

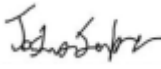

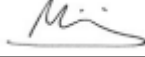
CONSTRUCTION FLORA AND FAUNA MANAGEMENT PLAN

Moorebank Precinct East Stage 1, Package 2

07 JULY 2021

SYDNEY INTERMODAL TERMINAL ALLIANCE

Moorebank Precinct East Stage 1, Package 2

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REVISIONS

Revision	Date	Description	Prepared by	Approved by
0	29/04/16	Draft issue to SIMTA for comment	ERM	ERM
1	16/06/16	Addressed comments from SIMTA	ERM	ERM
2	31/01/17	Update CoC for consultation	ERM	K Patel
3	17/02/17	Update based on consultation and submission for DP&E	K Patel	K Patel
4	28/03/17	Updated based on DP&E comments	K Patel	K Patel
5	11/05/17	Updated based on DotEE comments and DP&E CEMP and CFFMP Approval Letter dated 09/05/17	ERM B Fyvie	K Patel
6	20/06/17	Updates and map added to clarify definition of native vegetation	J Rodd	K Patel
7	01/08/17	Further clarification of the definition of native vegetation	K Patel	K Patel
8	05/09/17	Inclusion of MPE Stage 1, Package 1 Nest Box Strategy and Package 2 Specific Nest Box Addendum	K Patel/ Biosis	K Patel
9	07/11/2017	Updates associated with IMEX RfMA 003	Ben Fethers	K Patel
10	10/01/2018	Updates associated with IMEX RfMA 004 & 005	Ben Fethers	K Patel
11	13/06/2018	Updated to include the results of the latest threatened species surveys and amended conditions as per the Land and Environment Court Ruling (March 2018)	Ed Cooper	K Patel/ H Tilley
12	02/10/2018	Revisions associated with the internal environmental and sustainability audit & RfMA 008	M Barton	K Patel
13	11/01/2019	Minor updates associated with 'non-conformance,' 'non-compliance' and 'corrective and preventative actions'	J Hou	J Crawford
14	11/07/2019	Revisions associated with RfMA 011 and RfMA 015	M Watson- Reeves	J Crawford
15	12/09/2019	Revisions associated with DotEE review of the MPE Stage 1 plans	M Watson- Reeves	A Lusher
16	28/10/2019	Update following DotEE comments requiring update to Figure 4-3(a) and Figure 4-3(b)	M Watson- Reeves	A Lusher
17	07/07/2021	Revision associated with Disused Rail Spur Removal	J Jenkins	M Williams

ACRONYMS AND DEFINITIONS

Terms	Explanation
Blue Book	Managing Urban Stormwater: Soils and Construction, published by Landcom in 2004
CEMP	Construction Environmental Management Plan
CFFMP	Construction Flora and Fauna Management Plan
CoC	Conditions of Consent
Contractor	Principal Contractor
DNSDC	Defence National Storage and Distribution Centre
DoE	Commonwealth Department of the Environment
DP&E	Department of Planning and Environment
DPI	NSW Department of Primary Industries
DURS	Disused Rail Spur
EDO	Environmental Defenders Office
EEC	Endangered Ecological Community
EIS	Environmental Impact Statement
EPA	NSW Environment Protection Authority
EPBC Act	Commonwealth Environment Protection and Biodiversity Conservation Act 1999
EPBC Approval	Approval (No. 2011/6229) granted under the EPBC Act on March 2014 by the Commonwealth Department of Environment for the development of the SIMTA Moorebank Intermodal Terminal Facility at Moorebank.
FCMM	Final Compilation of Mitigation Measures
IMEX	<p>Import Export Terminal. Includes the following key components:</p> <ul style="list-style-type: none"> • Truck processing, holding and loading areas - entrance and exit from Moorebank Avenue • Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively • Administration facility and associated car parking- light vehicle access from Moorebank Avenue.
IMT facility	<p>MPE Stage 1 Package 2 including the construction of the following key components together comprising the intermodal terminal (IMT):</p> <ul style="list-style-type: none"> • Truck processing and loading areas. • Rail loading and container storage areas. • Administration facility and associated car parking • Rail Link.
Moorebank Precinct	Both MPE site and MPW site
Minister, the	NSW Minister for Planning
MPE	Moorebank Precinct East as approved by the Concept Plan (MP_10_0913)
MPE Site	The site at Moorebank as approved by the Concept Plan (MP_10_0913)

Terms	Explanation
MPE Stage 1, Package 1	The construction of the Rail Link connecting the Southern Sydney Freight Line to the IMEX, traversing across the Boot land, RailCorp Land, Moorebank Avenue, the MPW Golf Course, Georges River, and Glenfield Waste Facility
MPE Stage 1, Package 2	Construction of the IMEX Terminal (Figure 1-1) including the following key components: <ol style="list-style-type: none"> 1. Truck processing, holding and loading areas - entrance and exit from Moorebank Avenue 2. Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively 3. Administration facility and associated car parking- light vehicle access from Moorebank Avenue
MPE Stage 1 Project	The whole of the land to which the MPE Stage 1 Project approval SSD 6766 relates including both MPE Stage 1 Package 1, and MPE Stage 1 Package 2.
MPW	Moorebank Precinct West
MPW Site	The site at Moorebank as approved by the Concept Plan (SSD 5066)
Native vegetation	Areas of Plant Community Types (PCT) mapped by Arcadis and WSP Parsons Brinckerhoff in the Moorebank Precinct (including Moorebank Precinct East and Moorebank Precinct West) being a consolidation of all assessments for the Moorebank Precinct conducted since 2011 (Figure 3-1)
Native vegetation clearance	Native vegetation clearance includes the cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning of any native vegetation.
NBMS	Nest Box Management Strategy
Non-compliance	An occurrence, set of circumstances, or development that results in a non-compliance or is non-compliant with Development Consent SSD 6766 Conditions of Consent or EPBC Act Approval (EPBC 2011/6229) Conditions of Approval but is not an incident
Non-conformance	Non-conformances are observations or actions that are not in strict accordance with the CEMP and the aspect specific sub-plan.
OEH	Office of Environment and Heritage
PAC	Planning Assessment Commission
PCT	Plant Community Type
Project, the (site)	The Project is the MPE Stage 1 Package 2 Project i.e. the IMEX Terminal construction site as depicted in Figure 1-1. This is also the area of impact on any flora and fauna species.
RSoC	Revised Statement of Commitments
SIMTA	Sydney Intermodal Terminal Alliance
SSD	State Significant Development
SSFL	Southern Sydney Freight Line
WIRES	NSW Wildlife Information, Rescue and Education Service Inc
WoNS	Weed of National Significance

COMPLIANCE MATRICES

Table 1 Ministers Conditions of Consent (CoC)

CoC	Requirement	Document Reference
<p><i>Note that conditions C10, C11, C12, C20, C21, C23A and E9 refer to works associated with Georges River Bridge and will be addressed by the Construction Flora and Fauna Management Plan developed for MPE Stage 1, Package 1.</i></p>		
C22	<p>The Applicant shall prepare and implement a 'Threatened Dragonfly Species Survey Plan' to determine the presence or absence of threatened dragonfly species listed under the Fisheries Management Act 1994 on the Georges River, adjacent to the development site. The plan, including survey methodology, shall be prepared in consultation with DPI Fisheries prior to the commencement of construction.</p> <p>On implementing the plan, the survey results are to be forwarded onto DPI Fisheries. Should threatened dragonfly species be found at this site, DPI Fisheries should be contacted to agree on possible mitigation measures to avoid impacts in accordance with NSW OPI Policy and Guidelines for Fish Habitat Conservation and Management (2013).</p>	<p>Appendix B</p> <p>Completed by Arcadis in September 2016 for the Moorebank Precinct West project. DPI Fisheries confirmed that further assessment is not required and that this existing Plan also be used to satisfy C22 SSD 6766. (correspondence dated 22/12/16, refer to Appendix B).</p>
C23A	<p>"Prior to the commencement of clearing within the railway corridor between the southern boundary of the terminal site and the eastern side of the approved Moorebank Avenue Bridge, the Applicant shall develop and implement a Biodiversity Offset Package to the satisfaction of the Secretary. The Package shall detail how the ecological values lost as a result of the SSD will be offset. The Package shall be consistent with the NSW Biodiversity Offsets Policy for Major Projects (OEH 2014), unless otherwise agreed by the Secretary. The Package shall include, but not necessarily be limited to: (a) the identification of the extent and types of habitat that would be lost or degraded as a result of the final design of the SSD;</p> <p>(b) the objectives and biodiversity outcomes to be achieved;</p> <p>(c) the final suite of the biodiversity offset measures selected and secured in consultation with OEH;</p> <p>(d) the management and monitoring requirements for compensatory habitat works and other biodiversity offset measures proposed to ensure the outcomes of the package are achieved, including:</p> <p>(e) the monitoring of the condition of species and ecological communities at offset (including translocation) locations;</p> <p>(f) the method for the monitoring program(s), including the number and location of offset monitoring sites, and the sampling frequency at these sites;</p> <p>(g) provisions for the annual reporting of the monitoring results for a set period of time as determined in consultation with the OEH; and</p> <p>(h) timing and responsibilities for the implementation of the provisions of the Package.</p> <p>The Approved Biodiversity Offset Package shall be published on the Project Website within 7 days of its approval. Where land offsets cannot solely achieve compensation for the loss of</p>	<p>Does not apply to MPE Stage 1 Package 2 (IMEX)</p>

CoC	Requirement	Document Reference
	<p>habitat, additional measures shall be provided to collectively deliver an improved or maintained biodiversity outcome for the region. Where monitoring referred to in (e) above indicates that biodiversity outcomes are not being achieved, remedial actions shall be undertaken to ensure that the objectives of the Biodiversity Offset Package are achieved to the satisfaction of the Secretary. Such remedial actions shall be documented under an addendum to the Biodiversity Offset Package and the addendum be submitted to the satisfaction of the Secretary, prior to the implementation of that addendum. If the applicant can demonstrate to the satisfaction of the Secretary that the proposed offset land for between the southern boundary of the terminal site and the eastern side of the approved Moorebank Avenue Bridge has been secured, the Applicant shall within 12 months of the commencement of construction develop and implement the Biodiversity Offset Package to the satisfaction of the Secretary in accordance with items (a)-(h) above. Note: Where the Applicant has opted to develop a consolidated Biodiversity Offset Package covering both the Moorebank Intermodal Terminal (SSD 5066) and SIMTA sites, this must be submitted to the Secretary within 12 months of submitting the initial Biodiversity Offset Package in accordance with this condition unless otherwise agreed by the Secretary."</p>	
C23B	<p>"The Applicant shall:</p> <p>(a) remove the disused rail spur traversing the Southern Boot Land and remediate and rehabilitate the land containing the disused rail spur traversing the Southern Boot Land, which is identified in blue dotted outline on Attachment A to these conditions titled "Figure 1 – Wattle Grove Offset Area"; and</p> <p>(b) once remediation of the disused rail spur is complete, apply within 2 months of completion of the remediation to amend the biobanking agreement to incorporate the land shaded yellow on Attachment A to these conditions titled "Figure 1 – Wattle Grove Offset Area"; and</p> <p>(c) apply within 2 months of the issue of the biobanking agreement to amend the biobanking agreement to incorporate the land shaded red on Attachment A to these conditions titled "Figure 1 – Wattle Grove Offset Area".</p> <p>Nothing in this condition requires the Applicant to amend the biobanking agreement application lodged with OEH in February 2017."</p>	Section 1.1.1
E31	<p>No threatened species or communities can be cleared other than that required for construction.</p>	<p>Table 11 FF2.1 No threatened species have been recorded within the Project site. The results of a preclearance survey for listed threatened species will be used to update the Environmental Control Map where required.</p>
E31A	<p>Where any threatened flora species are to be cleared, individual plants of species suitable for translocation shall be considered for translocation into areas that have been identified</p>	Table 11 FF7.3

CoC	Requirement	Document Reference
	as requiring rehabilitation within the Biodiversity Offset Package.	No threatened species have been recorded within the Project site. If identified, translocation of threatened species will be considered
E32	The existing mature trees located on the eastern side of Moorebank Avenue shown on Drawing LA01 (Landscape Masterplan) dated 30.3.2015 shall be retained, unless where required to be removed for construction of a permanent access point to the terminal site. Trees to be retained shall be protected and maintained during preconstruction and construction activities in accordance with AS4970-2009 Protection of trees on development sites. Details of tree protection must be provided to the Certifying Authority prior to the commencement of construction.	Table 11 FF2.2
E34 d)	a Construction Flora and Fauna Management Plan to detail how impacts on ecology will be minimised and managed. The Plan shall be developed by a suitably qualified and experienced ecologist and in consultation with the OEH, and shall include, but not necessarily be limited to:	This Plan Consultation outlined in Section 1.4
E34 d)	(i) plans for impacted and adjoining areas showing vegetation communities; important flora and fauna habitat areas; locations where threatened species, populations or ecological communities have been recorded; including pre-clearing surveys to confirm the location of threatened flora and fauna species and associated habitat features;	Section 3 Table 11 FF2.1 Table 11 FF2.3 Table 11 FF2.4 No threatened species (Figure 3-2, Figure 3-3, Figure 3-4) have been recorded within the Project site. The results of preclearance surveys will be used to update the Environmental Control Map where required.
E34 d)	(ii) the identification of areas to be cleared and details of management measures to avoid residual habitat damage or loss and to minimise or eliminate time lags between the removal and subsequent replacement of habitat such as:	Table 11 FF2.2
E34 d) (ii)	(a) clearing minimisation procedures (including fencing),	Table 11 FF2.3 Section 5.1
E34 d) (ii)	(b) clearing procedures (including nest box plan),	Section 5.1, Section 5.3, Appendix D During the original approval of this plan, hollow bearing trees had not been identified on the Project site. However, a Nest Box Management Strategy (NBMS) was included within the Stage 1 Package 1 CFFMP and has been adopted as part of this plan with site specific requirements. The NBMS is

CoC	Requirement	Document Reference
		included within Appendix D. Where hollow bearing trees are identified during preclearing surveys, the process outlined in Section 5.1 will be followed and the NBMS would be implemented.
E34 d) (ii)	(c) removal and relocation of fauna during clearing,	Table 11 FF3.2, FF3.3
E34 d) (ii)	(d) habitat tree management,	Table 11 FF3.2
E34 d) (ii)	(e) construction worker education; and	Table 11 FF1.1 Section 6.2
E34 d) (ii)	(f) installation of exclusion fencing prior to commencement of construction	Table 11 FF2.2 Section 5.1
E34 d)	(iii) rehabilitation details, including identification of flora species and sources, and measures for the management and maintenance of rehabilitated areas;	Table 11 FF5.1 Section 5.2
E34 d)	(iv) a Weed Management Strategy* , incorporating weed management measures focusing on early identification of invasive weeds and effective management controls (including for those related to aquatic and riparian zones);	No weeds have been identified within the Project site, however, the management of weeds is outlined in Section 3.3. A weed management strategy has been prepared for the Stage 1 Package 1 CFFMP.
E34 d)	(v) a description of how the effectiveness of these management measures would be monitored;	Table 11 FF 4.1 and 4.2 Section 6.3
E34 d)	(vi) a procedure for dealing with unexpected EEC/ threatened species identified during construction, including cessation of work and notification of the OEH and DPI Fisheries, determination of appropriate mitigation measures in consultation with the OEH and DPI Fisheries (including relevant re-location measures) and updating of ecological monitoring and/ or biodiversity offset requirements; and	Table 11 FF 7.3
E34 d)	(vii) mechanisms for the monitoring, review and amendment of this plan.	Section 6.3

Table 2 Final Compilation of Mitigation Measures (FCMM)

FCMM	Requirement	Doc. Reference
<p><i>Note that conditions 8B, 8C, 8D, 8E, 8F, 8G, 8H and parts of 8A are not relevant to MPE Stage 1, Package 2 and will be addressed separately by the Construction Flora and Fauna Management Plan developed for MPE Stage 1, Package 1.</i></p>		
8A	<p>A Flora and Fauna Management Plan will be prepared as part of the CEMP. Native vegetation clearing will not occur until the Flora and Fauna Management Plan is approved. The Flora and Fauna Management Plan will include the following measures as a minimum:</p>	This Plan
	<p>Site inductions are to include a briefing regarding the local threatened flora and native fauna of the site and protocols to be undertaken if they are encountered</p>	Table 11 FF1.1 Section 6.1
	<p>If any animal is injured, contact the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by:</p> <ul style="list-style-type: none"> • Handling fauna with care and as little as possible. • Covering larger animals with a towel or blanket and placing in a large cardboard box. • Placing small animals in a cotton bag, tied at the top. • Keeping the animal in a quiet, warm, ventilated and dark location. 	Table 11 FF3.2 and FF8.1 Section 5.1
	<p>Flora and fauna surveys will be undertaken of the RailCorp land prior to commencement of construction in this area. If required, an addendum biodiversity report would be prepared, and the Biodiversity Offset Strategy and the Threatened Species Management Plan would be updated</p>	* Not applicable to this CFFMP as works do not extend into the RailCorp Land. This will be addressed in MPE Stage 1, Package 1
	<p>Clearing of vegetation will be timed to avoid periods when rain is forecast in accordance with Chapter 4.4.2 of 'the Blue Book'</p>	Table 11 FF3.1
	<p>The extent of vegetation clearing is to be clearly identified on construction plans. Clearly identifying sensitive areas ('no-go areas') which cannot be impacted by construction and managing clearing such that clearing activities are constrained to these approved areas only. High visibility plastic fencing is to be installed to clearly define the limits of the works area within the Rail link specifically the Southern Boot Land, and works areas at the riparian corridor of the Georges River.</p>	Table 11 FF 2.1

FCMM	Requirement	Doc. Reference
	In circumstances where native vegetation or mature tree clearing is required outside of the biodiversity study area, an ecologist will inspect the proposed area and provide advice on the impact to flora and fauna and appropriate management.	Table 11 FF 3.2
	Management of noxious weeds is to be undertaken in accordance with the <i>Noxious Weeds Act 1993</i> and include details relating to the monitoring, management and where necessary eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols if required.	Table 11 FF 3.4
	Equipment used for treating weed infestation(s) will be cleaned prior to moving to a new area within the Proposal site to minimise the likelihood of transferring any plant material and soil.	Table 11 FF 3.4
	Soil stripped and stockpiled from areas containing known weed infestations are to be stored on cleared land at least 40 m from native vegetation	Table 11 FF 3.4
	Water from the truck wash down in the Rail East Compound will be captured and disposed of offsite to prevent weed spread to adjoining native vegetation	* Not applicable to this CFFMP. This will be addressed in MPE Stage 1, Package 1
	Works areas at each watercourse crossing will be clearly delineated prior to commencement of works	* Not applicable to this CFFMP. This will be addressed in MPE Stage 1, Package 1
	<p>Undertake a two-stage approach to clearing:</p> <ul style="list-style-type: none"> • Remove non-hollow bearing trees at least 48 hours before habitat trees are removed. • Hollow bearing trees are to be knocked with an excavator bucket or other machinery to encourage fauna to evacuate the tree immediately prior to felling. • Felled trees must be left for a short period of time on the ground to give any fauna trapped in the trees an opportunity to escape before further processing of the trees. • Felled hollow bearing trees must be inspected by an ecologist as soon as possible (not longer than 2 hours after felling). <p>Fauna microhabitat (such as hollow logs) should be removed from areas to be cleared and relocated to suitable nearby bushland areas in the presence of an ecologist.</p>	Table 11 FF2.5, FF 3.2
	Large woody <i>debris</i> will be retained in watercourses where possible. In the event large woody debris are to be impacted they will be relocated in consultation with an ecologist	* Not applicable to this CFFMP. This will be addressed in MPE Stage 1, Package 1

FCMM	Requirement	Doc. Reference
	Instream works at Georges River and Anzac Creek will be minimised where possible, including disturbance to aquatic vegetation. Disturbed areas will be contained to the 20 m wide corridor	* Not applicable to this CFFMP. This will be addressed in MPE Stage 1, Package 1
	If any pits/trenches are to remain open overnight, they are to be securely covered, where reasonable and feasible. Alternatively, fauna ramps (logs or wooden planks) are to be installed to provide an escape for trapped fauna.	Table 11 FF6.7
	Undertake a pre-start-up check for sheltering native fauna of all infrastructure, plant and equipment and/or during relocation of stored construction materials	Table 11 FF6.4
	Directional lighting will be used where lighting is required in construction areas.	Table 11 FF6.5

Table 3 Revised Statement of Commitments (RSoC)

RSoC	Requirement	Document Reference
<p>Note that Impacts to riparian corridors, threatened flora and aquatic habitats are not relevant to MPE Stage 1, Package 2 and will be addressed separately by the Construction Flora and Fauna Management Plan developed for MPE Stage 1, Package 1.</p>		
Biodiversity	<p>The Proponent will undertake further detailed assessment to establish the potential biodiversity impacts of the proposed rail link and measures to mitigate its potential impacts. The investigations shall incorporate the mitigation measures listed within Section 5 of the Flora and Fauna Assessment and as summarised below:</p>	
	<p><u>Avoid impacts</u> Site establishment, earthworks and rail construction</p>	Table 11 FF 2.2
	<p><u>Mitigate impacts</u></p> <ul style="list-style-type: none"> • Soil disturbance related to site establishment, earthworks and rail construction* • Vegetation clearance for rail construction, access and maintenance tracks • Construction in riparian areas/in proximity to watercourse* • Construction of pavement, slabs and building structures • Hot works (including vegetation clearing requiring heat producing equipment) • Alteration to air quality and noise environments • Operation of the SIMTA proposal 	<p>Table 11</p> <p>*Impacts to riparian corridors not applicable to the Project site, this will be addressed in the CFFMP for MPE Stage 1 Package 1.</p>
	<p><u>Management of Threatened Plant Species</u> The Proponent shall prepare and implement a Threatened Species Management Plan for the <i>Persoonia nutans</i> and <i>Grevillea parviflora</i> subsp. <i>parviflora</i> populations within the rail corridor that would be affected by the rail link</p>	<p>*Impacts to threatened flora not applicable to the Project site, this will be addressed in the CFFMP for MPE Stage 1 Package 1.</p>
	<p><u>Off-Set impacts</u> The Proponent will update the Preliminary Biodiversity Offset Strategy (Hyder Consulting 2013) in accordance with the NSW offset principles for major projects (state significant development and state significant infrastructure) and continue to consult with the Department of the Environment (DOTE) through the project approval processes. The offset package will be secured before any clearing of endangered ecological communities or threatened species is carried out.</p>	<p>The Biodiversity Offset Strategy is being prepared by SIMTA and does not form part of the construction environmental management plan (CEMP).</p>
<p><u>Aquatic Flora and Fauna</u> The Proponent will implement the following measures to protect the aquatic flora and fauna as part of the applications for the detailed planning applications (where relevant and applicable):</p> <ul style="list-style-type: none"> • Implementation of design principles for friendly fish passage. • Implementation of Construction and Operation Management Plans for maintenance of structures in riparian and aquatic zones. 	<p>*Impacts to aquatic habitats not applicable to the Project site. This will be addressed in MPE Stage 1, Package 1</p>	

RSoC	Requirement	Document Reference
	<ul style="list-style-type: none"> • Minimise siltation of the Georges River during construction through implementing the water quality mitigation measures detailed within the Stormwater and Flooding section of the Statement of Commitments. • Thorough assessment of any development within the Anzac Creek CSWL community, including potential impacts on groundwater quality and quantity. • Lantana removal within nominated construction zones to reduce degradation of streamside vegetation and offset any potential impacts to aquatic biodiversity. 	
	<p><u>Riparian</u></p> <p>The proposed rail link (located within the rail corridor) is exempt from the requirement for a WM Act controlled activity approval from NOW as a transitional Part 3A project; however the detailed design of the rail link will seek to conform to the objects of the WM Act and its associated guidelines.</p> <p>The riparian setback for Anzac Creek, as specified by NOW, is 30 metres (20 metre CRZ and 10 metre VB), for Georges River the riparian setback is likely to be a minimum of 50 metres (40 metre CRZ and 10 metre VB).</p> <p>Riparian corridors will be appropriately revegetated to restore and/or maintain ecological, functional and habitat values and impede surface flows and drop sediment before it reaches the waterways.</p> <p>Water quality and quantity issues will be managed during the construction phase through the implementation, inspection and maintenance of best practice soil and water management techniques which will be defined in the CEMP for sedimentation and erosion control during construction.</p> <p>Water quality and quantity issues will be managed during the operation phase through the implementation, inspection and maintenance of Water Sensitive Urban Design (WSUD) measures such as rainwater tanks, grass filter strips, swales and bio retention.</p>	<p>*Impacts to riparian corridors not applicable to the Project site. This will be addressed in MPE Stage 1, Package 1</p>

Table 4 Commonwealth Approvals

No.	Requirement	Document Reference
<p><i>The mitigation measures outlined in Annexure A of the Commonwealth Approval are included within Table 11 of this plan where relevant.</i></p>		
5	<p><u>Flora and Fauna Management Plan</u> For the better protection of EPBC listed flora and the environment on Commonwealth land, the person undertaking the action must engage a suitable qualified expert to prepare a Flora and Fauna Management Plan (FFMP) for the approval of the Minister. The FFMP must include (but need not be limited to):</p>	# This Plan
5a	Details on the timing of native vegetation clearance works;	Table 11 FF2.3 and Section 4.2.1
5b	detailed maps of the rail link easement and construction zone showing: <ul style="list-style-type: none"> i. permanent infrastructure and temporary works; ii. no-go areas; and iii. physical barriers used for the protection of native vegetation on Commonwealth land, and of EPBC Act listed Nodding Geebung and Small-flower Grevillea 	Figure 3-3, Figure 3-4 Table 11 FF2.1 Table 11 FF2.1 and FF2.2
5c	measures to minimise the extent of native vegetation clearing upon Commonwealth land and the clearing of Nodding Geebung and Small-flower Grevillea	Table 11 FF2.1 Section 5.1
5d	provisions to ensure no more than 17 individuals of Nodding Geebung and 634 stems of Small-flower Grevillea are cleared	Table Table FF2.1, FF3.0 Section 5.1
5e	the results of targeted surveys for <i>Hibbertia</i> sp. Bankstown and Bynoe's Wattle (including the number of individuals recorded) and what measures will be implemented to avoid, mitigate and manage impacts to these species, if individuals are found on site;	Section 3.5 Section 5 Table 11 FF7.3
5f	Measures which allow terrestrial fauna to disperse naturally ahead of clearing activities, and minimise the risk of injury to individuals;	Table 11 FF3.3
5g	actions to maintain or enhance the long-term viability of native vegetation adjoining the rail easement in particular, adjoining populations of Nodding Geebung and Small-flower Grevillea	Not applicable to this plan – management of flora and fauna impacts adjacent to the rail link easement are outlined in the MPE Stage 1, Package 1 (RALP) CFFMP.
5h	Measures to safeguard flora and fauna from the threat of weeds, fire, pathogens and unauthorised access, including (but not limited to) the commitments outlined in Section 7.4.1 of the EIS; and	Table 11 FF1.2, FF2.1, FF3.3, FF3.5, FF6.8
5i	ongoing monitoring to inform the adaptive management of native vegetation adjoining the rail easement;	Not applicable to this plan – management of flora and fauna impacts adjacent to the rail link easement are outlined in the MPE Stage 1, Package 1 (RALP) CFFMP.

There are no conditions specifically relating to Flora and Fauna Management in Concept Plan Conditions of Consent.

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1 INTRODUCTION

The Sydney Intermodal Terminal Alliance (SIMTA) received approval for the construction and operation of Stage 1 of the Moorebank Precinct East (MPE) Project, comprising an Intermodal (IMT) Facility including a rail link (Package 1) and Import Export (IMEX) Terminal (Package 2) on 12 December 2016 (SSD 6766). The construction and operation of the MPE Stage 1 project was subject to an appeal in September 2017 (Appeal Number 2017/00081889). The approval was upheld and the revised Conditions of Consent (CoC) were released on 13 March 2018.

This Construction Flora and Fauna Management Plan (CFFMP) has been developed to manage impacts to threatened and protected flora and fauna species, populations and communities and terrestrial biodiversity values during the construction of Package 2 of the MPE Stage 1 Project (hereafter the Project). The Project was also approved under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 6 March 2014 (EPBC 2011/6229).

Within this plan, a strategy has been established to demonstrate the contractor's approach to the management of terrestrial biodiversity values. The CFFMP also accounts for requirements of the MPE Stage 1 Project Environmental Impact Statement (EIS) [*Appendix S – SIMTA Stage 1 – Biodiversity Assessment Report and Threatened Species Management Plan*].

This CFFMP addresses the relevant requirements of the Project Approvals, including the EIS, Submissions Report and Minister's Conditions of Consent (CoC), and all applicable State and Commonwealth guidelines and standards specific to the management of terrestrial biodiversity during construction of the Project.

1.1 Background and Scope

The MPE Project site is located approximately 27 kilometres (km) south-west of the Sydney Central Business District (CBD) and approximately 26 km west of Port Botany and includes the former Defence National Storage and Distribution Centre (DNSDC) site.

The MPE Project involves the development of an IMT, including warehouse and distribution facilities, rail link, freight village (ancillary site and operational services), stormwater, landscaping, servicing and associated works on the eastern side of Moorebank Avenue, Moorebank. It is to be developed in three key stages:

- Stage 1 - Construction of the IMEX and rail link
- Stage 2 - Construction of warehouse and Distribution Facilities
- Stage 3 - Extension of the IMEX and completion of Warehouse and Distribution Facilities.

Stage 1 of the MPE Project comprises, and will be constructed across, two packages:

- Package 1: The Rail Link (not included within this CFFMP) includes a connection to the IMEX, and traverses across Moorebank Avenue, Anzac Creek and Georges River prior to connecting to the Southern Sydney Freight Line (SSFL).
- Package 2 (Figure 1-1): The IMEX (subject of this CFFMP) includes the following key components:
 - Truck processing, holding and loading areas - entrance and exit from Moorebank Avenue
 - Rail loading and container storage areas – installation of four rail sidings with adjacent container storage area serviced by manual handling equipment initially and overhead gantry cranes progressively
 - Administration facility and associated car parking- light vehicle access from Moorebank Avenue.
- Removal of the Disused Rail Spur (DURS) and rehabilitation of the land containing the DURS as required by CoC C23B of the MPE Stage 1 Consent (as amended by the court decision on 13 March 2018).

The layout of the IMEX generally comprises operational areas, an administration area, rail sidings, utilities and drainage infrastructure, landscaping and signage. The operational areas of the IMEX

consist of the primary and secondary container loading / unloading areas and container storage areas, and the truck holding area. Within these areas containers will be stacked up to five high.

1.1.1 Removal of Disused Rail Spur

As a result of the NSW Land and Environment Court Order of 13 March 2018, the MPE Stage 1 Consent was amended to include the removal of the DURS as CoC 23B. The DURS removal works involve the removal of the DURS and associated infrastructure, followed by the remediation and rehabilitation of the DURS footprint. Remediation of the site will be covered by the existing “Boot Land” Environmental Management Plan (EMP) prepared by GHD and dated May 2016. This EMP includes procedures for managing unexpected finds, water and sediment monitoring, reporting and record keeping.

Management measures in this CFFMP are considered appropriate to manage the DURS construction activities.

