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Moorebank Precinct West (MPW) – Stage 2 Proposal

Biodiversity Assessment Report

SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

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SYDNEY INTERMODAL TERMINAL ALLIANCE (SIMTA)
MPW STAGE 2

Biodiversity Assessment Report

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APPENDICES

1 INTRODUCTION

On the 3 June 2016 Concept Plan Approval (SSD 5066) was granted, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to develop the Moorebank Precinct West Project (MPW Project) on the western side of Moorebank Avenue, Moorebank, in south-western Sydney (the MPW site).

The MPW Project involves the development of intermodal freight terminal facilities (IMT), linked to Port Botany, the interstate and intrastate freight rail network. The MPW Project includes associated commercial infrastructure (i.e. warehousing), a rail link connecting the MPW site to the Southern Sydney Freight Line (SSFL), and a road entry and exit point from Moorebank Avenue.

Under the Concept Plan Approval, the MPW Project is to be developed in four phases, being:

- Early Works development phase, comprising:
    - The demolition of existing buildings and structures
    - Service utility terminations and diversion/relocation
    - Removal of existing hardstand/roads/pavements and infrastructure associated with existing buildings
    - Rehabilitation of the excavation/earthmoving training area (i.e. 'dust bowl')
    - Remediation of contaminated land and hotspots, including areas known to contain asbestos, and the removal of:
        - Underground storage tanks (USTs)
        - Unexploded ordnance (UXO) and explosive ordnance waste (EOW) if found
        - Asbestos contaminated buildings
    - Archaeological salvage of Aboriginal and European sites
    - Establishment of a conservation area along the Georges River
    - Establishment of construction facilities (which may include a construction laydown area, site offices, hygiene units, kitchen facilities, wheel wash and staff parking) and access, including site security
    - Vegetation removal, including the relocation of hollow-bearing trees, as required for remediation and demolition purposes
- Development of the intermodal terminal (IMT) facility and initial warehousing facilities
- 'Ramp up' of the IMT capacity and warehousing
- Development of further warehousing.

Approval for the Early Works phase (MPW Concept Plan Approval) was granted as the first stage of the MPW Project within the Concept Plan Approval. Works, approved as part of this stage are anticipated to commence in the third quarter of 2016.

Commonwealth Approval (No. 2011/6086), under the *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act), was also granted in mid 2016 (soon after the Concept Plan Approval) for the MPW Project). In addition to this, the Planning Proposal (PP_2012_LPOOL_004_00) which provided a rezoning of part of the MPW site, and surrounds, was gazetted on 24 June 2016 into the *Liverpool Local Environmental Plan 2008* (Amendment No. 62).

On 5 December 2014, Moorebank Intermodal Terminal Company (MIC) and SIMTA announced their in-principle agreement to develop the Moorebank IMT Precinct on a whole of precinct basis. This agreement is subject to satisfying several conditions which both parties are currently working towards. SIMTA is therefore seeking approval to build and operate the IMT facility and warehousing under the MPW Project Concept Approval, known as the MPW Stage 2 Proposal (the Proposal).

1.1 Report purpose

This report has been prepared to support the Environmental Impact Statement (EIS) for approval of the Proposal. A summary of the works included in the Proposal is provided below.

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 report has been prepared in accordance with the Secretary's Environmental Assessment Requirements (SEARs) (ref: SSD 16-7709 and dated 14 July 2016), and revised environmental mitigation measures (REMMs) identified in the MPW Concept Plan Approval (SSD_5066). Table 1-1 provides a summary of the SEARs and the REMMs from the MPW Concept Plan Approval, which are relevant to this report and the section where they have been addressed in this report.

Table 1-1 Assessment requirements

Section / number	SEAR / CoA / REMM	Where addressed in this report
SEARs		
12.	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 (and vulnerable) 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;	Sections 6, 7, 8 and 9
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;	This assessment relies on the detailed site assessments conducted by PB (2014b) – see Section 4
c)	assess and document impacts related to the proposed project in accordance with the Framework for Biodiversity	This report has been prepared in

Section / number	SEAR / CoA / REMM	Where addressed in this report
	Assessment (OEH 2014), unless otherwise agreed by OEH, by a person accredited in accordance with s142B(1)(c) of the Threatened Species Conservation Act 1995. This assessment shall include consideration of any new impacts that are outside of previous assessments; and	accordance with the FBA.
d)	include a comprehensive offset strategy, or provide an updated strategy (including any new impacts if relevant), in accordance with the NSW Biodiversity Offsets Policy for Major Projects including the Framework for Biodiversity Assessment (OEH 2014), consistent with the 'avoid, minimise or offset' principle.	A Biodiversity Offset Strategy (BOS) for the MPW Project is being prepared as part of the MPW Concept Plan Approval.. Further discussion in Section 10.
8.	Soil and Water	
a)	assess impacts on surface and groundwater flows, quality and quantity, with particular reference to any likely impacts on dragonfly species listed under the Fisheries Management Act 1994, the Georges River and Anzac Creek;	Section 7.3 Section 8.2
REMMs		
6A	Following detailed design and before construction, detailed flora and fauna mitigation measures would be developed and presented as part of the CEMP. These detailed measures would incorporate the measures listed in 6B to 6W. The CEMP would address: • general impact mitigation; • staff/contractor inductions; • vegetation clearing protocols; • pre-clearing surveys and fauna salvage/translocation; • rehabilitation and restitution of adjoining habitat; • weed control; • pest management; and • monitoring. The plans would include clear objectives and actions for the	Section 9, Table 9-1

Section / number	SEAR / CoA / REMM	Where addressed in this report
	Project including how to: • minimise human interferences to flora and fauna; • minimise vegetation clearing/disturbance; • minimise impact to threatened species and communities; • minimise impacts to aquatic habitats and species; and • undertake flora and fauna monitoring at regular intervals.	
6B	Vegetation clearing would be restricted to the construction footprint and sensitive areas would be clearly identified as exclusion zones.	Section 9, Table 9-1
6C	The exclusion zones would be marked on maps, which would be provided to contractors, and would also be marked on the ground using high visibility fencing (such as barrier mesh).	Section 9, Table 9-1
6D	A trained ecologist would accompany clearing crews to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat.	Section 9, Table 9-1
6E	A staged habitat removal process would be developed and would include the identification and marking of all habitat trees in the area. Where reasonable and feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-dependent birds in the locality are also unlikely to be breeding. Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor. Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave the tree. A minimum 48 hour waiting period would allow animals to leave. After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which may then be felled, commencing with the most distant trees from secure habitat. Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the	Section 9, Table 9-1

Section / number	SEAR / CoA / REMM	Where addressed in this report
	construction area, at the discretion of the supervising ecologist. All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in relation to any animal injured or orphaned during clearing. Within areas of high quality intact native vegetation proposed to be removed: • topsoil (and seedbank) is to be collected from native vegetation that are to be permanently cleared and used in the revegetation of riparian areas; and • Native plants in areas that are to be permanently cleared are to be relocated and transplanted in riparian areas identified for rehabilitation	
6F	Relocation of fauna to adjacent retained habitat would be undertaken by an ecologist during the supervision of vegetation removal.	Section 9, Table 9-1
6G	An ecologist would supervise the drainage of any waterbodies on the Project site and would relocate native fish (e.g. eels), tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the IMT site.	Section 9, Table 9-1
6H	The design of site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk where practicable.	Section 9, Table 9-1
6I	The potential for translocation of threatened plant species as individuals or as part of a soil translocation process would be considered during the detailed development of the CEMP.	Section 9, Table 9-1
6J	Consideration would be given to fitting roost boxes to the bridge over the Georges River to provide roost sites for the Large-footed Myotis and other species of microbats (e.g. Eastern Bentwing-bat) which may utilise such structures. Provision of roost boxes under bridges has been identified as priority action for the recovery of the Large-footed Myotis.	N/A – Georges River Bridge is not part of the current Proposal
6K	Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the conservation area which would not be cleared during the Project, or to stockpiles for later use in vegetation/habitat restoration.	Section 9, Table 9-1

Section / number	SEAR / CoA / REMM	Where addressed in this report
6L	Winter-flowering trees would be preferentially planted in landscaped areas of the Project site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox.	Section 9, Table 9-1
6M	A bridge/viaduct or similar design would be used for the railway crossing of the Georges River. This may allow connectivity of terrestrial habitat along the river banks underneath the bridge	N/A – Georges River Bridge is not part of the current Proposal
6N	Options for maintaining habitat connectivity would be investigated, and may include establishing native vegetation and placing habitat elements such as rock piles and large woody debris under the bridge to provide cover for fauna. Where reasonable and feasible options to allow light and moisture to penetrate under the Georges River bridge will be incorporated into the detailed design.	N/A – Georges River Bridge is not part of the current Proposal
6O	Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality.	Section 9, Table 9-1
6P	The detailed design process for the bridge over the Georges River would consider disturbance to aquatic habitat and fish passage conditions. The design would as a minimum adhere to the fish friendly passage guidelines (Fairfull & Witheridge 2003) for waterway crossings.	N/A – Georges River Bridge is not part of the current Proposal
6Q	Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Project and, if practicable, implemented so that they would provide similar habitat in the medium term to that lost through the removal of existing basins.	Section 9, Table 9-1
6R	The CEMP (or equivalent) would include detailed measures for minimising the risk of introducing weeds and pathogens.	Section 9, Table 9-1
6S	The Project would include a long-term program for the duration of the Project operation of weed removal and riparian vegetation restoration within parts of the Georges River corridor, which would include monitoring landscaped areas for the presence of noxious and environmental weeds. A preliminary weed management strategy is provided in Appendix E of Technical Paper 3 – Ecological Impact Assessment in Volume 4 of the EIS, setting out the principles for the management of the riparian zone.	Section 9, Table 9-1

Section / number	SEAR / CoA / REMM	Where addressed in this report
6T	Appropriate design and landscape/vegetation management measures would be implemented to reduce the bushfire risk and threat to biodiversity.	Section 9, Table 9-1
6U	The management of the conservation area along the Georges River would include management of fire regimes to promote biodiversity conservation.	Section 9, Table 9-1
6V	The detailed design process would consider the potential groundwater impacts on ground-dependent ecosystems. In most cases, these impacts would be mitigated at the design phase.	Section 9, Table 9-1
6W	The management plan for the Georges River riparian corridor (refer to Appendix E of Technical Paper 3 – Ecological Impact Assessment in Volume 4 of the EIS) would be implemented and would include a monitoring program designed to detect operational impacts.	Section 9, Table 9-1

The biodiversity impacts of the MPW Concept Plan and Stage 1 (Early Works) were assessed by Parsons Brinckerhoff (PB) in an Ecological Impact Assessment (PB 2014a) prepared for the MPW Concept Plan EIS, and an assessment of values under the NSW Framework For Biodiversity Assessment (FBA) was prepared as part of the Response to Submissions for the MPW Concept Plan EIS (PB 2015b). The FBA assessment prepared by PB (2015b) considered the impacts on native vegetation within the Moorebank Development Site (as shown in Figure 6-1 of this report).

Although the technical papers prepared for the MPW Concept Plan EIS addressed the biodiversity values and potential impacts across the entire MPW site, only the Early Works component of the proposal is approved under the MPW Concept Plan EIS.

PB (2014a) state that the Early Works are unlikely to result in the clearing of any native vegetation communities including any threatened species. They are likely to result in the removal of scattered native and introduced trees and shrubs within the highly modified, park-like grounds in the east of the MPW site, associated with the built-up areas of the MPW site.

The current assessment relies on ecological data collected and presented in the biodiversity assessments of the site to date (PB 2014a and PB 2015b and c) and builds on the assessments, providing:

- a revised calculation of the biodiversity impacts within the Moorebank Development Site;
- a separate calculation of additional impacts outside the Moorebank Development Site as a result of additional design development for the Proposal.

Impact calculations have been prepared in accordance with the FBA.

The impacts identified for the Proposal, included within this BAR, are to be considered and offset as part of the Biodiversity Offset Strategy to be prepared for the Moorebank Precinct (including the MPW Project and MPE Project) under the MPW Concept Plan Approval.

1.2 MPW Stage 2 Proposal Overview

The MPW Stage 2 Proposal involves the construction and operation of an Intermodal terminal (IMT) facility and associated warehousing, as shown in Figure 1-1.

The IMT facility would have the necessary infrastructure to support a container freight throughput volume of 500,000 twenty-foot equivalent units (TEUs) per annum. Specifically, the IMT facility within the Proposal site would include the following key components:

- Truck processing, holding and loading areas – with entrance and exit from Moorebank Avenue via an upgraded intersection and a round-about to distribute traffic between the warehousing precinct and the IMT
- Rail loading and container storage areas – installation of nine rail sidings, with an adjacent container storage area serviced by manual handling equipment
- Administration facility – office building with associated car parking and light vehicle access from Moorebank Avenue
- The Rail link connection – rail sidings within the IMT facility, which would be linked (to the south – to the Rail link (constructed as part of the MPE Project (SSD 14-6766)).

Also included within the Proposal are the following key components:

- Warehousing area – construction and operation of approximately 215,000 m^2 GFA of warehousing, with warehouses ranging in size from 4,000 m^2 to 71,000 m^2. Included within the warehousing area would be ancillary offices, truck and light vehicle parking, associated warehouse access roads.
- Upgraded intersection on Moorebank Avenue and internal road – including works to Moorebank Avenue, Anzac Road to accommodate the proposed site entrance to Moorebank Avenue, and construction of an internal road.
- Ancillary works – including vegetation clearing, earth works, drainage and on-site detention, utilities installation/connection, signage and landscaping.

1.2.1 Proposal components and key terms

Table 1-2 provides a summary of the key terms which are included within this technical report, in addition to the glossary provided above. Figure 1-1 also provides an indication of the site areas discussed in Table 1-2.

Table 1-2 Summary of key terms used throughout this document

Term	Definition
Moorebank Precinct West (MPW) Concept Plan Approval	MPW Concept Plan and Stage 1 Approval (SSD 5066) granted on 3 June 2016 for the development of the MPW Intermodal terminal facility at Moorebank and the undertaking of the Early Works. Granted under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979*. This reference also includes associated Conditions of Approval and Revised Environmental

Term	Definition
(Concept approval and Early Works)	Management Measures, which form part of the documentation for the approval. N.B. Previously the MIC Concept Plan Approval
Moorebank Precinct West (MPW) EPBC Approval	Commonwealth Approval (No. 2011/6086), granted in mid-2016 under the *Environmental Biodiversity Protection Conservation Act 1999*, for the impact of the MPW Project on listed threatened species and communities and impacts on the environment by a Commonwealth agency.
Moorebank Precinct West (MPW) Concept Plan EIS	The Environmental Impact Statement prepared to support the application for approval of the MPW Concept Plan and Early Works (Stage 1) under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Environmental Planning and Assessment Act 1979*. N.B. Previously the MIC Concept Plan EIS
Revised Environmental Management Measures (REMMs)	The environmental management measures for the MPW Concept Plan Approval as presented within the MIC Supplementary Response to Submissions (SRtS) (PB, 2015) and approved under the MPW Concept Plan Approval.
Moorebank Precinct West (MPW) Planning Proposal	Planning Proposal (PP_2012_LPOOL_004_00) to rezone the MPW site from 'SP2- Defence to 'IN1- Light Industrial' and 'E3- Management', as part of an amendment to the *Liverpool Local Environmental Plan 2008* (as amended) gazetted on 24 June 2016.
Moorebank Precinct West (MPW) Project	The MPW Intermodal Terminal Facility as approved under the MPW Concept Plan Approval (5066) and the MPW EPBC Approval (2011/6086). N.B. Previously the MIC Project
Moorebank Precinct West (MPW) site	The site which is the subject of the MPW Concept Plan Approval, MPW EPBC Proposal and MPW Planning Proposal (comprising Lot 1 DP1197707 and Lots 100, 101 DP1049508 and Lot 2 DP 1197707). The MPW site does not include the rail link as referenced in the MPW Concept Plan Approval or MPE Concept Plan Approval. N.B. Previously the MIC site.
Early Works	Works approved under Stage 1 of the MPW Concept Plan Approval (SSD 5066), within the MPW site, including: establishment of construction compounds, building demolition, remediation, heritage impact mitigation works and establishment of the conservation area.
Early Works Approval	Approval for the Early Works (Stage 1) component of the MPW Project under the MPW Concept Plan Approval (SSD 5066) and

Term	Definition
	the (yet to be granted) MPW EPBC Approval. Largely contained in Schedule 3 of the MPW Concept Plan Approval.
Early Works area	Includes the area of the MPW site subject to the Early works approved under the MPW Concept Plan Approval (SSD 5066).
Proposal	MPW Stage 2 Proposal (the subject of this EIS), namely Stage 2 of the MPW Concept Plan Approval (SSD 5066) including construction and operation of an IMT facility, warehouses, a Rail link connection and Moorebank Avenue/Anzac Road intersection works.
Proposal site	The subject of this EIS, the part of the MPW site which includes all areas to be disturbed by the MPW Stage 2 Proposal (including the operational area and construction area).
Moorebank Development Site	Area of impact assessed in the FBA assessment (PB 2015b) prepared for the MPW Concept Plan RtS
IMT facility	The Intermodal terminal facility on the Proposal site, including truck processing, holding and loading areas, rail loading and container storage areas, nine rail sidings, loco shifter and an administration facility and workshop.
internal road	Main internal road through the Proposal site which generally travels along the western perimeter of the site. Provides access between Moorebank Avenue and the IMT and warehouses.
Rail link connection	Rail connection located within the Proposal site which connects to the Rail link included in the MPE Stage 1 Proposal (SSD 14-6766).
Proposal operational rail line	The section of the Rail link connection and Rail link between the SSFL and the Rail link connection (included in the MPE Stage 1 Proposal) to be utilised for the operation of the Proposal.
construction area	Extent of construction works, namely areas to be disturbed during the construction of the Proposal.
operational area	Extent of operational activities for the operation of the Proposal.
Moorebank conservation area/conservation area	Vegetated area to remain to the west of the Georges River, to be subject to biodiversity offset, as part of the MPW Project.
Moorebank Precinct (MP)	Refers to the whole Moorebank intermodal precinct, i.e. the MPE site and the MPW site.
Moorebank Precinct East (MPE) Project	The Intermodal terminal facility on the MPE site as approved by the MPE Concept Plan Approval (MP 10_0913) and including the MPE Stage 1 Proposal (14-6766). N.B. Previously the SIMTA Concept Plan Approval

Term	Definition
Moorebank Precinct East (MPE) site	The site which is the subject of the MPE Concept Plan Approval, and includes the site which is the subject of the MPE Stage 1 Approval. N.B. Previously the SIMTA site
Moorebank Precinct East (MPE) Stage 1 Proposal	MPE Stage 1 Proposal (14-6766) for the development of the Intermodal terminal facility at Moorebank. This reference also includes associated conditions of approval and environmental management measures which form part of the documentation for the approval. N.B. Previously the SIMTA Stage 1 Proposal
Rail link	Part of the MPE Stage 1 Proposal (14-6766), connecting the MPE site to the SSFL. The Rail link (as discussed above) is to be utilised for the operation of the Proposal.

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 MPW Stage 2 proposal site (Figure 1-2). For the purposes of this assessment, the proposal site has been divided into two areas:

- The area of the proposal site within the Moorebank Development Site
- Areas of the proposal site outside the Moorebank Development Site.

These areas (Figure 1-2) are considered separately primarily because they have different landscape values under the FBA (see section 5.4.2). Separate assessment additionally enables consistency with the assessments prepared for the MPW Concept Plan, given that detailed assessment and review under the FBA has already been completed for the area within the Moorebank Development Site.

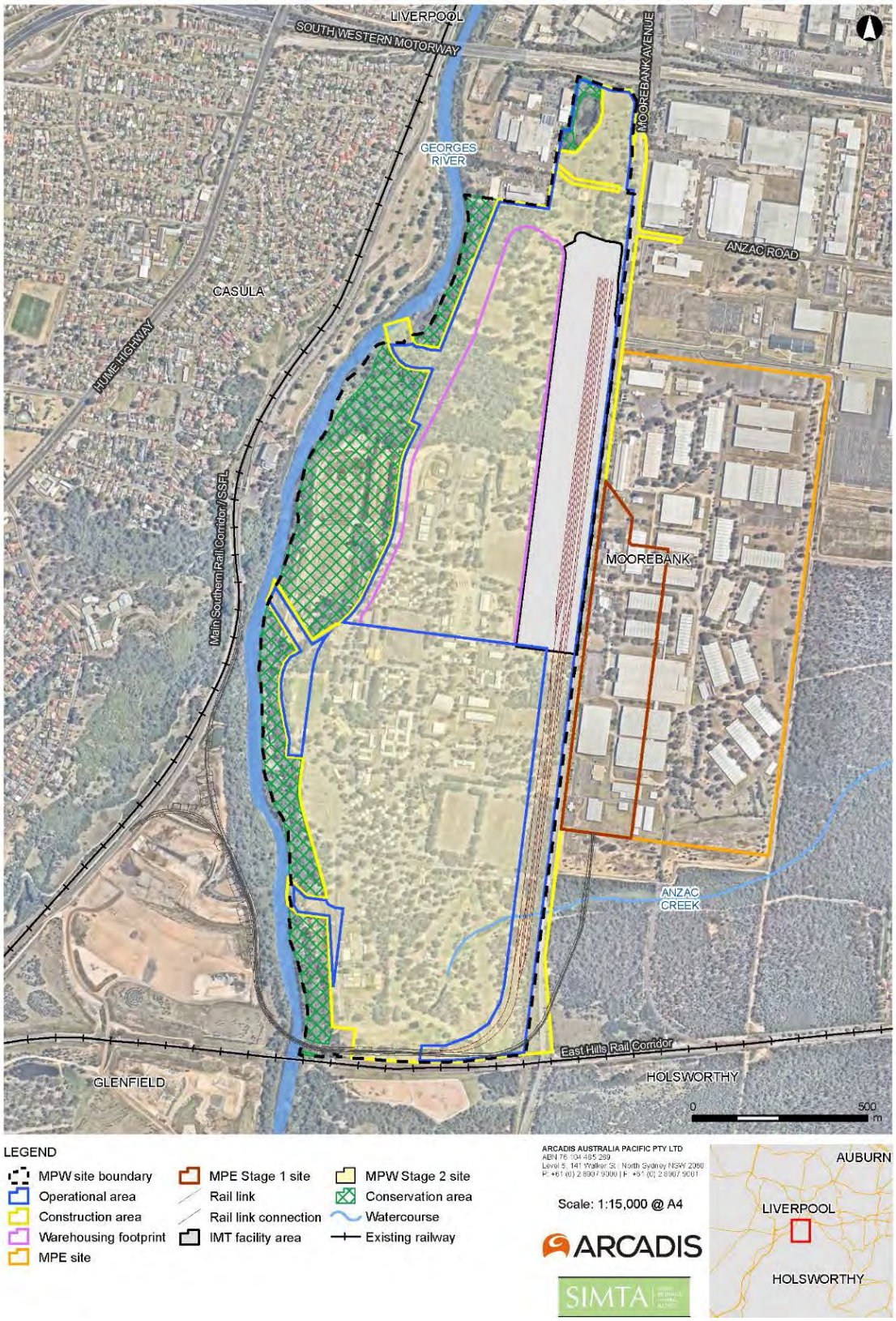

Figure 1-1 Proposal site

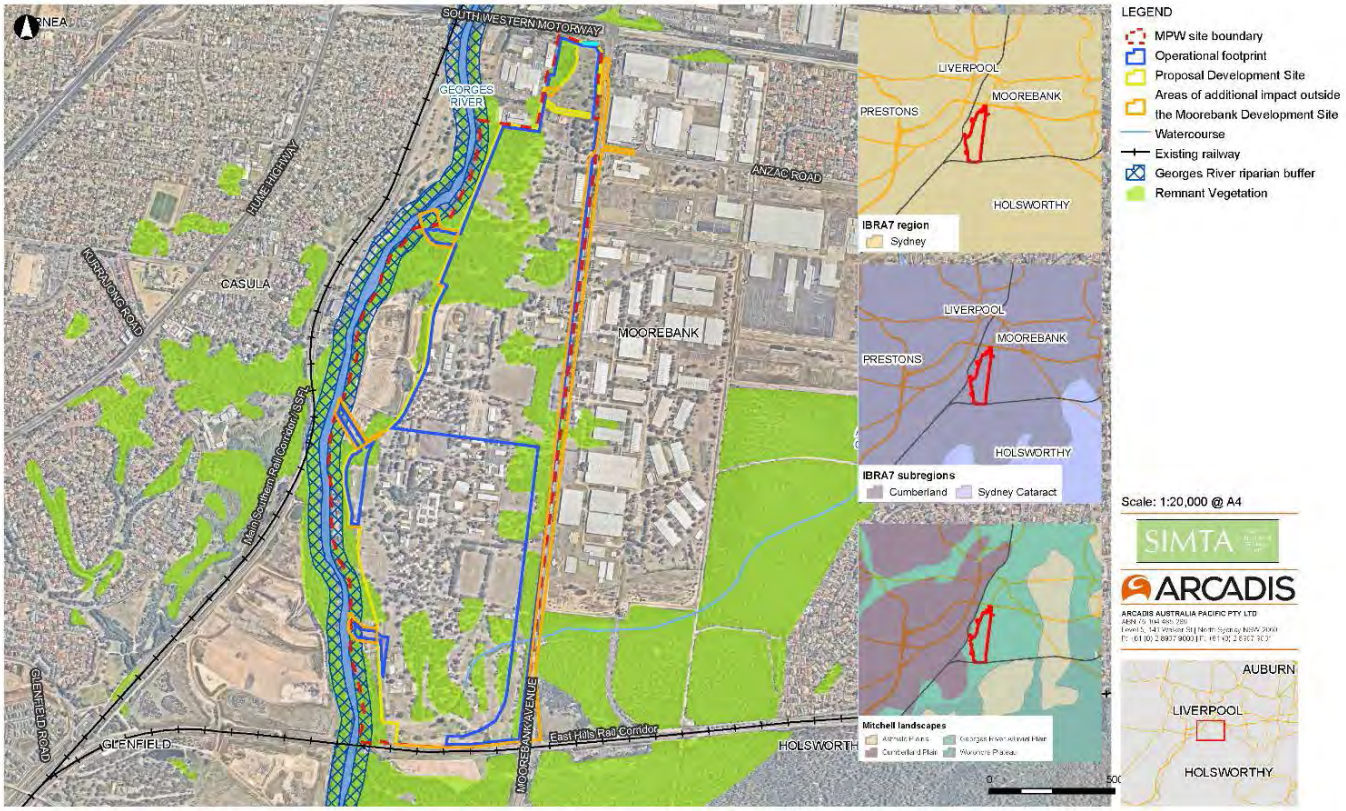

Figure 1-2 Site map

2 SITE DESCRIPTION

The Proposal site is generally bounded by the Georges River to the west, Moorebank Avenue to the east, the East Hills Railway Line to the south and the M5 Motorway to the north. It is located on Moorebank Avenue, Moorebank and forms Lot 1 in Deposited Plan (DP) 1197707[1]. The Proposal site also contains Lots 100 and 101 DP1049508, which are located north of Bapaume Road and west of Moorebank Avenue. The Proposal site is located wholly within Commonwealth Land.

