The floristic composition, position in the landscape, surrounding vegetation, and natural soil as evidenced by historical aerial photography indicate that VZ 5b is representative of *PCT 1237 Blue Gum high forest*, being the Critically Endangered Ecological Community.

Figure 19: Vegetation Zone 5b (BAM12) showing even-aged regrowth forest.
Photo by E. Ashby, 28th April 2020.

3.5.5 Vegetation Zone 5c

Vegetation Zone 5c occurs on the protected slopes above the creek like VZ 5b, but there is no evidence of clearing or alterations to the ground in this area within at least the last 78 years. The floristic composition is more diverse (and with a significantly smaller weed load) than the nearby VZ 5b. VZ 5b has been sampled in a Rapid Data Point plot (RDP 12) and a BAM plot (BAM12). The species recorded and other characteristics of VZ 5b are detailed in Tables 3 and 6 and illustrated in Figure 20.

Like VZ 5b, VZ 5c is also considered to represent *PCT 1237 Blue Gum high forest*, as well as the Critically Endangered Ecological Community.

Figure 20: Vegetation Zone 5c (BAM10) showing the forest on the bank of the creek.
Photo by E. Ashby, 28th April 2020.

The distribution of TECs and Vegetation Zones in relation to the entire subject lot is shown in Figure 21 and in more detail at Figures 22 and 23.

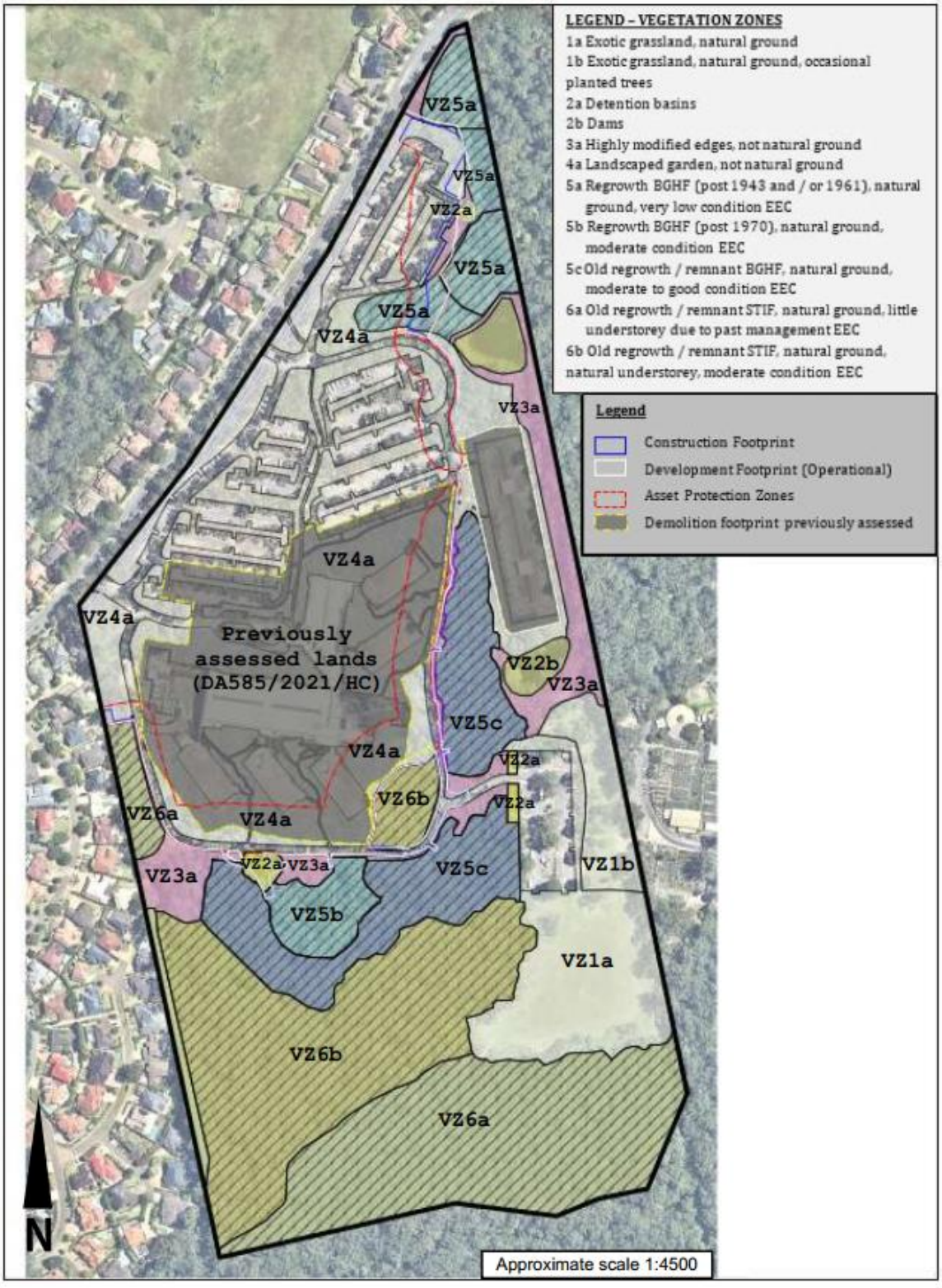

Figure 21: Vegetation Zones and TECs (diagonal stripes)

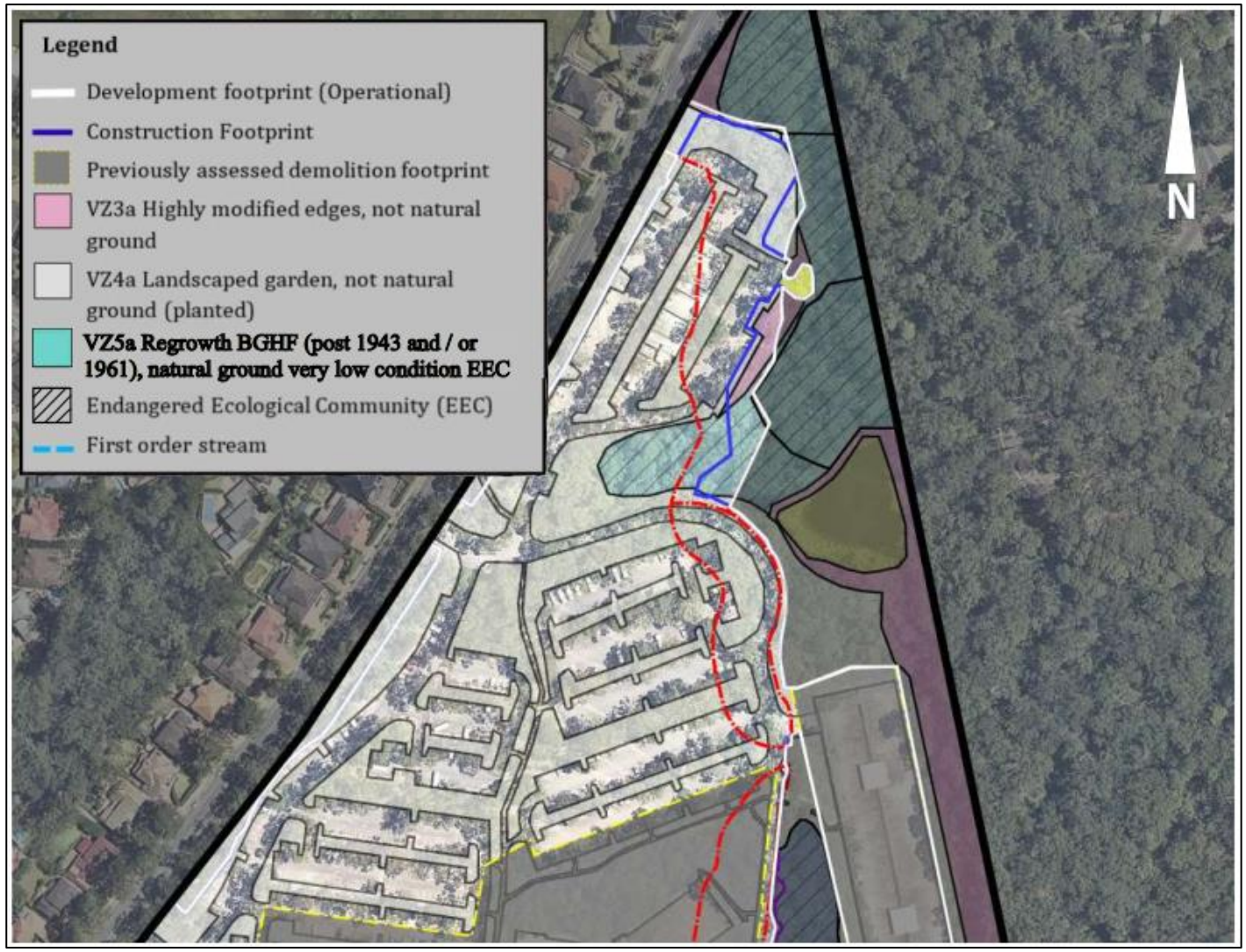

Figure 22: Vegetation Zones and TECs - detail northern end

Figure 23: Vegetation Zones and TECs - detail southern end

3.6 Vegetation Integrity Assessment

The biodiversity value of vegetation in a development site, including the threatened species they may support (and therefore ultimately the offsets required), is determined by its "integrity". In order to fulfil the vegetation integrity assessment, a number of features need to be defined and measured.

Vegetation Zones

Vegetation polygons are defined as constituting the same Vegetation Zone if they contain the same PCT in the same overall condition. Only **native vegetation** can be assessed for its integrity in the BAM calculator.

The identification of vegetation zones is described in Sections 3.3, 3.4, and 3.5 above, and relies upon a suite of information including

- Historical land use analysis
- Historical aerial photography
- Interpretation of current aerial photography
- Extensive random meander across the site in all seasons over a number of years
- Collection of floristic and structural information in Rapid Data Points
- Collection of full floristics, structure, and function data in BAM plots

The footprint will impact on the following Vegetation Zones:

- VZ 2a – 0.06 hectares, detention basins, does not include natural vegetation, exempt from offset
- VZ 3a – 0.08 hectares, highly modified edges, equivalent to *PCT 1237 Blue Gum high forest*, but not considered to be the CEEC
- VZ 4a – 2.40 hectares, planted native vegetation, not equivalent to any PCT and exempt from offset or assessment under Chapters 4 and 5 of the BAM
- VZ 5a – 0.20 hectares, highly modified multi-aged regrowth with elements of planted vegetation, equivalent to *PCT 1237 Blue Gum high forest*, considered to be CEEC
- VZ 5b – 0.01 hectares (55.86 square metres), even-aged regrowth equivalent to *PCT 1237 Blue Gum high forest*, considered to be CEEC
- VZ 5c – 0.01 hectares (78.96 square metres), remnant / old regrowth equivalent to *PCT 1237 Blue Gum high forest*, considered to be CEEC

Data for each of the BAM plot measured for Vegetation Zones 3a, 4a, 5a, 5b, and 5c are provided in Tables 1 to 5.

Patch Size

Patch size is an integral component of the BAM as it assists in the calculation and identification of the threatened species likely to use the habitats available on the development site, according to the respective PCTs. Species so identified are those likely to be impacted by the proposed

development and therefore are subject to further assessment.

Patch size is categorised within the BAM as <5 hectares, 5 to 24 hectares, 25 to 100 hectares, and ≥100 hectares. The close proximity of continuous vegetation to the identified Vegetation Zone in the project area imposes the patch size of ≥100 hectares.

Vegetation Integrity score

Vegetation integrity is an overall measure of the site's ecological value and is made up of a measure of its composition, structure and function. The integrity scores of the sample site are compared with the benchmark scores of the relevant PCT in order to judge its relative ecological value.

Benchmark data provided in the BAM tool for the PCT of interest for composition, structure and function are detailed below.

Composition condition scores are initially scored out of 100 and are calculated using the mean species richness of the growth form group. The average observed values for each growth form group are converted to an unweighted condition score.

Structure condition scores are calculated initially out of 100 and by the mean of all observed cover values for a growth form within a vegetation zone and is converted to a continuous unweighted condition score.

Function condition score is determined for a PCT classified as:

- vegetation formations that are rainforests, wet sclerophyll forests, dry sclerophyll forests, forested wetlands, grassy woodlands, semi-arid woodlands, and
- vegetation classes that are Wallum Sand Heaths, Sydney Coastal Heaths, Northern Montane Heaths, and Sydney Montane Heaths.

Current vegetation integrity (VI) scores and benchmark data are provided for VZ 3a, 5a, 5b, and 5c in Tables 8, 9, 10, and 11 respectively. No vegetation integrity assessment is required for Vegetation Zone 4a Planted Native Vegetation in accordance with Appendix D of the BAM.

Table 8a: Vegetation integrity data and benchmarks for Vegetation Zone 3a in the development area.

Vegetation Zone 3a							
Plant Community Type:	1237 – Blue Gum High Forest, not TEC						
Area: 0.08 hectares	**Condition class:** Low/Moderate; some planted vegetation with natural regrowth						
Composition condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 3	7	2	3	6	1	4	**41.5**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	9	15	6	8	5	13
Observed mean (x̄)	7	2	3	6	1	4
Unweighted composition score (UCSi)	93.7	3.2	59.1	91.9	8.6	23.3
Weighted composition score (WCSi)	15.1	0.9	6.3	13.1	0.8	5.4
Dynamic weighting (wi)	0.16	0.27	0.11	0.14	0.09	0.23

Structure condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 3	146.1	5.1	25.3	7.9	0.1	0.4	**49.9**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	73	52	8	4	15	20
Observed mean (x̄)	146.1	5.1	25.3	7.9	0.1	0.4
Unweighted structure score (USSi)	100	1.5	100	100	0	0
Weighted structure score (WSSi)	42.4	0.5	4.7	2.3	0	0
Dynamic weighting (wi)	0.42	0.3	0.05	0.02	0.09	0.12

Table 8b: Vegetation integrity data and benchmarks for Vegetation Zone 3a in the development area.

Vegetation Zone 3a											
Plant Community Type		1237 – Blue Gum High Forest, not TEC									
Area: 0.08 hectares		**Condition class:** Low/Moderate; planted gardens with natural regrowth									
Zone function data											
Plot	**Regenerating stems <5cm DBH**	**Stem classes**					**No. of large trees (>80cm DBHOB)**	**Hollow-bearing trees**	**Litter cover**	**Coarse woody debris**	**High threat weed cover**	**Current function condition score**
		5-9	**10-19**	**20-29**	**30-49**	**50-79**						
Plot 3	Absent	x	x	x	x	x	0	0	22.4	45	25.7	**39.3**

Calculation results						
	Regenerating stems <5cm DBH	**Stem size class**	**No. of large trees**	**Litter cover**	**Coarse woody debris**	**High threat weed cover**
Benchmark	Present	5	3	66	14	-
Observed mean ($\bar{x}$)	0	5	0	22.4	45	25.7
Weighted function score (WFSi)	0	15	0	4.3	20	-
Weighting (wi)	0.15	0.15	0.35	0.15	0.2	-
Overall current vegetation integrity score						
43.3						

Table 9a: Vegetation integrity data and benchmarks for Vegetation Zone 5a in the development area.

Vegetation Zone 5a							
Plant Community Type:	1237 – Blue Gum High Forest						
Area: 0.20 hectares	**Condition class:** Low/Moderate; some planted vegetation with natural regrowth						
Composition condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 3	8	2	2	2	2	5	**33.9**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	9	15	6	8	5	13
Observed mean (x̄)	8	2	2	2	2	5
Unweighted composition score (UCSi)	98.3	3.2	27.6	14.6	40	37
Weighted composition score (WCSi)	15.8	0.9	3	2.1	3.6	8.6
Dynamic weighting (wi)	0.16	0.27	0.11	0.14	0.09	0.23

Structure condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 3	37.6	1.5	0.3	0.2	7	70.3	**42.5**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	73	52	8	4	15	20
Observed mean (x̄)	37.6	1.5	0.3	0.2	7	70.3
Unweighted structure score (USSi)	61.8	0.1	0.1	0.3	52.8	100
Weighted structure score (WSSi)	26.2	0	0	0	4.6	11.6
Dynamic weighting (wi)	0.42	0.3	0.05	0.02	0.09	0.12

Table 9b: Vegetation integrity data and benchmarks for Vegetation Zone 5a in the development area.

Vegetation Zone 5a											
Plant Community Type		1237 – Blue Gum High Forest									
Area: 0.20 hectares		**Condition class:** Low/Moderate; planted gardens with natural regrowth									
Zone function data											
Plot	**Regenerating stems <5cm DBH**	**Stem classes**					**No. of large trees (>80cm DBHOB)**	**Hollow-bearing trees**	**Litter cover**	**Coarse woody debris**	**High threat weed cover**	**Current function condition score**
		5-9	**10-19**	**20-29**	**30-49**	**50-79**						
Plot 3	Absent		x	x	x	x	0	0	90.6	60	91.5	**49.2**
Calculation results												
	Regenerating stems <5cm DBH	**Stem size class**	**No. of large trees**	**Litter cover**	**Coarse woody debris**	**High threat weed cover**						
Benchmark	Present	5	3	66	14	-						
Observed mean (x̄)	0	4	0	90.6	60	91.5						
Weighted function score (WFSi)	0	14.2	0	15	20	-						
Weighting (wi)	0.15	0.15	0.35	0.15	0.2	-						
Overall current vegetation integrity score												
41.4												

Table 10a: Vegetation integrity data and benchmarks for Vegetation Zone 5b in the development area.

Vegetation Zone 5b							
Plant Community Type:	1237 – Blue Gum High Forest						
Area: 0.01 hectares	**Condition class:** Low/Moderate vegetation with some regrowth						
Composition condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 10	2	3	2	1	2	5	**19.6**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	9	15	6	8	5	13
Observed mean (x̄)	2	3	2	1	2	5
Unweighted composition score (UCSi)	11.1	8.6	27.6	2.7	40	37
Weighted composition score (WCSi)	1.8	2.3	3	0.4	3.6	8.6
Dynamic weighting (wi)	0.16	0.27	0.11	0.14	0.09	0.23

Structure condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 10	90	15.5	1.2	0.2	5.1	43.5	**63.3**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	73	52	8	4	15	20
Observed mean (x̄)	90	15.5	1.2	0.2	5.1	43.5
Unweighted structure score (USSi)	100	21.7	4.3	0.3	28.8	100
Weighted structure score (WSSi)	42.4	6.6	0.2	0	2.5	11.6
Dynamic weighting (wi)	0.42	0.3	0.05	0.02	0.09	0.12

Table 10b: Vegetation integrity data and benchmarks for Vegetation Zone 5b in the development area.

Vegetation Zone 5b											
Plant Community Type		1237 – Blue Gum High Forest									
Area: 0.01 hectares		**Condition class:** Low/Moderate									
Zone function data											
Plot	**Regenerating stems <5cm DBH**	**Stem classes**					**No. of large trees (>80cm DBHOB)**	**Hollow-bearing trees**	**Litter cover**	**Coarse woody debris**	**High threat weed cover**	**Current function condition score**
		5-9	**10-19**	**20-29**	**30-49**	**50-79**						
Plot 10	Present	x	x	x	x		0	0	60	15	22.3	**64.0**
Calculation results												
		Regenerating stems <5cm DBH		**Stem size class**			**No. of large trees**		**Litter cover**	**Coarse woody debris**	**High threat weed cover**	
Benchmark		Present		5			3		66	14	-	
Observed mean (x̄)		1		4			0		60	15	22.3	
Weighted function score (WFSi)		15		14.2			0		14.8	20	-	
Weighting (wi)		0.15		0.15			0.35		0.15	0.2	-	
Overall current vegetation integrity score												
43.0												

Table 11a: Vegetation integrity data and benchmarks for Vegetation Zone 5c in the development area.

Vegetation Zone 5c							
Plant Community Type:	1237 – Blue Gum High Forest						
Area: 0.01 hectares	**Condition class:** Moderate vegetation with some regrowth						
Composition condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 12	4	8	4	0	0	6	**46.3**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	9	15	6	8	5	13
Observed mean ($\bar{x}$)	4	8	4	0	0	6
Unweighted composition score (UCSi)	48.6	65	84.3	0	0	51.8
Weighted composition score (WCSi)	7.8	17.4	9	0	0	12
Dynamic weighting (wi)	0.16	0.27	0.11	0.14	0.09	0.23

Structure condition score							
Plot	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**	**Current composition condition score**
Plot 12	92.6	10.4	16.1	0	0	49.1	**61.3**

Calculation results						
Plot data	**Tree**	**Shrub**	**Grass and grass like**	**Forb**	**Fern**	**Other**
Benchmark	73	52	8	4	15	20
Observed mean ($\bar{x}$)	92.6	10.4	16.1	0	0	49.1
Unweighted structure score (USSi)	100	8.6	100	0	0	100
Weighted structure score (WSSi)	42.4	2.6	4.7	0	0	11.6
Dynamic weighting (wi)	0.42	0.3	0.05	0.02	0.09	0.12

Table 11b: Vegetation integrity data and benchmarks for Vegetation Zone 5c in the development area.

Vegetation Zone 5c											
Plant Community Type		1237 – Blue Gum High Forest									
Area: 0.01 hectares		**Condition class:** Moderate with some regrowth									
Zone function data											
Plot	**Regenerating stems <5cm DBH**	**Stem classes**					**No. of large trees (>80cm DBHOB)**	**Hollow-bearing trees**	**Litter cover**	**Coarse woody debris**	**High threat weed cover**	**Current function condition score**
		5-9	**10-19**	**20-29**	**30-49**	**50-79**						
Plot 12	Present	x	x		x		0	0	69	25	6.3	**64.2**
Calculation results												
	Regenerating stems <5cm DBH		**Stem size class**				**No. of large trees**		**Litter cover**	**Coarse woody debris**	**High threat weed cover**	
Benchmark	Present		5				3		66	14		
Observed mean (x̄)	1		4				0		69	25	6.3	
Weighted function score (WFSi)	15		14.2				0		15	20		
Weighting (wi)	0.15		0.15				0.35		0.15	0.2		
Overall current vegetation integrity score												
56.7												

4 THREATENED SPECIES

Section 5 of BAM 2020 details the process for determining the habitat suitability for threatened species. For the purposes of assessing impact and offset obligations under the BAM, threatened species are separated into two types, 'ecosystem' and 'species' credit species:

- **Ecosystem credit species** are those threatened species whose occurrence can generally be predicted by vegetation surrogates and/or landscape features, or that have a low probability of detection using targeted surveys. The Threatened Biodiversity Data Collection (TBDC) identifies the threatened species assessed for ecosystem credits. A targeted survey is not required to identify or confirm the presence of ecosystem credit species; and
- **Species credit species** are threatened species for which vegetation surrogates and/or landscape features cannot reliably predict the likelihood of their occurrence or components of their habitat. These species are identified in the TBDC. A targeted survey or an expert report is required to confirm the presence of these species on the subject land. Alternatively, for a development, activity, clearing or biodiversity certification proposal only, the proponent may elect to assume the species is present

Some threatened species may be identified as both ecosystem and species credit species, with different aspects of the habitat and life cycle representing different credit types. Commonly, threatened fauna species may have foraging habitat as an ecosystem credit, while their breeding habitat represents a species credit. The following sections outline the process for determining the habitat suitability for threatened species within the subject lot and development area, and the results of targeted surveys for candidate threatened species.