1.1.2 Environmental Planning Approval

The MPE Stage 1 Project has been assessed by the Department of Planning and Environment (DP&E) under Division 4.7 (Division 4.1 prior to March 2018) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) as State Significant Development (SSD). The Planning Assessment Commission (PAC) granted Approval for the MPE Stage 1 Project on 12 December 2016 and is subject to the Minister’s Conditions of Consent (CoC, 18 December 2016 (ref SSD-6766)). The MPE Stage 1 Project, its impacts, consultation and mitigation were documented in the following suite of documents:

- State Significant Development Application SSD 6766 (as amended in the Land and Environment Court 13 March 2018)
- SIMTA Intermodal Terminal Facility – Stage 1 – Environmental Impact Statement (Hyder Consulting Pty Ltd, May 2014)
- SIMTA Intermodal Terminal Facility – Stage 1 – Response to Submissions (Hyder Consulting Pty Ltd, September 2015)
- Biodiversity Assessment Report, MPE Stage 1, (Arcadis 2017)
- *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Approval (No. 2011/6229) granted on March 2014.
- SIMTA Intermodal Terminal Facility - Moorebank Precinct East -Stage 1 Project Securing Biodiversity Offset Land (Arcadis, November 2017).

1.2 Purpose and Application

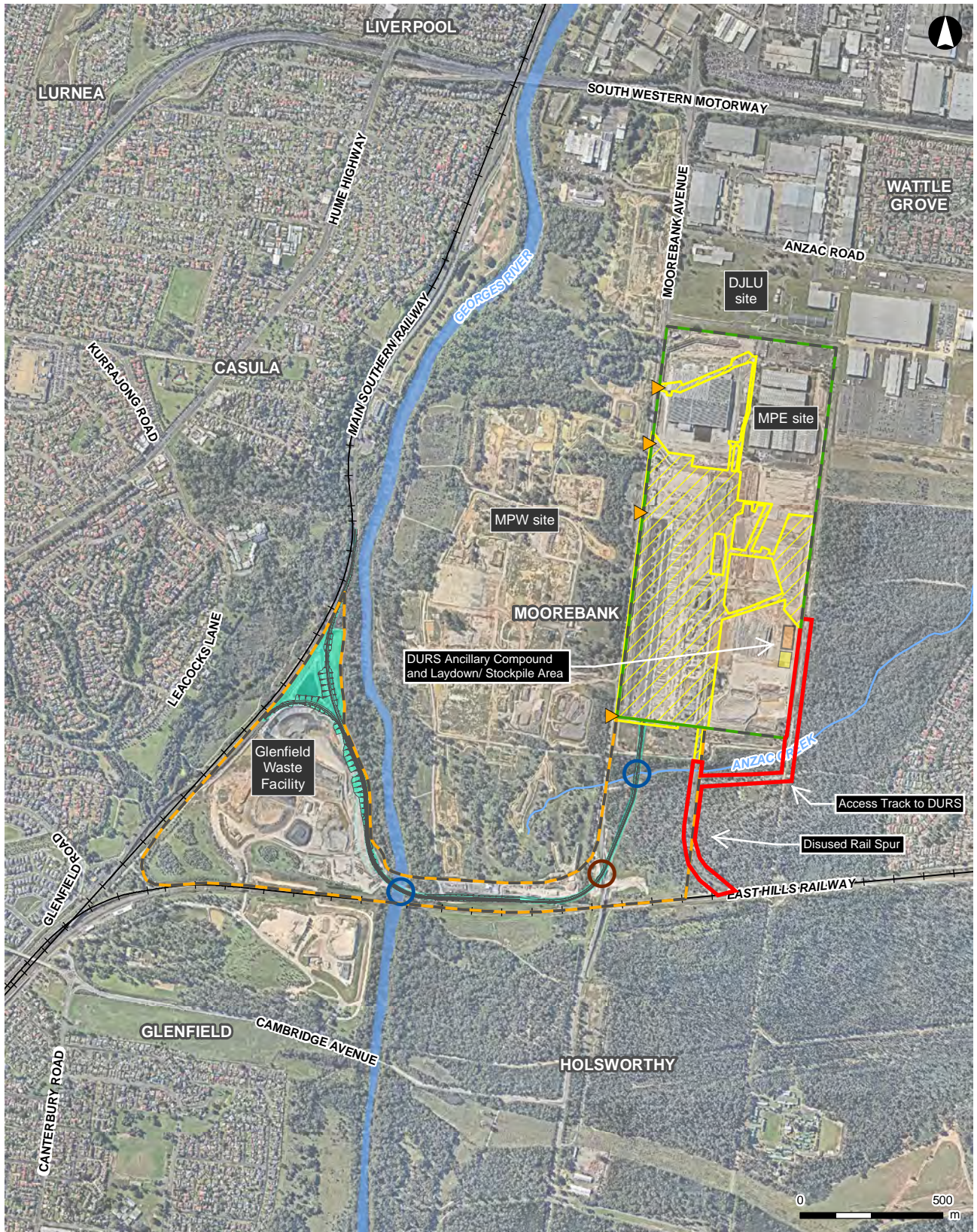
Within the submission of planning approval for the MPE Stage 1, Arcadis (then Hyder Consulting) undertook a Biodiversity Assessment Report (Hyder 2015). SIMTA have developed this CFFMP based on the initial biodiversity impact assessment, and to address the final compilation of mitigation measures within the EIS and revised statement of commitments. This plan aims to demonstrate how terrestrial biodiversity will be managed during construction of the Project.

This plan provides methods to measure and reduce the impact to terrestrial biodiversity by the contractor during the construction of the Project, including all contractor and consultant partners.

Specifically, the purpose of this CFFMP is to:

- Manage flora and fauna impacts in accordance with the Project approval documents (as outlined in Section 1.1.1)
- Review and consider the Biodiversity Assessment Report and Threatened Species Management Plan (Appendix S of EIS) during the construction phase of Package 2 of the Project
- Ensure that through the use of best practice, impacts to terrestrial biodiversity are minimised.

MPE Stage 1 CFFMP



LEGEND

- | | |
|-----------------------------------|-------------------------|
| Project site | Creek/river crossing |
| Construction footprint | Road crossing |
| MPE site | Rail link |
| Rail corridor | Existing railway |
| MPE Stage 1 Package 1 (Rail Link) | Watercourse |
| Construction access | DURS works footprint |
| DURS Laydown/ Stockpile Area | DURS Ancillary Facility |

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Figure 1: MPE Site Overview

1.3 Objectives and Targets

The following high level objectives and targets identified in Table 5 are set for the Project for the management of terrestrial biodiversity:

Table 5 Objectives and Targets

Objectives	Performance Indicators
<ul style="list-style-type: none"> To correctly implement flora and fauna management controls to ensure ecological impacts are minimised during construction and to comply with contractual and legislative requirements. Minimise impacts or environmental consequences to threatened species, threatened populations, endangered ecological communities and their habitats Maintain existing areas of vegetation not affected by construction as viable habitat through the control of weeds, pests, pathogens, access and fire to promote natural regeneration. 	<ul style="list-style-type: none"> No death or injury to fauna No unapproved destruction of flora or fauna habitats Weeds controlled in accordance with the requirements of the relevant legislation. Any threatened fauna or flora that have not been identified in the EIS, but which may inhabit the Project site, are identified as early as practicable.

1.4 Consultation

The NSW Minister’s Condition of Approval requires that the Flora and Fauna Sub-Plan be prepared in consultation with the Office of Environment and Heritage (OEH). A draft version of the CFFMP was provided to the OEH for comment and review as outlined below (Table 6). Appendix C contains evidence of consultation.

Table 6 Consultation Summary

Agency	Date	Person Contacted	Comment	Status
OEH	22/12/16	Richard Bonner	Contacted by phone to inform the CEMP would be submitted mid-January. OEH Stated they were happy to receive.	Open
	23/01/17	Richard Bonner	Contacted by phone to inform the CEMP would be submitted 1 February with a consultation period of 2 weeks. No answer, voice message left.	Open
	25/01/17	Richard Bonner	Phone call received from OEH. OEH stated they were happy to receive the documents and make comment within given timeline.	Open
	1/02/17	Richard Bonner	Email sent containing briefing note CEMP, CHMP and CFFMP for review, reiterating February 15 deadline for comments.	Open

Agency	Date	Person Contacted	Comment	Status
	8/02/17	Richard Bonner	Phone call and email sent to track progress of document reviews. No answer, voice message left Response received stating that documents were unable to be opened. The documents were resent via email.	Open
	16/02/16	Richard Bonner	Phone call and email sent to remind OEH that deadline has passed and any comments would need to be submitted ASAP.	Open
	16/02/16	Richard Bonner	Comments on CFFMP received, it was advised that OEH were unable to provide comments on the CHMP and CEMP.	Open
	20/02/17	Richard Bonner	Email sent to indicate how comments have been addressed within Draft Document (to be submitted to DP&E). (See Appendix A). Consultation complete	Closed

2 ENVIRONMENTAL OBLIGATIONS

Table 7 below details the legislation, planning instruments and guidelines relevant to this sub-plan.

Table 7 Legislation, Planning Instruments and Guidelines

Environmental Planning Legislation	Description	Relevance to this CFFMP
<i>Environmental Planning and Assessment Act 1979</i>	This Act establishes a system of environmental planning and assessment of development proposals for the State.	The Development Consent conditions and obligations are incorporated into this CFFMP.
<i>Environment Protection and Biodiversity Conservation Act 1999 (Cwth)</i>	The main purpose of this Act is to provide for the protection of the environment especially those aspects that are of national environmental importance and to promote ecological sustainable development. The Act binds the Crown. Do not take, use, keep or interfere with “nationally significant” cultural and natural resources, protected wildlife and protected plants without Approval.	The project as a whole is a controlled action under the EPBC Act with controlling provisions related mainly to the Rail connection (refer to compliance matrices).
<i>Threatened Species Conservation Act 1995</i> <i>Threatened Species Conservation Regulation 2002</i> <i>Threatened Species Conservation (Savings and Transitional) Regulation 1996</i>	This Act and Regulations provide for obtaining licenses to harm or pick threatened species populations or ecological communities whether plant or animal or to damage any critical habitat. The offence of picking or harming any threatened species is covered under the National Parks & Wildlife Act Part 8A. It is a defence under Part 8A of that Act if the offence was essential to carrying out development that is in accordance with a Development Consent within the meaning of the EP&A Act or an approval within the meaning of Part 5 of the EP&A Act.	The CoC addresses the requirements of the TSC Act and regulations (refer to compliance matrices). This Act was repealed by Schedule 10 to the <i>Biodiversity Conservation Act 2016 No 63</i> with effect from 25 August 2017. See <i>Biodiversity Conservation Act</i> below.

Environmental Planning Legislation	Description	Relevance to this CFFMP
<i>Biodiversity Conservation Act 2016</i>	This Act broadly incorporates similar objectives to those identified under TSC Act, and additionally seeks to establish a framework for assessment and offsetting of development impacts as well as investment in biodiversity conservation.	This CFFMP prescribes measures to avoid and minimise impacts on threatened species and communities listed under the BC Act, that are known or considered likely to occur in the Project site.
<i>Fisheries Management Act 1994</i>	This Act is applicable to all waters within the state including private and public waters and all permanent and intermittent waters. The Act is most relevant in respect to maintaining water quality and ensuring no polluted water from site works enters streams, creeks and waterways. In addition this Act also has relevance for the removal of marine vegetation.	Water discharging from the Project site must not pollute the adjacent streams or watercourses.
<i>Noxious Weeds Act 1993</i>	This Act provides for the classification and control of noxious weeds. Declared noxious weeds are classified as Class 1, State Prohibited Weeds; Class 2, Regionally prohibited Weeds, Class 3 Regionally Controlled Weeds, Locally Controlled Weeds and Class 5 Restricted Plants. Class 1, 2 & 5 weeds are referred to in the Act as “Notifiable Weeds”.	<p>The Act applies to owners or occupiers of land. Management of weeds is a requirement of the CoC (refer to compliance matrices).</p> <p>This Act was repealed by Schedule 6 to the <i>Biosecurity Act 2015 No 24</i> with effect from 1 July 2017</p>
<i>Biosecurity Act 2015</i>	The primary objective of the Act is to provide a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers. Division 2 of the Act defines local control authorities for weeds and Schedule 1 outlines special provisions relating to weeds, including the duty of land occupiers to control and manage weeds.	This CFFMP prescribes measures to manage weeds and pests that may be identified in the Project site, although none have been identified to date.

3 EXISTING ENVIRONMENT

3.1 Flora

The methodology and results of initial surveys of the Project are set out in the Biodiversity Assessment Report (BAR, Hyder 2015). The BAR was amended by Arcadis in November 2017 to satisfy part of Condition C23 to facilitate the commencement of clearing from the Southern Boundary of MPE Stage 1, Package 2 to the RailCorp Land section of MPE Stage 1, Package 1.

The vegetation within the Project site consisted almost entirely of planted trees with a mown or managed understorey, which does not meet the criteria for any threatened ecological communities.

The planted tree species are typical of cultivated eucalypts that are commonly found as mature street trees in suburban Sydney, with *Eucalyptus microcorys* (Tallowwood), *E. saligna* (Sydney Blue Gum), *Corymbia maculata* (Spotted Gum) and *C. citriodora* (Lemon-scented Gum) frequently recorded.



Photograph 1: Mature trees of *Eucalyptus saligna* and *Corymbia maculata* on the Project site (Hyder 2015)



Photograph 2: Mature trees of *Eucalyptus microcorys* on the Project site (Hyder 2015)

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










There was one area adjoining the disused rail line bordering the south-eastern boundary of the Project site that supported mature trees of *Eucalyptus sclerophylla* (Hard-leaved Scribbly Gum) and an understorey of native shrubs, grasses and herbs. Exotic cover was low, with *Eragrostis curvula* (African Lovegrass) dominating in patches. It is possible that this area has been subject to management as there were mesh tree guards around the bases of two trees. This small (0.1 ha) area has been mapped as native vegetation (Figure 3-1). To the southeast of the Project site is a network of drainage channels with some tree plantings and some apparent tree and shrub regeneration. The channels supported a mixture of native, nonlocal native and exotic trees and shrubs including *Eucalyptus saligna*, *E. tereticornis* (Forest Red Gum), *Corymbia maculata*, *Melaleuca quinquenervia* (Broad-leaved Paperbark), *Casuarina glauca* (Swamp Oak) and *Eucalyptus parramattensis* (Parramatta Red Gum).

For Moorebank Precinct, native vegetation is defined as “Areas of Plant Community Types (PCT) mapped by Arcadis and WSP Parsons Brinckerhoff in the Moorebank Precinct (including Moorebank Precinct East and Moorebank Precinct West) being a consolidation of all assessments for the Moorebank Precinct conducted since 2011. The areas of native vegetation within the vicinity of the Project site is shown in Figure 3-1.

MPE Stage 1 CFFMP



LEGEND

- | | |
|---|---|
|  Project site |  Proposed rail alignment |
|  Construction footprint |  Native vegetation |
|  MPE site |  Watercourse |
|  Rail corridor |  Existing railway |
|  MPE Stage 1 Package 1 (Rail Link) | |

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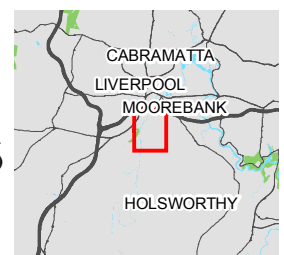


Figure 3-1: Native Vegetation within the vicinity of the Project site

3.2 Landscaping

Landscaping on the western boundary of the Project site, along Moorebank Avenue will consist of an 18m wide setback. Differentiating plant species will be used at the Project site entry/exits to accentuate these nodal points. This 18m wide setback will include a bio-retention swale which will be used for water capture and management along this boundary. Water treatment is to be facilitated in this bio-retention channel with the plantings of suitable wetland plants. All planting is to be informal, with groups of trees, shrubs and swathes of groundcovers. This will serve to enhance the natural characteristics of the landscape. A high diversity of species will help to integrate the site into the surrounding area.

Landscaping along the southern boundary of the Project site will include a mix of trees, shrubs and swathes of groundcover to create a biological connection to the bushland to the south. Landscaping will also be provided around the northern and eastern boundaries of the Project site. This landscaping will include a mix of shrubs and turfed areas. The landscape design aims to integrate the Project site with its broader environment by:



- using species that are local to the area.
- using trees throughout the Project site, where feasible, to provide for a uniform canopy cover within vegetated areas.
- using local species as understorey planting to enhance local habitat values.
- using materials in high visibility areas that are sympathetic to the colours and textures of local plant species being used.




Only trees required to be removed as part of establishing permanent access on Moorebank Avenue, Main IMT construction haulage road and Main IMT construction stockpile will be removed; other existing mature trees will be retained. Trees to be retained shall be protected and maintained during preconstruction and construction activities as outlined in Table 11 F2.3.

3.3 Noxious Weeds

Noxious weeds have not been detected within the Project site, however the presence/absence of noxious weeds is to be confirmed by an ecologist prior to clearing and bulk earthworks commencing. Noxious weeds that have the potential to occur, based on the results of field surveys within surrounding lands by Hyder (2015) are summarised in Table 8 below. Management measures for weeds are outlined in Table 11 FF3.4.

Table 8 Noxious weeds with the potential to occur within the Project site

Name	Example Photo	Class	WoNS	Weed control requirements
<i>Chrysanthemoides monilifera</i> subsp. <i>rotundata</i> Bitou Bush		3	Yes	The plant must be fully and continuously suppressed and destroyed.
<i>Cortaderia selloana</i> Pampas Grass		3	No	The plant must be fully and continuously suppressed and destroyed.

Name	Example Photo	Class	WoNS	Weed control requirements
<i>Lantana camara</i> Lantana		4	Yes	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
<i>Opuntia</i> sp. Prickly Pear		4	Yes	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.
<i>Rubus fruticosus</i> Blackberry		4	Yes	The growth and spread of the plant must be controlled according to the measures specified in a management plan published by the local control authority.

* Photos sourced from NSW Weedwise. <http://weeds.dpi.nsw.gov.au/>

3.4 Fauna Habitat

Native vegetation has been predominantly cleared from the Project site and persists as isolated trees amongst expanses of mown exotic and native grasses. Habitat features such as rocky features, well-developed leaf litter, ground timber and hollow logs are absent from cleared and disturbed areas. Thus, the availability of sheltering and foraging habitat for reptiles and cover-dependent terrestrial mammals is reduced.

Isolated trees offer potential nesting, sheltering and roosting habitat to birds such as Pied Currawong (*Strepera graculina*) and Noisy Miner (*Manorina melanocephala*). Flowering eucalypts also provide foraging habitat for Grey-headed Flying Fox (*Pteropus poliocephalus*).

A small number of scribbly gums (*Eucalyptus sclerophylla*) located in the south of the Project site (outside of the impact area) support small and medium-sized hollows, offering nesting habitat to hollow-dependent species such as Rainbow Lorikeet (*Trichoglossus haematodus*) and Scaly-breasted Lorikeet (*Trichoglossus chlorolepidotus*).

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

Open grassy areas provide foraging habitat for ground-feeding birds such as White-winged Chough (*Corcorax melanorhamphos*), Red-rumped parrot (*Psephotus haematonotus*) and small terrestrial mammals such as the Brown Hare (*Lepus capensis*). Other small trees and shrubs throughout the SIMTA site that may offer sheltering and nesting habitat to smaller birds are restricted to small areas of horticultural plantings.

Identified fauna habitat and threatened fauna species are shown in Figure 3-2.

The buildings currently on the Project site offer limited habitat features to native fauna, although they may support potential roosting habitat for microchiropteran bats. Given that inspection of these buildings was not possible during site surveys, it is assumed that some of the buildings offer potential fauna habitat. As outlined in Table 8, preclearance surveys, including echolocation call recording and

dawn/dusk surveys will be undertaken by an ecologist to confirm any roost sites. If confirmed within the construction site, demolition of the buildings may be restricted to winter, outside of the critical breeding season.

A lack of habitat connectivity within the Project site, and between the site and adjacent areas, reduces potential movement of arboreal mammals and cover-dependent fauna into and through the Project site. The riparian corridors associated with the Georges River and Anzac Creek, and the vegetated lands within the Southern Boot Land are not included within the current scope and are unlikely to be directly impacted by the Project. Specific management measures for these habitats will be included within a separate CFFMP for the Rail Link.

MPE Stage 1 CFFMP



LEGEND

- | | | |
|------------------------|---|--------------------------------|
| Rail Corridor | Ecological study area | Fauna Habitat |
| MPE site | Hollow bearing trees | Remnant woodland |
| Construction footprint | Threatened Fauna Species | Riparian habitat - Anzac Creek |
| Buildings | Eastern Bentwing-bat | Landscaped areas |
| Rail link | Eastern Bentwing-bat (probable recording) | Cleared and disturbed |
| Watercourse | Grey-headed Flying-fox | Waterbody |

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Figure 3-2 Fauna Habitat and Threatened Fauna Species Locations

3.5 Threatened Species

The amended Biodiversity Assessment Report prepared by Arcadis (2017) identified the below threatened species within the Project study area as outlined in the Environmental Impact Statement Figure 14-1: Ecological Study Area listed under the NSW *Threatened Species Act 1995* (TSC Act), two of which are also listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- East Coast Freetail Bat (*Mormopterus norfolkensis*), TSC Listed: Vulnerable;
- Southern Myotis (*Myotis macropus*), TSC Listed: Vulnerable;
- Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*) TSC Listed: Vulnerable;
- Grey-headed Flying Fox (*Pteropus poliocephalus*), TSC Listed: Vulnerable, EPBC Listed: Vulnerable;
- Nodding Geebung (*Persoonia nutans*), TSC Listed: Endangered, EPBC Listed: Endangered; and
- Small-flower Grevillea (*Grevillea parviflora subsp. parviflora*), TSC Listed: Vulnerable, EPBC Listed: Vulnerable
- *Hibbertia puberula subsp. puberula* (endangered, TSC Act)
- *Hibbertia fumana* (critically endangered TSC act).

Of these, Eastern Bentwing-bat, Grey-headed Flying Fox, and Nodding Geebung were recorded close to the Project site (refer to Figure 3-2 and Figure 3-3, Table 9 and Table 11 FF7.1 and FF7.2).

The area of impact is restricted to the Project site as depicted in Figure 1-1i.e. the MPE Stage 1, Package 2 site. No clearing outside this area will be undertaken, and as such, no flora or fauna outside of this area will be impacted upon. It is noted that the Project site has been previously cleared and it is unlikely that any endangered flora species will be encountered. Pre-clearing surveys undertaken prior to clearing will include the identification of threatened species; where threatened species are identified the Unexpected Threatened Species Procedure will be enacted as outlined in Table 11 FF7.3.

Further surveys undertaken by Arcadis in October and November 2016 within the Boot Land south of the Project site identified three additional threatened plant species. These identified species were:

- Bynoe's Wattle (*Acacia bynoeana*), TSC Act listed: Endangered, EPBC Act listed: Vulnerable;
- Downy Wattle (*Acacia pubescens*), TSC listed: vulnerable, EPBC listed: Vulnerable;
- *Hibbertia puberula subsp. puberula*, TSC Listed: Endangered;
- *Hibbertia fumana*, TSC Listed: Critically endangered

Additional targeted flora surveys for the MPE Stage 1: Package 1, undertaken by Cumberland Ecology in summer 2017, identified 184 *Hibbertia fumana* and 186 *Hibbertia puberula subsp. puberula* within the construction boundary for that package. Neither of these species have been recorded within the Package 2 construction boundary.

Hibbertia sp. Bankstown (syn. *Hibbertia puberula subsp. glabrescens*) is currently known to occur in only one population at Bankstown Airport. The airport site is very heavily modified from the natural state, lacks canopy species and is currently a low grass/shrub association with many pasture grasses and other introduced herbaceous weeds. Soil at the site is a sandy (Tertiary) alluvium with a high silt content. Based on the presence of potentially similar habitat surveys for the species were undertaken to support the MPE Stage 1 Biodiversity Assessment Report (updated by Arcadis 2017). The species was not detected and was considered unlikely to occur within the Project Site.

No threatened species have been identified within the Project site to date. The nearest threatened species are located north of Anzac Creek within the Boot Land over 100m to the south of the Project, with the exception of one strand of *persoonia nutans* which was identified in the EIS to be within 50m of the southern boundary of the Project (Figure 3-3, Figure 3-4. Table 9 outlines the likelihood of encountering threatened species. The flora species identified have been assessed as being **unlikely** to occur within the project boundary. Despite this, a precautionary approach has been adopted for

clearing; pre-clearing surveys will be undertaken by an ecologist prior to any clearing on site, (Table 11) and staff will be educated in the identification of threatened species.

Should any unexpected threatened species be identified within the Project site, the Unexpected Threatened Species procedure will be implemented (Table 11 FF7.3) however no threatened species have been recorded within the Project site. If identified, translocation of threatened species will be undertaken.

CoC C22 also requires that a 'Threatened Dragonfly Species Survey Plan' is undertaken to determine the presence or absence of threatened dragonfly species listed under the Fisheries Management Act 1994. As outlined in Table 9, a habitat assessment was undertaken by Arcadis (2016). No habitats for either *Archaeophya adamsi* or *Austrocordulia leonardi* were detected in the survey area (Georges River between the crossings of Cambridge Avenue and the M5 Southwestern Motorway at Moorebank) and it was concluded highly unlikely that the threatened dragonflies occur in the survey area.

MPE Stage 1 CFFMP

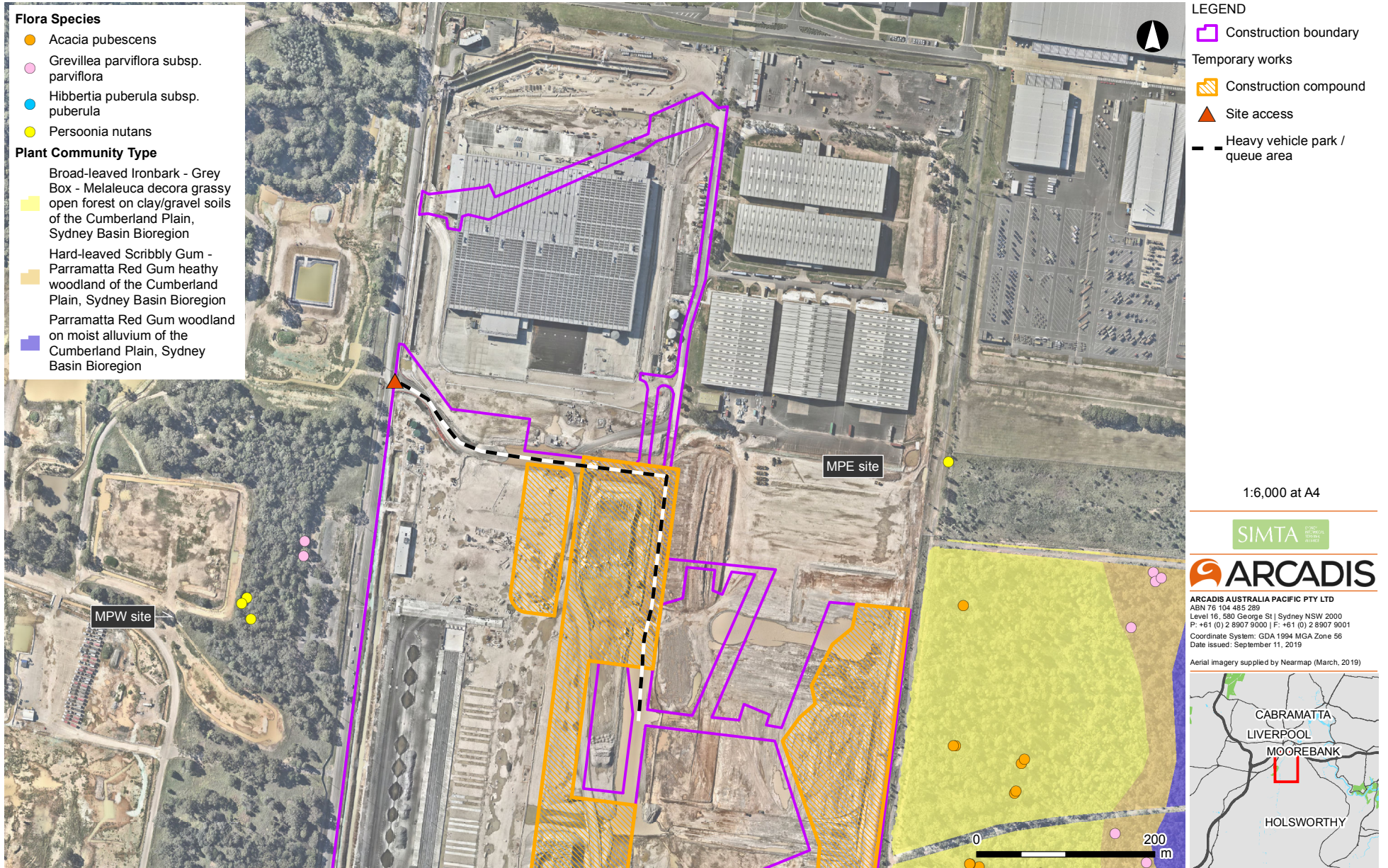


Figure 3-3a: Threatened Flora Species and Plant Community Types - Temporary Works

MPE Stage 1 CFFMP

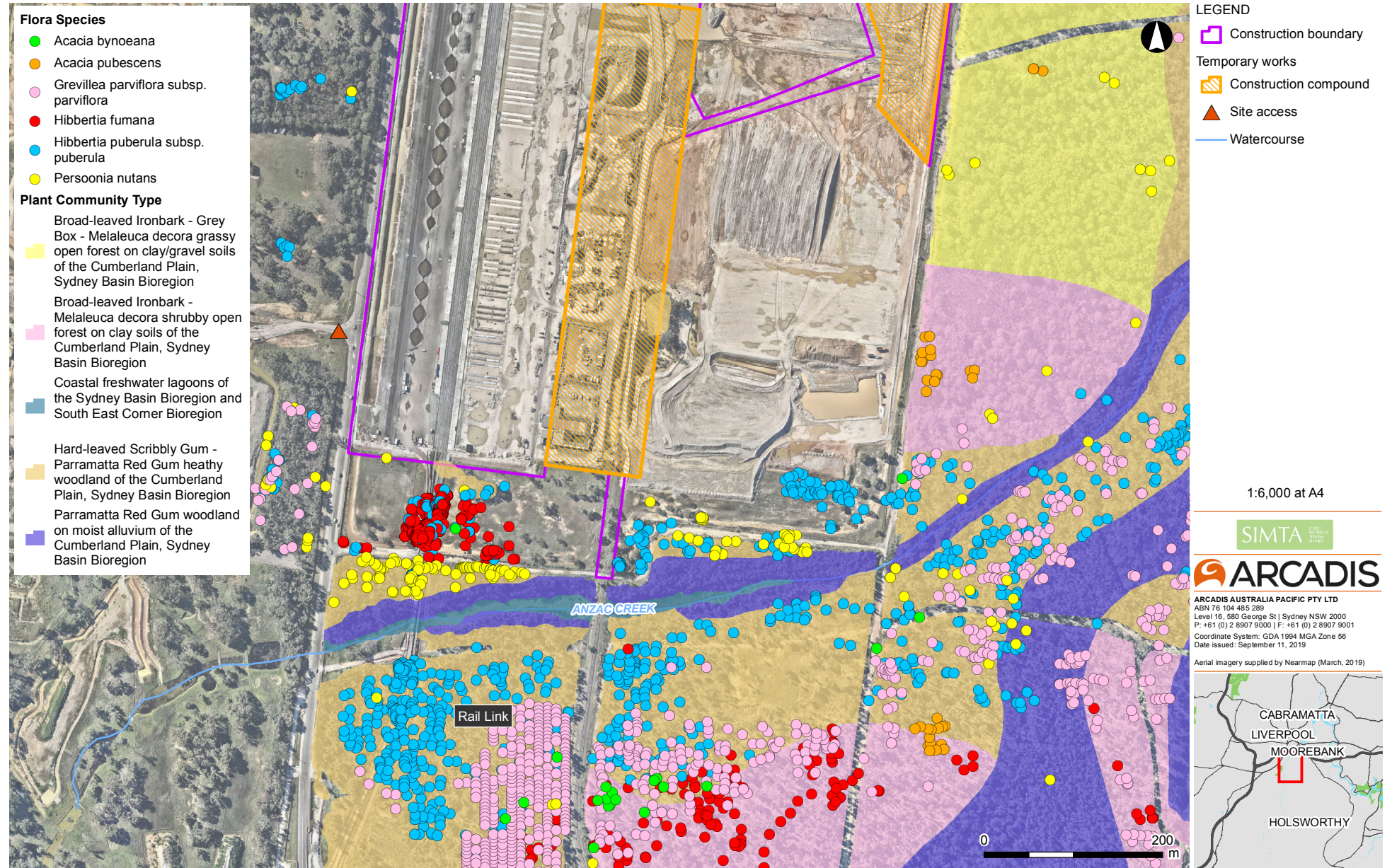


Figure 3-3b: Threatened Flora Species and Plant Community Types - Temporary Works