The Proposal would also require works to upgrade the intersection of the MPW site with Moorebank Avenue and would therefore be undertaken on the following parcels of land:

- Moorebank Avenue, owned by the Commonwealth Government, south of Anzac Road Lot 2, DP 1197707 (formerly part of Lot 3001, DP 1125930)
- Moorebank Avenue, owned by Roads and Maritime Services, north of Anzac Road
- A portion of Bapaume Road, a public road that is the responsibility of Liverpool City Council
- A portion of Anzac Road, owned by Liverpool City Council, to the east of Moorebank Avenue

The key existing features of the site are:

- Relatively flat topography, with the western edge flowing down towards the Georges River, which forms the western boundary to the MPW site
- A number of linked ponds in the south-west corner of the Proposal site, within the existing golf course, that link to Anzac Creek, which is an ephemeral tributary of the Georges River
- An existing stormwater system comprising pits, pipes and open channels
- Direct frontage to Moorebank Avenue, which is a publicly used private road, south of Anzac Road and a publicly owned and used road north of Anzac Road
- The majority of the site has been developed and comprises low-rise buildings (including warehouses, administrative offices, operative buildings and residential buildings), access roads, open areas and landscaped fields for the former School of Military Engineering (SME) and the Royal Australian Engineers (RAE) Golf Course and Club. Defence has since vacated and all buildings on the site are currently unoccupied and will be removed during the Early Works
- Native and exotic vegetation is scattered across the Proposal site
- The riparian area of the Georges River lies to the west of the Proposal site and contains a substantial corridor of native and introduced vegetation. The riparian vegetation corridor provides a wildlife corridor and a buffer for the protection of soil stability, water quality and aquatic habitats. This area has been defined as a conservation area as part of the MPW Concept Plan Approval
- As stated above, the majority of the Proposal site has been developed, however heritage and biodiversity values still remain on the site
- A strip of land (up to approximately 250 metres wide) along the western edge of the MPW site lies below the 1% annual exceedance probability (AEP) flood level
- The site is privately owned by the Commonwealth and leased by SIMTA.

[1] Previously legally described as “Lot 3001, DP 1125930” in the MPW Concept Plan Approval (SSD 5066), however has since been subdivided.

A number of residential suburbs are located in proximity to the Proposal site, including:

- Wattle Grove, located approximately 1,000 m from the Proposal site and 1,000 m from the Rail link connection to the east. The Rail link, which will be used during operation of the Proposal is 1,260 m to the west of Wattle Grove at its closest point
- Moorebank, located approximately 630 m from the Proposal site and more than 1,400 m from the Rail link connection to the north. The Rail link is 2,500 m to the south of Moorebank at its closest point
- Casula, located approximately 330 m from the Proposal site and 1,200 m from the Rail link connection to the west. The Rail link is approximately 290 m to the east of Casula at the closest point
- Glenfield, located approximately 820 metres from the Proposal site and 1,100 metres from the Rail link connection to the south-west. The Rail link is approximately 750 m to the east of Glenfield at its closest point.

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 EPBC 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 MPW Project was determined to be a controlled action under the EPBC Act, EPBC Reference 2011/6086, and the MPW Concept Plan EIS was prepared to address the requirements of the EPBC Act assessment requirements. The MPW Project was granted approval as a controlled action under the EPBC Act in late 2016 (MPW EPBC Approval).

3.2 NSW Environmental Planning and Assessment Act 1979

Approval of the MPW Project (SSD 5066) was granted on 3 June 2016 under Division 4.1, Part 4 of the EP&A Act, by the Planning Assessment Commission (PAC). The MPW Concept Plan Approval included approval of:

- Concept Proposal: involving the use of the site as an intermodal facility, including a rail link to the Southern Sydney Freight Line, warehouse and distribution facilities, and associated works; and
- Early Works (Stage 1): involving the demolition of buildings and existing hardstand, services termination and diversion; rehabilitation of the excavation/ earthmoving training area; remediation of contaminated land; removal of underground storage tanks; heritage impact remediation works; and the establishment of construction facilities and access, including site security.

Clause 2, Schedule 2 of the MPW Concept Plan Approval prescribes that all development, other than the Early Works, shall be the subject of future development applications. Approval of any subsequent development applications must be consistent with the terms of the MPW Concept Plan Approval, as described in Schedule 1 and subject to the conditions in Schedule 4 of the approval.

The Proposal would involve construction and operation of an intermodal terminal facility, warehouses and Rail link connection. Under Schedule 1, Clause 19 of *State Environmental Planning Policy (State and Regional Development)* 2011 (SEPP (S&RD)) development for the purposes of 'rail and related transport facilities', including railway freight terminals, sidings and inter-modal facilities with a capital investment value of more than $30 million is classified as State Significant Development (SSD). . Furthermore, Schedule 1, Clause 12 of SEPP(S&RD) states that a development that has a capital investment value of more than $50 million for the purpose of warehouses or distribution centres (including container storage facilities) at one location and related to the same operation' is also classified as an SSD. The capital cost of the Proposal is estimated to be approximately $533,000,000 million. Therefore the Proposal is classified as SSD, and assessable under Division 4.1, Part 4 of the EP&A Act.

3.2.1 NSW Biodiversity Offsets Policy for Major Projects

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 SEARs for the Proposal require that it be assessed under the Framework for Biodiversity Assessment, including an assessment of any potential impacts on riparian vegetation and groundwater dependent ecosystems.

3.3 NSW Threatened Species Conservation Act 1995

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 TSC 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 Proposal could potentially have impacts on threatened species and ecological communities listed under the TSC Act. This report assesses and quantifies the impacts to these threatened entities in accordance with the FBA requirements and outlines the corresponding offsetting requirements.

3.4 NSW Fisheries Management Act 1990

The *Fisheries Management Act 1994* (FM Act) provides for the identification, conservation and recovery of threatened fish, aquatic invertebrates and marine vegetation. The Act also covers the identification and management of key threatening processes which affect threatened species or could cause other species to become threatened.

If a planned development or activity is likely to have any impact on a threatened species listed under the FM Act, an Assessment of Significance must be undertaken. If the impacts are likely to be significant, or if critical habitat is affected, a species impact statement must be prepared in accordance with Part 7A of the FM Act.

The FM Act requires permits for the harming of aquatic vegetation, blockage of fish passage and dredging and reclamation. Though the Proposal could result in these impacts, Clause 89J of the EP&A Act provides an exemption for these permits for SSD assessed under Part 4, Division 4.1 of the EP&A Act.

4 METHODOLOGY

4.1 Introduction

The sections below provide a summary and update (where applicable) of the assessment completed by PB (2015b) for the MPW Concept Plan, and a separate more detailed assessment of the biodiversity impacts in the additional areas of impact outside the Moorebank Development Site.

The FBA calculator used for the MPW Concept Plan FBA Assessment (PB 2015b) was updated by Alex Cockerill (Parsons Brinckerhoff) (Assessor No. 0058) using revised impact areas and vegetation classifications, in order to obtain credit values for the area of the proposal site within the Moorebank Development Site.

A separate calculation was prepared by Jane Rodd (Assessor No. 0023) for the additional areas of the proposal site outside the Moorebank Development Site.

4.2 Desktop Assessment

4.2.1 Database Interrogation

Database searches were undertaken to identify records, classifications and habitat descriptions of threatened entities under the TSC 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.

4.2.2 Literature Review

A review of relevant information was undertaken to provide an understanding of ecological values occurring or potentially occurring in the development 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).
- *Interpretation Guidelines for the Native Vegetation of the Cumberland Plain* (NPWS 2002a).
- *Conservation significance guidelines for the Native Vegetation of the Cumberland Plain* (NPWS 2002b).

- *Moorebank Intermodal Terminal – Ecological Impact Assessment* (Parsons Brinckerhoff (PB) 2014a). https://majorprojects.affinitylive.com/public/f47206dc2358ff1265fb0478db877546/051%20Technical%20Paper%203_%20Ecological%20Impact%20Assessment.pdf
- *Biodiversity Offset Strategy.* Appendix C of the Moorebank Intermodal Terminal Response to Submissions Report (PB 2015a)
- *Framework for Biodiversity Assessment credit report.* Appendix A of Appendix C of the Moorebank Intermodal Terminal Response to Submissions Report (PB 2015b).
- *Biodiversity Offset Areas Biodiversity Assessment Report.* Appendix A of the Moorebank Intermodal Terminal Supplementary Response to Submissions Report (PB 2015c)

4.2.3 Vegetation mapping

Vegetation mapping reviewed for this study is as follows:

- *Native vegetation maps of the Cumberland Plain, western Sydney* (NPWS 2002c).
- *The native vegetation of the Cumberland Plain, western Sydney: systematic classification and field identification of communities* (Tozer 2003).
- *Changes in the distribution of Cumberland Plain Woodland* (NSW Scientific Committee and Simpson 2008).
- *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009).
- *Native vegetation of southeast NSW: a revised classification and map for the coast and eastern tablelands* (Tozer *et al.* 2006)
- Vegetation mapping prepared by Parsons Brinckerhoff (2014-2015) based on detailed site surveys.

4.3 Field assessment

Field assessment of the biodiversity values of the development site has been conducted on numerous occasions between November 2010 and September 2014, as documented in PB (2014a). A detailed field investigation to quantify offset requirements in accordance with the FBA/Biobanking Assessment Methodology was undertaken during daylight hours by a team of two ecologists on 5, 20, 21, 22 and 23 May 2014 (PB 2015b).

Arcadis ecologists, Jane Rodd and Laura Hoffman, inspected the site on 3 March 2016. Areas of native vegetation on the MPW site were inspected, with particular focus on the areas of potential additional impact within the Georges River riparian zone.

Vegetation Plots

Vegetation plot surveys were undertaken as outlined in the methodology contained within BioBanking Operation Manual (Seidel & Briggs 2008) and described below. Fourteen BioBanking plots sampling the area within the Moorebank Development Site were used in the calculation that has been updated for the current assessment. Four plots from the Moorebank Conservation Area, representing the vegetation in the

additional areas of impact, were used in this assessment. Quadrat sampling was conducted in May 2014. Figure 4-1 shows the location of the plots.

The following site attributes were recorded at each site:

- Location (easting – northing grid type MGA 94, Zone 56).
- Vegetation structure and dominant species and vegetation condition. Vegetation structure was recorded through estimates of percentage foliage cover, average height and height range for each vegetation layer. Vegetation condition was recorded in accordance with the BioBanking methodology.
- Native and exotic species richness (within a 400 m^2 quadrat): This consisted of recording all species by systematically walking through each 20 x 20 m quadrat. The cover abundance (percentage of area of quadrat covered) of each species was estimated.
- Number of trees with hollows (1,000 m^2 quadrat): This was the frequency of hollows within living and dead trees within each 50 x 20 m quadrat. A hollow was only recorded if:

  (a) the entrance could be seen;

  (b) the estimated entrance width was at least 5 cm across;

  (c) the hollow appeared to have depth;

  (d) the hollow was at least 1 m above the ground; and

  (e) the centre of the tree was located within the sampled quadrat.
- Total length of fallen logs (1,000 m^2 quadrat): This was the cumulative total of logs within each 50 x 20 m quadrat with a diameter of at least 10 cm and a length of at least 0.5 m.
- Native overstorey cover: This consisted of estimating the percentage foliage projective cover of the tallest woody stratum present (>1 m and including emergents). The woody stratum included species that were native to New South Wales including both indigenous and non-indigenous native species.
- Native mid-storey cover: This involved estimating the foliage projective cover of vegetation between the overstorey stratum and a height of 1 m (i.e. tall shrubs, under-storey trees and tree regeneration).
- Ground cover: This comprised estimating the foliage projective cover of plants below 1 m in height. The following categories of plants were recorded:
  - Native ground cover (grasses): native grasses (Poaceae family native to NSW).
  - Native ground cover (shrubs): all woody vegetation below 1 m in height and native to New South Wales.
  - Native ground cover (other): non-woody vegetation (i.e. vascular plants – ferns and herbs) below 1 m in height and native to New South Wales.
- Exotic plant cover: vascular plants not native to Australia.

- Evaluation of regeneration: This was estimated as the proportion of overstorey species present at the site that was regenerating (i.e. saplings with a diameter at breast height >5 cm). The maximum value for this measure was 1.

Targeted threatened species surveys

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

- Threatened plant targeted surveys using random meanders, quadrats and BBAM survey techniques as described above
- Night time water bodies searches for Green and Golden Bell Frog
- Targeted diurnal and nocturnal call – playback for threatened bird surveys for species such as the Regent Honeyeater, Swift Parrot and Powerful Owl
- Habitat searches for species such as the Cumberland Plain Land Snail
- Mammal trapping and hair tubes for species such as Spotted-tailed Quoll and Squirrel Glider
- Bat (harp) trapping and ANABAT detection for threatened bat species such as Eastern Bent-wing Bat and Large-footed Myotis
- Opportunistic observations.

Additional surveys undertaken between 2011 and 2014 (PB 2014a) include:

- A tree hollow survey conducted in September 2011 to estimate the number of hollow bearing trees likely to be affected.
- Targeted threatened species surveys in September 2014.

Details of threatened species survey methodology are provided in PB (2014a).

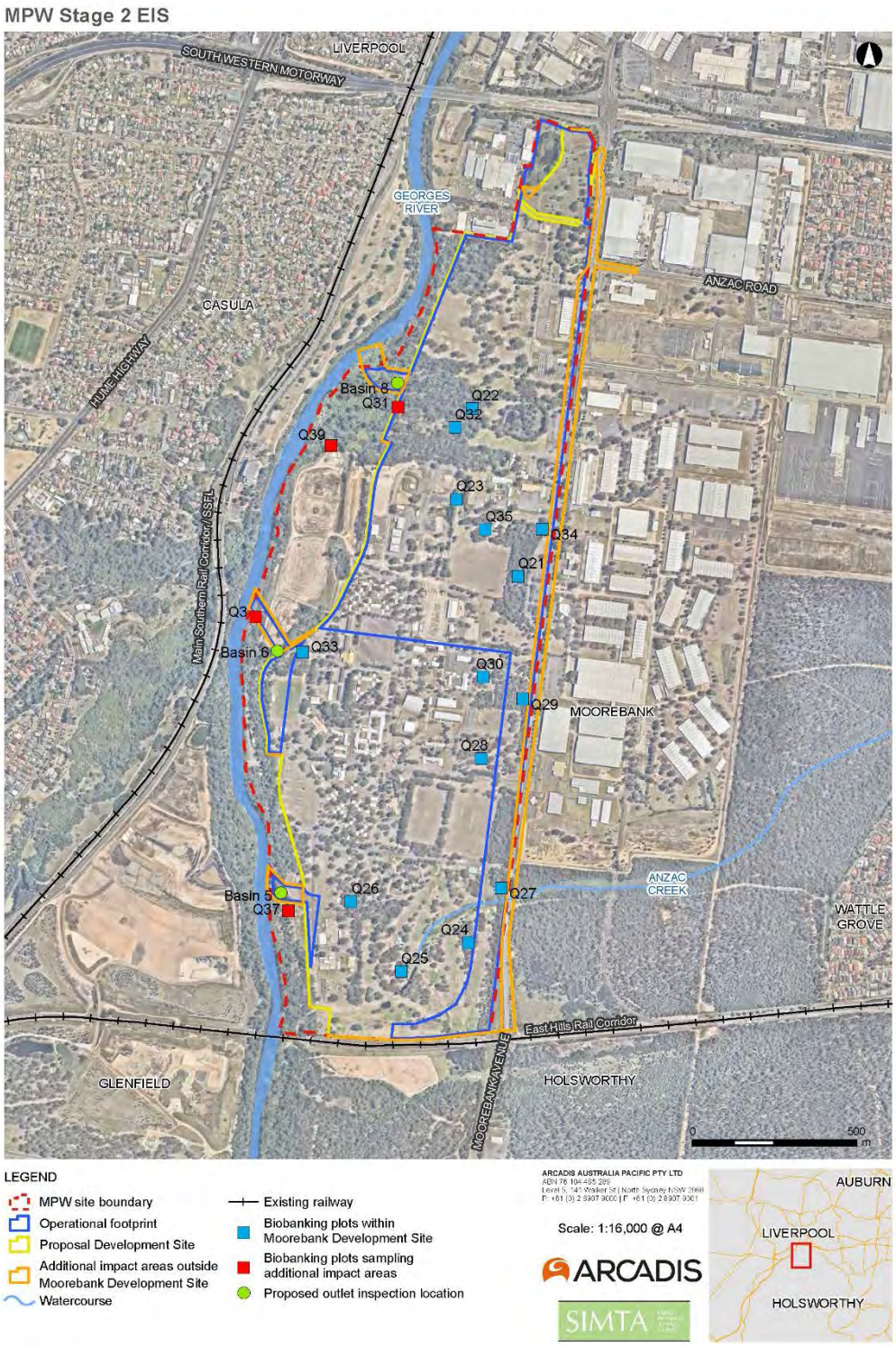

Figure 4-1 Vegetation sampling of the development site

5 LANDSCAPE ASSESSMENT

5.1 Landscape regions

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

The MPW site is located within the Sydney Metropolitan Major Catchment Area (MCA). The development site is in the Cumberland IBRA subregion.

The development 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 by PB (2015b) to enable assessment of landscape values, including the percent current extent of native vegetation cover within and adjacent to the development 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 Development site (Figure 5-1).These assessment circles are also used for the assessment of additional areas outside the Moorebank Development Site.

5.3 Rivers, streams and wetlands

The development site is located within the Georges River catchment, which covers approximately 960 square kilometres and is managed by the Sydney Metropolitan LLS. Georges River flows north along the western edge of the development site, where it is considered to be a 6th order stream. The river is freshwater here, until it flows over the Liverpool Weir approximately 3.5 kilometres to the north. The weir, constructed in 1836, defines the upper reach of the Georges River estuary; below the weir the Georges River is influenced by tidal flows. The Georges River meanders south-east from Chipping Norton before draining into Botany Bay.

Anzac Creek originates from the MPW site and extends to the north-east. 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. On the development site, it is considered to be a 1st order stream. The section of Anzac Creek on the development site is highly modified, located within cleared/disturbed lands within the former golf course.

In addition to these named watercourses, there is a formalised drainage channel located in the north of the development site. The large open channel is concrete lined and conveys stormwater in a north-westerly direction across the MPW site, discharging into the Georges River. Other hydrological features are restricted to constructed artificial wetlands and detention basins in the MPW site.

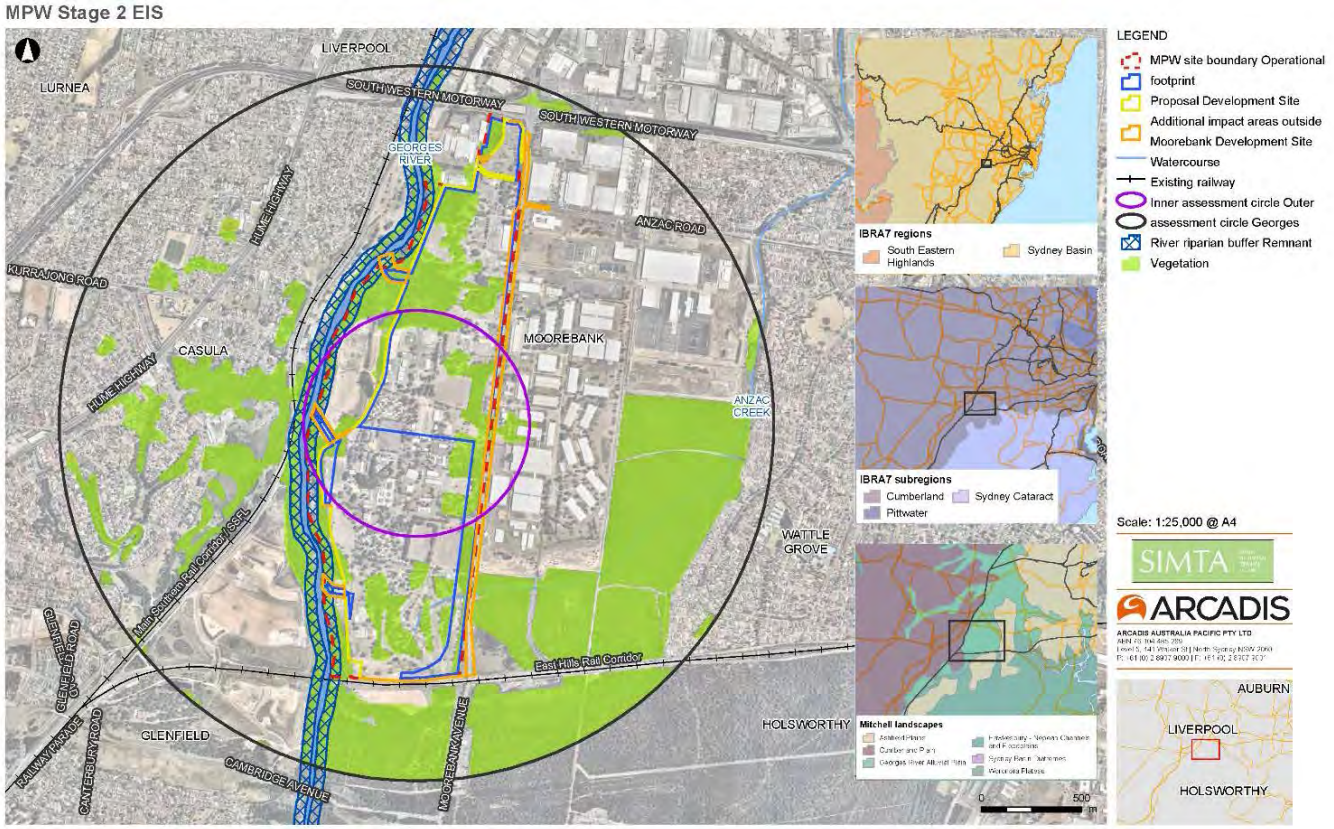

Figure 5-1 Landscape assessment

No local or important wetlands occur in the outer assessment circle. However, several local wetlands lie downstream of the development site on the Georges River. This includes Lake Moore Wetlands approximately 5.3 kilometres downstream of the development site and Chipping Norton Lake a further 2.7 kilometres downstream of the development site.

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 by determining the percent native vegetation cover in the landscape, connectivity value and patch size score.

A discussion of each of these determining factors in relation to the 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 NPWS (2002)/Tozer *et al.* (2003). All native vegetation types mapped by NPWS (2002)/Tozer *et al.* (2003) 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 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.

Figure 5-2 Watercourses and wetlands

Table 5-1 Scores for the assessment of landscape value

Criteria	Assessment Circle	% cover	Score
Current native vegetation cover	Inner assessment circle	16-20	3
	Outer assessment circle	16-20	5
Future native vegetation cover	Inner assessment circle	11-15	2.25
	Outer assessment circle	16-20	5

5.4.2 Connectivity value

PB (2015b) undertook an assessment to determine the existing Linkage Width Class of the MPW site, by determining the narrowest (most limiting) link that connects site vegetation to adjoining vegetation.

PB (2015b) determined that the MPW Project (which included the bridge over the Georges River) would have limited impact on the existing connectivity of the Georges River riparian zone as it would not decrease the corridor width or the overstorey and understorey benchmark values. Connectivity for the landscape assessment as determined by PB (2015b) is summarised in Table 5-2.

Table 5-2 Scores for the assessment of landscape value

Corridor values	Before development	After development
Corridor width (m)	>30-100 m	>30-100 m
Overstorey	PFC >50% of lower BM	PFC >50% of lower BM
Understorey	PFC mid-storey/ground cover <50% lower BM	PFC mid-storey/ground cover <50% lower BM

The Proposal includes construction of three stormwater basin outlets within the Georges River riparian zone, therefore impacts to this connecting link need to be considered in the current assessment. While it was identified in the MPW Concept Plan EIS that stormwater overflows would be required from the site to the Georges River, assessment of these outlets was not included in PB (2015b) as the exact location of the channels had not been determined. The impacts from the stormwater basin outlets are within the additional areas of impact outside the Moorebank Development Site.

The Georges River is a 6th order stream and as such the riparian buffer 50 metres either side is considered to be a state significant biodiversity link in accordance with Appendix 4 of the FBA. This link is also shown in Figure 5-1. The corresponding connectivity value for the additional impact areas is 12.

