1111 Elizabeth Drive Pty Ltd

Elizabeth Drive

Biodiversity Development Assessment Report

August 2020

15 June 2020

Elizabeth Drive Pty Ltd C/O Mill Oakley
Level 7, 151 Clarence Street
Sydney NSW 2000

Our ref: 2127092-26735-20
Your ref:

Dear Approver,

Elizabeth Drive Biodiversity Assessment
Certification under Section 6.15 of the Biodiversity Conservation Act 2016

I, Kath Chesnut (BAAS17031), certify that this Biodiversity Development Assessment Report and the accompanying finalised credit report dated 4 June 2020 has been prepared in accordance with the requirements of (and information provided under) the Biodiversity Assessment Method.

Sincerely
GHD

Kath Chesnut
Senior Ecologist
+61 2 92397722

Executive summary

1111 Elizabeth Drive Pty Ltd proposes to develop an 11 Lot industrial subdivision at 1111-1141 Elizabeth Drive, Cecil Park, 2178, NSW (Lot 2 DP 2954). This Biodiversity Development Assessment Report (BDAR) has been prepared by GHD Pty Ltd to identify the potential impacts of the proposal on biodiversity values within the subject site. This assessment has been completed in accordance with the Biodiversity Assessment Method (BAM) and includes:

- Desktop assessment to describe the existing environment and landscape features of the subject site and to identify the suite of threatened biota potentially affected by the proposal.
- Field survey to describe the biodiversity values of the subject site and surrounding study area and determine the likelihood of threatened biota and their habitats occurring in the proposal footprint including targeted seasonal surveys for species credit entities.
- Discussion of measures to avoid and minimise impacts to biodiversity values.
- BAM calculations using the credit calculator version 1.2.7.4 to quantify the biodiversity impacts of the proposal following implementation of measures to avoid and minimise impacts and to determine the biodiversity credits that would be required to be retired to offset the residual impacts of the proposal.

The proposal is located near the intersection of the M7 Motorway and Elizabeth Drive, within a small lot comprising a patch of modified native vegetation surrounding cleared land and a residential dwelling. The proposal has been purposefully designed to minimise impacts on biodiversity values as far as is practicable.

The proposal would result in impacts to one plant community type (PCT) comprising removal of 1.15 hectares (ha) of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (HN528, Moderate). The area of this PCT at the study area comprises an occurrence of Cumberland Plain Woodland in the Sydney Basin Bioregion, which is listed as a critically endangered ecological community (CEEC) under the NSW *Biodiversity Conservation Act 2016* (BC Act) and the related community Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest, which is listed as a CEEC under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The proposal would remove habitat for the Southern Myotis (*Myotis macropus)*, which is a species credit entity according to the BAM.

The proposal would not impact any threatened biota listed under the *Fisheries Management Act 1994* (FM Act).

A biodiversity assessment and credit calculations have been performed in accordance with the BAM (OEH 2017a) and using credit calculator version 1.2.7.4. The following credits required to be retired to offset the impacts of the proposal:

- 48 ecosystem credits to offset impacts to 1.15 ha of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain.
- 36 Southern Myotis species credits to offset the removal of habitat within a 1.06 hectare species polygon.

Other threatened species identified as potentially being impacted by the proposal are ecosystem credit species which would be offset through the retirement of the above listed ecosystem credits.

Impacts to a total of 3.56 ha would not require offsetting as this area is not native vegetation as defined in the BAM and comprises exotic vegetation or cleared land that currently contains buildings, infrastructure and dumped fill.

To avoid and minimise potential impacts of the proposal on biodiversity values, a series of mitigation and management measures have been identified, which would be implemented as part of the construction environmental management plan (CEMP) for the site. These include measures relating to:

- Standard CEMP protocols– including site inductions and dust suppression measures.
- Vegetation protection – including protective fencing to prevent impacts to surrounding vegetation, vehicle washing to avoid spread of pathogens/weeds, appropriate locations of stockpiles during construction and installation of sediment fences.
- Weeds – including weed management actions/planning, weed propagule spread control measures and sediment control.
- Fauna habitat – including hygiene protocol implementation, presence of an ecologist during clearing, staged vegetation clearing and protocols for the removal of hollow-bearing trees and other habitat features.
- Water quality and aquatic habitats – including erosion and sediment control measures, plans and surface stabilisation, dust control, spill kits and protocols.

During operation there is potential for the proposal to impact surrounding vegetation and habitat values through:

- Generation of additional light and noise.
- Erosion and sedimentation as a result of runoff from hard stand areas.
- Introduction of weed propagules by vehicle and/or residents/businesses.
- Fauna mortality as a result of collision with vehicles.
- Increased risk of fire.
- Rubbish dumping.

Mitigation measures would be implemented to minimise potential operational impacts. These would include:

- Ongoing management of priority weeds according to statutory requirements.
- Ongoing water quality management.
- Measures to reduce the increased risk of fire.
- Prescribed fencing requirements.
- Ecologically sensitive street lighting design.

The preferred approach to offset the residual impacts of the proposal is to secure and retire appropriate credits from stewardship sites that fit within the trading rules of the NSW Biodiversity Offsets Scheme (BOS) in accordance with the ‘like for like’ report generated by the BAM calculator. If such credits are unavailable, credits would be sourced in accordance with the ‘variation report’ generated by the BAM calculator (Appendix D). Under the NSW Assessment Bilateral Agreement, offsets for matters of National Environmental Significance (MNES) required under the EPBC Act can be assessed and met through the use of the NSW BOS. Credits may not be sourced in accordance with the ‘variation report’ for controlled actions under the EPBC Act.

A payment to the Biodiversity Conservation Trust would be considered if a suitable number and type of biodiversity credits cannot be secured.

This report is subject to, and must be read in conjunction with, the limitations set out in Section 1.11 and the assumptions and qualifications contained throughout this BDAR.

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1. Introduction

1.1 Overview

GHD Pty Ltd (GHD) has been engaged by 1111 Elizabeth Drive Pty Ltd to prepare a Biodiversity Development Assessment Report (BDAR). The BDAR is required to address the potential biodiversity impacts associated with a proposed 11 lot industrial subdivision, located at Lot 2, DP 2954, 1111-1141 Elizabeth Drive, at the Junction of Cecil Road and Elizabeth Drive, in Cecil Park, NSW. The total lot is 7.37 ha in size, and the proposed subdivision covers 4.72 ha. GHD understands that the proposal will be assessed as a State Significant Development (SSD) under Part 4.1 of the *Environmental Planning and assessment Act 1979 (*EPA Act) and that Secretary's Environmental Assessment Requirements (SEARS) have been issued for the proposal (SSD 8859).

The SEARS issued for the proposal require that an assessment of biodiversity impacts be completed in accordance with the Biodiversity Assessment Method (BAM) and documented in a BDAR, in the form required by Section 6.12 of the *Biodiversity Conservation Act 2016* (BC Act) and Section 6.8 of the *Biodiversity Conservation Regulation 2017* and the BAM.

This BDAR assesses the third iteration of the proposal. The original proposal was modified in response to comments received from the New South Wales (NSW) Department of Planning, Industry and Environment (DPIE) regarding the quantum of impacts on threatened ecological communities on site. This current BDAR has been prepared in response to notification that Transport for NSW intends to acquire a portion of the site in order to construct the proposed M12 Motorway. As such, this BDAR assesses a reduced footprint, reflecting the smaller area of the lot that is now available to develop.

This report describes the biodiversity values at the site, with particular emphasis on identification of native Plant Community Types (PCTs) and threatened ecological communities, populations, species and their habitats. It assesses the impact of the proposal, contains measures to avoid and minimise impacts and describes and quantifies the biodiversity credits required to offset the residual impacts of the proposal on biodiversity values.

This report has been prepared in response to the proposed acquisition of part of the site which will reduce the site area by 26,617m^2. The acquisition of the area of the site proposed by TfNSW has required amendments to be made to the proposed development and development footprint which require a re-assessment of the impacts and design which responds to the new development Site.

1.2 Biodiversity offset scheme and biodiversity assessment methodology

The BC Act, together with the *Biodiversity Conservation Regulations 2017***,** provides a mechanism to address impacts on biodiversity from land clearing associated with development. Under this legislation, there are provisions for a Biodiversity Offsets Scheme (BOS), which includes a framework to avoid, minimise and offset impacts of development on biodiversity.

The aim of the BOS is to provide a transparent, consistent and scientifically based approach to biodiversity assessment and offsetting. It also allows for the establishment of biodiversity stewardship agreements, which are in-perpetuity agreements entered into by landholders, to secure offset sites and generate biodiversity credits, which can be used to offset impacts of development. The aim of the BOS is to ensure that the impacts of development, clearing or biodiversity certification will result in no net loss of biodiversity in NSW.

The Biodiversity Assessment Method (BAM) was established by the NSW Office of Environment and Heritage (OEH) as a standard method to implement the aims of the BOS and to address the loss of biodiversity and threatened species. The scheme creates a market framework for the conservation of biodiversity values and the offsetting of development impacts. It also provides the mechanisms to offset impacts of development, clearing or biodiversity certification such that there is no loss of biodiversity values.

The BAM sets out how biodiversity values will be assessed, proscribes requirements to avoid and minimise impacts, establishes rules for calculating the number and class of credits required for unavoidable impacts, and determines the trading rules that will apply. The methodology includes a software package known as the Biodiversity Assessment Method Calculator (the credit calculator) which processes site survey and assessment data. The credit calculator specifies the type and extent of surveys required for a biodiversity assessment and then processes survey data to calculate the number and type of biodiversity credits that are either required at a development site or will be generated at a stewardship site. The BAM must be applied by a person accredited under the BC Act.

The Biodiversity Conservation Trust Fund ensures that landowners have the funds needed to carry out the management actions required each year and provides a financial incentive to landowners to carry out those actions. The scheme is administered by OEH and ensures accountability and compliance through legislation, regular reporting requirements and financial measures.

1.3 Approach

This BDAR has been prepared to assess the impacts of the proposal on threatened biota and their habitats (OEH, 2017a).

The main components of the methodology for the biodiversity assessment include:

- Desktop assessment to describe the existing environment and landscape features of the study area and to identify the suite of threatened biota potentially affected by the proposal.
- Field survey in accordance with the BAM to describe the biodiversity values of the subject site and surrounding study area and determine the likelihood of threatened biota and their habitats occurring in the subject site or being affected by the proposal.
- Determining reasonable actions to avoid and minimise impacts to biodiversity values.
- Completing calculations using the credit calculator to quantify the residual biodiversity impacts of the proposal and to determine the ecosystem and species credits that would require retirement to offset these impacts.

This biodiversity assessment and credit calculations were completed by Kath Chesnut (accredited assessor number BAAS17031) in accordance with the BAM, based on field surveys completed by Ben Harrington (accredited assessor number BAAS17023) and other GHD staff. A technical review of the report was undertaken by Dan Williams (accredited assessor number BAAS17025).

1.4 Proposal description

The proposal is for an 11 lot industrial subdivision. The subject site is shown in Figure 1-1 and the proposed subdivision layout is included in Figure 5-1. The majority of the subject site comprises cleared agricultural land. The proposal would include the removal of a residential dwelling, around 3.56 ha of exotic vegetation and up to 1.15 ha of native vegetation. The subject site is surrounded by partly cleared, private rural residential blocks.

1.5 Purpose of this report

This BDAR has been prepared to assess the potential biodiversity impacts of the proposal and determine the potential for offset requirements. Specifically, the objectives of this assessment are to:

- Outline the methods used in the biodiversity assessment.
- Describe the existing environment of the subject site in terms of its biodiversity values, including type and condition of PCTs, flora and fauna species and terrestrial and aquatic habitats.
- Describe the conservation significance of the subject site in terms of threatened biota and their habitats that are known or predicted to occur.
- Provide a description of the proposal, including potential impacts on biodiversity values.
- Identify measures undertaken to avoid and minimise impact to biodiversity values.
- Present the data used to perform the BAM assessment and credit calculations for the proposal.
- Calculate the number and type of biodiversity credits using the BAM that would be required to offset impacts of the proposal.
- Briefly discuss measures proposed to offset the residual impact of the proposal.

1.6 Site location

The subject site is located at Lot 2, DP 2954, 1111-1141 Elizabeth Drive, at the Junction of Cecil Road and Elizabeth Drive, in Cecil Park, NSW. The study area is approximately 7.37 ha and currently includes a residence in the south east near Elizabeth Drive, a drainage line along the western boundary, three farm dams, cleared agricultural land in the central and eastern portions, and a 20-100 m wide strip of native vegetation around the western and northern boundaries of the lot (Figure 1-1). The subject site (which will be impacted by the subdivision) covers about 4.72 ha of this area. The study area is surrounded by partly cleared, private rural residential blocks, with Cecil Road and Elizabeth Drive bounding the western and southern boundaries and the M7 Motorway and Wallgrove Road within 300 m of the eastern border.

The proponent has been notified that a portion of the lot will be acquired by Transport for NSW (TfNSW) as part of the proposed M12 Motorway Project. The proposed M12 Motorway layout is shown on Figure 5-1. It is assumed that the area of land proposed for acquisition by TfNSW will not change at this point, and that the M12 Motorway proposal will proceed as per the detailed construction drawings provided. As such, the context of the site will be substantially modified, once the M12 Motorway is constructed. Based on the information provided to the proponent, illustrated on Figure 5-1, Elizabeth Drive will be widened, and the western and northern boundary of the lot will form the edge of the M12 Motorway.

The subject site is within the Fairfield Local Government Area (LGA). As per Section 9(2) of the *Western Sydney Parklands SEPP 2009*, the site is not zoned under a Local Environment Plan. The subject site adjoins lots to the north zoned as RU4 Primary Production Small Lots. Part of the subject site (and adjoining areas) is identified as Future Residential Growth Area.

The subject site falls within the Western Sydney Parklands ('the Parklands'), which covers an area of about 5,280 ha through three LGAs (Blacktown, Fairfield and Liverpool). The *Western Sydney Parklands Plan of Management 2030* (WSPT, 2018) identifies target land uses and includes an allowance of 2% of the parklands for development as 'business hubs'. In 2018, Western Sydney Parklands Trust (WSPT) had allocated 63 ha (1.2% of the Parklands) as business hubs (WSPT, 2018). The 4.72 ha subject site would comprise 0.09% of the parklands. The Executive director of the WSPT notes in the SEARS received for the project that the WSPT "*is not intending to include the Site as part of the 2% allocation of Business Hubs for the Parklands*".

The Plan of Management for the Parklands shows the different precincts within the Parklands. The subject site falls within Precinct 11 (Cecil Park North), which is described as "*a small area of bushland and rural residential lands isolated from the main Parklands corridor by the M7 Motorway and Elizabeth Drive*" (WSPT, 2018). The objectives for the precinct include:

- *"Protect and enhance the natural systems and environmental values.*
- *Provide for service infrastructure as required.*
- *Investigate business and tourism potential on remaining lands" (WSPT, 2010)".*

The Land Use Framework included in the Plan of Management for the Parklands identifies the subject site as falling within 'interim land uses (short term residential tenancies, vacant land, private land yet to be acquired)' (WSPT, 2010). The Land Use Framework notes that in identifying suitable sites for business hubs, the following criteria will apply:

> *"Located on land with low environmental and recreational value, WSPT Business Hubs typically include retail, commercial and/ or industrial uses. They generate revenue to support the Parklands' operations, including maintenance and development of new and existing facilities. WSPT Business Hubs make a significant contribution to economic development, employment and training opportunities in Western Sydney" (WSPT, 2018).*

The proposed land use appears to be consistent with the objectives of Precinct 11 (Cecil Park North) and with the Land Use Framework described for Business Hubs in the Parklands.

The subject site does not fall within areas designated as 'Environmental Conservation Areas' based on the *Environmental Conservation Areas Map Sheet ECA_005* included within the *Western Sydney Parklands SEPP 2009*.

1.7 Information sources

Information sources used in the preparation of this report include:

- The NSW BioNet database to help identify PCTs that occur in the subject site as required by the BAM (OEH, 2018c).
- OEH threatened biota profiles for descriptions of the ecology, distribution and habitat requirements of threatened biota (OEH, 2018b). This resource was used to identify the suite of threatened ecological communities (TECs) that could potentially be affected by the proposal and to inform habitat assessments.
- Department of the Environment and Energy (DEE) *Protected Matters Online Search Tool* for MNES listed under the EPBC Act and predicted to occur in the locality (DEE 2018a).
- DEE online *Species profiles and threats database* (SPRAT) (DEE 2018b).
- The NSW *BioNet Vegetation Classification* database to help identify Plant Community Types (PCTs) that occur in the subject site as required by the BAM (OEH, 2018c).

- Threatened Biodiversity Data Collection (TBDC) for information relating to species credit and ecosystem credit threatened species and thresholds for SAII assessments (DPIE 2020b).
- Department of Primary Industries (DPI) freshwater threatened species distribution maps. For distribution of threatened aquatic species that may occur in the locality (DPI, 2018a).
- Groundwater Dependent Ecosystem Atlas (BOM 2018a).
- The list of species credit-type species identified by the BAM Credit Calculator based on the initial credit calculations.
- Existing vegetation mapping of the subject site, including NPWS (2002a;b) and Tozer *et al.*, (2010).
- Aerial photographs and satellite imagery of the subject site and buffer area.

1.8 Glossary of terms and acronyms

Term	Definition
AOBV	Areas of Outstanding Biodiversity Value
BC Act	*Biodiversity Conservation Act 2016*
BCT	Biodiversity Conservation Trust
BDAR	Biodiversity Development Assessment Report
Biodiversity Assessment Method (BAM)	The rules for biodiversity assessment established under the BC Act that determine credits created, credits required and the circumstances that improve or maintain biodiversity values.
Biodiversity credit	A unit of biodiversity value to measure specific development impacts or conservation gains in accordance with the BAM. Includes ecosystem credits and species credits.
Biodiversity credit report	Specifies the number and type of biodiversity credits: required to offset the impacts of a development to obtain a Biodiversity Certification Agreement; or that would be generated through conservation and management of a Stewardship site under a Biodiversity Stewardship site agreement.
Biodiversity offsets	Specific measures that are put in place to compensate for impacts on biodiversity values.
Biodiversity values	The composition, structure and function of ecosystems, including threatened species, populations and ecological communities, and their habitats.
BOS	Biodiversity Offset Scheme
CEEC	Critically endangered ecological community
CEMP	Construction Environmental Management Plan
DAWE	Department of Agriculture, Water and the Environment
DEE	Department of the Environment and Energy
DPI	Department of Primary Industries
DPIE	Department of Planning, Industry and Environment
Ecosystem credit	A credit that relates to a vegetation type and the threatened species that are reliably predicted by that vegetation type (as a habitat surrogate).
EEC	Endangered ecological community
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FFMP	Flora and Fauna Management Plan
GDE	Groundwater Dependent Ecosystem

Term	Definition
IBRA	Interim Biogeographic Regionalisation for Australia
LEP	Local Environment Plan
LGA	Local Government Area
Locality	The area within a 10 km radius of the subject site
Migratory species	Species listed under listed under international agreements (i.e. Ramsar, JAMBA and CAMBA conventions) to which Australia is a party
MNES	Matters of National Environmental Significance
OEH	Office of Environment and Heritage
PCT	Plant community type
SAII	Serious and irreversible impacts
SAII entity	Species and ecological communities that are likely to be the subject of serious and irreversible impacts (SAIIs)
SEPP	State Environment Planning Policy
Species credit	A credit that relates to an individual threatened species that cannot be reliably predicted based on habitat surrogates. Threatened species that require species credits are identified in the Threatened Biodiversity Data Collection.
Study area	The area that was subject to a site survey and assessed for direct or indirect impacts arising from construction and operation of the proposal.
Subject site	The area that would be directly impacted by construction and operation of the proposal.
TBDC	Threatened Biodiversity Data Collection
TEC	Threatened ecological community
TfNSW	Transport for New South Wales
The Parklands	The Western Sydney Parklands
Threatened biota	Threatened species, populations or ecological communities listed under the BC Act and/or the EPBC Act
WSPT	Western Sydney Parklands Trust

1.9 Definitions

The following terms are used in this report:

- The ‘proposal’ refers to the proposed subdivision works.
- The ‘subject site’ refers to the area that would be directly impacted by the proposal.
- The ‘study area’ refers to the area that was subject to field survey and assessed for direct or indirect impacts that may arise from the proposal.
- The ‘locality’ refers to the area within a 10 km radius of the subject site.

1.10 Assumptions and accredited assessor judgments

This report has been prepared based on the proposal description and maps and plans provided by the proponent. A 'proposal footprint' polygon (i.e. disturbance footprint) was prepared for the biodiversity assessment based on these inputs and confirmed in consultation with the proponent. It is assumed that the description and spatial data accurately represent the extent of direct impacts arising from the proposal and so these data have been used to calculate the extent of removal of vegetation and habitat arising from the proposal using GIS. These calculations have in turn been relied upon in the BAM calculations and the determination of key thresholds such as whether the proposal would have a direct impact on a threatened species, whether biodiversity offsets are required for a particular impact and whether a particular impact is likely to be significant. The assessment conclusions may change as a result of the provision of an updated proposal design and/or spatial data.

The accredited assessor has assumed that all impacts associated with the development, including construction and operational impacts, are included within the footprint provided, including all impacts associated with water infrastructure.

Accredited assessors 'use of judgment' has been used in the identification of soil landscape selection. The subject site appears to occur on the Blacktown soil landscape; not the Luddenham soil landscaped as mapped.

No threshold has been published for the potential serious and irreversible impact (SAII) entity PCT 849 (Cumberland Plain Woodland), with the TBDC (DPIE, 2020b) noting that the threshold is 'under development'. Advice available from the DPIE website notes that "*if thresholds are still under development, the consent authority will rely on the information provided in the biodiversity development assessment report in determining whether a serious and irreversible impact is likely to occur*" (DPIE 2020c).

1.11 Scope and limitations

This BDAR: has been prepared by GHD for 1111 Elizabeth Drive Pty Ltd and may only be used and relied on by 1111 Elizabeth Drive Pty Ltd for the purpose agreed between GHD and the 1111 Elizabeth Drive Pty Ltd as set out in Section 1 of this BDAR.

GHD otherwise disclaims responsibility to any person other than 1111 Elizabeth Drive Pty Ltd arising in connection with this BDAR. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this BDAR were limited to those specifically detailed in the BDAR and are subject to the scope limitations set out in the BDAR.

The opinions, conclusions and any recommendations in this BDAR are based on conditions encountered and information reviewed at the date of preparation of the BDAR. GHD has no responsibility or obligation to update this BDAR to account for events or changes occurring subsequent to the date that the BDAR was prepared.

The opinions, conclusions and any recommendations in this BDAR are based on assumptions made by GHD described in this BDAR (refer Sections 1.10, 6 and 7 of this BDAR). GHD disclaims liability arising from any of the assumptions being incorrect.

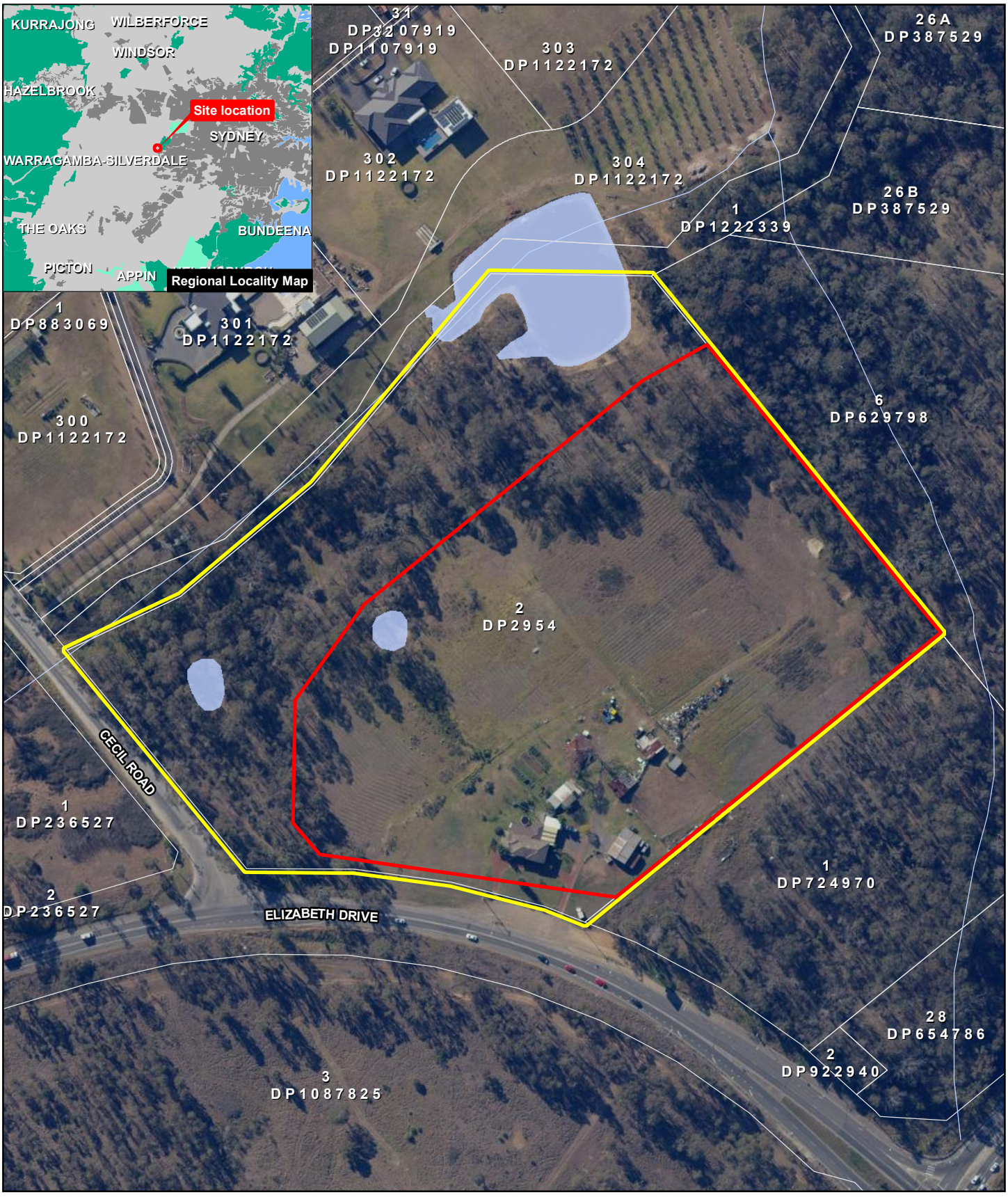
GHD has prepared this BDAR on the basis of information provided by 1111 Elizabeth Drive Pty Ltd and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the BDAR which were caused by errors or omissions in that information.

The opinions, conclusions and any recommendations in this BDAR are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this BDAR are constrained by the particular site conditions, such as the location of buildings, services and vegetation. As a result, not all relevant site features and conditions may have been identified in this BDAR.

Site conditions (including the presence of threatened biota and their habitats) may change after the date of this BDAR. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.

This report has been prepared in response to the proposed acquisition of part of the site which will reduce the site area by 26,617m2. The acquisition of the area of the site proposed by TfNSW has required amendments to be made to the proposed development and development footprint which require a re-assessment of the impacts and design which responds to the new development Site.



LEGEND

- Study area
- Subject site
- Cadastre
- Dams
- Waterways

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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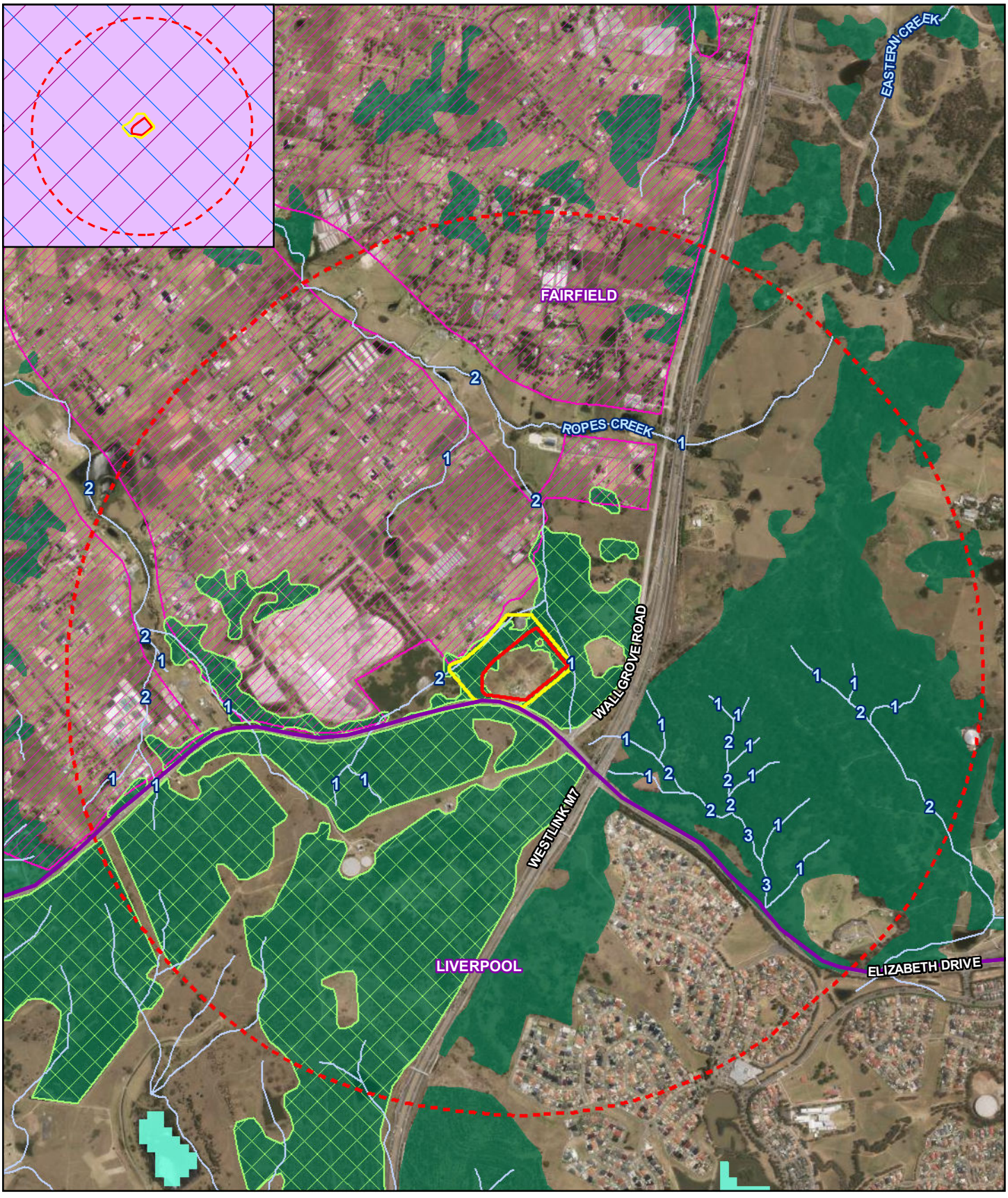
Site map

Figure 1-1

N:\AU\Sydney\Projects\21\27092\GIS\Maps\Deliverables\RevisedLayout\21_27092_Z001_RL_SiteLocation_0.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Aerial imagery - SIX Maps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2017, 2015 & 2012; Cadastre - NSW LPI DCDB 2017; Inset map - Geoscience Australia. Created by:J.Price



LEGEND

- Study area
- Subject site
- 1500m buffer area (839.4 ha)
- LGA boundary
- Waterways
- Wetlands
- Native vegetation extent
- Patch size
- Development / growth areas

INSET MAP

IBRA subregion
- Cumberland

IBRA region
- Sydney Basin

Mitchell Landscape
- Cumberland Plain

Paper Size A4

0 100 200 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Location map

Figure 1-2

N:\AU\Sydney\Projects\21\27092\GIS\Maps\Deliverables\RevisedLayout\21_27092_Z002_RL_LandscapeAssessment_0.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Aerial imagery - SIX Maps 2020(© Department of Customer Service 2020); General topo - NSW LPI DTDB 2017, 2015 & 2012; Native vegetation mapping, Mitchell Landscapes, IBRA regions & subregions, wetlands - OEH.
Created by:J.Price

2. Methodology

2.1 Desktop assessment

Literature and database review A desktop database review was undertaken to identify threatened flora and fauna species, populations and ecological communities (threatened biota) listed under the BC Act, FM Act, and EPBC Act, that could be expected to occur in the locality, based on previous records, known distribution ranges, and habitats present. These were also used to obtain the necessary site data to perform BAM calculations. Biodiversity resources pertaining to the subject site and locality (i.e. within a 10 km radius of the site) that were reviewed prior to conducting field investigations are outlined in Section 1.7.