MPE Stage 1 CFFMP

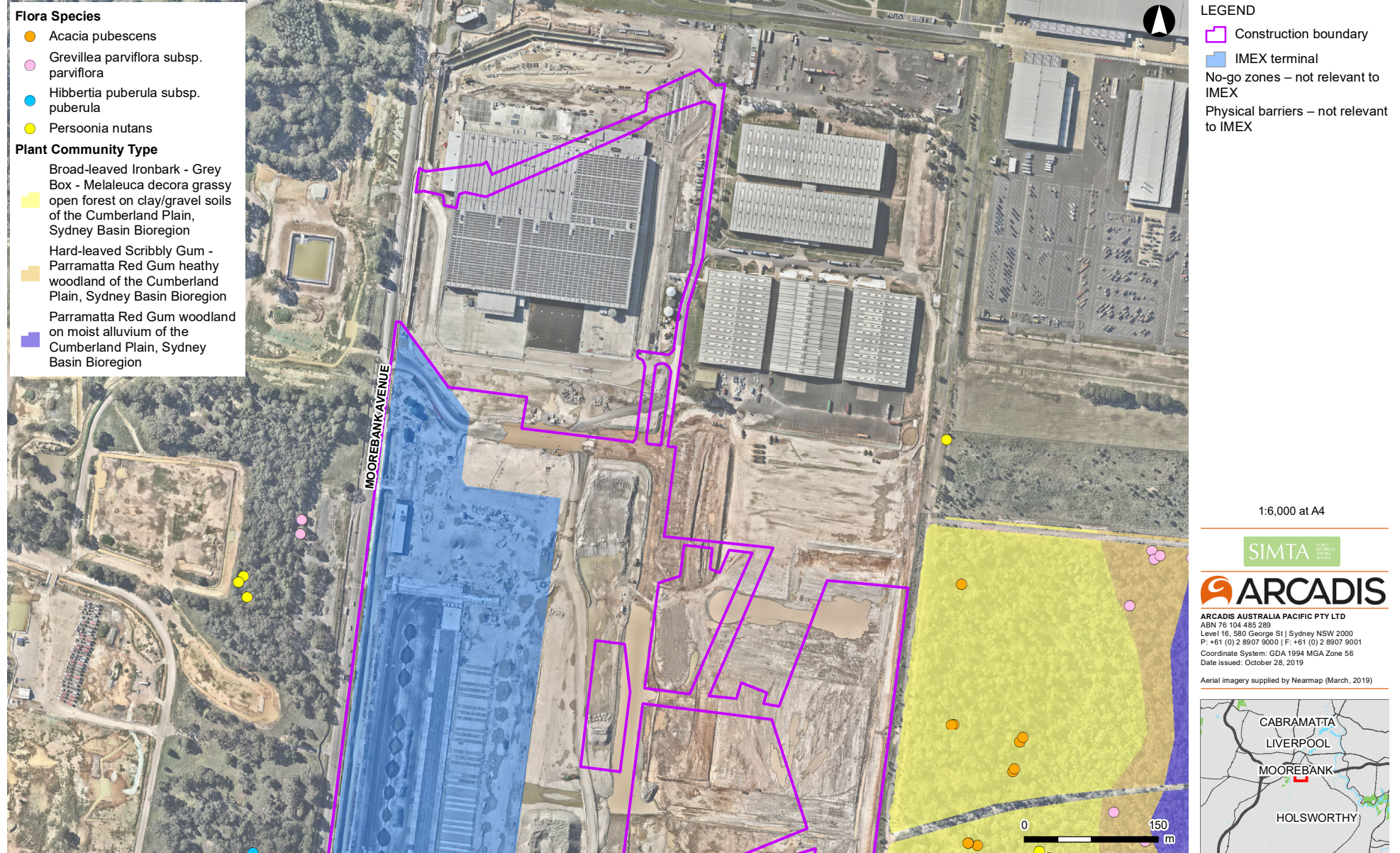


Figure 3-4a: Threatened Flora Species and Plant Community Types - Permanent Infrastructure

MPE Stage 1 CFFMP

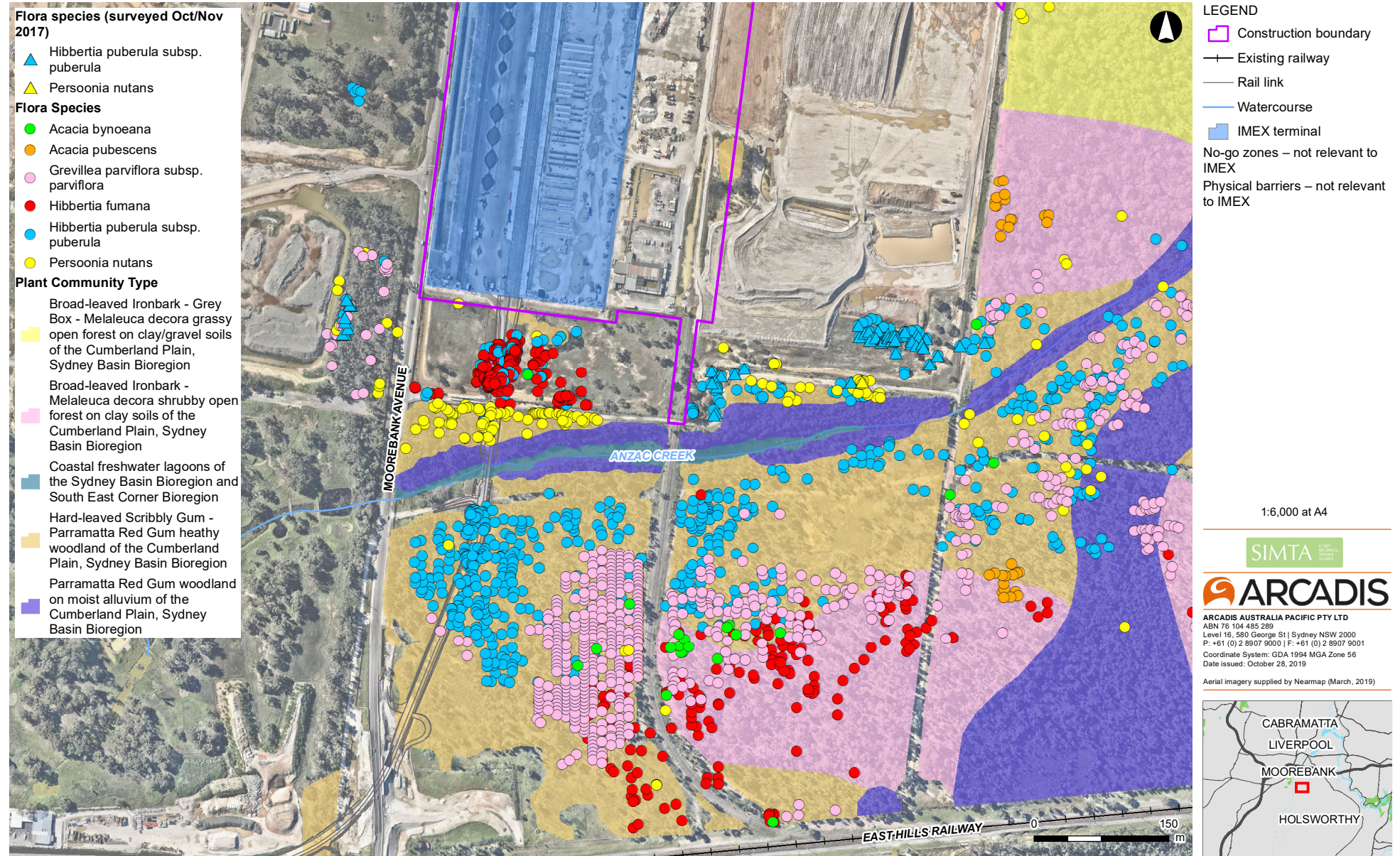










Figure 3-4b: Threatened Flora Species and Plant Community Types - Permanent Infrastructure



Table 9 Threatened Species, Likelihood of Occurrence within the Project



Threatened Species	Habitat Requirements*	Likelihood of Occurrence	Mitigation Measures
<p>East Coast Freetail Bat <i>(Mormopterus norfolkensis)</i></p> <p>TSC Listed: Vulnerable</p> <p>EPBC Listed: Not Listed</p>	 <p>This species occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. It roosts mainly in tree hollows but will also roost under bark or in man-made structures.</p> <p>Usually solitary but also recorded roosting communally, probably insectivorous.</p>	<p><u>Unlikely.</u></p> <p>This species was recorded in the riparian vegetation of the western bank of the Georges River. As described by Hyder (2015), the species may roost in tree hollows occurring on the western bank of the Georges River, or under exfoliating bark of rough-barked eucalypts in riparian habitats.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>
<p>Southern Myotis <i>(Myotis macropus)</i></p> <p>TSC Listed: Vulnerable</p> <p>EPBC Listed: Not Listed</p>	 <p>The Southern Myotis is found in the coastal band from the north-west of Australia, across the top-end and south to western Victoria. It is rarely found more than 100 km inland, except along major rivers. It generally roosts in groups of 10 - 15 close to water in caves, mine shafts, hollow-bearing trees, storm water channels, buildings, under bridges and in dense foliage. Forage over streams and pools catching insects and small fish by raking their feet across the water surface.</p>	<p><u>Unlikely.</u></p> <p>The species is typically found in association with riparian vegetation and may forage along Georges River and Anzac Creek for fish and invertebrates.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>

Threatened Species	Habitat Requirements*	Likelihood of Occurrence	Mitigation Measures
<p>Eastern Bentwing-bat <i>(Miniopterus schreibersii oceanensis)</i></p> <p>TSC Listed: Vulnerable</p> <p>EPBC Listed: Not Listed</p>	 <p>Eastern Bentwing-bats occur along the east and north-west coasts of Australia. The hunt in forested areas, catching moths and other flying insects above the tree tops.</p> <p>Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures. The species form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young. Maternity caves have very specific temperature and humidity regimes. At other times of the year, populations disperse within about 300 km range of maternity caves.</p>	<p><u>Possible foraging/hunting and roosting habitat.</u></p> <p>This species was recorded by Hyder (2015) in remnant woodland and forest, and cleared and disturbed areas, suggesting that the Project site may provide some foraging opportunities.</p> <p>The buildings currently on the Project site may support potential roosting habitat for this species.</p>	<p>Preclearance surveys, including echolocation call recording and dawn/dusk surveys to confirm any roost sites.</p> <p>If confirmed within the construction site, demolition of the buildings may be restricted to winter, outside of the critical breeding season.</p>
<p>Grey-headed Flying Fox <i>(Pteropus poliocephalus)</i></p> <p>TSC Listed: Vulnerable</p> <p>EPBC Listed: Vulnerable</p>	 <p>The Grey-headed Flying-fox requires foraging resources and roosting sites. It is a canopy-feeding frugivore and nectarivore, which utilises vegetation communities including rainforests, open forests, closed and open woodlands, Melaleuca swamps and Banksia woodlands. It also feeds on commercial fruit crops and on introduced tree species in urban areas. The primary food source is blossom from Eucalyptus and related genera but in some areas it also utilises a wide range of rainforest fruits. The Grey-headed Flying-fox roosts in aggregations of various sizes on exposed branches. Roost sites are typically located near water, such as lakes, rivers or the coast.</p>	<p><u>Possible foraging habitat only.</u></p> <p>The Grey-Headed Flying fox was observed foraging amongst eucalypts in the SIMTA site and flying over remnant woodland further to the south.</p> <p>Flowering exotic and native trees, predominantly eucalypts located within the Project site provides a seasonal foraging resource only. No suitable roosting sites have been reported to occur.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>

Threatened Species	Habitat Requirements*	Likelihood of Occurrence	Mitigation Measures
<p>Bynoe's Wattle (<i>Acacia bynoeana</i>) TSC Listed: Endangered EPBC Listed: Vulnerable</p>	 <p>Occurs in heath or dry sclerophyll forest on sandy soils. Seems to prefer open, sometimes slightly disturbed sites such as trail margins, edges of roadside spoil mounds and in recently burnt patches. Associated overstorey species include Red Bloodwood, Scribbly Gum, Parramatta Red Gum, Saw Banksia and Narrow-leaved Apple.</p>	<p><u>Unlikely.</u></p> <p>This species was recorded in native vegetation within the conservation area, to the south-east of the site and south of Anzac Creek.</p> <p>The Project site is already cleared of native vegetation and the maintained understorey (mown) is not preferred by this species.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>
<p>Downy Wattle (<i>Acacia pubescens</i>) TSC listed: Vulnerable EPBC listed: Vulnerable</p>	 <p>Occurs on alluviums, shales and at the intergrade between shales and sandstones. in open woodland and forest. Found in a variety of plant communities, including Cooks River/Castlereagh Ironbark Forest, Shale/Gravel Transition Forest and Cumberland Plain Woodland.</p>	<p><u>Unlikely.</u></p> <p>This species was recorded in native vegetation within the conservation area, to the south-east and east of the site.</p> <p>The Project site is already cleared of native vegetation and the maintained understorey (mown) is not preferred by this species.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>

Threatened Species	Habitat Requirements*	Likelihood of Occurrence	Mitigation Measures
<p>Nodding Geebung (<i>Persoonia nutans</i>) TSC Listed: Endangered EPBC Listed: Endangered</p>	 <p>Restricted to the Cumberland Plain in western Sydney, between Richmond in the north and Macquarie Fields in the south. Northern populations are confined to aeolian and alluvial sediments and occur in a range of sclerophyll forest and woodland vegetation communities, with the majority of individuals occurring within Agnes Banks Woodland or Castlereagh Scribbly Gum Woodland and some in Cooks River / Castlereagh Ironbark Forests. Peak flowering is from November to March with sporadic flowering all year round.</p>	<p><u>Unlikely.</u></p> <p>A population of this species was previously identified in native vegetation north of Anzac Creek and to the east of the MPE site. One individual was recorded on the MPE site, in the fragmented woodland adjoining the southern edge of the project site</p> <p>The Project site is already cleared of native vegetation and the maintained understorey (mown) is not preferred by this species. Individuals found in the south of the MPE site were growing in fragmented native vegetation.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>
<p>Small-flower Grevillea (<i>Grevillea parviflora subsp. parviflora</i>) TSC Listed: Vulnerable EPBC Listed: Vulnerable</p>	 <p>Sporadically distributed throughout the Sydney Basin and in the Hunter at in the Cessnock - Kurri Kurri area (particularly Werakata NP). Sydney region occurrences are usually on Tertiary sands and alluvium, and soils derived from the Mittagong Formation. Soil landscapes include Lucas Heights or Berkshire Park.</p> <p>Flowering has been recorded between July to December as well as April-May. Flowers are insect-pollinated and seed dispersal is limited. Seedling recruitment after fire is uncommon, and most recovery after disturbance appears to be resprouting from rhizomes.</p>	<p><u>Unlikely.</u></p> <p>This species was recorded in native vegetation to the south-east of the site and south of Anzac Creek. The Project site is already cleared of native vegetation and the maintained understorey (mown) is not preferred by this species.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>

Threatened Species	Habitat Requirements*	Likelihood of Occurrence	Mitigation Measures
<p><i>Hibbertia fumana</i></p> <p>TSC Listed: Critically Endangered</p> <p>Not listed under the EPBC Act</p>	 <p>This recently rediscovered species was previously known only from historical herbarium records and presumed to be extinct.</p> <p>The species has been recorded in a transitional zone between Castlereagh Ironbark Forest and Castlereagh Scribbly Gum Woodland, with an open understorey and this habitat is not present within the Project site.</p>	<p><u>Unlikely</u></p> <p>This species was recorded in the MPE Stage 1: Package 2 construction boundary and the native vegetation within the conservation area, to the south-east of the site and south of Anzac Creek.</p> <p>The Project site is already cleared of native vegetation and the maintained understorey (mown) is considered unlikely to support this species.</p>	<p>Preclearance surveys including targeted surveys for threatened flora.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>
<p><i>Hibbertia puberula</i> subsp. <i>puberula</i></p> <p>TSC Listed: Endangered</p> <p>Not listed under the EPBC Act</p>	 <p>Occurs on sandy soil often associated with sandstone, or on clay. Habitats are typically dry sclerophyll woodland communities, although heaths are also occupied. This habitat is not present within the Project site.</p>	<p><u>Unlikely</u></p> <p>This species was recorded in the MPE Stage 1: Package 2 construction boundary and the native vegetation within the conservation area, to the south-east of the site and south of Anzac Creek.</p> <p>The Project site is already cleared of native vegetation and the maintained understorey (mown) is not preferred by this species.</p>	<p>Preclearance surveys.</p> <p>Environmental awareness to be included in site inductions and toolbox talks.</p>

Threatened Species	Habitat Requirements*	Likelihood of Occurrence	Mitigation Measures
<p>Adam's Emerald Dragonfly - <i>Archaeophya adamsi</i></p> <p>FM Act Listed: Endangered</p>	 <p>Adam's Emerald Dragonfly is one of Australia's rarest dragonflies. Larvae have been found in narrow, shaded riffle zones with moss and abundant riparian vegetation (often closed canopy) in small to moderate sized creeks with gravel or sandy bottoms (DPI Fisheries 2013). Adults can be found on rocks or in litter among the stream margins or in riffle situations. The majority of sightings for this species have occurred in undisturbed, well-vegetated habitats which are mostly located in national parks or reserves (Theischinger et al., 2011, cited in Arcadis 2016).</p>	<p><u>Unlikely</u></p> <p>A habitat assessment along a 3.7 kilometre reach of the Georges River between the crossings of Cambridge Avenue and the M5 Southwestern Motorway at Moorebank was undertaken by Arcadis in 2016 (Arcadis 2016). No habitats for either</p>	<p><i>Archaeophya adamsi</i> or <i>Austrocordulia leonardi</i> were detected in the survey area. Arcadis concluded that it was highly unlikely that the threatened dragonflies occur in the survey area and no further investigation or targeted surveys are required.</p> <p>N/A</p>
<p>Sydney Hawk Dragonfly</p> <p><i>Austrocordulia leonardi</i></p> <p>FM Act Listed: Endangered</p>	 <p>Until recently the known distribution of Sydney Hawk Dragonfly has been extremely limited, being found in only three locations in a small area south of Sydney, from Audley to Picton including the Hawkesbury-Nepean, Georges River and Port Hacking drainages. This species has specific habitat requirements, including deep pools in permanently flowing rocky rivers with steep sides that provide shady resting areas. All specimens collected came from deep riverine pools with cooler water (along the Woronora River, Kangaroo Creek and Nepean River)(Arcadis 2016).</p>		

Department of the Environment (2016). Species Profile and Threats Database. Available from: <http://www.environment.gov.au/sprat>

NSW Office of Environment and Heritage (2016) Threatened Species Profiles. Available from: <http://www.environment.nsw.gov.au/threatenedSpeciesApp/>

Threatened Species	Habitat Requirements*	Likelihood of Occurrence	Mitigation Measures
*Photos sourced from Australian Museum (http://australianmuseum.net.au/) and OEH Threatened Species Profiles (http://www.environment.nsw.gov.au/threatenedSpeciesApp/)			

4 ASPECTS, IMPACTS & RISKS

4.1 EIS Identified Impacts

SIMTA Intermodal Terminal Facility- Stage 1: Environmental Impact Statement identified the following Biodiversity risk related to the current Project site:

- Environmental impacts resulting from the inadvertent removal and/or modification of areas containing populations, endangered ecological communities and/or habitat for threatened species.
- Environmental impacts resulting from the collective loss of vegetation and fauna habitat across the landscape, as a result of removal and/or modification of native vegetation and fauna habitat.
- Vegetation clearing (including riparian areas) and loss and fragmentation of foraging, nesting and roosting areas.
- Environmental impacts resulting from the loss of hollow bearing trees and fauna habitat.
- Environmental impacts resulting from the permanent loss of biodiversity due to changes in hydrological function of the Project site and lowering of water quality, including potential impacts to groundwater dependent ecosystems.
- Environmental impacts resulting from the loss of biodiversity due to weed infestation.

4.2 Construction Impacts

Further to Section 4.1, construction impacts directly related to the Project are described in Table 10 and the aspects and impacts register in the CEMP. Management measures to address these identified risks are included in Sections 5 and 6.

Table 10 Potential construction impacts to flora and fauna

Construction Activity	Description of Potential Impact	Management/Mitigation Measures Required
Clearing and grubbing of vegetation within work site.	The Project site consists almost entirely of planted trees with a mown or managed understorey, and does not meet the criteria for any threatened ecological communities. One small area (0.1 ha) of native vegetation (as defined within this plan) adjoins the disused rail line bordering the south-eastern boundary of the Project site (Figure 3-1). Potential impact relates to inadvertent removal of native vegetation.	Exclusion fencing to delineate site construction boundary and any areas of Native Vegetation within close proximity to construction works. Awareness of exclusion areas to be communicated within site induction
	Non-native vegetation clearing for the Project would include the removal of mature, planted eucalypts (such as Tallowood, Sydney Blue Gum, Spotted Gum and Lemon-scented Gum), as well as mown or understorey plants throughout the site. The clearing boundary is defined as the limits of construction (i.e. the Project Construction footprint in Figure 1-1).	<ol style="list-style-type: none"> 1. Pre-clearing survey to be undertaken by ecologist to determine habitat value of vegetation. 2. If no habitat significance identified, then removal as per Section 5.1 of this document to be undertaken. 3. If habitat significance is identified, ecologist to determine whether habitat is occupied, and to safely remove fauna (if possible and licenced to do so). No eggs/chicks are to be removed. 4. Once clear of fauna, vegetation may be cleared.
	<u>Fauna mortality</u> Fauna injury or mortality is most likely to occur during vegetation clearing activities, but also may	Pre-clearing surveys Fauna Handling Procedures

Construction Activity	Description of Potential Impact	Management/Mitigation Measures Required
	<p>result from collisions with construction vehicles or plant, or accidental entrapment in plant, trenches or other earthworks.</p> <hr/> <p><u>Removal of dead wood and dead trees.</u> Vegetation clearing may result in the removal of dead timber containing arboreal and ground hollows. Initial surveys have not identified the presence of any hollows and the EIS states that habitat features such as ground timber and hollow logs are absent from cleared and disturbed areas.</p> <hr/> <p><u>Unauthorised works</u> Removal of vegetation outside defined work area, possibility of removing threatened species, fines incurred.</p> <hr/> <p><u>Disturbance of soils</u> Erosion of soils, uncontrolled runoff, sediment deposited into surrounding vegetated areas and water courses. Increased movement of people, vehicles, machinery, vegetation waste and soil may also facilitate the introduction or spread of weeds.</p>	<p>Pre-clearing surveys will identify these features if present, prior to removal, and assess whether they can be salvaged and relocated</p> <hr/> <p>Unlikely to occur. Additional ecological survey would be required</p> <hr/> <p>Erosion and sediment control measures</p>
Site establishment	<p><u>Impacts to roost sites in buildings</u> The buildings currently on the Project site offer limited habitat features to native fauna, although they may support potential roosting habitat for microchiropteran bats. Given that inspection of these buildings was not possible during site surveys, it is assumed that some of the buildings offer potential fauna habitat and will be impacted during site establishment and demolition.</p>	<p>Preclearance surveys, including echolocation call recording and dawn/dusk surveys to confirm any roost sites</p>
Demolition and construction activities	<p><u>Noise and Lighting impacts</u> Indirect impacts on biodiversity could potentially be caused by noise during demolition and site establishment activities. These activities could alter behaviour on sensitive species such as nocturnal birds, nocturnal mammals, Microchiropteran bats, and small diurnal birds. Artificial lighting has potential to further disorientate species.</p>	<p>Directional lighting will be used where lighting is required in construction areas</p>
Demolition and construction activities	<p><u>Use of chemicals / fuels (potential for spills)</u> Any fuel or chemical spills associated with construction have the potential to impact habitats, particularly downstream aquatic habitats via stormwater systems or waterways. This will be managed on site through the use of spill kits, appropriate storage and in accordance with emergency response protocols contained in the CEMP.</p>	<p>Refer to CEMP</p>
Removal of disused rail spur	<p><u>Impacts to threatened flora species, threatened EEC and fauna habitat</u> Pre-clearance surveys undertaken in February 2019 indicated that no threatened flora species or hollow-</p>	<p>An exclusion zone will be placed around the construction area to minimise potential impact on surrounding vegetation</p>

Construction Activity	Description of Potential Impact	Management/Mitigation Measures Required
	bearing trees are located within, and 20m either side, the construction area.	

4.2.1 Timing of Vegetation Clearance Works

Vegetation clearance is scheduled to occur and be completed within the first six months of construction with an expected commencement date of late June to early July 2017. The start date is subject to receiving all project approvals.

4.2.2 Proposed Infrastructure

All existing vegetation and infrastructure within the Project site boundary will be cleared / demolished (refer to Figure 1-1 MPE Site boundary highlighted yellow). Existing vegetation and infrastructure outside the site Project boundary will be retained and protected. The proposed IMEX infrastructure is illustrated in Figure 4-1.

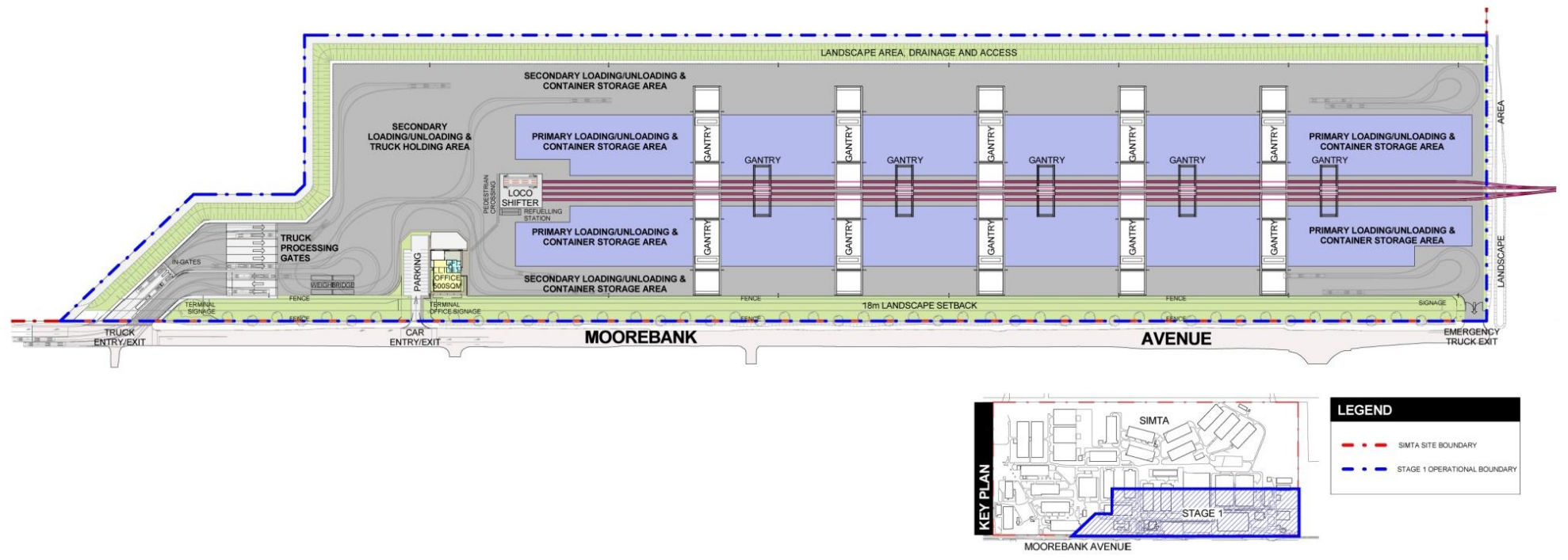


Figure 4-1 Proposed IMEX Terminal Layout (subject to change) - Extract from EIS (Hyder, 2015).

5 MANAGEMENT MEASURES

This Section describes the overall approach and principles associated with managing and mitigating Biodiversity risks during the Project Construction. The management measures in Table 11 are based on the mitigation measures compiled from the EIS, Submissions Report (Final Compilation of Mitigation Measures) and the Minister's Conditions of Consent (CoC), EPBC Act approval, as well as the requirements and standards of SIMTA and the contractor.

A Vegetation Clearance Protocol is outlined in Section 5.1.