5.4.3 Patch size

The size of the largest patch of native vegetation occurring in and adjacent to the development site is the riparian corridor adjoining the Georges River, a portion of which is identified as the Moorebank Conservation Area. This vegetation connects to large areas of bushland in the Holsworthy Military Area to the south, which comprises approximately 18,000 hectares of continuous native vegetation. As such, the vegetation in the development site has been assigned the maximum patch size of 1001 hectares. In accordance with the criteria in Table 15 of Appendix 4 of the FBA, the patch size class is considered to be *extra large* with a corresponding patch size score of 12.

6 NATIVE VEGETATION

6.1 Background

Vegetation within the development site and locality has been mapped at the regional scale by the '*Native Vegetation of the Cumberland Plain, Western Sydney'* and recent update (Tozer 2003). Field validation (ground-truthing) of the existing broad scale vegetation classification was undertaken to determine the vegetation structure, dominant canopy species, native diversity and condition.

6.2 Vegetation observations

The majority of the vegetation within the MPW site consisted of remnant forest and woodland vegetation that has been moderately modified as a result of:

- road infrastructure; e.g. Moorebank Avenue and the internal road network within the Defence land
- Defence infrastructure; e.g. internal road network, training grounds and buildings
- sewerage and stormwater infrastructure
- foot paths and fire trails within the vegetation remnants
- invasion by exotic species of plant such as *Lantana camara* (Lantana), *Tradescantia fluminensis* (Wandering Jew) *Ligustrum* spp. (Privets).

Nevertheless, there remain some areas that contain moderate to good condition remnant vegetation that is connected to larger areas of vegetation. The vegetation within the development site provides habitat for a large variety of flora and fauna species such as those being assessed as part of this FBA report. Detailed observations of the vegetation in the development site are provided in PB (2014a, 2015b and c).

6.2.1 Additional areas of impact

In addition to the site assessment and vegetation mapping undertaken by PB (2014a, 2015b and c), vegetation observations were made on the development site by Arcadis ecologists Jane Rodd and Laura Hoffman in March 2016, focusing on additional areas of impact outside the Moorebank Development Site. The areas of the proposed sediment basin outfall channels were inspected, as shown on Figure 4-1.

Basin 5 Outlet

The section of the proposed basin 5 outlet outside the Moorebank Development Site was largely inaccessible due to the steep slope in the east of the section and dense cover of *Lantana camara* in the midstorey. The proposed channel is in the location of an existing major channel draining the north of the development site; the existing drainage infrastructure in this location has collapsed, leaving uncontrolled flows and substantial erosion channels running down the slope.

The vegetation in the proposed area of impact is highly modified; scattered *Eucalyptus tereticornis* (Forest Red Gum) were observed on the slope, with a dense midlayer of *Lantana camara* (Lantana) and *Ligustrum* spp. (Privets). Access to the lower slope was obstructed, so it could not be inspected.

Vegetation downslope of existing drain in basin 5 Outlet

Existing damaged/collapsed drainage structure

Basin 6 Outlet

This outlet intersects the former plant and equipment operation training area, known as the 'dust bowl', which is currently cleared of native vegetation and dominated by exotic grassland. There is a band of native vegetation mapped in the south-east of the outlet area; this is mainly comprised of *Acacia binervia* (Coast Myall) with an exotic-dominated understorey including *Lantana camara, Jacaranda mimosifolia* (Jacaranda) and *Olea europaea* subsp. *cuspidata* (African Olive).

The basin 6 outlet also intersects riparian vegetation adjoining the Georges River. In this location, the vegetation is characterised by a sparse canopy dominated by *Eucalyptus botryoides x saligna* and *Angophora subvelutina* (Broad-leaved Apple) and a midstorey dominated by native shrubs including *Acacia binervia, Acacia decurrens* (Black Wattle), *Glochidion ferdinandi* (Cheese Tree) and *Kunzea ambigua* (Tick Bush). The ground layer vegetation is sparse and dominated by the native grass *Microlaena stipoides* (Weeping Grass). There is variable abundance and cover of exotic species in this area, with higher exotic occurrence closer to the river, where *Lantana camara, Olea europaea* subsp. *cuspidata* and *Ligustrum* spp. frequently occur.

Vegetation in south-east of basin 6 outlet area

Riparian vegetation adjoining Georges River

Basin 8 Outlet

The proposed basin 8 outlet crosses areas of cleared grassland in the east, with scattered trees and a wide, gravel-covered track. In the west of this area there is degraded riparian forest, with a canopy of *Eucalyptus botryoides x saligna* and a dense understorey of weeds including *Lantana camara, Arundo donax* (Giant Reed), *Ligustrum* spp., *Cardiospermum grandiflorum* (Balloon Vine), *Bidens pilosa* (Cobblers Pegs) and *Eragrostis curvula* (African Lovegrass). There was low occurrence of native understorey species, with some *Pteridium esculentum* (Bracken), *Acacia binervia* and *Melicytus dentatus* (Tree Violet) observed in the northern part of the basin outlet area.

Cleared areas in eastern part of basin 8 outlet

Riparian vegetation adjoining the Georges River in basin 8 outlet

6.3 Plant Community Types on the development site

The vegetation within the development site consisted predominantly of remnant and regrowth vegetation that has been subjected to weed invasion in some areas. The majority of the vegetation within the MPW site was native and representative of endangered ecological communities listed in Schedule 1 and 2 of the TSC Act.

Four Plant Community Types (PCTs) were identified by PB (2014a) 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 (Table 6-1, Figure 6-1). The PCTs are described in detail in PB (2014a).

Table 6-1 Plant community types (PCTs) identified by PB (2014a) on the development site

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) in previous development site
Sydney Sand Flats Dry Sclerophyll Forests	ME003	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	50%	16.1
Cumberland Dry	ME005	Parramatta Red Gum woodland on moist alluvium	45%	0.9

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement	Area (ha) in previous development site
Sclerophyll Forests		of the Cumberland Plain, Sydney Basin		
Coastal Valley Grassy Woodlands	ME018	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	95%	28.1
North Coast Wet Sclerophyll Forests	ME044	Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin	45%	3.6

Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin is equivalent to Warm Temperate Layered Forest (Tozer *et al.* 2006), wet sclerophyll forest with a moist shrubby understorey which occurs predominantly south of the Hacking River along the Illawarra scarp, to Nowra and throughout the Kangaroo Valley. The vegetation mapping of the Sydney Metro Catchment Management Authority (CMA) area (DECCW 2009), which the development site falls within, mapped the areas of Warm Temperate Layered Forest within the Royal National Park as Illawarra Escarpment Blue Gum Wet Forest.

In the Sydney Metro CMA vegetation mapping of the development site and surrounds, this section of the Georges River riparian corridor is mapped as Hinterland Flats Eucalypt Forest, which is referenced as being a component of Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (DECCW 2009). This community is considered to be a better fit for the vegetation on the MPW site and more consistent with regional vegetation mapping and classifications, therefore areas within the development site previously mapped as Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin have been reclassified as Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin in the current assessment.

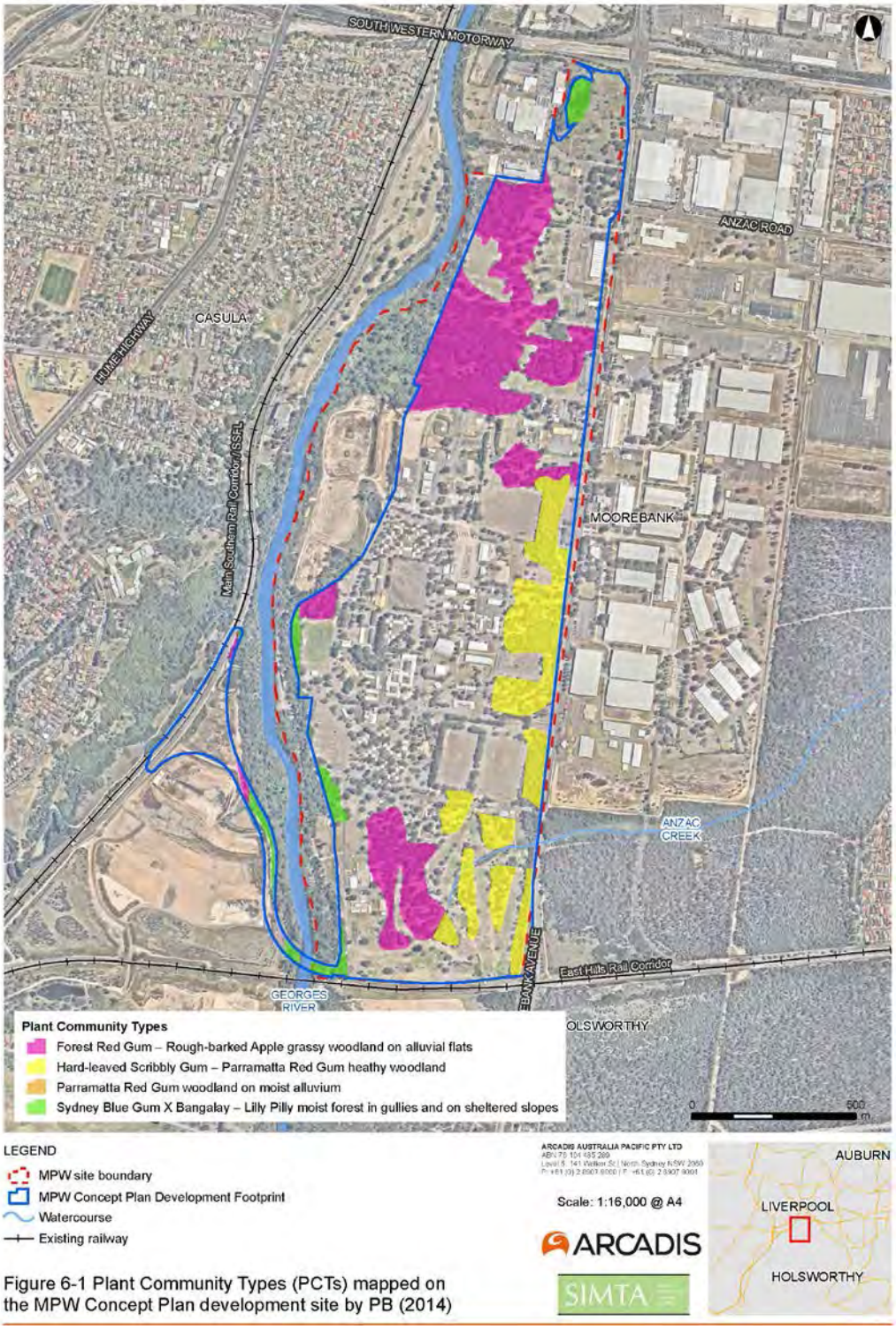

Figure 6-1 Plant Community Types (PCTs) mapped on the development site by PB (2014a)

The justification for assigning PCTs is provided below in Table 6-2:

Table 6-2 Justification for identification of PCTs on the development 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* *Eucalyptus parramattensis*	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.
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.

The revised PCTs identified within the development site are presented in Table 6-3 and shown on Figure 6-2. The areas of each PCT within the development site are in Table 6-4.

Table 6-3 Revised PCTs in development site

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement
Sydney Sand Flats Dry	ME003	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy	50%

Vegetation Class (Keith 2004)	PCT ID	Plant Community Type	Estimated clearance of PCT since European settlement
Sclerophyll Forests		woodland of the Cumberland Plain, Sydney Basin	
Sydney Sand Flats Dry Sclerophyll Forests	ME005	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	45%
Coastal Floodplain Wetlands	ME018	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	95%

Table 6-4 Areas of revised PCTs in development site

PCT ID	Plant Community Type	Area (ha) within development site (within Moorebank Development Site)	Area (ha) within additional impact areas
ME003	Hard-leaved Scribbly Gum – Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin	15.51	0
ME005	Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	0.92	0
ME018	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin	28.94	1.68

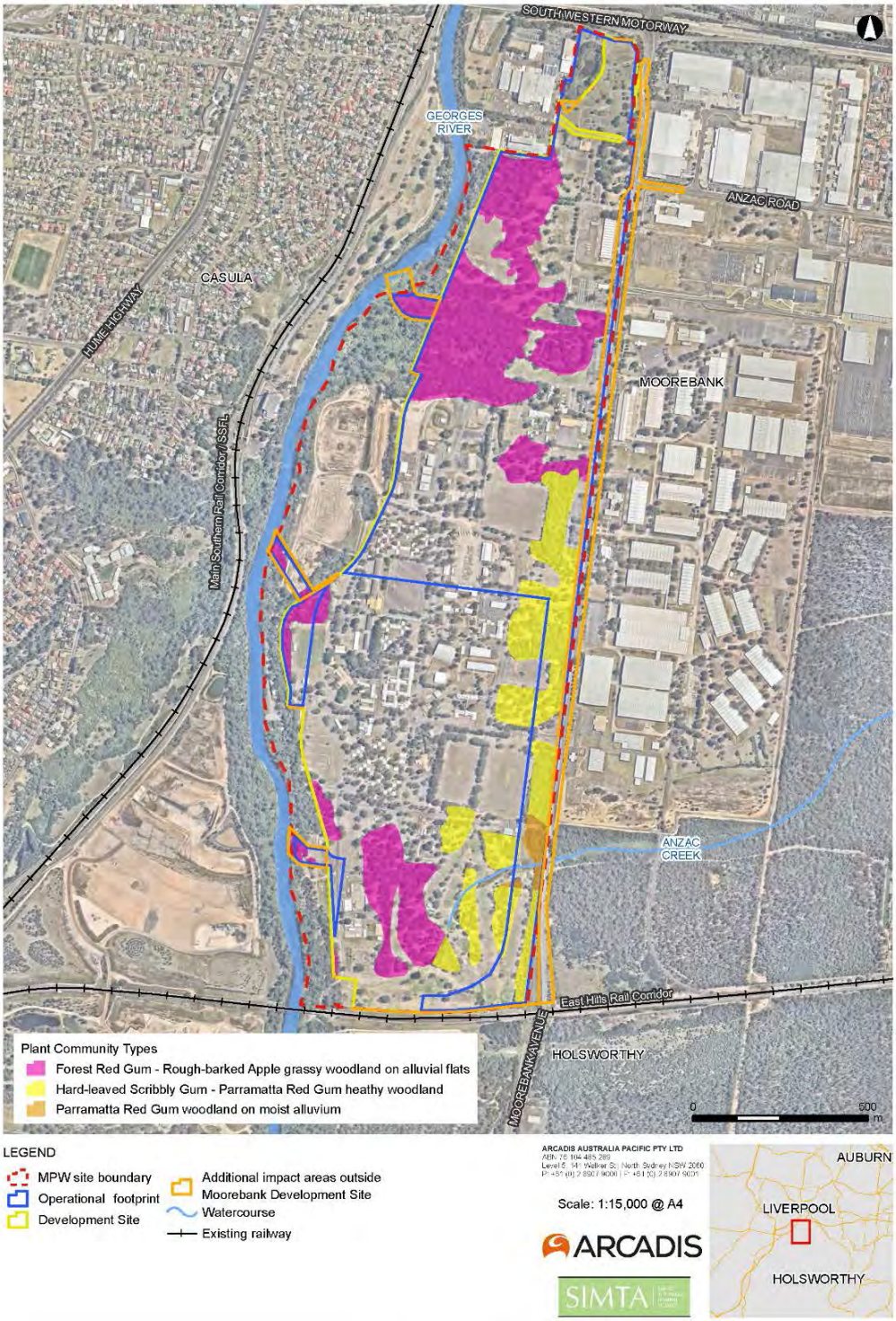

Figure 6-2 Revised Plant Community Types (PCTs)

6.3.1 Threatened Ecological Communities

The three PCTs identified in the MPW site fall within the definitions of threatened ecological communities listed under the TSC Act and/or EPBC Act, as per Table 6-5.

Table 6-5 Threatened ecological communities on the development site

Plant Community Type	Equivalent TEC	TSC Act Status	EPBC Act Status
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	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

6.4 Vegetation zones

For the purpose of the FBA assessment, the development site contained three distinct vegetation types in the moderate to good condition category. The vegetation zones in the area of the development site within the Moorebank Development Site are shown in Figure 6-3 summarised in Table 6-6. These vegetation zones are the same as those identified in PB (2015b), except that all areas previously mapped as ME044 Sydney Blue Gum X Bangalay – Lilly Pilly moist forest in gullies and on sheltered slopes, southern Sydney Basin have been reclassified as ME018 Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin.

The vegetation zones in the additional areas of impact outside the Moorebank Development Site are also in Moderate to Good condition, however some areas in the northern basin outlet footprint are highly degraded and have been put into a separate vegetation zone (Moderate/Good – Poor). The vegetation zones within additional areas are summarised in Table 6-7 and shown in Figure 6-3.

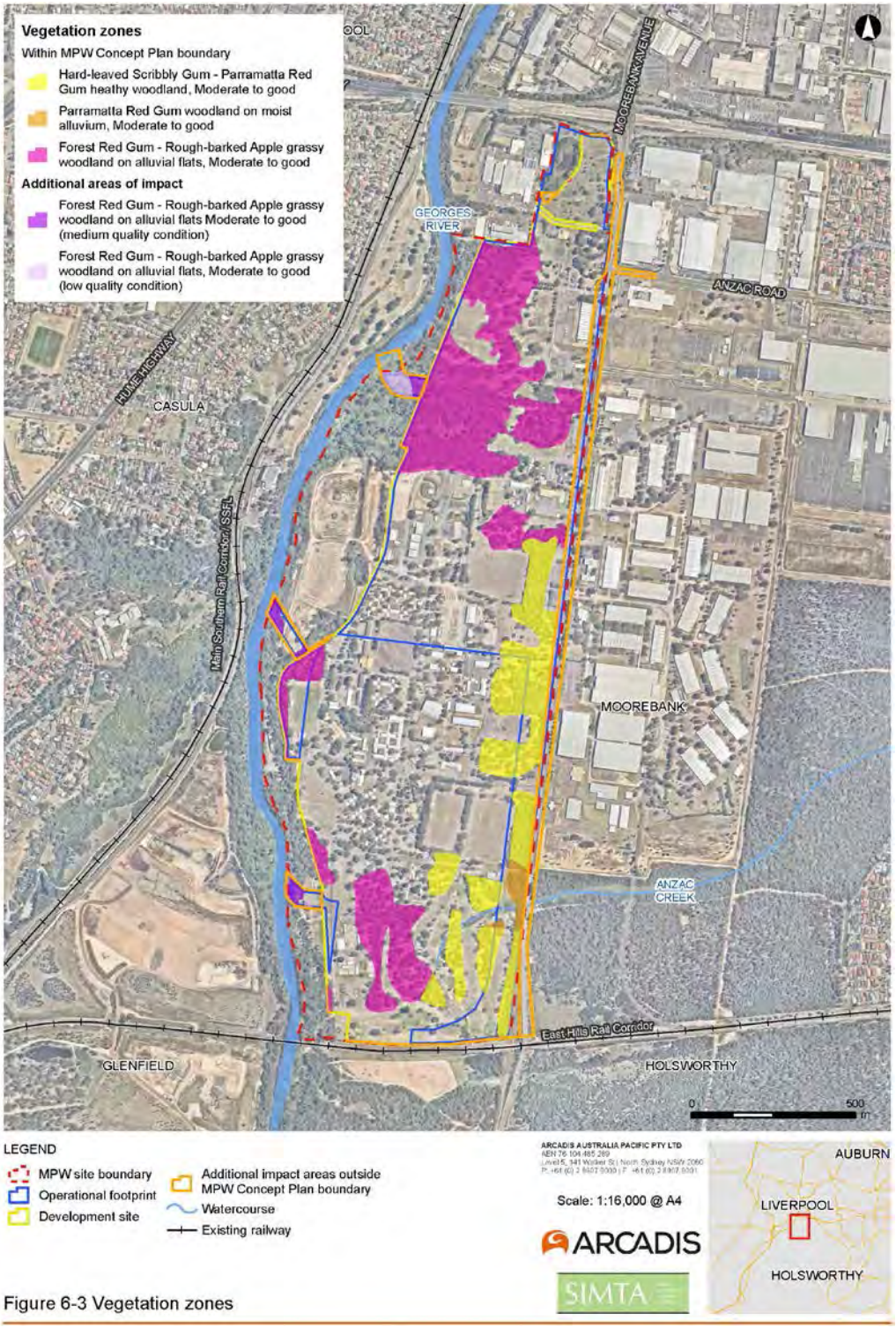

Figure 6-3 Vegetation zones

Table 6-6 Vegetation zones on the development site (within the Moorebank Development Site)

Vegetation zone	1	2	3
Vegetation class	Dry Sclerophyll forests (Shrub/grass)	Dry Sclerophyll forests (Shrub/grass)	Grassy Woodlands
Biometric code	ME003	ME005	ME018
PCT name	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	Moderate/Good
Area (ha)	15.51	0.92	28.94
Plots	• Q21 • Q24 • Q28 • Q29 • Q30 • Q33	• Q27	• Q22 • Q23 • Q25 • Q26 • Q32 • Q34 • Q35

Table 6-7 Vegetation zones in additional areas of impact (outside the Moorebank Development Site)

Vegetation zone	1	2
Vegetation class	Grassy Woodlands	Grassy Woodlands
Biometric code	ME018	ME018
PCT name	Forest Red Gum – Rough-barked Apple grassy woodland on alluvial flats 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 - Poor

Vegetation zone	1	2
Area (ha)	1.07	0.61
Plots	Q03 Q31 Q37	Q39

6.5 Site value scores for vegetation zones

The site value score for each vegetation zone identified in the development site was determined through assessment of site attribute data collected in vegetation plots. The site attribute data entered into the credit calculator for the current assessment is as presented in PB (2015a), as shown in Table 6-8.

Table 6-8 Quadrat data from the development site (within the Moorebank Development 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										
Benchmark	**40**	**10-20**	**23-33**	**12-24**	**0-10**	**12-24**	-	**1**		**30**
Q21	33	22	18	44	2	22	0	0	1	2
Q24	8	24	1.5	72	0	0	2	1	1	0
Q28	21	15.5	26	40	18	24	4	0	1	1
Q29	7	13	3	16	0	2	62	0	1	4
Q30	12	14	1	28	0	0*	6	0	1	0
Q33	26	26	5.5	52	2	18	44	0	1	0
ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good										
Benchmark	**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										

Plot Name	Site attributes									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL
Benchmark	**24**	**27.5-32.5**	**21-31**	**24.45-30.45**	**0-10**	**24.45-32.45**	-	**1**		**50**
Q22	9	17.5	0.5	20	0	50	6	0	1	0
Q23	10	24	6	4	6	0	72	0	1	0
Q25	10	30	0	50	0	2	20	0	1	0
Q26	21	20	15	62	8	12	0	0	1	4
Q32	2	31	0	0	2	0	70	0	1	0
Q34	4	15	0	32	0	0	8	0	1	0
Q35	14	24	0.5	32	0	8	12	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)

To calculate credit values for areas of additional impact outside the Moorebank Development Site, site attributes from four vegetation plots sampled by Parsons Brinckerhoff (2015b, 2015c) were entered into the credit calculator for the relevant zones (Table 6-9). Although the additional areas of impact are not large, the areas are geographically separate and the quadrats selected are representative of the vegetation within those areas.

Table 6-9 Quadrat data from areas of additional impact (outside the Moorebank Development Site)

Plot Name	Site attributes									
	NPS	NOS	NMS	NGCG	NGCS	NGCO	EPC	NTH	OR	FL
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Medium										
Benchmark	**36**	**6.5-41.5**	**5-25**	**12.2-38.2**	**0-10**	**12.2-38.2**	-	**0**		**0**
Q03	20	27	17.5	60	0	0	14	0	1	21
Q31	2	22	0	20	0	0	80	1	1	0
Q37	6	11.1	0.5	6	6	0	34	0	0	1
ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion: Moderate/Good - Poor										
Benchmark	**24**	**27.5-32.5**	**21-31**	**24.45-30.45**	**0-10**	**24.45-32.45**	-	**1**		**50**
Q39	5	19.5	8	0	0	0	100	2	0	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 each vegetation zone are provided in Table 6-10.

Table 6-10 Area and site value score for each vegetation zone

Vegetation Zone	Area mapped in development site	Site value score
Area of development site within the Moorebank Development Site		
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin: Moderate/Good	15.51 ha	44.27
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin: Moderate/Good	0.92 ha	39.58
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good	28.94 ha	35.76
Additional areas of impact outside the Moorebank Development Site		
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Medium	1.07	55.21
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin: Moderate/Good - Poor	0.61	30.21

6.6 Noxious weeds

The Ecological Impact Assessment prepared for the MPW Concept Plan (PB 2014a) identified 12 noxious weeds listed under the *Noxious Weeds Act 1993,* of which nine are also listed as Weeds of National Significance (Australian Weeds Committee 2010).

Review of the flora species list for the site against the current list of declared weeds for Liverpool City Council (DPI 2016) found an additional two noxious weeds, one of which is a Weed of National Significance. The noxious weeds recorded on and adjacent to the development site are listed in Table 6-11.

Table 6-11 Noxious weeds recorded in the development site and adjoining areas

Scientific name	Common name	Control Class	Weed of National Significance
Alternanthera philoxeroides	Alligator Weed	3	Yes
Arundo donax	Giant Reed	4	No
Asparagus aethiopicus	Ground Asparagus	4	Yes
Asparagus asparagoides	Bridal Creeper	4	Yes
Chrysanthemoides monilifera subsp. *monilifera*	Boneseed	1	Yes
Chrysanthemoides monilifera subsp. *rotundata*	Bitou Bush	3	Yes
Lantana camara	Lantana	4	Yes
Ligustrum lucidum	Broad-leaved Privet	4	No
Ligustrum sinense	Small-leaved Privet	4	No
Ludwigia peruviana	Peruvian Primrose	3	No
Olea europaea subsp. *cuspidata*	African Olive	4	No
Rubus fruticosus	Blackberry	4	Yes
Sagittaria platyphylla	Sagittaria	4	Yes
Salvinia molesta	Salvinia	2	Yes
Senecio madagascariensis	Fireweed	4	Yes

6.7 Groundwater Dependent Ecosystems

Geotechnical and Phase 2 investigations of the development site have found groundwater at depths of between 5.2 and 12.4 m Below Ground Level (BGL) (1.7 and 9.11 m Australian Height Datum (AHD)). Local groundwater flow is inferred to be west to the north-west towards the Georges River (Parsons Brinckerhoff 2014b).

