

MOOREBANK PRECINCT EAST – OPERATIONAL FACILITY

Annual Flora and Fauna Monitoring Report

11 MAY 2021



CONTACT



Arcadis

Level 16 / 580 George Street,
Sydney 2000 NSW

QUBE PROJECT MANAGEMENT SERVICES MOOREBANK PRECINCT EAST – OPERATIONAL FACILITY

Annual Monitoring Report

Author

Checker

Approver

Report No 1.0

Date 11/05/2021

Revision Text C

This report has been prepared for Qube Project Management Services in accordance with the terms and conditions of appointment 22 June 2016. Arcadis Australia Pacific Pty Limited (ABN 76 104 485 289) cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

REVISIONS

Revision	Date	Description	Prepared by	Approved by
A	15/03/2021	First Draft	Nathan Banks & Thea Kane	Ed Cooper
B	17/03/2021	Final – updated following Tactical comments	Nathan Banks & Thea Kane	Ed Cooper
C	11/05/2021	Final – updated following second round of comments	Nathan Banks & Thea Kane	Kate Carroll

CONTENTS

1 INTRODUCTION	1
1.1 Moorebank Precinct East background	1
1.2 Monitoring objectives	2
1.3 Requirements for monitoring	4
2 METHODOLOGY	8
2.1 Native vegetation monitoring	9
2.1.1 Lands adjoining Rail Link	9
2.1.2 Riparian vegetation management	9
2.2 Threatened flora monitoring	11
2.2.1 Lands adjoining Rail Link	11
2.2.2 EPBC offset sites	11
2.3 Weed monitoring	12
2.4 Fauna monitoring	13
2.4.1 Habitat connectivity monitoring	13
2.4.2 Koala management monitoring	14
2.4.3 Nest box monitoring	14
2.4.4 Feral animal monitoring	15
3 RESULTS	17
3.1 Native vegetation	17
3.1.1 Lands adjoining Rail Link	17
3.1.2 Riparian vegetation management	17
3.2 Threatened flora	25
3.2.1 Lands adjoining Rail Link	25
3.2.2 EPBC offset sites	28
3.3 Weed occurrence and coverage	29
3.4 Fauna	32
3.4.1 Habitat connectivity	32
3.4.2 Koala management	32
3.4.3 Nest boxes	34
3.4.4 Feral animals	35
4 DISCUSSION AND RECOMMENDATIONS	37
4.1 Native vegetation	37
4.1.1 Lands adjoining Rail Link	37

4.1.2 Riparian vegetation management.....	37
4.2 Threatened flora	42
4.2.1 Lands adjoining the Rail Link	42
4.2.2 EPBC offset sites	42
4.3 Weed occurrence and coverage	44
4.4 Fauna.....	46
4.4.1 Fauna habitat connectivity.....	46
4.4.2 Koala management monitoring	46
4.4.3 Nest boxes	46
4.4.4 Feral animals.....	47
4.5 Summary of recommendations.....	48
5 REFERENCES.....	51
6 APPENDICES.....	52

APPENDICES

APPENDIX A . BI-MONTHLY WEED MONITORING REPORTS (APRIL 2020 – FEBRUARY 2021)

APPENDIX B . EPBC OFFSET SITES - 2020 ANNUAL MONITORING REPORT

APPENDIX C . RIPARIAN VEGETATION MANAGEMENT – FLORA INVENTORIES

APPENDIX D . LANDS ADJOINING RAIL LINK - QUADRAT MONITORING DATA

APPENDIX E . NEST BOX MONITORING REPORT (SPRING 2020)

APPENDIX F . FAUNA SPECIES INVENTORY FROM FERAL ANIMAL AND HABITAT CONNECTIVITY MONITORING

APPENDIX G . KOALA FENCING AND STRUCTURES ACROSS MOOREBANK LOGISTICS PARK

1 INTRODUCTION

Arcadis were commissioned by Tactical Group on behalf of Qube Holdings to undertake monitoring inspections and deliver the annual flora and fauna monitoring report for the Moorebank Precinct East (MPE) operational facility. The MPE operational facility is subject to monitoring requirements and conditions of approval which are specified in the:

- Moorebank Precinct East – Stage 1 (SSD 6766) and Moorebank Precinct East – Stage 2 (SSD 7628) Environmental Impact Statements (EIS)
- Moorebank Precinct East EPBC Concept Approval (EPBC 2011/6229), Conditions of Approval
- Ministers Conditions of Consent (CoC) (SSD 6766; SSD 7628)

Additional requirements to monitor biodiversity values and approved monitoring methodologies are included in the following project documents:

- Riparian Vegetation Management Plan for SIMTA Intermodal Terminal Facility – Stage 1 (Hyder 2015)
- SIMTA Intermodal Terminal Facility – Stage 1. Riparian Vegetation Management Plan – 2017 Updated (AMBS 2017)
- Operational Flora and Fauna Management Plan for Moorebank Logistics Park – East Precinct (Arcadis 2020a)
- Threatened Flora Offset Management Plan (Arcadis 2020b)
- Nest Box Management Strategy. Moorebank Precinct East Stage 1 – Rail Link (CPB 2017)
- Moorebank Precinct West Stage 2. Koala Management Plan (Cumberland ecology 2020)

1.1 Moorebank Precinct East background

The Moorebank Logistics Park (MLP) is an integral component of the Freight, Ports and Transport strategies of both the NSW and Commonwealth governments to help manage the challenges of an expected tripling of freight volumes at Port Botany by 2031.

The MLP aims to streamline the freight logistics supply chain from port to store, deliver savings to businesses and consumers, and help service the rapidly growing demand for imported goods in south-west Sydney. It is located approximately 27 kilometres south-west of the Sydney Central Business District and approximately 26 kilometres west of Port Botany within the Liverpool Local Government Area. The MLP is divided into an East Precinct and a West Precinct, located east and west of Moorebank Avenue respectively.

The main features of MPE include:

- An Import Export (IMEX) Terminal. The IMEX Terminal comprises:
 - Truck processing, holding and loading areas with an entrance and exit from Moorebank Avenue
 - Rail loading and container storage areas serviced by container handling equipment
- An Administration facility and associated car parking with light vehicle access from Moorebank Avenue
- An Operational Rail Link connecting the IMEX terminal and the Southern Sydney Freight Line (SSFL) traversing Moorebank Avenue, Anzac Creek, Georges River and Glenfield Waste Facility
- Associated ancillary infrastructure including signage, lighting, landscaping, water management
- Warehouse and distribution facilities including warehousing up to 21 metres in height, typically ranging in size from 20,000 meters squared to 62,000 meters squared
 - Office and administration facilities
 - Amenities

- Car parking
- Truck loading/unloading docks
- Internal parking for pick-up and delivery vehicles (PUD)
- Specialised sortation and conveyor equipment
- Hardstand areas that provide trailer parking spaces, external PUD parking spaces, vehicle manoeuvring areas and access to the main internal site road
- Signage for business identification purposes, including backlit illuminated signage on each warehouse
- Internal fitout, comprising racking and storage
- A freight village including a mix of retail, commercial and light industrial spaces typically up to 15 metres in height and varying in size and design
- An internal road network to enable efficient movement of vehicles, dispatch of freight from the warehouses and transport of containers between the IMEX Terminal and warehouse and distribution facilities

In addition to the constructed assets of the MPE development there are several other areas which have been included within the MPE operational facility for the purpose of flora and fauna monitoring. These include:

- Five designated offset sites for EPBC listed threatened flora species within Wattle Grove offset area
- Lands adjoining (within 10 meters of) the Rail Link
- Riparian vegetation management sites at Anzac Creek and Georges River
- Nest box locations within Moorebank and Wattle Grove offset areas

1.2 Monitoring objectives

Management of flora and fauna values within the MPE operational facility and associated lands is reviewed on an annual basis following a series of detailed monitoring surveys. The core objectives of flora and fauna monitoring is to:

- Monitor protected threatened flora species
- Monitor protected vegetated areas adjacent to the operational facility (including EPBC offset areas)
- Monitoring to minimise harm to fauna and maintain habitat offsets (nest boxes)
- Monitor works to protect and improve riparian and aquatic environments
- Monitor for weed occurrence and recruitment within operational site

The results of flora and fauna monitoring across the MPE operational facility is the subject of this report. A series of recommendations are included to rectify any management issues identified during monitoring and enhance the biodiversity values within the MPE operational facility.

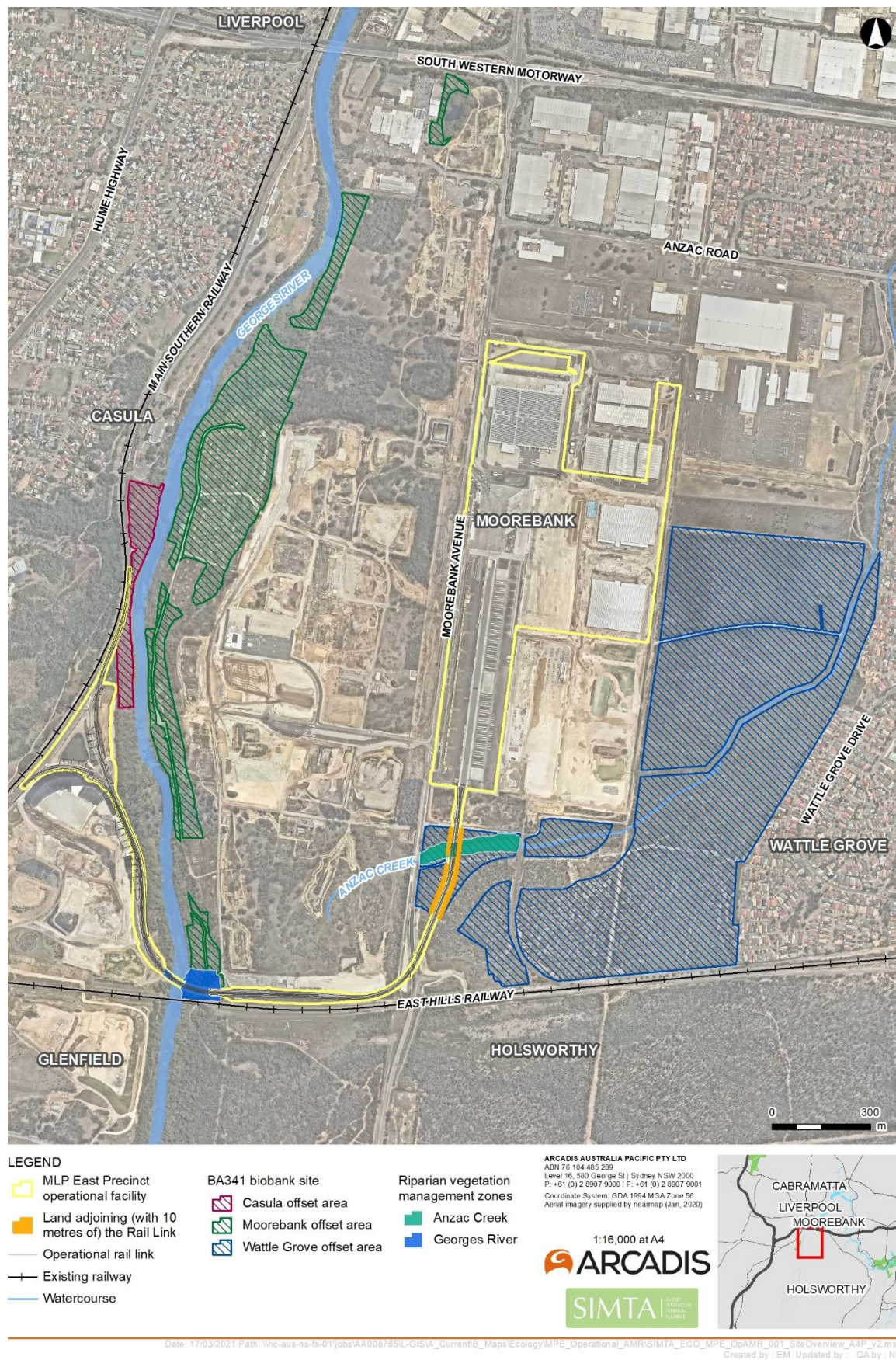


Figure 1. MPE operational facility and adjacent biobank site

1.3 Requirements for monitoring

The requirements to monitor flora and fauna values during operation of the MPE facility are summarised below in Table 1.

Table 1. MPE operational facility flora and fauna monitoring requirements

Subject	Approval condition	Requirement	Where addressed
Weed and feral animal monitoring	CoC B110 (SSD 7628)	<i>B110. Prior to operation, the Applicant must prepare an Operational Flora and Fauna Management Plan (OFFMP) in consultation with OEH. The OFFMP must form part of the OEMP required by condition C3 and must include measures to ensure biodiversity values not intended to be impacted are protected, including but not limited to:</i> <i>i. Weed control</i> <i>ii. Feral animal control</i> <i>iii. Pathogen management procedures</i> <i>iv. Monitoring</i> <i>v. Rehabilitation actions.</i>	Sections: 2.3, 3.3, 4.3 (weeds) 2.4.4, 3.4.4, 4.4.4 (feral animals)
	CoC B127 (SSD 7628)	<i>The Applicant must:</i> <i>a) take all reasonable steps to manage pests and vermin on the site;</i> <i>b) manage declared noxious weeds on the site in accordance with the requirements of the Noxious Weeds Act 1993;</i> <i>c) inspect the site on a regular basis, no less than every 3 months, to ensure that these measures are working effectively, and that pests, vermin or noxious weeds are not present on site in sufficient numbers to pose an environmental hazard, or cause the loss of amenity in the surrounding area</i>	
	CoA 5(h) (EPBC 2011.6229)	<i>For the better protection of EPBC listed flora & the environment on Commonwealth land, the person taking the action must engage a suitably 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):</i> <i>h) 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)</i>	
Riparian rehabilitation and management	CoC C21, E9 (SSD 6766)	<i>C21. The Georges River Bridge shall be designed to ensure fauna movement within the riparian corridor is maintained. The bridge shall be designed in consultation with DPI Water and DPI Fisheries and approved by the Certifying Authority. A copy of the final design shall be submitted to the Secretary for information and made available on the Project Website.</i>	Sections: 2.1.2, 3.1.1, 4.1.1

Subject	Approval condition	Requirement	Where addressed
		<i>E9. All activities taking place in, on or under waterfront land, as defined in the Water Management Act 2000 should be conducted generally in accordance with the NSW Office of Water's Guidelines for Controlled Activities.</i>	
	CoC B110 (i) (v) (SSD 7628)	<i>B110 (i),(v). See above.</i> Riparian vegetation monitoring will be conducted within the riparian management areas identified within the original MPE Stage 1 Riparian Vegetation Management Plan (Hyder 2015) and updated version (AMBS 2017). The monitoring requirements are also set out in these documents.	
EPBC threatened flora offsets	EPBC CoA 6(e)	<i>6(e). measures for regular monitoring of the status of individuals of Nodding Geebung and Small-flower Grevillea and their habitat as measured against the baseline population and distribution, including:</i> <i>i. fluctuations in population size and distribution; and</i> <i>ii. response to disturbances and/or management actions.</i> Monitoring of threatened flora species (Nodding Geebung and Small-flowered Grevillea) within the EPBC offset areas will be completed in accordance with the Threatened Flora Offset Management Plan (Arcadis 2020).	Sections: 2.2.2, 3.2.2, 4.2.2
Monitoring condition of threatened flora and vegetation adjacent to the Rail Link, within BA341 lands	EPBC CoA 5(i)	<i>ongoing monitoring to inform the adaptive management of native vegetation adjoining the rail easement</i> Monitoring of threatened flora and vegetation condition adjoining the Rail Link will be conducted in accordance with the OFFMP (Arcadis 2020a) and the BA341 Biobanking Agreement (OEH 2019) requirements.	Sections: 2.1.1, 2.2.1, 3.1.1, 3.2.1, 4.1.1, 4.2.1
Koala management	CoC B152 (SSD 7709)	<i>B152. Prior to clearing of native vegetation, a Koala Management Plan (KMP) must be prepared by a suitably qualified person in consultation with OEH and be submitted to the Planning Secretary for approval. KMP must:</i> <i>(a) identify habitat corridors, of adequate dimension to provide Koala habitat corridors as supported by Koala specialist, to provide connectivity both within the Intermodal Precinct area and with other core koala habitat areas (i.e. to the south and to the west along Georges River);</i> <i>(b) include details of structures to eliminate barriers to movement (presented by fences, roads, drainage culverts or pits, rail lines and the like) for koalas and other native fauna likely to use the site of habitat corridor;</i>	Sections: 2.4.2, 3.4.2, 4.4.2

Subject	Approval condition	Requirement	Where addressed
		(c) <i>include other measures to minimise the risk of harm to koalas.</i> Koala fencing is to be installed along the interface of the occupied habitat (the Boot Land) and the MPE operational site. Annual monitoring of the fencing will be conducted to ensure it is functional and in agreement within the Koala Management Plan (cumberland ecology 2020).	
Nest Boxes	EPBC CoA Annexure A – Summary of mitigation measures	<i>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.</i>	Sections: 2.4.3, 3.4.3, 4.4.3
	CoC E34(d)(ii)(b) (SSD 6766)	<i>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:</i> - <i>clearing procedures (including nest box plan)</i> Requirements for nest box monitoring have been documented with the approved Nest Box Management Strategy for Moorebank East Precinct Stage 1 – Rail Link (CPB 2017)	
	CoC B108 (a) (b (SSD 7628))	<i>B108. Prior to clearing of native vegetation, the Applicant must prepare a Construction Flora and Fauna Management Plan (CFFMP) in consultation with OEH. The CFFMP must form part of the CEMP required by condition C1 and must include the following:</i> (a) <i>measures to minimise the loss of key fauna habitat, including tree hollows;</i> (b) <i>measures to minimise the impacts on fauna on site, including conducting fauna pre-clearance surveys prior to vegetation clearing and building demolition</i>	

2 METHODOLOGY

This annual monitoring report summarises the findings of field surveys conducted across the MPE operational facility and provides an assessment of the management actions being implemented. This report contains the results of surveys and site inspections undertaken during the monitoring period, including details of:

- Date, time and location
- Nature of the inspection
- Name of the person conducting the inspection
- Weather observations.

Table 2 itemises the dates of survey including the monitoring actions completed and the prevailing weather conditions from the nearest weather station at Holsworthy Aerodrome AWS {station 066161} (BOM 2021).

Table 2. Timings and weather conditions on survey dates

Date	Survey Type	Temperature		Rain (mm)
		Min (°C)	Max (°C)	
1/04/2020	Weed monitoring survey	17.4	22.9	0
23/06/2020	Weed monitoring survey	2.8	15.6	0
13/08/2020	Weed monitoring survey	6.7	22.1	0
1/09/2020	Monitoring of EPBC offset sites (P1, P2, P3, G1)	8.3	18.1	0
7/09/2020	Monitoring of EPBC offset sites (P1, P2, P3, G1)	8.1	22.6	0
17/09/2020	Monitoring of EPBC offset sites (P1, P2, P3, G1)	10.2	30.9	0
21/09/2020	Monitoring of EPBC offset sites (P1, P2, P3, G1)	12.1	29.1	8.8
28/09/2020	Spring nest box monitoring	4.4	20.7	0
7/10/2020	Establishment and monitoring of EPBC offset site (P4)	16.2	No data	0
9/10/2020	Spring nest box monitoring	9.1	No data	0
14/10/2020	Monitoring of lands adjoining the Rail Link	13.4	22.6	0
15/10/2021	Weed monitoring survey	11.5	29.3	0
19/10/2020	Spring nest box monitoring	14.4	20.8	2.0
4/11/2020	Deploy remote cameras for feral animal and habitat connectivity monitoring, Monitoring of lands adjoining the Rail Link	10.2	29.0	0
10/11/2021	Establishment and monitoring of EPBC offset site (P4)	9.4	24.3	0
17/11/2020	Riparian vegetation monitoring at Georges River	15.7	23.6	0
18/11/2020	Spring nest box monitoring	16.2	No data	0
1/12/2020	Weed monitoring survey + Riparian vegetation monitoring at Georges River	17.1	32.4	0
10/02/2021	Weed monitoring	14.0	25.1	0
23/02/2021	Koala fencing inspection	18.8	20.5	0

2.1 Native vegetation monitoring

The methodologies applied to monitoring native vegetation at riparian vegetation management sites and in the lands adjoining the Rail Link are discussed below.