Table 11 Stage 1 Construction, Management Action and Responsibilities

Item	Action	Trigger/Timing	Responsibility	Requirement
Induction				
FF1.1	All site personnel shall undergo site specific induction training, which will include environmental awareness and Flora and Fauna management training. Toolbox meetings will also be undertaken as and when required and may be triggered by the detection of a threatened species or noxious weed (for example); covering specific environmental issues and Flora and Fauna control measures and identified threatened species as identified in this CFFMP. All staff shall be notified in the induction that clearing is limited to the construction footprint, and that clearing in Commonwealth Land is prohibited.	Ongoing	Construction Manager All site personnel	FCMM 8A
FF1.2	<p>Induction training must also include bushfire hazards and risks. The bushfire threat during Stage 1 construction is considered to be low. However, there is a risk of ignition of adjoining bush to the south of the Project. Grassfires tend to be less intense than a forest fire however they can still generate enormous amounts of radiant heat and it is important that:</p> <ul style="list-style-type: none"> all site offices would be accessible via all-weather access roads suitable for firefighting vehicles; water supply must be readily identifiable and appropriate signage must be provided; and application of restrictions during days of elevated fire danger including all activities likely to cause sparks or fire. <p>On days declared 'Total Fire Ban', no hot works to be undertaken and there is to be no high-risk activities or plant and equipment to be used for:</p> <ul style="list-style-type: none"> Grass or vegetation reduction works (including mowing/slashing); Arborist works (chainsaw); Vehicle operations in long grass; Other than – (Emergency works). 	Ongoing	Construction Manager All site personnel	Commonwealth Approval – 5h)
Pre-clearing				
FF2.1	No-go areas are identified as any area outside of the Project construction footprint. To minimise the extent of native vegetation clearing upon Commonwealth Land and the potential clearing of Nodding Geebung and Small-flower Grevillea, these no-go areas will be clearly identified on construction plans and include the southern and eastern boundaries of the site. The project boundaries will be physically	Prior to vegetation clearing activities	Construction Manager Environment Manager Site Supervisor	CoC E34 d) ii) f) Commonwealth Approval - 5c, 5d, 5h

Item	Action	Trigger/Timing	Responsibility	Requirement
	<p>demarcated on site with exclusion zone signage, as well as on construction plans to minimise the potential for staff and workers clearing outside the project boundaries. Existing chain link fencing on project boundaries will be inspected and fixed where necessary prior to clearing activities commencing.</p> <p>The extent of vegetation clearing is restricted to the MPE Stage 1, Package 2 construction boundary and is to be clearly identified on pre-clearing surveys and construction plans. Clearly identifying sensitive areas ('no-go areas') which cannot be impacted by construction and managing clearing such that clearing activities are constrained to these approved areas only. The boundary between the area to be cleared and adjoining vegetation will be clearly marked with high visibility fencing. This will also act to exclude fauna from entering the construction areas and reduce potential for direct fauna mortality.</p>			
FF2.2	<p>Trees will be removed for the construction of a permanent access point to the terminal site. Retained trees include:</p> <ol style="list-style-type: none"> 1. The existing mature trees located on the eastern side of Moorebank Avenue shown on Drawing LA01 (Landscape Masterplan) (dated 30.3.2015) 2. Trees adjacent to the southern boundary of the site (as shown in Figure 3-2). 3. Habitat trees marked on Figure 3-2 are to be retained <p>Trees to be retained shall be protected and maintained during preconstruction and construction activities in accordance with AS4970-2009 Protection of trees on development sites. This requires the establishment of Tree Protection Zone (TPZ), so that the trees remain viable.</p> <p>The radius of the TPZ is calculated for each tree by multiplying its DBH x 12. Fencing of the TPZ should be erected before any machinery or materials are brought onto the site and before the commencement of works including demolition. AS4687 specifies applicable fencing requirements. Shade cloth or similar should be attached to reduce the transport of dust, other particulate matter and liquids into the protected area. Fence posts and supports should have a diameter greater than 20 mm and be located clear of roots.</p> <p>Signs identifying the TPZ should be placed around the edge of the TPZ and be visible from within the development site.</p>	<p>Details of tree protection must be provided to the Certifying Authority prior to the commencement of construction.</p>	<p>Construction Manager Environment Manager</p>	<p>CoC E34 d) ii) FCMM 8A</p>

Item	Action	Trigger/Timing	Responsibility	Requirement
FF2.3	<p>The project Ecologist to undertake a pre-clearing survey at least two weeks prior to vegetation clearing to identify any potential threatened species, endangered vegetation, weed infestation and habitat trees. The project Ecologist will identify at a minimum:</p> <ul style="list-style-type: none"> • The species, relative density and location of any weeds; • Locations of threatened flora and fauna species and habitat or hollow bearing trees; • Echolocation call recording and dawn/dusk surveys to confirm if the buildings are being used as roosting sites for any microchiropteran bats; • Trees which require limbs to be removed; • Native wildlife (e.g. reptiles, frogs) that can be captured and relocated; and • Identification of pest fauna species. <p>Should any threatened species be identified within the area to be cleared, the Environment Manager will notify the Project Manager immediately. See also FF7.3.</p> <p>Should any hollow bearing trees be identified within the area to be cleared, the NBMS will be implemented prior to clearing (Appendix D).</p>	Prior to site disturbance	Construction Manager Environment Manager Ecologist	CoC E34 d) ii)
FF2.4	<p>Ecologist to provide report with plans marking which trees can be removed. Based on the results of these preclearance surveys, mark up trees as follows (with spray paint on their trunks in a visible location):</p> <p>'H' = Habitat Tree. If hollow-bearing or habitat trees are identified as requiring removal the two-staged clearing process outlined in FF3.2 and Section 5.1 is to be implemented and the clearing supervised by an ecologist;</p> <p>● = Ecologist has assessed the tree and it is ready for removal;</p> <p>● = Ecologist has assessed the tree and it requires pre-inspection immediately prior to, and during removal. Two-staged clearing process outlined in in FF3.2 and Section 5.1 is to be implemented and the clearing supervised by an ecologist.</p>	Prior to site disturbance	Construction Manager Environment Manager Ecologist	CoC E34 d) ii)
FF2.5	<p>If fauna microhabitat (such as hollow logs) are identified, these will be removed from areas to be cleared and relocated outside of any exclusion fencing to suitable nearby bushland areas in the presence of an ecologist, as described in the Vegetation Clearance Protocol.</p>	Ongoing	Construction Manager Environment Manager Ecologist	CoC E34 d) ii) Best Practice

Item	Action	Trigger/Timing	Responsibility	Requirement
				Commonwealth Mitigation Measure
FF2.6	<p>The following alternative vegetation removal strategy is to be applied for the removal of up to 15 Tallowood trees associated with IMEX RfMA 003 <i>Proposed for Main IMT Construction Haul Road</i>, whose root structure has been impacted and are at risk of falling:</p> <ol style="list-style-type: none"> 1. Ecologist to undertake pre-clearing survey and determine whether there is habitat 2. If no habitat is present, remove trees as per CFFMP 3. If habitat is present, ecologist to determine whether the habitat is occupied and remove fauna if possible if licenced to do so. No eggs/chicks are to be removed. 4. Once clear of fauna, the tree can be removed. 	During vegetation clearance associated with IMEX RfMA and AA 003.	Construction Manager Ecologist Construction supervisors	IMEX RfMA and Accordance Assessment 003
Clearing				
FF3.0	<p>To ensure that no more than 17 individual Nodding Geebung and no more than 634 Small-flow Grevillea are cleared, the following will be undertaken:</p> <ul style="list-style-type: none"> • Recording of individuals cleared of each species cumulatively • Reconciling of totals of individuals of each species cleared against MPES1 and MPES2 cumulatively. • 	Ongoing	Environment Manager	Commonwealth Condition No. 5d
FF3.1	Clearing of vegetation will be timed to avoid periods when rain is forecast in accordance with Chapter 4.4.2 of 'the Blue Book' and will not be undertaken during overland flow events.	Ongoing	Construction Manager Construction supervisors	CoC E34 d) ii) Best Practice
FF3.2	<p>No clearing of any vegetation outside of the project footprint is permitted and clearing of native vegetation will be minimised where possible. Additional project approvals will be required.</p> <p>Clearing of vegetation outside of the defined clearing permit boundary is not permitted. Ecologist to be present on site during the clearing process for red flagged trees ('H' and ●). The two stage clearing process is outlined below and in Section 5.1.</p>	During vegetation clearance	Construction Manager Construction supervisors Ecologist	CoC E34 d) ii) FCMM 8A

Item	Action	Trigger/Timing	Responsibility	Requirement
	<p>Stage 1:</p> <ul style="list-style-type: none"> • Non-habitat vegetation removal must be undertaken a minimum of 48 hours prior to habitat tree removal. Habitat trees are to remain standing for 48 hours before clearing to allow fauna to vacate the habitat on their own accord. <p>Stage 2:</p> <ul style="list-style-type: none"> • Immediately prior to felling, the habitat tree is to be knocked with an excavator bucket (or other machinery) to encourage fauna to evacuate the tree under the supervision of an ecologist. The tree may then be felled. • Felled trees must be left on the ground for a short period to allow any trapped fauna the opportunity to escape. • Felled hollow-bearing trees must be inspected by an ecologist immediately to check for injured or immature fauna. • Animals found prior to or during clearing activities will be released outside of any exclusion fencing to surrounding suitable habitat. • If any animal is injured, contact the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by: <ul style="list-style-type: none"> – Handling fauna with care and as little as possible. – Covering larger animals with a towel or blanket and placing in a large cardboard box. – Placing small animals in a cotton bag, tied at the top. Keeping the animal in a quiet, warm, ventilated and dark location. • In the case of arboreal or flying mammals attempts will be made to relocate the den or roost. After capture, the animal(s) will be held by a trained wildlife carer for a period of no longer than two weeks until the roost or den can be relocated, either as an entire tree or part thereof. • Work may recommence once the animal(s) have been captured and removed from the area. • Felled trees will be placed between cleared and remnant bushland where possible to provide runways of ground cover for dispersal of animals. • Excess material may be mulched and used on site. • Remove unused mulch to designated stockpile locations and do not use mulch within 50m of waterways or drainage lines. 			

Item	Action	Trigger/Timing	Responsibility	Requirement
FF3.3	<p>Fauna Handling</p> <p>Only the ecologist or fauna handler to touch or move fauna.</p> <p>If fauna is present, allow to move through worksite. If fauna does not relocate, or is injured (see also FF8.1), contact the ecologist, fauna handler, WIRES or local veterinary surgery as soon as practical to assist in relocation to adjacent retained habitat.</p> <p>Where handling of frogs is necessary, the risk of Chytrid pathogen transfer will be minimised and will follow the OEH Hygiene Protocol for the Control of Disease in Frogs (DECCW 2008a) as follows:</p> <ul style="list-style-type: none"> • Hands to be cleaned / disinfected between each frog or a new pair of disposable gloves used for each sample. • A 'one bag – one frog / tadpole' approach to handling will be used where capture and relocation is necessary. Bags are not to be reused. 	During vegetation clearing	Construction Manager Environment Manager Ecologist	CoC E34 d) ii) FCMM 8A Commonwealth Approval – 5 f)
Weed and Pathogen Management				
FF3.4	<p>Management of noxious weeds is to be undertaken in accordance with the Noxious Weeds Act 1993 and include details relating to the monitoring, management and where necessary eradication of weeds, disposal of green waste, and vehicle/plant weed wash down protocols including:</p> <ul style="list-style-type: none"> • Weed areas to be flagged; • Weeds to be sprayed two weeks prior to clearing or stripped and disposed of off-site at a licenced waste facility. Weedy material must not be mulched or retained on site; • Equipment used for treating weed infestation(s) will be cleaned prior to moving to a new area within the Proposal site to minimise the likelihood of transferring any plant material and soil; • Soil stripped and stockpiled from areas containing known weed infestations are to be stored on cleared land at least 40 m from native vegetation. Stockpiles to be banded and covered to minimise potential of seed washing away; • Weed contaminated spoil to be removed to licenced landfill and • Plant and equipment brought on to site must be cleaned and free of deleterious material, mud and other material that may harbour weed seeds • Weekly inspections will also be undertaken. The identification of weeds will be included as part of this inspection. 	It is noted that no noxious weeds are described as occurring within the Project site, however the presence/absence of noxious weeds is to be confirmed by an ecologist prior to clearing and bulk earthworks commencing.	Construction Manager Environment Manager	CoC E34 d) iv) FCMM 8A

Item	Action	Trigger/Timing	Responsibility	Requirement
FF3.5	All vehicles and other equipment to be used on site will be checked upon arrival to site to ensure it is free from excessive soil and vegetative matter to minimise the likelihood of introducing weeds and plant pathogens. Where necessary vehicles will be cleaned.	Ongoing	Construction Manager Environment Manager	Commonwealth Approval – 5h)
Monitoring				
FF4.1	The Environment Manager will undertake weekly inspections and monitoring of construction activities to ensure compliance and conformance with the requirements of the CoC and this plan. Monitoring will include inspections on the integrity of flora/fauna exclusion zones and the identification of potential noxious weeds and endangered species.	Weekly	Construction Manager Environment Manager	CEMP CoC E34 d) vii)
FF4.2	Daily inspections of controls will be made by Supervisors and maintenance will be recorded in site diaries during active site works.	Daily	Construction supervisors	CEMP CoC E34 d) vii)
FF4.3	Annual monitoring and maintenance of nest boxes in Spring	Annually	Contractors Ecologist	NBMS
Revegetation				
FF5.1	The immediate intent of rehabilitation actions throughout the Project site is to re-establish site surfaces as soon as possible after disturbance to assist with erosion mitigation, and prevent the establishment of weed species. Actions will include: <ul style="list-style-type: none"> Rehabilitation to commence as soon as practical after use of disturbed area has ceased. Where soil has been compacted, ripping may be required prior to re-spread of topsoil. Seed with native species to stabilise disturbed areas. Where rainfall is not sufficient, watering will be required. Where required, install temporary fencing until stabilisation is achieved. Ongoing treatment of weed infestations is required throughout construction. 	Ongoing	Construction Manager Environment Manager	CoC E34 d) iii)
General Management				
FF6.1	Construction plant, equipment and materials are not to be stored within the dripline of any trees or vegetation to be retained or block access to any fire trails	Ongoing	Construction Manager Environment Manager	Best Practice

Item	Action	Trigger/Timing	Responsibility	Requirement
			Construction supervisors	
FF6.2	A site speed limit of 20km/h will be adhered to by all personnel to minimise the potential for fauna to be struck by a vehicle within the construction areas. All vehicles and plant in operation during construction are to adhere to site rules relating to speed limits.	Ongoing	All site personnel	Best Practice FCMM 8A
FF6.3	Haul roads and access tracks will be directed clear of the tree drip line.	Ongoing	All site personnel	Best Practice
FF6.4	Undertake a pre-start-up check for sheltering native fauna of all infrastructure, plant and equipment and/or during relocation of stored construction materials	During Construction	All site personnel	FCMM 8A
FF6.5	Directional lighting will be used where lighting is required in construction areas to minimise disruption to fauna foraging, nesting or roosting behaviours	During Construction	Construction supervisors	FCMM 8A
FF6.6	Personnel are not permitted to hunt, fish, feed, capture, extract, or otherwise disturb aquatic, animal, or vegetative species except in accordance with this CFFMP.	Ongoing	All site personnel	Best Practice
FF6.7	If any pits/trenches are to remain open overnight, they are to be securely covered, where reasonable and feasible. Alternatively, fauna ramps (logs or wooden planks) are to be installed to provide an escape for trapped fauna.	During Construction	Construction Manager Environment Manager Ecologist	FCMM 8A
FF6.8	Unauthorised access to site during construction will be managed in accordance with the approved Construction Traffic and Access Management Plan. Where required, additional traffic control and warning signs would be installed during vegetation clearing activities.	During Construction	Construction Manager Environment Manager Ecologist	Commonwealth Approval – 5h)
FF6.9	Any additional construction areas, such as site offices, construction stockpile locations and machinery/equipment laydown areas will be located in previously cleared areas where possible.	During Construction	Construction Manager Environment Manager	EPBC Flora and Fauna Mitigation Measure
FF6.10	Dust suppression activities to be undertaken where appropriate.	During Construction	Construction Manager Construction supervisors Environment Manager	EPBC Flora and Fauna Mitigation Measure

Item	Action	Trigger/Timing	Responsibility	Requirement
FF6.11	Frequent maintenance of construction machinery and plant will be undertaken to minimise unnecessary noise.	During Construction	Construction Manager Construction supervisors	EPBC Flora and Fauna Mitigation Measure
FF6.12	Locate soil or mulch stockpiles away from watercourses and key stormwater flow paths to limit potential transport of these substances into the watercourses via runoff	During Construction	Construction Manager Construction supervisors	EPBC Flora and Fauna Mitigation Measure
FF6.13	Spill kits will be appropriately located to allow for timely response to uncontained spills.	During Construction	Construction supervisors	EPBC Flora and Fauna Mitigation Measure
Threatened Species				
FF7.1	<p>Management of Eastern Bentwing-Bat</p> <p>The project Ecologist is to undertake a pre-clearing survey of the buildings to be removed from within the Project site. This survey must include a combination of echolocation call recording and dawn/dusk surveys to confirm if the buildings are currently being utilised for roosting. If confirmed, demolition of the buildings may be restricted to winter, outside of the critical breeding season.</p>	Pre-Clearance	Construction Manager Environment Manager Ecologist	FCMM 8A
FF7.2	<p>Management of Grey-headed Flying Fox</p> <p>The project Ecologist is to undertake a pre-clearing survey to detect the presence of any threatened species, including the Grey-headed Flying Fox.</p>	Pre-Clearance	Construction Manager Environment Manager Ecologist	FCMM 8A
FF7.3	<p>Unexpected Finds Procedure</p> <p>Preclearance surveys will be used to identify the presence of any previously unrecorded threatened flora and/or fauna species within the Project site. Examples of such threatened flora species include Hibbertia sp. Bankstown and Bynoe's Wattle. Upon detection of a threatened species:</p> <ol style="list-style-type: none"> 1. Stop works; 2. Notify supervisor/environment team/principal; 3. Environment advisor to contact ecologist to attend site; 4. Ecologist to confirm presence of threatened species; 5. Environment advisor to notify OEH and DPI Fisheries if it is a threatened species; 	Upon detection of a threatened species.	Construction Manager Environment Manager Ecologist	CoC E34 d) vi) CoC E31A FCMM 8A

Item	Action	Trigger/Timing	Responsibility	Requirement
	6. An assessment will be undertaken regarding whether the species is a critical stage of its life cycle; 7. Determine mitigation measures in consultation with OEH and DPI Fisheries (including relocation); 8. Update relevant environmental management plans, procedures, monitoring requirements, induction, toolbox talks, environmental control maps and biodiversity offset requirements where necessary; 9. Brief all staff on updated mitigation measures; and 10. Works will not recommence until the species has vacated the habitat or can be relocated. No fauna will be relocated without the consent of the OEH and DPI Fisheries. 11. If threatened flora species are identified, translocation will be considered.			
Incident Response				
FF8.1	If any animal is injured, contact the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by: <ul style="list-style-type: none"> • Handling fauna with care and as little as possible. • Covering larger animals with a towel or blanket and placing in a large cardboard box. • Placing small animals in a cotton bag, tied at the top. • Keeping the animal in a quiet, warm, ventilated and dark location. 	If injured terrestrial animals are found prior to or during clearing activities.	Construction Manager Environment Manager Ecologist All site personnel	FCMM 8A Best Practice
FF8.2	Where perceptible impacts to terrestrial habitats are noted (not included within the project approval), the following procedure will be followed and reported: <ul style="list-style-type: none"> • Undertake additional investigation to ascertain the actual cause (project related or other); • Assess the impact against the performance measures and indicators; • If project related, consult relevant government agencies; • Develop and implement a specific response plan to prevent further impacts; and • Undertake remediation as required. 	If perceptible impacts noted during monitoring activities	Construction Manager Environment Manager Ecologist	Best Practice

5.1 Vegetation Clearance Protocol

Preclearance inspections

The project Ecologist is to undertake a pre-clearing survey within two weeks of vegetation clearing to identify any potential threatened species, endangered vegetation, weed infestation and habitat trees. The ecologist will identify at a minimum:

- The species, relative density and location of any weeds;
- Locations of threatened flora and fauna species and habitat or hollow bearing trees;
- Echolocation call recording and dawn/dusk surveys to confirm if the buildings are being used as roosting sites for any microchiropteran bats;
- Trees which require limbs to be removed;
- Native wildlife (e.g. reptiles, frogs) that can be captured and relocated; and
- Identification of pest fauna species.

Should any threatened species be identified within the area to be cleared, refer to the Unexpected Finds Protocol in Table 11 (FF7.3).

Prior to the commencement of clearing, to ensure that no more than 17 individual Nodding Geebungs and no more than 634 Small-flower Grevillea are cleared, the following will be undertaken:

- Confirm the individuals cleared of each species to date
- Confirm the total individuals of each species cleared against MPES1 and MPES2 cumulatively to date.

Based on the results of these preclearance surveys, mark up trees as follows (with spray paint on their trunks in a visible location):

- **'H'** = Habitat Tree. If hollow-bearing or habitat trees are identified as requiring removal the two-staged clearing process outlined below is to be implemented and the clearing supervised by an ecologist;
- **●** = Ecologist has assessed the tree and it is ready for removal;
- **●** = Ecologist has assessed the tree and it requires pre-inspection immediately prior to, and during removal. Two-staged clearing process outlined below.

Where hollow bearing trees are identified during preclearing surveys, the NBMS will be implemented prior to clearing.

Stage 1:

- Non-habitat vegetation removal must be undertaken a minimum of 48 hours prior to habitat tree removal. Habitat trees are to remain standing for 48 hours before clearing to allow fauna to vacate the habitat on their own accord.

Stage 2:

- Immediately prior to felling, the habitat tree is to be knocked with an excavator bucket (or other machinery) to encourage fauna to evacuate the tree under the supervision of an ecologist. The tree may then be felled.
- Felled trees must be left on the ground for a short period to allow any trapped fauna the opportunity to escape.
- Felled hollow-bearing trees must be inspected by an ecologist immediately to check for injured or immature fauna.
- Animals found prior to or during clearing activities will be released outside of any exclusion fencing to surrounding suitable habitat.
- If any animal is injured, contact the relevant local wildlife rescue agency (e.g. WIRES) and/or veterinary surgery as soon as practical. Until the animal can be cared for by a suitably qualified animal handler, if possible minimise stress to the animal and reduce the risk of further injury by:
 - Handling fauna with care and as little as possible.
 - Covering larger animals with a towel or blanket and placing in a large cardboard box.
 - Placing small animals in a cotton bag, tied at the top. Keeping the animal in a quiet, warm, ventilated and dark location.
- In the case of arboreal or flying mammals, attempts will be made to relocate the den or roost. After capture, the animal(s) will be held by a trained wildlife carer for a period of no longer than two weeks until the roost or den can be relocated, either as an entire tree or part thereof.
- Work may recommence once the animal(s) have been captured and removed from the area.
- Felled trees will be placed between cleared and remnant bushland where possible to provide runways of ground cover for dispersal of animals.
- Excess material may be mulched and used on site. Remove unused mulch to designated stockpile locations and do not use mulch within 50m of waterways or drainage lines.

5.2 Rehabilitation

The immediate intent of rehabilitation throughout the Project is to re-establish site surfaces as soon as possible after disturbance to assist with erosion and sediment control and prevent the establishment of weed species.

The following measures will be undertaken as appropriate:

- Disturbed areas to be stabilised as soon as possible after ground disturbing activities have ceased. This will include one or more of the following measures:
 - Preparing compacted ground (scarification) and covering with topsoil
 - Hydroseeding with cover crop and/or native seed mix as appropriate
 - Spraying of polymer to stabilise exposed soil
 - Placement of geofabric to cover exposed areas
 - Spreading of mulch
 - Implementation of progressive landscaping
- Removal and/or treatment of noxious weeds
- Watering seeded areas until established
- Ensuring erosion and sediment controls are in place until stabilisation is achieved
- Obtaining cover crop and/or native seed mix from a reputable source

A landscape plan has been developed and nominates flora species to be utilised across the project and any relevant standards in terms of seed procurement in line with the approval documents and best practice. The early implementation of landscape plantings will be investigated in order to provide visual screening along Moorebank Avenue during construction.

5.3 Nest Box Management

At the time of the original approval of the CFFMP, a NBMS was not required to be developed as the RtS had not identified any hollow bearing trees. However, during pre-clearing surveys undertaken by Biosis, 25 hollows were identified in 13 hollow bearing trees across the MPE Stage 1, Package 2 site. Annexure B of the NBMS (see Appendix D) details the hollows identified in the MPE Stage 1, Package 2 site and specific measures to be implemented relating to Package 2.

In accordance with this plan and advice received by DP&E during approval of this document, the NBMS approved by DP&E for MPE Stage 1 Package 1 has been adapted for use for Package 2 and is included as Appendix D. The amendments to the NBMS are consolidated within Annexure B of the NBMS and detailed below. Annexure B relates specifically to requirements for MPE stage 1, Package 2 and must be read in conjunction with the NBMS main document. Any measures outlined in other sections of the NBMS will be adhered to. Package 2 specific requirements of the NBMS are as follows:

- Section 4.1 - Given the larger number of tree hollows to be removed for Stage 1, Package 2 (i.e. 33 hollows), the minimum offset ratio of 1:1 of nest boxes per hollow removed will be applied. The higher offset ratio of 2:1 as detailed within the NBMS is only recommended where very few hollows are to be removed.
- Section 4.3.1 – Nest boxes for Stage 1, Package 2 are to be installed within land on the eastern bank of Georges River, as illustrated in Figure 4 of the NBMS. Where additional land is required to avoid over-crowding, nest boxes will be installed along the eastern bank of the Georges River immediately to the north of the area illustrated in Figure 4. The Southern Boot Land is not currently available for installation of nest boxes for Stage 1, Package 2.

- Section 4.3.2 and Section 4.3.3 – Nest boxes will be installed and recorded by Waratah in accordance with the methodology provided in the NBMS. Data recorded (including GPS coordinates of individual nest box locations) will be appended to the NBMS.
- Section 5.1 and Section 5.2 – Monitoring and maintenance is required annually in spring for the duration of construction.

To satisfy nest box monitoring required in accordance with the NBMS, nest box monitoring was undertaken across both MPE and MPW in November 2018 by Arcadis Ecologists in order to assess the condition and number of nest boxes across these sites.

Based on these investigations, a memorandum (Moorebank Precinct – Nest Box Advice, dated 08 February 2019) was developed on 8 February 2019 to consider the requirement to install additional nest boxes at the Moorebank Logistics Park (MLP). The memorandum provided a review of nest boxes installed to date and assessed the values and risks associated with the installation of additional nest boxes at MLP. This advice recommended that no additional nest boxes be installed for the following reasons:

- The total number of nest boxes installed within the Georges River Corridor exceeds the recommended densities (i.e. is oversaturated), favouring over-abundant, adaptable and/or aggressive species which outcompete less tolerant native species
- Availability of tree hollows and installation of nest boxes within the Bootland currently meet benchmark conditions so that additional supplementary nest boxes are not required
- In addition to the above, there is no suitable woodland present in the rail corridor and the southern Bootland has recently been burned; presenting installation risks, as well as risks to the highly sensitive land
- No threatened hollow-dependent fauna was recorded and therefore no habitat for these species will be removed. All hollows are in landscape planted trees in highly disturbed cleared or developed lands which do not provide habitat for threatened fauna
- Installation of nest boxes is likely to benefit over-abundant highly adaptable species to the detriment of other fauna, as observed during monitoring in November 2018.

Based on this advice, no further nest boxes will be installed for the MPE Stage 1 site.

6 COMPLIANCE MANAGEMENT

6.1 Roles and Responsibilities

Relevant roles and responsibilities associated with this CFFMP are presented in Table 12. It is important to note that all personnel are responsible for ensuring that the clearing limits are addressed and native flora and fauna species are protected.

Table 12 Roles and Responsibilities

Roles	Responsibilities
Construction Manager	<ul style="list-style-type: none"> • Oversee the overall implementation of this CFFMP • Ensure that sufficient resources are allocated for the implementation of this CFFMP • Ensure that the CEMP covers the management and mitigation measures presented in this CFFMP • Ensure that the outcomes of the visual checks/ compliance and conformance construction monitoring/ incident reporting are systematically evaluated as part of ongoing management of construction activities • Ensure audits of construction site records/ monitoring records/ incident reports are undertaken on a monthly basis; findings are shared with relevant site personnel and corrective actions are implemented • Ensure all relevant personnel have and understand the most up-to-date copy of this CFFMP • Ensure that any required actions arising from the preclearance surveys, detection of a threatened species or if clearing is required outside of the approved Project development footprint are reported to the relevant personnel for further action and ensure that the actions are effectively implemented • Ensure that qualified personnel conduct the preclearance surveys and any animal handling procedures • Ensure all monitoring reporting requirements are met and maintained on site • Authorise all monitoring reports and any revisions to this CFFMP
Environment Manager Construction supervisors, contractors and subcontractors	<ul style="list-style-type: none"> • Understand and implement mitigation protocols as required in the CFFMP and any other required measures during construction • Undertake relevant training to implement the requirements of this CFFMP • All personnel are responsible for ensuring that the clearing limits are addressed and native flora and fauna species are protected. • All site personnel to undertake toolbox talks in relation to the reporting process for injury/ death to fauna or clearing of flora occurring beyond the required limits for construction. • Supervisors will be responsible for implementing environmental controls as outlined by the Environmental Manager.
Ecologist	<ul style="list-style-type: none"> • Preclearance surveys must be undertaken by a suitably qualified and experience ecologist. • The ecologist may also be responsible for providing advice to minimise potential impacts to any threatened and/or protected fauna species that may be recorded during the preclearance surveys or as incidental observations during the construction activities.

6.2 Training

All site personnel shall undergo site specific induction training, which will include environmental awareness and flora and fauna management training. Through the environmental induction construction staff will be made aware of:

- The significance of the remnant vegetation and methods to avoid or minimise impacts
- The location of potential and actual habitat areas
- Locations of endangered ecological communities and all occurring or potentially occurring threatened species locations
- Vegetation clearing protocol and no-go zones including Commonwealth Land
- Weed management practices
- Fauna handling and rescue processes
- Penalties associated with environmental breach
- Emergency and incident response
- Spill management procedures including the management of chemical and fuel spills and fire.

Toolbox meetings will also be undertaken as and when required and may be triggered by the detection of a threatened species or noxious weed (for example).

Personnel directly involved in implementing flora and fauna control measures will be given specific training in the various measures to be implemented.

Records of all training are to be filed in accordance with the project filing system.

6.3 Monitoring, Auditing and Reporting

Auditing and reporting will be undertaken in accordance with the CEMP.

Monitoring under this plan will be undertaken by the Environment Manager during weekly inspections of construction activities to ensure compliance and conformance with the requirements of the CoC and this plan. In particular, weekly inspections will focus on the following biodiversity issues:

- Inspections of exclusion fencing
- Observations of fauna on site
- Inspections of clearing activities
- Identification of weeds and/or threatened species.

An Environmental Inspection Checklist will be used to maintain compliance, conformance and effectiveness of controls. Items that require action will be managed in accordance with the CEMP section 9.2.1, such as its documentation during environmental inspection. The site supervisor will be responsible for providing appropriate resources in terms of labour, plant and equipment to enable the items to be rectified in the nominated timeframes.

Daily inspections and maintenance of controls will be made by the Site Supervisors and maintenance will be recorded in site diaries during active site works.

Annual monitoring and maintenance of nest boxes will be undertaken in spring for the duration of construction.

6.4 Enquiries, Complaints and Incident Management

Enquiries, complaints and incident management will be undertaken as per the CEMP section 9.2.1, including those related to Flora and Fauna impacts.

6.5 Non-compliances, Non-conformance and Actions

It is the responsibility of all site personnel to report non-compliances and non-conformances to the Site Supervisor and/or the Contractor's EM.

Non-compliances, non-conformances and corrective and preventative actions will be managed in accordance with Section 9.2.1 of the CEMP.

6.6 Review and Improvement

Continuous improvement of this plan will be achieved by the ongoing evaluation of environmental management performance against regulatory environmental policies, legislative requirements, SIMTA's Environmental Policy, Project objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process is designed to:

- Identify areas of opportunity for improvement of environmental management and performance.
- Determine the cause or causes of non-conformances and deficiencies.
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions.
- Document any changes in procedures resulting from process improvement.
- Make comparisons with objectives and targets.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure.

This plan will be reviewed annually as a minimum but may be updated more regularly depending on process changes and refinements or where there is identification of hollow bearing trees, unexpected threatened species, or as a result of an environmental incident.

APPENDIX A

Office of Environment and Heritage Consultation Comments

Consultation comments were received by the OEHL, Richard Bonner on Thursday, 16 February 2017 3:29pm. The comments and SIMTAs response are outlined in the below table. The response was submitted to OEHL on 17/2/17.

