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Moorebank Precinct East - Stage 2 Proposal

Biodiversity Assessment Report

SIMTA SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

November 2017

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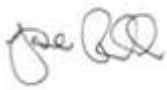
SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)
MOOREBANK PRECINCT EAST STAGE 2

Biodiversity Assessment Report

Author	Jane Rodd	
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REVISIONS

Revision	Date	Description	Prepared by	Approved by
1	18/10/2016	Draft 1	Jane Rodd	Westley Owers
2	11/11/2016	Draft 2	Jane Rodd	Bradley Searle
3	01/12/16	Final for Public Exhibition (EIS)	Jane Rodd	Bradley Searle
4	6/11/2017	Updated (RtS)	Jane Rodd	Westley Owers
5	16/11/2017	Updated (RtS – OEH comments)	Jane Rodd	Westley Owers

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1 INTRODUCTION

Concept Plan Approval (MP 10_0193) for an intermodal terminal (IMT) facility at Moorebank, NSW (the Moorebank Precinct East Project (MPE Project) (formerly the SIMTA Project)) was received on 29 September 2014 from the NSW Department of Planning and Environment (DP&E). The Concept Plan for the MPE Project involves the development of an IMT, including a rail link to the Southern Sydney Freight Line (SSFL) within the Rail Corridor, warehouse and distribution facilities with ancillary offices, a freight village (ancillary site and operational services), stormwater, landscaping, servicing, associated works on the eastern side of Moorebank Avenue, Moorebank, and construction or operation of any part of the project, which is subject to separate approval(s) under the *Environmental Planning and Assessment Act 1979* (EP&A Act).

Sydney Intermodal Terminal Alliance (SIMTA) are seeking approval for the construction and operation of the Moorebank Precinct East (MPE) Stage 2 Proposal (the Proposal), which would comprise the second stage of development under the MPE Concept Approval (MP10_0193).

An Environmental Impact Statement (EIS) was prepared for the Proposal seeking approval, under Part 4, Division 4.1 of the EP&A Act. In particular, the EIS was prepared to address:

- The Secretary's Environmental Assessment Requirements (SEARs) (SSD 16-7628) for the Proposal, issued by NSW DP&E on 27 May 2016.
- The relevant requirements of the Concept Plan Approval MP 10_0913 dated 29 September 2014 (as modified).
- The relevant requirements of the approval under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (No. 2011/6229, granted in March 2014 by the Commonwealth Department of the Environment (DoE)) (as relevant).

The EIS was publicly exhibited, in accordance with Section 89F (1)(a) of the EP&A Act, between 13 December 2016 and 24 February 2017. During the exhibition period, submissions were invited from all stakeholders including members of the community and government stakeholders.

A Response to Submissions (RtS) report was prepared to respond to submissions raised by stakeholders during the exhibition of the EIS. The RtS was prepared to satisfy the provisions of Section 89G of the EP&A Act and Clause 85A of the EP&A Regulations.

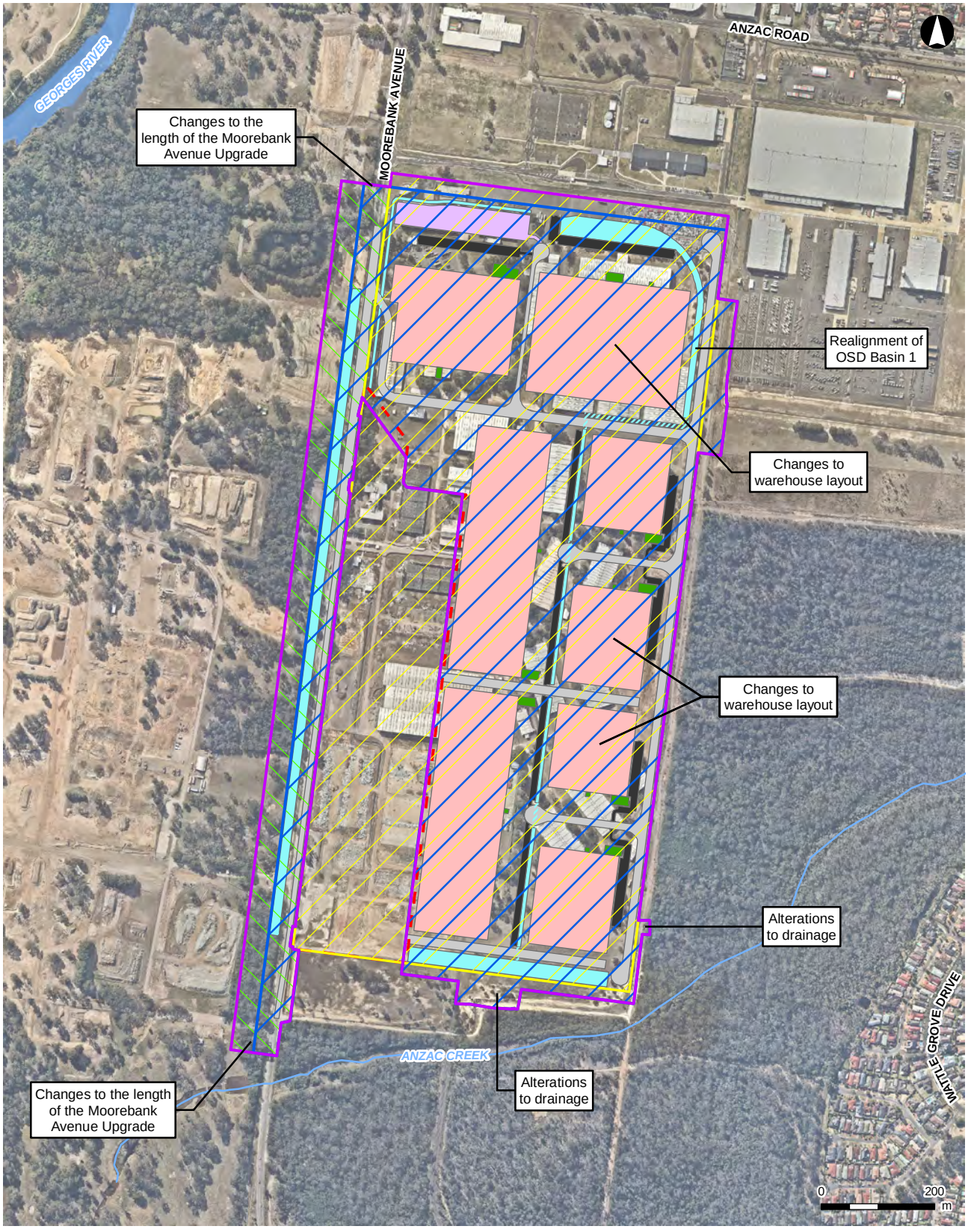
In response to the submissions received, and also to respond to design progression, amendments have been made to the Proposal (the Amended Proposal), namely:

- Realignment of the OSD Basin 1 and inclusion of a spillway
- Changes to the length of the Moorebank Avenue Upgrade
- Changes to warehouse layout
- Alterations to the drainage design to the south of the MPE site
- Amendments to the Construction Area and Operational Area as a result of the above amendments

Amended Proposal, at the Amended Proposal site, includes both the MPE Stage 2 site and the Moorebank Avenue site. The Amended Proposal components are shown in Figure 1-1. A more detailed description of the Amended Proposal is provided in section 1.3.

This Biodiversity Assessment Report (BAR) has been prepared by accredited ecologists to support the *Moorebank Precinct East-Stage 2 Proposal Response to*

Submissions (Arcadis 2017). This BAR replaces the BAR that was prepared to support the *Moorebank Precinct East-Stage 2 Proposal Environmental Impacts Statement* (Arcadis 2016), and describes the Amended Proposal (refer to section 1.2), considers impacts of the Moorebank Avenue site (refer to section 1.3) and addresses submissions received by government agencies, that specifically related to the content of the previous BAR (refer to section 1.4).



LEGEND

- MPE Site
- Amended Proposal site
- Amended operational area
- Moorebank Avenue site
- MPE Stage 1 operational area
- Watercourse
- Carpark
- Freight Village
- OSD
- Office
- Road
- Warehouse

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Aerial imagery supplied by nearmap (August, 2017)

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Figure 1-1 Amendments to the Proposal

1.1 Purpose of this report

This Biodiversity Assessment Report (BAR) has been prepared to support the *Moorebank Precinct East-Stage 2 Proposal Response to Submissions* (Arcadis 2017). This BAR replaces the BAR prepared to support the *Moorebank Precinct East-Stage 2 Proposal Environmental Impacts Statement* (Arcadis 2016) and provides the following additional information:

- Details on how comments received by key government agencies (specifically, NSW OEH and DP&E) provided during the public exhibition of the EIS have been addressed.
- Details of additional environmental assessment that has been carried out for the Amended Proposal (including the results of additional threatened flora surveys along and near the MPE site boundary).
- A validation of previous identification of Hibbertia species that occur in the MPE Stage 2 site.
- Identification of additional Hibbertia species that occur in the MPE Stage 2 site, in areas that were previously surveyed.
- Consideration of all impacts related to the clearing required in the Moorebank Avenue site, for Moorebank Avenue Upgrade Works.
- A validation of previous identification of Hibbertia species that occur in the Moorebank Avenue site.
- Revised mapping and calculations relating to impacts, predicted species and ecosystem credits and offsetting requirements

This report has been prepared as part of a State Significant Development (SSD) Application for which approval is sought under Part 4, Division 4.1 of the EP&A Act.

This BAR has been prepared in accordance with the NSW *Framework for Biodiversity Assessment* (FBA) (OEH 2014) by Jane Rodd, accredited under s142B(1) of the *Threatened Species Conservation Act 1995* (Accreditation Number 0023) to apply the FBA, which is the assessment methodology that is adopted by the NSW Offset Policy for Major Projects.

This BAR provides an assessment of potential biodiversity impacts of the Amended Proposal, at the Amended Proposal site which includes both the MPE Stage 2 site and the Moorebank Avenue site.

1.1.1 SEARs and the Concept Plan Conditions of Approval and Statement of Commitments

The SEARs and the Concept Plan Conditions of Approval and Statement of Commitments relevant to this study, and the section of this report where they have been addressed are provided in Table 1-1 and Table 1-2 respectively.

Table 1-1: Secretary's Environmental Assessment Requirements relevant to this study

Section	Environmental Assessment Requirement	Where addressed in this report
11. Biodiversity – including but not limited to: A Flora and Fauna assessment. The assessment shall:		
a)	assess impacts on the biodiversity values of the site and adjoining areas, including Endangered Ecological Communities and threatened flora and fauna species and their habitat, groundwater dependent ecosystems, impacts on wildlife and habitat corridors, riparian land, and habitat fragmentation and details of mitigation measures. The assessment shall be undertaken in accordance with the Framework for Biodiversity Assessment, unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the *Threatened Species Conservation Act 1995*;	Section 8.2
b)	consider of the OEH's Threatened Species Survey and Assessment Guidelines (www.environment.nsw.gov.au/threatenedspecies/surveyassessmentgdlns.htm), any relevant draft or final recovery plans, and Commonwealth Significant Impact Guidelines;	Section 4
c)	assess and document impacts related to the proposed project in accordance with the Framework for Biodiversity Assessment (FBA) (OEH 2014), unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the Threatened Species Conservation Act 1995;	Sections 5 to 10
d)	include a comprehensive offset strategy, in accordance with the NSW Biodiversity Offsets Policy for Major Projects including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise, offset' principle.	Section 10

Table 1-2 Concept Plan conditions of approval and Statement of Commitments relevant to this study

Conditions of Approval/Statement of Commitments	Where addressed in this report
Concept plan conditions of approval	
Biodiversity Any future Development Application shall include a Flora and Fauna assessment. The assessment shall: a) assess impacts on the biodiversity values of the site and adjoining areas, including Endangered Ecological Communities and threatened flora and fauna species and their habitat, impacts on wildlife and habitat	Sections 8 to 10 Note: opportunities for connectivity across the rail link between the site and the East Hills Passenger Line are not relevant to the Amended Proposal, as it does not include construction of the rail link.

Conditions of Approval/Statement of Commitments	Where addressed in this report
corridors, riparian land, and habitat fragmentation and details of mitigation measures, having regard to the range of fauna species and opportunities for connectivity (terrestrial, arboreal and aquatic) across the rail link between the site and the EHPL;	
b) include a Vegetation Management Plan that has been prepared in consultation with the NSW Office of Water;	Not relevant to Amended Proposal, as there are no direct impacts on Anzac Creek and Georges River as a result of the Amended Proposal.
c) document how impacts to the *Persoonia nutans* and the *Grevillea parviflora* subsp. *parviflora* flora species have been minimised through the detailed design process;	Sections 8, 9 and 10
d) include the details of available offset measures to compensate the biodiversity impacts of the proposal where offset measures are proposed to address residual impacts, in particular the following should be considered: i. As stipulated in principle 2 of 'NSW offset principles for major projects (state significant development and infrastructure)', for terrestrial biodiversity, established assessment tools, such as the BioBanking Assessment Methodology (BBAM), are considered best practice; ii. the Biodiversity Offset Strategy will be undertaken in accordance with the 'NSW offset principles for major projects (state significant development and state significant infrastructure)'; and iii. Offsets shall be identified, and demonstrate that they can be secured.	Section 10
Statements of commitment	
The Proponent will undertake further detailed assessment to establish the potential biodiversity impacts of the proposed rail link	N/A – Amended Proposal does not include rail link

Conditions of Approval/Statement of Commitments	Where addressed in this report
and measures to mitigate its potential impacts. The investigations shall incorporate the mitigation measures listed within Section 5 of the Flora and Fauna Assessment and as summarised below: Avoid Impacts ▪ Site establishment, earthworks and rail construction Mitigate Impacts ▪ Soil disturbance related to site establishment, earthworks and rail construction ▪ Vegetation clearance for rail construction, access and maintenance tracks Construction in riparian areas/in proximity to watercourse ▪ Construction of pavement, slabs and building structures ▪ Hot works (including vegetation clearing requiring heat producing equipment) ▪ Alteration to air quality and noise environments Operation of the SIMTA proposal	
Management of Threatened Plant Species The Proponent shall prepare and implement a Threatened Species Management Plan for the *P. nutans* and *G. parviflora* subsp. *parviflora* populations within the rail corridor that would be affected by the rail link	Although the Amended Proposal will impact threatened plant species, none of the impacts are within the rail corridor as identified in the MPE Stage 1 BAR. A Threatened Species Offset Management Plan (TFOMP) (Arcadis 2017b) has been prepared to address the offset and management requirements for the EPBC Act listed threatened flora species that will be impacted by the MPE Stage 1 rail link. The TFOMP was approved by the Commonwealth Department of the Environment and Energy (DoEE) on 29 August 2017.
Off-Set Impacts The Proponent will update the *Preliminary Biodiversity Offset Strategy* (Hyder Consulting 2013) and continue to consult with the Department of the Environment (DOTE) and	Section 10

Conditions of Approval/Statement of Commitments	Where addressed in this report
the NSW Office of Environment and Heritage (OEH) through the project approval processes.	
Aquatic Flora and Fauna The Proponent will implement the following measures to protect the aquatic flora and fauna as part of the applications for the detailed planning applications (where relevant and applicable): ▪ Implementation of design principles for friendly fish passage. ▪ Implementation of Construction and Operation Management Plans for maintenance of structures in riparian and aquatic zones. ▪ Minimise siltation of the Georges River during construction through implementing the water quality mitigation measures detailed within the Stormwater and Flooding section of the Statement of Commitments. ▪ Thorough assessment of any development within the Anzac Creek CSWL community, including potential impacts on groundwater quality and quantity. ▪ Lantana removal within nominated construction zones to reduce degradation of streamside vegetation and offset any potential impacts to aquatic biodiversity.	Mostly not applicable, as there are minimal aquatic impacts. Potential aquatic impacts are addressed in Sections 9 and 10.
Riparian ▪ The proposed rail link (located within the rail corridor) is exempt from the requirement for a WM Act controlled activity approval from NOW as a transitional Part 3A project; however the detailed design of the rail link will seek to conform to the objects of the WM Act and its associated guidelines.	Mostly not applicable, as there are minimal riparian impacts. Potential riparian impacts are addressed in Sections 9 and 10.

Conditions of Approval/Statement of Commitments	Where addressed in this report
▪ The riparian setback for Anzac Creek, as specified by NOW, is 30 metres (20 metre CRZ and 10 metre VB), while for Georges River the riparian setback is likely to be a minimum of 50 metres (40 metre CRZ and 10 metre VB). ▪ Riparian corridors will be appropriately revegetated to restore and/or maintain ecological, functional and habitat values and impede surface flows and drop sediment before it reaches the waterways. ▪ Water quality and quantity issues will be managed during the construction phase through the implementation, inspection and maintenance of best practice soil and water management techniques which will be defined in the CEMP for sedimentation and erosion control during construction. ▪ Water quality and quantity issues will be managed during the operation phase through the implementation, inspection and maintenance of Water Sensitive Urban Design (WSUD) measures such as rainwater tanks, grass filter strips, swales and bio retention.	

1.1.2 Submissions and requests for further information

The EIS was publicly exhibited, in accordance with Section 89F (1)(a) of the *Environmental Planning and Assessment Act 1979* (EP&A Act), between 13 December 2016 and 24 February 2017. During the exhibition period, submissions were invited from all stakeholders including members of the community and government stakeholders.

Submissions relating to biodiversity were received from a number of stakeholders, including NSW Office of Environment and Heritage (OEH) and DP&E. Specifically, both OEH and DP&E requested that additional survey for threatened flora species be carried out (Table 1-3). Accordingly, this BAR describes the methodology and results of additional targeted flora surveys that have been carried out by Arcadis ecologists, and provides an assessment of impacts.

Table 1-3: Government agency submissions and requests relevant to this BAR

Agency	Details of submission relevant to this BAR
A formal submission comprising a letter (dated 4 May 2017) was received from the NSW DP&E.	Additional targeted vegetation survey for threatened species is required including for *Acacia byoeana, Hibbertia puberula* subsp. *prberula* and *Hibbertia fumana* and *Persoonia nutans* (where previously identified): • From the southern-most existing building on the MPE site, extending to Anzac Creek • From 10m inside the eastern boundary of the MPE site extending at least 30m into the Boot Land
A formal submission comprising a letter (dated 24 February 2017) was received from the NSW OEH.	The BAR acknowledges the potential impacts of increased sedimentation, risk of weed invasion and changes to hydrology on threatened flora populations in the adjacent Boot land, however, these concerns appear to be restricted to locations of Persoonia nutans known when the BAR was prepared. Given the threatened species found during more recent flora surveys of the Boot land south of Anzac Creek (e.g. Hibbertia puberula and Hibbertia fumana), OEH recommends additional flora surveys be undertaken along the eastern and southern boundary at least 30m into the Boot land. Measures to avoid, mitigate or offset unavoidable indirect impacts should be assessed if additional threatened flora species are found.
A request from DP&E, received via email (dated 18 October 2017), for an updated BAR to be submitted to DP&E.	Detail the survey effort, and timing of surveys, undertaken to identify the Hibbertia species (including the potential for H. fumana) in MPE stage 2 and within thirty metres of all adjoining land to MPE Stage 2 or further if this is required to address impacts from the stormwater outlet and its discharge as detailed in the RTS. This information is to be contained in an updated BAR signed by an accredited person.

1.2 Description of the Amended Proposal

The Amended Proposal involves the construction and operation of Stage 2 of the MPE Project, comprising warehousing and distribution facilities on the MPE site and upgrades to approximately 1.5 kilometres of Moorebank Avenue from approximately 35 metres south of the northern boundary of the MPE site to approximately 185 metres south of the southern MPE site boundary.

Key components of the Amended Proposal include:

- Warehousing comprising approximately 300,000m^2 GFA and additional ancillary offices
- A freight village, comprising 8,000m^2 GFA of retail, commercial and light industrial land uses
- Establishment of an internal road network, and connection of the Amended Proposal to the surrounding public road network
- Ancillary supporting infrastructure within the Amended Proposal site, including:
  - Stormwater, drainage and flooding infrastructure
  - Utilities relocation and installation
  - Vegetation clearing, remediation, earthworks, signage and landscaping
- Subdivision of the MPE Stage 2 site
- The Moorebank Avenue upgrade, which comprises the following key components:
  - Alterations to the existing lane configuration, including some widening
  - Earthworks, including construction of embankments and tie-ins to existing Moorebank Avenue road level at the Amended Proposal's southern and northern extents
  - Raking of the existing pavement and installation of new road pavement
  - Establishment of temporary drainage infrastructure, including temporary basins and / or swales
  - Adjusting the vertical alignment by about two metres from the existing levels, including kerbs, gutters and a sealed shoulder
  - Signalling and intersection works
- Upgrading existing intersections along Moorebank Avenue, including:
  - Moorebank Avenue / MPE Stage 2 access
  - Moorebank Avenue / MPE Stage 1 northern access
  - Moorebank Avenue / MPE Stage 2 central access
  - MPW Northern Access / MPE Stage 2 southern emergency access.

The Moorebank Avenue site, which includes the upgrade of Moorebank Avenue, may be either cleared as part of the Amended Proposal or the MPW Project (SSD 5066), subject to the timing of approvals (it is likely that the MPE Stage 2 Proposal would be approved prior to the MPW Stage 2 Proposal).

Accordingly, this report has been updated to consider all impacts of the clearing required for the Moorebank Avenue site, which includes vegetation that occurs on the MPW site, and assumes that all areas within the Moorebank Avenue site would be cleared of native vegetation as part of the Amended Proposal.

The Amended Proposal would interact with the MPE Stage 1 Proposal (SSD_6766) via the transfer of containers between the MPE Stage 1 IMT and the Amended Proposal's warehousing and distribution facilities. This transfer of freight would be via a fleet of heavy vehicles capable of being loaded with containers and owned by SIMTA. The fleet of vehicles would be stored and used on the MPE Stage 2 site, but registered and suitable for on-road use. The Amended Proposal is expected to operate 24 hours a day, seven days per week.

An overview of the Amended Proposal is shown in Figure 1-2.

Construction of the Amended Proposal would occur over a period of approximately 24-36 months. Construction is considered to include all work in respective of the Amended Proposal other than, pre-construction works, namely:

- works within Works period A (pre-construction activities), including:
  - Establishment of site access points
  - Importation, stockpiling and placement of clean general fill for site preparation activities
  - Installation of site fencing
  - Remediation, where required, including unexploded ordnance (UXO), exploded ordnance (EO) and exploded ordnance waste (EOW) management.
- survey; acquisitions; or building/ road dilapidation surveys; fencing; investigative drilling, excavation or salvage
- clearing any native vegetation within the Amended construction area, with the exception of the southern and eastern swales located outside of the MPE site
- establishment of site compounds and construction facilities
- installation of environmental mitigation measures
- utilities adjustment and relocation that do not present a significant risk to the environment, as determined by the Environmental Representative
- other activities determined by the Environmental Representative to have minimal environmental impact.

Key construction activities occurring during the construction period include, but are not limited to, the following:

- Vegetation clearance within the southern and eastern swales
- Demolition of existing buildings and infrastructure on the Amended Proposal site
- Earthworks (with the exception of importation, stockpiling and placement of clean general fill for site preparation activities undertaken during pre-construction)
- Drainage and utilities installation
- Establishment of hardstand across the Amended Proposal site
- Establishment of a temporary batching plant (potential including concrete, cement and pre-mix and hot-mix works) and materials crushing (inc. grinding and separating) and testing
- Construction of a temporary diversion road to allow for traffic management along the Moorebank Avenue site during construction (including temporary signalised intersections adjacent to the existing intersections) (the Moorebank Avenue Diversion Road)
- Upgrade of Moorebank Avenue including:
  - Adjustment of the formation level and levelling of Moorebank Avenue

  - Road pavement and intersection works along Moorebank Avenue
- Establishment of a site vehicle entrance to the MPE Stage 2 site from Moorebank Avenue
- Construction of the warehouses and warehouse access roads
- Fit-out of warehousing
- Construction of warehouses and distribution facilities, ancillary offices and the ancillary freight village
- Construction works associated with signage, landscaping, stormwater and drainage works.

Further detail regarding the construction methodology is provided in Appendix I of the MPE Stage 2 RtS.

1.3 Key terms relevant to the Amended Proposal

Table 1-3 provides a summary of the key terms relevant to the Amended Proposal, which are included throughout this report.

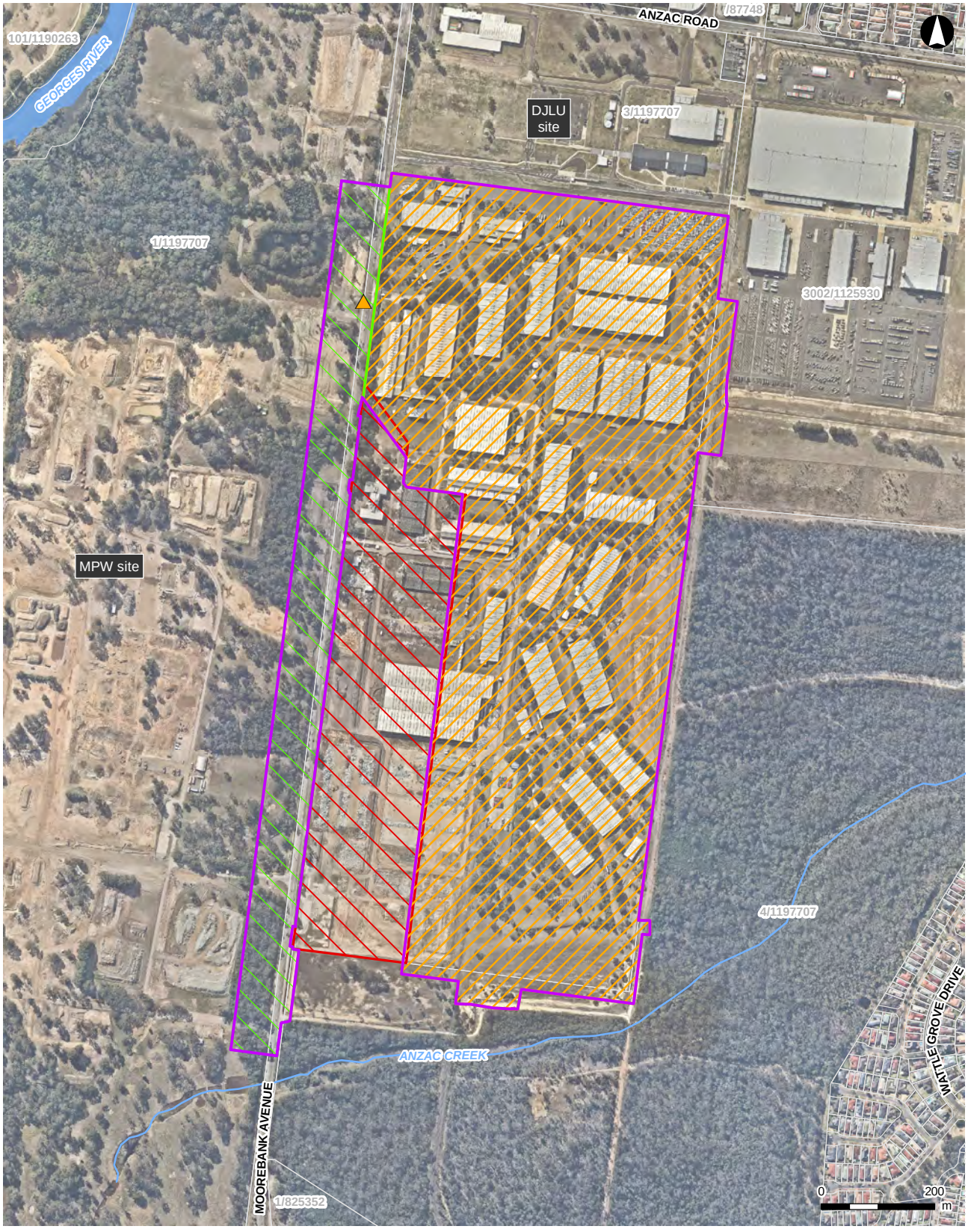
Table 1-4 Summary of key terms used throughout this document

Term	Definition
General terms	
The Moorebank Precinct	Refers to the whole Moorebank intermodal precinct, i.e. the MPE site and the MPW site
Moorebank Precinct West (MPW) Project (formerly the MIC Project)	The MPW Intermodal Terminal Facility as approved under the MPW Concept Plan Approval (SSD_5066) and the MPW EPBC Approval (No. 2011/6086).
Moorebank Precinct West (MPW) site (formerly the MIC site)	The site which is the subject of the MPW Concept Plan Approval, MPW EPBC Approval and MPW Planning Proposal. The MPW site does not include the rail link as referenced in the MPW Concept Plan Approval or MPE Concept Plan Approval.
Moorebank Precinct East (MPE) Concept Plan Approval (formerly the SIMTA Concept Plan Approval)	MPE Concept Plan Approval (SSD_0193) granted by the NSW Department of Planning and Environment on 29 September 2014 for the development of former defence land at Moorebank to be developed in three stages; a rail link connecting the site to the Southern Sydney Freight Line, an intermodal terminal, warehousing and distribution facilities and a freight village.
Moorebank Precinct East (MPE) Project (formerly the SIMTA Project)	The MPE Intermodal Terminal Facility, including a rail link and warehouse and distribution facilities at Moorebank (eastern side of Moorebank Avenue) as approved by the Concept Plan Approval (MP 10_0913) and the MPE Stage 1 Approval (14_6766).
Moorebank Precinct East (MPE) Site (formerly the SIMTA Site)	Including the former DSNDC site and the land owned by SIMTA which is subject to the Concept Plan Approval. The MPE site does not include the rail corridor, which relates to the land on which the rail link is to be constructed.