2.1.1 Lands adjoining Rail Link

Monitoring the condition of native vegetation adjoining the Rail Link was conducted to satisfy the conditional requirement: EPBC Act CoA 5(i) (Table 1). Condition monitoring was limited to native vegetation adjoining (within 10 metres) the Rail Link.

Vegetation condition was monitored by conducting two 10 x 40 metre vegetation quadrats using the Biodiversity Assessment Method (BAM). Vegetation quadrats were established on either side of the Rail Link corridor within the biobank site during the monitoring survey and permanently demarcated with a metal star picket. The permanent stake will allow for replication of vegetation condition plots in subsequent monitoring surveys.

The following variables were quantitatively assessed within BAM vegetation quadrats:

- Percent foliage cover of canopy species
- Percent foliage cover of shrub species
- Percent foliage cover of ground cover species
- Percent foliage cover of exotic species

2.1.2 Riparian vegetation management

Riparian vegetation monitoring has been undertaken to measure the success of bush regeneration works and track the regeneration of native vegetation at Georges River and Anzac Creek management areas. Results will be compared annually against the performance criteria identified in the Riparian Vegetation Management Plan (Table 4: Riparian vegetation management monitoring report Hyder 2015) to determine whether the implemented works are on track to achieving the RVMP objectives, which are to

- Restore, conserve and enhance the riparian vegetation in the Georges River and Anzac Creek site that fall within the SIMTA Rail Corridor
- Long term eradication of weed species from the management sites
- Maintain an adequate width of riparian vegetation adjoining Georges River and Anzac Creek
- Protect and enhance fauna habitat connectivity along the Georges River and Anzac Creek riparian zone.

In April 2018, the Anzac Creek riparian management area was severely burned in a bushfire. Following the bushfire asbestos was identified within the area, and since then, no bush regeneration works have been conducted within the Anzac Creek management zone. Subsequently, monitoring was not conducted by Arcadis to review bush regeneration activities within this management area.

The following monitoring activities were conducted at Georges River management area during the 2020 survey:

- A meandering walk traversing the management areas identifying signs of weed treatment (manual removal or chemical)
- Recording a flora species inventory
- Mapping the extent of weed control and revegetation works using an Arc-GIS enabled iPad
- Establishing photo-points and capture monitoring photographs
- Establishing and conducting fixed quadrat monitoring to assess the success of revegetation works (Plate 1). The methodology used to measure success of revegetation differed between the eastern

and western sides of the management site due to the different ages of plantings at revegetation sites. The applied methodologies are summarised in Table 3.



Plate 1. Quadrat monitoring of revegetation areas

Table 3. Quadrat monitoring methodology to measure revegetation success

Quadrat monitoring	Eastern side	Western side
Approximate time since installation of plantings	30 months	12 months
Chosen method of assessment	Measure percent coverage across a 25-metre squared quadrat for: • Native vegetation • Exotic vegetation • Bare ground A total of two quadrats were conducted.	Undertake a count for native plantings within a 25-metre squared quadrat and measure the percent coverage of exotic species cover. A total of two quadrats were conducted
Indicator of success	A minimum of 80 percent coverage of native plant species <5 percent weed coverage	Planting density is recommended at seven plant per square metre (AMBS 2017) which equates to 175 plants per 25 metres squared. Therefore, to achieve a 80 percent survivorship a minimum of 140 plantings must be present per 25 metres squared

- Remote camera monitoring to determine whether fauna are using the area to move between the BA341 biobank site and bushland in the south. Four remote infra-red cameras were deployed for a one-month period. Each camera was focusing on different sections of the corridor beneath the Rail Link bridge (Table 4).

Table 4. Remote cameras deployed to assess connectivity value of Georges River management site



2.2 Threatened flora monitoring

Threatened flora species were monitored within EPBC offset sites and lands adjoining the Rail Link. The methodologies used to monitor threatened flora are discussed below.

2.2.1 Lands adjoining Rail Link

Monitoring of threatened flora in the areas adjoining the Rail Link was conducted to satisfy the conditional requirement: EPBC Act CoA 5(i) (Table 1). This monitoring requirement is limited to land adjoining (within 10 metres) the Rail Link (subject area).

Monitoring for threatened flora species occurrence was conducted by walking parallel field transects across the subject area at three metre spacings, identifying threatened flora presence. Locations of threatened plants were recorded with an Arc-GIS enabled iPad and notes were collected on the health of plants and whether individuals were seeding, budding or lowering. Any impacts to threatened flora were documented.

2.2.2 EPBC offset sites

Annual monitoring of threatened flora EPBC offset sites was undertaken by Arcadis ecologists over six days in Spring 2020 (Table 2). A total of five offset sites were monitored within Wattle Grove offset area; four designated Nodding Geebung offset sites and one offset site for Small-flower Grevillea.

The monitoring activities conducted at each offset site are summarised in Table 5.

Table 5. Summary of monitoring action conducted for EPBC offset sites

Monitoring action	Methodology
Population census	Parallel field transect were undertaken across the EPBC offset sites, recording the number of Small-flower Grevillea and Nodding Geebung encountered. Transects were conducted on a three-metre spacing. The location of each plant identified was recorded with an Arc-GIS enabled iPad. For Nodding Geebung, the plants identified in the offset sites, which had not been already marked, were identified with numbered metal tags. The following information was collected for each Nodding Geebung identified during the survey: • size (height and spread) • health

Monitoring action	Methodology
	• reproductive status (evidence of flowering and fruiting)
Habitat assessment	A habitat assessment was undertaken at each of the EPBC offset sites. Habitat monitoring was assessed by conducting a 50 metre x 20 metre vegetation monitoring quadrat utilising the Biodiversity Assessment Method (BAM). Vegetation quadrats commenced from the demarcated central photo-point location and will maintain the midline bearing utilised during the inaugural EPBC offset monitoring survey. The BAM vegetation quadrat was used to quantitatively assess the following variables: • Per cent foliage cover of canopy species • Per cent foliage cover of shrub species • Per cent foliage cover of ground cover species • Per cent foliage cover of exotic species
Photo point monitoring	Photographs were captured at four demarcated locations around the perimeter of each offset site and at one location in the centre of the offset site. The locations of photo points have been demarcated with a metal stake and identifying metal tree tag. One photograph was captured in a single direction (as documented in the initial EPBC Threatened flora offset monitoring report) at each photo point located on the perimeter of offset sites. Four photographs were captured from central photo point locations in each of the four cardinal directions (North, East, South and West).

The results of monitoring for the EPBC offset sites has been summarised within the body of this report. For the complete EPBC Offset Site Annual Monitoring Report see Appendix B.

2.3 Weed monitoring

Weed monitoring has been conducted by an ecologist on a bi-monthly basis over the 2020/2021 monitoring period: during the months of April, June, August, October, December and February.

Weed monitoring involved inspection of landscaped areas, stormwater infrastructure and areas adjoining the Rail Link for invasive plant species. The attending ecologist traversed the operational area on foot identifying weed species and mapping infestations on an Arc-GIS enabled iPad.

The following information was collected during monitoring surveys:

- Presence of exotic species, including priority weeds¹
- Percent foliage cover of exotic species
- Percent foliage cover of priority weeds

The coverage of exotic and priority weeds was estimated based on the area of cover within mapped polygons.

The ecologist recorded any signs of weed control works conducted between monitoring periods.

A summary of changes to weed occurrence across the MPE operational facility has been included with the body of this report. For a compilation of bi-monthly weed monitoring reports produced in the monitoring year see Appendix A.

¹ invasive plant species listed as priority status under the Biosecurity Act 2015 for the Greater Sydney Local Land Services region

2.4 Fauna monitoring

A series of surveys were undertaken to assess fauna habitat, fauna infrastructure and feral animal presence across the MPE operational area. The survey methodologies conducted have been discussed below.

2.4.1 Habitat connectivity monitoring

Fauna habitat connectivity monitoring was conducted at Anzac Creek culvert using four remote infra-red cameras. Cameras were located to capture animals moving between two patches of bushland connected by the Anzac Creek culvert. Cameras were set up at the following locations:

- Northern bank of Anzac Creek facing downstream
- Northern bank of Anzac Creek facing upstream
- Southern bank of Anzac Creek facing downstream
- Southern bank of Anzac Creek facing upstream

The captured view of deployed cameras at each survey location are presented in Table 6.

Following collection of remotes cameras captured photographs were reviewed for animal presence. The species captured, date and time of the photograph were recorded.

Table 6. Remote cameras deployed at Anzac Creek management site to monitor habitat connectivity

	
Remote camera: Downstream South	Remote camera: Downstream North
	
Remote camera: Upstream South	Remote camera: Upstream North

2.4.2 Koala management monitoring

Arcadis ecologists made a visual inspection of fencing and Koala structures separating the BA341 biobank site (Wattle Grove offset area) from the MPE site. Koala fencing, bridges and culverts were assessed for installation and condition in accordance with *Figure 9. Location of Koala Grids and Bridges* of the Moorebank Precinct West Stage 2 Koala Management Plan (KMP) (Cumberland Ecology, 2020) (Appendix G).

Visual inspections included an assessment of:

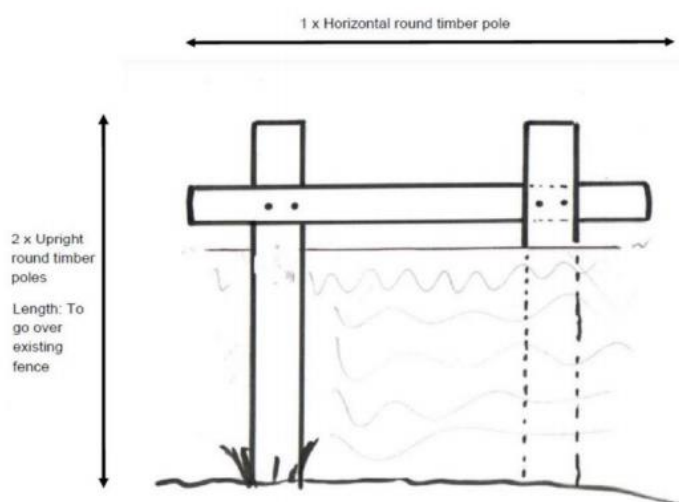
- The level of intactness of fences, identifying damage, holes, points of entry, and areas of collapse or corrosion
- Condition of koala bridges across cyclone fencing
- Condition of koala gates and grids at management access points to the biobank site (Table 7)

Where issues were identified photographs were captured and locations recorded using an Arc-GIS enabled iPad.

Table 7. Koala structures to be installed in conjunction with perimeter fencing



Koala grids



Koala bridges

2.4.3 Nest box monitoring

Two Arcadis ecologists attended MLP to conduct nest box monitoring over four days during September, October and November 2020 (Table 2). Nest boxes are located across Wattle Grove and Moorebank offset areas within the BA341 biobank site.

The Wattle Grove offset area and Moorebank offset area were traversed on foot inspecting nest boxes. During the 2020 surveys 213 of the 253 nest boxes previously identified were re-found and monitored. A visual investigation of each nest box was conducted, inspecting the outside of each nest box with binoculars and the inside using a pole mounted inspection camera. The following information was collected:

- Inspection details (such as date, time and attending ecologist(s))
- Nest box number and location (to confirm against previous rounds of monitoring in 2018 and 2019)
- Occupancy status (including species level identification where possible)
- Evidence of previous occupancy (such as scratches, debris, feathers or whitewash)

- Presence or evidence of feral species occupation
- General condition of the nest box
- Any recommended maintenance requirements, such as:
 - 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 other notes such as changes to land use or reasons for low occupancy.

Since the previous survey in 2019, 13 nest boxes had been decommissioned, however a further 27 boxes within the Georges River Corridor could not be located. It is possible that some of these boxes have fallen since the 2019 survey and were subsequently not detected or may have been overlooked during the spring 2020 survey.

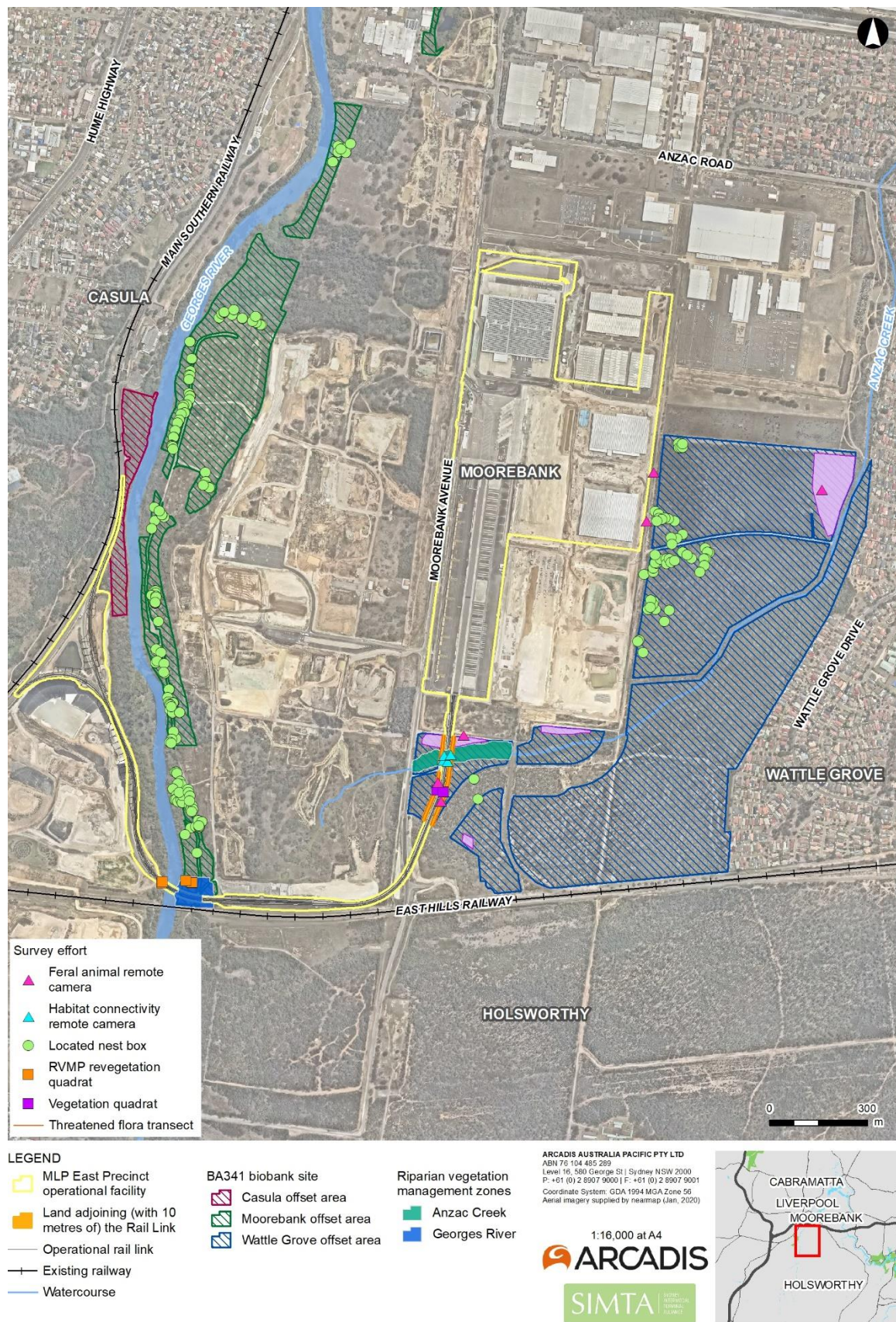
2.4.4 Feral animal monitoring

Feral animal presence was investigated within the MPE operational facility by deploying remote cameras. Six remote infra-red cameras were set up along the boundary fence of MPE where it interfaces the BA341 Biobank Site. Cameras were left in place for a period of two months to detect feral animal activity, following which, the captured images were reviewed and processed. The species captured, date and time of the photograph was recorded.

Baits were not used to lure animals instead cameras were placed in areas which had evidence of feral species presence (burrows and animal trails) and along access trails, internal roads and connecting passages that are likely to be used by feral animals when moving across the landscape. Examples of the captured view of deployed cameras is presented in Table 8.

Table 8. Feral animal remote camera locations

	
Remote camera focusing on animal trail parallel to Rail Link corridor fence	Remote camera focusing on access road within Wattle Grove offset area



3 RESULTS

A suite of surveys were undertaken to assess the condition of flora and fauna values across the MPE operational facility. The section below discusses results of this monitoring.

3.1 Native vegetation

The result of monitoring native vegetation at riparian vegetation management sites and in the lands adjoining the Rail Link are discussed below.

3.1.1 Lands adjoining Rail Link

The Rail Link of the MPE development dissects Wattle Grove offset area, which forms part of the BA341 biobank site. Monitoring was conducted for vegetation in the biobank site, which adjoins (within 10 metres of) the Rail Link.

Native vegetation either side of the Rail Link is the Plant Community Type (PCT) 883 Castlereagh Scribbly Gum woodland. This vegetation has a good condition with low levels of weed occurrence and a diversity of native plant species. This assemblage of native woodland is fully structured including trees, shrubs and groundcover vegetation. No signs of natural dieback were observed during monitoring surveys.

Two vegetation quadrats were conducted within the lands adjoining the Rail Link; one on the eastern side and one on the western side. A summary of the results of quadrat monitoring is presented in Table 9.

Table 9. Results of vegetation quadrat monitoring

Coverage (%)	Monitoring quadrat on western side of Rail Link (Q1)	Monitoring quadrat on eastern side of Rail Link (Q2)
Native canopy species	31.0	25.0
Native shrub species	33.0	28.3
Native groundcover species	23.0	13.1
Exotic species	0.0	0.1

Two species of exotic plant were recorded during quadrat monitoring, *Eragrostis curvula* (African Love Grass) and *Senecio madagascariensis* (Fireweed). Exotic species recorded a low coverage across both quadrats; equating to 0.1 percent or less. No other notable infestations of weeds was observed in native vegetation adjacent to the Rail Link during the inspection.

3.1.2 Riparian vegetation management

The results of monitoring native vegetation and bush regeneration works at Georges River management site is summarised below.

3.1.2.1 Weed occurrence

Weed occurrence and coverages varies across the eastern and western sides of the Georges River management site. Bush regeneration works including weed removal and revegetation plantings have been undertaken at different times. The current weed levels at each location are discussed below.

Georges River management site (eastern side)

Within revegetated areas in the northern half of the Georges River management site weed occurrence and coverage is low. A sparse scattering of invasive grasses, herbaceous weeds and exotic vines were observed amongst native plantings including *Cardiospermum grandiflorum* (Balloon Vine), *Bidens pilosa* (Cobblers Peg) and *Anagallis arvensis* (Scarlet Pimpernel). Minimal encroachment of woody weeds

Lantana camara (Lantana) and *Ligustrum sinense* (Narrow-leaved Privet) was observed into revegetation areas from infestations immediately to the north.

On the southern side of the Rail Link bridge weed occurrence amongst plantings is greater. Commonly encountered weeds in this area include *Acetosa sagittata* (Turkey Rhubarb), *Conyza bonariensis* (Flea bane), *Ehrharta erecta* (Panic Veldtgrass), *Senecio madagascariensis* (Fireweed) and *Solanum nigrum* (Blackberry Nightshade).