The threatened biota and migratory species identified in the desktop assessment are presented in Appendix A. Following collation of database records and threatened species and community profiles, a 'likelihood of occurrence' assessment was prepared for threatened biota and migratory species with reference to the broad vegetation types and habitats contained within the study area. This was further refined following field surveys and verification of vegetation types and identification and assessment of habitat present within the subject site. A likelihood of occurrence ranking was attributed to these biota based on this information.

2.1.1 Groundwater dependent ecosystems

The NSW Groundwater Dependent Ecosystem (GDE) Policy defines GDEs as ecosystems, which have their species composition, and their natural ecological processes determined by groundwater (DLWC 2002). The Policy defines groundwater as the water beneath the earth's surface that has filtered down to the zone where the earth or rocks are fully saturated (DLWC 2002). Ecosystems vary dramatically in the degree of dependency of groundwater, from having no apparent dependence through to being entirely dependent on it (DLWC 2002).

The Australian Government Atlas of Groundwater Dependent Ecosystems was used to identify any previously mapped GDEs that occur in or near the subject site. This atlas identifies GDEs reliant on surface groundwater (rivers, springs and wetlands) and subsurface groundwater (vegetation). The Atlas was reviewed to ascertain whether any GDEs are likely to occur in the subject site.

2.2 Site survey

2.2.1 Survey effort and timing

Staged surveys of the subject site were conducted in accordance with the BAM and with reference to appropriate threatened species survey guidelines for targeted species.

Survey effort that has directly contributed to this BDAR is summarised in Table 2-1 and is described in detail below.

Table 2-1 Survey effort associated with project impacts

Stage	Date	Survey Technique
BAM assessment survey	15 March 2018	Vegetation integrity plots Targeted threatened flora surveys, Opportunistic fauna observations Fauna habitat assessment.
Candidate species credit flora survey	31 October-2 November 2018	Targeted flora surveys.
Candidate species credit fauna survey	31 October-2 November 2018	Targeted fauna survey including: Active searches for the Cumberland Plain land Snail and other ground-dwelling fauna Spotlighting Call Playback Ultrasonic call recording Active searches for nests, roosts, scats and other signs of fauna occupancy Fauna habitat assessment

2.2.2 Vegetation mapping

Existing vegetation mapping of the site (NPWS, 2002a,b and Tozer *et al*., 2010) was ground-truthed in the field via systematic walked transects across the subject site and by walking the boundary of vegetation units. Necessary adjustments were made by hand on aerial photographs of the subject site with reference to a handheld Global Positioning System (GPS) unit. Native vegetation was divided into vegetation zones which represented a distinct PCT and broad condition state. PCTs were identified based on vegetation structure, species composition, soil type and landscape position and with reference to the *BioNet Vegetation Classification* (OEH 2018c).

2.2.3 Vegetation integrity survey plots

Plot surveys were conducted on site in accordance with the BAM to obtain vegetation integrity data for the calculation of biodiversity credits. The site value was determined by assessing ten attributes used to assess function, composition and structure of vegetation within a 50 metre X 20 metre plot. These attributes were then assessed against benchmark values. Benchmarks are quantitative measures of the range of variability in condition in vegetation with relatively little evidence of alteration, disturbance or modification by humans since European settlement (DECC, 2009).

All flora species within a 20 metre x 20 metre quadrat nestled within the 50 m x 20 m plot were identified according to the nomenclature of the Royal Botanic Gardens and Domain Trust (2018). Each species identified was allocated a growth form group and designated as either native, exotic or high threat exotic in accordance with lists provided by OEH.

Plots were sampled within the single vegetation zone at the subject site according to the minimum number of plots required by Table 4 in the BAM (OEH 2017a) (refer to Table 2-2 below). An additional plot was sampled within exotic grassland vegetation which does not require further assessment (as per Section 5.2.1.5 of the BAM) to confirm this area does not comprise native vegetation. The location of survey plots is shown on Figure 3-1.

Table 2-2 Minimum plot survey requirements

Vegetation zone	Area (ha)	Minimum number of plots required	Number of plots sampled
PCT 849 Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (Moderate/good)	1.15	1	1 within subject site, 2 additional ones in the larger study area.
Exotic grassland	3.05	0	1
Total		**2**	**3**

A total of three plots were completed in PCT 849 across the study area, however following revisions to the site boundary (as discussed in Section 1.6), only one of these plot (Plot 3) now falls within the subject site. Data from all plots located in PCT 849 were entered into the credit calculator to ensure the vegetation integrity across the site was correctly represented. The location of all plots is shown on Figure 3-1.

The overall condition of vegetation was assessed through general observation and comparison against the PCT condition benchmark data as well as using parameters such as species diversity, history of disturbance, weed invasion and canopy health.

2.2.4 Targeted threatened flora surveys

Targeted surveys were undertaken for threatened flora species that were either predicted to occur at the site by the BAM calculator or identified during the desktop review as having potential to occur within the study area given known distributions, previous records in the locality and habitat requirements for each species (refer to Appendix A). A number of species were considered unlikely to occur on site due to an absence of habitat and these species were not included in the targeted searches (Appendix A). Targeted flora searches were completed by walking parallel transects spaced 10 m apart across parts of the study area that support native vegetation, with reference to Cropper (1993) and DPIE (2020) threatened plant survey guidelines.

Targeted threatened flora surveys were undertaken in Autumn and Spring (15 March, 31 October - 2 November 2018) which, according to the BAM calculator, is a suitable time of the year to identify all six candidate threatened flora species identified as having the potential to occur.

Candidate threatened flora species that were targeted during these surveys and the appropriate survey period specified in the BAM calculator are listed in Table 2-3.

The desktop assessment and site survey confirmed that there is potential habitat for the Spiked Rice Flower (*Pimelea spicata*) in the study area. The Spiked Rice Flower is recognised as a cryptic species that may be difficult to detect when not flowering and so targeted surveys are frequently combined with checking of reference populations. GHD have engaged botanists from the Australian Botanical Gardens Mount Annan to monitor and sample a population of the species at Luddenham, around 13 km to the west of the subject site. These botanists confirmed that the Spiked Rice Flower population at Luddenham was actively growing and flowering at the time of the March BAM assessment survey in a report to GHD on 29 March 2018 (Cuneo P, *pers. comm*.). The reference population was verified at the time of the October - November species credit entities surveys by GHD ecologists on 1 November 2018. It is likely that this species would also have been flowering and readily detectable if present in the study area on 15 March 2018 and between 31 October - 2 November.

GHD ecologists also checked a reference population of *Marsdenia viridiflora* subsp*. viridiflora* at Badgerys Creek and confirmed that individuals of this species featured actively growing, above ground tissue at the time of the site surveys. Some *Marsdenia viridiflora* subsp*. viridiflora* individuals were flowering. It is likely that this species would also have been readily detectable if present in the study area on 15 March 2018 and between 31 October - 2 November.

Further detail regarding candidate threatened flora species targeted during surveys are provided in Section 4.1.

Table 2-3 Threatened flora species targeted during surveys

Scientific name	Common Name	Appropriate survey period
Acacia pubescens	Downy Wattle	All year
Dillwynia tenuifolia	*Dillwynia tenuifolia*	August to October
Grevillea juniperina subsp*. juniperina*	Juniper-leaved Grevillea	All year
Marsdenia viridiflora subsp*. viridiflora - endangered population*	*Marsdenia viridiflora* R. Br. subsp. viridiflora population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs	November to February
Pimelea spicata	Spiked Rice-flower	All year
Pultenaea pedunculata	Matted Bush-pea	September to November

2.2.5 Terrestrial fauna survey

Under the BAM, targeted surveys are not required for threatened fauna species known or predicted to occur within the subject site (ecosystem credit species). These species are assumed to be present within certain PCTs, given a certain patch size and condition.

Targeted, seasonal surveys are required for species credit entities that could potentially at the subject site based on the habitat resources present (referred to as 'candidate threatened species' under the BAM). Candidate threatened species that were targeted during these surveys and the appropriate survey period as specified in the credit calculator are listed in Table 2-4.

Fauna survey techniques and effort are summarised in Table 2-5. All fauna observations were recorded on pro-forma field data sheets.

Further detail regarding candidate fauna species targeted during surveys is provided in Section 4.1.

Table 2-4 Threatened fauna species targeted during surveys

Species name	Common Name	Appropriate survey period	Survey Method/s utilised	Comment
Burhinus grallarius	Bush Stone-curlew	All year	Performed as per DEC 2004 Threatened Species Survey and Assessment Guidelines- Call playback for 30 seconds followed by 4.5 minutes of listening and repeated up to 3 times a night.	Calm clear, moonlight nights provide the best survey conditions for this species. These conditions were experienced on one of the two nights where this technique was employed.
Meridolum corneovirens	Cumberland Plain Land Snail	All year	Active searches around woody debris and around the base of trees where leaf litter is present. Active searches around and under areas of human-made rubbish and debris, across the entire study area.	Searches completed in sub-optimal conditions in March when the substrate and soil were dry and compact. Additional October/November surveys comprised optimal survey conditions with damp leaf litter and soil around the base of most trees. Numerous Garden Snails were located during this survey effort, indicating conditions were likely to be appropriate for detection of Cumberland Plain Land Snail (CPLS), should they be present. Some rain was also experienced on the night of 31 November which was likely to increase detection rates, if the species is present on site.
Myotis macropus	Southern Myotis	October to March	Performed as per DEC 2004 Threatened Species Survey and Assessment Guidelines-Two sound activated recording devices utilised for the entire night (a minimum of eight hours), starting at dusk, for two nights.	A recent study has shown that the rate of species detection is such that three hours of recording immediately after dusk is required to identify 90% of species present (Richards 2001a). Further, the average time taken to detect threatened species using echolocation recording was 94 minutes, with some threatened species only detected after three hours of recording (Richards 2001a).

Table 2-5 Fauna survey techniques and effort

Survey technique	Survey effort
Spotlighting	Two consecutive nights of spotlighting on the evenings of 31 October and 1 November, four person hours each night, conducted between the hours of 8 – 10 PM. Survey effort included stag watching on dusk followed by walked transects. Total effort = eight person hours.
Call Playback	Two consecutive nights of call playback on the evenings of 31 October and 1 November, in one location, targeting Bush Stone-curlew. Three rounds of call broadcasting per evening along with four hours of listening, coinciding with spotlighting surveys. Total effort = two playback nights.
Daytime traverses Active reptile/ amphibian searches Active searches for scats and signs	Targeted active searches of potential habitat throughout the study area targeting the Cumberland Plain Land Snail and other shelter dependent fauna such as small reptiles and frogs. Woody debris and other shelter substrate was lifted and inspected. Leaf litter was raked and inspected. Dedicated searches for any signs of fauna occupation. Included searching for evidence of feeding, foraging and signs of bird presence (such as pellets, whitewash, nests etc.) and other biota (scats, scratchings, diggings, nests etc.). At least four hours of dedicated searching by two ecologists in the March survey round and on November 1 and additional observations throughout all time on site. Total effort = greater than 16 person hours.
Ultrasonic call recording	Two Anabat units positioned over three locations within the site over two nights. 10 hours recording hours each per night from 31 October to 2 November. Equipment failure for one unit on one night. Total effort = 30 recording hours.

Fauna habitat assessment

Fauna habitat assessments were undertaken throughout the subject site, including active searches for potential shelter, basking, roosting, nesting and/or foraging sites. Specific habitat features and resources such as water bodies, food trees, the density of understorey vegetation, the composition of ground cover, the soil type, presence of hollow-bearing trees, leaf litter and ground debris were noted.

Indicative habitat criteria for targeted threatened species (i.e. those determined as having the potential to occur within the subject site following the desktop review) were identified prior to fieldwork. Habitat criteria were based on information provided in DPIE and DEE threatened species profiles, field guides, and the knowledge and experience of GHD field ecologists.

Habitat assessments included searches for resources of potential value to threatened fauna including:

- Trees with bird nests or other potential fauna roosts.
- Rock outcrops or overhangs providing potential shelter sites for fauna.
- Burrows, dens and warrens.
- Distinctive scats or latrine sites, owl white wash and regurgitated pellets under roost sites.
- Tracks or animal remains.
- Evidence of activity such as feeding scars, scratches and diggings.

The locations and quantitative descriptions of significant habitat features were captured with a handheld GPS unit and photographed where appropriate.

Active searches

Active searches of woody debris and other ground litter were conducted throughout the subject site targeting threatened frogs and reptiles. Fallen timber and other potential shelter sites such as corrugated iron sheets and rock piles were carefully turned and inspected.

Opportunistic observations

Opportunistic and incidental observations of fauna species were recorded at all times during field surveys. This included a conscious focus on suitable areas of habitat during flora surveys, for instance fallen timber was scanned and/or turned for reptiles and mature trees and stags were scanned for roosting birds.

Aquatic habitat survey

Aquatic habitat within the subject site is limited to one small constructed farm dam, with a water level that varies depending on the amount of rainfall received. This dam was dry at the time of all field surveys. This dam did not appear to be associated with any drainage lines within or around the study area.

Within the wider study area, there is a small ephemeral drainage line (dam inflow) that leads to the large dam in the north of the study area. One other small constructed farm dam is present in the west of the study area, which was also dry at the time of field surveys. This dam did not appear to be associated with any drainage lines.

2.3 Survey conditions

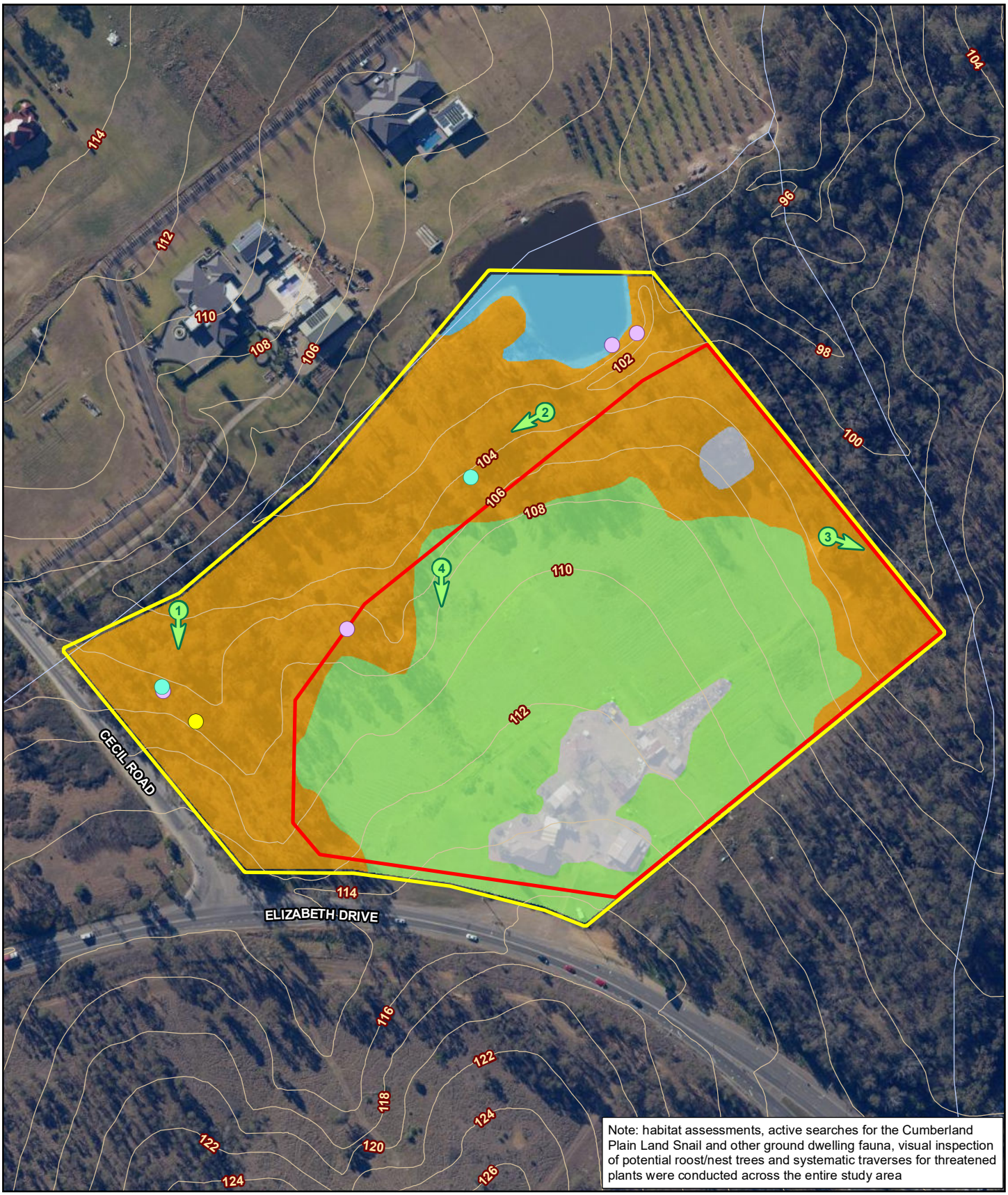
Conditions during the March 2018 survey were hot and humid. A small amount (1.4 mm) of rain had fallen in the week preceding the survey. Wind during opportunistic fauna surveys was low to none and so would not have hampered the detection of bird species. As noted elsewhere in this report, leaf litter was dry and the soil was hard and so conditions may not have been suitable for detecting the Cumberland Plain Land Snail.

Conditions during the October - November survey were mild to hot and humid. There had been several heavy rainfall events in preceding weeks with up to 78 mm falling within the 21 days prior to this survey. Frogs were abundant and actively calling in water bodies at the study area and bats were abundant and active (see Appendix B). As noted elsewhere in this report, leaf litter was damp and the soil was moist and friable and so conditions would have been suitable for detecting the Cumberland Plain Land Snail, if present.

Bureau of Meteorology (BOM) records for the survey dates are outlined in Table 2-6. These records were taken at Horsley Park Equestrian Centre weather station (067119) located approximately 5 kilometres from the subject site (BOM 2018b).

Table 2-6 Daily weather observations during the survey period

Date	Minimum temp (Deg Celsius)	Max temp (Deg Celsius)	Rainfall (24 hours to 9am) (mm)
15/03/2018	17.6	34.5	0.2
31/10/2018	12.9	30.3	0.2
1/11/2018	15.9	32.5	0
2/11/2018	20.4	36.9	0



LEGEND

- Study area
- Subject site
- Contours (2m)
- Waterways

Other site features

- Buildings, infrastructure and dumped fill
- Exotic grassland
- Water body

Native vegetation

- 1. PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate) (CEEC BC Act; CEEC EPBC Act)
- Plot/transect

- Anabat
- Call playback
- Stag watch

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

GHD

1111 Elizabeth Drive Pty Ltd
Elizabeth Drive
Biodiversity Development Assessment Report

Job Number 21-27092
Revision 0
Date 15 Jun 2020

Survey effort

Figure 2-1

N:\AU\Sydney\Projects\21\27092\GIS\Maps\Deliverables\RevisedLayout\21_27092_Z004_RL_SurveyEffort_0.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 T 61 2 9239 7100 F 61 2 9239 7199 E sydmail@ghd.com.au W www.ghd.com.au

Data source: Aerial imagery - SIX Maps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2017, 2015 & 2012; Vegetation mapping - Cumberland Plains NPWS 2002 (OEH); Threatened species - OEH 2018.
Created by:J.Price

2.3.1 Geographical Information System (GIS) analysis

GIS analysis is an integral part of the BAM. GIS was used to:

- Plot the subject site on a high resolution aerial photo base and to map vegetation zones, survey effort, habitat resources and biodiversity values across the site.
- Calculate the extent of native vegetation to be impacted.
- Confirm the relevant IBRA bioregion, IBRA subregion and Mitchell Landscape for the site.

Additional GIS analysis was used to plot a 1,500 m buffer area surrounding the site in which site context components were calculated. Native vegetation cover, extent and connectivity were assessed using aerial photography. Air photo interpretation was used to identify and record distinct vegetation patches, determine the broad condition state of vegetation types and the location and extent of vegetated habitat corridors. The buffer area and GIS area calculations were used to enter information about landscape value and to determine the change in Landscape Value score by assessing the impact of the proposal on native vegetation cover and connectivity as well as the patch size.

2.4 BAM calculations

The proposal was assessed according to the methodology presented in the BAM (OEH, 2017a), and the *Biodiversity Assessment Methods Calculator Users Guide* (OEH 2017b). The credit calculator is a software application that is used to apply the BAM. Data is entered into the credit calculator based on information collected in the desktop assessment, site surveys and from using GIS mapping software.

The BAM credit calculations were performed by Kath Chesnut using credit calculator version 1.2.7.4. The biodiversity credit report is included as Appendix D. The data and assumptions used to perform the BAM credit calculations are summarised in Section 5.

2.5 Staff qualifications

This BDAR was prepared by Kath Chesnut (accredited assessor number BAAS17031) in accordance with the BAM, based on field surveys completed by Ben Harrington (accredited assessor number BAAS17023) and other GHD staff. A technical review of the report was undertaken by Dan Williams (accredited assessor number BAAS17025), Ben Harrington and Jayne Tipping. Staff qualifications are presented in Table 2-7.

Table 2-7 GHD ecology staff and qualifications

Name	Position / Project Role	Qualifications	Relevant Experience
Mal Weerakoon	Ecologist / desktop assessment and field surveys	BSc, Mphil by research	5+ years
Maddy Young	Ecologist / reporting, BAM-C calculations	BEnvSc (Hons), Accredited BAM Assessor	3+ years
Kath Chesnut	Senior Ecologist / desktop assessment and reporting	BEnvSc (Hons) Accredited BAM Assessor	11+ years
Ben Harrington	Technical Director – Biodiversity / field surveys, technical review	BSc, PhD (Zoology) Accredited BAM Assessor	15+ years

Name	Position / Project Role	Qualifications	Relevant Experience
Daniel Williams	Associate/ technical review / BAM-C review	B. App. Sc Accredited BAM Assessor	18+ years
Jayne Tipping	Technical Director – Biodiversity / BDAR review	BSc Masters Environmental Law	24+ years

3. Existing environment

3.1 Landscape features

The BAM requires the assessment of landscape features to help describe the biodiversity values of the subject site and assess the impacts of the proposal. Landscape features relevant to the BAM calculations are shown on Figure 1-2, discussed below and summarised in Table 3-1.

3.1.1 Location and land uses

The subject site is located north-east of the intersection of the M7 Motorway and Elizabeth Drive within the City of Fairfield Local Government Area (LGA) as shown on Figure 1-1. The 4.72 ha subject site is located entirely within Lot 2 DP 2954. It is bound to the south by Elizabeth Drive, to the east by native vegetation, to the west by Cecil Road and to the north by private property.

The site is currently tenanted. Recent land uses have included agricultural pursuits and grazing, and historical land uses appear to have included timber-getting and agriculture.

As outlined in Section 1.6, the proponent has been notified that a portion of the lot will be acquired in the future by Transport for NSW (TfNSW) as part of the proposed M12 Motorway Project. The proposed M12 Motorway layout is shown on Figure 5-1. It is assumed that the area of land proposed for acquisition by TfNSW will not change at this point, and that the M12 Motorway proposal will proceed. As such, the context of the site will be substantially modified, once the M12 Motorway is constructed. Based on the information provided to the proponent, illustrated on Figure 5-1, Elizabeth Drive will be widened, and the western and northern boundary of the lot will form the edge of the M12 Motorway.

The construction of the M12 Motorway will result in a notable change from the current landscape context of the site, with the following differences:

- Along the southern portion of the site: Elizabeth Drive will be increased from a two lane road to a multiple lane road in each direction.
- Along the western portion of the site: Cecil Road is currently a quiet, two lane road that runs along the south west boundary of the site. The M12 Motorway will eventually form the western and northern boundary of the site, and will result in the removal of vegetation along the current western and northern boundaries of the site.

These changes will result in a far greater degree of isolation of the site from surrounding vegetation to the south, as Elizabeth Drive will become a hostile barrier to movement, as defined by DECC (2008e), and the site will be largely cut off from vegetation to the south, west and north (refer to Figure 5-1 which shows the proposed M12 Motorway alignment, as it occurs adjacent to the site), with only a small patch of vegetation left between the site and Wallgrove Road to the east (refer to Figure 1-2, which shows the small area of vegetation between the site and Wallgrove Road).

3.1.2 Bioregion and IBRA subregion

The subject site occurs within the Cumberland IBRA (Interim Biogeographic Regionalisation for Australia) subregion of the Sydney Basin IBRA bioregion (refer to Figure 1-2). The Sydney Basin IBRA bioregion lies on the central east coast of NSW and covers an area of about 3,624,008 ha which includes about 4.53 per cent of NSW. The region extends north from Batemans Bay to Nelson Bay and west to Mudgee and includes a significant proportion of the catchments of the Hawkesbury-Nepean, Hunter and Shoalhaven river systems.

3.1.3 NSW landscape region (Mitchell Landscapes)

The site is mapped entirely within the 'Cumberland Plain' Mitchell Landscape (refer to Figure 1-2) (DECC, 2008a).

The Cumberland Plain is described as occurring on low rolling hills and valleys in a rain shadow area between the Blue Mountains and the coast on horizontal Triassic shales and lithic sandstones. Elevations within the landscape are generally 30 to 120 m, with a local relief of 50 m. Soils are comprised of red and brown texture soils on crests with yellow soils in valleys (DECC, 2008b).

Vegetation comprises woodlands and open forest with a canopy of Grey Box (*Eucalyptus moluccana*), Forest Red Gum (*Eucalyptus tereticornis*), Narrow-leaved Ironbark (*Eucalyptus crebra*), Thin-leaved Stringybark (*Eucalyptus eugenioides*), Cabbage Gum (*Eucalyptus amplifolia*) and Broad-leaved Apple (*Angophora subvelutina*). A grassy to shrubby understorey is often dominated by Boxthorn (*Bursaria spinosa*). Poorly drained valley floors often contain Swamp oak (*Casuarina glauca*) and Paperbark (*Melaleuca* sp.).

Based on the vegetation, land forms and soils observed during the field survey the Cumberland Mitchell landscape is a good fit for the biophysical environment at the subject site.

3.1.4 Climate

The site has a temperate climate. Based on data from the Abbotsbury (Fairfield City Farm 067114) weather station, the site has a mean annual rainfall of 721 mm, falling predominantly in summer and autumn. The site can reach mean daily maximum temperatures of 30.0 degrees and mean daily minimum temperature of 5.8 degrees Celsius (BOM, 2018b).

3.1.5 Soils and geology

Soil landscapes

The subject site is mapped as occurring on the Luddenham soil landscape which comprises gently undulating low hills and flats on Wianamatta Group shales with Minchinbury Sandstone (OEH 2018d). This soil landscape has a local relief 50–80 m with slopes between 5–20%. Soils in this landscape are shallow (<100 cm) and comprise dark podzolic soils, massive earthy clays on crests; red podzolic soils on upper slopes and yellow podzolic and prairie soils on lower slopes and drainage lines.

The Blacktown soil landscape occurs nearby to the site and forms a large part of the surrounding landscape. This landscape comprises gently undulating low hills and flats on Wianamatta Group shales. Local relief is 10–30 m with slopes generally >5% but occasionally up to 10%. Crests and ridges are broad (200–600 m) and rounded with convex upper slopes grading into concave lower slopes. Soils are deep, moderately fertile clay loams and clays (Bannerman and Hazelton 1990).

Based on the conditions observed on site during the field survey and GHD field staff experience, it is considered that the Blacktown soil landscape may be a more appropriate soil landscape for the site, rather than the Luddenham soil landscape.

Soil hazards

Soil landscapes for the subject site and surrounding buffer area indicate that soils associated with the Luddenham soil landscape have a moderate to very high potential for erosion with slopes of 5–20 per cent and soil profiles that contain highly erodible clays. Minor gully erosion and moderate sheet erosion are common in disturbed areas.

Soils associated with the Blacktown soil landscape have a slight to moderate potential for erosion, with slopes usually greater than five per cent. Some clay subsoils are sodic and dispersive making them highly erodible. Existing minor gully erosion and sheet erosion may be found in disturbed areas.

There is minimal risk of acid sulfate soils as the site is not in a coastal location and has an elevation ranging from about 100-116 m AHD. Acid sulfate soil risk mapping indicates that there are no known occurrences at the subject site (OEH 2018d).

Areas of geological significance

There are no karst, caves, crevices, cliffs or other areas of geological significance located within the subject site or buffer area surrounding the site. The Luddenham dyke occurs about 10 km to the south west of the subject site.

3.1.6 Hydrology

No watercourses are present in the subject site. A small, ephemeral 2nd order drainage line occurs in the north west of the study area and eventually flows into Ropes Creek. A 1st order unnamed ephemeral drainage line runs through the adjoining property to the east of the subject site, outside of the study area (see Figure 1-1).Each of these drainage lines have been heavily modified by existing infrastructure, including, but not limited to, Elizabeth Drive, Cecil Road and Wallgrove Road, as well as by historical land clearing and agricultural use.

These drainage lines form part of the Ropes Creek riparian corridor which is a biodiversity corridor in the locality, largely because it supports some of the only remaining vegetation in the area. The riparian corridor associated with Ropes Creek is fragmented along its extent by existing infrastructure and residential development, as well as by historical agricultural activities.

Drainage lines around the site are particularly impacted by the presence of the M7, Wallgrove Road, Cecil Road and Elizabeth Drive, with the natural topography and drainage of the surrounding area heavily influenced by the construction of these roads. Substantial further modification resulting from construction of the M12 motorway is likely.