Term	Definition
Statement of Commitments (SoC)	Recommendations provided in the specialist consultant reports prepared as part of the MPE Concept Plan application to mitigate environmental impacts, monitor environmental performance and/or achieve a positive environmentally sustainable outcome in respect of the MPE Project. The Statement of Commitments have been proposed by SIMTA as the Proponent of the MPE Concept Plan Approval.
Biobank site	Land that is designated by a biobanking agreement to be a biobank site. The proposed biobank site referenced in this document includes three identified offset areas: the Wattle Grove Offset Area, Moorebank Offset Area, and Casula Offset Area.
Wattle Grove Offset Area	Located within the Boot land. An application for a biobanking agreement has been lodged with OEH to establish a biobank site which includes this offset area.
Moorebank Offset Area	Located on the eastern side of Georges River. An application for a biobanking agreement has been lodged with OEH to establish a biobank site which includes this offset area.
Casula Offset Area	Located on the western side of the Georges River. An application for a biobanking agreement has been lodged with OEH to establish a biobank site which includes this offset area.
MPE Stage 1 Project-specific terms	
Rail Corridor	Area defined as the 'Rail Corridor' within the MPE Concept Plan Approval.
Rail Link	The rail link from the South Sydney Freight Line to the MPE IMEX Terminal, including the area on either side to be impacted by the construction works included in MPE Stage 1.
MPE Stage 1	Stage 1 (14-6766) of the MPE Concept Plan Approval for the development of the MPE Intermodal Terminal Facility, including the rail link at Moorebank. This reference also includes associated conditions of approval and environmental management measures which form part of the documentation for the approval.
MPE Stage 1 site	Includes the MPE Stage 1 site and the Rail Corridor, i.e. the area for which approval (construction and operation) was sought within the MPE Stage 1 Proposal EIS.

Term	Definition
MPE Stage 2 specific terms	
MPE Stage 2 Proposal/ the Proposal	The subject of the BAR prepared to accompany the EIS; being Stage 2 of the MPE Concept Plan Approval including the construction and operation of 300,000m^2 of warehousing and distribution facilities on the MPE site and the Moorebank Avenue upgrade within the Moorebank Precinct.
MPE Stage 2 Amended Proposal/the Amended Proposal	The subject of this BAR), being the Stage 2 for the construction and operation of 300,000m^2 of warehousing and distribution facilities on the MPE site and the Moorebank Avenue upgrade within the Moorebank Precinct. This proposal includes all of the amendments undertaken as part of the RtS (refer to Section 1.2, above). For the purpose of this assessment, the area of impact assessed in this BAR (i.e. the amended proposal site) is consistent with the definition of "development site" that would be assessed by a FBA Assessment
The Amended Proposal site/ development site [1]	The area within the MPE site which would be disturbed by the MPE Stage 2 Amended Proposal (including the operational area and construction area). The MPE Stage 2 site includes the former DSNDC site and the land owned by SIMTA which is subject to the MPE Concept Plan Approval.
The Moorebank Avenue site	The extent of construction works to facilitate the construction of the Moorebank Avenue upgrade (Figure 1-3).
The Moorebank Avenue upgrade	Raising of the vertical alignment of Moorebank Avenue for 1.5 kilometres of its length by about two metres, from the northern boundary of the MPE site to approximately 120 metres south of the MPE site. The Moorebank Avenue upgrade also includes upgrades to intersections, ancillary works and the construction of an on-site detention basin to the west of Moorebank Avenue within the MPW site.
Construction area	Extent of construction works, namely areas to be disturbed during the construction of the MPE Stage 2 Amended Proposal (the Amended Proposal).
Operational area	Extent of operational activities for the operation of the MPE Stage 2 Amended Proposal (the Amended Proposal).

[1] Under the FBA, the area subject to impact assessment is referred to as the 'development site'. In this assessment, the development site is considered to encompass the MPE Stage 2 site and construction area as shown on Figure 1-2. For the purpose of this report the term MPE Stage 2 site has been used.



LEGEND

- MPE Stage 2 site
- Amended Proposal site
- Moorebank Avenue Site
- MPE Stage 1 operational area
- Site access
- Cadastre (NSW DFSI, 2017)
- Watercourse

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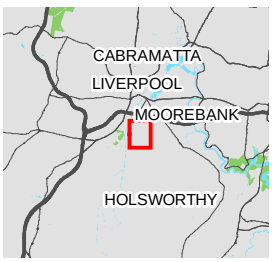

Figure 1-2 Overview of the Proposal

LEGEND

- MPE Stage 2 site
- Amended Proposal site
- Moorebank Avenue Site
- MPE Stage 1 operational area
- Site access
- Cadastre (NSW DFSI, 2017)
- Watercourse

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SIMTA

Figure 1-3 Overview of the Moorebank Avenue site

2 SITE DESCRIPTION

2.1 Regional context

The Amended Proposal site (comprising the MPE Stage 2 site and the Moorebank Avenue site) is located approximately 27 km south-west of the Sydney Central Business District (CBD) and approximately 26 km west of Port Botany. The MPE site is situated within the Liverpool Local Government Area (LGA), in Sydney's South West subregion, approximately 2.5 km from the Liverpool City Centre.

The Amended Proposal site is located approximately 800 m south of the intersection of Moorebank Avenue and the M5 Motorway. The M5 Motorway provides the main road link between the Amended Proposal site, and the key employment and industrial areas within Sydney's West and South-Western subregions, the Sydney orbital network and the National Road Network. The M5 connects with the M7 Motorway to the west, providing access to the Greater Metropolitan Region and NSW road network. Similarly, the M5 Motorway is the principal connection to Sydney's north and north-east via the Hume Highway. The regional context of the Amended Proposal is shown on Figure 2-1.

2.2 Local context

The Amended Proposal site is located approximately 2.5 km south of the Liverpool City Centre, 800 m south of the Moorebank Avenue/M5 Motorway interchange and one kilometre to the east of the SSFL providing convenient access to and from the site for rail freight (via a dedicated freight rail line) and for trucks via the Sydney Motorway Network.

The majority of the land surrounding the Amended Proposal site is owned and operated by the Commonwealth and comprises:

- The MPW site, formerly the School of Military Engineering (SME), on the western side of Moorebank Avenue directly adjacent to the MPE site (subject to the MPW Concept Plan Approval)
- The Holsworthy Military Reserve, to the south of the MPE site on the southern side of the East Hills Rail Corridor, which is owned and operated by Sydney Trains.

Residual Commonwealth Land (known as the Boot Land), to the east of the Amended Proposal site between the site boundary and the Wattle Grove residential area.

Glenfield Waste Services, south-west of the Amended Proposal is proposing to develop a Materials Recycling Facility on land owned by the Glenfield Waste Services Group within the boundary of the current landfill site at Glenfield. The facility is proposed to recycle a maximum of 450,000 tonnes of material per year. The Glenfield Waste Services Proposal is the subject of a DA (SSD_6249) under Part 4, Division 4.1 of the EP&A Act.

The area immediately south of the MPE site, known as the 'Southern Boot Land', includes an existing rail spur within heavily vegetated remnant bushland. The Southern Boot Land to the south of the Amended Proposal and forming part of the MPE Stage 1 Proposal site includes a range of vegetation, varying from remnant bushland to the north-east of the Sydney Trains East Hills Rail Corridor.

A number of residential suburbs are located in proximity to the Amended Proposal site. The approximate distances of these suburbs to the MPE Stage 2 site and the Moorebank Avenue site are provided in Table 2-1 below.

Table 2-1 Distance to residential suburbs from the Amended Proposal site

Suburb	Distance to MPE Stage 2 site	Distance to Moorebank Avenue site
Wattle Grove	360 m to the north-east	865 m to the north-east
Moorebank	1300 m to the north	1430 m to the north
Casula	820 m to the west	760 m to the west
Glenfield	1830 m to the south-west	1540 m to the south-west

The closest industrial precinct to the Amended Proposal is at Moorebank, comprising around 200 hectares of industrial development. This area includes (but is not limited to) the Yulong and ABB sites to the south of the M5 Motorway and the Goodman MFive Business Park and Miscellaneous industrial and commercial development to the north of the M5 Motorway. The majority of this development is located to the north of the M5 Motorway between Newbridge Road, the Georges River and Anzac Creek. The Moorebank Industrial Area supports a range of industrial and commercial uses, including freight and logistics, heavy and light manufacturing, offices and business park developments.

There are other areas of industrial development near the Amended Proposal at Warwick Farm to the north, Chipping Norton to the north-east, Prestons to the west and Glenfield and Ingleburn to the south-west.

The local context of the Amended Proposal is shown on Figure 2-2.

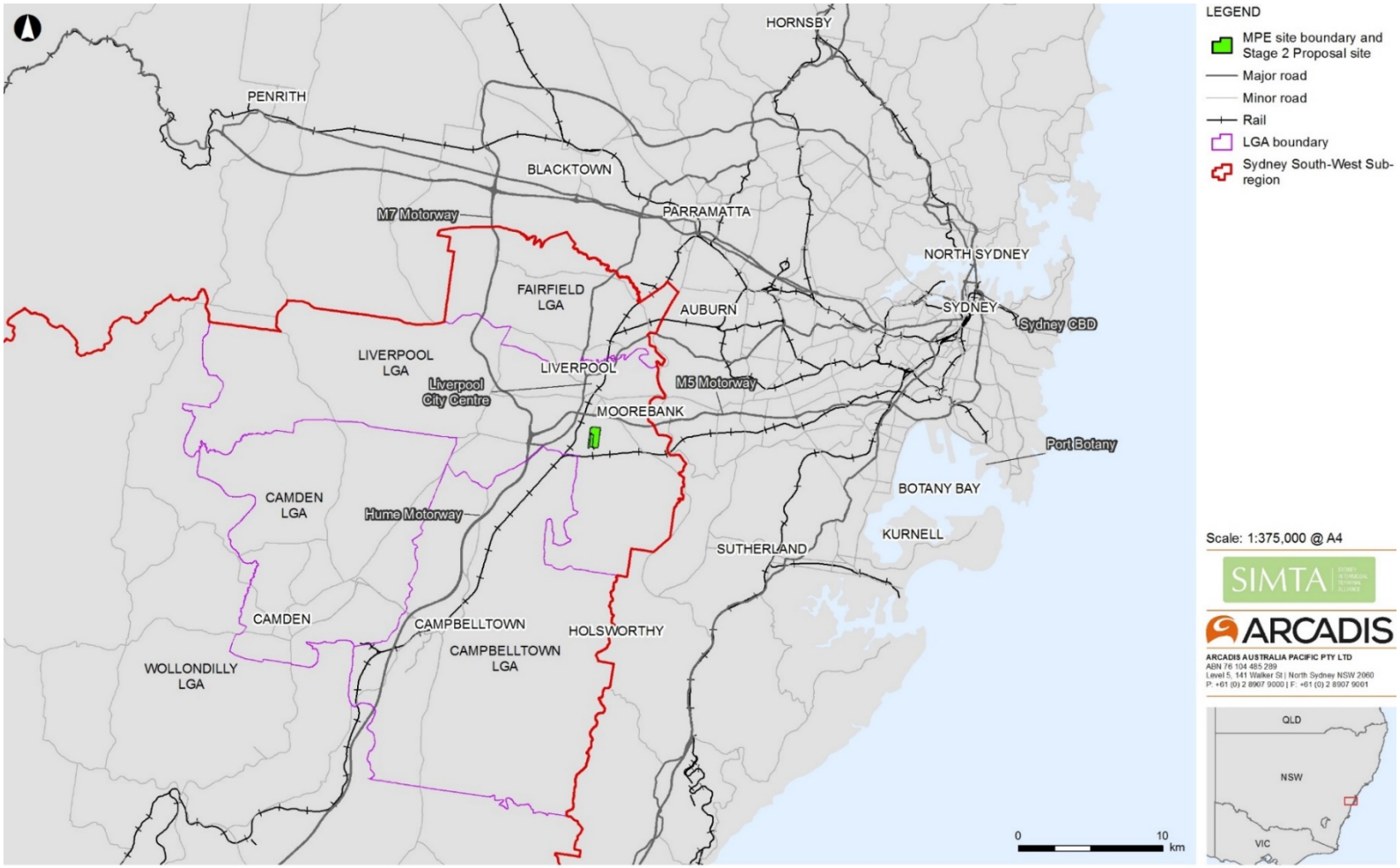
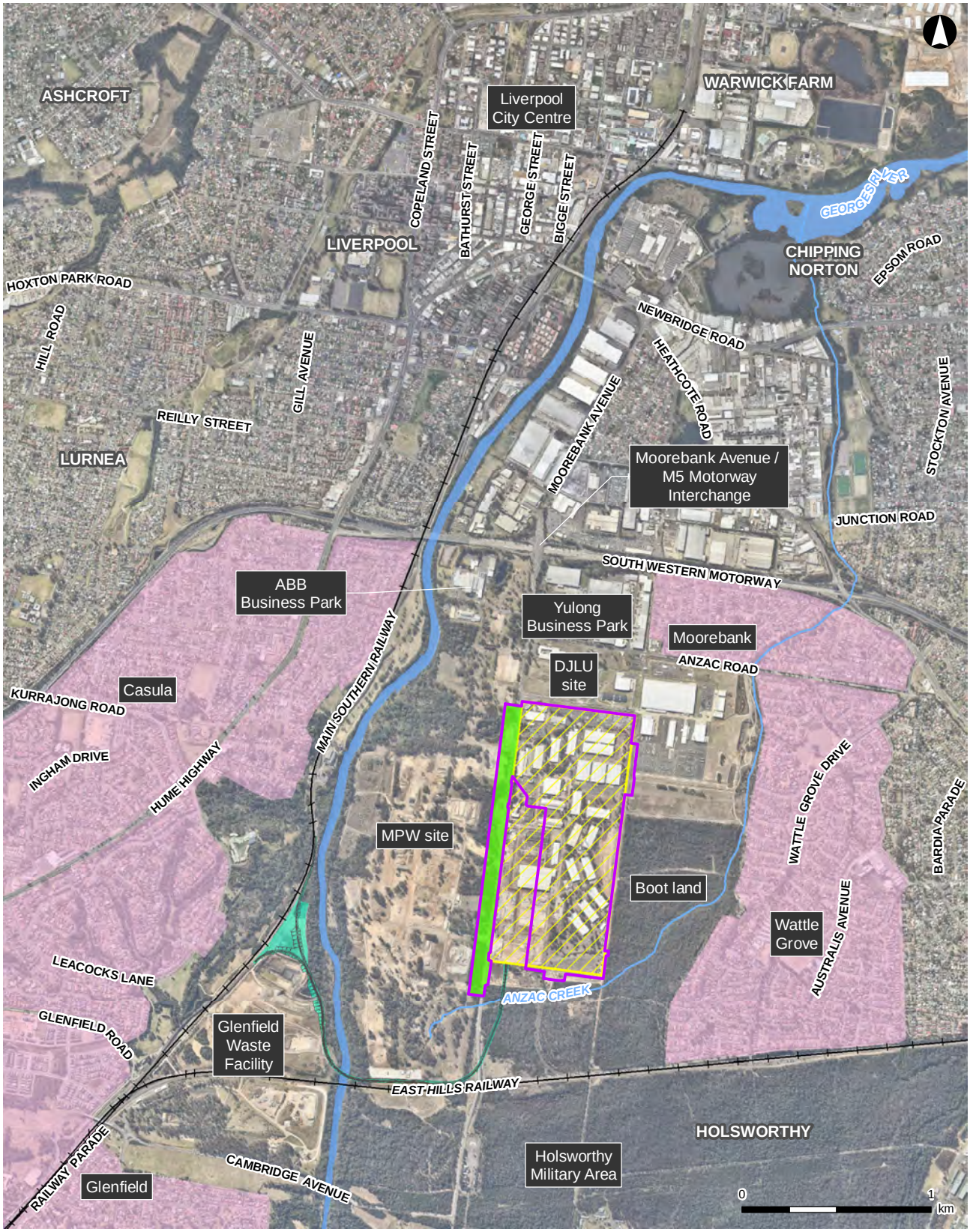


Figure 2-1 Regional context of the Amended Proposal



LEGEND

- MPE site
- Amended Proposal site
- Moorebank Avenue Site
- Rail Link (including 20m width and variable buffer)
- Residential area
- Rail link (Stage 1 Proposal)
- Existing railway
- Watercourse

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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (August, 2017)

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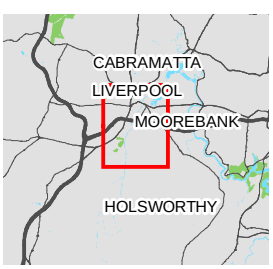


Figure 2-2 Local context of the Amended Proposal

3 LEGISLATION AND POLICY

3.1 Commonwealth Environment Protection and Biodiversity Conservation Act 1999

The Commonwealth Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (MNES). MNES identified in the Act include:

- World heritage properties.
- National heritage places.
- Wetlands of international importance (listed under the Ramsar Convention).
- Threatened species and communities.
- Migratory species protected under international agreements.
- Commonwealth marine areas.
- The Great Barrier Reef Marine Park.
- Nuclear actions (including uranium mines).

In accordance with sections 67 and 67A of the EPBC Act, any works that have the potential to result in an impact on any MNES or on Commonwealth land are considered 'controlled actions' and require a referral to the Federal Minister for the Environment for approval. The MPE Project was determined to be a controlled action under the EPBC Act, as a result of the project's impacts on listed threatened species and communities and Commonwealth land. The MPE Project was granted approval as a controlled action under the EPBC Act in March 2014 (EPBC 2011/6229), subject to conditions.

3.2 NSW Environmental Planning and Assessment Act 1979

On 29 September 2014 Concept Plan Approval was granted, under Part 3A (Transitional), Section 75O of the EP&A Act for the "use of the site [Project Site] as an intermodal facility, including a Rail link to the Southern Sydney Freight Line within an identified Rail Corridor, warehouse and distribution facilities, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works".

Notwithstanding this, as indicated in the Conditions of Approval, this Concept Plan Approval does not permit the construction or operation of any part of the MPE Project, which is subject to obtaining subsequent development consent under the EP&A Act. The Concept Plan Approval states that approval to carry out the MPE Project is subject to an application and approval under Part 4, Division 4.1 of the EP&A Act and the environmental assessment requirements specified in Schedule 3 of the Conditions of Approval. These are presented in Table 1-2.

3.2.1 NSW Biodiversity Offsets Policy for Major Projects and the Biodiversity Offsets Scheme

The *NSW Biodiversity Offsets Policy for Major Projects* was released in October 2014 and is applicable to projects that are SSD or State Significant Infrastructure (SSI) under the EP&A Act. The NSW Biodiversity Offsets Policy for Major Projects requires proponents to apply the *Framework for Biodiversity Assessment* (FBA) to assess impacts on biodiversity. The FBA also guides the identification of reasonable measures and strategies that can be taken to avoid and minimise impacts on biodiversity associated with a proposal.

The Biodiversity Offsets Policy for Major Projects has recently been replaced by the Biodiversity Offsets Scheme, which was established by the *Biodiversity Conservation Regulation 2017* commencing on 25 August 2017. The Biodiversity Offsets Policy for Major Projects and the FBA are still relevant for savings and transitional arrangements, including for all development applications (DAs) for which SEARs have been issued. The SEARs for the Amended Proposal (SSD-7628) were issued prior to 25 August 2017, and the Amended Proposal has been assessed in accordance with the Biodiversity Offsets Policy for Major Projects and the FBA, as required by the SEARs.

3.3 NSW *Threatened Species Conservation Act 1995* and *Biodiversity Conservation Act 2016*

The NSW *Threatened Species Conservation Act 1995* (TSC Act) provides for the protection and management of threatened species, populations and ecological communities listed under schedules 1, 1A and 2 of the Act. The purpose of the TSC Act is to:

- Conserve biological diversity and promote ecologically sustainable development.
- Prevent the extinction and promote the recovery of threatened species, populations and ecological communities.
- Protect the critical habitat of those species, populations and ecological communities that are endangered.
- Eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities.
- Ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed.
- Encourage the conservation of threatened species, populations and ecological communities through co-operative management.

The TSC Act was repealed on 25 August 2017 and replaced with the *Biodiversity Conservation Act 2016* (BC Act). The BC Act broadly incorporates similar objectives to those identified the TSC Act, and additionally seeks to establish a framework for assessment and offsetting of development impacts as well as investment in biodiversity conservation.

As described in section 3.2.1, the Biodiversity Offsets Policy for Major Projects and the FBA are still relevant for savings and transitional arrangements, under which this BAR falls. Accordingly, the Amended Proposal has been assessed in accordance with the Biodiversity Offsets Policy for Major Projects and the FBA, as required by the SEARs, and outlines the corresponding offsetting requirements.

4 METHODOLOGY

4.1.1 Database Interrogation

Database searches were undertaken to identify State records of threatened entities under the TSC Act and *Fisheries Management Act 1991* (FM Act). Databases interrogated for this purpose were:

- The NSW Threatened Species Profile Database (TSPD) which is managed by OEH.
- The Vegetation Information System (VIS) classification database which is managed by OEH.
- The over-cleared landscapes database (Mitchell landscapes)
- The Directory of Important Wetlands of Australia (DIWA), maintained by the Australian Government.

4.1.2 Literature/mapping review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the Amended Proposal site and wider region. Reports, vegetation maps, topographic maps, aerial photography and literature reviewed included, but were not limited to, the following:

- *Soil Landscapes of the Penrith 1:100 000 Sheet* (Bannerman & Hazelton 1990).
- *Assessment of the Sydney Intermodal Terminal Facility, Moorebank: Aquatic Ecology* (ALS 2011)
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (OEH 2013).
- *SIMTA Stage 1: Biodiversity Assessment Report* (Hyder Consulting 2015)
- *Moorebank Intermodal Terminal Project Ecological Impact Assessment* (Parsons Brinckerhoff 2014).
- *Framework for Biodiversity Assessment credit report.* Appendix A of Appendix C of the Moorebank Intermodal Terminal Response to Submissions Report (Parsons Brinckerhoff 2015a).
- *Moorebank Intermodal Terminal: Biodiversity Offset Areas Biodiversity Assessment Report* (Parsons Brinckerhoff 2015b).
- *Boot Land', Moorebank, NSW Ecological Impact Assessment of Remediation* (GHD 2015)
- *MPE Stage 1 Biodiversity Assessment Report* (updated) (Arcadis 2017a).
- *Moorebank Precent West-Stage 2 Proposal Biodiversity Assessment Report* (Arcadis 2016).

4.1.3 Previous biodiversity assessments of relevance

A number of biodiversity surveys and assessments have been carried out across the MPE site and MPW site, including across areas that fall within the Moorebank Avenue site.

MPE site

The biodiversity impacts of the MPE Concept Plan and MPE Stage 1 Project were assessed in an Ecological Impact Assessment (Hyder Consulting 2013) prepared for the MPE Concept Plan EIS, and an assessment of values under the NSW Framework for Biodiversity Assessment (FBA) prepared for the MPE Stage 1 EIS (Hyder Consulting 2015). The Biodiversity Assessment Report (BAR) prepared for the MPE Stage 1 Project was updated in September 2017 (Arcadis 2017a).

MPW site

The biodiversity impacts of MPW Concept Plan were assessed in an Ecological Impact Assessment (Parsons Brinckerhoff 2014), which was prepared to inform the *Moorebank Intermodal Terminal Project Environmental Impact Statement.* This assessment identified a diversity of biodiversity values within the MPW site, some of which fall within the Moorebank Avenue site. The survey effort (section 4.1.3) and results of surveys relevant to the Moorebank Avenue site (section 6 and 7) have been incorporated in this BAR.

A *Biodiversity Assessment Report* (BAR) was prepared by Arcadis (2016) to inform the *Moorebank Precent West-Stage 2 Proposal Environmental Impact Statement.* The BAR identified biodiversity values within the MPW site that were generally consistent with the results of the Ecological Impact Assessment (Parsons Brinckerhoff 2014) some of which fall within the Moorebank Avenue site. The survey effort (section 4.1.3) and results of surveys relevant to the Moorebank Avenue site (section 6 and 7) have been incorporated in this BAR.

4.1.4 Field assessment

Field assessment of the biodiversity values of the Amended Proposal site, Moorebank Avenue site (previously surveyed as part of the MPW site) and surrounding areas has been conducted on a number of occasions between November 2010 and November 2017. The dates, locations of the surveys and personnel who undertook these surveys on the Amended Proposal site, Moorebank Avenue site and adjoining areas are listed in Table 4-1.

Table 4-1 Dates, location and personnel for flora and fauna surveys

Date	Project/Proposal	Survey details/purpose	Personnel
MPE site surveys, including Amended Proposal			
2 May 2011 to 25 May 2011	MPE Concept Plan Approval (MP 10_0193)	Fauna surveys across the MPE Project study area, including Amended Proposal site.	Jane Rodd (Arcadis) Laura Hoffman (Arcadis)
30 May 2012 and 31 May 2012	MPE Concept Plan Approval (MP 10_0193)	Fauna surveys of the riparian corridor and disturbed lands on and adjoining the Glenfield Waste Facility	Jane Rodd (Arcadis) Laura Hoffman (Arcadis)
13,18, 26 and 27 November 2014	MPE Stage 1 Proposal (SSD 14-6766)	Revisiting the previous field survey plots within the MPE Concept Approval biodiversity study area (established during 2011-2012 surveys) to assess any changes to flora and fauna habitat since the field surveys that were carried out in 2011-2012; threatened species surveys in the Boot land.	Jane Rodd (Arcadis) Kate Carroll (Arcadis)
20 January and 11 March 2015	MPE Stage 1 Proposal (SSD 14-6766)	Targeted threatened flora surveys in the Boot land	Jane Rodd (Arcadis) Kate Carroll (Arcadis)
21 June 2016	MPE Stage 2 Proposal (SSD 7628)	Fauna habitat assessments, vegetation plots and targeted threatened flora surveys within the Amended Proposal site.	Jane Rodd (Arcadis) Laura Hoffman (Arcadis)
13 October 2016	MPE Stage 2 Proposal (SSD 7628)	Assessment of the trees within the Moorebank Avenue road reserve	Jane Rodd (Arcadis) Kate Carroll (Arcadis)
11 and 18 May 2017	MPE Stage 2 Proposal (SSD 7628)	Targeted threatened flora species surveys in areas within 30 metres of the eastern and southern	Jane Rodd (Arcadis)

Date	Project/Proposal	Survey details/purpose	Personnel
		boundary of the MPE site, to the east of the existing disused Defence rail spur	Kate Carroll (Arcadis)
24 and 26 October and 3 November 2017	MPE Stage 2 Proposal (SSD 7628)	Validation of February, March and May 2017 targeted threatened flora surveys, by carrying out surveys in flowering period of target species Reinspection and targeted threatened flora surveys within mown and slashed areas in the south of the Amended Proposal site and adjacent areas.	Jane Rodd (Arcadis)
MPW site surveys, relevant to Moorebank Avenue site			
8, 10 and 12 November 2010	MPW Concept Approval (SSD 5066)	Targeted threatened flora surveys, fauna surveys	Parsons Brinckerhoff (2014)
5 May to 23 May 2014	MPW Concept Approval (SSD 5066)	Assessment of the extent and condition of vegetation, vegetation plots	Parsons Brinckerhoff (2015a)
3 March 2016	MPW Stage 2 Proposal (SSD 7709)	Inspection of patches of native vegetation, with particular focus on the areas of potential additional impact within the Georges River riparian zone	Jane Rodd (Arcadis) Laura Hoffman (Arcadis)
9 and 14 February and 14 March 2017	MPW Stage 2 Proposal (SSD 7709)	Targeted threatened flora species surveys	Jane Rodd (Arcadis) Laura Hoffman (Arcadis) Kate Carroll (Arcadis)
3 November 2017	Moorebank Avenue (SSD 7268/SSD 7709))	Verification of threatened flora locations previously recorded	Jane Rodd (Arcadis) Meredith Leal (Arcadis)

Weather conditions at the time of surveys ranged from hot and sunny to cool and cloudy. The weather records from Holsworthy Aerodrome (station 06616) for the surveyed dates in 2016 and 2017 are as shown Table 4-2 (BOM 2016, 2017).