Plate 2. Plantings to the south of the Rail Link bridge with a low-moderate coverage of weeds

No evidence of weed control works in the months preceding the monitoring inspection were identified. No dead weeds were observed in situ indicating herbicide spraying nor were any recently removed weeds stockpiled on site. However, scarcity of weeds throughout revegetation areas in the northern half of the management site suggests that weed control works have been conducted within the year.

Georges River management site (western side)

The Georges River management site on the western side of the Georges River is significantly smaller than that on the eastern side. Weed removal works and revegetation has been undertaken in this area over the past year. All areas within the management site have been cleared of weeds and planted out with native tube stock plants. Weed cover is low across the site with only a sparse scattering of exotic species being present. Weed species identified within the management site included *Bromus catharticus* (Prairie Grass), *Cirsium vulgare* (Spear Thistle), *Cyperus eragrostis* (Umbrella sedge) and *Verbena bonariensis* (Purpletop).

Either side of the management site weed levels are higher. To the north, thickets of Small-leaved Privet, Balloon Vine and *Olea europaea* subsp. *cuspidata* (African Olive) are present. To the south, vegetation is mixed native exotic. A moderate coverage of herbaceous weed, invasive grass and woody weeds are present amongst native trees, shrubs and groundcovers. Herbaceous weeds from the south were observed encroaching on the management site whereas vines and woody weed infestations to the north were not.



Plate 3. Mixed native exotic vegetation to the south of management site

Other than initial weed clearance works prior to revegetation, no signs of weed control works were observed during the monitoring survey. No dead weeds were observed in situ indicating herbicide spraying nor were any recently removed weeds stockpiled on site. The encroachment of weeds from the south suggest that weed control works have not been undertaken within this section of the management site in the months preceding the monitoring survey.

3.1.2.2 Revegetation

Plantings for the Georges River management site were selected based on species included in the River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bioregions (RFEFCF) Endangered Ecological Community (EEC). Species commensurate with this EEC which have been planted at the Georges River management site include *Acacia Parramattensis* (Parramatta Wattle), *Bursaria Spinosa* (Native Blackthorn), *Echinopogon ovatus* (Forest Hedgehog Grass) and *Melaleuca styphelioides* (Prickly-leaved Tea Tree). A full list of RFEFCF EEC species that were used for revegetation is included in Appendix C

The 2020 survey marked the second time monitoring has occurred for plantings on the eastern side of the Georges River management site. Plantings on the western side of the Georges River were monitored for the first time to provide a baseline data set and photographs to compare against in future monitoring periods.

Four 5 x 5 metre monitoring quadrats were situated within the revegetated areas in the Georges River management area; two on the western side and two on the eastern side of the river. Plantings on the western side of the river (Q3 and Q4) have occurred more recently than those on the eastern side (Q1 and Q2) and were able to be assessed for individual plant survivorship rather than overall percent coverage.

An inventory of flora species identified within the fixed monitoring quadrats has been included in Appendix C.

Georges River management site (eastern side)

Plantings on the eastern side of the Georges River within the management site have displayed significant growth over the past year. Generally, the coverage of native species has increased and weed coverage remains at low levels. The results of quadrat monitoring are summarised in Table 10 and discussed below.



Plate 4. Prolific growth of plantings at Georges River management site (eastern side)

Quadrat Q1 recorded 17 native species and 11 exotic species. Total native species cover accounted for 85 percent of the 25 metres squared area. Native species identified included *Eucalyptus* spp., *Themeda triandra* (Kangaroo Grass), *Acacia binerva* (Coast Myall) and *Melaleuca stypheliodes* (Prickly-leaved Tea Tree). Total invasive species cover across quadrat Q1 accounted for 2 percent. Invasive species identified included *Cardiospermum grandiflorum* (Balloon Vine), *Ligustrum sinense* (Small-leaved Privet) and *Anagallis arvensis* (Scarlet Pimpernel).

Quadrat 2 recorded 23 native species and 14 invasive species. Total native species cover accounted for 70 percent of the 25 metres squared area. Native species identified included Coast Myall, *Alternanthera denticulate* (Lesser Joyweed) and *Melaleuca linariifolia* (Flax-leaved Paperbark). Total weed coverage across quadrat Q2 accounted for 5 percent. Invasive species identified included *Bidens pilosa* (Cobbler's Pegs), *Lantana Camara* (Lantana) and *Conyza bonariensis* (Flaxleaf Fleabane).

Table 10. Results of quadrat monitoring

Quadrat identifier	Objective	Result
Georges River management site (eastern side)		
Quadrat 1	80% coverage	85%
Quadrat 2		70%

Table 11. Photo point tracking at Georges River Management Site

	
Photo point 1 (2019)	Photo point 1 (2020)
	
Photo point 2 (2019)	Photo point 2 (2020)

Georges River management site (western side)

Plantings at the western side of Georges River management site have established and growing well. The density of plantings across the area ranges. Some areas have a high density of plantings of between 10 - 12 plants per square metre and other areas have scattered plantings of one to three plants per square meter. Exotic coverage was generally low however some areas have small, isolated infestations of exotic grasses and herbaceous weeds. The results of quadrat monitoring are summarised in Table 12 and discussed below.



Plate 5. Established plantings at Georges River management site (western side)

Quadrat 3 recorded 19 native species and ten invasive species. A total count of plantings within Q3 recorded 155 individuals. Plantings included a suite of native species including *Dichelachne micrantha* (Shorthair Plumegrass), *Geranium homeanum* and *Hardenbergia violacea* (False Sarsaparilla). Total weed cover across Q3 accounted for around 1 percent. Invasive species identified included *Anagallis arvensis* (Scarlet Pimpernel) and *Trifolium repens* (White Clover).

Quadrat 4 recorded nine native species and 16 invasive species. A total count of plantings within Q4 recorded 129 native individuals. Plantings included a suite of native species including *Acacia parramattensis* (Parramatta Wattle), *Bursaria spinosa* (Native Blackthorn) and *Entolasia marginate* (Bordered Panic). Total weed cover across Q4 accounted for around ten percent. Invasive species identified included *Holcus lanatus* (Yorkshire Fog) and *Verbena bonariensis* (Purpletop).

Table 12. Results of quadrat monitoring

Quadrat identifier	Objective	Result
Georges River management site (western side)		
Quadrat 3	80% survivorship	89% survivorship 155 plants / 175 plants *100
Quadrat 4		74% survivorship 129 plants / 175 plants *100

Two photo point locations were established during the 2020 surveys. Photographs will be captured at these locations during future monitoring events to track changes to vegetation and survivorship of plantings. These photo points have been presented in Table 13.

Table 13. Established photo points at Georges River management site on the western side of the river

	
Photo point 1 (2020)	Photo point 2 (2020)

3.1.2.3 Habitat connectivity

The eastern side of the Georges River management site was assessed to determine whether it provides connectivity to facilitate the movement of native fauna between bushland within the MLP site and areas of bushland to the south.

Areas to the north of the Rail Link bridge have been restored with native vegetation. Extensive weed control works have been undertaken followed by revegetation of the area with native species. Beneath the Rail Link bridge rock ballast has been placed and no revegetation has occurred. Large logs and piles of thin course wood debris have been placed on top of the ballast to increase the suitability of the area for fauna movement (Plate 6). The section of Georges River management site to the south of the Rail Link bridge has been revegetated native species and provides adequate vegetation structures for fauna to use when moving through the landscape.



Plate 6. Large logs and piles of coarse woody debris placed to facilitate movement of fauna across ballast

Four remote cameras were set up to monitor the area beneath the Rail Link bridge to determine whether fauna are moving under the Rail Link bridge to vegetated areas either side and whether they are using the coarse woody debris structures placed on the rock ballast.

A total two fauna species were identified on remote cameras beneath the Rail Link bridge including Red Fox (*Vulpes vulpes*) and Swamp Wallaby (*Wallabia bicolor*). Neither species was observed using placed logs and debris to cross beneath the bridge. Photographs captured on remote cameras are displayed in Table 14.

Table 14. Fauna recorded crossing the ballast under the Rail Link

 A photograph of a Swamp Wallaby crossing a rocky area under a bridge. The wallaby is dark-colored and is captured in motion. The background shows a concrete bridge pillar and some vegetation. 15 °C 59 °F 15/02/2021 06:37:54 0001 0043	 A photograph of a Red Fox crossing a rocky area under a bridge. The fox is reddish-brown and is captured in motion. The background shows a concrete bridge pillar and some vegetation. 25 °C 77 °F 25/02/2021 14:11:58 0025
Swamp Wallabies	Red Fox

It was noted during the inspection of Georges River management site that a cyclone fence with top-line barbed wire has been erected at the southern extent of the site. The fence delineates the MLP site from areas to the south and is likely to form a barrier to the movement of some fauna species across the landscape (i.e. macropods) (Plate 7).



Plate 7. Newly erected cyclone fence at the southern extent of the management site

3.2 Threatened flora

The results of monitoring threatened flora are discussed below.

3.2.1 Lands adjoining Rail Link

Threatened species transect identified three threatened plant species within 10 metres of the Rail Link corridor fencing:

- *Acacia bynoeana* (Bynoe's Wattle)
- *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)
- *Hibbertia puberula* subsp. *puberula*

Bynoe's Wattle and Small-flower Grevillea were observed to be sparsely scattered in localised patches whereas *Hibbertia puberula* subsp. *puberula* was observed in high numbers particularly at the southern extent of the site on the eastern side of the Rail Link. The locations of threatened plants has been presented in Figure 3.

Table 15 provides the listing status for the threatened plant species located and a count for the number of individuals found.

Table 15. Threatened plant species identified within lands adjoining the Operational Rail Link

Species	Listing status	Number of individuals identified
<i>Acacia bynoeana</i> (Bynoe's Wattle)	BC Act: Endangered EPBC Act: Vulnerable	6
<i>Grevillea parviflora</i> subsp. <i>parviflora</i> (Small-flower Grevillea)	BC Act: Vulnerable EPBC Act: Vulnerable	1
<i>Hibbertia puberula</i> subsp. <i>puberula</i>	BC Act: Endangered EPBC Act: Not listed	85

Threatened plants were mostly observed to be in good condition. All plants observed have germinated or resprouted since the area was burnt in April 2018 by a wildfire. *Hibbertia puberula* subsp. *puberula* were observed flowering and a number of recently sprouted individuals were identified. Small-flower Grevillea and Bynoe's Wattle were not observed to be fruiting or flowering at the time of survey.

Impacts to native vegetation and threatened species from herbicide was observed on the outside of the Rail Link corridor fencing. Shrubs and native ground covers within 1.5 metres of the fencing showed signs of impacts. It is hypothesized that overspray of native plants occurred during hi-volume spraying of weeds as a part of remediation works within the Rail Link between August and October. Patches of *Hardenbergia violacea* growing on corridor fencing showed signs of impacts from herbicide, browning off and in some instances completely dying.

One individual of *Acacia bynoeana* (Bynoe's Wattle) was identified as being moderately impacted by herbicide overspray. At the time of surveying this individual was identified as being alive but was in a poor condition. Subsequent surveys have confirmed the individual has recovered since being impacted by herbicide (Table 16).

Table 16. *Bynoe's Wattle* in close proximity to rail corridor impacted by herbicide overspray



Date captured: 14 October 2020



Date captured: 23 February 2021



Figure 3. Results of monitoring lands adjoining the operational Rail Link

3.2.2 EPBC offset sites

The results of monitoring Nodding Geebung and Small-flower Grevillea populations within EPBC offset sites is summarised below. The complete 2020 Annual Monitoring Report for EPBC offset sites is included in Appendix B.

3.2.2.1 Population census counts

The population census results for Nodding Geebung and Small-flower Grevillea are presented below.

Nodding Geebung

A total of 133 Nodding Geebung were recoded across the four EPBC offset sites established within Wattle Grove offset area.

Table 17. Populations of Nodding Geebung within EPBC offset sites

EPBC offset site	Number of individuals
Nodding Geebung P1	13
Nodding Geebung P2	0
Nodding Geebung P3	77
Nodding Geebung P4	43
Total	113

A total of 90 individuals were recorded across offset sites P1, P2 and P3. These offset sites were surveyed during 2019 and have a baseline data set that can be readily compared with to provide information on survivorship of individuals as well as recruitment rates. Nodding Geebung populations within offset site P1, P2 and P3 fluctuated over the monitoring year (Table 18). A moderate proportion (4 percent) of Nodding Geebung recorded during the previous survey (2019) were not re-found during the recent survey and are presumed have perished. The numbered metal tags were recovered for all perished juvenile plants. New recruitment of Nodding Geebung was observed across two of the offset sites with 29 new Nodding Geebung identified. Changes to Nodding Geebung across offset sites is summarised in Table 18.

Table 18. Fluctuation in Nodding Geebung population across offset sites P1, P2 and P3

Attribute	Nodding Geebung individuals
Re-found	61
Not re-found (presumed dead)	50
New individuals (presumed to have germinated)	29
Total number present	90

A total of 43 Nodding Geebung were identified in offset site P4 during the 2020 survey. Only adult plants were present, most of which were observed flowering and seeding at the time of survey. The 2020 survey marked the first time this offset site has been monitored and subsequently changes to population can't be measured. Results from this survey will form a baseline data set that can be compared against in future monitoring events.

Small-flower Grevillea

A total of 60 Small-flower Grevillea were identified within offset site G1 during the 2020 survey. Unlike Nodding Geebung, the TFOMP (Arcadis 2020) did not include provisions to mark Small-flower Grevillea individuals during the 2019 survey, therefore, recruitment and death rates within the population can't be accurately determined.

3.2.2.2 Habitat assessment

Habitat assessments for Nodding Geebung and Small-flower Grevillea were conducted by undertaking BAM vegetation quadrats within offset sites. This method gave scores for vegetation coverage and species abundance that could be compared across monitoring periods to describe changes to vegetation structure and composition. The result of vegetation condition quadrats including resulting Vegetation Integrity (VI) Scores is presented in Table 19.

Table 19. Summary of vegetation assessments using BAM quadrats

Offset Sites	P1	P2	P3	P4(A)	P4(B)	G1
Canopy cover	16	47.3	36	45	32.4	24
Shrub cover	46	15.7	5.7	43.9	18	21.2
Ground cover	6.8	22.1	22.9	25.4	8.2	17
Exotic cover	0.1	0	0.2	0	0	0.1
VIS	64.8	56.5	59.6	73.4	50	47

No obvious threats to Nodding Geebung or Small-flower Grevillea or their habitats were identified during the monitoring event. Exotic species occurrence and coverage across offset areas was generally low and was not observed to be negatively impacting either species. Currently there is significant competition in the shrub and understorey stratum with an overabundance of post-fire recruiters like *Acacia decurrens* (Black Wattle), *Imperata cylindrica* (Blady Grass), *Pimelea linifolia* (Slender Rice Flower), *Platysace ericoides*, *Pultenaea villosa* (Hairy Bush-pea) and *Trachymene incisa* (Trachymene). These native species were observed competing for habit resources and in some instance smothering individuals of Nodding Geebung and Small-flower Grevillea.

3.3 Weed occurrence and coverage

A total of six monitoring surveys of the MPE operational facility and Rail Link have been undertaken during the first year of operations at the site. These were undertaken in April, June, August, October and December during 2020 and in February 2021.

Across the MPE operational facility and Rail Link, eight priority weed species have been identified including *Alternanthera philoxeroides* (Alligator Weed), *Asparagus asparagoides* (Bridal Creeper), *Cortaderia selloana* (Pampas Grass), *Lantana camara* (Lantana), *Ludwigia peruviana* (Ludwigia), *Nassella neesiana* (Chilean Needle Grass), *Olea europaea* subsp. *cuspidate* (African Olive), *Senecio madagascariensis* (Fireweed). Priority weeds were sparsely scattered, mainly located within the Rail Link corridor. No infestations of priority weeds are present or have been recorded within the MPE operational facility.

Coverage of weeds across the MPE operational facility is generally low. Minor increases in weed coverage and exotic species diversity has been observed within trunk drainage infrastructure running along the western boundary and in drainage swales at the north-eastern extent of the site. Weeds are more prevalent within the Rail Link.

Monitoring surveys in April and June identified significant infestations of weeds within the Rail Link corridor. Weeds were observed colonising soft batters and soft landscaped areas adjacent to the rail track with a high percent coverage. A suite of exotic grasses, herbaceous and woody weeds were recorded including *Acacia saligna* (Golden Wreath Wattle), *Chloris gayana* (Rhodes Grass), *Eragrostis*

curvula (African Love Grass), *Pennisetum clandestinum* (Kikuyu), *Ricinus communis* (Caster Oil Plant) *Sida rhombifolia* (Paddy’s Lucerne) and *Verbena bonariensis* (Purple Top).

Minor occurrences of weed control works were observed during the June, April and August surveys including spot spraying with herbicide and slashing of exotic grasses. Major remediation works were undertaken between the August and October surveys within the Rail Link to remove weeds and stabilise slumping soft batters. Works occurred along the Rail Link from the MPE operational facility to the junction between the Qube Rail Link and the Southern Sydney Freight Line. Works undertaken during this major remediation event included:

- Spraying of weeds colonising soft batters with herbicide
- Clearing of treated weeds, removing vegetative material back to exposed soil
- Reforming of slumped soft batters
- Placing and securing of coir mesh to stabilise exposed batters
- Clearing of exotic grassland outside of the rail corridor fence on the western side of Georges River adjacent to the Rail Link and bridge structure
- Removal of Burr Medic and other weed species observed growing outside of the rail corridor fence on the western side of the Rail Link, nearest the MPE operational facility.

A series of before and after photographs captured along the Rail Link are presented in Table 20 below.

Table 20. Photographs of the Rail Link showing changes following major remediation works

	
August 2020	October 2020
	
June 2020	October 2020



Herbaceous weeds and exotic grasses were observed to be re-colonising remediated areas within the Rail Link during the December survey, Colonising weed species included *Conyza* sp. (Fleabane) *Medicago polymorpha* (Burr Medic), *Solanum nigrum* (African Nightshade) and *Trifolium repens* (White Clover) (Plate 3).

During the February 2021 weed inspection regenerating weed growth within remediated areas of the Rail Link were observed to have been treated with herbicide (Plate 8). A large proportion of weeds were observed to have decreased as a result of treatment, however scatterings of live plants were still present. Biomass of treated weeds remain along remediated batters.



Plate 8. Regenerating weed growth treated with herbicide

A compilation of bi-monthly weed monitoring reports prepared for the MPE operational facility have been included in Appendix A.

3.4 Fauna

The results of monitoring fauna habitat, fauna infrastructure and feral animal presence across the MPE operational area is discussed below.

3.4.1 Habitat connectivity

Remote infra-red cameras captured a suite of native and introduced fauna utilising the Anzac Creek culvert to move between patches of bushland within Wattle Grove offset area. Remote cameras were positioned at four locations at Anzac Creek culvert. Native species recorded moving through Anzac Creek culvert included Eastern Grey Kangaroo (*Macropus giganteus*), Red-bellied Black Snake (*Pseudechis porphyriacus*) and White-faced Heron (*Egretta novaehollandiae*) (Table 21).

Introduced fauna were also captured moving through Anzac Creek culvert including Red Fox (*Vulpes vulpes*), Black Rat (*Rattus rattus*) and Domestic Cat (*Felis catus*).

A complete list of fauna recorded on remote cameras at Anzac Creek culvert has been included in Appendix F.

Table 21. Fauna captured on remote cameras moving between patches of bushland using Anzac Creek culvert



Eastern Grey Kangaroo



White-faced Heron

3.4.2 Koala management

Arcadis ecologists traversed the fence line separating the Wattle Grove offset area from the MPE operational facility on 23 February 2021.

No Koala bridges or grids (Table 7) recommended for installation as per the MLP Koala Management Plan (KMP)(Cumberland ecology 2020), were recorded during the inspection. Fauna ramps were located at Anzac Creek culvert which may provide connectivity between patches of bushland for Koala. Fauna ramps were observed to be in good condition.