Background information was gathered on threatened species known to occur in the local area, comprising an interrogation of BioNet for threatened species recorded within 10 kilometres of the site, further filtered to a buffer area of 1.5 kilometres radius. This was combined with expert habitat assessment of the site and surrounds, and targeted survey where appropriate and possible.

4.1 Predicted Threatened Species (Ecosystem Credit Species)

The subject ecosystem credit species are detailed in Table 12 and have arisen from the assigning of PCT 1237 to impacted Vegetation Zones 3a, 5a, 5b, and 5c. All of these species were deemed to have potential habitat within the Vegetation Zones and therefore are included in the analysis.

Table 12: Ecosystem credit species derived from PCT 1237 in the BAM-C. Predicted threatened species were included in the BAM-C calculations.

Predicted Threatened Species list derived from PCT 1237 Blue Gum High Forest				
Scientific Name	**Common Name**	**Status *BC Act 2016***	**Status *EPBC Act 1999***	**Sensitivity to gain**
Anthochaera phrygia	Regent Honeyeater (Foraging)	CE	CE	High
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Moderate
Callocephalon fimbriatum	Gang-gang Cockatoo (Foraging)	V	-	Moderate
Calyptorhynchus lathami	Glossy Black-Cockatoo (Foraging)	V	-	High
Daphoenositta chrysoptera	Varied Sittella	V	-	Moderate
Dasyurus maculatus	Spotted-tailed Quoll	V	E	High
Glossopsitta pusilla	Little Lorikeet	V	-	High
Hieraaetus morphnoides	Little Eagle (Foraging)	V	-	Moderate
Hirundapus caudacutus	White-throated Needletail	-	V	High
Lathamus discolor	Swift Parrot (Foraging)	E	CE	Moderate
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V	-	High
Miniopterus australis	Little Bent-winged Bat (Foraging)	V	-	High
Miniopterus orianae oceanensis	Large Bent-winged Bat (Foraging)	V	-	High
Ninox connivens	Barking Owl (Foraging)	V	-	High
Ninox strenua	Powerful Owl (Foraging)	V	-	High
Phascolarctos cinereus	Koala (Foraging)	V	V	High
Pteropus poliocephalus	Grey-headed Flying-fox (Foraging)	V	V	High
Ptilinopus superbus	Superb Fruit-Dove	V	-	Moderate
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	High
Tyto novaehollandiae	Masked Owl (Foraging)	V	-	High

4.2 Candidate Threatened Species (Species Credit Species)

The potential candidate threatened are detailed in Table 13, and have arisen from the assigning of PCT 1237 to impacted Vegetation Zones 3a, 5a, 5b, and 5c. Of these species, the following 5 species were excluded from further consideration:

- ***Anthochaera phrygia* Regent Honeyeater.** The TBDC indicates that this species is a potential candidate species if there is mapped important habitat present. There is no such mapped habitat on or near the site. Important areas for this species have been identified around its breeding stronghold at Capertee Valley, in the Upper Hunter, Lower Hunter, and near Warragamba Dam.

  Of the 9 records of this species in the BioNet database within 10 kilometres of the site, none are from the site or within the assessment circle. Of these records, only one is recent (2019, from Bennelong Parkway).

  Given the mobility of this species and the degree of formal and informal birdwatching that is carried out in the bushland of the site and the contiguous vegetation in Cumberland State Forest (e.g. by Cumberland Bird Observers Club), the absence of records is considered an indication of how unsuitable the habitat is for this species.

- ***Lathamus discolor* Swift Parrot.** The TBDC indicates that this species is a potential candidate species if there is mapped important habitat present. It migrates from its breeding habitat in Tasmania, overwintering on the mainland, therefore, the presence of winter forage is essential for this species. There is no such mapped important habitat on or near the site. Important areas for this species have been identified across the state, and on the Cumberland Plain these areas are concentrated where *Eucalyptus tereticornis* Forest Red Gum or *Corymbia maculata* Spotted Gum are dominant in the vegetation.

  Of the 33 records of this species in the BioNet database within 10 kilometres of the site, none are from the site or the assessment area. While three records are from the local area (probably Cumberland State Forest), it has not been observed since 1992.

  Given the degree of formal and informal birdwatching that is carried out in the bushland of the site and the contiguous Cumberland State Forest (e.g. by Cumberland Bird Observers Club), the absence of records is considered an indication of how unlikely it is that this species will occur on site in large numbers. Therefore, it is considered to provide unimportant habitat for this species.

- ***Miniopterus australis* Little Bent-winged Bat.** The TBDC indicates that this species is a potential candidate species when specific breeding habitat features or indications of breeding are present. The habitat features include caves, tunnels, mines, culverts or other structure known or suspected to be used for breeding. Indications include the presence of a record in BioNet with microhabitat code "IC" (in cave) or "E" (nest/roost); an observation of >500 individuals; or information in the scientific literature.

  The site does not support any habitat features suitable for breeding or roosting. The BioNet database records within 10 kilometres of the site are confined to foraging records (codes AR, U, W) and Fox kill (V).

  This species roosts communally in caves or similar suitable spaces, often with *Miniopterus orianae oceanensis* Eastern Bent-winged Bat (Hoye and Hall 2008) and may form mixed clusters in winter (OEH 2020). In the Sydney area, there are a number of urban nonbreeding roost sites known to be occupied by *Miniopterus orianae oceanensis* Eastern Bent-winged Bat that extend from coastal military sites to drains in western Sydney (White 2011), and some may be shared by this species. Females gather in large maternity colonies in summer (Menkhorst and Knight 2001), and only five such sites are known across Australia (OEH 2020). The only known maternity roost for this species is in the Willi Willi Caves in the limestone near Kempsey (Dwyer and Hamilton-Smith 1965).

  The site does not provide suitable breeding habitat for this species and it can be dismissed as a potential candidate species.

- ***Miniopterus orianae oceanensis* Eastern Bent-wing Bat.** The TBDC indicates that this species is a potential candidate species when specific breeding habitat features or indications of breeding are present. The habitat features include caves, tunnels, mines,

culverts or other structure known or suspected to be used for breeding. Indications include the presence of a record in BioNet with microhabitat code "IC" (in cave) or "E" (nest/roost); an observation of >500 individuals; or information in the scientific literature.

The site does not support any habitat features suitable for breeding or roosting. The BioNet database contains two "E" records within 10 kilometres of the site – one from a known roost site in a drain at Castle Hill and the other from a tunnel constructed for the M2 at Bidjigal Reserve. All other records are foraging records of this species (codes A, AR, U, W), trapped (O, T), or injured/killed (WR, V).

This species roosts communally in caves or similar suitable spaces, often with *Miniopterus australis* Little Bent-winged Bat (Hoye and Hall 2008) and may form mixed clusters in winter (OEH 2020). In the Sydney area, there are a number of urban nonbreeding roost sites that extend from coastal military sites to drains in western Sydney (White 2011). A number of maternity sites are known across NSW, but all are distant from the Sydney Basin, being in limestone cave systems at Willi Willi, Bungonia, and Wee Jasper (Dwyer and Hamilton-Smith 1965).

The site does not provide suitable breeding habitat for this species and it can be dismissed as a potential candidate species.

- ***Pteropus poliocephalus* Grey-headed Flying-fox.** The TBDC indicate that this species is a potential candidate species because breeding camps are localised and, if impacted, must be offset by protecting and enhancing another breeding camp.

  Of the large number of records in BioNet of this species recorded within 10 kilometres of the site, none of the record indicate that a camp is situated on or near the site. The National Flying-fox Monitoring Program has counted flying-foxes in camps and reported on their since 2013. The latest information available[1] indicate that the nearest permanent camps are the national-important ones at Parramatta Park (6 kilometres to the south west) and Gordon (12 kilometres to the east).

  No camps were observed on or near the site during the years of survey of the subject lot, although individuals were recorded foraging on the trees in the northern end of the site in the summer of 2018-2019.

  It is considered that the site does not support suitable habitat for a breeding camp of this species and it can therefore be dismissed as a potential candidate species

[1] National Flying-fox Monitoring Viewer available at https://www.environment.gov.au/webgis-framework/apps/ffc-wide/ffc-wide.jsf

Table 13: Candidate threatened species derived from PCT 1237 Blue Gum High Forest.

Flora / Fauna	Scientific name	Common name	BAM-C Analysis		Present		
			Include	Exclude	Yes (surveyed)	Yes (assumed)	No (surveyed)
Fauna	*Anthochaera phrygia* (Breeding)	Regent Honeyeater		✓	Not applicable		
Fauna	*Callocephalon fimbriatum* (Breeding)	Gang-gang Cockatoo	✓				✓
Fauna	*Calyptorhynchus lathami* (Breeding)	Glossy Black-Cockatoo	✓				✓
Fauna	*Cercartetus nanus*	Eastern Pygmy-possum	✓			✓	
Fauna	*Chalinolobus dwyeri*	Large-eared Pied Bat	✓			✓	
Flora	*Galium australe*	Tangled Bedstraw	✓				✓
Flora	*Grammitis stenophylla*	Narrow-leaf Finger Fern	✓				✓
Flora	*Hibbertia spanantha*	Julian's Hibbertia	✓				✓
Fauna	*Hieraaetus morphnoides* (Breeding)	Little Eagle	✓				✓

Flora / Fauna	Scientific name	Common name	BAM-C Analysis		Present		
			Include	Exclude	Yes (surveyed)	Yes (assumed)	No (surveyed)
Fauna	*Lathamus discolor* (Important habitat)	Swift Parrot		✓	Not applicable		
Fauna	*Litoria aurea*	Green and Golden Bell Frog	✓				✓
Fauna	*Miniopterus australis* (Breeding)	Little Bent-winged Bat		✓	Not applicable		
Fauna	*Miniopterus orianae oceanensis* (Breeding)	Large Bent-winged Bat		✓	Not applicable		
Fauna	*Myotis macropus*	Southern Myotis	✓			✓	
Fauna	*Ninox connivens* (Breeding)	Barking Owl	✓				✓
Fauna	*Ninox strenua* (Breeding)	Powerful Owl	✓		Has been recorded nesting on site in previous years. Absent during this survey. Assumed present in nest tree closest to footprint.		
Fauna	*Phascolarctos cinereus* (Breeding)	Koala	✓				✓
Fauna	*Pommerhelix duralensis*	Dural Land Snail	✓		✓		

Flora / Fauna	Scientific name	Common name	BAM-C Analysis		Present		
			Include	Exclude	Yes (surveyed)	Yes (assumed)	No (surveyed)
Fauna	*Pseudophryne australis*	Red-crowned Toadlet	✓				✓
Fauna	*Pteropus poliocephalus* (Breeding)	Grey-headed Flying-fox		✓	Not applicable Present in VZ4a - foraging habitat only		
Flora	*Rhodamnia rubescens*	Scrub Turpentine	✓				✓
Flora	*Syzygium paniculatum*	Magenta Lilly Pilly	✓		✓ Planted in VZ4a		✓ Absent from VZ 3a,5a,5b,5c
Flora	*Tetratheca glandulosa*	-	✓				✓
Fauna	*Tyto novaehollandiae* (Breeding)	Masked Owl	✓				✓

4.3 Threatened Species Survey

Flora and fauna surveys were undertaken across the development site from 2014 to 2020 in all seasons, and included targeted surveys for most of the candidate species identified, as well as other threatened species otherwise considered to have a high likelihood to occur.

Threatened species surveys included the following techniques across the development lot:

- **Flora** – targeted searches within suitable habitats specific to each species, BAM plots, and random meander;
- **Invertebrates** – targeted transects within areas of suitable habitat, random meander, opportunistic surveys;
- **Amphibians** – BAR audio recording, targeted surveys around dams and riparian lands, active listening, opportunistic surveys;
- **Reptiles** - Camera trapping, spotlighting, opportunistic, scat searches;
- **Diurnal Birds** – BAR audio recording, camera trapping, active listening, dawn surveys, dusk surveys, opportunistic;
- **Nocturnal Birds** - BAR audio recording, camera trapping, active listening, stagwatching, spotlighting, call broadcast;
- **Arboreal mammals** – BAR audio recording, camera trapping, stagwatching, spotlighting, habitat assessment, including scat searches and tree scratches;
- **Terrestrial mammals** – Camera trapping, spotlighting, opportunistic, scat searches;
- **Megachiropteran bats** – BAR audio recording, spotlighting, active listening, opportunistic;
- **Microchiropteran bats** – ultrasonic audio recording (Anabat) and analysis.

Survey details for each of the candidate threatened species are provided in Table 14, and locations of survey activities are provided in Figures 24A to 24F.

Table 14: Survey for candidate threatened species. Blue coloured cells indicate when survey is optimal, ticks indicate when survey was conducted.

Month of Survey												Survey activity
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
***Callocephalon fimbriatum* Gang-gang Cockatoo**												
✓									✓		✓	• Opportunistic survey during all other activities. • Passive audio recording in December 2017, December 2018, July 2019, April 2020. • Specific diurnal bird spot counts undertaken in December 2017 (afternoon - Elizabeth Ashby) and December 2018 (morning – Gavin Shelley). • Opportunistic bird survey by specialist Corey Mead in winter and spring 2021.
***Calyptorhynchus lathami* Glossy Black-Cockatoo**												
						✓						• Opportunistic survey during all other activities. • Passive audio recording in December 2017, December 2018, July 2019, April 2020. • Specific diurnal bird spot counts undertaken in December 2017 (afternoon - Elizabeth Ashby) and December 2018 (morning – Gavin Shelley). • Opportunistic bird survey by specialist Corey Mead in winter and spring 2021.
***Cercartetus nanus* Eastern Pygmy-possum**												
												• No specific targeted survey undertaken. • Presence is assumed
***Chalinolobus dwyeri* Large-eared Pied Bat**												
											✓	• Ultrasonic recording carried out in December 2017 and 2018 for a total of 6 survey nights. • Insufficient survey to establish its presence / absence; presence is assumed.

Month of Survey												Survey activity
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
***Galium australe* Tangled Bedstraw**												
											✓	• Close searching of ground layer across development area undertaken by a team of 4 in December 2018. • Rapid Data Points and BAM plots measured in December 2017, March 2018, May and June 2019, and April 2020 – no *Galium* species recorded.
***Grammitis stenophylla* Narrow-leaf Finger Fern**												
					✓						✓	• Close survey of drainage outlet footprint and other potential suitable habitat along the creek bank undertaken by Principal Ecologist Elizabeth Ashby in June 2018. • Close searching of ground layer across development area undertaken by a team of 4 in December 2018.
***Hibbertia spanantha* Julian's Hibbertia**												
									✓			• Targeted survey of APZ and development footprint in October 2019 and October 2020 by authors. • Rapid Data Points and BAM plots measured in December 2017, March 2018, May and June 2019, and April 2020 – no narrow-leaved *Hibbertia* species recorded.
***Hieraaetus morphnoides* Little Eagle**												
									✓			• Opportunistic survey during all other activities. • Passive audio recording in December 2017, December 2018, July 2019, April 2020. • Specific diurnal bird spot counts undertaken in December 2017 (afternoon - Elizabeth Ashby) and December 2018 (morning – Gavin Shelley). • Opportunistic bird survey by specialist Corey Mead in winter and spring 2021.
***Litoria aurea* Green and Golden Bell Frog**												
											✓	• Targeted passive audio recording in December 2018 at dam.

Month of Survey												Survey activity
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
***Myotis macropus* Southern Myotis**												
											✓	• Ultrasonic recording carried out in December 2017 and 2018 for a total of 6 survey nights. • Insufficient survey to establish its presence / absence; presence is assumed.
***Ninox connivens* Barking Owl**												
					✓	✓	✓					• Targeted nocturnal survey carried out by passive listening, spotlighting, passive call recording, and motion cameras from 2017 to 2021. • Targeted search for likely hollows and signs of owl roosts carried out in 2019 by expert Dr Stephen Ambrose and in 2021 by specialist Corey Mead. This survey is ongoing.
Ninox strenua Powerful Owl												
					✓	✓	✓					• Targeted nocturnal survey carried out by passive listening, spotlighting, passive call recording, and motion cameras from 2017 to 2021. • Targeted search for likely hollows and signs of owl roosts carried out in 2019 by expert Dr Stephen Ambrose and in 2021 by specialist Corey Mead. This survey is ongoing.
***Phascolarctos cinereus* Koala**												
											✓	• Opportunistic survey during all other activities. • Targeted systematic survey using SPOT assessment technique carried out in December 2018 by team of 4 surveyors throughout the entire development footprint.
***Pommerhelix duralensis* Dural Land Snail**												
											✓	• Opportunistic survey during all other activities. • Targeted systematic survey in December 2020 by species expert (Dr Stephanie Clark) established population density and extent of species polygon. • Targeted survey of areas to be impacted by the works as well as in natural bushland on the subject lot and in immediately adjacent parts of Cumberland SF. In total, approximately 4.3 hectares of vegetation was surveyed over two nights.

Month of Survey												Survey activity
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
												• Survey techniques included diurnal searches of logs, rocks, ground debris, raking and searching of leaf litter, and nocturnal spotlighting to search for active individuals. Samples of leaf litter were also collected for analysis.
***Pseudophryne australis* Red-crowned Toadlet**												
											✓	• Opportunistic survey during all other activities. • Targeted audio call recording in gully system and passive listening in 2018.
***Rhodamnia rubescens* Scrub Turpentine**												
		✓	✓	✓	✓		✓		✓		✓	• Close survey of drainage outlet footprint and other potential suitable habitat along the creek bank undertaken by Principal Ecologist Elizabeth Ashby in June 2018. • Close survey of understorey across footprint by Principal Ecologist Elizabeth Ashby in June 2021. • Rapid Data Points and BAM plots measured in December 2017, March 2018, May and June 2019, and April 2020. • Close searching of ground layer across development area undertaken by a team of 4 in December 2018.
***Syzygium paniculatum* Magenta Lilly Pilly**												
			✓		✓							• Close survey of drainage outlet footprint and other potential suitable habitat along the creek bank undertaken by Principal Ecologist Elizabeth Ashby in June 2018. • Targeted survey in April 2021 when planted specimens were in fruit.
Tetratheca glandulosa												
		✓	✓	✓	✓		✓		✓		✓	• Close survey of drainage outlet footprint and other potential suitable rocky habitat along the creek bank undertaken by Principal Ecologist Elizabeth Ashby in June 2018. • Close survey of understorey across footprint by Principal Ecologist Elizabeth Ashby in August 2018 and June 2021. • Rapid Data Points and BAM plots measured in December 2017, March 2018, May and June 2019, and April 2020.

Month of Survey												Survey activity
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
												• Close searching of ground layer across development area undertaken by a team of 4 in December 2018.
***Tyto novaehollandiae* Masked Owl**												
					✓	✓	✓					• Targeted nocturnal survey carried out by passive listening, spotlighting, passive call recording, and motion cameras from 2017 to 2021. • Targeted search for likely hollows and signs of owl roosts carried out in 2019 by expert Dr Stephen Ambrose and in 2021 by specialist Corey Mead. This survey is ongoing.

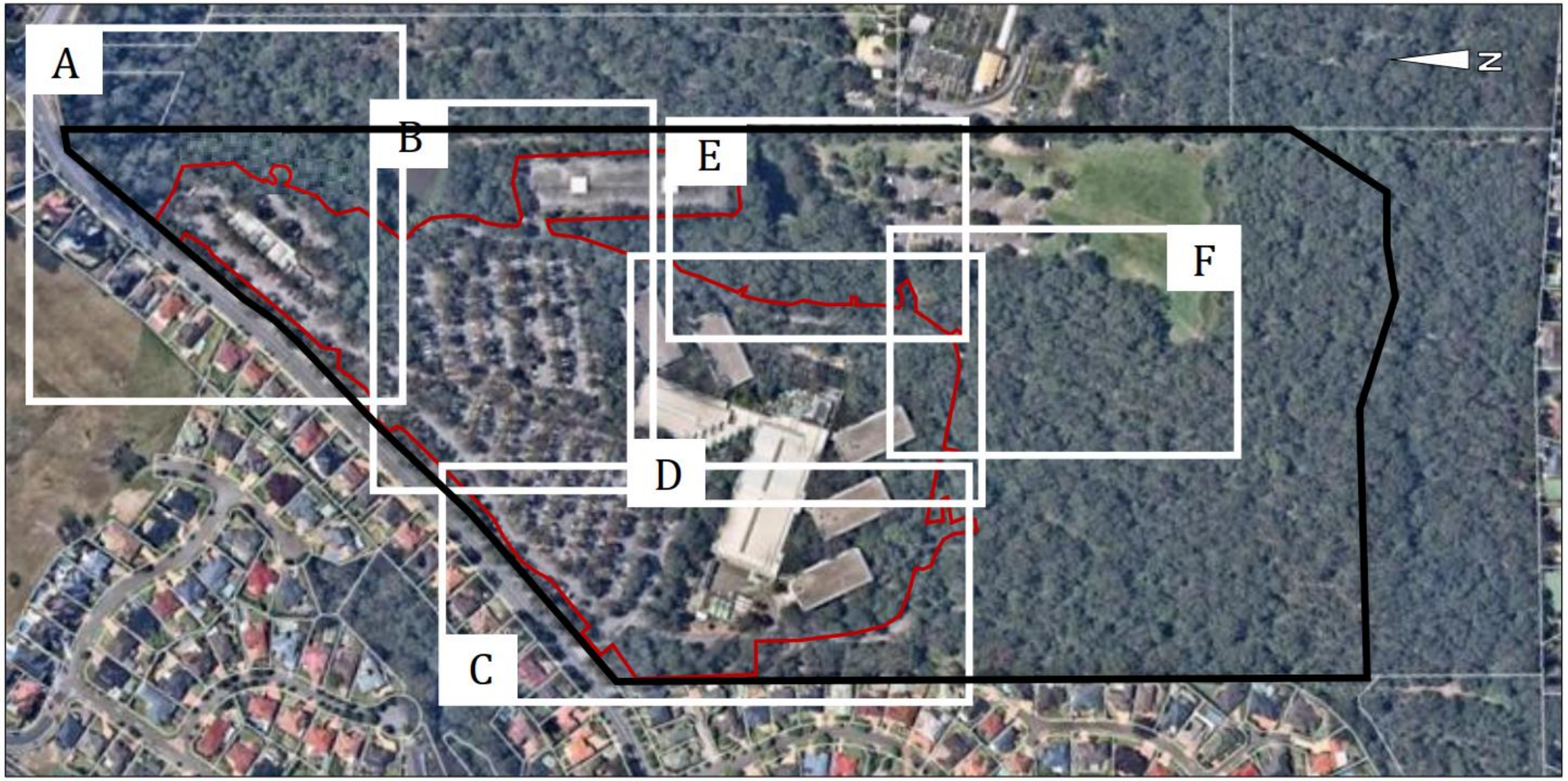

Figure 24: Fauna survey effort across the development footprint.