Table 4-2 Weather records from Holsworthy Aerodrome weather stations for the survey dates

Date	Temperature		Rain	Maximum wind gust	
	Min	Max		Direction	Speed
	°C	°C	mm		km/h
21 Jun 2016	11.9	17.4	0	Not available	Not available
13 Oct 2016	10.1	18.5	0	SSE	50
9 Feb 2017	19.8	34.6	14.2	NNW	35
14 Feb 2017	18.3	22.6	0	SSE	44
14 Mar 2017	20.8	25.0	1.6	E	41
11 May 2017	7.2	20.9	0	ESE	24
18 May 2017	8.6	21.3	0	E	31
24 Oct 2017	8.5	29.4	0.2	ENE	35
26 Oct 2017	15.4	23.7	1.8	E	31
3 Nov 2017	14.0	30.3	0	SE	44

Vegetation Plots

Quantitative (quadrat/transect) site surveys were undertaken on and adjacent to the Amended Proposal site in accordance with the guidelines in Section 5 of the FBA. The structure and floristics of each plant community present in the study area were sampled using a total of six 0.1 hectare quadrats. The quadrats were in the form of a 20 metre x 50 metre plot with a nested 20 metre x 20 metre plot (Figure 4-1).

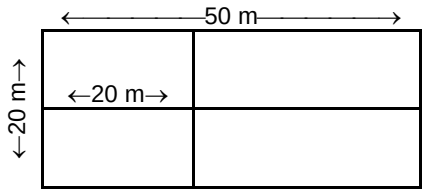


Figure 4-1 Flora quadrat layout

One of the flora quadrats used was sampled by Parsons Brinckerhoff (2015b) in the Boot land, as part of assessment of biodiversity credit value of proposed biodiversity offset areas. Quadrat 10 of Parsons Brinckerhoff (2015b) sampled vegetation close to the Amended Proposal site, and data from this quadrat was used to support the current assessment.

Four of the flora quadrats were sampled by Parsons Brinckerhoff (2015a) within or close to the areas of the MPW site that intersect the Moorebank Avenue site. Data from Quadrats 21, 27, 29 and 34 of Parsons Brinckerhoff (2015a) were used to support the current assessment.

The other flora quadrat used in the current assessment (QA) were sampled by Arcadis in June 2016. Plots should be randomly within each vegetation zone, however given the small size of vegetation fragments in the Amended Proposal site, there were limitations to where the plot could be located.

The quadrat locations are shown on Figure 4-2.

Floristic data were collected from each plot in accordance with the Table 1 of the FBA (Table 4-3).

Table 4-3 Data collected from vegetation plots

Variable	Data collected
Stratum (and layer)	Stratum and layer in which each species occurs
Growth form	Growth form for each recorded species
Species name	Scientific name and common name (where applicable)
Cover	A measure or estimate of the appropriate cover measure for each species recorded within the 20 m x 20 m plot. Recorded from 1–5% and then to the nearest 5%. If the cover of a species is less than 1% and the species is considered important, then the estimated cover is entered (e.g. 0.4)
Abundance rating	A relative measure of the number of individuals or shoots of a species within the 20 m x 20 m plot using the following intervals (numbers above about 20 are estimates only): 1,2,3,4,5,6,7,8,9,10,20,50,100,500,1000 or specify a number greater than 1000 if required

During the terrestrial flora survey the vegetation condition was assessed and rated according to the degree to which it resembled relatively natural, undisturbed vegetation. The initial condition assessment was based on visual assessment of the current habitat condition for each of the Plant Community Types (PCTs) identified in the study area.

Site attribute data were collected from each plot in accordance with Table 2 of the FBA (Table 4-4).

Table 4-4 Site attribute data collected from vegetation plots

Variable	Data collected
Indigenous plant species richness	Number of indigenous plant species within 20 m x 20 m plot
Native over-storey cover	Estimate of percent foliage cover at 10 points (every 5 m) along the 50 m transect
Native mid-storey cover	Estimate of percent foliage cover at 10 points (every 5 m) along the 50 m transect
Native ground cover (grasses)	At 50 points along the 50 m transect (every 1 m), recorded whether native grass intersects that point.
Native ground cover (shrubs)	At 50 points along the 50 m transect (every 1 m), recorded whether native ground cover (shrub) intersects that point.
Native ground cover (other)	At 50 points along the 50 m transect (every 1 m), recorded whether native ground cover (other) intersects that point.
Exotic plant cover	Measured as total percent foliage cover of all exotics in all strata; exotic cover measured using the same method as for native over-storey, mid-storey and ground cover.
Number of trees with hollows	Count of the number of living and dead trees within the 50 m x 20 m plot that have at least one hollow.
Regeneration	Measured as the proportion of over-storey species present in the zone that are regenerating (i.e. with diameter at breast height < 5 cm).
Total length of fallen logs	Total length of logs at least 10 cm in diameter and at least 0.5 m long.

The vegetation condition data obtained for each vegetation community in quadrats was used to obtain site attribute scores and given a weighting as per Table 2 in the FBA. The scores were assessed against the Vegetation Type Benchmarks for the identified vegetation types in the VIS classification database.

Tree survey

An assessment of trees on the MPE site was undertaken by Jane Rodd and Laura Hoffman in May 2011. Individual trees or groups of trees on the site were documented, with the species, approximate height, diameter at breast height and apparent health noted. Health was assessed by inspection of the tree canopy for dead limbs or diseased/dying leaves, signs of stress including epicormic reshooting, and evidence of bark disease or fungal infection. Tree health was assessed using the following measures:

- Good: Almost all branches living, no evidence of disease or stress.
- Moderate: Some dead branches in canopy, minor bark disease or fungal infestation.
- Poor: Numerous dead branches or limbs, significant bark disease or fungal infestation, signs of stress and/or senescence.

Assessment of the trees within the Moorebank Avenue road reserve was conducted by Jane Rodd and Kate Carroll on 13 October 2016.

Targeted threatened species surveys

MPE Stage 2 site

Targeted surveys for threatened flora species for species listed in Table 4-5 were undertaken in the following areas, as shown on Figure 4-2:

- Areas of marginal potential habitat in the south of the MPE Stage 2 site, using random meanders, within vegetation quadrats and using parallel transects.
- Within 30 m of the eastern boundary of the MPE Stage 2 site where it adjoins the Boot land, and within 30 m of the portion of the Boot land south of the MPE Stage 2 site that adjoins the fenceline to the south of the Amended Proposal.
- Areas of potential suitable habitat, comprising areas mapped as Castlereagh Scribbly Gum Woodland and Castlereagh Swamp Woodland, within the Moorebank Avenue site.

Targeted threatened flora surveys were conducted by Arcadis ecologists on 21 June 2016, 11 and 18 May 2017 and 24 and 26 October 2017 in and adjoining the MPE Stage 2 site.

The surveys were undertaken via walking parallel transects spaced approximately 5 m apart in dense bushland, and approximately 10 metres apart in cleared areas and open grassland. Where threatened flora species were detected, the number of individuals were recorded and GPS point locations captured. Surveys of *Grevillea parviflora* subsp. *parviflora* counted the number of stems, not individuals.

Table 4-5 Threatened flora species targeted in surveys

Scientific name	Common name	TSC Act status	EPBC Act status
Acacia bynoeana	Bynoe's Wattle	Endangered	Vulnerable
Acacia pubescens	Downy Wattle	Vulnerable	Vulnerable
Grevillea parviflora subsp. *parviflora*	Small-flowered Grevillea	Vulnerable	Vulnerable
Hibbertia fumana	-	Critically Endangered (provisional listing)	Not listed
Hibbertia puberula subsp. *puberula*	-	Endangered	Not listed
Persoonia nutans	Nodding Geebung	Endangered	Endangered

Moorebank Avenue site

The Moorebank Avenue site has been previously surveyed by Parsons Brinckerhoff in 2014 (to inform the *Moorebank Intermodal Terminal Project Environmental Impact Statement)* and by Arcadis in 2017 to inform *Moorebank Precent West-Stage 2 Proposal Environmental Impact Statement.*

More recently, targeted threatened flora surveys were conducted by Arcadis ecologists on 9 and 14 February 2017 and 14 March 2017 in the Moorebank Avenue site. The surveys were undertaken via walking parallel transects spaced approximately 5 m apart in dense bushland, and approximately 10 metres apart in

cleared areas and open grassland. Where threatened flora species were detected, the number of individuals were recorded and GPS point locations captured. Surveys of *Grevillea parviflora* subsp. *parviflora* counted the number of stems, not individuals.

The Moorebank Avenue site was revisited on 3 November 2017 to validate previous identifications of *Hibbertia* species that occur in the Moorebank Avenue site.

Identification of *Hibbertia* species

The threatened *Hibbertia* species in the Boot land are known to flower mainly from September to December, and surveys undertaken in May 2017 were outside the known flowering period. *Hibbertia* spp. recorded in May 2017 surveys were identified by examining remnant fruiting and flowering material still attached to plants, which were present on almost all plants detected. One of the *Hibbertia puberula* subps. *puberula* plants recorded in May 2017 was in flower at the time of surveys, and could be more reliably identified.

The identifications of *Hibbertia* spp. made in May 2017 were validated by the October-November 2017 surveys, during the species' flowering period, in accordance with FBA requirements. Most of the *Hibbertia* spp. in the Boot land to the east of the Amended Proposal site was not in flower at the time of the October surveys; microscopic examination of stems and leaves in situ found plants had only simple hairs, and not the stellate hairs typical of *Hibbertia fumana. Hibbertia* spp. recorded to the south of the Amended Proposal site and within the Amended Proposal site were in bud, with some in flower, and could be readily identified as *Hibbertia puberula* subsp. *puberula* based on the presence of 10-14 stamens and distinctively ridged and beaked calyx lobes. The species was not in flower on the Moorebank Avenue site during November surveys, but numerous plants were in bud and specimens were examined using a microscope to confirm their identification as *Hibbertia puberula* subsp. *puberula*.

Fauna habitat assessment

Components of fauna habitat were assessed using 20 x 20m quadrats, randomly located across the Amended Proposal site. Data collected included:

- Structure and floristics of vegetation
- Surface drainage features
- Rocky features
- Abundance and type of tree and log hollows
- Foraging resources
- Microhabitats.

Fauna surveys

MPE Stage 2 site

Numerous fauna field surveys were conducted between 2011 and 2014 (Table 4-1), including targeted surveys for those threatened species considered likely to occur. The entire Amended Proposal site was traversed on foot and all species and evidence of fauna presence observed was recorded. An inventory of fauna species recorded in the Amended Proposal site was compiled. Fauna survey locations are identified on

Figure 4-2. The Amended Proposal site was visited again in June 2016 to assess any change to habitat condition.

Diurnal fauna surveys involved:

- Direct visual observations of animal activity
- Aural recognition of bird and frog calls
- Raking leaf litter and turning logs, rocks and other debris
- Inspecting tree hollows, logs and built structures, including under bridges and culverts where access was possible
- Searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings)

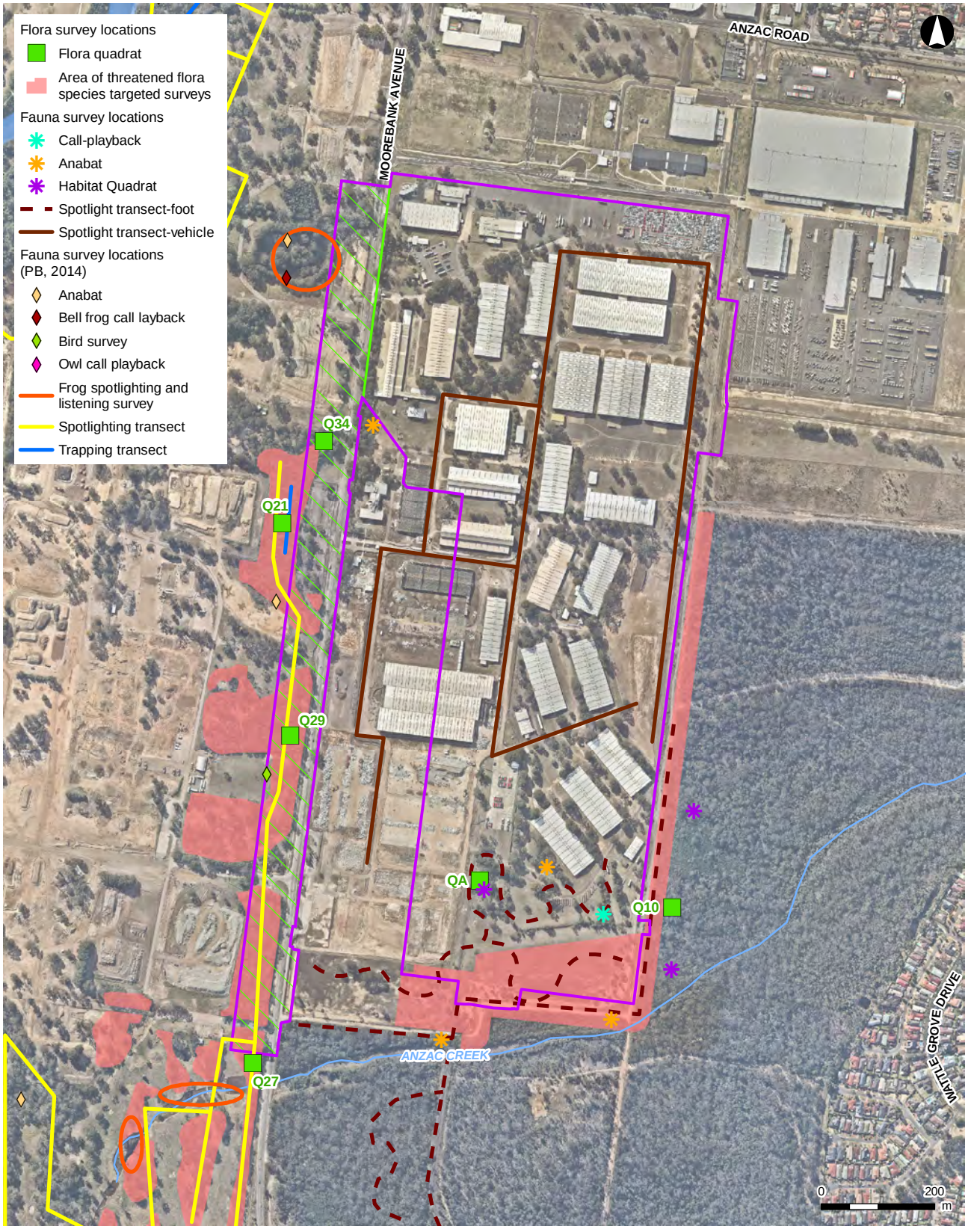
Nocturnal surveys involved:

- Spotlighting from a vehicle and along foot traverses for direct visual observations of animal activity. Spotlight effort comprised of 16 person hours across four nights during the survey period.
- Call-playback for aural recognition of threatened owls and frogs at one site within the study area, on each of four nights during the survey period. Upon arrival, listening for vocalisations for 10 minutes was undertaken. Calls were played intermittently for 15 minutes, followed by another listening period of 10 minutes.
- Searching microhabitats, including turning logs and rocks and searching fringing vegetation of waterbodies.
- Stationary placement of ultrasonic bat call detection equipment (Anabats) in potential flyways. Anabats were placed overnight in four locations within or immediately adjacent to the MPE site during the survey periods.

Moorebank Avenue site

Numerous flora and fauna field surveys were conducted in 2010 as part of the original MPW Environmental Impact Assessment (Parsons Brinckerhoff 2011) prepared for the MPW Concept Approval (SSD 5066), including targeted fauna surveys for those threatened species considered likely to occur. The surveys, relevant to the Moorebank Avenue site included:

- Bird surveys. a point surveys whereby all birds observed from a single point were noted for a set period of time (minimum 30 minutes).
- Spotlighting undertaken along a single transect by two persons on foot, each using a handheld 100 Watt spotlight. Spotlighting was used to target arboreal, flying and large ground-dwelling mammals, as well as nocturnal birds, reptiles and amphibians.
- Opportunistic observations.



LEGEND

- Amended Proposal site
- Moorebank Avenue site
- Watercourse

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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (August, 2017)

1:10,000 at A4

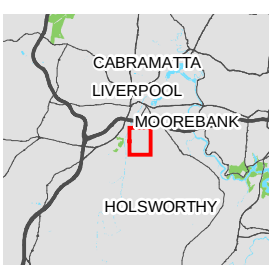


Figure 4-2 Flora and fauna survey locations on the Amended Proposal site

5 LANDSCAPE ASSESSMENT

5.1 Landscape regions

Bioregions and landscapes associated with the Amended Proposal site and outer assessment circle are mapped in Figure 5-1.The Amended Proposal site is located within the Sydney Basin Bioregion and the Cumberland Subregion classified under IBRA (Interim Biogeographic Regionalisation for Australia).

The Amended Proposal site is located within the Sydney Metropolitan Catchment Management Authority (CMA) Area and the Cumberland CMA subregion.

The Amended Proposal site is located within the Georges River Alluvial Plain Mitchell landscape. This Mitchell Landscape is not currently listed in the credit calculator, so the Cumberland Plain Mitchell Landscape was used following advice from OEH (pers. comm. Biobanking Team, OEH, 25 August 2015).

5.2 Assessment circles

Two assessment circles were mapped to enable assessment of landscape values, including the percent current extent of native vegetation cover within and adjacent to the Amended Proposal site. In accordance with the allowable combinations of inner and outer assessment circles in Table 8 of the FBA, an inner circle of 100 hectares and an outer circle of 1000 hectares were used. Both circles were centred on the Amended Proposal site (Figure 5-1).

5.3 Rivers, streams and wetlands

The Amended Proposal site is located within the Georges River catchment, covering approximately 960 square kilometres and managed by the Sydney Metropolitan CMA. Georges River is located between 600 metres to one kilometre west of the Amended Proposal site, where it flows to the north then meanders south-east from Chipping Norton before draining into Botany Bay.

Anzac Creek originates from the MPW site west of Moorebank Avenue and extends to the north-east, to the south of the Amended Proposal site; at its closest point, it is located approximately 70 metres from the south-eastern corner of the Amended Proposal site. The creek flows north past the adjoining suburbs of Wattle Grove and Moorebank before draining into Lake Moore in Chipping Norton, which flows into the Georges River. The section of Anzac Creek to the south of the Amended Proposal site is considered to be a 3rd order stream.

In addition to these named watercourses, there is a network of formalised drainage channels located in the south of the Amended Proposal site. These channels drain into the native vegetation to the east of the MPE site.

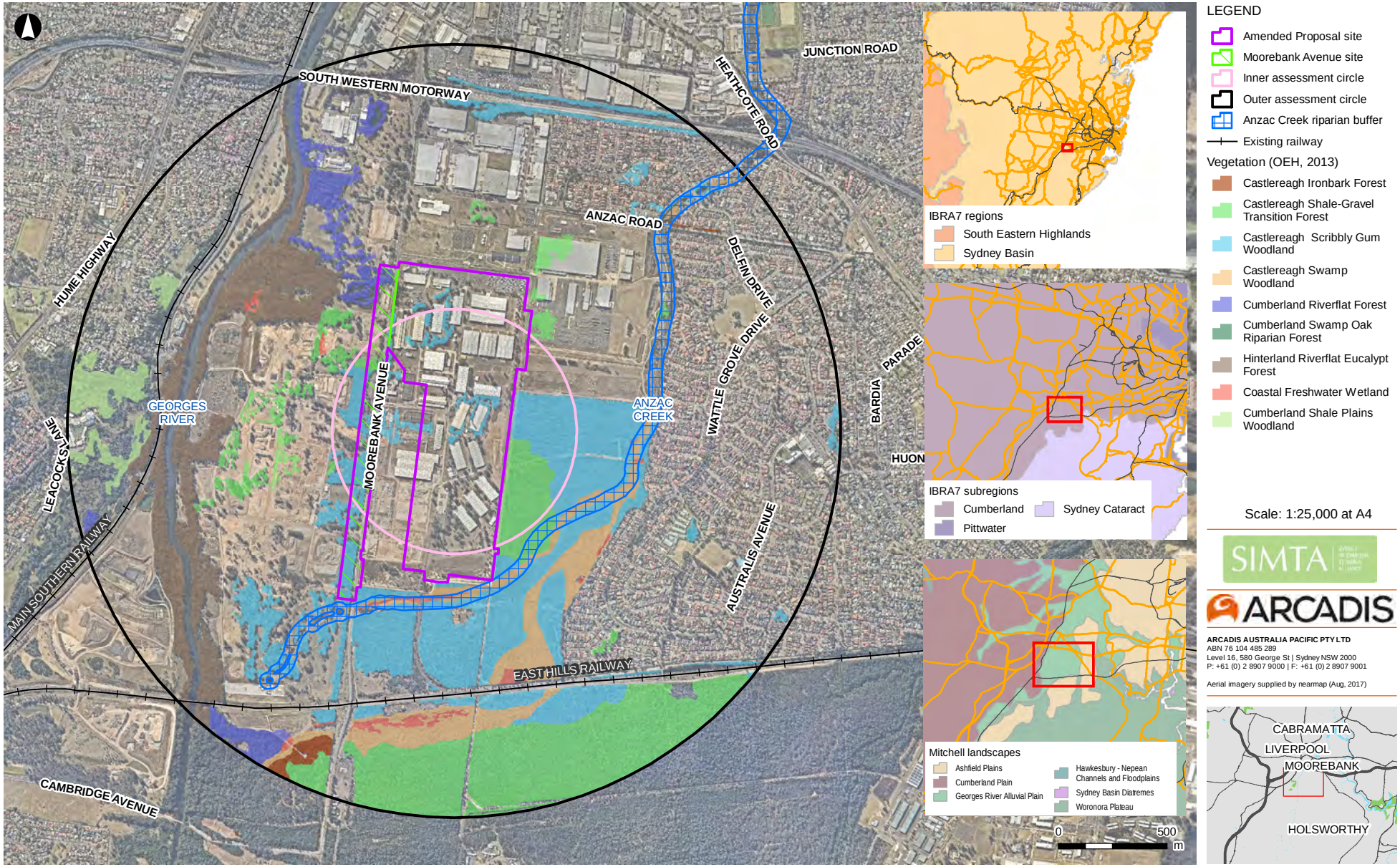


Figure 5-1 Landscape Assessment

Date: 3/11/2017 Path: \\hc-aus-ns-fs-01\jobs\AA008765\L-GIS\A_Current\B_Maps\MPES2\MPES2_BAR_RtS\SIMTA_MPES2_BAR_RtS_006_LandscapeAssessment_A4L_v2.mxd
Created by : CC
QA by : CA

No local or important wetlands occur in the outer assessment circle. Watercourses and wetlands in the locality are mapped in Figure 5-2.

5.4 Landscape Value Score

The landscape value has been calculated from the site-based methodology outlined in Appendix 4 of the FBA (OEH 2014) by determining the following:

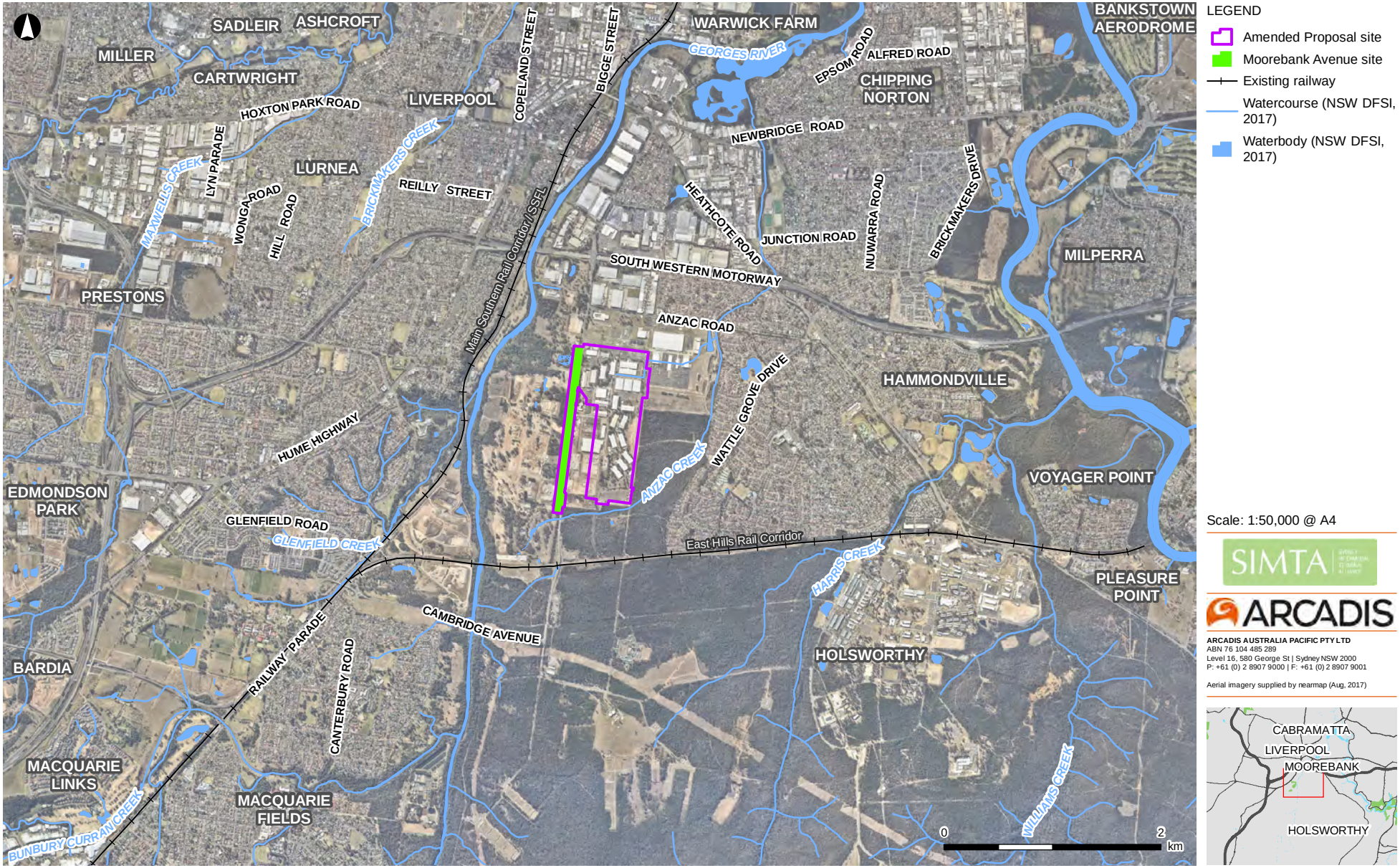
1. Percent native vegetation cover in the landscape – percentage of all land within the inner and outer assessment circles that contains native vegetation is to be calculated for the current extent of cover and future extent of cover once clearing for the development has occurred.
2. Connectivity value – the value determined by identifying connecting links and state or regional biodiversity links. Where the development will impact on more than one connecting link, a connectivity value must be determined for each link based on the linkage widths and conditions. State significant biodiversity links have a connectivity value of 12 and regionally significant biodiversity links have a connectivity value score of 9.
3. Patch size score – determined from the percentage of native vegetation that has been cleared within the Mitchell landscape in which most of the development occurs and the patch size class. The patch size class considers the largest patch of native vegetation occurring within or connecting to the Amended Proposal site and attributing a size class between nil or small to extra large, dependent on the size of the patch in hectares and the percentage of native vegetation cleared.

A discussion of each of these determining factors in relation to the Amended Proposal site is provided below.

5.4.1 Native vegetation cover in landscape

The native vegetation cover in the landscape was determined with reference to the regional vegetation mapping by OEH (2013). All native vegetation types mapped by OEH (2013) within the inner and outer assessment circles were considered to represent the current native vegetation cover. The future native vegetation cover was determined by subtracting the area of native vegetation to be cleared for the Amended Proposal from the current summed native vegetation cover in each circle. Native vegetation cover percentages were calculated as a proportion of all land within each assessment circle that contains native vegetation.

The current and future percentage of native vegetation cover in the inner and outer assessment circles has been provided in Table 5-1. Scores for each percent cover were then determined using the score criteria in Table 9, Appendix 4 of the FBA.



LEGEND

- Amended Proposal site
- Moorebank Avenue site
- Existing railway
- Watercourse (NSW DFSI, 2017)
- Waterbody (NSW DFSI, 2017)

Scale: 1:50,000 @ A4

SIMTA

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Aerial imagery supplied by nearmap (Aug, 2017)

Figure 5-2 Watercourses and waterbodies

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Created by : CC
QA by : CA

Table 5-1 Scores for the assessment of landscape value

Criteria	Assessment Circle	% cover	Score
Current native vegetation cover	Inner assessment circle	25-30	4.5
	Outer assessment circle	25-30	7.5
Future native vegetation cover	Inner assessment circle	25-30	4.5
	Outer assessment circle	25-30	7.5

5.4.2 Connectivity value

One connecting link has been identified immediately adjacent to the Amended Proposal site, in the 'Boot land'. The vegetation in this area represents native vegetation in moderate to good condition, has a patch size greater than one hectare and minimal cleared or hostile land features between patches of vegetation.