The fencing separating the MPE operational facility from Wattle Grove offset area had a good structure and was observed to be intact along most of its alignment. Only one section of fencing was identified to be damaged with the top line of barbed wire being snapped.



Figure 4. Locations of Koala fencing issues

3.4.3 Nest boxes

A total of 213 nest boxes were located by Arcadis during 2020 monitoring, with 192 inspected internally using a pole-mounted camera. The remaining 21 were not inspected internally for the following reasons:

- Boxes were occupied by fauna during external inspections. Internal inspections were not undertaken to avoid further disturbance to fauna occupying these boxes.
- Boxes were installed too high and could not be reached by pole-mounted camera.
- Boxes were not fitted with hinged lids and could not be accessed with pole-mounted camera.

A total of 47 nest boxes were occupied by native fauna at the time of inspection, which equates to 31 percent of nest boxes within the Bootland and 19 percent in the Georges river corridor. Native species identified as inhabiting nest boxes include Australian Owlet-nightjar (*Aegotheles cristatus*), Rainbow Lorikeet (*Trichoglossus moluccanus*), Ringtail Possum (*Pseudocheirus peregrinus*), and Sugar Glider (*Petaurus breviceps*) (Table 22).

Ten of the 213 nest boxes inspected were occupied or showed signs of occupation by introduced species. Introduced fauna included *Acridotheres tristis* (Common Myna), *Apis mellifera* (European Honey Bee) (Table 22), and *Rattus rattus* (Black Rat).

Table 22. Inhabited nest boxes during the 2020 survey

	
Owlet Nightjar within nest box	Ringtail Possum within nest box
	
Sugar glider within nest box	European Honey-bee hive within nest box

A total of 186 nest boxes, 49 in the Bootland and 137 in the Georges River Corridor, are in good condition and providing suitable habitat for hollow dependant fauna.

Surveys identified 17 nest boxes, all from the Georges River Corridor, as being 'dysfunctional' for the following reasons:

- Two boxes (boxes #81 and #128) were in a state of disrepair.
- 12 boxes mounted incorrectly (e.g. upside down, unsteady on tree, lids open), including box #55, #68, #80, #91, #92, #93, #95, #101, #102, #133, #136 and #202.
- Three boxes (#8, #24, #14) have resulted in the death of animals due to not having an internal ladder for fauna to exit.

According to Section 5 of the MPE NBS (CPB 2017), nest boxes must be installed at a height below 10 metres to allow for visual inspection using an inspection camera and extension pole. A total of 9 nest boxes (#71, #117, #125, #148, #172, #206, #232, #233, #250) in the Georges River Corridor were installed at a height above 10 m and could not be reached using a pole-mounted camera.

3.4.4 Feral animals

Remote camera monitoring identified four feral animal species within the MPE operational facility including European Hare (*Lepus europeus*), Domestic Cat (*Felis catus*)², Red Fox (*Vulpes vulpes*) and Black Rat (*Rattus rattus*) (Table 23).

Remote cameras were deployed at six locations along the western boundary of Wattle Grove offset area, nearest to the operational facility. Red Fox and Domestic Cat were captured at all locations immediately adjacent to the operational facility.

A complete list of fauna recorded on remote cameras has been included in Appendix F.

Table 23. Feral animal species within the MPE operational facility

	
European Hare	Domestic Cat

² Domestic Cat has been used to describe household and feral animals



Red Fox



Black Rat

4 DISCUSSION AND RECOMMENDATIONS

An assessment of the various monitoring requirements for the MPE operation facility has been discussed below. Where necessary recommendations have been included to improve or enhance the management of biodiversity values.

4.1 Native vegetation

4.1.1 Lands adjoining Rail Link

Castlereagh Scribbly Gum woodland (PCT 883) vegetation adjacent to the Rail Link was in good condition and showed low levels of weed occurrence. There was a high diversity of native plant species within the area, with the native woodland assemblage being fully structured, including trees, shrubs and native groundcover vegetation.

Both monitoring quadrats recorded low levels of exotic species coverage (0 percent within monitoring quadrat Q1 and 0.1 percent within monitoring quadrat Q2). The results of the 2020 survey will formulate a baseline data set which will be useful in comparing future monitoring results to determine whether the condition of vegetation is increasing or decreasing over time.

Currently no management actions are recommended to increase the condition of native vegetation adjoining the Rail Link.

4.1.2 Riparian vegetation management

Bush regeneration works within the Georges River management site were conducted by Toolijooa environmental restoration on behalf of CPB Contractors up until June 2020. Works within the management site have been conducted with the objective of re-establishing the vegetation community River-Flat Eucalypt Forest on Coastal Floodplain (RFEFCF) throughout areas impacted by the MPE Stage 1 Rail Access Link Package (RALP) project.

Works within the management site have been compared against a series of Key Performance Indicators (KPIs) (Hyder 2015) in Table 24. It is evident that bush regeneration works have progressed well and that majority of the KPI's are being achieved. Recommendations for revegetation, weed control and connectivity enhancement are discussed further below.

Table 24. Key Performance Indicators (KPIs) for RVMP works

Key Performance Indicator	Status		Comments
	Georges River	Anzac Creek	
Certification that all plant stock used for revegetation are of local botanical provenance	Unknown	NA	<i>DRAFTING NOTE: Toolijooa environmental restoration to supply native propagation certificate</i>
Gradual improvement of native plant establishment with the aim of achieving 80 percent cover of native vegetation after five years following initial planting	Achieving	NA	Eastern side of Georges River Approximately 30 months has lapsed since planting was conducted on the eastern side of the Georges River management site. Quadrat monitoring of revegetated areas identified on average a native plant coverage of 77.5 percent; 85 percent at Q1 and 75 percent at Q2. Although both quadrats did not achieve an 80 percent native vegetation cover, exotic species coverage is low and bare areas are anticipated to be colonised by native species over the coming year. It is recommended that instead of installing additional plants in this area to make up minor shortfalls in native percent coverage, bush regeneration activities should be undertaken to reduce exotic species cover and encourage natural recruitment of bare areas by native species that are already present. Western side of Georges River Revegetation on the western side of the Georges River management site has occurred within the monitoring year. Quadrat monitoring of the revegetated area identified a plant survivorship rate of 89 percent and 74 percent. It is anticipated that plantings observed during the monitoring survey have established and are likely to persist to maturity with routine support (watering, weed removal) from a bush regeneration contractor. It is recommended that infill planting be conducted during the 2021 Autumn period to increase planting density and revegetate bare areas. Undertaking additional infill planting now will likely reduce the amount of weed control works required in the future for this management site as native plants will increase in coverage, subsequently outcompeting and suppressing colonisation of invasive species.
Gradual reduction in weed density to 5 percent of total area of each management site (eastern bank of Georges River and Anzac Creek only)	Achieving	NA	Both fixed monitoring quadrats conducted within revegetated areas of Georges River management site recorded weed cover at less than one percent. Increased weed coverage was observed on the southern side of the Rail Link bridge, however, is unlikely to increase weed coverage across the

Key Performance Indicator	Status		Comments
	Georges River	Anzac Creek	
			management site to more than five percent. It is encouraging that weed levels are low across the management site considering weed control works have not been conducted since June 2020. Native plantings have been successful in out competing and suppressing weed colonisation through the site. It is recommended that weed control works are commenced immediately within the management site on the eastern bank of the Georges River to support natural regeneration and further colonisation by native species. Weed control works should remove scattered weeds from revegetated areas and remove weeds encroaching from infested areas adjacent to the management site
Reduction in weed density to 5 percent of total area of management site 5 years after construction (western bank of Georges River only)	Achieving	NA	Weed cover is low across the site with only a sparse scattering of exotic species being present. Total coverage is estimated at less than five percent. Encroachment of weeds into the revegetation areas was observed from adjoining areas to the south of the site. It is recommended that weed control works are commenced immediately within the management site on the western bank of Georges River to support recent plantings and encourage natural regeneration and colonisation by native species. Weed control works should remove scattered weeds from revegetated areas and remove weeds encroaching from infested areas adjacent to the management site
Gradual extension of native plant cover in each management site through natural regeneration	Achieving	NA	Eastern side of Georges River Evidence of natural regeneration was observed at the eastern side of Georges River management site. Bare areas between plantings are being increasingly colonised by native species including <i>Imperata cylindrica</i> (Blady Grass), <i>Microlaena stipoides</i> (Weeping Grass), <i>Dichondra repens</i> (Kidney weed), <i>Cayratia clematidea</i> (Native Grape) and <i>Cassytha glabella</i> (Slender Devil's Twine). Western side of Georges River Natural regeneration was not observed at the western side of Georges River management site. It is anticipated that when native plantings mature and set seed natural regeneration will occur, as has been observed on the eastern side of the management site.

Key Performance Indicator	Status		Comments
	Georges River	Anzac Creek	
Stability of riparian banks including maintenance or reduction of erosion within management sites	Achieving	NA	Groundcover and shrubs species installed amongst coir mesh on steep slopes on the eastern side of Georges River management site have established and a providing stabilisation to the substrate. Natural regeneration of native species was observed on slopes which will increase stabilisation of the slope across the monitoring year. Coir mesh has been installed and secured with intermittent planting of groundcover and shrubs species on exposed sections of river bank at the western side of the Georges River management site. As plantings mature they will offer increased stabilisation of soils.
Re-establish and maintain connectivity for fauna habitat, particularly in the Georges River management site.	Scope of rehabilitation changed	NA	Habitat connectivity is not consistent the approved habitat connectivity strategy as documented within the RVMP produced by Hyder (2015) and other project related documents. Changes to habitat connectivity measures is discussed in more detail below; see Section 4.1.2.1. Habitat connectivity across the Georges River management site, linking bushland within the MLP site with bushland to the south, currently consists of large logs placed on rock ballast with small piles of thin course wood debris assembled either side. A total of two fauna species were captured on remote cameras traversing the area beneath the Rail Link bridge including Red Fox (<i>Vulpes vulpes</i>) and Swamp Wallaby (<i>Wallabia bicolor</i>).

4.1.2.1 Habitat connectivity

Habitat connectivity is not consistent with the approved habitat connectivity strategy as documented within the RVMP produced by Hyder (2015) and other project related documents. The RVMP proposed the following methodology to enhance habitat connectivity between the MLP site and bushland to the south:

The area beneath and adjoining the proposed rail bridge which would be cleared for construction will be revegetated with the objective of maintaining and enhancing fauna habitat. Revegetation of the 20 metre wide gap cleared for the bridge will be primarily with shrub, small tree and groundcover species. Planting and management of adjacent areas on the eastern bank will ensure that trees are located as close as possible to the bridge, without posing a safety risk to the operation of the Rail link. Species in the revegetation area will be selected to provide habitat resources for native fauna, such as structural habitat components or food sources

During construction of the Rail Access Land Package, ballast was installed in the 20 metre wide gap cleared for the bridge on the eastern side of the Georges River as a design requirement to minimise erosion and sedimentation. Subsequently, revegetation with native species has only been undertaken either side of the Rail Link bridge and not in the 20 metre wide gap beneath. This gap of rock ballast provides a barrier to fauna movement and is a disconnect to habitat connectivity along the Georges River riparian corridor.

Alternative habitat connectivity measures were adopted to maintain connectivity (fauna crossing) as a means to comply with project requirements whilst maintaining design requirements and ballast placement. Alternative connectivity measures included placement of large logs and coarse wood debris, as is currently present.

Additionally, a six-foot-high cyclone fence with top-line barbed wire was identified at the southern extent of the Georges River management site, delineating the MLP site from areas to the south. This fence is likely to be an additional barrier to the movement of some fauna species across the landscape (i.e. macropods).

Remote camera monitoring for this area identified two species as using the corridor, including Red Fox and Swamp Wallaby. This is a small subset of the fauna species which have been identified within the MLP site. If revegetation works were conducted as per the RVMP (Hyder 2015) and the six-foot-high cyclone fencing was removed a greater diversity of fauna species would likely be recorded using the passage to move along the Georges River riparian corridor.

A series of actions have been recommended in Table 25 to increase the connectivity value of the Georges River management site. These actions integrate components of the methodology outlined in the RVMP to maintaining and enhancing fauna habitat beneath the Rail Link bridge.

Table 25. Recommended actions to increase the ecological value of the Georges River management site

Identified Issue	Recommended action
Increased weed coverage within revegetation areas	Bush regenerators should commence weed control works within the Georges River management site immediately. Weed control works should aim to support natural regeneration through removal of scattered weeds and weeds encroaching from infested areas adjacent to the management site.
Encroachment of weed species from adjacent areas of infested bushland	The installation of a sediment fence to limit the amount of weed seed being transported into the revegetated site should be considered if encroachment is continuing despite routine weeding exercises.
Bare patches between plantings on eastern side of Georges River	Encourage natural recruitment of native species by maintaining low levels of weeds in bare areas between plantings.
Infill planting through bare areas on the western side of Georges River.	Infill planting with native tube stock should be conducted in bare areas beneath the Rail Link bridge. Plantings should be commensurate with species present in the RFEFCF vegetation community.

Identified Issue	Recommended action
Inadequate habitat connectivity beneath the Rail Link bridge	Review of rock ballast as the necessary means for erosion and sediment control beneath the Rail Link bridge. If rock ballast is not deemed necessary for the entire 20 metre wide gap, it should be removed and replaced with alternative soil stabilisation materials (i.e. coir logs, jute and coir mesh). Planting of native species should be undertaken in conjunction with installation of soft stabilisation materials as per the original habitat connectivity enhancement plan from the RVMP (Hyder 2015).
Installation of six-foot-high cyclone fence at the southern extent of management site restricting movement of fauna along the Georges River riparian corridor	A review of the fencing location and design should be conducted to determine whether it is necessary and/or whether it can be modified to allow the movement of fauna from the MLP site to bushland south of the site. Considerations should be made for the installation of crossing mechanisms for fauna (i.e. Koala bridges)

4.2 Threatened flora

4.2.1 Lands adjoining the Rail Link

Threatened species transect identified three threatened plant species within 10 metres of the Rail Link corridor fencing, including *Acacia bynoeana* (Bynoe's Wattle), *Grevillea parviflora subsp. parviflora* (Small-flower Grevillea) and *Hibbertia puberula subsp. puberula*. These threatened species were mostly observed to be in a good condition.

Off target damage to native vegetation outside of the Rail Link corridor has occurred during hi-volume spraying. Future weed control works should consider the locations of listed threatened flora species and protected native vegetation. Hi-volume spraying of herbicide should not be conducted within the Rail Link in areas adjacent to the BA341 biobank site to avoid overspray and impacts to threatened species and protected vegetation.

Table 26. Recommended management actions to protect native vegetation in lands adjoining the Rail Link

Identified Issue	Recommended action
Native vegetation, including an individual Bynoe's Wattle, was over sprayed with herbicide during weed control works conducted with the operational Rail Link.	Hi-volume spraying of herbicide within the Rail Link in areas adjacent to native vegetation (specifically the BA341 biobank site) should not be conducted in the future. Weed control works within these areas should include manual removal or spot spraying with herbicide. Spot spraying with herbicide should only be undertaken during optimal conditions to avoid spray drift. If there is risk of overspray or off target poisoning to native vegetation (particularly threatened flora) then targeted granular herbicide such as Flupropanate granular herbicide should be adopted. Prior to commencing weed control works with the Rail Link contractors should be supplied with sensitive area mapping which identifies the location of threatened species and the BA341 biobank site.

4.2.2 EPBC offset sites

Changes to Nodding Geebung and Small-flowered Grevillea populations and their habitat within offset sites between the 2019 and 2020 has been summarised below. For a comprehensive discussion see Appendix B. EPBC offset sites - 2020 Annual monitoring report.

4.2.2.1 Population assessment

The total population of Nodding Geebung and Small-flower Grevillea within offset sites has declined since the 2019 survey.

Changes to Nodding Geebung and Small-flower Grevillea populations across offset sites P1, P2, P3 and G1 can be measured by comparing the 2020 results against data collected in 2019. Offset site P4 was established and monitored for the first time during the 2020 monitoring event and cannot be compared with previous data to make an assessment on population dynamics.

A total of 90 Nodding Geebung were identified across offset sites P1, P2 and P3 in comparison to 112 individuals recorded in 2019. A decline across the Nodding Geebung population was anticipated in the 2019 Annual Monitoring Report (Arcadis 2020a) as 110 of the 112 individuals identified in 2019 were juvenile plants. Juvenile Nodding Geebung plants are fragile and are at risk of perishing from minor changes to their environment and interspecies competition. Of the 110 juvenile Nodding Geebung plants previously tagged 61 were re-found during the 2020 surveys, equating to a 56 percent survival rate. Persistence of more than half of Nodding Geebung individuals is considered a reasonable result. The finding of an addition 29 new individuals which have naturally recruited since the 2019 survey is a positive sign that Nodding Geebung are continuing to germinate and add to the current population within offset sites.

The population of Small-flower Grevillea in offset site G1 saw a reduction in the number of individuals since the 2019 survey. The population has reduced from 143 to 60 individuals; marking a decline of 56 percent over the 2020 monitoring period. A reduction in stem count across the offset site does not necessarily mean that there has been a reduction in the number of Small-flower Grevillea individuals. This species is capable of suckering from rootstock and demonstrates a degree of vegetative spread, particularly after disturbance such as fire (DPIE 2019a). It is feasible that stems may have died back following increased competition over the 2020 monitoring period from an overabundance of post-fire recruiters in the shrub and understory stratum; however, the individual is still alive and present within the offset site, albeit with a lesser biomass. Natural fluctuations in shrub and understorey vegetation cover may reduce the amount of competition and make available habitat resources for Small-flower Grevillea. At this point new individuals may recruit, or existing individuals may increase in stem count resulting in similar counts as to what was recorded in 2019 surveys.

For an assessment on how populations of Nodding Geebung and Small-flower Grevillea are tracking to achieve a net gain of 16 and 17 individuals respectively across offset sites within a 20-year period see Appendix B. EPBC offset sites - 2020 Annual monitoring report.

4.2.2.2 Habitat assessment and potential impacts

Patches of Hard-leaved Scribbly Gum - Parramatta Red Gum heathy woodland across all offset sites increased in condition since the 2019 survey. The increased VI Score does not necessarily reflect an increase in habitat value for Nodding Geebung or Small-flower Grevillea within offset sites. The abundance of Nodding Geebung can often be related to disturbance history. Sites with higher abundance also appear to be more disturbed (DPIE 2019). Furthermore, the distribution of Small-flower Grevillea can be influenced by the density of lower stratum vegetation. Competition from *Kunzea ambigua* (Tick bush) and species alike can affect recruitment and recovery, including spread, following disturbance (DPIE 2020).

No obvious threats to Nodding Geebung or Small-flower Grevillea were identified during monitoring. A few individuals of Nodding Geebung and Small-flower Grevillea were observed as being smothered by native plant species. Some minor occurrences of weeds were observed within offset areas, however were at low densities and had a low cumulative coverage. Increase in native vegetation coverage, specifically in the shrub and ground stratum may be reducing the amount of habitat of Nodding Geebung or Small-flower Grevillea.

As it is only the second year of monitoring for these species it is not yet recommended that any major management actions are implemented to increase the protection of Nodding Geebung or Small-flower Grevillea and encourage recruitment. Monitoring over the following year will aim to determine whether increases in native and exotic coverage in areas supporting these threatened plant species is having an adverse impact.

The following actions are recommended for offset sites to increase the condition of vegetation and conserve current populations of Small-flower Grevillea and Nodding Geebung.