3.1.7 Wetlands

There are three farm dams in the study area (refer to Figure 1-1). The two small dams appear to have been excavated to capture local surface flow and were dry at the time of field surveys. These two dams are very small (less than 10 m diameter) and do not comprise a notable gap in canopy vegetation and so they were not separated from the surrounding terrestrial vegetation. One of these dams is within the subject site (refer to Figure 1-1). Neither of these dams is associated with any drainage lines evident on site.

There is a larger dam in the northwest of the study area that has been constructed across the second order drainage line described above and which contained around 1 ha of surface water at the time of the field survey. It is clearly an artificial waterbody, which has been created by damming the drainage line, and it contains minimal fringing or aquatic vegetation. This water body does not comprise an occurrence of the TEC Freshwater Wetlands on Coastal Floodplains as it is an artificial waterbody created on previously dry land for purposes such as farm production. Such artificial water bodies do not comprise part of the TEC according to the identification guidelines for the community (DECC 2008).

3.1.8 Patch size and connectivity features

Vegetation that would be disturbed within the site is part of a larger patch that extends to the south, north and west of the site. The total size of this patch is about 331 ha within the 1,500 m buffer of the subject site. As shown on Figure 1-2, there is a larger patch of vegetation to the east of the site, which is separated from the subject site by the M7 Motorway. Highly mobile fauna species could readily traverse the gap created by this roadway, however it would constitute a hostile gap for less mobile species. Elizabeth Drive is located to the south of the site and is only a two lane road at this point and would not create a hostile gap to connectivity as defined by DECC (2008e), as such, vegetation patches to the south of the site that are not separated by a gap of more than 100 m are considered to form part of the overall patch.

The M12 Motorway will also act as a hostile gap to fauna movement as defined by DECC (2008e), and will result in the fragmentation of vegetation along the riparian area once it is constructed, as it is likely to removal all vegetation along the western and northern portions of the lot. This assessment has been completed based on conditions as they are on site now.

The BAM provides guidance on assessing the patch size for a vegetation zone, and notes that patch size should be assigned to a class. The patch size for the vegetation zone that occurs within the subject site is ≥ 100 ha, with 331 ha occurring within the 1,500 m buffer of the subject site. For the purposes of the calculations in the BAM and for this assessment, the total patch size has not been calculated outside of the 1,500 m buffer area, given the highest class was already reached within the buffer area. 331 ha was entered as the patch size in the BAM calculator.

Within the 1,500 m buffer area surrounding the subject site native vegetation comprises approximately 39.43 percent of the area.

No watercourses are present in the subject site. A 2nd order drainage line occurs to the north west of the study area and eventually flows into Ropes Creek, which occurs as a degraded waterway typical of western Sydney. There is limited riparian vegetation remaining along the smaller tributaries of Ropes Creek or along the main creekline itself, and therefor limited potential to act as a vegetated link to the aquatic and riparian habitats elsewhere along Ropes Creek. A 1st order unnamed drainage line runs through the adjoining property to the east of the subject site. There are no plans to remove vegetation associated with the drainage line that runs along the north western boundary of the study area as part of this proposal, as it is outside of the subject site. As such, the proposal is unlikely to further fragment the vegetation associated with this drainage line. However, this vegetation will likely be heavily impacted by the proposed M12 Motorway, as shown on Figure 5-1.

Table 3-1 Summary of landscape features present within the subject site

Landscape feature	Subject site
Method applied for site context components	Site-based
Interim Biogeographic regionalisation of Australia (IBRA) bioregion	Sydney Basin
IBRA subregion	Cumberland
Mitchell landscapes	Cumberland Plain
Rivers, streams and estuaries	There are no rivers streams or estuaries on the subject site.
Wetlands	None

Landscape feature	Subject site
Connectivity features	The site is connected to small areas of vegetation to the north and east of the site. Vegetation within the buffer area is largely restricted to small and isolated fragments, resulting from existing infrastructure and historical land clearing. There is a larger patch of vegetation to the south and east of the site, separated from the subject site by the Elizabeth Drive and the M7 Motorway.
Areas of geological significance or soil hazard features	Soil landscapes for the subject site and surrounding buffer area indicate that soils associated with the Luddenham soil landscape have a moderate to very high potential for erosion. Soils associated with the Blacktown soil landscape have a slight to moderate potential for erosion. Acid sulfate soil risk mapping indicates that there are no known occurrences at the subject site (OEH 2018d). There are no karst, caves, crevices, cliffs or other areas of geological significance located within the subject site or buffer area surrounding the site.
Other landscape features	Nil
Current percent native vegetation cover buffer area	39.43 percent
The future percent native vegetation cover buffer area	39.29 percent

3.1.9 Other site features

Other site features include an artificial water body (farm dam), buildings, infrastructure and dumped fill and exotic grassland. Exotic grassland is discussed further in Section 3.1.10. Up to 0.51 ha of buildings, infrastructure and dumped fill occur in two discrete patches within the subject site. A further 0.25 ha containing a waterbody was also mapped as 'other site features'. Buildings, infrastructure, dumped fill and waterbodies were not included in BAM calculations, however are considered in regards to potential prescribed biodiversity impacts on threatened species.

3.1.10 Non-native vegetation

Non-native vegetation occurs as exotic grassland within the subject site. Exotic grassland occupies 3.05 ha of the site, between an existing dwelling and native vegetation within open woodlands. Exotic grassland in the subject site has been subject to historical and ongoing disturbances including ploughing for agriculture and grazing by livestock. One floristic plot (Plot 4) was sampled in exotic grassland (refer to Figure 3-1) to confirm the absence of native vegetation from within this portion of the site. There was no native overstorey or midstorey species within this portion of the site. Native species richness was very low in the understorey, and was restricted to very sparse occurrences of Couch (*Cynodon dactylon*) and Weeping Grass (*Microlaena stipoides* var. *stipoides*). An exotic understorey comprising mostly Kikuyu (*Pennisetum clandestinum*), *Setaria parviflora* and *Briza subaristata* dominated cover and abundance of flora within the plot. Exotic grassland was not assigned a PCT or was considered in BAM calculations due to the level of disturbance and absence of native vegetation (refer to Section 5.1.1.5 of the BAM (OEH 2017a).

3.2 Native vegetation

3.2.1 Native vegetation extent

The subject site contains a mix of native and non-native vegetation. There is 1.15 ha of native vegetation in the subject site.

3.2.2 Flora species

A total of 69 flora species from 31 families were recorded within the study area, comprising 38 native and 31 exotic species. The Poaceae (grasses, 15 species, 10 native) and Asteraceae (5 species, all exotic) were the most diverse families recorded. A full list of flora species recorded is provided in Appendix B. Common species recorded are discussed below in relation to the vegetation zones occurring within the subject site.

3.2.3 Plant community types

Overview

Field surveys confirmed the presence of one native PCT within the subject site, as shown on Figure 3-1, summarised in Table 3-2 and described below. One exotic vegetation zone (Exotic grassland, refer to Figure 3-1) was also identified. Vegetation within each zone was considered relatively homogenous, however was not considered homogenous across the entire site.

Mature and hollow-bearing trees are scattered throughout native vegetation within the subject site and there is regeneration of all canopy species within native vegetation.

The native vegetation within the site is in moderate condition with few weeds present. There are some dense patches of weedy grasses including *Setaria parviflora* and *Briza subaristata.* Blackberry (*Rubus fruticosus* spp. agg) is present along the western boundary of the site.

Table 3-2 Native vegetation zone within the subject site

Plant community type (OEH, 2018c)	PCT ID	Condition	Area (ha)	Patch size (ha)	Vegetation integrity score	BC Act Status	EPBC Act Status
Grey Box - Forest Red Gum grassy woodland on flats	849	Moderate	1.15	≥100 (331)	67.2	CEEC (Cumberland Plain Woodland)	CEEC (Cumberland Plain Woodland and Shale-gravel Transition Forest)
		Total area	**1.15**				

Native vegetation zones

The structure, species composition and condition of the vegetation zone within the subject site is described below. Plant species lists are provided in Appendix B. Plot data is provided in Appendix C, along with benchmark values for the vegetation type.

Zone 1 - Grey Box - Forest Red Gum grassy woodland on flats

Grey Box - Forest Red Gum grassy woodland on flats	
PCT (OEH, 2018c)	Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion
PCT ID	849
Photo	
Survey effort	Plots 1, 2, 3
Conservation significance	Comprises an occurrence of Cumberland Plain Woodland in the Sydney Basin Bioregion which is listed as a CEEC under the BC Act and the related community Cumberland Plain Woodland and Shale-gravel Transition Forest which is listed as a CEEC under the EPBC Act.
Patch size class	≥100 ha (331 ha within the 1500 m buffer of the subject site)
Condition	Plot data confirms that this vegetation is in moderate condition, with near-benchmark values for native plant species richness and most vegetation cover attributes although percentage of shrub and forb cover was substantially lower than benchmark. Hollow-bearing trees were recorded in two of the three plots sampled. There was a moderate amount of fallen logs and leaf litter present; with accumulations of woody debris in places. All of the native canopy species present in the vegetation zone were observed regenerating.
Current vegetation integrity score	67.2
Landscape position	This community occurs on clay/loam soils derived from Wianamatta Shales on gently undulating low hills and flats at an elevation between 100-112 m.
Structure	Open woodland
Over storey	Dominated by Forest Red Gum (*Eucalyptus tereticornis*), Grey Box (*Eucalyptus moluccana*) and Spotted Gum (*Corymbia maculata*)
Mid storey	Sparse and lacking in diversity. Where present, comprises occasional Native Blackthorn (*Bursaria spinosa*).

Grey Box - Forest Red Gum grassy woodland on flats	
Groundcover	Typically characterised by grasses such as Weeping Grass, Red Grass (*Bothriochloa macra*), Slender Rat's Tail Grass (*Sporobolus creber*) and Couch; forbs such as Kidney Weed (*Dichondra repens*) and Native Wandering Jew (*Commelina cyanea*); rushes and sedges such as *Juncus usitasis* and Slender Flat-sedge (*Cyperus gracilis*); and scrambling climbers including Variable Glycine (*Glycine tabacina*) and Native Grape (*Cayratia clematidea*).
Exotic species	Exotic plant cover is low but was moderate in diversity. Weeds in this vegetation zone are dominated by Purpletop (*Verbena bonariensis*), Rhodes Grass (*Chloris gayana*), *Setaria parviflora* and Paddy's Lucerne (*Sida rhombifolia*). Between 4 to 7 percentage cover of high threat weeds was recorded within plots sampled while high threat exotic plant cover ranged between 0.9-8.4 percentage cover.

3.2.4 Groundwater dependent ecosystems

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

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

Native vegetation within the subject site is mapped as the terrestrial GDE Cumberland Shale Plains Woodland. This is identified as vegetation that has high potential for being reliant on the subsurface presence of groundwater, and a likelihood of 8 that the vegetation type is an in-flow dependant ecosystem, namely an ecosystem that is "*accessing a water source in addition to rainfall, such as water stored in the unsaturated zone, surface water or groundwater*" (Australian Government, 2012).

3.3 Habitat resources

The subject site comprises a mixture of native vegetation (PCT 849), as well as buildings, infrastructure and dumped fill and exotic grassland.. These areas may provide broadly suitable habitat for the Cumberland Plain Land Snail, as the species is known to shelter in disturbed areas under anthropogenic rubbish, in close proximity to areas of Cumberland Plain Woodland. Despite extensive searches, no Cumberland Plain Land Snails were recorded during the targeted surveys. The photos below show the types of potential habitat present on site in terms of woody debris and refuse. Additional potential habitat is also present around the base of trees with leaf litter accumulations.

Photo 1 Small pile of wood

Photo 2 Large pile of rubbish and debris

Photo 3 Large 'burn pile' of wood and debris

The buildings onsite have the potential to provide roosting resources for some insectivorous bats species. Some bat species, including the Large Bent-winged Bat (*Miniopterus orianae oceanensis),* Little Bent-winged Bat (*Miniopterus australis*) and the Southern Myotis (*Myotis macropus*) are known to roost in man-made structures such as buildings and bridges.

With the exception of the Cumberland Plain Land Snail and some insectivorous bats, the areas of the subject site not covered in native vegetation are not considered to provide suitable habitat for threatened species listed under the BC or EPBC Acts.

Portions of the subject site that support native vegetation are part of a larger network of fragmented vegetated patches throughout the western Sydney landscape. There are extensive areas of residential and industrial development and numerous major roads throughout the locality around the subject site. This level of fragmentation and disturbance reduces the potential available habitat for many threatened species, particularly those which require large and intact tracts of vegetation to persist in the landscape.

Fauna species with the potential to occur at the subject site would be limited to those species capable of persisting in fragmented and modified landscapes, or wide-ranging highly mobile species capable of travelling throughout fragmented landscapes may utilise the site on occasion, as part of a larger home range and network of habitats. Species that may utilise the site in response to favourable conditions include highly mobile wide ranging fauna such as the Dusky Woodswallow (*Artamus cyanopterus*), Varied Sittella (*Daphoenositta chrysoptera*), and some of the large forest owls, such as the Powerful Owl (*Ninox strenua*).

The dominant overstorey trees in the subject site are Forest Red Gum and Grey Box (with occasional Spotted Gum. These trees provide potential foraging resources for nectarivorous fauna, including honeyeaters, lorikeets and parrots such as the threatened Little Lorikeet (*Glossopsitta pusilla*), Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*). Grey Box in particular, can flower at any time of year and could provide all year-round foraging habitat for these species. The Grey-headed Flying Fox (*Pteropus poliocephalus*) may also forage amongst these canopy species on occasion.

The overstorey contains a small number of hollow-bearing trees in the open woodland and estimated at densities of <1 hollow-bearing tree per hectare. Across the site, hollow sizes range from small (<50 mm aperture) limb and trunk hollows through to large (>150 mm aperture). Together, they may provide roosting, refuge and breeding habitat for a range of native species, including micro bats, arboreal species (e.g. possums) and birds (parrots, lorikeets). A resident Common Brushtail Possum with dependant young was observed utilising a hollow within the subject site during nocturnal surveys. In addition, several birds including Little Black Cormorant, Australasian Grebe, White-faced Heron and Noisy Miner were observed roosting in trees.

The low density of hollows in the subject site is likely to create nesting/roosting competition between species mentioned above. Hollow-bearing trees within the subject site may also be used by threatened microbat species such as the Eastern Free-tail Bat (*Mormopterus norfolkensis*) and Eastern False Pipistrelle (*Falsistrellus tasmaniensis*). A number of threatened birds may also utilise these hollows. There are no large hollows suitable for threatened forest owls such as the Masked Owl (*Tyto novaehollandiae*) and Powerful Owl (*Ninox strenua*) and, in general, these species would be unlikely to utilise hollows in relatively open and fragmented woodland remnants such as those at the subject site.

The midstorey at the subject site is largely absent, and is limited to occasional juvenile specimens of Native Blackthorn (*Bursaria spinosa*).

The understorey is dominated by a limited diversity of native grass species. There are reasonable quantities of fallen timber throughout PCT 849, and leaf litter is present, particularly around the base of trees. These resources could provide habitat for a range of native reptiles and gastropods, including the threatened Cumberland Plain Land Snail (*Meridolum corneovirens*), as well as common species such as skinks and snakes.

The ephemeral small dam (refer to Figure 1-1 and Section 3.1.7) and the large artificial water body in the north of the study area lack any fringing, emergent or aquatic vegetation, and as such, are unlikely to provide suitable habitat for wetland species such as the Australasian Bittern (*Botaurus poiciloptilus*) or the Green and Golden Bell Frog (*Litoria aurea*), as outlined below.

The preferred habitat of the Green and Golden Bell Frog is noted to "*always contain plenty of vegetation in and around water*" (DECC, 2008). Further, the species is known to prefer sites that support *Typha* spp. or *Eleocharis* spp. which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. There are no permanent water bodies within the subject site, as outlined in Section 3.1.7, and no suitable habitat for the Green and Golden Bell Frog within the subject site. The large artificial water body in the north of the study area does contain a permanent source of water, but lacks any aquatic vegetation, has limited fringing vegetation around the water's edge (restricted to exotic grasses such as Kikuyu and patchy native grasses or canopy trees with no understorey species and bare earth), and has no occurrences of *Typha* spp. or *Eleocharis* spp. (refer to Photo 4 and Photo 5). As such, it is unlikely that the Green and Golden Bell Frog would occur within the study area.

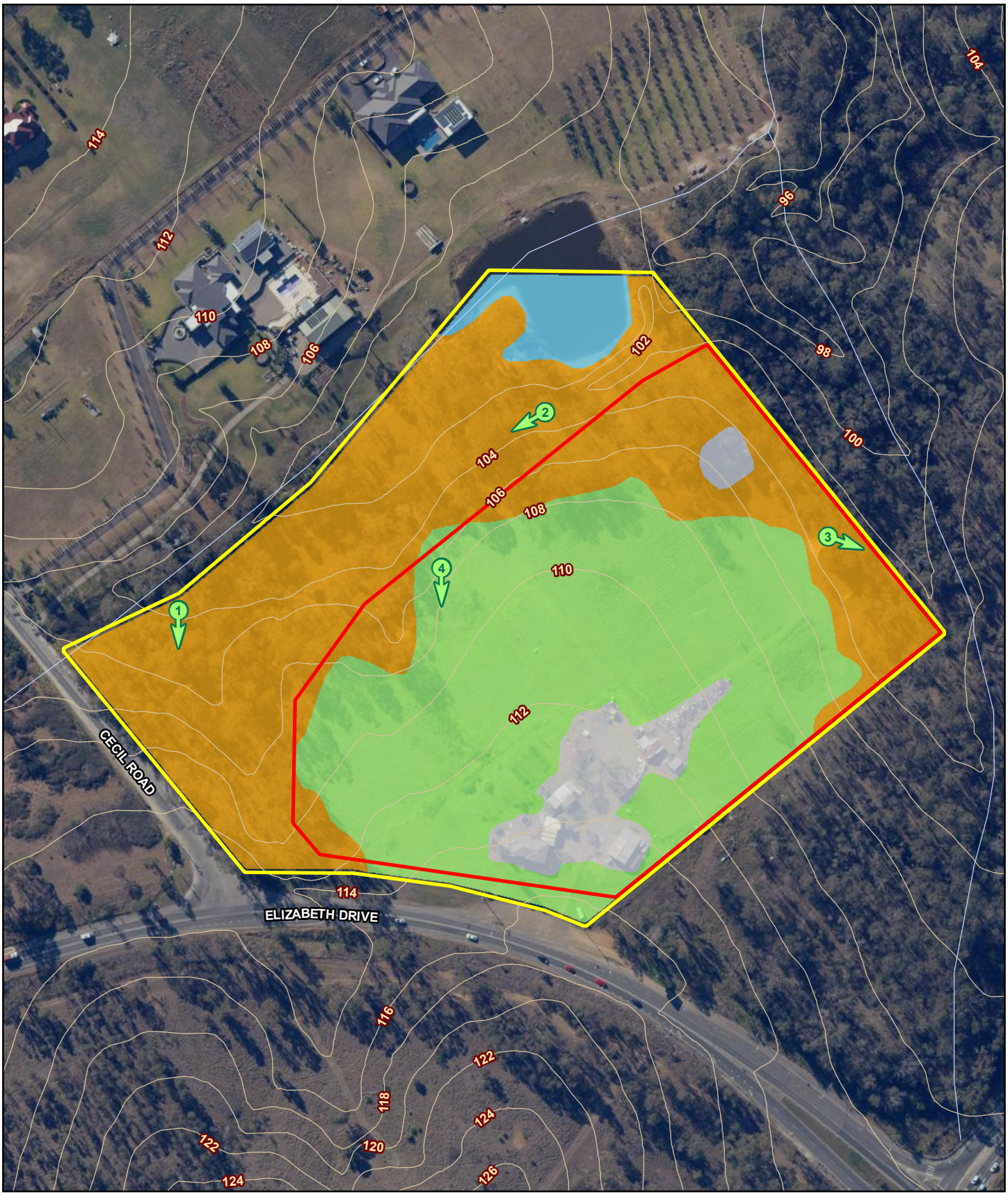
Photo 4 Large artificial waterbody in the north of the study area, showing lack of emergent vegetation

Photo 5 Large artificial waterbody in the north of the study area showing lack of fringing vegetation

The Australasian Bittern favours permanent freshwater wetlands with tall dense reedbeds, particularly *Typha* spp. and *Eleocharis* spp., with adjacent shallow, open water for foraging. The photos taken during the field survey confirm that there is no suitable habitat present for this species in the study area (see Photo 4 and Photo 5), and given the lack of any permanent water bodies within the subject site, and thus the lack of aquatic plants such as *Typha* spp. and *Eleocharis* spp., the subject site does not contain adequate habitat for this species.

The BAM assessment of habitat resources at the subject site was completed with reference to the above observations. The following specific geographic and habitat features were identified within the site and indicate the potential presence of threatened species that contribute to the credit calculations:

- Fallen/standing dead timber, including logs.
- Semi-permanent/ephemeral wet areas.
- Land within 1 kilometre of wet areas/swamps.
- Hollow-bearing trees.
- Land within 1 kilometre of waterbodies/swamps.
- Land within 200 m of riparian zone.



LEGEND

- Study area
- Subject site
- Contours (2m)
- Waterways

Other site features

- Buildings, infrastructure and dumped fill
- Exotic grassland
- Water body

Native vegetation

- 1. PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate) (CEEC BC Act; CEEC EPBC Act)

- Plot/transect

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

1111 Elizabeth Drive Pty Ltd
Elizabeth Drive
Biodiversity Development Assessment Report

Job Number 21-27092
Revision 0
Date 15 Jun 2020

Vegetation

Figure 3-1

N:\AU\Sydney\Projects\21\27092\GIS\Maps\Deliverables\RevisedLayout\21_27092_Z003_RL_Vegetation_0.mxd Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Aerial imagery - SIX Maps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2017, 2015 & 2012; Vegetation mapping - Cumberland Plains NPWS 2002 (OEH); Threatened species - OEH 2018.
Created by:J.Price

4. Threatened biota

4.1 Identification of threatened species under the BAM

4.1.1 Predicted threatened species

Based on the vegetation types and habitat resources present within the site, the BAM calculator generates a list of threatened fauna species that are predicted to utilise the subject site. The suite of threatened species associated with ecosystem credits required for the subject site are listed in Table 4-1. For each predicted threatened species a sensitivity class rating is also provided. Targeted surveys are not required for these species.

Three predicted threatened fauna species; the Eastern Free-tail Bat (*Mormopterus norfolkensis*), Eastern Bentwing Bat (*Miniopterus schreibersii oceanensis*) and Grey-headed Flying-fox (*Pteropus poliocephalus*) were recorded within the study area during field surveys.

Table 4-1 Predicted threatened species (ecosystem species)

Common name	Scientific name	Sensitivity class[1]	Habitat present
Regent Honeyeater[2]	*Anthochaera phrygia*	High	Yes
Dusky Woodswallow	*Artamus cyanopterus*	Moderate	Yes
Gang-gang Cockatoo[2]	*Callocephalon fimbriatum*	Moderate	Yes
Speckled Warbler	*Chthonicola sagittata*	High	Yes
Spotted Harrier	*Circus assimilis*	Moderate	Yes
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus victoriae*	High	Yes
Varied Sittella	*Daphoenositta chrysoptera*	Moderate	Yes
Spotted-tailed Quoll	*Dasyurus maculatus*	High	Yes
Little Lorikeet	*Glossopsitta pusilla*	High	Yes
Painted Honeyeater	*Grantiella picta*	Moderate	Yes
White-bellied Sea-Eagle[2]	*Haliaeetus leucogaster*	High	Yes
Little Eagle[2]	*Hieraaetus morphnoides*	Moderate	Yes
Swift Parrot[2]	*Lathamus discolor*	Moderate	Yes
Square-tailed Kite[2]	*Lophoictinia isura*	Moderate	Yes
Hooded Robin (south-eastern form)	*Melanodryas cucullata*	Moderate	Yes
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis*	Moderate	Yes
Little Bentwing-bat[2]	*Miniopterus australis*	High	Yes
Eastern Bentwing-bat[2]	*Miniopterus schreibersii oceanensis*	High	Yes. Recorded via Anabat detection
Eastern Coastal Freetailed-bat	*Micronomus norfolkensis*	High	Yes. Recorded via Anabat detection
Turquoise Parrot	*Neophema pulchella*	High	Yes

Common name	Scientific name	Sensitivity class[1]	Habitat present
Barking Owl[2]	*Ninox connivens*	High	Yes
Powerful Owl[2]	*Ninox strenua*	High	Yes
Scarlet Robin	*Petroica boodang*	Moderate	Yes
Flame Robin	*Petroica phoenicea*	Moderate	Yes
Koala[2]	*Phascolarctos cinereus*	High	Yes
Grey-headed Flying-fox[2]	*Pteropus poliocephalus*	High	Yes. Seen within the study area
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*	High	Yes
Diamond Firetail	*Stagonopleura guttata*	Moderate	Yes
Masked Owl[2]	*Tyto novaehollandiae*	High	Yes

[1] Sensitivity to gain class – High = high sensitivity to potential gain, Moderate = moderate sensitivity to potential gain.

[2] These species are predicted ecosystem credit species due to the presence of foraging habitat within the site.

4.1.2 Species credit species

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

Searches of threatened species databases were also completed to determine any additional species to those generated by the credit calculator that are known or predicted to occur in the locality (refer to likelihood of occurrence table in Appendix A). These results were reviewed giving consideration to the habitats available on site, to determine the candidate species credit species that have potential to occur at the subject site. Targeted surveys were undertaken for the species considered to have the potential to occur on site, given the presence of suitable habitat, as identified in Table 4-2. Surveys were conducted in the appropriate season for all of the species credit-type species (see Table 4-2).

One species credit species, the Southern Myotis (*Myotis macropus*), was recorded in the subject site via anabat echolocation call recording.

Table 4-2 Candidate species credit species with potential to occur within subject site

Common name	Scientific name	Habitat present within the site	Recorded within subject site	Survey adequacy	Recommended survey period
Downy Wattle	*Acacia pubescens*	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	All year
Bush Stone-curlew	*Burhinus grallarius*	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	All year
Dillwynia tenuifolia	*Dillwynia tenuifolia*	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	August to October
Juniper-leaved Grevillea	*Grevillea juniperina* subsp. *juniperina*	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	All year
Marsdenia viridiflora R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith LGAs	*Marsdenia viridiflora* subsp. *viridiflora* - endangered population	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	November – February
Cumberland Plain Land Snail	*Meridolum corneovirens*	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	All year
Southern Myotis	*Myotis macropus*	Yes	Yes	Adequate: surveyed October 31, November 1-2.	October to March
Spiked Rice-flower	*Pimelea spicata*	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	All year
Matted Bush-pea	*Pultenaea pedunculata*	Yes	No	Adequate: surveyed March 15, October 31, November 1-2	September to November

4.2 Threatened species survey results

4.2.1 Threatened flora

No threatened flora species were identified within the subject site.

Visibility across the subject site was good, with minimal midstorey vegetation present, which allowed for easy sighting of all species in the understorey and midstorey. The site was also easily traversed on foot, with no barriers to human movement encountered during the field survey. As such, field staff were able to traverse all areas of potential threatened flora habitat on foot, in a manner that reflected threatened species survey guidelines (DPIE, 2020; Cropper, 1993). Given the lack of obstacles to accurate and definitive survey, candidate threatened flora species can be excluded from occurring within the site, given they were not located by an experienced botanist familiar with each of the species.

4.2.2 Threatened fauna

Four threatened fauna species were identified within the subject site during field surveys:

- Southern Myotis (*Myotis macropus*).
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).
- Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*).
- Grey-headed Flying-fox (*Pteropus poliocephalus*).

The Southern Myotis (*Myotis macropus*) is a species credit candidate species and is discussed in more detail in Sections 5.4.1, 6.1 and 6.6. The species credit candidate species, Grey-headed Flying-fox (*Pteropus poliocephalus*) and Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) are only included in species credit calculations if there is suitable breeding habitat present on the subject site. No Grey-headed Flying-fox (*Pteropus poliocephalus*) breeding camps are located on the subject site so the species was excluded from the credit calculations for species credit species. The Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) primarily breeds in maternity caves and has been excluded from the species credit calculations as no caves area located within the subject site. The Eastern Coastal Free-tailed Bat (*Micronomus norfolkensis*) is an ecosystem credit species.

There is broadly suitable habitat for other candidate threatened fauna species listed in Table 4-2 within the subject site however they were not recorded during targeted surveys for these species. There are no local records for the Bush Stone-curlew, and given the site disturbance history, presence of predators (dogs and cats) and surrounding fragmentation of intact woodland and grazing pressure, the subject site has poor potential habitat for this species.

There are a large number of records of the Cumberland Plain Land Snail (>300) in the locality from the last 20 years (OEH 2018a) and there is broadly suitable habitat within Cumberland Plain Woodland as well as around areas of human-made rubbish and debris at the subject site. However, no Cumberland Plain Land Snails or their shells were recorded despite intensive targeted survey effort conducted under appropriate survey conditions by experienced ecologists. The subject site does not appear to contain a local population of the species and so no species credit calculations are required according to the BAM. The species may have become locally extinct because of historical clearing and fragmentation of habitat or factors such as grazing, soil compaction by livestock or pesticide use may have made the habitat at the site unsuitable.

4.2.1 Threatened ecological communities

Areas mapped as PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion (HN528 Moderate) comprise an occurrence of Cumberland Plain Woodland as listed under the BC Act.

Cumberland Plain Woodland on the subject site also comprises an occurrence of the associated CEEC listed under the EPBC Act (Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest) according to the criteria in the listing advice for the community, specifically:

- Woodland that is part of a patch >0.5 ha in area.
- With >10% over storey cover of characteristic canopy species.
- That is associated with shale-influenced soils.
- And contains >50% perennial native plants in the groundcover (TSSC, 2008).

5. Impact assessment

5.1 Introduction

The proposal would result in direct impacts on native biota and their habitats within the subject site. There is also the potential for indirect impacts on retained areas of native vegetation adjacent to the subject site, both during construction and from the resulting operation of the service centre and subdivision.

Specific mitigation measures are recommended to minimise likely impacts on biodiversity values. These measures are presented according to the hierarchy of avoidance and mitigation of impacts, and the provision of offsets to counter residual impacts of the proposal that cannot be avoided or mitigated.

5.2 Avoidance of impacts

The proposal has aimed to avoid impacts on native vegetation and habitat values by focusing development in areas of exotic grassland where possible, and adjusting the proposal footprint to limit impacts on better quality (i.e. native) vegetation within the remainder of the site (see Figure 5-1). The proposal includes 11 industrial lots that would result in impacts to 1.15 ha of native vegetation. The current footprint represents a third iteration of the proposal, and was devised following ongoing consultation with DPIE regarding the need to avoid impacts on the CEEC Cumberland Plain Woodland (PCT 849), as well as consultation with TfNSW regarding compulsory acquisition of a portion of the lot.