The Amended Proposal has very minor overlap with areas of vegetation in the Boot land, and would not alter the existing connectivity values, further sever native vegetation or form a hard barrier within the connecting link.

5.4.3 Patch size

The largest patches of native vegetation occurring within the Amended Proposal site are those adjoining the western side of Moorebank Avenue. The Amended Proposal site overlaps a very small (0.05 hectare) area within the 83 hectare patch of native vegetation in the Boot land. Both these patches, or groups of patches, connect to larger areas of bushland within Holsworthy Military Area to the south, which comprises approximately 18,000 hectares of continuous native vegetation. As such, the vegetation in the Amended Proposal site has been assigned the maximum patch size of 1,001 hectares. In accordance with the criteria in Table 15 of Appendix 4 of the FBA, the patch size class is considered to be *very large* with a corresponding patch size score of 12.

6 NATIVE VEGETATION

6.1 Mapped vegetation communities

OEH (2013) mapped the vegetation of the Sydney Metropolitan CMA Area. The Sydney CMA Area encompasses the eastern portions of the Sydney Metropolis, extending from the coastline to the catchments that flow to the Parramatta, Georges and Hacking River.

Nine different native vegetation communities were mapped within the outer assessment circle (Figure 5-1\) and are listed in Table 6-4. All of these communities correspond to TECs as noted in Table 6-1.

Table 6-1 Vegetation communities mapped by OEH (2013) and corresponding TECs

Vegetation map unit (DECCW 2009)	Corresponding TEC	EPBC Act Status	TSC Act Status
Castlereagh Ironbark Forest	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Critically Endangered	Endangered
Castlereagh Shale-gravel Transition Forest	Shale/Gravel Transition Forest in the Sydney Basin bioregion	Critically Endangered	Endangered
Castlereagh Scribbly Gum Woodland	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Endangered	Vulnerable
Castlereagh Swamp Woodland	Castlereagh Swamp Woodland Community	Not listed	Endangered
Coastal Freshwater Wetland	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Cumberland Riverflat Forest	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Cumberland Swamp Oak Riparian Forest	Swamp Oak Floodplain	Not listed	Endangered
Hinterland Riverflat Eucalypt Forest	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions	Not listed	Endangered
Cumberland Shale Plains Woodland	Cumberland Plain Woodland in the Sydney Basin bioregion	Critically Endangered	Critically Endangered

In addition to the described vegetation communities were two map units, “Urban_E/N” and “Weed_Ex” that were not described in the report accompanying the map, but are

assumed to refer to degraded urban vegetation fragments and vegetation dominated by weeds and exotic species.

Parsons Brinckerhoff (2015b) mapped the vegetation of the "Boot land', which adjoins the Amended Proposal site to the east and south, based on detailed site surveys conducted in 2014 and 2015. Four Plant Community Types (PCTs) were identified on the Boot land, all of which correspond to TECs (Table 6-2).

Table 6-2 Plant Community Types mapped by Parsons Brinckerhoff (2015b) on the Boot land and corresponding TECs

Vegetation map unit (Parsons Brinckerhoff 2015b)	Corresponding TEC (TSC Act)
Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin.	Shale/Gravel Transition Forest in the Sydney Basin bioregion
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion
Parramatta Red Gum Woodland on moist alluvium of the Cumberland Plain, Sydney Basin.	Castlereagh Swamp Woodland Community

Hyder Consulting (2015) mapped the vegetation of the southern part of the Boot land for the MPE Stage 1 EIS. Three PCTs were identified on the Boot land, two of which (Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin and Parramatta Red Gum Woodland on moist alluvium of the Cumberland Plain, Sydney Basin) were also mapped by Parsons Brinckerhoff (2015b). One additional PCT was identified within Anzac Creek: Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion. This PCT corresponds with the TEC Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregion, listed as Endangered under the TSC Act.

Four PCTs were identified in the MPW site by Parsons Brinckerhoff (2014), following review of existing regional mapping (NPWS 2002/Tozer 2003), soil and geology attributes, landscape position and structural and floristic attributes recorded during site assessments. Arcadis revised this mapping in 2016, resulting in the identification of three PCTs. Patches of these three PCTs fall within the Moorebank Avenue site (Table 6-3).

The ground-truthed native vegetation mapping of the Amended Proposal site and adjoining areas within the Moorebank Precinct East (MPE) and Moorebank Precinct West (MPW) Projects are shown in Figure 6-1.

Table 6-3: Plant Community Types mapped by Arcadis (2016) on MPW site, which occur within Moorebank Avenue site

Vegetation map unit (Arcadis 2016)	Corresponding TEC (TSC Act)
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions

6.2 Vegetation observations

Following site survey and ground-truthing, six vegetation types were identified within the Amended Proposal site:

- MPE Stage 2 site: two native vegetation communities (Disturbed Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland and Broad-leaved Ironbark - Melaleuca decora shrubby open forest) and one modified vegetation type, Planted and disturbed vegetation.
- Moorebank Avenue site: three native vegetation communities (Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland, Parramatta Red Gum Woodland, and Forest Red Gum – Rough-barked Apple Grassy Woodland) and one modified vegetation type, Planted and disturbed vegetation.

6.2.1 MPE Stage 2 site

6.2.1.1 Planted and disturbed vegetation

The MPE site was formerly used for the Defence National Storage and Distribution Centre (DNSDC). The site contains numerous large warehouse buildings and is covered by a network of roads, carparks and other hardstand areas. The site was largely developed between 1939 and 1945 and trees were probably planted at or shortly after this time, as there are distinct rows of tree crowns visible on the 1955 aerial photograph. Further development occurred in the early 1990s (Artefact 2015), whereupon additional plantings or landscaping would have occurred.

There are currently mature and mainly healthy trees lining the roads and paved areas (Plate 1, Plate 2). Planted tree species are typical of cultivated eucalypts that are commonly found as mature street trees in suburban Sydney, with *Eucalyptus microcorys* (Tallowwood), *E. saligna* (Sydney Blue Gum), *Corymbia maculata* (Spotted Gum) and *C. citriodora* (Lemon-scented Gum) frequently recorded.

Plate 1. Mature trees of *Eucalyptus saligna* and *Corymbia maculata* on MPE site

Plate 2. Mature trees of *Eucalyptus microcorys* on MPE site

The ground layer in the non-paved areas of the Amended Proposal site consists of mown grass lawns, dominated by *Cynodon dactylon* (Couch), *Pennisetum clandestinum* (Kikuyu) and other exotic grass species; there was a native grass component persisting in some locations, with native grasses observed including *Paspalidium distans, Austrodanthonia* sp. (Wallaby Grass) and *Eragrostis leptostachya* (Paddock Lovegrass) as well as some small native herbs.

In the south of the Amended Proposal site is a network of drainage channels with some tree plantings and some apparent tree and shrub regeneration. The channels supported a mixture of native, non-local native and exotic trees and shrubs including *E. saligna, E. tereticornis* (Forest Red Gum), *C. maculata, Melaleuca quinquenervia* (Broad-leaved Paperbark), *Casuarina glauca* (Swamp Oak) and *E. parramattensis* (Parramatta Red Gum).

6.2.1.2 Disturbed Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland

There was one area adjoining the disused rail line in the south-east of the MPE site that supported native understorey (Plate 3, Plate 4); it is possible that this area has been subject to management as there were mesh tree guards around the bases of two trees. This area supported mature trees of *E. sclerophylla* (Hard-leaved Scribbly Gum) and numerous shrubs of *Acacia* spp., *Allocasuarina littoralis* (Black She-oak), *Hakea salicifolia* (Willow Hakea) and *Melaleuca nodosa* (Ball Honey-myrtle). The ground layer was characterised by native grasses including *Aristida ramosa* (Wiregrass), *Entolasia stricta* (Wiry Panic), *Paspalidium distans* and *Themeda australis* (Kangaroo Grass) and there were a number of small groundlayer herb and shrub species including *Astroloma humifusum* (Cranberry Heath), *Laxmannia gracilis* (Slender Wire Lily), *Pimelea linifolia* (Slender Rice Flower) and *Lomandra* spp. Exotic cover was low, with *Eragrostis curvula* (African Lovegrass) dominating in patches.

Plate 3. Native regrowth near existing rail line in MPE site

Plate 4. Native regrowth near rail spur in southern part of the MPE site

6.2.1.3 Broad-leaved Ironbark - Melaleuca decora shrubby open forest

A small area of native vegetation within the Boot land falls within the Amended Proposal site along its eastern boundary. This area within the Amended Proposal site adjoins a drainage channel that drains from the MPE site, and forms the disturbed edge of a larger patch of Broad-leaved Ironbark - Melaleuca decora shrubby open forest to the east (Plate 5).

The vegetation in this area consists of dense cover of trees and tall shrubs of *Angophora bakeri* (Narrow-leaved Apple), *Acacia binervia* (Coast Myall), *Acacia parramattensis* (Parramatta Wattle) and *Melaleuca decora* (White Feather Honeymyrtle). The understorey is shrubby and grassy, with *Pultenaea villosa* (Hairy Bush-pea) and *Ozothamus diosmifolius* (White Dogwood) in the shrub layer and *Microlaena stipoides* (Meadow Rice-grass)*, Lomandra longifolia* (Spiny-headed Mat-rush), *Imperata cylindrica* (Blady Grass) and the exotic *Eragrostis curvula* abundant, particularly at the cleared edge.

The drainage channel is an open trench, cleared and disturbed at the edge of the easement track, with only scattered groundcover present. Further east within the native vegetation, the channel is adjoined by ferns, mainly *Adianthum aethiopicum* (Maidenhair Fern).

Plate 5. Broad-leaved Ironbark - Melaleuca decora shrubby open forest in the east of the Amended Proposal site

Plate 6. Coastal freshwater lagoons within the Amended Proposal site.

6.2.2 Moorebank Avenue site

6.2.2.1 Planted and disturbed vegetation

The road reserve adjoining Moorebank Avenue is largely entirely cleared, with closely mown grass on the verges. There were some planted trees in sections along the road edge, mainly native eucalypts species; commonly occurring species were *E. microcorys, E. saligna x botryoides, E. camaldulensis* and *E. tereticornis.* The trees ranged in height from 6 to 8 metres, and in diameter at breast height (dbh) from 0.1 to over one metre. Most trees were in good health, although some had dead branches or had been pruned into poor shape.

6.2.2.2 Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland

Patches of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland occur in the east of the MPW site, adjoining Moorebank Avenue. Portions of these patches are within the Moorebank Avenue site. Parsons Brinckerhoff (2015a) described this community as subject to high disturbance from edge effects, existing roads, foot paths, golf course and weed invasion.

The canopy is dominated by native species including *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum), *Eucalyptus globoidea* (White Stringybark), *Eucalyptus parramattensis subsp. parramattensis (*Parramatta Red Gum) *and Melaleuca decora.* The shrub layer includes *Leucopogon juniperinus* (Prickly Beard-heath), *Pittosporum undulatum* (Sweet Pittosporum), *Acacia spp., Exocarpos cupressiformis* (Cherry Ballart), *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea) and *Persoonia nutans* (Nodding Geebung). The groundcover is dominated by native species including *Microlaena stipoides (*Weeping grass), *Lomandra longifolia* (spiny-headed mat-rush), *Dianella revolute* (Blue Flax-Lily), *Poa affinis, Dichondra repens* (Kidney weed), and *Echinopogon ovatus* (Forest Hedgehog Grass) with scattered exotic species such as *Ehrharta erecta* (Panic Veldtgrass), *Lantana camara* (Lantana), *Asparagus asparagoides* (Bridal Creeper), *Senecio madagascariensis* (Fireweed), *Eragrostis curvula* (African lovegrass), *Chloris gayana* (Rhodes Grass), *Ligustrum*

sinense (Small-leaved Privet) and *Olea europaea* subsp*. cuspidata* (African Olive) (Parsons Brinckerhoff 2015a).

6.2.2.3 Parramatta Red Gum woodland

Parramatta Red Gum Woodland occurs in the south of the Moorebank Avenue site. Parsons Brinckerhoff (2015a) describe this community as subject to high disturbance from edge effects, existing roads, foot paths, former Department of Defence activities and weed invasion.

The canopy and shrublayer are dominated by native species including *Melaleuca linariifolia* (Flax-leaved Paperbark)*, Casuarina glauca* (Swamp Oak) and *Leptospermum trinervium I*Flaky-barked Tea-tree). The groundcover is dominated by native species including *Pteridium esculentum* (Common Bracken)*, Persicaria decipiens* (Slender knotweed)*, Imperata cylindrica* (Blady Grass)*, Gratiola pedunculata, Typha orientalis* (Broadleaf Cumbungi)*, Baumea articulata (*Jointed Twig-rush)*, Hydrocotyle verticillata* (Shield Pennywort) and *Euchiton sphaericus* with scattered exotic species such as *Rubus fruticosus* (Blackberry)*, Ludwigia peruviana* (Peruvian Primrose)*, Araujia sericifera* (Moth vine)*, Gomphocarpus fruticosus* (Narrow-leaved Cotton Bush) and *Paspalum urvillei* (Vasey Grass) (Parsons Brinckerhoff 2015a).

6.2.2.4 Forest Red Gum – Rough-barked Apple grassy woodland

The Forest Red Gum – Rough-barked Apple grassy woodland in the Moorebank Avenue site represents the eastern extent of larger patches of this community adjoining the Georges River to the west. Parsons Brinckerhoff (2015a) describe this community as subject to high disturbance from edge effects, existing roads, foot paths, former Department of Defence activities and weed invasion.

The canopy and shrublayer are dominated by native species including *Eucalyptus tereticornis* (Forest Red Gum)*, Eucalyptus amplifolia* (Cabbage Gum)*, Angophora floribunda* (Rough-barked Apple)*, Bursaria spinose* (Blackthorn, Boxthorn)*, Breynia oblongifolia* (Coffee bush)*, Leucopogon juniperinus* (Prickly Beard-heath)*, Jacksonia scoparia* (Winged Broom-pea)*, Acacia spp.,* and *Exocarpos cupressiformis* (Cherry Ballart). The groundcover is dominated by native species including *Microlaena stipoides* (Weeping grass)*, Lomandra longifolia* (Spiny-headed mat-rush)*, Entolasia stricta* (Wiry panic)*, Austrostipa ramosissima* (Stout Bamboo Grass)*, Dianella revolute* (Blue Flax-Lily), *Themeda triandra* (Kangaroo grass)*, Cynodon dactylon* (Couch), *Aristida ramose* (Purple Wiregrass), *Carex appressa* (Tall sedge)*, Dichondra repens* (Kidney weed) and *Oplismenus imbecillis* (Basket grass)*.* Some areas within this community were dominated by an exotic shrub layer such as *Ehrharta erecta* (Panic Veldtgrass)*, Ligustrum* spp., *Olea europaea* subsp. *cuspidata* (African Olive) and *Lantana camara* (Lantana) (Parsons Brinckerhoff (2015a).

6.3 Plant Community Types on the Amended Proposal site

The vegetation within the Amended Proposal site consisted predominantly of planted and disturbed vegetation. Native vegetation within the MPE Stage 2 site consists of small, fragmented patches of vegetation and the disturbed edges of larger patches, and the Moorebank Avenue site containing larger patches.

Four native Plant Community Types (PCTs) were identified within the Amended Proposal site following review of existing information and structural and floristic attributes recorded during site assessments (Table 6-4, Figure 6-1). Amendments to the Construction Area and Operational Area (as described in section 1) have avoided direct impacts on Coastal freshwater lagoons, as was previously shown in the BAR

that was prepared to support the *Moorebank Precinct East-Stage 2 Proposal Environmental Impacts Statement* (Arcadis 2016).

Table 6-4 Plant community types (PCTs) identified on the Amended Proposal site

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) within Amended Proposal site
MPE Stage 2 site				
Sydney Sand Flats Dry Sclerophyll Forests	ME003	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	50%	0.1 ha
Cumberland Dry Sclerophyll Forests	ME002	Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	95%	0.05 ha
Moorebank Avenue site				
Sydney Sand Flats Dry Sclerophyll Forests	ME003	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	50%	3.73 ha
Sydney Sand Flats Dry Sclerophyll Forests	ME005	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	45%	0.22 ha
Coastal Floodplain Wetlands	ME018	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	95%	0.59 ha

The justification for assigning PCTs is provided below in Table 6-5.

Table 6-5 Justification for identification of PCTs on the Amended Proposal site

Plant Community Type	Species relied upon for ID of PCT	Justification of evidence used to identify a PCT
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	*Eucalyptus sclerophylla*	Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is broadly consistent with descriptions in VIS database and published references.

Plant Community Type	Species relied upon for ID of PCT	Justification of evidence used to identify a PCT
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	*Eucalyptus fibrosa* *Melaleuca decora*	Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references.
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	*Melaleuca linariifolia*	Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references.
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	*Eucalyptus tereticornis* *Eucalyptus amplifolia* *Angophora subvelutina* *Angophora floribunda* *Eucalyptus saligna x botryoides*	Previous regional mapping as an equivalent vegetation type Landscape position Characteristic tree species present Structure and species composition is consistent with descriptions in VIS database and published references.

Further quantitative analysis of the vegetation quadrat data was undertaken to test the justifications for assigning PCTs. The vegetation data was compared with the lists of positive diagnostic species for communities mapped within and adjacent to the Amended Proposal site, as specified in OEH (2016). The descriptions and lists of positive diagnostic species for equivalent vegetation communities in Tozer *et al*. (2010), which are generally referenced in the PCT scientific descriptions in the Bionet Vegetation Classification Database, were also reviewed but no analysis was undertaken. The equivalent vegetation communities are listed in Table 6-6.

Table 6-6 PCTs that were considered to potentially occur in or adjacent to the Amended Proposal site

Plant Community Type	Equivalent OEH (2016) vegetation community	Equivalent Tozer et al. (2010) vegetation community
Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion (PCT 725)	S_DSF01: Castlereagh Ironbark Forest	DSF p1: Castlereagh Ironbark Forest

Plant Community Type	Equivalent OEH (2016) vegetation community	Equivalent Tozer et al. (2010) vegetation community
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (PCT 724)	S_DSF02: Castlereagh Shale-Gravel Transition Forest	DSF p502: Castlereagh Shale-Gravel Transition Forest
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (PCT 883)	S_DSF19: Castlereagh Scribbly Gum Woodland	DSF p7: Castlereagh Scribbly Gum Woodland
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (PCT 1067)	S_DSF20: Castlereagh Swamp Woodland	DSF p4: Castlereagh Swamp Woodland
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (PCT 835)	S_FoW06: Cumberland Riverflat Forest	FoW p33: Cumberland River Flat Forest
Mountain Blue Gum - Thin-leaved Stringybark open forest on river flat alluvium in the Sydney Basin Bioregion (PCT 941)	S_FoW09: Hinterland Riverflat Eucalypt Forest	FoW p31: Burragorang River Flat Forest

For each vegetation community, the minimum number of positive diagnostic species expected to be recorded in a sample site has been calculated (OEH 2016). The presence of the minimum number of positive diagnostic species in a sample site is strong evidence that the sample belongs to the vegetation community. It is necessary for identification using this method that the total number of native species recorded in the sample site exceeds a specified minimum; species-poor sites cannot be tested (OEH 2016). As can be seen in Table 6-7, due to low native species counts in the quadrats, for most samples the vegetation cannot be positively identified using analysis of positive diagnostic species.

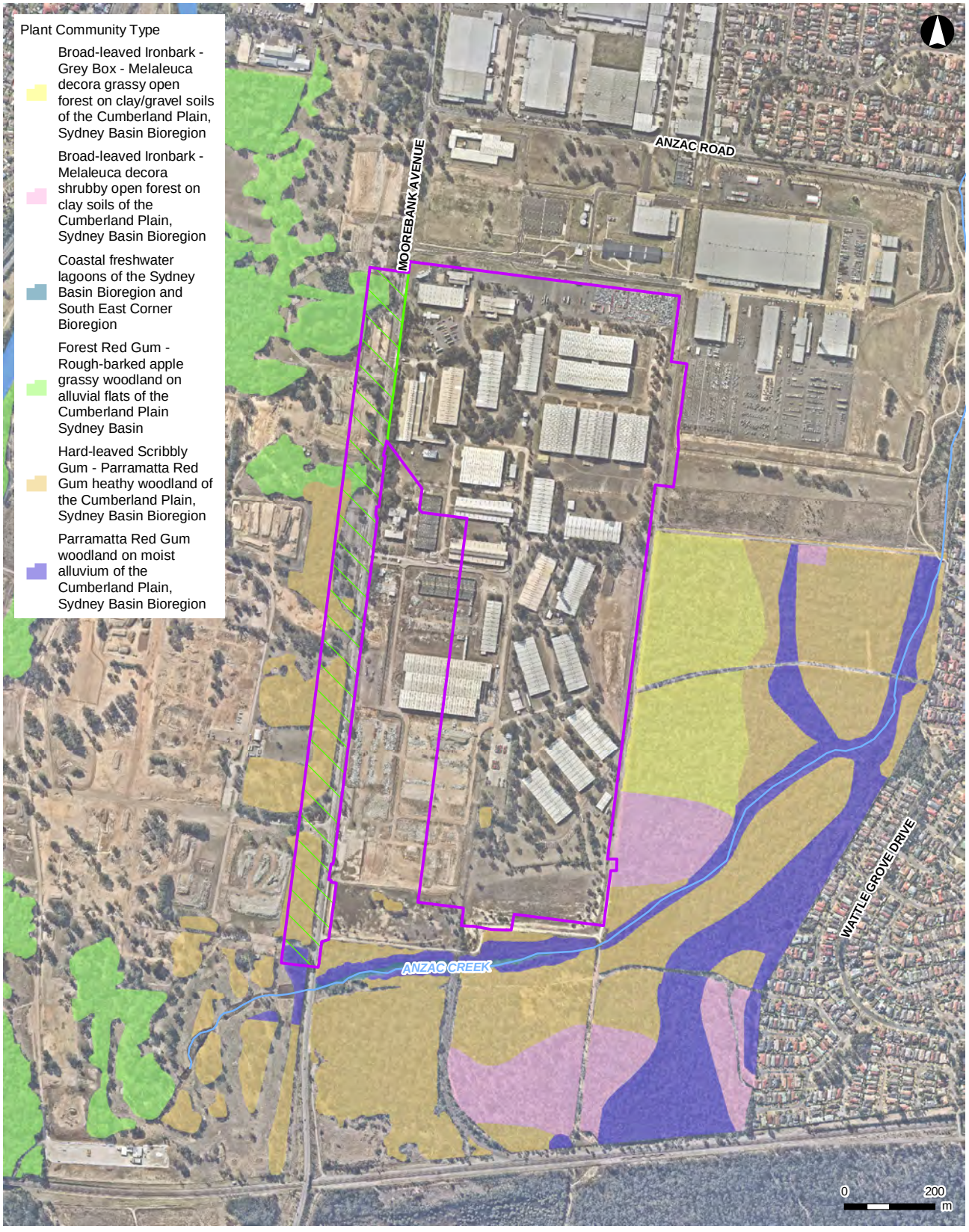
Table 6-7 Comparison of quadrat data with positive diagnostic species for OEH (2016)

Biometric code of mapped vegetation types	Quadrat	Native species	Positive diagnostic species recorded					
			FoW09	FoW06	DSF01	DSF02	DSF19	DSF20
Minimum native species required			24	22	35	28	37	18
Minimum positive diagnostic species required			7	10	20	13	21	6
ME003	Q21	32	7	6	12	10	15	8
	Q29	21	6	3	11	10	11	4
	QA	29	5	2	12	13	11	4

Biometric code of mapped vegetation types	Quadrat	Native species	Positive diagnostic species recorded					
			FoW09	FoW06	DSF01	DSF02	DSF19	DSF20
ME002	Q10	22	5	6	16	16	12	6
ME005	Q27	13	4	0	0	1	2	4
ME018	Q34	4	0	2	1	2	2	1

Quadrats QA (located within an area mapped as Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin) does meet the minimum native species and minimum 13 positive diagnostic species requirements to be classified as S_DSF02: Castlereagh Shale-Gravel Transition Forest. However the vegetation in this 0.1 ha area has been subject to additional planting, and given that the only canopy species recorded was *Eucalyptus sclerophylla,* and the similar number (12) of positive diagnostic species for S_DSF19: Castlereagh Scribbly Gum Woodland, the mapping as Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin is considered to be more appropriate.

Quadrat Q10 (located within an area mapped as Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion) also contained greater than the minimum 13 positive diagnostic species required for classification as S_DSF02: Castlereagh Shale-Gravel Transition Forest, however does not have the minimum number of native species required for a positive identification. Nevertheless, the count supports classification of this vegetation as Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion.



LEGEND

- Amended Proposal site
- Moorebank Avenue site
- Watercourse

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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (August, 2017)

1:12,500 at A4

Figure 6-1 Plant Community Types (PCTs) mapped on the Amended Proposal site

6.3.1 Threatened Ecological Communities

Two PCTS identified in the Amended Proposal site and three PCTs identified in the Moorebank Avenue site fall within the definitions of threatened ecological communities listed under the TSC Act and/or EPBC Act, as per Table 6-8.

Table 6-8 Threatened ecological communities on the Amended Proposal site and Moorebank Avenue site

Plant Community Type	Equivalent TEC	TSC Act Status	EPBC Act Status
Amended Proposal site			
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable	Endangered
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (ME002)	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Endangered	Critically Endangered
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered	Not listed
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered	Not listed
Moorebank Avenue site			
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable	Endangered
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered	Not listed
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered	Not listed

6.5 Vegetation zones

For the purposes of the FBA assessment, the Amended Proposal site contained five vegetation zones in the moderate to good condition category. The vegetation zones are summarised in Table 6-9.

Table 6-9 Vegetation zones on the Amended Proposal site

Vegetation zone	1	2	3	4	5
Vegetation class	Dry Sclerophyll forests (Shrubby)	Dry Sclerophyll forests (Shrub/grass)	Dry Sclerophyll forests (Shrubby)	Dry Sclerophyll forests (Shrubby)	Forested Wetlands
Biometric code	ME003	ME002	ME003	ME005	ME018
PCT name	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain	Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin
Condition class	Moderate/ Good	Moderate/ Good - High	Moderate/ Good - Medium	Moderate/ Good - Poor	Moderate/ Good - Medium
Area (ha)	0.1 ha	0.05 ha	3.73 ha	0.22 ha	0.59 ha
Plots	QA	Q10	Q21, Q29	Q27	Q34

6.6 Site value scores for vegetation zones

The site value score for each vegetation zone identified in the Amended Proposal site was determined through assessment of site attribute data collected in vegetation plots. The site attribute data was entered into the credit calculator to generate site value scores. The site attribute data entered into the credit calculator is shown in Table 6-10.

Table 6-10 Vegetation zone on the Amended Proposal site

Plot Name	Site attributes									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good										

Plot Name	Site attributes									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL
Bench-mark	**39**	**5-34**	**4-38**	**12-56**	**7-26**	**16-75**	**-**	**1**	**1**	**30**
QA	29	32.5	13	24	20	18	46	1	0	38
ME002 Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion										
Bench-mark	**35**	**9-31**	**6-42**	**12-61**	**6-24**	**9-46**	**-**	**1**	**1**	**30**
Q10	22	51.5	16.5	6	10	30	10	3	1	20
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Medium										
Bench-mark	**39**	**5-34**	**4-38**	**12-56**	**7-26**	**16-75**	**-**	**1**	**1**	**30**
Q21	33	22	18	44	2	22	0	0	1	2
Q29	7	13	3	16	0	2	62	0	1	4
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good										
Bench-mark	**36**	**6.5-41.5**	**5-25**	**12.2-38.2**	**0-10**	**12.2-38.2**	-	**0**		**0**
Q27	12	35	0	0	0	52	0	0	1	4
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good										
Bench-mark	**16**	**15-44**	**4-34**	**32-82**	**8-37**	**32-82**	**-**	**1**	**1**	**>30**
Q34	4	15	0	32	0	0	8	0	1	0

Key to site attributes

NPS = Native plant species	NGCO = Native groundcover – other
NOS = Native overstorey cover	EPC = Exotic percent cover
NMS = Native midstorey cover	NTH = Number of trees with hollows
NGCG = Native groundcover – grass	OR = Overstorey regeneration
NGCS = Native groundcover - shrubs	FL = Fallen logs (m)

The site value scores for the vegetation zones are provided in Table 6-11.