Table 27. Recommended actions to enhance threatened flora habitat within EPBC offset sites

Identified issues	Recommended action
Patch of the woody weed Camphor Laurel with offset site P4	Bush regenerators to remove occurrence of Camphor laurel.
Encroaching Blackberry at offset site P4	Blackberry infestation should be monitored and controlled as necessary to prevent encroachment into the offset site.
Increased coverage of African Love Grass along the edges of offset sites P1, P2, P3 and encroaching on offset site G1	Monitor occurrences of African Love Grass adjacent to and within offset sites. If this invasive grass species is thought to be having a negative impact upon Small-flower Grevillea, Nodding Geebung or their habitats weed control works maybe implemented. Manual control methodologies should be prioritised unless a targeted herbicide treatment, that has no risk of over spray or off target poisoning, can be used. An example of a selective herbicide that may be suitable for control of African Lovegrass within offset areas is Flupropanate granular herbicide.
Native plant species outcompeting Nodding Geebung and Small-flower Grevillea (i.e. smothering, occupying habitat)	Monitoring of Nodding Geebung and Small-flower Grevillea population over the following year to determine whether the distribution of individuals is changing as a result of increased coverages of exotic or native vegetation Juvenile Nodding Geebung in plots P1, P2 and P3 should be monitored for smothering from native plant species. Any native plants observed to be crushing or smothering individuals should be cut back. i.e. Slender Devils Twine observed on juvenile Nodding Geebung should be removed. NOE: Native plants/vegetation in the immediate vicinity of Nodding Geebung which are not crushing, or smothering individuals should not be removed as they provide protections from grazing herbivores and inclement weather.

4.3 Weed occurrence and coverage

Since the first monitoring survey in April 2020 weed levels across the Rail Link have significantly reduced. Weed coverage across the MPE operational facility have been maintained at a low level.

Revegetation should be planned for the Autumn months in areas which have been recently remediated within the Rail Link. Revegetation of these areas should utilise a native planting palette and be conducted in accordance with the methodology outlined in the approved Urban Design and Landscaping plan (UDLP) (Arcadis 2019; Arcadis 2020c).

If weedy areas are going to be retained adjacent to remediated areas within the Rail Link, sediment fencing should be installed to reduce encroachment and weed seed spread. Weedy areas which are not subject to remediation or complete removal should be slashed regularly to ensure plants do not reach seeding maturity. If measures are not implemented to prevent weed encroachment, remediated areas will quickly become infested by exotic species and revert to their condition prior to remediation.

Weed levels throughout the operation facility including trunk drainage infrastructure, onsite detention basins and drainage swales are relatively low. There are no significant infestations of weeds, instead weeds are present as a uniform light coverage. Increases in weed coverage was observed during the December and February survey. It is apparent that majority of areas within the operational facility have been previously revegetation with a sterile cover crop seed mix. As this temporary vegetation coverage has died back weed coverage has increased. Few native species are present within soft landscaped areas or drainage infrastructure; exotic plants represent majority of coverage. Revegetation of these areas should be undertaken with a native species planting palette as per the approved UDLPs and

planned for the Autumn months. Revegetation with native species will suppress the colonisation of weeds and stabilise soft batters, reducing erosion risks.

Table 28. Soft landscaped areas recommended for revegetation with native species to reduce weed colonisation and increase soil stabilisation



Although priority weeds are sparse across the Rail Link and operational facility, the remaining scattered occurrences of *Ludwigia peruviana* (Ludwigia), *Olea europaea* subsp. *africana* (African Olive), *Asparagus asparagoides* (Bridal Creeper) and *Lantana camara* (Lantana) should be prioritised for removal.

Table 29. Recommended management actions to reduce weeds coverage within the MPE Operational Facility

Identified Issue	Recommended Corrective Action
Priority weeds within the operational Rail Link and at northern extent of operational facility	Remove all scattered occurrences of priority weed species (Alligator weed, Ludwigia, Lantana, African Olive, Bridal Creeper, Fireweed) through the Rail Link and operational facility to prevent further spread:
Encroachment and increased coverage of weeds with remediated areas and sparsely vegetated soft landscaped areas.	Revegetation of remediated areas within the Rail Link and for sparsely vegetated areas surrounding onsite detention basins and drainage swales at the northern extent of the operational facility. Revegetation should use a native species seed palette or tube stock plantings and should be prioritised for the Autumn months. Revegetation works should be undertaken in accordance with the approved UDLPs (Arcadis 2019, Arcadis 2020b)

4.4 Fauna

4.4.1 Fauna habitat connectivity

Fauna habitat connectivity monitoring identified that a number of species, both native and invasive, are utilising Anzac Creek corridor to move between patches of native vegetation within the Wattle Grove offset area. The fauna ramps installed at the culvert are being readily used by native fauna and provide access and egress between patches of bushland either side of the operation Rail Link.

Intermittent monitoring inspections should be made of the culvert to ensure fauna ramps remain in situ and vegetation growth within crossing passages does not begin to obstruct movement or cause an issue to the culvert infrastructure or operation of the Rail Link.

Table 30. Recommended actions to improve habitat connectivity at Anzac Creek culvert

Identified Issue	Recommended action
Vegetation growth within crossing passages on the northern and southern sides of the culvert.	Intermittent monitoring inspections should be made of the culvert to ensure fauna ramps remain in situ and vegetation growth within crossing passages does not begin to obstruct movement or cause an issue to the culvert infrastructure or operation of the Rail Link

4.4.2 Koala management monitoring

Koala proof fencing is present along the interface between Wattle Grove offset area and the MPE operational facility restricting movement of Koalas into unsuitable areas.. Inspection of the perimeter identified one section of damaged fencing. The extent of damage were two broken top lines of barbed wire.

Barbed wire top lines have not been identified as a design requirement of Koala exclusion fencing in the KMP (Cumberland ecology, 2020) and can therefore be postponed for repair until other necessary fencing repairs are completed.

Currently no structures (bridges, culverts, refuge posts) have been installed which facilitate the movement of Koala from the Wattle Grove offset area to adjoining areas of suitable habitat. Koala bridges are yet to be installed along the southern boundary of the offset area as per the KPM (Cumberland ecology 2020) to facilitate Koala movement into bushland areas within the Holsworthy defence area. It is noted in the KPM that prior to installing Koala bridges "Transport for NSW and Department of Defence will need to be consulted... to gain necessary access/permits." Additionally a series of other actions are required to increase suitability for Koala movement across the rail line as discussed in Section 8.3.5.2 of the KMP(Cumberland ecology 2020).

As development continues across the MLP site Koala fences, bridges, gates and grids will be installed in accordance with the plans outlined in the KMP (Cumberland ecology, 2020).

Table 31. Recommended management actions to maintain Koala fencing adjacent to the MPE operational facility

Identified Issue	Recommended action
No connectivity between Wattle Grove offset area and bushland in Holsworthy defence area	Discussions should commence with TfNSW and Department of Defence to determine the feasibility of implementing connectivity measures outlined in the KMP (Cumberland ecology 2020) to allow Koalas and other fauna to move between the Wattle Grove offset area and bushland in the Holsworthy defence area.

4.4.3 Nest boxes

Nest box occupancy and utilisation by native fauna is considered to be adequate in both the Bootland and the Georges River Corridor. This is based on the assumption that 10 percent of nest boxes should be occupied by target (native) fauna (Goldingay et al. 2018, Lindenmayer et al. 2017). A comparison

between spring 2019 and spring 2020 results indicates that occupancy by native fauna has increased between these two periods.

A total of 186 nest boxes, 49 in the Bootland and 137 in the Georges River Corridor, are in good condition and providing suitable habitat for hollow dependant fauna. Essential maintenance should be prioritised for nest boxes which have been:

- identified as causing fauna fatalities
- damaged and require removal (decommissioning)
- installed above 10 metres in height and are unable to be internally inspected

A total of 14 nest boxes require essential maintenance (Table 32).

Table 32. Nest boxes requiring essential maintenance

Next box identifier	Maintenance action
#8, #24	Remove deceased animal and nesting material Retrofit internal ladder
#14	Retrofit internal ladder
#81, 128	Decommission nest box
#71, #117, #125, #148, #172, #206, #232, #233, #250	Relocate nest boxes to 8 metres above ground to allow internal inspection in future surveys

The complete annual nest box report has been included in Appendix E and outlines all essential and recommended management actions to maintain nest boxes within Wattle Grove and Moorebank offset areas.

4.4.4 Feral animals

Four feral animal species were captured on remote cameras during monitoring surveys; European Hare (*Lepus europeus*), Domestic Cat (*Felis catus*), Red Fox (*Vulpes vulpes*) and Black Rat (*Rattus rattus*). The abundance of these species can't be determined based on camera data, however it is anticipated that feral animal abundance is low across the MPE operation facility. These species have been rarely observed during other ecological investigations across the MLP precinct, including spotlighting surveys conducted across the BA341 biobank site.

European Hare can cause significant damage when gnawing the bark of young trees and shrubs and can cause severe damage to revegetation sites (Agriculture Victoria 2021). Although no evidence of gnawing of native vegetation was observed within the operational facility, upcoming revegetation activities planned for the Rail Link and onsite detention basins (OSDs) may be at risk from this species. Opportunistic monitoring of European Hare and signs of impact to native vegetation from this species recorded over the following year to determine whether the population needs to be controlled.

Domestic Cat³ and Red Fox were recorded on remote cameras at five locations on the boundary of the MPE operational facility. It is likely that these species regularly traverse the operational area whilst moving across the landscape. No signs of predation by Red Fox or Domestic Cat to native wildlife was observed within the operation facility or BA341 biobank site. Opportunistic monitoring of Red Fox and Domestic Cat and signs of predation to native wildlife from this species should be recorded over the following year to determine whether the population is increasing and requires control.

The occurrence of Black Rat within the MPE operational facility is not considered to be a significant issue. This species is common across the landscape. No significant infestations of this species or signs of infestation have been observed across the facility or within the BA341 biobank site. In large numbers this species has potential to impact upon native fauna through predation and competition for resources.

³ Domestic Cat has been used to describe household and feral animals

One Black Rat was observed inhabiting a nest box during 2020 nest box surveys indicating this species may predate on native bird eggs and/or compete for nesting space with hollow-dependant fauna. During ecological monitoring inspections in the upcoming monitoring year, ecologists should remain vigilant for signs of Black Rat indicating increasing population numbers across the MPE operation facility and surrounds.

Table 33. Recommended monitoring for feral animals within the MPE operational facility

Identified Issue	Recommended Corrective Action
Vertebrate pests within the MPE operational facility and surrounds	Ongoing opportunistic monitoring should be conducted through MPE operational facility and surrounds to determine whether populations of European Hare, Red Fox Black Rat and Domestic Cat are having a negative impact on native biota. Any signs of novel pests within the biobank site should also be recorded.

4.5 Summary of recommendations

Table 34 compiles management issues identified during the 2020 monitoring period within the MPE operational facility and recommends appropriate corrective actions.

Table 34. Compiled list of management issues identified within MPE operational facility and recommended corrective actions

Identified issue	Recommended action
Weed occurrence in MPE operational facility and Rail Link	
Priority weeds within the operational Rail Link and at northern extent of operational facility	Remove all scattered occurrences of priority weed species (Alligator weed, Ludwigia, Lantana, African Olive, Bridal Creeper, Fireweed) through the Rail Link and operational facility to prevent further spread:
Encroachment and increased coverage of weeds with remediated areas and sparsely vegetated soft landscaped areas.	Revegetation of remediated areas within the Rail Link and for sparsely vegetated areas surrounding onsite detention basins and drainage swales at the northern extent of the operational facility. Revegetation should use a native species seed palette or tube stock plantings and should be prioritised for the Autumn months. Revegetation works should be undertaken in accordance with the approved UDLPs (Arcadis 2019, Arcadis 2020b)
EPBC threatened flora offset sites	
Patch of the woody weed Camphor Laurel with offset site P4	Bush regenerators to remove occurrence of Camphor laurel.
Encroaching Blackberry at offset site P4	Blackberry infestation should be monitored and controlled as necessary to prevent encroachment into the offset site.
Increased coverage of African Love Grass along the edges of offset sites P1, P2, P3 and encroaching on offset site G1	Monitor occurrences of African Love Grass adjacent to and within offset sites. If this invasive grass species is thought to be having a negative impact upon Small-flower Grevillea, Nodding Geebung or their habitats weed control works maybe implemented. Manual control methodologies should be prioritised unless a targeted herbicide treatment, that has no risk of over spray or off target poisoning, can be used. An example of a selective herbicide that may be suitable for control of African Lovegrass within offset areas is Flupropanate granular herbicide.
Native plant species outcompeting Nodding Geebung and Small-flower Grevillea (i.e. smothering, occupying habitat)	Monitoring of Nodding Geebung and Small-flower Grevillea population over the following year to determine whether the distribution of individuals is changing as a result of increased coverages of exotic or native vegetation Juvenile Nodding Geebung in plots P1, P2 and P3 should be monitored for smothering from native plant species. Any native plants observed to be

Identified issue	Recommended action
	crushing or smothering individuals should be cut back. i.e. Slender Devils Twine observed on juvenile Nodding Geebung should be removed. NOE: Native plants/vegetation in the immediate vicinity of Nodding Geebung which are not crushing, or smothering individuals should not be removed as they provide protections from grazing herbivores and inclement weather.
Riparian vegetation management: Georges River management site	
Increased weed coverage within revegetation areas	Bush regenerators should commence weed control works within the Georges River management site immediately. Weed control works should aim to support natural regeneration through removal of scattered weeds and weeds encroaching from infested areas adjacent to the management site.
Encroachment of weed species from adjacent areas of infested bushland	The installation of a sediment fence to limit the amount of weed seed being transported into the revegetated site should be considered if encroachment is continuing despite routine weeding exercises.
Bare patches between plantings on eastern side of Georges River	Encourage natural recruitment of native species by maintaining low levels of weeds in bare areas between plantings.
Infill planting through bare areas on the western side of Georges River.	Infill planting with native tube stock should be conducted in bare areas beneath the Rail Link bridge. Plantings should be commensurate with species present in the RFEFCF vegetation community.
Inadequate habitat connectivity beneath the Rail Link bridge	Review of rock ballast as the necessary means for erosion and sediment control beneath the Rail Link bridge. If rock ballast is not deemed necessary for the entire 20 metre wide gap, it should be removed and replaced with alternative soil stabilisation materials (i.e. coir logs, jute and coir mesh). Planting of native species should be undertaken in conjunction with installation of soft stabilisation materials as per the original habitat connectivity enhancement plan from the RVMP (Hyder 2015).
Installation of six-foot-high cyclone fence at the southern extent of management site restricting movement of fauna along the Georges River riparian corridor	A review of the fencing location and design should be conducted to determine whether it is necessary and/or whether it can be modified to allow the movement of fauna from the MLP site to bushland south of the site. Considerations should be made for the installation of crossing mechanisms for fauna (i.e. Koala bridges)
Lands adjoining (within 10 metres of) the Rail Link	
Native vegetation, including an individual Bynoe's Wattle, was over sprayed with herbicide during weed control works conducted with the operational Rail Link.	Hi-volume spraying of herbicide within the Rail Link in areas adjacent to native vegetation (specifically the BA341 biobank site) should not be conducted in the future. Weed control works within these areas should include manual removal or spot spraying with herbicide. Spot spraying with herbicide should only be undertaken during optimal conditions to avoid spray drift. If there is risk of overspray or off target poisoning to native vegetation (particularly threatened flora) then targeted granular herbicide such as Flupropanate granular herbicide should be adopted. Prior to commencing weed control works with the Rail Link contractors should be supplied with sensitive area mapping which identifies the location of threatened species and the BA341 biobank site.
Koala fencing around Wattle Gove offset area	
No connectivity between Wattle Grove offset area and bushland in Holsworthy defence area	Discussions should commence with TfNSW and Department of Defence to determine the feasibility of implementing connectivity measures outlined in the KMP to allow Koalas and other fauna to move between the Wattle Grove offset area and bushland in the Holsworthy defence area.
Nest box monitoring	

Identified issue	Recommended action
The following nest boxes have been identified as requiring essential maintenance: #8, #24, #14, #81, #128, #71, #117, #125, #148, #172, #206, #232, #233, #250	An arborist or tree climber should be commissioned to remove nest boxes requiring essential maintenance from trees. Works should be undertaken under the supervision of an ecologist. Nest boxes which can be repaired, should be fixed and re-installed at a height below 8 metres.
Feral animals	
Vertebrate pests within the MPE operational facility and surrounds	Ongoing opportunistic monitoring should be conducted through MPE operational facility and surrounds to determine whether populations of European Hare, Red Fox Black Rat and Domestic Cat are having a negative impact on native biota. Any signs of novel pests within the biobank site should also be recorded.
Habitat connectivity at Anzac Creek culvert	
Vegetation growth within crossing passages on the northern and southern sides of the culvert.	Intermittent monitoring inspections should be made of the culvert to ensure fauna ramps remain in situ and vegetation growth within crossing passages does not begin to obstruct movement or cause an issue to the culvert infrastructure or operation of the Rail Link

5 REFERENCES

- Agriculture Victoria (2021) Biosecurity: European Hare. Visited at <https://agriculture.vic.gov.au/biosecurity/pest-animals/priority-pest-animals/european-hare>
- AMBS Ecology + Heritage (AMBS) (2017) SIMTA Intermodal Terminal Facility – Stage 1. Riparian Vegetation Management plan – 2017 Update
- Arcadis (2017) Moorebank Intermodal Facility. Threatened Flora Offset Management Plan
- Arcadis (2019) Urban Design and Landscaping Plan. Moorebank Precinct East Stage 1
- Arcadis (2020a) Operational Flora and Fauna Management Plan (OFFMP). Moorebank Logistics Park – East Precinct
- Arcadis (2020b) Threatened Flora Offset Management Plan
- Arcadis (2020c) Urban Design and Landscape Plan. Moorebank Precinct East Stage 2
- Australian Government: Department of Environment (DoE) (2014) Conditions attached to the approval: SIMTA Moorebank Intermodal Terminal Facility, Sydney, NSW (EPBC 2011/6229)
- CPB Contractors (CPB) (2017) Nest Box Management Strategy. Moorebank Precinct East Stage 1 – Rail Link
- Cumberland ecology (2020) Moorebank Precinct West Stage 2. Koala Management Plan prepared for SIMTA
- Department of Planning, Industry and Environment (DPIE) (2011) NSW Scientific Committee – final determination. River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South east Corner bioregions
- Department of Planning, Industry and Environment (DPIE) (2017) Biodiversity Assessment Method
- Department of Planning, Industry and Environment (DPIE) (2019) Threatened Biodiversity Data Collection (TBDC). Species profile: *Persoonia nutans* (Nodding Geebung)
- Department of Planning, Industry and Environment (DPIE) (2019a). Biodiversity Assessment Methodology Calculator BAMC.
- Department of Planning, Industry and Environment (DPIE) (2020) Threatened Biodiversity Data Collection (TBDC). Species profile: *Grevillea parviflora* subsp. *parviflora* (Small-flower Grevillea)
- Goldingay, R, Thomas, K, Shanty, D, (2018) Outcomes of decades long installation of nest boxes for arboreal mammals in southern Australia
- Hyder Consulting (Hyder) (2015) Response to Submissions - Riparian Vegetation Management Plan - SIMTA Sydney Intermodal Terminal Alliance. Part 4, Division 4.1, State Significant Development
- Office of Environment and Heritage (OEH) (2019) BioBanking Agreement (BA341) for Moorebank Intermodal Terminal Biobank Site

6 APPENDICIES

Appendix A. Bi-monthly Weed monitoring reports (April 2020 – February 2021)

Appendix B. EPBC offset sites - 2020 Annual monitoring report

Appendix C. Riparian vegetation management – Flora inventories

Appendix D. Lands adjoining Rail Link - Quadrat monitoring data

Appendix E. Nest box monitoring report (Spring 2020)

Appendix F. Fauna species inventory from feral animal and habitat connectivity monitoring

Appendix G. Koala fencing and structures across Moorebank Logistics Park

APPENDIX A. BI-MONTHLY WEED MONITORING REPORTS (APRIL 2020 – FEBRUARY 2021)

Date 6/05/2020
To [REDACTED]
From [REDACTED]
Copy to [REDACTED]
Subject MPE Operational – Weed Monitoring Report April 2020

Introduction

Arcadis have been commissioned by Tactical on behalf of Qube Holdings to conduct bi-monthly weed monitoring surveys within Moorebank Precinct East (MPE) Operational Facility at Moorebank Logistics Park (**Figure 1**). The MPE Operational Facility includes the:

- Import and Export Terminal (IMEX)
- Rail Access Land Package (RALP)
- Warehouses, distribution facilities and freight village
- Stormwater trunk drainage infrastructure and landscaping areas

Regular monitoring of the MPE Operational Facility will inform the land manager of weed coverages and the presence of any weeds listed as *Priority* under the *Biosecurity Act 2015*.