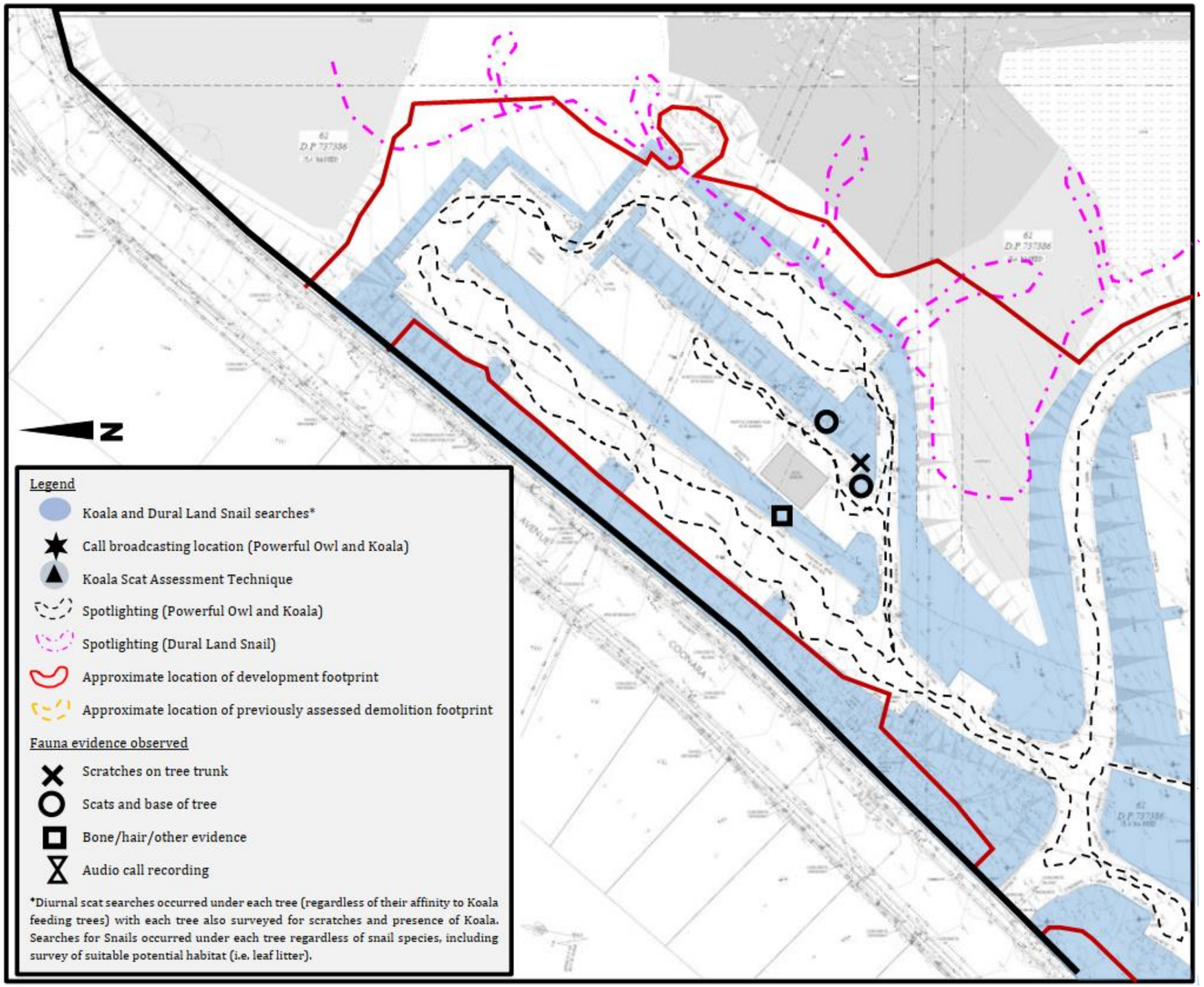

Figure 24A: Fauna Survey effort and general fauna evidence observed- section A.

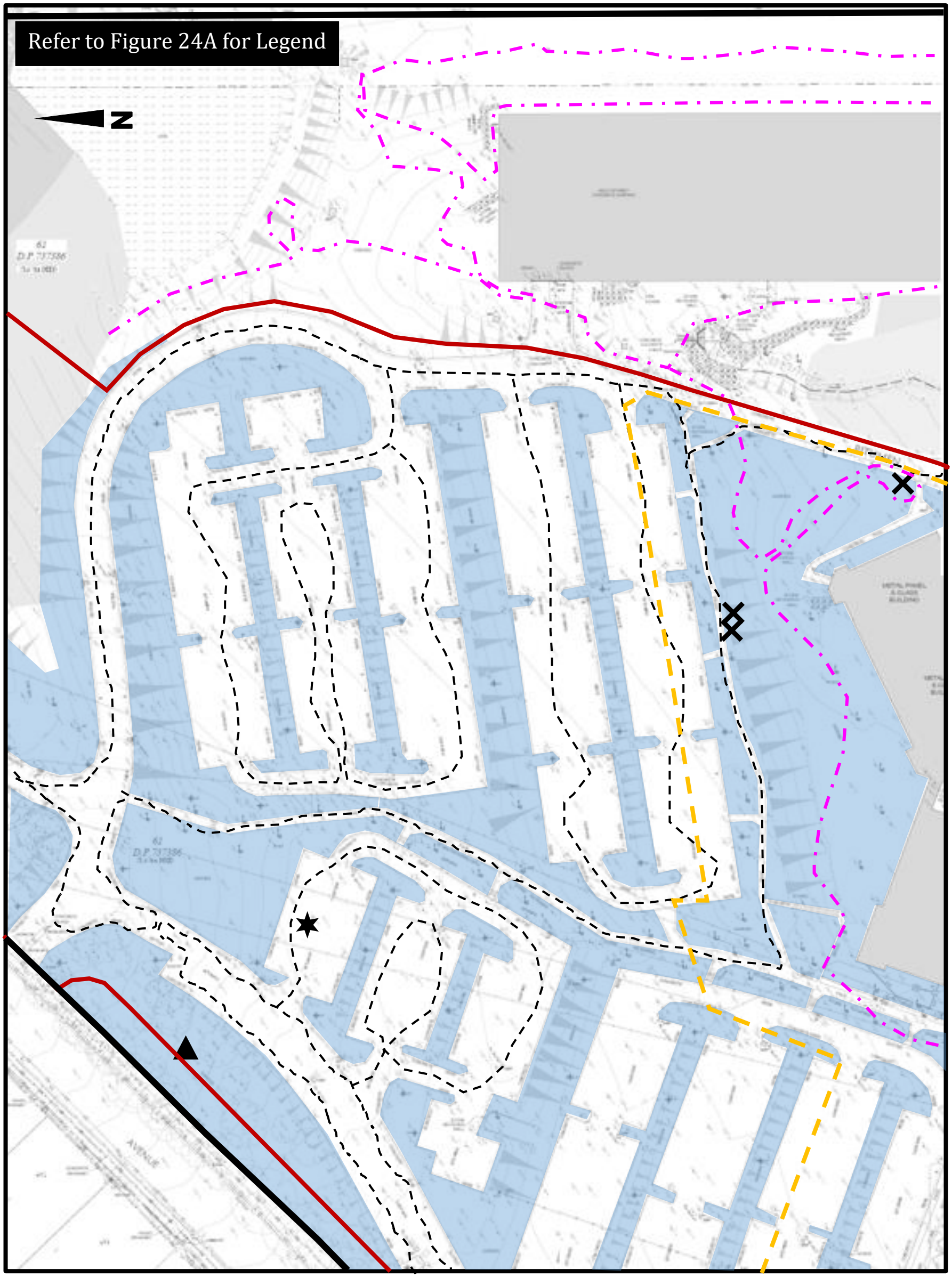

Figure 24B: Fauna Survey effort and general fauna evidence observed - section B..

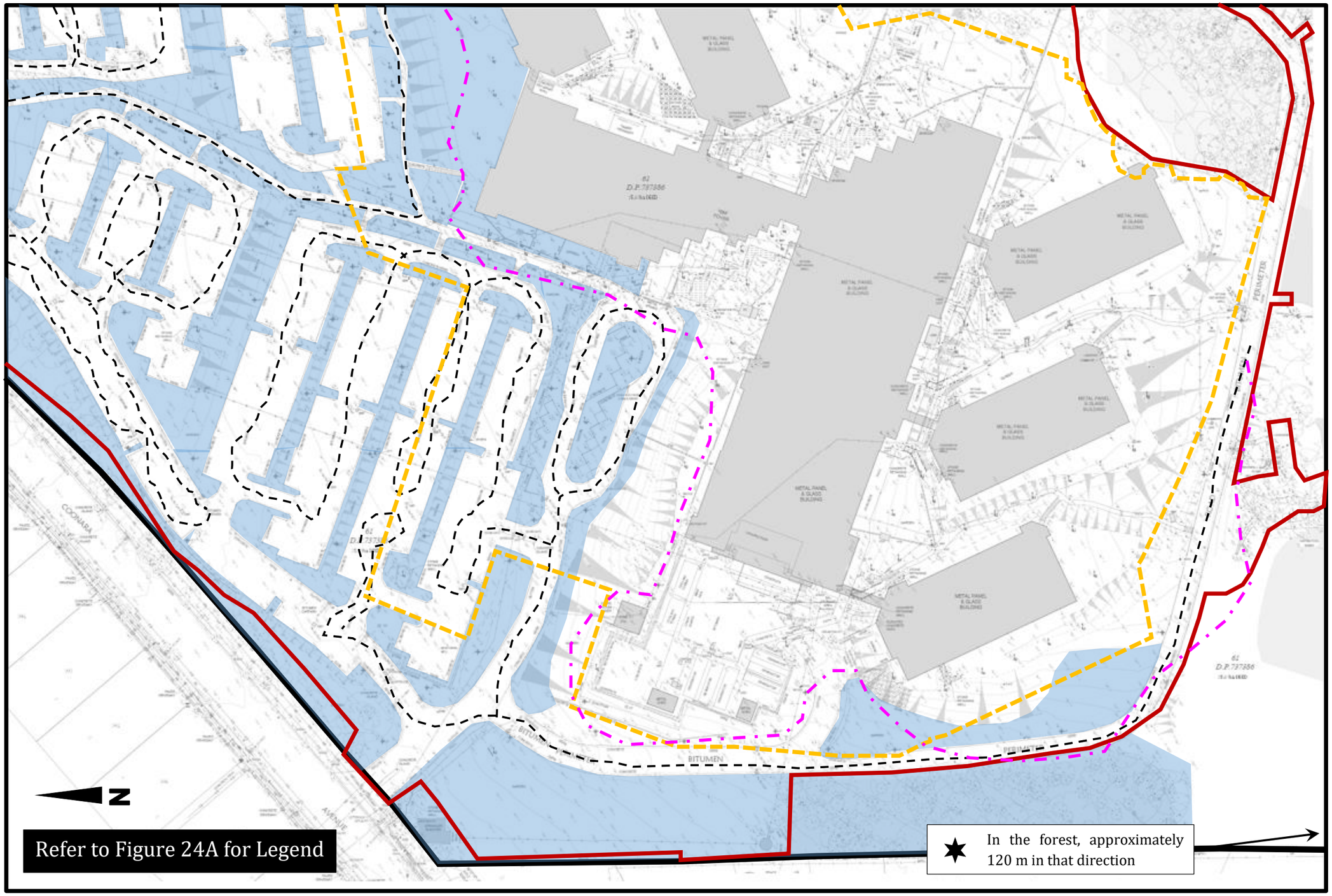

Figure 24C: Fauna Survey effort and general fauna evidence observed - section

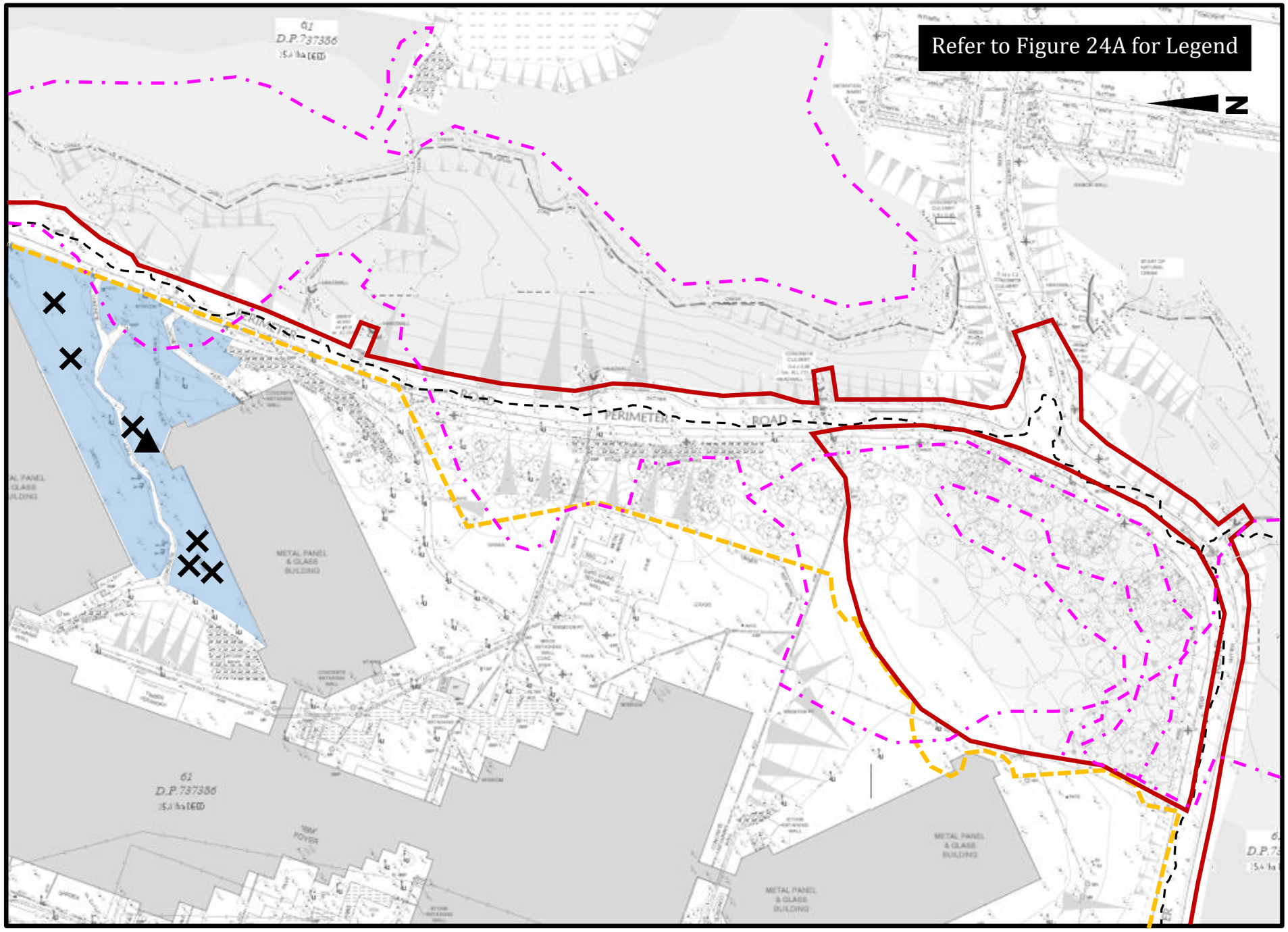

Figure 24D: Fauna Survey effort and general fauna evidence observed - section D.

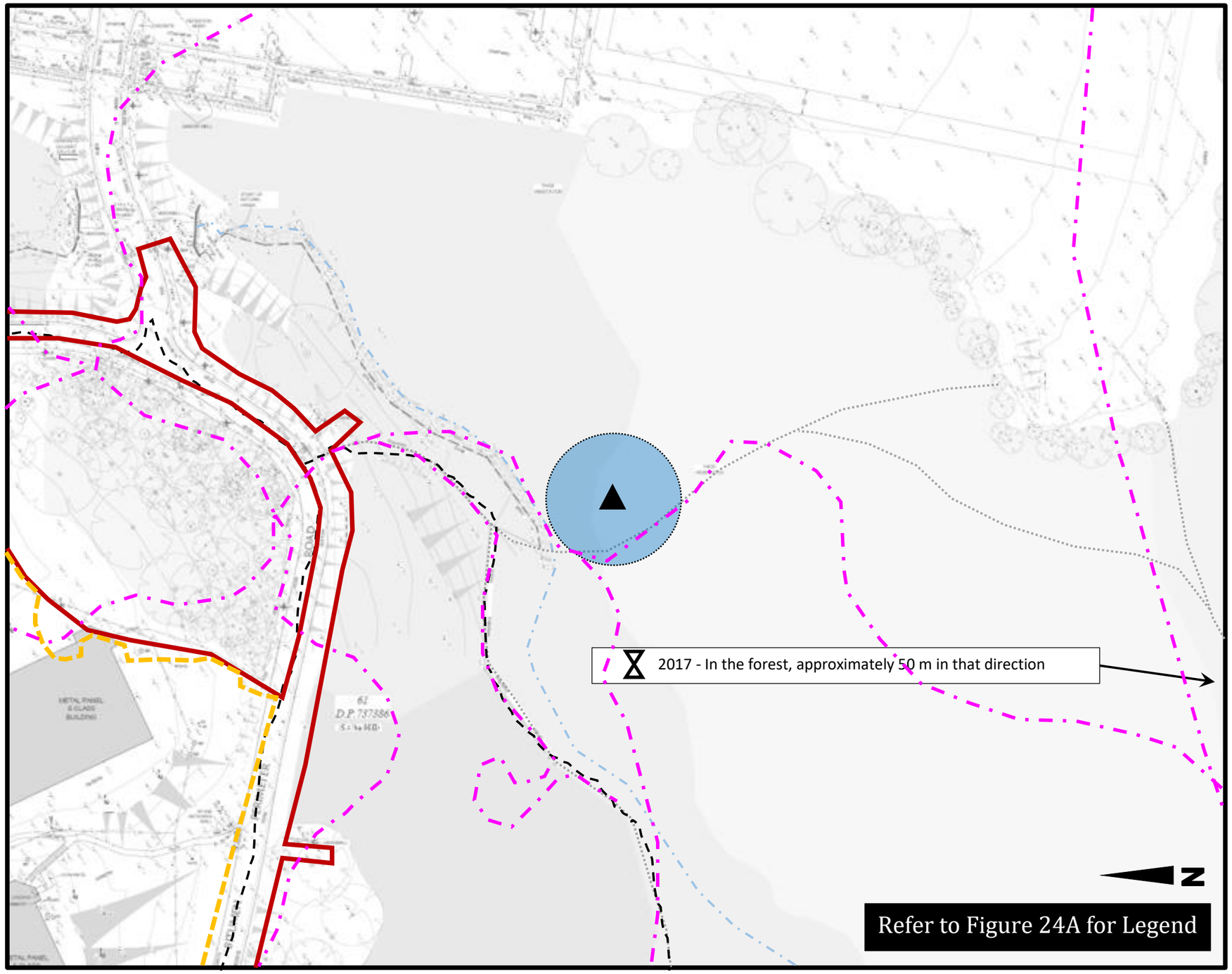

Figure 24E: Fauna Survey effort and general fauna evidence observed - section E.

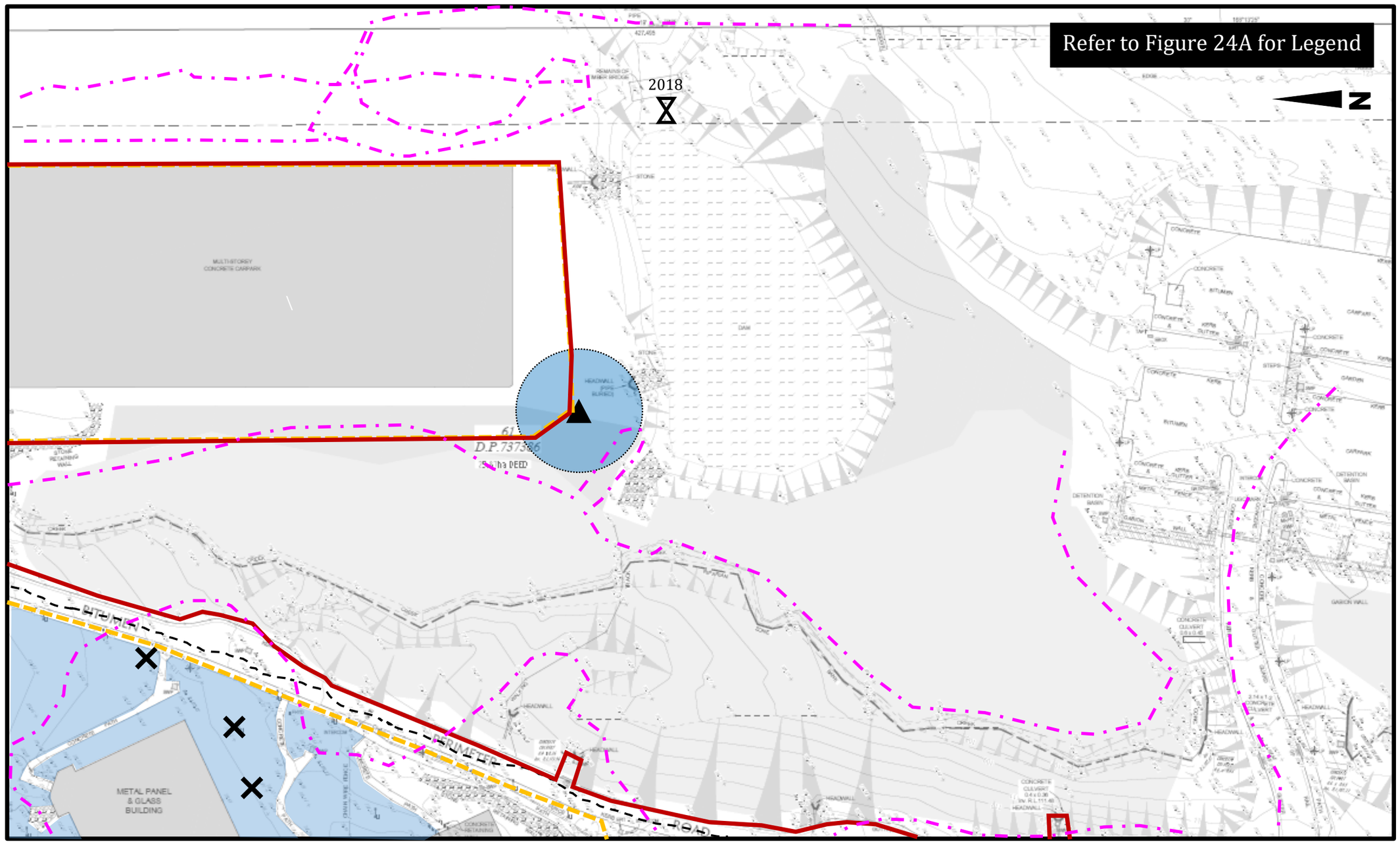

Figure 24F: Fauna Survey effort and general fauna evidence observed – section F.