Table 6-11 Area and site value score for vegetation zones

Vegetation Zone	Area mapped in Amended Proposal site	Site value score
MPE Stage 2 site		
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good (ME003)	0.1 ha	68.23
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good (ME002)	0.05 ha	74.48
Moorebank Avenue site		
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium (ME003)	3.73	55.73
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good	0.22	33.33
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good	0.59	34.38

6.7 Groundwater Dependent Ecosystems

Geotechnical and Phase 2 investigations of the Amended Proposal site have found groundwater at depths of between 5.2 and 12.4 m BGL (1.7 and 9.11 m Australian Height Datum (AHD)). Groundwater flow is inferred to be west to the north-west towards the Georges River (Parsons Brinckerhoff 2014b). Riparian woodland vegetation adjoining the Georges River was identified as having a high potential for groundwater interaction. Some of the fragmented patches of vegetation along the eastern boundary of the MPW site were identified as having a moderate potential for groundwater interaction (Arcadis 2016).

It is probable, due to local hydrogeology, that groundwater across the Amended Proposal site, Moorebank Avenue site and the wider region is interconnected. As such, if stygofauna were present they are unlikely to be isolated to the vicinity of the Amended Proposal site.

A search of the Australian Government's Atlas of Groundwater Dependent Ecosystems was undertaken on 7 April 2016. No data on subterranean groundwater-dependent ecosystems (GDEs) is available for the locality. Notwithstanding this, several GDEs with potential reliance on subsurface groundwater were identified in the locality including in the Amended Proposal site (Bureau of Meteorology 2016). Results are mapped in Figure 8-2.

6.8 Fauna habitats

6.8.1 Terrestrial habitats

Moorebank Avenue site

Structurally intact woodland occurs scattered throughout the Moorebank Avenue site providing a range of fauna habitat values. These areas contain a relatively intact native understorey and/or groundcover vegetation. They contain a complete vegetation structure, fallen timber, and dense leaf litter layers that are essential to the life cycles of many fauna. Patches of dense understorey and diverse groundcover in this habitat type provide potential foraging and nesting habitat for a variety of terrestrial reptiles, bird and mammals.

The canopy of this habitat type consists of a moderate to dense cover of immature, semi-mature and mature trees. The canopy provides foraging habitat for nectar-feeding and seed-eating animals and is likely to contain hollows suitable for birds such as small to large parrots, owls, tree roosting microchiropteran bat and small to large arboreal mammals. Foraging opportunities exist in the canopy for predatory species including Powerful Owl and Spotted-tailed Quoll. Overall, this fauna habitat type is in moderate to good condition providing potential habitat for species of animal that require diverse native understorey vegetation, canopy connectivity and tree hollows.

In addition to intact woodland, the Moorebank Avenue site also contains highly disturbed areas with scattered trees. This habitat type occurs in areas that have been subject to substantial human disturbance including hardstand areas on the MPW site and the Moorebank Avenue road reserve. This habitat type does not correspond to any native vegetation community. Native vegetation in this habitat type is restricted to occasional trees, shrubs and groundcover plants within otherwise exotic vegetation. This habitat is only likely to provide habitat for native and introduced fauna species that are adapted to open environments and tolerant of human disturbance. Many such native species (e.g. Willie Wagtail and Noisy Miners) have increased in abundance in response to human disturbance. This habitat type is in poor condition and generally of very limited value to threatened fauna species.

MPE Stage 2 site

Landscaped areas occur across the majority of the MPE Stage 2 site. Native vegetation has been predominantly cleared from these areas and persists as isolated trees amongst expanses of mown exotic and native grasses.

Isolated trees offer potential nesting, sheltering and roosting habitat to birds such as Pied Currawong (*Strepera graculina*) and Noisy Miner (*Manorina melanocephala*). Flowering eucalypts also provide foraging habitat for Grey-headed Flying Fox (*Pteropus poliocephalus)*. A small number of scribbly gums (*Eucalyptus sclerophylla)* located in the south of the Amended Proposal site support small and medium-sized hollows, offering nesting habitat to hollow-dependent species such as Rainbow Lorikeet (*Trichoglossus haematodus*) and Scaly-breasted Lorikeet (*Trichoglossus chlorolepidotus*). Seven eucalypts in the Moorebank Avenue road reserve were identified as containing small hollows or bark fissures that represent habitat for microbats.

A diversity of microchiropteran bat species were recorded in cleared and disturbed areas, including White-striped Mastiff Bat (*Tadarida australis*), Gould's Wattled Bat (*Chalinolobus gouldii*), Chocolate Wattled Bat (*Chalinolobus morio*), Little Forest Bat (*Vespadelus vulturnus*) and the threatened Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*).

Open grassy areas provide foraging habitat for ground-feeding birds such as White-winged Chough (*Corcorax melanorhamphos*), Red-rumped parrot (*Psephotus haematonotus*) and small terrestrial mammals such as the Brown Hare (*Lupus capensis*).

Scattered native and exotic shrubs and trees associated with the formalised drainage channels in the south of the Amended Proposal site, such as Black She-oak (*Allocasuarina littoralis*), eucalypts, Camphor Laurel (*Cinnamomum camphora*) and *Cotoneaster* sp., offer foraging, sheltering and roosting habitat to birds such as Noisy Miner (*Manorina melanocephala*), Raven (*Corvus coronoides*) and Magpie Lark (*Grallina cyanoleuca*). Other small trees and shrubs throughout the Amended Proposal site that may offer sheltering and nesting habitat to smaller birds are restricted to small areas of horticultural plantings.

Other fauna habitat features such as rocky features, well-developed leaf litter, ground timber and hollow logs are absent from cleared and disturbed areas. As a result, the availability of sheltering and foraging habitat for reptiles and cover-dependent terrestrial mammals is reduced. Depressions in open areas that contain temporary water following rain events offer habitat to colonising amphibians such as Common Eastern Froglet (*Crinia signifera*).

The buildings currently within the Amended Proposal site offer limited habitat features to native fauna, although they may support potential roosting habitat for microchiropteran bats. Given that inspection of these buildings was not possible during site surveys, it is assumed that some of the buildings offer potential fauna habitat. Further discussion on impacts and mitigation is provided in Sections 8.2 and 9 respectively.

6.8.2 Aquatic habitats

Anzac Creek comprises a named waterway with intermittent flow supporting semi-permanent to permanent water in pools and as such, is classified as Class 3 (Minimal Fish Habitat) in accordance with Fairfull and Witheridge (2003).

Aquatic habitat types of Anzac Creek within the study area included soft substrate pools and extensive macrophyte cover. Water in Anzac Creek was mostly static and shallow; small pools were heavily vegetated with floating and emergent macrophytes.

The introduced Gambusia (*Gambusia holbrooki*) was recorded at Anzac Creek. One Long-fin Eel (*Anguilla reinhardtii*) was identified in the upper reaches of Anzac Creek within the MPW site (outside of the study area).

A total of 23 macroinvertebrate families were recorded in Anzac Creek (ALS 2011). Family diversity was generally low and many sensitive taxa were not recorded. Anzac Creek falls into AUSRIVAS Band B, indicating that the macroinvertebrate community was 'significantly impaired'; fewer families than expected were observed. This result may be attributed to a current/existing 'potential' impact on water quality or habitat quality or both (ALS 2011).

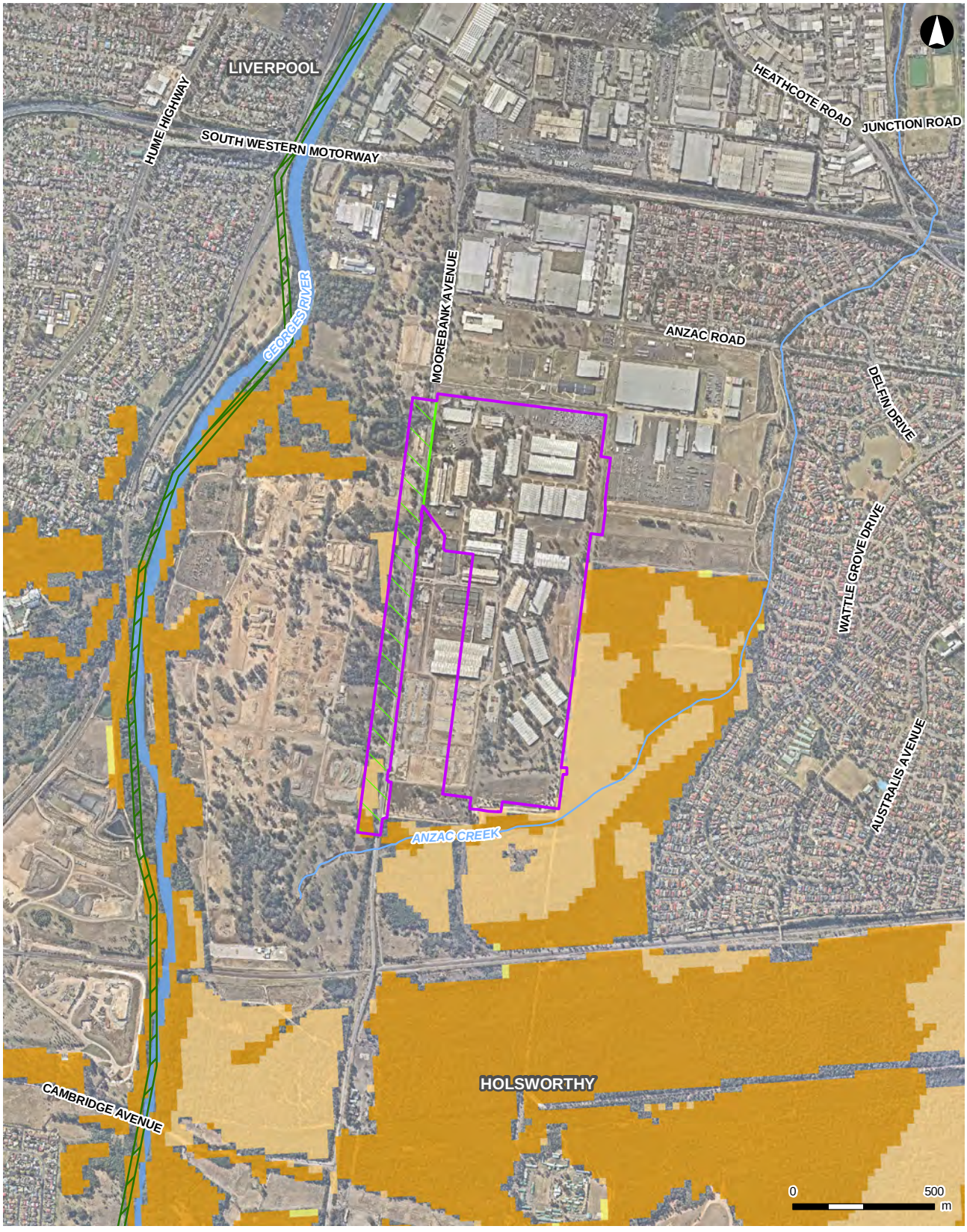
There is a network of formalised drainage channels in the south of the Amended Proposal site. These channels do not all support permanent water; some flow only ephemerally following rain. Channels that support aquatic and fringing vegetation, such as *Typha* sp, offer habitat for reptiles and amphibians such as Common Eastern Froglet (*Crinia signifera*).

6.8.3 Habitat connectivity

The Amended Proposal site is located within a relatively industrialised and urbanised landscape with small fragmented patches of structurally intact woodland, scattered trees and a narrow avenue of trees on the Moorebank Avenue site providing some connectivity across the landscape. Structurally intact woodland has some connectivity to other similar vegetation on the MPW site, which also occurs in a patchy/fragmented state. Vegetation of landscaped areas/disturbed areas with scattered trees are generally limited to single, isolated trees or patches of trees amongst expanses of mown exotic and native grasses and hardstand; habitat features of these areas do not maintain connectivity with larger areas of habitat to the east and south.

The fragmented habitat within the majority of the Amended Proposal site is further isolated from adjacent habitat due to the presence of significant barriers to fauna movement. These barriers include Moorebank Avenue and the chain-mesh fencing surrounding the MPE site and MPW site. The chain-mesh fencing would limit movement into and through the MPE Stage 2 site to small terrestrial mammals, reptiles, amphibians and birds and bats. Larger terrestrial mammals that may occur in the locality would be excluded from much of the MPE Stage 2 site as a result.

The small area of the Amended Proposal site that falls within the Boot land contains habitat that is continuous with approximately 83 hectares of native vegetation within the Boot land. The native vegetation in the Moorebank Avenue site is fragmented, but maintains connectivity with riparian vegetation adjoining the Georges River that extends to the north and south of the MPW site.



LEGEND

- Amended Proposal site
- Moorebank Avenue site
- Watercourse

Surface Groundwater Dependent Ecosystems
Potential for grounderwater interaction

- High potential

Subsurface Groundwater Dependent Ecosystems
Potential for Groundwater interaction

- High potential
- Moderate potential
- Low potential

Figure 6-2 Groundwater-dependent ecosystems on the vicinity of the Amended Proposal site (BOM 2016)

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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (August, 2017)

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7 THREATENED SPECIES

7.1 Predicted Ecosystem credit species

The following species were derived from the PCTs identified on the Amended Proposal site as predicted ecosystem credit species:

- Barking Owl (*Ninox connivens*)
- Black-chinned Honeyeater (eastern subspecies) (*Melithreptus gularis* subsp. *gularis*)
- Brown Treecreeper (eastern subspecies) (*Climacteris picumnus subsp. victoriae*)
- Bush-stone Curlew (*Burhinus grallarius*)
- Diamond Firetail (*Stagonopleura guttata*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Flame Robin (*Petroica phoenicea*)
- Gang-gang Cockatoo (*Callocephalon fimbriatum*)
- Greater Broad-nosed Bat (*Scoteanax rueppellii*)
- Hooded Robin (south-eastern form) (*Melanodryas cucullata* subsp. *cucullata*)
- Little Eagle (*Hieraaetus morphnoides*)
- Little Lorikeet (*Glossopsitta pusilla*)
- New Holland Mouse (*Pseudomys novaehollandiae*)
- Painted Honeyeater (*Grantiella picta*)
- Powerful Owl (*Ninox strenua*)
- Scarlet Robin (*Phoenica boodang*)
- Speckled Warbler (*Chthonicola sagittata*)
- Spotted-tailed Quoll (*Dasyurus maculatus maculatus*)
- Square-tailed Kite (*Lophoictinia isura*)
- Swift Parrot (*Lathamus discolor*)
- Varied Sitella (*Daphoenositta chrysoptera*)
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

Each species has been assessed for potential presence in each of the vegetation zones in the Amended Proposal site in Table 7-1 using information obtained from the Threatened Species Profiles Database (TSPD).

Table 7-1 Predicted ecosystem credit species presence assessment

Predicted ecosystem credit species	Associated PCTs found on Amended Proposal site	Patch size	TS offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Amended Proposal site?	Species likelihood of occurrence on Amended Proposal site
Barking Owl *Ninox connivens* V-TSC Act	ME002 ME003	25-100 ha	3.0	Foraging habitat includes associated vegetation types and up to 250 m from these into adjoining grassland. Larger trees and hollow trees facilitate a more diverse and abundant prey base, thus improving breeding success. Living or dead trees with hollows >20 cm diameter that are > 4 m above the ground are required for breeding.	Yes	Moderate
Black-chinned Honeyeater (eastern subspecies) *Melithreptus gularis* subsp. *gularis* V-TSC Act	ME002 ME003	5-25 ha	1.3	Occupies mostly upper levels of drier open forests or woodlands dominated by box and ironbark eucalypts. Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. 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 hectares.	Yes	Moderate
Brown Treecreeper (eastern subspecies) *Climacteris picumnus* subsp. *victoriae* V-TSC Act	ME002	5-25 ha	2.0	Associated vegetation types provide foraging and refuge habitat for the species. Hollows >6cm in live trees or in dead standing or fallen timber provide breeding habitat.	Yes	Unlikely
Bush Stone-curlew	ME002 ME003	25-100 ha	2.6	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Associated vegetation types provide foraging and	Yes	Unlikely

Predicted ecosystem credit species	Associated PCTs found on Amended Proposal site	Patch size	TS offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Amended Proposal site?	Species likelihood of occurrence on Amended Proposal site
Burhinus grallarius E-TSC Act				refuge habitat for the species. Open grassy woodland with fallen dead timber provides breeding habitat.		
Diamond Firetail *Stagonopleura guttata* V-TSC Act	ME002 ME003	<5 ha	1.3	Foraging habitat includes associated vegetation types with native grassy understorey or adjoining native grassland. Does not occur within grasslands which are further than 1.5 km from trees or woodland. Breeding occurs in vegetation with small patches of shrubs.	Yes	Unlikely
Eastern False Pipistrelle *Falsistrellus tasmaniensis* V-TSC Act	ME002 ME003	5-25 ha	2.2	Prefers moist habitats, with trees taller than 20 m. Associated vegetation types provide foraging habitat for the species. Species roosts in live or dead hollow-bearing trees, under bark, caves buildings.	Unlikely – trees generally less than 20m tall	Unlikely
Eastern Freetail-bat *Mormopterus norfolkensis* V-TSC Act	ME002 ME003	5-25 ha	2.2	Associated vegetation types provide foraging habitat for the species. Species roosts in tree hollows, loose bark or man-made structures. Breed in hollows in dead or alive trees.	Yes	High
Flame Robin *Petroica phoenicea* V-TSC Act	ME002 ME003	25-100 ha	1.3	Breeds in upland tall moist eucalypt forests and woodlands, often on ridges and slopes. Prefers clearings or areas with open understoreys. The groundlayer of the breeding habitat is dominated by native grasses and the shrub layer may be either sparse or dense.	No. Species prefers tall forest with clearings or open understorey. This veg zone is not tall or moist.	Unlikely

Predicted ecosystem credit species	Associated PCTs found on Amended Proposal site	Patch size	TS offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Amended Proposal site?	Species likelihood of occurrence on Amended Proposal site
Gang-gang Cockatoo *Callocephalon fimbriatum* V-TSC Act	ME002 ME003	<5 ha	2.0	In summer, generally found in tall mountain forests and woodlands, particularly in heavily timbered and mature wet sclerophyll forests. In winter, may occur at lower altitudes in drier more open eucalypt forests and woodlands, and often found in urban areas. Favours old growth attributes required for nesting and roosting purposes. Uses hollows for breeding >10cm diameter and >9m above the ground.	Yes	Moderate
Greater Broad-nosed Bat *Scoteanax rueppellii* V-TSC Act	ME002 ME003	<5 ha	2.2	Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in buildings.	Yes	Moderate
Hooded Robin (south-eastern form) *Melanodryas cucullata* subsp. *cucullata* V-TSC Act	ME002 ME003	5-25 ha	1.7	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.	Yes	Unlikely
Little Eagle *Hieraaetus morphnoides* V-TSC Act	ME002 ME003	<5 ha	1.4	Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. Nests in tall living trees within a remnant patch, where pairs build a large stick nest in winter.	Yes	Moderate
Little Lorikeet	ME002	<5 ha	1.8	Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree	Yes	High

Predicted ecosystem credit species	Associated PCTs found on Amended Proposal site	Patch size	TS offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Amended Proposal site?	Species likelihood of occurrence on Amended Proposal site
Glossopsitta pusilla V-TSC Act	ME003			species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.		
New Holland Mouse *Pseudomys novaehollandiae* V-TSC Act	ME003	<5 ha	2.6	Known to inhabit open heathlands, woodlands and forests with a heathland understorey and vegetated sand dunes. Lives predominantly in burrows shared with other individuals. Distribution is patchy in time and space, with peaks in abundance during early to mid stages of vegetation succession typically induced by fire.	Marginal	Unlikely
Painted Honeyeater *Grantiella picta* V-TSC Act	ME002	<5 ha	1.3	Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias.	Yes	Unlikely
Powerful Owl *Ninox strenua* V-TSC Act	ME002 ME003	>100 ha	3.0	Inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. Requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation. Nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old.	Yes	Moderate

Predicted ecosystem credit species	Associated PCTs found on Amended Proposal site	Patch size	TS offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Amended Proposal site?	Species likelihood of occurrence on Amended Proposal site
Scarlet Robin *Petroica boodang* V-TSC Act	ME002 ME003	25-100 ha	1.3	The Scarlet Robin 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. Abundant logs and fallen timber are important habitat components.	Yes	Moderate
Speckled Warbler *Chthonicola sagittata* V-TSC Act	ME002 ME003	5-25 ha	2.6	The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt regrowth and an open canopy.	Yes	Unlikely
Spotted-tailed Quoll *Dasyurus maculatus* V-TSC Act E-EPBC Act	ME002 ME003	25-100 ha	2.6	Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites.	Yes	Unlikely
Square-tailed Kite *Lophoictinia isura* V- TSC Act Not listed – EPBC Act	ME003	25-100 ha	1.4	Found in a variety of timbered habitats including dry woodlands and open forests, showing a particular preference for timbered watercourses. Appears to occupy large hunting ranges of more than 100km^2.	Yes	Unlikely

Predicted ecosystem credit species	Associated PCTs found on Amended Proposal site	Patch size	TS offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on Amended Proposal site?	Species likelihood of occurrence on Amended Proposal site
Swift Parrot *Lathamus discolor* E-TSC Act E-EPBC Act	ME002 ME003	<5 ha	1.3	Occurs in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany *Eucalyptus robusta*, Spotted Gum *Corymbia maculata*, Red Bloodwood *C. gummifera*, Mugga Ironbark *E. sideroxylon*, and White Box *E. albens*.	Yes	Moderate
Varied Sittella *Daphoenositta chrysoptera* V-TSC Act	ME002 ME003	5-25 ha	1.3	Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland.	Yes	Moderate
Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* V-TSC Act	ME002 ME003	<5 ha	2.2	Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. Forages in most habitats across its very wide range, with and without trees; appears to defend an aerial territory.	Yes	Moderate

7.2 Predicted Species credit species

7.2.1 Geographic and habitat features

The credit calculator identified species which will require assessment at the Amended Proposal site for species credits. Specific geographic and habitat features were given for each species. The potential for each of the identified species to occur on the Amended Proposal site based on these geographic and habitat features was assessed based on site surveys and reference to regional maps and reports.

Eight species were identified by the credit calculator, of which five could potentially occur in the Amended Proposal site based solely on the geographic and habitat descriptors (Table 7-2). These species, which could potentially occur based solely on the geographic and habitat descriptors are considered further in sections 7.2.2 and 7.2.3.

Table 7-2 Geographic and habitat features for threatened species habitat

Common name	Scientific name	Feature	Impact on potential habitat?
Rosenberg's Goanna	*Varanus rosenbergi*	land within 250 m of termite mounds or rock outcrops	No
Cumberland Plain Land Snail	*Meridolum corneovirens*	land containing bark or leaf litter accumulation	Yes
Large-eared Pied Bat	*Chalinolobus dwyeri*	land containing escarpments, cliffs, caves, deep crevices, old mine shafts or tunnels	No
Eastern Osprey	*Pandion cristatus*	land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters	No
Green and Golden Bell Frog	*Litoria aurea*	land within 100 m of emergent aquatic or riparian vegetation	Yes
Wahlenbergia multicaulis (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield local government areas	*Wahlenbergia multicaulis* – endangered population	land situated in damp, disturbed sites	Yes
Hypsela sessiliflora	*Hypsela sessiliflora*	Wet and damp areas only.	Yes
Black Bittern	*Ixobrychus flavicollis*	land within 40 m of freshwater and estuarine wetlands, in areas of permanent water and	Yes

Common name	Scientific name	Feature	Impact on potential habitat?
		dense vegetation or emergent aquatic vegetation	

7.2.2 Flora

The following threatened flora species listed under the TSC Act were identified in the credit calculator as predicted flora species credit species:

- *Acacia bynoeana* (Bynoe's Wattle)
- *Acacia pubescens* (Downy Wattle)
- *Caladenia tessellata* (Thick Lip Spider Orchid)
- *Callistemon linearifolius* (Netted Bottle Brush)
- *Cynanchum elegans* (White-Flowered Wax Plant)
- *Dillwynia tenuifolia*
- *Epacris purpurascens subsp. purpurascens*
- *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea)
- *Gyrostemon thesioides*
- *Hibbertia sp. Bankstown*
- *Hibbertia puberula*
- *Hypsela sessiliflora*
- *Leucopogon exolasius* (Woronora Beard-heath)
- *Persoonia hirsuta* (Hairy Geebung)
- *Persoonia nutans* (Nodding Geebung)
- *Pimelea curviflora subsp. curviflora*
- *Pultenaea pedunculata* (Matted Bush-pea)

Table 7-3 assesses the potential for these flora species credit species to be present on the Amended Proposal site using information from the TSPD. It also identifies species that cannot withstand further loss and whether further action is required.

Four of the threatened flora species credit species identified by the credit calculator were recorded in the Boot land to the south and east of the Amended Proposal site: *Acacia bynoeana, Acacia pubescens, Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.*

One threatened flora species not identified by the credit calculator, *Hibbertia puberula* subsp. *puberula,* was recorded in the Amended Proposal site and in the Boot land to the south and east of the Amended Proposal site. Another threatened species not identified by the calculator, *Hibbertia fumana,* was recorded in the Boot land to the south of the Amended Proposal site. This species occurs in several locations, varying between 77 and 133 metres from the Amended Proposal site boundary. The locations of the threatened flora species recorded in the Amended Proposal site and adjacent areas are shown on Figure 7-1.

The majority of the MPE Stage 2 site represents low quality habitat for threatened flora species, with highly modified and fragmented native vegetation. Threatened flora

species were recorded in areas of marginal habitat in the south-east of the MPE Stage 2 site and adjoining cleared access tracks in the Boot land adjoining the southern and eastern boundaries of the Amended Proposal site. The Moorebank Avenue site contains threatened flora habitat within patches of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin, although much of this is also disturbed.

Detailed consideration of the threatened flora species recorded on the Amended Proposal site and adjoining lands is provided in section 7.2.1.1.

Three threatened flora populations were also identified in the credit calculator as potentially occurring:

- *Acacia prominens* (Gosford Wattle) population, Hurstville and Kogarah local government areas
- *Pomaderris prunifolia* (Plum-leaf Pomaderris) population, Parramatta, Auburn, Strathfiedl and Bankstown local government areas
- *Wahlenbergia multicaulis* (Tadgells Bluebell) population, Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strtahfield local government areas.

None of the identified threatened flora populations occur within the Liverpool local government area, in which the Amended Proposal site is located.