Comment Page number, section	Comments	SIMTA Response
p.vi, table 1, CoC E34; p.42, table 11	The reference to FF 4 in table 11 does not exist.	How the effectiveness of the management measures outlined in table 11 would be monitored is outlined in Table 11 FF 4.1 and 4.2. This typo has been updated.
p.ix, table 2, FCMM 8A; p.42, table 11	<p>It is not clear where the 'biodiversity study area' is and under what circumstances clearing of native vegetation of mature trees would be necessary.</p> <p>The reference to FF 7.4 in table 11 does not exist.</p>	<p>The biodiversity study area is identified in the Environmental Impact Statement Figure 14-1: Ecological study area. The area for the purposes of this project is the extent of the MPE site shown in figure 1 of this plan. The only time where vegetation would be required to be cleared outside of this area is if there were an expansion of the project footprint. If this were the case, then the appropriate approvals would be sought in order to undertake this work, prior to any work, including clearing of vegetation being undertaken outside of the project boundary.</p> <p>The following text has been included for clarity in Table 11 FF3.2: <i>"No clearing of any vegetation outside of the project footprint is permitted. Additional project approvals will be required."</i></p> <p>Reference amended to FF3.2.</p>
p.x, table 2, FCMM 8A; p.42, table 11	The reference to FF 3 in table 11 does not exist.	Reference amended to FF3.2.
p.18, figure 1; p.27, figure 2; p.30 figure 3	Figure 1 shows an area covered by the management plan (the yellow hatched area) which does not align with the 'Stage 1 Site (Extent of Clearing)' area shown in figures 2 and 3. Is this because some of the yellow hatched area in figure 1 will not be cleared at any stage? If not, amendments to some (or all) of these figures is required.	Figures 2 and 3 have been updated to show the extent of the Project

Comment Page number, section	Comments	SIMTA Response
p.30, figure 3; p.33, table 9	Figure 3 does not show the locations of Nodding Geebung (<i>Persoonia nutans</i>) mentioned on page 33 (identified in areas north of Anzac Creek by Hyder Consulting).	This has been updated in line with the Environmental Impact Statement.
p.39, table 10	The location of the 1.25 ha of native vegetation and threatened fauna habitat to be cleared is not shown on figures 2 or 3.	Reference to the 1.25 ha of native vegetation clearing is incorrect and is related entirely with the rail link. This text has been deleted.
p.44, table 11, item FF2.3	The following amendments in shown in red to the 1 st sentence are recommended: The project Ecologist to undertake a pre-clearing survey within at least two weeks of prior to vegetation clearing to identify any potential threatened species, endangered vegetation, weed infestation and habitat trees.	Amended
p.55, s.6.2	It is recommended the induction program for construction staff also include emergency and incident response/spill management procedures (e.g. fire and chemical/fuel spills).	<p>Section 6.2 text amended to:</p> <p><i>“Through the environmental induction construction staff will be made aware of:</i></p> <ul style="list-style-type: none"> • <i>The significance of the remnant vegetation and methods to avoid or minimise impacts</i> • <i>The location of potential and actual habitat areas</i> • <i>Locations of endangered ecological communities and all occurring or potentially occurring threatened species locations</i> • <i>Vegetation clearing protocol</i> • <i>Weed management practices</i> • <i>Fauna handling and rescue processes</i> • <i>Penalties associated with environmental breach</i> • <i>Emergency and incident response</i> • <i>Spill management procedures including the management of chemical and fuel spills and fire.”</i>

APPENDIX B

Threatened Dragonfly Species Survey Plan and DPI Fisheries Correspondence

Moorebank Precinct West

Threatened Dragonfly Species Survey Plan Report

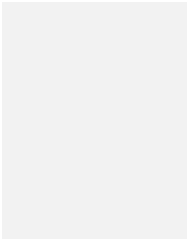


SIMTA

SYDNEY INTERMODAL TERMINAL ALLIANCE

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Threatened Dragonfly Species Survey Plan Report

Author [REDACTED] [REDACTED]

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Approver [REDACTED] [REDACTED]

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REVISIONS

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EXECUTIVE SUMMARY

This report presents the findings of a threatened dragonfly habitat assessment that Arcadis ecologists conducted in September 2016. This assessment was undertaken in accordance with Condition of Approval D19 (SSD_5066) for the Moorebank Precinct West (MPW) project in Moorebank, NSW, which is situated directly adjacent to the Georges River. Two threatened dragonflies, Adam's Emerald Dragonfly and Sydney Hawk Dragonfly, were the target species for this assessment. A desktop review was completed and approved by DPI Fisheries in August 2016 as part of the Threatened Dragonfly Species Survey Plan.

Two Arcadis ecologists traversed the survey area by kayak in order to carry out the habitat assessment along the banks of the river. The assessment involved a systematic visual search for habitat features that could accommodate the larval stages of the targeted species throughout the survey area.

The character of the Georges River within the survey area is markedly different from known habitat for the targeted dragonfly species. No habitats for either Adam's Emerald Dragonfly or Sydney Hawk Dragonfly were detected in the survey area. It is thus highly unlikely that threatened dragonflies occur in the survey area and therefore no impact to these species is expected to occur as a consequence of the MPW project.

Considering the absence of suitable habitat within the survey area, it is the recommendation of this assessment that no further investigation or targeted exuviae surveys are required.

1 INTRODUCTION

1.1 Project Overview

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.

The MPW 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 (Figure 1).



Figure 1 Project boundary.

1.2 Purpose of this report

This report has been prepared with due regard for condition D19 of the Moorebank Precinct West (MPW) Concept Plan Approval (SSD_5066) which states:

The Applicant shall prepare and implement a 'Threatened Dragonfly Species Survey Plan' to determine the presence or absence of threatened dragonfly species listed under the Fisheries Management Act 1994 on the Georges River, adjacent to the development site. The plan, including survey methodology, shall be prepared in consultation with DPI Fisheries prior to the commencement of Early Works.

On implementing the plan, the survey results are to be forwarded onto DPI Fisheries. Should threatened dragonfly species be found at this site, DPI Fisheries should be contacted to agree on possible mitigation measures to avoid impacts in accordance with NSW DPI Policy and Guidelines for Fish Habitat Conservation and Management (2013).

The Threatened Dragonfly Species Survey Plan (TSSSP) must be prepared prior to the commencement of Early Works which is defined as follows:

"the demolition of buildings, including 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."

A TDSSP was prepared by Arcadis and accepted by DPI Fisheries on 11 August 2016. This report presents the findings of the habitat assessment carried out in accordance with the TDSSP during September 2016.

1.3 Aims of this Report

The overarching objective of the Threatened Dragonfly Species Survey Plan and this associated report is to assess the presence of threatened dragonflies or their habitat along the Georges River adjacent to the Project site. Two threatened dragonfly species are addressed in this report, Sydney Hawk Dragonfly *Austrocordulia leonardi* and Adams Emerald Dragonfly *Archaeophya adamsi*.

The commitment was made in the TDSSP to carry out a field-based habitat assessment of the Georges River adjacent to the Project site to determine the likelihood that threatened dragonflies occur within the site. The aim of this report is to present the findings of that habitat assessment to DPI Fisheries and to make recommendations regarding further investigations.

1.4 Consultation

The TDSSP was produced in consultation with DPI Fisheries. This report continues that process and provides further opportunity for consultation regarding further actions required. The chronology of correspondence to date is as follows:

- 13/07/16 – Arcadis provided initial overview of methodology to DPI Fisheries in order to identify survey requirements,
- 21/07/16 – DPI Fisheries respond to initial methodology and outline specific expectations for TDSSP,
- 09/08/16 – Arcadis submit TDSSP for DPI review,
- 11/08/16 – DPI Fisheries accept TDSSP with one minor amendment,
- 26/09/16 – Arcadis submit final updated TDSSP to DPI Fisheries with TDSSP Report – Habitat Assessment (this report).

2 METHODOLOGY

The proposed methodology for the Dragonfly surveys as per the TDSSP involves a three-stage process:

1. Desktop assessment
2. Habitat assessment with report (this report)
3. Targeted dragonfly exuviae searches

The first two stages are detailed below; Stage 3 was not undertaken as habitat was not identified (see section 5).

2.1 Desktop Assessment

The desktop assessment involves a detailed review of the scientific literature, government publications and all available database records for each of the target species. This review has been collated in the form of species profiles (see section 3) that have been used to determine the ecology and habitat requirements of the targeted species. This information informs the habitat assessment and targeted searches within the study area. Previous records of the species across the Sydney Basin have been mapped in relation to the survey area (Figure 3).

2.2 Habitat Assessment

2.2.1 Survey area

The survey area comprises a 3.7 kilometre reach of the Georges River between the crossings of Cambridge Avenue and the M5 Southwestern Motorway at Moorebank, NSW (Figure 2). This area includes the 2.7 kilometre stretch of river adjacent to the MPW site plus 500 metres up and downstream of the MPW site.

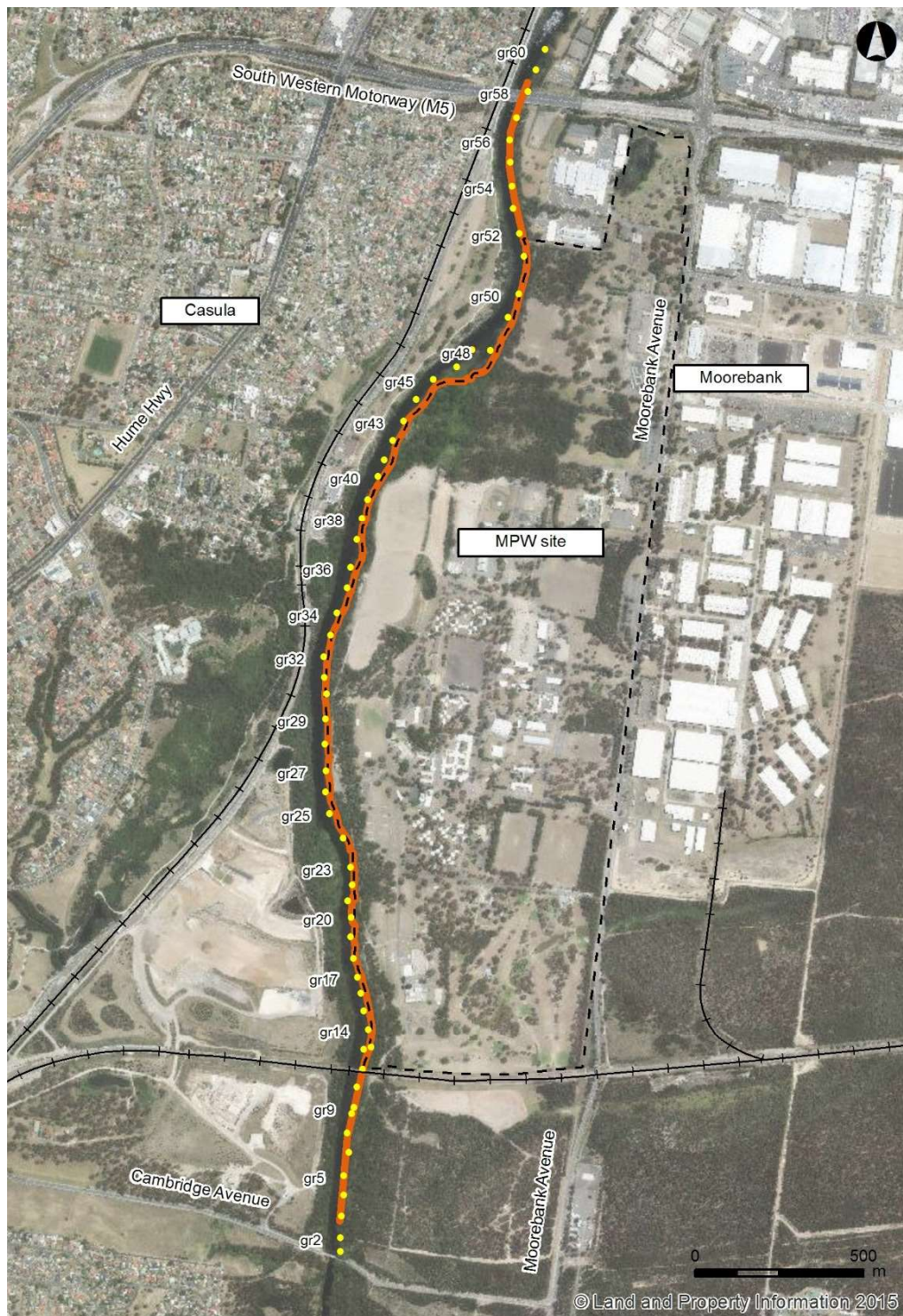
The survey focused on edge habitats adjacent to the MPW site on the eastern bank of the river but also included any mid-stream habitats (such as riffles or pools) and also comparison to the western bank along the full length of the survey area.

2.2.2 Reference site comparison

The specific qualities of known habitat sites were identified for the targeted species during the desktop review of the scientific literature. Prior to the habitat assessment in the survey area the ecology team visited two of these known habitat sites to gather photographs as a visual reference of quality habitat features that sustain the targeted species. These two sites included:

- Freres Crossing on the Georges River near Campbelltown (34.06137°S, 150.879274°E)
- Floods Creek, Somersby Falls within Brisbane Waters National Park on the Central Coast (33.401363°S, 151.267845°E).

Features that matched the qualities associated with each species were photographed to allow visual comparison of the features within the study area.



- Development site boundary
- Proposed survey area
- Edge habitat sample locations
- Railway

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Figure 2 Survey area and actual habitat sample locations. The orange line indicates the survey area as proposed in the TDSSP.

2.2.3 Habitat features

The habitat assessment involved a systematic visual search for habitat features that are known to accommodate the larval stages of the targeted species throughout the survey area (as listed in Table 1). Larval habitats were targeted because it is in this development stage that the species spends the majority of its life-cycle and it is these habitats that the adults return to for breeding. These habitat features have been determined based on the results of the comprehensive literature review (Section 3) and through consultation with DPI Fisheries.

Table 1 Habitat features that were searched for within the survey area

Species	Habitat features
Sydney Hawk Dragonfly <i>Austrocordulia leonardi</i>	<ul style="list-style-type: none"> • Deep riverine pools with cool water • Permanently flowing rocky river with steep sides that provide shady rest areas • Rocks for larvae to shelter beneath • Representative habitats depicted in Figure 10 and Figure 11
Adam's Emerald Dragonfly <i>Archaeophya adamsi</i>	<ul style="list-style-type: none"> • Small to moderate sized creeks with gravel or sandy bottom • Narrow shaded riffle zones with moss and abundant riparian vegetation • Canopy cover • Representative habitats depicted in section 4.2

2.2.4 Survey effort

The survey area was traversed by two Arcadis ecologists, Laura Hoffman and Adam Costenoble, using kayaks in order to facilitate efficient access to mid-stream and edge habitats along the eastern bank of Georges River. The bank of this section of the Georges River is steep and heavily vegetated in parts and this access method ensured uninhibited access to the survey area. This assessment was carried out on 13 September 2016 in accordance with the commitments made in the TDSSP. Conditions on the day were dry, warm and mostly overcast.

A systematic survey approach was employed to ensure thorough assessment of the survey area.

Edge habitats were sampled where the qualities of the edge habitat changed, or at 50-100 metre intervals along stretches where the edge habitat remained consistent. In total, 60 sample points were taken along the 3.7 kilometre eastern bank of the survey area. Ten metres of bank habitat along the water's edge were considered at each sample point location. The survey area was traversed from south to north starting with GR01 at the most upstream position near Cambridge Avenue to GR60 just north of the South-Western Motorway bridge, (see Figure 2 for sample density and actual sample points).

A change in edge habitat was characterised by variation of the following features:

- bank slope (flat to steep or undercut)
- riparian vegetation structure (wetland, paddock, forest)
- change in degree of overshadowing from riparian vegetation
- noticeable change in substrate material (mud/silt to gravel, sand or rock)
- change in river flow velocity (straight channel becomes beach-like embayment)
- change in turbidity (areas where water visibility changes)

- bend in the river
- creek junction
- other visible changes (to be determined on site)

No mid-stream habitats such as riffles or pools were detected, thus the survey consisted primarily of edge habitat assessment.

2.2.5 Data collection

Each survey location was marked by GPS and mapped (see Figure 2). A photograph was taken at each sample point location. At each survey point a datasheet pro-forma was filled out to thoroughly consider the habitat features at each point (see Appendix A). This pro-forma has been selectively adapted from the AUSRIVAS Physical Assessment Protocol to target abiotic and biotic river features that relate to the targeted threatened dragonfly species.

Photographs and a general overview of the river conditions was also carried out in the upper (GR01-GR20), mid (GR21-GR40) and lower sections (GR41-GR60) of the survey area.

2.2.6 Habitat assessment reporting

This document forms the TDSSP Report that was proposed in section 3.2.6 of the TDSSP. Its purpose is to communicate the results of the field habitat assessment of the study area and to make recommendations regarding the need for further investigations, if required. See section 4 and section 5 for the results of the habitat assessment of the study area.

3 DESKTOP ASSESSMENT – THREATENED DRAGONFLIES SPECIES PROFILES

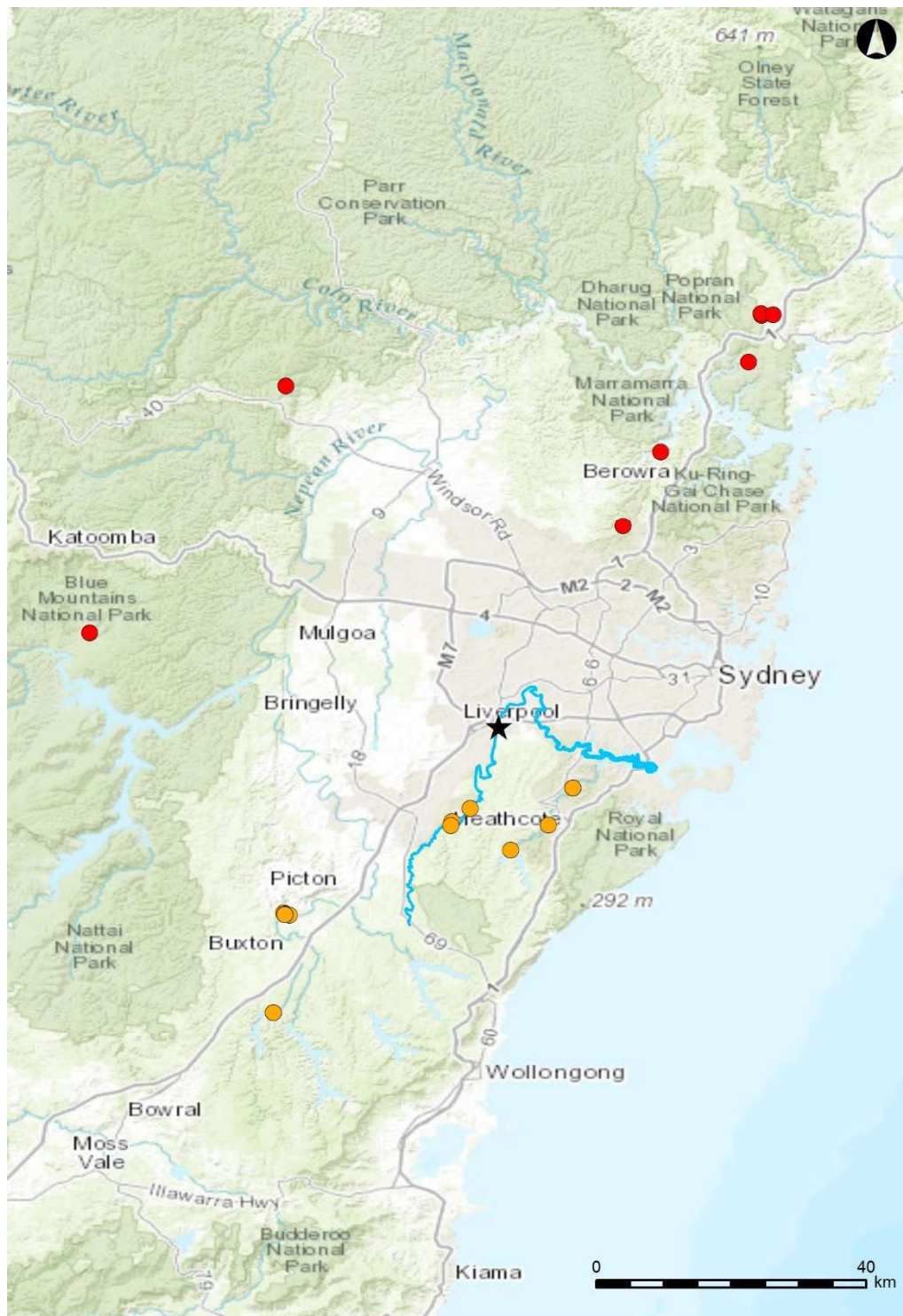
There are three dragonfly species currently listed under the *Fisheries Management Act 1994* (FM Act):

- Adams Emerald Dragonfly (*Archaeophya adamsi*) - Endangered
- Sydney Hawk Dragonfly (*Austrocordulia leonardi*) - Endangered
- Alpine Redspot Dragonfly (*Austropetalia tonyana*) – Vulnerable

These species are not listed under the NSW *Threatened Species Conservation Act 1995* (TSC Act) or Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Both Adams Emerald Dragonfly and the Sydney Hawk Dragonfly are known from the Sydney basin with the closest historic records of the species occurring within 35km and 12.5km from the Project site respectively. The Alpine Redspot Dragonfly is only known to occur at altitudes above 600 metres and is thus excluded from this survey plan as the Project site is less than 10m above sea level. An additional dragonfly species, the Giant Dragonfly (*Petalura gigantea*), is listed under the TSC Act but is not included in this study since it does not occur in the Sydney metropolitan area.

The target species are the rarest in Australia. These species are sparsely distributed within known habitat and little is known about their biology. A comprehensive review on the available background information including species descriptions, habitat preferences and distribution (Figure 3) has been collected through desktop literature review and database searches. This review is presented in the remainder of this section.



- ★ Moorepark Intermodal Precinct
- Georges River
- Dragonfly records (Atlas of Living Australia and others)**
- Adams Emerald Dragonfly
- Sydney Hawk Dragonfly

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Figure 3 - Records of threatened dragonflies across the Sydney Basin as sourced from the Atlas of Living Australia database, Theischinger et al. (2009) and Theischinger et al. (2011).

3.1 Adam's Emerald Dragonfly - *Archaeophya adamsi*

3.1.1 Description

A member of the Gomphomacromiidae family (formerly part of Corduliidae).

The Adam's Emerald Dragonfly is a moderately large, robust Dragonfly. Larvae grow to about 23mm in length and have a large two-lobed frontal plate on the head, which distinguishes them from any other species found in NSW (Figure 6). The adults have a brown-black body with yellow markings, and a slight green or bluish metallic reflection on some parts (Figure 4, Figure 5 & Figure 7). The abdomen length is around 46 mm and wingspan around 75 mm (DPI Fisheries 2013).



Figure 4 *Archaeophya adamsi*, teneral male and exuvia. Photo: G. Theischinger.



Figure 5 *Archaeophya adamsi*, female, dorsal view. Photo: L.Müller



Figure 6 *Archaeophya adamsi*, larva. Photo: S. Jacobs



Figure 7 *Archaeophya adamsi*, female, lateral view. Photo: L. Müller

3.1.2 Distribution

Adam's Emerald Dragonfly is one of Australia's rarest dragonflies. Only a small number of adults have ever been collected, and the species is only known from a few sites in the greater Sydney region. These sites include a number of creeks near Galston Gorge at Hornsby, Somersby Falls in Brisbane Waters National Park on the Central Coast and a few creeks in the Blue Mountains and Wollemi National Parks (Figure 3).

Despite there being limited records for the species the potential distribution includes all of the Sydney basin and thus includes the Project site (Figure 8).

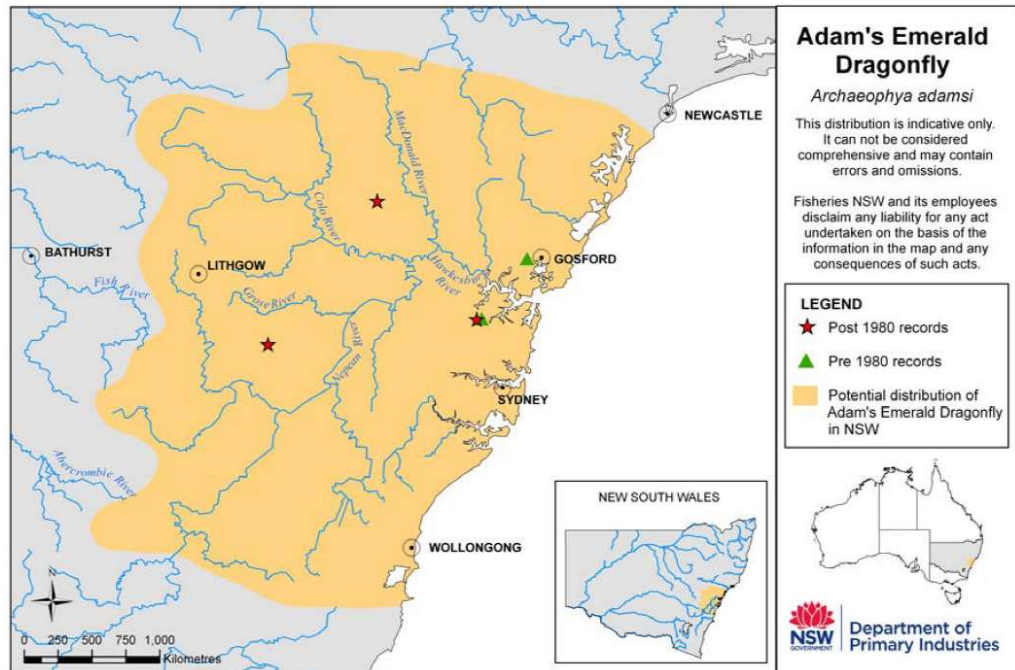


Figure 8 Potential distribution of *Archaeophya adamsi* (Fisheries NSW)

3.1.3 Habitat

Adam's Emerald Dragonfly larvae have been found in narrow, shaded riffle zones with moss and abundant riparian vegetation (often closed canopy) in small to moderate sized creeks with gravel or sandy bottoms (DPI Fisheries 2013). Adults can be found on rocks or in litter among the stream margins or in riffle situations (Theischinger and Hawking, 2006). The majority of sightings for this species have occurred in undisturbed, well-vegetated habitats which are mostly located in national parks or reserves (Theischinger *et al.*, 2011).

3.1.4 Life history

Adam's Emerald Dragonfly may live up to 7 years and undergo various moults as a larvae before metamorphosing into a flying adult. Adult dragonflies generally fly away from the water to mature before returning to breed. Males fly actively at breeding sites and often guard a territory. Females probably lay their eggs into the water. The lifespan of an adult is limited to a few months duration.

This species has a low natural rate of recruitment and limited dispersal abilities.

3.2 Sydney Hawk Dragonfly - *Austrocordulia leonardi*

3.2.1 Description

A member of the Austrocorduliidae family (formerly part of the Corduliidae family).

The Sydney Hawk Dragonfly is a black and yellow dragonfly with clear wings spanning 60-70mm, and with an adult abdomen length of 35-40mm (Figure 9). The aquatic larvae have a body length of 22-24mm and are distinguished from the similar Eastern Hawk dragonfly, *Austrocordulia refracta*, by a uniformly arched abdomen and distinctive abdominal colour pattern (Figure 12) (DPI Fisheries 2016).



Figure 9 *A. leonardi*. Photo: G. Theischinger



Figure 10 *A. leonardi* habitat. Photo: A. Bruce



Figure 11 *A. leonardi* habitat. Photo: G. Theischinger



Figure 12 Final instar exuvia, dorsal view of *A. leonardi*. Photo: G. Theischinger

3.2.2 Distribution

Until recently the known distribution of Sydney Hawk Dragonfly has been extremely limited, being found in only three locations in a small area south of Sydney, from Audley to Picton including the Hawkesbury-Nepean, Georges River and Port Hacking drainages. First discovered in the Woronora River and Kangaroo Creek, south of Sydney it was later recorded from the Nepean River, Maldon Bridge near Wilton. Recent sightings have shown that the species also occurs beyond the Sydney Basin north of the Hunter River (Theischinger *et al.* 2013). Recent habitat searches within the Sydney Basin have found additional sightings of the species on the upper reaches of the Georges River in Heathcote National Park near Campbelltown approximately 18km upstream from the Project site (Theischinger *et al.* 2009) (Figure 3).

Despite there being limited records for the species the potential distribution includes south and southwest Sydney with the Project site situated on the northern edge of this potential range within the Sydney Basin. Intensive surveys by Theischinger and colleagues have failed to detect the presence of any of the life stages of Sydney Hawk Dragonfly in previously known habitats along the Woronora River (DPI Fisheries 2005); however, the species persists in the Kangaroo River within the Royal National Park (Theischinger, 2009).

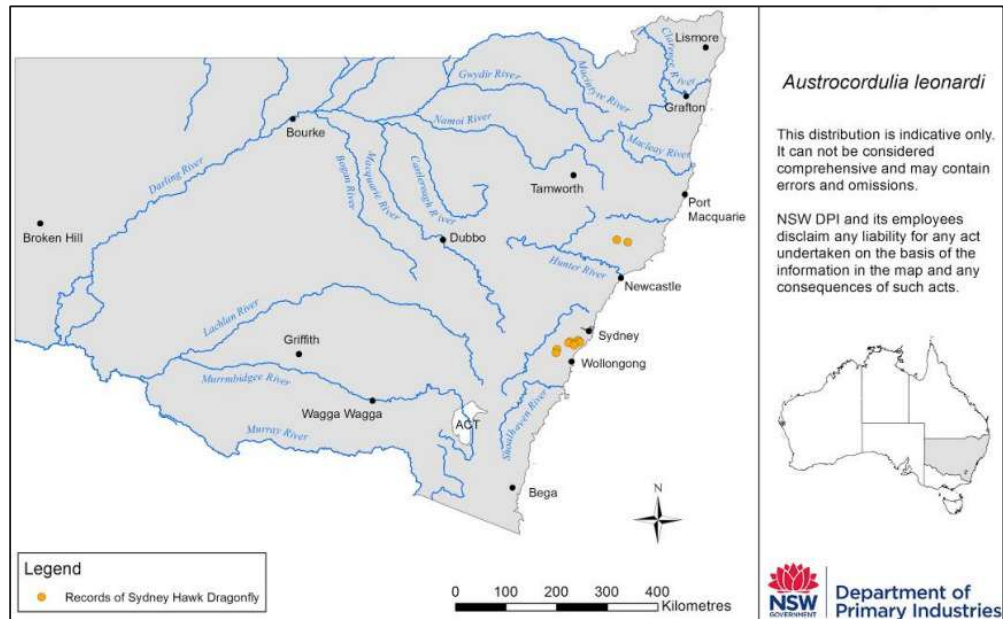


Figure 13 Potential distribution of *Austrocordulia leonardi* in Sydney Basin (DPI Fisheries 2016)

3.2.3 Habitat

This species has specific habitat requirements, including deep pools in permanently flowing rocky rivers with steep sides that provide shady resting areas. All specimens collected came from deep riverine pools with cooler water (along the Woronora River, Kangaroo Creek and Nepean River). The site of first discovery of the species is a deep pool above the weir at Heathcote in the Woronora River. Larvae can be found under rocks where they may coexist with the similar Eastern Hawk dragonfly *Austrocordulia refracta*. Representative images of potential habitat are depicted in Figure 10 and Figure 11 above.

3.2.4 Life history

Austrocordulia leonardi is a rare species. While many exuviae (the moulted shell of the larvae from which the adults emerge) have been found, only 11 adult specimens have been discovered. Most of the life cycle of this species is spent as an aquatic larva, while adults are present for only a few weeks. It is strictly a diurnal dragonfly that requires open, sunlit space (DPI Fisheries 2016).

4 REFERENCE SITE COMPARISON

4.1 Freres Crossing, Freres Crossing Reserve

Freres Crossing was visited as a comparison site of known habitat for the Sydney Hawk Dragonfly (*Austrocordulia leonardi*). *Austrocordulia leonardi* were recorded during surveys in the Georges River at Freres Crossing in February 2009 (Theischinger *et al.* 2009). The site is situated approximately 18km upstream from the survey area and was chosen for comparison because of its ease of access and its proximity to the survey area.