The original proposal sought to impact 2.35 ha of PCT 849 (GHD 2018). This amount was reduced to 2.00 ha in October 2019 following consultation with DPIE on an acceptable quantum of impacts. This amount has been further reduced to 1.15 ha in the current BDAR, taking into account the constraints associated with the proposed land acquisition for the M12 Motorway, while still achieving a viable development

5.3 Minimisation of impacts

5.3.1 Construction phase

Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) would be required for the construction phase of the project, and would be prepared prior to issue of the Construction Certificate. The CEMP would include, as a minimum, industry-standard measures for the management of soil, surface water, weeds and pollutants, as well as site-specific measures, including the procedures outlined below. The proposed mitigation measures would include environmental safeguards for protection of neighbouring properties and waterways in accordance with relevant policy documentation and Government guidelines.

In order to address the potential impacts of the proposal on biodiversity as discussed in Section 5.4, the mitigation and management measures outlined in Table 5-1 would be implemented as part of the CEMP for the site.

Table 5-1 Mitigation measures (construction)

Impact	Mitigation	Timing	Responsibility
General	All workers are to be provided with an environmental induction prior to starting work on site. This would include information on the ecological values of the site, protection measures to be implemented to protect biodiversity and penalties for breaches.	Prior to clearing/construction works.	Construction contractor
	Prepare a flora and fauna management sub-plan as part of the CEMP, incorporating recommendations below, and expanding on specific details where necessary.	Prior to clearing/construction works.	Construction contractor
	Measures to suppress dust implemented during clearing and construction.	Throughout clearing and construction phases	Construction contractor
Vegetation clearing	Limit disturbance of vegetation to the minimum necessary to undertake the proposal.	Prior to works commencing	Construction contractor
	Prior to the commencement of any work in or adjoining areas of native vegetation, a survey would be carried out to mark the construction impact boundary. The perimeter of this area will be fenced using high visibility fencing and clearly marked as the limits of clearing. All vegetation outside this fence line will be clearly delineated as an exclusion zone to avoid unnecessary vegetation and habitat removal. Fencing and signage must be maintained for the duration of the construction period. Fencing should be designed to allow fauna to exit the site during clearing activities.	Prior to clearing / Daily inspections of exclusion zones during works in area.	Construction contractor and qualified ecologist
	Stockpiles of fill or vegetation should be placed within existing cleared areas (and not within areas of adjoining native vegetation).	Prior to clearing/ construction works	Construction contractor
	Sediment fences should be installed to prevent transfer of sediments into adjacent vegetation.	Prior to clearing/ construction works	Construction contractor

Impact	Mitigation	Timing	Responsibility
Introduction of Weeds and Pathogens	Develop a weed and pest species management sub-plan as part of project CEMP to manage weeds and pathogens during the construction and operational phase of the proposal.	Prior to clearing/ construction works	Construction contractor
	The location and extent of any priority and/or high threat environmental weeds within the site will be identified by a suitably qualified ecologist during pre-clearance surveys. The introduction and spread of weed species will be minimised by restricting access to areas of native vegetation and communicating the responsibilities of all Project personnel at site inductions and during regular toolbox meetings. All priority weeds identified on the site will be controlled and removed in accordance with the requirements of the Biosecurity Act 2016 and Council's relevant Weed Control Manuals: Appropriate pesticides will be applied if required and a record of such application made in the pesticide application register. All noxious and environmental weeds will be cleared and stockpiled separately to all other vegetation, removed from site and disposed of at an appropriately licenced disposal facility. When transporting weed waste from the site to the waste facility, trucks must be covered to avoid the spread of weed-contaminated material. Disposal must be documented, and evidence of appropriate disposal must be kept.	Prior to clearing/ construction works	Construction contractor and qualified ecologist
	All machinery entering the site must be appropriately washed down and disinfected prior to work on site to prevent the potential spread of weeds, Cinnamon Fungus (*Phytophthora cinnamomi*) and Myrtle Rust (*Pucciniales fungi*) in accordance with the national best practice guidelines for Phytophthora (O'Gara *et al.,* 2005) and the Myrtle Rust factsheet (DPI 2015b) for hygiene control.	Prior to any plant or machinery being brought onto the site	Construction contractor
	Incorporate control measures in the design of the proposal to limit the spread of weed propagules downstream of subject site. Sediment control devices, such as silt fences, would assist in reducing the potential for spreading weeds.	Prior to clearing/ throughout construction works	Construction contractor

Impact	Mitigation	Timing	Responsibility
Removal of fauna habitat	Protocols to prevent introduction or spread of chytrid fungus should be implemented following Office of Environment and Heritage Hygiene protocol for the control of disease in frogs (DECCW, 2008c).	Prior to clearing/ throughout construction works	Construction contractor
	A trained ecologist should be present during the clearing of native vegetation or removal of potential fauna habitat to avoid impacts on resident fauna and to salvage habitat resources as far as is practicable. Clearing surveys should include the following:	Prior to and during clearing works	Qualified ecologist
	Staged vegetation clearing, commencing with the most disturbed vegetation in the south of the site and progressing northwards to increase the opportunity for fauna to vacate the site and disperse into areas of adjoining habitat to evade injury. It is preferable for the clearing of hollow-bearing trees to occur outside of the breeding season of bats and birds with the potential to occur at the site (typically during September-December), and periods when some species (microbats) are in torpor (typically during June-August).	During clearing phase	Construction contractor
	Pre-clearance fauna surveys, undertaken in accordance with the following procedure: • An initial pre-clearance survey of the site will be undertaken by a suitably qualified ecologist prior to the commencement of any clearing activities. During the initial survey all hollow-bearing trees and significant habitat features such as fallen logs, will be identified with an “H” in high visibility spray paint. Significant environmental or priority weed infestations would also be identified and communicated to the contractor. A daily pre-clearance fauna survey is also to be undertaken by a suitably qualified ecologist each day prior to the clearing of native vegetation: • Surrounding vegetation (i.e. non-hollowing bearing trees and understory plants) will be inspected by the ecologist for the presence of fauna. • If animals are found, procedures outlined in the protocol for capture and relocation (below) will be followed. Surrounding vegetation can then be cleared. • If no fauna are found, then surrounding non-hollow-bearing vegetation can be cleared. This process will be monitored by the ecologist in case fauna are found to be at risk; and • The ecologist will document the outcomes of this process (e.g. number and species encountered/rescued). • As discussed above clearing of hollow-bearing trees and logs is to take place outside the breeding and torpor periods for the majority of species that may potentially occur. As such it is unlikely that any breeding activity would be present.	Prior to and during clearing works	Qualified ecologist

Impact	Mitigation	Timing	Responsibility
	A suitably qualified and appropriately licenced ecologist is to be present during clearing of all native vegetation to ensure felling of trees is carried out in an appropriate manner, and that any fauna present can be rescued and relocated. All trees marked with an "H" are to be felled in accordance with the procedure detailed below: • When clearing within the approved construction area, all vegetation surrounding a hollow-bearing tree (excluding other hollow-bearing trees and logs) will be removed at least 24 hours prior to the hollow-bearing tree or log being removed. • At least 24 hours after the removal of surrounding (non "H" marked) vegetation, the hollow-bearing tree or log can be removed (in accordance with the technique outlined below). Appropriate fauna 'capture and release' techniques will be implemented (see procedure below). • During the removal of any identified sensitive habitat or hollow-bearing trees: • A suitably qualified and experienced ecologist will be present, with appropriate animal-handling equipment and holding containers. **For hollow-bearing trees:** • Prior to felling or removal, clearing machinery will be used to gently shake or 'bang' the habitat tree for a period of 2-3 minutes (dependant on tree health and structural integrity) to encourage any resident fauna to vacate hollows. Sticks, poles or other similar hand-held objects will also be used to hit the trunk of the tree or log at various points, to encourage animals to vacate the tree. The tree will be observed for at least 5 minutes prior to completing this action. • After the observation period, trees will be gently lowered/felled using an excavator bucket or dozer blade for support if possible. The ecologist will observe the tree felling and ensure that any hollows are not blocked by being placed against the ground. • Once deemed safe by the plant operator, the ecologist will inspect each tree and hollows for fauna that may be present (uninjured, injured or deceased). Use of fibre-optic cameras to assist this process is recommended. The ecologist will document this process using the tree hollow inspection register. • Felled habitat trees with any occupied hollows will be left on the ground overnight or up to 24 hours to allow the animal to exit the hollow. Habitat trees can then be cut into appropriate sections according to the protocol for habitat salvage and relocation (described below).	During clearing phase	Qualified ecologist

Impact	Mitigation	Timing	Responsibility
	For any hollow logs: • Gently knock the log with an excavator for a short time while the log is observed by the ecologists. • Any fauna leaving the log will be rescued by the ecologists according to the protocol for fauna capture and relocation (described below); and • If no fauna emerge after an appropriate time (>5 min), the ecologists will inspect the hollow and instruct the plant operator to salvage hollows or translocate the log in accordance with the protocol for habitat salvage and relocation (described below).		
	Significant habitat features (fallen logs and tree hollows) removed from site would be salvaged and relocated within adjacent areas of vegetation. Prior to removal hollow logs should be knocked gently knocked with an excavator for a short time while the log is observed by a qualified ecologist. Any fauna leaving the log will be rescued by the ecologists according to the protocol for fauna capture and relocation into adjoining vegetation	Following clearing activities	Construction contractor and qualified ecologist
	A suitably qualified and appropriately licenced ecologist will be present during the clearance of all native vegetation and/or fauna habitats. Animals that require handling must not be approached or handled until the ecologist is present, unless in an emergency (e.g. when there are both no authorised persons present and where the failure to immediately intervene would place the animal at significant risk). In such an emergency, the site manager may obtain over the phone instructions from the project ecologist to ameliorate the situation. A wildlife rescue organisation (e.g. WIRES or Sydney Wildlife) should be made aware of operations in case any injured fauna are found. All animals encountered will be treated humanely, ethically, and in accordance with relevant codes under the NSW *Prevention of Cruelty to Animals Act 1979*, including: • Australian code of practice for the care of animals for scientific purposes (NHMRC 2004). • Code of practice for the welfare of wildlife during rehabilitation (DPI 2001). • Animal ethics considerations and protocols outlined in this document. If the project ecologist considers an animal is at risk of injury or undue stress, it is to be gently directed into secure adjoining habitat. Where deemed necessary by the project ecologist, the animal may be required to be captured and released. Capture and release operations will proceed via the following protocols:	During clearing	Qualified ecologist

Impact	Mitigation	Timing	Responsibility
	All construction activities that are considered by the project ecologist be likely to increase the risk of injury, mortality or stress to the animal will be halted until the animal has been removed, which will be enforced with the co-operation of the Contractor. Construction activities that do not contribute to the risk of injury, mortality or stress to the animal can continue (as determined by the project ecologist). Only qualified ecologists or wildlife carers are authorised to handle animals. Animals will be captured (if required) by the project ecologist using a safe and ethical technique, as is appropriate for the particular species (see below). Native animals that are unable to depart of their own accord will be captured and held in a receptacle appropriate for that species until release. All captive-held animals will be provided with food, water and warmth as is appropriate for the species. Each receptacle will only hold one animal at a time and will be cleaned and disinfected between use to avoid the spread of disease. Details of any fauna relocated from hollows would be recorded on the tree hollow inspection register. Any other fauna relocated from trees, shrubs or other areas would also be recorded.		
	The construction contractor is to contact the Project ecologist for advice if any unexpected fauna are found during the construction period (i.e. following clearing of native vegetation when the Project ecologist is no longer on site).	During clearing	Construction contractor
	Natural hollows and fallen timber will be salvaged during clearing. Plant operators will be instructed to maximise the salvage of habitat resources in accordance with the projects conditions of approval. The following protocol is recommended for the salvage of hollows and subsequent habitat enhancement in the adjacent vegetation reserve: Significant hollows (as determined by the project ecologist) will be salvaged during clearing. Following felling, hollow-bearing trees will be left in place for a period of 24 hours. During this period, the ecologist will identify and mark any hollows to be salvaged. Felled habitat trees and logs can be cut into sections after at least 24 hours on the ground/post clearing to permit the recovery of hollow resources. The project ecologist is to direct an appropriately accredited chainsaw operator in these works. Hollow trunks and limbs should be inspected using a fibre-optic camera and/or tapped by the ecologists prior to being cut to check that fauna have departed. Following clearing operations, salvaged hollows are to be relocated in the adjacent vegetation reserve, under direction from the project ecologist.	During clearing	Construction contractor Project Ecologist

Impact	Mitigation	Timing	Responsibility
	Any stockpiled hollow sections of trunks or branches should be placed on their ends (with the hollow opening against the ground) to minimise the chance of fauna entering hollows while they are stockpiled. Vegetation in the adjacent vegetation reserve is not to be damaged during relocation habitat features. Appropriately, sized machinery should be used to relocate hollow trunks and limbs and will use existing tracks or disturbed areas only.		
	A post-clearing report will be prepared documenting all animals that are handled, or otherwise managed, within the site. Data to be recorded includes: • Date and time of the sighting and details of the observer • Species • Number of individuals recorded • Adult/juvenile • Condition of the animal (living/dead/injured/sick) • Management action undertaken (e.g. captured, handled, taken to vet) • Results of any management actions (e.g. released, placed in a nest box, euthanised, placed with carer) • An inventory of hollows and fallen timber salvaged and relocated will be maintained.	Post clearing	Construction contractor/ Qualified ecologist
Water Quality and aquatic habitats	Erosion and sediment control plans should be prepared in accordance with Volume 2D of Managing Urban Stormwater: Soils and Construction (DECC 2008d). The erosion and sediment control plans would be established prior to the commencement of construction and be updated and managed throughout as relevant to the activities during the construction phase.	Prior to construction commencing	Construction contractor
	Erosion and sediment control controls would be regularly inspected, particularly following rainfall events, to ensure their ongoing functionality.	Weekly during construction phase or after any significant rainfall event	Construction contractor
	Stabilised surfaces should be reinstated as quickly as practicable after construction.	Immediately following clearing	Construction contractor
	Appropriate speeds are to be enforced to limit dust generation and minimise chances of fauna mortality through vehicle strike.	During construction	Construction contractor
	All stockpiled material should be stored in bunded areas and kept away from waterways to avoid sediment or contaminants entering the waterway.	During construction	Construction contractor
	Spill kits would be made available to construction vehicles. A management protocol for accidental spills would be put in place.	During construction	Construction contractor

5.3.2 Operation phase

The following mitigation measures would be implemented during the operational phase of the proposal:

- Signposting and enforcement of appropriate speed limits along internal roads to reduce the likelihood of vehicle strike and mortality of native fauna.
- Appropriate management of bushfire asset protection zones (APZ) to prevent the spread of weeds or soil into adjacent areas of retained vegetation.
- Water Sensitive Urban Design infrastructure, perimeter roads and setbacks would be included in APZ. These design features would act as a buffer between the built form and vegetation reserve.
- Appropriate fencing to be erected at interface between subdivision lots and adjoining vegetation reserve to restrict access to the vegetated area.
- Enforcement of legal obligations to control priority weeds within subdivision areas to prevent the spread of propagules into adjacent areas of native vegetation.
- Street lighting to be designed to direct light away from adjoining bushland areas and to limit the impacts of light spill on native fauna habitats.

5.4 Residual impacts to be offset

5.4.1 Construction phase

Direct impacts

Clearing of vegetation

The proposal would result in direct impacts on 1.15 ha of native vegetation comprising PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats. This vegetation is in moderate condition with moderate species diversity. The impacts on this vegetation are associated with clearing for the subdivision and construction of associated infrastructure (roads, services etc.). There are fragmented remnant patches collectively comprising extensive areas of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats throughout the local area, including within nearby reserves such as the Western Sydney Parklands. The proposal would remove a small proportion of individual plant species, PCTs and associated habitats comparative to that in the surrounding area.

In addition to the removal of this native vegetation approximately 3.05 ha of exotic grassland and 0.51 ha of cleared land (comprising buildings, infrastructure and dumped fill) would be impacted.

Table 5-2 Proposed impacts within the subject site

Vegetation Community	PCT (OEH 2018c)	Area within the subject site (ha)
Grey Box - Forest Red Gum grassy woodland on flats	849	1.15
Exotic grassland	N/A	3.05
Buildings, infrastructure and dumped fill	N/A	0.51

The proposal would result in the total clearing of the subject site. The future values of the composition condition scores, structural condition score and function condition score would be 0 for the vegetation zone within the subject site.

Removal of habitat and habitat resources

The vegetation that would be removed provides potential habitat resources for native fauna species, including the Southern Myotis. The proposal is therefore assumed to result in impacts on up to 1.06 ha of potential roosting habitat for this species credit entity (refer to Section 6.6).

The clearing of 1.15 ha of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats would include the removal of several mature trees. Mature trees have value for fauna populations as sources of foraging resources such as leaves, nectar, sap or seed and substrate for invertebrate prey. In the context of the areas of remaining native vegetation surrounding the subject site, the proposal would remove a small proportion of available foraging resources for local populations of native fauna.

Fauna injury and mortality

As described above, the subject site provides a variety of habitat resources for native fauna species, including foraging, roosting and shelter resources for threatened species as well as common native fauna. Groundcover vegetation, leaf litter and woody debris would provide shelter and foraging substrate for reptiles, frogs and invertebrates. Construction is likely to result in the injury or mortality of some individuals of these less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the subject site during clearing activities. There are four identified hollow-bearing trees in the subject site (refer to Figure 3-1), and therefore there is a potential risk of injury or mortality to any species which may be using these hollows, such as microbats, arboreal mammals or hollow-nesting birds. The potential for impacts on fauna utilising hollows would be reduced through pre-clearance surveys of habitat trees. Alternative habitat resources and refuge from construction activities is available in retained native vegetation adjoining the subject site. More mobile native fauna such as native birds, bats, terrestrial and arboreal mammals that may be sheltering in vegetation in the subject site are likely to evade injury during construction activities.

Recommendations have been made in Section 5.3 above to minimise the risk of vegetation clearing activities resulting in the injury or mortality of resident fauna.

Fragmentation or isolation of habitat

Habitat fragmentation through the clearing of vegetation can increase the isolation of remnant vegetation and create barriers to the movements of small and sedentary fauna such as ground dwelling mammals, reptiles and amphibians. Furthermore, habitat fragmentation can create barriers to the movement of pollinator vectors, such as insects, and consequently affect the life cycle of both common and threatened flora.

The project would require the removal of a small amount of vegetation and habitat from within an already highly modified and fragmented landscape. Impacts resulting from the proposal would increase gaps in habitat within the landscape. Given the existing degree of fragmentation in the locality it is unlikely that the project would create any new barriers to the movement of pollinator and seed dispersal vectors, such as insects and birds.

Given the landscape context of the proposal, it is highly unlikely that the site would ever attain any improved level of connectivity in the locality. There is extensive development planned or underway around the site, including:

- The M12 Motorway immediate adjacent to the site.
- The Western Sydney Aerotropolis (located about 4.5 km to the west of the site).
- The Western Sydney Employment Area.
- Developments as noted in the WSP PoM and Greater Sydney Commission website.

The existing degree of fragmentation and isolation from large tracts of remnant, intact vegetation means the potential for connectivity improvement (even without the proposed development) is limited.

Aquatic habitats

Aquatic habitats in the subject site are limited to small farm dams and drainage depressions. There would be no impact as a result of this proposal to the drainage line that runs along the north west boundary of the site. None of the aquatic habitats in the subject site or study area are classified as Key Fish Habitat and would not provide potential habitat for threatened fish. Aquatic habitats may provide limited breeding and shelter resources for common frog and reptile species as discussed above.

Indirect impacts

Weed invasion and edge effects

'Edge effects' can include increased noise and light or erosion and sedimentation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the subject site.

Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge zones can be subject to higher levels of predation by introduced mammalian predators and native avian predators.

Vegetation within and adjoining the subject site is in a relatively modified condition with numerous weed species present. As such there is a low to moderate risk that construction activities would introduce and/or spread any new weeds into adjoining vegetation. Management measures including the development of a weed management sub-plan as part of the project CEMP would be implemented to mitigate these potential impacts (refer to Section 5-3).

Other relevant mitigation measures to reduce the impacts of edge effects include the establishment of an APZ which could act as a buffer from development land, lighting design to minimise light spill as well as dust suppression and erosion and sediment measures during construction.

Introduction and spread of weeds, pests and pathogens

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

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

Construction activities within the subject site also have the potential to introduce or spread pathogens such as Phytophthora (*Phytophthora cinnamomi*), Myrtle Rust (*Uredo rangelii*) and Chytrid fungus (*Batrachochytrium dendrobatidis*) into adjacent native vegetation through vegetation disturbance and increased visitation. There is little available information about the distribution of these pathogens within the locality, and no evidence of these pathogens was observed during surveys. Phytophthora and Myrtle Rust may result in the dieback or modification of native vegetation and damage to fauna habitats. Chytrid fungus affects both tadpoles and adult frogs and can wipe out entire populations once introduced into an area.

The potential for impacts associated with these pathogens is relatively low, given the fairly disturbed and modified nature of the subject site. Diseases and pathogens can be introduced or spread to site via dirt or organic material attached to machinery, vehicles, equipment and employees. To help mitigate the risk of pathogens being brought onto and/or spread through the site all machinery brought to site will be washed down and inspected to be free of soils, seeds and other organic material in accordance with Section 5.3.1.

Noise and light impacts on fauna

The majority of the proposed construction works would be undertaken during standard, daytime construction hours. Exemptions and approval for works outside of the above standard construction hours may be required during certain circumstances

Construction noise would be temporary and generally confined to daylight hours. There would be a minor increase above existing background levels and that is unlikely to result in a significantly impact on fauna that occur in the subject site. Once the industrial development is in operation there may also be some indirect impacts from noise and light around the immediate periphery of the site. To help mitigate these impacts lighting within the subject site will be designed to direct light inward to limit the light spill into adjoining vegetation.

Aquatic disturbance and impacts on fish habitat

The introduction of pollutants from the project into the surrounding environment, if uncontrolled, could potentially impact on water quality further downstream.

The potential for water quality impacts on Ropes Creek (which is downstream from the drainage line that runs along the north west boundary of the subject site), are considered to be low to moderate given the existing disturbance within and around the subject site, and existing potential pollution sources such as the M7 Motorway. Potential water quality impacts would be managed through the implementation of mitigation measures, including the provision of sedimentation basins, silt fences and other structures to intercept runoff.

No endangered aquatic communities, aquatic fauna or marine vegetation listed under the FM Act or EPBC Act occur in the subject site and no significant impacts on riparian vegetation or habitats downstream of the subject site are anticipated as a result of the project. There would be no impact on Key Fish Habitat as a result of the project.

5.4.2 Operation phase

Impacts on biodiversity values would be largely restricted to the construction phase of the project. There are however a number of potential impacts to surrounding vegetation that may occur as a result of the operation of the proposal these include:

- Generation of additional light and noise.
- Erosion and sedimentation as a result of runoff from hard stand areas.
- Introduction of weed propagules by vehicle and/or residents.
- Fauna mortality as a result of collision with vehicles.
- Fauna mortality as a result of domesticated animals.
- Increased risk of fire.
- Rubbish dumping.

Given current land uses at the subject site and in adjacent areas, and especially the location of Elizabeth Drive and the M7 in the immediate vicinity, the proposal would not result in a substantial increase in the operation of any of these potential impacts.

These potential impacts are linked to human occupation of the site and are likely to persist indefinitely. Mitigation measures to be implemented to minimise these potential impacts are discussed in Section 5.3.1.

5.5 Consideration of MNES

The proposal will result in impact to 1.15 ha of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC which is a MNES protected under the EPBC Act.

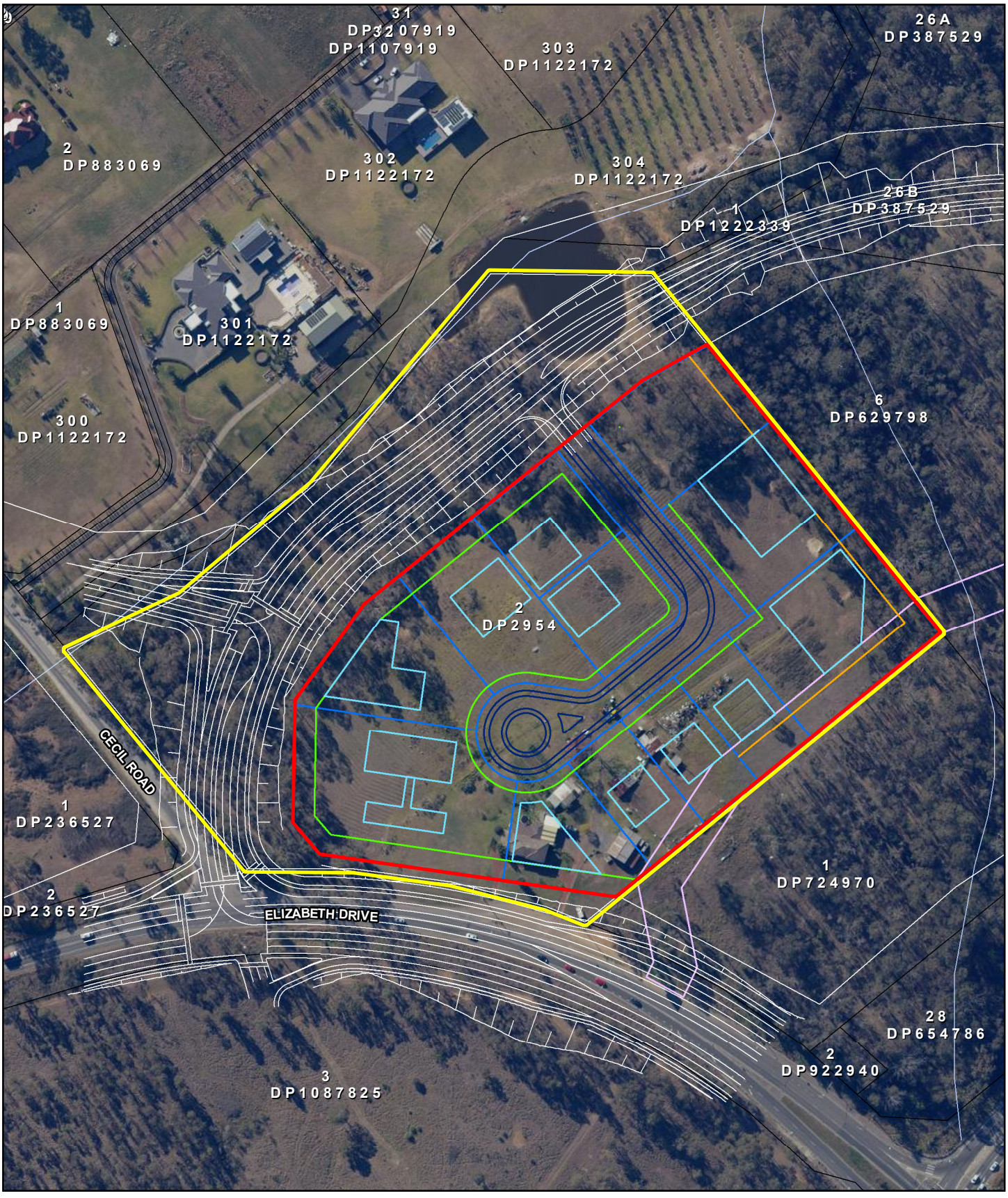
An assessment of significance has been prepared in accordance with the '*Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999*' (DoE 2013a) for impacts on Cumberland Plain Woodland and Shale-Gravel Transition Forest (Cumberland Plain Woodland) and is included as Appendix D.

The outcome of the assessment of significance is that the proposal is unlikely to have a significant impact on the local and/or regional occurrence of Cumberland Plain Woodland and Shale-Gravel Transition Forest. To gain certainty over this matter however, a referral to the Commonwealth Environment Minister for determination is recommended.

If the Minister decides the proposed works are a likely to have a significant impact on a MNES further assessment of impact can be carried out in accordance with the NSW Assessment Bilateral Agreement. The Australian Government has endorsed the NSW BOS through the NSW Assessment Bilateral Agreement which aims to streamline the assessment process for major projects requiring both NSW and Commonwealth approval.

Additional information on this community within the locality of the subject site is included in Section 7 of this report as part of the SAII assessment for this candidate entity.

The proposal would include the permanent removal of 1.15 ha of vegetation within the local occurrence of Cumberland Plain Woodland that is commensurate with the form of the community listed under the EPBC Act as shown on Figure 3-1. A permanent reduction in extent of this magnitude is unlikely to threaten the viability and persistence of Cumberland Plain Woodland within the locality.



LEGEND

- Study area
- Subject site
- Cadastre
- Waterways

Site layout

- APZ
- Indicative building envelope
- Landscaping setback
- Lot boundary
- Gas pipe easement
- Road
- Proposed M12 Motorway alignment

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

N

1111 Elizabeth Drive Pty Ltd
Elizabeth Drive
Biodiversity Development Assessment Report

Job Number	21-27092
Revision	0
Date	05 Aug 2020

Project footprint

Figure 5-1

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Level 15, 133 Castlereagh Street Sydney NSW 2000 **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com.au **W** www.ghd.com.au

Data source: Aerial imagery - SIX Maps 2020(© Department of Customer Service 2020); General topo - NSW LPI DTDB 2017, 2015 & 2012; Cadastre - NSW LPI DCDB 2017; Site layout - AE Design. Created by:J.Price

6. Offset requirements

6.1 Assessment of impacts requiring offsetting

Impacts associated with the proposal that require offsetting include the removal of 1.15 ha of native vegetation, comprising:

- 1.15 ha of PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats.
- 1.06 ha of habitat for the Southern Myotis.

Impacts within the subject site requiring offsetting are shown on Figure 6-1.

6.2 Assessment of impacts not requiring offsetting

The study area contains 2.31 ha of native vegetation (PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats) which would not be impacted by the proposal, and which does not require offsetting.

There are unlikely to be any impacts within the subject site that require assessment but not offsetting.

6.3 Assessment of serious and irreversible impacts

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

The principles are aimed at capturing impacts which are likely to contribute significantly to the risk of extinction of a threatened species or ecological community in New South Wales. These include impacts that will:

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

A set of criteria have been developed and are included in the *OEH Guidelines to assist a decision-maker to determine a SAII* (OEH 2017c). Threatened biota that meet the criteria under one or more of the above principles have been identified as potential SAII and are listed in the fore mentioned document. Impact thresholds for each potential SAII entity are being developed to help determine if a development will result in SAII.

PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats is identified by the BAM calculator as a candidate SAII. An assessment of potential SAIIs is included in Section 7.

The Southern Myotis is not identified as an SAII entity (OEH 2018a).

6.4 Areas not requiring assessment

The subject site includes 3.56 ha defined as 'cleared land' in accordance with the BAM. This cleared land comprises:

- 3.05 ha of exotic grassland that has been ploughed and grazed, and which contains occasional piles of woody debris and rubbish (such as those described in Section 3.3) which provide broadly suitable potential habitat for the Cumberland Plain Land Snail. As described in Section 4.2.2, the Cumberland Plain Land Snail was not detected at the site despite targeted searches, and has been assumed to be not present.
- 0.51 ha of buildings, infrastructure and dumped fill. The areas of dumped fill referred to in this section do not comprise potential habitat for the Cumberland Plain Land Snail, as they lack the necessary shelter and refuge habitats required by this species.