4.4 Threatened Species Survey Results

Callocephalon fimbriatum **Gang-gang Cockatoo.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Calyptorhynchus lathami **Glossy Black-Cockatoo.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Cercartetus nanus **Eastern Pygmy-possum.** Targeted survey was not undertaken for this species. Therefore it is assumed to be present in all of the potential habitat to be removed in VZ 3a, 5a, 5b, and 5c, and this represents the species polygon for this species.

Chalinolobus dwyeri **Large-eared Pied Bat.** Sufficient survey to detect this species was not carried out and therefore it is assumed to be present in all of the potential habitat to be removed in VZ 3a (0.08 hectares), 5a (0.20 hectares), 5b (0.01 hectares), and 5c (0.01 hectares), and this represents the species polygon for this species.

Galium australe **Tangled Bedstraw.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset. Also, many recent records in NSW have been re-determined as other species of *Galium*, with *Galium australe* only confirmed from historical records in the Nowra and Narooma areas, and is extant in Nadgee Nature Reserve, south of Eden. The Biodiversity and Conservation Division of the Department of Planning and Environment therefore advise that only sightings from Nadgee Nature Reserve should be considered as *Galium australe.* Thus, this species can be discounted as a candidate species.

Grammitis stenophylla **Narrow-leaf Finger Fern.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Hibbertia spanantha **Julian's Hibbertia.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Hieraaetus morphnoides **Little Eagle.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Litoria aurea **Green and Golden Bell Frog.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Myotis macropus **Southern Myotis.** Sufficient survey to detect this species was not carried out and therefore it is assumed to be present in all of the potential habitat to be removed in VZ 3a (0.08 hectares), 5a (0.20 hectares), 5b (0.01 hectares), and 5c (0.01 hectares), and this represents the species polygon for this species.

Ninox connivens **Barking Owl.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

***Ninox strenua* Powerful Owl.** This species was not detected on the subject site during survey by Keystone Ecological or Treehouse Ecology. Importantly, it has not been detected breeding on the subject lot during the entire survey period, instead using nest trees in Cumberland SF. However, a pair is known to have nested in the past in two trees on the subject lot. The appropriate 100 metre radius buffer of one of these trees (tree 2) intersects with the development footprint.

Therefore, in recognition that there is still the **potential** for that impact to occur if the owls were to return and nest in that tree, the area of impact to that breeding habitat is to be offset. This species polygon is illustrated in Figure 25 and comprises VZ 3a (0.03 hectares) and VZ 5c (0.003 hectares). The majority of the impact area (0.09 hectares) occurs within VZ 4a which, as Planted Native Vegetation, cannot be reasonably assigned to a PCT and need not be offset.

During recent survey in Cumberland State Forest as part of Birdlife Australia's Powerful Owl Project, two individuals were observed in roosting separately by day in dense vegetation near the northern end of the subject lot. This vegetation is associated with a drain that passes under Castle Hill Road and it is overwhelmingly dominated by weeds in the understorey, such as is illustrated in Figures 16, 17, and 18. Although the diurnal roosts in the drain were not associated with breeding (as the sightings dated from February 2022, which is outside of the breeding season), a 50 metre radius buffer has been applied to the summer roost trees. The APZ has been located outside of this buffer to prevent interference with the preferred dense and moist microhabitat. This relocation of the APZ has necessitated a new layout to be developed for the northern section, comprising fewer dwellings and a different road configuration.

***Phascolarctos cinereus* Koala.** This species was not detected during comprehensive survey. Removal of potential habitat for the proposal is therefore not required to be offset.

***Pommerhelix duralensis* Dural Land Snail.** This species was detected during opportunistic survey (2 empty shells) and subsequent targeted survey undertaken by species expert Dr Stephanie Clark (18 live individuals).

The 18 live individuals of this species (comprising both adults and juveniles) were observed in the following 11 locations:

- 4 sites on and above the retaining wall to the north and east of the multi storey car park where one empty shell was found previously;
- 3 sites immediately adjacent and to the east of the car park in Cumberland State Forest;
- 1 site (and 1 individual) in the retained bushland where one of the empty shells was found previously;
- 1 site to the south of the works area in the retained bushland that is to be transferred to Forestry Corporation; and
- 2 sites in Cumberland State Forest beyond the subject lot to the south.

The habitats across the subject lot were classified in terms of their suitability for this species and potential habitat was mapped in consultation with Dr Clark (see Figure 26). A total of 12.81

hectares of potential habitat for this species was identified across the entire subject lot, of which 0.31 hectares occurs in the development footprint, comprising VZ 3a (0.01 hectares), VZ 4a (0.21 hectares), VZ 5a (0.083 hectares), VZ 5b (0.004 hectares), and VZ 5c (0.005 hectares).

Of the 4.3 hectares surveyed specifically for this species in December 2020, 1.86 hectares occurred within the areas subsequently classified as potential habitat for this species, giving a density of 8 snails per hectare of suitable habitat. However, survey conditions were not optimal as the rain that fell before and during survey was insufficient to moisten the leaf litter (personal communication Dr Stephanie Clark). The size of the population in the area surveyed is therefore considered to be larger than the 18 live animals observed.

The total area of habitat within VZ 3a, VZ 5a, VZ 5b, and VZ 5c are to be offset.

Pseudophryne australis **Red-crowned Toadlet.** This species was not detected in the footprint during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Rhodamnia rubescens **Scrub Turpentine. This** species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Syzygium paniculatum **Magenta Lilly Pilly.** A singe individual of this species was detected during survey. However, it is a planted specimen located within VZ 4a and therefore does not need to be offset.

Tetratheca glandulosa. This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

Tyto novaehollandiae **Masked Owl.** This species was not detected during survey. Removal of potential habitat for the proposal is therefore not required to be offset.

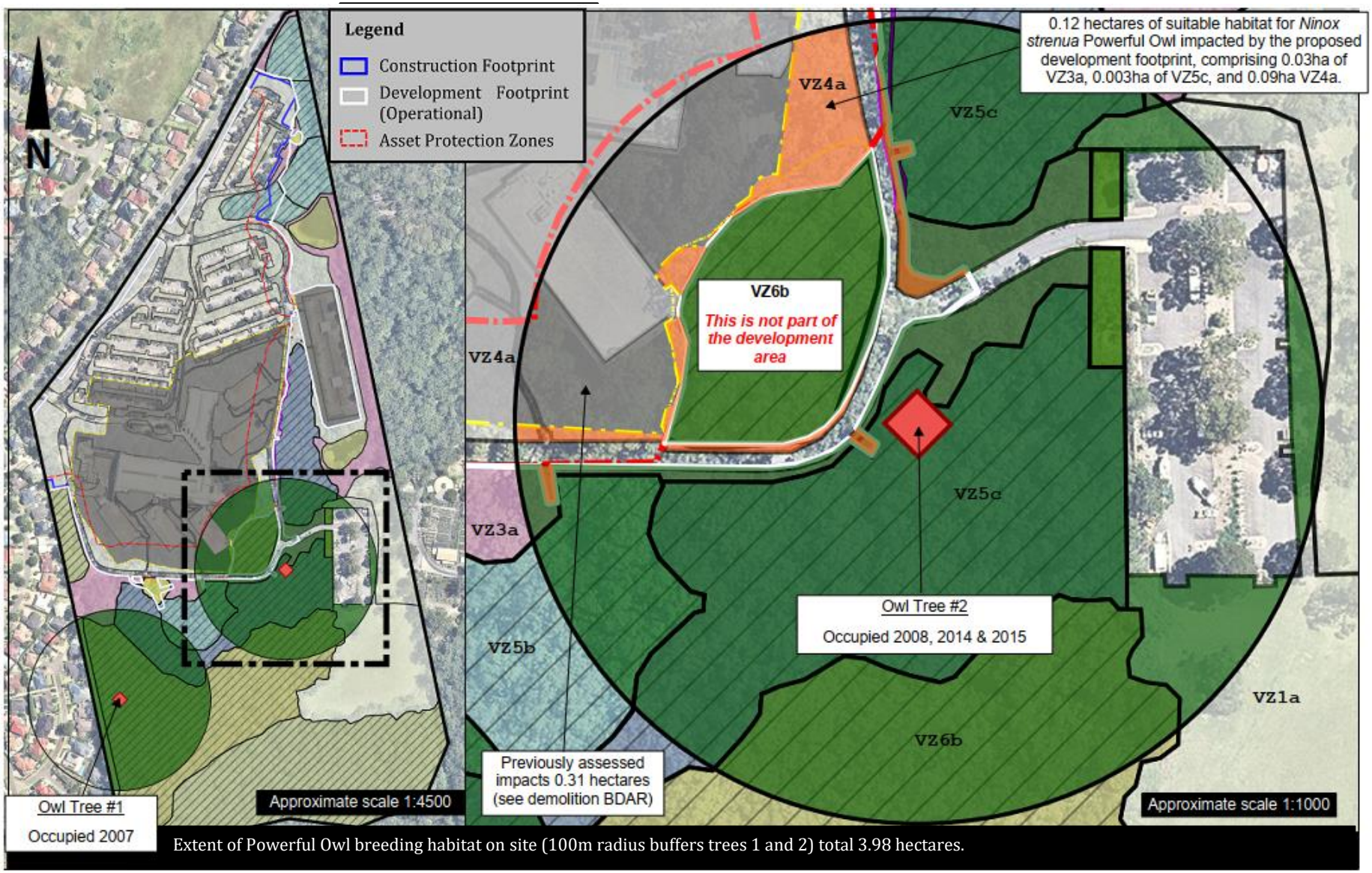

Figure 25: Powerful Owl species polygon comprising nest tree buffers.

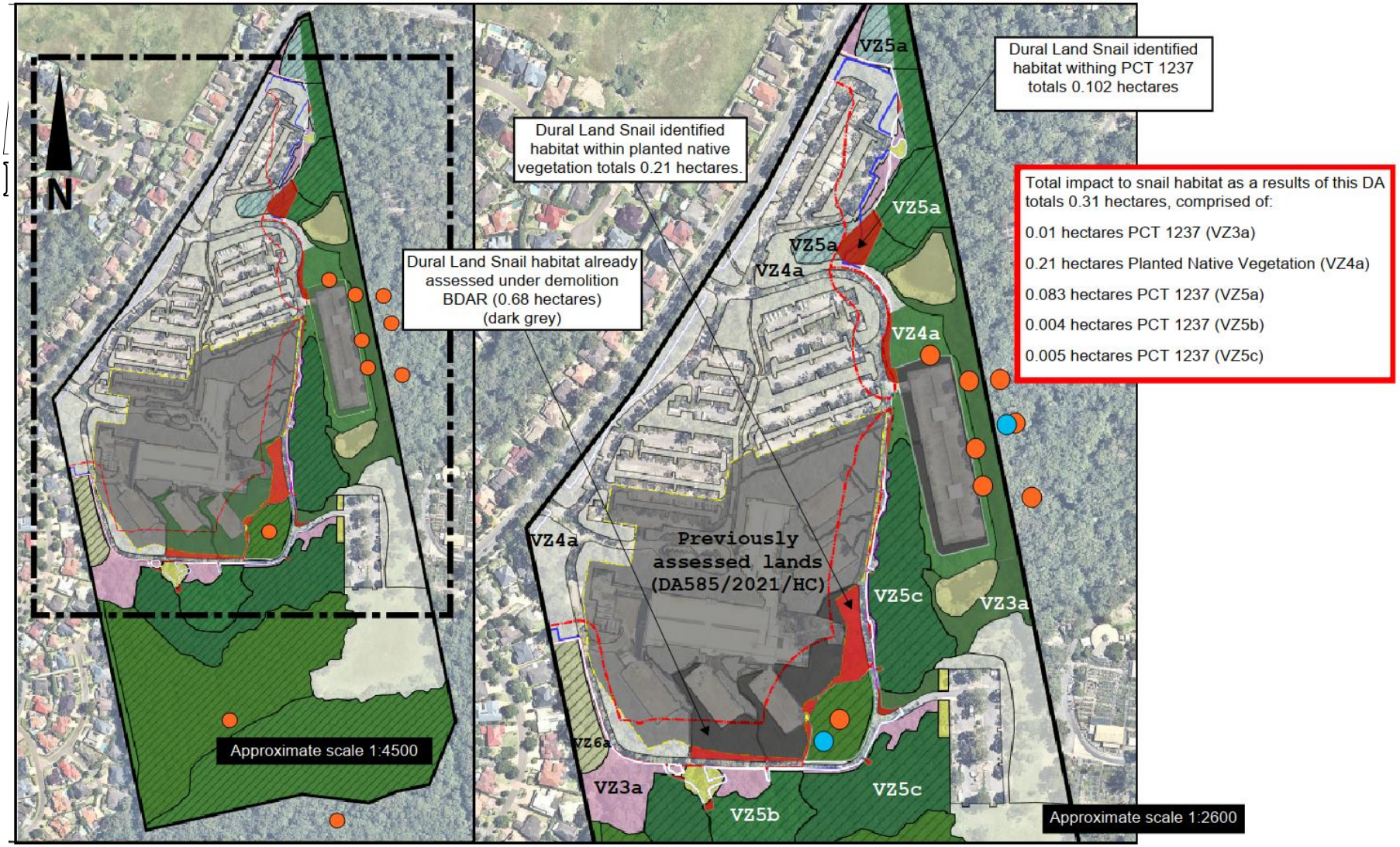

Figure 26: Survey results and species polygon for Dural Land Snail. Development footprint (white outline) in relation to live individuals observed (orange dot); empty shells observed (blue dot) and identified suitable species habitat on the subject lot (black diagonal hatching). The total area of suitable habitat across the subject lot totals 12.81 ha, while the extent of suitable habitat within the development footprint totals 0.31 ha.

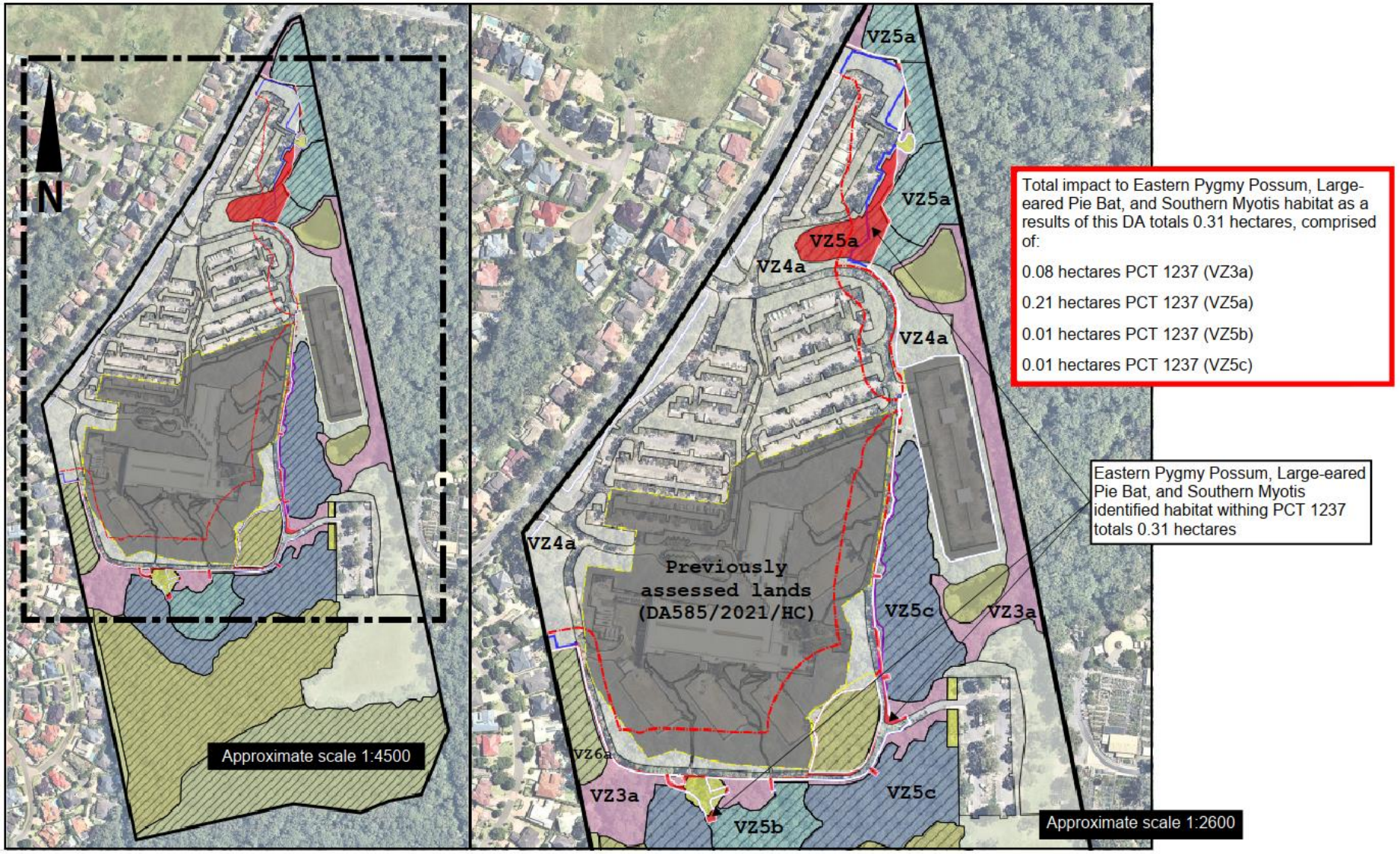

Figure 26A: Species polygons for Eastern Pygmy Possum, Large-eared Pied Bat, and Southern Myotis (comprises PCT 1237 within footprint).

5 PRESCRIBED IMPACTS

Impacts for which there is not a formal offset procedure are "prescribed impacts" as per Part 6 Division 6.1 of the *BCR 2017*.

Prescribed impacts are detailed in Chapter 6 of the BAM and include:

- Karst, caves, crevices, cliffs, rocks and other geological features of significance
- Human-made structures and non-native vegetation
- Habitat connectivity
- Water bodies, water quality and hydrological processes
- Wind farm developments
- Vehicle strikes

Of these, a number of prescribed impacts were identified within the development footprint and are detailed below. Note that although open air car parks are strictly human-made structures, they do not provide flora or fauna habitats and their removal are therefore dismissed as a potential prescribed impact. All other human-made structures to be removed have been addressed in the Demolition BDAR.

5.1 Removal of Non-native Vegetation

Non-native vegetation occurs in the development footprint in almost all of the impact areas. Some of these are horticultural exotics planted in the landscaped gardens (e.g. African Iris), while others are infestations of weeds (e.g. Lantana). Environmental weeds occur particularly in the ecotonal habitats in VZ3a and in the unmanaged understorey of surrounding forest.

The loss of non-native vegetation within the development footprint is a long term impact, as the area will be developed for housing or supporting infrastructure, or in a landscaped patch.

The Powerful Owl may prey on species that use dense weed patches, and the terrestrial species *Pommerhelix duralensis* Dural Land Snail may also live and forage in understorey habitat that contains exotic vegetation.

The most significant potential impact on biodiversity related to the removal of exotic vegetation is bush regeneration works in roosting habitat of the Powerful Owl. The Powerful Owl selects dense canopy for roosting (particularly in gully habitat) irrespective of the tree species. Rapid and widespread removal of dense stands of exotics such as Large-leaved Privet may displace the Powerful Owl, at least in the short to medium term.

5.2 Habitat Connectivity

The loss of 2.70 hectares of vegetation within the development footprint will have some impact on connectivity across the site and surrounds. At the local scale, connectivity is delivered by the connected habitats principally along the riparian corridors, but also across the contiguous habitat between the subject site and the adjacent Cumberland State Forest.

Connections with habitats that are more fragmented in the urban matrix are delivered by "stepping stones" of habitat, such as in the retained gully at the end of Lyndhurst Court to the north west of the subject lot. The stepping stone connectivity will be diminished in this direction – but only to a small degree - with the removal of the planted vegetation in the development footprint.

In all other directions, connectivity will remain unchanged.

5.3 Water Bodies, Water Quality and Hydrological Processes

The development lot contains a first order stream running from an existing dam in the north of the site to the south and south west, before joining Bellamys Creek, approximately 475 metres downslope of the lot. The stormwater drains from the existing developed areas feed into this gully, and will be maintained and upgraded as necessary to continue this hydrological function after redevelopment.

There is also a large detention basin on the southern side of the perimeter road that is to be upgraded to increase the storage capacity as part of the development proposal. The footprint of this stormwater infrastructure will remain the same as its current footprint, with an outlet draining south to a first order tributary of the main gully.

Works undertaken upslope of the riparian zones have the potential to impact on the quality of the water in the creeks through, for example, the mobilisation of exposed soils or the movement of pollutants in stormwater. These are short to medium term risks associated with the works phase.

During occupation, the quality of the water leaving the site and entering the local creek system may be compromised by pollutants washing from hard surfaces, or by herbicides and nutrients leaching out from gardens and lawns. The quantity of the water fed into the system as runoff may also be impacted by the extent and nature of hardstand.

5.4 Vehicle Strike

The numbers of vehicle movements experienced by the site since its original redevelopment from an orchard to office space have been significant and constant.

The open air and multi storey car parks dominate the existing site's development, with over 1,600 car parking spaces provided. This is a testament to the reliance on car travel for the large numbers of staff that populated the IBM buildings every day. The site was used day and night, 7 days a week, but most vehicle movements occurred in the morning and late afternoon / early evening from Monday to Friday, when the majority of the workforce arrived and left the site.

After the departure of IBM as the primary tenant, the vehicular use of the site continued with a variety of activities such as those associated with the Northconnex site office (including a workers car park, works compound and heavy machinery depot), sewer works, and the COVID-19 testing site. The on site traffic continued through the night for shift changeovers and truck and machinery

movements.

Death by fauna from vehicle strike has not been reported on site despite this high number of vehicular movements, but the surrounding busy roads – particularly Castle Hill Road – feature heavily in the WIRES database records.

STAGE 2 - IMPACT ASSESSMENT

6 AVOID AND MINIMISE IMPACTS

The *Biodiversity Conservation Act 2016* requires as a legislative imperative that impacts are to be avoided, then minimised by implementation of ameliorative measures, with offsetting only of unavoidable impacts. Prior to the commencement of this Act, this cascade of principles was only good practice, and not enforceable.