It is probable, due to local hydrogeology, that groundwater across the development site and the wider region is interconnected. As such, if stygofauna (aquatic animals that live in groundwater) were present they are unlikely to be isolated to the vicinity of the development site.

A search of the Australian Government's Atlas of Groundwater Dependent Ecosystems was undertaken on 7 April 2016. Several GDEs with potential reliance on subsurface groundwater were identified in the locality including in the development site (Bureau of Meteorology 2016). Results are mapped in Figure 6-4. 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 development site were identified as having a moderate potential for groundwater interaction. No data on subterranean groundwater-dependent ecosystems (GDEs) is available for the locality.

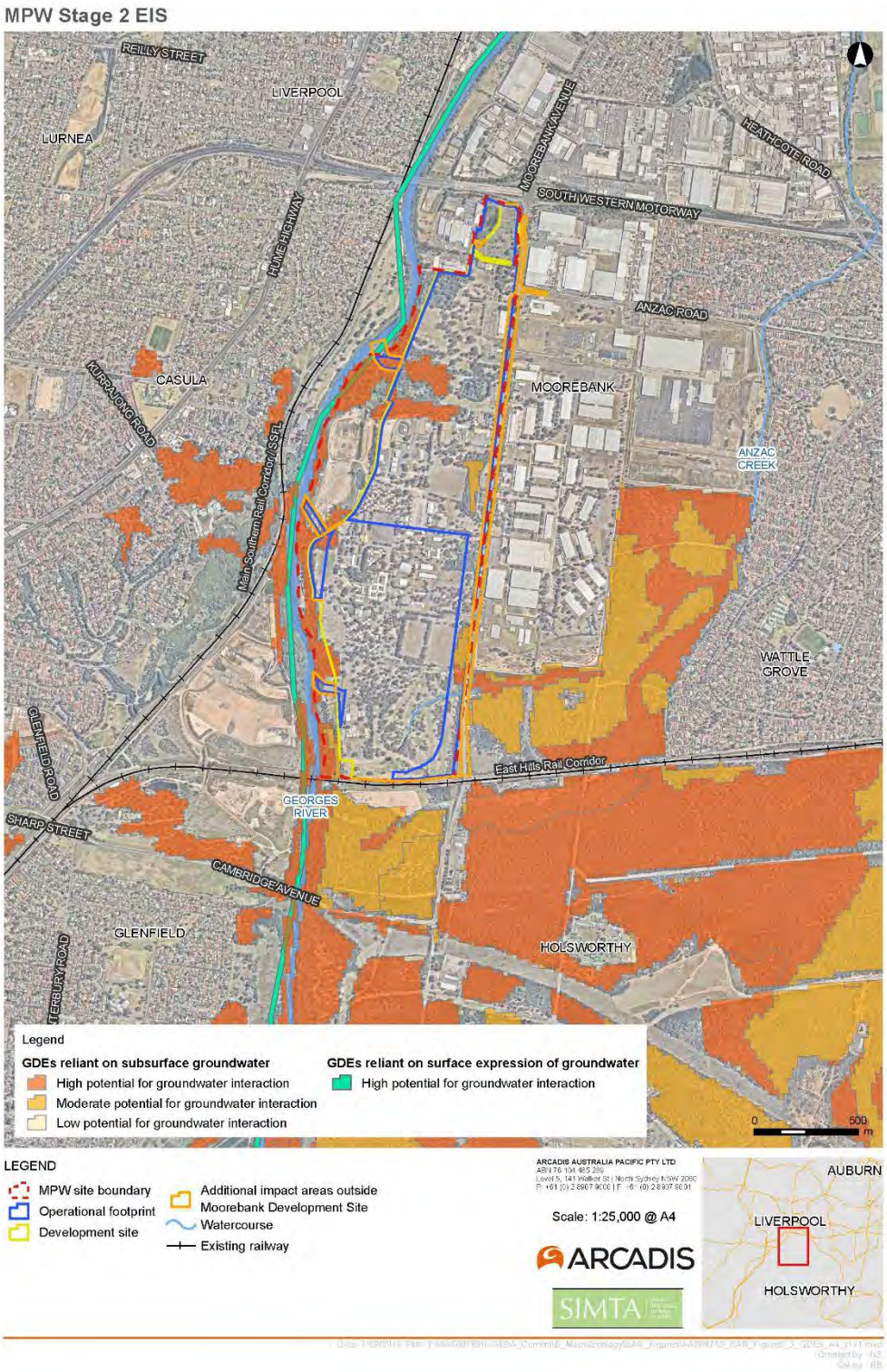

Figure 6-4 Groundwater-dependent ecosystems in the vicinity of the development site (BOM 2016)

7 THREATENED SPECIES

7.1 Ecosystem credit species

The FBA Assessment for the MPW Concept Plan found twenty ecosystem credit species predicted to occur within the development site. Although none of the species were recorded in the development site, 13 were considered to have a moderate to high likelihood of occurrence there. The species are listed in Table 3.16 of PB (2015b).

A total of 22 species were derived from the PCTs identified on the development site as predicted ecosystem credit species for the additional areas of impact outside the Moorebank Development Site. Most of these species were also identified in the MPW Concept Plan FBA calculation.

- 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*)
- Painted Honeyeater (*Grantiella picta*)
- Powerful Owl (*Ninox strenua*)
- Scarlet Robin (*Phoenica boodang*)
- Speckled Warbler (*Chthonicola sagittata*)
- Spot-tailed Quoll (*Dasyurus maculatus maculatus*)
- Spotted Harrier (*Circus assimilis*)
- Swift Parrot (*Lathamus discolor*)
- Varied Sitella (*Daphoenositta chrysoptera)*
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*)

Each species has been assessed for potential presence in the additional areas of impact in the development site in Table 7-1 using information obtained from the Threatened Species Profiles Database (TSPD).

The assessment found that of the 22 species identified in the calculator, two have a high likelihood of occurrence and 12 have a moderate likelihood of occurrence in additional areas of impact within the development site. One species, Little Eagle, was recorded in the Georges River riparian corridor, about 200 metres north of proposed basin outlet 5 (PB 2015c) (Figure 7-1).

Bat calls attributable to either the Greater Broad-nosed Bat (*Scoteanax rueppellii*) or Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), both listed as Vulnerable under the TSC Act, were also recorded by PB (2014a). These calls were not of sufficient quality to reliably differentiate the species; however they were considered more likely to be the Greater Broad-nosed Bat, based on presence of suitable habitat and previous records in the locality (PB 2014a). Both species are identified as predicted ecosystem credit species in the calculator.

The threatened species with the highest Threatened Species (TS) offset multiplier in each vegetation zone determine the final ecosystem credit value. The two threatened owl species which have a moderate likelihood of occurrence on the development site, Barking Owl and Powerful Owl, have a high offset multiplier score of 3.0; this score is only relevant to breeding habitat containing large tree hollows, which does not occur in the development site. As such, the offset multiplier has been lowered to 1.5 for these species, in accordance with the BBAM. Ecosystem credit species considered unlikely to occur, based on review of habitat requirements, were removed from the calculator. The species with the highest offset multiplier, following adjustment or removal of species, was Greater Broad-nosed Bat, with an offset multiplier of 2.2.

Three additional ecosystem credit species not identified by the credit calculator were either recorded or tentatively identified in the development site:

- Grey-headed Flying-fox (*Pteropus poliocephalus*), listed as Vulnerable under the TSC Act and EPBC Act, was recorded flying over the development site by PB (2014a).
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*), listed as Vulnerable under the TSC Act, was recorded by Hyder Consulting (2015) in the Georges River riparian corridor to the south-west of the development site (Figure 7-1). The species was recorded in an earlier fauna study of the site in 2003 (LesryK Environmental Consultants 2003, cited in PB 2014a) and possible recordings of the species were also made by PB (2014a).
- Possible recordings of Large-footed Myotis (*Myotis macropus*) were made by Hyder Consulting (2015) in the Georges River riparian corridor to the south-west of the development site (Figure 7-1), and by PB (2014a). This species was also recorded in the LesryK (2005) fauna study of the site.

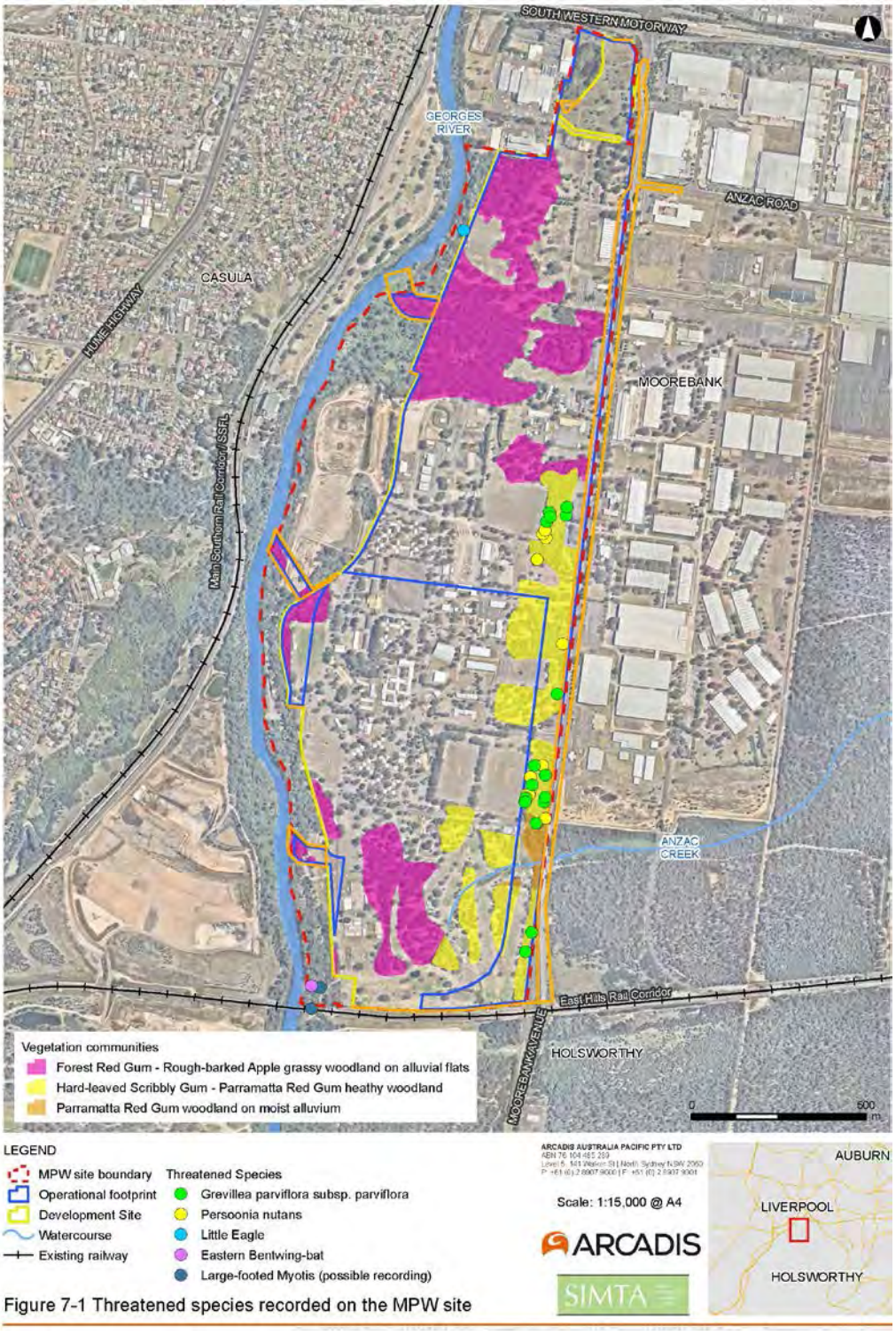

Figure 7-1 Threatened species recorded in the development site

Table 7-1 Predicted ecosystem credit species presence assessment

Predicted ecosystem credit species	Patch size	TS Offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on development site?	Species likelihood of occurrence on development site (based on PB 2014/2015)
Barking Owl *Ninox connivens* V-TSC Act	25-100 ha	(3.0) **revised to 1.5**	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	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)	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

Predicted ecosystem credit species	Patch size	TS Offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on development site?	Species likelihood of occurrence on development site (based on PB 2014/2015)
Climacteris picumnus subsp. *victoriae* V-TSC Act					
Bush Stone-curlew *Burhinus grallarius* E-TSC Act	25-100 ha	2.6	Inhabits open forests and woodlands with a sparse grassy groundlayer and fallen timber. Associated vegetation types provide foraging and refuge habitat for the species. Open grassy woodland with fallen dead timber provides breeding habitat.	Yes	Unlikely
Diamond Firetail *Stagonopleura guttata* V-TSC Act	<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	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.	Yes	Moderate
Eastern Freetail-bat *Mormopterus norfolkensis*	5-25 ha	2.2	Associated vegetation types provide foraging habitat for the species. Species roosts in tree hollows, loose bark or	Yes	High

Predicted ecosystem credit species	Patch size	TS Offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on development site?	Species likelihood of occurrence on development site (based on PB 2014/2015)
V-TSC Act			man-made structures. Breed in hollows in dead or alive trees.		
Flame Robin *Petroica phoenicea* V-TSC Act	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.	Yes	Moderate
Gang-gang Cockatoo *Callocephalon fimbriatum* V-TSC Act	<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	<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

Predicted ecosystem credit species	Patch size	TS Offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on development site?	Species likelihood of occurrence on development site (based on PB 2014/2015)
Hooded Robin (south-eastern form) *Melanodryas cucullata* subsp. *cucullata* V-TSC Act	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	<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	Recorded in Georges River riparian corridor
Little Lorikeet *Glossopsitta pusilla* V-TSC Act	<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 species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity.	Yes	High
Painted Honeyeater *Grantiella picta* V-TSC Act	<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

Predicted ecosystem credit species	Patch size	TS Offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on development site?	Species likelihood of occurrence on development site (based on PB 2014/2015)
Powerful Owl *Ninox strenua* V-TSC Act	>100 ha	(3.0) **revised to 1.5**	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
Scarlet Robin *Petroica boodang* V-TSC Act	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	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	Yes	Unlikely

Predicted ecosystem credit species	Patch size	TS Offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on development site?	Species likelihood of occurrence on development site (based on PB 2014/2015)
			sparse shrub layer, some eucalypt regrowth and an open canopy.		
Spotted Harrier *Circus assimilis* V-TSC Act	<5 ha	1.4	Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Yes	Moderate
Spotted-tailed Quoll *Dasyurus maculatus* V-TSC Act E-EPBC Act	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
Swift Parrot *Lathamus discolor* E-TSC Act E-EPBC Act	<5 ha	1.3	Occurs in areas where eucalypts are flowering profusely or where there are abundant lerp (honeydew produced by 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

Predicted ecosystem credit species	Patch size	TS Offset multiplier	Habitat requirements (from TSPD)	Ecosystem credit species habitat presence on development site?	Species likelihood of occurrence on development site (based on PB 2014/2015)
Varied Sittella *Daphoenositta chrysoptera* V-TSC Act	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	<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 Species credit species

7.2.1 Flora

The FBA Assessment for the MPW Concept Plan found 13 flora species credit species predicted to occur within the development site. The species are listed in Table 3.14 of PB (2015b).

Two of the threatened flora species credit species were recorded on the development site: *Persoonia nutans* (Nodding Geebung) and *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea).

At least 16 apparent individuals (individual shrubs or groups of suckers) of *Grevillea parviflora* subsp. *parviflora* were recorded. The precise number of individuals of this species present is very difficult to gauge due to its suckering habit and the possible presence of a soil seedbank. Approximately 10 individuals of *Persoonia nutans* were present; however additional individuals may also be represented in a soil seed bank.

Both species were recorded in the Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin in the east of the development site. The locations of the threatened flora species recorded in the development site are shown on Figure 7-1.

A total of four species were identified in the credit calculator as predicted flora species credit species for the additional areas of impact outside the Moorebank Development Site. Most of these species were also identified in the MPW Concept Plan FBA calculation:

- *Callistemon linearifolius* (Netted Bottle Brush)
- *Cynanchum elegans* (White-Flowered Wax Plant)
- *Hibbertia sp. Bankstown*
- *Hypsela sessiliflora*

Table 7-2 assesses the potential for these flora species credit species to be present on the development site using information from the TSPD. It also identifies species that cannot withstand further loss and whether further action is required.

Wahlenbergia multicaulis (Tadgells Bluebell) in the local government areas of Auburn, Bankstown, Baulkham Hills, Canterbury, Hornsby, Parramatta and Strathfield, listed as an Endangered Population under the TSC Act, was also predicted to occur within the development site by the credit calculator. As this population is not endangered in the Liverpool LGA, it was not considered further in the current assessment.

Table 7-2 Flora species credit species and their presence status

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on development site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Callistemon linearifolius Netted Bottlebrush	The species was more widespread in the past, and there are currently only 5-6 populations remaining from the 22 populations historically recorded in the Sydney area. 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. Open-forest e.g. with Corymbia eximia, Eucalyptus punctata, E. umbra, Allocasuarina littoralis, Angophora costata; sandy to clayey soils on sandstone.	No.	No typical habitat in study area.	Species not targeted.	Unlikely to occur; no nearby records and typical habitat is not present.	No	No

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on development site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Cynanchum elegans White-flowered Wax Plant E-TSC Act V-EPBC Act	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 development site.	N/A – species not targeted as unlikely to occur	N/A	Unlikely. No suitable habitat present.	No	Not required
Hibbertia sp. *Bankstown* (syn. *Hibbertia puberula* subsp. *glabrescens*) CE-TSC Act CE-EPBC Act	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	Habitat in the development site was considered unlikely to be suitable.	N/A – species not targeted as unlikely to occur.	November 2010, February 2013, May 2014, September 2014	Unlikely.	No	Not required

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on development site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
	other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content.						
Hypsela sessiliflora (syn. *Isotoma sessiliflora*) E-TSC Act Ex-EPBC Act (Note: a preliminary determination to remove this species from the TSC Act was gazetted on 19 February 2016).	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

7.2.2 Fauna

The FBA Assessment for the MPW Concept Plan found eight fauna species credit species predicted to occur within the development site. Although none of the species were recorded in the development site, one (Regent Honeyeater) was considered to have a moderate likelihood of occurrence there. The species are listed in Table 3.16 of PB (2015b).

A total of seven species were identified in the credit calculator as predicted species credit species for the additional areas of impact outside the Moorebank Development Site. Most of these species were also identified in the MPW Concept Plan FBA calculation:

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

Table 7-3 assesses the potential for fauna species credit species to be present within additional areas of impact on the development site using information obtained from the TSPD. Habitat requirements for each species were assessed against the habitat values on the development site. Habitat information was obtained from OEH's Threatened Species Profiles Database. 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 7-3 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 in additional areas of impact within the development site based on the assessment provided in Table 7-3.

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

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on development site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
Cumberland Plain Land Snail *Meridolum corneovirens* E-TSC Act	Occurs in bark or leaf litter accumulation in associated vegetation types (ME003, ME005, ME018). 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.	Yes. Development site supports small isolated areas of marginal habitat.	6 person hours of hand searches in areas of potential habitat.	November 2010	Unlikely. The species was not found during targeted surveys.	Yes	Not required
Eastern Osprey *Pandion cristatus* V-TSC Act	Land within 40 m of fresh/brackish/saline waters of larger rivers or creeks; estuaries, coastal lagoons, lakes and/or inshore marine waters. Breed from July to September in NSW. Nests are made high up in dead	Foraging habitat present. Unlikely to breed on site as species typically nests within 1km of the ocean.	Diurnal bird surveys: 8 person hours (2 sessions in each of 4 locations)	November 2010	Unlikely as nest and feeding signs are conspicuous and were not found during surveys.	Yes	Not required

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on development site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
	trees or in dead crowns of live trees, usually within one kilometre of the sea.						
Eastern Pygmy-possum *Cercartetus nanus* V-TSC Act	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.	Marginal habitat present, likely only along the Georges River; other vegetation unlikely to be occupied due to fragmentation.	Spotlighting: 10 person hours; Small mammal trapping: 99 trap nights	November 2010	Unlikely. The species was not found during targeted surveys.	Yes	Not required
Green and Golden Bell Frog *Litoria aurea* E-TSC Act V-EPBC Act	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,	Marginal habitat present in basins and minor wetlands.	Call playback and night time water body searches – two sessions on separate nights in two locations with potential habitat, total 6 person hours.	November 2010	Unlikely. Habitat is marginal and species not recorded during targeted surveys.	Yes	Not required

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on development site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
	rocks and building materials such as fibro, sheet iron or bricks.						
Koala *Phascolarctos cinereus* V-TSC Act V-EPBC Act	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.	Habitat present in native vegetation where Koala feed trees for the Central Coast management region were recorded including primary feed trees *E. parramattensis* and *E. tereticornis*. *E. baueriana* (secondary food tree in the region) was also recorded in low densities.	Call playback: 12 person hours over two nights; Spotlighting: 10 person hours over two nights.	November 2010	Unlikely. The species was not found during targeted surveys.	Yes	Not required
Regent Honeyeater *Anthochaera phrygia* CE-TSC Act	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	Marginal habitat present in the Alluvial Woodland of the Georges River riparian corridor and local records are present. May forage sporadically on the site	Diurnal bird surveys: 8 person hours (2 sessions in each of 4 locations)	November 2010	Unlikely. The species was not found during targeted surveys.	Yes	Not required

Predicted species credit species	Habitat requirements (from TSPD)	Habitat presence on development site?	Targeted survey effort/ methods	Targeted survey timing	Presence status	Can species withstand further loss?	Further action?
E-EPBC Act	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.	in winter but unlikely to breed locally.					
Squirrel Glider *Petaurus norfolcensis* V-TSC Act	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.	Marginal habitat only present. One record at Holsworthy Military Reserve. If present, likely to be restricted to the Georges River Corridor as other areas are too disturbed and fragmented.	Call playback: 12 person hours over two nights; Spotlighting: 10 person hours over two nights; Small mammal trapping: 99 trap nights.	November 2010	Unlikely. The species was not found during targeted surveys.	Yes	Not required

7.3 Aquatic species

PB (2014a) assessed the aquatic fauna habitats and potential presence of threatened species through habitat assessment and reference to aquatic surveys reported in Gehrke *et al.* (2004) and Hyder Consulting (2012).

The stretch of the Georges River adjoining the western edge of the development site varies from approximately 40 to 50 metres in width and is characterised by sluggish water flow. The riverbank varies from very steep in the north to gently sloping in the south. Bank erosion is evident on parts of the very steep eastern bank of the river in the north of the site. The vegetation on the bank in this area is variable, being dominated by native shrubs in the north and mats of weedy vines and shrubby thickets of *Lantana camara* in the centre and south. Native emergent aquatic vegetation, mostly comprising *Typha orientalis* and *Phragmites australis,* occurs in patches along the river edge (PB 2014a).

The Georges River is a major permanently flowing waterway and is classified as Class 1 (major fish habitat) in accordance with the criteria of Fairfull and Witheridge (2003).

Seven common native fish species two exotic fish species were previously recorded in the Georges River and Anzac Creek in the vicinity of the development site by Gehrke *et al.* (2004) and Hyder Consulting (2012). No species currently listed under the NSW Fisheries Management Act 1994 (FM Act) were recorded in the catchment and none were considered likely to occur in the adjacent stretch of the Georges River by PB (2014a). Due to the degraded condition of the river, the native species that persist here are likely to consist of disturbance tolerant species which are less sensitive to alterations in environmental conditions than species restricted to relatively unmodified environments (PB 2014a).

There are two dragonfly species currently listed under the FM Act occurring in the Sydney basin:

- Adams Emerald Dragonfly (*Archaeophya adamsi*) - Endangered
- Sydney Hawk Dragonfly (*Austrocordulia leonardi*) - Endangered

Neither species is listed under the TSC Act or EPBC Act. The closest historical records of the Adams Emerald Dragonfly and the Sydney Hawk Dragonfly are respectively 35 km and 12.5 km from the development site.

A Threatened Dragonfly Species Survey Plan (Arcadis 2016) was prepared in consultation with DPI Fisheries as part of the Concept Plan Approval, i.e. not prepared as part of the Proposal. The objective of the plan is to determine the presence or absence of threatened dragonfly species listed under the FM Act on the Georges River, adjacent to the development site.

Field assessment of potential dragonfly habitat was undertaken in September 2016 as part of the plan. The character of the Georges River within the survey area was found to be markedly different from known habitat for the targeted threatened dragonfly species. No habitats for threatened dragonfly species were detected in the survey area after an extensive ecological assessment, and it is considered highly unlikely that they occur in the surveyed area. No impact to threatened dragonflies is anticipated as a consequence of the Proposal.

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 8.3.2 of 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 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 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 MPW site was undertaken as part of a preliminary assessment of the MPW Project and as part of the Ecological Assessment for the Concept Plan Approval.
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 MPW Concept Plan Approval.
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	The scale and type of development provides only limited possibilities for the incorporation of small isolated patches of vegetation into the design of a large industrial and warehouse layout. It was acknowledged in the biodiversity assessments for the MPW Concept

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
	biodiversity values present on the development site.	Plan that the current proposal will clear threatened ecological communities, threatened species and their habitat; however the majority of this vegetation/habitat is made up of small, highly fragmented and disturbed patches of vegetation.
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 MPW site represents an ideal position for an intermodal facility as: ▪ The site is situated in close proximity to the SSFL, reducing the length of Rail link needed and subsequently minimising potential vegetation clearing. ▪ 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 Proposal is not a linear project.