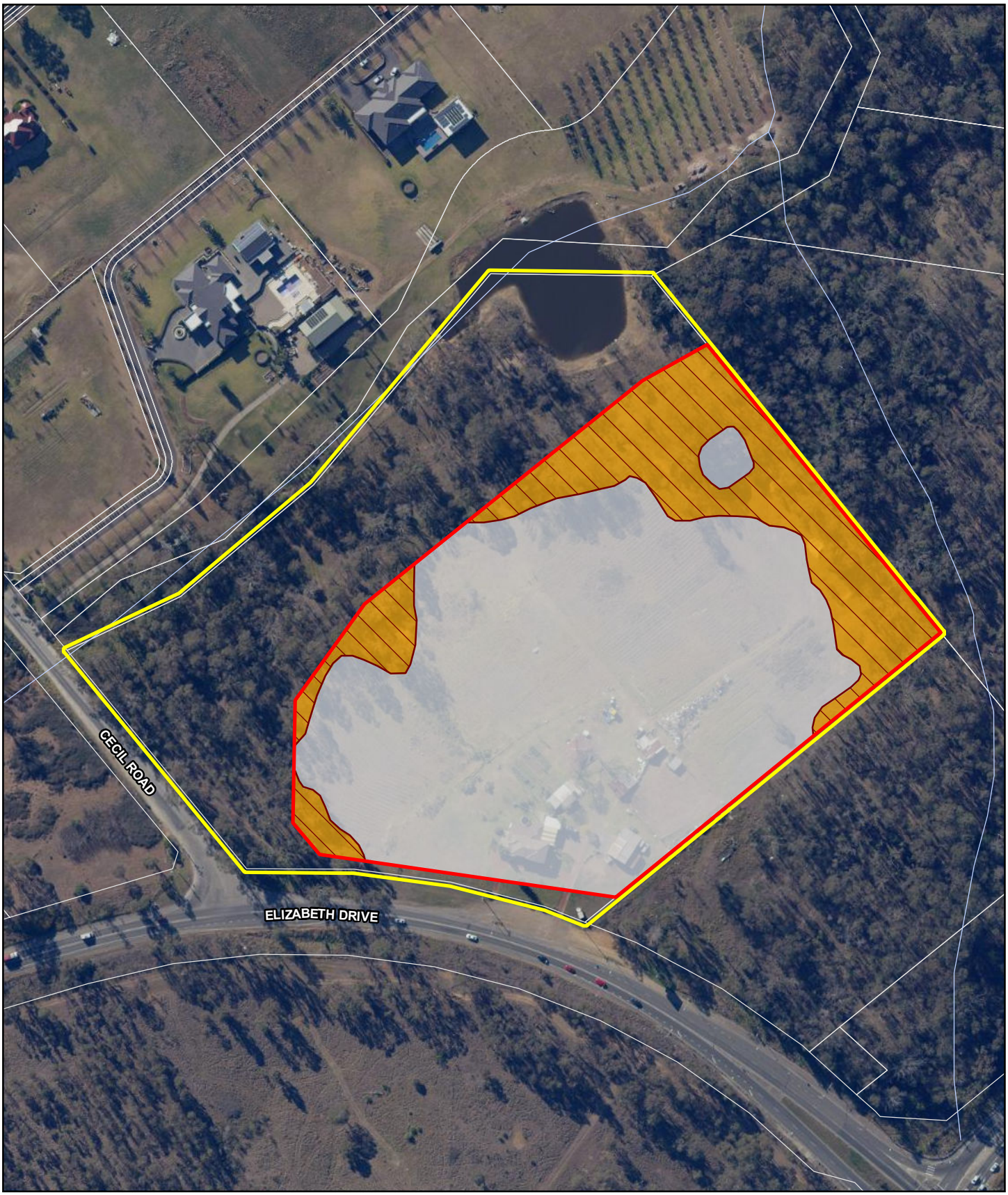
The BAM states that "*areas that are not native vegetation… do not require further assessment in the BAM except where:*

a. They are proposed for restoration as part of an offset.

b. They are assessed as habitats for threatened species".

As such, the 3.56 ha has not been included in this assessment.

Photo 6 Cleared land not requiring offsetting



LEGEND

- Study area
- Subject site
- Cadastre
- Waterways
- Impacts requiring offset
- PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats SAII
- Impacts not requiring offset

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Elizabeth Drive
Biodiversity Development Assessment Report

Job Number	21-27092
Revision	0
Date	15 Jun 2020

Impact summary

Figure 6-1

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Data source: Aerial imagery - SIX Maps 2020(© Department of Customer Service 2020); General topo - NSW LPI DTDB 2017, 2015 & 2012; Cadastre - NSW LPI DCDB 2017. Created by:J.Price

6.5 Calculation of the offset requirement for ecosystem credits

The data from the fieldwork and mapping was entered into version 1.2.7.4 of the BAM credit calculator as a 'Development Assessment' to determine the number and type of biodiversity credits that would be required to offset impacts of the proposal. The Biodiversity credit report is included in Appendix D and summarised below.

A total of 48 ecosystem credits would be required to offset the impacts of the project as shown in Table 6-1.

Table 6-1 Ecosystem credits required to offset impacts of the project

Plant community type	Area (ha)	Current vegetation integrity score	Future vegetation integrity score	BC Act status	Ecosystem credits required
849 – Grey Box - Forest Red Gum grassy woodland on flats	1.15	67.2	0	CEEC[1]	48
Total					**48**

Notes: 1-Cumberland Plain Woodland in the Sydney Basin Bioregion.

6.6 Calculation of the offset requirement for species credits

Species credits are required to offset impacts on Southern Myotis.

Definite calls of the Southern Myotis were recorded on both nights of the October - November targeted survey over the water body in the northwest of the study area (see Anabat recording results in Appendix B and Figure 6-2). This waterbody would provide foraging habitat for this species. It may roost in tree hollows in the subject site where they are located close to suitable foraging habitat.

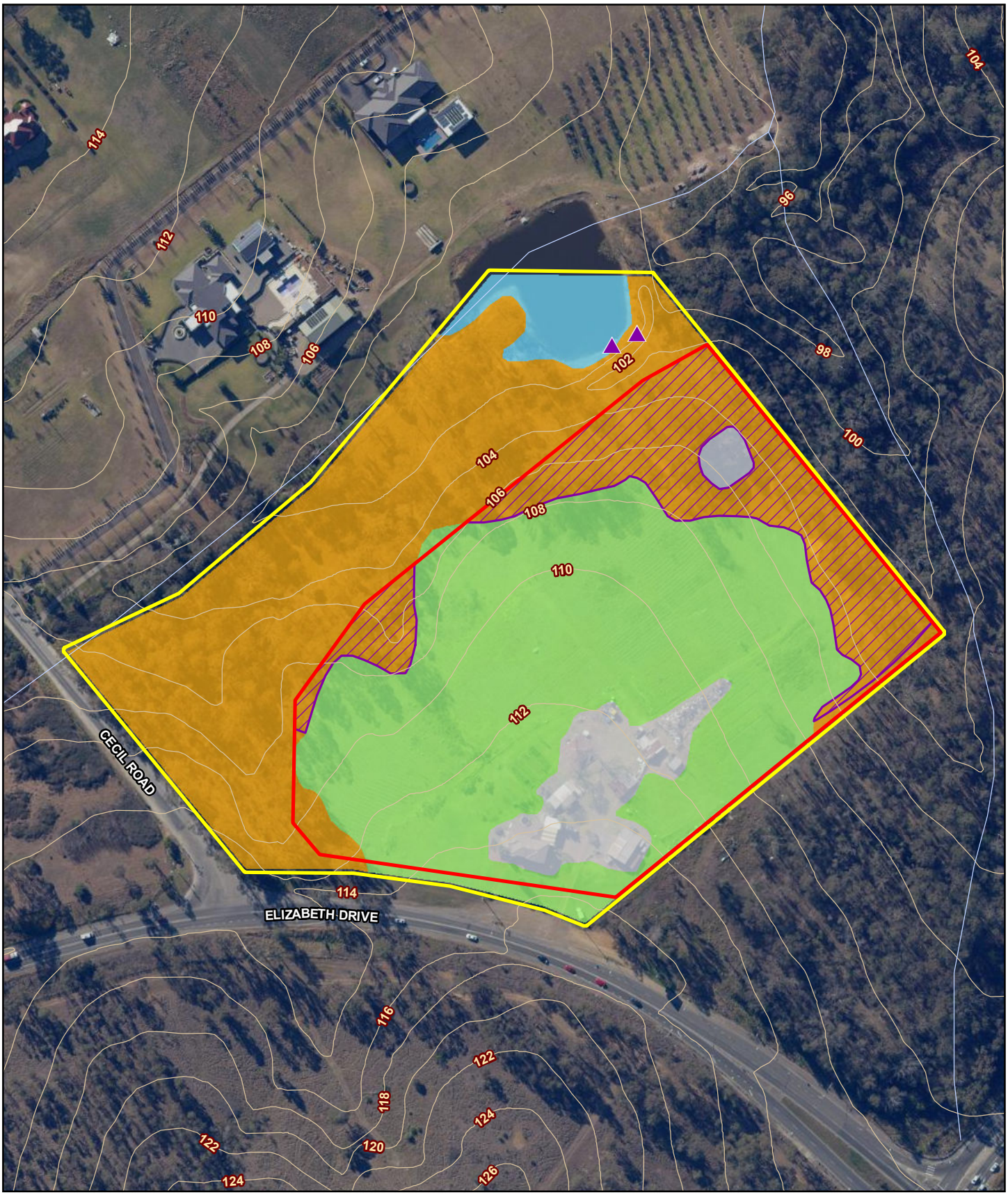
Species credits were calculated for the species, by preparing a Southern Myotis species polygon consistent with the BAM. The area of foraging and roosting habitat for the species was mapped based on the presence of woodland with hollow-bearing trees or other roost sites within the vicinity of foraging habitat associated with permanent water bodies. This was achieved with GIS by buffering the water body in the northwest of the study area by 200 metres and then clipping out areas that did not contain native vegetation with suitable roost sites such as tree hollows.

There are mapped drainage lines along the northern and western boundaries of the study area (see Figure 1-2). The reaches of these drainage lines within and adjacent to the study area are intermittent, with only occasional narrow and shallow pools and are surrounded by dense riparian vegetation. They would contain few, if any, aquatic prey species for the Southern Myotis. They do not feature open water surrounded by open fly ways that could be used by hunting Southern Myotis. These drainage lines do not comprise foraging habitat for the Southern Myotis and so they have not been mapped as part of a species polygon, except for areas of overlap with the polygon surrounding the permanent water body described above.

Based on the approach described above, a 1.06 hectare Southern Myotis species polygon was mapped at the subject site as shown in Figure 6-2. Species credit requirements based on the removal of habitat within this species polygon are summarised in Table 6-2 below.

Table 6-2 Species credits required to offset impacts of the proposal

Species	Area of Habitat	Species Credits Required
Southern Myotis *(Myotis macropus)*	1.06 ha	36



LEGEND

- Study area
- Subject site
- Contours (2m)
- Waterways

Other site features

- Buildings, infrastructure and dumped fill
- Exotic grassland
- Water body
- Southern Myotis (listed as vulnerable under the BC Act)
- Southern Myotis species polygon (1.06 ha)

Native vegetation

- 1. PCT 849 - Grey Box - Forest Red Gum grassy woodland on flats (HN528, Moderate) (CEEC BC Act; CEEC EPBC Act)

Paper Size A4

0 20 40 80

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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GHD

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Elizabeth Drive
Biodiversity Development Assessment Report

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Revision 0
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Species polygon

Figure 6-2

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Data source: Aerial imagery - SIX Maps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2017, 2015 & 2012; Vegetation mapping - Cumberland Plains NPWS 2002 (OEH); Threatened species - OEH 2018.
Created by:J.Price

6.7 Offsetting of impacts on MNES

If the proposal is determined to be a controlled action under the EPBC Act, offsets may be required under the EPBC Act for impacts on MNES, specifically impacts on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. As of 24 March 2020, offsets for MNES required under the EPBC Act can be met through the use of the NSW BOS. The Commonwealth has also supported the use of the BAM to assess a projects impacts on MNES for calculating the biodiversity credit requirements as stated in the Bilateral Agreement. To meet offset requirements for Commonwealth listed entities for controlled actions through the NSW BOS, the following options are available:

- Retire biodiversity credits based on the like-for-like provisions in the Biodiversity Conservation Regulation 2017.
- Fund biodiversity conservation actions that are listed in the Ancillary rules: Biodiversity conservation actions and directly benefit the threatened entity impacted.
- Pay into the Biodiversity Conservation Fund, noting it is the proponent's responsibility to notify the Biodiversity Conservation Trust that their payment is for a controlled action.

Note: the variation rules typically available through the NSW BOS do not apply to offsets required for Commonwealth listed entities for controlled actions.

7. Impact assessment of SAIIs

The BAM states that "*To assist the consent authority to evaluate the nature of an impact on a potential entity at risk of a serious and irreversible impact, the BDAR or BCAR must contain details of the assessment of serious and irreversible impacts, in accordance with the assessment criteria set out in Subsection 10.2.2 for impacts on each potential TEC and in Subsection 10.2.3 for impacts on each potential threatened species*".

The following information is provided in relation to PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats, which is listed as Cumberland Plain Woodland in the Sydney Basin Bioregion, in accordance with the requirements of Section 10.2.2 of the BAM.

Guidance to assist a decision-maker to determine a serious and irreversible impact (DPIE 2019) contains a list of BC Act listed ecological communities that are potential for SAII. Cumberland Plain Woodland in the Sydney Basin Bioregion is included on this list as it meets Principles 1 and 2:

- Principle 1 – species or ecological community currently in a rapid rate of decline.
- Principle 2 – species or ecological communities with very small population size.

The proposal would result in an impact on 1.15 ha of a candidate SAII through the proposed clearing of PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats for the proposed subdivision and associated permanent infrastructure. The remainder of the development footprint does not comprise a candidate SAII because it encompasses either cleared land or hardstand areas.

The following criteria consider the additional impact assessment provisions for ecological communities, as required by Section 10.2.2 of the BAM.

a. **The action and measures taken to avoid the direct and indirect impact on the potential entity for an SAII**

The site is 4.71 ha in area (comprising 1.15 ha of PCT 849, 3.05 ha of exotic grassland and 0.51 ha of buildings, infrastructure and dumped fill). There is very limited scope for retaining extensive areas of vegetation by reducing the size of the development footprint.

As outlined in Section 5.2, previous iterations of the proposal aimed to avoid impacts to the majority of the CEEC that occurs within the lot. Given that much of the lot that supports this CEEC will be acquired by TfNSW, the potential for avoiding the vegetation within the remaining developable portion of the lot is limited, if a viable subdivision is to be achieved.

b. **The area (ha) and condition of the TEC to be impacted directly and indirectly by the proposed development. The condition of the TEC is to be represented by the vegetation integrity score for each vegetation zone**

The proposal will result in the removal of 1.15 ha of vegetation commensurate with the SAII entity Cumberland Plain Woodland. Vegetation to be impacted is in in question is currently in moderate condition, with a vegetation integrity score of 67.2. Vegetation immediately outside of the subject site is in a comparable condition and is assumed to have a similar vegetation integrity score.

Native vegetation in the subject site is already exposed to edge effects and weed infestation and is likely to be subject to predation of native fauna by exotic predators and domestic pets. Without a change in land use and active management, it is likely that these impacts would continue to degrade the condition of the subject site over time.

The subject site sits within a landscape that has been substantially modified by agriculture and development with a mix of cleared land and scattered, fragmented native vegetation as shown on Figure 3-1. Vegetation cover in the area comprises isolated patches within a matrix of cleared land used for agriculture, urban development and major infrastructure corridors. The area of contiguous treed vegetation connected to the subject site was calculated with GIS and is about 331 ha within the 1,500 m buffer of the subject site, which is within the largest patch size class in the BAM (Section 5.3.2) of ≥100 ha.

Development impacts are likely to be restricted to the subject site. Given the mitigation measures specified Section 5.3, existing and adjoining land uses, and the extent of existing weed infestation and disturbance in the study area, the development is unlikely to increase indirect impacts.

As outlined in Section 1.6, it is likely that a portion of the lot will be acquired by Transport for NSW (TfNSW) as part of the proposed M12 Motorway Project (refer to Figure 5-1). As such, the context of the site will be substantially modified, once the M12 Motorway is constructed.

The construction of the M12 Motorway will result in a notable change from the current landscape context of the site, with the following differences:

- Along the southern portion of the site, Elizabeth Drive being increased from a two lane road to a multiple lane road in each direction.
- Along the western portion of the site, Cecil Road is currently a quiet, two lane road that runs along the south west boundary of the site. The M12 Motorway will eventually form the western and northern boundary of the site, and will result in the removal of vegetation along the current western and northern boundary of the site.

These changes have the potential to result in a far greater degree of isolation of the site from surrounding vegetation to the south, as Elizabeth Drive will likely become a hostile gap to movement, as defined by DECC (2008e), and the site will likely be largely cut off from vegetation to the south, west and north, with only a small patch of vegetation left between the site and Wallgrove Road to the east (refer to Figure 1-2). In the context of these plans, the likely resilience of the vegetation within the site is likely to be substantially lower than it currently is, and impacts resulting from this current proposal are less significant, given much of the surrounding area will be impacted by the construction of a major roadway in the near future.

c. **A description of the extent to which the impact exceeds the threshold for the potential entity that is specified in the Guidance to assist a decision-maker to determine a serious and irreversible impact**

Thresholds for SAII entities are designed to assist in determining whether an impact will be a potential SAII. Any impact below the threshold is unlikely to be a SAII. No threshold has been published for this CEEC (Cumberland Plain Woodland), with the TBDC (DPIE, 2020b) noting that the threshold is 'under development'. Advice available from the DPIE website notes that "*if thresholds are still under development, the consent authority will rely on the information provided in the biodiversity development assessment report in determining whether a serious and irreversible impact is likely to occur*" (DPIE 2020c). As such, this assessments aims to provide information on the SAII entity as it exists within the site and surrounding local area in order to allow DPIE to determine whether the proposal is likely to result in an SAII.

The proposal will result in a maximum of 1.15 ha of PCT 849 being permanently removed from the subject site.

d. **The extent and overall condition of the potential TEC within an area of 1000 ha, and then 10,000 ha, surrounding the proposed development footprint**

Within 1,000 ha of the subject site, Tozer *et al*. (2010) has mapped 13 ha of the equivalent vegetation type; GW p29: Cumberland Shale Plains Woodland. This vegetation type is comparable to PCT 849, which occurs within the subject site.

Within 10,000 ha of the subject site, Tozer *et al*. (2010) has mapped 237 ha of the equivalent vegetation type; GW p29: Cumberland Shale Plains Woodland.

In regards to condition, Tozer *et al.* (2010) states the following: "*Cumberland Shale Plains Woodland was extensively cleared for the rural and urban development of western Sydney. The remaining stands are small fragments threatened by continued clearing, degradation, weed invasion and high fire frequency*". This description is likely to be accurate for all occurrences of the vegetation type within 1,000 and 10,000 ha of the subject site. Remaining occurrences of the PCT typically exist as small and isolated fragments in modified and/or degraded condition, exposed to ongoing threats from edge effect, weed invasion, altered fire and flooding regimes, increased nutrient loads from urban run-off and on-going vegetation clearing.

An extensive program of revegetation has been undertaken throughout the Western Sydney Parklands in recent years, which has resulted in an increase in the amount of several vegetation types, including PCT 849. There is no publicly available data on exactly how much of the revegetation that has been completed is equivalent to PCT 849, and so the data provided in Tozer *et al.* (2010) has been used for this assessment, however there are likely to be extensive additional patches of PCT 849 that are not included in these calculations.

e. **An estimate of the extant area and overall condition of the potential TEC remaining in the IBRA subregion before and after the impact of the proposed development has been taken into consideration**

The remaining area of the equivalent vegetation type (as mapped by Tozer *et al*., 2010) in the IBRA subregion before the proposed development is 6,576 ha. It is likely that this number is an overestimate of the amount of the vegetation type left in the IBRA subregion, given the extensive development that has taken place since the mapping was completed in 2010. The proposal would result in a further reduction of 1.15 ha of this vegetation type from within the IBRA subregion.

This vegetation type is largely limited to the subregion in which the subject site is located; the Cumberland IBRA subregion of the Sydney Basin IBRA bioregion, as it only occurs on clay-loam soils derived from Wianamatta shale on the Cumberland Plain in Western Sydney. Tozer *et al*. (2010) has mapped about 189 ha of this vegetation type outside of the Cumberland IBRA subregion, with very small scattered remnants immediately to the north and west of the subregion (refer to Figure 7-1).

The condition of the remaining vegetation within the IBRA subregion is likely to be similar to that within part D of this assessment.

f. **An estimate of the area of the potential TEC that is in the reserve system within the IBRA region and the IBRA subregion**

The remaining area of the equivalent vegetation type (as mapped by Tozer *et al*., 2010) in the NPWS reserve system within the IBRA region is estimated to be 663 ha. Approximately 656 ha of this occurs within the Cumberland IBRA subregion, the same subregion as the subject site.

g. **The development, clearing or biodiversity certification proposal's impact on:**

- **(i) Abiotic factors critical to the long-term survival of the potential TEC; for example, how much the impact will lead to a reduction of groundwater levels or the substantial alteration of surface water patterns**

The primary threat to Cumberland Plain Woodland is identified as "*further loss and fragmentation of habitat*" by the *Cumberland Plain Recovery Plan* (DECCW, 2011). The proposal will contribute to an increase in the loss of actual vegetation commensurate with Cumberland Plain Woodland, as well as a minor contribution to fragmentation of remnants.

PCT 849 is also threatened by weed invasion, increased soil nutrients (often from urban run-off), rubbish dumping and frequent fire. The proposal has the potential to influence several of these threats, primarily weed invasion, increased soil nutrients and rubbish dumping. Mitigation measures listed in Section 5.3 will limit the likelihood of the proposal increasing these threats to this community.

The subject site is adjacent to Elizabeth Drive, and is close to the M7 Motorway. These roadways have already modified the natural drainage of the area immediately around the subject site (and elsewhere throughout the locality), and have increased the amounts of impermeable surfaces that could be sources of urban run-off and nutrient spread. The proposal is unlikely to result in a substantial increase to these threats.

The proposal is unlikely to significantly modify abiotic factors critical to the long-term survival of the community, given the existing levels of disturbance in the locality and immediate area.

- **(ii) Characteristic and functionally important species through impacts such as, but not limited to, inappropriate fire/flooding regimes, removal of understorey species or harvesting of plants**

Within the study area, PCT 849 exists in a modified state, albeit one that still meets the condition criteria for listing as a CEEC under the BC Act and EPBC Act. Much of the midstorey has been removed within the subject site and the fire and flood regimes of the locality have been substantially altered due to past development and land management practices.

The proposal will require the permanent removal of 1.15 ha of vegetation commensurate with this SAII entity. There is minimal likelihood of indirect impacts on vegetation to be retained outside of the subject site, and no plans associated with this proposal for changes to the existing fire or flood regimes, modification of vegetation or similar. As such, the proposal is unlikely to have any impact on characteristic and functionally important species outside of the subject site.

- **(iii) The quality and integrity of an occurrence of the potential TEC through threats and indirect impacts including, but not limited to, assisting invasive flora and fauna species to become established or causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants which may harm or inhibit growth of species in the potential TEC**

Within the subject site, PCT 849 occurs as a stand of canopy species over a predominantly native understorey, with a largely absent midstorey resulting from existing land management practices. There is a patch of exotic grassland in the southern half of the site that has been ploughed and used for agricultural purposes in the past. The proposal would result in the complete removal of all vegetation (native and exotic) from within the subject site, and development of an industrial subdivision and associated buildings and infrastructure.

Vegetation outside of the subject site that would not be directly impacted by the proposal is at some risk of indirect impacts resulting from the proposal, if appropriate mitigation measures are not adopted and implemented. A number of mitigation measures are recommended in Section 5.3 to limit the potential for indirect impacts that may affect vegetation and habitats outside of the subject site.

There are likely to be impacts resulting from the proposed M12 Motorway on vegetation in the north of the Lot (refer to Figure 5-1), however given the impacts associated with the M12 Motorway are not known, and no construction methodology or vegetation clearing footprint is available, this assessment has not taken into account impacts associated with that project.

h. **Direct or indirect fragmentation and isolation of an important area of the potential TEC**

Vegetation within the subject site has been degraded by historical vegetation modification and weed infestation. It is exposed to edge effects; is likely to be subject to predation of native fauna by exotic predators and domestic pets, and without a change in land use and active management, these impacts would continue to degrade the condition of the subject site over time. It is part of a local-scale vegetated corridor with an overall patch size of about 331 ha within the 1500 m buffer of the subject site.

Based on regional vegetation mapping, the subject site contains about 0.02 % of the mapped occurrence of this vegetation type within the IBRA subregion (Tozer *et al.*, 2010). The relative contribution of the subject site to the overall viability of this vegetation type and of the CEEC Cumberland Plain Woodland is likely to be less than this relative abundance suggests because it is part of a relatively small patch, in moderate condition, in a locality with highly fragmented vegetation and moderate viability as described above.

The subject site comprises a negligible contribution to the overall extent of native vegetation and habitat for native fauna in the region. Overall the subject site would make a minor contribution to regional biodiversity values and is unlikely to be considered an important area of the PCT/TEC.

i. **The measures proposed to contribute to the recovery of the potential TEC in the IBRA subregion**

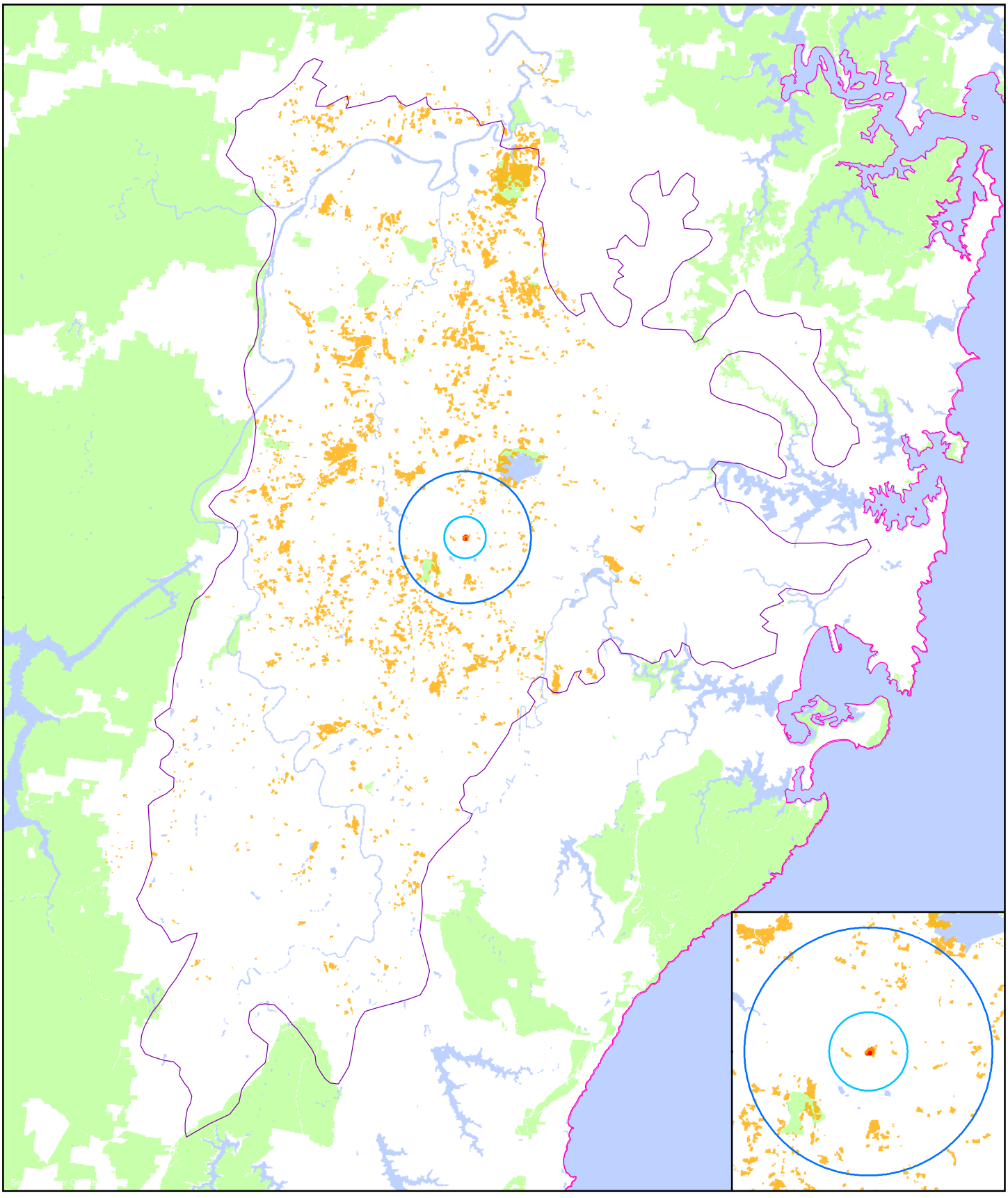
The approved *Cumberland Plain Recovery Plan* (DECCW, 2011) has identified four specific recovery objectives for the ecological community:

1. *"To build a protected area network, comprising public and private lands, focused on the priority conservation lands*
2. *To deliver best practice management for threatened biodiversity across the Cumberland Plain, with a specific focus on the priority conservation lands and public lands where the primary management objectives are compatible with biodiversity conservation*
3. *To develop an understanding and enhanced awareness in the community of the Cumberland Plain's threatened biodiversity, the best practice standards for its management, and the recovery program*
4. *To increase knowledge of the threats to the survival of the Cumberland Plain's threatened biodiversity, and thereby improve capacity to manage these in a strategic and effective manner".*

The proposal will not result in any impacts to priority conservation lands as identified in the *Cumberland Plain Recovery Plan* (DECCW, 2011), or on the bushland corridor identified in the *Western Sydney Parklands Plan of Management 2020* (WSPT, 2010). Impacts will be restricted to an isolated patch of vegetation that is identified in the *Western Sydney Parklands Plan of Management 2020* (WSPT, 2010) as being isolated from the main Parklands corridor by the M7 Motorway and Elizabeth Drive. While the proposal would result in an overall reduction in the area of existing vegetation and potential habitat for vegetation, it will have a minimal impact on the overall protected area network in the locality and wider subregion.

Mitigation measures are proposed to limit the potential for impacts to vegetation outside the subject site, which are broadly similar to the best practice management guidelines developed for this community.

Offsets for residual negative impacts will be provided as required by the BAM and BOS, which will contribute to the security of an area of equivalent vegetation within the IBRA subregion in perpetuity.