Potential impacts of this proposal have been avoided and minimised by application of this best practice protocol.

The location of the development footprint has been chosen as a result of a long and iterative process of ecological constraints assessment, starting in 2014. The initial constraints assessment (Ashby 2016) was based on site survey and analysis of published scientific papers and reports, interpretation of aerial photography, the interrogation of publicly available databases and supplemented by site visits in June 2014 and September 2015. The major objective of that early work was to establish the broad ecological parameters of the site: the classification and distribution of vegetation communities and the habitats available for threatened species of flora and fauna likely to occur on site.

The history and vegetation of the site was mapped by combining the aerial photography from 1943, the early 1980s and 2014, along with the most recent vegetation mapping produced by (then) OEH. Analysis of the topographic maps revealed the position and order of the gazetted streams on site and the extent of the protected Riparian Zones, pursuant to the Water Management Act (2000).

These data were then distilled in order to identify the ecological constraints of the site. The biodiversity features of the subject land were then ranked from 1 to 10 in order of ecological value, with existing built form ranked 1 and natural forest with no record of clearing ranked 10.

The map of these ecological constraints were then provided to a bushfire consultant (Mr Stuart McMonnies of Building Code and Bushfire Hazard Solutions) for the application of an appropriate Asset Protection Zone (APZ) that would be sufficient to protect potential development areas from the adjacent vegetated hazard. An Indicative Masterplan was then developed after these environmental constraints had been identified and mapped.

Impact avoidance has also been incorporated into the design in the event that past Powerful Owl breeding activity on site is repeated. There are two trees on the subject lot that have been used by Powerful Owls in the past for nesting. Although neither of these trees have been used for a number of years, and the resident pair is known to have nested in Cumberland State Forest for the last several breeding seasons, recommended buffers and other controls have been incorporated into the design in case the owls were to return. While the existing buffer distance from Powerful Owl nest tree 2 to the IBM building is less than 70 metres, this buffer has been extended for the redevelopment. The development footprint shows the closest building 105 metres away from nest tree 2; the recommended buffer distance is 100 metres.

The ecological survey continued and intensified, and as more detailed and comprehensive ecological information has been collected on the site, the Masterplan has been modified to avoid and minimise potential impacts to threatened species habitat (Powerful Owl and Dural Land Snail) and endangered communities (Blue Gum High Forest and Sydney Turpentine Ironbark Forest). Many of the modifications are small adjustments (e.g. to avoid impacts on individual trees), but are manifest most obviously in changes to the road design, deletion of the soccer field, and the APZ arrangement:

- Although not strictly required, a buffer has been applied to a Powerful Owl summer roost location in the northern part of the site. The reconfigured APZ and lot layout has resulted in the retention and protection of an area of dense vegetation - albeit highly modified and dominated by weeds – that was originally slated for APZ treatment.
- As the current perimeter road is narrow (4.5 metres wide), it needs to be expanded to carry two way traffic, including important emergency vehicles such as fire trucks. The original designs expanded the perimeter road *in situ* along its entire length in accordance with the engineering requirements.
  However, this widening was compromised in the vicinity of the south eastern corner by the Powerful Owl nest tree downslope in the gully, and the upslope occurrence of Sydney Turpentine Ironbark Forest (Vegetation Zone 6b) that also contained realised habitat for the Dural Land Snail. Safe passage along this stretch of road could not be achieved without imposing an impact on one of the important biodiversity features of the site.
  Therefore, the road design was entirely reconfigured so that – other than resurfacing works - the south eastern corner of the roadway is to remain as is, with the major carriageway instead to be constructed along the north western edge of the owl tree buffer outside of the Critically Endangered Ecological Community.
- The widening of the perimeter road along the rest of its length has been designed so that it expands inwards into the existing developed parts rather than outwards into the adjacent bushland.
- The soccer field (part of the original proposal) has also been deleted, which will remove potential disturbances to Powerful Owl breeding and roosting habitat from noise and activity on the field, additional traffic leading to the field, and the need to widen the perimeter road and entry bridge for buses to deliver school groups to the field.
- Similarly, the APZ has been applied from the outer edge of important vegetation inwards to the existing developed areas, rather than from a preferred building footprint out into the bushland. This is an unusual approach to designing residential development as it preferences biodiversity benefit over maximising yield.
- The existing stormwater detention basin within the proposed E2 zone and locations of all other stormwater detention basins within the development footprint identify the preference for re-utilisation and retrofitting of existing stormwater systems where possible in order to minimise potential ecological impacts. Infrastructure has also been designed to achieve suitable stormwater detention and runoff rates, and water quality best practice targets for the surrounding creek network.

The location chosen for the development footprint is the area of least biodiversity impact being where buildings, car parks, and planted gardens currently occur. All other parts of the site are constrained by the presence of important and sensitive biodiversity such as Critically Endangered Ecological Communities (BGHF and STIF) and Powerful Owl breeding habitat, as well as other important environmental features such as riparian corridors, and the necessity to include an APZ for the protection of the residents and neighbours.

There is no other suitable or viable alternative location within the property that can accommodate all of these objectives; the remainder of the site supports Critically Endangered Ecological Communities and creek lines and are therefore unsuitable for development consideration.

In summary, the location and extent of the project footprint was driven by the objective to avoid impacts on important biodiversity, and the extent and nature of the development has been modified as more and better information has been accumulated.

7 ASSESSMENT OF IMPACTS

Despite the careful initial location of the development footprint and the many modifications over time to avoid and minimise biodiversity impacts, the proposal cannot avoid all potential impacts to biodiversity of the site.

However, the first impact to be considered is illusory and is therefore dismissed. The development footprint is located in an area that is mapped as containing areas of high biodiversity value (see Figure 3) and is in fact the trigger for the Biodiversity Offset Scheme. These mapped polygons are defined as representing entities whose loss has the potential to bring about a Serious and Irreversible Impact (SAII), presumably being Blue Gum High Forest as is shown in identical polygons in the OEH mapping (see Figure 9).

The investigations undertaken for this BDAR have demonstrated that this mapping is in error. The mix of Australian native trees planted in the 1980's does not represent an occurrence of Blue Gum High Forest. The area in question is made up of planted native vegetation in a highly modified excavated environment, and its floristic composition cannot be reasonably assigned to any natural PCT.

This mapping mistake is explained by the methodology relied upon for the mapping, which in this case must have been principally the interpretation of aerial photographs. The pattern provided by the canopy of the dominant tree species in the car park (*Corymbia citriodora* Lemon-scented Gum) in aerial photographs is very similar to the canopy pattern provided by the tree species dominant in Blue Gum High Forest (particularly *Eucalyptus saligna* Sydney Blue Gum and *Eucalyptus pilularis* Blackbutt).

Therefore, this large scale impact on what was thought to be Blue Gum High Forest will not occur. However, while the development footprint will impact primarily on the existing built form, it will necessarily have impacts on the landscaped gardens embedded in the car parks and surrounding the buildings (VZ 4a), as well as on the edge habitats around the boundary of the footprint and in the APZ (VZ 3a).

Also, despite all of the deliberate decisions made and modifications incorporated into the design to avoid impacts, the final engineering details associated with the upgrade of the large detention basin will unavoidably result in small incursions into the surrounding vegetation that comprises Blue Gum High Forest Critically Endangered Ecological Community (VZ 5a, VZ 5b and VZ 5c). This arises from the need to provide access for machinery to the basin for the upgrade works, and the extent of the improved riprap outlet at the bottom of the basin.

The areas impacted by the development footprint that is the subject of this BDAR are made up of hardstand (car parks and roadways), plus:

- 0.06 hectares- VZ2a – No PCT - Detention Basins
- 0.08 hectares - VZ3a – PCT 1237 – Highly Modified Edges (contains BGHF characteristic species but is not CEEC)
- 2.40 hectares – VZ4a – No PCT – Planted Native Vegetation
- 0.20 hectares – VZ5a - PCT 1237 – Blue Gum High Forest (CEEC)

- 0.01 hectares – VZ5b - PCT 1237 – Blue Gum High Forest (CEEC)
- 0.01 hectares – VZ5c - PCT 1237 – Blue Gum High Forest (CEEC)

The distribution of these impacts is detailed for BGHF below in Figure 27.

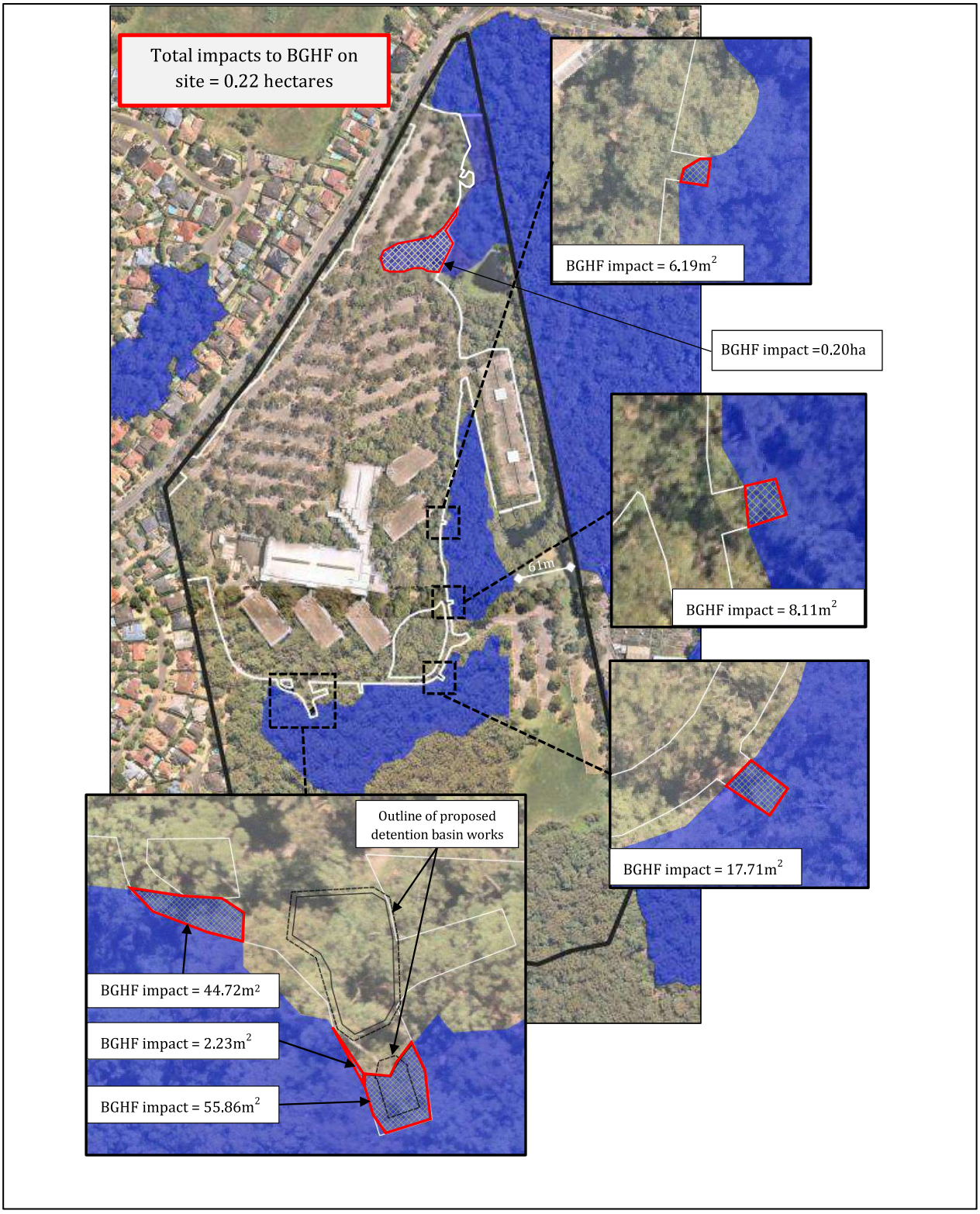

Figure 27: Detail of proposed impacts to BGHF (blue).

7.1 Potential Impacts to Vegetation Zone 3a

The highly modified edge habitats (Vegetation Zone 3a) are of significantly lesser ecological value than other patches of vegetation on the subject lot. The following factors all contribute to the vegetation within these areas as not representing the Critically Endangered Ecological Community Blue Gum High Forest, despite the presence of some characteristic species that makes PCT 1237 the most reasonable fit:

- These areas were planted out as part of the IBM development, but not as closely maintained as the landscaped gardens. Bush regeneration management also fell away after the first decade and as a result, a number of plants have freely established, including both native and exotic species.
- Due to its ecotonal position, many parts of Vegetation Zone 3a support significant weed loads, some of which are serious environmental weeds or transformer weeds recognised as Weeds of National Significance. Lantana, Small-leaved Privet, and Large-leaved Privet are the principal weed species in these categories, but there are also smaller outbreaks of other weeds with the potential to cause great environmental harm, such as African Olive and Asparagus species.
- The substrate in VZ3a comprises compacted fill, as it serves a structural purpose. The soil chemistry is therefore very different to that of the freer-draining clay loams that occur naturally on site, and its biotic composition would therefore be different, and probably highly simplified.

The loss of a total area of 0.08 hectares of Vegetation Zone 3a is made up of a number of small patches, as shown in Figure 8. The largest impact area is in the northern part of the lot, within the APZ.

The remainder of the impact comprises a set of small patches and edges associated primarily with the detention basin upgrade, and for a slight widening of the northern corner of the southern bridge leading to the already cleared part of the subject land to the east.

This scale and configuration of vegetation loss is unlikely to contribute significantly to harm for species likely to occur within these areas or use these areas as movement corridors.

7.2 Potential Impacts to Vegetation Zone 4a

The proposal has been deliberately concentrated in the already developed parts of the site so that the precious areas of natural forest can be retained and protected. Vegetation Zone 4a is integrated with the built form and the impact on this vegetation is therefore unavoidable. Because these are landscaped gardens – the majority in the development footprint for this DA being narrow garden beds in the open air car parks – they are of significantly lesser ecological value than other patches of natural vegetation on the subject lot. The following features contribute to this outcome:

- The planted landscaped gardens are relatively young, being planted in the early 1980s. As a consequence, although the trees are tall, they do not possess the additional habitat

values that old forests provide such as hollow-bearing trees. Hollows are an important habitat feature for many species of fauna, but particularly threatened species known from the local area. This is illustrated in Figure 13.

- The floristic composition and the pattern of planting reflects the design of the landscape plan, and is not a reflection of a natural system. The combination of species is not equivalent to any known plant community and therefore provides an unexpected mix of resources that may not provide sufficient resources through all seasons of the year for local threatened species. Notably, the planting mix is dominated by trees that flower in the spring-summer period, when winter blossom is critical for the persistence of many threatened fauna species.
- The planted *Corymbia citriodora* Lemon-scented Gum is one of the dominant planted species, being 22% of the trees planted. This species is native to Queensland and known to to readily hybridise with *Eucalyptus saligna* Sydney Blue Gum, a locally native species. This is an integral element of the significant patches of Blue Gum High Forest growing on and around the development lot. Thus the continued presence of *Corymbia citriodora* Lemon-scented Gum in such large numbers is a continued threat to the genetic integrity of the local critically endangered ecological community.
- *Casuarina glauca* Swamp Oak, represents 12% of the trees planted in the landscaped parts of the site. This species is native low-lying habitats on saline soils. They do not produce blossom, rarely produce hollows, and generally provide poor habitat for fauna.
- The trees – particularly in the car parks - have reached a growth limit imposed by the shallow excavated troughs into which they have been planted. During survey, they were observed to suffer regular heat stress and water stress, no doubt a result of the planting medium now being hydrophobic. Leaves and blossom of stressed trees provide forage of a lesser nutritional value to fauna species feeding on them.
- There are few patches with understorey, instead these garden beds are dominated by trees over bare ground or woodchips. At best, a sparse layer of plants occur but these are usually weed species (such as the exotic grass *Ehrharta erecta* Panic Veldtgrass).
- The configuration of most of the garden beds in this Vegetation Zone – narrow depauperate patches separated by expanses of car park or buildings – is fragmented and unsuited to many species of fauna. This is particularly so for small terrestrial species such as the Dural Land Snail that require habitat to be well connected.

7.3 Potential Impacts to Blue Gum High Forest Vegetation Zones 5a, 5b, and 5c

The impact area of Vegetation Zone 5a 0.20 hectares. The impact area of Vegetation Zone 5b is only 55.86 square metres and of 5c is 78.96 square metres, but for the purposes of the BAM-C, these figures are rounded up to 0.01 hectares for each Vegetation Zone. These areas re illustrated in Figure 27.

Notwithstanding the rounding up, the patches of 5b and 5c are very small areas of impact, being half and three quarters respectively of the the area occupied by the average Sydney Blue Gum tree in these Vegetation Zones.[2] These small impacts will occur at the edge of the works area associated

[2] Based on the Tree Protection Zones (TPZs) calculated from size data collected by the Project Arborist from

with the detention basin upgrade, and where machinery access must be provided to the basin.

The total area of Blue Gum High Forest across the subject lot in all condition states is 3.06 hectares; the impact area represents only 0.4% of this extent and a much smaller percentage of the extent in the local area.

While the impact to VZ 5a is larger – totalling 0.20 hectares – it is concentrated in a very weedy area of lesser biodiversity value.

Overall, the impacts to this vegetation have been avoided and minimised. These very small scale impacts are unavoidable and not sufficient to trigger a significant adverse impact, or a Serious and Irreversible Impact (SAII).

7.4 Potential Impacts to Powerful Owl

Habitat suitable for breeding, roosting (breeding and non-breeding), and foraging occurs in the forested parts of the subject lot, in adjacent Cumberland State Forest, and in nearby smaller and more fragmented habitats in parks, gardens, and golf courses. However, the only habitat that is subject to consideration under the BOS is breeding habitat, which is defined as and confined to the 100 metre radius buffer around past nesting sites.

The development footprint is concentrated in the existing footprint of the IBM site and the surrounding planted and modified vegetation. The vegetated area in the footprint (3.09 hectares) may provide habitat for prey species of the resident Powerful Owls, the most favoured being Common Ringtail Possum, Grey-headed Flying-fox, and Australian Brush Turkey. Such habitat is common across the subject lot (most of which is to be conserved) and in the adjoining Cumberland State Forest. These prey species are also common in the surrounding urban areas.

The Powerful Owl preferentially roosts in dense canopy, and the areas with the most suitable canopy occur within the gullies. These gully habitats are all protected, being within the riparian zones of the creek lines. The only potential impacts to these habitats may arise from weed removal implemented as part of their conservation management.

The trees that define the species polygon for this species are not active nest sites, with nest tree 1 used in 2007, and nest tree 2 in 2008, 2014, and 2015. The birds are known to have been nesting in the adjacent Cumberland State Forest since 2018. However, in recognition that they may use the nest trees again, the potential impact of the proposal on this breeding habitat has been considered. These buffers are shown in Figure 25 in relation to Vegetation Zones and the proposal's footprint.

The buffer around nest tree number 1 is clear of the proposed works, and will remain in its current form in the post-development landscape, and dominated by bushland.

However, the buffer for nest tree number 2 is more complex. It currently has one of the IBM

32 *Eucalyptus saligna* trees that occur in Vegetation Zones 5b and 5c. The average TPZ radius from these 32 trees is 5.72 metres, giving an average TPZ area of 103 square metres.

buildings almost entirely within the buffer and only 67 metres from the tree. The buffer is bisected by the perimeter road and vehicle bridge, and also contains an open air car park, two detention basins, and part of the cleared grassland. Vegetated parts of the buffer includes Highly Modified Edges (VZ 3a), Planted Native Vegetation (VZ 4a), Sydney Turpentine Ironbark Forest (VZ 6b), and Blue Gum High Forest (VZ 5b and 5c), including a gully.

The works area within this buffer includes 0.31 hectares of built form and VZ 4a that falls within the previously assessed demolition footprint, and 0.12 hectares of VZ 4a and VZ 3a within the works area that is the subject of this current BDAR. These impact areas will be incorporated into the APZ and the new section of road that allows the perimeter road (that is much closer to the nest tree) to remain *in situ.*

The proposed works in the outer part of the buffer (mostly) includes works already approved: demolition of the building, removal of planted vegetation, building of a road, widening of the corner at the bridge, and establishment of the APZ. This will occur across 0.53 hectares (or 17%) of the 3.14 hectare buffer.

The purpose of the buffer is to prevent disturbances during the breeding season that might stop the establishment of a nest or contribute to the abandonment of a nest. The buffer to nest tree number 2 is already partially developed and busy with lights, movement, and noise. At night, lights shine into the bushland around tree number 2 from the office building, the street light, and lights in the open air car park. North Connex workers used the perimeter road 24 hours per day, with many heavy vehicle movements.

As the resident Powerful Owls have been successfully breeding on the site and Cumberland State Forest for many years, they are presumably habituated to human activity on and around the site, including that around nest tree number 2. The ultimate uses of the outer part of the buffer around nest tree 2 will be less intrusive than those previously experienced, as no buildings will occur within 100 metres of the tree and there will be fewer light sources, with none directed into the bushland. Therefore, the new potential impacts to this breeding habitat will be confined to the period of the clearing and construction work itself, and the transformation of areas of landscaped garden to APZ.

It is important to note that these potential impacts will **only** occur if the birds return to use nest tree number 2 again. If they continue to use nest trees elsewhere (such as in Cumberland State Forest where they have been breeding for the last several years), then there will be no potential impact to Powerful Owl breeding habitat wrought by any stage of the proposal.

7.5 Potential Impacts to Dural Land Snail

Surveys established the presence of this species in suitable habitat to the east and south east of the project area, as well as in the southern bushland and in Cumberland State Forest. The area of suitable habitat on the subject lot and in the works area (the species polygon) was identified by species expert Dr Stephanie Clark. The extent of this habitat and the impact arising from the footprint are shown in Figure 26.

The development footprint contains 0.31 hectares of suitable habitat comprising:

- 0.01 hectares within VZ3a – *PCT 1237 – Blue Gum High Forest* (Not CEEC)
- 0.21 hectares within VZ4a – No PCT – Planted Native Vegetation
- 0.083 hectares within VZ5a – *PCT 1237 – Blue Gum High Forest* (CEEC)
- 0.01 hectares within VZ5b – *PCT 1237 – Blue Gum High Forest* (CEEC)
- 0.01 hectares within VZ5c – *PCT 1237 – Blue Gum High Forest* (CEEC)

Notwithstanding that the density is likely to be greater than that observed, the observed density of 8 snails per hectare of suitable habitat surveyed gives a likely total population size of at least 97 across the 12.13 hectares of suitable habitat identified and remaining in the development footprint, and at least 102 in total including the habitat within the previously assessed demolition footprint. As the proposed amelioration includes relocation of snails from the demolition footprint into adjacent secure habitat, this larger population size is considered to be maintained.