The Georges River at this location borders the small suburb of Kentlyn (near Campbelltown) to the west and Holsworthy Army Reserve on the east. The river at this location is characterised as an upland mountain stream in a river valley. The river at this location is approximately 40 above sea level (ASL) and is surrounded by 80-90 metre ridgelines and naturally vegetated woodland slopes. The western slope is well vegetated up to Kentlyn on the ridge and a large expanse of bushland continues on the east throughout the army reserve.

Freres Crossing itself is the site of the remains of a historic bridge on a road that once formed part of the 1917 highway connecting Campbelltown and Newcastle. A rock platform at this location forms somewhat of a natural weir at a narrowing of the river (Figure 14) which has resulted in a number of deep wide pools either side of it. These pools, which have a gravel/rock substrate and steep shaded sides, are characteristic of habitat for *A. leonardi* (Figure 15 and Figure 16).



Figure 14 Freres Crossing



Figure 15 Deep pool with steep shaded sides and rocky bottom just upstream from Freres Crossing

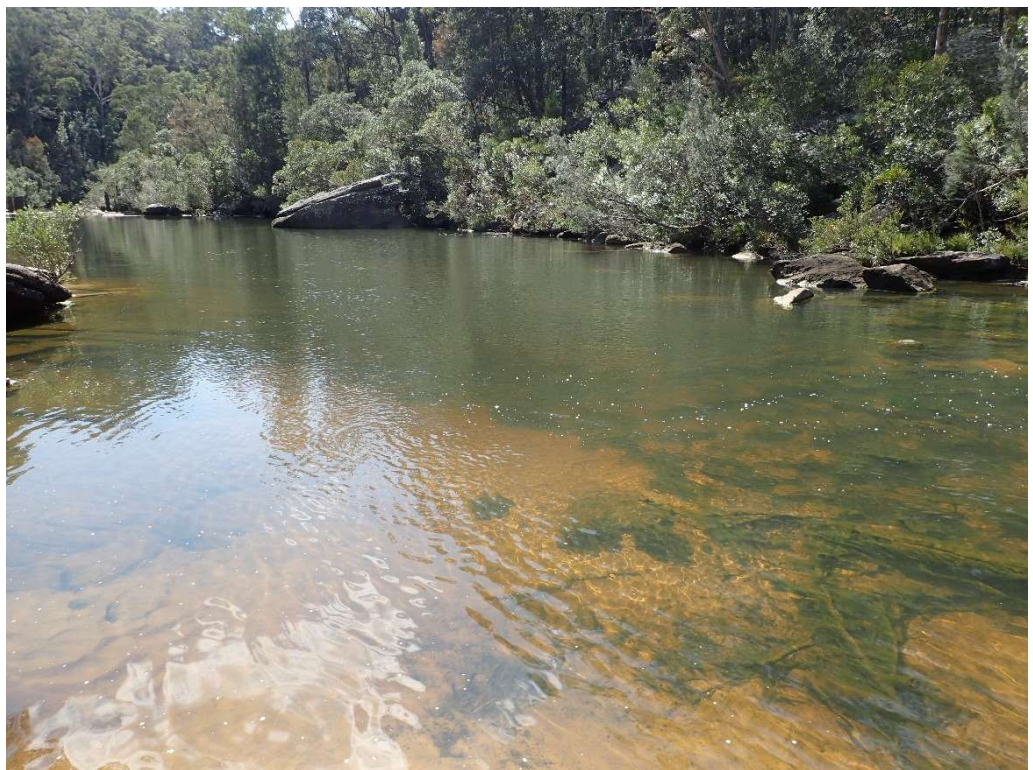


Figure 16 Rocky bottom pool upstream from Freres Crossing

4.2 Floods Creek, Somersby Falls

Floods Creek at Somersby Falls was visited as a comparison site for known habitat of Adam's Emerald Dragonfly (*Archaeophya adamsi*). This location is frequently cited as known habitat for *A. adamsi* (DPI, 2013).

Floods Creek and Somersby Falls are situated in Brisbane Water National Park at Somersby on the Central Coast. At the top of the falls Floods Creek is a shallow and narrow clear water mountain stream that flows over bare sandstone. The falls drop approximately 100 metres in a series of cascades to a steep and narrow lush rainforest canyon that continues to flow southward until it meets Mooney Mooney Creek, a tributary of the Hawkesbury River.

Downstream of Somersby Falls, Floods Creek is abundant in characteristic features of *A. adamsi* habitat. The stream is located below a closed canopy, with numerous riffle zones, mossy boulders and riparian vegetation. The substrate of the stream varied between bare sandstone, gravel and sand.

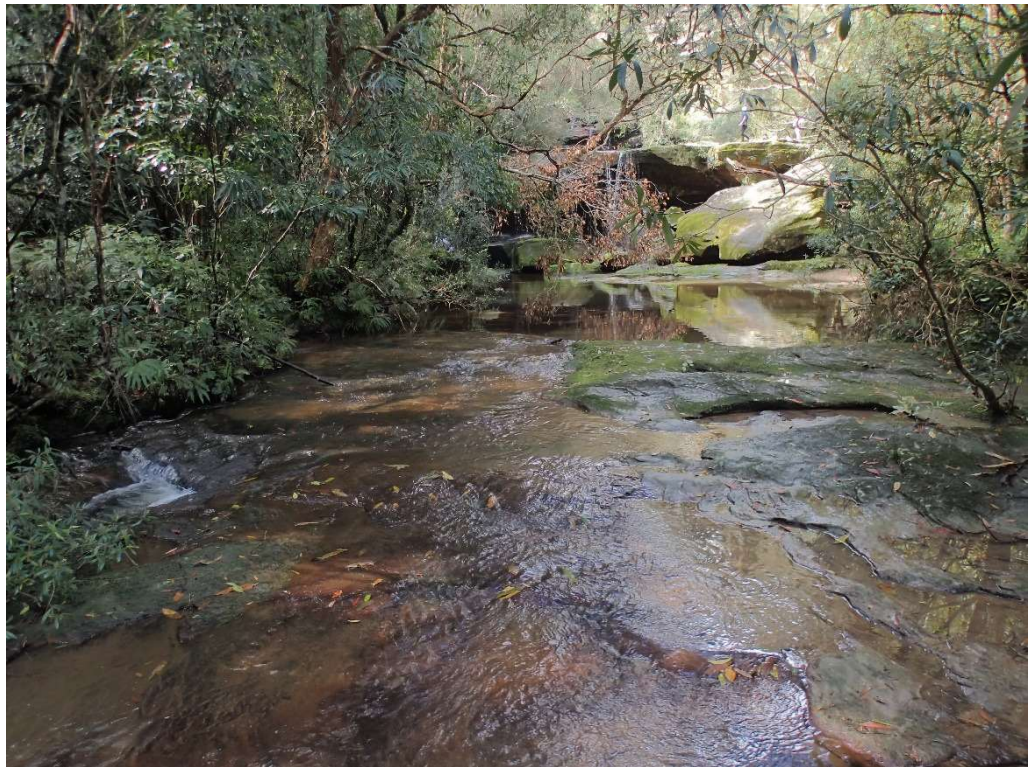


Figure 17 Floods Creek, habitat for *A. adamsi*. Narrow stream with shaded riffle zones, moss, riparian vegetation and sandy/gravel substrate.



Figure 18 Floods Creek riffle zone.

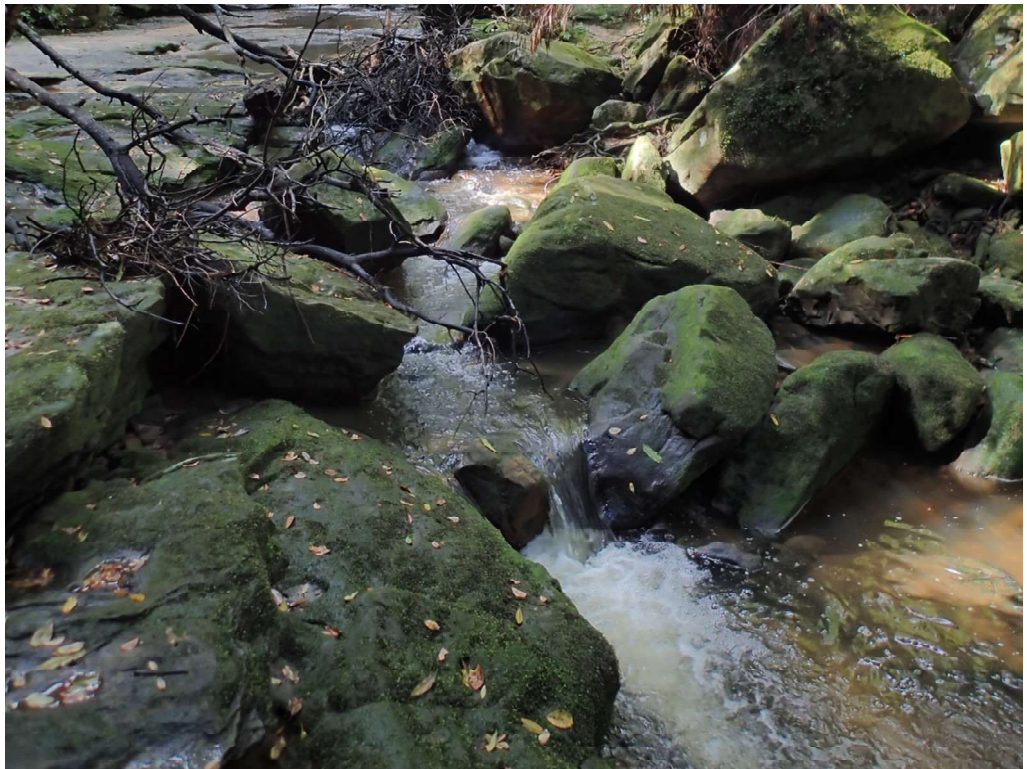


Figure 19 Floods Creek riffle zone.

5 HABITAT ASSESSMENT RESULTS

The Georges River within the survey area differs significantly from the character of the reference sites. The river at this location is characteristic of a lowland river on alluvial plains. The width varies between 25-45 metres, the channel is a continuous run and riffles or pools are absent. The water is turbid, the substrate consists of a fine mud and sand matrix and shading of the channel is minimal (<5%). Erosion of the riverbank varies from minor to severe; in some places, the entire bank has collapsed. The exposed banks are devoid of vegetation and the loose substrate is subject to further erosion.

Riparian vegetation is characterised by an open forest community that is degraded by dense infestation of exotic species, including several species declared as noxious weeds for Liverpool Local Government Area. Riparian vegetation generally did not overhang or shade the river. The canopy to 15 metres is dominated by *Eucalyptus botryoides x saligna*, with occasional occurrences of *Angophora subvelutina* (Broad-leaved Apple) and *Casuarina glauca* (Swamp Oak). Exotic trees such as *Jacaranda mimosifolia* (Jacaranda) and *Cinnamomum camphora* (Camphor Laurel) were recorded in low abundances.

The understorey is dominated by dense infestation of exotic species, such as *Lantana camara* (Lantana), Broad-leaf Privet (*Ligustrum lucidum*), Small-lead Privet (*Ligustrum sinense*), *Olea europaea* subsp. *cuspidata* (African Olive), *Arundo donax* (Giant Reed) and *Cardiospermum grandiflorum* (Balloon Vine). Native species occur only occasionally throughout the understorey, predominantly small trees such as *Acacia binervia* (Coast Myall), *Acacia decurrens* (Black Wattle) and *Pittosporum undulatum* (Sweet Pittosporum).

Groundlayer vegetation along the banks of the river is generally absent due to the presence of impenetrable thickets of woody weeds. Native species such as *Pteridium esculentum* (Bracken), *Lomandra longifolia* (Spiny-head Mat-rush) occur in low abundances. Small, discrete patches of emergent vegetation are scattered along the river banks, with commonly occurring species included *Phragmites australis* (Common Reed), *Typha orientalis* (Broadleaf Cumbungi), *Gahnia sp* and *Eleocharis sp*.

Riparian vegetation is most intact in the upstream (southern extent) of the study area (GR01-GR20 see Figure 2) where the average width of the riparian corridor is at least 25 metres (Figure 20 & Figure 21). The canopy cover decreases in the mid-section of the survey area (GR21-GR40). The riparian corridor narrows to less than 25 metres with the occasional wider patch of adjacent woodland in the mid-section (Figure 22 & Figure 23). An intact riparian corridor is generally absent from the northern extent of the study area (GR41-GR60), where vegetation occurring along the banks of the river is limited to exotic grasses and scattered exotic shrubs such as *Solanum mauritianum* (Tobacco Tree) (Figure 24 & Figure 25). The banks of the Georges River beneath the twin bridges of the M5 are stabilised by rock gabion baskets, and vegetation is absent from this area.

The habitat assessment for the 60 sample locations failed to detect suitable threatened dragonfly habitat throughout the survey area (Table 2). Both east and west banks were similar in character, extent and type of riparian vegetation. There were no mid-stream habitat features such as riffles or pools and the substrate throughout the majority of the site is inappropriate for the target species. Frequent snags and woody debris provide some aquatic habitat, however emergent and trailing vegetation is sparse throughout the survey area. For a photo of the habitat at each sample location refer to Appendix B.

No areas of habitat have been identified for targeted dragonfly exuviae surveys within the survey area.

Table 2 Habitat features for target species are absent in the survey area

Species	Habitat features	Present in survey area?
Sydney Hawk Dragonfly <i>Austrocordulia leonardi</i>	<ul style="list-style-type: none"> • Deep riverine pools with cool water • Permanently flowing rocky river with steep sides that provide shady rest areas • Rocks for larvae to shelter beneath 	<ul style="list-style-type: none"> • No • No • No
Adam's Emerald Dragonfly <i>Archaeophya adamsi</i>	<ul style="list-style-type: none"> • Small to moderate sized creeks with gravel or sandy bottom • Narrow shaded riffle zones with moss and abundant riparian vegetation • Canopy cover 	<ul style="list-style-type: none"> • No • No • No



Figure 20 Upper third of the study area looking downstream 1



Figure 21 Upper third of the study area looking downstream 2



Figure 22 Mid-section of the study area looking downstream 1



Figure 23 Mid-section of the study area looking downstream 2



Figure 24 Lower third of the study area looking downstream 1



Figure 25 Lower third of the study area looking toward west bank. M5 motorway to right of frame.

6 CONCLUSION

The character of the Georges River within the survey area is markedly different from known habitat for the targeted threatened dragonfly species. No habitats for either *Archaeophya adamsi* or *Austrocordulia leonardi* were detected in the survey area after an extensive ecological assessment. It is thus highly unlikely that threatened dragonflies occur in the survey area and therefore no impact to these species is anticipated as a consequence of the MPW project.

Considering the absence of suitable habitat within the survey area, it is the recommendation of this assessment that no further investigation or targeted exuviae surveys are required.

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Theischinger, G., Miller, S., Miller, R., and Krogh, M. (2009). Rediscovery of *Austrocordulia leonardi* (Sydney Hawk) in the suburbia of Sydney. Agrion 13(2).

Theischinger, G., Jacobs, S. and Krogh, M. (2011). *Archaeophya adamsi* Fraser (Odonata, Gomphomacromiidae): not in Queensland, but safe in New South Wales? Agrion 15(2)

Theischinger, G., Jacobs, S. and Bush, A., 2013. Significant Range Extensions of Two Iconic Australian Dragonfly Species (Odonata: Anisoptera: Libelluloidea). Victorian Entomologist, 43(1), p.1.

APPENDIX A

Habitat assessment pro-forma and guide

Moorebank Precinct West – Appendix A – Dragonfly Habitat Assessment Datasheet and Guide
Habitat Assessment Guide (extracted from AUSRIVAS Physical Assessment Protocol)

GPS Waypoint:

Site identifier as mapped

PHYSICAL FEATURES

Habitat Feature:

The surveyed entity type based on likely dragonfly habitat preferences.

Edge includes the bank of the river, riparian and fringing vegetation and the channel substrate.

Pool refers to an open area where stream widens or deepens and current declines. Habitat includes the channel substrate material.

Riffle includes a section with a gradient 1-3°. Moderate currents Surface unbroken but unsmooth

Pool/Riffle depth (m):

The average depth from the surface to the substrate for the mid-stream habitat feature. This variable does not apply to edge habitat features.

Turbidity:

At each sampling site, visually assess the turbidity of the water as one of the following categories:

Category	Description
clear	water very clear in pools and shallows
slight	water slightly turbid in pools and/or shallows
turbid	water moderately turbid in pools and/or shallows
opaque	water very turbid in both pools and shallows

Turbidity refers to the relative clarity of water and measures the extent to which light penetration is reduced from suspended materials such as clay, mud, organic matter or plankton. The presence of dissolved materials derived from plant leachates can also reduce water clarity (e.g. blackwater streams) and in such cases, water will be 'tea' coloured. The type of material causing any reduction in water clarity should be noted on the data sheet at each sampling site.






Substrate Composition:

Within the 10m long sample area, assess the relative percent cover of each of the following size classes:

Sediment category	Size
Bedrock	
Boulder	> 256mm
Cobble	64 – 256mm
Pebble	16 – 64mm
Gravel	2 – 16mm
Sand	0.06 – 2mm
Fines (silt and clay)	< 0.06mm



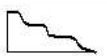

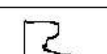
Bedform at sample location:

Determine the bedform of the river at the sample location based on the following options:

	Riffle Gradient 1-3° Moderate currents Surface unbroken but unsmooth
	Glide Gradient 1-3° Small currents Surface unbroken and smooth
	Run Gradient 1-3° Small but distinct & uniform current Surface unbroken
	Pool Area where stream widens or deepens and current declines
	Backwater A reasonable sized (>20% of channel width) cut-off section away from the channel

Bank Shape:

For edge habitat samples define the bank shape as follows:

	concave
	convex
	stepped
	wide lower bench
	undercut

Moorebank Precinct West – Appendix A – Dragonfly Habitat Assessment Datasheet and Guide
Habitat Assessment Guide (extracted from AUSRIVAS Physical Assessment Protocol) Continued

RIPARIAN VEGETATION

Description:

The riparian zone is defined as the area from the water's edge (under baseflow conditions) to a distance from the bank where the stream still interacts with and influences the type and density of the bank-side vegetation. Where known, include a description of the main species present or the main vegetation types present (e.g. native grasses, rainforest, willows, river red gum, tea tree, casuarina, blackberries, paragrass etc.) in each vegetation component.

Extent of riparian cover (%)



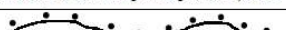

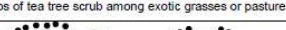
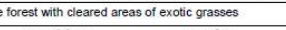
At each sampling site, identify the riparian zone and visually estimate the percentage area of the riparian zone that is covered by each of the following components:

- Trees
- Shrubs
- Grasses/ferns/sedges

Longitudinal extent of riparian vegetation

Along the length of each 10 metre sampling site, visually assess the longitudinal extent, or patchiness, of the riparian zone on target bank. Include only the tree and shrub layer components (native or exotic) in the assessment of longitudinal extent, and disregard the ground cover layer. However, for sites where the riparian zone is naturally composed entirely of native grasses, either along the entire site length or in significant patches, include grasses in the assessment of longitudinal extent.

Assess longitudinal extent of riparian vegetation using one of the following categories:

Category	Description and examples ¹ (shown for one bank only)
None	 No trees or shrubs, only exotic grasses or pasture
Isolated / scattered	 Isolated trees or shrubs among exotic grasses or pasture
Regularly spaced, single	 Planted poplars
Occasional clumps	 Clumps of tea tree scrub among exotic grasses or pasture
Semi-continuous	 Native forest with cleared areas of exotic grasses
Continuous	 Undisturbed native forest, river red gum canopy

Cover of macrophytes (%)

Estimate the percentage of macrophyte cover at the sample site:

- Submerged
- Emergent
- Floating

Extent of trailing bank vegetation:

Visually estimate the occurrence and density of trailing bank vegetation along the length of the sampling site as one of the following categories:

- Nil
- Slight
- Moderate
- Extensive

Trailing bank vegetation is the component of the terrestrial riparian vegetation that has direct contact with the water (under baseflow conditions) and which provides habitat and shelter for macroinvertebrates and fish.

Presence of moss at sample site:

Shaded sites with mossy vegetation are characterised as habitat for *Archaeophya adamsi*. Is moss present at the sample site?

Shading of channel:

At each 10 metre edge habitat sampling site, visually estimate the percentage of the stream area that would be shaded by riparian vegetation when the sun is directly overhead.



Extend of shading: < 5% shading (left), >76% shading (right)

APPENDIX B

Sample location photographs



Moorebank Precinct West

GR01
(33.969898S
150.912534E)



GR02
(33.969537S
150.912538E)



GR03
(33.968949S
150.91258E)



GR04
(33.968388S
150.912673E)



GR05
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150.91269E)



GR06
(33.967255S
150.912868E)



Moorebank Precinct West – Appendix B – Dragonfly Habitat Assessment Datasheet and Guide

GR07
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150.912817E)



GR08
(33.966208S
150.91298E)



GR09
(33.966043S
150.913068E)



GR10
(-33.965505S
150.913163E)



GR11
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150.913355E)



GR12
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150.913412E)



GR13
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GR14
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GR15
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GR16
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GR17
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GR18
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GR19
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GR20
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GR21
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GR22
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GR23
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GR24
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Moorebank Precinct West – Appendix B – Dragonfly Habitat Assessment Datasheet and Guide

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GR26
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GR27
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Moorebank Precinct West – Appendix B – Dragonfly Habitat Assessment Datasheet and Guide

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GR29
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GR30
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GR31
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GR32
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GR33
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GR34
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GR36
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GR37
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GR38
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GR39
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GR40
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GR41
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GR42
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GR43
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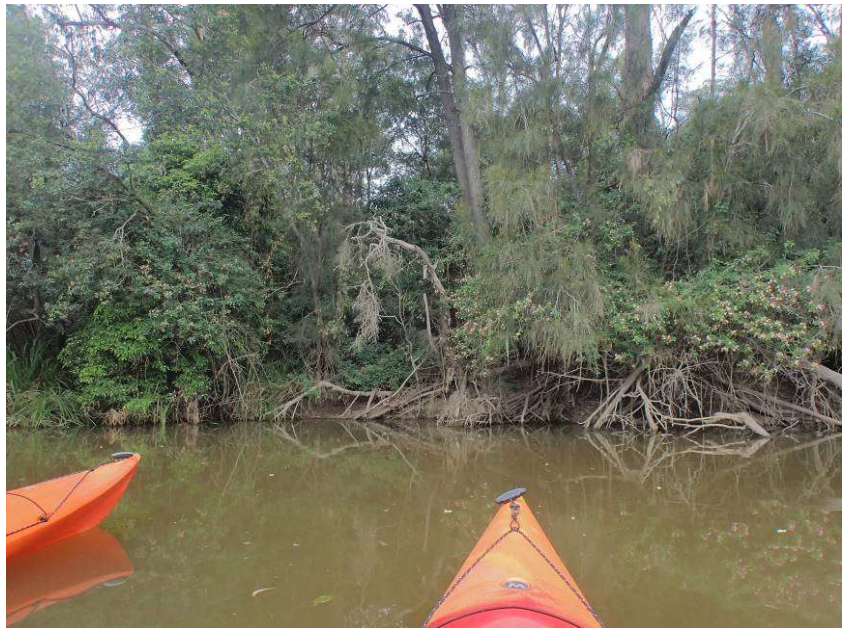
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GR49
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GR51
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GR53
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GR54
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Moorebank Precinct West – Appendix B – Dragonfly Habitat Assessment Datasheet and Guide
GR55
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GR56
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GR57
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GR58
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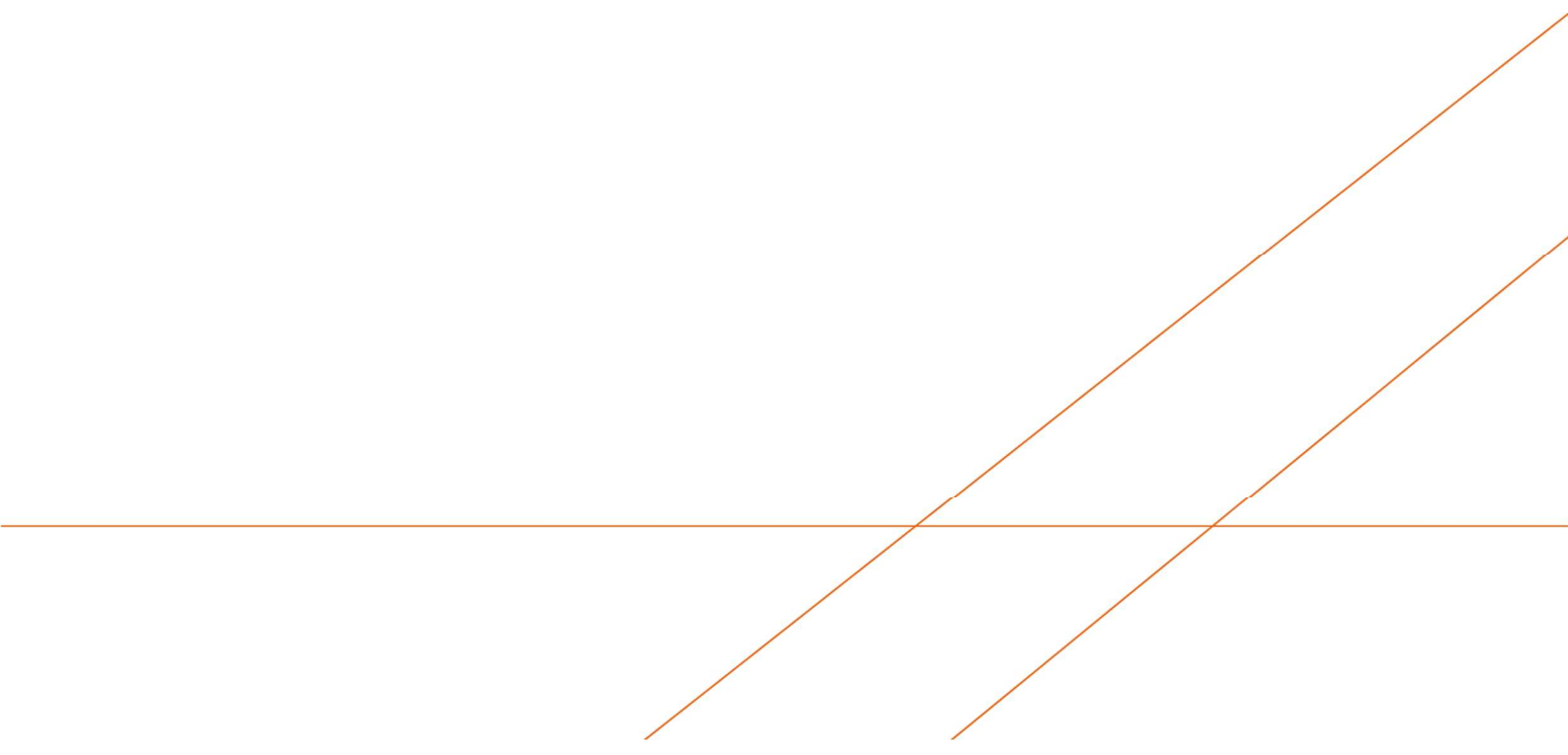


GR59
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GR60
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150.919886E)





From: [REDACTED]
To: [REDACTED]
Subject: Re: FW: Moorebank Precinct East, Stage 1 Construction Management: Consultation
Date: 2 February 2017 10:36:00 AM
Attachments: [image012.jpg](#)
[image009.jpg](#)
[image011.png](#)
[image010.jpg](#)

Dear [REDACTED],

Please be advised that DPI Fisheries has reviewed the following plans sent with your email below and has no objections to what is being proposed and has no suggested changes or other comments to make on these plans:

- *Construction Environmental Management Plan - Moorebank Precinct East Stage 1, Package 2 (SIMTA, 30 January 2017, Revision Text 001)*
- *Construction Soil and Water Management Plan - Moorebank Precinct East Stage 1, Package 2 (SIMTA, 31 January 2017, V2)*

If you wish to discuss this further, please call.

Regards,

[REDACTED] | Fisheries Manager | Aquatic Ecosystems Unit
NSW Department of Primary Industries | Fisheries NSW
Block E, Level 3, 84 Crown Street, Wollongong NSW 2500
SEND MAIL TO: Locked Bag 1 | Nelson Bay NSW 2315
T: [REDACTED]
W: www.dpi.nsw.gov.au

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PERMIT APPLICATION FORMS & FISH HABITAT PROTECTION POLICIES AT:
www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats/toolkit
EMAIL COMPLETED APPLICATIONS TO: ahp.central@dpi.nsw.gov.au
APPLICATION PROCESSING TIMES (from date received): 28 days for Permits & Consultations; 40 days for IDA Referrals

On 1 February 2017 at 12:41, [REDACTED] > wrote:

Dear [REDACTED],

As highlighted previously (I refer back to our telephone discussion on 23 January 2017), we are currently preparing to undertake construction works for the Moorebank Precinct East, Stage 1 Works (Construction of IMEX Terminal). A key component of this work is the preparation of the Construction Environmental Management Plan (CEMP) and sub-plans, which we have now drafted and are now seeking your input as part of the consultation process.

Accordingly, please find dropbox links enclosed for the following documentation:

- Construction Environmental Management Plan (CEMP):
<https://www.dropbox.com/s/l6ezq7phq5nk1j8/IMEX-QPMS-EN-PLN-00000%20CEMP%20FINAL.pdf?dl=0>
- Construction Soil and Water Management Plan (CSWMP):

https://www.dropbox.com/s/nin82v7vm59rg5u/IMEX-QPMS-EN-PLN-00008-V2%20SWMP_FINAL%20-%20Signed.pdf?dl=0

Please provide any comments on the plans by the 15th February 2017 (two weeks from today).

Please also find attached a briefing note, intended to provide you with background information regarding the spatial layout, context of the works with regard to the overall precinct, and the role of the CEMP as an effective environmental management tool.

Should you have any questions regarding the above please do not hesitate to call either myself, or [REDACTED]

Regards,

[REDACTED]

[REDACTED] | Environmental Consultant | MSc. EMP | [REDACTED]

Arcadis | Level 5/141 Walker Street, North Sydney | NSW 2060 | Australia

T. [REDACTED]

M. [REDACTED]

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APPENDIX C

Stakeholder Consultation Response

From: [REDACTED]
Sent: Wednesday, 21 December 2016 4:04 PM
To: [REDACTED]
Subject: Re: MPW Threatened dragonfly habitat assessment report

Dear [REDACTED],

DPI Fisheries agrees that a further assessment for Threatened Dragonfly matters adjacent to the Moorebank Site is not required.

The survey conducted as part of Condition D19 of SSD 5066 for Moorebank Precinct West, can also apply to Condition C22 for the SSD 6766 Moorebank Precinct East proposal.

Please use this email as required to report on compliance with Condition 22 of SSD 6766.

Regards,

[REDACTED] | Fisheries Manager | Aquatic Ecosystems Unit
NSW Department of Primary Industries | Fisheries NSW
Block E, Level 3, 84 Crown Street, Wollongong NSW 2500
SEND MAIL TO: Locked Bag 1 | Nelson Bay NSW 2315
T: [REDACTED]
W: www.dpi.nsw.gov.au

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www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats/toolkit
EMAIL COMPLETED APPLICATIONS TO: ahp.central@dpi.nsw.gov.au
APPLICATION PROCESSING TIMES (from date received): 28 days for Permits & Consultations; 40 days for IDA Referrals

On 21 December 2016 at 15:57, [REDACTED] > wrote:

Hi [REDACTED],

Apologies, further to the below, Arcadis believe that as the survey has already been undertaken on the Georges River adjacent to the MPW site, that further assessment would not be warranted as dragonfly habitat conditions will not have changed.