LEGEND

- Subject site
- 1,000 ha circle
- 10,000 ha circle
- IBRA subregion - Cumberland
- IBRA region - Sydney Basin
- Equivalent PCT surrounding subject site
- NPWS reserve
- Waterbody

Note: Main map zoomed to extent of surrounding PCT

Paper Size A4

0 2 4 8

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Elizabeth Drive
Biodiversity Development Assessment Report

Job Number 21-27092
Revision 0
Date 15 Jun 2020

SAII assessment

Figure 7-1

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Data source: General topo - NSW LPI DTDB 2017, 2015 & 2012; Native vegetation mapping, Mitchell Landscapes, IBRA regions & subregions, wetlands - OEH. Created by:J.Price

8. Proposed conservation measures

8.1 Options to meet offset obligations

In accordance with the offset rules established by the *Biodiversity Conservation Regulation 2017* there are various means by which offset obligations described in Section 6.1 can be met. These include

- Retiring the appropriate credits from an established stewardship site.
- Monitory payment directly into the Biodiversity Conservation Trust Fund.
- Funding an approved biodiversity action (note this mechanism is only available to actions listed in the ancillary rules for biodiversity conservation actions (OEH 2017d) and therefore is not relevant to this site).

8.2 Conservation measures proposed to offset impacts of development

The preferred approach to offset the residual impacts of the proposal is to secure and retire appropriate credits from stewardship site/s that fit within the trading rules of the BOS in accordance with the 'like for like' report generated by the BAM calculator. If such credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAM calculator.

The variation rules of the BOS and the 'variation report' produced by the BAM calculator, both indicate that PCT 849 can be offset with 'like for like' options, including PCT 849 or 850 that contain hollow-bearing trees, and occur within the Cumberland, Burragorang, Pittwater, Sydney Cataract, Wollemi or Yengo IBRA subregion, or any IBRA subregion that is within 100 km of the outer edge of the impacted site.

Note the variation rules do not apply to offsets required for Commonwealth listed entities for controlled actions. If this project is the subject of a referral, and is found to be a controlled action, additional offset measures may be required for impacts to Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC.

A payment to the Biodiversity Conservation Trust would only be considered if a suitable number and type of biodiversity credits cannot be secured from third parties.

9. Conclusion

1111 Elizabeth Drive Pty Ltd is proposing to develop an 11 Lot industrial subdivision, at Lot 2, DP 2954, 1111-1141 Elizabeth Drive, at the Junction of Cecil Road and Elizabeth Drive, in Cecil Park, NSW. This Biodiversity Development Assessment Report (BDAR) has been prepared by GHD to identify the potential impacts of the proposal on biodiversity values within the subject site. This assessment has been completed in accordance with the BAM and includes:

- Desktop assessment to describe the existing environment and landscape features of the subject site and to identify the suite of threatened biota potentially affected by the proposal.
- Field survey to describe the biodiversity values of the subject site and surrounding study area and to determine the likelihood of threatened biota and their habitats occurring in the subject site or being affected by the proposal.
- BAM calculations using the credit calculator version 1.2.7.4 to quantify the biodiversity impacts of the proposal following implementation of measures to avoid and minimise impacts and to determine the biodiversity credits that would be required to be retired to offset the residual impacts of the proposal.

The proposal would result in the following impacts:

- Removal of 1.15 ha of PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats, which is listed as Cumberland Plain Woodland in the Sydney Basin Bioregion CEEC under the BC Act and Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC under the EPBC Act.
- Removal of 1.06 ha of known habitat for the Southern Myotis.
- Potential indirect impacts to adjoining vegetation associated with edge effects, light spill, noise and introduction of weeds and pathogens.

The proposal would not impact any threatened biota listed under the *Fisheries Management Act 1994*.

A BAM assessment and credit calculations have been performed in accordance with the methodology (OEH 2017a) and using credit calculator version 1.2.7.4. Credits required to be retired to offset the impacts of the proposal include:

- 48 ecosystem credits for impacts on PCT 849 – Grey Box - Forest Red Gum grassy woodland on flats.
- 36 Southern Myotis species credits.

Other threatened species identified as potentially being impacted by the proposal are ecosystem credit species which would be offset through the retirement of the above listed ecosystem credits. Review by OEH and/or the BCT is required to verify inputs into the BAM calculator tool to determine the final credit impact score.

To avoid and minimise potential impacts of the proposal on biodiversity, a series of mitigation and management measures have been identified, which would be implemented as part of the construction environmental management plan for the site.

The preferred approach to offset the residual impacts of the proposal is to secure and retire appropriate credits from stewardship sites that fit within the trading rules of the BOS in accordance with the 'like for like' report generated by the BAM calculator. If such credits are unavailable, credits would be sourced in accordance with the 'variation report' generated by the BAM calculator.

A payment to the Biodiversity Conservation Trust would only be considered if a suitable number and type of biodiversity credits cannot be secured from third parties.

The proposal will result in impact to 1.15 ha of Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest CEEC which is a MNES protected under the EPBC Act. An assessment of significance has been prepared. The outcome of this assessment is that the proposal is unlikely to result in a significant impact on this MNES, however to minimise risk to the project, and to gain certainty, it is recommended that the proposal be referred to the Commonwealth Environment Minister for assessment. Should the proposal be considered a controlled action, additional offsets may be required. It should be noted that there are stricter rules around provision of offsets for Commonwealth listed entities, and that the variation rules typically available under the BOS do not apply to offsets required for Commonwealth listed entities for controlled actions.

10. References

Australian Government (2012) Atlas of Groundwater Dependent Ecosystems (GDE Atlas), Phase 2 Task 5 Report: Identifying and mapping GDEs. Final report prepared by CSIRO and SKM. http://www.bom.gov.au/water/groundwater/gde/reports.shtml.

BOM (2018a). Atlas of Groundwater Dependent Ecosystems http://www.bom.gov.au/water/groundwater/gde/map.shtml.

BOM (2018b) Climate Data Online. http://www.bom.gov.au/climate/averages/tables/cw_067084.shtml.

Cropper, S.C. (1993). *Management of Australian Plants.* CSIRO, Melbourne.

DAWE (2020) Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest. http://www.environment.gov.au/cgi-bin/sprat/public/publicshowcommunity.pl?id=112&status=Critically+Endangered.

DECC (2008a). *NSW (Mitchell) Landscapes Version 3*. Department of Environment and Climate Change.

DECC (2008b). *Descriptions for NSW (Mitchell) Landscapes Version 2.* Based on descriptions compiled by Dr. Peter Mitchell. DECC, NSW. Department of Environment and Climate Change.

DECC (2008c). *Hygiene protocol for the control of disease in frogs*. http://www.environment.nsw.gov.au/resources/nature/hyprfrog.pdf.

DECC (2008d) *Managing Urban Stormwater – Soils and Construction. Volume 2D – Main road construction*. Department of Environment and Climate Change NSW. http://www.environment.nsw.gov.au/resources/stormwater/08207soilsconststorm2d.pdf.

DECC (2008e) *Biobanking Operation Manual*. NSW DECC, Sydney.

DECC (2008f) Best practice guidelines Green and golden bell frog habitat. https://www.environment.nsw.gov.au/resources/threatenedspecies/08510tsdsgreengoldbfbpg.pdf

DECCW (2011) Cumberland Plain Recovery Plan, Department of Environment, Climate Change and Water (NSW), Sydney.

DEE (2018a). *Protected Matters Online Search Tool*. Department of the Environment. Accessed at http://www.environment.gov.au/arcgis-framework/apps/pmst/pmst.jsf.

DEE (2018b). Species profiles and threats database (SPRAT). Department of the Environment. Accessed at http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Department of Environment, Climate Change and Water (DECCW) (2010) NSW Interim Vegetation Extent Remote Sensing Imagery. Database. http://www.environment.nsw.gov.au/BioBanking/VegTypeDatabase.htm.

DEWHA (2009). Approved Conservation Advice for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community. Canberra, ACT: Department of the Environment, Water, Heritage and the Arts. http://www.environment.gov.au/biodiversity/threatened/communities/pubs/112-conservation-advice.pdf. In effect under the EPBC Act from 09-Dec-2009.

DLWC (2002). *The NSW State Groundwater Dependent Ecosystem policy: A component policy of the NSW State Groundwater Policy Framework Document*. NSW Department for Land and Water Conservation.

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

DoEE (2017c). Australia's bioregions (IBRA) http://www.environment.gov.au/land/nrs/science/ibra.

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

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

DPIE (2019) Guidance to assist a decision-maker to determine a serious and irreversible impact. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/guidance-decision-makers-determine-serious-irreversible-impact-190511.pdf.

DPIE (2020a). Surveying threatened plants and their habitats. NSW Department of Planning, Industry and Environment, April 2020.

DPIE (2020b) Threatened Biodiversity Data Collection. https://www.environment.nsw.gov.au/AtlasApp/UI_Modules/TSM_/Default.aspx.

DPIE (2020c) Determining serious and irreversible impacts. https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Animals-and-plants/Biodiversity/bulletins/determining-serious-irreversible-impacts-no4-190368.pdf?la=en&hash=65BFCB93A386174B2D117496CACFC9C91A0B9DC0.

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

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

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

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

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

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

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

New South Wales Scientific Committee and Simpson (2008) Change in the distribution of

Cumberland Plain Woodland.

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

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

OEH (2017a) *Biodiversity Assessment Method*. Published by the Office of Environment and Heritage on behalf of the NSW Government.

OEH (2017b) *Biodiversity Assessment Method Calculator Users Guide,* Office of Environment and Heritage.

OEH (2017d) *Ancillary rules: Biodiversity conservation actions – published under clause 6.5 of the Biodiversity Conservation Regulations,* Office of Environment and Heritage.

OEH (2017e) *Biodiversity Assessment Method Calculator Version 1.2.1.,* Office of Environment and Heritage, https://customer.lmbc.nsw.gov.au/assessment/s/userlogin?startURL=%2Fassessment%2Fs%2F.

OEH (2018a). *NSW BioNet Atlas*. http://www.bionet.nsw.gov.au/.

OEH (2018b). T*hreatened biodiversity profile search* http://www.environment.nsw.gov.au/threatenedspecies/.

OEH (2018c) NSW *BioNet Vegetation Classification*. http://www.environment.nsw.gov.au/NSWVCA20PRapp/default.aspx.

OEH (2018d) eSPADE. NSW Soil and Land Information. http://www.environment.nsw.gov.au/eSpade2WebApp#.

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

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

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

RGBT (2018). *PlantNET - The Plant Information Network System of The Royal Botanic Gardens and Domain Trust, Sydney, Australia*. Royal Botanic Gardens and Domain Trust. Accessed at http://plantnet.rbgsyd.nsw.gov.au.

Serov P, Kuginis L, Williams J.P., May 2012, *Risk assessment guidelines for groundwater dependent ecosystems, Volume 1 – The conceptual framework*, NSW Department of Primary Industries, Office of Water, Sydney. http://www.water.nsw.gov.au/Water-management/Water-availability/Risk-assessment/Groundwater-dependent-ecosystems/Risk-assessment-guidelines-for-groundwater-dependent-ecosystems.

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

Tozer, M.G., Turner, K. Keith, D.A, Tindall, D., Pennay, C. Simpson, C., Mackenzie, B, Beukers, P. and Cox, S. (2010). Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands, *Cunninghamia*, 11(3) 359-406.

TSSC 2008, *Commonwealth Listing Advice on Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest.* Threatened Species Scientific Committee, Department of the Environment, Water, Heritage and the Arts. Canberra, ACT. Accessed at http://www.environment.gov.au/biodiversity/threatened/communities/pubs/112-listing-advice.pdf.

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

WSPT (2010) *Western Sydney Parklands Plan of Management 2020*. December 2010. Prepared by the Western Sydney Parklands Trust.

WSPT (2014) *Western Sydney Parklands Plan of Management 2020 Supplement*. March 2014. Prepared by the Western Sydney Parklands Trust.

WSPT (2018) *Western Sydney Parklands Plan of Management 2030 Supplement*. December 2018. Prepared by the Western Sydney Parklands Trust.

Appendices

Appendix A – Likelihood of occurrence table

Databases searched

Office of Environment and Heritage (OEH) (2018a) BioNet Atlas - threatened species results within a 10 km buffer

Office of Environment and Heritage (OEH) (2018c) *Biodiversity Assessment Method Calculator Version 1.2.1 – predicted threatened species based on habitat types present*

Department of the Environment and Energy (DoEE) (2018) EPBC PMST Online Search including a 10 km buffer.

Note: Marine species which are restricted to marine environments only (such as whales, dolphins, sharks and seabirds) are excluded from the Likelihood of Occurrence Table as there is no marine habitat in immediately adjacent to the subject site.

Likelihood of occurrence

Matters considered in determining the likelihood of occurrence include:

- Known natural distributions including prior records (database searches) and site survey results.
- Geological/ soil preferences.
- Specific habitat requirements (e.g. aquatic environs, seasonal nectar resources, tree hollows etc.).
- Climatic considerations (e.g. wet summers; snow fall).
- Home range size and habitat dependence.
- Topographical preferences (e.g. coastal headlands, ridgetops, midslopes, gilgai, wetlands).

The likelihood of occurrence scale is defined in the following table.

Likelihood of occurrence scale

Scale	Description
Known	Species known to occur within the site (e.g. breeding and foraging habitat; foraging habitat; movement corridors). Detected on or immediately adjacent to the site.
Likely	Presence of high value suitable habitat (e.g. breeding and foraging habitat; important movement corridors). Not detected.
Possible	Presence of medium value suitable habitat (e.g. disturbed breeding conditions; constrained foraging habitat; movement corridors). Not detected.
Unlikely	Presence of low value suitable habitat (e.g. disturbed conditions; isolated small habitat area; fragmented movement corridors). Not detected.
Nil	No suitable habitat or corridors linking suitable habitat present. Not detected.

Table A1 Threatened flora known or predicted from the locality, habitat association and likelihood of occurring at the site

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Acacia bynoeana	Bynoe's Wattle	E	V	Species or species' habitat may occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Endemic to central eastern NSW, currently known from only 34 locations, many of only 1-5 plants. Grows mainly in heath/ dry sclerophyll forest on sandy soils, prefers open, sometimes slightly disturbed sites such as trail margins, road edges, and in recently burnt open patches. Flowers September to March, and fruit matures in November.	Unlikely. No sandy soils present at the site.
Acacia pubescens	Downy Wattle	V	V	123 records within 10 km (OEH 2018a); Species or species' habitat known to occur within 10km (DoE 2018a); Predicted by the BAM calculator.	Occurs mainly in Bankstown-Fairfield-Rookwood and Pitt Town areas, with outliers at Barden Ridge, Oakdale and Mountain Lagoon. Grows on alluviums, shales and shale/sandstone intergrades. Soils characteristically gravely, often with ironstone. Occurs in open woodland and forest, in communities including Cooks River/ Castlereagh Ironbark Forest, Shale/ Gravel Transition Forest and Cumberland Plain Woodland. Flowers August to October.	Possible. Suitable habitat present. Species is easily identifiable and was not located during field surveys by experienced botanist.
Allocasuarina glareicola		E	E	Species or species' habitat likely to occur within 10 km (DoE 2018a)	Primarily restricted to small populations in and around Castlereagh NR (NW Cumberland Plain), but with an outlier population at Voyager Point, Liverpool. Also reported from Holsworthy Military Area. Grows on tertiary alluvial gravels, with yellow clayey subsoil and lateritic soil. Occurs in Castlereagh open woodland.	Nil. No tertiary gravel or Castlereagh Woodland at the site.
Caladenia tessellata	Thick Lip Spider Orchid	E	V	Predicted by the BAM calculator.	Within NSW, currently known from two disjunct areas; one population near Braidwood on the Southern Tablelands and three populations in the Wyong area on the Central Coast. Generally found in grassy sclerophyll woodland on clay loam or sandy soils, though the population near Braidwood is in low woodland with stony soil. The area where *C. tessellata* was first collected and described from, is now completely cleared and no longer contains any remnant vegetation likely to be suitable for the persistence of the species. There are also many other old records from suburban Sydney which were collected from populations that are likely to have been in areas that are now cleared.	Unlikely. No local records, no clay loam, sandy soil or stony soil. Known populations now restricted to the southern tablelands.
Callistemon linearifolius	Netted Bottle Brush	V		1 record within 10 km (OEH 2018a)	Recorded from the Georges to Hawkesbury Rivers in Sydney, and north to Nelson Bay. There is also a recent record from the northern Illawarra. In Sydney, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Unlikely. Easily identifiable species that was not located during field surveys by experienced botanist.
Cynanchum elegans	White-flowered Wax Plant	E	E	Species or species' habitat known to occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Occurs from Gerroa (Illawarra) to Brunswick Heads and west to Merriwa in the upper Hunter. Most common near Kempsey. Usually occurs on the edge of dry rainforest or littoral rainforest, but also occurs in Coastal Banksia Scrub, open forest and woodland, and Melaleuca scrub. Soil and geology types are not limiting.	Unlikely. Site disturbance history and ongoing grazing and understorey management mean occurrence is very unlikely. No local records.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Dillwynia tenuifolia	*Dillwynia tenuifolia*, Kemps Creek	EP		40 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Bounded by Western Road, Elizabeth Drive, Devonshire Road and Cross Street, Kemps Creek in the Liverpool Local Government Area. This population occurs on a small outlier of the Berkshire Park Soil Landscape; the site supports a transition from Castlereagh Ironbark Forest to Castlereagh Scribbly Gum Woodland.	Nil. Outside of listed area for population.
Dillwynia tenuifolia		V		458 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs in western Sydney, predominately the Cumberland Plain as well as the Lower Blue Mountains and north to Yengo. Grows in scrubby/dry heath areas of Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays, and associated transitional communities including Castlereagh Scribbly Gum Woodland.	Possible. Suitable habitat present. Species is easily identifiable and was not located during field surveys by experienced botanist.
Eucalyptus benthamii	Camden White Gum	V	V	Predicted by the BAM calculator.	Occurs on the alluvial flats of the Nepean River and its tributaries. There are two major subpopulations: in the Kedumba Valley of the Blue Mountains National Park and at Bents Basin State Recreation Area. Several trees are scattered along the Nepean River around Camden and Cobbitty, with a further stand at Werriberri (Monkey) Creek in The Oaks. Requires a combination of deep alluvial sands and a flooding regime that permits seedling establishment. Recruitment of juveniles appears to be most successful on bare silt deposits in rivers and streams. Occurs in open forest.	Unlikely. No suitable soils or flooding regime present within the subject site.
Eucalyptus nicholii	Narrow-leaved Black Peppermint	V	V	2 records within 10 km (OEH 2018a)	Naturally occurs only in New England Tablelands from Nundle to north of Tenterfield. Widely planted as urban street tree. Grows in dry grassy woodland, on shallow and infertile soils, mainly on granite.	Nil. No suitable habitat. Outside of species' known distribution.
Eucalyptus scoparia	Wallangarra White Gum	E	V	1 record within 10 km, last recorded 2005 (OEH 2018a)	Occurs mostly in Queensland with only three known occurrences in NSW near Tenterfield. In NSW it is found on well-drained granitic hilltops, slopes and outcrops, often as scattered trees in open forest and woodland.	Nil. No suitable habitat. Outside of species' known distribution.
Genoplesium baueri	Yellow Gnat-orchid	E	E	Species or species' habitat may occur within 10km (DoE 2018a)	Occurs from Ulladulla to Port Stephens, with only 13 known extant populations. Grows in sparse sclerophyll forest and moss gardens over sandstone	Nil. No suitable sandstone habitat.
Grevillea juniperina subsp. juniperina	Juniper-leaved Grevillea	V		89 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs only within western Sydney in an area bounded by Blacktown, Erskine Park, Londonderry and Windsor. Outlier populations also at Kemps Creek and Pitt Town. Grows on reddish clay to sandy soils derived from Wianamatta Shale and Tertiary alluvium, typically containing lateritic gravels. Occurs in association with Cumberland Plain Woodland, Castlereagh Ironbark Woodland, Castlereagh Scribbly Gum Woodland and Shale/Gravel Transition Forests.	Possible. Suitable habitat present. Species is easily identifiable and was not located during field surveys by experienced botanist.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Grevillea parviflora subsp. parviflora	Small-flower Grevillea	V	V	11 records within 10 km (OEH 2018a); Species or species' habitat known to occur within 10km (DoE 2018a)	Occurs between Moss Vale/Bargo and lower Hunter Valley, with most occurrences in Appin, Wedderburn, Picton and Bargo. Broad habitat range including heath, shrubby woodland and open forest on light clay or sandy soils, and often in disturbed areas such as on the fringes of tracks.	Unlikely. Easily identifiable species that was not located during field surveys by experienced botanist.
Haloragis exalata subsp. exalata	Wingless Raspwort	V	V	Species or species' habitat may occur within 10 km (DoE 2018a)	Occurs in 4 widely scattered localities in eastern NSW, in the central coast, south coast and north-western slopes. Requires protected and shaded damp situations in riparian habitats.	Nil. Outside of species' known distribution.
Hypsela sessiliflora			X	7 records within 10 km, last recorded 2002 (OEH 2018a)	Currently known from a single location less than 10x15 m on the Cumberland Plain in western Sydney. Known to grow in damp places, on the Cumberland Plain, including freshwater wetland, grassland/alluvial woodland and an alluvial woodland/shale plains woodland (Cumberland Plain Woodland) ecotone. May be an early successional species that benefits from some disturbance. Possibly out competed when overgrown by some species such as Couch.	Unlikely. Low quality potential habitat present in wetland to the north west of the site, however no fringing or aquatic species present so should have been visible during field survey.
Leucopogon exolasius	Woronora Beard-heath	V	V	Species or species' habitat likely to occur within 10 km (DoE 2018a)	Occurs along the upper Georges River and in Heathcote NP, Royal NP and is also known from the Blue Mountains along the Grose River. Grows in woodland on sandstone and prefers rocky hillsides along creek banks up to 100 m altitude. Associated species include Sydney Peppermint and Silvertop Ash and Graceful Bush-pea, Flaky-barked Tea-tree and *Dillwynia retorta*.	Nil. No suitable sandstone habitat.
Marsdenia viridiflora subsp. viridiflora	*Marsdenia viridiflora* R. Br. subsp. *viridiflora* population in the Bankstown, Blacktown, Camden, Campbelltown, Fairfield, Holroyd, Liverpool and Penrith local government areas	EP		29 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Recent records are from Prospect, Bankstown, Smithfield, Cabramatta Creek and St Marys. Previously known north from Razorback Range. A climber that grows in vine thickets and open shale woodland.	Possible. Potential habitat present in PCT 849.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Persoonia bargoensis	Bargo Geebung	E	V	Predicted by the BAM calculator.	Restricted to a small area south-west of Sydney on the western edge of the Woronora Plateau and the northern edge of the Southern Highlands. The historical limits are Picton and Douglas Park (northern), Yanderra (southern), Cataract River (eastern) and Thirlmere (western). Occurs in woodland or dry sclerophyll forest on sandstone and on heavier, well drained, loamy, gravelly soils of the Wianamatta Shale and Hawkesbury Sandstone. It favours interface soil landscapes such as between the Blacktown Soil Landscape and the complex Mittagong Formation soils (Lucas Heights Soil Landscape) with the underlying sandstone (Hawkesbury Soil Landscape and Gymea Soil Landscape). Some of the vegetation the species occurs within would be recognised as the Shale/Sandstone Transition Forest, a listed community.	Unlikely. Easily identifiable species that was not located during field surveys by experienced botanist. Subject site does not fall on the interface of shale and sandstone soil landscapes which are preferred by this species. Site does not contain Shale-Sandstone Transition Forest.
Persoonia nutans	Nodding Geebung	E	E	4 records within 10 km (OEH 2018a); Species or species' habitat likely to occur within 10 km (DoE 2018a)	Occurs from Richmond to Macquarie Fields on the Cumberland Plain. Grows only on aeolian and alluvial sediments in sclerophyll forest and woodland vegetation communities. Largest populations occur in Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland.	Unlikely. Easily identifiable species that was not located during field surveys by experienced botanist.
Pimelea curviflora var. curviflora		V	V	Species or species' habitat may occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Confined to area between north Sydney in the south and Maroota in the north-west. Former range extended to Parramatta River including Five Dock, Bellevue Hill and Manly. Grows on shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands. Often grows amongst dense grasses and sedges. Flowers October to May.	Nil. No sandstone-transition habitat present. No records in the locality.
Pimelea spicata	Spiked Rice-flower	E	E	112 records within 10 km (OEH 2018a); Species or species' habitat known to occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Disjunct populations within the Cumberland Plain (from Mount Annan and Narellan Vale to Freemans Reach and Penrith to Georges Hall) and Illawarra (from Mt Warrigal to Gerroa) (DEC 2005). In the Cumberland Plain region, restricted to areas which support or historically supported Cumberland Plain Woodland. Grows on well-structured clay soils derived from Wianamatta Shale. In the Illawarra, grows on variable soils in close proximity to the coast on hills or coastal headlands. Inhabits coastal woodland or grassland with emergent shrubs (DEC 2005).	Possible. Potential habitat present in PCT 849.
Pomaderris brunnea	Rufous Pomaderris	V	V	Species or species' habitat likely to occur within 10 km (DoE 2018a)	Mainly occurs in SW Sydney (Wollondilly and Camden LGAs), with other populations in the Hawkesbury-Wollemi region, near Walcha in the New England tablelands and Gippsland in VIC. In NSW, grows in moist woodland or open forest on clay and alluvial soils on flood plains and creek lines. Near Sydney occurs in open woodland dominated by Cabbage Gum with *Allocasuarina* sp. and *Bursaria* sp. understorey, or on alluvial flats with eucalypts including River Peppermint, Sydney Peppermint and Grey Gum (Sutter 2011).	Unlikely. Easily identifiable species that was not located during field surveys by experienced botanist.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Pterostylis gibbosa	Illawarra Greenhood	E	E	Species or species' habitat may occur within 10 km (DoE 2018a)	Known from a small number of populations in the Illawarra, Nowra and Hunter regions. First collected in western Sydney. Only visible above the ground between late summer and spring, and only when soil moisture levels can sustain its growth. Grows in open forest or woodland, on flat or gently sloping land with poor drainage. In the Illawarra region, the species grows in woodland dominated by Forest Red Gum, Woollybutt and *Melaleuca decora*. Near Nowra, the species grows in an open forest of Spotted Gum, Forest Red Gum and Grey Ironbark. In the Hunter region, the species grows in open woodland dominated by Narrow-leaved Ironbark, Forest Red Gum and Black Cypress Pine.	Unlikely. Known from Illawarra, Nowra and Hunter regions. Site disturbance history and ongoing management make occurrence unlikely. Not previously recorded in the locality.
Pterostylis saxicola	Sydney Plains Greenhood	E	E	Species or species' habitat likely to occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Occurs in western Sydney between Picton and Freemans Reach. Grows in small pockets of shallow soil in depressions on sandstone rock shelves above cliff lines. Associated vegetation above these rock shelves is sclerophyll forest or woodland on shale or shale/sandstone transition soils.	Nil. No sandstone rock shelf habitat present.
Pultenaea parviflora		E	V	66 records within 10 km (OEH 2018a); Species or species' habitat known to occur within 10 km (DoE 2018a)	Occurs on the Cumberland Plain, with core distribution from Windsor to Penrith and east to Dean Park, and outliers in Kemps Creek and Wilberforce. Grows in dry sclerophyll woodlands, forest or in grasslands on Wianamatta Shale, laterite or Tertiary alluvium, on infertile sandy to clay soils. Associated communities include Castlereagh Ironbark Forest, Shale Gravel transition Forest and intergrade with Castlereagh Scribbly Gum Woodland.	Unlikely. Easily identifiable species that was not located during field surveys by experienced botanist.
Pultenaea pedunculata	Matted Bush-pea	E		8 records within 10 km, last recorded 2005 (OEH 2018a); Predicted by the BAM calculator.	Three disjunct populations in NSW: in the Cumberland Plains in Sydney, the coast between Tathra and Bermagui and the Windellama area south of Goulburn (where it is locally abundant). NSW populations typically among woodland vegetation but also found on road batters and coastal cliffs. In Windellama it is largely confined to loamy soils in dry gullies.	Possible. Suitable habitat present. Experienced botanist did not see any unknown Fabaceae species within the site.
Syzygium paniculatum	Magenta Lilly Pilly	E	E	Species or species' habitat likely to occur within 10 km (DoE 2018a)	Occurs in narrow coastal strip from Bulahdelah to Conjola State Forest. Grows in rainforest on sandy soils or stabilised Quaternary sand dunes at low altitudes in coastal areas, often in remnant littoral or gallery rainforests.	Nil. No rainforest habitat present.
Thesium australe	Austral Toadflax	V	V	Species or species' habitat may occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Found in small, scattered populations along the east coast, northern and southern tablelands. Occurs in grassland or grassy woodland, and is often found in association with Kangaroo Grass.	Unlikely. Marginal habitat present. Not previously recorded in the locality.

Notes:

All information in this table is taken from NSW OEH and Commonwealth DotE Threatened Species profiles (OEH, 2018a; DoEE 2018a) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population.