Requirement for monitoring

Bi-monthly weed surveys are being undertaken in accordance with the monitoring requirements outlined in the Operational Flora and Fauna Management Plan (Arcadis 2019), which was prepared in consultation with the Department of Planning, Industry and Environment (DPIE) to satisfy the development and operational conditions of the MPE project (**Table 1**).

Table 1. Conditions relating to weed management within MPE Operational Facility

Reference	Condition
CoC B110 (SSD 7628)	Prior to operation, the Applicant must prepare an Operational Flora and Fauna Management Plan (OFFMP) in consultation with OEH (now DPIE). The OFFMP must form part of the OEMP required by condition C3 and must include measures to ensure biodiversity values not intended to be impacted are protected, including but not limited to: i. weed control; ii. feral animal control; iii. pathogen management procedures; iv. monitoring; and v. rehabilitation actions.
CoC B127 (SSD 7628)	The Applicant must: a) take all reasonable steps to manage pests and vermin on the site; b) manage declared noxious weeds on the site in accordance with the requirements of the <i>Noxious Weeds Act 1993</i>;

Reference	Condition
	c) inspect the site on a regular basis, no less than every 3 months, to ensure that these measures are working effectively, and that pests, vermin or noxious weeds are not present on site in sufficient numbers to pose an environmental hazard, or cause the loss of amenity in the surrounding area.
CoA 5(h) (EPBC 2011.6229)	For the better protection of EPBC listed flora & the environment on Commonwealth land, the person taking the action must engage a suitably 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): h) 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);

The *Noxious Weeds Act 1993* has since been superseded by the *Biosecurity Act 2016*, subsequently notable weed species have been re-classified from *Noxious* weeds to *Priority* weeds.

Priority weeds

Under the *Biosecurity Act 2015*, each region has a Regional Strategic Weed Management Plan. Appendix 1 of the Greater Sydney Regional Strategic Weed Management Plan 2017-2022 (Greater Sydney Local Land Services 2019) (LLS 2019) identifies the *Priority* weeds for control in the Greater Sydney Local Land Service region. The MPE Operational Facility falls within the Greater Sydney LLS Region. A General Biosecurity Duty applies to all plants listed within Appendix 1, which requires:

All Priority weeds to be regulated to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable (DPI 2020).

Additional biosecurity duties have been included to manage *Priority* weeds which have a greater capacity to spread and cause significant environmental, social and economic impacts. The biosecurity duty for management of *Priority* weeds identified within the MPE Operational Facility have been outlined in **Table 4**.

Corrective action triggers

Bimonthly weed monitoring surveys will inform the land manager of weed infestations and *Priority* weeds with the MPE Operational Facility. Results of monitoring surveys will trigger corrective actions from the land manager to control and suppress weeds. Triggers for weed control works have been adopted from the OFFMP (Arcadis 2019) and are detailed in **Table 2**.

Table 2. Triggers for corrective action (Arcadis 2019)

Trigger	Corrective Action
Weed infestations on the Facility	Implement weed controls in accordance with the Biosecurity Duties (Table 4) associated with the weed species.
Identification of weed spread into adjacent areas attributed to the facility\	
Biosecurity direction issued from DPI	
<i>Priority</i> weed cover in the Rail Link corridor is greater than 5 per cent.	Increase weed control and monitoring frequency.

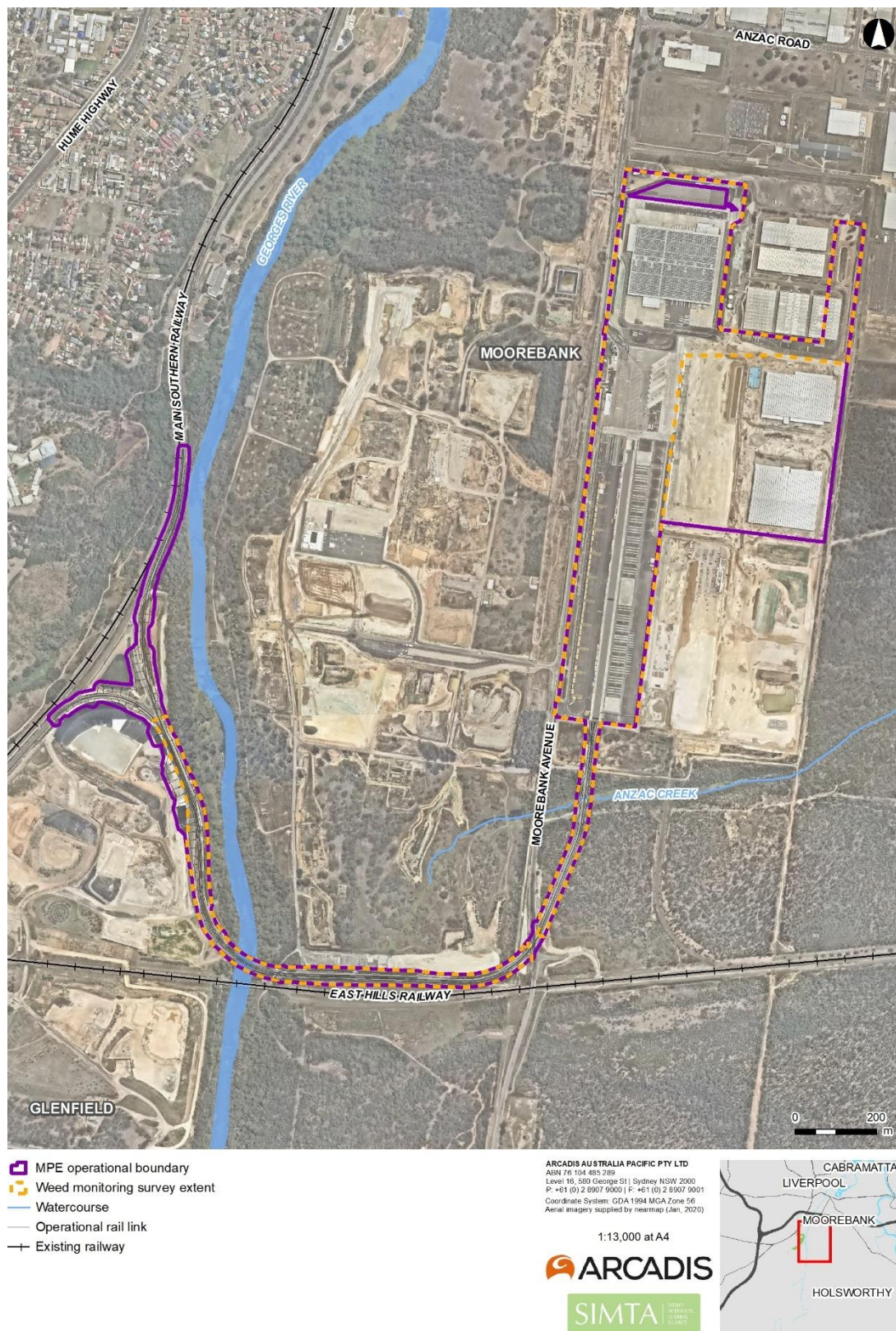


Figure 1. Survey extent within the MPE Operational Facility

Methodology

Arcadis ecologist Nathan Banks attended the MPE Operational Facility on Wednesday the 1 April 2020 to conduct the inaugural weed monitoring survey. The area surveyed by the attending ecologist is presented in **Figure 1**.

Monitoring involved traversing the MPE operational area on foot surveying landscaped areas, stormwater infrastructure and areas adjoining the rail link for the occurrence of weed species. The following information was collected where weeds were identified:

- Presence of exotic species, including *Priority* weeds
- Per cent foliage cover of exotic species
- Per cent foliage cover of *Priority* weeds

The coverage of environmental and *Priority* weeds was estimated based on the area of cover within a patch and categorised as per **Table 3**

Table 3. Categories to describe percent coverage of weeds

Categories	Percentage cover of weeds within a patch (%)
Low	10 – 25
Moderate	25 – 75
High	75 – 100

The location of weed infestations and *Priority* weed species was recorded on an Arc-GIS enabled iPad.

The weather on the day of survey was overcast with rain being experienced. The temperature was mild, recording 19.5°C at 9am at the nearest weather station at Holsworthy Aerodrome (station 066161) (BOM 2020).

Study Limitations

The data presented within this report is restricted to what was observed and recoded by the attending Arcadis ecologist during the site assessment on the 1 April 2020.

Monitoring of weeds was restricted to operational areas; weeds were not assessed within the bounds of the active construction site in the eastern portion of the MPE project site currently under the control of Hansen Yuncken.

Furthermore, surveys were not able to be undertaken in areas extending beyond the junction between the Qube Rail Link and the Southern Sydney Freight Line (SSFL) as the ecologist was not under the supervision of an Australian Rail Track Corporation (ARTC) Protection Officer (PO). Future surveys will require the attendance of a PO to access these areas.

Results

Rail Link

Native flora species are sparse along the rail link. Individuals or small clumps of native grass, likely remnants from historical planting, are present amongst weed infestations. Native graminoids observed included Couch (*Cyndoon dactylon*) and Queensland Bluegrass (*Dichanthium sericeum*).

A majority of undeveloped areas either side of the rail line are colonised by weeds (**Figure 3; Figure 4**). Most un-developed areas have a percent coverage of weed species greater than 60%. Soft batters are dominated by a combination of exotic grass species interspersed by common environmental herbs and woody weeds. Dominant exotic grasses include Rhodes Grass (*Chloris gayana*), African Love Grass (*Eragrostis curvula*) and Kikuyu (*Pennisetum clandestinum*). Dominant woody and herbaceous weed species include *Solanum sisymbriifolium*, Stinking Roger (*Tagetes minuta*) Cassia (*Senna pendula*), Paddy's Lucerne (*Sida rhombifolia*) and Purple top (*Verbena bonariensis*). A comparatively high diversity of weed species was identified within the Rail Link compared to that identified around IMEX terminal and warehouses.

More than 40 species of weeds are present within the Rail Link, of which seven are listed as *Priority* weed species for the Greater Sydney region, including:

- Chilean Needle Grass (*Nassella neesiana*)
- Pampas Grass (*Cortaderia selloana*)
- Lantana (*Lantana camara*)
- Fireweed (*Senecio madagascariensis*)
- Alligator Weed (*Alternanthera philoxeroides*)
- African Olive (*Olea europaea* subsp. *cuspidata*)
- Bridal Creeper (*Asparagus asparagoides*)

Priority weeds within the Rail Link have a low percent coverage (less than 1%) and are mainly present as individuals or small isolated patches.

Six notable weed species not listed as *Priority*, however present an increased risk to biodiversity than common environmental weeds exist within the rail corridor. These species include Balloon Vine (*Cardiospermum grandiflorum*), Small-leaved Privet (*Ligustrum sinense*), Castor Oil Plant (*Ricinus communis*), Moth Vine (*Araujia sericifera*), Common Moring Glory (*Ipomoea purpurea*) and Coolatai Grass (*Hyparrhenia hirta*).

Barnyard Grass (*Echinochloa crus-galli*), Cereal Rye (*Secale cereale*), Red Clover (*Trifolium pratense*) and White Clover (*Trifolium repens*) were observed colonising batters either side of the Rail Link at its northern extent, closest to the IMEX terminal.

An inventory of invasive plant species identified during the field survey has been included in **Appendix A**.

Import Export Terminal, warehouses and surrounds

A notable patch of exotic grassland dominated by Rhodes Grass and African Love Grass is present within the north-eastern corner of the MPE Operational Facility (Figure 2). Weeds infestations are isolated to less managed areas and areas where formal landscaping or hydroseeding of native species has not been conducted within the IMEX Terminal.

Landscaped areas surrounding new warehouses are vegetated with garden plantings and mowed grassland. In less managed areas without formal revegetation the following species were observed Windmill Grass (*Chloris truncata*), Queensland Bluegrass, Barnyard Grass, Cereal Rye and White Clover. These species may have opportunistically recruited in these bare areas following construction or may be remnants of a cover crop hydromulching mixture. Three of these species are exotic and are not listed within the native seed palette approved for hydroseeding within the MPE Operational Area (Arcadis 2019a, Arcadis 2020b).

Environmental weeds including Rhodes Grass, Cats Ear (*Hypochaeris radicata*) and Cobblers Peg (*Bidens pilosa*) are sparsely scattered through landscaped areas.

Trunk drainage system and Anzac Creek

No notable weed infestations were observed within trunk drainage infrastructure. A sparse scattering of invasive grasses, mainly *Setaria* sp. is present along the soft batters each side of the truck drainage channel running down the western boundary of the MPE Operational Facility. Isolated occurrences of herbaceous weeds were also observed including Paddy's Lucerne and Purple Top.

One *Priority* weed species was observed growing at the north-eastern corner of the facility. Peruvian Primrose (*Ludwigia peruviana*) was observed growing amongst the native ephemeral species Bulrush (*Typha orientalis*) within a former drainage channel. The location of this species is presented in **Figure 2** and photos of it in situ in **Appendix B**.

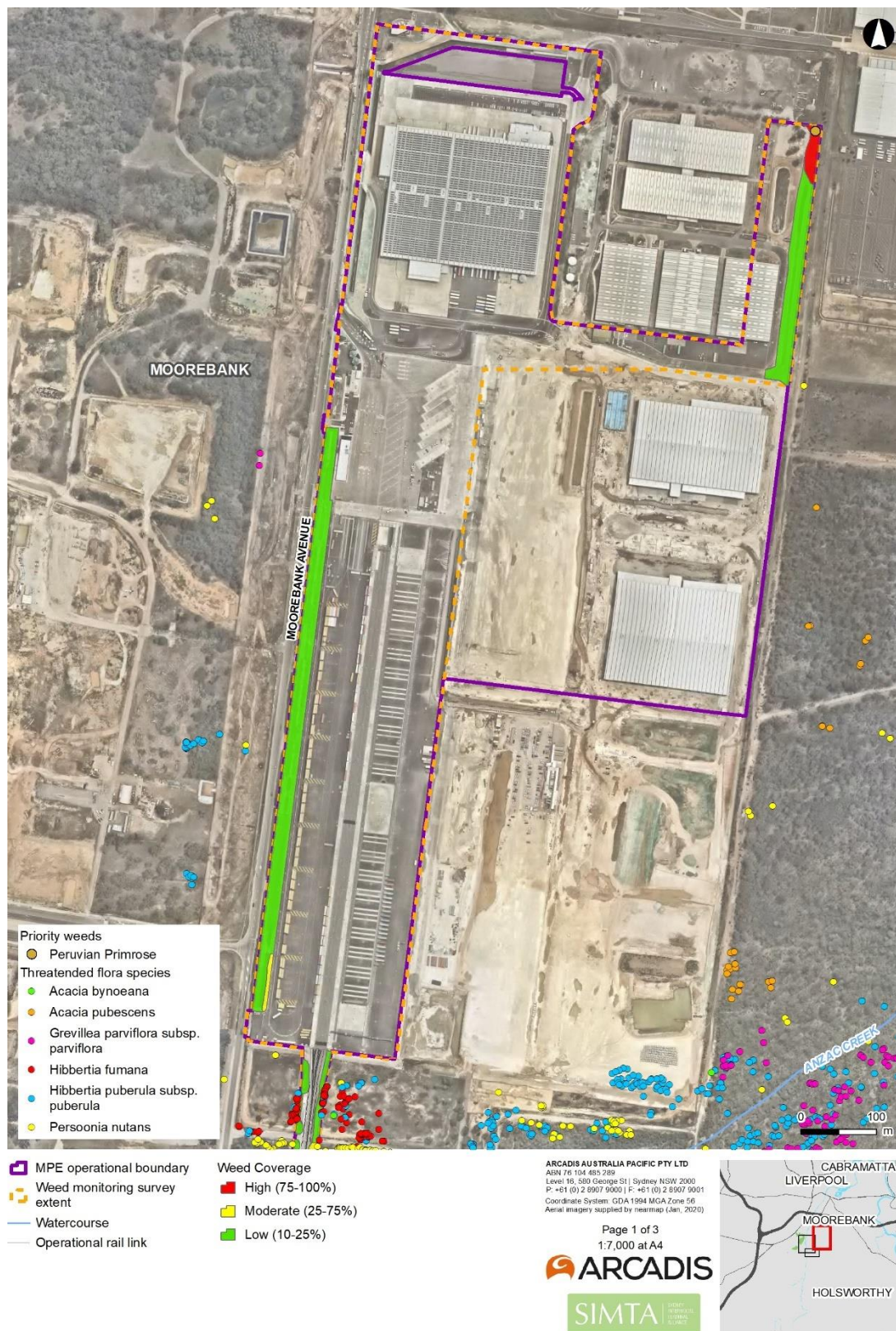


Figure 2. Weed coverages and Priority weeds identified across the MPE Operational Facility (Map 1 of 3)

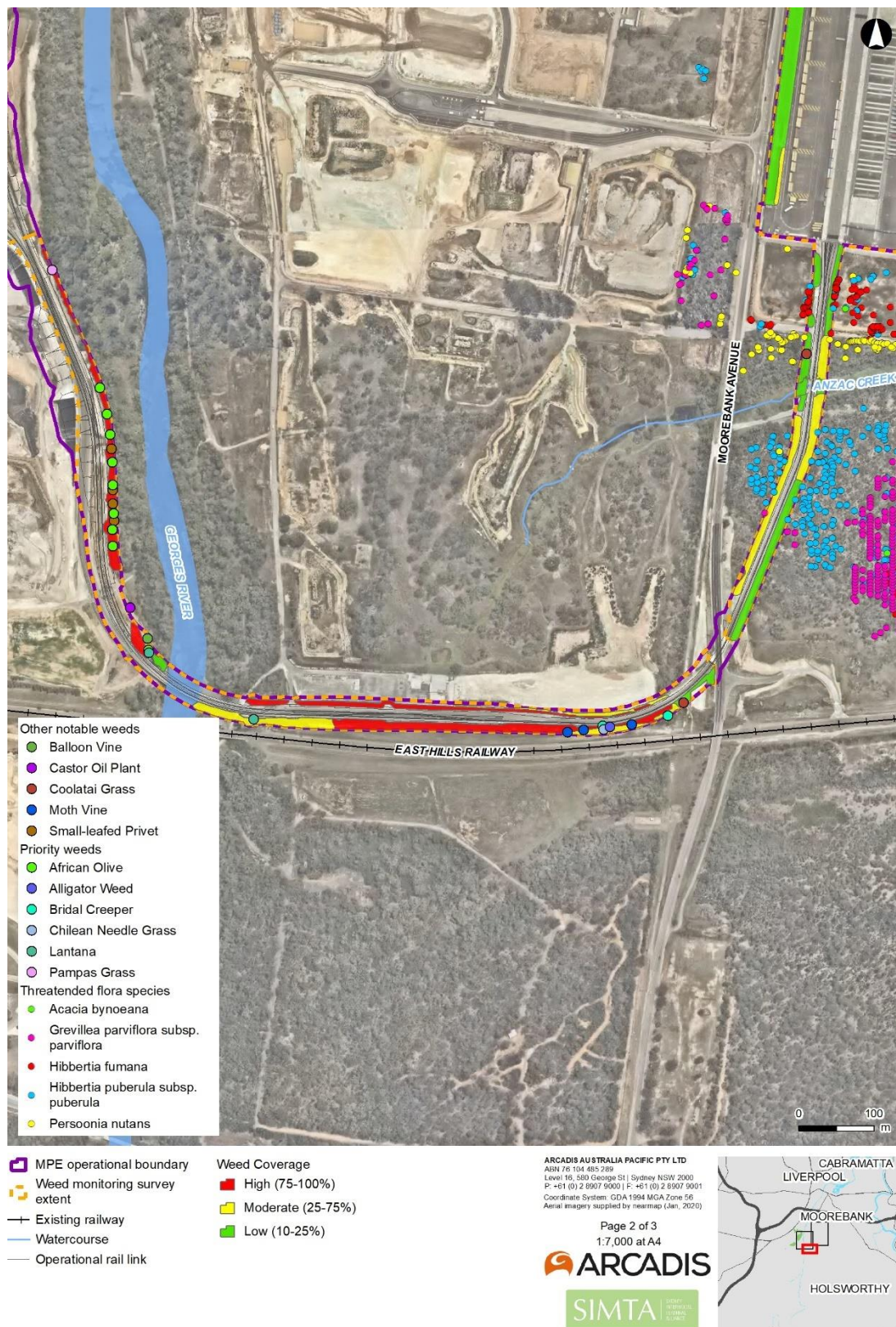


Figure 3. Weed coverages and Priority weeds identified across the MPE Operational Facility (Map 2 of 3)