Kind regards

[REDACTED] | Senior Environmental Consultant | MSc BSc | [REDACTED]
Arcadis | Level 2/141 Walker Street, North Sydney | NSW 2060 | Australia

T. + [REDACTED]

www.arcadis.com/au



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Registered office: Level 5, 141 Walker Street, Sydney NSW 2060, Australia ABN 76 104 485 289

From: [REDACTED]
Sent: Wednesday, 21 December 2016 3:52 PM
To: [REDACTED]
Cc: [REDACTED]
Subject: MPW Threatened dragonfly habitat assessment report

Hi [REDACTED],

How are you? Arcadis submitted a *Threatened Dragonfly Species Survey Plan Report* to comply with Condition D19 of SSD 5066 (as approved below) for Moorebank Precinct West. However, as part of Moorebank Precinct East Conditions of Approval SSD 6766 (SIMTA Stage 1), Condition C22 has also asked for a *Threatened Dragonfly Species Survey Plan Report* to be undertaken.

Please could you confirm whether DPI Fisheries would accept the previous report to satisfy condition C22 of SSD 6766?

Many thanks

██████████ | Senior Environmental Consultant | MSc BSc | ██████████

Arcadis | Level 2/141 Walker Street, North Sydney | NSW 2060 | Australia

T. ██████████

www.arcadis.com/au



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Registered office: Level 5, 141 Walker Street, Sydney NSW 2060, Australia ABN 76 104 485 289

From: ██████████

Sent: 10 October 2016 10:53 AM

To: ██████████

Subject: Re: MPW Threatened dragonfly habitat assessment report

Dear ████████,

PERMIT APPLICATION FORMS & FISH HABITAT PROTECTION POLICIES AT:

www.dpi.nsw.gov.au/fisheries/habitat/protecting-habitats/toolkit

EMAIL COMPLETED APPLICATIONS TO: ahp.central@dpi.nsw.gov.au

APPLICATION PROCESSING TIMES (from date received): 28 days for Permits & Consultations; 40 days for IDA Referrals

On 26 September 2016 at 18:06, [REDACTED] wrote:

Dear [REDACTED],

Please see attached the Threatened Dragonfly Species Survey Plan Report which documents the results of our September dragonfly habitat assessment on the Georges River.

Please advise your thoughts on the report results at your convenience.

Don't hesitate to contact me if you have any queries about the report.

Kind regards,

[REDACTED] | Ecologist | BEnvSc (Hons) Biology | [REDACTED]
Arcadis | Level 5/141 Walker Street, North Sydney | NSW 2060 | Australia
T. [REDACTED]
www.arcadis.com<<http://www.arcadis.com/>>

[cid:image002.jpg@01D21820.61F015F0]

Be green, leave it on the screen.

[cid:image004.png@01D21820.61F015F0]<<http://www.linkedin.com/company/5840?trk=tyah&trkInfo=clickedVertical:company,clickedEntityId:5840,idx:2-1-4,tarId:1442272190497,tas:arcadis>>[cid:image006.png@01D21820.61F015F0]<<https://twitter.com/arcadisglobal>>

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APPENDIX D

Nest Box Management Strategy

Nest Box Management Strategy

Moorebank Precinct East Stage 1 – Rail Link

Project number:	N01031
Document number:	EN-PLN-0019
Revision date:	5 September 2017
Revision:	G

Document Approval

Rev.	Date	Prepared by	Reviewed by	Approved by	Remarks
A	9 Mar 2016	[REDACTED]			Initial draft
B	6 Jun 2016	[REDACTED]			Updated to address SIMTA comments
C	15 Jul 2016	[REDACTED]			For SIMTA's second review
D	21 Dec 2016	[REDACTED]			Updated to address final CoAs and for consultation
E	6 Feb 2017	[REDACTED]			Updated for submission to DP&E
F	6 Apr 2017	[REDACTED]			Final DP&E Submission
G	5 September 2017	[REDACTED]			In relation to the inclusion of Annexure B Only
Signature:					

Details of Revision Amendments and Authorship

Document Control

The Project Director is responsible for ensuring that this strategy is reviewed and approved. The Environment Manager is responsible for updating this strategy to reflect changes to legal and other requirements, as required.

Amendments

Any revisions or amendments must be approved by the Project Director before being distributed / implemented.

Revision Details

Revision	Details
A	Initial draft for SIMTA review
B	Updated to address SIMTA comments
C	For SIMTA's second review
D	Updated to address final CoAs and for consultation
E	Updated for submission to DP&E
F	Final update for DP&E Submission
G	Inclusion of Annexure B

Document Authors, Reviewers and Qualifications

This document has been prepared and reviewed by appropriately qualified professionals as detailed below.

Author's Name	Qualifications
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██████████	Master of Environmental Engineering Management, University of Technology Sydney Bachelor of Engineering, University of Technology Sydney
██████████	Master of Science, Environmental Management, University of Cape Town
██████████████████	Master of Environmental Engineering Management, University of Technology Sydney Bachelor of Engineering (Civil & Environmental), University of Technology Sydney
██████████	Master of Environmental Science and Law, University of Sydney Bachelor of Science, University of Sydney
██████████████████	Bachelor of Business Administration majoring in Environmental Resource Management, Macquarie University Post Graduate Diploma in Safety Science, University of New South Wales Masters of Applied Science in Environmental Science, Sydney University

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Nest Box Management Strategy

1. Overview

1.1 Background

The purpose of this Nest Box Management Strategy (NBMS) is to compensate the loss of hollow-bearing trees in the Rail Link project. The scope of this NBMS has been determined based on the recommendations and conditions presented in a number of key Project documents, including:

- Services Agreement – Schedule 5 Principal's Project Requirements
- Conditions of Approval under SSD-6676 SIMTA Intermodal Terminal Facility – Stage 1 (NSW)
- Stage 1 EIS (including Framework CEMP)
- Stage 1 Response to Submissions Report (including Final Compilation of Mitigation Measures)
- Commonwealth Concept Plan EIS (including Framework CEMP)
- Other applicable legislative obligations

1.2 Project Scope

SIMTA's Moorebank Intermodal Terminal Development involves the construction and operation of the necessary infrastructure to support a container freight road volume of 250,000 twenty-foot equivalent units (TEU).

CPB Contractors' scope of work specifically applies to Stage 1 – RALP No. 1 which consists of a 2.8 kilometre rail line, along with its required infrastructure, to connect the Import-Export Terminal and Interstate Terminals to the Southern Sydney Freight Line (SSFL), and capable of accommodating trains up to 1,800m in length. An addendum to this nest box management strategy has been developed by Biosis for hollows identified in MPE Stage 1 Package 2. This addendum should be read in conjunction with the SIMTA Construction Flora and Fauna Management Plan.

The SIMTA site is located in the Liverpool local government area. It is 27 kilometres south-west of the Sydney Central Business District (CBD), 26 kilometres west of Port Botany, 16 kilometres south of the Parramatta CBD, 0.6 kilometres from the M5 South-West Motorway, five kilometres east of the M5 South-West Motorway / Westlink M7 Motorway Interchange and connecting to the main north-south rail line via the Southern Sydney Freight Line.

The Moorebank Intermodal Terminal Development – RALP No. 1 is the first package of Stage 1 of the overall project and its construction will include:

- A northbound connection and a southbound connection to the SSFL
- Civil and earthworks, including remediation works and benching
- A viaduct over a section of the Glenfield Waste Services landfill site
- A bridge over the Georges River
- A culvert crossing over Anzac Creek
- Installation of new Moorebank Avenue overbridge
- Service relocation and protection
- Track work
- Signalling systems
- Security fencing

An indicative map of the Project is provided in Figure 1 below.

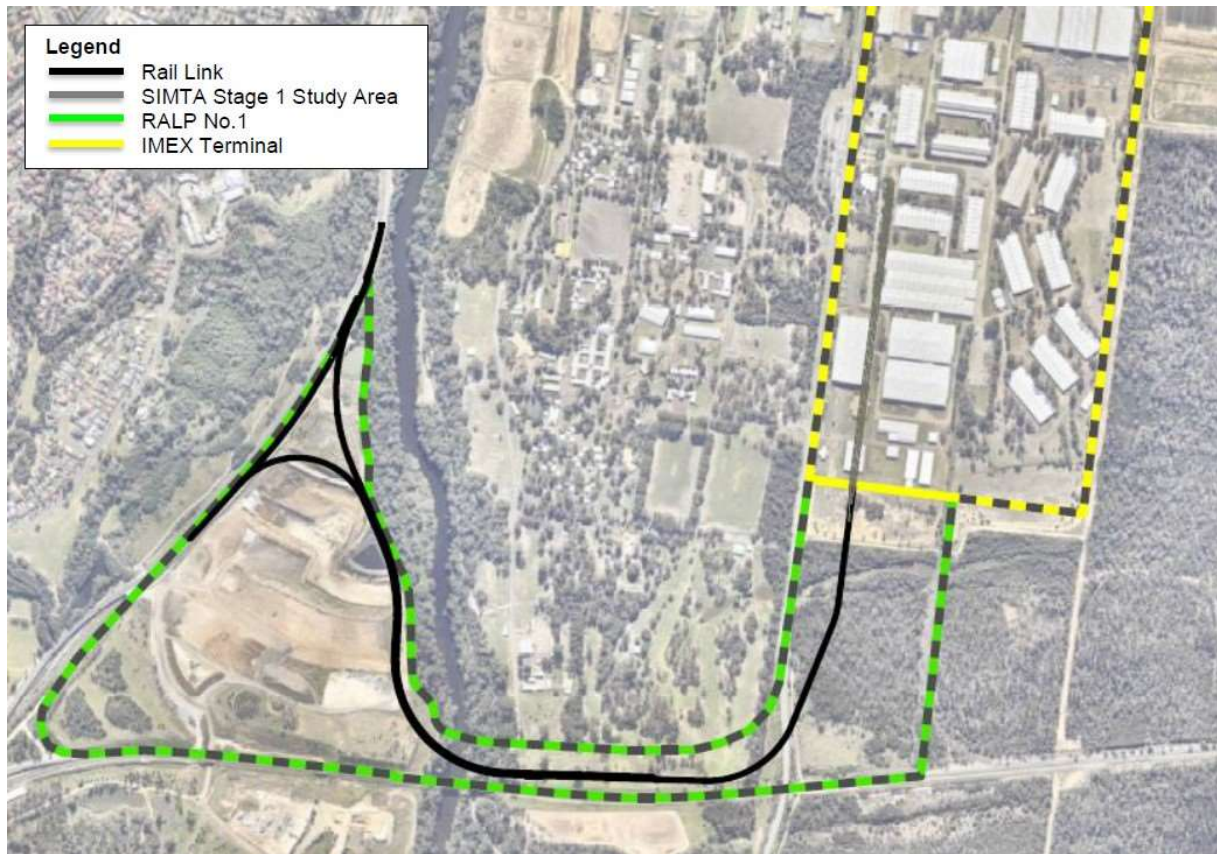


Figure 1: Indicative Project Map

1.3 Objectives

The objectives of this NBMS are to:

- Manage the impacts of the Rail Link Project on hollow-dependant fauna.
- Outline the potential threatened species that may utilise these resources.
- Detail the number, size and type of hollows being removed (based on the Project EIS data).
- Detail the number and type of nest boxes to be installed.
- Provide details of the location, maintenance and monitoring of nest boxes.
- Outline a framework for adaptive management.

1.4 Interactions with Other Management Plans

This NBMS is an attachment to the Construction Flora and Fauna Management Plan, which is in turn a Sub Plan to the Construction Environmental Management Plan (CEMP) for MPE Stage 1 Package 1. Figure 2 sets out interactions of this NBMS with the other environmental management documents that will be implemented on the Rail Link project. This NBMS should also be read in conjunction with the SIMTA Construction Flora and Fauna Management Plan.

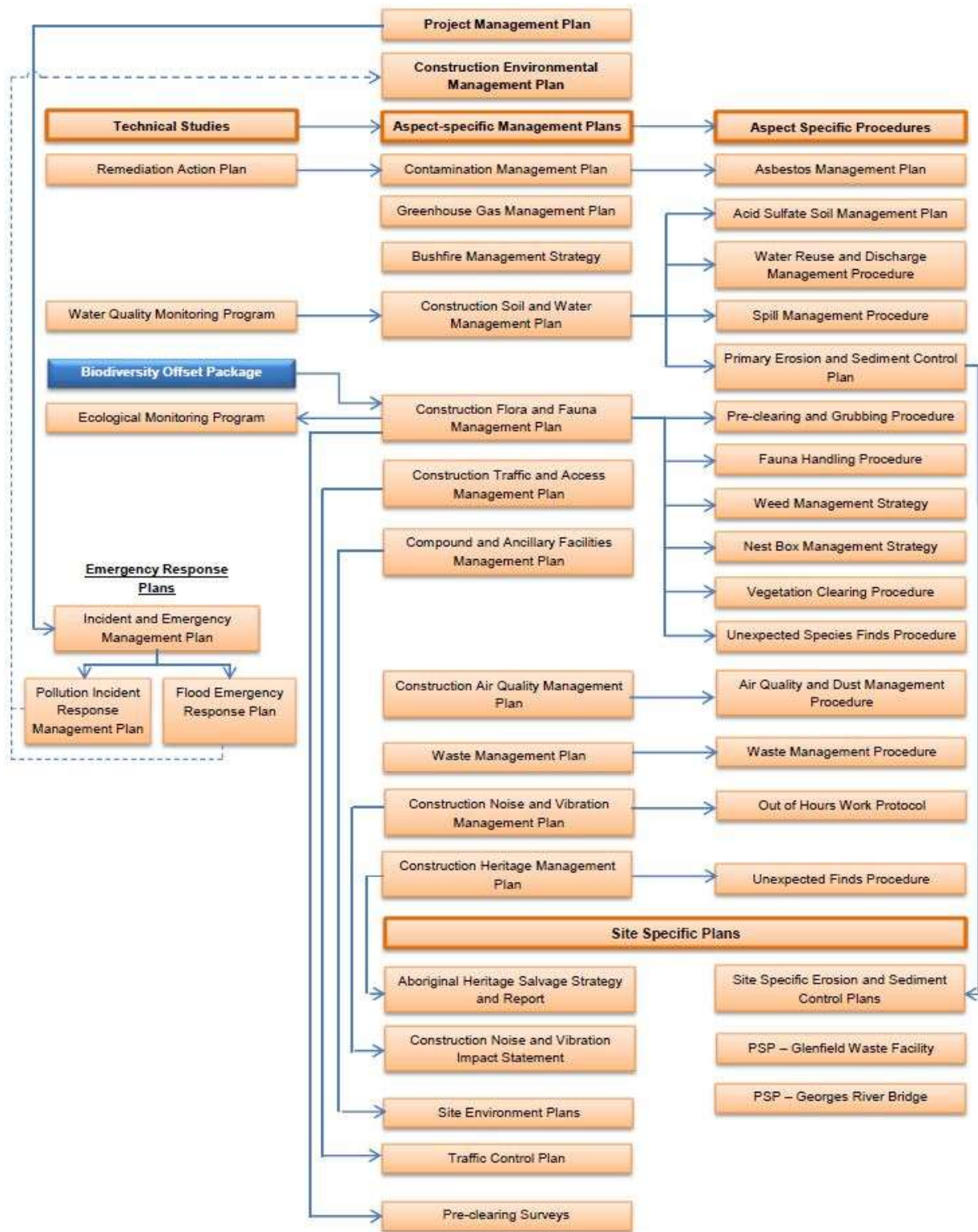


Figure 2: Environmental Documents Map

2. Legal and Other Requirements

2.1 Conditions of Project Environmental Approvals

The compliance of this document with the various environmental approval documents is demonstrated in Annexure A.

2.2 Relevant Legislation

The Project is designated State Significant Development (SSD) and has been assessed under Part 4 Division 4.1 of the EP&A Act. Key legislation relevant to the NBMS for the Project includes:

- *Environmental Planning and Assessment Act 1979* (EP&A Act)
- *Environmental Protection and Biodiversity Conservation Act 1999* (Commonwealth) (EPBC Act)
- *Threatened Species and Conservation Act 1995* (TSC Act)

2.3 Guidelines

Reports, best practice guidelines and plans of relevance to the preparation of this NBMS include:

- Australian Government, 2015. Protected Matters Search Tool.
- Beyer & Goldingay, 2006. The value of nest boxes in the research and management of Australian hollow-using arboreal marsupials. *Wildlife Research* **33**: 161-174.
- BirdLife Australia (undated). Nest Boxes – Technical Information. Available at: http://birdlife.org.au/images/uploads/education_sheets/INFO-Nestbox-technical.pdf.
- DECC, 2005. Recovering Bushland on the Cumberland Plain. Best practice guidelines for the management and restoration of bushland.
- DECCW, 2011. Cumberland Plain Recovery Plan.
- Department of Planning and Environment, 2015. SSD-14-6766 Indicative Conditions of Approval
- Gibbons and Lindenmayer, 2002. *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing, Collingwood, Australia.
- Gleeson and Gleeson, 2012. Reducing the Impacts of Development on Wildlife. CSIRO Publishing, Collingwood.
- Goldingay and Stevens, 2009. Use of artificial tree hollows by Australian birds and bats. *Wildlife Research* **36**: 81-97.
- Goldingay, 2009. Characteristics of tree hollows used by Australian birds and bats. *Wildlife Research* **36**: 394-409.
- OEH, 2015. Threatened Species Profile Database.
- TSSC, 2007. Loss of hollow-bearing trees – Key threatening process declaration. NSW Threatened Species Scientific Committee. Accessed online – <http://www.environment.nsw.gov.au/determinations/lossofhollowtreesktp.htm>.

3. Existing Environment

The existing biodiversity characteristics of the Rail Link project are described in detail within the Stage 1 EIS and summarised within the CEMP. The sections below focus specifically on the hollow dependant fauna and hollow bearing trees associated with the Rail Link project.

3.1 Threatened Species

The Stage 1 EIS identified 28 threatened fauna species as having potential to occur within the RALP No.1 Project Area. Of these 28 species, 10 are known to utilise tree hollows of various sizes for refuge and breeding. A large number of species that are not listed under State and Commonwealth legislation will also utilise tree hollows for refuge and breeding purposes. Table 1 provides a summary of the threatened species that could potentially utilise tree hollows within the Rail Link project.

Table 1: Hollow Dependent Fauna with Potential Habitat within the Rail Link Project

Common Name	Scientific Name	TSC Act	EPBC Act	Habitat association based on vegetation communities			
				ME003	ME005	ME007	ME018
Birds							
Barking Owl	<i>Ninox connivens</i>	Vulnerable	-	Yes	Yes	No	Yes
Brown Treecreeper	<i>Climacteris picumnus subsp. victoriae</i>	Vulnerable	-	No	No	No	Yes
Gang-gang Cockatoo	<i>Callocephalon fimbriatum</i>	Vulnerable	-	Yes	Yes	No	Yes
Little Lorikeet	<i>Glossopsitta pusilla</i>	Vulnerable	-	Yes	Yes	No	Yes
Arboreal mammals							
Eastern Pygmy-possum	<i>Cercartatus nanus</i>	Vulnerable	-	Yes	Yes	No	Yes
Squirrel Glider	<i>Petaurus norfolkensis</i>	Vulnerable	-	Yes	Yes	No	Yes
Microbats							
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>	Vulnerable	-	No	No	No	Yes
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	Vulnerable	-	Yes	Yes	Yes	Yes
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	Vulnerable	-	Yes	Yes	No	Yes
Yellow-bellied Sheath-tail-bat	<i>Saccolaimus flaviventris</i>	Vulnerable	-	Yes	Yes	Yes	Yes

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

ME005 - Parramatta Red Gum woodland on moist alluvium of the Cumberland Plain, Sydney Basin Bioregion

ME007 - Coastal freshwater lagoons of the Sydney Basin Bioregion and South East Corner Bioregion

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

3.2 Hollow-bearing Tree Inventory

Based on the results of the Stage 1 EIS field surveys presented within the Biodiversity Assessment Report (Hyder 2015), three hollow-bearing trees each with one hollow, occur within the Rail Link Project footprint (Figure 3). The hollow bearing tree inventory was compiled during diurnal surveys conducted across a total of seven days for the entire survey area. Therefore a combined total of three hollows will be removed to facilitate construction of the Rail Link project. Large numbers of hollow bearing trees were recorded outside of the Rail Link project, particularly on the western bank of the Georges River and will be retained.

These hollows provide refuge and nesting habitat for woodland birds, arboreal mammals, hollow-roosting microbats, owls, cockatoos, reptiles, amphibians and invertebrate species. Threatened hollow-dependent fauna species that have the potential to occur within the Rail Link Project are outlined in Table 1. The location of known hollow bearing trees to be removed for the Rail Link is presented in Table 2 and illustrated in Figure 3.

Additional information regarding the hollow-bearing trees identified for removal and listed in Table 2 will be verified during prior to the installation of nest boxes so that appropriate nest boxes are procured. The information to be confirmed includes tree species, size, height and size of hollow.

Although three hollows were recorded within the Rail Link project, it is possible that additional hollows were not identified as the entrance was not visible from the ground. This NBMS can be adapted to reflect this and further details regarding adaptive management of the loss of tree hollows is provided in Section 5.4.

Table 2: Location of Hollow-bearing Trees to be Removed

HBT No.	Common Name	Scientific Name	Easting	Northing
1	Hard-leaved Scribbly Gum	<i>Eucalyptus sclerophylla</i>	308038.4	6240165.5
2	Unknown	Unknown	308041.7	6240133.4
3	Unknown	Unknown	307154.7	6239829.8



4. Nest Box Installation

4.1 Nest Box Design and Construction

The environmental safeguards and mitigation measures presented in the various approval documents have not stipulated a required offset ratio for the removal of tree hollows. A minimum offset ratio of 1:1 is typical on infrastructure projects, however based on the very small number of hollows to be removed, a ratio of 2:1 has been implemented on this project. The removal of three hollow bearing trees that contain a total of three tree hollows will therefore require the installation of six appropriately sized nest boxes.

The nest box design requirements for nest boxes differ between species. The requirements for the species identified as having potential habitat within the Rail Link project (Table 1) are detailed in Table 3. The numbers required has been derived based on the available data on hollows to be removed in the Biodiversity Assessment Report (Hyder 2015). Likewise, additional species requirements have been included for future information as more nest boxes may be required once the vegetation clearing is completed (to compensate for unidentified tree hollows that are removed).

Table 3: Design Characteristics for Nest Boxes

Fauna Group and Species	Nest Box Dimensions				Number Required
	Internal (mm)	Depth (mm)	Entrance (mm)	Height above ground (m)	
Woodland Birds					
Little Lorikeet	150x150	350	55	3–5	1
Brown Treecreeper	90-150	100-400	50-80	5	
Forest Owls					
Barking Owl	250x300	500	100	4–6	2
Cockatoos					
Gang-gang Cockatoo	300x400	1200	200	8–10	2
Arboreal Mammals					
Eastern Pygmy-possum	150x150	300	30	3-6	0
Squirrel Glider	150x250	300	45	3–6	
Microbats					
Eastern False Pipistrelle	20 (slot)	400	30 hole	3–5	1
Eastern Freetail-bat	20 (slot)	400	30 hole	3–5	
Greater Broad-nosed Bat	20 (slot)	400	30 hole	3–5	
Yellow-bellied Sheath-tail-bat	20 (slot)	400	30 hole	3–5	

4.2 Competition Reduction Strategies

A key factor in the unsuccessful installation of nest boxes is their occupation by pest species. Some of these pest species can be put at competitive disadvantage by designing and installing the boxes appropriately. A summary of these is provided in Table 4 (based on Gleeson and Gleeson, 2012). These measures can be implemented during construction and installation or can be implemented if pest species are noted during monitoring activities.

Table 4: Measures to Minimise Pest Species Occupation

Pest Species	Appropriate Measure
Common Myna	An overhanging sheet of ply in front of the entrance (known as a Myna baffle) successfully deters Common Myna whilst allowing native species to use them.
Common Starling	Painting the interior of the box white deters Common Starling.
Ants and other insects	Talcum powder applied to the entrance, edges and inside of the nest boxes prevents use by ants.
	Petroleum jelly can be applied to the entrance or to the trunk of the tree to prevent ants from colonising or returning if already colonised.
Wasps	2cm roost spacing discourages wasp infestations in bat boxes.
European Honeybee	Lining the upper surfaces of nest box with a piece of carpet or petroleum jelly will prevent the attachment of the hive.

The nest box manufacturer will provide additional information on the competition reduction strategies that are integrated into their nest box design.

4.3 Nest Box Installation

The techniques applied for the installation of the nest box is key to their success, particularly when targeting certain species. Height, aspect, density and surrounding vegetation types must all be considered when sourcing a suitable location for installation. The proposed methodology is detailed below.

4.3.1 Nest Box Locations

The locations for installation of the nest boxes will broadly reflect the locations of the hollows to be removed. There will be installation of four nest boxes within the Southern Boot Land and two on the eastern bank of Georges River. Nest boxes are being installed on the eastern bank of the Georges River instead of the western bank as there is more room on the eastern bank and the eastern bank is a proposed offset site for other intermodal project, providing additional protection to the installed nest boxes. Where possible, nest boxes will be installed at least 50 metres from the boundary of vegetation clearance. This will reduce the disturbance to any fauna that take up residence in the nest boxes, by the Rail Link project. Figure 4 provides indicative locations for installation of nest boxes. These indicative locations have been selected based on the following criteria:

- Similarity of vegetation types when compared to the tree hollows to be removed.
- Suitability of the vegetation for the target species (see Table 1).
- Distance from the hollow-bearing tree to be removed.
- Distance from existing and future disturbances.

Other site selection criteria will need to be assessed at the time of installation, such as:

- Proximity of other hollow resources in the immediate vicinity.
- Similarity of vegetation structure immediately surrounding the hollow-bearing tree and nest box location.

The Project Ecologist or experienced nest box installer will therefore use their discretion to determine the final location of the nest box.

4.3.2 Methodology

It is important that a tree of a suitable size, form and, in some cases, species be selected for the installation of a nest box. Various attachment mechanisms can be used to secure the box to the trunk. The Habisure System (TM Hollow Log Homes) uses a concertinaed wire and plastic guard to both protect the tree and allow for future growth. This system utilises existing forks in the trunk to support the load in a less invasive way than traditional affixing systems. This is the preferred method of fixing. Nest boxes will be installed:

- In eucalypts with a minimum diameter at breast height (DBH) of 30cm that contain no existing hollows.
- No less than three metres above the ground (and ideally no higher than 10 metres to allow for monitoring).
- With an aspect between north-west and east to minimise exposure.
- With approximately 50mm of dry organic material in the bottom for nesting.

4.3.3 Reporting

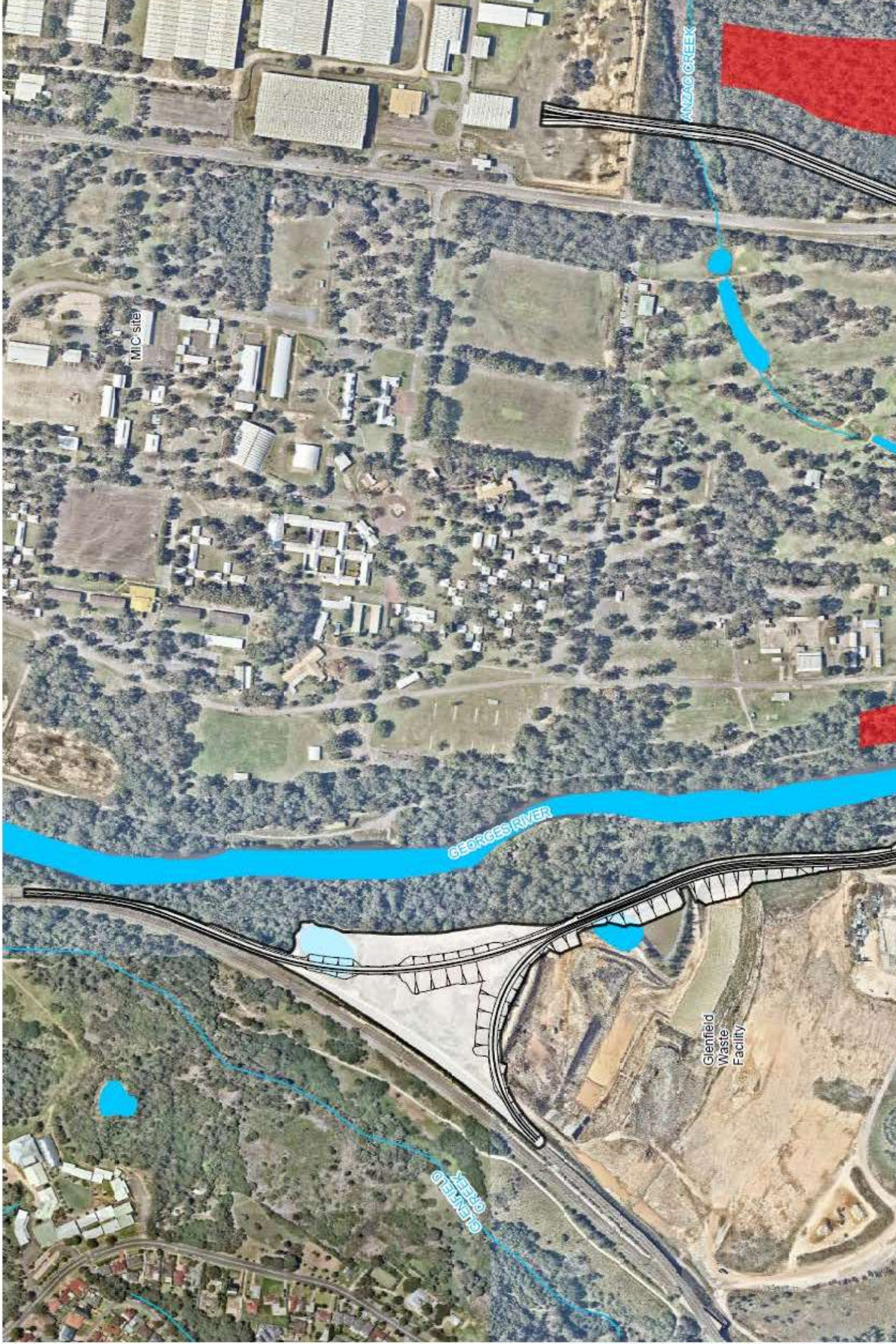
The Project Ecologist or experienced nest box installer will make note of the following attributes during installation:

- Nest box number.
- Type of nest box.
- Location (using an un-corrected hand held GPS as a minimum).
- Approximate height above ground.
- Approximate aspect.
- Species of host tree.

These attributes will be compiled and submitted in the initial post installation monitoring report to be prepared and submitted to SIMTA within one month of installation (see Section 5.1 below).

4.3.4 Timing

Nest boxes will be installed up to one month prior to the commencement of clearing activities in order to provide refuge habitat for fauna that may be displaced during clearing. This will include the six nest boxes that are required to compensate the loss of the three tree hollows identified within the Rail Link project. As previously noted and further discussed in Section 5.4, if additional hollows are identified during vegetation clearance activities then additional nest boxes will be installed within a month of the completion of clearing.



5. Nest Box Monitoring and Maintenance

Responsibility for completion of adequate monitoring and maintenance of nest boxes during the construction phase of the Rail Link project lies with the Environment Manager and would be delegated to the Project Ecologist to implement (see roles and responsibilities defined within the CFFMP).