Applying the 8 snails per hectare density measure to the 0.31 hectares of suitable habitat within the development footprint, means that 2 individuals could be expected to be impacted, or 2% of the population on the subject lot.

The suitable habitat on the subject lot is directly connected to realised suitable habitat in Cumberland State Forest. This is in turn directly connected to potential and realised habitat to the south west and beyond, as individuals have also been found in bushland associated with Darling Mills Creek and its tributaries to the west and north west (personal communication Dr Stephanie Clark). The total area of connected bushland that potentially provides habitat for this species (including the subject lot) is therefore 301 hectares; most of this habitat is in reserved land or land otherwise zoned for protection.

The development footprint will remove only 2.4% of the habitat on the subject lot, and only 0.1% of the contiguous habitat judged to occur in the local area.

8 MITIGATION AND MANAGEMENT OF IMPACTS

8.1 General Controls

To mitigate potential impacts to native vegetation and threatened species and their habitats, a number of ameliorative measures are to be implemented as part of the proposed works. These are detailed in Table 15.

These include:

- Protective fencing;
- Installation and maintenance of erosion and sedimentation controls;
- Implementation of hygiene protocols;
- Control of weeds;
- Pre-clearing and monitoring surveys for targeted fauna;
- Enrichment of habitat for hollow-dependant fauna in adjacent secure habitats;
- Continued targeted monitoring of Powerful Owl breeding activity;
- Implementation of additional controls on works if Powerful Owl breeding occurs within a pre-set distance of works;
- Slow and gradual replacement of exotic species with suitable fast-growing native species in Powerful Owl roosting habitat;
- Removal of habitats under ecological supervision;
- Establishment of APZ in vegetated parts to retain as much vegetation as is allowed under the IPA specifications (e.g. 15% tree canopy). This will result in the retention of some biodiversity values ; and
- Tree removal to be supervised by a Project Arborist.

8.2 Dural Land Snail

Although the population of the Dural Land Snail is considered capable of withstanding a loss of 2%, a pre-clearing mitigation or salvage translocation protocol will be implemented by accredited species expert Dr Clark prior to works, in order to prevent and minimise the loss of individuals.

Dr Clark advises that the close proximity and continuity between the habitat to be cleared and the habitat to be retained means that the individuals present can be considered to constitute a single genetically-related population. Therefore it is not anticipated that the relocation will disrupt the genetic integrity of the inhabitants of the recipient area.

Daylight survey will first be conducted by Dr Clark to check on the relative value ranking of potential habitat for this species in donor and recipient areas. Recipient areas must contain habitat of high value (or be able to be enriched by simple provision of additional habitat features such as coarse woody debris), be protected from future anticipated impacts (e.g. edge effects), and have a secure conservation tenure. The resultant map will guide the subsequent survey and relocation actions.

After site preparation and habitat mapping, Dr Clark will undertake nocturnal surveys of areas of potential habitat identified in the donor and recipient vegetation. This survey is to be undertaken under optimum conditions – in the warmer summer months, preferably while raining or when the leaf litter is wet from adequate recent prior rain.

All individuals observed will be logged (age, activity, location) and those observed in the development areas will be collected for eventual relocation.

The distribution and abundance of individuals observed and the quality of habitat in the retained vegetation will determine where the salvaged individuals are to be released. Data to be logged include the locations of the release sites, the number and ages of resident animals, and the number and ages of released animals.

Follow up monitoring and any additional relocations are to occur on a monthly basis during the warm summer months until vegetation clearing works commence in the development area. A control area will also be monitored pre and post relocation. The control area is to be close enough to the site to to experience the same climatic conditions, but far enough away so as not to be impacted by the presence of relocated animals. If the population dynamics of the control area and relocation area are not significantly different, then the relocation is considered to be a success.

Monitoring of the recipient and control areas will continue on an annual basis for the life of the VMP.

Survey and results are to be written up in brief annual reports and provided to Council, with a final report to include all results, conclusions, and recommendations.

This type of relocation protocol has been implemented successfully for closely-related *Meridolum* and *Pommerhelix* species by Dr Clark as an ameliorative measure for development in other locations in metropolitan Sydney (e.g. Halcrows Road Cattai).

As this mitigation translocation is proposed as part of a Development Application, it does not trigger the provisions of the *Translocation operational policy* (Department of Planning Industry and Environment 2019). However, this protocol is considered to be largely consistent with that document's principles in the following ways:

- *Pommerhelix duralensis* Dural Land Snail is a threatened species that is at a greater risk remaining in the development area than from the risks of translocation;
- The proposal has been designed so as to avoid and minimise impacts to vegetation that is understood to provide habitat for this species;
- This type of relocation has been successful for this and other closely-related species carried out previously by Dr Clark;
- The individuals to be salvaged from the development area are considered to be part of the same population as the individuals in the recipient habitat;
- The recipient habitats are equivalent to or better than the habitats occupied by the salvaged individuals; and
- The protocol has clear objectives and a methodology for monitoring its success.

8.3 Powerful Owl

If nest tree number 2 was to be used again in the future during the construction stage of the project, conflict will be avoided by the imposition of controls on the timing of noisy works within the buffer area. Monitoring of the Powerful Owl is therefore essential in order to implement this protection protocol.

The breeding activity of the Powerful Owls is therefore being closely monitored across the lot and in Cumberland State Forest, as is any activity specifically around nest tree number 2. This monitoring will allow appropriate action to be implemented to protect the breeding owls from potential impacts arising from the development works program. Such ameliorative measures include restricting noisy and disruptive activities within 100 metres of active nest trees during the breeding season:

- Where possible, reschedule works that will occur within the buffer area outside of the breeding season (March to September);
- When not possible to avoid the March to September breeding season entirely, work is not to start until 1 hour after sunrise and must finish by 4 p.m. to avoid the periods when the birds are active; and
- Between September and February, noisy works have the potential to interrupt the movement of fledglings (Dr Stephen Ambrose, personal communication). Therefore, noisy works should not begin until at least 30 minutes after dawn and be completed at least 60 minutes before dusk during that period.

8.4 Prescribed Impacts

Prescribed impacts per the *Biodiversity Conservation Regulation* relevant to this proposal are removal of non-native vegetation; changes to habitat connectivity; potential indirect impacts to water bodies, water quality and hydrological processes; and vehicle strike.

The consequences of the **removal of exotic vegetation** in an area with surrounding sensitive vegetation is considered to be a positive conservation outcome in the long run, although in the short term there may be adverse consequences for fauna that may rely on it for sheltering habitat or foraging resources. Such removal of exotic vegetation will occur where weedy vegetation is to be removed in the development footprint or APZ, as well as in surrounding bushland that is to be actively managed as part of an approved Vegetation Management Plan.

The terrestrial species *Pommerhelix duralensis* Dural Land Snail may live and forage in understorey habitat that contains exotic vegetation, but not in areas where exotic species dominate. Nevertheless, the potential for impacting this species during APZ or bushland management works will be ameliorated by specific pre-works searches in likely habitat niches.

The Powerful Owl may prey on species that use dense weedy patches (such as Common Ringtail Possums). Pre-works checks will establish the presence of dreys and left *in situ* where possible. Otherwise, animals may be relocated into other suitable and secure nearby habitat by the Project

Ecologist. Other ameliorative measures include the installation of suitable artificial denning sites in retained habitat to enrich habitat for Powerful Owl prey species.

The most significant potential impact on biodiversity related to the removal of exotic vegetation, is the weeding of Powerful Owl roosting habitat. The Powerful Owl selects dense canopy for roosting (particularly in gully habitat) irrespective of the tree species. Rapid and widespread removal of dense stands of exotics such as Large-leaved Privet may displace this species, at least in the short to medium term. Therefore, it is important that this potential impact is controlled by protocols incorporated into the Approved Vegetation Management Plan and any subsequent works plan. The weedy canopy must be removed very gradually, and replaced by appropriate and fast-growing native species such as *Glochidion ferdinandi* Cheese Tree, *Ficus coronata* Sandpaper Fig, *Alphitonia excelsa* Red Ash, and *Pittosporum undulatum* Sweet Pittosporum.

The main impacts to **habitat connectivity** will occur to the north west with the removal of trees within the large open air car parks. This connection is of minor value to fauna and generally restricted to flying species, as it leads to only a small gully with approximately 8,500 square metres of vegetation, and is separated from the subject site by a wide busy road and a row of residences. There is virtually no woody habitat for almost 1 kilometre beyond that small gully, with this part of West Pennant Hills being occupied by large houses on small blocks with few trees.

The connectivity in this direction is also likely to be of value to only a few species, as the trees planted in the car park provide habitat of a lesser value. Many of these trees are not locally-native (e.g. Lemon-scented Gums from Queensland), have not reached their full potential due to growing conditions, do not contain hollows, and have little or no understorey.

The only threatened species considered likely to use these car park trees is *Pteropus poliocephalus* Grey-headed Flying-fox. This is a highly mobile species, able to fly long distances between foraging sites and day camps (e.g. 60 kilometres has been recorded by the senior author). The removal of the trees from the car park increases the distance between vegetation on the site and the nearest vegetation to the north west by approximately 180 metres at its maximum point. This additional distance is of no consequence to Grey-headed Flying-fox: it will not serve as an impediment to them moving through the landscape.

The loss of vegetation within the existing developed area will be offset to some degree by the implementation of a Landscape Plan throughout the developed areas and parkland, and conservation management of any remaining bushland. A concept Landscape Plan has been prepared, and the species selection has been largely driven by the need for the urban plantings to be more sympathetic to the surrounding Critically Endangered Ecological Communities than the previous treatment.

The installation of locally-native species will enhance and support habitats, and the removal of weeds and exotics will help to control threatening processes.

Potential indirect impacts to **aquatic habitats and hydrological processes** during the works phases will be managed by the implementation of standard controls such as sediment fences and installation of bunds. These controls are routinely incorporated into Construction Management

Plans.

In the long term residential phase, the exposed soils will be stabilised under hardstand and within parks and gardens. These potential impacts to the quality of stormwater runoff will be controlled by the implementation of water sensitive urban design principles, along with an emphasis on planting locally native species that are adapted to the local conditions.

The site is currently dominated by hardstand and the long term balance of hardstand and soft landscaping will not be significantly different in the post-development landscape. However, the engineering design will deliver the same quantity of stormwater runoff post-development. Measures for water conservation and re-use will maintain the water balance of the site.

The absence of reported **vehicle strike** on site is likely to be the result of slow-moving traffic due to traffic calming measures incorporated into the road design (e.g. speed humps, chicanes) and only short sections of road within a labyrinth of parking bays.

Numerous traffic studies have been undertaken for the redevelopment of this site. The current proposal will result in fewer vehicles on site than is allowed for in the current configuration, and will maintain other traffic calming design principles, such as short sections of road. The south eastern corner of the perimeter road will remain a narrow section, closed for general traffic. This part of the road passes through forest vegetation, rather than just alongside it, and therefore presents the greatest risk for crossing wildlife. Therefore, these design elements are considered to further ameliorate vehicle strike for most species of fauna.

Vehicle strike is thought to be an increasing problem for Powerful Owls, with information collected by Birdlife Australia indicating that it is responsible for the mortality of more than 10% of the total Sydney Basin population and more than 80% of the recorded deaths of Powerful Owls tracked within the Birdlife Australia Powerful Owl Project. [3] This may be due to a change in hunting strategies as the owls switch to prey species that spend more time on the ground.

Mitigation and amelioration of this potential impact will be delivered on the subject site by the road design elements mentioned above, the imposition of low speed in vulnerable areas, the presence of warning signs, and information provided to the residents regarding the potential of vehicle strike and the resident Powerful Owls.

[3] https://www.birdsinbackyards.net/content/article/Powerful-Owl-Sydney-Update

Table 15: Measures to be implemented before, during and after construction to avoid and minimise the impacts of the project, including action, outcome, timing and responsibility.

MEASURES TO AVOID AND MINIMISE IMPACTS							
Area	**Management activity**	**Action**	**Outcome**	**Sequencing and Timing of Actions**			**Responsibility**
				Before Construction	**During Construction**	**After Construction**	
All Areas	Fencing	• Erect exclusion fencing and gates.	Prevent accidental incursion into protected vegetation.	✓	✓		Civil Contractor
	Erosion and sedimentation controls	• Install erosion and sedimentation controls on the development site.	Prevent downslope sedimentation	✓	✓		Civil Contractor
Weed infested patches	Weed control	• Appropriate action in accordance with weed species present.	Weeds not spread during clearing works.	✓	✓		Project Ecologist / Bush Regeneration Contractor Civil Contractor
Gardens	Removal of sandstone blocks	• Removal under direct ecological supervision to protect resident fauna.	Blocks removed without injury to fauna; injured fauna receives veterinary care, rehabilitated and released	✓	✓		Project Ecologist Civil Contractor
	Fencing	• Erect protective fencing around trees to be retained under Arborist supervision.	Trees and vegetation protected from construction activities.	✓	✓		Civil Contractor
	Tree removal - general	• General tree removal under arborist supervision.	Trees felled without damage to retained vegetation.	✓	✓		Arborist Civil Contractor
	Tree removal – fauna habitat	• Tree and vegetation removal from areas identified as having specific fauna habitat (e.g. hollow-bearing trees, dense undergrowth) to be conducted under direct ecological supervision.	Trees felled without injury to fauna; injured fauna receives veterinary care, rehabilitated and released.	✓	✓		Project Ecologist Civil Contractor

MEASURES TO AVOID AND MINIMISE IMPACTS							
Area	**Management activity**	**Action**	**Outcome**	**Sequencing and Timing of Actions**			**Responsibility**
				Before Construction	**During Construction**	**After Construction**	
Snail habitat	Dural Land Snail Protection	• Targeted pre-clearing surveys undertaken and individuals relocated to closest, most suitable and secure habitat within the subject lot and / or Cumberland State Forest.	Snails safely relocated into suitable retained habitats	✓			Project Ecologist
		• Impose conservation zones ('no go' zones) within areas of suitable habitat, outside of the demolition footprint.	Impacts to habitats are avoided and minimised during demolition.	✓	✓		Project Ecologist Civil Contractor
		• Monitor known locations and habitats as part of a long term management plan for the entire site.	Monitor the viability of the species and their habitats.			✓	Project Ecologist
	Demolition of existing multi-storey carpark	• The retaining wall to the east of the carpark will be kept in place. • Fencing around the carpark is to be 1 metre off the existing structure on the eastern side (between the carpark and the inner surface of the retaining wall) and 2 metres along the northern side of the carpark. • The carpark is to be disassembled slowly in slabs / pieces in direction away from habitat to avoid disturbance. • Slow disassembling within specific fauna habitat areas to be conducted under ecological supervision.	Habitats retained and minimally disturbed.	✓	✓		Project Ecologist Civil Contractor
All areas	Myrtle Rust and Phytophthora Control	• Ensure hygiene protocols are in place to minimise the potential spread of Myrtle Rust or Phytophthora across the site and off site.	Minimise potential spread of Myrtle Rust on and off site.	✓	✓	✓	Project Ecologist Civil Contractor Bush Regeneration Contractor
		• Wash down stations to be installed at entry / exit points to demolition footprint.					Civil Contractor

MEASURES TO AVOID AND MINIMISE IMPACTS							
	Powerful Owl protection	• Monitor resident Powerful Owls with particular attention to potential nest trees near the development area during the breeding season.	Breeding owls not disturbed.	✓	✓	✓	Project Ecologist Civil Contractor

		• Impose the following controls to construction if works are too close to Powerful Owl breeding habitat.
		  • Demolition activity should be restricted in areas that are within 100 metres of the active nest tree during the breeding season from March to September. In such circumstances, work is not to start until 1 hour after sunrise and must finish by 4 p.m.
		  • There is the potential for noisy works to interrupt the movement of fledglings between September and February (Dr Stephen Ambrose, personal communication). Therefore, noisy works should not begin until at least 30 minutes after dawn and be completed at least 60 minutes before dusk during that period.
			Breeding owls not disturbed.	✓	✓		

	Fauna welfare	• Clearing of vegetation to be undertaken with the supervision of the Project Ecologist to minimise impacts to potential resident fauna. • Vegetation clearing to be staged to allow fauna 'escape' paths.	Impacts to fauna and animal welfare avoided.	✓	✓		Project Ecologist Civil Contractor

9 THRESHOLDS

The potential for Serious and Irreversible Impacts (SAIIs) to arise from the proposed development works must be in terms of the following There are four SAII principles that need to be considered:

- Principle 1 – Species or ecological community currently in a rapid rate of decline;
- Principle 2 – Species or ecological communities with very small population size;
- Principle 3 – Species or area of ecological community with very limited geographic distribution; and
- Principle 4 - Species or ecological community that is unlikely to respond to management and is therefore irreplaceable.

Within the proposed development site, there are two entities at risk of a SAII:

- The Critically Endangered Ecological Community Blue Gum High Forest; and
- The Vulnerable microbat species *Chalinolobus dwyeri* Large-eared Pied Bat.

BAM 2020 requires additional information to be provided to help guide the decision maker in their determination whether the proposal will result in a Serious and Irreversible Impact. In accordance with Section 9.1 of *BAM 2020*, the following questions and responses are provided below, relevant to these two candidate entities.

9.1 Blue Gum High Forest CEEC

In order to determine the likelihood of a SAII, the decision maker requires guidance as to the current status of the TEC including:

a. evidence of reduction in geographic distribution (Principle 1, clause 6.7(2)(a) BC Regulation) as the current total geographic extent of the TEC in NSW AND the estimated reduction in geographic extent of the TEC since 1970 (not including impacts of the proposal)

Response

There is good evidence that there has been a reduction in the geographic distribution of BGHF, with a documented 95% decline in its extent since 1750. In its Final Determination, the NSW Scientific Committee (2011) states "*Its current extent amounts to less than 5% of this original distribution*" which was estimated to be 3,700 hectares. There are no reliable data sources to inform the query regarding the geographic extent of STIF since 1970.

b. extent of reduction in ecological function for the TEC using evidence that describes the degree of environmental degradation or disruption to biotic processes (Principle 2, clause 6.7(2)(b) BC Regulation) indicated by:
    i. change in community structure
    ii. change in species composition
    iii. disruption of ecological processes

iv. invasion and establishment of exotic species
v. degradation of habitat, and
vi. fragmentation of habitat

Response

European settlement of the West Pennant Hills area was early, swift, and destructive. Sydney Town was built from the extensive stands of tall forests that occurred on the rich shale soils of the Hornsby plateau (Benson and Howell 1994), and by the mid 1800s these forests were practically all cleared and turned into farmland (Rowland 2008). The forests of Blue Gum, Blackbutt, Turpentine and Ironbark were quickly reduced to scattered small remnants within a matrix of orchards and modest farms. In such an overwhelmingly agricultural landscape, the remnant and regrowth patches continued to be subjected to a range of anthropogenic disturbances with continued timber cutting, firewood collecting, grazing by domesticated livestock, and burning at varying intensities (Benson and Howell 1994). Such intense disturbances to small patches have affected the structure and potentially the composition of remnants (NSW Scientific Committee 2019). Remnants of BGHF are now typically small and fragmented and therefore susceptible to continuing attrition through clearing for routine land management practices, as the majority of remnants are small clusters of trees in backyards. Remnants of BGHF continue to be subject to ongoing invasion by an extensive range of naturalised plant species (NSW Scientific Committee 2019). These threats are ongoing and likely to cause continuing decline in geographic distribution and disruption of biotic processes and interactions (NSW Scientific Committee 2019).

c. evidence of restricted geographic distribution (Principle 3, clause 6.7(2)(c) BC Regulation), based on the TEC's geographic range in NSW according to the:
    i. extent of occurrence
    ii. area of occupancy, and
    iii. number of threat-defined locations

Response

BGHF has a restricted geographic range. Recent communication from BAM Support (query BSM-3517, email dated 6th September 2021), advised the following –

- EOO = 644.55 square kilometres
- AOO = 200 square kilometres
- Total current extent = 795.35 hectares.

It is not known how many threat-defined locations there are for BGHF.

d. evidence that the TEC is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation).

Response

This TEC is being managed for conservation purposes in a number of locations across Sydney – from small occurrences in development lots (such as in Turramurra) to larger expanses in reserves. Conservation management and restoration actions are detailed in *Best Practice Guidelines Blue Gum High Forest* (DECC 2008) and these are being implemented by the NSW National Parks and Wildlife Service in the "demonstration site" at Dalrymple Hay Nature Reserve / Browns Forest.. There are no progress reports available, but it is presumably a successful program given that the guidelines are provided as official Government advice, applied in a formal conservation reserve.

At Sheldon Forest (a Ku-ring-gai Council reserve), combinations of conservation actions (e.g. manual weeding with and without fire) are being trialled and reported on in the restoration literature (McDonald et al. 2002). These trials demonstrated that targeted disturbance is an important initiator of the recovery of BGHF.

These case studies illustrate that BGHF responds to all standard conservation management actions.

The decision maker also requires guidance as to the impacts of the proposal on the subject TEC, given the status information provided above. In particular:

a. the impact on the geographic extent of the TEC (Principles 1 and 3) by estimating the total area of the TEC to be impacted by the proposal:
    i. in hectares, and
    ii. as a percentage of the current geographic extent of the TEC in NSW.

Response

The direct impact area of BGHF is very small, being 0.22 hectares.

This represents only 0.028% of the total current extent (being 795.35hectares).

The proposal is unlikely to impose other indirect impacts in any significant way as it is exchanging a residential and office block development in the same footprint.

b. the extent that the proposed impacts are likely to contribute to further environmental degradation or the disruption of biotic processes (Principle 2) of the TEC by:
    i. estimating the size of any remaining, but now isolated, areas of the TEC; including areas of the TEC within 500 m of the development footprint or equivalent area for other types of proposals
    ii. describing the impacts on connectivity and fragmentation of the remaining areas of TEC measured by:
        - distance between isolated areas of the TEC, presented as the average distance if the remnant is retained AND the average distance if the remnant is removed as proposed, and
        - estimated maximum dispersal distance for native flora species

characteristic of the TEC, and

- other information relevant to describing the impact on connectivity and fragmentation, such as the area to perimeter ratio for remaining areas of the TEC as a result of the development

iii. describing the condition of the TEC according to the vegetation integrity score for the relevant vegetation zone(s) (Section 4.3). The assessor must also include the relevant composition, structure and function condition scores for each vegetation zone.

Response

The development lot is within a patch of mapped BGHF of more than 60 hectares. This is likely to be an overestimate hover, as that mapping also recognised the planted gardens on the subject lot as BGHF. Nevertheless, the site is part of a unique area that supports relatively intact large area of urban bushland that is at least partially occupied by BGHF.

The removal of approximately 0.22 hectares of weedy edge BGHF on the subject lot will reduce this area by only a tiny fraction.