The MPW site has been granted approval, in the form of a Concept Plan Approval, for the development of an intermodal facility and therefore is considered suitable for the development.

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 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 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 MPW Project, and the potential biodiversity impacts of the 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 total development site is approximately 166 ha in area, of which 28% (or 47 ha) will be located in areas mapped as native plant community types (PCTs). The vegetation to be impacted within the development site has relatively low site value scores (refer to section 6.5 of this report) for each of the vegetation types below: ▪ 35.76 to 55.21 for ME018 Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion; ▪ 39.58 for the ME005 Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion; and ▪ 44.27 for ME003 Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion. In contrast, the condition of the remnant vegetation within the proposed offset areas within riparian vegetation

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
		to the west of the site is relatively good, as demonstrated by the higher current site value scores of 43-70 for these vegetation remnants (as determined in PB (2015b)).
	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 Proposal and its context with regard to existing road and rail infrastructure, there is limited scope for using alternative locations to entirely avoid impacts on biodiversity. Given the scale and type of development, there are only limited possibilities for the incorporation of small isolated patches of vegetation into the design of a large industrial and warehouse development. The Proposal has generally minimised the area of clearing and habitat loss to those areas of disturbed and fragmented patches of vegetation within the centre and east of the MPW site, further consolidating the existing and proposed future industrial development area. Based on the number of stormwater basins proposed for the development, it was initially anticipated that four basin outlets would be required within the Georges River riparian corridor. Following discussions with the design team, the number of proposed basins, and corresponding outlets, has been reduced to three. The design of the basin outlets has incorporated features to facilitate fauna passage and outlets will be revegetated as far as is practicable while still maintaining functional flows.
	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 development site is located within an urban area and predominantly consists of Defence land, urban development, internal road network and a golf course. The majority of development of the site currently occurs on fragmented remnant vegetation within an urban environment and will not result in a change in connectivity. The site is connected to riparian vegetation along Georges River to the west which connects to extensive

FBA section	FBA guidelines	Consistency of the Proposal with FBA guidelines
		vegetation in the south and south east. The majority of the Georges River riparian corridor will be incorporated within the proposed offset areas, which through restoration and management will result in the likely improvement of habitat quality within this corridor and further consolidate the connectivity value of this corridor. The construction of basin outlets within the Georges River riparian corridor is likely to result in three gaps in the riparian vegetation ranging in width from 50 to 70 metres. It is proposed to design the outlets to facilitate fauna movement and avoid creating any additional barriers to terrestrial fauna.
	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.	The Proposal has also considered the flood planning levels and Georges River riparian zone in the development of the Proposal layout, incorporating these areas into the Moorebank and Casula conservation areas. Where possible any new services will also be located adjoining existing service areas or within disturbed areas.

8.2 Unavoidable impacts

8.2.1 Construction phase

8.2.1.1 Construction program and activities

Subject to planning approval, construction of the Proposal is planned to commence in the third quarter of 2017. The total period of construction works for the Proposal is anticipated to be approximately 36 months.

The construction works have been divided into seven ‘works periods’ which are interrelated and also may potentially overlap. Subject to confirmation of construction staging, the order of these construction works periods may shift slightly.

A summary of the indicative activities included in each of these works periods, which is relevant to the construction of the IMT facility, the Rail link connection and the warehouses, is provided in Table 8-3.

Table 8-3 Works periods and activities

Works period	Activities
Pre-construction fill placement and stockpiling	• Establishment of temporary erosion and sediment controls • Minor clearing and grubbing of temporary stockpiling area • Establishment of a temporary stockpiling pad and associated temporary access roads • Installation of temporary construction compound, including amenities and office for bulk earthworks • Importation and placement of approximately 400,000 cubic metres (m3) of clean fill
Site preparation activities	• Establishment of construction compound fencing and hoardings • Installation of temporary sediment and erosion control measures • Vegetation clearance • Installation of temporary site offices and amenities • Construction of hardstands for staff parking and laydown areas • Establishment of temporary batch plant sites and installation of batch plant • Construction of access roads, site entry and exit points and security (N.B. preference is to use existing access where practicable) • Set up of construction monitoring equipment
Bulk earthworks, drainage and utilities	• Importation, stockpiling and placement of approximately 1,200,000 m3 of imported clean fill (Bulk Earthworks) and raising of the Proposal site to final level • Installation of OSDs • Drainage and utilities installation • Establishment of a concrete batching plant
Moorebank Avenue intersection works and internal road network	• Relocation, adjustment and/or protection of all affected utilities, services and signage, as required • Establishment of traffic management devices • Installation of erosion and sediment controls • Stripping and stockpiling of topsoil by excavators and trucks • Drainage works • Progressive stabilisation of exposed areas • Compaction of widening areas • Preparation of new lane surfaces • Forming of new kerbs, gutters, medians and other structures

Works period	Activities
	• Construction of asphalt and concrete pavement • Landscaping of exposed earthworks areas • New line marking, lighting and sign posting • Removal of construction traffic management and progressive opening of new works to traffic
IMT facility and Rail link connection construction	• Importation, placement and compaction of engineering fill • Compaction of engineering fill • Importation and placement of ballast material • Establish formwork and reinforcement for sidings and bridge infrastructure • Placement of concrete, curing and sealing • Installation of permanent ways and rail systems • Installation of permanent access gates, security gatehouse and permanent fencing • Installation of the connection between the Rail link and the IMT facility sidings • Erection of IMT facility administration building – excavation foundation and floor slab construction, structural wall and roof framework, and roofing • Internal fit-out of building with control room, office, workshops, loco-shifter and staff amenities
Construction and fit-out of warehousing	• Establishment of construction compound, temporary fencing/ hoardings and temporary sediment and erosion control • Installation of temporary site offices and amenities • Excavation, foundation and floor slab installation • Erection of framework and structural walls • Installation of roof • Internal fit out • Landscaping and surrounds • Preparation of warehouse access road subgrade • Forming of new kerbs, gutters, medians and other structures • Construction of asphalt and concrete pavement • New line marking, lighting and sign posting • Removal of construction traffic management and progressive opening of the internal road and warehouse access roads to traffic

Works period	Activities
Miscellaneous structural construction and finishing works	▪ Decommissioning/demobilisation of construction sites ▪ Commissioning of operational facilities ▪ Landscaping ▪ Rehabilitation of affected areas ▪ Post-construction condition surveys ▪ Removal of construction environmental controls ▪ Removal of construction ancillary facility related traffic signage

8.2.1.2 Ancillary compounds

Temporary construction compounds, a batching plant and communal parking areas would be required to support construction works for the Proposal. The locations of these compounds and facilities are indicative and subject to confirmation by the construction contractor and are shown in Figure 8-1.

At this stage construction compounds identified for the Proposal include:

- Earthworks Compound
- IMT Facility Compound
- Rail Compound.

Access to the compound sites would be via existing access points to the MPW site from Moorebank Avenue. An area would be made available in the northern portion of the Proposal site to provide worker parking, once the Moorebank Avenue / Anzac Avenue intersection upgrade is complete. In addition, to the above compounds, individual smaller compounds would be established for the construction of each warehouse.

The indicative location of these compounds is shown in Figure 8-1. Compound and stockpile sites would be temporary in nature and removed/decommissioned at the completion of construction. Where not within the footprint of the operational area, these areas would be rehabilitated upon completion of the works and the sites left in a stable condition.

8.2.1.3 Stormwater Basin Outlets

Each of the proposed basins (5, 6 and 8) discharging to the Georges River requires outlet channels that are:

- to be configured with energy dissipaters and scour protection, in traversing the overbank areas of the Georges River,
- are to be no higher than existing ground surface levels (to avoid adverse flood impacts); and
- aligned with no less than a 45 degree entry angle into the Georges River channel.

The outlet channels will include gabion and reno-mattress elements that accommodate grass and low vegetation.

Figure 8-1 Proposed works

8.2.1.4 Potential impacts on biodiversity

Likely impacts are those impacts that may arise as a result of unmitigated activities associated with the construction of the Proposal. The impacts specified in point 12a) of the SEARs are considered below.

Endangered (and vulnerable) ecological communities

The Proposal will require clearing of all vegetation within the development site, including threatened ecological communities. The threatened ecological communities to be directly impacted and the total areas of impact are listed in Table 8-4.

Table 8-4 Areas of direct impact to threatened ecological communities

Plant Community Type	Equivalent TEC	Conservation status	Area of impact
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)	15.51 ha
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin	Castlereagh Swamp Woodland	Endangered (TSC Act)	0.92 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)	30.62 ha

Ecosystem credits are required to offset the impacts to these threatened ecological communities. The credit requirements are provided in Section 9.1.1.

Threatened flora and fauna species and their habitat

The Proposal will have direct impacts on populations of two threatened flora species listed under the TSC Act and EPBC Act. Table 8-5 summarises the impacts to these species.

Table 8-5 Impacts to threatened flora species

Threatened flora species	Conservation status	Impacts
Persoonia nutans	Endangered	10 individuals
Grevillea parviflora subsp. *parviflora*	Vulnerable	16 individuals

Species credits are required to offset the impacts to these species. The credit requirements are provided in Section 9.1.2. No other threatened plant species listed under the TSC Act and/or EPBC Act are anticipated to be impacted by the Proposal.

The clearing of vegetation will result in the loss of specific fauna habitat components, including live trees, tree hollows, foraging resources, groundlayer habitats such as ground timber and well-developed leaf litter. These resources offer sheltering, foraging, nesting and roosting habitat to a variety of fauna, including threatened fauna, occurring within the locality. The Proposal will require removal of over 43 hollow-bearing trees.

The assessment of ecosystem credit species associated with PCTs on the development site found that two threatened fauna species have a high likelihood of occurrence and 16 have a moderate likelihood of occurrence. Ecosystem credits are required to offset the impacts to these threatened fauna species; the credit requirements are provided in Section 9.1.1.

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 retained vegetation and habitat that may utilise the shallow groundwater aquifers present. The riparian vegetation in the west of the site has been identified as having high potential for groundwater interaction.

Impacts on wildlife and habitat corridors and habitat fragmentation

Most of the habitat to be removed for the Proposal is currently fragmented by the existing development. The vegetation in the riparian corridor adjoining the Georges River maintains connectivity with riparian vegetation to the north and south of the development site and may facilitate the movement of less mobile species, including cover-dependent species, larger terrestrial mammals and arboreal mammals. The vegetation within the basin outlet locations is currently disturbed, with high abundance and cover of exotic species including invasive weedy species.

The riparian corridor would be impacted by the removal of vegetation for construction of sediment basin outlets in three locations. Vegetation would be removed to the water's edge, creating a temporary barrier to habitat connectivity along the riparian corridor; the resulting gaps in the vegetation would range from 50 metres to 70 metres during construction. The areas to be disturbed would be recontoured and partially revegetated upon completion of the basin outlets to restore habitat connectivity.

These impacts are discussed further in Section 8.3.

Riparian land

Additional areas of riparian vegetation will be removed for the three basin outlets required for the Proposal. This additional riparian vegetation amounts to a total of 1.68 hectares of Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin outside of the area to be impacted for the MPW Concept Plan.

The retained riparian vegetation adjoining the development site will be conserved and restored as part of biodiversity offsetting for the Proposal, within the area known as the Moorebank Conservation Area (see Section 10). The conservation area ranges in

width from approximately 35 metres in the north to approximately 290 metres in the centre.

8.2.1.5 Comparison with impacts of the MPW Concept Plan

The impacts of the Proposal are largely similar in nature and extent to the impacts of the MPW Concept Plan considered and assessed by PB (2014a). A comparison of the impacts considered by PB (2014a) and the impacts of the Proposal is presented in Table 8-6.

Table 8-6 Comparison of impacts assessed in PB (2014, 2015) and the impacts of the Proposal.

Impact	MPW Concept Plan impacts (full build)	Proposal impacts
Vegetation clearing and habitat loss	Vegetation clearing would occur throughout the eastern part of the development site adjacent to Moorebank Avenue and would extend to the west through the middle of the site to the existing riparian vegetation corridor along the Georges River. Three sediment basin outlets intersecting the riparian corridor were assumed to require clearing of about 10 metres wide.	Vegetation clearing would occur through similar area as assessed in the MPW Concept Plan EIS, with the exception of the rail crossing of the Georges River (subject to separate approval) and with a greater extent of clearing for the three sediment basin outlets within the riparian zone adjoining the Georges River.
Loss of roosting and breeding habitat in hollow bearing trees	Removal of over 43 hollow-bearing trees containing hollows of a wide variety of shapes and sizes, ranging from narrow cracks and fissures in dead wood, to hollows within tree trunks with very large entrance diameters (>300mm) and large internal volumes. The majority of the hollows that would be lost are in trees located in heavily cleared areas of the development site.	Similar impacts to those identified in the MPW Concept Plan EIS.
Direct mortality	Specimens of *Grevillea parviflora* subsp. *parviflora* and *Persoonia nutans* on the site would be killed during clearing unless a translocation program for these species is implemented. Fauna injury or death could occur as a result of the MPW Project's construction phase, particularly when vegetation is being cleared and existing detention basins filled.	Similar impacts to those identified in the MPW Concept Plan EIS.
Loss of foraging resources	In addition to the displacement of resident animals and loss of shelter, vegetation clearing would result in the loss of potential foraging resources for species which shelter and breed outside	Similar impacts to those identified in the MPW Concept Plan EIS.

Impact	MPW Concept Plan impacts (full build)	Proposal impacts
	the development site. This loss may impact highly mobile fauna species occurring in adjacent habitat.	
Fragmentation and loss of connectivity	The MPW Project would result in the removal of a substantial area of woodland/forest habitat. This habitat is currently isolated/fragmented by existing rail infrastructure, internal and external roads, built and landscaped areas, sporting fields and a golf course. The MPW Project is not likely to significantly fragment or isolate retained vegetation along the Georges River Corridor. The proposed Rail link across the Georges River would create a break in the canopy of the riparian vegetation approximately 50 m in width. The proposed overland drainage channels which form part of the stormwater infrastructure for the MPW Project would result in minor (<10 m) wide gaps in the canopy in the short term; however vegetation restoration would restore canopy connectivity in the medium term to long term.	The Proposal does not include the Rail link across the Georges River. The proposed stormwater basin outlets would be wider than considered in the MPW Concept Plan EIS and may result in further fragmentation of the riparian corridor.
Increased edge effects	As most patches of native vegetation across the development site would be entirely removed, there would be no increase in edge effects on these patches. In the short term, the MPW Project would result in increased edge effects on the habitat of the Georges River riparian corridor due to clearing, particularly for overland drainage infrastructure. Due to the relatively narrow width of this corridor and its high edge to area ratio, edge effects are already quite severe. The short-term increase in edge effects as a result of the MPW Project is, therefore, unlikely to significantly alter the present edge effects on this habitat.	Similar impacts to those identified in the MPW Concept Plan EIS.
Noise impacts on fauna	The wildlife of the development site is likely to be habituated to frequent noise exposure as a result of current activities	Similar impacts to those identified in the MPW Concept Plan EIS.

Impact	MPW Concept Plan impacts (full build)	Proposal impacts
	on and adjoining the site. While the construction phases of the MPW Project may cause temporary disturbance to animals, the impacts from noise emissions are likely to be localised close to development site (up to100 m) and are not likely to have a significant, long-term, impact on wildlife populations.	
Light impacts to fauna	Under present conditions there is little light pollution of the core habitat of the development site, within the vegetation along the Georges River. Light pollution is likely to be substantially higher during the construction and operation of the MPW Project due to fixed lighting within the facility and lighting from trucks and trains.	Similar impacts to those identified in the MPW Concept Plan EIS.
Dust pollution	Dust generated during construction may be deposited onto the foliage of adjacent native vegetation. This has potential to reduce photosynthesis, which may reduce the overall health of the vegetation adjacent to the development site through changes to vegetation structure and composition.	Similar impacts to those identified in the MPW Concept Plan EIS.
Introduction and spread of weeds, pests and pathogens	The MPW Project has the potential to further disperse weeds into areas of native vegetation within the development site, particularly adjacent to cleared areas. The vegetation of the riparian corridor currently has a moderate to high level of weed invasion, particularly of woody and vine weeds. The habitat that would be removed for the MPW Project is already affected by pest species. Removal of this habitat would result in a reduction in habitat available to these species. In the short term this may lead to increased competition for resources (e.g. tree hollows) and increased pressure on remaining habitats. There is potential for pathogens including Amphibian Chytrid Fungus, Exotic Rust Fungi and Phytophthora Root Rot Fungus to occur on the site at present or in the future. With the implementation of hygiene procedures	Similar impacts to those identified in the MPW Concept Plan EIS.

Impact	MPW Concept Plan impacts (full build)	Proposal impacts
	for the use of vehicles and the importation of materials to the site, the risk of introducing or spreading these pathogens would be low.	
Fire regimes	The development site has been identified as containing bushfire prone land. With the implementation of design and management measures, the risk of the project causing a change to fire regimes that would be detrimental to biodiversity is low.	Similar impacts to those identified in the MPW Concept Plan EIS.
Disturbance to aquatic habitat	Bridges would have multiple piers located both adjacent to the Georges River and within the Georges River floodplain. If possible, it is not intended to locate any bridge piers within the river channel itself. Impacts could include: possible disturbance to the substrate of the river or removal of submerged or emergent aquatic vegetation; shading of aquatic vegetation; potential increases in turbidity from construction runoff; accidental spillage/leakage of construction materials; loss of fringing and riparian vegetation. The section of Anzac Creek on the development site would be removed, and flows redirected through stormwater detention basins on the development site. Removal of this creek was considered by PB (2014a) to be unlikely to result in a significant negative impact to the receiving waters of the remainder of Anzac Creek, as current inflows are likely to be polluted with fertilisers, pesticides and silt and would constitute only a small proportion of total inflows.	The Proposal does not include the rail link across the Georges River, therefore impacts arising from the bridge construction are not applicable. There would be potential impacts to aquatic habitats in the Georges River as a result of vegetation clearing for the proposed sediment basin outlets. Impacts to Anzac Creek would be similar to those identified in the MPW Concept Plan EIS.
Disturbance of 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 retained vegetation and habitat that may utilise the shallow groundwater	Similar impacts to those identified in the MPW Concept Plan EIS.

Impact	MPW Concept Plan impacts (full build)	Proposal impacts
	aquifers present. The Alluvial Woodland vegetation in the west of the site has been identified as having high potential for groundwater interaction.	

8.2.2 Operational phase

As concluded by PB (2014a), most of the construction impacts on biodiversity would continue through to the operation of the Proposal. The operational impacts on biodiversity will be reduced once mitigation measures are implemented and the revegetation and restoration works within the adjoining conserved riparian vegetation progress.

8.3 Impacts requiring further consideration

Under the FBA, certain impacts on biodiversity values require further consideration by the relevant consent authority. These are impacts that are considered to be complicated or severe, and a decision will be made by the relevant consent authority on whether it is appropriate for these impacts to occur, and whether additional offsets, supplementary measures or other actions may be required.

Impacts that require further consideration include:

- Impacts that will substantially reduce the width of vegetation in the riparian buffer zone bordering rivers and streams 4th order or greater.
- Impacts in state biodiversity links.

The Georges River is at least a 6th order stream. The area within 50 metres of the Georges River is defined as a state biodiversity link under the FBA, and several sections of this area would be subject to impacts from the Proposal.

The Georges River riparian corridor state significant biodiversity link would be impacted by the removal of vegetation for construction of sediment basin outlets in three locations. Vegetation would be removed to the water's edge, creating a temporary barrier to habitat connectivity along the riparian corridor.

The vegetation within the basin outlet locations is currently disturbed, with high abundance and cover of exotic species including invasive weedy species such as *Lantana camara*, *Ligustrum* spp., *Cardiospermum grandiflorum* and *Arundo donax.* The existing drainage infrastructure in the location of the proposed basin outlet 5 has catastrophically failed, resulting in an incised and scoured drainage line on the steep slope down to the Georges River, and there is dense cover of *Lantana camara* on the slope.

The areas to be disturbed would be recontoured and partially revegetated upon completion of the basin outlets to restore habitat connectivity. While there would be a considerable temporary and short term impact during construction of the outlets, the

permanent impacts would be unlikely to significantly impede fauna movement provided that connectivity is enhanced using strategic revegetation and other fauna habitat features such as rocks and hollows logs to provide cover in these areas. The gaps in the riparian corridor vegetation as a result of the proposed basin outlets would range from 50 metres to 70 metres during construction, and from 20 metres to 40 metres following revegetation. An indicative cross-section of the proposed basin outlet, incorporating revegetation, is provided in Figure 9-1.

The impacts to the Georges River Riparian Corridor are considered unlikely to fall into the category of impacts requiring further consideration as they:

- Will not result in a gap greater than 100 metres between two areas of moderate to good condition native vegetation with a patch size greater than 1 ha.
- Will not remove over-storey cover and mid-storey cover vegetation within the state significant biodiversity link to create a gap in over-storey cover vegetation greater than 100 metres.
- Will not create a hostile barrier within the state significant biodiversity link.

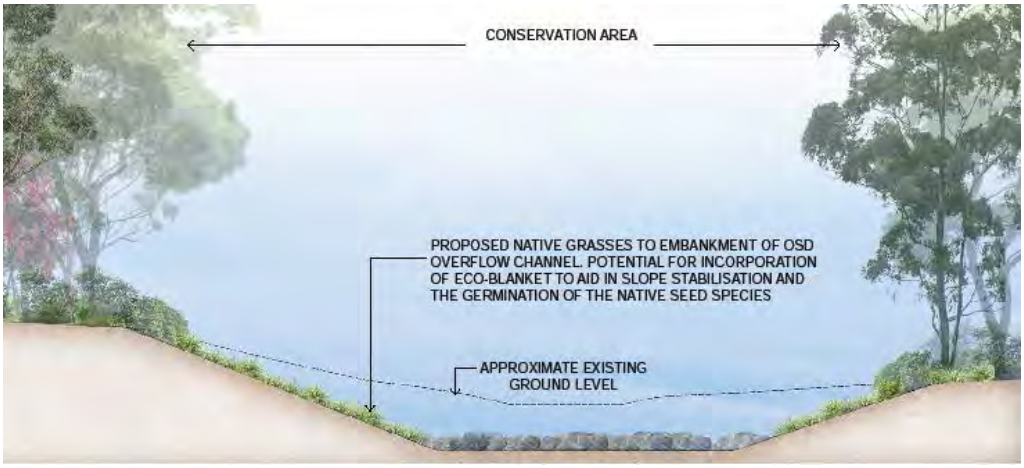

Figure 9-2Indicative cross-section of the proposed basin outlets (adapted from GroundInk 2016)

9 MITIGATION OF IMPACTS

Biodiversity impacts cannot be avoided for many aspects of the 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
Following detailed design and before construction, detailed flora and fauna mitigation measures would be developed and presented as part of the CEMP. These detailed measures would incorporate the measures listed below. The CEMP would address: • general impact mitigation; • staff/contractor inductions; • vegetation clearing protocols; • pre-clearing surveys and fauna salvage/translocation; • rehabilitation and restitution of adjoining habitat; • weed control; • pest management; and • monitoring. The plans would include clear objectives and actions for the Proposal including how to: • minimise human interferences to flora and fauna;	Flora and fauna would be managed in accordance with the requirements of the CEMP.	Pre-construction and construction	Design contractor, construction contractor

Mitigation measure	Outcome	Timing	Responsibility
• minimise vegetation clearing/disturbance; • minimise impact to threatened species and communities; • minimise impacts to aquatic habitats and species; and • undertake flora and fauna monitoring at regular intervals.			
Vegetation clearing would be restricted to the construction footprint and sensitive areas would be clearly identified as exclusion zones.	Prevention of over clearing of vegetation	Pre-construction and Construction	Design contractor, construction contractor
The exclusion zones would be marked on maps, which would be provided to contractors, and would also be marked on the ground using high visibility fencing (such as barrier mesh).	Prevention of over clearing of vegetation	Pre-construction and Construction	Design contractor, construction contractor
A suitably qualified ecologist would accompany clearing crews to ensure disturbance is minimised and to assist in relocating any native fauna to adjacent habitat.	Prevention of over clearing of vegetation and fauna injury/mortality	Construction	Construction contractor

Mitigation measure	Outcome	Timing	Responsibility
The following procedures would be implemented to minimise fauna impacts from vegetation clearance: • A staged habitat removal process would be developed and would include the identification and marking of all habitat trees in the area. • Where reasonable and feasible, clearing of hollow-bearing trees would be undertaken in March and April when most microbats are likely to be active (not in torpor) but are unlikely to be breeding or caring for young, and when threatened hollow-dependent birds in the locality are also unlikely to be breeding. • Pre-clearing surveys would be conducted 12 to 48 hours before vegetation clearing to search for native wildlife (e.g. reptiles, frogs, Cumberland Land Snail) that can be captured and relocated to the retained riparian vegetation of the Georges River corridor. • Vegetation would be cleared from a 10 m radius around habitat trees to encourage animals roosting in hollows to leave the tree. A minimum 48 hour waiting period would allow animals to leave.	Prevents fauna injury/mortality	Construction	Construction contractor