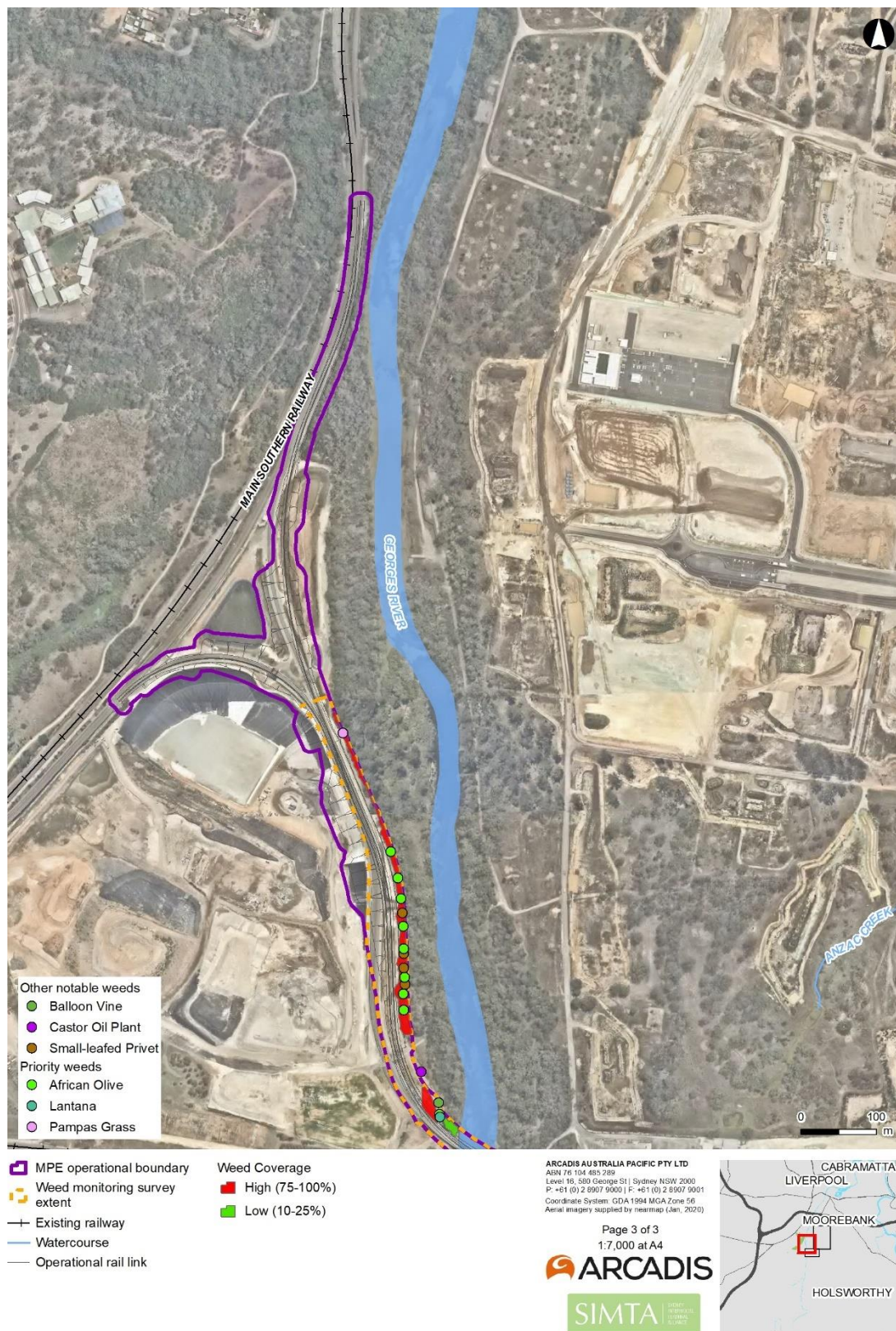


Figure 4. Weed coverages and Priority weeds identified across the MPE Operational Facility (Map 3 of 3)

Recommendations

Priority weeds identified within the MPE Operational Facility should be prioritised for removal to avoid further spread. Table 4 outlines the biosecurity duty of the landholder towards controlling *Priority* weeds identified with the MPE Operational Facility. Other 'notable' weeds species identified in **Figure 2- Figure 4** should also be prioritised for removal before controlling environmental weed infestation.

Revegetation should be undertaken in accordance with the approved Urban Design and Landscaping Plan (Arcadis 2019a, Arcadis 2020) for soft batters and un-developed areas within the MPE Operational Facility currently supporting weed infestation. A staged plan to remove weeds and replace with native species will act to reduce the recruitment of weed species. This will reduce the management effort and cost required to control weeds in the future.

The removal of weed infestations should be undertaken in a staged approach and not conducted simultaneously across the operational facility to reduce the potential for erosion and limit inefficiencies in management.

Treatment of weeds should be undertaken in accordance with the approved Operational Flora and Fauna Management Plan (Arcadis 2019) and Landscape Vegetation Management Sub Plan (Arcadis 2019). The application of herbicide should be undertaken with precaution for native species, specifically areas of native bushland adjacent to the Rail Link. Herbicide spraying should not be conducted in the vicinity of threatened flora, specifically populations of Nodding Geebung (*Persoonia nutans*) in the adjacent biobank land (**Figure 3**).

Appendix A summarises priority actions recommended for weed control within the MPE operational facility and provides a performance criterion in which will be used to track works conducted between monitoring periods. Performance criteria will be reviewed and updated based on the results of weed monitoring surveys.

Table 4. The biosecurity duty of land managers to control Priority weeds identified within the MPE facility

Priority weed species	Biosecurity Duty (DPI 2020)
Chilean Needle Grass (<i>Nassella neesiana</i>)	General Biosecurity Duty Prohibitions on Dealings: <i>Must not be imported into the State or sold</i>
Pampas Grass (<i>Cortaderia selloana</i>)	General Biosecurity Duty Regional Recommended Measure: <i>Land managers mitigate the risk of the plant being introduced to their land. Land managers prevent spread from their land where feasible. Land managers reduce the impact on priority assets. The plant should not be bought, sold, grown, carried or released into the environment.</i>
Lantana (<i>Lantana camara</i>)	General Biosecurity Duty Prohibitions on Dealings: <i>Must not be imported into the State or sold</i>
Fireweed (<i>Senecio madagascariensis</i>)	General Biosecurity Duty Prohibitions on Dealings: <i>Must not be imported into the State or sold</i>
Alligator Weed (<i>Alternanthera philoxeroides</i>)	General Biosecurity Duty Prohibitions on Dealings: <i>Must not be imported into the State or sold</i> Regional Recommended Measure: <i>Land managers prevent spread from their land where feasible.</i>
African Olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>)	General Biosecurity Duty Regional Recommended Measure: <i>The plant should be eradicated from the land and the land kept free of the plant. Land managers should mitigate the risk of the plant being introduced to their land.</i>

Priority weed species	Biosecurity Duty (DPI 2020)
Bridal Creeper (<i>Asparagus asparagoides</i>)	General Biosecurity Duty Prohibitions on Dealings: <i>Must not be imported into the State or sold</i>
Peruvian Primrose (<i>Ludwigia peruviana</i>)	General Biosecurity Duty Regional Recommended Measure: <i>Land managers mitigate the risk of the plant being introduced to their land. Land managers prevent spread from their land where feasible. Land managers reduce the impact on priority assets. The plant should not be bought, sold, grown, carried or released into the environment. Local Control Authority is notified if the plant is found on the land.</i>

References

Arcadis (2019a) Urban Design and Landscape Plan. Moorebank Precinct East Stage 1

Arcadis (2019b) Operational Flora and Fauna Management Plan. Moorebank Logistics Park – East Precinct

Arcadis (2019c) Landscape Vegetation Management Sub Plan. Moorebank Precinct East Stage 2

Arcadis (2020) Urban Design and Landscape Plan. Moorebank Precinct East Stage 2

Bureau of Meteorology (BOM) (2020) Climate Data Online. Weather and Climate: Holsworthy Aerodrome NSW (station 066161) <http://www.bom.gov.au/climate/dwo/IDCJDW2161.latest.shtml>

NSW Department of Primary Industries (DPI) (accessed 2020) NSW WeedWise. Priority weeds for the Greater Sydney. <https://weeds.dpi.nsw.gov.au/WeedBiosecurities?AreaId=3>

APPENDIX A. WORKS AND PERFORMANCE TRACKING

Priority	Objective description	Action	Performance
1	Removal of <i>Priority</i> weeds. <i>Priority</i> weeds controlled through manual removal can commence immediately. Species requiring treatment with herbicide should be undertaken with consideration of the most appropriate timing (i.e. applying herbicide when weeds are actively growing)	<i>Expected action;</i> Evidence of commencement of removal/control of <i>Priority</i> weeds	
2	Control and management of <i>notable</i> weeds. Notable weeds within the rail link should be removed or managed effectively (i.e. deseeding, slashing) to reduce chance of further spread.	<i>Expected action;</i> Evidence of management of notable weeds.	
3	Control of environmental weeds adjacent to biobank areas and natural bushland environments. Manual removal should be adopted in areas adjacent to where threatened flora species have been identified.	<i>Expected action;</i> Evidence of environmental weed control. Reducing percent coverage in areas adjacent to natural bushland	
4	Management of environmental weeds, specifically invasive grasses such as Rhodes Grass within the Rail Link. Efforts should be made to mow or slash large areas of exotic grassland to reduce seeding.	<i>Where time permits:</i> Evidence of slashing or other control method of invasive grasses	
5	Reduction in percent coverage of environmental weed infestations throughout the Rail Link	<i>Where time permits:</i> Evidence of environmental weed control. Reducing overall weed percent coverage of environmental weeds,=	
6	Reduction in percent coverage of environmental weed infestations in trunk drainage infrastructure	<i>Where time permits:</i> Evidence of environmental weed control. Reducing overall weed percent coverage of environmental weeds	

APPENDIX B. SITE PHOTOGRAPHS (01/04/2020)



Peruvian Primrose colonising drainage channel



Trunk drainage system vegetated with *Setaria* sp. and the native aquatic plant, *Persicaria decipiens*



Soft batters in the rail link dominated by environmental weeds



Soft batter susceptible to weed infiltration following demise of cover crop.



Mowed exotic grasslands surrounding warehouses



Soft batter with remnant cover crop and scattered environmental weeds

APPENDIX C. PRIORITY WEED PROFILES



Chilean Needle Grass (*Nassella neesiana*)



Pampas Grass (*Cortaderia selloana*)



Lantana (*Lantana camara*)



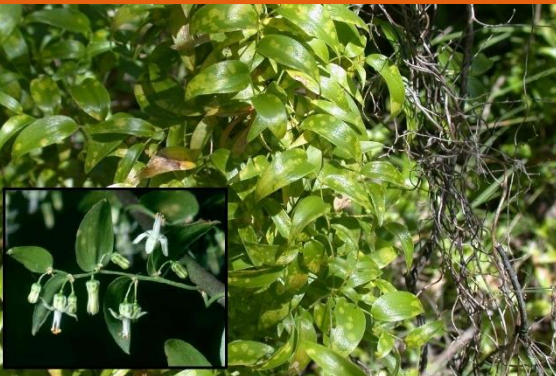
Fireweed (*Senecio madagascariensis*)



Alligator Weed (*Alternanthera philoxeroides*)



African Olive (*Olea europaea* subsp. *cuspidata*)



Bridal Creeper (*Asparagus asparagoides*)

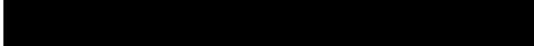


Peruvian Primrose (*Ludwigia peruviana*)

APPENDIX D. WEED SPECIES INVENTORY

Scientific Name	Common name	Status
<i>Acacia saligna</i>	Golden Wreath Wattle	
<i>Acetosa sagittata</i>	Rambling Dock	
<i>Alternanthera philoxeroides</i>	Alligator Weed	Priority
<i>Anagallis arvensis</i>	Scarlet Pimpernel	
<i>Araujia sericifera</i>	Moth Vine	
<i>Asparagus asparagoides</i>	Bridal Creeper	Priority
<i>Bidens pilosa</i>	Cobbler's Pegs	
<i>Cardiospermum grandiflorum</i>	Balloon Vine	
<i>Chenopodium album</i>	Fat Hen	
<i>Chloris gayana</i>	Rhodes Grass	
<i>Cirsium vulgare</i>	Spear Thistle	
<i>Conyza bonariensis</i>	Flaxleaf Fleabane	
<i>Cortaderia selloana</i>	Pampas Grass	Priority
<i>Cyperus eragrostis</i>	Umbrella Sedge	
<i>Echinochloa crus-galli</i>	Barnyard Grass	
<i>Eragrostis curvula</i>	African Lovegrass	
<i>Foeniculum vulgare</i>	Fennel	
<i>Gomphocarpus fruticosus</i>	Narrow-leaved Cotton Bush	
<i>Hyparrhenia hirta</i>	Coolatai Grass	
<i>Hypochaeris radicata</i>	Catsear	
<i>Ipomoea purpurea</i>	Common Morning Glory	
<i>Lantana camara</i>	Lantana	Priority
<i>Ligustrum sinense</i>	Small-leaved Privet	
<i>Ludwigia peruviana</i>	Peruvian Primrose	Priority
<i>Modiola caroliniana</i>	Red-flowered Mallow	
<i>Nassella neesiana</i>	Chilean Needle Grass	Priority
<i>Olea europaea subsp. cuspidata</i>	African Olive	Priority
<i>Paspalum dilatatum</i>	Paspalum	
<i>Paspalum urvillei</i>	Vasey Grass	
<i>Pennisetum clandestinum</i>	Kikuyu Grass	
<i>Pennisetum setaceum</i>	Fountain Grass	
<i>Phytolacca octandra</i>	Inkweed	
<i>Plantago lanceolata</i>	Lamb's Tongues	
<i>Ricinus communis</i>	Castor Oil Plant	
<i>Secale cereale</i>	Cereal Rye	

Scientific Name	Common name	Status
<i>Senecio madagascariensis</i>	Fireweed	Priority
<i>Senna pendula</i>	Cassia	
<i>Setaria pumila</i>	Pale Pigeon Grass	
<i>Sida rhombifolia</i>	Paddy's Lucerne	
<i>Solanum nigrum</i>	Black-berry Nightshade	
<i>Solanum sisymbriifolium</i>		
<i>Sonchus oleraceus</i>	Common Sowthistle	
<i>Tagetes minuta</i>	Stinking Roger	
<i>Trifolium repens</i>	White Clover	
<i>Verbena bonariensis</i>	Purpletop	
<i>Vicia sativa</i>	Common vetch	

Date 20/07/2020
To 
From 
Copy to 
Subject MPE Operational – Weed Monitoring Report June 2020

Introduction

Arcadis have been commissioned by Tactical on behalf of Qube Holdings to conduct bi-monthly weed monitoring surveys within Moorebank Precinct East (MPE) Operational Facility at Moorebank Logistics Park (**Figure 1**). The MPE Operational Facility includes the:

- Import and Export Terminal (IMEX)
- Rail Access Land Package (RALP)
- Warehouses, distribution facilities and freight village
- Stormwater trunk drainage infrastructure and landscaping areas

Regular monitoring of the MPE Operational Facility will inform the land manager of weed coverages and the presence of any weeds listed as Priority under the *Biosecurity Act 2015*.

The first monitoring report (May 2020) included a comprehensive baseline assessment of weed coverage within the MPE Operational Area. Subsequent reports, including this report (June 2020), will include survey methodology, summarise changes to weed condition and assess weed control actions against previous recommendations listed in Table 2.

Methodology

Arcadis ecologist Nathan Banks attended the MPE Operational Facility on Tuesday 23 June 2020. The area surveyed by the attending ecologist is presented in Figure 1.

Monitoring involved traversing the MPE operational area on foot surveying landscaped areas, stormwater infrastructure and areas adjoining the Rail Link for the occurrence of weed species and signs of weed control works. The following information was collected where weeds were identified:

- Presence of exotic species, including Priority weeds
- Per cent foliage cover of exotic species
- Per cent foliage cover of Priority weeds

The coverage of environmental and Priority weeds was estimated based on the area of cover within a patch and categorised as per Table 1.

Table 1. Categories to describe percent coverage of weeds

Categories	Percentage cover of weeds within a patch (%)
Low	10 – 25
Moderate	25 – 75
High	75 – 100

The location of weed infestations, Priority weed species and observed weed control works were recorded on an Arc-GIS enabled iPad.

The weather on the day of survey was overcast with rain being experienced. The temperature was cool, recording 8.1°C at 9am at the nearest weather station at Holsworthy Aerodrome (station 066161) (BOM 2020).

Study Limitations

The data presented within this report is restricted to what was observed and recoded by the attending Arcadis ecologist during the site assessment on the 23 June 2020.

Monitoring of weeds was restricted to operational areas; weeds were not assessed within the bounds of the active construction site in the eastern portion of the MPE project site currently under the control of Hansen Yuncken.

Surveys were not undertaken in areas extending beyond the junction between the Qube Rail Link and the Southern Sydney Freight Line (SSFL) as the ecologist was not under the supervision of an Australian Rail Track Corporation (ARTC) Protection Officer (PO). Future surveys will require the attendance of a PO to access these areas.