Although the site and TEC is within a residential matrix, connectivity is high, as evidenced by the patch size of 100+ hectares across the assessment area.

The local fragmentation will be only marginally increased by the proposal: the adjacent mapped gap will be increased by only a few metres.

The Vegetation Integrity scores for each of the two vegetation zones on site have been detailed above in Section 3. The proposal will result in a zero score for VZ1, as this falls within the footprint.

It is considered that the proposal is unlikely to result in a SAII for BGHF, largely due to the small scale of the loss of habitat and the high value nature of the existing surrounding vegetation. Its loss is not considered serious or irreversible, and can be offset adequately in accordance with the BAM-C.

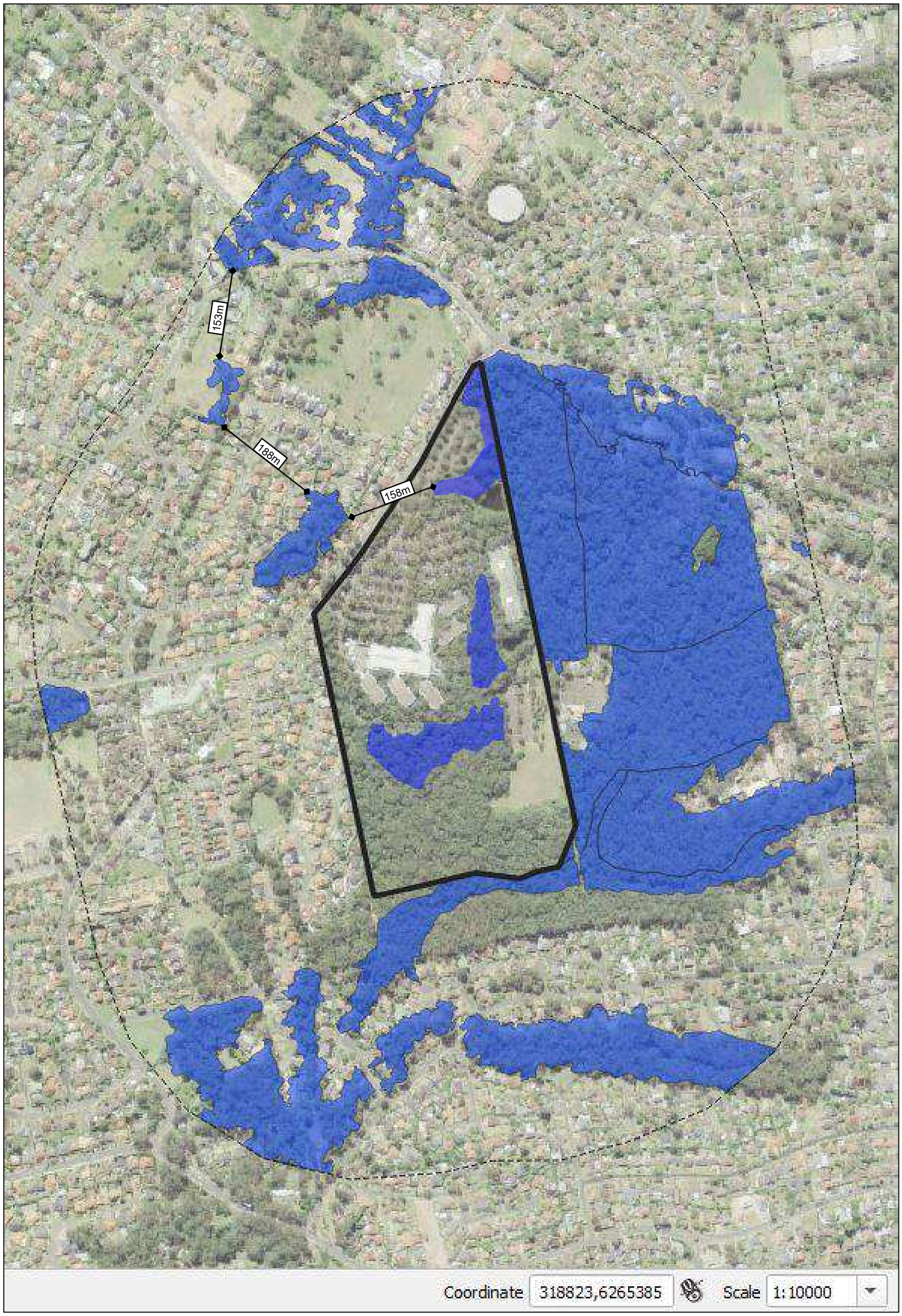

Figure 28: Extent of BGHF (blue) mapped within 500 metres (dotted outline) of the subject land (black outline). BGHF ground-truthed on site forms part of the larger patch within Cumberland State Forest and to the south of the site.

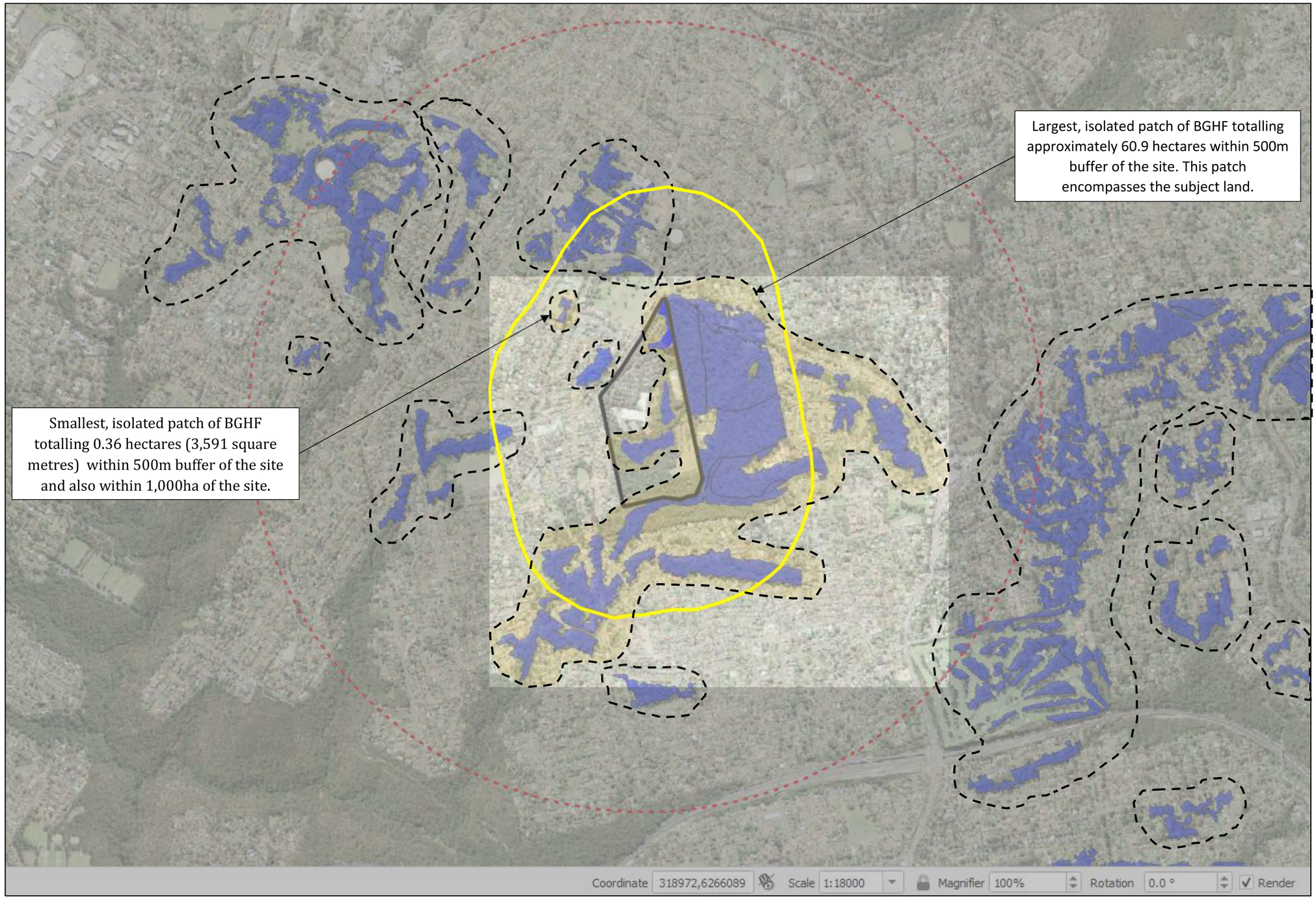

Figure 29: BGHF (Blue) within 1,000ha (red dashed circle) and 500 metres (yellow line) of the subject land (black outline). Black dashed polygons represent patches of BGHF >100m apart from each other within the local area. The subject land occurs within the largest patch within a 500 metre buffer and within 1,000 hectares of the site.

9.2 *Chalinolobus dwyeri* Large-eared Pied Bat

This species is included initially for consideration as a candidate species because potentially suitable breeding and roosting habitat may occur within 2 kilometres of the site (in gully systems in reserves to the south west), and adequate seasonal survey could not be conducted to establish its presence or absence.

The SAII threshold is potential breeding habitat and presence of breeding individuals. Potential breeding habitat is defined as PCTs associated with the species within 100 metres of rocky areas containing caves, or overhangs or crevices, cliffs or escarpments, or old mines, tunnels, culverts, derelict concrete buildings. There is no such potential breeding habitat within 100 metres of the site. However, the presence of breeding individuals could not be definitively ruled out due to survey limitations and therefore the potential for SAII is further explored.

In order to determine the likelihood of a SAII, the decision maker requires guidance as to the current status of the species including:

a. evidence of rapid decline (Principle 1, clause 6.7(2)(a) BC Regulation) presented by an estimate of the:
    i. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer), or
    ii. decline in population of the species in NSW in the past 10 years or three generations (whichever is longer) as indicated by: an index of abundance appropriate to the species; decline in geographic distribution and/or habitat quality; exploitation; effect of introduced species, hybridisation, pathogens, pollutants, competitors or parasites

    Response

    This is a data deficient species. Both a reduction in numbers and generation length have not been established (Threatened Species Scientific Committee 2012). There are no good data to indicate a decline in geographic distribution and anecdotal evidence could indicate the opposite in the Sydney area, with a population expansion per increasing numbers of records being reported as part of the development assessment process (personal observation). However, this could also be an artefact of increased survey effort.

b. evidence of small population size (Principle 2, clause 6.7(2)(b) BC Regulation) presented by:
    i. an estimate of the species' current population size in NSW, and
    ii. an estimate of the decline in the species' population size in NSW in three years or one generation (whichever is longer), and
    iii. where such data is [sic] available, an estimate of the number of mature individuals in each subpopulation, or the percentage of mature individuals in each subpopulation, or whether the species is likely to undergo extreme fluctuations

Response

This is a data deficient species, and its conservation status has been inferred (Threatened Species Scientific Committee 2012) from the following information:

- observations of only a small number of known maternity sites
- the presence of only small numbers of animals at these maternity roosts
- low fecundity
- restricted habitat preferences
- the major habitat areas are under intensifying clearing pressure for agriculture and residential subdivision
- the first known maternity site was flooded for the construction of Copeton Dam, and other roosting sites in disused mines are equally insecure.

There are no reliable estimates of population size in the scientific literature.

c. evidence of limited geographic range for the threatened species (Principle 3, clause 6.7(2)(c) BC Regulation) presented by:
    i. extent of occurrence
    ii. area of occupancy
    iii. number of threat-defined locations (geographically or ecologically distinct areas in which a single threatening event may rapidly affect all species occurrences), and
    iv. whether the species' population is likely to undergo extreme fluctuations

Response

This is a data deficient species but the Threatened Species Scientific Committee (2012) concludes that it has a very restricted geographic distribution. In the scientific literature, the extent of occurrence was estimated as 570,000 square kilometre (Hoye and Dwyer 1995), but this was prior to current knowledge of restricted habitat preferences and is therefore likely to be an overestimate.

Despite extensive surveys throughout NSW, only three nursery roosts are known, and only one of these is currently being used (Threatened Species Scientific Committee 2012), which is located north west of Coonabarabran (Pennay 2008). The area of occupancy in NSW during the breeding season is likely to be limited to this one site, which is therefore less than 1 square kilometre.

Any impacts to maternity sites – especially during the breeding season - is likely to result in a catastrophic decline in the population.

Given its low reproductive rate, its population size is unlikely to undergo extreme fluctuations.

Its susceptibility to changes in habitat as a result of climate change is unknown. However, its propensity to roost in relatively shallow caves may expose them to heat and smoke

hazards from more frequent and higher intensity bushfires, and perhaps increased ambient temperature and / or drought.

d. evidence that the species is unlikely to respond to management (Principle 4, clause 6.7(2)(d) BC Regulation) because:
    i. known reproductive characteristics severely limit the ability to increase the existing population on, or occupy new habitat (e.g. species is clonal) on, a biodiversity stewardship site
    ii. the species is reliant on abiotic habitats which cannot be restored or replaced (e.g. karst systems) on a biodiversity stewardship site, or
    iii. life history traits and/or ecology is known but the ability to control key threatening processes at a biodiversity stewardship site is currently negligible (e.g. frogs severely impacted by chytrid fungus).

Response

Critical habitat for this species is provided by suitable sandstone escarpment country for breeding and roosting. The loss of these resources cannot be replaced by the setting aside of a stewardship site.

However, other conservation management actions may favour this species in and around roosting and breeding sites (such as control of feral goats or predators), as well as in their foraging habitat (such as weed control).

The decision maker also requires guidance as to the impacts of the proposal on the subject species, given the information provided above. In particular:

a. the impact on the species' population (Principles 1 and 2) presented by:
    i. an estimate of the number of individuals (mature and immature) present in the subpopulation on the subject land (the site may intersect or encompass the subpopulation) and as a percentage of the total NSW population, and
    ii. an estimate of the number of individuals (mature and immature) to be impacted by the proposal and as a percentage of the total NSW population, or
    iii. if the species' unit of measure is area, provide data on the number of individuals on the site, and the estimated number that will be impacted, along with the area of habitat to be impacted by the proposal

Response

This species is data deficient, and there is no estimate available of the sizes or locations of populations and sub-populations. However, examination of the surrounding records within 10 kilometres of the subject site reveal that this species has been recorded 6 or 7 times, with 1 record from Shrimptons Creek at Ryde in 2021, and 2 records from the gully immediately to the south west of the site, near Aiken Road, West Pennant Hills.

The subject site is within 2 kilometres from suitable roosting habitat – which is assumed to be in the more rocky sandstone areas in Bidjigal Reserve to the south west - and so the gully forest and large expanse of fully structured BGHF and STIF in particular may contribute to the foraging habitat for this species. However, the numbers of individuals potentially impacted by the removal of poor quality habitat in the car park and very slivers of weedy BGHF along the edges of development could only be very small.

b. impact on geographic range (Principles 1 and 3) presented by:
    i. the area of the species' geographic range to be impacted by the proposal in hectares, and a percentage of the total AOO, or EOO within NSW
    ii. the impact on the subpopulation as either: all individuals will be impacted (subpopulation eliminated); OR impact will affect some individuals and habitat; OR impact will affect some habitat, but no individuals of the species will be directly impacted
    iii. to determine if the persisting subpopulation that is fragmented will remain viable, estimate (based on published and unpublished sources such as scientific publications, technical reports, databases or documented field observations) the habitat area required to support the remaining population, and habitat available within dispersal distance, and distance over which genetic exchange can occur (e.g. seed dispersal) and pollination distance for the species
    iv. to determine changes in threats affecting remaining subpopulations and habitat if the proposed impact proceeds, estimate changes in environmental factors including changes to fire regimes (frequency, severity); hydrology, pollutants; species interactions (increased competition and effects on pollinators or dispersal); fragmentation, increased edge effects, likelihood of disturbance; and disease, pathogens and parasites. Where these factors have been considered elsewhere in relation to the target specie

Response

Although this is a data-deficient species, the very small area of impact to vegetation that might contribute to its foraging habitat is highly unlikely to manifest as an existential threat to this species, threaten the viability of a population, fragment its habitat to any significant degree, or meaningfully impact on any other factor that might influence the survival of this species in the Sydney area. The retained areas of good bushland far outweigh the loss of planted landscaped gardens and small edge habitats.

It is considered that the proposal is unlikely to result in a SAII for *Chalinolobus dwyeri*, largely due to the small scale of the loss of habitat and the high value nature of the existing surrounding vegetation. Its loss is not considered serious or irreversible, and can be offset adequately in accordance with the BAM-C.

9.2 Impacts Requiring Offset

The proposed development will require offsetting of the following impacts:

Ecosystem Credits

- 0.08 hectares - VZ3a – PCT 1237 – Blue Gum High Forest (Not EEC)
- 0.20 hectares – VZ5a - PCT 1237 – Blue Gum High Forest (EEC)
- 0.01 hectares – VZ5b - PCT 1237 – Blue Gum High Forest (EEC)
- 0.01 hectares – VZ5c - PCT 1237 – Blue Gum High Forest (EEC)

Species Credits

- *Cercartetus nanus* Eastern Pygmy Possum
    - 0.08 hectares - VZ3a – PCT 1237 – Blue Gum High Forest (Not EEC)
    - 0.20 hectares – VZ5a - PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares – VZ5b - PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares – VZ5c - PCT 1237 – Blue Gum High Forest (EEC)
- *Chalinolobus dwyeri* Large-eared Pied Bat
    - 0.08 hectares - VZ3a – PCT 1237 – Blue Gum High Forest (Not EEC)
    - 0.20 hectares – VZ5a - PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares – VZ5b - PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares – VZ5c - PCT 1237 – Blue Gum High Forest (EEC)
- *Myotis macropus* Southern Myotis
    - 0.08 hectares - VZ3a – PCT 1237 – Blue Gum High Forest (Not EEC)
    - 0.20 hectares – VZ5a - PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares – VZ5b - PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares – VZ5c - PCT 1237 – Blue Gum High Forest (EEC)
- *Ninox strenua* Powerful Owl. While the resident Powerful Owls have not used the nest trees on site for a number of years, the potential for them to return is acknowledged and the following offsets are therefore proposed irrespective of their chosen breeding location:
    - 0.03 hectares – VZ3a – PCT 1237 – Blue Gum High Forest (Not EEC)
    - 0.003 hectares – VZ5c – PCT 1237 – Blue Gum High Forest (CEEC)
- *Pommerhelix duralensis* Dural Land Snail
    - 0.01 hectares - VZ3a – PCT 1237 – Blue Gum High Forest (Not EEC)
    - 0.083 hectares - VZ5a – PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares - VZ5b – PCT 1237 – Blue Gum High Forest (EEC)
    - 0.01 hectares - VZ5c – PCT 1237 – Blue Gum High Forest (EEC)

9.3 Impacts Not Requiring Offset

The following impacts do not require offsetting in accordance with the BAM:

- 0.06 hectares- VZ2a – No PCT - Detention Basins
- 2.4 hectares – VZ4a – No PCT – Planted Native Vegetation

- Impacts to species polygons for the following candidate species that occur within VZ 4a:
    - *Ninox strenua* Powerful Owl – 0.09 hectares VZ 4a
    - *Pommerhelix duralensis* Dural Land Snail – 0.21 hectares VZ 4a

Other impacts not requiring offset are "prescribed impacts" as per Part 6 Division 6.1 of the *BCR 2017,* and indirect impacts. The relevant impacts not requiring offset are detailed below.

Impacts not requiring offset are those related to:

- clearing of areas that do not contain native vegetation;
- clearing of areas that contain native vegetation with a very low vegetation integrity score;
- prescribed impacts as per Part 6 Division 6.1 of the *BCR 2017;* and
- indirect impacts.

Prescribed impacts and indirect impacts are detailed in Section 5 above. All potential impacts are considered to be satisfactorily mitigated by the recommended ameliorative actions in Table 15.

9.4 Impacts Not Requiring Assessment

It is considered that all impacts proposed as a result of the development footprint (direct, indirect, and prescribed) require assessment in accordance with the BAM and have been assessed accordingly.

A number of ecological values occur on the subject lot and outside of the proposed footprint:

- 3.28 hectares of Blue Gum High Forest
- 7.10 hectares of Sydney Turpentine Ironbark Forest
- Over 10 hectares of suitable Roosting and potential breeding habitat for *Ninox strenua* Powerful Owl;
- 12.5 ha of suitable habitats for *Pommerhelix duralensis* Dural Land Snail
- Riparian habitats.

These values do not require any further assessment as no impacts are proposed to occur to these lands. To minimise potential impacts to retained areas of the site, mitigation measures identified in Table 15 are to be implemented as part of a detailed Vegetation Management Plan (VMP) for the entire site.

10 NO NET LOSS

10.1 Future Vegetation Integrity Score

The proposal will result in a future VI score of 0 for part of the extent of VZ5a assessed and all areas of VZ 3a, VZ5b, and VZ5c proposed to be impacted. VZ5a has been delineated into to Management Zones in the BAM-C, indicating the potential future VI score for areas to be modified for APZs.

Future Vegetation Integrity (VI) Scores						
Vegetation Zone Name	**Management Zone**	**Area (ha)**	**Future Composition Condition Score**	**Future Structure Condition Score**	**Future Function Condition Score**	**Future VI Score**
VZ3a – PCT 1237 – BGHF (Not EEC)	NA	0.08	0			
VZ5a – PCT 1237 – BGHF (EEC)	MZ 1 - Footprint	0.13	0	0	0	0
	MZ 2 - APZ	0.07	33.9	10.2	22.8	19.9
VZ5b – PCT 1237 – BGHF (EEC)	NA	0.01	0	0	0	0
VZ5c – PCT 1237 – BGHF (EEC)	NA	0.01	0	0	0	0

10.2 Change in Vegetation Integrity Score

It is inevitable that the loss and modification to native vegetation will result in a change of VI score due to the direct result of clearing works required to be undertaken for the proposed development. The changes to VI scores are shown below.