Mitigation measure	Outcome	Timing	Responsibility
• After the waiting period, standing habitat trees would be shaken (where safe and practicable) under the supervision of an ecologist to encourage animals roosting in hollows to leave the trees, which may then be felled, commencing with the most distant trees from secure habitat. • Felled habitat trees would either be immediately moved to the edge of retained vegetation, or left on the ground for a further 24 hours before being removed from the construction area, at the discretion of the supervising ecologist. • All contractors would have the contact numbers of wildlife rescue groups and would be instructed to coordinate with these groups in relation to any animal injured or orphaned during clearing.			
Within areas of high quality intact native vegetation proposed to be removed: • Topsoil (and seedbank) is to be collected from native vegetation that are to be permanently cleared and used in the revegetation of riparian areas; and	Conservation of genetic material from local native plant communities	Construction	Construction contractor

Mitigation measure	Outcome	Timing	Responsibility
• Native plants in areas that are to be permanently cleared are to be relocated and transplanted in riparian areas identified for rehabilitation			
Relocation of fauna to adjacent retained habitat would be undertaken by an ecologist during the supervision of vegetation removal.	Prevents fauna injury/mortality	Construction	Construction contractor
An ecologist would supervise the drainage of any waterbodies on the Proposal site and would relocate native fish (e.g. eels), tortoises and frogs to the edge of the Georges River and/or the existing pond at the northern end of the Proposal site.	Prevents fauna injury/mortality	Construction	Construction contractor
The design of site fencing and any overhead powerlines would consider the potential for collision by birds and bats and minimise this risk where practicable.	Prevents fauna injury/mortality	Detailed design & Pre-construction	Design contractor
The potential for translocation of threatened plant species as individuals or as part of a soil translocation process would be considered during the detailed development of the CEMP.	Reducing impacts to threatened plant species	Detailed design & Pre-construction	Design contractor, construction contractor

Mitigation measure	Outcome	Timing	Responsibility
Important habitat elements (e.g. large woody debris) would be moved from the construction area to locations within the conservation area which would not be cleared during the Proposal, or to stockpiles for later use in vegetation/habitat restoration.	Retaining fauna habitat resources	Pre-construction and Construction	Design contractor, construction contractor
Winter-flowering trees would be preferentially planted in landscaped areas of the Proposal site to provide a winter foraging resource for migratory and nomadic nectar-feeding birds and the Grey-headed Flying-fox.	Maintaining and enhancing fauna habitat resources	Detailed design, Pre-construction and Construction	Design contractor, construction contractor
Erosion and sediment control measures such as silt fencing and hay bales would be used to minimise sedimentation of streams and resultant impacts on aquatic habitats and water quality.	Prevention of sedimentation and erosion leading to a reduction in water quality and degradation of aquatic habitats	Pre-construction and Construction	Design contractor, construction contractor
Opportunities for planting of detention basins with native aquatic emergent plants and fringing trees would be explored in the detailed design of the Proposal and, if practicable, implemented so that they would provide	Maintain aquatic habitat values	Pre-construction	Design contractor, construction contractor

Mitigation measure	Outcome	Timing	Responsibility
similar habitat in the medium term to that lost through the removal of existing basins.			
The CEMP (or equivalent) would include detailed measures for minimising the risk of introducing weeds and pathogens.	Prevention of weed establishment and invasion	Pre-construction	
The CEMP and OEMP for the Proposal would consider and have reference to the weed removal and riparian vegetation restoration undertaken within parts of the Georges River corridor under the MPW Concept Approval (identified within the Biodiversity Offset Package for the MPW Project).	Prevention of weed establishment and invasion	Pre-construction, construction and operation	Design contractor, construction contractor, operations contractor
The detailed design process would consider the potential groundwater impacts on groundwater-dependent ecosystems. In most cases, these impacts would be mitigated at the design phase.	Prevention of impacts to groundwater-dependent ecosystems.	Detailed design & Pre-construction	Design contractor, construction contractor, operations contractor
The OEMP would include a biodiversity monitoring program designed to detect operational impacts of the Georges River riparian corridor (within the offset site).	Minimise impacts to native riparian vegetation, retains habitat connectivity and improves native biodiversity	Pre-construction, construction and operation	Design contractor, construction contractor, operations contractor

Mitigation measure	Outcome	Timing	Responsibility
	values along riparian corridor of the Georges River		
Ongoing monitoring of macroinvertebrate communities will be undertaken prior to, during and following construction upstream and downstream of the proposed impacts at the proposed basin outlets in the Georges River and reference locations to assist in identifying any changes in aquatic communities.	Minimise impacts to the aquatic environment in the Georges River.	Pre-construction, construction and operation	Design contractor, construction contractor, operations contractor
The proposed stormwater outlets would be designed to minimise biodiversity impacts by incorporating native revegetation and fauna habitat features as possible.	Maintaining native vegetation values and fauna connectivity in basin outlets (which are located within the proposed conservation area)	Pre-construction	Design contractor
The native vegetation and connectivity values in the proposed basin outlets would be monitored to ensure that fauna passage is maintained.	Maintaining native vegetation values and fauna connectivity in basin outlets (which are located within the proposed conservation area)	Construction and operation	Construction contractor, operations contractor

10 OFFSETTING IMPACTS

A comprehensive Biodiversity Offset Strategy (BOS) for the MPW Project is required to be prepared and implemented under the MPW 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 or offset' principle.

The BOS will be prepared with the objective of offsetting all biodiversity impacts within the Moorebank Precinct (comprising the MPW site and the Moorebank Precinct East (MPE) site).The BOS will consider all of the relevant biodiversity impacts of the Proposal.

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 ecosystem and species credit offset requirements for the biodiversity impacts of the Proposal are detailed below.

The FBA calculator used for the MPW Concept Plan FBA Assessment (PB 2015b) was updated by Alex Cockerill (Parsons Brinckerhoff) (Assessor No. 0058) using revised impact areas and vegetation classifications, in order to obtain credit values for the area of the proposal site within the Moorebank Development Site.

A separate calculation was prepared by Jane Rodd (Assessor No. 0023) for the additional areas of the Proposal site outside the MPW Concept Plan Approval boundary.

The full credit reports 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 development 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 6-3.

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	Loss in landscape value	Loss in site value score	Number of Ecosystems credits required
Area of development site within the Moorebank Development 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) ▪ *Persoonia nutans* ▪ *Grevillea parviflora* subsp. *parviflora*	12.8	44.3	427

Vegetation zone	Associated EECs and/or Threatened Species	Loss in landscape value	Loss in site value score	Number of Ecosystems credits required
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin (ME005): Moderate/Good	▪ Castlereagh Swamp Woodland (EEC)	12.8	39.58	30
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good	▪ River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC)	12.8	35.76	869
Additional areas of impact outside the Moorebank Development Site				
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good - Moderate	▪ River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC)	24.8	55.21	57
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin (ME018): Moderate/Good - Poor	▪ River-flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South-east Corner bioregions (EEC)	24.8	30.21	18

10.1.2 Impacts on threatened species

Impacts to threatened species credit species and their associated species are summarised in Table 9-2. The full credit report is provided in Appendix A.

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

Common name	Scientific name	Status	Impacts	Number of species credits required
Nodding Geebung	*Persoonia nutans*	Endangered	10	770
Small-flowered Grevillea	*Grevillea parviflora* subsp. *parviflora*	Vulnerable	16	235

11 REFERENCES

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APPENDIX A

BIOBANKING CREDIT REPORTS

Biodiversity credit report

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

Date of report: 2/09/2016 Time: 3:33:38PM Calculator version: v4.0

Major Project details

Proposal ID:	0034/2014/1071D
Proposal name:	Moorebank Southern Option
Proposal address:	Moorebank Avenue Moorebank NSW
Proponent name:	Department of Finance and Deregulation
Proponent address:	John Gorton Building King Edward Terrace PARKES ACT 2600
Proponent phone:	8265 5604
Assessor name:	Alex Cockerill
Assessor address:	PO Box 1162 Newcastle NSW 2300
Assessor phone:	02 4929 8333
Assessor accreditation:	0058

Summary of ecosystem credits required

Plant Community type	Area (ha)	Credits created
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	28.94	868.78
Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland of the Cumberland Plain, Sydney Basin Bioregion	15.51	427.00
Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion	0.92	30.25
Total	45.37	1,326

Credit profiles

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

Number of ecosystem credits created	869
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

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

Number of ecosystem credits created	30
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) Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, (ME002) Broad-leaved Ironbark - Grey Box - Melaleuca decora grassy open forest on clay/gravel soils of the Cumberland Plain, Sydney Basin Bioregion, (ME004) Narrow-leaved Ironbark - Broad-leaved Ironbark - Grey Gum open forest of the edges of the Cumberland Plain, Sydney Basin Bioregion, (ME021) Turpentine - Grey Ironbark open forest on shale in the lower Blue Mountains, Sydney Basin Bioregion, (ME041)	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	427
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

Summary of species credits required

Common name	Scientific name	Extent of impact Ha or individuals	Number of species credits created
Small-flower Grevillea	Grevillea parviflora subsp. parviflora	16.00	235
Nodding Geebung	Persoonia nutans	10.00	770

Biodiversity credit report

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

Date of report: 9/09/2016 Time: 10:08:39AM Calculator version: v4.0

Major Project details

Proposal ID:	0023/2016/3912MP
Proposal name:	MPW Stage 2 additional impacts
Proposal address:	Moorebank Avenue Moorebank NSW 2170
Proponent name:	Tactical Group
Proponent address:	Level 15, 124 Walker Street North Sydney NSW 2060
Proponent phone:	02 8907 0700
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
Forest Red Gum - Rough-barked Apple grassy woodland on alluvial flats of the Cumberland Plain, Sydney Basin Bioregion	1.68	74.39
Total	1.68	74

Credit profiles

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

Number of ecosystem credits created	74
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

ARCADIS Design & Consultancy for natural and built assets

ARCADIS Design & Consultancy for natural and built assets

Moorebank Precinct West (MPW) - Stage 2 Proposal

Amiens Wetlands Assessment

SIMTA

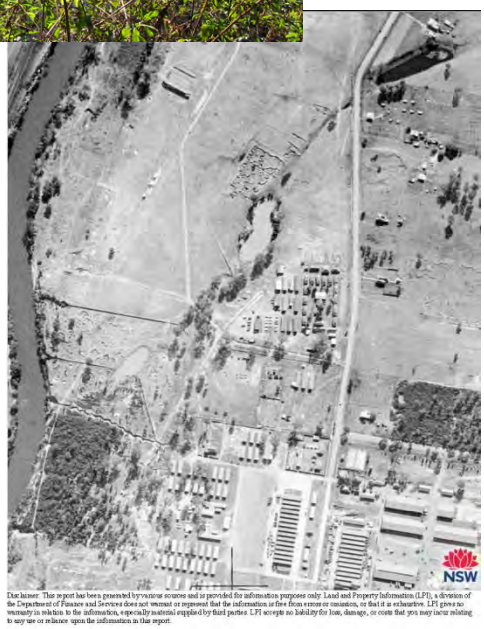
SYDNEY INTERMODAL TERMINAL ALLIANCE

Part 4, Division 4.1, State Significant Development

October 2016

Amiens Wetland Assessment

Report to Arcadis Consulting



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July 2016

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Contents

1. Introduction[1]

On the 3 June 2016 Concept Plan Approval (SSD 5066) was granted, under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979* (EP&A Act), to develop the Moorebank Precinct West Project (MPW Project) on the western side of Moorebank Avenue, Moorebank, in south-western Sydney (the MPW site).

The MPW Project involves the development of intermodal freight terminal facilities (IMT), linked to Port Botany, the interstate and intrastate freight rail network. The MPW Project includes associated commercial infrastructure (i.e. warehousing), a rail link connecting the MPW site to the Southern Sydney Freight Line (SSFL), and a road entry and exit point from Moorebank Avenue.

Under the Concept Plan Approval, the MPW Project is to be developed in four phases, being:

- Early Works development phase, comprising:
    - The demolition of existing buildings and structures
    - Service utility terminations and diversion/relocation
    - Removal of existing hardstand/roads/pavements and infrastructure associated with existing buildings
    - Rehabilitation of the excavation/earthmoving training area (i.e. 'dust bowl')
    - Remediation of contaminated land and hotspots, including areas known to contain asbestos, and the removal of:
        - Underground storage tanks (USTs)
        - Unexploded ordnance (UXO) and explosive ordnance waste (EOW) if found
        - Asbestos contaminated buildings
    - Archaeological salvage of Aboriginal and European sites
    - Establishment of a conservation area along the Georges River
    - Establishment of construction facilities (which may include a construction laydown area, site offices, hygiene units, kitchen facilities, wheel wash and staff parking) and access, including site security
    - Vegetation removal, including the relocation of hollow-bearing trees, as required for remediation and demolition purposes
- Development of the intermodal terminal (IMT) facility and initial warehousing facilities
- 'Ramp up' of the IMT capacity and warehousing
- Development of further warehousing.

Approval for the Early Works phase (MPW Concept Plan Approval) was granted as the first stage of the MPW Project within the Concept Plan Approval. Works, approved as part of this stage are anticipated to commence in the third quarter of 2016.

Commonwealth Approval (No. 2011/6086), under the *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act), was also granted in mid-2016 (soon after the Concept Plan Approval) for the MPW Project. In addition to this, the Planning Proposal (PP_2012_LPOOL_004_00) which provided a rezoning of part of the MPW site, and surrounds, was gazetted on 24 June 2016 into the *Liverpool Local Environmental Plan 2008* (Amendment No. 62).

On 5 December 2014, Moorebank Intermodal Terminal Company (MIC) and SIMTA announced their in-principle agreement to develop the Moorebank IMT Precinct on a whole of precinct basis. This agreement is subject to satisfying several conditions which both parties are currently working towards. SIMTA is therefore seeking approval to build and operate the IMT facility and warehousing under the MPW Project Concept Approval, known as the MPW Stage 2 Proposal (the Proposal).

The MPW Project has required preparation of various Environmental Impact Statement (EIS) documentation and approvals for successive stages of the project. Reporting prepared for the EIS

[1] Text for Sections 1 and 2 supplied and used by permission from Arcadis Consulting

for the concept plan stage of the development contained conflicting information on the status and origin of a small wetland at the northern tip of the development site, the Amiens Wetland.

The Surface Water Assessment report (Parsons Brinckerhoff 2014) identifies the wetland as a man-made outlet controlled detention basin for the M5 Motorway and adjacent catchment and suggests this area will be developed. In contrast the Aboriginal Heritage Assessment (Navin Officer Heritage Consultants 2014) states it is a natural lake basin and is 'now the last remaining relatively unmodified basin from the local Georges River flood plain'(p153). The Response to Submissions Report (Parsons Brinckerhoff 2015 Response to Submissions Report, Appendix B, page 28) also states the wetland is an artificial basin:

The Amiens wetland is an artificial structure that has been planted with and/or colonised by native aquatic emergent plants and exotic species. While this wetland does provide habitat for native animal species, it is not likely to be important habitat for any threatened species. If retained, it would also be isolated from other retained habitat on site by intervening areas of development.

This lack of clarity was identified by the Planning Assessment Commission of NSW and has resulted in the following draft condition of approval (Planning Assessment Commission NSW 2015, Schedule 4, E21, p25)

E21: All future Development Application which includes construction in the vicinity of Amiens Wetland shall include advice from an independent wetland expert to determine whether it is artificial or a natural lake basin, its significance, and any recommendations on mitigation measures (if appropriate).

1.1 Report purpose

The purpose of this study is to address the condition of approval E21 noted above and determine:

i) whether the Amiens wetland is artificial or a natural lake basin,
ii) its significance
iii) any recommendations on mitigation measures (if appropriate).

1.2 Moorebank Precinct West Stage 2 Proposal Overview

The MPW Stage 2 Proposal (the Proposal) involves the construction and operation of an Intermodal terminal (IMT) facility and associated warehousing.

The IMT facility would have the necessary infrastructure to support a container freight throughput volume of 500,000 twenty-foot equivalent units (TEUs) per annum. Specifically, the IMT facility within the Proposal site would include the following key components:

- Truck processing, holding and loading areas – with entrance and exit from Moorebank Avenue via an upgraded intersection and a round-about to distribute traffic between the warehousing precinct and the IMT
- Rail loading and container storage areas – installation of nine rail sidings, with an adjacent container storage area serviced by manual handling equipment

- Administration facility – office building with associated car parking and light vehicle access from Moorebank Avenue
- The Rail link connection – rail sidings within the IMT facility, which would be linked (to the south) to the Rail link (constructed as part of the MPE Project (SSD 14-6766)).

Also included within the Proposal are the following key components:

- Warehousing area – construction and operation of approximately 215,000 m^2 GFA of warehousing, with warehouses ranging in size from 4,000 m^2 to 71,000 m^2. Included within the warehousing area would be ancillary offices, truck and light vehicle parking, associated warehouse access roads.
- Freight village – construction and operation of approximately 800 m^2 of retail premises, with access from the internal road.
- Upgraded intersection on Moorebank Avenue and internal road – including works to Moorebank Avenue, Anzac Road to accommodate the proposed site entrance to Moorebank Avenue, and construction of an internal road.
- Ancillary works – including vegetation clearing, earth works, drainage and on-site detention, utilities installation/connection, signage and landscaping.

Of particular importance is that the Proposal does not include works within the wetland area, i.e. the wetland is located outside of the construction area. The Proposal will therefore not directly impact on the wetland, however there is the potential for indirect impacts during construction and operation of the Proposal which have been addressed in other technical specialists reports appended to the EIS for the Proposal.

1.3 Moorebank Precinct West (MPW) Stage 2 Proposal components and key terms

A summary of key terms, used within this report or related documentation is presented below (Table 1).

Table 1: Summary of key terms and definitions

Term	Definition
Moorebank Precinct West (MPW) Concept Plan Approval (Concept approval and Early Works)	MPW Concept Plan and Stage 1 Approval (SSD 5066) granted on 3 June 2016 for the development of the MPW Intermodal terminal facility at Moorebank and the undertaking of the Early Works. Granted under Part 4, Division 4.1 of the *Environmental Planning and Assessment Act 1979*. This reference also includes associated Conditions of Approval and Revised Environmental Management Measures, which form part of the documentation for the approval. N.B. Previously the MIC Concept Plan Approval
Moorebank Precinct West (MPW) EPBC Approval	Commonwealth Approval (No. 2011/6086), granted in mid-2016, for the impact of the MPW Project on listed threatened species and communities and impacts on the environment by a Commonwealth agency. Anticipated to be granted under the *Environmental Biodiversity Protection Conservation Act 1999*.
Moorebank Precinct West (MPW) Concept Plan EIS	The Environmental Impact Statement prepared to support the application for approval of the MPW Concept Plan and Early Works (Stage 1) under the *Environment Protection and Biodiversity Conservation Act 1999* and the *Environmental Planning and Assessment Act 1979*. N.B. Previously the MIC Concept Plan EIS
Revised Environmental Management Measures	The environmental management measures for the MPW Concept Plan Approval as presented within the MIC Supplementary Response to Submissions (SRtS) (PB,

Term	Definition
(REMMs)	2015) and approved under the MPW Concept Plan Approval.
Moorebank Precinct West (MPW) Planning Proposal	Planning Proposal (PP_2012_LPOOL_004_00) to rezone the MPW site from 'SP2-Defence to 'IN1- Light Industrial' and 'E3- Management', as part of an amendment to the *Liverpool Local Environmental Plan 2008* (as amended) gazetted on 24 June 2016.
Moorebank Precinct West (MPW) Project	The MPW Intermodal Terminal Facility as approved under the MPW Concept Plan Approval (5066) and the anticipated MPW EPBC Approval (2011/6086). N.B. Previously the MIC Project
Moorebank Precinct West (MPW) site	The site which is the subject of the MPW Concept Plan Approval, MPW EPBC Proposal and MPW Planning Proposal (comprising Lot 1 DP1197707 and Lots 100, 101 DP1049508 and Lot 2 DP 1197707). The MPW site does not include the rail link as referenced in the MPW Concept Plan Approval or MPE Concept Plan Approval. N.B. Previously the MIC site.
Proposal	MPW Stage 2 Proposal (the subject of this EIS), namely Stage 2 of the MPW Concept Plan Approval (SSD 5066) including construction and operation of an IMT facility, warehouses, a Rail link connection and Moorebank Avenue/Anzac Road intersection works.
Proposal site	The subject of this EIS, the part of the MPW site which includes all areas to be disturbed by the MPW Stage 2 Proposal (including the operational area and construction area).
IMT facility	The Intermodal terminal facility on the Proposal site, including truck processing, holding and loading areas, rail loading and container storage areas, nine rail sidings, loco shifter and an administration facility and workshop.
construction area	Extent of construction works, namely areas to be disturbed during the construction of the Proposal.
operational area	Extent of operational activities for the operation of the Proposal.
Moorebank conservation area/conservation area	Vegetated area to remain to the west of the Georges River, to be subject to biodiversity offset, as part of the MPW Project.
Moorebank Precinct (MP)	Refers to the whole Moorebank intermodal precinct, i.e. the MPE site and the MPW site.
Moorebank Precinct East (MPE) Project	The Intermodal terminal facility on the MPE site as approved by the MPE Concept Plan Approval (MP 10_0913) and including the MPE Stage 1 Proposal (14-6766). N.B. Previously the SIMTA Concept Plan Approval
Moorebank Precinct East (MPE) site	The site which is the subject of the MPE Concept Plan Approval, and includes the site which is the subject of the MPE Stage 1 Approval. N.B. Previously the SIMTA site
Moorebank Precinct East (MPE) Stage 1 Proposal	MPE Stage 1 Proposal (14-6766) for the development of the Intermodal terminal facility at Moorebank. This reference also includes associated conditions of approval and environmental management measures which form part of the documentation for the approval. N.B. Previously the SIMTA Stage 1 Proposal

2. Moorebank Precinct West (MPW) Site description

The Proposal site of approximately 220 Ha is bounded by the Georges River to the west, Moorebank Avenue to the east, the East Hills Railway Line to the south and the M5 Motorway to the north (Fig. 1). It is located on Moorebank Avenue, Moorebank and forms Lot 1 in Deposited Plan (DP) 1197707[1]. The Proposal site also contains Lots 100 and 101 DP1049508, which are located north of Bapaume Road and west of Moorebank Avenue. The Proposal site is located wholly within Commonwealth Land.

The Proposal would also require works to upgrade the intersection of the MPW site with Moorebank Avenue and would therefore be undertaken on the following parcels of land:

- Moorebank Avenue, owned by the Commonwealth Government, south of Anzac Road Lot 2, DP 1197707 (formerly part of Lot 3001, DP 1125930)
- Moorebank Avenue, owned by Roads and Maritime Services, north of Anzac Road
- A portion of Bapaume Road, a public road that is the responsibility of Liverpool City Council
- A portion of Anzac Road, owned by Roads and Maritime Services, to the east of Moorebank Avenue

The key existing features of the site are:

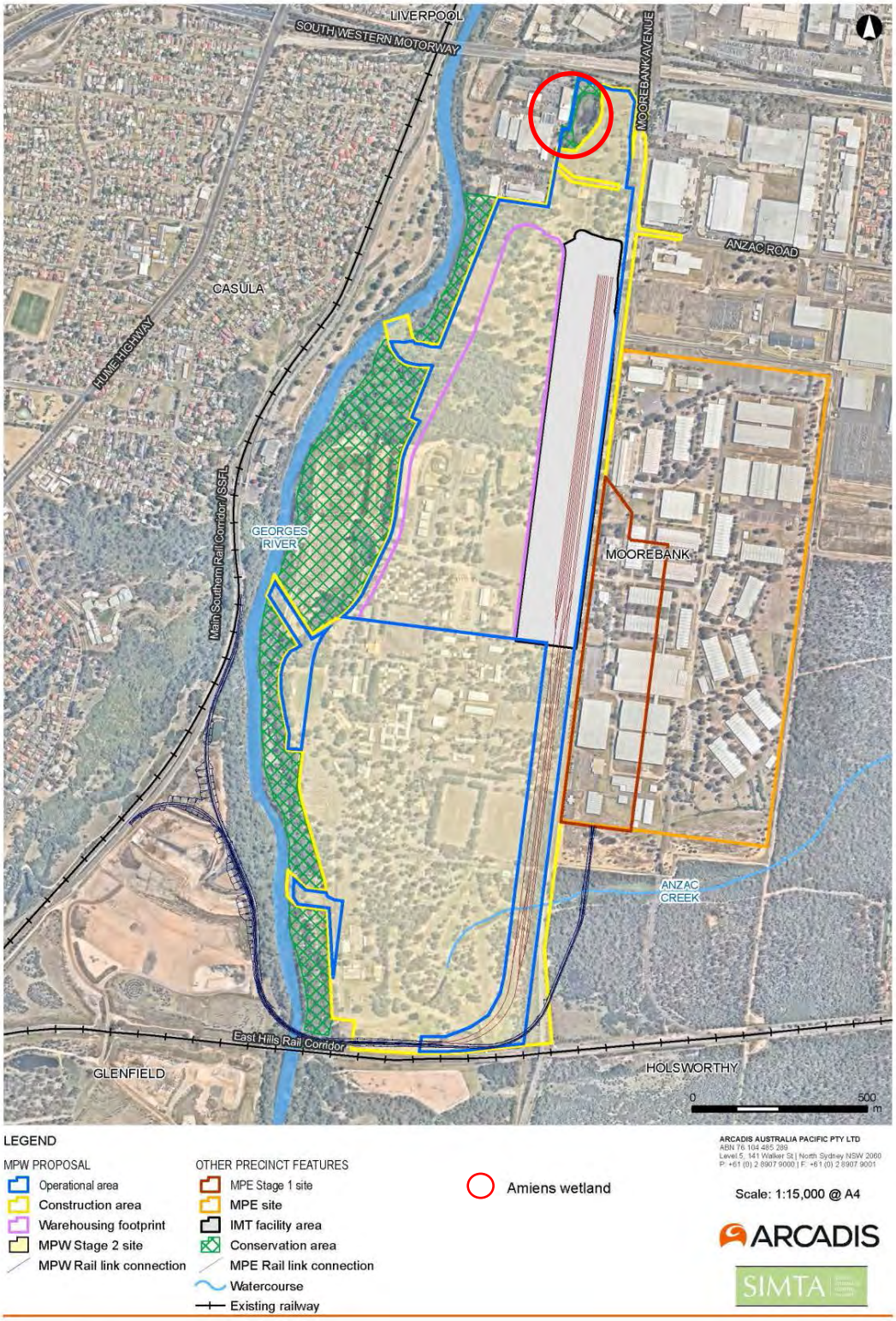
- Relatively flat topography, with the western edge flowing down towards the Georges River, which forms the western boundary to the MPW site
- A number of linked ponds in the south-west corner of the Proposal site, within the existing golf course, that link to Anzac Creek, which is an ephemeral tributary of the Georges River
- An existing stormwater system comprising pits, pipes and open channels
- Direct frontage to Moorebank Avenue, which is a publicly used private road, south of Anzac Road and a publicly owned and used road north of Anzac Road
- The majority of the site has been developed and comprises low-rise buildings (including warehouses, administrative offices, operative buildings and residential buildings), access roads, open areas and landscaped fields for the former School of Military Engineering (SME) and the Royal Australian Engineers (RAE) Golf Course and Club. Defence has since vacated and all buildings on the site are currently unoccupied and will be removed during the Early Works
- Native and exotic vegetation is scattered across the Proposal site
- The riparian area of the Georges River lies to the west of the Proposal site and contains a substantial corridor of native and introduced vegetation. The riparian vegetation corridor provides a wildlife corridor and a buffer for the protection of soil stability, water quality and aquatic habitats. This area has been defined as a conservation area as part of the MPW Concept Plan Approval
- As stated above, the majority of the Proposal site has been developed, however heritage and biodiversity values still remain on the site
- A strip of land (up to approximately 250 metres wide) along the western edge of the MPW site lies below the 1% annual exceedance probability (AEP) flood level
- The site is privately owned by the Commonwealth and leased by SIMTA.