Table 7-3 Flora species credit species and their presence status

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Acacia bynoeana Bynoe's Wattle E-TSC Act V-EPBC Act	ME003	Heath or dry sclerophyll forest on sandy soils. Prefers open, sometimes slightly disturbed sites. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.	Marginal habitat may be present in ME003	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Unlikely to occur across majority of Amended Proposal site, and not found within Amended Proposal site during targeted surveys; populations of the species were recorded to the south and east, including one plant located approximately 6m to the east of the MPE Stage 2 site boundary.	No	Assess indirect impacts

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Acacia pubescens Downy Wattle V-TSC Act V-EPBC Act	ME002	Occurs on alluviums, shales and at the intergrade between shales and sandstones. Occurs in open woodland and forest, in a variety of plant communities, including Cooks River/ Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland.	Marginal habitat present in ME002	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Unlikely to occur across majority of Amended Proposal site, and not found within Amended Proposal site during targeted surveys; populations of the species were recorded to the south and east, including approximately 20m east of the MPE Stage 2 site boundary.	No	Assess indirect impacts
Caladenia tessellata Thick Lip Spider Orchid E – TSC Act V – EPBC Act	ME002 ME003	Generally found in grassy sclerophyll woodland on clay loam or sandy soils.	Marginal habitat present in ME002	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Unlikely. The species was not found during targeted surveys.	No	Not required

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Callistemon linearifolius Netted Bottle Brush V-TSC Act	ME002	For the Sydney area, recent records are limited to the Hornsby Plateau area near the Hawkesbury River. Grows in dry sclerophyll forest on the coast and adjacent ranges.	Marginal habitat present in ME002	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Unlikely. The species was not found during targeted surveys.	No	Not required
Cynanchum elegans White-flowered Wax Plant E-TSC Act E-EPBC Act	ME018	Usually occurs on the edge of dry rainforest vegetation. Other associated vegetation types include littoral rainforest; *Leptospermum laevigatum –Banksia integrifolia* subsp. *integrifolia* coastal scrub; *Eucalyptus tereticornis* aligned open forest and woodland; *Corymbia maculata* aligned open forest and woodland; and *Melaleuca armillaris* scrub to open scrub.	No suitable habitat exists within the Amended Proposal site.	N/A – species not targeted as unlikely to occur	N/A	Unlikely. No suitable habitat present.	No	Not required

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Dillwynia tenuifolia V-TSC Act	ME002 ME003	May be locally abundant particularly within scrubby/dry heath areas within Castlereagh Ironbark Forest and Shale Gravel Transition Forest on tertiary alluvium or laterised clays. May also be common in transitional areas where these communities adjoin Castlereagh Scribbly Gum Woodland.	Marginal habitat may be present in ME003	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Unlikely. The species was not found during targeted surveys.	No	Not required
Epacris purpurascens subsp. *purpurascens* V-TSC Act	ME002	Found in a range of habitat types, most of which have a strong shale soil influence.	Marginal habitat present in ME002.	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Unlikely. The species was not found during targeted surveys.	No	Not required
Grevillea parviflora subsp. *parviflora* Small-flower Grevillea V-TSC Act V-EPBC Act	ME002 ME003	Grows in sandy or light clay soils usually over thin shales, often with lateritic ironstone gravels and nodules. Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park.	Marginal habitat may be present in ME003.	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Recorded in Moorebank Avenue site.	No	Assess direct and indirect impacts

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Gyrostemon thesioides E-TSC Act	ME002	Has only been recorded at three sites in NSW, near the Colo, Georges and Nepean River. Grows on hillsides and riverbanks and may be restricted to fine sandy soils.	Habitat in the Amended Proposal site was considered unlikely to be suitable.	N/A – species not targeted as unlikely to occur.	June 2016, October 2016, October 2017	Unlikely.	No	Not required
Hibbertia sp. *Bankstown* (syn. *Hibbertia puberula* subsp. *glabrescens*) CE-TSC Act CE-EPBC Act	ME002	The species is currently known to occur in only one population at Bankstown Airport. The airport site is very heavily modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content.	Habitat in the Amended Proposal site was considered unlikely to be suitable.	N/A – species not targeted as unlikely to occur.	June 2016, October 2016, October-November 2017	Unlikely.	No	Not required

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Hibbertia puberula E – TSC Act Not listed – EPBC Act	ME003	Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. One of the recently (2012) described subspecies also favours upland swamps.	Occupied habitat present	Targeted searches within potential habitat areas.	November 2010, February 2013, May 2014, September 2014, February-March 2017, October-November 2017	*Hibbertia puberula* subsp. *puberula* recorded during targeted surveys	Yes	Assess direct and indirect impacts
Hypsela sessiliflora (syn. *Isotoma sessiliflora*) Not listed – TSC Act Ex-EPBC Act (Note: this species was removed from the TSC Act on 25 November 2016).	ME018 ME005	Currently known from only two adjacent sites on a single private property at Erskine Park in the Penrith LGA. Previous sightings are all from western Sydney, at Homebush and at Agnes Banks. 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.	No.	N/A – species not targeted as unlikely to occur.	N/A	Unlikely. No suitable habitat present.	No	Not required

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Leucopogon exolasius Woronora Beard-heath V-TSC Act V-EPBC Act	ME003	Occurs in woodland on sandstone.	Marginal habitat may be present in ME003.	Targeted searches within potential habitat areas	June 2016, October 2016, October 2017	Unlikely. The species was not found during targeted surveys.	No	Not required
Persoonia hirsuta Hairy Geebung E-TSC Act E-EPBC Act	ME018	Found in sandy soils in dry sclerophyll open forest, woodland and heath on sandstone	Marginal habitat may be present.	Targeted searches within potential habitat areas	November 2010, February 2013, May 2014, September 2014, February-March 2017	Unlikely. The species was not found during targeted surveys.	No	Not required
Persoonia nutans Nodding Geebung E-TSC Act E-EPBC Act	ME002 ME003	This species occupies tertiary alluvium, extending onto shale sandstone transition communities and into Cooks River / Castlereagh Ironbark Forest.	Habitat present in ME002 and ME003.	Targeted searches within potential habitat areas	June 2016, May 2017, October 2017	Unlikely to occur across majority of Amended Proposal site. Four small seedlings found in southernmost part of MPE Stage 2 site and 12 plants in Moorebank Avenue site.	No	Assess direct and indirect impacts

Predicted species credit species	Associated PCTs on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Pimelea curviflora subsp. *curviflora* V-TSC Act V-EPBC Act	ME003	Confined to the coastal area of Sydney between northern Sydney in the south and Maroota in the north-*west*. Distribution associated with shaley/lateritic soils over sandstone and shale/sandstone transition soils on ridgetops and upper slopes amongst woodlands.	No. The Amended Proposal site is outside of the known distribution of the species in the Sydney region. Typical habitat does not occur in the Amended Proposal site,	N/A – species not targeted as unlikely to occur.	N/A	Unlikely.	No	Not required
Pultenaea pedunculata Matted Bush-pea E-TSC Act	ME002	Generally among woodland vegetation but plants have also been found on road batters and coastal cliffs. In the Liverpool - Fairfield area the majority of occurrences are in lower-lying areas and often close to creek lines. Soils are moderately to poorly drained.	Habitat present in ME002	Targeted searches within potential habitat areas	May 2017, October 2017	Unlikely. The species was not found during targeted surveys.	No	Not required

7.2.2.1 Threatened flora species recorded on the Amended Proposal site and adjoining areas

Three threatened flora species were recorded within the Amended Proposal site: *Hibbertia puberula* subsp. *puberula, Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.* Three other threatened flora species were recorded during surveys of adjacent areas of the Boot land between 2011 and 2017 (Table 7-4). The locations of threatened species recorded are shown in Figure 7-1, 7-2 and 7-3. A discussion of each threatened species is also provided below.

Table 7-4 Threatened flora species recorded during surveys of the Amended Proposal site and Boot land

Scientific name	Common name	EPBC Act status	TSC Act status	Distance between closest record and Amended Proposal site
Acacia bynoeana	Bynoe's Wattle	Vulnerable	Endangered	6 metres
Acacia pubescens	Downy Wattle	Vulnerable	Vulnerable	18 metres
Grevillea parviflora subsp. *parviflora*	Small-flowered Grevillea	Vulnerable	Vulnerable	N/A – occurs within Amended Proposal site
Hibbertia fumana	-	Not listed	Critically Endangered (provisional listing)	100 metres
Hibbertia puberula subsp. *puberula*	-	Not listed	Endangered	N/A – occurs within Amended Proposal site
Persoonia nutans	Nodding Geebung	Endangered	Endangered	N/A – occurs within Amended Proposal site

Hibbertia puberula* subsp. *puberula

Hibbertia puberula was listed as endangered under the TSC Act on 12 September 2003. At the time of listing, the following advice was included in the final determination:

> Hibbertia puberula *is found in the central coast botanical subdivision in sandy soil often associated with sandstone. Early records are from the Hawkesbury River area and Frenchs Forest in northern Sydney, South Coogee in eastern Sydney, the Hacking River area in southern Sydney, and the Blue Mountains.* Hibbertia puberula *has not been collected for over 40 years.*

Toelken and Miller (2012) described seven new species and four new subspecies of *Hibbertia,* including *Hibbertia puberula* subsp. *puberula. Hibbertia puberula* subsp. *puberula* was identified as being more widespread than previously thought, based on over 50 specimens collected from varying locations including Wollemi National Park,

Voyager Point, Simmos Beach Reserve at Macquarie Fields, Kentlyn, Warrimoo, Royal National Park and areas south-west of Nowra, near Morton National Park. None of these records appear to have been assigned to the species in the NSW Wildlife Atlas or Australia's Virtual Herbarium (http://avh.chah.org.au/). *Hibbertia puberula* subsp. *puberula* has been recorded from a wide range of habitats and Toelken and Miller (2012) state that the species seems to be adequately conserved.

Hibbertia puberula subsp. *puberula* is considered to form part of the endangered listing of *Hibbertia puberula* at the species level under the TSC Act.

Surveys of the Boot land in October-November 2016 recorded *Hibbertia puberula* subsp. *puberula* in the central southern part of the Boot land, south of Anzac Creek, where it was found to be abundant in Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (Arcadis 2017a). Further investigations of areas of this PCT to the north of Anzac Creek in May 2017 found additional records of the species. *Hibbertia puberula* subsp. *puberula* was also recorded in disturbed areas next to the cleared tracks along the northern and western boundaries of the Boot land where it adjoins the MPE site, in May and September 2017. A total of 1,230 plants of *Hibbertia puberula* subsp. *puberula* were identified in the Boot land by Arcadis (2017a). Validation of the May 2017 surveys, undertaken in October 2017, identified additional plants of *Hibbertia puberula* subsp. *puberula* in disturbed areas, including within the Amended Proposal site.

Approximately 88 plants of *Hibbertia puberula* subsp. *puberula* were recorded within the MPE Stage 2 site, in three locations:

- Five plants in an area of sparse regrowth adjoining the fenceline in the south of the Amended Proposal site, next to the access track;
- One plant in denser regrowth adjoining the fenceline in the south-east of the Amended Proposal site, next to the powerline easement;
- Approximately 82 plants in mown grassland in the south-east of the Amended Proposal site (Plates 7 and 8). Plants in the mown grassland were difficult to detect due to their very small size, even within the open grassland habitat. The patch of *Hibbertia puberula* subsp. *puberula* in the south-east of the Amended Proposal site is located directly west of records of the species in Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland in the Boot land, and the distribution of the species in this part of the Amended Proposal site appears to correlate with the habitat to the east.

Plate 7. *Hibbertia puberula* subsp. *puberula* in bud in the south-east of the Amended Proposal site

Plate 8. Area of mown grassland in south-east of Amended Proposal site where *Hibbertia puberula* subsp. *puberula* was recorded

Another 22 plants of *Hibbertia puberula* subsp. *puberula* are located in the Moorebank Avenue site. Of these, 16 were recorded in February and March 2017 surveys, with an additional six plants identified during validation surveys in November 2017. The species was recorded in two of the larger patches of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland.

***Persoonia nutans* (Nodding Geebung)**

Persoonia nutans is listed as Endangered under the EPBC Act and the TSC Act. This species is an erect to spreading shrub 0.5–1.5 metres high, with linear leaves and hairy young branches (DotE 2017).

Persoonia nutans is restricted to the Cumberland Plain in Western Sydney, between Richmond in the north and Macquarie Fields in the south. Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests. Peak flowering is from November to March with sporadic flowering all year round (OEH 2017).

Persoonia nutans was recorded in the Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland north of Anzac Creek in the Boot land. Targeted searches for this species between 2011 and 2015 recorded 126 individual plants (Hyder Consulting 2015), with a further 60 plants recorded in the eastern part of the Boot land by Parsons Brinckerhoff (2015b) and 11 additional scattered plants recorded between October 2016 and May 2017 (Arcadis 2017a). A total of 197 plants of *Persoonia nutans* have been recorded in the Boot land to date.

Three individuals of *Persoonia nutans* were recorded adjoining the fenceline to the south of the MPE Stage 2 site in May 2017. Reinspection of this area in October 2017 found an additional two small plants near the previous records. Another four small plants of *Persoonia nutans* (10-25 centimetres in height) were recorded in the far south of the MPE Stage 2 site.

Plate 9. *Persoonia nutans* seedlings recorded in the Amended Proposal site

Plate 10. *Persoonia nutans* adjoining southern fenceline south of the Amended Proposal site

Records of *Persoonia nutans* previously identified by PB (2015b) along the eastern boundary of the MPE site were reinspected in October 2016 and found to be completely cleared, with no evidence of the species presence remaining. There are additional records of *Persoonia nutans* just outside the southern boundary of the Amended Proposal site where it adjoins Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland in the Boot land (Figure 7-1).

Another eight plants of *Persoonia nutans* were recorded in the Moorebank Avenue site in Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland in surveys conducted between 2011 and 2017.

Acacia bynoeana (Bynoe's Wattle)

Acacia bynoeana is listed as Vulnerable under the EPBC Act and Endangered under the TSC Act.

Acacia bynoeana occurs in heath or dry sclerophyll forest on sandy soils. The species seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple (OEH 2017).

Acacia bynoeana has been recorded in the Boot land (GHD 2015, Arcadis 2017a), with most individuals clustered in the central southern section of the Boot land east of the existing disused Defence rail spur, and scattered isolated occurences elsewhere (Figure 7-1). A total of 35 individuals were recorded by Arcadis (2017a).

One individual of *Acacia bynoeana* was recorded in October 2017, in a clearing next to the cleared powerline easement to the east of the Amended Proposal site. The species was growing in a patch of bare sandy soils with sparse grass cover, with some regenerating eucalypts and shrubs nearby (Plates 7 and 8). The individual of *Acacia bynoeana* is located approximately 6 metres east of the eastern boundary of the Amended Proposal site.

Plate 11. *Acacia bynoeana* recorded east of the Amended Proposal site

Plate 12. Area where *Acacia bynoeana* was recorded (species is in foreground)

Acacia pubescens (Downy Wattle)

Acacia pubescens is listed as Vulnerable under the EPBC Act and the TSC Act. *A. pubescens* is a spreading shrub growing from 1 to 4 metres high with bright yellow flowers, bipinnate leaves and conspicuously hairy branchlets.

Acacia pubescens occurs on alluviums, shales and at the intergrade between shales and sandstones in open woodland and forest. It is found in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland (OEH 2017; DotE 2017).

Acacia pubescens has previously been recorded in the Boot land by Hyder Consulting (2011), Parsons Brinckerhoff (2015b) and GHD (2015). Two individuals of *Acacia pubescens* were recorded by Hyder Consulting (2011) at the edge of bushland immediately to the east of the MPE site. The species was recorded in three distinct

patches in the Boot Land by Parsons Brinckerhoff (2015b). Due to its suckering habit resulting in clonal reproduction, it is difficult to determine how many genetic individuals are represented. The total number of stems over the three patches was estimated by PB (2015b) at 100 stems. GHD estimated a larger population of 263 individuals in the Boot land.

The two stems recorded in the native vegetation east of the powerline easement that borders the MPE site in 2012 were resurveyed in May 2017, and a larger population of 43 stems was recorded. Given that this stand of *Acacia pubescens* is in a location where GHD (2015) also recorded the species, it is assumed that the 43 stems are captured in their population count of 263.

The closest record of *Acacia pubescens* is located approximately 18 metres east of the eastern boundary of the Amended Proposal site, at the edge of Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (Figure 7-1).

Hibbertia fumana

Hibbertia fumana is a recently rediscovered species that was previously known only from historical herbarium records and was presumed to be extinct when formally published in 2012 (Toelken and Miller 2012). *Hibbertia fumana* is provisionally listed as Critically Endangered under the TSC Act.

The core population of *Hibbertia fumana* is located in a transitional zone between Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin and Broad-leaved Ironbark -Grey Box- Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin, in the central southern part of the Boot Land, south of Anzac Creek. The population within the Boot Land is the only known population of the species recorded to date. The core population size of *Hibbertia fumana* was estimated at 14,270 by Arcadis (2017a).

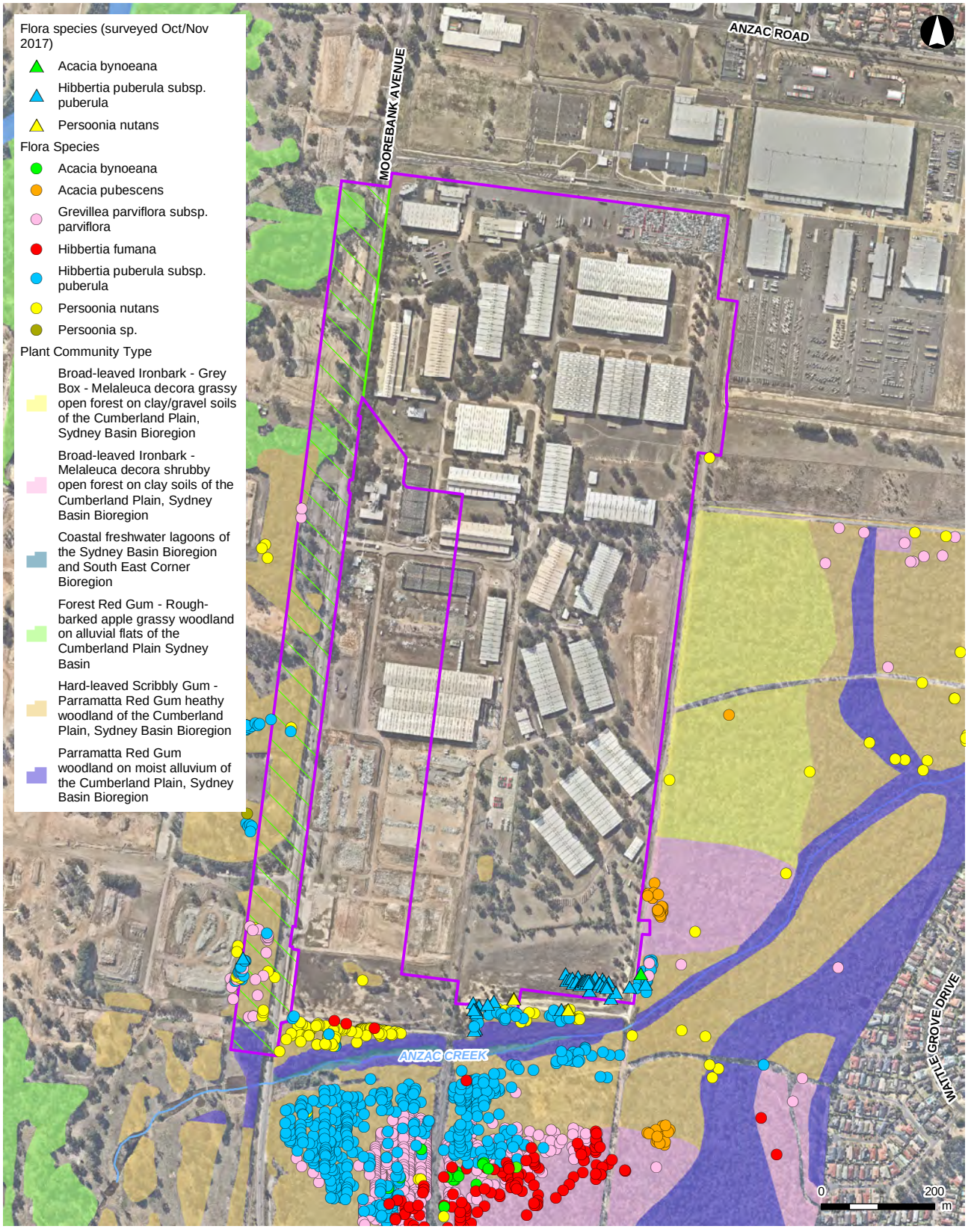
Hibbertia fumana was additionally recorded in disturbed edge habitat adjacent to and partially within the East Hills rail corridor adjoining the southern boundary of the Boot Land, and in scattered locations in disturbed areas next to the cleared tracks along the northern boundary of the Boot Land where it adjoins the MPE site (Arcadis 2017a). The closest record of *Hibbertia fumana* to the Amended Proposal site is approximately 100 metres south-west of the south-western corner of the Amended Proposal site.

***Grevillea parviflora* subsp. *parviflora* (Small-flowered Grevillea)**

Grevillea parviflora subsp. *parviflora* is listed as Vulnerable under the EPBC Act and in Schedule 2 of the TSC Act. *G. parviflora* subsp. *parviflora* is a spindly shrub varying from prostrate to erect, usually 0.3–1m high but growing up to 1.5 to 2 metres. The species suckers readily from rhizomes, although individuals sometimes have single stems (DotE 2017).

Grevillea parviflora subsp. *parviflora* was recorded in a large patch of Castlereagh Scribbly Gum Woodland south of Anzac Creek in the Boot land (Arcadis 2017a). Hyder Consulting (2015) estimated approximately 7063 stems of the species occurred in the western parts of the Boot land, based on transect surveys undertaken in 2012 and 2014. Parsons Brinckerhoff (2015b) used the results of the Hyder Consulting surveys (2015), in conjunction with habitat inspection and mapping, to produce a stem count estimate of 13,600 for *Grevillea parviflora* subsp. *parviflora* across the proposed Wattle Grove offset biobank site, which is located within the Boot Land.

No individuals of *Grevillea parviflora* subsp. *parviflora* are located within the MPE Stage 2 site; the closest records are approximately 18 metres east of the eastern boundary of the Amended Proposal site within Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland in the Boot land (Figure 7-1). A total of 79 stems of *Grevillea parviflora* subsp. *parviflora* were recorded in the Moorebank Avenue site.



LEGEND

- Amended Proposal site
- Moorebank Avenue site
- Watercourse

ARCADIS AUSTRALIA PACIFIC PTY LTD
ABN 76 104 485 289
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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (August, 2017)

1:10,000 at A4

ARCADIS

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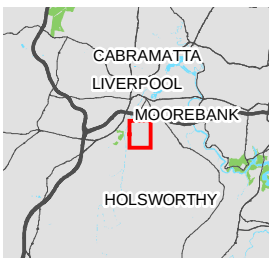
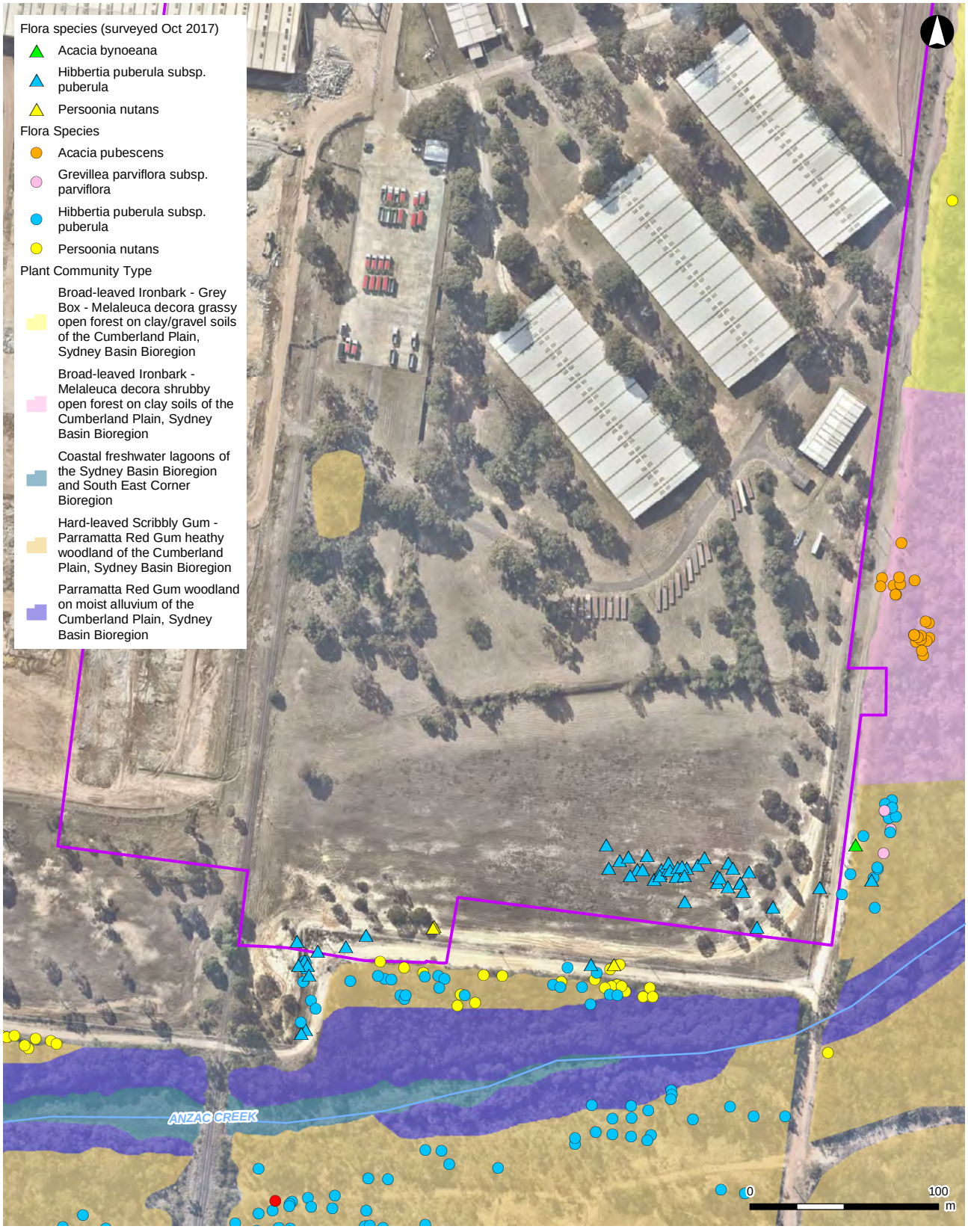


Figure 7-1 Threatened flora species recorded within and adjacent ot the Amended Proposal



LEGEND

Amended Proposal site

Watercourse

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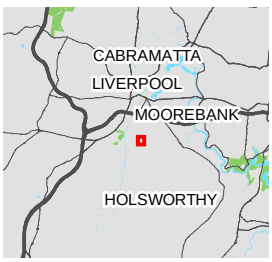
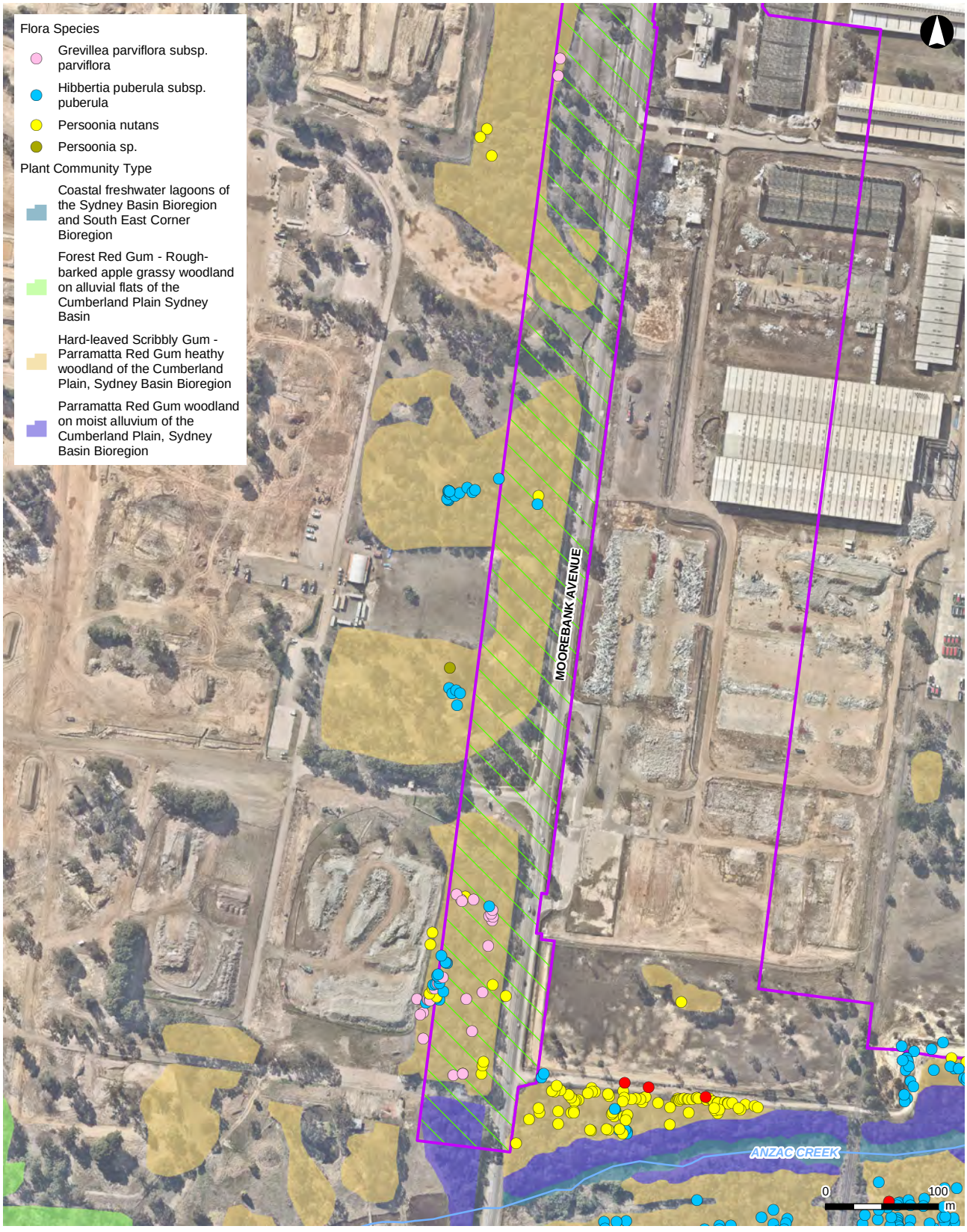


Figure 7-2 Threatened flora species recorded within and adjacent to the Amended Proposal (detail)



LEGEND

Amended Proposal site

Watercourse

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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (August, 2017)

1:5,000 at A4

Figure 7-3 Threatened flora species recorded within and adjacent to the Moorebank Avenue site

7.2.3 Fauna

The following were identified in the credit calculator as predicted fauna species credit species:

- Black Bittern (*Ixobrychus flavicolis*)
- Cumberland Plain Land Snail (*Meridolum corneovirens*)
- Eastern Pygmy-possum (*Cercartatus nanus*)
- Green and Golden Bell Frog (*Litoria aurea*)
- Koala (*Phascolarctos cinereus*)
- Regent Honeyeater (*Anthochaera phrygia*)
- Squirrel Glider (*Petaurus norfolkensis*).