Future Vegetation Integrity (VI) Scores					
Vegetation Zone Name	**Management Zone**	**Area (ha)**	**Current VI Score**	**Future VI Score**	**Change in VI Score**
VZ3a – PCT 1237 – BGHF (Not EEC)	NA	0.08	43.3	0	-43.3
VZ5a – PCT 1237 – BGHF (EEC)	MZ 1 - Footprint	0.13	41.4	0	-41.4
	MZ 2 - APZ	0.07	41.4	19.9	-21.5
VZ5b – PCT 1237 – BGHF (EEC)	NA	0.01	43.0	0	-43.0
VZ5c – PCT 1237 – BGHF (EEC)	NA	0.01	56.7	0	-56.7

10.3 Ecosystem Credits

No nett loss will be achieved for impacts to the following PCTs in accordance with the BAM if the following Ecosystem Credits are retired:

- Removal and modification of 0.08 hectares of PCT 1237 Blue Gum high forest (Not TEC) will require the retirement of 2 Ecosystem Credits
- Removal and modification of 0.22 hectare of PCT 1237 – BGHF (CEEC) will require the retirement of 6 Ecosystem Credits

10.4 Species Credits

No nett loss will be achieved for impacts to the habitat of the following candidate species in accordance with the BAM if the following Species Credits are retired:

- *Cercartetus nanus* Eastern Pygmy Possum – 7 Species Credits
- *Chalinolobus dwyeri* Large-eared Pied Bat – 10 Species Credits
- *Myotis macropus* Southern Myotis – 7 Species Credits
- *Ninox strenua* Powerful Owl – 2 Species Credits
- *Pommerhelix duralensis* Dural Land Snail – 7 Species Credits

11 BIODIVERSITY CREDIT REPORTS

The following reports from the BAM-Calculator are provided in Appendix 1:

- Credit Summary Report
- Candidate Species Report
- Predicted Species Report
- Vegetation Zones Report
- Biodiversity Credit Report
- Biodiversity Credit Report (Variation)

The BAM Credit Summary report details the following like-for-like offset requirements:

Entity	Quantum of impact	Credit type	Number of credits
PCT 1237 BGHF (not TEC) – VZ 3a	0.08 hectares	Ecosystem	2
PCT 1237 BGHF (TEC) – VZ 5a,5b,5c	0.22 hectares	Ecosystem	6
Cercartetus nanus Eastern Pygmy Possum	0.3 hectares	Species	7
Chalinolobus dwyeri Large-eared Pied Bat	0.3 hectares	Species	10
Myotis macropus Southern Myotis	0.3 hectares	Species	7
Ninox strenua Powerful Owl	0.04 hectares	Species	2
Pommerhelix duralensis Dural Land Snail	0.3 hectares	Species	7

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APPENDIX 1

BAM-C REPORTS

BAM Credit Summary Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00022689/BAAS17045/20/00022690	Development Stage - 55 Coonara Ave West Pennant Hills - Scenario 1	16/06/2022
Assessor Name	**Report Created**	**BAM Data version ***
Elizabeth Ashby	16/06/2022	54
Assessor Number	**BAM Case Status**	**Date Finalised**
BAAS17045	Open	To be finalised
Assessment Revision	**Assessment Type**	**BOS entry trigger**
7	Part 4 Developments (General)	BOS Threshold: Biodiversity Values Map

* 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.

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

Zone	Vegetation zone name	TEC name	Current Vegetation integrity score	Change in Vegetation integrity (loss / gain)	Area (ha)	Sensitivity to loss (Justification)	Species sensitivity to gain class	BC Act Listing status	EPBC Act listing status	Biodiversity risk weighting	Potential SAII	Ecosystem credits

Blue Gum high forest											
3	1237_VZ3a_BAM_19	Not a TEC	43.3	43.3	0.08	PCT Cleared - 90%	High Sensitivity to Gain			2.50		2
											Subtotal	**2**
Blue Gum high forest											
1	1237_VZ5b_BAM_12	Blue Gum High Forest in the Sydney Basin Bioregion	43	43.0	0.01	PCT Cleared - 90%	High Sensitivity to Gain	Critically Endangered Ecological Community	Critically Endangered	2.50	True	1
2	1237_VZ5c_BAM_10	Blue Gum High Forest in the Sydney Basin Bioregion	56.7	56.7	0.01	PCT Cleared - 90%	High Sensitivity to Gain	Critically Endangered Ecological Community	Critically Endangered	2.50	True	1
4	1237_VZ5a_BAM_3	Blue Gum High Forest in the Sydney Basin Bioregion	41.4	34.4	0.2	PCT Cleared - 90%	High Sensitivity to Gain	Critically Endangered Ecological Community	Critically Endangered	2.50	True	4
											Subtotal	**6**
											Total	**8**

Species credits for threatened species

Vegetation zone name	Habitat condition (Vegetation Integrity)	Change in habitat condition	Area (ha)/Count (no. individuals)	Sensitivity to loss (Justification)	Sensitivity to gain (Justification)	BC Act Listing status	EPBC Act listing status	Potential SAII	Species credits

Cercartetus nanus / Eastern Pygmy-possum (Fauna)									
1237_VZ5b_BAM_12	43.0	43.0	0.01			Vulnerable	Not Listed	False	1
1237_VZ5c_BAM_10	56.7	56.7	0.01			Vulnerable	Not Listed	False	1
1237_VZ5a_BAM_3	34.4	34.4	0.2			Vulnerable	Not Listed	False	3
1237_VZ3a_BAM_19	43.3	43.3	0.08			Vulnerable	Not Listed	False	2
								Subtotal	**7**
Chalinolobus dwyeri / Large-eared Pied Bat (Fauna)									
1237_VZ5b_BAM_12	43.0	43.0	0.01			Vulnerable	Vulnerable	True	1
1237_VZ5c_BAM_10	56.7	56.7	0.01			Vulnerable	Vulnerable	True	1
1237_VZ5a_BAM_3	34.4	34.4	0.2			Vulnerable	Vulnerable	True	5
1237_VZ3a_BAM_19	43.3	43.3	0.08			Vulnerable	Vulnerable	True	3
								Subtotal	**10**
Myotis macropus / Southern Myotis (Fauna)									
1237_VZ5b_BAM_12	43.0	43.0	0.01			Vulnerable	Not Listed	False	1
1237_VZ5c_BAM_10	56.7	56.7	0.01			Vulnerable	Not Listed	False	1
1237_VZ5a_BAM_3	34.4	34.4	0.2			Vulnerable	Not Listed	False	3

1237_VZ3a_BAM_19	43.3	43.3	0.08			Vulnerable	Not Listed	False	2
								Subtotal	**7**
Ninox strenua / Powerful Owl (Fauna)									
1237_VZ5c_BAM_10	56.7	56.7	0.01			Vulnerable	Not Listed	False	1
1237_VZ3a_BAM_19	43.3	43.3	0.03			Vulnerable	Not Listed	False	1
								Subtotal	**2**
Pommerhelix duralensis / Dural Land Snail (Fauna)									
1237_VZ5b_BAM_12	43.0	43.0	0.01			Endangered	Endangered	False	1
1237_VZ5c_BAM_10	56.7	56.7	0.01			Endangered	Endangered	False	1
1237_VZ5a_BAM_3	34.4	34.4	0.2			Endangered	Endangered	False	3
1237_VZ3a_BAM_19	43.3	43.3	0.08			Endangered	Endangered	False	2
								Subtotal	**7**

BAM Candidate Species Report

Proposal Details

Assessment Id 00022689/BAAS17045/20/00022690	Proposal Name Development Stage - 55 Coonara Ave West Pennant Hills - Scenario 1	BAM data last updated * 16/06/2022
Assessor Name Elizabeth Ashby	Report Created 16/06/2022	BAM Data version * 54
Assessor Number BAAS17045	Assessment Type Part 4 Developments (General)	BAM Case Status Open
Assessment Revision 7	Date Finalised To be finalised	BOS entry trigger BOS Threshold: Biodiversity Values Map

* 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.

List of Species Requiring Survey

Name	Presence	Survey Months
Callocephalon fimbriatum Gang-gang Cockatoo	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Calyptorhynchus lathami Glossy Black-Cockatoo	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Cercartetus nanus Eastern Pygmy-possum	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Chalinolobus dwyeri Large-eared Pied Bat	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Grammitis stenophylla Narrow-leaf Finger Fern	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☑ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Hibbertia spanantha Julian's Hibbertia	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Hieraaetus morphnoides Little Eagle	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Litoria aurea Green and Golden Bell Frog	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Myotis macropus Southern Myotis	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Ninox connivens Barking Owl	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☑ Jun ☑ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Ninox strenua Powerful Owl	Yes (assumed present)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Phascolarctos cinereus Koala	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Pommerhelix duralensis Dural Land Snail	Yes (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Pseudophryne australis Red-crowned Toadlet	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☑ Dec ☐ Survey month outside the specified months?
Rhodamnia rubescens Scrub Turpentine	No (surveyed)	☑ Jan ☐ Feb ☐ Mar ☐ Apr ☑ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Syzygium paniculatum Magenta Lilly Pilly	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☑ Apr ☐ May ☐ Jun ☐ Jul ☐ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Tetratheca glandulosa Tetratheca glandulosa	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☐ Jun ☐ Jul ☑ Aug ☐ Sep ☑ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?
Tyto novaehollandiae Masked Owl	No (surveyed)	☐ Jan ☐ Feb ☐ Mar ☐ Apr ☐ May ☑ Jun ☑ Jul ☑ Aug ☐ Sep ☐ Oct ☐ Nov ☐ Dec ☐ Survey month outside the specified months?

Threatened species Manually Added

None added

Threatened species assessed as not on site

Refer to BAR for detailed justification

Common name	Scientific name	Justification in the BAM-C
Grey-headed Flying-fox	Pteropus poliocephalus	Habitat constraints
Large Bent-winged Bat	Miniopterus orianae oceanensis	Habitat constraints
Little Bent-winged Bat	Miniopterus australis	Habitat constraints
Regent Honeyeater	Anthochaera phrygia	Habitat constraints
Swift Parrot	Lathamus discolor	Habitat constraints

BAM Predicted Species Report

Proposal Details

Assessment Id	Proposal Name	BAM data last updated *
00022689/BAAS17045/20/00022690	Development Stage - 55 Coonara Ave West Pennant Hills - Scenario 1	16/06/2022
Assessor Name	**Report Created**	**BAM Data version ***
Elizabeth Ashby	16/06/2022	54
Assessor Number	**Assessment Type**	**BAM Case Status**
BAAS17045	Part 4 Developments (General)	Open
Assessment Revision	**BOS entry trigger**	**Date Finalised**
7	BOS Threshold: Biodiversity Values Map	To be finalised

* 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.

Threatened species reliably predicted to utilise the site. No surveys are required for these species. Ecosystem credits apply to these species.

Common Name	Scientific Name	Vegetation Types(s)
Barking Owl	Ninox connivens	1237-Blue Gum high forest
Dusky Woodswallow	Artamus cyanopterus cyanopterus	1237-Blue Gum high forest
Eastern Coastal Free-tailed Bat	Micronomus norfolkensis	1237-Blue Gum high forest
Gang-gang Cockatoo	Callocephalon fimbriatum	1237-Blue Gum high forest
Glossy Black-Cockatoo	Calyptorhynchus lathami	1237-Blue Gum high forest
Grey-headed Flying-fox	Pteropus poliocephalus	1237-Blue Gum high forest
Large Bent-winged Bat	Miniopterus orianae oceanensis	1237-Blue Gum high forest
Little Bent-winged Bat	Miniopterus australis	1237-Blue Gum high forest
Little Eagle	Hieraaetus morphnoides	1237-Blue Gum high forest
Little Lorikeet	Glossopsitta pusilla	1237-Blue Gum high forest

Masked Owl	Tyto novaehollandiae	1237-Blue Gum high forest
Powerful Owl	Ninox strenua	1237-Blue Gum high forest
Regent Honeyeater	Anthochaera phrygia	1237-Blue Gum high forest
Spotted-tailed Quoll	Dasyurus maculatus	1237-Blue Gum high forest
Superb Fruit-Dove	Ptilinopus superbus	1237-Blue Gum high forest
Swift Parrot	Lathamus discolor	1237-Blue Gum high forest
Varied Sittella	Daphoenositta chrysoptera	1237-Blue Gum high forest
White-throated Needletail	Hirundapus caudacutus	1237-Blue Gum high forest
Yellow-bellied Sheathtail-bat	Saccolaimus flaviventris	1237-Blue Gum high forest

Threatened species Manually Added

None added

Threatened species assessed as not within the vegetation zone(s) for the PCT(s)

Refer to BAR for detailed justification

Common Name	Scientific Name	Justification in the BAM-C

BAM Vegetation Zones Report

Proposal Details

Assessment Id	Assessment name	BAM data last updated *
00022689/BAAS17045/20/00022690	Development Stage - 55 Coonara Ave West Pennant Hills - Scenario 1	16/06/2022
Assessor Name	Report Created	BAM Data version *
Elizabeth Ashby	16/06/2022	54
Assessor Number	Assessment Type	BAM Case Status
BAAS17045	Part 4 Developments (General)	Open
Assessment Revision	Date Finalised	BOS entry trigger
7	To be finalised	BOS Threshold: Biodiversity Values Map

* 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.

Vegetation Zones

#	Name	PCT	Condition	Area	Minimum number of plots	Management zones

1	1237_VZ5b_BAM_12	1237-Blue Gum high forest	VZ5b_BAM_12	0.01	1	
2	1237_VZ5c_BAM_10	1237-Blue Gum high forest	VZ5c_BAM_10	0.01	1	
3	1237_VZ3a_BAM_19	1237-Blue Gum high forest	VZ3a_BAM_19	0.08	1	
4	1237_VZ5a_BAM_3	1237-Blue Gum high forest	VZ5a_BAM_3	0.2	1	Footprint (0.13 ha) APZ (0.07 ha)

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00022689/BAAS17045/20/00022690

Proposal Name
Development Stage - 55 Coonara Ave West Pennant Hills - Scenario 1

BAM data last updated *
16/06/2022

Assessor Name
Elizabeth Ashby

Assessor Number
BAAS17045

BAM Data version *
54

Proponent Names
Stuart Allen

Report Created
16/06/2022

BAM Case Status
Open

Assessment Revision
7

Assessment Type
Part 4 Developments (General)

Date Finalised
To be finalised

BOS entry trigger
BOS Threshold: Biodiversity Values Map

* 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
Blue Gum High Forest in the Sydney Basin Bioregion	Critically Endangered Ecological Community	1237-Blue Gum high forest

Species
Chalinolobus dwyeri / Large-eared Pied Bat

BAM Biodiversity Credit Report (Like for like)

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
1237-Blue Gum high forest	Blue Gum High Forest in the Sydney Basin Bioregion	0.2	0	6	6
1237-Blue Gum high forest	Not a TEC	0.1	0	2	2

1237-Blue Gum high forest	**Like-for-like credit retirement options**					
	Name of offset trading group	Trading group	Zone	HBT	Credits	IBRA region

	Blue Gum High Forest in the Sydney Basin Bioregion This includes PCT's: 1237	-	1237_VZ5b_BAM_12	No	1	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Blue Gum High Forest in the Sydney Basin Bioregion This includes PCT's: 1237	-	1237_VZ5c_BAM_10	No	1	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Blue Gum High Forest in the Sydney Basin Bioregion This includes PCT's: 1237	-	1237_VZ5a_BAM_3	No	4	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1237-Blue Gum high forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region

	North Coast Wet Sclerophyll Forests This includes PCT's: 1237	North Coast Wet Sclerophyll Forests >=90%	1237_VZ3a_BAM_19	No	2	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi 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
Cercartetus nanus / Eastern Pygmy-possum	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	7.00
Chalinolobus dwyeri / Large-eared Pied Bat	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	10.00
Myotis macropus / Southern Myotis	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	7.00

Ninox strenua / Powerful Owl	**1237_VZ5c_BAM_10, 1237_VZ3a_BAM_19**	0.0	2.00
Pommerhelix duralensis / Dural Land Snail	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	7.00

Credit Retirement Options

Like-for-like credit retirement options

Cercartetus nanus / Eastern Pygmy-possum	Spp	IBRA subregion
	Cercartetus nanus / Eastern Pygmy-possum	Any in NSW
Chalinolobus dwyeri / Large-eared Pied Bat	Spp	IBRA subregion
	Chalinolobus dwyeri / Large-eared Pied Bat	Any in NSW
Myotis macropus / Southern Myotis	Spp	IBRA subregion
	Myotis macropus / Southern Myotis	Any in NSW
Ninox strenua / Powerful Owl	Spp	IBRA subregion
	Ninox strenua / Powerful Owl	Any in NSW

Pommerhelix duralensis / Dural Land Snail	Spp	IBRA subregion
	Pommerhelix duralensis / Dural Land Snail	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id

00022689/BAAS17045/20/00022690

Proposal Name

Development Stage - 55 Coonara Ave West Pennant Hills - Scenario 1

BAM data last updated *

16/06/2022

Assessor Name

Elizabeth Ashby

Assessor Number

BAAS17045

BAM Data version *

54

Proponent Name(s)

Stuart Allen

Report Created

16/06/2022

BAM Case Status

Open

Assessment Revision

7

Assessment Type

Part 4 Developments (General)

Date Finalised

To be finalised

BOS entry trigger

BOS Threshold: Biodiversity Values Map

* 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
Blue Gum High Forest in the Sydney Basin Bioregion	Critically Endangered Ecological Community	1237-Blue Gum high forest
Species		
Chalinolobus dwyeri / Large-eared Pied Bat		

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
1237-Blue Gum high forest	Blue Gum High Forest in the Sydney Basin Bioregion	0.2	0	6	6.00
1237-Blue Gum high forest	Not a TEC	0.1	0	2	2.00

1237-Blue Gum high forest

Like-for-like credit retirement options

Class	Trading group	Zone	HBT	Credits	IBRA region
Blue Gum High Forest in the Sydney Basin Bioregion This includes PCT's: 1237	-	1237_VZ5b_BAM_12	No	1	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

	Blue Gum High Forest in the Sydney Basin Bioregion This includes PCT's: 1237	-	1237_VZ5c_BAM_10	No	1	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Blue Gum High Forest in the Sydney Basin Bioregion This includes PCT's: 1237	-	1237_VZ5a_BAM_3	No	4	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
1237-Blue Gum high forest	**Like-for-like credit retirement options**					
	Class	Trading group	Zone	HBT	Credits	IBRA region
	North Coast Wet Sclerophyll Forests This includes PCT's: 1237	North Coast Wet Sclerophyll Forests >=90%	1237_VZ3a_BAM_19	No	2	Cumberland,Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
	Variation options					
	Formation	Trading group	Zone	HBT	Credits	IBRA region
	Wet Sclerophyll Forests (Shrubby sub-formation)	Tier 1	1237_VZ3a_BAM_19	No	2	IBRA Region: Sydney Basin, or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Species Credit Summary

BAM Biodiversity Credit Report (Variations)

Species	Vegetation Zone/s	Area / Count	Credits
Cercartetus nanus / Eastern Pygmy-possum	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	7.00
Chalinolobus dwyeri / Large-eared Pied Bat	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	10.00
Myotis macropus / Southern Myotis	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	7.00
Ninox strenua / Powerful Owl	**1237_VZ5c_BAM_10, 1237_VZ3a_BAM_19**	0.0	2.00
Pommerhelix duralensis / Dural Land Snail	**1237_VZ5b_BAM_12, 1237_VZ5c_BAM_10, 1237_VZ5a_BAM_3, 1237_VZ3a_BAM_19**	0.3	7.00

Credit Retirement Options

Like-for-like options

Cercartetus nanus/ Eastern Pygmy-possum	Spp		IBRA region
	Cercartetus nanus/Eastern Pygmy-possum		Any in NSW
	Variation options		
	Kingdom	Any species with same or higher category of listing	IBRA region

		under Part 4 of the BC Act shown below	
	Fauna	Vulnerable	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Chalinolobus dwyeri/ Large-eared Pied Bat	Spp	IBRA region	
	Chalinolobus dwyeri/Large-eared Pied Bat	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Myotis macropus/ Southern Myotis	Spp	IBRA region	
	Myotis macropus/Southern Myotis	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing	IBRA region

		under Part 4 of the BC Act shown below	
	Fauna	Vulnerable	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Ninox strenua/ Powerful Owl	Spp	IBRA region	
	Ninox strenua/Powerful Owl	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing under Part 4 of the BC Act shown below	IBRA region
	Fauna	Vulnerable	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.
Pommerhelix duralensis/ Dural Land Snail	Spp	IBRA region	
	Pommerhelix duralensis/Dural Land Snail	Any in NSW	
	Variation options		
	Kingdom	Any species with same or higher category of listing	IBRA region

		under Part 4 of the BC Act shown below	
	Fauna	Endangered	Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi and Yengo. or Any IBRA subregion that is within 100 kilometers of the outer edge of the impacted site.

Biodiversity payment summary report

Assessment Id	Payment data version	Assessment Revision	Report created
00022689/BAAS17045/20/00022690		7	16/06/2022

Assessor Name	Assessor Number	Proposal Name	BAM Case Status
Elizabeth Ashby	BAAS17045	Development Stage - 55 Coonara Ave West Pennant Hills - Scenario 1	Open

Assessment Type	Date Finalised	BOS entry trigger
Part 4 Developments (General)	To be finalised	BOS Threshold: Biodiversity Values Map

PCT list

Price calculated	PCT common name	Credits
Yes	**1237 -** Blue Gum high forest	2
Yes	**1237 -** Blue Gum high forest	6

Species list

Price calculated	Species	Credits
Yes	***Cercartetus nanus*** (Eastern Pygmy-possum)	7
Yes	***Chalinolobus dwyeri*** (Large-eared Pied Bat)	10
Yes	***Myotis macropus*** (Southern Myotis)	7

Biodiversity payment summary report

Yes	***Ninox strenua*** (Powerful Owl)	2
Yes	***Pommerhelix duralensis*** (Dural Land Snail)	7

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

IBRA sub region	PCT common name	Threat status	Offset trading group	Risk premium	Administrative cost	Methodology adjustment factor	Price per credit	No. of ecosystem credits	Final credits price
Cumberland	**1237 -** Blue Gum high forest	No	North Coast Wet Sclerophyll Forests >90%	20.69%	$161.21	1.8361	$5,025.44	2	$10,050.87
Cumberland	**1237 -** Blue Gum high forest	Yes	Blue Gum High Forest in the Sydney Basin Bioregion	18.83%	$163.65	2.0860	$5,025.42	6	$30,152.52

Subtotal (excl. GST)	**$40,203.39**
GST	**$4,020.34**
Total ecosystem credits (incl. GST)	**$44,223.73**

Species credits for threatened species

Biodiversity payment summary report

Species profile ID	Species	Threat status	Price per credit	Risk premium	Administrative cost	No. of species credits	Final credits price
10155	***Cercartetus nanus*** (Eastern Pygmy-possum)	Vulnerable	$495.24	20.6900%	$80.00	7	$4,743.94
10157	***Chalinolobus dwyeri*** (Large-eared Pied Bat)	Vulnerable	$741.31	20.6900%	$80.00	10	$9,746.87
10549	***Myotis macropus*** (Southern Myotis)	Vulnerable	$741.31	20.6900%	$80.00	7	$6,822.81
10562	***Ninox strenua*** (Powerful Owl)	Vulnerable	$463.67	20.6900%	$80.00	2	$1,279.21
20283	***Pommerhelix duralensis*** (Dural Land Snail)	Endangered	$309.97	20.6900%	$80.00	7	$3,178.72

Subtotal (excl. GST)	**$25,771.55**
GST	**$2,577.16**
Total species credits (incl. GST)	**$28,348.70**
Grand total	**$72,572.43**