[1] Previously legally described as “Lot 3001, DP 1125930” in the MPW Concept Plan Approval (SSD 5066), however has since been subdivided.

A number of residential suburbs are located in proximity to the Proposal site, including:

- Wattle Grove, located approximately 1,000 m from the Proposal site and 1,000 m from the Rail link connection to the east. The Rail link, which will be used during operation of the Proposal is 1,260 m to the west of Wattle Grove at its closest point
- Moorebank, located approximately 630 m from the Proposal site and more than 1,400 m from the Rail link connection to the north. The Rail link is 2,500 m to the south of Moorebank at its closest point
- Casula, located approximately 330 m from the Proposal site and 1,200 m from the Rail link connection to the west. The Rail link is approximately 290 m to the east of Casula at the closest point
- Glenfield, located approximately 820 metres from the Proposal site and 1,100 metres from the Rail link connection to the south-west. The Rail link is approximately 750 m to the east of Glenfield at its closest point.

Figure 1. Moorebank Precinct West (MPW) Proposal site and Amiens Wetland (figure supplied with permission by Arcadis Consulting)



3. Amiens wetland description

The Amiens wetland is a small (4,855 m^2) freshwater wetland on the Georges River floodplain and adjacent to Amiens Road in Moorebank NSW near the intersection of Moorebank Avenue and the M5 Motorway (Fig.1). It is referred to throughout this report as the "Amiens wetland" or "study site". It lies within the northern tip of the Moorebank Precinct West (MPW) site and includes the wetland and its fringing (littoral) vegetation. To enable comparisons with similar freshwater wetland habitats, a larger area that encompassed a nearby section of the central Georges River floodplain was defined as the "Wetland Study Area" (Fig.2). Relevant planning, cadastral and environmental details are summarised in Table 2.1.

The Amiens wetland is surrounded by industrial and residential development to the west, north and east with major transport corridors carrying high volumes of heavy traffic (Fig.2). Areas immediately to the south contain small areas of less developed open woodland and parkland on the MPW site, formerly owned and occupied by the Department of Defence. At a broader scale, the total catchment area of the Georges River covers approximately 960 square kilometres and contains c. 1.2 million people. It is managed by a number of local government authorities and NSW Government agencies (GRCCC 2015). Land use within the catchment is mixed, including industrial, agricultural, mining and defence. Around 40% of the upper River catchment is protected or reserved in some way for residential water use (Kuhn & Freeman 2012). The wetland essentially acts as an outlet controlled detention basin for the M5 Motorway and adjacent catchment, which means that if the water levels in the Georges River are elevated, the basin will not release water until river levels are below the outlet pipe levels. Waters are discharged from the Amiens wetland via piped connection to the Georges River' (Parsons Brinkerhoff 2014a).

The lands adjacent to the Georges River were occupied for many thousands of years by the Dharug, Tharawal and Eora Aboriginal peoples. They used the river as an important source of food and a place for trade (Kuhn & Freeman 2012).

Other prominent hydrological features in the area include Clinches Pond Reserve and Anzac Creek which flows northward into Lake Moore (Fig.2). The Georges River, while still retaining important aquatic biodiversity habitat values has been heavily modified by extensive catchment development, drainage, flood mitigation works and flow modifications including Liverpool weir (Munro *et al*. 1967; GRCCC 2015). These impacts, together with disease outbreaks have contributed to declines in commercial fishing and oyster farming (Brown & McPherson 1992; Ogburn 2011). Lake Moore, originally a freshwater wetland adjacent to main river channel is now semi estuarine after river modifications merged it into the main Georges River channel (Department of Public Works 1990). Lake Moore flooding and Chipping Norton Lake creation occurred after environmental damage from sand mining in the 1950's left the area severely damaged and denuded of vegetation (Soros, Longworth & Mackenzie 1975; Department of Public Works 1990).

Modification and clearing of the landscapes of the study site began soon after the first settlement in Sydney began to grow. As early as 1798, grants of land for farming and development had been made

around George's River in the Holsworthy area, particularly along Harris Creek (Loane 1967). The grants were mainly to military or naval officers who had cleared some of the land and begun to grow wheat and maize and to raise sheep, cattle, hogs and horses. In 1805, a prominent businessman Thomas Moore acquired partly by purchase and partly by grant an expanse of 750 acres along the eastern bank of the Georges River in what are now the suburbs of Chipping Norton and Moorebank (named after Moore's early farm estate known as 'Moorebank') (Loane 1967; Navin Officer Heritage Consultants 2014). Moore died in 1840 and left much of his considerable estates (2,588 ha) around Moorebank to the Church of England who rented the farmland for income. In 1890 the farm estates were subdivided into smaller holdings and sold. Shortly before the onset of the world war, in 1913 these smaller farm holdings which included the Amiens wetland study site were resumed by the Commonwealth for the Department of Defence.

Table 2 Amiens wetland site details

Category	description
Address	adjacent to Amiens Road Moorebank, near the corner of Moorebank Ave and the M5 Motorway
Location	Lat -33.940861°, Lon 150.922943°
Wetland Area	4,855 m^2
Local catchment area	5.9 ha
Parish	Holsworthy
County	Cumberland
LGA	Liverpool
IBRA	Sydney Basin
Vegetation type	Cumberland Riverflat forest (OEH 2013b)
Soil type	Alluvial - Berkshire Park ALbp (DECCW 1990)
Altitude m ASL	10

Figure 2. Amiens wetland study area and study site –2015

Location of study area (green box), Amiens wetland study site (red circle) and local hydrological features in 2015: Clinches Pond Reserve (CPR), Lake Moore (LKM) Georges River (GR) Chipping Norton Lake (CNL), Anzac Creek (ACK), Liverpool Weir (LIW) and Milperra Bridge (MBR).

Google earth Pro V 7.1.5.1557 Imagery 16/10/2015
Moorebank & Georges River Lat -33.930393 Lon 150.947168
Eye alt 12.15 km http://www.earth.google.com Accessed 20Jun2016

Figure 3. Amiens wetland study area and study site –1943

Study area (green box), Amiens wetland study site (red circle) and local hydrological features in 1943: Amiens wetland (AW), Clinches Pond Reserve (CPR), Lake Moore (LKM) Georges River (GR) and Chipping Norton Lake (CNL). Note the differences in the Georges River, Chipping Norton Lake and Lake Moore before flooding in 1975.

Google earth Pro V 7.1.5.1557 Imagery 05/05/2016 Moorebank & Georges River
Lat -33.940877 Lon 150.922932 Eye alt 9.70km http://www.earth.google.com Accessed 20Jun2016

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4. Methods and study site

4.1 General

A combination of field inspection and desktop investigation was used to collect information and compare and contrast the Amiens wetland with other natural and artificial wetlands on the nearby Georges River floodplain. Publications, reports, remote sensing and historical maps and records were examined to assist in determining the origins of the wetland and its significance.

4.2 Field inspection

A brief field inspection of the Amiens wetland was done on a single occasion in winter on 25th May 2016 during daylight hours (8:30-11:00 am). It was not feasible to comprehensively document fauna and flora present at the site in a single brief visit. The information collected from this visit is intended primarily for descriptive and comparative purposes but does provide a representative sample of biodiversity present at a point in time. Many more species would occur at this site than are indicated in this report. For example, nocturnal or night calling fauna species would not have been detected, nor would annual plant species that occur above ground only during warmer months. Conditions were unusually dry around the time of the field inspection so species that may be more prevalent during warmer or wetter conditions (e.g. frogs, gastropods) would be unlikely to be detected. Non-native (introduced) species are indicated by an asterisk at the end of their species name. Nomenclature for plants follows the National Herbarium of New South Wales and the Flora of NSW (Harden 1990-1993). Introduced species are denoted with an asterisk. For vertebrates, nomenclature follows the Australian Fauna Directory (ABRS 2009; previously known as Census of Australian Vertebrate Species).

4.3 Terminology

Wetlands are defined as areas that are inundated by water cyclically, intermittently or permanently and can have fresh, brackish or salt water, which may be still or flowing. Wetlands include swamps, marshes, billabongs, lakes, salt marshes, mudflats, mangroves, coral reefs, fens, peat bogs, or bodies of water - whether natural or artificial, permanent or temporary (OEH 2016).

4.4 Desktop assessment

Information on the wetland and study area was sought using searches of published and unpublished literature, reports, maps and online databases, archives and information sources. The wetland is small (> 0.5 ha) and therefore has not been mapped by many larger scale topographic, cadastral, natural resource and thematic mapping or assessment programs – e.g. State-wide mapping of wetlands (Kingsford *et al*. 2003).

A range of remote sensing and mapping data sources and databases were used to locate historic records relevant to the wetland. The NSW Land and Property Information's (LPI) Historical Land

Records Viewer (HLRV 2016) provides online access to more than 2.5 million images of historical maps, plans, titles and indexes. The following records were searched using the HLRV:

- Charting Maps: Parish Maps, Town Maps, and other maps known as 'Charting Maps', recording subdivision and status changes to land parcels.
- Plan Lodgement Books: used between 1863 to 1995 to record details of plans lodged with the department.
- Old Form Torrens Registers: Torrens Titles from 1863 to 1961
- Historical Parish Maps: cancelled editions of Crown Land Parish and Town Maps which show how subdivisions and other actions have altered land parcels over time.
- Old System Grant Index and Register 1792-1862: a chronological record of the surnames or company names of those who bought or received grants of land from the Crown, and the associated images.
- Old System Purchasers Index 1896-1985: a record of individuals purchasing an estate or interest in land.
- Old System Vendors Index 1825-1986: a record of individuals selling an estate or interest in land.
- Old System Deeds 1825-1992: images from the General Register of Deeds for all registered common law (known as Old System) land transactions.

Aerial photography and satellite imagery collections were searched to examine changes at the site over time. Satellite imagery became available from 1972 onwards, when the first Landsat was launched but the sensors on these early satellites lacked the resolution to reliably detect such a small wetland. The earliest available aerial photography for topographic mapping was flown in 1930. Aerial photography from 1930 and in particular 1943 were available from the NSW LPI Spatial Information data viewing tool “SIX Maps” and used in this report (LPI 2016). The scale and availability of the 1943 photography online as a photomosaic made them an ideal source of information for this report. Google Earth Pro (V 7.1.5.1557 June 05, 2016) and other mapping tools including ArcGIS V10.3 (ESRI 2014) were also used to produce fine scale maps showing changes over time at the Amiens wetland site and the Georges River floodplain.

5. Results

5.1 Desktop assessment

Documentation – reports and publications

The Amiens wetland is small in size and has not been identified in available literature as significant or as habitat for any species of conservation concern. Additionally, long term Commonwealth Government (Australian Army) ownership of the site has restricted access and reduced historical biodiversity (e.g. Wildlife atlas) records available. Consequently there is a general paucity of information that specifically refers to or documents this site and its biodiversity values.

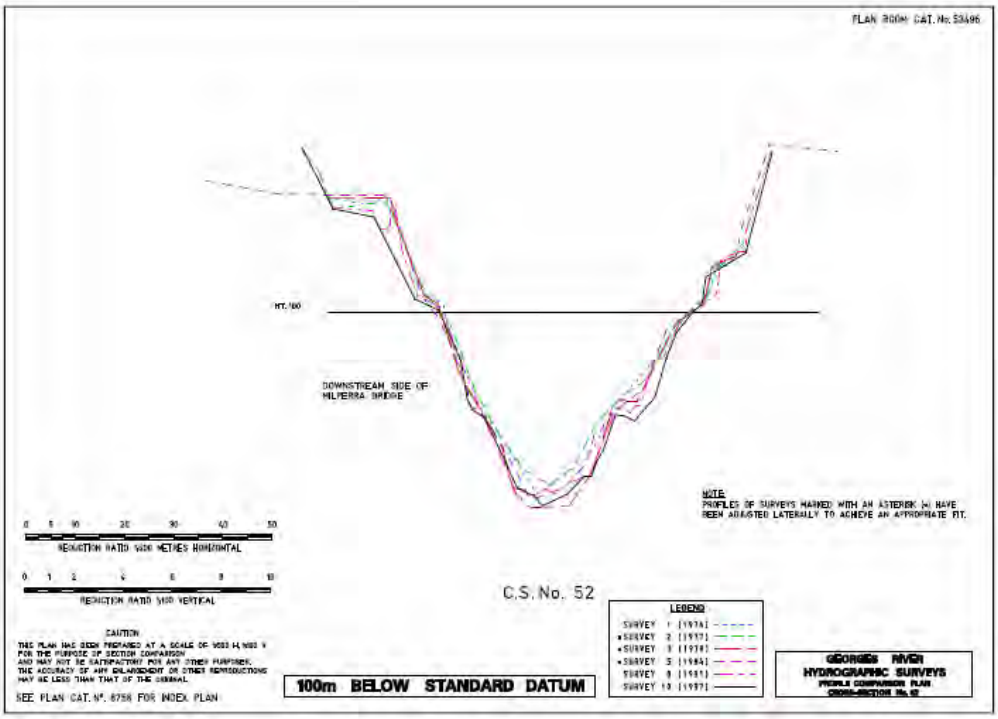
The wetland is only briefly mentioned in parts of the EIS documentation; the MIC Concept Plan Technical Paper 10, Aboriginal Heritage Assessment (Navin Officer Heritage Consultants 2014 p153) notes that “*The banks of the lake are now steep sided and are suggestive of the dumping and encroachment of landfill. This may have occurred as a result of successive Defence related*

development of the land to the east and south of the basin, and more recent commercial development on the lake's western side". In addition Technical Paper 10 also goes on to note the Amiens wetland "*..is now the last remaining relatively unmodified basin from the local Georges River flood plain, which originally included at least 6 lakes or anabranches "*

Georges River channel morphology has been documented by hydrographic surveys of the Department of Public Works and provides detailed information on the cross sectional morphology of the channel at a range of locations (Fig 4.; Department of Public Works 1999). This implies similar morphologies may have occurred in the past and still occur in nearby relic paleochannels on the floodplain which support freshwater wetlands. Paleochannels are remnants of past streams and channels where water once flowed, and may be filled with more recent sediments or with water to form wetlands (e.g. billabongs and lagoons). Steeply banked wetlands in such paleochannels are not unexpected or necessarily a sign that the wetland has been impacted by landfill, dredged or artificially constructed.

Figure 4. River channel cross section near Milperra bridge

Figure from Department of Public Works (1999) Hydrographic surveys report showing the cross sectional shape of the Georges River channel near Milperra Bridge ; Coloured lines show repeated measurements over successive years, an indication of the extent and rate of change in channel morphology;



Thematic mapping - vegetation

The most recent and comprehensive vegetation mapping covering the study area, the Native Vegetation of the Sydney Metropolitan Area, has classified the site as Cumberland Riverflat Forest (S_FoW06) (OEH 2013b; OEH 2013c). The mapped community description is in general agreement with what was found during the field inspection. Cumberland Riverflat Forest comprises open eucalypt forest on broad alluvial flats, which can form narrow ribbons and corridors along stream creeks and drainage lines. It occurs between altitudes of 1-160 m asl and typically the canopy is comprised of Forest red gum (*Eucalyptus tereticornis*) and Cabbage gum (*Eucalyptus amplifolia*), with Blue box (*Eucalyptus baueriana*) sometimes occurring in the Georges River area (OEH 2013c). Other species typically found include Green wattle (*Acacia decurrens*) and *Glycine tabacina* (OEH 2013c).

Historic maps

Few of the many historic maps examined contained much detail on hydrological features such as wetlands. Many of the maps were simply too large scale to detail such a small feature and most ignored topography and hydrology for except the largest features (such as the main channel of the Georges River)

However, a real estate auction notice from 1890 advertising Moorebank farm lots for sale shows a series of waterholes including Clinches Pond, and the unnamed wetland (FW-2 and FW-4; Fig 5) as well as the Amiens wetland (Fig. 5).

A topographic map of the Liverpool area (1929) also shows a series of freshwater wetlands including the Amiens wetland and Clinches Pond reserve (Fig. 6).

Aerial photography

Freshwater wetlands (lagoons and billabongs) connected by relict river channels (paleochannels) and tributary channels lines are common feature on riverine floodplains and numerous floodplain wetlands and paleochannels are clearly visible on the 1930 and 1943 aerial photographs (Figs 7, 8 and 9). Lake Moore can be seen in its original form as classic horseshoe shaped freshwater billabong formed from an old river channel before it was cut off as the channel migrated over geological time.

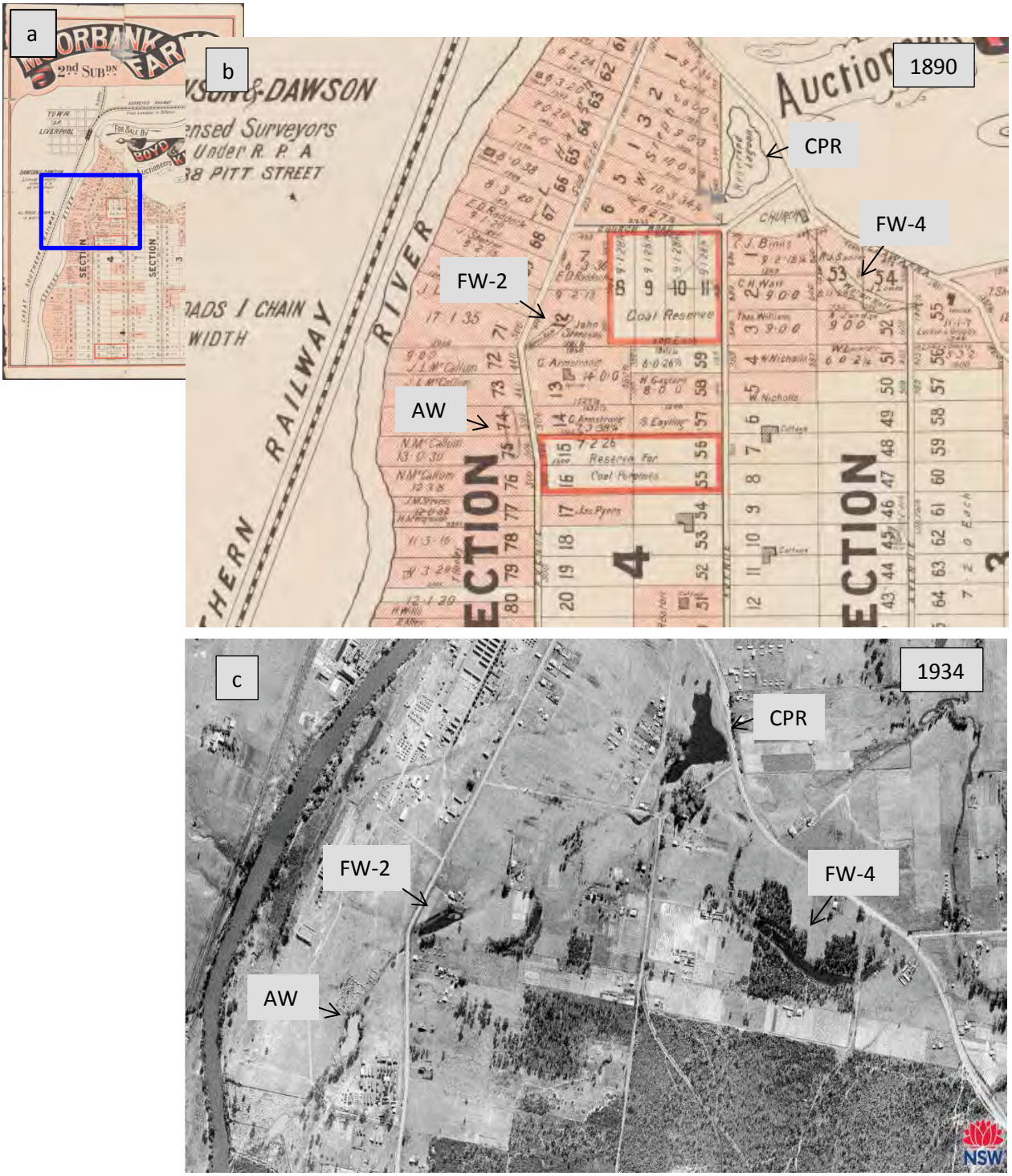
A chain of wetlands are visible on an old drainage channel that links Clinches Pond reserve to Amiens wetland and several unnamed and now destroyed wetlands (Figs 8 and 9). Outflows from the southern tip of Amiens wetland run into several drains that direct flow into the main river channel (Figs 8 and 9). The unnamed wetland FW-2 is relatively deeply incised into the floodplain and a steep bank on its northern margin can be seen (Fig. 9). Apart from some trenching (possibly for army exercises) there are no signs of significant past earth works, dredging or excavation around these wetlands, nor straight edges indicating construction or alteration.

The Amiens wetland has maintained the same size and shape throughout the period where aerial or satellite imagery is available (1930-present), but considerable changes have occurred to the extent of vegetation within the wetland and around its margins (Figs 7, 9 & 11). This is not unusual as wetland vegetation communities are often highly dynamic. Over the same period, the surrounding catchment has also changed markedly, with urban and industrial development, population increases and subsequent changes to the hydrology of the Georges River. The number of man-made or constructed wetlands has increased within the study area largely due to small waterbodies on golf courses and recreational parks and reserves (Fig. 2). The habitat value of these wetlands is unknown but may potentially offset at least some of the losses from development.

There are around 19 floodplain wetlands in the study area visible in 1943 photography (Fig. 10); by 2016 this number has fallen to two – Clinches Pond Reserve and Amiens wetland. This represents an extensive loss (89%) in total number of natural wetlands since 1943. The remaining wetlands likely only survived because they were protected by their tenure as a local council reserve (Clinched Pond reserve) and within Defence Force land Amiens wetland. (In fact a third example survived - Lake Moore, but it has been heavily modified from freshwater to estuarine).