Table 7-5 assesses the potential for fauna species credit species to be present on the Amended Proposal site using information obtained from the TSPD. Habitat requirements for each species were assessed against the habitat values on the Amended Proposal site. Habitat information was obtained from OEH's Threatened Species Profiles Database. Where applicable, targeted survey methods and timing for each identified species is noted and an assessment of the presence status of each species was determined based on targeted survey results and habitat presence. Table 7-5 also identifies species that cannot withstand further loss and whether any further assessment is required.

Of the seven species, none are considered likely to occur on the Amended Proposal site based on the assessment provided in Table 7-5.

7.2.3.1 Koala

No koalas or incidental observations of koala presence (i.e. scats or scratches) have been recorded within the Moorebank Precinct (MPE site, MPW site nor the Biobanking Sites) during any ecological field survey carried out between 2011 and 2016.

MPE Stage 2 site

No *Core* habitat for koalas was identified in the MPE Stage 2 site. While several koala feed trees listed under Schedule 2 of SEPP 44 were recorded in landscaped areas (which cover the majority of the MPE Stage 2 study area), such as *Eucalyptus microcorys* (Tallowood), *Eucalyptus camaldulensis* (River red gum) and *Eucalyptus tereticornis* (Forest red gum), they do not constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. Accordingly, MPE Stage 2 study area does not comprise *Potential* koala habitat.

Several barriers to koala movement, such as chain-mesh fencing along the southern boundary of the MPE Site, the fenced East Hills Rail Corridor south of MPE site, Moorebank Avenue to the west and expanses of landscaped areas (from which intact native vegetation is absent), reduce the likelihood of koalas that have been previously recorded in the surrounding locality (OEH Bionet) moving into or through the MPE Stage 2 site.

The potential for koalas to occur in the MPE Stage 2 site was determined using information obtained from the TSPD. It was determined that the probability of koalas occurring within the MPE Stage 2 site is "unlikely", based on the lack of *Core* or *Potential* habitat for koala and barriers to koala movement. Accordingly, no further surveys for koalas within the MPE Stage 2 site were required, and no further assessment was required.

Moorebank Avenue site

No koalas or incidental observations of koala presence (i.e. scats or scratches) were identified during field surveys carried out in the MPW Stage 2 study area, which includes the Moorebank Avenue site.

The potential for koalas to occur in the Moorebank Avenue site has been determined using information obtained from the TSPD. It was determined that the probability of koalas occurring within the Moorebank Avenue site is “unlikely”, based on the lack of *Core* or *Potential* habitat for koala and barriers to koala movement. Only one koala feed species listed under Schedule 2 of SEPP 44, *Eucalyptus tereticornis* (Forest Red Gum) occurs in the Moorebank Avenue site. Koala feed trees for the Central Coast KMA that occur in the Moorebank Avenue site include two primary feed tree species, *Eucalyptus parramattensis* and *Eucalyptus tereticornis*. One secondary food tree species, *Eucalyptus baueriana,* also occurs in low densities. Accordingly, no further surveys for koalas within the Moorebank Avenue site were required, and no further assessment was required.

Table 7-5 Fauna species credit species and their presence status

Predicted species credit species	Associated PCTs found on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Black Bittern *Ixobrychus flavicollis* V-TSC Act	ME018	Inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation. Where permanent water is present, the species may occur in flooded grassland, forest, woodland, rainforest and mangroves.	No. No habitat on the Amended Proposal site; wetlands in adjoining areas on the MPW site are heavily degraded and have minimal or no fringing vegetation, which this species prefers.	N/A	N/A	Unlikely	Yes	Not required
Cumberland Plain Land Snail *Meridolum corneovirens* E-TSC Act	ME002 ME003	Occurs in bark or leaf litter accumulation in associated vegetation types. Primarily inhabits Cumberland Plain Woodland; also known from Shale Gravel Transition Forests, Castlereagh Swamp Woodlands and the margins of River-flat Eucalypt Forest. It lives under litter of bark, leaves and logs, or shelters in loose soil around grass clumps. Occasionally shelters under rubbish.	Marginal habitat may be present in ME002 and ME003, however there was minimal leaf litter observed within the small area to be impacted	N/A	N/A	Unlikely.	Yes	Not required

Predicted species credit species	Associated PCTs found on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Eastern Pygmy-possum *Cercartetus nanus* V-TSC Act	ME003	Inhabits woodlands and heath, occasionally rainforest where it forages for nectar and pollen of banksias, eucalypts and bottlebrushes. Shelters in tree hollows, rotten stumps, holes in the ground or abandoned bird-nests.	Potential habitat on site in ME003 is unlikely to be occupied by this species due to fragmentation.	N/A	N/A	Unlikely.	Yes	Not required
Green and Golden Bell Frog *Litoria aurea* E-TSC Act V-EPBC Act	ME002 ME003	Breeding habitat comprises natural and constructed waterbodies including wetlands, stormwater detention basins, marshes, dams and streams-side, preferably those that are unshaded but with fringing vegetation. Forage for invertebrates within grassy habitats near breeding habitat. May shelter under vegetation, rocks and building materials such as fibro, sheet iron or bricks.	Marginal habitat present in basins and drainage lines. Infestation of *Gambusia holbrooki* (a predator of tadpoles) reduces the likelihood of occurrence.	Call playback and night time water body searches in two locations within marginal potential habitat.	May 2011	Unlikely. Habitat is marginal and species not recorded during targeted surveys.	Yes	Not required

Predicted species credit species	Associated PCTs found on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Koala *Phascolarctos cinereus* V-TSC Act V-EPBC Act	ME002 ME003	Species inhabits eucalypt woodlands and forests. The species feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.	Potential habitat on site in ME003 is unlikely to be occupied by this species due to fragmentation. ME002 does not include potential feed trees.	Spotlight survey from a vehicle and along foot traverses for direct visual observations of animal activity	May 2011	Unlikely.	Yes	Not required
Regent Honeyeater *Anthochaera phrygia* CE-TSC Act E-EPBC Act	ME002 ME003	The Regent Honeyeater mainly inhabits temperate woodlands and open forests of the inland slopes of south-east Australia. Only three known key breeding regions remaining: north-east Victoria, and in NSW at Capertee Valley and the Bundarra-Barraba region. In NSW the distribution is very patchy and mainly confined to the two main breeding areas and surrounding fragmented woodlands. In some years flocks converge on flowering coastal woodlands and forests.	Potential habitat on site in ME003 is unlikely to be occupied by this species due to fragmentation. May forage sporadically on the site in winter but unlikely to breed locally.	Diurnal visual and aural observations of bird calls by ecologist with experience in bird identification.	May 2011	Unlikely. The species was not found during targeted surveys. Species records within 10km are 20 years old or more. The closest recent Bionet record (<20 years) is approximately 26 km west of the Amended Proposal site, at Greendale, and is dated from 2009; there are also anecdotal reports of the species in Campbelltown dated from 2012.	Yes	Not required

Predicted species credit species	Associated PCTs found on Amended Proposal site	Habitat requirements (from TSPD)	Habitat presence on Amended Proposal site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Squirrel Glider *Petaurus norfolcensis* V-TSC Act	ME002 ME003	Inhabits Blackbutt-Bloodwood forest with heath understorey in coastal areas. Require abundant tree hollows for refuge and nest sites. Forages for nectar, sap, invertebrates and pollen.	No. Species requires abundant hollows. Hollows are a limited resource in the Amended Proposal site.	Spotlight survey from a vehicle and along foot traverses for direct visual observations of animal activity	May 2011	Unlikely. The species was not found during targeted surveys.	Yes	Not required

8 AVOID AND MINIMISE IMPACTS

The FBA requires consideration of the steps taken to avoid and minimise the direct and indirect impacts of a development proposal on biodiversity values. Section 8.3.2of the FBA sets out guidelines for the avoidance and minimisation of impacts to biodiversity during all phases of the project life cycle, comprising:

- Site selection phase
- Planning phase
- Construction phase
- Operational phase

8.1 Measures to avoid impacts

8.1.1 Site selection phase

The guidelines for site selection phase in sections 8.3.2.2 to 8.3.2.6 of the FBA and the biodiversity assessment process undertaken for the Amended Proposal are presented in Table 8-1.

Table 8-1 Site selection phase FBA guidelines for avoidance and minimisation of biodiversity impacts

FBA section	FBA guidelines	Consistency of the Amended Proposal with FBA guidelines
8.3.2.2	Selecting a suitable development site for a Major Project or a route for linear projects, should be informed by knowledge of biodiversity values. An initial desktop assessment of biodiversity values would assist in identifying areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species.	A desktop assessment of the biodiversity values of the MPE site was undertaken as part of a preliminary assessment of the MPE Project and as part of the Ecological Assessment for the Concept Plan Approval (MP10_0193).
8.3.2.3	Stage 1 of the FBA will provide the preliminary information necessary to inform project planning. Early consideration of biodiversity values is recommended in site selection, or route selection for linear projects, and the planning phase.	Early consideration of biodiversity values was undertaken in preliminary assessments and in the Ecological Assessment for the Concept Plan Approval (MP10_0193).
8.3.2.4	The site/route selection process should include consideration and analysis of the biodiversity constraints of the proposed development site and consider the suitability of the Major Project based on the types of biodiversity values present on the development site.	The majority of the MPE site is located within cleared and disturbed land, with no native vegetation communities and low habitat values for flora and fauna.

FBA section	FBA guidelines	Consistency of the Amended Proposal with FBA guidelines
8.3.2.5	When considering and analysing the biodiversity constraints for the purpose of selecting a development site, the following matters should be addressed: (a) whether there are alternative sites within the property on which the proposed development is located where siting the proposed Major Project would avoid and minimise impacts on biodiversity values (b) how the development site can be selected to avoid and minimise impacts on biodiversity values as far as practicable (c) whether an alternative development site to the proposed development site, which would avoid adversely impacting on biodiversity values, might be feasible.	There were limited alternative options for a viable intermodal facility within the area. The MPE site represents an ideal position for an intermodal facility as: ▪ There is a direct intersection linking the adjacent Moorebank Avenue to the M5 Motorway reducing the need for road works and subsequent additional biodiversity impacts. ▪ It is zoned as industrial land for use as industrial warehousing. ▪ Buffer zones are provided between the facility and nearby residential areas. ▪ It is within the freight catchment for which there is a freight demand, resulting in minimal use of road transport between origins / destinations and the IMT. The location has also been identified in both state and federal strategies as the best and only location for an IMT facility to service a defined catchment in South-Western Sydney.
8.3.2.6	For linear projects, the route selection process must include consideration and an analysis of the biodiversity constraints of the various route options. In selecting a preferred option, loss of biodiversity values must be weighed up and justified against social and economic costs and benefits.	Not applicable – the Amended Proposal is not a linear project.

The Amended Proposal site has been granted approval, in the form of a Concept Plan (MP10_0193), for the development of an intermodal facility and therefore is considered suitable.

8.1.2 Planning phase

The guidelines for planning phase in sections 8.3.2.7 to 8.3.2.8 of the FBA and the biodiversity assessment process undertaken for the Amended Proposal are presented in Table 8-2.

Table 8-2 Planning phase FBA guidelines for avoidance and minimisation of biodiversity impacts

FBA section	FBA guidelines	Consistency of the Amended Proposal with FBA guidelines
8.3.2.7	Once a suitable development site has been selected, further analysis of the biodiversity constraints of the proposed development site can then be used to inform concept planning, project siting and design. This includes the proposed location of temporary construction infrastructure such as roads, camps, stockpile sites and parking bays.	The identified biodiversity constraints have been considered during the development of the MPE Project, and the biodiversity impacts of the Amended Proposal have been approved within the Concept Plan.
8.3.2.8	The Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value) or which avoid an EEC or CEEC. The following matters should be considered for this purpose: 1. siting of the project – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC.	The majority of the Amended Proposal site is located within cleared and disturbed land, with no native vegetation communities and low habitat values for flora and fauna. The areas of native vegetation to be impacted in the MPE Stage 2 site are a fragmented, isolated patch (0.1 ha) and a small area (0.05 ha) at the edge of a much larger patch of native vegetation that will be conserved as part of offsetting for the larger Moorebank Project. Some larger areas of native vegetation will be impacted in the Moorebank Avenue site.
	2. minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development footprint is minimised), and/or in areas where other impacts to biodiversity will be the lowest	Given the location and nature of the Amended Proposal and its context with regard to existing road and rail infrastructure, there is no scope for using alternative locations to entirely avoid impacts on biodiversity. Given the scale and type of development, and the raising of the site levels, there are very few possibilities for the incorporation of patches of vegetation into the design of a large industrial and warehouse development. During detailed design, investigations will be undertaken to refine the footprint of proposed drainage design in the south of the MPE Stage 2 site to minimise impacts the threatened plant species recorded within and adjacent to the Amended Proposal site. The Amended Proposal has revised the stormwater management design to minimise impacts to Anzac Creek. The revised stormwater design has

FBA section	FBA guidelines	Consistency of the Amended Proposal with FBA guidelines
		removed the southern drainage swale that discharged to Anzac Creek and previously resulted in the clearing of 0.01 hectares of Freshwater Wetlands EEC.
	3. loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile gaps.	The Amended Proposal site is located within an urban area and consists of predominantly cleared former Defence land. The development of the site will not result in a change in the connectivity value of adjoining areas of habitat in the Boot land.
	4. other site constraints – any other constraints that the assessor has considered in determining the siting and layout of the Major Project, e.g. bushfire protection requirements including clearing for asset protection zones, flood planning levels, servicing constraints.	N/A

8.2 Unavoidable impacts

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the construction of the Amended Proposal. Potential impacts specified in point 11a) of the SEARs as requiring assessment are considered below.

Endangered (and vulnerable) ecological communities

The Amended Proposal will require clearing of all vegetation within the Amended Proposal site, including threatened ecological communities. The threatened ecological communities to be directly impacted and the total areas of impact are listed in Table 8-3.

Table 8-3 Areas of direct impact to threatened ecological communities

Plant Community Type	Equivalent TEC	Conservation status	Area of impact		Total area of impact
			MPE Stage 2 site	Moorebank Avenue site	
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable (TSC Act) Endangered (EPBC Act)	0.1 ha	3.73 ha	3.74 ha
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Endangered (TSC Act)	0.05 ha	0 ha	0.05 ha

Plant Community Type	Equivalent TEC	Conservation status	Area of impact		Total area of impact
			MPE Stage 2 site	Moorebank Avenue site	
of the Cumberland Plain, Sydney Basin Bioregion		Critically Endangered (EPBC Act)			
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	Castlereagh Swamp Woodland	Endangered (TSC Act)	0 ha	0.22 ha	0.22 ha
Forest Red Gum - Rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered (TSC Act)	0 ha	0.59 ha	0.59 ha

The total area of native vegetation to be cleared from the Amended Proposal is 4.69 ha. A total of 0.15 ha will be cleared from the MPE Stage 2 site; the areas to be cleared consist of small, fragmented patches of vegetation and the disturbed edges of larger patches. The total area of native vegetation to be cleared from the Moorebank Avenue site is 4.54 ha.

Ecosystem credits are required to offset the impacts to these threatened ecological communities. The credit requirements are provided in Section 10.1.1.

Threatened flora and fauna species and their habitat

MPE Stage 2 site

Populations of several threatened plant species have been identified in the Boot land, to the east and south of the MPE Stage 2 site. Potential habitat for these species in the MPE Stage 2 site is marginal, and subject to fragmentation and/or edge effects.

The MPE Stage 2 site will have direct impacts on two threatened plant species; *Hibbertia puberula* subsp. *puberula* and *Persoonia nutans.* The *Hibbertia puberula* subsp. *puberula* to be directly impacted are growing in areas of marginal habitat in the regularly mown grassland in the south-east of the MPE Stage 2 site. The *Persoonia nutans* to be directly impacted are recently-sprouted seedlings growing at the southern extent of the MPE Stage 2 site.

There are additional records of *Persoonia nutans* and *Hibbertia puberula* subsp. *puberula* in the Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland adjoining the southern extent of the MPE Stage 2 site. There is potential for indirect impacts on these individuals, such as increased sedimentation, changes to hydrology and increased risk of weed invasion, from adjoining areas of proposed fill.

Moorebank Avenue site

The Amended Proposal will have direct impacts on three threatened plant species in the Moorebank Avenue site: *Hibbertia puberula* subsp. *puberula, Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.* The number of each species to be cleared is presented in Table 8-4.

The number of plants/stems to be cleared for the Amended Proposal has been compared with the total number of plants/stems in the Amended Proposal site plus the Wattle Grove Offset Area, as specified in the BAR prepared for the application for the Biobanking agreement (WSP Parsons Brinckerhoff 2017) as discussed in Section 10.1.

Table 8-4 Impacts to threatened flora species

Threatened Flora Species	Population in Amended Proposal site + Wattle Grove Offset Area	Number to be cleared		Total number to be cleared	Percentage of known/ estimated population on the Amended Proposal site + Wattle Grove Offset Area to be cleared
		MPE Stage 2 site	Moorebank Avenue site		
Acacia bynoeana Endangered (EPBC Act) Vulnerable (TSC Act)	33 plants	0	0	0	0%
Acacia pubescens Vulnerable (EPBC Act) Vulnerable (TSC Act)	Estimated stem count of 100	0	0	0	0%
Grevillea parviflora subsp. *parviflora* Vulnerable (EPBC Act) Vulnerable (TSC Act)	Estimated stem count of 13,679	0	79	79	0.58%
Hibbertia fumana Not listed (EPBC Act) Critically Endangered (TSC Act)	370 individuals*	0	0	0	0%
Hibbertia puberula subsp. puberula Not listed (EPBC Act)	653 plants	88 plants	22 plants	110 plants	17%

Threatened Flora Species	Population in Amended Proposal site + Wattle Grove Offset Area	Number to be cleared		Total number to be cleared	Percentage of known/ estimated population on the Amended Proposal site + Wattle Grove Offset Area to be cleared
		MPE Stage 2 site	Moorebank Avenue site		
Endangered (TSC Act)					
Persoonia nutans Endangered (EPBC Act) Endangered (TSC Act)	193 plants	4 plants	8 plants	12 plants	6%

*Additional investigations in September 2017 resulted in a population estimate of 14,270 individuals of this species (see Arcadis 2017a).

The Amended Proposal would result in the removal of structurally intact woodland, highly disturbed areas with scattered trees and landscaped vegetation providing habitat for fauna. The clearing of this vegetation will result in the loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, and groundlayer habitats such as ground timber and minor leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna, including threatened fauna, occurring within the locality. The Amended Proposal will require removal of seven trees identified as containing small hollows or bark fissures, located in the Moorebank Avenue road reserve (MPE Stage 2 site) and another two hollow-bearing trees identified by PB (2014a) on the Moorebank Avenue Site.

The removal of buildings currently within the Amended Proposal site may remove potential marginal roosting habitat for microchiropteran bats; this habitat is not considered likely to be significant. It is recommended that buildings are checked for roosting bats by an ecologist prior to demolition, to avoid potential mortality.

The assessment of ecosystem credit species associated with PCTs on the Amended Proposal site found that two threatened fauna species have a high likelihood of occurrence and 10 have a moderate likelihood of occurrence (Table 7-1). Ecosystem credits are required to offset the impacts to these threatened fauna species; the credit requirements are provided in Section 10.1.1.

The seven fauna species credit species identified by the credit calculator were all assessed as being unlikely to occur on the Amended Proposal site.

Groundwater dependent ecosystems

Impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of earthworks and geotechnical construction activities. This may have the potential to affect adjacent areas of retained vegetation and habitat that may utilise the shallow groundwater aquifers present. The vegetation adjoining Anzac Creek to the south of the Amended Proposal site has been identified as having high potential for groundwater interaction.

Any impacts are expected to be minor given the limited scope of excavation proposed, particularly in the southern portion of the Amended Proposal site. The detailed design process would further consider potential groundwater impacts and effects on groundwater-dependent ecosystems. In most cases, any impacts would be mitigated at the design phase.

Impacts on wildlife and habitat corridors and habitat fragmentation

The areas of habitat to be removed from within the Amended Proposal site for the Amended Proposal are currently fragmented by the existing development and other cleared land. There is good quality fauna habitat immediately adjacent to the MPE Stage 2 site, in the Boot land. The Boot land contains approximately 83 hectares of native vegetation in moderate to good condition.

The Amended Proposal has very minor overlap with the Boot land, and would not alter the existing connectivity values, further sever native vegetation or form a hard barrier within the connecting link.

The removal of vegetation in the Moorebank Avenue site would impact a narrow linear patch of trees that provides some connectivity for urban fauna in the road reserve, and allows for movement of some native fauna species across the MPW site and broader landscape (although much of the surrounding vegetation is fragmented).

Riparian land and aquatic habitat

Construction activities in proximity to Anzac Creek have the potential to adversely affect aquatic habitat, particularly the potential construction of stormwater drainage works in the south of the Amended Proposal site. The Amended Proposal includes construction of a fill mound in the south of the MPE Stage 2 site that would direct surface flows away from the MPE site, and towards Anzac Creek similar to the natural drainage patterns. The construction of this fill mound is unlikely to increase the volumes of sediments carried downstream or reduce water quality downstream.

No instream vegetation within Anzac Creek would be directly impacted as a result of the Amended Proposal. Other minor areas of aquatic habitat will be lost, such as the formalised channels/swales in the south of the Amended Proposal site that support aquatic and fringing vegetation and, offer habitat for reptiles and amphibians such as Common Eastern Froglet (*Crinia signifera*).

The Amended Proposal would increase the impervious surfaces on the site, potentially resulting in an increase in surface water runoff and changes to the flood regime within the Amended Proposal site and surrounding area. Modelling has demonstrated that sufficient capacity can be provided within the stormwater structures proposed to effectively drain the site in a 100 year ARI event and would not have any flooding impact to surrounding river systems.

Further, modelling also indicates that the discharge of surface water from the Proposal site would not alter the environmental availability of water to Anzac Creek and the Georges River. Water quality performance modelling (detailed in Section 12.3 of the EIS and Section 7 of the RtS) indicates that with the implementation of mitigation on the Amended Proposal site, including rain gardens and gross pollutant traps, the Amended Proposal would result in an improvement in water quality being discharged to Anzac Creek, the Georges River and hence surrounding river systems.

8.3 Cumulative impacts

There are three additional major approved and proposed developments within the immediate vicinity of the Amended Proposal: the MPE Stage 1 Project, the Moorebank Precinct West (MPW) Project and the Glenfield Recycling Facility.

The development of the three adjoining sites (MPW, MPE Stage 1 and Glenfield Waste facility) would reduce or remove a range of biodiversity values, including available fauna habitat (roosting, nesting and foraging habitat), potential threatened fauna habitat, threatened plant species, TECs, local provenance plant species and potential seedbanks.

The Glenfield Waste Facility proposal requires clearing of 9.5 hectares of the PCT Grey Box – Forest Red Gum grassy woodland on flats of the Cumberland Plain, Sydney Basin Bioregion, which forms part of the Critically Endangered Ecological Community (CEEC) Cumberland Plain Woodland, listed under the EPBC Act and TSC Act. As the Amended Proposal does not impact on Cumberland Plain Woodland, cumulative impacts on this TEC as a result of the Proposal are not predicted.

The total impacts to native vegetation, including TECs, are detailed in Table 8-5.

Table 8-5 Cumulative impacts to native vegetation from the Amended Proposal, MPE Stage 1 Project and MPW Stage 2 Proposal

Plant Community Type	Equivalent TEC	Area impacted by Amended Proposal		Area impacted by MPE Stage 1	Area impacted by MPW Stage 2*	Total area of impact
		Area impacted in the MPE Stage 2 site	Area impacted in the Moorebank Avenue site			
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion Endangered (TSC Act) Critically Endangered (EPBC Act)	0.05 ha	0 ha	0	0	0.05 ha
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion Vulnerable (TSC Act)	0.1 ha	3.73 ha	0.74 ha	13.54 ha	14.38 ha

Plant Community Type	Equivalent TEC	Area impacted by Amended Proposal		Area impacted by MPE Stage 1	Area impacted by MPW Stage 2*	Total area of impact
		Area impacted in the MPE Stage 2 site	Area impacted in the Moorebank Avenue site			
	Endangered (EPBC Act)					
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland Endangered (TSC Act)	0	0.22 ha	0.05 ha	0.68 ha	0.73 ha
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions Endangered (TSC Act)	0	0.59 ha	0.41 ha	28.47 ha	28.88 ha
Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion	Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions Endangered (TSC Act)	0	0	0.03 ha	0	0.03 ha
Total area of native vegetation cleared		**0.15 ha**	**4.54 ha**	**1.23 ha**	**42.69 ha**	**44.07 ha**

*Note that the MPW Stage 2 Proposal includes the area within the Moorebank Avenue site. As such, the Moorebank Avenue impacts are not included in the total.

The MPW Stage 2 Proposal will have direct impacts on populations of three threatened flora species listed under the TSC Act and EPBC Act, all of which were also recorded on the Stage 1 Project site. A summary of the impacts to threatened flora species from the MPW Stage 2 Proposal and the Stage 1 Project is shown in Table 8-6.

Table 8-6 Cumulative impacts to threatened flora species from the Amended Proposal, MPE Stage 1 Project and MPW Stage 2 Proposal

Threatened flora species	Conservation Status	Amended Proposal impacts		MPE Stage 1 impacts	MPW Stage 2 impacts*	Total impacts
		MPE Stage 2 site impacts	Moorebank Avenue site impacts			
Persoonia nutans	Endangered (EPBC Act, TSC Act)	4 plants	8 plants	11 plants	16 plants	31 plants
Grevillea parviflora subsp. *parviflora*	Vulnerable (EPBC Act, TSC Act)	0 stems	79 stems	20 stems	333 stems	353 stems
Hibbertia fumana	Critically endangered (TSC Act)	0 plants	0 plants	Up to 3 plants	0 plants	Up to 3 plants
Hibbertia puberula subsp. *puberula*	Endangered (TSC Act)	88 plants	22 plants	45 plants	83 plants	216 plants

*Note that the MPW Stage 2 Proposal includes the area within the Moorebank Avenue site. As such, the Moorebank Avenue site impacts are not included in the total.

Two threatened fauna species have a high likelihood of occurrence and 11 have a moderate likelihood of occurrence on the Amended Proposal Site. Given the modified and fragmented nature of fauna habitat in the Amended Proposal site, potential impacts on these species are considered likely to be minimal, and mainly comprise removal of marginal foraging, sheltering and roosting habitat. As a result, cumulative impacts to threatened fauna species from the Amended Proposal are considered to be unlikely.

9 MITIGATION OF IMPACTS

Biodiversity impacts cannot be avoided for many aspects of the Amended Proposal. As such, the measures in Table 9-1 should be implemented to mitigate these impacts during construction and operation.

Table 9-1 Measures to be implemented to minimise impacts on biodiversity

Mitigation measure	Outcome	Timing	Responsibility
A Construction Flora and Fauna Management Plan (CFFMP) would be prepared as part of the CEMP for the Amended Proposal. Native vegetation clearing for southern and eastern swales located outside of the MPE site would not occur until the Flora and Fauna Management Plan is approved. This would include the following: • Clear identification of vegetation exclusion zones • Site induction procedure, including briefings regarding the local threatened flora and local fauna of the site and protocols to be undertaken if they are encountered • Pre-clearance surveys of threatened flora species to determine the number of individuals impacted and requiring offset • A pre-start up check for sheltering native fauna of all infrastructure, plant and equipment and/or during relocation of stored construction materials • Application of speed limits in areas adjacent to native vegetation.	Flora and fauna would be managed in accordance with the requirements of the FFMP; prevention of over clearing of vegetation; prevention of weed establishment and invasion.	Pre-construction and construction	SIMTA and construction contractor
The threatened plant populations identified to the south of the Amended Proposal site would be protected by a minimum 10 metre setback between the edge of the area of occupied habitat and the proposed works. Where a 10 metre setback cannot be implemented, further assessment of impacts would be required and alternative mitigation strategies would be considered.	Prevention of indirect impacts to threatened plant species.	Construction	Construction contractor

Mitigation measure	Outcome	Timing	Responsibility
During detailed design, investigations will be undertaken to refine the footprint of proposed drainage design to minimise impacts the threatened plant species recorded within and adjacent to the Amended Proposal site. Where possible, the soils on the Amended Proposal site would be used instead of imported fill to construct batters and mounds, and revegetation of batters and mounds would use local native shrub and groundlayer species.	Prevention of direct impacts to threatened plant species, conservation of existing soils that may contain propagules of threatened plant species	Pre-construction and construction	SIMTA and construction contractor
Potential bat roosting locations in buildings to be demolished would be checked, as far as is practicable, by a qualified ecologist or wildlife carer for presence of bats prior to demolition. Any bats found would be relocated.	Prevents fauna injury/mortality	Construction	Construction contractor
Undertake a two-stage approach to clearing: • Remove non-hollow bearing trees at least 48 hours before habitat trees are removed. • Hollow bearing trees are to be knocked with an excavator bucket or other machinery to encourage fauna to evacuate the tree immediately prior to felling. • Felled trees must be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees. Felled hollow bearing trees must be inspected by an ecologist as soon as possible (not longer than 2 hours after felling).	Prevents fauna injury/mortality	Construction	Construction contractor

Mitigation measure	Outcome	Timing	Responsibility
Site inductions are to include a briefing regarding the local fauna of the site and protocols to be undertaken if fauna are encountered.	Prevents fauna injury/mortality	Construction	Construction contractor
If any animal is injured, contact the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by: • Handling fauna with care and as little as possible. • Covering larger animals with a towel or blanket and placing in a large cardboard box. • Placing small animals in a cotton bag, tied at the top. Keeping the animal in a quiet, warm, ventilated and dark location.	Prevents fauna injury/ mortality	Pre-construction, construction and operation	Construction contractor and SIMTA
Directional lighting will be used where lighting is required in construction areas.	Minimises disruption to fauna foraging, nesting or roosting behaviours	Construction	Construction contractor
Frequent maintenance of construction machinery and plant will be undertaken to minimise unnecessary noise.	Minimises disruption to fauna foraging, nesting or roosting behaviours	Construction	Construction contractor
A Flora and Fauna Management Plan would be prepared as part of the OEMP for the Amended Proposal. This FFMP would focus on minimising impacts on biodiversity values on the adjacent Boot Land.	Prevention of impacts to flora and fauna within conservation area.	Pre-construction/construction	Construction contractor

10 OFFSETTING IMPACTS

A comprehensive Biodiversity Offset Strategy (BOS) for the MPE Project is required to be prepared and implemented under the MPE Concept Plan Approval. The BOS will be prepared in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise, offset' principle.