5.1 Nest Box Monitoring

A monitoring program is proposed to determine the success of nest boxes, and identify any required maintenance activities. The monitoring program will be in addition to a post-installation round of monitoring, to be completed within one month of the final nest box installation. Note that the final installation may occur after the clearance of vegetation within the Rail Link project has been completed, as further nest boxes may be required if additional hollow bearing trees are identified.

The annual spring monitoring program will be conducted for the duration of CPB Contractors' construction period and will include a visual inspection of each nest box to collect the following information:

- Inspection details (such as date and time).
- Nest box number and location (for confirmation if the nest box number is illegible).
- Occupancy status (including species level identification where possible).
- Evidence of previous occupancy (such as scratches, debris, feathers or whitewash).
- Presence or evidence of previous feral species occupation.
- General condition of the nest box.
- Any recommended maintenance requirements.
- Any other notes such as changes to land use or reasons for low occupancy.

Installing the nest boxes below 10 metres in height will allow visual assessment from the ground using an inspection camera and extension pole.

Additional monitoring will be undertaken generally in accordance with Section 8.1 of the CFFMP.

5.2 Nest Box Maintenance

Nest box maintenance will be conducted on an as required basis, based on the outcomes and recommendations of the monitoring program. Common maintenance activities that may be required include:

- The need to remove pest species.
- Replacement of damaged nest boxes or components.
- Removal of excessive nesting material.
- Moving nest boxes that are not functioning correctly.
- Checking that boxes are draining adequately.

Any required maintenance activities should be noted within the annual report and classified as urgent or non-urgent activities. Urgent activities are ones that significantly hinder the ability of the nest box to deliver the objective of providing habitat for native species and should be actioned within 4 weeks of submission of the annual report. Non-urgent maintenance activities may be slight defects or temporary issues that do not require immediate action but that should be reassessed in the following monitoring event.

5.3 Annual Reporting

Following each annual spring monitoring event, a summary report will be prepared to describe the results of the monitoring program (as outlined in Section 5.1) and any corrective maintenance activities that were completed or are recommended. This report will be submitted to SIMTA for distribution amongst relevant stakeholders.

5.4 Adaptive Management

The quantity and type of nest boxes to be installed has been derived from the data presented within the Stage 1 EIS. Tree hollows may be missed during habitat assessments due to a lack of visibility of

the hollow entrance from the ground. These obscured hollows will be recorded during vegetation clearing activities either due to the presence of fauna or observations following clearing.

As a part of the vegetation clearing process and associated reporting detailed within the CFFMP, records of fauna encounters and additional habitat features identified and removed will be reported. Additional tree hollows that are removed and identified post-clearing will be compensated by applying the framework outlined within this NBMS. Additional required nest boxes will be installed within four weeks of the completion of clearing within the Rail Link project and will be reported in the first issued report.

Annexures

Annexure A: Compliance Matrix

Conditions of Project Environmental Approvals

Conditions of project environmental approvals that specifically address the nest box management include:

Stage 1 Conditions of Approval

Table 5: Stage 1 Conditions of Approval

Stage 1 CoA Ref	Requirement	Where Addressed
E34 d)	a Construction Flora and Fauna Management Plan to detail how impacts on ecology will be minimised and managed. The Plan shall be developed by a suitably qualified and experienced ecologist and in consultation with the OEH, and shall include, but not necessarily be limited to:	CFFMP
(ii)	the identification of areas to be cleared and details of management measures to avoid residual habitat damage or loss and to minimise or eliminate time lags between the removal and subsequent replacement of habitat such as:	CFFMP
b)	clearing procedures (including nest box plan),	This Strategy

Stage 1 Final Compilation of Mitigation Measures

Table 6: Stage 1 Final Compilation of Mitigation Measures

Stage 1 FCMM Ref	Requirement	Where Addressed
8C	A nest box management strategy will be prepared prior to clearing of hollow bearing trees. The strategy will inform the installation of nest boxes in retained native vegetation in the riparian corridor of the Georges River and the woodland in the Southern Boot Land and the on-going monitoring and maintenance of nest boxes through the construction and operational phases.	This Strategy

Commonwealth Concept Plan Mitigation Measures

Table 7: Commonwealth Concept Plan Mitigation Measures

C'th Concept Plan MM Ref	Requirement	Where Addressed
7.4.1.3	<u>Mitigate</u>	
n)	Consider the installation of nest boxes in woodland vegetation in the rail corridor that may offer alternative nesting habitat to hollow dependent species recorded in the study area.	This Strategy

Annexure B: Addendum to Nest Box Management Strategy for MPE Stage 1, Package 2

4 September 2017

Mr [REDACTED]
Project Engineer
Liberty Industrial
95-99 Bridge Road
Glebe NSW, 3000

Dear [REDACTED]

Re: IMEX Ecological Services: Addendum to CPB Nest Box Management Strategy
Project no. 25485

Biosis Pty Ltd was commissioned by Liberty Industrial to complete a habitat tree assessment and pre-clearing survey of Demolition Zones 1 (Priority areas 1-7) and 2 (Stockpile Area) of the IMEX project site (the 'study area'). The assessment undertaken was to determine the presence/absence of any threatened species not detected during previous surveys as well as identification, mapping and marking of any hollow-bearing trees and other fauna habitat features to be impacted during tree removal works.

Method

A field investigation of the study area was undertaken on 13 July 2017 by James Lidsey (Field Zoologist) of Biosis. Presence/absence of threatened species within the study area was surveyed using the random meander technique (Cropper 1993) over 8 person hours. Marking of all hollow-bearing trees and habitat features within the study area was undertaken using a combination of flagging tape and spray-painting each tree with an 'H'.

Results

A total of 25 hollows were identified across 13 hollow-bearing trees within the study area (Appendix 1; Figure 1). An inventory of the trees and habitat features (hollows) recorded is included in Table 1.

Trees 1, 2, 3, 6, 18 and 19 were identified during the habitat tree inspection, however these trees will not be removed as they are located outside of the Liberty site boundary.

All remaining trees within the study area showed no evidence of hollows or other significant habitat features.

Table 1 Hollow-bearing tree inventory

Tree ID	DBH (cm)	Species	Common Name	Hollows within Tree	Signs of Use	Notes
1						Tree located outside of the Liberty site boundary. This tree will not be removed.

Biosis Pty Ltd

Wollongong Resource Group

8 Tate Street
Wollongong NSW 2500

Phone: 02 4201 1090

ACN 006 175 097
ABN 65 006 175 097

Email: wollongong@biosis.com.au

biosis.com.au

Tree ID	DBH (cm)	Species	Common Name	Hollows within Tree	Signs of Use	Notes
2	Tree located outside of the Liberty site boundary. This tree will not be removed.					
3	Tree located outside of the Liberty site boundary. This tree will not be removed.					
4	75		Forest Red Gum	1 large, 2 medium	Yes	Marked with 'H'
5	100	<i>Corymbia citriodora</i>	Lemon-scented Gum	1 large	No	Marked with 'H'
6	Tree located outside of the Liberty site boundary. This tree will not be removed.					
7	100	<i>Corymbia citriodora</i>	Lemon-scented Gum	2 medium	No	Marked with 'H'
8	70	<i>Eucalyptus tereticornis</i>	Forest Red Gum	2 medium, 1 small	No	Marked with 'H'
9	120	<i>Eucalyptus tereticornis</i>	Forest Red Gum	1 large, 2 small	No	Marked with 'H'
10	80	<i>Corymbia maculata</i>	Spotted Gum	1 medium, 1 small	No	Marked with 'H'
11	90	<i>Corymbia citriodora</i>	Lemon-scented Gum	2 large	No	Marked with 'H'
12	110	<i>Angophora floribunda</i>	Rough-barked Apple	1 medium	No	Marked with 'H'
13	110	<i>Corymbia citriodora</i>	Lemon-scented Gum	3 medium	Yes	Marked with 'H'
14	60	<i>Corymbia citriodora</i>	Lemon-scented Gum	1 small	No	Marked with 'H'
15	70	<i>Corymbia citriodora</i>	Lemon-scented Gum	1 medium	No	Marked with 'H'
16	60	<i>Corymbia citriodora</i>	Lemon-scented Gum	1 medium	No	Marked with 'H'
17	110	<i>Eucalyptus mannifera</i>	Brittle Gum	1 medium, 1 large	Yes	Marked with 'H'
18	Tree located outside of the Liberty site boundary. This tree will not be removed.					
19	Tree located outside of the Liberty site boundary. This tree will not be removed.					

Addendum to CPB Nest Box Management Strategy

Within the IMEX Construction Flora and Fauna Management Plan: Moorebank Precinct East Stage 1, Package 2 (Simta 2017) (CFFMP), the Conditions of Approval (CoA) table states;

- 'Where hollow bearing trees are identified during preclearing surveys, the process outlined in section 5.1 will be followed and a nest box plan would be implemented under advice of an ecologist.'

Where hollow bearing trees are identified during preclearance surveys, the project CFFMP recommends a two-stage clearing process as follows;

- *Non-habitat vegetation removal must be undertaken 48 hours prior to habitat tree removal to allow fauna to relocate on their own accord*
- *Prior to the removal of habitat trees, trees must be knocked with an excavator bucket to allow fauna to escape, trees can then be felled under the supervision of an ecologists, who will then inspect the felled tree for any fauna and either relocate individuals to surrounding suitable habitat or a local veterinary clinic if injured.*

The CFFM specifies that non-habitat vegetation must be undertaken 48 hours prior to habitat tree removal. Given this specification is to allow nocturnal fauna to relocate prior to stage 2 clearing, it is considered adequate to leave habitat trees standing for 24 hours (including one whole night) prior to stage 2 clearing. Other hollow-dependent fauna (e.g. nesting birds) will not vacate hollows during staged clearing, and will require management during stage 2 clearing if present.

As per the CFFMP (SIMTA 2017) a nest box strategy is to be developed and implemented prior to clearing of habitat trees. The 'Nest Box Management Strategy (NBMS): Moorebank Precinct East Stage 1 – Rail Link' (CPB Contractors 2017) is to be used as the nest box strategy for Moorebank Precinct East Stage 1, Package 2. This addendum provides the background information required to update the NBMS for use as the nest box strategy for Moorebank Precinct East Stage 1, Package 2. The relevant sections of the NBMS are to be used

Section 4 'Nest Box Installation' and Section 5 'Nest Box Monitoring and Maintenance' of the NBMS are broadly applicable, however some elements are not relevant to Stage 1, Package 2. The following points should be implemented for the Stage 1, Package 2 works:

- Section 4.1 - Given the larger number of tree hollows to be removed for Stage 1, Package 2, the minimum offset ratio of 1:1 of nest boxes per hollow removed should be applied. The higher offset ratio of 2:1 is only recommended where very few hollows are to be removed.
- Section 4.3.1 – Nest boxes for Stage 1, Package 2 are to be installed within land on the eastern bank of Georges River, as illustrated in Figure 4 of the NBMS. Where additional land is required to avoid over-crowding, nest boxes will be installed along the eastern bank of the Georges River immediately to the north of the area illustrated in Figure 4. The larger potential nest box location shown in the figure (the Southern Boot Land) is not available for installation of net boxes for Stage 1, Package 2.
- Section 4.3.2 and Section 4.3.3 – Nest boxes will be installed and recorded by Waratah in accordance with the methodology provided in the NBMS. Data recorded (including GPS coordinates of individual nest box locations) has been provided in Appendix 2.
- Section 5.1 and Section 5.2 – Monitoring and maintenance is required for Stage 1, Package 2 as specified in the NBMS. These should be undertaken annually in spring for the duration of the SIMTA construction period, as per the methodology provided in the NBMS. Liberty Industrial will be responsible for nest box monitoring and maintenance for the duration of their occupancy of the site. Following this period, ongoing monitoring and maintenance will be the responsibility of the relevant construction contractor.

I trust that this advice is of assistance to you however please contact me if you would like to discuss any elements of this ecological advice further.

Yours sincerely



Zoologist

Appendix 1: Figure 1



Appendix 2: GPS co-ordinates of nest box locations

Date	Box#	Nesting Box Type	Height Installed	Condition of box	Evidence of Habitation	Species present	Box facing	GPS coordinates	GPS coordinates2
23/08/2017	1	Small mammal	5m	New	No		N	33 57 50 S	150 54 52 E
23/08/2017	2	Small mammal	5m	New	No		NE	33 57 49 S	150 54 52 E
23/08/2017	3	Small mammal	5m	New	No		N	33 57 50 S	150 54 52 E
23/08/2017	4	Microbat	5m	New	No		N	33 57 50 S	150 54 52 E
23/08/2017	5	Small mammal	5m	New	No		S	33 57 50 S	150 54 51 E
23/08/2017	6	Small parrot	5m	New	No		NW	33 57 50 S	150 54 51 E
23/08/2017	7	Microbat	5m	New	No		NW	33 57 50 S	150 54 51 E
23/08/2017	8	Small mammal	5m	New	No		NE	33 57 10 S	150 54 30 E
23/08/2017	9	Small parrot	5m	New	No		NE	33 57 49 S	150 54 51 E
23/08/2017	10	Small parrot	5m	New	No		E	33 57 49 S	150 54 52 E
23/08/2017	11	Small mammal	5m	New	No		S	33 57 49 S	150 54 52 E
23/08/2017	12	Microbat	5m	New	No		SW	33 57 50 S	150 54 52 E
23/08/2017	13	Large mammal	5m	New	No		NE	33 57 50 S	150 54 51 E
23/08/2017	14	Small parrot	5m	New	No		NW	33 57 48 S	150 54 50 E
23/08/2017	15	Large parrot	5m	New	No		N	33 57 48 S	150 54 50 E
23/08/2017	16	Small parrot	5m	New	No		NW	33 57 46 S	150 54 51 E
23/08/2017	17	Microbat	5m	New	No		E	33 57 46 S	150 54 51 E
23/08/2017	18	Large mammal	5m	New	No		S	33 57 47 S	150 54 50 E
23/08/2017	19	Small parrot	5m	New	No		E	33 57 10 S	150 54 30 E
23/08/2017	20	Small mammal	5m	New	No		E	33 57 10 S	150 54 30 E
23/08/2017	21	Owl	5m	New	No		NE	33 57 47 S	150 54 51 E
23/08/2017	22	Small mammal	5m	New	No		SE	33 57 47 S	150 54 51 E
23/08/2017	23	Small mammal	5m	New	No		NE	33 57 47 S	150 54 51 E
23/08/2017	24	Microbat	5m	New	No		SW	33 57 46 S	150 54 50 E
23/08/2017	25	Microbat	5m	New	No		E	33 57 46 S	150 54 50 E
23/08/2017	26	Microbat	5m	New	No		E	33 57 45 S	150 54 51 E
23/08/2017	27	Small mammal	5m	New	No		S	33 57 46 S	150 54 51 E
23/08/2017	28	Large mammal	5m	New	No		S	33 57 46 S	150 54 51 E
23/08/2017	29	Small parrot	5m	New	No		NE	33 57 42 S	150 54 49 E
23/08/2017	30	Large mammal	5m	New	No		NE	33 57 42 S	150 54 49 E
23/08/2017	31	Small mammal	5m	New	No		NE	33 57 10 S	150 54 30 E
23/08/2017	32	Microbat	5m	New	No		NE	33 57 11 S	150 54 30 E
23/08/2017	33	Small parrot	5m	New	No		NE	33 57 11 S	150 54 30 E
23/08/2017	34	Small mammal	5m	New	No		E	33 57 11 S	150 54 30 E
23/08/2017	35	Small parrot	5m	New	No		N	33 57 11 S	150 54 50 E

APPENDIX E

Nest Box Advice – February 2019

Date 8/02/2019
To [REDACTED]
From [REDACTED]
Subject Moorebank Precinct – Nest Box Advice

1 Introduction

The purpose of this memorandum is to demonstrate consideration of the requirement to install additional nest boxes at Moorebank Logistics Park (MLP). This memorandum provides a review of nest boxes installed to date, and assesses the values and risks associated with installation of additional nest boxes at MLP.

The requirements for installation of nest boxes at MLP are as outlined in the following approvals and documents:

Moorebank Precinct East (MPE)

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Approval (No. 2011/6229) granted on March 2014.
- Stage 1, Package 1 – Rail Access Land Package Works (SSD 6766) Construction Environmental Management Plan (CEMP) and sub-plans.
- Stage 1, Package 1 – Rail Access Land Package Works – Nest Box Management Strategy (CPB, 6 April 2017).
- Stage 1, Package 2 – Import Export Terminal Works (SSD 6766) Construction Environmental Management Plan (CEMP) and sub-plans.
- Stage 2 – State Significant Development Consent (SSD 7628).
- Stage 2 – Environmental Impact Statement (Arcadis Australia Pacific Pty Limited, December 2016).
- Stage 2 – Response to Submissions (Arcadis Australia Pacific Pty Limited, July 2017).
- Consolidated assessment clarification responses issued on 10 November 2017.

Moorebank Precinct West (MPW)

- Concept Plan - *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Approval (No. 2011/6086) granted on September 2016.
- Stage 1, Early Works - State Significant Development Consent (SSD 5066).
- Stage 1, Early Works – Construction Flora and Fauna Management Plan (Biosis, 14 August 2018).
- Stage 1, Early Works – Nest Box Plan (Biosis, 20 August 2018).

Specifically, this advice has been prepared to address the recommended mitigation measure of Annexure A of EPBC Approval No. 2011/6229:

- *Consider installation of nest boxes in woodland vegetation in the rail corridor that may offer alternative nesting habitat to hollow dependent species recorded in the study area.*

This requirement has been included within the MPE Stage 2 Construction Flora and Fauna Management Plan item FF6 within Table 25 Management Measures which states:

- *Where practicable, install nest boxes and/or microbat roost boxes in vegetation to be retained within the precinct, to compensate for the loss of hollow-bearing trees from the construction footprint.*

During assessments undertaken by Arcadis ecologists for the development of the MPE Stage 2 Biodiversity Assessment Report in 2017, a total of four hollow-bearing trees were recorded in the MPE Stage 2 Project area. These four hollow-bearing trees were removed for construction of the Project. The provision of nest boxes to mitigate the loss of these hollow-bearing trees was not included as a mitigation measure in the MPE Stage 2 Biodiversity Assessment Report (BAR) and RtS, nor was it included as a Condition of Consent under SSD 7628. However, as outlined above, the EPBC approval requires that the installation of nest boxes be considered.

This memorandum demonstrates consideration of the installation of additional nest boxes to offset removal of four hollow-bearing trees for MPE Stage 2 in accordance with the aforementioned EPBC mitigation measure and provides advice as to whether any additional nest boxes should be installed at MLP for MPE and MPW.

2 Background and context

Nest boxes have been installed as a result of vegetation clearing, specifically the removal of hollow-bearing trees that provide habitat for hollow-dependent fauna, progressively undertaken within both MPE and MPW. Nest boxes were installed in accordance with approval conditions, and requirements within the Nest Box Strategy (NBS). The NBS was developed for MPE Stage 1 (SSD 6766 CoC E34(d)(ii)(b)) Package 1 (Rail Link), and MPW Stage 1 (SSD 5066 CoC D21(d)(ii)(d)).

2.1 Nest box installation to date

The location of nest box installation was based on the following selection criteria:

- The vegetation should be outside of construction boundaries.
- The vegetation should be deficient in natural tree hollows.
- Installation of nest boxes should not result in damage to threatened flora, fauna or ecological communities.
- The vegetation should have some level of connectivity to other bushland patches.
- The nest boxes should be located as far as practical from development.

By applying these selection criteria, two locations within the Moorebank Precinct biobank site were prioritised for nest box installation as detailed below (Figure 1, Table 1).

Table 1: Nest Box Locations

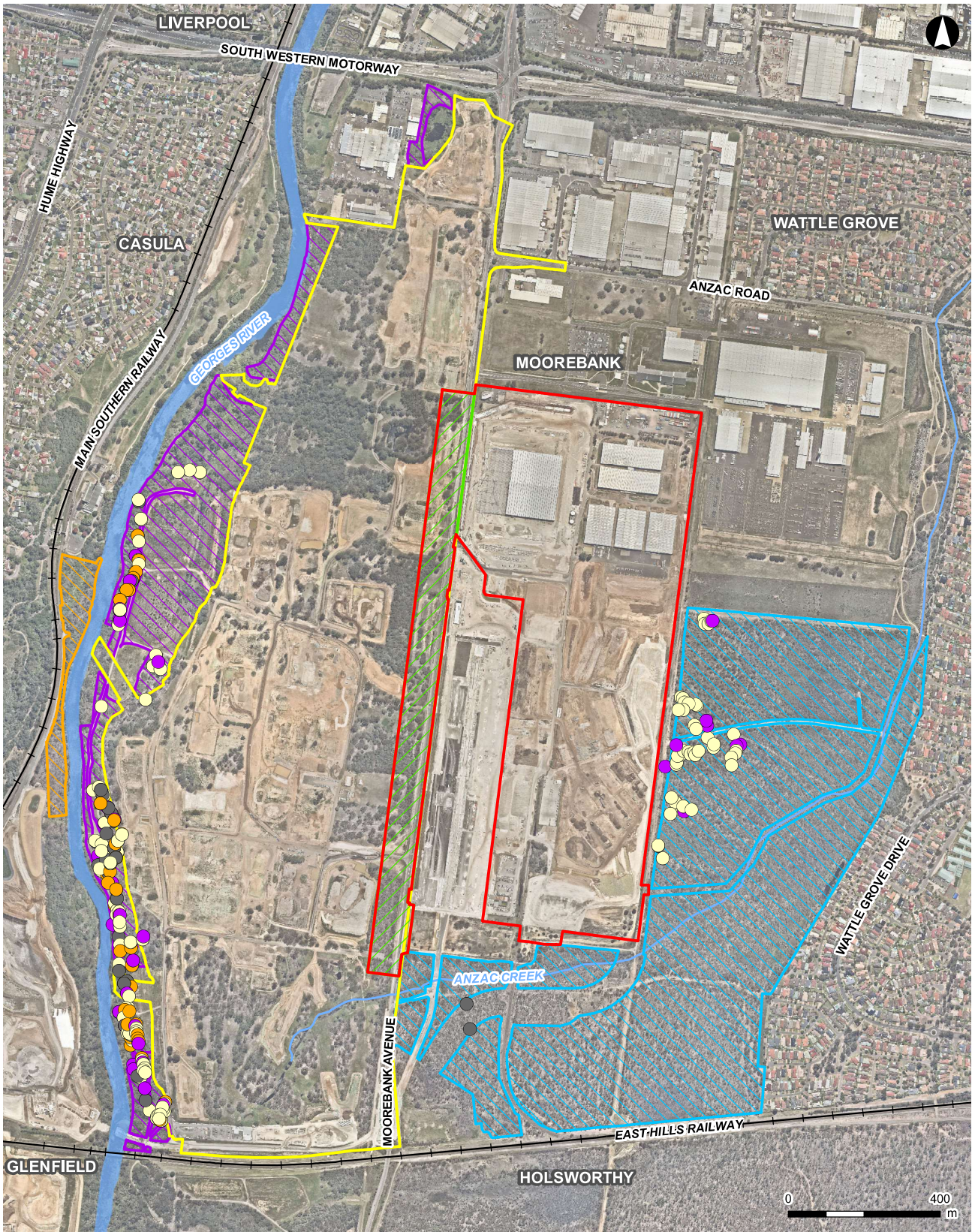
Location	Description
Georges River Corridor (Riparian Corridor)	The Georges River Corridor is comprised of a narrow, linear strip of bushland that extends for approximately three kilometres, alongside the MPW project. This vegetation is within the Moorebank offset area. A total of 195 nest boxes have been installed in this area, including a mix of boxes designed for microbats, small, medium and large arboreal mammals, small birds, parrots, cockatoos and owls.
Bootland	The Bootland is located to the east of the MPE site. It is comprised of relatively intact native vegetation, providing potential habitat for several hollow dependant fauna species. A total of 50 nest boxes have been installed in this area, including a mix of boxes designed for microbats, small, medium and large arboreal mammals, small birds, parrots,

Location	Description
	cockatoos and owls. The southern Bootland was recently burned by intense bushfires and this vegetation is currently regenerating.

2.1 Nest box monitoring

Nest box monitoring, undertaken in accordance with the NBS, was undertaken in November 2018 in the Bootland and Georges River Corridor. Monitoring efforts identified the following:

- A total of 247 nest boxes were located by Arcadis; 52 in the Bootland and 195 in the Georges River Corridor.
- A total of 219 nest boxes (89%) were inspected by camera.
- A total of 38 nest boxes were occupied at the time of inspection; eight in the Bootland (15%) and 30 in the Georges River Corridor (15%).
- Of those occupied, eight of the 38 nest boxes (21%) contained introduced species.
- A total of six deceased fledgling birds were discovered in three nest boxes; two in the Bootland and one in the Georges River Corridor.
- A total of 22 nest boxes within the Georges River Corridor (11%) require maintenance. Two nest boxes recently discovered in the southern section of the Bootland also require maintenance as they were installed at a height above 10 m and recent bushfires may have affected their structure and stability.



LEGEND

- | | |
|-------------------------------|---------------------------------------|
| MPE Stage 2 construction area | Moorebank Avenue site |
| Nest box locations | MPW Stage 2 construction area |
| Empty | Casula offset site (Hourglass) |
| Occupied | Moorebank offset site (Georges River) |
| Previous occupancy | Wattle Grove offset site (Bootland) |
| N/A | Existing railway |
| | Watercourse |

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 Aerial Imagery supplied by nearmap (Nov, 2018)



Figure 1: Nest box location and occupancy

3. Assessment of nest box installation

3.1 Nest box saturation

The installation of 195 nest boxes within the Georges River Corridor is considered in excess of recommended densities (i.e. saturated; Franks & Franks, 2011; RTA, 2011) (Table 2). Consequences of nest box saturation include an over-abundance of common, adaptable and/or aggressive native and introduced species such as Rainbow Lorikeet *Trichoglossus moluccanus*, Galah *Eolophus roseicapilla* Common Brushtail Possum *Trichosurus vulpecula*, Common Ringtail Possum *Pseudocheirus peregrinus*, Common Myna and European Honey Bee (Goldingay & Stevens, 2009; RTA, 2011). These species may outcompete less common or adaptable native species for resources. Monitoring conducted in November 2018 identified that nest boxes were predominately occupied by these species. As such, it is recommended that no additional nest boxes should be placed within the Georges River Corridor.

Table 2: Recommended densities of nest boxes (modified from Table 8.2 in RTA, 2011)

Nest box type	Recommended density
Microbat sp.	One every 50 metres
Eastern Pygmy Possum <i>Cercartetus nanus</i>	One every 20 – 40 metres
Australian Owlet Night-jar <i>Aegotheles cristatus</i>	One every 50 metres
Cockatoo sp.	One every 200 metres
Brown Tree creeper <i>Climacteris picumnus</i>	One every 50 metres
Brush-tailed Phascogale <i>Phascogale tapoatafa</i>	One every 200 metres
Squirrel Glider <i>Petaurus norfolcensis</i>	One every 60 – 100 metres
Yellow-bellied Glider <i>Petaurus australis</i>	One every 180 – 200 metres
Large Forest Owl sp.	One every >500 metres

3.2 Vegetation condition

Biobanking plot data collected under the BAM from the Bootland identified that much of this area is in 'benchmark' condition for tree hollows (i.e. the current availability of natural hollows is typical for native vegetation in good condition). While some areas within the Bootland are below benchmark condition, including the northern section of the Bootland, supplementation of additional nest boxes is not recommended given the availability of natural tree hollows and current installation of 52 artificial nest boxes in the Bootland.

Currently, there are no nest boxes installed within the rail corridor and it is recommended that no nest boxes should be installed within this area. The rail corridor does not support woodland vegetation and therefore does not provide opportunities for installation of nest boxes. While areas adjacent to the rail corridor contain woodland vegetation, the operational noise, vibration and light impacts associated with the rail corridor mean that this vegetation is not ideal for installing nest boxes.

The southern Bootland was recently burned by intense bushfires and this vegetation is currently regenerating and therefore highly sensitive. Two out of the four nest boxes installed in this area

remain intact. Many of the trees in this area are unsound and therefore further installation of nest boxes would not be recommended. Further, installation of nest boxes could have detrimental impacts on this highly sensitive land (including the threatened plants and EEC vegetation that it contains) by resulting in damage to individual plants or potential introduction and spread of weeds and pathogens.

Installation of additional nest boxes may therefore be contrary to EPBC condition of approval 5 h) which states that the Flora and Fauna Management Plan must include (but need not be limited to):

- *Measures to safeguard flora and fauna from the threat of weeds, fire, pathogens and unauthorised access, including (but not limited to) the commitments outlined in section 7.4.1 of the EIS (and summarised at Annexure A).*

3.3 Occupation by over-abundant species

Many fauna species recorded using hollows within the project are considered over-abundant and adaptable. These include:

- Rainbow Lorikeet *Trichoglossus moluccanus*.
- Galah *Eolophus roseicapilla*.
- Common Ringtail Possum *Pseudocheirus peregrinus*.

Installation of nest boxes is likely to provide additional nesting and roosting habitat for these and other common adaptable and aggressive species to the detriment of smaller, less tolerant fauna. Medium and large nest boxes are more likely to be detrimental by favouring already over-abundant and adaptable species such as Galah, Rainbow Lorikeet and Common Ringtail Possum. Nest boxes designed for microbats are also likely to support only common, adaptable species. It is currently unclear whether any of these species aggressively displace threatened or less tolerant microbat species.

3.4 Hollow dependent fauna

No threatened hollow-dependent fauna was recorded during assessments undertaken by Arcadis ecologists for the development of the MPE Stage 2 Biodiversity Assessment Report in 2017. Further, no threatened hollow-dependent fauna was recorded during nest box monitoring undertaken by Arcadis in November 2018.

All hollows identified for MPE Stage 2 were in landscape planted trees, in highly disturbed, cleared or developed lands. These environments do not provide habitat for threatened fauna and therefore, no habitat for these species was or will be removed.

4. Conclusion and recommendations

This advice has been prepared to address the recommended mitigation measure of Annexure A of EPBC Approval No. 2011/6229 that installation of nest boxes in woodland vegetation in the rail corridor should be considered. Nest boxes have been installed for both MPE and MPW. Arcadis recommend that no additional nest boxes should be installed to offset the loss of four hollow-bearing trees from MPE Stage 2, or for any additional hollows that are encountered as part of future clearing works associated with MPE or MPW.

It is recommended that no additional nest boxes should be installed for the following reasons:

- The total number of nest boxes installed within the Georges River Corridor exceeds the recommended densities (i.e. - is oversaturated), favouring over-abundant, adaptable and/or aggressive species which outcompete less tolerant native species.

- Availability of tree hollows and installation of nest boxes within the Bootland currently meet benchmark conditions so that additional supplementary nest boxes are not required.
- In addition to the above, there is no suitable woodland present in the rail corridor and the southern Bootland has recently been burned; presenting installation risks, as well as risks to the highly sensitive land.
- No threatened hollow-dependent fauna was recorded and therefore no habitat for these species will be removed. All hollows are in landscape planted trees in highly disturbed cleared or developed lands which do not provide habitat for threatened fauna.
- Installation of nest boxes is likely to benefit over-abundant highly adaptable species to the detriment of other fauna, as observed during monitoring in November 2018.

Yours sincerely,

A large black rectangular redaction box covering the signature area.


Consultant Ecologist

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Franks, A., & Franks, S. (2011). *Nest Boxes for Wildlife: A Practical Guide*. Melbourne: Bloomings Books.

Goldingay, R., & Stevens, J. (2009). Use of artificial tree hollows by Australian birds and bats. *Wildlife Research*, 81-97.

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