Table A2 Threatened fauna known or predicted from the locality, habitat association and likelihood of occurring at the site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
BIRDS						
Anthochaera phrygia	Regent Honeyeater	CE	E	Species or species' habitat known to occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	In NSW confined to two known breeding areas: the Capertee Valley and Bundarra-Barraba region. Non-breeding flocks occasionally seen in coastal areas foraging in flowering Spotted Gum and Swamp Mahogany forests, presumably in response to drought. Inhabits dry open forest and woodlands, particularly Box-Ironbark woodland and riparian forests of River Sheoak, with an abundance of mature trees, high canopy cover and abundance of mistletoes.	Unlikely. No Spotted Gum or Swamp Mahogany Forest present. Sparse occurrences of individual spotted Gums within the site are unlikely to provide sufficient habitat for the species. No records from the locality.
Artamus cyanopterus	Dusky Woodswallow	V		14 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Widespread from the coast to inland, including the western slopes of the Great Dividing Range and farther west. It is often recorded in woodlands and dry open sclerophyll forests, and has also been recorded in shrublands, heathlands regenerating forests and very occasionally in moist forests or rainforests. The understorey is typically open with sparse eucalypt saplings, acacias and other shrubs, often with coarse woody debris. It is also recorded in farmland, usually at the edges of forest or woodland or in roadside remnants or wind breaks with dead timber. The nest is an open shallow untidy cup frequently built in an open hollow, crevice or stump. Have large home ranges, but individuals may spend most of their time in about a 2 ha range and defend an area about 50 m around the nest. Prefer larger remnants over smaller remnants. Competitive exclusion by Noisy Miners (*Manorina melanocephala*) is a significant threat to this species.	Possible. PCT 849 has an open understorey that provides potential foraging habitat.
Botaurus poiciloptilus	Australasian Bittern	E	E	Species or species' habitat known to occur within 10 km (DoE 2018a)	Widespread but uncommon over most NSW except the northwest. Favours permanent freshwater wetlands with tall dense reed beds particularly *Typha* spp. and *Eleocharis* spp., with adjacent shallow, open water for foraging. Roosts during the day amongst dense reeds or rushes and feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails.	Nil. No reed beds present in dam. No records from the locality.
Burhinus grallarius	Bush Stone-curlew	E		Predicted by the BAM calculator	Found throughout Australia except for the central southern coast and inland, the far south-east corner, and Tasmania. Only in northern Australia is it still common however and in the south-east it is either rare or extinct throughout its former range. Inhabits open forests and woodlands with a sparse grassy ground layer and fallen timber. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch.	Possible. No local records. Broadly suitable habitat is present. Site disturbance history, presence of predators and surrounding fragmentation make the site poor potential habitat for this species.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Callocephalon fimbriatum	Gang-gang Cockatoo	V		1 record within 10 km, last recorded 2007 (OEH 2018a); Predicted by the BAM calculator.	Restricted to the south-eastern coast and highlands, from the lower Hunter and northern Blue Mountains to the South western Slopes, south to and contiguous with the Victorian population. Inhabits eucalypt open forests and woodlands with an acacia understorey. In summer it lives in moist highland forest types, and in winter it moves to more open types at lower elevations. The Gang-Gang Cockatoo nests in hollows in the trunks, limbs or dead spouts of tall living trees, especially eucalypts, often near water. The Gang-gang Cockatoo feeds on seeds obtained in trees and shrubs, mostly from eucalypts and wattles.	Unlikely. Site lacks an Acacia understorey. Minimal potential breeding habitat (hollows) present.
Chthonicola sagittata	Speckled Warbler	V		1 record within 10 km, last recorded 2003 (OEH 2018a); Predicted by the BAM calculator.	Within NSW most frequently reported from the hills and tablelands of the Great Dividing Range, rarely from the coast. Inhabits a wide range of Eucalyptus-dominated communities with a grassy understorey, a sparse shrub layer, often on rocky ridges or in gullies. Sedentary and requires large, relatively undisturbed remnants to persist in an area. Forages on the ground for seeds and insects, and nests in a slight hollow in the ground or at the base of a low dense plant.	Unlikely. Requires large and undisturbed remnants to persist - none present within the study area or surrounds.
Circus assimilis	Spotted Harrier	V		1 record within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs throughout Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Inhabits grassy open woodland including acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe (e.g. chenopods). Most commonly in native grassland, but also in agricultural land, foraging over open habitats including edges of inland wetlands. Builds a stick nest in a tree and lays eggs in spring (or sometimes autumn).	Unlikely. Limited potential foraging habitat in grassy open woodland and agricultural land. No breeding habitat present and only one local record.
Climacteris picumnus victoriae	Brown Treecreeper (eastern subspecies)	V		Predicted by the BAM calculator	Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Lives in eastern NSW in eucalypt woodlands through central NSW and in coastal areas with drier open woodlands such as the Snowy River Valley, Cumberland Plains, Hunter Valley and parts of the Richmond and Clarence Valleys. Declines have occurred in remnant vegetation fragments smaller than 300 ha, that have been isolated or fragmented for more than 50 years. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (*Eucalyptus camaldulensis*) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. Sedentary, considered to be resident in many locations throughout its range; present in all seasons or year-round at many sites; territorial year-round. Hollows in standing dead or live trees and tree stumps are essential for nesting.	Unlikely. No local records. Unlikely to occur in small, isolated and fragmented patches.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Daphoenositta chrysoptera	Varied Sittella	V		15 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Sedentary, occurs across NSW from the coast to the far west. Inhabits eucalypt forests and woodlands, especially rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Sensitive to habitat isolation and loss of structural complexity, and adversely affected by dominance of Noisy Miners. Cleared agricultural land is potentially a barrier to movement. Builds a cup-shaped nest of plant fibres and cobwebs in an upright tree fork high in the living tree canopy, and often re-uses the same fork or tree in successive years.	Unlikely. Site lacks the necessary structural complexity preferred by this species and exists as a relatively isolated patch of modified and disturbed vegetation. Surrounding cleared land may be a barrier to movement.
Dasyornis brachypterus	Eastern Bristlebird	E	E	Species or species' habitat may occur within 10 km (DoE 2018a)	Occurs in three disjunct areas of south-eastern Australia: southern Queensland/northern NSW, the Illawarra Region and in the vicinity of the NSW/Victorian border. Illawarra population comprises an estimated 1600 birds, mainly from Barren Grounds Nature Reserve, Budderoo National Park and the Jervis Bay area. Habitat characterised by dense, low vegetation including heath and open woodland with a heathy understorey. The fire history of habitat is important, and the Illawarra and southern populations reach maximum densities in habitat that have not been burnt for over 15 years.	Nil. Heathy understorey is absent. No local records.
Falco subniger	Black Falcon	V		1 record within 10 km, last recorded 2000 (OEH 2018a)	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. Occurs in plains, grasslands, foothills, timbered watercourses, wetland environs, crops, and occasionally over towns and cities. Breeding occurs along timbered waterways in in land areas.	Unlikely. Few local records and known to occur in mostly inland regions. No timbered waterways present at the site.
Glossopsitta pusilla	Little Lorikeet	V		2 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs from coast to western slopes of the Great Dividing Range. Inhabits dry, open eucalypt forests and woodlands. Occurrence is positively associated with patch size, and with components of habitat complexity including canopy cover, shrub cover, ground cover, logs, fallen branches and litter. Feed primarily on profusely-flowering eucalypts and a variety of other species including melaleucas and mistletoes. On the western slopes and tablelands *Eucalyptus albens* and *E. melliodora* are particularly important food sources for pollen and nectar respectively. Mostly nests in small (opening approx. 3 cm) hollows in living, smooth-barked eucalypts, especially *Eucalyptus viminalis*, *E. blakelyi* and *E. dealbata*. Most breeding records are from the western slopes.	Unlikely. Site lacks structural complexity. Marginal foraging habitat in eucalypts when flowering.
Grantiella picta	Painted Honeyeater	V	V	Species or species' habitat likely to occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Nomadic, occurring in low densities across most of NSW. Highest concentrations and almost all breeding occur on inland slopes of the Great Dividing Range. Inhabits Boree, Brigalow and Box Gum woodlands and Box-Ironbark forests. Specialist forager on the fruits of mistletoes, preferably of the Amyema genus. Nests in outer tree canopy.	Unlikely. Preferred vegetation types absent from the site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Haliaeetus leucogaster	White-bellied Sea-Eagle	V	C	4 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Primarily coastal but may extend inland over major river systems. Breeds close to water, mainly in tall open forest/woodland but also in dense forest, rainforest, closed scrub or remnant trees. Usually forages over large expanses of open water, but also over open terrestrial habitats (e.g. grasslands).	Possible. Potential foraging habitat present in PCT 849. No nests observed, and no breeding habitat present.
Hieraaetus morphnoides	Little Eagle	V		20 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Possible. Potential foraging habitat present in PCT 849. No nests observed, and no breeding habitat present.
Lathamus discolor	Swift Parrot	E	CE	5 records within 10 km, last recorded 2007 (OEH 2018a); Species or species' habitat likely to occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Migratory, travelling to the mainland from March to October. Breeds in Tasmania from September to January. On the mainland, it mostly occurs in the southeast foraging on winter flowering eucalypts and lerps, with records of the species between Adelaide and Brisbane. Principal over-winter habitat is box-ironbark communities on the inland slopes and plains. *Eucalyptus robusta, Corymbia maculata* and *C. gummifera* dominated coastal forests are also important habitat.	Unlikely. No breeding habitat present at the site. Marginal potential foraging habitat in the form of scattered Spotted Gums within PCT 849.
Lophoictinia isura	Square-tailed Kite	V		1 record within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs across NSW, resident in North, northeast and along west-flowing rivers. Summer breeding migrant to southeast of state. Inhabits a variety of habitats including woodlands and open forests, with preference for timbered watercourses. Favours productive forests on the coastal plain, box-ironbark-gum woodlands on the inland slopes, and Coolibah/River Red Gum on the inland plains. In Sydney area nests in mature living trees within 100 m of ephemeral/permanent watercourse. Large home range > 100 km^2.	Unlikely. The subject site does not contain a timbered watercourse which is preferred habitat for this species.
Melanodryas cucullata	Hooded Robin (south-eastern form)	V		Predicted by the BAM calculator	Widespread across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. It is considered a sedentary species, but local seasonal movements are possible. The south-eastern form (subspecies *cucullata*) is found from Brisbane to Adelaide and throughout much of inland NSW, with the exception of the extreme north-west. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. Often perches on low dead stumps and fallen timber or on low-hanging branches, using a perch-and-pounce method of hunting insect prey.	Unlikely. Subject site lacks structurally diverse habitat required by this species. No local records.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Melithreptus gularis	Black-chinned Honeyeater (eastern subspecies)	V		Predicted by the BAM calculator	Extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. It is rarely recorded east of the Great Dividing Range, although regularly observed from the Richmond and Clarence River areas. It has also been recorded at a few scattered sites in the Hunter, Central Coast and Illawarra regions, though it is very rare in the latter. Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (*E. blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. Feeding territories are large making the species locally nomadic. Recent studies have found that the Black-chinned Honeyeater tends to occur in the largest woodland patches in the landscape as birds forage over large home ranges of at least 5 ha. The nest is placed high in the crown of a tree, in the uppermost lateral branches, hidden by foliage. It is a compact, suspended, cup-shaped nest.	Unlikely. Site occurs within a small, isolated patch of vegetation and this species prefers large woodland patches. No local records and rarely recorded east of the Great Dividing Range.
Neophema pulchella	Turquoise Parrot	V		Predicted by the BAM calculator	Extends from southern Queensland through to northern Victoria, from the coastal plains to the western slopes of the Great Dividing Range. Lives on the edges of eucalypt woodland adjoining clearings, timbered ridges and creeks in farmland. Usually seen in pairs or small, possibly family, groups and have also been reported in flocks of up to thirty individuals. Prefers to feed in the shade of a tree and spends most of the day on the ground searching for the seeds or grasses and herbaceous plants, or browsing on vegetable matter. Nests in tree hollows, logs or posts, from August to December. It lays four or five white, rounded eggs on a nest of decayed wood dust.	Unlikely. No local records. Species unlikely to occur in highly fragmented landscape on the edge of the M7 with high levels of disturbance and modification.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Ninox connivens	Barking Owl	V		Predicted by the BAM calculator	Found throughout continental Australia except for the central arid regions. Core populations exist on the western slopes and plains and in some northeast coastal and escarpment forests. Many populations crashed as woodland on fertile soils was cleared over the past century, leaving linear riparian strips of remnant trees as the last inhabitable areas. The owls sometimes extend their home range into urban areas, hunting birds in garden trees and insects attracted to streetlights. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. Sometimes able to successfully breed along timbered watercourses in heavily cleared habitats (e.g. western NSW) due to the higher density of prey on these fertile riparian soils. Roost in shaded portions of tree canopies, including tall midstorey trees with dense foliage such as Acacia and Casuarina species. Requires very large permanent territories in most habitats due to sparse prey densities. Monogamous pairs hunt over as much as 6,000 ha, with 2,000 ha being more typical in NSW habitats. Two or three eggs are laid in hollows of large, old trees. Living eucalypts are preferred though dead trees are also used. Nest sites are used repeatedly over years by a pair, but they may switch sites if disturbed by predators (e.g. goannas).	Possible. Wide ranging species. Limited foraging habitat in open woodland and grassland areas. No suitable breeding hollows present.
Ninox strenua	Powerful Owl	V		3 records within 10km (OEH 2018a); Predicted by the BAM calculator.	Occurs from the coast to the western slopes. Solitary and sedentary species. Inhabits a range of habitats from woodland and open sclerophyll forest to tall open wet forest and rainforest. Prefers large tracts of vegetation. Nests in large tree hollows (> 0.5 m deep), in large eucalypts (dbh 80-240 cm) that are at least 150 years old. Pairs have high fidelity to a small number of hollow-bearing nest trees and defend a large home range of 400 - 1,450 ha. Forages within open and closed woodlands as well as open areas.	Possible. Wide ranging species. Limited foraging habitat in open woodland and grassland areas. No suitable breeding hollows present.
Petroica boodang	Scarlet Robin	V		Predicted by the BAM calculator	Found from south east Queensland to south east South Australia and also in Tasmania and south west Western Australia. In NSW, it occurs from the coast to the inland slopes. Lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and regrowth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. Habitat usually contains abundant logs and fallen timber: these are important components of its habitat.	Possible. Woody debris; which is an important component for this species, is present. May forage in open understorey. No local records.
Petroica phoenicea	Flame Robin	V		1 record within 10km, last recorded 2004 (OEH 2018a); Predicted by the BAM calculator.	Breeds in upland moist eucalypt forests and woodlands, often on ridges and slopes, in areas of open understorey. Migrates in winter to more open lowland habitats such as grassland with scattered trees and open woodland on the inland slopes and plains. Forages from low perches, feeding on invertebrates taken from the ground, tree trunks, logs and other coarse woody debris. Fallen logs and coarse woody debris are important habitat components. Open cup nest of plant fibres and cobweb is often built near the ground in a sheltered niche, ledge or shallow cavity in a tree, stump or bank.	Possible. Woody debris; which is an important component for this species, is present. May forage in open understorey. Only one local record.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Rostratula australis	Australian Painted Snipe	E	E	1 record within 10 km (OEH 2018a); Species or species' habitat likely to occur within 10km (DoE 2018a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Nil. No reed beds present in dam.
Stagonopleura guttata	Diamond Firetail	V		1 record within 10 km (OEH 2018a); Predicted by the BAM calculator.	Typically found west of the Great Dividing Range, but populations also occur in drier coastal areas including W Sydney, Hunter, Clarence and Snowy River valleys. Occurs in grassy eucalypt woodlands including Box Gum and Snow Gum communities, as well as open forest, mallee and natural and derived grasslands. Often found in riparian areas and occasionally in lightly wooded farmland. Nests in shrubby understorey or higher up under nests of other species.	Possible. May forage in open understorey. Only one local record.
Tyto novaehollandiae	Masked Owl	V		2 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs across NSW except NW corner. Most common on the coast. Inhabits dry eucalypt woodlands from sea level to 1100 m. Roosts and breeds in large (>40 cm) hollows and sometime caves in moist eucalypt forested gullies. Hunts along the edges of forests and roadsides. Home range between 500 ha and 1000 ha. Prey mostly terrestrial mammals but arboreal species may also be taken.	Possible. Wide ranging species. Limited foraging habitat in open woodland and grassland areas. No suitable breeding habitat (hollows) present.
FISH						
Macquaria australasica	Macquarie Perch	V	E	Species or species' habitat may occur within 10 km (DoE 2018a)	Occurs in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers, and in parts of the Hawkesbury and Shoalhaven catchment areas. Inhabits river and lake habitats, especially the upper reaches of rivers and their tributaries. Requires clear water with deep, rocky holes and abundant cover (including aquatic vegetation, woody debris, large boulders and overhanging banks). Spawning occurs in spring and summer in shallow upland streams or flowing sections of river systems.	Nil. No suitable habitat is present at the site.
Prototroctes maraena	Australian Grayling		V	Species or species' habitat may occur within 10 km (DoE 2018a)	Occurs in coastal rivers and streams south from the Shoalhaven River. Inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults. Most of their lives are spent in freshwater rivers and streams in cool, clear waters with a gravel substrate and alternating pool and riffle zones, however can also occur in turbid water. The species can penetrate well inland, being recorded over 100 km inland from the sea. (Backhouse *et al.* 2008).	Nil. No suitable habitat is present at the site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
FROGS						
Heleioporus australiacus	Giant Burrowing Frog	V	V	Species or species' habitat may occur within 10 km (DoE 2018a)	Occurs along the coast and eastern slopes of the Great Dividing Range south from Wollemi National Park. Appears to exist as 2 populations with a 100 km gap in records between Jervis Bay and Eden. Northern population occurs on sandy soils supporting heath, woodland or open forest. Breeds in ephemeral to intermittent streams with persistent pools. Only infrequently moves to breeding sites, most commonly found on ridges away from creeks, several hundred metres from water.	Nil. No sandstone habitat present for this species.
Litoria aurea	Green and Golden Bell Frog	E	V	Species or species' habitat likely to occur within 10 km (DoE 2018a); Predicted by the BAM calculator.	Formerly occurred from Brunswick Heads to Victoria, but >80% populations now extinct. Inhabits marshes, natural and artificial freshwater to brackish wetlands, dams and in stream wetlands. Prefers sites containing cumbungi (*Typha spp*.) or spike rushes (*Eleocharis spp*.), which are unshaded and have a grassy area and/or rubble as shelter/refuge habitat nearby. *Gambusia holbrooki* is a key threat as they feed on green and Golden Bell Frog eggs and tadpoles.	Nil. No emergent fringing or aquatic vegetation is present in dam. No local records.
Litoria raniformis	Growling Grass Frog	E	V	Species or species' habitat may occur within 10 km (DoE 2018a)	Currently, the species is known to exist only in isolated populations in the Coleambally Irrigation Area, the Lowbidgee floodplain and around Lake Victoria. Usually found in or around permanent or ephemeral Black Box/Lignum/Nitre Goosefoot swamps, Lignum/Typha swamps and River Red Gum swamps or billabongs along floodplains and river valleys. They are also found in irrigated rice crops, particularly where there is no available natural habitat (OEH 2013).	Nil. No suitable habitat is present at the site.
SNAILS						
Meridolum corneovirens	Cumberland Plain Land Snail	E		320 records within 10 km (OEH 2018a); Predicted by the BAM calculator.	Occurs within a small area of the Cumberland Plain, from Richmond and Windsor to Picton. Found primarily under litter of bark, leaves and logs, or in loose soil around grass clumps within Cumberland Plain Woodland. Has also been found under rubbish. Feeds on fungus. During periods of drought can burrow into the soil to escape the dry conditions.	Possible. Foraging and refuge habitat present under woody debris and leaf litter at the base of trees.
Pommerhelix duralensis	Dural Woodland Snail	E	E	Predicted by the BAM calculator	The species is a shale-influenced-habitat specialist, which occurs in low densities along the western and northwest fringes of the Cumberland IBRA subregion on shale-sandstone transitional landscapes. *Pommerhelix duralensis* in the strict sense is found in an area of north-western Sydney between Rouse Hill - Cattai and Wiseman's Ferry, west from Berowra Creek. The species has a strong affinity for communities in the interface region between shale-derived and sandstone-derived soils, with forested habitats that have good native cover and woody debris. It favours sheltering under rocks or inside curled-up bark. It does not burrow nor climb. The species has also been observed resting in exposed areas, such as on exposed rock or leaf litter, however it will also shelter beneath leaves, rocks and light woody debris.	Nil. Outside known range of this species. Within the locality of the subject site, this species would be replaced by the Cumberland Plain Land Snail.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
MAMMALS						
Cercartetus nanus	Eastern Pygmy-possum	V		Predicted by the BAM calculator	Found in south-eastern Australia, from southern Queensland to eastern South Australia and in Tasmania. In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes. Found in a broad range of habitats from rainforest through sclerophyll (including Box-Ironbark) forest and woodland to heath, but in most areas woodlands and heath appear to be preferred, except in north-eastern NSW where they are most frequently encountered in rainforest. Feeds largely on nectar and pollen collected from banksias, eucalypts and bottlebrushes; an important pollinator of heathland plants such as banksias; soft fruits are eaten when flowers are unavailable. Also feeds on insects throughout the year; this feed source may be more important in habitats where flowers are less abundant such as wet forests. Shelters in tree hollows, rotten stumps, holes in the ground, abandoned bird-nests, Ringtail Possum (*Pseudocheirus peregrinus*) dreys or thickets of vegetation, (e.g. grass-tree skirts); nest-building appears to be restricted to breeding females; tree hollows are favoured but spherical nests have been found under the bark of eucalypts and in shredded bark in tree forks.	Unlikely. No local records. Site disturbance history and surrounding fragmentation make the site poor potential habitat for this species. Limited potential food sources present on site.
Chalinolobus dwyeri	Large-eared Pied Bat	V	V	Species or species' habitat likely to occur within 10km (DoE 2018a); Predicted by the BAM calculator.	Occurs from the coast to the western slopes of the divide. Largest numbers of records from sandstone escarpment country in the Sydney Basin and Hunter Valley (Hoye and Schulz 2008). Roosts in caves and mines and most commonly recorded from dry sclerophyll forests and woodlands. An insectivorous species that flies over the canopy or along creek beds (Churchill 2008). In southern Sydney appears to be largely restricted to the interface between sandstone escarpments and fertile valleys.	Unlikely. No preferred sandstone habitat present.
Dasyurus maculatus	Spot-tailed Quoll	V	E	Species or species' habitat known to occur within 10km (DoE 2018a); Predicted by the BAM calculator.	Inhabits a range of environments including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Den sites are in hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces. Females occupy home ranges of up to 750 ha and males up to 3,500 ha, usually traversed along densely vegetated creek lines.	Unlikely. No denning habitat is present. Potential foraging habitat. No local records. Site is largely isolated and does not provide suitable habitat for this wide-ranging species.
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V		15 records within 10km (OEH 2018a)	Occurs on southeast coast and ranges. Prefers tall (>20 m) and wet forest with dense understorey. Absent from small remnants, preferring continuous forest but can move through cleared landscapes and may forage in open areas. Roosts in hollow trunks of Eucalypts, underneath bark or in buildings. Forages in gaps and spaces within forest, with large foraging range (12 km foraging movements recorded) (Churchill 2008, Law *et al.* 2008).	Unlikely. Unlikely to occur in small patches of vegetation such as within the site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Miniopterus australis	Little Bentwing-bat	V		Predicted by the BAM calculator	Occur along the east coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Utilise moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. Generally found in well-timbered areas. Roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. Only five nursery sites /maternity colonies are known in Australia.	Possible. Potential foraging habitat in open woodland (PCT 849). No breeding habitat is present. A number of records in the locality.
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat	V		39 records within 10km (OEH 2018a); Predicted by the BAM calculator.	Generally occurs east of the Great Dividing Range along NSW coast (Churchill 2008). Inhabits various habitats from open grasslands to woodlands, wet and dry sclerophyll forests and rainforest. Essentially a cave bat but may also roost in road culverts, stormwater tunnels and other man-made structures. Only 4 known maternity caves in NSW, near Wee Jasper, Bungonia, Kempsey and Texas. Females may travel hundreds of kilometres to the nearest maternal colony (Churchill 2008).	Possible. Potential foraging habitat in open woodland (PCT 849). No breeding habitat is present. A number of records in the locality.
Micronomus norfolkensis	Eastern Coastal Free-tailed Bat	V		30 records within 10km (OEH 2018a); Predicted by the BAM calculator.	Occurs in dry sclerophyll forest and woodland east of the Great Dividing Range. Forages in natural and artificial openings in vegetation, typically within a few kilometres of its roost. Roosts primarily in tree hollows but also recorded from man-made structures or under bark (Churchill 2008).	Present. Definite call recorded via anabat. Potential breeding and roosting habitat present in tree hollows. Foraging habitat present in open woodland (PCT 849).
Myotis macropus	Southern Myotis	V		26 records within 10km (OEH 2018a); Predicted by the BAM calculator.	Mainly coastal but may occur inland along large river systems. Usually associated with permanent waterways at low elevations in flat/undulating country, usually in vegetated areas. Forages over streams and watercourses feeding on fish and insects from the water surface. Roosts in a variety of habitats including caves, mine shafts, hollow-bearing trees, stormwater channels, buildings, under bridges and in dense foliage, typically in close proximity to water (Campbell 2011). Breeds November or December (Churchill 2008).	Present. Definite call recorded via anabat. Foraging habitat in dam in the north west. Potential breeding and roosting habitat present in tree hollows.
Petauroides volans	Greater Glider		V	Species or species' habitat may occur within 10km (DoE 2018a)	The greater glider is restricted to eastern Australia, occurring from the Windsor Tableland in north Queensland through to central Victoria (Wombat State Forest), with an elevational range from sea level to 1200 m above sea level. It prefers taller montane, moist eucalypt forest with relatively old trees and abundant hollows.	Unlikely. Only a few relatively old trees and limited denning hollows present at the site. Limited foraging habitat. Site is isolated from large tracts of vegetation and this species would be unlikely to traverse the highly fragmented landscape that surrounds the site.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Petaurus norfolcensis	Squirrel Glider	V		Predicted by the BAM calculator	The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or Acacia midstorey. Require abundant tree hollows for refuge and nest sites.	Unlikely. No known vegetation associations present on site (Blackbutt-Bloodwood Forest), no heathy understorey present. No shrub or Acacia midstorey. Tree hollows not abundant. No local records.
Petrogale penicillata	Brush-tailed Rock-wallaby	E	V	Species or species' habitat may occur within 10km (DoE 2018a)	Occurs from the Shoalhaven north to the Queensland border. Now mostly extinct west of the Great Dividing Range, except in the Warrumbungles and Mt Kaputar. Occurs on rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges facing north. Diet consists of vegetation in adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees.	Nil. No rocky escarpment habitat present.
Phascolarctos cinereus	Koala	V	V	3 records within 10km, last recorded 2003 (OEH 2018a); Species or species' habitat known to occur within 10km (DoE 2018a); Predicted by the BAM calculator.	Occurs from coast to inland slopes and plains. Restricted to areas of preferred feed trees in eucalypt woodlands and forests. Home range varies depending on habitat quality, from < 2 to several hundred ha.	Unlikely. Few local records. Limited foraging habitat in PCT 849. Site is isolated from large tracts of vegetation and this species would be unlikely to traverse the highly fragmented landscape that surrounds the site.
Pseudomys novaehollandiae	New Holland Mouse		V	Species or species' habitat may occur within 10km (DoE 2018a)	Occurs in disjunct, coastal populations from Tasmania to Queensland. In NSW inhabits a variety of coastal habitats including heathland, woodland, dry sclerophyll forest with a dense shrub layer and vegetated sand dunes (Wilson and Bradtke 1999). Populations may recolonise/ increase in size in regenerating native vegetation after wildfire, clearing and sandmining. Presence strongly correlated with understorey vegetation density, and high floristic diversity in regenerating heath (Lock and Wilson 1999).	Nil. Dense understorey cover is absent from the site.
Pteropus poliocephalus	Grey-headed Flying-fox	V	V	73 records within 10km (OEH 2018a); Roosting known to occur within 10km (DoE 2018a); Predicted by the BAM calculator.	Roosts in camps within 20 km of a regular food source, typically in gullies, close to water and in vegetation with a dense canopy. Forages in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths, swamps and street trees, particularly in eucalypts, melaleucas and banksias. Highly mobile with movements largely determined by food availability (Eby and Law 2008). Will also forage in urban gardens and cultivated fruit crops.	Possible. Foraging habitat present in open woodland (PCT 849). No roost camps observed during survey.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		2 records within 10km (OEH 2018a); Predicted by the BAM calculator.	Migrates from tropics to SE Australia in summer. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings (Churchill 2008).	Possible. Potential breeding and roosting habitat present in tree hollows. Potential foraging habitat in open woodland (PCT 849). Only few local records.
Scoteanax rueppellii	Greater Broad-nosed Bat	V		20 records within 10km (OEH 2018a)	Occurs on the east coast and Great Dividing Range. Inhabits a variety of habitats from woodland to wet and dry sclerophyll forests and rainforest, also remnant paddock trees and timber-lined creeks, typically below 500 m asl. Forages in relatively uncluttered areas, using natural or man-made openings in denser habitats. Usually roosts in tree hollows or fissures but also under exfoliating bark or in the roofs of old buildings. Females congregate in maternal roosts in suitable hollow trees (Hoye and Richards 2008, Churchill 2008).	Possible. Potential breeding and roosting habitat present in tree hollows. Potential foraging habitat in open woodland (PCT 849).

Notes:

Wildlife Atlas records: only records from 1998 or later were considered. All information in this table is taken from NSW OEH and Commonwealth DotE Threatened Species profiles (OEH, 2018b; DoEE 2018b) unless otherwise stated. The codes used in this table are: CE – Critically Endangered; E – Endangered; V – Vulnerable; EP – Endangered Population.

Table A3 Migratory fauna predicted from the locality, habitat association and likelihood of occurring at the site

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Cuculus optatus	Oriental Cuckoo		C,J,K	Species or species' habitat known to occur within 10 km (DoE 2018a)	This species migrates to northern and eastern Australia in the warmer months. Occurs south to the Shoalhaven area. Occurs in a range of habitats, including monsoon forest, rainforest edges, leafy trees in paddocks, river flats, roadsides and mangroves.	Low. Limited leafy paddocks in trees present.
Hirundapus caudacutus	White-throated Needletail			Species or species' habitat known to occur within 10 km (DoE 2018a)	Recorded along NSW coast to the western slopes and occasionally from the inland plains. Breeds in northern hemisphere. Almost exclusively aerial while in Australia. Occur above most habitat types, but are more frequently recorded above more densely vegetated habitats (rainforest, open forest and heathland) than over woodland or treeless areas.	Moderate. May fly over the site on occasion.
Monarcha melanopsis	Black-faced Monarch			Species or species' habitat known to occur within 10 km (DoE 2018a)	Found along the coast of eastern Australia, becoming less common further south. Found in rainforests, eucalypt woodlands, coastal scrub and damp gullies. It may be found in more open woodland when migrating. Resident in the north of its range, but is a summer breeding migrant to coastal south-eastern Australia, arriving in September and returning northwards in March. It may also migrate to Papua New Guinea in autumn and winter.	Moderate. Could occur in open woodland in the site during migration.

Scientific name	Common name	BC Status	EPBC Status	Source	Habitat description	Likelihood of occurrence
Motacilla flava	Yellow Wagtail		C,J,K	Species or species' habitat likely to occur within 10 km (DoE 2018a)	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	Moderate. Foraging habitat in exotic grassland in the site.
Myiagra cyanoleuca	Satin Flycatcher			Species or species' habitat known to occur within 10 km (DoE 2018a)	In NSW widespread on and east of the Great Divide, sparsely scattered on the western slopes, very occasional records on the western plains. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, often near wetlands and watercourses. On migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. Generally not in rainforests.	Moderate. Could occur in open woodland in the site during migration.
Rhipidura rufifrons	Rufous Fantail			Species or species' habitat known to occur within 10 km (DoE 2018a)	Found along NSW coast and ranges. Inhabits rainforest, dense wet forests, swamp woodlands and mangroves. During migration, it may be found in more open habitats or urban areas (Birds Australia 2008).	Moderate. Could occur in open woodland in the site during migration.