10.1 Offset credit requirements

Under the *NSW Biodiversity Offsets Policy for Major Projects*, a biobanking agreement is required to be used to secure an offset site. The direct offsets for threatened species and communities impacted by the Amended Proposal will be delivered through the establishment of a Biobanking site to offset the broader project impacts under the NSW Biobanking scheme.

A Biobanking agreement application has been submitted to, and is currently being assessed by, the NSW Office of Environment and Heritage. The proposed Biobanking agreement will provide funded management actions, monitoring and long-term security of the Biobank site in-perpetuity.

Upon execution of the Biobanking agreement, the appropriate number of Biobanking credits generated from the Biobank site to offset the impacts of the Amended Proposal will be retired. Should additional credits not available on the offset sites included in the Biobanking Agreement be required, these would be sourced from the market or additional offset sites outside the Moorebank precinct, in accordance with the BOS.

It should be noted that the impacts to PCTs and threatened species in the Moorebank Avenue site have also been assessed in the MPW Stage 2 BAR prepared by Arcadis (2017c). The Moorebank Avenue site is located within the larger MPW Stage 2 Proposal site. The offset requirements related to values in the Moorebank Avenue site may be included within either the BOS for the MPE Project or the MPW Project, subject to the timing of determination of the MPE Stage 2 Proposal (Amended Proposal) and the MPW Stage 2 Proposal.

Offset credit requirements were calculated using the FBA calculator, by Jane Rodd (Assessor No. 0023) for the Amended Proposal. The full credit report for both calculations are provided in Appendix A.

10.1.1 Impacts on native vegetation

Loss of landscape and site value for each PCT identified on the Amended Proposal site and its associated ecosystem species, as determined using the credit calculator, is presented in Table 10-1. The PCTs to be offset are shown in Figure 6-1.

Table 10-1 Impact summary for PCTs and associated ecosystem credit species requiring offsets and their required credits

Vegetation zone	Associated EECs and/or Threatened Species	Area to be impacted	Loss in landscape value	Loss in site value score	Number of Ecosystem credits required
MPE Stage 2 site					
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003): Moderate/Good	Castlereagh Scribbly Gum Woodland of the Sydney Basin bioregion (VEC)	0.1 ha	12	68.23	4
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (ME002): Moderate/Good	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	0.05 ha	12	74.48	3
Moorebank Avenue site					
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium (ME003)	Castlereagh Scribbly Gum Woodland of the Sydney Basin bioregion (VEC)	3.73	12	55.73	167
Parramatta Red Gum woodland on moist alluvium of the Cumberland	Castlereagh Swamp Woodland	0.22	12	33.33	6

Vegetation zone	Associated EECs and/or Threatened Species	Area to be impacted	Loss in landscape value	Loss in site value score	Number of Ecosystem credits required
Plain, Sydney Basin: Moderate/Good					
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	0.59	12	34.38	17

10.1.2 Impacts on threatened species

Impacts to threatened species credit species and their associated species are summarised in Table 10-2.

Table 10-2 Impact summary for threatened species credit species requiring offsets and their required credits

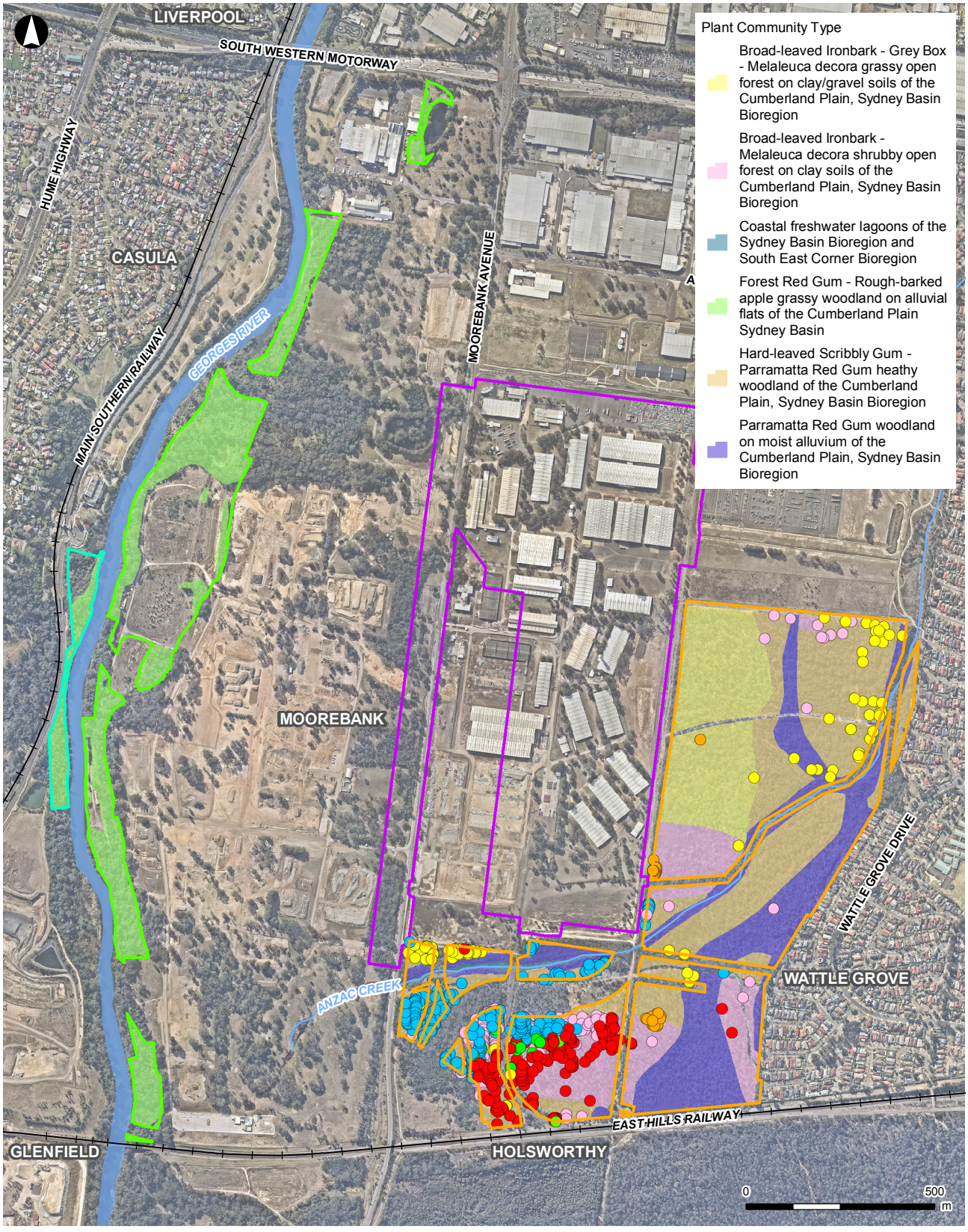
Common name	Scientific name	TSC Act Status	Impacts (number of individuals		Total impacts	Number of species credits required
			MPE Stage 2 site	Moorebank Avenue site		
Nodding Geebung	*Persoonia nutans*	Endangered	4	8	12	924
-	*Hibbertia puberula* subsp. *puberula*	Endangered	88	22	110	4400
Small-flower Grevillea	*Grevillea parviflora* subsp. *parviflora*	Vulnerable	0	79	79	1106

10.2 Offset site identification

The proposed biobank site to be established under the proposed Biobanking agreement comprises of three biodiversity offset areas, as outlined below :

- Wattle Grove Offset Area – management to maintain or improve the condition of vegetation and habitat of native vegetation (approximately 73.81 hectares) within part of the eastern portion of Lot 4 DP 1197707 (the Boot land) east of Moorebank Avenue, which adjoins the East Hills Railway Line to the south, land owned by the SIMTA consortium to the northwest, and the residential area of the Wattle Grove to the east.
- Moorebank Offset Area – Georges River riparian zone: restoration and management of the Georges River riparian zone (approximately 32.3–38.6 hectares) including the eastern side of the river corridor from approximately 300 metres south of the M5 Motorway for a length of approximately 2.5 km south of the East Hills Railway Line within part of Lot 1 DP 1197707 and part of Lot 100 DP 1049508.
- Casula Offset Area (also referred to as the 'hourglass land'): restoration and management of vegetation within part of Lot 4 DP 1130937 which is an irregular shaped allotment (approximately 3.2 hectares) on the western side of the Georges River.

The proposed Wattle Grove Offset Areas is located immediately adjacent to the area impacted by the Amended Proposal, and the Moorebank Offset Area is located approximately 450 metres to the west of the Amended Proposal site, next to the Georges River. The Casula Offset Area is located on the western side of the Georges River approximately 850 metres west of the Amended Proposal site. The proposed biobank site is shown on Figure 10-1.



LEGEND

- Amended Proposal site
- Casula offset area
- Moorebank offset area
- Wattle Grove offset area
- Watercourse
- Existing railway

Flora Species

- Acacia bynoeana
- Acacia pubescens
- Grevillea parviflora subsp. parviflora
- Hibbertia fumana
- Hibbertia puberula subsp. puberula
- Persoonia nutans

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Coordinate System: GDA 1994 MGA Zone 56
Aerial imagery supplied by nearmap (August, 2017)

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SIMTA

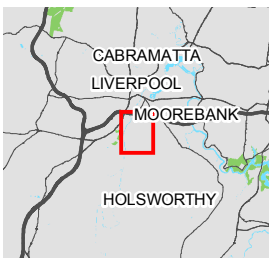

Figure 10-1: Proposed biobank site

10.3 Improvement in biodiversity values at an offset site

A BAR has been prepared to determine the credit values generated on the proposed offset sites (WSP Parsons Brinckerhoff 2017). The biodiversity assessment for the proposed biobank site included desk-based searches of relevant databases and historical records, as well as field inspections of the proposed biobank site.

The BAR prepared for the Biobanking agreement application is currently under assessment; the information in sections 10.3 and 10.4 below is as presented in the BAR and is subject to further review by OEH. Some changes to credit values and PCT definitions may occur following assessment and prior to finalisation of the Biobanking Agreement.

10.3.1 Ecosystem credits

The vegetation within the Wattle Grove Offset Area consisted of remnant and regrowth native vegetation that has been subjected to minor weed invasion in small areas. The majority of the vegetation within this offset area consists of remnant forest vegetation in moderate to good condition, representative of five PCTs within the Sydney Metro CMA.

The majority of the vegetation within the proposed Moorebank and Casula Offset Areas consisted of remnant vegetation in moderate condition, representative of one PCT within the Sydney Metro CMA (ME018).

The six PCTs identified in the biobank site generate ecosystem credits as listed in Table 10-3.

Table 10-3 Availability of ecosystem credit offsets on proposed biobank site

Plant community type	Area of PCT in biobank site	Ecosystem credits available on biobank site
ME002 Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	12.58 ha	143
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	30.71 ha	414
ME004 Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion	13.08 ha	193
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	18.65 ha	250
ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner	0.60 ha	8
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	31.56 ha	410

10.3.2 Species credits

The Wattle Grove Offset Area provides known habitat for at least six threatened plant species, as listed in Table 10-4 , with populations of these species present on site. The number of plants/stems and the species credits generated on the Wattle Grove Offset Area have been sourced from the BAR prepared for the application for the Biobanking agreement (WSP Parsons Brinckerhoff 2017), with additional reference to further surveys undertaken in September 2017 for the MPE Stage 1 updated BAR (Arcadis 2017a).

The population numbers for some threatened species may increase if additional plants/stems are detected on the offset area. Each plant/stem recorded generates approximately 7.1 species credits under the Biobanking framework.

Table 10-4 Availability of species credit offsets on proposed biobank site

Species	Conservation status	Approximate number of individuals/area of habitat in Wattle Grove Offset Area	Species credits available in Wattle Grove Offset Area
Acacia bynoeana Bynoe's Wattle	EPBC Act: Vulnerable TSC Act: Endangered	33 individuals	234
Acacia pubescens Downy Wattle	EPBC Act: Vulnerable TSC Act: Vulnerable	Estimated stem count of 100	710
Grevillea parviflora subsp. *parviflora* Small-flowered Grevillea	EPBC Act: Vulnerable TSC Act: Vulnerable	Estimated stem count of 13,600	96,560
Hibbertia fumana	EPBC Act: not listed TSC Act: Critically Endangered (provisional listing)	370 plants*	2,627
Hibbertia puberula subsp. *puberula*	EPBC Act: Not listed TSC Act: Endangered	549 individuals	3,898
Persoonia nutans Nodding Geebung	EPBC Act: Vulnerable TSC Act: Endangered	181 individuals	1,285
Cercartetus nanus Eastern Pygmy Possum	EPBC Act: not listed TSC Act: Vulnerable	54.23 ha	385
Myotis macropus Southern Myotis	EPBC Act: not listed TSC Act: Vulnerable	10 ha	71

Additional investigations in September 2017 by Arcadis (2017a) resulted in a population estimate of 14,270 individuals of this species (see section 7.2.2).

10.4 Credit balance

A comparison of the ecosystem and species credits calculated for the Amended Proposal site and the adjacent MPE Stage 1 Project, and the proposed biobank site, was undertaken. The MPW Stage 2 Amended Proposal has not been included in this comparison, as the MPW Stage 2 Amended Proposal site overlaps areas within the Amended Proposal site, and there would be associated credit overlaps.

The comparison (Table 10-5 and Table 10-6) indicates that the proposed biobank site generates sufficient ecosystem credits to offset the biodiversity impacts of the Amended Proposal and the MPE Stage 1 Project, but there is a deficit in the species credits required for offsets for *Hibbertia puberula* subsp. *puberula* and *Persoonia nutans* (Table 10-6).

The eastern half of the Wattle Grove Offset Area has not been subject to targeted threatened flora survey for *Hibbertia puberula* subsp. *puberula,* but does contain a large area of suitable habitat for the species. Additional surveys for threatened flora species in this area are scheduled for November - December 2017. If additional like-for-like species credits cannot be generated from the Wattle Grove Area, variation rules will be applied where appropriate. If a credit deficit remains, then credits will be sourced from the market as available, or supplementary measures will be investigated in consultation with OEH.

Table 10-5 Ecosystem credit comparison

Plant community type	Ecosystem credits required for Amended Proposal	Ecosystem credits required for MPE Stage 1 Project	Total Ecosystem credits required for MPE Project	Ecosystem credits available on biobank site	Ecosystem credits remaining
ME002 Broad-leaved Ironbark – Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	3	0	3	143	140
ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	171	102	273	414	141
ME004 Broad-leaved Ironbark – Grey Box – Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland	0	0	0	193	193

Plant community type	Ecosystem credits required for Amended Proposal	Ecosystem credits required for MPE Stage 1 Project	Total Ecosystem credits required for MPE Project	Ecosystem credits available on biobank site	Ecosystem credits remaining
Plain, Sydney Basin Bioregion					
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	6	8	14	250	236
ME007 Coastal freshwater lagoons of the Sydney Basin and South-east Corner	0	3	3	8	5
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	17	60	77	410	333

Table 10-6 Species credit comparison

Species	Species credits required for Amended Proposal	Species credits required for MPE Stage 1 Project	Total species credits required for MPE Project	Number of species credits available on Wattle Grove Offset Area	Species credits remaining
Acacia bynoeana Bynoe's Wattle	0	0	0	234	234
Acacia pubescens Downy Wattle	0	0	0	710	710
Grevillea parviflora subsp. *parviflora* Small-flowered Grevillea	1106	280	1386	96560	94038
Hibbertia fumana	0	231	231	2,627*	2,396

Species	Species credits required for Amended Proposal	Species credits required for MPE Stage 1 Project	Total species credits required for MPE Project	Number of species credits available on Wattle Grove Offset Area	Species credits remaining
Hibbertia puberula subsp. *puberula*	4400	1800	6200	3898	-2302
Persoonia nutans Nodding Geebung	924	847	1771	1285	-486
Cercartetus nanus Eastern Pygmy Possum	0	14	14	385	371
Myotis macropus Southern Myotis	0	1	1	71	70

Additional investigations in September 2017 by Arcadis (2017a) resulted in a population estimate of 14,270 individuals of this species (see section 7.2.2).

11 CONCLUSION

This Biodiversity Assessment Report (BAR) has been prepared by accredited ecologists to support the *Moorebank Precinct East-Stage 2 Proposal Response to Submissions* (Arcadis 2017). This BAR replaces the BAR that was prepared to support the *Moorebank Precinct East-Stage 2 Proposal Environmental Impacts Statement* (Arcadis 2016), and provides the following additional information:

- RtS updates:
  - Details on how comments received by key government agencies (specifically, NSW OEH and DP&E) provided during the public exhibition of the EIS have been addressed.
  - Details of additional environmental assessment that has been carried out for the Amended Proposal (including the results of additional threatened flora surveys along and near the MPE site boundary).
- Additional verification surveys:
  - A validation of previous identification of Hibbertia species that occur in the MPE Stage 2 site.
  - Identification of additional Hibbertia species that occur in the MPE Stage 2 site, in areas that were previously surveyed.
- Moorebank Avenue site:
  - Consideration of all impacts related to the clearing required in the Moorebank Avenue site, for Moorebank Avenue Upgrade Works.
  - A validation of previous identification of Hibbertia species that occur in the Moorebank Avenue site.
- Revised mapping and calculations relating to impacts, predicted species and ecosystem credits and offsetting requirements.

This BAR has been prepared in accordance with the Framework for Biodiversity Assessment (FBA), as required by the SEARs. The BAR provides an assessment of potential biodiversity impacts of the Amended Proposal, at the Amended Proposal site which includes both the MPE Stage 2 site and the Moorebank Avenue site.

The assessment is based on desktop research and detailed field surveys, undertaken across the MPE site on a number of occasions between 2011 and 2017. Supplementary field investigations of the MPE Stage 2 site were conducted in June and October 2016 and May and October 2017. Field surveys of the MPW site, some of which are relevant to the Moorebank Avenue site, have been undertaken on a number of occasions between 2010 and 2016. The Moorebank Avenue site was reinspected in November 2017 specifically to validate previous identification of *Hibbertia* species.

The biodiversity impacts and offset requirements for the MPE Stage 2 site and the Moorebank Avenue site (collectively the Amended Proposal site) were calculated using the FBA Credit Calculator in accordance with the FBA guidelines.

The vegetation within the MPE Stage 2 site consisted predominantly of planted and disturbed vegetation. Native vegetation within the MPE Stage 2 site consists of small, fragmented patches of vegetation and the disturbed edges of larger patches. Vegetation within the Moorebank Avenue site consists predominantly of remnant and regrowth native vegetation that has been subjected to weed invasion in some areas.

Following review of existing information and structural and floristic attributes recorded during field investigations, two PCTs identified in the MPE Stage 2 site and three PCTs identified in the Moorebank Avenue site fall within the definitions of threatened ecological communities listed under the TSC Act and/or EPBC Act, as per Table 11-1.

Table 11-1 Threatened ecological communities on the MPE Stage 2 site and Moorebank Avenue site

Plant Community Type	Equivalent TEC	TSC Act Status	EPBC Act Status
MPE Stage 2 site			
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable	Endangered
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion (ME002)	Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion	Endangered	Critically Endangered
Moorebank Avenue site			
Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin (ME003)	Castlereagh Scribbly Gum Woodland in the Sydney Basin bioregion	Vulnerable	Endangered
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered	Not listed
Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions	Endangered	Not listed

A total of 17 threatened flora species were identified in the FBA credit calculator as predicted flora species credit species. Three of the threatened flora species credit species identified by the credit calculator were recorded within the Amended Proposal site: *Hibbertia puberula* subsp. *puberula, Persoonia nutans* and *Grevillea parviflora* subsp. *parviflora.* These species as well as another two species credit species identified by the credit calculator, *Acacia bynoeana* and *Acacia pubescens,* were recorded in the Boot land to the south and east of the Amended Proposal site. Another threatened species not identified by the calculator, *Hibbertia fumana,* was recorded in the Boot land to the south of the Amended Proposal site. This species occurs in several locations, varying between 77 and 133 metres from the Amended Proposal site boundary.

The majority of the MPE Stage 2 site represents low quality habitat for threatened flora species, and threatened flora species were recorded in areas of marginal scattered regrowth habitat within this part of the Amended Proposal site. There are populations of several threatened flora species in the Boot land to the south and east of the MPE Stage 2 site. The threatened flora species recorded in the Moorebank Avenue site are within patches of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin.

A total of 23 threatened fauna species were derived from the PCTs identified on the Amended Proposal site as predicted ecosystem credit species. None of the predicted threatened fauna ecosystem credit species were recorded on the Amended Proposal site. Assessment of the potential presence of each species in the Amended Proposal site found that two species have a high likelihood of occurrence and 10 have a moderate likelihood of occurrence.

Seven threatened fauna species were identified in the credit calculator as predicted fauna species credit species. None of the predicted threatened fauna species credit species were recorded or are considered likely to occur on the Amended Proposal site.

The assessment considered the construction and operational impacts of the Amended Proposal. The potential biodiversity impacts of the Amended Proposal are as follows:

- Clearing of four Plant Community Types within the Amended Proposal site:
  - Clearing of all vegetation within the MPE Stage 2 site, including threatened ecological communities (TECs). The total area of native vegetation to be cleared is 0.15 ha; the areas to be cleared comprise small, fragmented patches of vegetation and the disturbed edges of larger patches. The total area to be cleared consists of two plant community types (PCTs):
    - 0.1 hectares of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin. This PCT corresponds with the TEC Castlereagh Scribbly Gum Woodland in the Sydney Basin Bioregion, which is listed as vulnerable under the TSC Act and endangered under the EPBC Act.
    - 0.05 hectares of Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain. This PCT corresponds with the TEC Cooks River – Castlereagh Ironbark Forest in the Sydney Basin Bioregion, which is listed as endangered under the TSC Act and critically endangered under the EPBC Act.
  - Clearing of all vegetation within the Moorebank Avenue site, including threatened ecological communities (TECs). The total area of native vegetation to be cleared is 4.54 ha; the areas to be cleared comprise small, fragmented patches of vegetation and the disturbed edges of larger patches. The total area to be cleared consists of three PCTs:
    - 3.72 hectares of Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin, which is listed as vulnerable under the TSC Act and endangered under the EPBC Act.
    - 0.22 hectares of Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion. This PCT corresponds with the TEC Castlereagh Swamp Woodland, which is listed as endangered under the TSC Act.
    - 0.59 hectares of Forest Red Gum - Rough-barked apple grassy woodland on alluvial flats of the Cumberland Plain Sydney Basin. This PCT corresponds with the TEC River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions, which is listed as endangered under the TSC Act.
- The Amended Proposal will have direct impacts on three threatened plant species;
  - Clearing of two threatened species that occur within MPE Stage 2 site:
    - *Hibbertia puberula* subsp. *puberula* (88 plants).
    - *Persoonia nutans* (4 plants).
  - Clearing of three threatened species that occur in the Moorebank Avenue site:
    - *Hibbertia puberula* subsp. *puberula* (22 plants).
    - *Persoonia nutans* (8 plants).
    - *Grevillea parviflora* subsp. *parviflora* (79 stems).
- Potential indirect impacts on records of *Persoonia nutans* and *Hibbertia puberula* subsp. *puberula* in the Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland immediately adjoining the southern extent of the MPE Stage 2 site.

Indirect impacts may include increased sedimentation, changes to hydrology and increased risk of weed invasion, from adjoining areas of proposed fill.

- Some loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, and groundlayer habitats such as ground timber and minor leaf litter. Removal of buildings currently within the Amended Proposal site may remove potential marginal roosting habitat for microchiropteran bats.
- Potential for minor impacts to groundwater dependent ecosystems, such as drawdown of groundwater from the root zone, may occur as a result of excavation during construction. While this may have some potential to affect adjacent areas of retained vegetation and habitat that may utilise the shallow groundwater aquifers present, any impacts are expected to be minor given the limited scope of excavation proposed, particularly in the southern portion of the Amended Proposal site. The detailed design process would further consider potential groundwater impacts and effects on groundwater-dependent ecosystems. In most cases, any impacts would be mitigated at the design phase
- The small areas of habitat to be removed from within the Amended Proposal site for the Amended Proposal are currently fragmented by the existing development. There is good quality fauna habitat on land immediately adjacent to the Amended Proposal site, known as the Boot land, which would be retained. The Boot land contains approximately 83 hectares of native vegetation in moderate to good condition which would not be impacted by the Amended Proposal.
- Minimal impact on wildlife and habitat corridors as neither the Amended Proposal would not alter existing connectivity values and would not further sever native vegetation or form a hard barrier within existing connecting links.
- Construction activities in proximity to Anzac Creek have the potential to adversely affect aquatic habitat, particularly the construction of a swale in the south of the Amended Proposal site to drain stormwater to Anzac Creek. Impacts to aquatic habitat are expected to be minor.

Impacts on the identified ecological values have been avoided in the Amended Proposal as far as practicable. Where impacts cannot be avoided, the scale and extent of impacts has been determined, and a range of mitigation measures have been recommended to ameliorate impacts on the biodiversity values during and following construction.

A comprehensive Biodiversity Offset Strategy (BOS) for the MPE Project is required to be prepared and implemented under the MPE Concept Plan Approval. The BOS will be prepared in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise, offset' principle.

The following offset requirements have been determined for the Amended Proposal:

- 171 ecosystem credits for Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin.
- 3 ecosystem credits for Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain.
- 6 ecosystem credits for Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin.
- 17 ecosystem credits for Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin.
- 4400 species credits for *Hibbertia puberula* subsp. *puberula.*
- 924 species credits for *Persoonia nutans.*

- 1106 species credit species for *Grevillea parviflora* subsp. *parviflora.*

The offset requirements related to values in the Moorebank Avenue site may be included within either the BOS for the MPE Project or the MPW Project, subject to the timing of determination of the MPE Stage 2 Proposal (Amended Proposal) and the MPW Stage 2 Proposal.

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APPENDIX A

BIOBANKING CREDIT REPORT

Biodiversity credit report

This report identifies the number and type of biodiversity credits required for a major project.

Date of report: 6/11/2017 Time: 6:25:47PM Calculator version: v4.0

Major Project details

Proposal ID:	0023/2017/4638MP
Proposal name:	MPE Stage 2 Amended Proposal
Proposal address:	Moorebank Avenue Moorebank NSW 2170
Proponent name:	Tactical Group
Proponent address:	Level 15, 124 Walker Street North Sydney NSW 2060
Proponent phone:	89070700
Assessor name:	Jane Rodd
Assessor address:	Level 5, 141 Walker Street NORTH SYDNEY NSW 2060
Assessor phone:	8907 8266
Assessor accreditation:	0023

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion	0.05	3.00
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	0.59	17.00
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	3.83	171.00
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	0.22	6.16
Total	4.69	197

Credit profiles

1. Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (ME002)

Number of ecosystem credits created	3
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (ME002)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

2. Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)

Number of ecosystem credits created	167
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

3. Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)

Number of ecosystem credits created	4
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion, (ME003)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

4. Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005)

Number of ecosystem credits created	6
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion, (ME005)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

5. Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018)

Number of ecosystem credits created	17
IBRA sub-region	Cumberland - Sydney Metro

Offset options - Plant Community types	Offset options - IBRA sub-regions
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion, (ME018)	Cumberland - Sydney Metro and any IBRA subregion that adjoins the IBRA subregion in which the development occurs

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Hibbertia puberula	Hibbertia puberula	110.00	4,400
Nodding Geebung	Persoonia nutans	12.00	924
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	79.00	1,106