Figure 5. Moorebank Farms 1890 auction notice and map

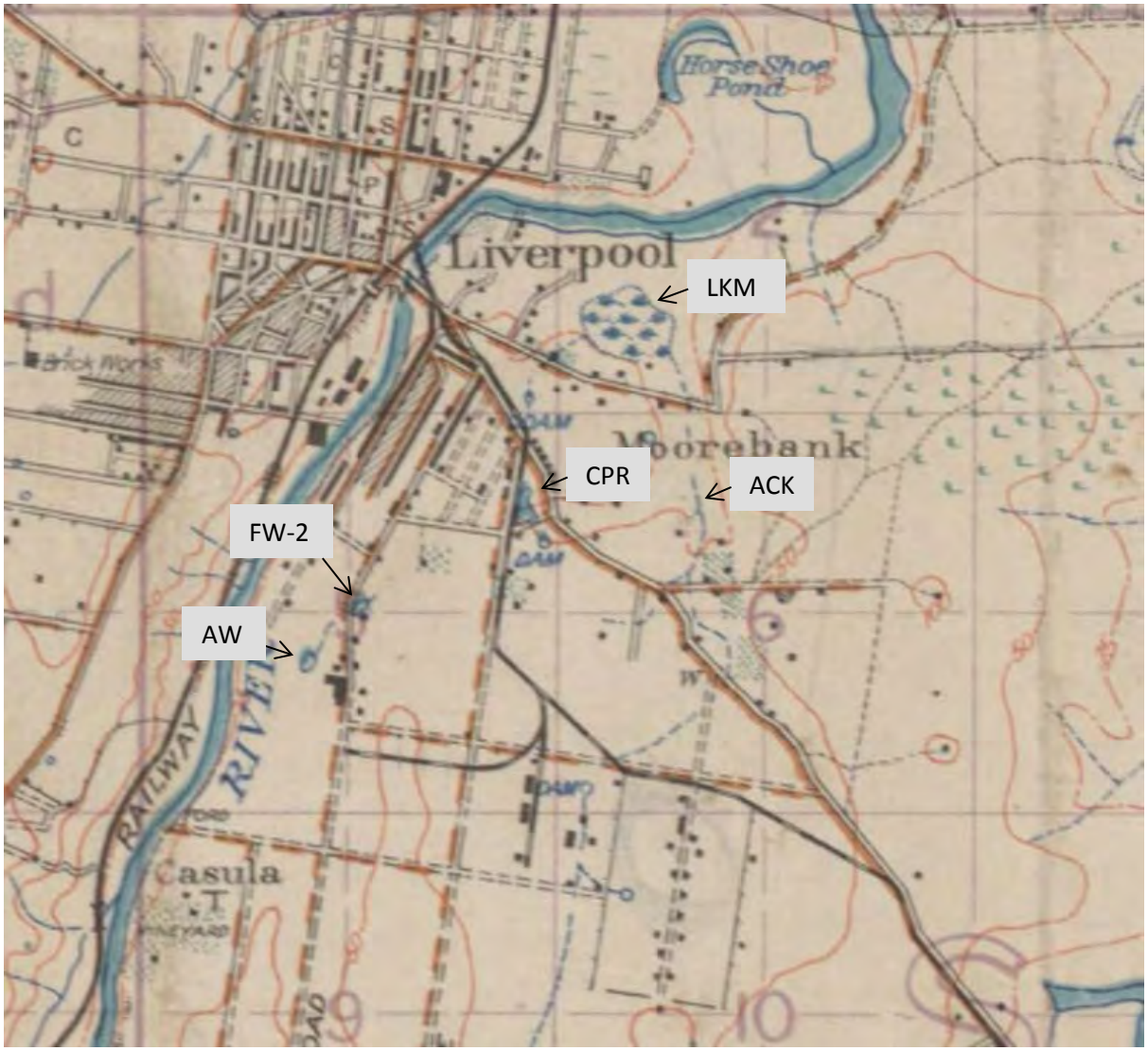
Auction notice and map from 1890 for Moorebank Farms 2nd subdivision (a); inset blue rectangle shows the location of (b) an enlarged area of the notice with the freshwater wetlands indicated; (c) Aerial photograph of the same area with freshwater wetlands marked; Amiens wetland (AW); Unnamed floodplain wetland 2 (FW-2); Unnamed floodplain wetland 4 (FW-4); Clinches Pond Reserve (CPR)



Land & Property Information (LPI) Spatial Information Exchange portal (SIX Maps) https://maps.six.nsw.gov.au/ Imagery date 1943. Accessed 12 June 2016. Disclaimer: This report has been generated by various sources and is provided for information purposes only. Land and Property Information (LPI), a division of the Department of Finance and Services does not warrant or represent that the information is free from errors or omission, or that it is exhaustive. LPI gives no warranty in relation to the information, especially material supplied by third parties. LPI accepts no liability for loss, damage, or costs that you may incur relating to any use or reliance upon the

Figure 6. Liverpool 1;63,360 Topographic map 1929 (part)

Extract from Liverpool topographic map showing Amiens wetland (AW) and nearby freshwater wetlands including Clinches Pond reserve (CPR); Unnamed freshwater wetland 2 (FW-2); Lake Moore (LKM); Anzac Creek (ACK)



National Library of Australia
http://nla.gov.au/nla.obj-229943757
Liverpool Topographic map 1:63,360
Govt Printer Melbourne 1929
Accessed on 18 June 2016

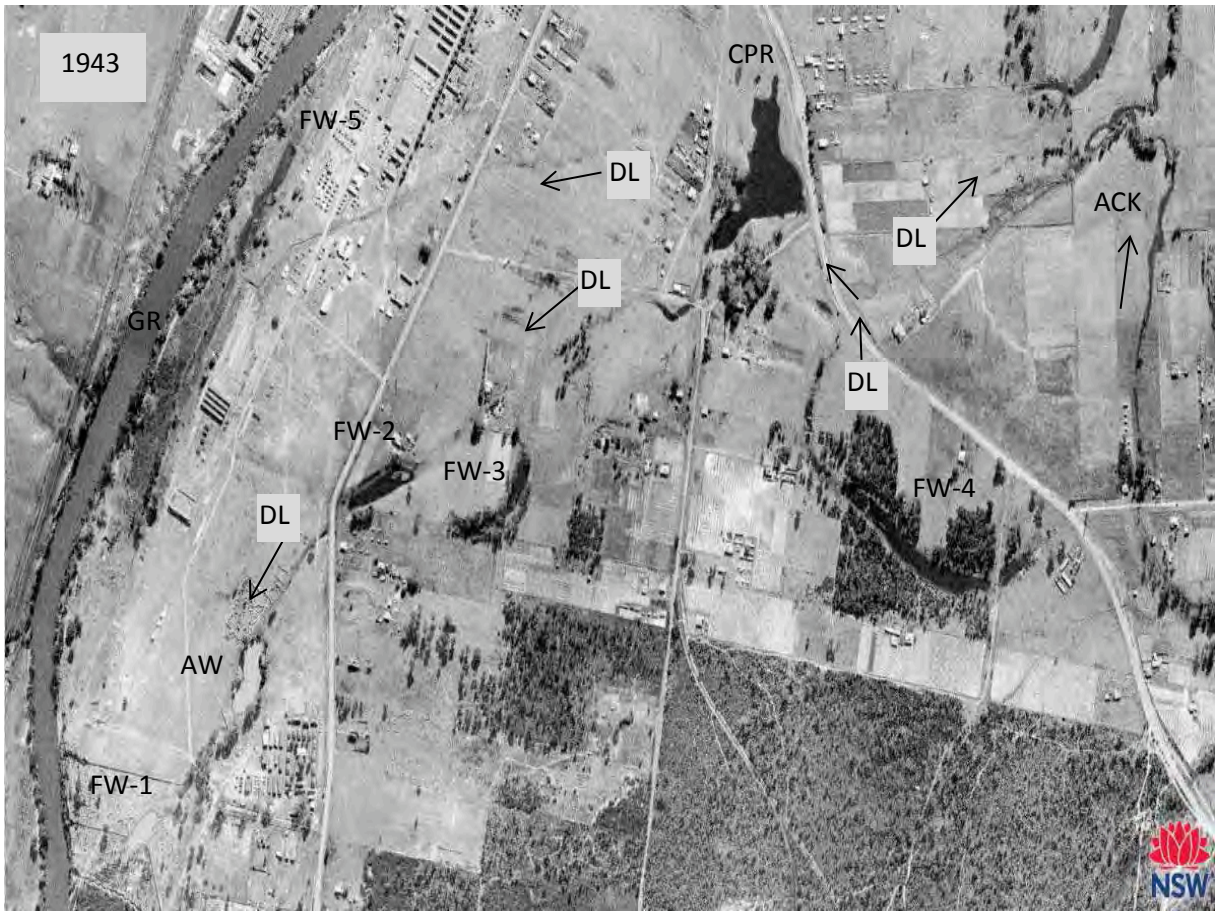
Figure 7. Amiens and Georges River floodplain wetlands 1930

Study area, Amiens wetland and local wetland features in 1930: Amiens wetland (AW), Clinches Pond Reserve (CPR), Lake Moore (LKM), Anzac Creek (ACK) and Georges River (GR).

Base layer image
Google earth Pro V 7.1.5.1557
Moorebank & Georges River
Lat -33.9279224 Lon 150.927886 Eye alt 6.61 km
http://www.earth.google.com Accessed 19Jun2016
Overlay Imagery 10/02/1930 Commonwealth of Australia

Figure 8. Amiens and Georges River floodplain wetlands 1943

Amiens wetland and nearby wetlands in 1930: Amiens wetland (AW); Clinches Pond Reserve (CPR); Georges River (GR); Anzac Creek (ACK); Unnamed floodplain wetland 1 (FW-1); Unnamed floodplain wetland 2 (FW-2); Unnamed floodplain wetland 3 (FW-3); Unnamed floodplain wetland 4 (FW-4); Unnamed floodplain wetland 5 (FW-5); Unnamed natural drainage line (DL) – arrows show direction of flows.



Land & Property Information (LPI) Spatial Information Exchange portal (SIX Maps) https://maps.six.nsw.gov.au/ Imagery date 1943. Accessed 12 June 2016. Disclaimer: This report has been generated by various sources and is provided for information purposes only. Land and Property Information (LPI), a division of the Department of Finance and Services does not warrant or represent that the information is free from errors or omission, or that it is exhaustive. LPI gives no warranty in relation to the information, especially material supplied by third parties. LPI accepts no liability for loss, damage, or costs that you may incur relating to any use or reliance upon the information in this report.

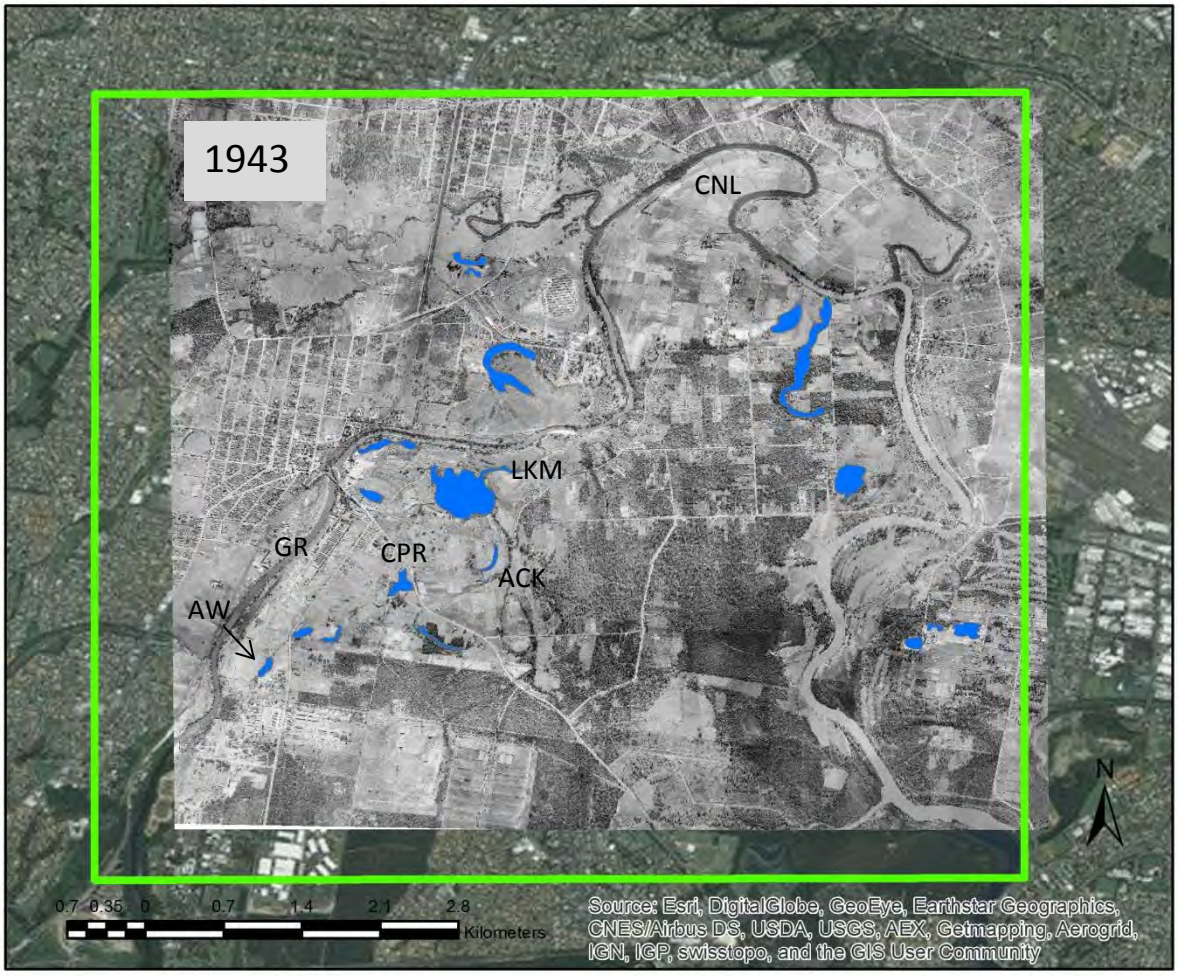
Figure 9. Amiens and Georges River floodplain wetlands 1943

Amiens wetland and nearby wetlands and features in 1930: Amiens wetland (AW); Georges River (GR); Unnamed floodplain wetland 1 (FW-1); Unnamed floodplain wetland 2 (FW-2); Unnamed natural drainage line (DL) – arrows show direction of flow; Drain – artificial (DRN)

Land & Property Information (LPI) Spatial Information Exchange portal (SIX Maps) https://maps.six.nsw.gov.au/ Imagery date 1943. Accessed 12 June 2016. Disclaimer: This report has been generated by various sources and is provided for information purposes only. Land and Property Information (LPI), a division of the Department of Finance and Services does not warrant or represent that the information is free from errors or omission, or that it is exhaustive. LPI gives no warranty in relation to the information, especially material supplied by third parties. LPI accepts no liability for loss, damage, or costs that you may incur relating to any use or reliance upon the information in this report.

Figure 10. Amiens and Georges River floodplain wetlands 1943

Location and extent of freshwater wetlands in the study area in 1943 (blue polygons); Amiens wetland (AW); Study area (green box); Clinches Pond Reserve (CPR), Lake Moore (LKM) Georges River (GR) and Chipping Norton Lake (CNL). Note the differences in the Georges River, Chipping Norton Lake and Lake Moore before flooding in 1975.



1943 Aerial photography (inset): Land & Property Information (LPI) Spatial Information Exchange portal (SIX Maps) https://maps.six.nsw.gov.au/ Imagery date 1943. Accessed 12 June 2016. Disclaimer: This report has been generated by various sources and is provided for information purposes only. Land and Property Information (LPI), a division of the Department of Finance and Services does not warrant or represent that the information is free from errors or omission, or that it is exhaustive. LPI gives no warranty in relation to the information, especially material supplied by third parties. LPI accepts no liability for loss, damage, or costs that you may incur relating to any use or reliance upon the information in this report.

5.2 Field inspection

Amiens wetland

The wetland was 60% full (area) at the time of inspection on 25th May 2016 8:30-11:00 am and moderately turbid despite the preceding 3-4 weeks without significant rainfall. High turbidity reduces light penetration, inhibits the growth and germination of aquatic plants and alters water temperatures (Porter *et al*. 2007). The wetland consisted of 44% open water and 56% floating vegetation (Fig 10).

The area of floodplain immediately surrounding the wetland is relatively flat with the main topographic features being the wetland depression itself and a drainage line which enters the wetland from its northern tip where a large culvert has been constructed. There was no obvious levee or embankment around the margins of the wetland. There was no visible evidence of past dredging spoil or significant earth works.

The western and eastern margins of the wetland are steeply banked with a vertical height of c. 2.5-3m to the waters edge at the time of inspection. The banks are similar in gradient and relief to some banks of the nearby Georges River. The northern and southern margins of the wetland are lower and much less steeply banked where the drainage line enters from the north and exits to the south. There were no discernible inflows or out flows evident at the time of inspection and the water level was below the height of the northern inlet culvert. Old disused drainage pipes (c.20 cm diameter) were present near the south-west end of the wetland – they terminate at the top of the bank and are not connected to any drainage (See Appendix 8.1).

Some old building waste and rubble was present on the western banks, and may have been deposited there after earthworks, clearing or building activity on the adjacent site.

Vegetation

Overall the vegetation of the wetland was dominated by dense patches of introduced weed species, with terrestrial woody weeds at higher and middle elevations and aquatic weeds in the littoral zone and floating on the water surface (specific names with an asterisk indicate an introduced species).

The canopy of the upper banks of the wetland was composed mainly of small to medium (15-25m) trees and large shrubs of introduced Camphor laurel (*Cinnamomum camphora**), Large leaved privet (*Ligustrum lucidum**), Small leaved privet (*Ligustrum sinense**) and Lantana (*Lantana camara**). Native tree species in this zone occur sparsely and include Cabbage gum (*Eucalyptus amplifolia spp amplifolia*), Forest red gum (*Eucalyptus tereticornis*), Swamp mahogany (*Eucalyptus robusta*), Green wattle (*Acacia decurrens*), Parramatta green wattle (*Acacia parramattensis*) and Silky oak (*Grevillea robusta*). Less common woody species observed were the introduced Black locust (*Robinia pseudoacacia**) and Senna (*Senna pendula var. glabrata**); a few native Swamp oaks (*Casuarina glauca*) were present. A single large Liquid amber (*Liquidambar styraciflua**) tree occurred on the eastern margin.

Ground cover was generally sparse in this zone under shrub and tree canopies (becoming denser away from cover) and included Castor oil plant (*Ricinis communis*)*, Wandering jew (*Tradescantia fluminensis*)*, Blackberry nightshade (*Solanum nigrum*)*, Spear thistle (*Cirsium vulgare*)*, Cobbers pegs (*Bidens pilosa*),* Fleabane (*Conyza bonariensis*)*, Purple top (*Verbena bonariensis*),* Fireweed (*Senecio madagascariensis*)*, Asparagus fern (*Asparagus aethiopicus*)* and Oxalis (*Oxalis debilis* var. *corymbosa*)*.

Occasional native herb species, such as Spiny-headed mat-rush (*Lomandra longifolia),* the native fern (*Blechnum sp.)* and *Glycine tabacina* were present. Native grass and sedge species included Weeping rice grass (*Microlaena stipoides* and Couch (*Cynodon dactylon)*. Introduced grass species included Whisky grass (*Andropogon virginicus*)*, Panic veldt grass (*Ehrharta erecta*)*, Narrow-leaved carpet grass *(Axonopus fissifolius*)*, African lovegrass (*Eragrostis curvula*),* Buffalo grass (*Stenotaphrum secundatum**) and Kikuyu (*Pennisetum clandestinum**).

Woody climbing weeds were also observed including White jasmine (*Jasminum polyanthum**) growing among dense Lantana the upper eastern margins and in the southern margin, Black-eyed Susan (*Thunbergia alata**)*.*

The littoral zone of the wetland was sparsely vegetated with occasional small Willow *Salix sp**) trees. Dense patches of the woody weed species Peruvian primrose (*Ludwidgia peruviana**) and Lantana (*Lantana camara**) also occured. Less common were occasional patches of native herbs including *Persicaria decipiens* and Water ribbons (*Triglochin procera*)*.* Large floating mats of Peruvian primrose (*Ludwidgia peruviana*)* extended over the water surface, together with Water hyacinth (*Eichhornia crassipes*) and the native fern Azolla (*Azolla pinnata*)*.* Small patches of the native aquatic plant Floating bladderwort (*Utricularia gibba*) also occurred on the water surface.

Fauna

A small number of waterbirds were observed bathing and feeding in the wetland, including Chestnut teal (*Anas castanea*) and Purple swamphen (*Porphyrio porphyrio*). Other species of birds observed using Eucalypts in the fringing tree canopy included Yellow-faced honeyeaters (*Lichenostomus chrysops*), New Holland honeyeaters (*Phylidonyris novaehollandiae)*, Grey butcherbirds (*Cracticus torquatus*), Australian magpie (*Gymnorhina tibicen*), Noisy miners (*Manorina melanocephala*) and Australian Ravens (*Corvus coronoides*).

A recently abandoned passerine nest (similar to a Grey fantail or Fairy wren nest) was observed in the dense lantana and blackberry growing in the northern culvert\inlet. Despite its other impacts on native species dense thickets of Lantana can offer protection and shelter from predators for small passerine species such as fairy wrens.

Common eastern froglets (*Crinia signifera*) were present and calling during the inspection.

Two species of fish were observed to be common in the shallow water of the wetland – the introduced pest Mosquito fish (*Gambusia holbrooki*) and the native Fire-tailed gudgeon (*Hypseleotris galii;* See Fig. A2 in Appendices). Both species are common and widespread in NSW – they are short lived, rapid breeders that can tolerate a wide range of environmental conditions and are adapted to rapid colonisation of wetland habitats. The presence of these species indicates the wetland has at times connected with nearby wetlands, or possibly backflow from the Georges River to allow the fish access.

Small skinks (unidentified) were observed sunning themselves in the groundcover and littoral vegetation.

A common crow butterfly (*Euploea core*) was observed sunning itself on lantana shrubs in the southern margin.

Threats

Ecological threats are processes that adversely affect the ecological integrity of ecosystems and habitats. The most obvious threats observed during the field inspection included:

- Severe woody and aquatic weed infestations that dominated the aquatic and fringing vegetation, including Peruvian water primrose (*Ludwigia Peruviana*)**,* Water hyacinth (*Eichhornia crassipes**)*,* Lantana (*Lantana camara**), Small leaved privet (*Ligustrum sinense**), Large leaved privet (*Ligustrum lucidum*)*** and White jasmine (*Jasminum polyanthum**)
- Pollution (litter) carried from urban and industrial run-off via the northern drainage line
- Pest species including the invasive Mosquito fish (*Gambusia holbrooki**)
- Noise pollution from the M5 Motorway

Figure 11. Amiens wetland 2016 habitat distribution.

Amiens wetland showing distribution of open water (blue line), floating vegetation, shoreline (red line) and fringing vegetation (green line) habitats.

Google earth Pro V 7.1.5.1557 Imagery 05/05/2016
Moorebank Lat -33.940903 Lon 150.922889 Eye alt 323 m
http://www.earth.google.com Accessed 20Jun2016

6. Discussion and recommendations

The evidence assembled for this report from published and unpublished reports, literature, historical maps and documents strongly supports the conclusion that the Amiens wetland is a natural floodplain wetland of the Georges River, albeit strongly impacted by weeds, vertebrate pests and pollution. The most relevant information can be summarised as follows:

- Aerial photography from 1930 and 1943 show a series of floodplain wetlands in relict drainage channels and depressions, including Amiens wetland
- The aerial photographs do not contain evidence of embankments, dredging spoil, construction or alteration of the wetlands, nor of straight lines or edges indicative of alteration
- The Amiens wetland is documented on several historical maps including a map from 1890 together with several other floodplain wetlands and a 1929 topographic map
- The size and shape of the wetland, including the steepness of its banks is consistent with local geomorphology of the Georges River and its floodplain, as evidenced from 1943 aerial photography and hydrographic surveys completed by the Department of Public Works

On-site inspection alone was insufficient to determine the wetlands origins. Visits to nearby wetlands including Clinches Pond Reserve highlighted the difficulty in unravelling conclusively if a wetland was of natural origin or constructed. A combination of field inspection and thorough searching of historical maps and documents was found to be much more effective.

Threats

The wetland is severely impacted by a combination of threats, in particular altered flow regimes, climate change, weeds, pest species and pollution – several of which are declared as threatening processes under the NSW Threatened Conservation Act (1995).

An impressive range of terrestrial woody and aquatic weeds (described above), dominate the plant community in and immediately surrounding the Amiens wetland. In addition the site has been colonised by Mosquito fish (*Gambusia holbrooki*) which are a significant threat to native aquatic species, predominantly fish and frogs.

The wetlands main inflow receives runoff from the M5 Motorway and associated roads. Although no specific water quality testing was undertaken for this study, this run-off may potentially be the source of heavy metal pollutants from heavy traffic, in particular hydrocarbon residues and heavy metals including Cd, Pb, Cu and Zn, as has been recorded elsewhere in the Georges River (Brown & McPherson 1992), and in comparable wetlands near motorways in the northern hemisphere (Sriyaraj & Shutes 2001).

In addition to waterborne contaminants, noise pollution and air quality are likely to significantly impact wetland biota. Noise pollution from the nearby motorway was constant during the field inspection. Noise can interfere with fauna that use acoustic signalling (calling) to attract potential

mates (e.g. amphibians, birds; Rios-Chellen *et al*. 2015; Zhang *et al*. 2015). Localised increases in air pollution can significantly affect biodiversity (Barker & Tingey 1992; Vallero 2014).

Significance

Despite obvious impacts from pollution, noise, weeds and pests the Amiens wetland is one of the last remaining examples of natural freshwater floodplain wetland in the study area and as such has significance for biodiversity and habitat conservation.

Freshwater wetlands are highly threatened, particularly those on floodplains in coastal NSW as these are highly prized by agriculture for fertile soils and for residential development because of visual amenity and recreational opportunities offered by rivers (Keith & Scott 2005; Boon 2012).

The Amiens wetland has been relatively well protected from recreational disturbance because of its location on Department of Defence lands since 1913.

The wetlands small size means it would be relatively easy to manage and mitigate impacts from pests and weeds.

Removing the wetland and offsetting the loss by enhancing or creating similar habitat elsewhere may be problematic; sites available for this purpose on the heavily developed Georges River may difficult or impossible to secure.

Recommendations/mitigation measures

Considering existing threats as well as biodiversity and habitat values the following recommendations/mitigation measures are suggested:

- Retain and maximise conservation value by removing and controlling weeds and pests;
- Install sediment traps or similar to limit siltation and particulate pollutants that may occur as a result of the Proposal;
- Maintain, or improve, existing water flows to the wetland;
- Maintain or enhance hydrological linkages with the Georges River, in particular to allow fish and other fauna to enter and exit the wetland;
- Continue to restrict recreational access to minimise disturbance.

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8. Appendices

8.1 Field inspection images

Fig A.1 Amiens wetland 25/05/2016

Fig A.2 Amiens wetland 25/05/2016
Fire tailed gudgeon *(Hypseleotris galii)*
Female (top) and Male (bottom)

Fig A. 3 Amiens wetland 25/05/2016
Peruvian water primrose *(Ludwigia peruviana**)

Fig A.4 Amiens wetland 25/05/2016 Disconnected pipe at south western tip of wetland, purpose unknown

Fig A.5 Amiens wetland 25/05/2016 Lantana *(Lantana camara**)

Fig A.6 Amiens wetland 25/05/2016 Recently used small passerine nest – possibly Grey fantail (*Rhipidura albiscapa*)