Key:

C- Listed as a migratory species under the China-Australia Migratory Bird Agreement (CAMBA)

J- Listed as a migratory species under the Japanese-Australia Migratory Bird Agreement (JAMBA)

K- Listed as a migratory species under the Korea-Australia Migratory Bird Agreement (KAMBA)

Appendix B – Species recorded within study area

Table A4 Flora species recorded within study area

Family	Common Name	Scientific Name	Exotic	Cover Plot 1	Cover Plot 2	Cover Plot 3	Cover Plot 4
Acanthaceae	Blue Trumpet	*Brunoniella australis*	0	0.1	0.1		
Amaranthaceae	Gomphrena Weed	*Gomphrena celosioides*	*		0.1		
Apiaceae	Indian Pennywort	*Centella asiatica*	0	0.2			
Apocynaceae	Moth Vine	*Araujia sericifera*	*	0.1		0.1	0.1
Apocynaceae	Periwinkle	*Vinca major*	*			5	
Asparagaceae	Asparagus	*Asparagus officinalis*	*	0.1			
Asparagaceae	Bridal Creeper	*Asparagus asparagoides*	*			0.1	
Asteraceae	Cobbler's Pegs	*Bidens pilosa*	*	0.1			
Asteraceae	Cudweed	*Gamochaeta americana*	*	0.1			
Asteraceae	Dandelion	*Taraxacum officinale*	*	0.1		0.1	
Asteraceae	Fireweed	*Senecio madagascariensis*	*	0.1		0.1	0.1
Asteraceae	Spear Thistle	*Cirsium vulgare*	*	0.1	0.1	0.1	
Chenopodiaceae	Berry Saltbush	*Einadia hastata*	0		0.1	0.2	
Chenopodiaceae	Fishweed	*Einadia trigonos*	0		0.1	0.2	
Commelinaceae	Native Wandering Jew	*Commelina cyanea*	0	0.5	0.5	0.1	
Convolvulaceae	Kidney Weed	*Dichondra repens*	0	2	0.1	0.1	
Cyperaceae		*Cyperus* sp.	0	0.1			
Cyperaceae	Common Fringe-sedge	*Fimbristylis dichotoma*	0			0.1	0.1
Cyperaceae	Slender Flat-sedge	*Cyperus gracilis*	0		0.1	0.1	
Ericaceae	Peach Heath	*Lissanthe strigosa*	0			0.2	
Fabaceae (Faboideae)	Slender Tick-trefoil	*Desmodium varians*	0			0.1	
Fabaceae (Faboideae)	Small-leaf Glycine	*Glycine microphylla*	0	0.1	0.1	0.1	
Fabaceae (Faboideae)	Subterranean Clover	*Trifolium subterraneum*	*				0.1
Fabaceae (Faboideae)	Variable Glycine	*Glycine tabacina*	0	0.1	0.1	0.1	
Juncaceae		*Juncus usitatus*	0	0.2			5
Lobeliaceae	Whiteroot	*Pratia purpurascens*	0	0.1			
Malvaceae		*Pavonia hastata*	*				0.1
Malvaceae	Paddy's Lucerne	*Sida rhombifolia*	*	0.2	2	0.1	
Malvaceae	Red-flowered Mallow	*Modiola caroliniana*	*		0.1	0.1	0.1
Myoporaceae	Amulla	*Eremophila debilis*	0		0.1		

Family	Common Name	Scientific Name	Exotic	Cover Plot 1	Cover Plot 2	Cover Plot 3	Cover Plot 4
Myrtaceae	Forest Red Gum	*Eucalyptus tereticornis*	0	10	15	25	
Myrtaceae	Grey Box	*Eucalyptus moluccana*	0	20	1	5	
Myrtaceae	Spotted Gum	*Corymbia maculata*	0	15	2		
Oleaceae	African Olive	*Olea europaea* subsp. *cuspidata*	*	0.1	0.5		
Oxalidaceae	Creeping Oxalis	*Oxalis corniculata*	*	0.1			0.1
Phyllanthaceae	Wiry Spurge	*Phyllanthus virgatus*	0	0.1	0.1		
Phytolaccaceae	Inkweed	*Phytolacca octandra*	*				0.1
Pittosporaceae	Native Blackthorn	*Bursaria spinosa*	0	1	1	5	
Plantaginaceae	Lamb's Tongues	*Plantago lanceolata*	*	0.1		0.1	0.1
Plantaginaceae	Trailing Speedwell	*Veronica plebeia*	0			0.1	
Poaceae		*Briza subaristata*	*			20	1
Poaceae		*Oplismenus aemulus*	0	0.5		0.2	
Poaceae		*Setaria parviflora*	*	20	10	5	10
Poaceae	Common Couch	*Cynodon dactylon*	0	10	10	10	5
Poaceae	Kangaroo Grass	*Themeda australis*	0		1		
Poaceae	Kikuyu Grass	*Pennisetum clandestinum*	*				60
Poaceae	Paddock Lovegrass	*Eragrostis leptostachya*	0		0.5		
Poaceae	Paspalum	*Paspalum dilatatum*	*		5		2
Poaceae	Purple Wiregrass	*Aristida ramosa*	0		2		
Poaceae	Red Grass	*Bothriochloa macra*	0	2			
Poaceae	Rhodes Grass	*Chloris gayana*	*	0.5	2	2	5
Poaceae	Slender Rat's Tail Grass	*Sporobolus creber*	0		5	2	
Poaceae	Slender Rat's Tail Grass	*Sporobolus elongatus*	0			2	
Poaceae	Tall Chloris	*Chloris ventricosa*	0		5		
Poaceae	Weeping Grass	*Microlaena stipoides* var. *stipoides*	0	50	40	30	1
Polygonaceae	Swamp Dock	*Rumex brownii*	0	0.1			
Portulacaceae	Pigweed	*Portulaca oleracea*	0			0.5	0.2
Rosaceae	Blackberry complex	*Rubus fruticosus* sp. agg.	*	0.1			20
Rosaceae	Native Raspberry	*Rubus parvifolius*	0	0.1		0.1	
Rubiaceae	Common Woodruff	*Asperula conferta*	0	0.1		0.1	
Solanaceae		*Solanum sisymbriifolium*	*				0.1

Family	Common Name	Scientific Name	Exotic	Cover Plot 1	Cover Plot 2	Cover Plot 3	Cover Plot 4
Solanaceae	Black-berry Nightshade	*Solanum nigrum*	*				0.2
Solanaceae	Forest Nightshade	*Solanum prinophyllum*	0		0.1		
Solanaceae	Madeira Winter Cherry	*Solanum pseudocapsicum*	*		0.1		
Verbenaceae	Lantana	*Lantana camara*	*		0.1	1	
Verbenaceae	Purpletop	*Verbena bonariensis*	*	0.1	0.2	0.1	1
Verbenaceae	Rough Verbena	*Verbena hispida*	*			0.1	
Verbenaceae	Shore Verbena	*Verbena caracasana*	*				0.1
Vitaceae	Native Grape	*Cayratia clematidea*	0	0.1	0.1	0.1	

Notes:

Cover-An estimate of Projected Foliage Cover for each species present with a 20x20m plot. Foliage cover estimates are recorded using the following number series: 0.1, 0.2, 0.3…1,2,3…10,15,20,25…100%.

Table A5 Fauna species recorded within study area

Scientific name	Common name	Exotic	BC Status	EPBC Status	Observation Type	Grassland	Woodland	Dam
FISH								
Anguilla australis	Longfin eel				O			X
FROGS								
Crinia signifera	Common Eastern Froglet				W			X
Litoria fallax	Eastern Dwarf Tree Frog				W		X	
Litoria peronii	Peron's Tree Frog				OW			X
Litoria verreauxii	Verreaux's Frog				W			X
BIRDS								
Anas superciliosa	Pacific Black Duck				O			X
Ardea ibis	Cattle Egret				O	X		
Cacatua sanguinea	Little Corella				O		X	
Chenonetta jubata	Australian Wood Duck				O			X
Corvus coronoides	Australian Raven				OW		X	
Cracticus tibicen	Australian Magpie				O		X	
Cracticus torquatus	Grey Butcherbird				OW		X	
Dacelo novaeguineae	Laughing Kookaburra				W		X	
Egretta novaehollandiae	White-faced Heron				O			X
Elseyornis melanops	Black-fronted Dotterel				O			X
Eudynamys orientalis	Eastern Koel				W		X	
Grallina cyanoleuca	Magpie-lark				OW		X	
Hirundo neoxena	Welcome Swallow				O	X		X
Manorina melanocephala	Noisy Miner				O		X	
Manorina melanophrys	Bell Miner				W		X	
Microcarbo melanoleucos	Little Pied Cormorant				O			X
Ocyphaps lophotes	Crested Pigeon				O		X	
Phalacrocorax sulcirostris	Little Black Cormorant				O			X
Platycercus eximius	Eastern Rosella				O	X	X	
Podargus strigoides	Tawny Frogmouth				O		X	
Psephotus haematonotus	Red-rumped Parrot				OW	X	X	

Scientific name	Common name	Exotic	BC Status	EPBC Status	Observation Type	Grassland	Woodland	Dam
Ptilonorhynchus violaceus	Satin Bowerbird				O		X	
Scythrops novaehollandiae	Channel-billed Cuckoo				W		X	
Streptopelia chinensis	Spotted Turtle-dove	*			O		X	
Sturnus vulgaris	Common Starling	*			OW	X	X	
Tachybaptus novaehollandiae	Australasian Grebe				O			X
Threskiornis molucca	Australian White Ibis				O	X		X
Trichoglossus haematodus	Rainbow Lorikeet				OW		X	
Vanellus miles	Masked Lapwing				OW			X
GASTROPODS								
Cornu aspersum	Garden Snail	*			O		X	
MAMMALS								
Canis lupus familiaris	Dog	*			O	X		
Chalinolobus gouldii / Mormopterus sp.					U			SG
Chalinolobus gouldii / Scotorepens balstoni / Scoteanax rueppellii					U		SG	SG
Equus caballus	Horse	*			O	X		
Miniopterus schreibersii oceanensis	Eastern Bentwing-bat		V		U			PR
Micronomus norfolkensis	Eastern Coastal Freetailed-bat		V		U			D
Mormopterus ozimops ridei	Ride's Free-tailed Bat				U			D
Myotis macropus	Southern Myotis		V		U			D
Myotis macropus / Nyctophilus sp.								SG
Oryctolagus cuniculus	Rabbit	*			O	X	X	
Ovis aries	Sheep	*			O	X		
Petaurus breviceps	Sugar Glider				O		X	
Pteropus poliocephalus	Grey-headed Flying-fox		V	V	O		X	
Scotorepens balstoni	Inland Broad-nosed Bat				U			PR
Scotorepens orion / Falsistrellus tasmaniensis							SG	SG
Tadarida australis	White-striped Freetail-bat				U			D
Trichosurus vulpecula	Common Brushtail Possum				O		X	

Scientific name	Common name	Exotic	BC Status	EPBC Status	Observation Type	Grassland	Woodland	Dam
Vespadelus regulus / Vespadelus darlingtoni								SG
Vespadelus vulturnus/troughtoni/pumilus							SG	SG
REPTILES								
Eulamprus quoyii	Eastern Water-skink				O		X	
Lampropholis delicata	Dark-flecked Garden Sunskink				O		X	

Key:

Observation type- O=observed, W=heard, U= ultrasonic recording

X= recorded within the subject site

SG= Call distinguished to Species Guild, D= Definite call identification, PR= Probable call identification

Anabat analysis

Analysis method

Bat calls were recorded during field surveys using Anabat Express detectors and an Anabat II coupled with ZCAIM (Titley Scientific).

Calls were identified using zero-crossing analysis and AnalookW software (version 4.2n, Chris Corben 2017) by visually comparing the time-frequency graph and call characteristics (e.g. characteristic frequency and call shape) with reference calls and/or species call descriptions from available reference material.

The *Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay *et al.* 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for possible species (Pennay *et al.* 2011; Van Dyck *et al.* 2013) and records from BioNet (2018). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000) as summarised in Table 1. Due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows van Dyck *et al*. (2013) and Reardon *et al.* (2014).

Table 1 Confidence ratings applied to calls

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

Summary of results and survey effort

GHD completed surveys ultrasonic detector surveys at 2 sites Cecil Park, totalling 4 survey nights. Approximately 1,896 Anabat files were recorded and analysed (all sites combined). Four species were positively (Definite) identified of the 15 or so species that are known to occur from the locality of the study area (OEH 2018a, Pennay *et al.*, 2011; Van Dyck *et al*. 2013). As many as 14 other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species. A summary of the Anabat analysis is detailed in Table 2.

Species notes

Two threatened species listed under the BC Act were recorded (Definite) as a resulting of calls analysis. These were:

Myotis macropus – Vulnerable

Micronomus norfolkensis- Vulnerable

Table 2 Summary of Anabat analysis at Cecil Park

Species / group name	31/10/2018		1/11/2018	
	Old Anabat	Anabat Express	Old Anabat	Anabat Express
Austronomus australis	D	Card Error – No data		
Austronomus australis / Saccolaimus flaviventris (v)			SG	
Mormopterus ozimops ridei	D		D	
Micronomus norfolkensis (v)	D			
Scotorepens balstoni	PR			
Chalinolobus gouldii / Scotorepens balstoni / Scoteanex rueppellii			SG	SG
Chalinolobus gouldii / Mormopterus sp.			SG	
Chalinolobus morio	D			
Miniopterus schreibersii oceaneansis (v)	PR			
Myotis macropus (v)	D		D	
Myotis macropus (v) / Nyctophilus sp.	SG		SG	
S. orion/Falsistrellus tasmaniensis (v)	SG			
Vespadeuls vulturnus/troughtoni (v)/pumilus	SG		SG	SG
Vespadelus regulus / Vespadelus darlingtoni			SG	
No of files	926		965	5
Approx. survey effort (hrs:min)	10.5		10.5	10.5

Table Notes:

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

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

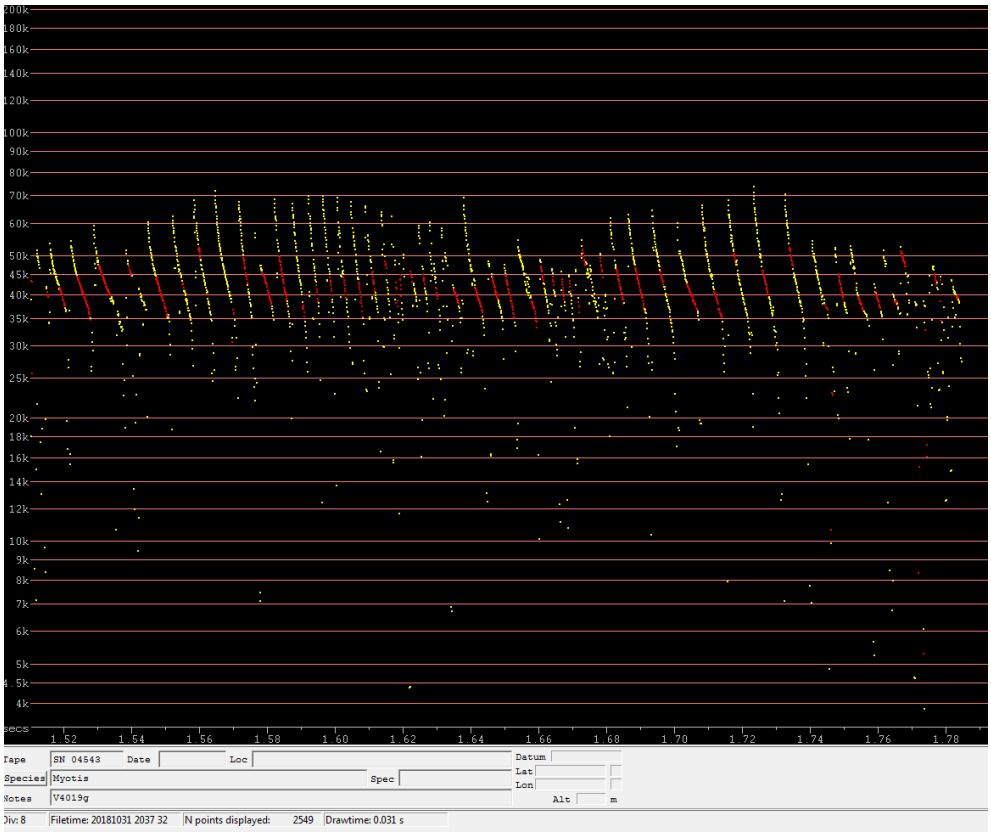
ce, e, v - species listed under the NSW *Biodiversity Conservation Act 2016*.

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

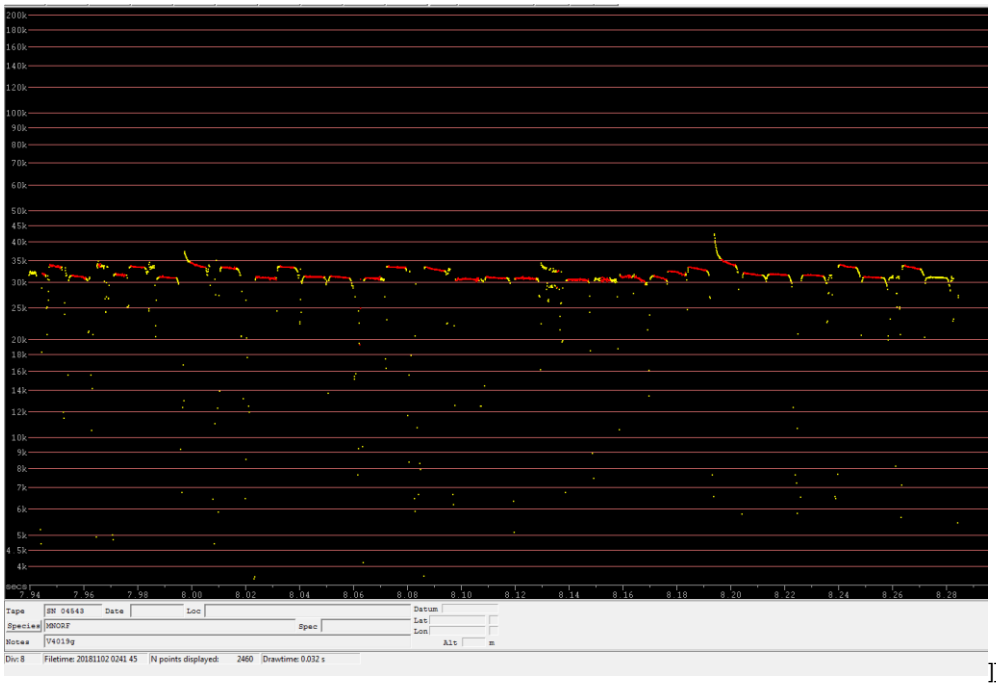
Survey effort: estimate of time between sunset and sunrise for a successful night of Anabat detection based on first and last files recorded.

Bat call examples for threatened species

Myotis macropus – Vulnerable



Micronomus norfolkensis- Vulnerable



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Appendix C – PCT and vegetation integrity plot data

Table A6 Summary of vegetation integrity plot data

PCT ID	Plot	Tree richness	Shrub richness	Grass and grass-like richness	Forb richness	Fern richness	Other richness	Tree cover	Shrub cover	Grass and grass-like cover	Forb cover	Fern cover	Other cover	Litter cover	Total length of fallen logs (m)	Number of large trees (threshold >50 cm dbh)
849	**Benchmark**	**5**	**8**	**12**	**15**	**2**	**5**	**52**	**18**	**61**	**10**	**1**	**5**	**35**	**40**	**3**
	1	3	2	6	8	0	3	45	1.1	62.8	3.2	0	0.3	56.0	24.0	0
	2	3	2	8	7	0	3	18.0	1.1	63.6	1.1	0.0	0.3	47.0	5.0	3
	3	2	3	7	8	0	4	30.0	5.3	44.4	1.5	0.0	0.4	24.0	41.0	1
Exotic grassland*	4	0	0	4	1	0	0	0.0	0.0	11.1	0.2	0.0	0.0	0.0	0.0	0

* Not entered into calculator

Appendix D – Assessment of significance for MNES

Legislative requirement

Assessments of significance have been prepared using the *Matters of National Environmental Significance Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (DoE 2013a) for the following MNES of relevance to the proposal:

- Cumberland Shale Plains Woodland and Shale-Gravel Transition Forest (Cumberland Plain Woodland) which is listed as a CEEC under the EPBC Act and occurs within non-certified lands within the proposed wastewater construction corridor. The proposal would result in impacts to 1.15 ha of vegetation that is commensurate with this CEEC.

Cumberland Plain Woodland, a CEEC.
According to the DoE (2013) 'significant impact criteria' for endangered or critically endangered ecological communities, an action is likely to have a significant impact on a community if there is a real chance or possibility that it will: **Reduce the extent of an ecological community**
The proposal would reduce the extent of the ecological community through the removal of 1.15 ha of vegetation commensurate with this CEEC from within the site. This represents a relatively small reduction in the total extent of the ecological community in the locality, given impacts would be restricted to a small, relatively isolated patch of vegetation, that is fragmented from other, larger patches of vegetation by existing cleared areas and infrastructure. However, vegetation to be removed is associated with the edges of the riparian corridor along tributaries to Ropes Creek. Riparian corridors typically represent the better condition, most intact native vegetation and habitat corridors that exist within the locality, as they are largely unsuitable for development due to flooding risk and associated planning constraints. Removal of 2.24 ha of this community is not a notable reduction at the regional scale given the extent of Cumberland Plain Woodland, however less than 10% of the estimated pre-European extent of the vegetation types that collectively comprise this community remains (OEH, 2018b).
Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines
The proposal would result in a reduction in the total amount of this CEEC, through vegetation clearing, primarily along the edges of a larger patch of vegetation. Clearing of vegetation within the site is unlikely to result in any substantial increase to fragmentation of habitat, given the context of the site and the surrounding land uses. Mobile species will not be impacted by the proposal. There would be an overall reduction in the amount of available habitat. The site is adjacent to Elizabeth Drive, and the proposal would remove only small area of CEEC vegetation around the edge of a patch of exotic grassland. This may result in a small increase in edge effects to vegetation outside of the site boundary, including elsewhere within the lot. However, it is likely that the remainder of vegetation in the lot would be cleared or impacted to some degree by the proposed construction of the M12 Motorway. The proposed M12 Motorway is likely to represent a far greater cause of habitat fragmentation and isolation, however the extent of clearing associated with it is not yet known. The local occurrence of the community is in a highly fragmented landscape. Fragmentation of native vegetation and associated fauna habitats in the locality has previously occurred through clearing for agriculture, residences and farm buildings and construction of linear infrastructure (such as transmission lines and roads). These land uses have created barriers to movement for many fauna species, particularly those that are limited by dispersal abilities and habitat preferences. The suite of fauna species recorded in field surveys is dominated by generalist species of open country such as birds and bats, reflecting the fragmented nature of vegetation within the site (see Section 3.3).

Cumberland Plain Woodland, a CEEC.
Adversely affect habitat critical to the survival of an ecological community
The community occurs on specific soil types within a restricted distribution that coincides with the Sydney region. The natural extent of the community has been extensively cleared and is subject to ongoing development pressure. All occupied habitat other than the smallest or most degraded remnants would be critical to the survival of the community. Any patches of the community that are greater than five hectares in area are considered inherently valuable due to their rarity (DAWE 2020). The local occurrence of the community at the site is in moderate to good condition, and there are substantial patches of this community within the local reserve system, such as within the Western Sydney Parklands. As such, vegetation to be removed is unlikely to comprise habitat critical to the survival of the community.
Modify or destroy abiotic (non-living) factors (such as water, nutrients of soil) necessary for an ecological community's survival, including reduction of groundwater levels or substantial alteration of surface water drainage patterns
The proposal would require clearing of 1.15 ha of vegetation commensurate with this ecological community. Clearing would be permanent, with all vegetation within the site to be removed. Impacts associated with the proposal are localised, and there are unlikely to be any impacts to areas outside of the site boundary that result in modifications or destruction of abiotic factors necessary for the survival of the community.
Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting
The project would remove native plants and displace or harm native animals that are component species of the community from within the site. The proposal would comprise a small reduction in the extent of this community in the locality. However the individual plants and animals affected by the proposal are unlikely to be an ecologically significant proportion of any of the individual species that make up the broader occurrence of the community in the locality or region. The areas of floristically similar vegetation in the locality and region are likely to be sufficient to maintain viable local populations of the species that comprise the community. The proposal may affect the species composition of patches of this community in the vicinity by promoting species that are more tolerant of edge habitats and light. This is likely to include aggressive fauna species like the Noisy Miner that would tolerate these conditions and may occur at the expense of other species. The proposal is unlikely to substantially modify the composition of any vegetation beyond the site and immediately adjoining areas. As such, the proposal is not likely to cause a substantial change in the composition of the community outside of the site.
Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including but not limited to: **Assisting invasive species, that are harmful to the listed ecological community, to become established, or**
The proposal would involve a small area of vegetation removal and would create new edges in vegetation and habitat adjoining the site. Construction activities may, in general, increase the degree of weed infestation in adjacent areas through dispersal of weed propagules (seeds, stems and flowers) into areas of native vegetation via erosion (wind and water), workers' shoes and clothing or construction vehicles. Recommendations have been made in Section 5.3 to minimise the spread of weeds during construction.

Cumberland Plain Woodland, a CEEC.
A CEMP is recommended for the construction of the proposal, which would contain measures to manage weeds and to reduce the risk of spreading weeds off site in soil or water. The extent of native vegetation cover would be reduced in the local area, with new edges created in retained vegetation that would exposed to edge effects and the potential influence of weeds and invasive species, particularly along the western and northern border of the site. Mitigation measures are recommended in Section 5.3 to limit the spread of weeds and invasive species, and this would reduce the chance that weeds would spread or that other edge effects would penetrate into habitat outside the site. The proposal would have a minor effect on the extent or seriousness of edge effects in the locality and is unlikely to introduce any new weed species or increase the significance of weed infestations. Assuming the recommended mitigation measures are implemented, no new invasive species that may cause the Cumberland Plain Woodland to decline are likely to become established in the locality as a result of the proposal.
Causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community
Construction vehicles and equipment would cause a minor localised increase in the risk of hydrocarbon contamination or other pollutants for the duration of construction activities. A CEMP is recommended for construction of the proposal, which would contain measures to manage harmful substances and to avoid impacts on vegetation, soil or water. Any accidental mobilisation of harmful substances during construction would not be 'regular' (if at all) and is highly unlikely to kill or inhibit the growth of any species in the ecological community in areas adjoining the site. During operation, depending on the future uses of the site, there is the potential for mobilisation of chemicals or pollutants, however any such mobilisation would also be accidental and unlikely to kill or inhibit the growth of any species in the ecological community in areas adjoining the site.
Interfere with the recovery of an ecological community
The 'recovery plan decision' for Cumberland Plain Woodland is currently: 'Recovery Plan required, at the time of listing a recovery plan was in preparation for Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest (17/11/2009)' (DAWE, 2020). The main threats to Cumberland Plain Woodland are clearing for urban, industrial or rural development, the consequent fragmentation of native vegetation remnants, inappropriate grazing and fire regimes, weed invasion and the low level of protection in reserves (DEWHA, 2009). The continuing decline is noted to be "predominately a consequence of dispersed, small scale clearing actions associated with urban development" (NSW Scientific Committee and Simpson, 2008). The approved conservation advice lists priority recovery and threat abatement actions that can be taken to support the recovery of the community (DEWHA, 2009). The following are particularly relevant to the proposal: • Liaise with planning authorities to ensure that planning for growth zones in urban and peri-urban areas takes the protection remnants into account, with due regard to principles for long-term conservation. • Liaise with local councils and State authorities to ensure new development, road widening, maintenance activities or other activities involving substrate or vegetation disturbance in areas where the Cumberland Plain Shale Woodlands and Shale-Gravel Transition Forest ecological community occurs do not adversely impact on known remnants (DEWHA, 2009).

Cumberland Plain Woodland, a CEEC.
The project would remove 1.15 ha of vegetation within the local occurrence of the community, primarily comprising the edges of a good condition patch, which is connected to a larger patch of similar vegetation. The proposal would result in the removal of a small amount of this CEEC, which is inconsistent with the regional priority actions for the community, as listed in the Conservation Advice for the CEEC (DEWHA, 2009). However, there is no approved recovery plan for the community.
Conclusion of Assessment of Significance:
The proposal is unlikely to have a significant impact on the local occurrence of Cumberland Plain Woodland. The proposal is only removing 1.15 ha of vegetation commensurate with this ecological community, from within a rural residential and agricultural setting, adjacent to a main road. The proposal is unlikely to influence the survival of any vegetation outside of the site boundary, nor would it impact the abiotic conditions of the surrounding areas or their floristic assemblages. Vegetation clearing associated with the proposal is unlikely to affect the continued persistence of this CEEC within the locality or region.

Appendix E - Biodiversity credit report

BAM Biodiversity Credit Report (Like for like)

Proposal Details

Assessment Id
00010354/BAAS19071/18/00010355

Proposal Name
Elizabeth Drive Service Centre Development Assessment

BAM data last updated *
05/05/2020

Assessor Name
Kathryn Chesnut

Assessor Number
BAAS17031

BAM Data version *
26

Proponent Names

Report Created
04/06/2020

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Major Projects

Date Finalised
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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	849-Cumberland shale plains woodland

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

BAM Biodiversity Credit Report (Like for like)

No Changes

Predicted Threatened Species Not On Site

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	Number of credits to be retired
849-Cumberland shale plains woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	1.2	48.00

849-Cumberland shale plains woodland	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region
	Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 849, 850	-	Yes	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	Area	Credits
Myotis macropus / Southern Myotis	1.1	36.00

Myotis macropus/ Southern Myotis	849_Moderate	**Like-for-like credit retirement options**

Spp	IBRA region
Myotis macropus/Southern Myotis	Any in NSW

BAM Biodiversity Credit Report (Variations)

Proposal Details

Assessment Id
00010354/BAAS19071/18/00010355

Proposal Name
Elizabeth Drive Service Centre Development Assessment

BAM data last updated *
05/05/2020

Assessor Name
Kathryn Chesnut

Assessor Number
BAAS17031

BAM Data version *
26

Proponent Name(s)

Report Created
04/06/2020

BAM Case Status
Open

Assessment Revision
0

Assessment Type
Major Projects

Date Finalised
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.

Potential Serious and Irreversible Impacts

Name of threatened ecological community	Listing status	Name of Plant Community Type/ID
Cumberland Plain Woodland in the Sydney Basin Bioregion	Critically Endangered Ecological Community	849-Cumberland shale plains woodland

Nil

Additional Information for Approval

PCTs With Customized Benchmarks

No Changes

BAM Biodiversity Credit Report (Variations)

Predicted Threatened Species Not On Site

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	Number of credits to be retired
849-Cumberland shale plains woodland	Cumberland Plain Woodland in the Sydney Basin Bioregion	1.2	48.00

849-Cumberland shale plains woodland	**Like-for-like credit retirement options**			
	Name of offset trading group	Trading group	HBT	IBRA region
	Cumberland Plain Woodland in the Sydney Basin Bioregion This includes PCT's: 849, 850	-	Yes	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	Area	Credits
Myotis macropus / Southern Myotis	1.1	36.00

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<tr><td rowspan="7">Myotis macropus/ Southern Myotis</td><td rowspan="7">849_Moderate</td><td colspan="3">Like-for-like options</td></tr>
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<tr><td colspan="3">Variation options</td></tr>
<tr><td>Kingdom</td><td>Any species with same or higher category of listing under Part 4 of the BC Act shown below</td><td>IBRA region</td></tr>
<tr><td>Fauna</td><td>Vulnerable</td><td>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.</td></tr>
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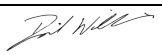
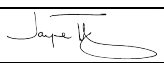
Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	K. Chesnut / M. Young	D. Williams		J. Tipping		16/06/2020
1	K. Chesnut/ M. Young	D. Williams		J. Tipping		13/08/2020

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