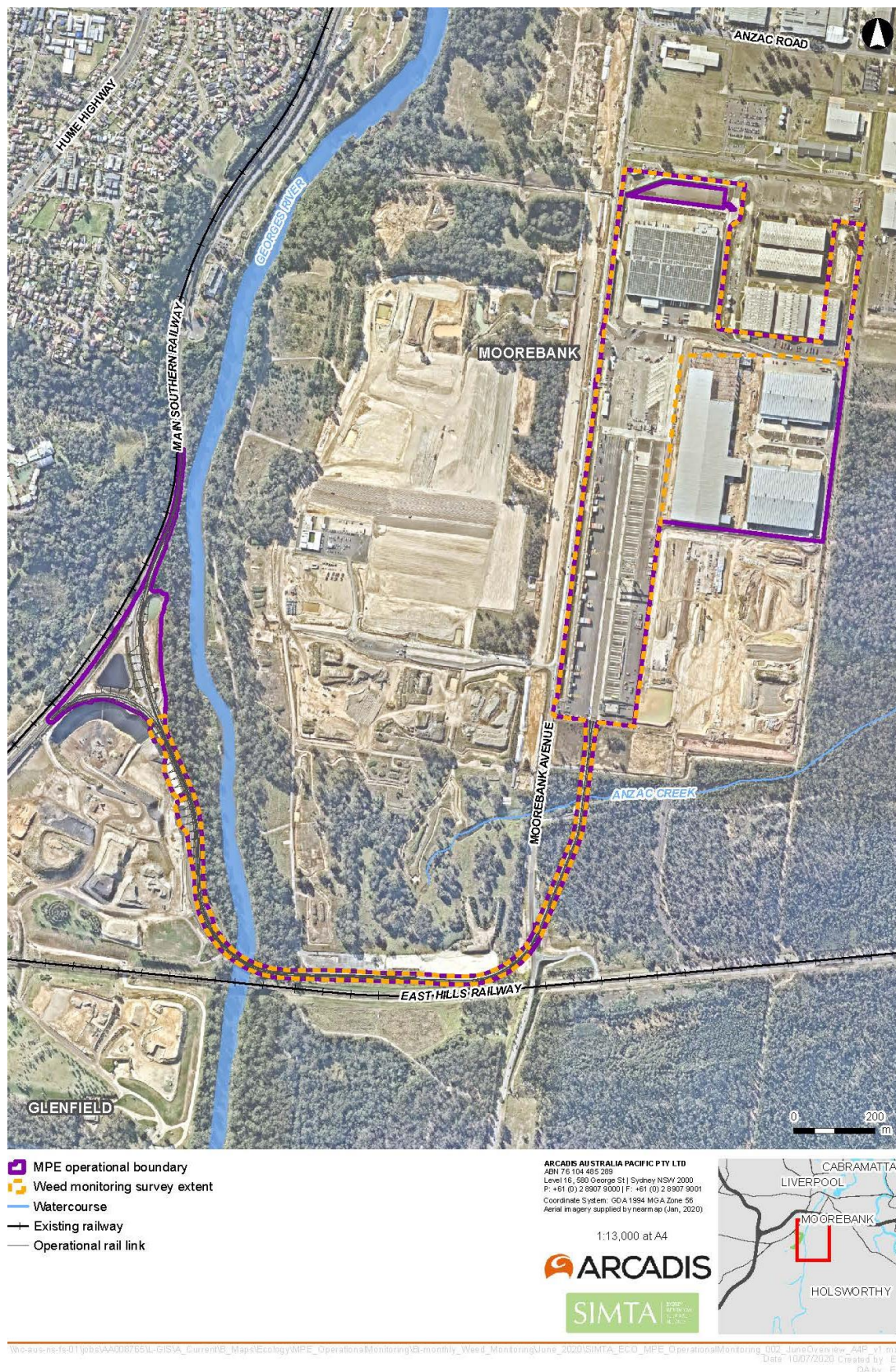


Figure 1. Survey extent within the MPE Operational Facility

Results

The following observations were made during monitoring of the MPE Operational Area:

- A narrow strip of exotic grassland within the Rail Link corridor has been slashed since the weed monitoring survey in April 2020. Slashing will inhibit exotic grasses from setting seed.
- Exotic plant cover within the north-western drainage infrastructure has been slashed, reducing vegetation biomass.
- Priority weed species including Bridal Creeper (*Asparagus aethiopicus*), Lantana (*Lantana camara*) and African Olive (*Olea europaea* subsp. *cuspidata*) have not been selectively targeted for removal within the Rail Link.
- Castor Oil Plant (*Ricinus communis*) a notable weed species was observed colonising new areas within the Rail link.
- Weed cover in the IMEX, surrounding the warehouses and distribution facilities, and within stormwater truck drainage infrastructure and landscaping areas remains to be low.
- Slumping was observed of soft batters at three locations within the Rail Link. Moderate to large portions of the soft batter have collapsed into the drainage channel which runs parallel to the rail tracks.

The location of weed control works and batter slumping has been presented in **Figure 2**.

Weed control works observed during the June 2020 monitoring survey have been compared against a series of recommended actions developed during the baseline monitoring survey (Table 2).

Table 2. Weed control works tracking

Priority	Action	Action description	June performance assessment
1	Eradicate Priority weeds	Target Priority weed species through a combination of manual removal and herbicide treatment. Herbicide application should be considerate of timing (i.e. applying herbicide when weeds are actively growing) and best practice methodologies.	Weed control works were not observed as targeting Priority weeds.
2	Removal of notable weed species	Notable weed species including Moth Vine and Castor Oil Plant should be removed from operational areas using a combination of manual and herbicide control.	Notable weeds were not observed to have been targeted by weed control works.
3	Suppress further colonisation of environmental weeds and encroachment into areas of bushland	Control of environmental weeds adjacent to biobank areas and natural bushland environments. Manual removal should be adopted in areas adjacent to threatened flora locations.	No evidence of weed control works.

Priority	Action	Action description	June performance assessment
4	Slashing of invasive grasses to prevent seeding.	Management of invasive grasses such as Rhodes Grass and African Love Grass through regular mowing or slashing.	Slashing of exotic grasses was observed at two locations (Figure 2): • within the Rail Link • within stormwater infrastructure in the north-eastern extent of MPE operational area
5	Reduce percent coverage of environmental weeds within the Rail Link	Reduction in percent coverage of environmental weed infestations by applying control methods commensurate with the Operational Flora and Fauna Management Plan (Arcadis 2019)	No evidence of weed control works.
6	Reduce percent coverage of environmental weeds within the operational area and trunk drainage infrastructure.	Reduction in percent coverage of environmental weed infestations by applying control methods commensurate with the Operational Flora and Fauna Management Plan (Arcadis 2019)	No evidence of weed control works.

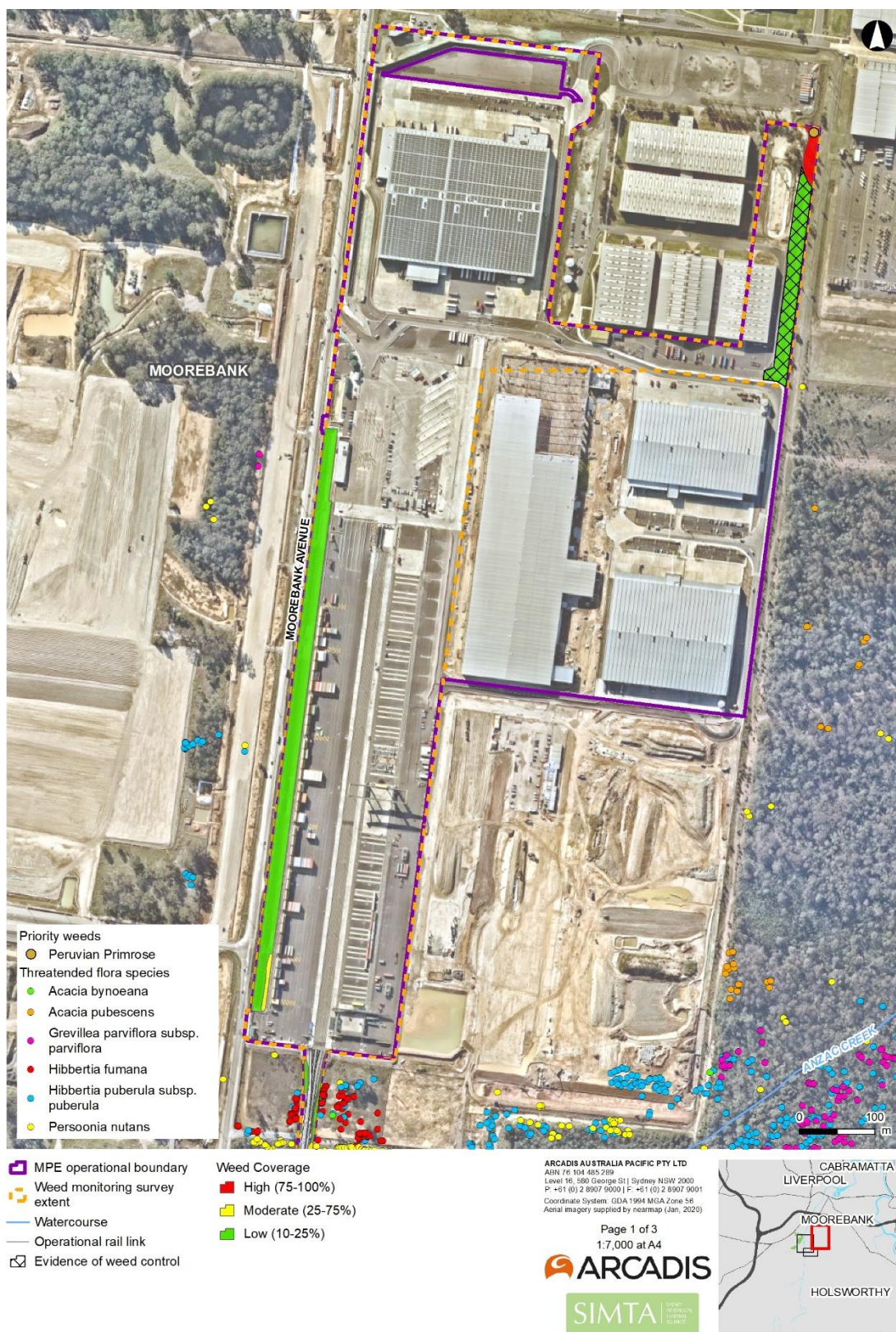


Figure 2. Weed coverages and Priority weeds identified across the MPE Operational Facility (Map 1 of 3)

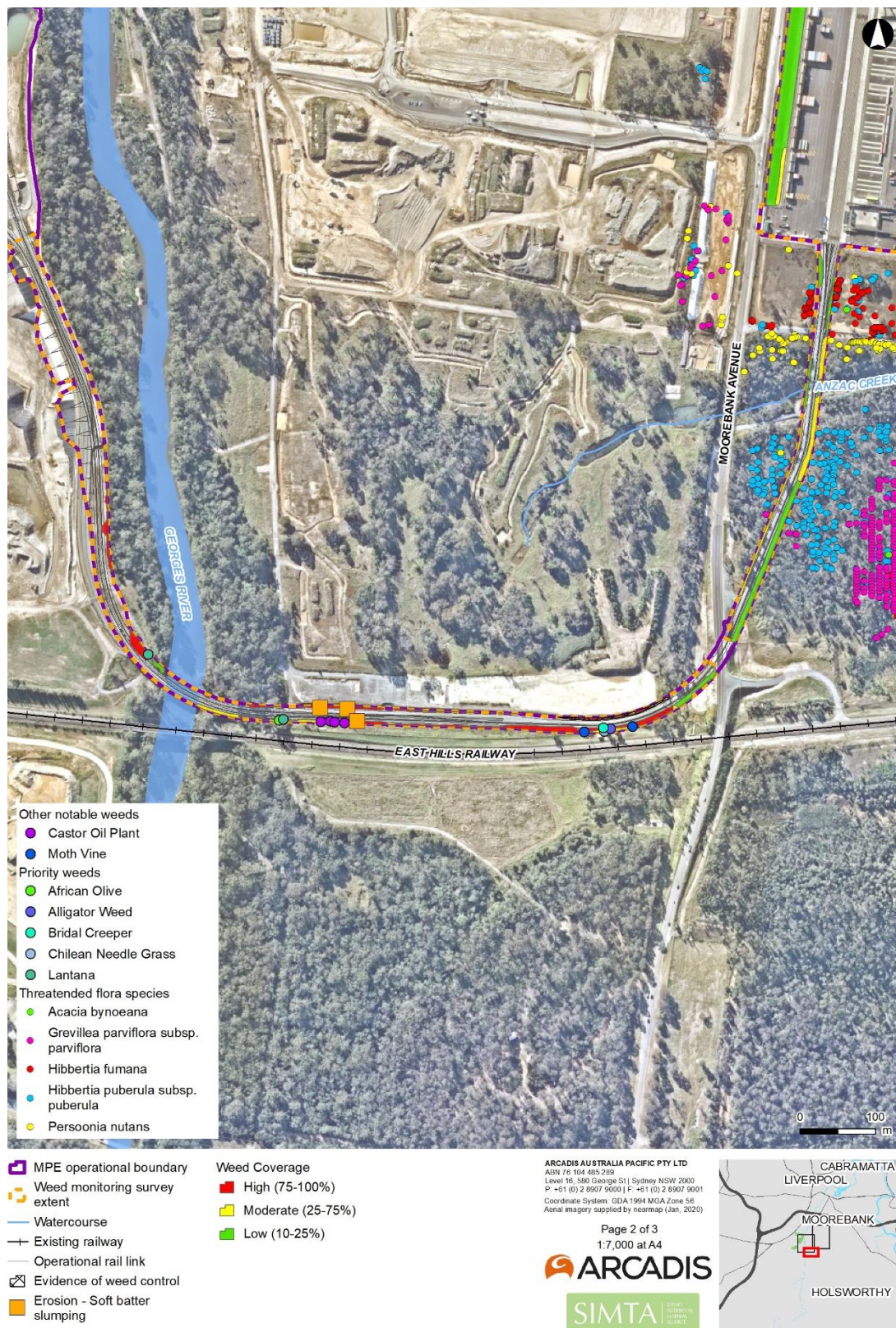


Figure 3. Weed coverages and Priority weeds identified across the MPE Operational Facility (Map 2 of 3)

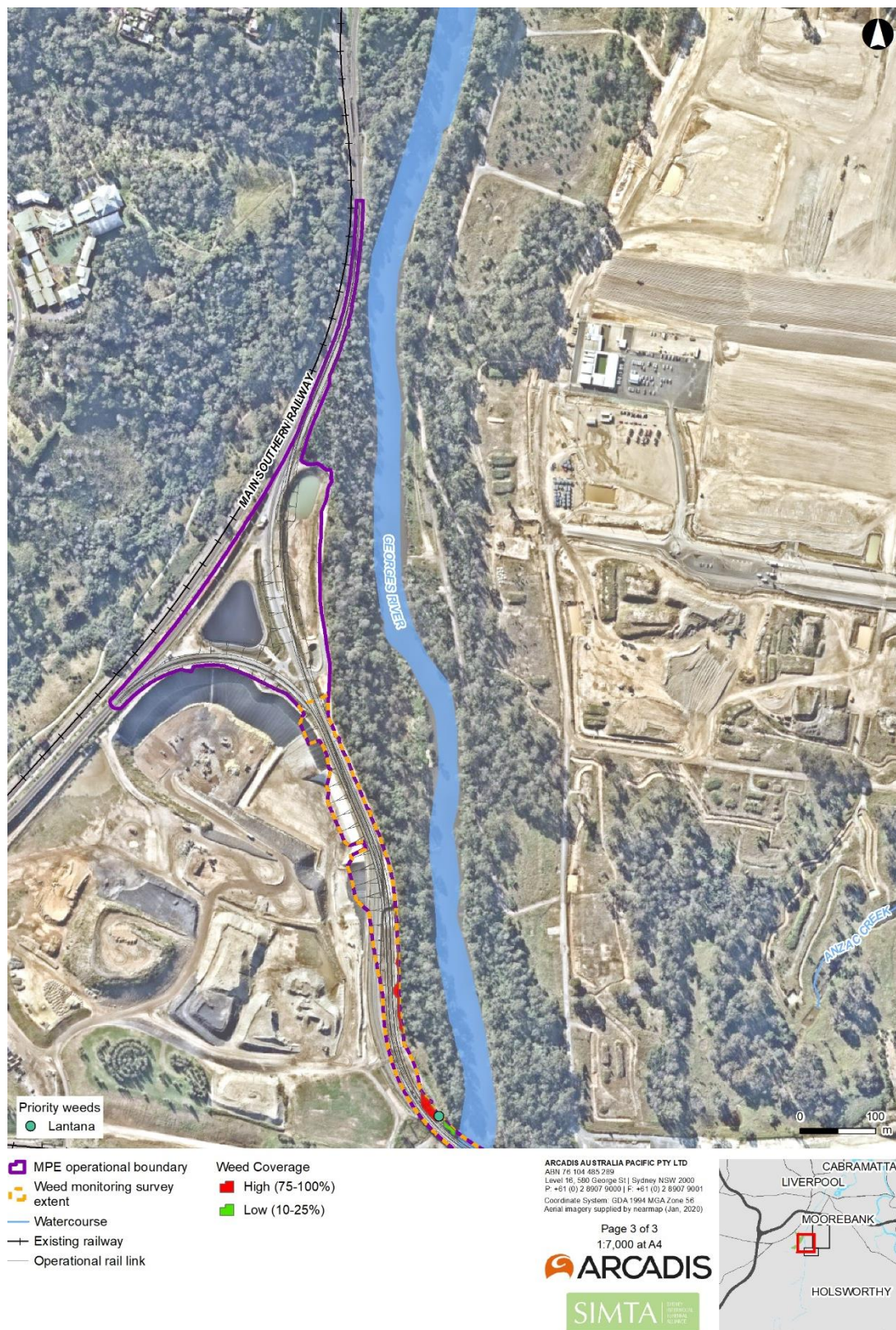


Figure 4. Weed coverages and Priority weeds identified across the MPE Operational Facility (Map 3 of 3)

Recommendations

Recommendations for weed monitoring works identified during the first weed monitoring report are included in Appendix A. Additional recommendations resulting from the recent weed monitoring survey include the following:

- At the north-eastern extent of the Rail Link where the rail corridor adjoins the Moorebank BioBank site all exotic vegetation including White Clover (*Trifolium repens*) should be cut back from the rail corridor fence. Exotic vegetation should be cut back approximately 0.5 metres from the rail corridor fence to avoid encroachment into native vegetation within the BioBank site.
- Planning should commence to remediate areas of soft batter within the Rail Link which have slumped.
- Planning should commence to revegetate soft batters and un-developed areas within the MPE Operational Facility with native species in accordance with the approved Urban Design and Landscaping Plan (Arcadis 2019a, Arcadis 2020).

References

Arcadis (2019a) Urban Design and Landscape Plan. Moorebank Precinct East Stage 1

Arcadis (2019b) Operational Flora and Fauna Management Plan. Moorebank Logistics Park – East Precinct

Arcadis (2019c) Landscape Vegetation Management Sub Plan. Moorebank Precinct East Stage 2

Arcadis (2020) MPE Operational – Weed Monitoring Report April 2020

Arcadis (2020) Urban Design and Landscape Plan. Moorebank Precinct East Stage 2

Bureau of Meteorology (BOM) (2020) Climate Data Online. Weather and Climate: Holsworthy Aerodrome NSW (station 066161) <http://www.bom.gov.au/climate/dwo/IDCJDW2161.latest.shtml>

NSW Department of Primary Industries (DPI) (accessed 2020) NSW WeedWise. Priority weeds for the Greater Sydney. <https://weeds.dpi.nsw.gov.au/WeedBiosecurities?AreaId=3>

APPENDIX A. RECOMMENDED ACTIONS CATALOGUE

Month of logging	Recommended action	Status (Not started, Commenced, Complete)
April 2020	Eradicate Priority weeds species including Bridal Creeper, Chilean Needle Grass, Alligator Weed, Lantana and African Olive	Not started
April 2020	Removal of notable weed species including Moth Vine, Castpr Oil Plant, Small-leafed Privet and Balloon Vine within Rail Link	Not started
April 2020	Slashing of invasive grasses including Rhodes Grass and African Love Grass to prevent the seeding.	Commenced
April 2020	Remove environmental weed from within 0.5 metres of the rail corridor fence within the Rail Link to prevent encroachment into areas of bushland.	Not started
June 2020	Planning should commence to remediate areas of soft batter within the Rail Link which have slumped.	
June 2020	Planning should commence to revegetate soft batters and undeveloped areas within the MPE Operational Facility with native species in accordance with the approved Urban Design and Landscaping Plan (Arcadis 2019a, Arcadis 2020)	

APPENDIX B SITE PHOTOGRAPHS (23/06/2020)



Slashing of exotic grasses observed along the rail corridor.



Exposed soft batters that are susceptible to weed invasion along the Rail Link.



Slashing of exotic vegetation within the stormwater channel in the operational area.



Slumping of soft batter within the Rail Link.



Soft batter dominated by weeds, including new occurrences of Castor Oil Plant.



Batter dominated by White Clover that should be cut back from the Rail Link fence to avoid encroachment in adjacent native bushland.